44TH MEETING OF THE ASTRONOMICAL SOCIETY OF INDIA

ABSTRACT BOOK

HOSTED BY
INDIAN INSTITUTE OF TECHNOLOGY
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15-19 MAY 2026

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15th May 2026 **Public Lecture** **[Chairperson: Divya Oberoi]** **[Time: 17:30 - 18:30]**

ASI2026_1163	Annapurni Subramaniam	Public Talk
Invited		
A decade of AstroSat - India's first Space Observatory		
AstroSat, India's first dedicated multiwavelength observatory, was launched by ISRO on 28th September 2015. AstroSat is unique in its ability to observe the Universe from the ultraviolet to soft and hard X-rays simultaneously, through its four parallely aligned payloads. Over the past 10 years, AstroSat has led to a number of key discoveries in the fields of star formation, hot stars, X-ray binaries, AGNs, etc. In this talk, I will discuss some key results, describe the challenges in building AstroSat, and explore the future directions of Indian space astronomy		

16th May 2026 **Distinguished Awardee Presentations** **[Chairperson: Devendra Ojha]** **[Time: 11:30 - 12:45]**

ASI2026_1261	Anupama G. C. (GROWTH India Team)	Award Lecture
ASI Zubin Kembhavi Award Lecture		
The GROWTH-India Telescope: Small Telescope, Big Dreams		
The GROWTH-India Telescope (GIT) is a 0.7 m robotic telescope located at the Indian Astronomical Observatory, Hanle. It was established in 2018 as a partnership between the Indian Institute of Astrophysics (IIA) and the Indian Institute of Technology Bombay (IITB), with support from DST-SERB and IUSSTF. Current operations are supported by IIA and generous support from the IITB alumni batch of 1994. The telescope, dedicated to time-domain astronomy, is part of the international GROWTH network, a Global Relay of Observatories Watching Transients Happen (GROWTH). The GIT has a wide field of view of 0.7 X 0.7 deg, with a 4K X 4K back-illuminated CCD as its primary detector. The imager is equipped with the SDSS ugriz (prime) filters, providing a sensitivity of m(g')~20.5 in 5-minute exposures. Robotic operations of the telescope are handled by custom software developed at IITB. This enables high on-sky observing efficiency (~85%) and rapid response to targets of opportunity. The data processing pipelines developed by the IITB and IIA teams perform point-spread function photometry and image subtraction for transient searches. In this talk, we provide an overview of GIT and its contributions to the studies of gammaray bursts, the electromagnetic counterparts to gravitational wave sources, fast transients, supernovae, novae, and solar system objects.		

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ASI2026_1288	Girish Kulkarni	Award Lecture
Laxminarayana and Nagalaxmi Modali Award Lecture		
How First Light Shaped the Cosmos		
The first stars, galaxies, and black holes did more than illuminate the Universe: they transformed it. Their radiation heated and ionized the diffuse hydrogen gas between galaxies, gradually changing the cosmic landscape and making the Universe transparent to ultraviolet light. This transition, from cosmic darkness to a Universe filled with galaxies and radiation, is one of the major frontiers of modern astrophysics. In this talk, I will give an overview of work carried out in my research group at TIFR over the last eight years towards understanding this formative era. I will discuss how theoretical modelling, numerical simulations, and observations of the Lyman-α forest, distant quasars, early galaxies, active galactic nuclei, and the redshifted 21-cm signal can be combined to study the evolving ionization state of the Universe during its first billion years. I will also look ahead to the coming decade, when facilities such as the Square Kilometre Array, the Vera C. Rubin Observatory, JWST, and large spectroscopic surveys will help us move from detecting the first light to understanding how it shaped the cosmos.		

ASI2026_292	Prateek Mayank	Award Lecture
Justice Oak Award for Outstanding Thesis in Astronomy Lecture		
Modeling the Evolution and Impact of Space Weather Drivers		
Understanding and predicting the evolution of space weather drivers (solar wind, CME, solar flare) remains a central challenge due to the multiscale and coupled nature of heliophysical processes. This talk presents a unified modeling framework developed during my PhD to address this challenge through physics-based and data-driven approaches. First, I introduce the SWASTi framework, a 3D MHD-based solar wind model that provides self-consistent background conditions by coupling coronal magnetic field extrapolations with heliospheric evolution. Building on this, I present SWASTi-CME, a physics-based model that captures CME evolution under varying ambient solar wind conditions, highlighting the role of drag and internal magnetic structure. I then discuss CME-CME interactions and their impact on geo-effectiveness, demonstrating how interactions can enhance disturbances and modify heliospheric structures. Complementarily, a machine learning approach using gradient boosting is explored for solar flare prediction, emphasizing feature selection and forecasting skill. Finally, I outline ongoing work on hybrid physics+AI models, including WSA+ enhancements and MHD suuroagte based on physics-informed neural operator, aimed at enabling fast, accurate, and uncertainty-aware space weather forecasting.		

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16th May 2026
Plenary Session I
[Chairperson: Yashwant Gupta]
[Time: 14:15 – 15:15]

ASI2026_975	Suratna Das	Invited
Plenary		
Cosmic Inflation: The standard picture and a promising variant		

Cosmic Inflation, that was once included in the Big Bang Cosmology in order to address its severe fine-tuning problems, has now become an integrated part of the Standard Model of Cosmology by predicting non-trivial observational signatures that are remarkably in accordance with the current precision cosmological data. Cosmic Inflation is a brief epoch of the early Universe when the Universe has expanded exponentially. Such an exponential expansion can be driven by the very simple dynamics of a slowly rolling scalar field, a.k.a. the inflaton field. However, such a simple picture of cosmic inflation assumes a very flat inflation potential where the inflaton field can slow roll. Moreover, due to this exponential expansion during inflation, the Universe becomes supercooled post inflation and is devoid of any matter or radiation. Thus the inflaton field must transfer its energy to radiation by oscillating at the bottom of a potential in order to "reheat" the Universe. Therefore, the standard picture of inflation demands a very stringent form of the inflaton potential that is difficult to realize in generic particle physics models. I will discuss a promising variant to this standard picture, known as Warm Inflation, where, by the very virtue of its dynamics, such restrictions can be alleviated making the inflationary scenario phenomenologically more sound.

ASI2026_1215	Chandreyee Maitra	Invited
Plenary		
Uncovering compact objects in the large astronomical surveys era		

The study of compact object populations has evolved from the first observational identification of white dwarfs, pulsars, and black hole candidates to the current era of large astronomical surveys. Today, more than 150 Galactic neutron stars and black holes with measured masses are known, complemented by over 180 compact object mergers detected through gravitational waves. With an increasingly detailed understanding of the diverse environments that host these objects and the physical processes governing their formation and evolution, we are now in a position to investigate the statistical properties of compact object populations and address long-standing open questions. In this talk, I will discuss how the current and upcoming generation of wide-area surveys is transforming our ability to uncover and characterise compact objects across the electromagnetic spectrum. In particular, I will highlight the role of the eROSITA all-sky X-ray survey in revealing accreting neutron stars and white dwarfs, and how systematic optical spectroscopic follow-ups. Further, I will also discuss the impact of time-domain surveys such as LSST in discovering compact objects through variability, transients, and the importance of deep multi-wavelength follow-up observations in building a coherent physical picture of these systems. By combining large, homogeneous survey datasets with targeted follow-up, we are entering a regime where population-level studies can be carried out with unprecedented statistical power. I will outline how these approaches allow us to build a unified view of compact object populations in the Milky Way and beyond.

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16th May 2026 Parallel Session - Sun, Solar System, Exoplanets, and Astrobiology I [Chairperson: Dipankar Banerjee] [Time: 16:50 – 18:25]

ASI2026_513	Himadri Sekhar Das	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Photometry, Spectroscopy, and Polarimetry of the Interstellar Comet 3I/ATLAS		

Comet 3I/ATLAS is only the third interstellar object discovered within our solar system. Previously, 1I/Oumuamua and 2I/Borisov were the first two such objects seen in our solar system. When we find one of these "visitor" comets, it provides us with an opportunity to study material formed in an extrasolar planetary system. This gives us an opportunity to directly observe how comets form in other areas of the universe, beyond our solar system, and also provides insight into the material that exists around distant stars. We present multi-wavelength observations of comet 3I/ATLAS obtained during December 2025 from ARIES, Nainital. Linear polarimetric observations in the R filter were conducted on December 8-10 using the AIMPOL instrument mounted on the 1-m Sampurnanand Telescope in Nainital. These measurements provide insight into the physical properties and composition of dust particles in the coma. Subsequently, complementary optical photometric observations in the Rp filter and NIR photometry in JHK filters were obtained on December 15 using the 3.6-m Devasthal Optical Telescope. Near-infrared spectroscopic observations spanning the 0.55–2.54 μm wavelength range enable the investigation of molecular emissions and dust continuum properties. We will report the results obtained from this coordinated campaign. The combined use of polarimetry, photometry, and spectroscopy in this coordinated observational effort provides an extensive characterization of the compositional and physical characteristics of 3I/ATLAS. This approach has produced constraints on the gas production rate, dust scattering, and overall activity of this interstellar object. In addition, a comparative study of 3I/ATLAS with comets from our solar system will provide insight into potential similarities and differences in composition and structure between these two types of objects. Thus, an increased understanding of both planet formation and cometary evolution can be achieved by comparing 3I/ATLAS with other cometary bodies throughout the galaxy.

ASI2026_624	Biki Prasad	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Polarimetric Properties of Main-Belt and Near-Earth Asteroids: A Comparative Study		

Polarimetric observations are an effective tool for investigating the surface scattering properties of asteroids through their phase–polarization curves. However, such studies are often limited to restricted phase-angle ranges because of observational constraints. In this work, we present a comparative polarimetric study of main-belt asteroids and near-Earth asteroids by combining new observations with published data to examine similarities and differences in their polarimetric properties across complementary phase-angle domains. We present R-band polarimetric observations of four main-belt asteroids: 13 Egeria, 4 Vesta, 10 Hygiea and 511 Davida, covering the low-phase-angle region of their phase-polarization curves, including the negative polarization branch and the inversion region. The observations of the four main-belt asteroids provide improved constraints on the negative polarization branch, inversion angle, and polarimetric slope, allowing a uniform characterization of their low-phase-angle polarimetric behavior across different compositional types. In contrast, we analyze polarimetric data of six near-Earth asteroids observed at phase angles extending up to ~140°, enabling characterization of the positive polarization branch and the maximum polarization. Using a common empirical phase–polarization model, key polarimetric parameters are derived for both main-belt and near-Earth asteroids and directly compared. The combined analysis reveals that the overall phase-polarization behavior of near-Earth asteroids is consistent with that of main-belt asteroids, taking into account differences in albedo and taxonomic class. This demonstrates that a unified analysis across complementary phase-angle domains plays a crucial role in reliably characterizing the full phase-polarization behavior of asteroids.

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ASI2026_185	Unnimaya K C	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Solar energetic particle contamination catalog development for HEL1OS aboard Aditya L1		

The High Energy L1 Orbiting X-ray Spectrometer (HEL1OS) onboard Aditya-L1 is optimized for high-resolution measurements of solar flare X-ray emission in the 10–150 keV energy range using Cadmium Telluride (CdTe) and Cadmium Zinc Telluride (CZT) detectors. In addition to solar photons, HEL1OS is inherently sensitive to energetic charged particles present in the interplanetary environment. During Solar Energetic Particle (SEP) events, accelerated protons and electrons can reach the L1 point and deposit energy in the detectors, leading to significant non-photonic background enhancements. Such particle-induced contamination poses a major challenge for the accurate interpretation of flare X-ray measurements.

In this work, we present a comprehensive and systematic framework for identifying and characterizing particle contamination in HEL1OS light curve data. The methodology integrates data preprocessing, background estimation, and trend-based diagnostics to robustly flag time intervals dominated by particle contributions.

Using this approach, we develop a particle contamination catalog for HEL1OS, providing a reliable means to identify and exclude affected intervals from scientific analyses. The identified particle-contaminated events are associated with their corresponding source solar events, and the results of the algorithm and detailed analysis are presented in this work. This catalog serves as a critical resource for improving the quality of HEL1OS X-ray datasets. The proposed framework significantly enhances the scientific utility of HEL1OS by mitigating particle background effects and strengthening its contribution to studies of solar flare energetics and space
weather phenomena.

ASI2026_273	Varghese Reji	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Modeling the vertical velocity gradient to disentangle stellar activity from exoplanet signal		

Extremely precise radial velocity (EPRV) measurements are critical for discovering
habitable planets and estimating their masses. Modern EPRV instruments have achieved cm/s stability, however, that hasn't translated to the discovery of earth-like planets around sun-like stars. Below a few m/s, the Doppler shift of spectral lines due to stellar activity will start dominating planetary signals. A planetary radial velocity signal should be consistent across all the heights, while a stellar activity-induced photospheric velocity, could be different at different heights of the stellar atmosphere. Based on this idea, we developed a method to disentangle stellar activity signals and planetary signals in radial velocity data. In our model, we treat the rising and falling lanes of granulation separately. We first calculate the 'granulation contrast', and then determine the velocity profile of both raising and falling lanes. Using Korg, a julia package for spectral synthesis, we solve the radiative transfer equation with an atmospheric model after Doppler shifting each photospheric layer by a vertical velocity profile model. To test our model, we fit this synthetic spectrum with multi epochs of disk-averaged solar spectra observed with NEID. The stellar activity parameters of our model are the coefficients of the velocity gradient polynomial. In this talk, I will present our model and its effectiveness in disentanglling planetary signals from stellar activity signals.

ASI2026_1026	Prithish Halder	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Prediction of solar flare occurrence and its precise location through magnetic topological parameters		
The accurate prediction of extreme solar flares relies on interpretative diagnostics that reflect the changing magnetic topology of active regions, beyond static complexity metrics. This study presents an in-depth spatiotemporal analysis of magnetic topology in the two most flare-productive active regions of Solar Cycle 25, NOAA AR 13664 and AR 13842, which generated multiple X-class and significant M-class flares. Using SDO/HMI vector magnetograms and EUV data from SDO/AIA, we analyze how magnetic helicity, winding flux, and polarity inversion line (PIL) features evolve from pre- to post-flare temporal ranges. We find that the magnetic winding flux exhibits systematic, localized increases during the flare precursor stage, whereas the helicity flux remains diffused. These winding increases are consistently near pre-existing or emerging flux-rope structures and appear minutes to hours before flares. Building on this, we propose a new winding-flux-based masked PIL framework that isolates stable and recurrent PIL structures linked to strong flaring activity. By tracking these masked PILs and the gradient of their intense segments, we identify localized regions that appear 3–7 hours before flare ignition and reliably locate flare trigger sites, even amid rapid magnetic reconfiguration following multiple eruptions. This approach is effective for recurring X-class flares, a regime where many existing forecasting methods struggle to perform. Our results demonstrate that magnetic winding and winding-based masked PIL metrics are robust and reliable early indicators of extreme solar flares. They offer a pathway to incorporate topological diagnostics into advanced physics-driven flare prediction and machine learning models, with significant implications for operational space-weather forecasting.		

ASI2026_893	Sana Ahmed	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Tracing Exocometary Gas Release in the β Pictoris Debris Disk		
Debris disks are reservoirs of icy exocomets around stellar systems and are the extrasolar analogs of the Kuiper belt. These are the remnants of planet formation that are left behind after the star has evolved into the main sequence and the protoplanetary disk has dissipated. Exocomets collide and grind down to release dust that is detected through thermal emission. ALMA's advanced sensitivity has also resulted in the detection of gaseous emissions in over 20 disks. The gas release mechanisms include collisional vaporization of small grains and photodesorption from icy grains, different from the sublimation-driven release of volatiles in solar system comets. The molecular gas is dissociated rapidly by the radiation fields and the long lifetime of CO may explain why it is the only molecule detected so far. The detection of atomic N and S, besides C and O, in the β Pictoris disk suggests the release of molecules other than CO. We have modeled the atomic and CO molecular gas emission in the β Pictoris disk. To find the excitation conditions of the gas, we solve the energy balance by considering heating due to photoelectrons emitted from the dust and energy released due to photo-ionization/dissociation of the gas. Cooling in the gas occurs due to the collisional excitation of the fine structure atomic levels and the molecular rovibrational levels. We also solve the ionization balance in the gas by including recombination of ionized carbon to form neutral carbon, and the thermal collection of electrons on dust grains. Once the excitation conditions are known, we do a radiative transfer using the RADMC3D package to estimate the total flux. Using the observed emission flux from ALMA and Herschel, we do an MCMC fitting to our estimated flux to find the density structure and mass of the gas.		

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16th May 2026
Parallel Session - Stars, Interstellar Medium, and Astrochemistry in Milky Way I
[Chairperson: T. Sivarani]
[Time: 16:50 – 18:25]

ASI2026_563	Subhashis Roy	Invited
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
The Galactic centre region: Recent advances		
The central region of the Galaxy allows us to observe the phenomena associated with the most highly dense region of a galaxy with high spatial resolution. Past observations in radio band uncovered several atypical objects and phenomena. These include the non-thermal filaments (NTFs), which could only be seen within about a degree from the Galactic centre (GC). Their origin is still not understood. More recent observations in radio bands have been able to unveil the region with almost an order of magnitude better sensitivity. We shall discuss on the understanding of the region made from these recent observations. For example, the recent Meerkat image of the region at ~1 GHz has resulted in discovery of many more filaments. Their properties, however, are somewhat in variance than the initially discovered NTFs. We shall examine whether these filaments are indeed omnipresent beyond the GC region. We have made an image of the region around the GC at ~400 MHz with uGMRT, which has comparable sensitivity as the Meerkat image for synchrotron emitting sources and shall discuss on the new findings from the low frequency image. We have also used HI absorption studies towards the same region, and show that indeed the 7' halo seen around the central region in radio is associated with the central few hundred pc region of the Galaxy.		

ASI2026_8	Sarita Vig	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
The Unique Case of IRAS 18162-2048: A massive protostar driving the largest scale jet in our Galaxy		
Our knowledge of massive protostars is limited compared to our understanding of their low-mass counterparts. IRAS 18162-2048, a massive protostar located at a distance of 1.4 kpc drives the largest known protostellar jet in our Galaxy, extending upto several parsecs. This presentation will highlight radio observations of the massive protostar and the jet through continuum and polarisation observations. Non-thermal emission has been observed from multiple lobes of the jet based on spectral index measurements using low frequency radio continuum observations from uGMRT at 325, 610 and 1280 MHz. Towards the massive protostar, we detect radio continuum circular polarization (CP) for the first time using observations carried out with the Karl G. Jansky Very Large Array. The observed fractional CP is found to be in the range 3% - 5% across frequencies between 4 and 6 GHz. No linear polarisation (LP) is detected towards the protostar. We examine several possible origins for the presence of CP and lack of LP. We identify two likely mechanisms: (i) gyrosynchrotron emission and (ii) Faraday conversion caused by turbulence in a magnetized medium, both involving mildly relativistic electrons. From these observations, we derive the first estimate of the magnetic field strength near a massive protostar, $B \gtrsim 20–35$ G. This magnetic field measurement provides valuable constraints on theoretical models of massive star formation. The magnetic field estimate obtained towards IRAS 18162 suggests that it is a likely precursor to a magnetic massive star.		

ASI2026_189	Muhammad Usman Shehu	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
The Role of Filament in Galactic Star Formation		
We present a multi-scale analysis of molecular gas flows in the massive star-forming complex G305, focusing on how large filaments feed dense cores hosting ATOMS-selected infrared sources. Using Herschel dust temperature and H2 column density maps together with molecular line data tracing gas near −38 km s−1, we link parsec-scale cloud morphology to sub-parsec star-forming regions. Five ATOMS targets—IRAS 13079−6218, IRAS 13080−6229, IRAS		

13111−6228, IRAS 13134−6242, and IRAS 13140−6226—lie in high column density filaments with H2 ≈ (0.5–3) × 10^22 cm−2 that converge into compact hubs. The molecular gas shows continuous velocity fields and ordered gradients along the filaments, indicating structured inflow from >10 pc scales down to the immediate vicinity of the ATOMS sources. The most massive and evolved object, IRAS 13079−6218, sits at the junction of several filaments in the eastern cloud, coincident with higher dust temperatures and larger velocity dispersion, consistent with active accretion and strong stellar feedback. In contrast, sources in the western cloud are associated with cooler dust and simpler filaments, suggesting earlier evolutionary stages. The alignment of filament intersections, dense gas peaks, and compact and extended H II regions indicates that ionizing radiation from massive stars both disrupts and compresses the molecular gas, channeling inflow along the remaining filaments. These results support a hierarchical accretion scenario in which large molecular clouds funnel material through filamentary networks into dense hubs, enabling high-mass star formation. G305 thus provides a key test bed for how global cloud dynamics and stellar feedback regulate mass accumulation from cloud to core scales.

ASI2026_1052	Harmeen Kaur	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Stellar Feedback and Dense Gas Survival in the Reflection Nebulae of the Young Cluster Ruprecht 32		
We present a comprehensive multi-wavelength investigation of the young stellar cluster Ruprecht 32 (hereafter Rup 32) and its associated H II region, aimed at understanding how stellar feedback regulates star formation and the evolution of molecular clouds. The Rup 32 star-forming complex comprises two reflection nebulae, BRAN 66A (hereafter, 66A) and BRAN 66B (hereafter, 66B). Our analysis shows that Rup 32 (radius ≈ 1.24 pc; distance ≈ 3.2 ± 0.12 kpc) is embedded within the reflection nebula 66B, located in close proximity to 66A. Mid-infrared observations at 3.6 and 4.5 μm reveal that 66A and 66B are physically connected through a photodissociation region characterized by arc-like structures surrounding the cluster. The central region of Rup 32 hosts several OB-type massive stars, indicating active radiative feedback. Far-infrared Herschel data (70–500 μm), combined with dust temperature and column density maps, reveal extended, ribbon-like filamentary structures at the outskirts of the cluster, along with multiple dense clumps and dust condensations. Crucially, the detection of CS(2–1) emission in ALMA Band 3 toward the reflection nebula 66B traces dense molecular gas ($n \gtrsim 10^4$ cm^{-3}) associated with the cluster, demonstrating that fragments of the natal molecular cloud persist despite early stellar feedback. These dense regions likely represent sites of ongoing or imminent star formation, potentially triggered by feedback-driven compression. Our results reveal a coherent picture of ionized shells, dense molecular clumps, and filamentary structures sculpted by the feedback from massive stars. This study highlights the critical role of feedback in shaping reflection nebulae, regulating star formation efficiency, and governing the early evolution of stellar clusters in Galactic environments.		

ASI2026_659	Rohit Chaudhary	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Understanding the importance of magnetic fields in the “collect and collapse” model of star formation: a case study towards S104		
Magnetic fields (B-fields) play a crucial role in regulating star formation by mediating the complex interplay between gravity, turbulence, and stellar feedback. However, their influence in feedback-dominated environments remains poorly understood, including in HII regions where expanding ionization fronts (I-fronts) interact with magnetized molecular clouds. HII regions created by massive stars provide ideal laboratories for studying how B-fields influence shell fragmentation and subsequent triggered star formation. We present the results based on high-resolution (14”) 850 μm dust continuum polarization observations using JCMT SCUBA-2/POL-2 towards two dense clumps located on the shell of the spherical HII bubble Sh2-104. B-fields in clump 1 exhibit two distinct components – one with 0±24° orientation, aligning the I-fronts, while the other with 125±40° appears to be perturbed by the Ultra-compact HII region formed within clump 1. To further examine the influence of the expanding HII region on the surrounding clumps and B-		

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field morphology, we produced offset angle maps (Δθ) between the tangential orientation of the I-front and the B-field position angle, revealing preferential alignment with the I-front in clump 1 (except those around UCHII) and radial configurations in clump 2. Our key findings: (i) Plane-of-sky B-fields strengths of 64±7 μG and 64±8 μG in clump 1 and 2, respectively, (ii) Magnetic pressures is either equipartition with (or marginally exceeds) turbulent pressure (PB/Pturb ≈ 1.1-1.5), (iii) Both clumps are magnetically supercritical or at critical state (λ = 3.4±1.5 and 1.8±0.4), indicating gravitational dominance over magnetic support at least in clump 1, and (iv) Sub-Alfvénic turbulence (MA ≈ 0.3-0.4) in both clumps suggest that B-fields regulate turbulent motions and stabilize clump morphology against feedback-driven instabilities. The combined thermal, turbulent, and magnetic support is insufficient to prevent gravitational collapse in clump 1 (critical mass ratios RC = 4.2 for clump 1), consistent with observed active star formation.

ASI2026_534	Ashish Kumar Maindola	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Parametrising Young Star Clusters in the Magellanic Bridge Using UVIT, Gaia, and VMC data		
We investigate star cluster formation in the Magellanic Bridge using multiwavelength data from the UVIT/AstroSat, combined with astrometric and optical data from Gaia and near-infrared observations from the VMC survey. High angular-resolution (≈1.4'') UV observations from the UVIT enable us to study individual hot, young, and massive stars (OB-type and A-type) and young star clusters (aged 100-300 Myrs or younger), at the distance of the Magellanic Clouds (50 to 60 kpc). In this work, we studied ≈ 75 star cluster candidates in five UVIT tiles with far-ultraviolet data (F148W) available for all tiles, and near-ultraviolet data (N242W) available for three tiles. These cluster candidates are identified by catalogues from literature, out of which 80 % of the candidates are non-parametrised, and some may not be clusters at all. We segregate bona fide clusters and probable star clusters from non-cluster candidates by analysing spatial stellar distributions in the UVIT, Gaia, and VMC data, and comparing the cluster region color-magnitude diagrams (CMDs) with their adjacent field region CMDs. To obtain reliable cluster memberships, we apply selection criteria based on Gaia parallaxes, proper motions, and photometric quality cuts from UVIT and Gaia data. To estimate the fundamental cluster parameters (age, metallicity, distance modulus, and extinction), we use UVIT and Gaia CMDs and employ an automated algorithm we developed. The algorithm uses a χ^2-minimisation technique to identify the best-fitting isochrone models to the cluster sequence from a grid of PARSEC models. Only 10 % to 30 % of the cluster candidates exhibit spatial clustering, and CMD features consistent with genuine star clusters and possible clusters. We deploy our technique to estimate the parameters for the non-cluster stellar aggregates as well. The parameterisation of all stellar aggregates in the Bridge is essential to deciphering its formation history and morphology.		

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16th May 2026
Parallel Session - Galaxies and Cosmology I
[Chairperson: Preeti Kharb]
[Time: 16:50 – 18:25]

ASI2026_634	Soumavo Ghosh	Contributed Talk
Galaxies and Cosmology		
Unveiling 'Yesterday' by studying 'Today' : comprehending the chemo-dynamical evolution of the Milky Way over cosmic time		
The Milky Way (MW) plays an instrumental role in unravelling the evolutionary pathway of disk galaxies over cosmic time as it allows us a unique opportunity to carry out detailed photometric, spectroscopic, and dynamical studies on an individual star-by-star basis, in a way that is impossible for external galaxies. The European Space Agency's Gaia mission has enabled us to carry out a detailed chemo-dynamical study for an unprecedented dataset (~ 33 million stars) of the MW. In this talk, I will broadly discuss how studying the chemo-dynamical structure, possibly shaped up by external and internal perturbing sources, can shed valuable insight on the overall galaxy evolution over cosmic time. I will further discuss how different chemo-dynamical structures in the MW can potentially be used as kinematic diagnostics to put stringent constraints on the properties of the bar and spirals in the Milky Way. Lastly, I will focus on the upcoming Gaia data release 4 (scheduled by the end of 2026), its potential to study the MW in further details, and the associated limitations in the study of the evolution and dynamics of the MW.		

ASI2026_420	Akhil Krishna R	Contributed Talk
Galaxies and Cosmology		
Extended ultraviolet emission and outer-disk star formation in Giant Low Surface Brightness Galaxies		
Giant low surface brightness (GLSB) galaxies are massive, gas-rich disk systems with low star-formation efficiencies, low metallicities, diffuse stellar disks, and extended H I reservoirs, yet their formation and evolutionary pathways remain poorly understood. We compile a multi-wavelength dataset for 15 nearby GLSBs using GALEX, DECaLS, and WISE/Spitzer imaging to construct radial surface-brightness and colour profiles. Most GLSBs exhibit extended ultraviolet (XUV) emission beyond the optical radius, indicating low-level star formation in extremely low-density environments, while a smaller subset shows no detectable XUV component. We perform spatially resolved SED fitting to recover radial star-formation histories, stellar mass distributions, and dust attenuation. For XUV-GLSBs, the inner (R25) disk and extended XUV regions are modeled separately, enabling direct comparison with non-XUV systems. This study probes the nature of outer-disk star formation in GLSBs, addressing episodic versus continuous growth, inside-out disk evolution, and the role of interactions or low-metallicity gas accretion. In the era of LSST, Euclid, and JWST, this study provide key constraints on the formation and evolution of extreme low surface brightness galaxies.		

ASI2026_223	Avinanda Chakraborty	Contributed Talk
Galaxies and Cosmology		
Unveiling feedback in a clumpy star-forming galaxy at cosmic noon: ERIS observations of ZC406690		
Cosmic Noon (z ~ 2) marked a period of intense star formation for most galaxies. To understand how the baryon cycle drives disc assembly and bulge growth, I use the ERIS integral field spectrograph (IFS) to obtain high spatial and spectral resolution maps of key optical lines (H-alpha, H-beta, [O III] 5007, [N II]) in massive star-forming galaxies. Here I'll present results for ZC406690 (z = 2.19), stellar mass ~10^10.6 solar masses), a clumpy, ring-like galaxy. The four brightest clumps show asymmetric [O III] and H-alpha profiles, indicating strong stellar feedback and intense star formation. However, the emission-line ratios reveal highly ionized, dusty regions, with two brightest clumps exhibiting the highest excitation and extinction. We checked outflow measurements of the individual clumps show moderate to extreme winds (480–1000 km/s), with electron densities and ionization parameters varying across clumps. Our results highlight strong, spatially variable stellar feedback shaping the physical conditions of star-forming clumps at Cosmic Noon.		

ASI2026_912	Prasun Dutta	Contributed Talk
Galaxies and Cosmology		
Understanding systematics to uncover the redshifted 21-cm emission		
Major challenge for redshifted 21-cm detection from the epoch of Reionization and post Reionization era is the systematics arising from various signal path effects, instruments and orders of magnitude high foreground. We investigate the case of interferometric gain residuals and their imprint on the power spectrum estimators, like the Tapered Gridded Estimator, and estimate the bias and uncertainty in power spectrum estimates from the uGMRT observations. The methodology, the effect of gain errors and their origin and some possible mitigation strategies will be discussed.		

ASI2026_838	Rashi Jain	Contributed Talk
Galaxies and Cosmology		
Alaknanda: A Massive Grand-design Spiral Galaxy from the Universe's Infancy at redshift z~4 with JWST		
We report the discovery of Alaknanda, a large (∼10 kpc diameter), massive ($\log(M_\star/M_\odot) \sim 10.2$), grand-design spiral galaxy with photometric redshift zphot ∼ 4.05 in the UNCOVER and Medium band, Mega Science surveys with JWST. This is among the highest redshift spiral galaxies discovered with JWST. Our morphological analysis using GALFIT reveals that this galaxy is a well-formed disk, with two symmetric spiral arms that are clearly visible in the GALFIT residual. In the rest-frame near-UV and far-UV, we clearly see the beads-on-a-string pattern of star formation; in the rest-frame visible bands, each string appears as an arm. We further confirm the disk dominated nature of this galaxy with non parametric morphological measurements using Statmorph. Spectral energy distribution modeling using the BAGPIPES and Prospector codes is strongly constrained by detections and flux measurements in 21 JWST and HST filters. From the BAGPIPES modeling, the stellar mass-weighted age is ∼199 Myr, implying 50% of the stars in the galaxy formed after z ∼ 4.6. This is a highly star-forming galaxy with a star formation rate (SFR) of ~63 $M_\odot$ yr^{-1}. We detect flux excesses in the F250M and F335M filters due to the presence of H-α+[NII] and [OIII]+H-β emission line complexes respectively which is consistent with our photometric redshift. Detection of a spiral galaxy at z ∼ 4 indicates that massive and large spiral galaxies and disks were already in place merely 1.5 billion years after the Big Bang. This discovery challenges the existing models of disk/spiral galaxy formation in the early universe. Future observations with NIRSpec IFU and ALMA will be able to probe the kinematics of the galactic disk, throwing light on the possible origin of the spiral arms in this galaxy.		

ASI2026_387	Suchira Sarkar	Contributed Talk
Galaxies and Cosmology		
Shedding light on the most massive, double-exponential disk galaxies with extended faint disk in the nearby universe		
Galaxies evolve in structure & morphology across cosmic time. Typically, the most massive galaxies (>=10^11 solar mass) are believed to undergo a morphological transformation from disk to ellipticals across cosmic time, and thus the morphology of such galaxies in the nearby universe should be dominated by ellipticals. Yet, observations as well as simulations show disk galaxies in the above mass range. One class of such galaxies are the giant low surface brightness galaxies that are characterised by a central typical high surface brightness (HSB) stellar disk surrounded by an extended (radial scale length > 10 kpc), photometrically decoupled, low surface brightness (LSB) stellar disk component (e.g, Malin 1, UGC 1378, UGC 1382). Our understanding on the number density of such galaxies in the local universe, the formation of such hybrid morphology , their morphological evolution across redshift remain unexplored due to the limitation of the detection of the faint outskirt. Thus our concept on massive galaxy formation and evolution remain highly biased by the bright galaxies. To fill this gap, we use IllustrisTNG50, a cosmological hydrodynamical simulations to study such double-exponential disk galaxies with extended LSB disk at z=0. We find ~12 % of the >=10^11 M_solar disk galaxies at z=0, similar to this, a first theoretical estimate obtained from such simulations. We show that they lie within the mass range of 11.0 -11.5 (log (M_solar)). They lie in the green-valley region on the specific star formation vs. stellar mass plane. They also satisfy Baryonic Tully-Fisher relation, one of the fundamental relations of disk galaxies. Upcoming data from LSST as well as future surveys with large optical telescopes will be able to trace the LSB envelope of such galaxies with unprecedented details and thus unravel the evolution of one of the most massive galaxies in the local universe.		

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16th May 2026
Parallel Session - High Energy Phenomena, Fundamental Physics and Astronomy I
[Chairperson: Sudip Bhattacharyya]
[Time: 16:50 – 18:25]

ASI2026_302	Kartick Sarkar	Invited
High Energy Phenomena, Fundamental Physics and Astronomy		
Fermi/eROSITA Bubbles: past, present, and the future		
The last decade of studying the diffuse gamma-ray emission from our Galaxy using the Fermi Telescope has advanced our understanding of the high-energy processes in galactic winds, particularly the Fermi Bubbles. The gamma-ray observations have been complemented by observations in X-ray, radio, and UV bands. Together, they represent a complex view of the energetic processes in the Galactic center. Several theoretical models have been proposed to explain these features but with no consensus about their origin. In this talk, I will review the last decade and a half of studying the Fermi/eROSITA bubbles and present the current understanding of these bubbles and the future directions.		

ASI2026_1005	Saswati Roy	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Non-Equatorial Deflection of Light due to Kerr-Newman Black Hole: A Material Medium Approach		
We explored the effect of space-time geometry on the trajectory of light rays in the context of a charged, rotating black hole. We derived an analytical expression for the deflection of light rays in Kerr-Newman space-time geometry, using a material medium approach, on non-equatorial plane. From this deflection angle expression it is evident that the charge and rotation of the black hole can affect the light rays' paths. For Kerr-Newman geometry, the deflection angle decreases with increasing charge when the rotation parameter is held constant. Conversely, for a constant charge, the deflection angle increases with the rotation parameter for prograde and decreases for retrograde trajectories. Applying both factors results in the deflection angle being lower than that of the Schwarzschild geometry. Non-equatorial study of the deflection angle reveals that it is maximum in the equatorial plane than in the pole. The frame-dragging effects in the Kerr-Newman field were taken into account to calculate the velocity of light rays, leading to the determination of the refractive index in this field geometry. This study concludes that, depending on the values of the rotation parameter and charge parameter, both prograde and retrograde trajectories coincide, result in that at some point the frame dragging effect is the same for prograde and retrograde motion. Also, the frame dragging effect increases towards poles than the equatorial plane, and this nontrivial nature results because of the interplay between charge, rotation parameter and rotation frequency of the black hole.		

ASI2026_376	Narendranath Layek	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Discovery of Changing-Look Transitions in NGC 3822: 17-Year Multiwavelength Monitoring		
Active galactic nuclei (AGNs) are the most luminous and energetic sources in the universe, powered by the accretion of matter onto the supermassive black holes located at the centers of the host galaxies. Here, we present 17 years (2008–2025) of X-ray, UV, and optical observations, incorporating data from Swift, XMM-Newton, and NuSTAR, as well as optical data from the Very Large Telescope and the Himalayan Chandra Telescope (HCT) at Hanley, for the AGN NGC 3822. Optical spectroscopic monitoring of NGC 3822 reveals variation in emission lines over time. The 2018 spectrum shows only narrow Balmer emission (Hβ and Hα), whereas the 2022 spectra reveal clear broad Hβ and Hα components, confirming a type transition from type 2 to type 1. Subsequent HCT monitoring from July 2024 to July 2025 shows that the broadness of the Hβ and Hα lines significantly decreased, indicating that the source is transitioning back toward a type 2 state. Optical spectroscopic monitoring confirms the changing-look nature of NGC		

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3822, characterized by the appearance and disappearance of BELs in the spectra. These CL transitions are driven by changes in the mass accretion rate rather than variable obscuration. The BELs appear only when the Eddington ratio is relatively high (∼3.8 × 10-3) and disappear when it drops to a lower value (∼0.9 × 10-3). The multi-wavelength light-curve analysis reveals significant flux variability across the X-ray to optical/UV bands. A sudden outburst is observed during the 2022 epoch, which could be linked to a tidal disruption event, and its signature is also seen in the 2022 optical spectra. X-ray spectral analysis reveals intrinsic absorption in this AGN in 2016 and 2022, likely due to clouds moving into the line of sight, which subsequently moved out of the way before and after these epochs.

ASI2026_751	Soma Mandal	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
AstroSat observations of the ultra-compact X-ray binaries 4U 0614-091 and 1A 1246-588		
We present the timing and spectral characteristics of the neutron star low-mass X-ray binaries 4U 0614+091 and 1A 1246-588, with an emphasis on the nature and origin of kilohertz quasi-periodic oscillations (kHz QPOs). For 4U 0614+091, we examine multiple observations spanning different spectral states. During the transition to intermediate states, the electron temperature drops, and the disk moves inward, coinciding with the appearance of a tentative QPO at ~1550 Hz with ~2σ significance. This is accompanied by soft lags and increasing rms, again pointing to heating rate variations as a plausible mechanism. In 1A 1246-588, we detect a narrow upper kHz QPO at 993 ± 2 Hz occurring during a relatively soft spectral state. Soft lags and energy-dependent increasing rms support a scenario where heating rate fluctuations may be responsible for QPO production.		

ASI2026_869	Sreetama Das Choudhury	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Investigation of Disc-Jet connection in galactic BH-XRBs		
We conduct a comprehensive spectro-temporal analysis in more than twenty BH-XRBs such as XTE J1859+226, 4U 1543−47, H1743−322, GX 339-4, XTE J1550−564, XTE J1752−223, XTE J1650−500, Swift J1753.5−0127, XTE J1748−288, GRO J1655−40, Swift J1727.8-1613, MAXI J1535-571, MAXI J1820+070, MAXI J1348-630, Swift J1658.2−4242, MAXI J1803-298 source, V404 Cyg, V4641 Sgr, Cyg X-3, GRS 1915+105, GRS 1758–258 and 1E 1740.7-2942 using AstroSat, RXTE, and HXMT observations (quasi-) simultaneous with radio observations. In the majority of these sources, we observe an increase in X-ray flux preceding the radio flares. Additionally, the presence of type-A/B QPOs (and occasionally the disappearance of QPOs) is observed during the radio flares, suggesting a connection between these QPOs and jet launching. Further, we observe a positive correlation between the QPO rms (1% - 15%) and normalized Comptonized flux (Fnth ~ 0.02-0.93) across all QPO types and inclination angles. In case of high inclination sources, type-B QPOs exhibit both positive and negative lags, whereas in low inclination sources, they exhibit only positive lag. On the other hand, type-A QPOs always exhibit a negative lag, regardless of the inclination. This implies a possible evolution of coronal geometry from radial to vertically elongated before jet ejections. During hard to softer state transitions, the jet velocities are constrained as ~0.3-0.8 c, and a positive correlation is observed between X-ray and radio fluxes. This suggests that the jet activity is possibly powered by an accretion process.		

ASI2026_1047	Prince Sharma	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Torque reversal and cyclotron absorption feature in HMXB 4U 1538-522		
This work present a detailed timing and spectral analysis of the high-mass X-ray binary 4U 1538−522 using observations from the Nuclear Spectroscopic Telescope Array (NuSTAR). The study is based on three observations obtained between 2019 and 2021. Coherent X-ray pulsations with a period of approximately 526 s are detected up to energies of 60 keV. During the first observation, we measure an instantaneous spin-down rate of P_dot = 6.6(+2.4/−6.0) × 10^(−6) s /s. The pulse profiles show a double-peaked structure, consisting of a broad primary peak and a weaker, energy-dependent secondary peak. We further examine the long-term spin period evolution of 4U 1538−522 using data spanning more than four decades, including measurements from Fermi/GBM. From recent spin-period trends, we find that the third torque reversal in the system occurred around MJD 58800. The neutron star was found to be in a spin-up phase with a rate of Pdot = −1.9(1) × 10−9 s s−1. In addition, we detect a periodic modulation in the spin period. The broadband persistent X-ray spectra are well described by a model consisting of a blackbody component combined with either a power-law or a Comptonization component. The spectra also show an Fe Kα emission line at 6.4 keV and a cyclotron absorption feature around 22 keV. In all three observations, we identify an additional weak absorption feature near 27 keV. These cyclotron features correspond to magnetic field strengths of 1.84(+0.04/−0.06)(1 + z) × 10^(12) G and 2.33(+0.15/−0.24)(1 + z) × 10^(12) G, respectively.		

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16th May 2026
Parallel Session - Education, Outreach and Heritage I
[Chairperson: Aniket Sule]
[Time: 16:50 – 18:25]

ASI2026_1037	Niruj Mohan Ramanujam	Invited
Education, Outreach and Heritage		
Rural Karnataka looks to the stars: Large scale collaborative frameworks for astronomy education		

Through 6000 libraries and 835 schools, the Indian Institute of Astrophysics (IIA) has been running two large scale programs in collaboration with the Government of Karnataka to promote astronomy education and awareness in rural Karnataka, solely in the Kannada language. Though STEM education, and hence opportunities in STEM careers, is known to be deficient in rural areas, they also enjoy access to darker skies, and have substantial untapped potential.
IIA has been working with around 6000 Rural Libraries (Arivu Kendras) through the Rural Development and Panchayat Raj Commission. It has been conducting a number of training workshops and online talks for the Rural Librarians, as well as disseminating activity sheets, multimedia messages on naked eye events, and a few in-person events. We will describe these activities and highlight the noticeable impact that special campaigns like Zero Shadow Day and the 7 Sept Total Lunar Eclipse have had in the rural communities served by these libraries.
IIA has been engaging with all 835 Residential Schools run by the Social Welfare Dept, for whom the Karnataka DST has recently purchased a telescope each. We have trained teachers from all these schools in using their telescopes, as well as setting up a framework for continued mentoring of these teachers, and the formation of astronomy clubs, with monthly activities. We will describe our current efforts and future plans in this collaborative project.
In summary, we will present the challenges as well as strengths involved in these large scale collaborative governmental projects, and the impact it has on promoting scientific temper and science literacy in rural Karnataka over the coming years.

ASI2026_969	Akshat Singhal	Contributed Talk
Education, Outreach and Heritage		
Understanding Teachers' Conceptualisation of Astronomical Scales		

Astronomy involves objects and distances that vary enormously in scale. To interpret observations, we often need proportional reasoning across many orders of magnitude. In this work, we designed a diagnostic questionnaire to characterise teachers' understanding of astronomical sizes and distances, and to identify common challenges and pitfalls. Participants placed a set of given sizes and distances on a relative number line, with space to add notes. The questionnaire was administered to 90 high-school science teachers across India who were part of a teacher training programme. We analyse their placements to study the ordering, internal consistency across related items, and mental scale models used. We present an initial analysis of recurring patterns in the responses, including common ordering difficulties, frequent pitfalls, and regions where placements are comparatively consistent. These results provide an empirical baseline of strengths and weaknesses in length scale conceptual reasoning about astronomical scales. We also outline with the long-term aim of using it as a diagnostic tool and as a pilot lens for future studies in astronomy teacher education.

ASI2026_432	Sonali Sachdeva	Contributed Talk
Education, Outreach and Heritage		
The challenge of spreading Astronomy in a remote place		

Anoopshahr, is a small town on the banks on river Ganges, in district Bulandshahr of the state of Uttar Pradesh. The whole region so far has had zero exposure to Astronomy. After joining Jaypee University Anoopshahr as a faculty in the Physics department, in February 2024, I have given a few introductory talks on Astronomy in my University and nearby colleges. I also organised visits of 4 eminent Astrophysicists, 2 of those visits were converted into one-day workshops,

in my university and a nearby government college. It is interesting to note that despite the lack of exposure, there is immense interest in the subject matter. Inspite of the increase in digital access and the spread of social media, students are not aware of academic options and career opportunities related to Astronomy. In the past year, I also got the opportunity to visit schools in nearby districts, focused on interacting with XIIth standard students, informing them about the range of career options. Across schools, the moment it was mentioned that I am an Astronomer, students used to become quite inquisitive about the details of what it entails. According to my observation, although the students possess a sound understanding of Physics concepts, they do not make it to the institutions of eminence, to pursue their subject of interest, due to two factors. One is the lack of information, and this includes being unaware of the authentic sources of information. Second is the language barrier. Although higher education in largely in English-medium, majority of the schools are in Hindi-medium. Not having enough exposure to English makes them hesitant towards the perusal of several career choices. Both these challenges can be addressed through strategic planning. I would like to elaborate on these challenges and their possible solutions in my talk.

ASI2026_913	T Malsawmtluanga	Contributed Talk
Education, Outreach and Heritage		
The Indigenous Astronomical Knowledge and Myths of the Mizo People		
This study explores the sophisticated astronomical knowledge system of the Mizo people, developed long before exposure to modern science or optical instruments. Through meticulous naked-eye observation of pristine night skies, Mizo ancestors identified, named, and wove intricate etiological myths around approximately 30 celestial bodies, including prominent constellations like Chhohreivung (Orion) and Zângkhua (Ursa Major). This paper argues that their astronomy was not a proto-scientific endeavour but a profound cultural and narrative enterprise deeply embedded in daily life, agricultural practices (e.g., jhum cultivation), and a holistic worldview. The analysis focuses on how purely speculative yet coherent folk narratives—such as the transformative event of Thim Zing (Great Darkness)—were constructed to explain stellar origins, often featuring humans, animals, and everyday objects. Stories behind stars like Siruk (Pleiades) or Sivahluk reveal a cosmology where the celestial and terrestrial realms are interwoven through themes of metamorphosis and social equity. Furthermore, this knowledge served practical functions: stars acted as seasonal calendars, agricultural markers, and omens. The paper concludes by highlighting the significance of this oral tradition, which demonstrates a unique, context-driven method of understanding the cosmos, emphasising keen observation, narrative ingenuity, and a symbiotic relationship with nature. It posits Mizo astronomy as a vital cultural heritage offering insights into how human communities construct meaning from the natural world.		

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17th May 2026 Plenary Session II [Chairperson: G. C. Anupama] [Time: 9:00 – 11:00]

ASI2026_820	Mithun N P S	Invited
Plenary		
Experimental X-ray Astronomy in India Beyond AstroSat		
X-ray astronomy in India began with early balloon-borne and sounding-rocket experiments, and entered the space era with the launch of Aryabhata, India's first satellite. A major milestone was achieved with AstroSat, which carried dedicated X-ray instrumentation with broad energy coverage spanning soft to hard X-rays. These instruments enabled fast timing studies of compact objects in an unprecedented manner, the first of their kind X-ray polarimetric studies of bright sources, and broad-band X-ray spectroscopy of different classes of sources. In parallel, X-ray experiments have also been an integral part of the Chandrayaan series of missions to the Moon, as well as the solar mission Aditya-L1. The XPoSat mission builds on the technological legacy of these previous experiments to explore a largely uncharted regime of X-ray polarimetry. Beyond these missions, ongoing efforts in India have focused primarily on the niche area of X-ray polarimetry over broad energy ranges using multiple techniques, the development of X-ray focusing optics to achieve higher sensitivity compared to collimated detectors, and all-sky monitoring for fast transients. In this talk, I will discuss the ongoing initiatives in these directions within our group and across the country, highlighting their connections to AstroSat results and recent planetary and solar X-ray experiments.		

ASI2026_1155	Bhaswati Mookerjea	Invited
Plenary		
Millimeter/Sub-Millimeter Astronomy : The Indian Perspective		
The cold component of the Universe (5-30 K) emits predominantly at millimeter and sub-millimeter wavelengths (0.3-3 mm) through the continuum emission of dust and the spectral lines of molecular gas. Emission in this regime arises from sources such as dark, cold star-forming clouds and filaments, dusty starburst galaxies in the early Universe, the immediate environments of galactic nuclei, and also from secondary anisotropies in the cosmic microwave background. A global network of sub-millimeter observatories recently produced the first image of a black hole in M87. The proposal for an Indian sub-millimeter telescope is included in the ASI and Mega-Science vision documents, reflecting the Indian community's aspirations for a dedicated facility on Indian soil. In this talk, I will present the science drivers for such a telescope and discuss the suitability of the Himalayan desert in Hanle as a potential site.		

ASI2026_1122	Jayanta Roy	Invited
Plenary		
Exploring the Transient Universe with SPOTLIGHT		
Exploration of the fast radio transient sky is a rapidly expanding area of research, expected to uncover a diverse range of transient sources such as pulsars, fast radio bursts (FRBs), and long-period transients (LPTs). While these phenomena are predominantly associated with neutron stars, they span physical scales ranging from relativistic compact binaries to cosmological distances. SPOTLIGHT is a time-domain survey instrument at the GMRT to perform a real-time commensal search for FRBs, Pulsars, and LPTs, powered by a petaflop-scale computing system funded under the National Supercomputing Mission (NSM). The system executes real-time HPC and AI applications to ensure simultaneous time-domain detection and arc-second imaging localisation of the detected bursts across the GMRT observing band. With an unprecedented sensitivity, SPOTLIGHT is expected to find hundreds of FRBs with possible host galaxy associations, allowing the use of the bursts as cosmological probes. The AI-assisted trigger for genuine astronomical signals enables the capturing of voltage samples spanning the burst duration to study the spectro-		

temporal-polarimetric properties at microsecond time resolution to probe FRB progenitor models as well as propagation imprints. Pulsar searches with SPOTLIGHT are uncovering exotic systems such as double neutron stars, young pulsars, and slow pulsars near the death line, thereby challenging existing emission models. With the successful execution of the SPOTLIGHT project, we expect that this instrument will enable transformational, high-impact science in time-domain astronomy with the GMRT. The presentation will outline the system architecture, emphasise its complementarity in the global context, and present interesting results.

ASI2026_1250	Anwesh Mazumdar	Invited
Plenary		
IOAA 2025: A celebration of astronomy at the high school level		
The International Olympiads in the sciences and mathematics aim to inspire and nurture young school students to embark on a scientific career, by offering them a unique intellectual stimulus, and providing uncommon opportunities of learning in a friendly competition. The International Olympiad on Astronomy and Astrophysics (IOAA) is an annual gathering of the most talented high school students from across the world to showcase their skills of problem solving in astronomy at a highly challenging level. India has been participating in the international astronomy Olympiads for nearly three decades, returning every year with a rich haul of medals. A national programme, anchored at the Homi Bhabha Centre for Science Education (TIFR), selects and trains the students through multiple levels of tests and training camps. India had the honour of hosting the 18th IOAA in Mumbai in 2025, the third occasion that the astronomy Olympiad came to India. We shall describe the overall academic programme of IOAA 2025, designed and developed by a team of Indian researchers, and implemented by a large body of professional astronomers, college and university teachers, amateur astronomers, and undergraduate students from across the country. A few illustrative examples from the tasks will provide a glimpse into the demanding nature of the competition, and how it focuses on creative thinking and problem solving skills essential in both theoretical and observational astronomy. We shall demonstrate how the Olympiad movement is a celebration of the very best in high school science, set in the context of modern advances in contemporary research.		

17th May 2026
Parallel Session - Thesis Presentations - Stars and Supernovae
[Time: 11:30 – 13:00]

ASI2026_443	Arvind Dattatrey	Contributed Talk
Thesis		
Probing the census of hot stars in Globular Clusters		

We present a homogeneous, multi-wavelength investigation of hot stellar populations in star clusters, aimed at constraining non-canonical evolutionary pathways driven by binary interaction, stellar collisions, and cluster dynamics. Our analysis focuses on blue straggler stars (BSSs), blue lurkers (BLs), horizontal branch (HB) stars, and white dwarfs (WDs) in the core-collapsed globular cluster NGC 362 and the open cluster NGC 2420, using UV–optical data from AstroSat/UVIT, UVOT, Gaia EDR3, HST, and the ESO/MPI 2.2-m telescope.

In NGC 362, we analyze 26 BSSs and identify 12 binary systems hosting extremely low-mass white dwarf (ELM WD) companions, providing strong evidence for formation via Case A/B mass-transfer channels. Cooling ages of nine ELM WDs (< 500 Myr) indicate recent binary evolution. The radial distribution of BSSs relative to a reference population exhibits strong central segregation, classifying NGC 362 as dynamically old and consistent with an advanced core-collapse phase that enhances binary-mediated and collisional interactions. We report the first detection of blue lurkers in a globular cluster, identifying four BL systems with low-mass or ELM WD companions through two-component SED fitting; their extremely young cooling ages (< 4 Myr) imply recent formation linked to late-stage dynamical evolution.

Core-collapsed globular clusters are ideal environments for stellar collision products. We identify 17 far-UV bright WD members in NGC 362 using UVIT and HST data. Fourteen WDs are well described by single-component SEDs, while three require two-component WD–main-sequence (MS) models. The WDs span effective temperatures of 22,000–70,000 K and masses of 0.30–1.13 $M_\odot$, while the MS companions are low-mass (0.14–0.24 $M_\odot$). The detection of massive WDs and WD–MS binaries provides the first evidence for massive WD formation in a core-collapsed cluster, a missing link for fast radio burst progenitors in globular clusters, and suggests potential evolutionary pathways toward Type Ia supernovae and FRBs.

ASI2026_421	Bhavya Ailawadhi	Contributed Talk
Thesis		
Probing the Harbingers of Exotic Astrophysical Transients		

Core-collapse supernovae (CCSNe) exhibit a wide diversity in their photometric and spectroscopic behaviour, reflecting differences in progenitor structure, circumstellar interaction, and metallicity. Understanding the physical drivers of this diversity is essential for constraining massive-star evolution and explosion mechanisms. In this work, I present the results of a detailed study of two transitional Type II SNe—SN 2020aze and SN 2020jfo—that do not fit within the conventional IIP–IIL classification scheme. SN 2020jfo displays a short plateau (~67 days) yet retains the observational characteristics of a typical Type IIP event, whereas SN 2020aze shows an extended (~140 days) but more rapidly declining plateau, early flash ionisation features, and a shallow P-Cygni absorption indicative of a Type IIL SN. To explore the underlying progenitor differences, I estimated metallicities for a sample of short- and long-plateau SNe using Fe-line equivalent widths as a diagnostic of progenitor chemical composition. Additionally, I introduce a fully automated Python-based photometric pipeline developed for the International Liquid Mirror Telescope (ILMT), which performs point-source extraction, aperture photometry, zero-point calibration with Pan-STARRS/SDSS catalogs, and generates calibrated light curves for supernovae and other transients. This integrated study advances our understanding of the continuum between Type IIP and IIL SNe while enabling efficient transient characterization with the ILMT.

ASI2026_296	Jyotirmoy Dey	Contributed Talk
Thesis		
From photon leakage to cloud–cloud collisions: The multi-scale nature of H II regions		

High-mass stars play a fundamental role in regulating the structure, chemistry, and evolution of the interstellar medium through intense ultraviolet radiation, stellar winds, and supernova explosions. Their ionizing photons create H II regions, making these objects key tracers of high-mass star formation. However, a long-standing problem persists: ionizing photon rates derived from radio observations are often significantly lower than those inferred from infrared data, particularly in compact and ultracompact H II regions. This discrepancy has challenged our understanding of H II region structure, evolution, and feedback for decades.

In this talk, we investigate whether extended radio emission surrounding compact H II regions can account for the missing ionizing flux. We present a multi-wavelength study of eight Galactic H II regions using high-sensitivity radio continuum and recombination line observations from the upgraded Giant Metrewave Radio Telescope, complemented by data from the GLOSTAR survey. Infrared constraints are obtained using Hi-GAL, MIPSGAL, and GLIMPSE data, enabling spectral energy distribution fitting and estimates of ionizing photon rates.

We detect significant extended radio emission around all targets, previously missed by high-resolution observations. Incorporating this extended emission substantially increases the radio-derived ionizing photon rates, bringing them into close agreement with infrared estimates. The ionized gas velocity field is continuous across compact and extended components, indicating a common physical origin. These results reveal a hierarchical structure in compact and ultracompact H II regions, suggesting the leakage of ionizing photons into the surrounding environments.

We also report compelling evidence for a cloud–cloud collision in the ultracompact H II region G18.148−0.283, including velocity gradients, molecular bridging features, and corresponding signatures in ionized gas. Overall, our findings underscore the critical importance of recovering diffuse ionized emission and highlight the transformative potential of future high-sensitivity facilities such as the Square Kilometre Array for understanding massive star feedback and Galactic evolution.

ASI2026_349	Nitesh Kumar	Contributed Talk
Thesis		
AUTOMATED ANALYSIS OF STELLAR PHOTOMETRIC AND SPECTROSCOPIC ASTRONOMICAL DATA		

In my thesis, we investigated the application of machine learning techniques to the analysis of stellar photometric and spectroscopic data, with particular emphasis on RR Lyrae stars and stellar parameter estimation. We developed artificial neural network (ANN) based interpolators to generate theoretical light curves of RRab stars in the V and I bands from a precomputed grid of pulsation models. The trained ANN interpolators were used to predict light curves of RRab stars in the Magellanic Clouds, and a good agreement was found between the predicted and observed light curves. This approach provided a fast and efficient method for constructing smooth model grids over a wide range of physical parameters.

We also carried out an extensive photometric study of RR Lyrae stars in the globular cluster M3 using 3140 optical CCD images spanning 35 years from multiple astronomical data archives. Periods of 238 RR Lyrae stars, including 178 RRab, 49 RRc, and 11 RRd variables, were rederived using multiband periodogram analysis. We derived the distance to M3 using Period Wesenheit relations calibrated with theoretically predicted relations from the literature. The physical parameters of 79 non-Blazhko RRab stars were determined through ANN-based comparisons between observed and theoretical light curves.

In addition, in my thesis, we applied ANN techniques to spectroscopic data to derive atmospheric parameters of stars in the globular cluster NGC 6397. The ANN was trained to interpolate within the parameter space of the Göttingen Spectral Library and applied to MUSE spectra obtained at the Very Large Telescope using the ULySS analysis framework. The derived atmospheric parameters were in excellent agreement with previously published results.

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ASI2026_851	Pallavi Saraf	Contributed Talk
Thesis		
Tracing the origin of heavy elements through metal-poor stars		

The oldest stars in the Milky Way preserve chemical imprints from the early Universe, offering vital clues to element formation processes nearly 13 billion years ago. Using "Stellar Archaeology," I analyze the chemical properties of these elements to address unresolved questions about their origins, particularly the rapid neutron-capture process (r-process). While neutron star mergers provide evidence of r-process nucleosynthesis, they alone cannot explain its enrichment, and there are still open questions regarding their timescale. In the talk, I will discuss some of the results of r-process stars observed with the Gran Telescopio Canarias (GTC) and the Very Large Telescope (VLT), as well as findings from the HESP-GOMPA survey. I will speak about the newly discovered very metal-poor (VMP) peculiar stars from the HESP-GOMPA survey. Additional scientific highlights of the thesis include the first metallicity-dependent Thorium production ratios, evidence for multiple r-process sites revealed through differential techniques for the first time, and orbital-based classification distinguishing RPE stars between the halo and disk of the Milky Way. I will also present insights from data-driven classification, highlighting diluted RPE stars and potential connections between RPE and CEMP-r/s stars.

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17th May 2026
Parallel Session - Thesis Presentations - Compact objects and Transients
[Time: 11:30 – 13:00]

ASI2026_483	Ashwin Devaraj	Contributed Talk
Thesis		
Probing Accretion Geometries of X-ray Pulsars using Cyclotron Resonant Scattering Features		

Cyclotron Resonant Scattering Features (CRSFs) appear as absorption-like features in the hard X-ray spectra of accretion-powered pulsars and provide the most direct measure of neutron-star magnetic fields. Their dependence on X-ray luminosity often signals accretion regime transitions, while their pulse-phase dependence offers insights into emission geometry shaped by complex magnetic fields. I will present our comprehensive observational studies of cyclotron line variability in three Be/X-ray binaries—GRO J1750−27, XTE J1946+274, and A0535+26—using data from NuSTAR, Insight-HXMT, and AstroSat.
In GRO J1750−27, we discovered a deep cyclotron line feature at ~43 keV during its giant 2021 outburst, observed at luminosities approaching the Eddington limit. In XTE J1946+274, we carried out the first detailed investigation of luminosity- and pulse-phase-dependent cyclotron line behavior. The CRSF was detected only over a subset of rotational phases at higher fluxes, while emerging across all pulse phases at lower fluxes. This behavior, coupled with pulse profile evolution from a double-peaked structure to a single peak near the ~39 keV resonance, indicates a non-dipolar magnetic field configuration in this system. A0535+26, a well-studied pulsar with a known 44 keV cyclotron line, showed luminosity-dependent behavior during its 2020 outburst, when it brightened to nearly 12 Crab. High-resolution phase-resolved spectroscopy revealed a new phase-transient cyclotron line in addition to the known feature, detected in only ~16% of the rotational phases and varying strongly with pulse phase and luminosity. This discovery constrains the system's accretion geometry, suggesting that the accretion column sweeps across the observer's line of sight. Together, these results constitute a comprehensive and systematic exploration of cyclotron line variability in accretion-powered pulsars. This thesis reports new observational discoveries and reveals previously unexplored phase- and luminosity-dependent behaviors of cyclotron lines, providing evidence for complex magnetic field geometries. In this talk, I will present these results and discuss their broader implications.

ASI2026_235	Ketan Rikame	Contributed Talk
Thesis		
Timing spectroscopy and polarimetry studies of X-ray binary systems		

X-ray binaries rank among the most luminous X-ray sources. They consist of a compact star (Neutron Star/Black-hole) gravitationally bound to a normal companion star. Due to their extreme gravity near the compact star and intense magnetic fields, in some cases, X-ray binaries serve as natural laboratories for studying extreme physical conditions. This thesis focuses on the timing, spectroscopy, and polarimetry studies of various X-ray binary systems to improve understanding of their accretion processes, emission mechanisms and reprocessing environment. The first study reports the discovery of transient quasi-periodic oscillations in the high-mass X-ray binary pulsar LMC X-4, enabling an indirect estimation of its magnetic field strength in the absence of Cyclotron Resonant Scattering Features. The second study investigates the reprocessing environment in high-mass X-ray binaries by analyzing eclipse flares in sources such as Vela X-1, LMC X-4, and 4U 1700-37. In 4U 1700-37, we detected a soft excess in the spectrum whose flux does not vary between eclipse flare and non-flare states. Our analysis suggests that this emission originates from the extremely thin shell of the stellar wind surrounding the photosphere of the companion star. The third study explores eclipse bursts in the low-mass X-ray binaries EXO 0748-676 and XTE J1710-281. We estimate the reprocessing efficiencies in both systems at various orbital phases by modeling the peculiar eclipse bursts, which exhibit tails extending beyond the eclipses. X-ray polarimetry is a relatively new area of research and offers unique insights into anisotropies within celestial systems. The thesis includes results from the Indian X-ray polarimeter (POLIX) onboard XPoSat, focusing on detector calibration, energy-dependent response, and data selection strategies to optimize the signal-to-noise ratio, particularly for faint X-ray sources. With results from timing and spectroscopy analyses, together with POLIX polarimetry data, this thesis aims to provide a comprehensive understanding of X-ray binary systems.

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ASI2026_450	Sneha Prakash Mudambi	Contributed Talk
Thesis		
Spectro-timing properties of a few selected Black hole binaries		

In this work, spectro-temporal studies on three BHXBs have been carried out primarily using AstroSat's SXT and LAXPC. Of the three sources, one is a transient source, MAXIJ1820+070, and the others are persistent sources, LMCX-1 and 4U1957+115. For the MAXI source, combined spectra (0.7–80.0 keV) were well modeled using disk blackbody emission, thermal Comptonization, and a reflection component. Source was found to be in its hard spectral state (Γ = 1.61) with a cool disk (kTin = 0.22 keV). We modelled observed flux variability using a single-zone stochastic propagation model at different frequencies using LAXPC data. Additionally, we confirm the detection of a QPO at 47.7 mHz for the first time using AstroSat.

Next, we modelled the combined SXT and LAXPC spectra (0.7-30.0 keV) of LMC X-1 with diskbb, simpl and Tbabs models. Spectral analysis revealed that the source was in its high-soft state (Γ = 2.67) with a hot disc (kTin = 0.86). Thermal disk emission was fitted with a relativistic model (kerrbb) and the spin of the black hole was estimated to be 0.93 (statistical errors) through X-ray continuum-fitting, which agrees with the previous results.

We then performed multi-mission spectral study of 4U 1957+115, using AstroSat, Swift, and NuSTAR. Modelling with a disk emission, thermal Comptonization, and blurred reflection components revealed that the source was in the high-soft state (Γ = 2.6) with the disc flux ∼87% of the total. We found evidence that either the inner disc radius varied by ∼25% or the colour hardening factor changed by ∼12%. Fixing the distance to 10 kpc and using a relativistic accretion disk model, constrained the black hole mass to 6 $M_\odot$ and inclination angle to 72°. A positive correlation is detected between the accretion rate and inner radii or equivalently between the accretion rate and colour factor.

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17th May 2026
Parallel Session - Thesis Presentations - Galaxies
[Time: 11:30 – 13:00]

ASI2026_92	Payel Nandi	Contributed Talk
Thesis		
Effect of AGN on the ISM of their hosts: A multi-wavelength perspective		

Active galactic nuclei (AGN), powered by accretion onto supermassive black holes (SMBHs), profoundly influence the evolution of their host galaxies through feedback. This feedback is a key ingredient in galaxy-formation models, invoked to explain the tight correlations between SMBH mass and host-galaxy properties. Among the various feedback channels, multi-phase outflows—observed in molecular, atomic, and ionised gas—are particularly promising, yet the physical drivers of these outflows and their impact on the interstellar medium (ISM) remain debated. Moreover, while the role of radio jets in shaping the ISM is well established in massive galaxies, their influence in dwarf galaxies is largely unexplored. The recent discovery of AGN in dwarf systems hosting intermediate-mass black holes now challenges traditional models that rely primarily on supernova-driven feedback.

In my thesis, I present a comprehensive, multi-wavelength investigation aimed at addressing three key questions: (a) What triggers outflows in AGN? (b) How does AGN activity regulate star formation in their hosts? (c) Do dwarf galaxies show observable signatures of AGN-driven feedback? To answer these, I assembled and analysed an extensive dataset spanning X-ray (Chandra), UV (AstroSat/UVIT), optical and infrared imaging and IFU spectroscopy (HCT, HST, GEMINI/GMOS(North), SDSS/MaNGA), radio continuum (VLA), and sub-millimetre molecular gas tracers (ALMA).

My results show that (i) ionised outflows are ubiquitous across all AGN classes; (ii) AGN radiation is the dominant driver of these outflows, with radio jets providing an additional boost to the gas kinematics; (iii) AGN activity can enhance, rather than quench, star formation in the nuclear regions; (iv) NGC 4395 exhibits the first clear evidence of jet–ISM interaction on ~10-pc scales in a dwarf galaxy; and (v) both AGN and supernovae jointly shape the feedback cycle in this system.

ASI2026_242	Prajwel Joseph	Contributed Talk
Thesis		
Study of the effect of AGN activity on star formation in nearby galaxies using UVIT		

Star formation plays a key role in galaxy evolution and can be significantly influenced by active galactic nuclei (AGN) through feedback processes. Using ultraviolet observations from UVIT and GALEX, complemented by multiwavelength data, we investigate the impact of AGN feedback on star formation in three nearby galaxies (within 16 Mpc): Centaurus A, NGC 3982, and NGC 628. In Centaurus A, we studied mechanical-mode AGN feedback and identified 352 ultraviolet sources in the Northern Star-forming Region. The spatial alignment of star-forming regions and the radio jet suggests jet-induced star formation, and our analysis reveals the likely trajectory of past jet activity. We also identified new star-forming sources where ongoing jet activity has plausibly triggered star formation. For NGC 3982, which hosts a Seyfert AGN, combined ultraviolet imaging and optical integral field spectroscopy reveal suppressed star formation in the central region due to negative radiative-mode AGN feedback. We also investigated NGC 628 for signatures of recent AGN activity. UVIT and JWST imaging reveal a central cavity devoid of recent star formation, while MUSE observations indicate strong ionisation within this region, likely produced by an AGN that was active until recently. Our results provide high spatial resolution evidence for both positive and negative AGN feedback in nearby galaxies. The cases of NGC 3982 and NGC 628 add to the limited observational evidence for AGN-driven regulation of star formation on sub-galactic scales. We also derive a relationship between radiative-mode AGN luminosity and the radius of the star formation cavity.

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ASI2026_870	Robin Thomas	Contributed Talk
Thesis		
Probing the Star Formation in Galaxies Belonging to Pairs and Cluster Environments		

Galaxy interactions can significantly influence evolutionary processes by triggering or suppressing SF. Gravitational perturbations during these events can compress gas, causing starbursts, or deplete gas reservoirs via mechanisms such as tidal stripping. Consequently, SF serves as a key diagnostic for quantifying the impact of interactions, allowing us to distinguish between secular and environmentally driven evolution. By examining variations in SF across interaction stages and conditions, we gain insights into how galaxies transition from gas-rich spirals to gas-depleted early-type systems.

This thesis presents a comprehensive framework to understand the role of interactions in the evolution of galaxies. Our study provides insight into the evolution of interacting galaxies in field and cluster environments. We observed that evolution a the current epoch is affected by environmental and secular factors. We studied the star formation rate (SFR) enhancement as a function of pair mass ratio and separation between the pairs. We observe a strong anti-correlation between the SFR enhancement and pair mass ratio and no correlation between the enhancement and separation between the pair. This trend suggests that the pair mass ratio may play a major role in the extent of star formation enhancement than pair separation. Additionally, our analysis of galaxy in the Virgo cluster highlights how triggering mechanisms maybe more critical than merely the presence of gas for SF process. The thesis presents an opportunity to build on and conduct further studies with high-resolution data. Expanding the interacting galaxy sample and acquiring high-resolution data will be essential to gain deeper insight into their evolution.

ASI2026_216	Sudeshna Patra	Contributed Talk
Thesis		
The Outer Milky Way: Laboratory for the Effects of Metallicity		

Elements heavier than hydrogen and helium are the building blocks of life. These elements are forged in stars that ultimately met their end, either in explosive supernovae or by gradually releasing their enriched material into space. This stellar recycling enriches the interstellar medium (ISM) with "metals," shaping how galaxies evolve, how stars are born, and how planets eventually form. Metallicity, the abundance of such heavy elements, is therefore a key ingredient governing the physical and chemical behavior of the ISM. Yet, nearly half of all stars in today's Universe formed at a time when the ISM was much poorer in metals. To understand how star and planet formation operated under such primitive conditions, this thesis studies a unique nearby analogue: the outer Milky Way (MW), refers to the region of the Galactic disk located beyond the Solar Circle. Its low-metallicity environment and relatively simplified interstellar conditions provide a powerful laboratory for addressing these gaps in our knowledge. Using HCN and HCO+ observations from the TRAO 14-m radio telescope combined with archival data, we show that commonly used dense gas tracers do not exclusively trace the densest regions of molecular clouds. Instead, much of the emission arises from diffuse gas, questioning the traditional uses of these tracers. We study that dense gas (HCN, HCO+) mass-luminosity conversion factors vary across the MW, challenging universal scaling relations and highlighting the need for metallicity-dependent interpretations in Galactic and extragalactic studies. Using uniform dataset from UKIDSS, we present the first robust comparison of disk fractions in low and solar-metallicity MW clusters, showing that metal-poor clusters host fewer protoplanetary disks without showing faster disk dispersal, challenging the idea that low metallicity universally accelerates disk loss. This thesis establishes the outer MW as a rich laboratory for low-metallicity studies and opens new avenues for future research.

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17th May 2026 Parallel Session - Thesis Presentations - Space / Solar (+ Instrumentation) [Time: 11:30 – 13:00]

ASI2026_867	Harsha Avinash Tanti	Contributed Talk
Thesis		
Detection of low frequency radio signal from space		

Low-frequency radio observations below 30 MHz is one of the unexplored regions of the radio spectrum and offer insights to a wide range of astrophysical phenomena, including planetary radio emissions, transient solar activity, and the dynamics of the interplanetary medium. Ground-based observations at these frequencies are blocked by ionospheric absorption and radio-frequency interference, thereby necessitating space-based measurements. This thesis tries to addresses both the scientific and technical challenges associated with detecting and interpreting low-frequency radio signals from space.

A central contribution of this work is the development of direction-of-arrival (DoA) and source localisation techniques for low-frequency space-based radio missions. The Snapshot Averaged Matrix Pencil (SAM) method is proposed to improve DoA and polarisation estimation using co-located tri-axial antenna configurations under low signal-to-noise ratios, limited snapshots, and multiple incoherent sources. The performance of the SAM-DoA algorithm is evaluated through electromagnetic simulations and scaled laboratory experiments, demonstrating improved estimation accuracy compared to conventional approaches. In addition, a machine-learning–based localisation framework is developed to enable faster, near–real-time inference for observation and resource constrained scenarios.

In the absence of routine space-based low-frequency observations, this thesis also investigates higher-frequency (327 MHz) observations using Interplanetary Scintillation (IPS) to study the interplanetary medium. IPS measurements capture the modulation of radio signals by solar wind density irregularities through Fresnel filtering effects, enabling remote probing of small-scale density fluctuations. Using long-term IPS datasets, this work examines the temporal evolution of solar wind microturbulence and density modulation, with results compared against in-situ measurements from spacecraft such as the Parker Solar Probe to study the radial evolution of plasma and magnetic field fluctuations in the inner heliosphere.

ASI2026_272	Souvik Roy	Contributed Talk
Thesis		
Modeling the Impact of Space Weather on Planetary Space Environments		

Space weather, driven by solar activity, poses substantial challenges to modern technological infrastructure and human exploration beyond Earth's atmosphere. This thesis aims to develop a computational modeling framework that evaluates the impact of space weather on planetary space environments, with a focus on interplanetary coronal mass ejections (ICMEs) and their effects on planetary magnetospheres. We develop the 3D MHD STORM Interaction Module (STORMI), built upon the PLUTO architecture, to investigate interactions between ICMEs and the magnetospheres of Earth-like planets. By introducing the Storm-Intensity index (STORMI) as a proxy for Dst/SYM-H, the model offers a simplified yet computationally efficient approach for predicting geo-storm intensity, demonstrating a significant correlation with established indices. The study showcases the efficacy of the model through simulations of the impact of two diverse storms, one weak and one strong, highlighting its potential for enhancing space weather forecasting capabilities. An independent application to the February 2022 space weather events which led to the premature de-orbiting of Starlink satellites, underscores the model's practical relevance. In addition, the thesis reveals the role of flux rope topology and geometry in determining the geoeffectiveness of ICMEs, physically explaining the seasonal variability of geomagnetic impact. Additionally, the thesis also explores how planetary magnetospheres contribute to the creation of dynamic space weather for their moons. By utilizing global magnetohydrodynamic simulations of a first-of-a-kind Sun-Earth-Moon model and leveraging spacecraft data, we establish that the lunar

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environment during full moon phases can be quite dynamic. Specifically, we explain intriguing observations by the Chandrayaan-2 mission and discover a unique ring-like structure around the Moon which manifests during its geotail passage. Through integration of novel computational models, satellite data analysis, and data-driven predictive capabilities, this thesis contributes to advancing our understanding of space weather phenomena on planetary bodies such as Earth, the Moon, and analogous (exo)planetary systems.

ASI2026_843	Yogesh Kumar Maurya	Contributed Talk
Thesis		
Spontaneous Generation and Annihilation of Three-Dimensional Magnetic Nulls in the Solar Corona		

Magnetic topology governs the storage and release of energy in the solar corona. Changes in topology imply magnetic reconnection, a process that converts magnetic energy into heat and kinetic energy and drives solar transients such as flares, coronal jets. In three dimensions, reconnection is associated with topological structures including magnetic null points and separators. Although 3D nulls are found to be abundant in the solar atmosphere, the physical mechanisms responsible for their generation remain poorly understood.

This thesis investigates the spontaneous creation and annihilation of 3D magnetic nulls using Implicit Large Eddy Simulations of incompressible magnetohydrodynamics without explicit magnetic diffusivity. All simulations rigorously preserve null identities and conserve the net topological degree. Three complementary scenarios are examined. First, an imposed flow acting on a magnetic configuration containing a single proper radial null triggers magnetic reconnection and produces null pairs with opposite topological degrees. These nulls form away from the original null via a mechanism distinct from classical pitchfork bifurcation, and additional null pairs emerge spontaneously during the evolution. Second, a data-driven simulation of a flaring solar active region, initialized using Non-Force-Free Field extrapolations of observed vector magnetograms, reveals spontaneous null generation through reconnection. The newly formed nulls exhibit dome-shaped fan structures and are associated with chromospheric brightenings consistent with slip reconnection, before undergoing pairwise annihilation. Third, simulations starting from chaotic magnetic fields with no pre-existing nulls demonstrate that increasing magnetic chaoticity leads to earlier and more frequent null formation, including evolving spiral and radial nulls that ultimately annihilate through reconnection.

Across all cases, magnetic reconnection is identified as the fundamental driver of null generation and annihilation. These results support a reconnection-assisted mechanism for the spontaneous formation of 3D nulls, offering a compelling explanation for their ubiquity in the solar atmosphere and their potential contribution to coronal heating.

17th May 2026
Parallel Session - Sun, Solar System, Exoplanets, and Astrobiology II
[Chairperson: Manoj Puravankara]
[Time: 14:15 - 15:50]

ASI2026_817	Liton Majumdar	Invited
Sun, Solar System, Exoplanets, and Astrobiology		
The New Frontier in Astrophysics: Unifying the Origins, Atmospheres, and Interiors of Exoplanets		
The discovery of exoplanets has transformed our understanding of planet formation and the diversity of planetary systems. These worlds span a wide range of masses, sizes, temperatures, orbital architectures, and chemical compositions, often challenging classical models based on our Solar System. In this talk, I will discuss the physical and chemical processes that shape the origins, atmospheres, and interiors of exoplanets, and explain why many of them differ so strongly from planets in our Solar System. I will highlight how combined observations from space- and ground-based facilities, together with advanced atmospheric, chemical, and interior models, allow us to probe their compositions, thermal structures, and evolutionary pathways. I will present recent efforts from my group to constrain exoplanetary atmospheres using data from the James Webb Space Telescope (JWST) and discuss prospects for characterizing potentially habitable worlds. Finally, I will outline the transformative potential of upcoming facilities such as the Extremely Large Telescope (ELT), ISRO's ExoWorlds mission, and NASA's proposed next flagship mission, the Habitable Worlds Observatory (HWO), which together promise to open a new era of precision exoplanet science.		

ASI2026_157	Bidya Binay Karak	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Bipolar magnetic regions and their tilts: Implications for the solar dynamo and cycle variability		
The solar convection zone is characterised by the birth of the concentrated magnetic field regions known as sunspots or, more generally, Bipolar Magnetic Regions (BMRs), which are tilted with respect to the equatorial line. Due to this tilt, when sunspots decay, they generate a poloidal field, which forms the seed for the sunspots for the next cycle. We shall present our observational efforts to identify the cause of the sunspot tilts. We analyse the tilt evolution of sunspots, starting from their appearance on the solar surface in the space-based magnetogram data over the last two solar cycles. We observe that from their appearance, BMRs exhibit tilts that are consistent with Joy's law. This early tilt signature of BMRs suggests that the tilt is developed underneath the photosphere, driven by the Coriolis force, as predicted by the thin flux tube model. We further study the tilt angle properties of the ephemeral regions and tiny BMRs. Next, we illustrate the mechanism behind the variations in the solar cycle due to the variations in the sunspot properties. We shall show that tilt, flux, and time delay all have variations as given by their distributions, and these variations cause variations in the solar cycle, including short-and long-term variations in the solar cycle.		

ASI2026_645	Trisha Bhowmik	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
The Ophiuchus DIsc Survey Employing ALMA (ODISEA). Substructures as a function of SED Class and disc mass in 100 systems.		
Understanding the origin of substructures in protoplanetary disks is a key challenge in planet-formation studies, yet current results are strongly biased toward small samples of bright, large disks. I present a high-resolution study of ~100 of the brightest disks from the Ophiuchus Disk Survey Employing ALMA (ODISEA), observed in Band 8 continuum (410 GHz; 0.7 mm), aimed at characterizing disk substructures as a function of SED class and disk mass. The sample extends down to faint disks containing as little as ~2 $M_\oplus$ of dust. Guided by the flux–size relationship, the brightest disks were observed at ~20 au resolution, while fainter disks were targeted at resolutions improved by a factor of three. In all cases, we applied the Frankenstein code to further enhance spatial resolution. Disk substructures		

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were classified within a unified evolutionary framework linking observed morphologies to stages of giant planet formation. We introduce Stage 0 to describe featureless disks and provide systematic definitions for Stages 0–V. Despite higher optical depths, Band 8 proves to be an efficient tracer of disk substructures, recovering the same gaps and cavities seen at longer wavelengths with significantly shorter integration times. Massive disks ($\gtrsim$10 M⨁ of dust, estimated from optically thinner Band 4 data) consistently show substructures compatible with the proposed evolutionary sequence, even at modest resolution. In contrast, lower-mass disks rarely exhibit clear gaps or cavities, even at higher angular resolution, likely due to the steep size–flux relationship. These results support the conclusion that giant planet formation drives substructures in disks with $\gtrsim$10 M⨁ of dust and demonstrate the strong potential of Band 8 observations. With ALMA capable of achieving ~1 au resolution in Band 8, this wavelength offers a promising path to explore substructures in low-mass disks, a regime that remains largely unexplored.

ASI2026_646	Debesh Bhattacharjee	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
On the role of compressibilty using multi-spacecraft in situ observations of ICME-ICME merging on March 3, 2024 event		
Earth-directed solar coronal mass ejections (CMEs) are the primary drivers of the space weather impacts on the Earth. Therefore, a good understanding of the physics of these events is crucial to better predict their arrival times and speeds at the Earth. The interplanetary counterparts of CMEs are called interplanetary coronal mass ejections (ICMEs). In this study, we are tracking down the CME/ICMEs that may have caused the major (Dst = -112 nT) geomagnetic storm on March 3, 2024. Using the in-situ observations from BepiColombo (0.48 AU), STEREO A (0.96 AU), Aditya L1 (0.99 AU), DISCOVR (0.99 AU), and Wind (0.99 AU) we have quantified the plasma and magnetic field compressibility of ICME plasma at various scales. The in situ signatures show a potential ICME-ICME interaction at STEREO A. The outcomes show that at STEREO A, the magnetic field compressibilities of different regions of the ICME structure have higher magnitudes (as compared to the magnitudes at the other spacecraft), which are indistinguishable for the different sub-structures of the event and fall under the same range of magnitudes, from ~0.03 at smaller scales to ~0.9, at larger scales. At STEREO A the magnitudes of plasma compressibility for different sub-structures, also remain indistinguishable and fall under the range between ~0.02 at smaller scales and ~0.4 at larger scales. These, therefore, suggest that during the ICME-ICME interaction, both plasma and magnetic fields of the two ICMEs tend to mix with each other at all scales in a similar fashion. We have also found that the compressibility features as well as magnitudes are different before the ICME-ICME interaction (at BepiColombo) and after the interaction (at Aditya L1, Wind, and DISCOVR). These findings can be important to better understand the turbulent structures at various scales, morphology, and overall cross-sectional coherence of Earth-directed ICMEs.		

ASI2026_988	Sneha Pandit	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Statistical Signatures of Solar Activity in Near-Sun Switchbacks		
Switchbacks are sudden deflections of the magnetic field that are uniquitous in the inner Heliosphere. However, there is no consensus on their origin, with proposed sources ranging from local in-situ processes to deeper coronal dynamics. The key question we investigate, is whether the properties of switchbacks carry the signature of the ~11 year solar Schwabe cycle, which would indeed provide constraints on their possible causes. To do so, we consider a large statistical ensemble of switchbacks observed by Parker Solar Probe (PSP) and evaluate the cycle-dependence of their physical properties, including deflection amplitude, duration, waiting time, and related parameters to the observing conditions.		

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ASI2026_818	Abhijit Chakraborty	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Bhaskaracharya Observatory for the Search of Exoplanets (BOSE): Towards the discovery of Earth's twin		

The Bhaskaracharya Observatory for the Search of Exoplanets (BOSE) is a proposed Indian space-based discovery and legacy mission designed to detect Earth-size exoplanets and potential Earth twins using high-precision transit photometry, proposed by the Physical Research Laboratory (PRL). Despite nearly three decades of exoplanet discoveries, the detection of a true Earth analogue remains beyond current observational capabilities. BOSE is designed to overcome these limitations through continuous, long-baseline photometric monitoring from the Sun–Earth L2 point. The payload consists of two co-aligned 500-mm clear-aperture refractive telescopes operating over the 500–1000 nm wavelength range, mounted on a single platform. The two telescopes will jointly monitor a ~400 deg^2 field using a focal plane mosaic comprising eight 14 K × 14 K low-noise sCMOS detectors. The mission is expected to achieve a photometric precision of ~30 ppm for 11th-magnitude stars and ~40 ppm for 12th-magnitude stars in one hour of effective exposure.

The nominal mission lifetime is seven years, during which two optimized fields in the Galactic plane will be observed continuously for 3.5 years each. Target fields have been selected using Gaia DR3, yielding a cumulative sample of ~800,000 stars dominated by main-sequence populations. End-to-end mission simulations indicate the potential discovery of 10-500 Earth-twins, along with a substantial population of short and long-period planetary systems of up to 6000.

With a spatial resolution of 2.65 arcsec/pixel, BOSE significantly reduces source contamination in crowded fields while combining wide field coverage and uninterrupted temporal sampling. In addition to its primary exoplanet science goals, BOSE will deliver high-value datasets for asteroseismology and time-domain astrophysics. The mission is envisaged for launch in the 2032–2035 time frame.

17th May 2026
Parallel Session - Stars, Interstellar Medium, and Astrochemistry in Milky Way II
[Chairperson: Sarita Vig]
[Time: 14:15 - 15:50]

ASI2026_567	Kuldeep Verma	Invited
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Inferring Stellar Structure and Properties from Starquake Observations		
The study of starquakes (also known as asteroseismology) has revolutionized our understanding of the internal structures of stars by allowing us to peer beneath their surfaces with unprecedented precision. With the advent of high-precision photometric space missions such as Kepler and TESS, asteroseismology has emerged as a powerful tool for placing stringent constraints on stellar internal structure, differential rotation, magnetic fields, convective core overshooting, and fundamental properties such as mass, radius, age, and surface helium abundance. In this talk, I will present recent developments in the field, with a particular focus on solar like oscillators on the main-sequence. I will then highlight our efforts to measure the surface helium abundance and ages of such stars with unprecedented precision and accuracy. Finally, I will discuss the broader implications of these studies in the context of the upcoming ESA's PLATO mission for exoplanetary science, and more importantly, Galactic archaeology.		

ASI2026_437	Antariksha Mitra	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Galactic Chemical Evolution of the Milky Way: An Isotopic Perspective		
Every atom heavier than hydrogen in the Milky Way records stellar processing, but isotopic compositions preserve the most detailed memory of the Galaxy's chemical history. While elemental abundances trace global evolution, isotopic ratios retain sensitivity to stellar masses, nucleosynthetic pathways, delay times, and interstellar mixing, enabling a more stringent reconstruction of Galactic Chemical Evolution (GCE). We present an isotopically resolved GCE model of the Milky Way that links stellar nucleosynthesis, Galactic-scale evolution, and meteoritic constraints within a unified framework. The Milky Way is modelled as a multi-zone system undergoing time-dependent gas accretion, star formation, and feedback-driven enrichment, following the inside-out disk growth paradigm (Chiappini et al. 1997; Matteucci 2012).The model tracks the isotopic evolution of the first 32 elements (H–Ge) and lead (Pb), incorporating metallicity-dependent yields from massive stars, asymptotic giant branch stars, and Type Ia supernovae. This isotopic treatment separates overlapping nucleosynthetic sources, including iron-peak and neutron-capture processes, with particular emphasis on late-time s-process Pb production (Karakas & Lugaro 2016). Model parameters are constrained using a Bayesian Markov Chain Monte Carlo framework calibrated against stellar abundances, radial gradients, age–metallicity relations, and the solar isotopic composition (Asplund et al. 2021). It reproduces observed elemental trends while providing predictive isotopic histories and radial gradients across the Galactic disk. Beyond stellar observations, this isotopic GCE framework directly interfaces with meteoritic and pre-solar grain studies by predicting the time and location-dependent isotopic composition of the Galactic ISM. This enables pre-solar grains to be placed within a quantitative Galactic context, constraining their stellar origins and formation epochs (Zinner 2014). Such an integrated isotopic approach significantly advances GCE as a predictive tool, with broad applications ranging from Galactic archaeology to the origin of Solar System material.		

ASI2026_481	Barnali Das	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
First monitoring campaign of a Main-sequence Radio Pulse emitter		
In my talk, I will present the results from the first monitoring campaign of a Main-sequence Radio Pulse emitter, or MRP. MRPs are main-sequence OBA type stars that emit periodic radio pulses by the electron cyclotron maser emission mechanism. The extra-ordinary stability and simplicity of their magnetic fields set them apart from other magnetic stars on the stellar main-sequence, and also make the MRPs celestial laboratories to understand magnetospheric physics. While spectral properties of the radio pulses from MRPs have been investigated (leading to a wealth of information about how their magnetospheres could operate), the temporal properties remain largely unknown. The key challenge here is the timescale of these pulses. The MRP rotation periods are ~days, so that any monitoring campaign aiming to conduct statistical analysis (e.g. average pulse-profile, drift rates etc.) would be extremely expensive in terms of telescope time. We partially overcame this challenge taking advantage of the stable magnetic properties of MRPs that allows us to reliably predict the pulse arrival times. Under this pilot study, we observed an MRP at 37 epochs using the 16-cm band of the Australia Telescope Compact Array. I will present our initial results that already challenge the current understanding of MRPs, and the potential ways forward.		

ASI2026_713	Prasanta Kumar Nayak	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A UV-Optical Census of Unresolved White Dwarf–Main Sequence Binaries in the Solar Neighborhood		
Understanding the demographics of white dwarf-main sequence (WDMS) binaries is crucial for constraining binary stellar evolution and the formation pathways of several exotic stellar populations. Despite extensive efforts, the census of unresolved WDMS binaries remains significantly incomplete, even within the 100 pc volume of the solar neighborhood. We present a simple and efficient method to identify WDMS binaries that are photometrically hidden within the main-sequence of optical color-magnitude diagrams (CMDs). Applying this technique to a 100 pc volume-limited sample, we identify 347 WDMS binary candidates, of which 188 are newly reported. Our approach exploits NUV-optical CMDs to distinguish unresolved WDMS systems from single stars, combining high-precision astrometry and photometry from Gaia-DR3 with NUV data from GALEX GR6/7. Stellar parameters (effective temperature, bolometric luminosity, and radius) are estimated using binary spectral energy distribution fitting with the Virtual Observatory SED Analyzer (VOSA). WD masses are derived using evolutionary cooling models. As we use the sources which are detected only in NUV band of GALEX, this study directly complements to majority of the previous studies. Consequently, our method preferentially identifies systems with cooler WD companions ($\lesssim$10,000 K). The inferred WD masses span ~0.2-1.3 $M_\odot$, and the majority of main-sequence companions are M-type stars. A significant fraction of our candidates is independently supported by spectroscopic observations from Gaia, LAMOST, SDSS-V, and other archival surveys. Accounting for the incomplete sky coverage of GALEX and avoidance of the Galactic plane, we estimate a conservative lower limit of ~2% for the catalog completeness. This methodology is readily applicable to forthcoming UV missions, such as INSIST, and when combined with Gaia, it offers a powerful route toward a more complete, volume-limited census of WDMS binaries within 100 pc.		

ASI2026_1077	Khushboo Kunwar Rao	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Unraveling Formation Mechanisms of Stragglers in Open Clusters		
Stragglers are stars that appear younger than the rest of their siblings, such as blue stragglers, yellow stragglers, and blue lurkers. They are thought to form through stellar interactions, including mass transfer or mergers in binary systems and, in some cases, direct collisions. Because of this, stragglers provide valuable clues about binary evolution and mass transfer processes. Recent advances, especially from the Gaia mission and large spectroscopic surveys, have		

greatly improved our ability to identify and study these unusual stars. In this talk, I will present results on the formation and evolution of several stragglers in open clusters, using time-series observations and modeling to reconstruct their evolutionary histories.

ASI2026_11	Sachindra Naik	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Photospheric Radius Expansion and Burst-Driven X-ray Reflection in NS LMXB 4U 1702–429		
Thermonuclear X-ray bursts arise from the unstable burning of material accreted from a low-mass companion onto the surface of a neutron star. Such bursts are commonly observed in low-mass X-ray binaries hosting weakly magnetized neutron stars ($\sim 10^7$–10^9 G). In some cases, the burst luminosity reaches the Eddington limit, causing the neutron-star photosphere to expand and producing a photospheric radius expansion (PRE) event. We present a comprehensive study of thermonuclear bursts from the neutron-star low-mass X-ray binary 4U 1702–429 using NICER and XMM-Newton observations. The NICER burst shows clear evidence of a PRE event along with a distinct feature in the burst profile. The burst exhibits strong energy dependence, with the hardness ratio varying significantly during the PRE phase. During the expansion, the photospheric radius reaches a maximum of ∼25 km, while the temperature drops to a minimum of ∼1.4 keV. Time-resolved spectroscopy of the NICER burst, modeled using the variable persistent emission approach, suggests that the observed soft excess may originate from enhanced mass accretion onto the neutron star. Alternatively, disc reflection during the burst can also account for the soft excess emission. We perform time-resolved spectral analysis of three thermonuclear bursts detected with XMM-Newton, which are well described by an absorbed blackbody model and show no signatures of PRE. Additionally, we analyze a 2025 NuSTAR observation of 4U 1702–429, revealing a broad Fe Kα line at ∼6.4 keV and a Compton hump near 20 keV, indicative of X-ray reflection in the persistent emission. Reflection modeling yields an inner disc radius of ∼24 km and an inclination of ∼39°, impliing a neutron-star polar magnetic field strength of $\sim 5.1 \times 10^8$ G assuming disc truncation at the magnetospheric boundary.		

17th May 2026
Parallel Session - Galaxies and Cosmology II
[Chairperson: Arunima Banerjee]
[Time: 14:15 - 15:50]

ASI2026_288	Chayan Mondal	Invited
Galaxies and Cosmology		
AstroSat UV Deep Field: From Interstellar Dust to Lyman Continuum Leaking Galaxies at redshift ~ 0.4–3.0		
The importance of multi-band Deep Field observations to study distant galaxies has become evident during the last few decades. Among various wavelengths, rest-frame far-ultraviolet emission is particularly sensitive to both young stellar populations and interstellar dust in galaxies. We use deep UV imaging from the Ultra-Violet Imaging Telescope (UVIT) onboard AstroSat, combined with observations in optical and infrared bands, to disentangle the dust extinction and the nature of the attenuation law in star-forming galaxies at redshifts of ~ 0.40-0.75 in the AstroSat UV Deep Field (AUDF) north. We further utilize mid-infrared imaging from the James Webb Space Telescope (JWST) of a sample of UV-selected galaxies in the AUDF south field to probe the 7.7 and 11.3 µm emission strength of the Polycyclic Aromatic Hydrocarbon (PAH) dust molecules under varying galaxy properties within the same redshift window. We find that the PAH emission strength increases with stellar mass and rest-frame FUV luminosity, identifying massive, UV-bright galaxies as strong PAH emitters. In addition, we observe an anti-correlation between the strength of PAH emission and the O32 line ratio, suggesting PAH destruction in harder radiation fields. Overall, our study presents key insights into interstellar dust of galaxies in a relatively unexplored redshift range that bridges the cosmic noon and the present-day universe. I will also discuss the unique scope of the AUDF survey in discovering Lyman Continuum (LyC) leaking galaxies at redshift ~ 1 - 3, along with our recent finding of a z=2.9803 He II1640 emitting potentially LyC leaking galaxy (GNHeII~J1236+6215) showing a promising signature of PopIII-like star formation.		

ASI2026_1010	sushma kurapati	Contributed Talk
Galaxies and Cosmology		
How Galaxies Build Mass and Angular Momentum: A Resolved View from Ultra-Deep MeerKAT H I Observations		
Mass and angular momentum are fundamental drivers of galaxy formation and evolution. Global scaling relations between specific angular momentum (j) and mass (M) are well established for stars, gas, and baryons, each component exhibiting distinct trends. However, global relations average over entire galaxies, obscuring how angular momentum is distributed internally and how structural differences between components shape these relationships. In this talk, I will present new insights from the MHONGOOSE survey, an ultra-deep MeerKAT HI survey targeting 30 nearby galaxies spanning a broad range of masses. MHONGOOSE's high spatial resolution and exceptional column-density sensitivity enable us to trace neutral hydrogen to large radii and faint surface densities. By deriving rotation curves with 3D tilted-ring modeling and measuring stellar surface-density profiles, we construct spatially resolved specific angular momentum–mass profiles for stars, gas, and baryons. Our results reveal systematic differences between components. Stars, characterized by steep exponential surface-density profiles, predominantly occupy low-angular-momentum regions in galaxy centers. In contrast, the extended HI gas distributions, often broader and more Gaussian-like, carry a significant portion of angular momentum at intermediate and large radii. These internal differences naturally explain the contrasting global j-M slopes observed for stars (~0.55) versus gas (~1). We further highlight individual galaxies that, despite aligning closely with global scaling relations, show significant internal deviations. These cases demonstrate the power of resolved angular momentum mapping as a sensitive diagnostic of recent gas accretion, interactions, and feedback-driven disturbances.		

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ASI2026_938	Eshita Banerjee	Contributed Talk
Galaxies and Cosmology		
The gaseous environments surrounding high-redshift Lyman-alpha emitters		

The peak in cosmic star formation rate density around redshift ~2 remains a puzzle till date. It is believed that gas accretion and galactic winds within the circumgalactic medium (CGM) hold the key. Studying the CGM of high-z, low-mass galaxies is particularly important, as their shallow potentials make them more susceptible to galactic-scale outflows, though detecting these faint systems has long been challenging. With MUSE enabling the detection of high-z galaxies via their Lya emission, our MUSE Quasar-field Blind Emitters Survey (MUSEQuBES), is dedicated to study the extended gaseous medium around 96 z=3.3 Lyman-alpha Emitters (LAEs) using bright background quasars. Voigt-profile fitting of absorption lines associated with these LAEs reveals that, unlike low-redshift systems, a substantial fraction of the associated CIV components are not gravitationally bound to their host halos. We also find enhanced gas and metal content around galaxies in group environments compared to isolated systems. Galaxies rich in neutral gas, identified through their rest-frame Lya equivalent widths, preferentially reside in gas-rich surroundings. Furthermore, photoionization modelling of the galaxy-associated absorbers with mini-halo-like overdensities reveals two distinct populations: a metal-poor component consistent with the diffuse intergalactic medium and a significantly metal-rich component, likely tracing enriched galactic gas. By combining emission and absorption diagnostics, we also report the direct detection of a cosmic web filament traced by an overdensity of LAEs, along with a giant Lya nebula that we argue is powered predominantly by in-situ recombination. As massive structures were still assembling, the identification of galaxy groups embedded in filamentary environments, together with indications of enhanced cool CGM gas in group environments, suggests a link between large-scale environment, gas availability, and the rise of star formation toward cosmic noon.

ASI2026_926	Abhijeet Anand	Contributed Talk
Galaxies and Cosmology		
The Cosmic Evolution of Carbon Absorbers: First Insights from DESI Quasars		

We present new results on the distribution and evolution of triply ionized carbon (C IV) absorption systems over the past ~4 billion years. We developed an automated matched-kernel convolution technique combined with an adaptive signal-to-noise framework to robustly identify C IV absorbers in quasar spectra. Applying this method ~300,000 quasars from the DESI Year 3 sample, we detect more than 100,000 C IV systems spanning the redshift range $1.4 < z < 4.8$, constituting the largest C IV absorber catalog to date. We quantify the catalog completeness using Monte Carlo simulations, achieving over 95% completeness at rest-frame equivalent widths EW ≥ 1.5 Å. The underlying detection pipeline is generic and extensible to other metal-line doublets, enabling uniform searches for multiple ionic species in low-resolution spectroscopic data and joint constraints on metal enrichment using several tracers.

We study the redshift evolution of C IV absorbers by measuring their incidence and comoving number density. Both quantities increase by factors of about 2–5 from $z \approx 4.5$ to $z \approx 1.4$. Using the column densities measurements, we derive the cosmic mass density of C IV, which increases by a factor ~3.6 over this range, indicating a significant build-up of carbon in the Universe. Treating C IV as a reliable tracer of metal enrichment, we further constrain the mean IGM metallicity and provide a tight lower limit of log(Z_IGM/Z_sun) ≳ −3.5, with a smooth decline toward earlier cosmic times.

Finally, we discuss how these trends link to the evolution of the cosmic star-formation rate and He II photoheating and metal enrichment and the evolving ionizing background. Our publicly released catalog provides a valuable resource for connecting metal absorbers to the circumgalactic medium and the cosmic web, enabling key science for upcoming facilities such as Roman, LSST, and future Stage-V spectroscopic surveys.

ASI2026_365	Priyanjali Patel	Contributed Talk
Galaxies and Cosmology		
Optical Variability in Quasars: A Wavelength-Dependent Study Using ZTF		
Variability in quasars offers a powerful probe of the physical processes governing accretion onto supermassive black holes. Understanding the wavelength dependence of this variability is essential for testing and improving models of quasar variability. We study optical g- and r-band light curves from the Zwicky Transient Facility Data Release 15 for a sample of approximately 5000 quasars. The sample is defined using the homogeneous SDSS DR14 quasar catalog of Rakshit et al. (2020), providing well-constrained black hole masses and Eddington ratios. A spectral model that accounts for accretion-disk continuum emission, Balmer transitions, Fe II pseudo-continuum, and other emission lines is used to reliably interpret the variance spectrum. We quantify variability amplitudes by measuring the variance on different timescales using the Mexican Hat filtering technique. Rest-frame wavelengths are probed through the redshift distribution of the sample, with light curves corrected for redshift effects. By isolating variability on timescales of 30, 75, 150, and 300 days, we find a strong anticorrelation between median variance and rest-frame wavelength for quasars with black hole Mass $10^{8}\ M_\odot$ and Eddington ratio of 10^{-1}. This behavior suggests that optical variability on both short and long timescales originates from different annuli within the accretion disk. The variance ratios also show a clear dependence on rest-frame wavelength. The observed trends are consistent with a bending power-law power spectral density in which both the characteristic damping timescale and the high-frequency slope vary with wavelength. Comparison with the corona-heated accretion-disk reprocessing (CHAR) model (Sun et al. 2020) shows good agreement, indicating that coronal-driven temperature fluctuations play a key role in shaping the optical variability of quasars. This work is based on the analysis presented in Patel et al. (2025).		

ASI2026_154	Bannanje Ananthamoorthy	Contributed Talk
Galaxies and Cosmology		
Detection of a UV Star-Forming Knot in the Giant Radio Galaxy NGC 315		
Energy output from Active galactic nuclei (AGNs) plays a crucial role in regulating the star formation properties of the host galaxies, a process known as AGN feedback. Mechanical (jet-driven) feedback can influence the surrounding medium on galactic and even extragalactic scales, often manifesting as cavities in the hot cluster medium that are aligned with radio jets. However, direct observational evidence linking AGN feedback to localized star formation remains limited. We present a study of the ultraviolet (UV) star formation properties of the nearby elliptical galaxy NGC 315, which hosts a prominent large-scale radio jet. Observations with the UltraViolet Imaging Telescope (UVIT) onboard AstroSat reveal a bright UV knot located at a projected distance of $\sim$1.7 kpc from the nucleus. This knot lies along dusty filamentary structures identified in Hubble Space Telescope observations, suggesting a physical association between dust and UV emission. We propose that this UV emission is likely due to ongoing star formation in the galaxy. The star formation rate (SFR), averaged over 100 Myr, is estimated to be 0.23$\pm$0.10 M$_\odot$ yr^{-1}, which is significantly higher than the typical SFR observed in elliptical galaxies. We speculate a possible AGN jet-triggered star formation near the nuclear region of the galaxy, where the gas could have been supplied via minor merger, cooled gas falling into the central brightest cluster galaxy, and/or condensing of the gas uplifted by the AGN jet. The results also point to a possible role of the AGN in the formation of dust within the galaxy. The work has been published in MNRAS as B. Ananthamoorthy et al., 2025, MNRAS, 544, 3394.		

17th May 2026
Parallel Session - High Energy Phenomena, Fundamental Physics and Astronomy II
[Chairperson: Debarati Chatterjee]
[Time: 14:15 - 15:50]

ASI2026_609	Labani Mallick	Invited
High Energy Phenomena, Fundamental Physics and Astronomy		
Constraining Disk-to-Corona Power Transfer Fraction, Soft X-ray Excess Origin, and Black Hole Spin Population of Type-1 AGN		
Unveiling the nature of the accretion disk, its interaction with the X-ray corona, and assessing black hole spin demographics are some open challenges in astrophysics. To address these issues, we systematically modeled broadband X-ray spectra of a sample of Type-1 active galactic nuclei (AGN) across mass scales. In this talk, I will present the key results from our spectral modeling, discuss the implications of relativistic disk reflection and warm Comptonization for the origin of the soft X-ray excess, predictions of the standard alpha-disk model, and how we can compute the disk-to-corona power transfer fraction in accreting objects. I will also discuss how detailed measurements of the reflected X-rays from the accretion disk can be utilized to probe the innermost regions of accretion flow just outside the event horizon and determine one of the fundamental parameters, the spin of the central black hole, across mass scales in AGN.		

ASI2026_651	NILAKSHA BARMAN	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Equations of state of hot and dense matter and implication on Binary Neutron Star post-merger Gravitational Wave signal		
The nuclear equation of state (EoS) of hot and dense matter plays a crucial role in understanding extreme astrophysical phenomena such as proto-neutron stars and binary neutron star (BNS) mergers. In BNS mergers that do not undergo prompt collapse, the post-merger remnant emits gravitational waves (GWs) with characteristic frequencies that encode valuable information about the underlying nuclear EoS at finite temperature and high density. However, modeling the hot EoS remains challenging due to significant uncertainties in nuclear matter properties. Recent progress through microscopic calculations, heavy-ion experiments, and astrophysical observations from electromagnetic and gravitational waves provide new insights to constrain the nuclear EoS. In this work, we generate a posterior set of finite temperature EoS employing Non-Linear Relativistic Mean Field Theory model consistent with multi-messenger constraints. Using these EoS posteriors, we estimate the dominant post-merger GW peak frequency associated with the quadrupolar oscillations of the hot and rapidly rotating BNS merger remnant. Finally, we discuss the implications of our results for the optimal high-frequency configurations of future GW detectors such as the Einstein Telescope (ET), NEMO and KAGRA HF.		

ASI2026_742	Shubhagata Bhaumik	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Search for Eccentric Binary Black Hole Mergers in the Third Observing Run of LIGO-Virgo-KAGRA		
The increased sensitivity of the recent fourth observing run by LIGO-Virgo-KAGRA (LVK) along with the wealth of observations from LVK's first three observing runs will enable us to address a fundamental question: the origin of binary black hole systems. Gravitational-wave signals give us several hints that can help determine what kind of environment the binary formed and merged in. One of the biggest indicators that a binary interacted with its environment in the late stages of its evolution is its orbital eccentricity. In my presentation, I will talk about why the		

detection of gravitational wave signals from eccentric binary black holes has proved to be challenging and the progress that has been made by LVK in various domains to mitigate these challenges. I will also discuss the dependence of LVK's search sensitivity in the third observing run on source properties of the binary black hole system, and how this can be a useful tool to make astrophysical interpretations of our detections.

ASI2026_439	Sushmita Agarwal	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Extending the VHE Horizon: Systematic Hunting for high-synchrotron peaked Blazars and Prospects for the Cherenkov Observatory		

The detection of very high-energy (VHE; E > 100 GeV) gamma rays from extragalactic sources is a major frontier in high-energy astrophysics. Current and upcoming ground-based Cherenkov facilities, including the Indian experiment Major Atmospheric Cherenkov Experiment (MACE), are well positioned to bridge the 20–100 GeV observational gap. These instruments will substantially improve sensitivity to faint and distant VHE sources, enabling a more complete census of the high-energy extragalactic sky.

High-synchrotron-peaked (HSP) blazars are the dominant extragalactic sources of VHE gamma-ray emission. Identifying these objects is essential for constraining particle acceleration in relativistic jets and for probing the Extragalactic Background Light (EBL). However, the current VHE source catalog remains sparse and is largely biased toward detections during high flaring episodes.

We conduct a systematic search for VHE-emitting HSP blazars in a sample of 1,045 sources using 16 years of Fermi-LAT data. We identify 92 new VHE candidates and confirm 52 previously known emitters. The VHE population is characterized by lower redshifts ($\langle z \rangle \approx 0.2$), brighter synchrotron peaks, and significantly harder gamma-ray spectra (photon index < 2) compared to non-VHE sources. Possible redshift-related selection biases and their spectral implications will be discussed in detail in the talk.

We detect VHE photons during both quiescent and active states, suggesting that VHE emission arises from a persistent acceleration component in relativistic jets rather than being purely flare-driven. This enlarged population of VHE-emitting HSP blazars provides a robust target set for deep-exposure observations. The results are particularly timely for current and upcoming Cherenkov facilities, including the Indian experiment Major Atmospheric Cherenkov Experiment, and will inform source selection and long-term monitoring strategies for next-generation observatories such as the Cherenkov Telescope Array Observatory.

ASI2026_156	Kiran Wani	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Blazar observations with XSPECT onboard XPoSat		

Blazars are a subclass of active galactic nuclei (AGN) that host relativistic jets oriented close to our line of sight. Due to Doppler boosting, their emitted flux is often strongly enhanced, and the characteristic timescales of variability are significantly shortened. Understanding X-ray flux variations in blazars is particularly important as they can provide key constraints on the size of the emission region. Moreover, X-ray observations in conjunction with gamma-ray measurements offer valuable insights into the radiative processes operating in sub-parsec scales in AGN. We present the first results from X-ray observations of an AGN obtained with the XSPECT payload onboard XpoSat launched by ISRO on 1 January 2024. The target blazar was monitored with XSPECT over multiple epochs, complemented by contemporaneous observations with Swift-XRT. The primary objective was to validate XSPECT flux measurements against those obtained with Swift. Simultaneous observations with XSPECT and Swift-XRT conducted in August 2025 yielded consistent fluxes in the 0.8–4 keV band, with XSPECT and Swift-XRT reporting values of $(1.34 \pm 0.031) \times 10^{-10}$ erg cm^{-2} s^{-1} and $(1.38 \pm 0.037) \times 10^{-10}$ erg cm^{-2} s^{-1}, respectively. The XSPECT spectrum in this energy range is well described by a power-law model and exhibits a clear harder-when-brighter trend over a week-long monitoring campaign. Broadband spectral energy distribution modeling within leptonic emission scenarios, required the inclusion

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of an accretion component to account for the observed UV/optical excess. This accretion signature becomes particularly prominent during the source's low-flux state, emerging distinctly within the otherwise jet-dominated spectrum. These results demonstrate XSPECT's capability to deliver reliable X-ray flux measurements and highlight its potential for advancing studies of AGN variability and broadband emission. The results of this work will be presented at the meeting.

ASI2026_16	Shaswata Chowdhury	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
CME Signature and Mode Change in InPTA Millisecond Pulsars		
The second data release of the Indian Pulsar Timing Array (InPTA-DR2) comprises seven years of high-precision timing observations of 27 millisecond pulsars, obtained simultaneously at low (band 3: 300-500 MHz) and high (band 5: 1260-1460 MHz) radio frequencies using the upgraded Giant Metrewave Radio Telescope (uGMRT). The low-frequency data are especially sensitive to dispersion-measure (DM) fluctuations, making them powerful probes for identifying any intrinsic changes in a pulsar or changes in the medium of propagation of the radio signal. In this talk, I will focus on two striking DM outliers identified in the low frequency band-3 data of PSR J1022+1001 and PSR J2145−0750. PSR J1022+1001 lies extremely close to the ecliptic plane, while PSR J2145−0750 is one of the brightest millisecond pulsars and exhibits a multi-component pulse profile. We show that the DM excursion observed in PSR J1022+1001 is consistent with a coronal mass ejection intersecting the pulsar line of sight, whereas the anomalous DM behavior in PSR J2145−0750 is best explained by a possible intrinsic mode-changing event. By directly contrasting these two cases, I demonstrate how solar-event–driven and intrinsic pulsar-origin DM variations produce distinct observational signatures. This provides a physically motivated framework for classifying scientific outliers in PTA datasets and improves DM modelling essential for high-precision pulsar timing and PTA science.		

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17th May 2026
Parallel Session - Facilities, Technologies and Data science I
[Chairperson: Narendra Nath Patra]
[Time: 14:15 - 15:50]

ASI2026_642	Yogesh Wadadekar	Invited

Facilities, Technologies and Data science

Ensemble Machine Learning Photometric Redshifts for the Rubin/LSST Era: Performace and Readiness for Precision Cosmology

The imminent start of the Rubin Observatory's Legacy Survey of Space and Time (LSST), with its unprecedented depth, cadence, and sky coverage over the next decade, marks a transformative phase for observational cosmology. Alongside earlier wide-area surveys such as the Sloan Digital Sky Survey and Euclid, LSST will fundamentally reshape our ability to probe galaxy evolution, large-scale structure, and dark energy. A key prerequisite for fully exploiting LSST data is the accurate and robust estimation of photometric redshifts for billions of faint galaxies using multi-band optical photometry alone.

In this work, we present a new ensemble-based machine learning framework designed specifically for LSST-like data, targeting faint galaxies and extending reliably to higher redshifts. The model uses only optical "grizy" photometry, aligning closely with LSST observing constraints. Our scaled ensemble architecture combines multiple learning algorithms—including gradient boosting, extreme gradient boosting, k-nearest neighbors, and artificial neural networks—trained on bagged input datasets to enhance robustness and predictive accuracy. Compared to individual models, the ensemble delivers consistently improved performance across all redshift ranges, maintaining strong accuracy up to $z \sim 4$.

We validate the framework using publicly available Subaru telescope data from the Hyper Suprime-Cam Strategic Survey Program, which provides an excellent precursor dataset for LSST. The resulting photometric redshifts show significant improvements in precision, bias control, and catastrophic outlier rates. Importantly, the achieved performance meets—and in several cases exceeds—almost all the benchmarks defined in the LSST Science Requirements Document. Our work demonstrates the readiness of ensemble ML approaches for photometric redshift estimation in the LSST era and highlights their potential for enabling precision cosmology with the upcoming Rubin Observatory data.

ASI2026_158	Anirban Kopty	Contributed Talk

Facilities, Technologies and Data science

Optimal cross-correlation technique to search for strongly lensed gravitational waves

As the number of detected gravitational wave (GW) events increases with the improved sensitivity of the observatories, detecting strongly lensed pairs of events is becoming a real possibility. Identifying such lensed pairs, however, remains challenging due to the computational cost and/or the reliance on prior knowledge of source parameters in existing methods. This study investigates a direct cross-correlation (CC) approach applied to strain data from pairs of detectors for Compact Binary Coalescence (CBC) events identified by GW searches, using an optimal, mildly model-dependent, low computation cost approach for identifying strongly lensed candidates. This technique efficiently narrows down the search space, allowing for more sensitive, but (much) higher latency, algorithms to refine the results further. We demonstrate that our method performs significantly better than other computationally inexpensive methods. Particularly, we achieve $96\% \, (80\%)$ lensed events detection at a pairwise false positive probability of $\sim 10\% \, (5\%)$ for a single detector with LIGO design sensitivity, assuming an SNR $\geqslant 10$ astrophysically motivated lensed and unlensed populations. Thus, this method, using a network of detectors and in conjunction with sky-localisation information, can enormously reduce the false positive probability, making it highly viable to efficiently and quickly search for lensing pairs among thousands of events, including the sub-threshold candidates.

ASI2026_614	Bharat Chandra P	Contributed Talk
Facilities, Technologies and Data science		
PRATSUH 0: A Space-Based RFI Survey Mission for Low-Frequency Cosmology		

The Dark Ages and Cosmic Dawn are the poorly understood epochs in cosmology; they can be studied through observations of the redshifted 21-cm signal from neutral hydrogen. Although this signal provides a unique probe of early astrophysics and cosmology, its detection remains difficult from Earth due to ionospheric effects, antenna near field effects, and terrestrial radio frequency interference (RFI). While lunar farside experiments offer an ideal environment, their feasibility is limited by cost and a lack of quantified levels of RFI.

We propose the development and operation of a compact low-frequency radio spectrometer payload, targeting the 30–150 MHz band over a LEO or Moon mission. The payload will consist of a broadband antenna, a calibrated receiver chain, and an FPGA-based spectrometer capable of producing spectrally and temporally resolved data with precise attitude tagging. This configuration enables the separation of Earth-origin and sky-origin signals.

The primary objective is to deliver the first calibrated map of RFI power and occupancy in the orbits, capturing geographic and diurnal variability. Secondary science includes observations of solar radio bursts, meteor-induced scattering, transient luminous events, ionospheric variability, and measurements of the Galactic low-frequency spectrum above the ionosphere.

The results will directly inform the design of future space-based 21-cm experiments, including PRATUSH. We have developed an initial design concept for the analog front end, consisting of a dipole antenna with a matching network and an FPGA-based spectrometer. The project is now progressing toward assembly of a benchtop model, which will be followed by development of the engineering model of the payload. We will be presenting the current status of PRATUSH-0, summarizing the system design and development progress.

ASI2026_1063	Deepthi Ayyagari	Contributed Talk
Facilities, Technologies and Data science		
Regional Specification and Mitigation of Quiet and Disturbed Low-Latitude Ionospheric Effects for LEO-Based PNT Augmentation ove		

The low-latitude ionosphere over the Indian subcontinent undergoes strong spatio-temporal variability driven by quiet-time electrodynamic processes associated with the Equatorial Ionization Anomaly (EIA), as well as disturbed-time space weather events including solar flares, coronal mass ejections (CMEs), and geomagnetic storms. These dynamic perturbations modify ionosphere-thermosphere coupling, alter vertical electron density gradients, and induce rapid Total Electron Content (TEC) fluctuations, collectively degrading the performance of emerging LEO-based Positioning, Navigation and Timing (PNT) systems. While LEO-PNT is gaining global momentum, regional ionospheric specification and system-aware error mitigation frameworks for the Indian sector remain under-developed. This work addresses this gap through high-resolution characterization of ionospheric and atmospheric responses under both quiet and disturbed space weather conditions. A dense network of dual-frequency GNSS receivers is employed to generate regional Vertical TEC (VTEC) maps, capturing low-latitude ionospheric structure, EIA evolution, and storm-time TEC enhancements and depletions. To resolve critical 3-D ionospheric gradients, slant TEC measurements are further assimilated into a physics-informed tomographic inversion framework to reconstruct electron density across altitude, latitude, and longitude. Additionally, key solar-interplanetary-geomagnetic drivers, including solar flux indices, geomagnetic activity parameters, and IMF variability, are incorporated to link ionospheric disturbances with real-time geophysical forcing. This study directly supports national space weather science priorities by contributing to regional ionospheric modelling and augmentation strategies relevant to current and future Indian missions. Beyond navigation, the proposed framework strengthens broader space-weather-impacted applications such as satellite communication, RF propagation modelling, Earth observation, and digital infrastructure resilience in low-latitude regions. The performance of the developed corrections is assessed via their impact on LEO-PNT accuracy, establishing a scalable pathway for robust, real-time ionospheric augmentation in India’s space weather-sensitive technological ecosystem.

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ASI2026_52	Vipin K Yadav	Contributed Talk
Facilities, Technologies and Data science		
The Realization of a Deployable Boom for the MAG Payload aboard Indian Aditya-L1 Solar Mission		
The fluxgate magnetometers are regularly flown onboard space missions to measure local magnetic field in the vicinity of the spacecraft. However, these spacecrafts themselves generate magnetic field which contaminates the measurement of local ambient magnetic field in space. In order to reduce the magnetic noise arising from the spacecrafts, long booms are used to keep the magnetic field sensors as much away as possible from the spacecrafts carrying these magnetometers. Aditya-L1, the first Indian solar mission to study the Sun and placed in an orbit around the first Lagrangian (L1) point, has onboard a fluxgate magnetometer (MAG) to measure the local interplanetary magnetic field (IMF). The two sets of identical MAG sensors are placed on a 6 m long non-conducting deployable boom. In this paper, the details of this MAG boom are described which is working flawlessly in space.		

ASI2026_473	Kevikumar Lad	Contributed Talk
Facilities, Technologies and Data science		
Illumination stability in radial velocity measurements : Insights from PARAS-2		
High precision radial velocity (RV) measurements not only require thermally and mechanically stable spectrograph, but also need uniform illumination of the entrance slit. These illuminations induced effects are critical for extreme precision radial velocity measurements as non-uniformity in slit illuminations introduce drift in radial velocity measurements, which can not be traced using simulteneous wavelength calibration. Therefore, it is important to mitigate the slit non-uniformity by employing special arrangements. Several factors such as atmopsheric effects, telescope guiding , fiber effects, fiber feed etc. can introduce such variations. PARAS-2 (PRL Advanced Radial velocity Abu-sky Search - 2), is the indegeneously developed high resolution spectrograph designed for precision radial velocity measurements. PARAS-2, with resolution ~110000, operates in 380-690 nm waveband and coupled to PRL 2.5m Telescope at PRL Mount Abu Observatory. In my talk, I will present the important details about the different instrumentation aspects, including and design and development of different systems for illumination stability for PARAS-2.		

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18th May 2026
Plenary Session III
[Chairperson: Indranil Chattopadhyay]
[Time: 9:00 – 11:00]

ASI2026_503	Anupreeta More	Invited
Plenary		
Gravitational lensing in the LSST era		
Strong gravitational lensing is a versatile tool to study various phenomena in astrophysics and cosmology. Strong gravitational lenses being rare, their discovery itself has been a challenge. In the recent past, however, owing to large imaging surveys, we were able to discover several hundreds of lenses. I will present some results from these surveys. With the onset of the Rubin Legacy Survey of Space and Time (LSST), we need to prepare for the "big data" challenge. I will introduce LSST and discuss how the strong lensing landscape will have to change in the era of the next generation imaging surveys.		

ASI2026_1248	Anand Narayanan	Invited
Plenary		
Probing the Cosmic Baryon Cycle with Quasar Absorption Line Spectroscopy		
Throughout cosmic history, the bulk of the hydrogen and metals in the universe has resided outside galaxies in diffuse gaseous structures. Understanding this circumgalactic and intergalactic medium is essential for building a complete picture of galaxy formation and evolution, especially those gaseous structures that are at the interfaces of galaxies and IGM, regulating gas accretion, feedback, and chemical enrichment. Quasar absorption line spectroscopy provides one of the most sensitive methods to study such low-density gas over a wide range of redshifts and physical conditions. Over the past three decades, studies have revealed that the CGM is highly multiphased and that a significant portion of the baryonic content of galaxies resides in the CGM. Models combined with systematic galaxy surveys around quasar sightlines have shown that many metal line absorbers arise in extended halos, tracing inflowing, outflowing, and shock-heated gas, providing direct constraints on the baryon cycle in galaxies predicted by theoretical models. I will summarize key results from quasar absorption line studies and discuss how recent progress, including the use of integral field spectroscopy to identify absorber environments and comparisons with cosmological simulations, is helping to reveal the nature of gas at the interface between galaxies and the intergalactic medium across cosmic time.		

ASI2026_675	Suvendu Rakshit	Invited
Plenary		
Weighing the Monsters: Supermassive Black Holes in AGN		
Active galaxies are believed to be powered by the accretion of matter onto supermassive black holes. Measuring black hole masses and investigating the dynamics of the sub-parsec regions of active galactic nuclei (AGN) remain challenging because of the extremely high spatial resolution required. Long-term spectro-photometric monitoring has proven to be a powerful tool for probing the central engine, determining the linear size of the broad-line region (BLR), and estimating black hole masses. At the same time, recent advances in optical spectro-interferometry have provided an independent approach to black hole mass measurements by directly constraining the angular size of the BLR. By combining the linear sizes obtained from spectro-photometric studies with angular diameter measurements from optical interferometry, it becomes possible to estimate distances to AGN across the Universe. In this talk, I will summarize results from extensive long-term spectro-photometric monitoring programs, highlight recent findings from optical interferometric observations, and discuss their implications for black hole mass measurements and distance estimates in AGN.		

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ASI2026_289	Mayuri S Rao	Invited
Plenary		
Global cosmological signal detection experiments at radio frequencies		
Standard cosmology predicts inevitable signals that should be observable as global or all-sky signals. These include the additive distortions to the Cosmic Microwave Background (CMB) spectrum from photons emitted over the Epoch of Recombination. Another is the monopole signal from the redshifted 21-cm signal from hydrogen over the dark-ages, cosmic dawn, and epoch of reionization when the first stars and galaxies form. These signals can be detected at radio frequencies, but there has been no confirmed detection to date. Separating foregrounds, dominated by galactic emission, is a fundamental challenge to detection. Instrument properties, including the environment of operation of the instrument, is yet another challenge. I will discuss two experiments from the CMB DISTORTION Lab at RRI, Bangalore with a primary goal to detect faint global cosmological signals. These are: PRATUSH - a proposed space based experiment to detect the global signal from the cosmic dawn in the lunar farside over 55-110 MHz; and APSERa - an upcoming experiment that will be custom built to make a precise measurement of the CMB spectrum over 2-4 GHz, study any excess radio emission over these frequencies, and eventually detect the faint spectral distortion from the epoch of recombination. I will also discuss instrument design and foreground separation methods that are used in these experiments.		

18th May 2026
Parallel Session - Sun, Solar System, Exoplanets, and Astrobiology III
[Chairperson: S. P. Rajaguru]
[Time: 14:15 - 15:50]

ASI2026_274	Nitin Yadav	Invited
Sun, Solar System, Exoplanets, and Astrobiology		
MHD Wave Generation by Photospheric Vortex Flows and Their Chromospheric Signatures		

Small-scale vortex flows in the solar photosphere are efficient drivers of magnetohydrodynamic (MHD) waves and are thought to play a significant role in transporting energy into the chromosphere. In this study, we employ three-dimensional radiative MHD simulations using the MURaM code to investigate the excitation, propagation, and evolution of torsional Alfvén waves generated by photospheric vortex motions within magnetic flux concentrations. The simulations provide a realistic treatment of convection, radiative transfer, and magnetic field dynamics, allowing us to identify rotational motions and quantify the resulting Alfvénic energy flux as it propagates upward into the chromosphere.

To enable direct comparison with observations, we perform forward modelling of chromospheric spectral lines, such as Ca II 854.2 nm, based on the simulation outputs. Synthetic observables—including intensity, Doppler velocity, and non-thermal line broadening—are analyzed to identify characteristic signatures of torsional wave motions. By linking vortex-driven torsional Alfvén waves in realistic numerical simulations to their observable chromospheric manifestations, this work aims to establish robust diagnostics for detecting Alfvénic wave activity and to assess their contribution to chromospheric energy transport and heating.

ASI2026_472	Manjunath Hegde	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
A Declining Trend in Sunspot Group Tilt Angles Over Three and half solar cycles: 21-24		

The tilt angle, defined as the angle between the line connecting the two polarities of a sunspot group and the solar equator, plays a critical role in linking the Sun’s global magnetic field and is a key parameter in dynamo models. This study examines the long-term characteristics of sunspot group tilt angles using data from the Debrecen Photoheliographic Database (DPD), covering three and a half solar cycles (1974–2013). Using tilt angles provided in the DPD catalog, we compute annual averages and apply weighted linear regression to assess long-term trends, along with wavelet transform analysis to identify short-term periodicities. Our analysis reveals a significant, consistent decrease in the magnitude of sunspot tilt angles, with an average yearly decline of approximately \(0.06 \pm 0.01\) degrees. Additionally, a wavelet analysis indicates a short-term 4--6 year periodicity.

ASI2026_388	Surajit Mondal	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Enigmatic Centi-SFU and mSFU Nonthermal Radio Transients Detected in the Middle Corona		

Decades of solar observations have provided significant evidence for the presence nonthermal particles in the corona. In most cases, the site of particle acceleration can be approximately identified by combining high spatial and temporal resolution data from multiple instruments across a broad frequency range. Practically in all cases, these nonthermal particles are associated with quiescent active regions, flares, and coronal mass ejections (CMEs). Only recently, there has been some reports on the detection of nonthermal emission at locations outside these well-accepted regions. These emissions, now known as Weak Impulsive Narrowband Quiet Sun Emissions, were detected at heliocentric distances of approximately 1.2-1.5 solar radii. Here, we report for the first time multiple cases of transient nonthermal emissions, at much higher coronal heights, in the heliocentric range of ~3–7 solar radii. These emissions do not have any obvious counterparts in other wave bands, like white-light and extreme ultraviolet. These detections were made possible by the regular availability of high dynamic-range low-frequency radio images from the Owens Valley Radio

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Observatory's Long Wavelength Array. While earlier detections of nonthermal emissions at these high heliocentric distances often had comparable extensions in the plane of sky, they were primarily associated with radio CMEs, unlike the cases reported here. Thus, these results add on to the evidence that the middle corona is extremely dynamic and contains a population of nonthermal electrons, which is only becoming visible with high dynamic-range low-frequency radio images.

ASI2026_809	Megha Anand	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
The First Disk-Resolved Mg II Index from SUIT		
Solar UV variability governs key photochemical and radiative processes in Earth's middle and upper atmosphere. The Mg II core-to-wing ratio (also known as "Mg II index") is a standard proxy for this variability, but existing records are Sun-as-a-star and lack spatial attribution. We report the first disk-resolved Mg II index, derived from Aditya-L1/SUIT full-disk imaging in four narrow bands around the Mg II lines (NB02, NB03, NB04, NB05). We construct pixel-level index maps from weighted wing and core signals, generate daily regional indices for plage, sunspots, and quiet Sun, and quantify their contributions to the disk average. The disk-integrated SUIT index co-varies with a standard composite, providing continuity with legacy proxies while, for the first time, attributing changes to specific magnetic features. We also quantify the NB03–NB04 spectral-response overlap using GOME and IRIS reference spectra convolved with SUIT responses; the inferred contribution is small (also feature-dependent) and does not alter the main findings. Taken together, this spatially explicit proxy enables new tests of irradiance reconstructions, connects feature evolution to global UV variability on rotational and longer timescales, and offers improved inputs for middle-atmosphere and space-weather applications. By establishing a stable, disk-resolved Mg II index proxy with routine synoptic coverage, SUIT provides new constraints that connect magnetic-feature morphology to UV irradiance variability, complementing existing proxy and semi-empirical models.		

ASI2026_520	Soumya Roy	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
White-Light Continuum Observations across the Balmer Jump for SOL2024-10-03T12:18		
Solar flares release enormous energy across the solar atmosphere, often producing enhanced continuum emission at visible and near-ultraviolet (NUV) wavelengths. The physical origin of this white-light (WL) emission remains debated: it may arise from hydrogen recombination continua in the chromosphere, characterized by a Balmer jump (Type I), or from deep photospheric heating that produces a blackbody-like continuum (Type II). An X9 WL flare on 2024 October 3 was observed by the Solar Ultraviolet Imaging Telescope (SUIT) on board Aditya-L1, capturing continuum emission across the Balmer jump. Together with coordinated observations from other instruments, this event provides an exceptional opportunity to investigate the nature of flare-driven continuum enhancement. We combine data from SUIT, the High-Energy L1 Orbiting X-ray Spectrometer (HEL1OS), the Interface Region Imaging Spectrograph (IRIS), and the Atmospheric Imaging Assembly (AIA) on board SDO. SUIT delivers full-disk NUV images that track flare ribbon evolution and continuum brightening. IRIS provides high-resolution spectra and slit-jaw images that distinguish chromospheric line emission from continuum sources. AIA traces the response of the upper chromosphere and transition region, while HEL1OS measures hard X-ray spectra that constrain the properties of nonthermal electrons. By correlating the timing of hard X-ray bursts with WL and NUV intensity enhancements, we assess the role of energetic electrons in driving the observed continuum emission. This coordinated, multi-instrument dataset enables us to map energy transport from the corona to the lower solar atmosphere with unprecedented coverage. Together, the SUIT, IRIS, and AIA observations represent a significant step toward understanding how flare energy penetrates to the deepest visible layers of the Sun.		

ASI2026_446	Rishikesh Sharma	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
TOI-6038A b: A Dense sub-Saturn in the Transition Regime between the Neptunian Ridge and Savanna		

We have discovered and characterized a sub-Saturn exoplanet, TOI-6038 A b, based on radial-velocity observations from the PARAS-2 spectrograph combined with photometric data from the Transiting Exoplanet Survey Satellite (TESS). The planet orbits a bright (V = 9.9), metal-rich, late F-type host star with a period of 5.83 days on a nearly circular orbit. Joint modeling of the radial-velocity and photometry data, supported by speckle imaging observations from the PRL 2.5 m telescope, yields a planetary mass of ~78 Earth masses and a radius of ~6.4 Earth radii. Our internal structure modeling indicated a massive core comprising approximately 74% of the planet's total mass, surrounded by a low-density H/He envelope. TOI-6038A b lies in the transition region between the Neptunian ridge and the savanna and has a bulk density (≈1.6 gm/cm^3) consistent with dense sub-Saturns. Although the host star is part of a wide binary system, first-order estimates suggest that secular perturbations from the companion are unlikely to drive high-eccentricity migration. The bright host star makes TOI-6038A b a promising target for future studies of atmospheric escape and orbital architecture, providing valuable insight into the formation and evolution of close-in sub-Saturns.

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18th May 2026
Parallel Session - Stars, Interstellar Medium, and Astrochemistry in Milky Way III
[Chairperson: Drisya Karinkuzhi]
[Time: 14:15 - 15:50]

ASI2026_467	Govind Nandakumar	Invited
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Near-Infrared views of stellar populations in the Galactic center regions		

The Galactic center regions, encompassing the supermassive blackhole of the Milky Way, is unique with an early star formation and chemical enrichment history owing to the inside out formation of the Milky Way (MW). Strong magnetic field, dense gas and high turbulence in the Galactic center regions compared to those in the solar neighbourhood (SN), makes it an ideal test bed for studying star formation and evolution in such unique conditions and is a proxy for understanding initial stages of typical spiral galaxy formation and evolution. Meanwhile, Galactic center regions are very much unexplored owing to the large distance from Earth and the extinction in the optical wavelength regime caused by dust along the line of sight. Thus we have to rely on near infrared and longer wavelength regimes, wherein extinction due to dust is much lower.

In this talk, I will present the recent advancements made in the Galactic center studies. I will particularly focus on the results from our low and high resolution spectroscopic investigations of different stellar populations that constitute various structures in the Galactic center, thanks to near infrared instruments such as IGRINS and KMOS onboard GEMINI and VLT respectively. I will also briefly talk about our current understanding about the formation and evolution scenarios of these different structures based on the comparisons of observed abundance trends with the predictions from chemical evolution models. Finally, I will talk about the upcoming and future near infrared spectroscopic surveys planned to study the Galactic center stellar populations.

ASI2026_1073	AYAN BISWAS	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A Rapidly Evolving Stellar Magnetic Field in YZ Cet & Constraints on the Magnetosphere of Its Planet from Multi-wavelength Study		

Magnetic fields are expected to play a central role in shaping the atmospheric evolution and potential habitability of exoplanets, particularly around M dwarfs. In the Solar System, all magnetized planets exhibit aurorae driven by interactions with the solar wind, producing intense polarized radio emission. We have recently detected similar auroral radio emission from the nearby M-dwarf system YZ Cet, modulated with the orbital phase of its innermost planet and interpreted as evidence of star-planet interaction. However, inferring the magnetic properties of the planet from these radio observations critically depends on the strength and geometry of the host star's magnetic field. To address this, we present a spectropolarimetric study of YZ Cet based on near-infrared observations obtained with SPIRou at the Canada-France-Hawaii Telescope, combined with archival data. We report the discovery of a remarkably rapid evolution of the star's large-scale magnetic field, with substantial changes in both field strength and topology occurring over only a few stellar rotation cycles. Using Zeeman Doppler Imaging, we reconstruct surface magnetic maps at multiple epochs and reveal a dramatic reconfiguration of the global field, including a transition toward a stronger, more dipole-dominated and highly non-axisymmetric geometry. By linking these magnetic maps with previously reported low-frequency radio detections from the system, we refine constraints on the magnetic field of the innermost planet. Our results demonstrate that short-term stellar magnetic variability can strongly influence interpretations of radio signatures of star-planet interaction. This work highlights the need for coordinated spectropolarimetric and radio monitoring to robustly characterize exoplanet magnetospheres and their space-weather environments.

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ASI2026_918	Binduja Panja	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Influence of Methyl Substitution on the Dissociation Dynamics of PAHs: Experimental Observation of Metastable Decay Routes		

The presence of aliphatic substituents such as methyl groups plays a crucial role in determining the stability of polycyclic aromatic hydrocarbons (PAHs) in interstellar environments. Methyl addition to PAHs is chemically feasible through reactions of neutral aromatic molecules with abundant methyl radicals, leading to methylated analogues as proposed in earlier studies. The incorporation of a methyl-substituent strongly influences the stability and post-ionization dissociation dynamics of aromatic molecules. Although the CH_3-group is externally attached to the PAH backbone, its presence introduces additional low-frequency vibrational degrees of freedom that efficiently participate in intramolecular vibrational energy-redistribution (IVR). Following multiphoton absorption, the excess internal energy is rapidly channelled through IVR into the methyl side chain, effectively lowering the barriers for competitive fragmentation routes. This promotes prompt H-loss and CH_3-loss prior to backbone fragmentation, thereby enhancing the overall photostability of the PAH framework.

The experiments were performed at AMP Lab, IIST, using a high-resolution time-of-flight mass spectrometer. Comparative studies on benzene and its methylated analogue toluene, as well as on naphthalene and 1- and 2-methylnaphthalene under 266 nm multiphoton ionization, show that methyl-incorporation significantly enhances hydrogen-loss from the parent ion. All systems exhibit C_2H_2 loss as a metastable decay channel, while 1- and 2-methylnaphthalene show enhanced C_2H_2 yield together with CH_3 and C_3H_3 channels. DFT calculations indicate that 1H loss occurs efficiently from the external CH_3 group rather than from the aromatic ring. However, at higher internal energies, hydrogen migration processes induce ring expansion and ring contraction, enabling the molecule to evolve through several intermediate stages involving structural rearrangements before final dissociation. The experimental approach allows efficient discrimination between prompt and metastable decay processes, providing direct insight into fragmentation timescales. Combined with DFT calculations using Gaussian, this enables construction of dissociation pathways and a consistent interpretation of decay mechanisms in aromatic and methylated aromatic systems.

ASI2026_120	Neha Sharma	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Tracing a Decade of Change: Mid-Infrared Variability in 20,000 Young Stellar Objects		

We present a comprehensive analysis of mid-infrared variability in over 20,000 candidate young stellar objects (YSOs) using a decade-long light curve dataset from the ALLWISE and NEOWISE missions. By applying Lomb–Scargle periodograms and linear fits, we classify YSO variability into secular (linear, curved, periodic) and stochastic (burst, drop, irregular) categories. Approximately 26% of the sample displays significant variability, with irregular fluctuations being the most common. Class I sources show a higher incidence of variability (36%) compared to Class II and III objects (~22%). A detailed color–magnitude analysis (W1–W2 vs. W2) reveals that the "redder-when-brighter" trend dominates across all classes, though the "bluer-when-brighter" behavior is notably more frequent in younger, embedded YSOs. These findings provide new insights into the evolutionary stages and underlying physical mechanisms governing infrared variability in star-forming regions.

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ASI2026_753	MRIDUSMITA BURAGOHAIN	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Investigating variants of nitrogenated Polycyclic Aromatic Hydrocarbons as carriers for interstellar Aromatic Infrared Bands		

The Universe is an inventory of molecules, which are processed in the interstellar medium (ISM) from the beginning of the Universe and play a key role in the evolution of the galaxies. Amongst the remarkable organics in the ISM that generate spectral features in the ISM, polycyclic aromatic hydrocarbons (PAH) or PAH-like molecules are undoubtedly drawing massive attention revealed by their spectral footprints in the form of emission bands, particularly observed in the mid-infrared wavelength range starting from 3 to 20 μm [1,2,3]. These bands are popularly known as "Aromatic Infrared Bands (AIBs)" as suggested by nature of the anticipated carriers. Previous as well as current observations made by ISO, Spitzer, AKARI, SOFIA, SUBARU, JWST etc. have revealed various characteristics of PAH bands including variations among the bands which indicate variants of the suspected carrier. To characterize the variants of PAHs as carriers of various AIBs, calculating theoretical spectra of potentially sustaining PAH molecules in the ISM is inevitable. Earlier studies suggest that nitrogenated PAHs in which a nitrogen heteroatom replaces an inner carbon atom in the PAH structure may account for the short wavelength component of the 6.2 μm emission band [4]. Given the chemical pathways available, the formation of diverse nitrogenated PAH variants is likely unavoidable. Here, we present theoretically obtained synthetic spectra of a few potential variants of nitrogenated PAHs calculated using "Density Functional Theory (DFT)", which would enable us to classify the observed bands followed by a discussion on the limitation encountered in this approach.

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ASI2026_522	Divakara Mayya	Contributed Talk
Galaxies and Cosmology		
Resolved stellar population studies of nearby galaxies using the James Webb Space Telescope		

Most of our current understanding of nearby galaxies have come through the analysis of light integrated over its constituent stars with the use of the technique of stellar population synthesis. Thanks to the unprecedented spatial resolution and sensitivity at near infrared wavelengths offered by the James Webb Space Telescope (JWST), it is now possible to study the nearby galaxies up to a distance of at least 10 Mpc using the classical technique of colour magnitude diagrams (CMDs) of its constituent stars. The CMD technique is able to discern the ages and metallicities of stellar populations over the entire possible ranges of these values without the effects of degeneracy that normally complicates analysis using the integrated data. We have used the CMD technique to obtain the ages and metallicities of all its prominent stellar populations over kiloparsec square areas in a sample of nearby spiral and irregular galaxies. The relatively large Field of View of JWST NIRCam instrument has enabled us to construct the radial gradient of ages and metallicities, which has paved the way to understand the building up of galaxies over the Hubble time. In the talk I will review the progress that has been made in this field from all available JWST data on nearby galaxies.

18th May 2026
Parallel Session - Galaxies and Cosmology III
[Chairperson: Prasun Dutta]
[Time: 14:15 - 15:50]

ASI2026_984	Balpreet Kaur	Invited
Galaxies and Cosmology		
The HI properties of star-forming galaxies at z~1 in the COSMOS field		
Understanding galaxy evolution critically requires information on the evolution of the neutral gas content of galaxies across cosmic time. Unfortunately, the weakness of the HI 21cm transition makes it difficult to detect HI 21cm emission from individual high-redshift galaxies with current telescopes. However, it is possible to measure the average HI mass of a population of high-z galaxies, which have accurate redshifts and positions, by stacking their redshifted HI 21 cm emission signals. In this talk, I will present results from a deep Giant Metrewave Radio Telescope HI 21cm emission survey of star-forming galaxies at z~1 in the COSMOS field. This survey has yielded only the second detection of the stacked 21 cm emission signal from star-forming galaxies at z~1, and a measurement of the average HI mass of high-z star-forming galaxies. The outstanding multi-wavelength data available for the COSMOS galaxies will allow us to determine the dependence of their average HI properties upon their stellar properties, including the stellar mass, SFR, morphology, etc.		

ASI2026_718	Adarsh Kuruvanthodi	Contributed Talk
Galaxies and Cosmology		
Balmer break galaxies at z > 3: insights from the James Webb Space Telescope		
The Balmer break (at 364.5 nm) is a prominent continuum feature commonly used to constrain the redshifts of distant galaxies, estimate the ages of their stellar populations, and infer their star-formation histories. It becomes evident in integrated spectra when the light is dominated by A-type stars. In the case of an instantaneous burst of star formation, the Balmer break emerges after around a hundred million years. Measuring the strength of this feature for large galaxy samples provides constraints on their ages and star-formation histories, thereby offering insights into galaxy evolution over cosmic time (e.g., Belli et al. 2019). In this talk, we discuss the potential of measuring the Balmer break strength from photometry at redshifts 3 to 10 using JWST/NIRCam observations obtained as part of several large photometric surveys (CEERS, JADES, FRESCO, and PRIMER). We demonstrate that adequate photometric bands, within specific redshift intervals, can measure the strength of the Balmer break with an accuracy comparable to spectroscopic observations. We demonstrate that the Balmer break strength shows an evolution with redshift from the cosmic dawn to cosmic noon, which might be primarily driven by the age of the stellar population. We also show the median Balmer break strength in various redshift intervals and the correlation of the Balmer break strength with various physical parameters such as mass, age, specific star formation rate, etc. We also examine the effect of physical parameters on break strength from a modelling perspective and compare our observational results with theoretical expectations. Finally, we discuss some individual Balmer break objects in the epoch of reionization (e.g., Kuruvanthodi et al. 2024), which include post-starburst galaxies, mini-quenched galaxies, and Little Red Dots (LRDs). Overall, our analysis provides clues about galaxy quenching, the nature of star formation, and the onset of star formation in the early universe.		

ASI2026_134	Meera Nandakumar	Contributed Talk
Galaxies and Cosmology		
What Drives Turbulence in Galactic Discs? Evidence from MeerKAT HI Observations		

The interstellar medium (ISM) behaves as a compressible, turbulent fluid, producing scale-invariant density and velocity fluctuations. These turbulent structures regulate star formation by promoting gravitational collapse and contributing to pressure support. While statistical properties such as the density power spectrum and velocity dispersion are established in a few galaxies, their dynamical correlations and driving mechanisms remain unclear.

Successful measurements of the HI column density and line-of-sight velocity power spectra using the Visibility Moment Power Spectrum Estimator (VME) in a few spiral galaxies reveal a diversity in the mechanisms driving large-scale turbulence. Expanding on these studies, we use high-sensitivity MeerKAT HI observations of galaxies that are part of the large surveys MHONGOOSE and PHANGS-HI to quantify ISM turbulence. The galaxy sample spans a wide range of morphologies, star formation activities, and environmental conditions, enabling a systematic investigation of how ISM turbulence depends on overall galactic evolution and dynamics. I will present our results and discuss how they contribute to establishing a unified picture of turbulence dynamics in the ISM, focusing on the nature, origin, and implications of these structures on star formation and galactic evolution.

ASI2026_733	Rajorshi Sushovan Chandra	Contributed Talk
Galaxies and Cosmology		
21-cm Power Spectra From HERA : Analysis And Systematics Challenges		

The neutral Hydrogen spin-flip transition at 21-cm wavelength is a critical EM-window into the evolution of the Universe at redshifts between the CMB, and late time astrophysics. This signal, especially its statistical properties, such as the power-spectrum from radio-interferometers, promises to be an invaluable tool to probe early astrophysics, such as the Epoch of Reionization (EoR), star formation efficiency and X-ray heating of the ISM. The Hydrogen Epoch of Reionization Array (HERA) is a specialized radio-interferometer designed to detect the EoR power-spectrum. While its unique, redundant, and precision calibration techniques coupled with foreground avoidance have produced state-of-the-art upper limits, HERA analysis efforts have also uncovered challenges in the form of newer systematics. HERA Phase II observation results consist of major updates and upgrades from the previous upper limits. Novel hardware upgrades, such as wideband Vivaldi feeds, extend our bandwidth from 47 ~ 234 MHz, covering redshifts from 5 to 25. These upgrades result in newer systematics, such as crosstalk arising from mutual coupling in the new feeds. Redundant calibration of such arrays may also result in a partial decoherence of the 21-cm signal due to non-idealities, termed as signal loss. We will discuss the new upper limits on the 21-cm power-spectra. We will present an in-depth analysis of the 21-cm signal loss estimates due to non-redundancy in HERA and how to disentangle these estimates from other effects, such as different foreground sources interacting with different sections of the primary-beam. In addition, we will also discuss a suite of statistical tests that are useful for identifying hidden systematics that deviate from pure noise statistics expected at current sensitivities that are above the levels of most fiducial EoR models. This will be pivotal in the near future to conclusively detect the 21-cm power-spectra, bordering on the edge of precision radio-astronomy and cosmology.

ASI2026_896	Rudrani Kar Chowdhury	Contributed Talk
Galaxies and Cosmology		
TDEs on FIRE: Co-Evolution of Tidal Disruption Event Rates and Host Galaxies across Cosmic Time		

The disruption of stars by the strong tidal forces of supermassive black holes at galactic centres produces luminous emission that peaks on timescales of a few weeks to months and decays slowly over roughly a year. These high energy transient phenomena, known as tidal disruption events (TDEs), have been extensively studied in the local universe using diverse observations and theoretical frameworks. However, the study of TDEs at high redshifts has been relatively scarce. The launch of advanced high-resolution, wide-field surveys facilitated by telescopes such as JWST, eROSITA, Vera Rubin Observatory and upcoming Nancy Grace Roman Space Telescope (Roman) and Ultrasat is set to revolutionize our understanding of TDEs in the early universe. For the first time, we have explored the rates of TDEs and their correlation with various host galaxy properties across a wide redshift range (z=1-10) using the state-of-the-art cosmological zoom-in simulation FIRE-2. Unprecedented resolution of FIRE-2 provides realistic stellar density profiles at the galaxy centres, enabling accurate calculations of tidal disruption rates (TDR) using loss-cone theory. In this talk, I will discuss the key findings from our study, including the strong correlation of TDR with black hole and host galaxy mass and their redshift evolution, the connection between TDR and cosmic star formation history, and the potential for observing off-nuclear TDEs with Rubin, Roman, and Ultrasat at different redshifts.

ASI2026_709	Akshay Rana	Contributed Talk
Galaxies and Cosmology		
Are Type Ia Supernovae Truly Standard Candles? A Gaussian-Process Test of Luminosity Stability		

Type Ia supernovae (SNe Ia) form the backbone of observational cosmology under the assumption that their absolute luminosities, once standardized, remain constant with redshift. Even small departures from this assumption can lead to systematic biases in key cosmological parameters, including the Hubble constant and the dark-energy equation of state. In this work, we test the redshift stability of SN Ia luminosities using a fully model-independent approach based on Gaussian Process (GP) reconstruction of the cosmic expansion history. We reconstruct the Hubble parameter $H(z)$ from cosmic chronometer measurements, which provide a direct, late-time probe of the expansion rate without reliance on an assumed cosmological model or early-Universe physics. The reconstructed expansion history is then used to obtain a baseline distance modulus, $\mu_{\rm GP}(z)$. To propagate uncertainties robustly and improve numerical stability, we generate Monte Carlo realizations of $H(z)$ from the GP posterior and evaluate the resulting integrals on a Chebyshev grid. Supernova data are compared against this baseline through luminosity residuals, $\Delta M_B(z)$, and their redshift dependence. Applying this framework to the Pantheon+ sample (1701 SNe Ia) and the DES 5-year sample (435 SNe Ia), we find that SNe Ia are broadly consistent with standard-candle behavior at the 1σ level. However, both datasets exhibit localized, non-monotonic deviations: near $z \sim 1$ in Pantheon+ and in the range $z \sim 0.3$–0.5 in DES. The presence of similar features in two independent surveys suggests that these deviations are unlikely to be purely statistical. Our results indicate the possibility of subtle, epoch-dependent luminosity variations in SN Ia populations and highlight the importance of disentangling astrophysical systematics from cosmological inference in the era of precision cosmology.

18th May 2026 Parallel Session - High Energy Phenomena, Fundamental Physics and Astronomy III [Chairperson: Sachindra Naik] [Time: 14:15 - 15:50]

ASI2026_497	Pankaj Kushwaha	Invited
High Energy Phenomena, Fundamental Physics and Astronomy		
X-ray Polarization and Neutrinos: Insights into Blazar's Leptonic vs Hadronic and Single vs Multizone debate		
Blazars – the active galactic nuclei with a jet directed almost towards the Earth, emit across the entire electromagnetic spectrum from radio up to GeV-TeV gamma-rays that exhibit a characteristic broad bi-modal spectral energy distribution. The radio to optical/UV and even X-rays in some, is universally accepted as the synchrotron emission. However, the origin of gamma-rays remains one of the enigmas, with leptonic (electrons) scheme attributing it to inverse Compton while Hadronic (protons) scheme attributes it to proton synchrotron or proton-photon cascades. The extensive SED investigation in the Fermi observatory era, aided by its coordinated multi-wavelength support program complemented with simultaneous variability largely implies single emission region origin favoring leptonic scheme. The claim of association of neutrinos implies presence of a subdominant hadrons contribution. The recently launched Imaging X-ray Polarimetry Explorer (IXPE), however, has revealed systematically larger X-ray polarization compared to optical (synchrotron part). In this talk, I will revisit and discuss new insights from X-ray polarization and neutrinos and their implications on the emission schemes and single vs multi-zone origin debate.		

ASI2026_575	Samir Mandal	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing the Accretion Dynamics in Black Hole X-ray Binaries using UV-X-ray Spectral Studies		
Accretion onto stellar-mass black holes in X-ray binaries drives a rich range of spectral and temporal phenomena across the electromagnetic spectrum. In particular, the ultraviolet (UV) and X-ray bands provide direct probes of the accretion disk, hot corona, and disk–wind interactions, making them crucial for understanding accretion dynamics. In this work, we investigate the accretion properties of black hole X-ray binaries through combined UV–X-ray spectral studies. We utilise simultaneous and quasi-simultaneous observations from space-based UV and X-ray instruments, enabling broadband coverage from the outer accretion disk to the innermost regions near the black hole. The observed spectra are modelled using physically motivated broadband accretion models, incorporating thermal emission from the disk, Comptonization in the corona, and reprocessing and absorption by disk winds. This approach allows us to track the evolution of key accretion parameters—such as mass accretion rate, inner disk radius, coronal temperature, and optical depth—across different spectral states and luminosity regimes. Our results demonstrate how UV emission constrains the outer disk structure and irradiation effects, while X-ray spectra probe the inner accretion flow and high-energy processes. By linking UV and X-ray properties within a unified theoretical framework, we provide new insights into state transitions, disk–corona coupling, and the role of outflows in black hole X-ray binaries.		

ASI2026_160	Abhisek Tamang	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Super-orbital period evolution of Her X-1		
Her X-1 is an intermediate (or low) mass X-ray binary pulsar that exhibits a ~35-day super-orbital modulation whose origin-disc precession or neutron-star free precession-remains debated. Earlier work reported stochastic variations without a clear long-term trend. Using ~50 years of data from CGRO/BATSE, RXTE /ASM, Swift/BAT, Fermi/GBM, and MAXI /GSC supplemented with archival measurements, we studied the long-term evolution of this modulation. Three methods are applied: epoch-folding searches for constant periods, Chi-square maximisation in the period-period-		

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derivative space, and timing of main-on peaks via an O-C analysis. All approaches consistently show a long-term decrease in the super-orbital period at a rate of ~ -10^5 s/s, with additional short-timescale variabilities superposed on this trend. The possible mechanisms for the observed decay of the super-orbital period will be discussed.

ASI2026_698	Camelia Jana	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Impact of winds on accretion shocks in magnetized accretion flows around rotating black holes		

We investigate the global transonic solution for a relativistic, magnetized, viscous, dissipative, and advective accretion flow around a rotating black hole (BH), including the effects of mass and angular momentum loss through winds. In doing so, we consider dominant toroidal magnetic fields, with synchrotron radiation serving as the primary cooling mechanism inside the disk. To account for mass loss, we adopt the mass accretion rate to decrease inward as a power-law function of the disk radius. Within this framework, we solve the governing equations that describe accretion flows in the presence of winds and obtain the flow structure as a function of the inflow parameters, namely energy $\mathcal{E}$, angular momentum λ, plasma-β (=$P_{\rm gas}/P_{\rm mag}$, $P_{\rm gas}$ and $P_{\rm mag}$ being the gas and magnetic pressure), accretion rate $\dot{m}$, and viscosity $\alpha_{\rm B}$; the wind parameters governing mass loss (p) and angular momentum extraction (l); and the black hole spin ($a_{\rm k}$). Our results show that winds substantially modify the accretion dynamics, leading to a significant reduction in disk luminosity. We identify global solutions that admit standing shocks and demonstrate that winds have a strong influence on shock characteristics, including the shock radius ($x_{\rm s}$), compression ratio (R), and shock strength (S). Furthermore, we determine the critical wind parameter $p^{\rm crit}$ beyond which steady shock solutions no longer exist. We find that enhanced viscosity and more efficient angular momentum removal by winds systematically reduce $p^{\rm crit}$. These findings reveal the intricate interplay between viscosity and wind parameters in governing the dynamics of shock formation in accretion disk.

ASI2026_723	Tanima Mondal	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Multi Messenger Study of GRB 221009A with VHE Gamma-ray and Neutrino Afterglow from a Gaussian Structured Jet		

The detections of very-high-energy (VHE; $\gtrsim 100$~GeV) emission from GRB afterglows, highlighted by the exceptional brightness of GRB~221009A observed by LHAASO, indicate emission components beyond the standard electron synchrotron model. The presence of multi-TeV photons supports synchrotron self-Compton and potentially hadronic contributions, while the absence of coincident neutrinos in IceCube or KM3NeT places constraints on the microphysical parameters, jet kinetic energy, and ambient medium density. We model the VHE afterglow of GRB~221009A using an external forward shock from a Gaussian structured jet in a uniform density medium. This angular structure accounts for the extreme TeV output at an off-axis angle without requiring the energetics implied by a top-hat jet. We compute the associated $p\gamma$ neutrino flux in the PeV-EeV range and derive a time-integrated upper limit using the effective areas of upcoming neutrino detectors IceCube-Gen2 and GRAND200k, quantifying the contribution of individual GRBs to the expected neutrino events. For parameters inferred from the multi-wavelength spectral energy distribution, the predicted neutrino flux remains below the sensitivities of both detectors. Even for highly optimistic microphysical choices, our correlation analysis suggests that events from this GRB are of order ~ 0.1 for GRAND200k. We further compare on-axis and off-axis viewing geometries and find that jet geometry alone can change the predicted flux by nearly an order of magnitude. These results imply that a GRB that is both closer and brighter than GRB 221009A is required for realistic neutrino detection with upcoming facilities. Future CTA detections of GRBs will therefore be essential for constraining jet geometry, radiation mechanisms, and any associated neutrino emission.

ASI2026_891	Indranil Chattopadhyay	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
On low to high frequency QPO in microquasars and its relation to the black hole spin		

Accretion on to black holes is the best model to explain the observed radiation from AGN and microquasars. The black-hole microquasars generally show low frequency quasi periodic oscillations (LFQPO) in their hard and intermediate spectral states. LFQPO are oscillations in the hard-powerlaw part of the X-ray spectra, where the oscillation frequencies are in the range of just under 1 Hz to about 20 Hz, but generally around few Hz. LFQPO has been extensively studied. Even relations between QPO frequency and the spectral index of the power law tail has been emperically obtained by numerous observations. But only in a few observations, HFQPO (>50 Hz) has been detected. We present numerical simulation of transonic accretion disc in presence of various dissipative processes to explain LFQPO to HFQPO. In this presentation, we discuss the physics of QPOs in details, why such oscillating regions occur and what are the plasma parameters that governs this. We show that in accretion discs around non-spinning blackholes, oscillations in the inner part of the disc tends to produce LFQPOs. However for highly spinning blackholes, depending on outer boundary conditions, oscillations in the inner part of the disc can produce LFQPOs to HFQPOs. For highly spinning blackhole the oscillating region can be close to the horizon and therefore can produce HFQPO. However, that is a general trend , one can form an oscillating region at a slightly larger distance but can have smaller amplitude and higher frequencies. Due to low statistics there is no emperical relation between spectral index and QPO frequency for HFQPO. We predict a theoretical relation between the two, to be confirmed by more observations in future.

18th May 2026 Parallel Session - Facilities, Technologies and Data science II [Chairperson: Saurabh Sharma] [Time: 14:15 - 15:50]

ASI2026_478	Arun Surya	Invited
Facilities, Technologies and Data science		
Designing in the ELT Era: Insights from TMT Instrument Design for the next generation Indian Instruments		

The Indian astronomical community has participated extensively in the design of TMT's first-light instruments, gaining valuable insight into the technical, organizational, and systems-level challenges that accompany extremely large telescopes. During the design phase, the TMT instrument suite—including the Wide Field Optical Spectrograph (WFOS), the Infrared Imaging Spectrograph (IRIS), and MODHIS—has undergone multiple iterations driven by difficult trade-off studies involving performance, complexity, risk, and cost. In this talk, I will focus in particular on WFOS, a multi-object slit spectrograph, and IRIS, an adaptive-optics-fed integral field spectrograph, highlighting the key challenges, debates, and consensus-building processes that shaped their final designs.

I will then discuss how these design-phase lessons can inform the development of the next generation of instruments for existing Indian ground-based telescopes, as well as future facilities such as the proposed National Large Optical Telescope. In the Indian context, I will highlight ongoing efforts to develop a configurable-slit multi-object infrared spectrograph, as well as India's participation in the SCALES integral field spectrograph being built for Keck. Together, these examples illustrate how experience gained from ELT-scale instrument design can directly benefit national instrumentation programs.

ASI2026_772	Akshaya V G	Contributed Talk
Facilities, Technologies and Data science		
RFSoC-Based Digital Correlation Spectrometer for APSERa		

The Epoch of Recombination is a pivotal period in cosmological history, during which the hot plasma of the early Universe cooled and transitioned into an atomic state. Cosmological Recombination Radiation (CRR) lines that are emitted by the process of the formation of the first atoms over this era appear as faint additive ripples in the Cosmic Microwave Background.

APSERa, the Array of Precision Spectrometers for the Epoch of Recombination, is an upcoming cosmology experiment aimed at detecting CRR over 2-4 GHz where the sensitivity for a ground-based detection is expected to be the highest. On completion, APSERa will comprise a 128-element array with custom-designed antennas and cutting-edge electronics.

The prototype digital receiver for APSERa employs a Xilinx ZCU111 evaluation board based on Radio Frequency System-On-a-Chip (RFSoC) at the core of its Digital Correlation Spectrometer. This board includes eight high-speed 12-bit ADCs, each capable of sampling at up to 4.096 GSPS, of which two ADCs are used – each digitizing a signal having a bandwidth of 2 GHz. The correlation spectrometer is realized inside the RFSoC and leverages parallelism by implementing an F-engine comprising a 16384-point split-FFT architecture (M*N) through a combination of sixteen parallel, pipelined streaming 1024-point FFT IP cores, complex multipliers for phase correction, and a custom-designed 16-point parallel FFT engine. X-Engine performs complex multiplication and accumulation to produce two autocorrelation spectra and one cross-power spectrum, with an on-chip integration time of about 16.77 ms. The data is then streamed out via 1-gigabit Ethernet interface to a laptop for data acquisition and further processing.

In this talk we present the architecture of the digital correlation spectrometer for APSERa, implemented on the RFSoC, along with the accompanying results.

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ASI2026_1048	Rajesh Kumble Nayak	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
IndIGO-D: An Indian Initiative in gravitational wave observations in the Deci Hertz band		

IndIGO-D collaboration*

Since the landmark discovery in 2015, gravitational-wave observations have revolutionized our understanding of the cosmos. With the advent of next-generation ground-based gravitational-wave observatories such as Cosmic Explorer and the Einstein Telescope, the emerging evidence for nanohertz gravitational waves from pulsar timing arrays, and the planned Laser Interferometer Space Antenna (LISA) operating in the millihertz band, gravitational waves are poised to play an increasingly central role in astronomy and fundamental physics over the coming decade. Here, we discuss a potential space-based gravitational-wave mission operating in the Decihertz band, between 0.1–30 Hz. The concept consists of an L-shaped interferometer with an arm length of approximately 1,000 km. We tentatively refer to this mission as the Indian Initiative in Gravitational-wave Observations in the Decihertz band (IndIGO-D). We outline possible orbital configurations and projected sensitivities, and examine the unique astrophysical science enabled by observations in this frequency range. In particular, we highlight how decihertz gravitational-wave measurements can address several outstanding problems in astronomy and fundamental physics.

*Anand Sengupta, Anupreeta More, Apratim Ganguly, Archana Pai, Arunava Mukherjee, Banibrata Mukhopadhyay, Chandra Kant Mishra, Debarati Chatterjee, Dishari Malakar, Emanuel Hoque, Haris K, Kanika tKakran, Mayusree Das, Prakhar Dave, Prashanth Upadhya, Prayush Kumar, Rahul Kashyap, Rajesh Maiti, Sajal Mukherjee, Sanjit Mitra, Saurabh Kumar, Sendhil Raja S, Shasvath Kapadia, Shilpa Kastha, Soumen Basak, Souradeep Pal, Sreekumar P, Subhamoy Chakraborty, Sumanta Chakraborty, Suresh Doravari, Susmita Dash, Suvodip Mukherjee, Vincent A, Rashmi Meena, Ali Murtaza, Nikita Yadav, Sayantan Pal, Divya Tahelyani, Abhishek Sharma, Ajith Kumar Mehta, Karamveer Kaur

ASI2026_356	Sudip Bhattacharyya	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
XSat: A proposed large area X-ray astronomy space mission		

A large-area spectro-timing X-ray detector aboard an astronomy space mission is ideal for conducting deep studies of bright point sources, such as stellar-mass and supermassive black holes, neutron stars, and white dwarfs. Such an X-ray astronomy satellite could examine and discover a wide range of spectral and timing features, which are excellent probes of fundamental and extreme aspects of physics and astronomy, including strong gravity, dense matter, high magnetic fields, intense radiation, and accretion–ejection mechanisms that cannot be studied in terrestrial laboratories. We will discuss such a proposed next-generation Indian mission, with European collaboration, as a legacy of AstroSat, its scientific motivation and its potential role in making India a world leader in X-ray astronomy while sustaining and growing the Indian X-ray astronomy community.

ASI2026_549	Sriram Sripadmanaban	Contributed Talk
Facilities, Technologies and Data science		
DMD-based Multi-Object Spectrograph (D-MOS): AIV and First Light Results		

A Digital Micromirror Device (DMD)-based Multi-Object Spectrograph (D-MOS) with an integrated imager has been developed. The optical performance of the MOS is evaluated through comprehensive laboratory calibration and on-sky observations using the 1.3-meter J.C. Bhattacharya (JCB) Telescope at the Vainu Bappu Observatory (VBO). The system is designed to assess the viability of using a DMD as a programmable slit mechanism for future ultraviolet-optical space missions. A complete imager-cum-spectrograph assembly was constructed using off-the-shelf optical components and configured for operation in the optical band, employing a DLP9500 DMD with a 1920×1080 micromirror array. Calibration experiments established the DMD-to-detector coordinate mapping and validated the

strategies for object selection and slit placement. On-sky tests in crowded stellar fields confirmed successful slit targeting, precise object alignment, and multiplexed spectral acquisition. The spectrograph achieved a peak efficiency of 32\%, a spectral resolving power of R$\sim$1000 at 6000\AA, a multiplexing capability of up to 46 slits (extendable to 85), and a contrast ratio of $\sim$ 6000. These results demonstrate the robustness and effectiveness of the DMD MOS system under real observational conditions and raise its TRL level for use in next-generation spectroscopic space missions

ASI2026_989	Krishnakumar M A	Contributed Talk
Facilities, Technologies and Data science		
Reviving the Ooty Radio Telescope		
The Ooty Radio Telescope (ORT) is one of the largest steerable radio telescopes in the world, with an effective collecting area of approximately 9,000 m^2, operating at 326.5 MHz with a bandwidth of 16 MHz. It is capable of tracking a celestial radio source continuously for about 9.5 hours. Over the past ~55 years, the ORT has produced a wealth of important scientific results in diverse areas such as cosmology, solar wind studies, and pulsar astronomy. In recent years, ORT's sensitivity had degraded due to a variety of technical issues. A concerted effort was therefore undertaken to restore the system to its full performance. In this talk, we will briefly discuss the major technical interventions that enabled the recovery of the telescope's sensitivity, along with recent scientific results in areas such as studies of space weather using Interplanetary Scintillation, pulsar studies, and VLBI. We will also highlight the ongoing upgrades to the ORT, which will increase the observing bandwidth to approximately 40 MHz and provide additional flexibility in processing signals from individual (sub)elements of the array. These enhancements will significantly expand ORT's capabilities, enabling new areas of science such as studies of Fast Radio Bursts (FRBs) and Long-Period Transients (LPTs), in addition to the regular science programs for which the ORT is routinely used.		

19th May 2026
Plenary Session IV
[Chairperson: Divakara Mayya]
[Time: 9:00 – 11:00]

ASI2026_325	Projjwal Banerjee	Invited
Plenary		
Rapidly Rotating Early Massive Stars as a Source of High Carbon and Heavy Elements in the Early Galaxy		

I will discuss how rapidly rotating massive first (Pop III) and early (Pop II) stars that undergo quasi-chemically homogeneous (QCH) evolution can help resolve multiple unresolved puzzles related to the chemical evolution of the early Galaxy. One of the important puzzles is the origin of high carbon enrichment in the early Galaxy as deduced from Carbon Enhanced Metal-Poor-no (CEMP-no) stars, which are thought to have formed from gas polluted primarily by Pop III massive stars. Regular supernovae from non-rotating massive stars can account for moderate carbon enrichment and cannot explain the carbon enhancement in the majority of CEMP-no stars. In contrast, carbon-enriched winds and supernovae from Pop III QCH models can account for the entire range of carbon abundance observed in CEMP-no stars. Remarkably, Pop II QCH stars, in addition to producing carbon, also produce copious amounts of heavy elements via the slow neutron capture process (s-process), producing elements up to bismuth. This makes Pop II QCH stars a rare source of the main s-process in the early Galaxy, in contrast to the usual site of the main s-process in low-mass asymptotic giant branch stars, which does not contribute to very early Galactic enrichment. This can naturally explain important unresolved puzzles such as the early onset of s-process and the ubiquity of heavy elements in the early Galaxy as observed in very metal-poor stars. Additionally, the wind from Pop II QCH models can match the abundance of CEMP stars enhanced in s-process (CEMP-s stars) and even some of the CEMP stars with a mixture of rapid (r) and s-process patterns (CEMP-r/s stars). These results suggest that a large fraction of Pop III and Pop II stars were rapidly rotating.

ASI2026_271	Arkaprabha Sarangi	Invited
Plenary		
Supernovae and the Origin of Cosmic Dust		

Core-collapse supernovae are recognized as significant sources of cosmic dust in both local and high-redshift galaxies. Supernova environments are characterized by exotic phenomena such as shocks, radioactivity, non-equilibrium chemical processes, and rapid cooling. In this talk, I will provide an overview of the current state-of-the-art in modeling dust formation in supernovae, drawing on the physics and chemistry of these environments. I will discuss the nature and mechanisms of dust production in (a) the pre-supernova progenitor, (b) the ejecta post-explosion, and (c) the interaction region of the forward shock and the circumstellar medium (CSM). This talk will address all the properties of supernova dust, observed in the last two years with JWST, as well as its connection with Spitzer observations over the past few decades.

ASI2026_1090	Anshu Kumari	Invited
Plenary		
Solar Radiophysics: From Instrumentation to Observations		

Solar eruptive phenomena are the main drivers of space weather, influencing the Earth's magnetosphere, satellite communications, and technological infrastructure. Since solar radio observations can provide direct access to the solar and the heliospheric regions, they are considered as an excellent tool for studying magnetic fields, plasma densities, temperatures, and non-thermal particles in the solar atmosphere. To understand the solar transients and their space weather aspects, it is essential to conduct multi-wavelength observations, including radio observations of the Sun. Radio observations can answer open questions, such as when and where the bulk of energy is released during explosive events, what the properties of the heated coronal plasma and accelerated charged particles produced

during a flare are, and how the heated plasma and energetic particles are transported in the solar atmosphere. This talk will present an overview of solar radio observations as a diagnostic tool for solar transients, with a focus on current solar radio instruments, their limitations, challenges, and the path forward.

ASI2026_228	Shashikiran Ganesh	Invited
Plenary		
Comets in the Solar System		
Comets are leftovers thrown out of the inner solar system to the outer regions at the time of the formation of the planets. They spend most of their time far away from the Sun and hence are expected to retain undisturbed primordial material. When they approach the Sun, the surface material begins to sublimate, forming a coma and tail. Spectroscopic, photometric and polarimetric observations of the coma and tail provide great insight into the constituents of the comet and, hence, by proxy, of the material at the time and place of formation. Indian telescopes have been instrumental in advancing our understanding of the properties of dust and the molecular composition of various comet classes: short- and long-period comets, dynamically new and old, compositionally typical and depleted, as well as dust-rich and dust-poor. Classification of comets in terms of their orbital period as short and long-period, is typically on the basis of human timescales. Long-period comets are classified as dynamically new if it can be shown, by tracing back their orbit, that they are approaching the inner solar system for the first time. Based on the molecular emission signatures of the carbon content, comets are classified as either typical or depleted. It is clear that the process of planet formation is not unique to the Solar system and is a common occurrence across the Galaxy. This is exemplified by the discovery and characterisation of three interstellar objects in the last decade, two of which are comets. Indian telescopes were used very effectively in the observation of the two interstellar comets, although they were much fainter than the more well-observed solar system comets. In this talk, I shall discuss our results on these objects in the context of our work on solar system comets.		

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19th May 2026
Parallel Session - Sun, Solar System, Exoplanets, and Astrobiology IV
[Chairperson: Himadri Sekhar Das]
[Time: 13:45 – 15:05]

ASI2026_948	V. Muthu Priyal	Invited
Sun, Solar System, Exoplanets, and Astrobiology		
Fe XIV 5303 Å observations with VELC/Aditya-L1, and near-Sun coronal dynamics		
The Visible Emission Line Coronagraph (VELC) onboard Aditya-L1 has opened a new observational window for probing the near-Sun solar corona through high- cadence spectroscopy in the Fe XIV 5303 Å emission line. In this presentation, we report scientific results published in the last one year from VELC sit-and-stare and raster-scan observations, focusing on coronal mass ejections (CMEs), flares, and "quiet" corona in the height range of ~ 1.05 - 1.50 solar radii. The results reveal new spectroscopic signatures in 5303 Å , associated with CME onset and evolution, intensity enhancements, coronal dimmings, Doppler velocity patterns, and line broadening. Time-resolved measurements provide direct evidence of plasma and magnetic restructuring in the low corona prior to and during eruptive activity. We present diverse observations including flare-less CMEs, CME-less flares, and weak CMEs. Raster-scan observations help in two-dimensional mapping of coronal plasma parameters, facilitating the spatial characterization of variations in both eruptive and quiescent coronal structures.		

ASI2026_621	Parashmoni Kashyap	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Physics and Chemistry at Planet-forming Scales: The Ringworld Revisited		
Exoplanets inherit their chemical compositions from the protoplanetary disks in which they are born. While the disk midplane is the primary site of planetesimal growth, tracing this region remains a significant challenge due to extreme densities and optical opacity. Leveraging high-resolution and high-sensitivity observations from the Atacama Large Millimeter/submillimeter Array (ALMA), we present the first resolved molecular emissions from the midplane region of the GG Tau A protoplanetary disk—a system famous for its massive ring of dust and gas. By analysing ALMA Band 7 molecular line observations of N2H+ and DCO+, coupled with advanced disk modelling, we have constrained the physical and chemical properties of the midplane where indirect evidence suggests ongoing planet formation. Our findings reveal, a) Unprecedentedly low temperatures, with midplane values reaching as low as 12 K, significantly reshaping our understanding of planet-forming environments beyond major ice lines; (b) Very low ionisation rates, with important implications for the disk's magnetic coupling and accretion processes; and (c) Constraints on the elemental C/O ratio, a critical tracer linking the chemical evolution of the disk to the eventual atmospheric compositions of mature exoplanets. These results provide vital new constraints on the properties of ringworlds and offer a clearer window into the cold, dense environment where the next generation of planets is currently taking shape.		

ASI2026_643	Prasanta Bera	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Mass radius relation of rocky planets		
The mass-radius (M-R) relationship is a fundamental framework in planet study used to characterize the internal composition and structural integrity of terrestrial bodies. For rocky planets, this relationship is primarily governed by the Equations of State (EoS) of high-pressure mineral phases, typically modeled through a differentiated structure consisting of an iron-rich core and a silicate mantle. Theoretical models indicate that for a fixed chemical composition, the radius scales approximately as $R \propto M^{0.27}$. However, significant deviations occur based on the Core-Mass Fraction (CMF). Here, we examine the inherent degeneracies in M-R diagrams, where different ratios of water ice, silicates, and metals can yield identical observational signatures. By constraining these relations with stellar abundance data and thermal evolution models, we can distinguish between rocky planets and volatile-rich ocean planets.		

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ASI2026_524	Satyam Srivastav	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Temperature dependent Reaction Kinetics and Photodissociation cross-section data for exoplanetary atmospheres		

Over the past three decades, astrophysics has undergone a remarkable transformation with the discovery of nearly 6,000 exoplanets[1]. This rapid progress has shifted the focus from detection to detailed characterization of exoplanetary atmospheres. Spectroscopy across a broad spectral range (currently 0.2–24 μm) is the primary tool for probing atmospheric composition, chemical processes, and physical conditions, thereby addressing fundamental questions related to planetary formation, and potential habitability[2]. As the field enters a golden era of atmospheric studies of exoplanets and the first light of the Extremely Large Telescope draws closer, it is crucial that spectroscopic and chemical modelling techniques reach a level of maturity and reliability that can be confidently adopted by the wider scientific community. Accurate interpretation of exoplanetary spectra requires extensive temperature-dependent photodissociation cross-section data, two-body and three-body reaction rates. However, for the high-temperature conditions typical of many exoplanetary atmospheres, such data remain largely unavailable from laboratory measurements. This project aims to fill this critical gap by providing a comprehensive and self-consistent set of chemical data for molecules relevant to exoplanet atmospheres. To achieve this, a combination of first-principles and empirically tuned quantum-chemical methods will be employed to compute reaction rates and photodissociation cross-section data over temperature range (T = 1000–3000 K). In parallel, new computational methodologies will be developed to enable reliable treatment of larger and more complex molecular systems. By integrating high-level spectroscopic calculations with experimental collaborations, this work will clarify key molecular formation pathways and lifetimes under astrophysical conditions. The resulting advances will strengthen exoplanet research while also benefiting related fields such as atmospheric and combustion kinetics. Ultimately, the project will deliver a curated spectroscopic and kinetic rate database that will serve as a long-term resource for the astrophysical and astrochemical communities.

[1] https://exoplanetarchive.ipac.caltech.edu/
[2] Yurchenko et al. (2025), nature review physics, 7, pages 645–659 (2025)

ASI2026_422	Dhritimaan Gogoi	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Probing structure formation in a dusty protoplanetary disk.		

Observations have revealed nearly 6,000 exoplanets orbiting stars, with the majority residing in systems hosting two or more planets. Previous numerical studies have primarily focused on the dynamical interaction between a single planet and a protoplanetary disk, successfully explaining observed disk substructures such as gaps and rings. In contrast, the present numerical work explores the role of multiple planets in facilitating the formation of such structures by accounting for their mutual dynamical interactions with the disk. Multiplanet systems are typically characterized by low orbital eccentricities and convergent migration, which can lead to mean-motion resonance locking. In addition to axisymmetric features, non-axisymmetric structures such as vortices can emerge and act as efficient dust traps, thereby promoting planetesimal formation. Our results demonstrate the formation of pronounced dust clumps within gas vortices, where dust accumulates irrespective of particle size, as parameterized by the Stokes number. The formation and long-term survival of these gas vortices are strongly dependent on the initial disk conditions and are found to persist over extended evolutionary timescales (~10,000 orbits). This work can provide insight into the physical processes operating in recent “directly imaged” multiplanet systems such as PDS 70. Future work will aim to incorporate the effects of magnetic winds and detailed thermal processes to achieve a more comprehensive and physically realistic description of such disks.

Keywords: Protoplanetary Disk– method: numerical – hydrodynamics– planet-disk interaction

19th May 2026
Parallel Session - Stars, Interstellar Medium, and Astrochemistry in Milky Way IV
[Chairperson: Yogesh Joshi]
[Time: 13:45 – 15:05]

ASI2026_260	Dipen Sahu	Invited
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
From Pre-Solar Cores to Disk Structure to Exoplanet Demographics: Physical and Chemical Heritage of Solar Analogues		

The diverse demographics of observed exoplanets—from Super-Earths to gas giants—are a direct consequence of the physical and chemical conditions in their natal environments. This talk reconstructs the formation history of Solar-type systems, tracing their connection from the earliest phases of collapse to the final architecture of planetary systems. I will begin with the Pre-Solar Core phase, showing how our recent discoveries have reshaped our understanding of the initial stages of star formation. These cores likely determine the "Chemical Heritage" of future planets; I will discuss this by focusing on the complex organics and deuterium fractionation that set the planet's volatile budget. Transitioning to Disk Structure, we examine how these initial conditions evolve within protoplanetary disks. We discuss the physical processes that link observed substructures—such as rings and gaps—to grain growth and planet formation. Finally, we highlight the critical synergy between observations using global facilities and the discovery of exoplanets in the Indian context, particularly via the PARAS-2 spectrograph. We conclude by discussing how future Indian missions like BOSE (Bhaskaracharya Observatory for the Search of Exoplanets) will elevate our understanding of the complete journey from Exodisk to Exoplanet.
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ASI2026_249	Sriram Krishna	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Spectral analysis of hottest Extreme Helium stars HD 160641 and LS IV +06 2		

We present a comprehensive spectroscopic study of the two hottest known Extreme Helium (EHe) stars, HD 160641 and LS IV +06 2, using high-resolution optical spectra covering a wide wavelength range (3,100–10,000 Å). This work delivers the first detailed atmospheric and chemical abundance analysis for HD 160641. Given the extreme temperatures (Teff > 30,000 K) and helium-dominated composition of these objects, we computed custom LTE model atmospheres using TLUSTY, as no pre-existing grids are available for such compositions.

Our analysis yields refined stellar parameters - the effective temperature, the surface gravity and microturbulence - and surface chemical compositions. The detailed analysis reveals that HD 160641 has low surface gravity (log g = 3.0 in cgs) and high temperature (33,000 K) while LS IV +06 2 has a surface gravity of 4.2 and a similarly high temperature (32,000 K). The high-resolution study at this wide wavelength coverage enables detection of F II, and Ar III in LS IV +06 2. We have also refined the Iron abundance of LS IV +06 2 based on several newly identified Fe III lines.

Variation of radial velocity over several epochs are observed in both stars. These patterns are not consistent with binary motion, suggesting pulsations as the potential cause. However line asymmetry is observed only in HD 160641 and that further supports the pulsation hypothesis.

The lack of hydrogen and enhanced abundances of helium, carbon, nitrogen, and neon observed in both stars are consistent with predictions from a double white dwarf merger scenario.

ASI2026_279	Geeta Rangwal	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Orbits and vertical height distribution of 4006 open clusters in the Galactic disk using Gaia DR3		
Open clusters (OCs) in the Galaxy are excellent probes for tracing the structure and evolution of the Galactic disk. We present an updated catalog of the fundamental and kinematic parameters for 1145 OCs, estimated using the data from Gaia DR3, earlier listed in Cantat-Gaudin et al. (2020). This sample is complemented by 3677 OCs with astrometric solution from the catalog by Hunt & Reffert (2023). Using the Galaxy potential and the space velocities, orbits of 4006 OCs were computed, and we provide a catalog with orbital parameters such as eccentricity, perigalactic and apogalactic distance, and the maximum vertical height traced by OCs from the Galactic disk. The OCs in the sample are found to be distributed between 5 and 16 kpc from the Galactic center, with older OCs showing a radially extended distribution. The low number of old OCs in the inner region of the Solar circle will likely suggest their destruction in this area. Using the orbital estimations, we explored the maximum vertical height (Zmax) OCs can reach. We derive a quantitative expression for the dependency of Zmax on the cluster's age and Galactocentric radius for the first time. The young (age < 50 Myr) and the intermediate age (50 Myr < age < 1 Gyr) OCs show similar values of Zmax till 9 kpc, with the latter group having higher values beyond. OCs older than 1 Gyr show larger values of Zmax at all Galactocentric radii and significantly larger values beyond 9 kpc. Higher values of Zmax are found in the third Galactic quadrant, suggesting the link between the higher values and the Galactic warp. This large sample shows that young OCs are also involved in the diagonal ridge formation in the solar neighborhood.		

ASI2026_792	Subhajit Kar	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Cartography of the Milky Way: Mapping Galactic Stellar Populations using Machine Learning		
Precise distances to the stellar populations in the inner galactic region offer insights into the structure and early evolution of the Milky Way. However, direct astrometric distances remain absent or highly obscure for the majority of these sources due to severe extinction and complex variability. In this work, we construct a supervised machine-learning model employing the XGBoost regression framework to estimate reliable distances to the O-rich asymptotic giant branch (AGB) stars chosen from the AKARI mid-infrared (mid-IR) survey. The optimized model achieves $R^2 \cong 0.98$ with ~6% fractional accuracy and a typical absolute error of a few hundred parsecs. Applying this model to the whole AKARI AGB catalog yields distance estimates for over 36,000 AGB candidate sources, greatly expanding distance data for populations present in the dust-obscured regions of the Galaxy. The statistical distance estimates agree well with earlier reported distances to the Galactic Mira and those derived from period-luminosity relationships. Employing the updated distance data, we subsequently investigate the spatial distribution of Mira variables within the Galactic bulge and disk. Young Miras with longer periods are closer to the Galactic spiral arms and trace the bulge's barred morphology, while the older ones with shorter periods occupy the vertically extended regions. Our results imply that IR photometry-derived distances to the Mira variables provide a novel way to efficiently trace the stellar populations in heavily obscured regions and recover large-scale structures of the Milky Way.		

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19th May 2026
Parallel Session - Galaxies and Cosmology IV
[Chairperson: Debbijoy Bhattacharya]
[Time: 13:45 – 15:05]

ASI2026_872	Sougata Sarkar	Contributed Talk
Galaxies and Cosmology		
Comparative Study of Dark Matter Halos in Nearby Galaxies		

The distribution of dark matter in the inner regions of galaxies poses a key challenge for small-scale ΛCDM cosmology. While cold dark matter simulations predict cuspy inner density profiles, observations of low surface brightness (LSB) and dwarf galaxies often favour cored profiles, an issue known as the cusp-core problem. We investigate this problem by comparing four dark matter halo profiles: NFW (cuspy), Einasto (intermediate), Burkert (cored), and pseudo-isothermal (pISO) (cored) in a pilot sample of 11 galaxies from the GMRT archive atomic gas survey (GARCIA). We have performed mass modelling using Markov Chain Monte Carlo (MCMC) techniques, utilising rotation curves derived from robust 3D Kinematic modelling. Baryonic contributions from stars derived using stellar kinematics based on $3.6,\mu\mathrm{m}$ or r-band photometry via Multi-Gaussian Expansion (MGE) combined with Jeans Anisotropic Model (JAM) and from gas, calculated directly from the gas surface density (H\,\textsc{i} + He) without assuming any predefined functional form, are included. Our mass modelling shows that all halo profiles provide statistically good fits, yielding consistent estimates of halo mass and stellar mass-to-light ratio. To validate our analysis, we examine the stellar-to-halo mass relation and find broad agreement with empirical models. Non-parametric density profiles derived from baryon-subtracted rotation curves show that NFW fits the inner regions best, while all profiles converge in the outskirts. In this talk, we will present results from an expanded sample of 46 galaxies, adding 35 new galaxies (10 from CALIFA and 25 from GARCIA-II). This larger dataset enables stronger constraints on inner halo structure and provides a sharper test of the cusp–core problem

ASI2026_528	Janakee Raste	Contributed Talk
Galaxies and Cosmology		
Thermal Evolution of the IGM with Lyman-α photons during Cosmic Dawn		

Studying the nature of the first stars and the state of intergalactic medium (IGM) during the Cosmic Dawn (CD, z=10–30) is a key goal of modern cosmology. However, to correctly predict and interpret the observed signal, we need to model various astrophysical processes accurately. Motivated by this, we revisit the interaction of Lyman-α photons with the IGM at high redshifts, uncovering several new results.

It is well established that the photons between the Lyman-α and Lyman-limit frequencies, produced in the large-scale structures during the CD, redshift into the neutral IGM and undergo multiple scatterings by the HI atoms, coupling the HI spin temperature to the gas kinetic temperature. During this process, these photons also exchange energy with the medium. The photons that redshift into the Lyman-α line (continuum photons) heat up the medium, while those injected at the line centre (injected photons) cause cooling.

The inherent assumption in the literature has been that the profile near Lyman-α line centre is in quasi-static equilibrium. However, we find that the timescales to reach this equilibrium are often underestimated. Thermal feedback due to evolving IGM temperature and the short lifetime of the first luminous sources can significantly delay or prevent the onset of the equilibrium state. Moreover, the continuum photons also reach a new equilibrium profile over a much longer expansion timescale (~100 Myr). During the quasi-static equilibrium, the IGM attains an equilibrium temperature, and we find that this temperature only depends on the source spectrum and the redshift. We also find that these Lyman- α photons can act as a source of cooling in the presence of an external source of heating, and this effect should be detectable in the shape of the 21 cm signal.

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ASI2026_383	Ronaldo Laishram	Contributed Talk
Galaxies and Cosmology		
Spider-Webb: Spatially-Resolved Evidence of Inside-Out Quenching in the Spiderweb Protocluster at $z \sim 2$		
We present a spatially-resolved analysis of galaxy quenching within the Spiderweb Protocluster at $z \sim 2.16$, combining deep imaging from the James Webb Space Telescope (JWST) and the Hubble Space Telescope (HST). Utilizing pixel-by-pixel spectral energy distribution fitting, we derive maps of stellar mass, star formation rate (SFR), specific SFR (sSFR), and rest-frame UVJ colors. Quiescent galaxies, predominantly found at $\log(M_*/M_{\odot}) \geq 10.5$, exhibit clear mass-dependent inside-out quenching, with central sSFR approximately an order of magnitude lower than outer regions, while lower-mass star-forming galaxies show flat sSFR profiles. Central star formation activity fundamentally anti-correlates with Sérsic index, indicating reduced activity in bulge-dominated systems. Spatially resolved UVJ colors reveal heterogeneous internal star formation, distinguishing star-forming regions in quiescent hosts from those in globally star-forming systems. These findings demonstrate that quenching mechanisms were effectively operating by $z \sim 2$, with the observed inside-out patterns and morphological correlations consistent with AGN-driven feedback processes. Our study provides key observational constraints on galaxy evolution during this critical epoch		

ASI2026_1081	Deepali Agarwal	Contributed Talk
Galaxies and Cosmology		
Cosmic Variance of the Hellings and Downs Correlation and Source Anisotropies		
Gravitational waves (GWs) induce correlated perturbations to the arrival times of pulses from an array of galactic millisecond pulsars. The expected correlations, obtained by averaging over many pairs of pulsars having the same angular separation (pulsar averaging) and over an ensemble of model universes (ensemble averaging), are described by the Hellings and Downs curve. As shown by Allen [Phys. Rev. D 107, 043018 (2023)], the pulsar-averaged correlation will not agree exactly with the expected Hellings and Downs prediction if the gravitational-wave sources interfere with one another, differing instead by a "cosmic variance" contribution. The precise shape and size of the cosmic variance depends on the statistical properties of the ensemble of universes used to model the background. Here, we extend the calculations of the cosmic variance for the standard Gaussian ensemble to an ensemble of model universes which collectively has rotationally invariant correlations in the GW power on different angular scales (described by an angular power spectrum, for). We obtain an analytic form for the cosmic variance in terms of the 's and show that for realistic values , there is virtually no difference in the cosmic variance compared to that for the standard Gaussian ensemble (which has a zero angular power spectrum).		

19th May 2026
Parallel Session - High Energy Phenomena, Fundamental Physics and Astronomy IV
[Chairperson: Samir Mandal]
[Time: 13:45 – 15:05]

ASI2026_455	Rwitika Chatterjee	Invited
High Energy Phenomena, Fundamental Physics and Astronomy		
The First Two Years of XSPECT: Instrument Calibration and Science Highlights		

XSPECT (X-ray Spectroscopy and Timing) is a soft X-ray (0.8 - 15 keV) spectrometer on-board the XPoSat satellite, launched on 2024 January 1. Employing a non-imaging variant of CCDs, the instrument is capable of fast readout, enabling pile-up free observations of bright sources in the soft X-ray band. Flown along with XSPECT is the world's first medium energy polarimeter, POLIX. Owing to the long stare durations required to carry out polarimetry, the mission design enables XSPECT to perform continuous long term observation of X-ray sources, allowing tracking of spectral state transitions in X-ray binaries and studies of their temporal evolution. This talk will briefly describe the instrument and its calibration, both on-ground and on-board, which establish its capabilities and enable the inversion of observational data into science.
Following the initial performance verification phase, science operations of XSPECT commenced on 2024 March 9. Since then, XSPECT has observed over 30 sources, covering neutron star low-mass X-ray binaries, X-ray pulsars, Black hole X-ray binaries, AGN, magnetars, and T Tauri stars. Several interesting science results have emerged from these observations. A few notable examples include detailed soft X-ray spectroscopy of the brightest persistent X-ray source Sco X-1 along its full Z-track, the observation of a superburst from the soft X-ray transient 4U 1608-52, and the detection of all modes of Type-II X-ray bursts from the peculiar source Rapid Burster. I will highlight some of these results, and also discuss the unique platform that XSPECT provides for future observations.

ASI2026_226	Arghajit Jana	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Estimating Bolometric Correction using Changing-Look AGNs		

The bolometric luminosity of active galactic nuclei (AGNs) is a key tracer of accretion physics, but its direct determination is often hindered by limited spectral coverage and contamination of the host galaxy. Bolometric corrections (BC) offer a practical means of estimating bolometric luminosity, with the X-ray bolometric correction being crucial for exploring the coupling between the accretion disk and the X-ray corona. Using multi-epoch, multi-wavelength observations of five highly variable, changing-look AGNs that span more than three orders of magnitude in Eddington ratio, we present the most accurate estimataion bolometric correction. Our unique data set reveals a remarkably tight relation between BC and Eddington ratio, with an intrinsic scatter of only ~0.05 dex, which was not previously achived. Our results shows that the Eddington ratio, not luminosity, is the primary driver of AGN physics. Our results highlight how time-domain, multi-wavelength observations of variable AGN offer unique insights into the accretion flow structure and its radiative output.

ASI2026_295	Riya Bhowmick	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Properties of X-Ray Flux of Jet During the 2019-2020 Outburst of EXO 1846-031		

The Galactic X-ray transient EXO 1846-031 was initially detected during an outburst in 1985 by the EXOSAT mission. After this event, the source remained in a quiescent phase for nearly 34 years until its next outburst, which began on 23 July 2019. The 2019-2020 outburst lasted for nearly ten months, spanning from 23 July 2019 (MJD 58687) to 10 April 2020 (MJD 58949). Our study utilized eleven Swift/XRT observations (1–10 keV) and eight NICER/XTI observations (1–11 keV). To investigate the broadband spectral characteristics, we combined simultaneous MAXI/GSC data (7–20 keV) along with the NICER and Swift data.We investigated the accretion dynamics of this

outburst using the Two Component Advective Flow (TCAF) paradigm. During the outburst, the source traversed all four canonical spectral states; hard state (HS), hard intermediate state (HIMS), soft intermediate state (SIMS) and soft state (SS). However, due to limitations in the available data, the exact timing of transitions within the declining intermediate states could not be determined. During the outburst, the black hole candidate (BHC) displayed significant jet activity. In the TCAF model, the normalization parameter is expected to remain fixed for a given source. Thus, any requirement for a significantly altered normalization to achieve improved spectral fits indicates additional X-ray contributions from components not incorporated in the standard TCAF model. By comparing observed fits with the expected normalization, we estimated the fraction of X-rays arising from jets and outflows. Our analysis further explored the origin of the jet. The study also revealed that on certain days, up to ~92% of the total X-ray flux originated from the base of the jet itself.

ASI2026_595	Ramanshu P. Singh	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Broadband Spectral-Timing Evolution of GX 339-4 During Its 2023-2024 Outburst Using Multi-Mission Observations		
We present a broadband spectral–timing study of the black hole X-ray binary GX 339-4 during its 2023-2024 outburst using coordinated observations from AstroSat, NICER, NuSTAR, and INTEGRAL. The source evolution is investigated across the hard–intermediate, soft–intermediate, and soft spectral states. The near-peak soft–intermediate state benefits from simultaneous broadband coverage spanning 0.7–200 keV, enabling robust spectral constraints. The spectra are well described by a model consisting of thermal disk emission, thermal Comptonization, and relativistic reflection, expressed as const * TBabs * (thcomp * diskbb + relxillCp), with the inclusion of a low-energy absorption edge to account for residual calibration features in the soft X-ray band. The fits are statistically acceptable across all epochs.. Low frequency quasi-periodic oscillations (LFQPOs) are detected during the intermediate states, with centroid frequencies evolving alongside spectral parameters. The combined spectral-timing behaviour indicates systematic changes in the relative contributions of the accretion disk and corona during state transitions. While geometric parameters remain subject to model degeneracies, the broadband multi-mission coverage provides a coherent view of the accretion flow evolution throughout the outburst.		

ASI2026_355	Gunjan Tomar	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
High Energy Observations of Low-Luminosity Active Galactic Nuclei		
In the nearby universe, low-luminosity active galactic nuclei (LLAGNs) dominate, which are characterized by their low accretion rates and often misaligned jets. Due to their faintness, the high-energy (HE) properties of these sources remain less explored than those of their brighter counterparts. Multi-wavelength observations of their jets serve as a crucial probe into the physical mechanisms in these extreme environments. Recent advancements in gamma-ray observations by Fermi-LAT have significantly improved our understanding. I will present a detailed broadband study of two recently identified gamma-ray emitters, NGC 315 and NGC 4261, which hints at the presence of extended gamma-ray emissions, previously only known in two bright radio galaxies. Additionally, I will discuss temporal SED variations in another LLAGN, M81*, which shows behavior similar to high-synchrotron-peaked blazars, suggesting a potential universal jet mechanism across AGN luminosities. Finally, I will touch on our recent very high energy (VHE; >100 GeV) detections of a few more radio galaxies expanding the sample of misaligned VHE emitters despite modest Doppler boosting, and conclude with insights on their implications for VHE emission processes and AGN jet physics.		

19th May 2026 Parallel Session - Facilities, Technologies and Data science III [Chairperson: Yogesh Wadadekar] [Time: 13:45 – 15:05]

ASI2026_1198	B. Krishna Reddy	Invited
Facilities, Technologies and Data science		
Optical design of TA-MOONS Spectrographs		
TIFR and ARIES are jointly developing the TA-MOONS (TIFR ARIES Multi-Object Optical to Near Infrared Spectrograph). The primary science goal of the instrument is to conduct the largest broadband spectroscopic survey of the Young Stellar Objects (YSO's).This will be the second generation instrument for 3.6 meter Devasthal Optical Telescope, located at Nainital, Uttarakhand, India. This instrument uses a deployable slit (DS) technology. The front optics of the instrument uses the mirror based robotic pick-up arm system (8-nos) around the focal plane, each having translation and rotation movement capability to reach its patrol region of the sky field.The instrument will have capability to observe 8-sources simultaneously within the sky FOV of 12 arc-min diameter. The 8 pick up arms will cover the approx. 12 arc-min sky field of view at the telecentric telescope focal plane. The relayed image by the pick-up arm is further relayed by a generalized Offner relay, to form a compact 9 mm staggered slit that forms input to the two arm spectrographs. It will simultaneously obtain the spectra from 360nm to 2500nm without any gaps at a resolution of R~2700. The entire wavelength range is covered by two spectrographs namely optical channel and infrared channel. The optical channel covers the wavelength range from 360nm-960nm and the infrared channel covers the wavelength range from 860nm-2500nm. In this talk I will present the detailed optical designs of both the spectrographs and also other explored white pupil designs considered for these spectrographs.		

ASI2026_566	Twinkle Sharma	Contributed Talk
Facilities, Technologies and Data science		
Design and testing of the payload for microsatellite- ThaparSat		
Accurate space-based monitoring of atmospheric greenhouse gases requires a well-designed payload and a precisely calibrated detector system. This study presents the design, development, and laboratory-based calibration of the optical payload developed for ThaparSat, a pollution-monitoring microsatellite intended for the retrieval of tropospheric concentrations of CO2, CH4, N2O, and H2O. The payload architecture involves the selection of an appropriate infrared spectral region, detector technology, and gas-specific narrowband filters to minimise spectral cross-interference and prevent absorption saturation effects. The instrument utilises a Mercury Cadmium Telluride (HgCdTe) focal plane array detector operating over the 2–5 μm spectral range, enabling the detection of strong and spectrally isolated absorption features of the target gases. Eight dedicated bandpass filters are integrated into the optical assembly to facilitate simultaneous multi-gas sensing. A radiative transfer model incorporating HITRAN absorption cross-sections and Lorentzian line-shape functions was developed to quantify the photon flux incident on each spectral channel under varying atmospheric conditions. For detector calibration and performance assessment, a laboratory-scale multi-pass gas absorption chamber employing a nine-mirror configuration was designed, providing an effective optical path length of 344 cm while preserving beam stability and optical throughput. The detector output, acquired as 16-bit grayscale digital data, was converted to electron counts and subsequently to photon flux using the system conversion gain. The radiative transfer model has been used for the experimental validation and close agreement between experimentally measured and theoretically estimated photon flux values validates both the and the overall payload design.		

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ASI2026_1058	Sreejith Padinhatteeri	Contributed Talk
Facilities, Technologies and Data science		
Solar Imager for Magnetic and Doppler measurements at two heights.		

Much of the dynamic activity of the Sun, including flares, coronal mass ejections and the solar wind originate from the interplay of magnetic fields and plasma. Observations of magnetic fields and plasma flows on the solar surface and the magnetic structuring of the lower solar atmosphere are therefore of crucial importance in constraining solar activity and driving models of solar magnetic field evolution. India does not have its own magnetograph dopplergram instrument which can achieve these observations. While currently functional instruments such as the HMI onboard NASA's Solar Dynamics Observatory and the US National Science Foundation's GONG network provide routine measurement, they are limited in resolution and make measurements only at the photosphere (surface level). Here we present an Indian initiative for a magnetograph dopplergram instrument which is envisaged to make routine measurements at both photospheric and chromospheric heights at higher resolution. These observations will open up possibilities for better constraining magnetic structures and their interplay with plasma flows than hitherto possible. This presentation explores the shortcomings of current instruments and delineates the scientific objectives that have shaped the requirements for the new device. It also details the simulation studies conducted to choose the two specific spectral lines for probing different atmospheric layers and summarises the preliminary optical design.

ASI2026_26	Ashish Mandal	Contributed Talk
Facilities, Technologies and Data science		
Simulation of Silicon Drift Detector for High-Energy Astrophysics Experiments		

Silicon Drift Detectors (SDDs) use a novel charge transport scheme, unlike other semiconductor detectors, generating an internal drift electric field to rapidly collect charge at small-area anodes, resulting in low capacitance and excellent energy resolution in the 1–30 keV range. Unlike conventional diodes, the anode capacitance in SDDs is independent of detector area, leading to faster signal rise times, higher output amplitudes, and reduced electronic noise. Initially SDDs were designed for excellent spectroscopic applications, but later they were used for imaging as well with a different electrodes configuration.

SDDs are fabricated in both linear and cylindrical geometries. Though cylindrical SDDs are now commercially available, they are limited to small effective areas. On the other hand, linear SDDs can be fabricated over larger areas and can offer position sensitivity in addition to the excellent energy resolution. Motivated by these advantages, we have taken an initiative to develop large-area linear SDDs for X-ray astronomical applications. As a first step towards indigenous fabrication, we focus on developing a small 2 mm× 2mm × 300 μm linear SDD. For this device we have carried out simulation using Technology Computer Aided Design (TCAD) software to know its electrical and transient behaviour for an optimum electrodes configuration. Here we present the design and TCAD simulation results of the device.

Posters in Sun, Solar System, Exoplanets and Astrobiology

ASI2026_901	Aashirbad Sethi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Development of a CASA-based pipeline for the Gauribidanur Radioheliograph		

The Gauribidanur Radioheliograph (GRAPH) is a T-shaped interferometric array dedicated to observing the solar corona in the frequency range 40-130 MHz. It produces two-dimensional images at two spot frequencies presently. The frequency range corresponds to a heliocentric height of approximately 1.2~3.0 Rs (Rs = photospheric radius), the inner to middle corona, wherein the coronal transients that can affect the geospace originate.
The existing AIPS-based pipeline generates Stokes I and Stokes V images from a FITS file. Observatories around the world have adopted a new format called the Measurement Set (MS), a standard directory-based file format for storing interferometric and single-dish data, acting as a relational database for astronomical observations, using the NRAO's Common Astronomy Software Applications (CASA). We have redefined our imaging pipeline (CASA-GRAPH), which utilizes Python-based tools to write CASA MS files from daily observations of the Sun and other sources. We are currently in the preliminary stages of development for generating calibrators and Stokes I images of the Sun.
We discuss the features of the CASA-GRAPH, including flagging of RFI on short and long baselines, customized calibration techniques, and subsequent imaging of the Solar Corona. Our future plan is to develop a fully automated pipeline to produce Stokes I and Stokes V images from daily observations.

ASI2026_985	Abhay Kumar Prusty	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Intra-night chromospheric variability in a young M dwarf		

Young M dwarfs exhibit strong magnetic activity that can produce rapidly varying chromospheric emission on short timescales. We present time-resolved, low-resolution optical spectroscopy of the young M dwarf 2MASS J16111534 - 1757214 obtained over a single night using the Hanle Faint Optical Spectrograph and Camera (HFOSC) on the 2-m Himalayan Chandra Telescope (HCT) in Ladakh, India. This observation forms part of the SAYS (Stellar Activity in Young Stars) survey, a broader effort to characterize chromospheric variability in young low-mass stars. The target is a very young M dwarf, making it a valuable case for probing chromospheric behaviour at early evolutionary stages. We examine the temporal evolution of Balmer emission line ratios (H_alpha/H_beta, H_alpha/H_beta, and H_beta/H_gamma) as diagnostics of chromospheric conditions. Significant variability is detected on timescales of tens of minutes, with a systematic decrease in H_alpha/H_beta and H_alpha/H_gamma, while H_beta/H_gamma remains comparatively stable. This behaviour suggests changes in optical depth and emitting column density within a dense chromosphere rather than simple temperature variations. The observed variability is consistent with flare-related or post-flare activity. Our results demonstrate that even short spectroscopic time series can capture complex and evolving chromospheric states in young M dwarfs, highlighting the importance of time-resolved observations for interpreting stellar activity diagnostics.

ASI2026_681	Akanksha Khandelwal	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Searching for Small Planets Around Brown Dwarfs: Initial Results from the SAINT-EX Transit Survey		

Brown dwarfs are substellar objects with masses between those of planets and stars, insufficient to sustain stable hydrogen fusion. Understanding whether such objects can host small planets remains an open and intriguing question in exoplanet science. Observational results from Kepler and other surveys indicate a strong anticorrelation between stellar mass and the occurrence rate of short-period, super-Earth-sized planets (1–4$R_\oplus$), implying that lower-mass

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stars host approximate three times as many small planets. If this trend extends into the substellar regime, it could suggest a significant population of small planets orbiting brown dwarfs. However, theoretical models and disk observations indicate that most brown dwarfs possess low-mass protoplanetary disks, often below a Jupiter mass, which may limit the formation of Earth-sized planets.
To explore these possibilities and address these contrasting predictions, we have initiated a dedicated transit survey of brown dwarfs using the SAINT-EX telescope. Our program monitors a carefully selected sample of nearby brown dwarfs to search for small transiting planets. In this conference, I will present the survey objectives, target selection, and some of our initial findings from this ongoing effort.

ASI2026_526	AKASH BAIRAGI	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Interaction of EUV-wave Like Perturbations with the Localized Coronal Null and Occurrence of Fast to Alfvén Wave Mode Conversion		

The Sun's atmosphere possesses different kinds of MHD wave modes and their mutual conversion is possible under appropriate plasma and magnetic-field conditions. The fast and slow mode waves are ubiquitously observed in the Sun's corona but the Alfvén modes are very difficult to observe due to their incompressible nature. Owing to their properties, Alfvén mode is believed to be one of the energy sources for the solar corona and this mode can even be generated in the vicinity of the equipartition layer ($V_s \approx V_a$) through the interaction of fast mode with the magnetic null. In this present work, we have performed 2.5D resistive MHD numerical simulation of Alfvén mode generation through the mode conversion when an EUV wave-like perturbation, akin of the fast magnetoacoustic waves, interacts with the localized magnetic null. As the fast mode front interacts with the null, some parts of this wave-front get refracted, while some other part is trapped at the null region. Subsequently, the out of the plane velocity (i.e., V_z) and magnetic field fluctuations (i.e., B_z) have been seen propagating with local Alfvén speed along the separatrices at one side of the null region. In the synthetic SDO/AIA observations, no intensity fluctuations have been evident. Our results demonstrate that given the appropriate physical conditions at the coronal null, when EUV wave-like perturbations are incident, due to mode conversion Alfvén waves can excite further carrying substantial momentum and energy flux.

ASI2026_861	Akshat Rawat	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
From Shape to Activity: Thermo-Physical Simulations of Cometary Nuclei		

Comets are one of the most pristine bodies in the Solar System, preserving material from its earliest stage of formation. Cometary nuclei is the source of molecules and dust particles that form the majority of cometary atmosphere which is observed through ground and space based observations. Understanding the physical processes inside and at the surface of cometary nuclei is therefore essential for linking observational signatures to the underlying structure, compositions and processes.
Recent spacecraft missions have provided data on cometary nuclei, in particular high resolution three dimensional shape models. Employing these models is essential for examining how local topography, solar insolation, and heterogeneous material distributions affect cometary activity.
In this work, I present a thermo-physical model that based directly on these 3D nucleus shapes, the framework combines three models that together simulate the key physical processes controlling cometary evolution. First, the sublimation model captures surface processes including incident solar insolation, thermal reradiation, heat conduction and volatile sublimation. Second, the thermal model describes subsurface heat conduction by solving the one dimensional heat diffusion equation with depth and time dependent material properties of the nucleus. Last, the gas diffusion model links the evolving thermal structure with volatile transport. By accounting for the dynamic distribution of volatiles and dust, the model solves one dimensional pressure diffusion equation to compute sublimation fluxes from individual facets.

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By applying this framework to realistic 3D shape models, we investigate how surface morphology and heterogeneous composition govern localized sublimation, dust mantling, and pressure-driven gas flow. The approach enables tracking of spatial and temporal variations in temperature, gas fluxes and compositional changes across the nucleus. Ultimately, the model serves to connect in situ spacecraft measurements with remote observations of cometary comae, and the fundamental physical processes active within comet nuclei.

ASI2026_116	Ananthapadmanabhan KK	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Comparative Analysis of Solar Granulation Across Magnetic Regions		
Solar granulation, the surface manifestation of near-surface convection, is central to linking the solar interior and atmosphere. We present a comparative study of photospheric granulation in Quiet Sun, Weak Plage, and Strong Plage regions using high-resolution radiative magnetohydrodynamic simulations. Granules are iden- tified as coherent upflows at optical depth unity, enabling consistent comparisons across magnetic environments. We analyze granule sizes, shapes, thermodynamic and kinematic properties, fractal scaling, vorticity, and acoustic energy flux. Our results show that the characteristic granulation scale ($\sim$1–1.5 Mm) is insensitive to magnetic field strength, set primarily by radiative cooling and stratification. Magnetic fields modulate convection by suppressing horizontal expansion, shifting surface area from large to small granules, reducing contrasts, and narrowing thermodynamic ranges. Turbulent scaling remains universal, with invariant fractal dimensions and perimeter–area relations, though fragmentation occurs at smaller scales in stronger fields. Magnetized regions exhibit enhanced intergranular vorticity and acoustic energy flux, indicating more efficient wave generation without increased damp- ing. These findings reveal that magnetic fields reorganize granulation, channeling convective energy into stabilized, acoustically active structures that strengthen the photosphere–atmosphere coupling.		

ASI2026_652	Ananya Rai	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Effect of Stellar Flares on the evolution of exoplanet atmosphere around G, K, and M-type star		
Atmospheric escape is a fundamental process governing the long-term evolution and potential habitability of exoplanets, driven primarily by the high-energy X-ray and extreme ultraviolet (XUV) radiation from their host stars. In this study, we investigate the role of stellar flares in enhancing atmospheric escape from exoplanets. We employ a one-dimensional, self-consistent hydrodynamic escape model that traditionally assumes a constant stellar XUV luminosity. To estimate the mass-loss rate over stellar age, we perform multiple simulations using XUV fluxes representative of both quiescent and flaring stellar states. Our initial results focus on a hot Jupiter orbiting M-dwarf, K-type, and G-type host stars. We consider two cases: one using only the stellar spectral energy distribution (SED), and another including the effects of secondary ionization. We find that stellar flares significantly enhance atmospheric escape, with the strongest effect observed for M-dwarf hosts, followed by K-type and G-type stars, in both cases. Furthermore, the inclusion of secondary ionization leads to a reduction in the cumulative mass loss over stellar age compared to the SED-only case. This reduction is most pronounced for M-dwarf hosts, followed by K-type and G-type stars, a trend that is currently under investigation. Overall, our results highlight the crucial role of stellar flares in shaping planetary atmospheric evolution and demonstrate that incorporating more realistic physics, such as detailed SED and secondary ionization processes, leads to more accurate estimates of atmospheric mass loss rate.		

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ASI2026_313	Anoop Gavankar	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Vision Transformers as a Robust Alternative for Identifying Planetary Candidates in Solar EPRV Data		
Extreme precision radial velocity (EPRV) surveys usually require extensive observational baselines to confirm planetary candidates, making them resource-intensive. Traditionally, periodograms are used to identify promising signals before further observational investment, but their effectiveness is often limited for low-amplitude signals due to stellar activity. We introduce a machine-learning (ML) framework that extracts planetary signals from spectroscopic time-series data. Injection-recovery tests on randomly selected 100-observation subsets from NEID solar data (2020–2022 period) show that for low-amplitude systems (<1 m/s), our model improves planetary candidate identification by a factor of two compared to the traditional Lomb-Scargle periodogram. This highlights the potential of ML as a robust alternative for identifying planetary candidate signals in EPRV surveys. Our ML model is based on Vision Transformer (ViT) architecture that intakes a reduced representation of the solar spectrum observations and predicts the period and semi-amplitude of a planetary signal candidate. In this talk, I will present our model framework, data preprocessing, and the final results in comparison to the traditional Lomb-Scargle periodogram.		

ASI2026_248	Ashutosh Joshi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
ForwardRM : A data driven forward modelling framework for Rossiter-McLaughlin Effect		
The orbital architectures of exoplanetary systems probe their dynamical evolution. Among various other parameters, the spin-orbit obliquity, i.e. the angle between the planet's orbital angular momentum and star's spin angular momentum, provides useful information about the planet migration and planet-planet interaction mechanisms. The Rossiter McLaughlin (RM) effect allows measurement of sky-projected obliquity using time resolved spectroscopy of an exoplanetary transit. We present ForwardRM, a data driven forward model for RM effect measurements. Opposed to the classical RV based methods, this approach models the line distortions in the stellar spectrum during a transit using the information from all the available out of transit spectra of the host star. Modelling the entire spectrum can allow us to introduce different kinds of velocity fields and even features like active regions in the stellar photosphere and study their impact. The line distortion models can also aid the study of transmission spectroscopy. The framework has been successfully tested on available archival spectra taken with NEID spectrograph for the transit of TOI-2076b.		

ASI2026_347	Ayswarya Lakshmi D T	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Energetic neutral atoms and solar-cycle variability: IBEX constraints on the heliosphere–interstellar medium interaction		
The Interstellar Boundary Explorer (IBEX) has provided more than a solar cycle of energetic neutral atom (ENA) all sky maps, enabling global imaging of the interaction region between the solar wind dominated heliosphere and the surrounding local interstellar medium (LISM). These maps reveal both a broadly distributed ENA flux and the prominent IBEX Ribbon, whose temporal evolution reflects changes in solar wind output and Heliospheric structure. In this project we investigate how solar cycle variability in near-Earth solar-wind conditions is imprinted in IBEX ENA fluxes at the heliosphere-LISM boundary. We will select multiple IBEX map epochs spanning solar cycle 24 and, for a chosen ENA energy band, derive simple global metrics from each map: sky averaged ENA intensity, Ribbon averaged intensity, and low order spherical harmonic amplitudes describing large scale anisotropies. These ENA metrics will be compared with contemporaneous averages of insitu solar wind speed, density, and derived dynamic pressure, together with geomagnetic activity indices, compiled from operational space weather monitoring data sets. By correlating ENA flux variations with solar wind and activity proxies, we aim to quantify how changes in inner Heliospheric plasma conditions modulate ENA production in the outer heliosphere and very local interstellar medium.		

The resulting constraints on the relationship between solar cycle dependent solar wind forcing and global ENA emission will help refine our understanding of the large scale heliosphere–interstellar medium interaction and provide context for future, higher resolution ENA observations by missions such as IMAP.

ASI2026_707	Bablu Mandal	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Exploring Spatio-Temporal Evolution of a Long-lived Supersonic Downflow in AR 12135		
Flows in active regions have been a long-standing region of interest owing to their connection with the mass and energy transfer in the upper Solar atmosphere. Super-sonic Downflows are usually observed above sunspots as red-shifted components in the Transition Region (TR) spectral lines. These localised events occur in more than 80 per cent of sunspots, often recur at the same location with a timescale of a few minutes to hours. In this work, we investigate the short-term dynamics of a long-lived SSD in AR 12135 by utilising almost 3h long Interface Region Imaging Spectrograph (IRIS) observations. Instead of traditional double Gaussian fitting, triple Gaussian fitting with specific constraints is performed on each pixel of the TR spectral lines (Si IV 1394 & 1402, O IV 1399 & 1401) to study this event. Our analysis reveals that downflow is initially observed in both the umbral and penumbral regions. Over time, the penumbral downflow fades, while the umbral downflow strengthens and appears as a single structure that eventually splits into two spatial segments. By combining IRIS Spectroscopic observations with imaging data from the Atmospheric Imaging Assembly (AIA), we find that changes in the downflow's morphology are linked to alternations in the coronal loops' structure. Non-Force Free Field extrapolation indicates that a fan-spine magnetic topology is present near the sunspot. As observed from AIA images, magnetic reconnection near this site is the most probable reason for this splitting. Before the spitting event, we also observed a rare anomalous motion of the loop's footpoint above the sunspot's atmosphere in both IRIS as well as AIA channels. Derived average properties such as downflow speed, electron density, and mass flux of this event over the umbral region are consistent with existing studies.		

ASI2026_237	Bhupendra Kumar Tiwari	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Sporadic Solar Activity their Influence on galactic Cosmic Ray Modulation		
Abstract Solar activity produces Forbush effects as well as long-term modulations in galactic cosmic rays. This makes coronal mass ejections (CMEs), and flares, is the main sporadic manifestations of the solar activity, which should be considered in modulation on galactic cosmic rays. In this observation, a new version the CME-index is proposed based on a comparison of the data from coronographs with long-term variations of cosmic rays and Forbush effects. It is observed that the during minimum phase of Solar activity, the strength of the interplanetary magnetic field has been minimum, reduces the GCR entering inner- heliosphere and high anti-correlation with solar activity indices. It is also found that velocity of solar wind (Vsw) and turbulence and strength of the interplanetary magnetic field were positive correlated and, inverse correlated with count rate of cosmic ray intensity. Keywords- , Galactic Cosmic ray intensity), Interplanetary Magnetic Field (IMF), Solar Wind velocity (Vsw)		

ASI2026_1120	Borukote Sangadeep	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A study on underestimation of mesospheric temperature from meteor decay times during major meteor shower		
The all-sky meteor radar observations at three different geographical latitudes in Northern Hemisphere indicate that the mesospheric temperature derived from meteor decay times is systematically underestimated by 20-30 K during		

the Geminids and Quadrantids meteor showers which have their peak on 13 December and 3 January in every year, respectively. It is noticed that such underestimation is latitudinal dependent, with more lower estimation at low latitudes than high latitudes. A very good coincidence of maximum meteor count rate and minimum of temperature estimation was observed regularly on the days of the Geminid and Quadrantids meteor showers during 2005-2022. These observations are for a specific height-lifetime distribution of the Geminids meteor trails and indicate a larger percentage of overdense trails compared to that for sporadic meteors. A consequence of this, routine estimates of mesospheric temperature during the Geminids are in fact underestimate. The observations do, however, indicate unusual properties (e.g., mass, speed, or chemical composition) of the Geminids and Quadrantids meteoroids, which are thought to be asteroidal origin. However, no such underestimation of temperature for other meteor showers.

ASI2026_929	Chetan Bora	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Tracing the Dynamical Origins and Past Evolution of Near-Earth Asteroids		
Understanding the dynamical pathways that deliver asteroids into near-Earth orbits is critical for source-region inference and impact-risk assessment. We test whether short backward integrations encode sufficient information to discriminate NEAs with prior outer-Solar-System origins from long-term inner-Solar-System residents. Using 0.2~Myr backward integrations, we extract time series of primary orbital elements and train sequence-based classifiers to map orbital histories to distinct dynamical pathways. The models achieve classification accuracies of 86--88\% and ROC AUC values of $\sim$0.95, substantially outperforming simple temporal baselines. Remarkably, classifiers trained using eccentricity alone perform nearly as well as those incorporating both semi-major axis and eccentricity, indicating that eccentricity evolution is a particularly sensitive tracer of recent dynamical transport and orbital decoupling. Feature-attribution analyses show that early-time variations in semi-major axis and late-stage eccentricity growth dominate the classification, consistent with secular perturbations and resonance-driven transfers between the outer and inner Solar System. Extending the analysis to 1~Myr backward integrations for a large NEA sample, we find that more than 97\% remain on Earth- or Mars-crossing orbits throughout this interval, implying that only a small fraction follow backward trajectories compatible with outer-Solar-System origin. These results demonstrate that short orbital histories provide a physically interpretable and computationally efficient diagnostic of recent NEA origins, complementing traditional long-term N-body studies and offering a scalable framework applicable to other small-body populations.		

ASI2026_135	Chitradeep Saha	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A new millennial scale reconstruction of solar magnetic activity from 14C data		
The modulation in solar magnetic activity over the decadal timescales and beyond governs the heliospheric magnetic field and space climate conditions. These variations also modulate the flux of galactic cosmic rays reaching Earth, which in turn regulates the production of cosmogenic isotopes in the Earth's atmosphere. By harnessing the record of these radio-isotope proxies archived in natural terrestrial reservoirs over multiple millennia, it is therefore possible to reconstruct past solar magnetic activity. However, existing regression-based semi-empirical methods for estimating sunspot numbers (SSN) from radiocarbon data often produce negative SSN, which are physically implausible. Here, we employ a newly developed inverse modelling framework based on a Monte Carlo random search strategy, which combines a sequence of physics-based and semi-empirical forward models to reconstruct the open solar flux, SSN from the cosmogenic isotope production rates. We reconstruct yearly averaged SSN at annual resolution over the past millennia. The resulting SSN remains strictly non-negative throughout the entire record and shows excellent agreement with direct observations of the International Sunspot Number during the telescopic era. We further identify epochs of extremely high and low solar activity and examine their physical properties. These results offer new insights into long-term solar variability and its impact on the Earth’s climate. They also provide improved constraints for long-term solar dynamo modelling.		

ASI2026_667	Deepan Patra	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Multi-wavelength study of the Solar Corona using MeerKAT and space-based instruments		
Probing the dynamics and structure of the coronal plasma and the magnetic field requires a multi-wavelength approach. Space-based missions (e.g. Solar Dynamics Observatory, Solar Orbiter, Aditya L1, Parker Solar Probe etc.) provide unprecedented measurements of various physical quantities in corona such as the magnetic field, in-situ plasma parameters etc. Conversely, radio observations offer a unique and complementary diagnostic capability. New-generation radio interferometers like the MeerKAT, operating between 580–1710 MHz, enables high-fidelity spectroscopic snapshot imaging of the Sun at centimetre wavelengths, corresponding to emission heights of approximately 1.02–1.3 R_sun. The broad frequency coverage and high dynamic range allow full-disk imaging of both quiescent and active coronal plasma, helping in directly probing the various emission mechanisms such as thermal bremsstrahlung, gyroresonance, plasma emission etc. This capability bridges the diagnostic gap between slit-based EUV spectrographs and full-disk imagers, providing sensitivity to plasma across a wide temperature range (from the transition region to the low corona). Recent observations demonstrate MeerKAT's capability to image key coronal structures, including coronal holes, filaments, cavities, and eruptive events such as flares and coronal mass ejections, providing insight into evolving plasma conditions and non-thermal particle acceleration. When combined with space-based missions' continuous coverage in EUV, and X-ray wavelengths, together with magnetic field measurements, and in-situ observations, MeerKAT enables multi-thermal and multi-height diagnostics of coronal plasma and magnetic fields. This presentation will demonstrate some of the early results from a few solar observations from MeerKAT and how this will significantly enhance our ability to measure and model the coronal plasma and magnetic field, contributing to a better understanding of solar activity and its heliospheric impact.		

ASI2026_330	Dibyendu Misra	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
First Multi-Band Imaging Polarimetric Characterization of Lunar Pyroclastic Deposits from Mount Abu Observatory		
Lunar pyroclasts are considered as one of the best proxies for constraining the primitive lunar mantle composition [1] compared to other volcanic products (e.g., mare basalts). Lunar pyroclastic deposits (LPDs) are very low albedo, smooth, homogeneous lunar lithological units widely interpreted to have formed through explosive volcanic processes, and only restricted to ~1% of the lunar surface [2]. Though extensive spectral and morphological analyses of LPDs are carried out at finer spatial resolution, understanding of their physical properties is limited [3]. In order to characterize the physical properties of LPDs, we have carried out a systematic multi-band (UBVRI) imaging polarimetric study of nearside LPDs at phase angles ~3°–124°, using PolCam mounted on the 50 cm telescope at Mount Abu observatory of Physical Research Laboratory. The results obtained by deriving Stokes parameters, degree of linear polarization (DoLP), and the position angle for the plane of polarization provide information on the physical state of LPDs (e.g., relative grain size, roughness etc.) [4,5]. A comparative analysis of the wavelength-dependent derived key polarimetric parameters, including the minimum and maximum DoLP (P_{min}, P_{max}), their corresponding phase angles (α_{min}, α_{max}), inversion angle (α_{inv}), the slope (h) at α_{inv} [3,4,5] across different nearside LPDs, offers insights into surface modification processes and heterogeneity in lunar explosive volcanism. Reference: [1] Delano, J. W. (1986), JGR: Solid Earth, 91 (B4), 201–213; [2] Head, J. W. (1974), LPSC, 5, 207–222; [3] Misra, D. et al. (2024), No. EPSC2024-1085. Copernicus Meetings, [4] Wöhler, C., et al., (2024), The Astronomical Journal, 167(5), 187; [5] Bhatt, M., et al. (2023), A&A, 674, A82.		

ASI2026_86	Divya Oberoi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Enabling State-of-the-art Solar and Heliospheric Sciences with the SKA Telescopes		
The Sun is a surprisingly difficult radio source to observe and image, even with the Square Kilometre Array (SKA) telescopes. It is multiple orders brighter than the typical radio sources, which sensitive radio telescopes like SKA are optimized for. So, configuring the signal chain to enable solar observations while maintaining linearity is the very first non-standard requirement to be met. Next, the solar radio emission spans an impressive range along every single phase-space parameter that can be used to describe it -- time scales from solar cycles to millisecond; spectral scales from smooth thermal emission to ~100 kHz coherent emission; brightness temperatures from 10^4 K for gyrosynchrotron emissions to 10^{13} K for bright type-III bursts; fractional polarizations from less than 1% to nearly 100%; and angular scales extending beyond a degree. Capturing the dynamics in solar radio emission in their full glory requires, on the one hand, that all the data that goes into making an image be acquired over very short temporal and spectral spans and, on the other, also imposes requirements for very high imaging dynamic range with high polarization purity. Extracting the information at the requisite temporal and spectral scales from SKA data will require a spectropolarimetric snapshot capability with high dynamic range and fidelity. Additionally, some of the most interesting insights into solar physics and space weather come from studying solar activity, which remains inherently unpredictable. Illustrating using examples from SKA precursors and pathfinders, this work will discuss the various solar and heliospheric science specific aspects that need to be considered to help realize the promise of solar and heliospheric science from the SKA telescopes.		

ASI2026_850	Divya Paliwal	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A high-frequency type II radio burst associated with an X2.3 class flare		
Radio observations provide access to the corona, heliosphere, and ionosphere, and are thought to be an excellent indicator of disturbances in the solar atmosphere. An immediate indicator of solar transients, such as solar flares and coronal mass ejections, is solar radio bursts, especially in the inner and middle corona. We studied a rare type II high-frequency (start frequency: ~750 MHz), fast-drifting (~0.5 MHz/s) type II radio burst on November 6, 2024. The active region source location for this burst was S08E14 (AR13883). There was an X2.3 class flare associated with this burst, which started at 13:24 UT, peaked at 13:40 UT, and ended at 13:46 UT. The duration of the X-ray flare was ~ 22 min. There was an EUV wave seen just after the flare at ~ 13:55 UT in the SDO-AIA field of view (fov). Several ground-based radio spectrographs had recorded this type II radio burst at 13:50 and 13:56 UT, spanning frequencies from ~ 750 MHz to 45 MHz. Radio imaging observations with the Nancay radio heliograph (NRH) in the frequency range of 444-150 MHz, corresponding to a height range of 1.01-1.29 $R_\odot$, reveal that the radio sources were moving in the east direction. We used the High Energy L1 Orbiting X-Ray Spectrometer (HELIOS) on-board Aditya-L1 data for spectroscopy to find the cut-off energy range for non-thermal emission. We used the Spectrometer Telescope for Imaging X-rays (STIX) on board Solar Orbiter (SoLO) to locate the hard X-ray emission region at the eruption footpoints. Our preliminary analysis suggests that the type II bursts were not associated with any whitelight CME, as it was not sufficient to give rise to the shock in the inner corona. This Type II radio burst was associated with the flare blast wave generated due to the strong X2.3-class flare.		

ASI2026_840	Prithvi Raj Singh	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Variations of Solar wind Plasma and Interplanetary magnetic field during Solar Cycles 22–24		
In this paper, we have studied the relationship between the monthly variations of interplanetary magnetic field (IMF), solar wind plasma velocity, and geomagnetic activity index (Ap) during solar cycles 22–24 (1986–2020). The modulation parameter (ξ =V*B) is the product of strength of the interplanetary magnetic field (B) and solar wind plasma		

velocity (V). We have investigated the periodicities and their evolution using the RobPer periodogram and Continuous Wavelet Transformation methods. The significant periods present in the interplanetary magnetic field (B), geomagnetic activity index (Ap), solar wind plasma velocity (V), and modulation parameter include the Rieger type, semi-annual period, annual period, and quasi-biennial period. In this study, we have found that the rotation rate at the base of the convection zone is ~1.30 years. The modulation parameter appears to be a better representative of the geomagnetic changes than the other two.

ASI2026_806	Goldy Ahuja	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Dynamics Simulation of Comets		
Comets are the perfect objects to study the evolutionary beginnings of our solar system. Observational techniques such as Photometry, Spectroscopy, and Polarimetry provide insight into the physical and chemical properties of these objects, which help us understand their composition at the time of their formation. However, since the Solar System has evolved over time due to the migration of the giant planets, these bodies have been scattered outwards. Currently, there are two active reservoirs, which are the source of these objects. One is the Kuiper Belt, and the other is the Oort Cloud. Objects residing in the outer Oort Cloud (a > 25000 au) have a period of around a few million to tens of millions of years and form a distinct subclass in the Oort Cloud, known as Dynamically New Comets. Studying these objects is crucial, as they have never returned to the inner solar system. These bodies were ejected from the inner solar system after their formation, remaining in a state of deep freeze in the outer Oort Cloud. This is where the dynamical simulation becomes important, as the orbital parameters of the comets are affected once they enter the inner solar system due to various perturbative forces. The orbital evolution of these bodies in the presence of various forces, apart from gravity, such as Non-gravitational accelerations from their own outgassing, galactic tidal effects, and stellar perturbations, can reveal their exact orbital parameters and the possible origin, thereby verifying their "dynamically new" status. Observational studies of confirmed dynamically new comets can help explain the chemical and physical composition of the early solar system. Hence, it is important to study the orbital evolution of newly discovered comets at an early stage after their discovery. In this presentation, we'll discuss results from our recent studies of a sample of comets.		

ASI2026_159	Hardik Medhi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Reviving Interplanetary Scintillation Studies with the Ooty Radio Telescope		
The solar wind is a neutral plasma that constantly flows out of the Sun's corona and permeates the interplanetary space. The density irregularities cause the plane wavefronts from a distant compact radio source to develop phase corrugations as the waves travel through the plasma. By the time they reach the Earth, these phase corrugations grow into amplitude fluctuations. The solar wind's relative motion transforms these spatial variations into temporal intensity scintillations, also called Interplanetary Scintillations (IPS). IPS can monitor the solar wind in a vast swathe of interplanetary space revealing large scale structures in the normal solar wind, and characterising any variations in the interplanetary medium due to features and activities on the Sun. Commissioned in 1970, the Ooty Radio Telescope (ORT), designed to work at 326.5 MHz, has been used to pursue cutting-edge IPS studies for multiple decades. Sitting on a natural North-South slope of 11°, its 530m North-South and 30m East-West antenna allows the ORT to track celestial objects for almost ten hours in the East-West direction with high sensitivity. The telescope is currently being revived to reach and surpass legacy-level sensitivity. We have been using the ORT to observe a handful of known IPS sources since June 2025, fortuitously overlapping with the peak of the current solar cycle, to probe the interplanetary medium from ~0.1 AU to ~1 AU. We have computed the basic IPS observables - scintillation index and power spectrum - and obtained the m-p curves for a few strong sources. We have identified a few coronal mass ejections		

(CMEs) which crossed our IPS lines-of-sight. Here we present the current status of our study. Our work already demonstrates that the ORT is producing data suitable for investigations of the interplanetary medium for space weather applications.

ASI2026_61	Jithu J Athalathil	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Investigating Nonlinear Quenching Effects on Polar Field Buildup Using Physics-Informed Neural Networks		
The evolution of the solar magnetic field is the key factor governing space weather drivers. Accurate forecasting of space weather requires precise modelling of the magnetic field's evolution on the solar surface using methods like Surface flux transport (SFT). Conventionally used SFT modelling techniques involve grid-based numerical schemes, making them computationally expensive. In this presentation, we present a novel, mesh-independent machine learning-based approach using Physics-Informed Neural Networks (PINNs) to simulate the temporal evolution of Bipolar Magnetic Regions (BMRs) on the solar photosphere. The ability of PINNs to solve advection-diffusion equations make it an efficient and accurate technique to simulate SFT equation. We employ this approach to study how nonlinear effects influence SFT models, with the broader goal of improving our understanding and constraints on solar dynamo processes. In particular, we focus on two mechanisms recently proposed to modulate solar cycle amplitudes: tilt quenching (TQ), representing a negative feedback between the cycle strength and the average tilt angle of active regions, and latitude quenching (LQ), indicating a positive relationship between cycle strength and the mean emergence latitude of active regions. Using PINNs within the SFT framework, we systematically examine the nonlinearities introduced by TQ, LQ, and their combined effects. Our study aims to clarify the distinct contributions of TQ and LQ to the solar dynamo. We find that the balance between LQ and TQ effects is closely linked to the ratio of meridional flow speed to magnetic diffusivity in the SFT models. Given that LQ is better constrained through observations, it may offer a valuable benchmark for refining solar dynamo models to achieve closer alignment with solar observations.		

ASI2026_670	kiran kumar Kalisetti	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A Multi-Instrument Study of Energy Flow in Two Successive M-Class Solar Flares using HEL1OS/Adithya-L1, XRS/GOES, AIA&HMI/SDO		
On Dec 15, 2023, two successive GOES M-class flares (M-6.7 & M-6.97) were observed from the same active region (AR-13514) located at N05W64, occurring in immediate succession. Despite originating from the same active region and belonging to the same class, both flares exhibit different behaviors. We observed that the first flare follows the Neupert effect, while the second flare does not. The free magnetic energy density in the flaring region decreases during the first flare, which is expected. However, during the second flare, it increases. In addition, flare ribbon motion is more prominent during the first flare compared to the second flare. In this study, we investigate energy flow in the solar atmosphere during these two successive solar flares. HEL1OS (High Energy L1 Orbiting X-Ray Spectrometer) spectral and timing data along with GOES X-ray Sensors timing data are used to verify the Neupert effect and diagnose the evolution of thermal and non-thermal plasma. AIA (Atmospheric Imaging Assembly) multi-wavelength data are used to trace spatial and temporal evolution of flare emission across the chromosphere and corona. In addition, HMI (Heliosesimic and Magnetic Imager) photosphere magnetic field data are used to estimate free magnetic energy and reconnection rates from flare ribbons brightening. These observations suggest that the first flare may have influenced the evolution of the second flare.		

ASI2026_562	Malay Shukla	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A comparison of G-band brightness as a proxy-magnetometer in various magnetic configurations		
We investigate the diagnostic potential of the G-band intensity at 430.4 nm for probing small-scale magnetic fields in the solar photosphere. Combining three-dimensional MHD simulations from the MURaM code and spectral synthesis via the RH 1.5D code, we evaluate the intensity contrast in the G-band filtergrams by comparing the filter centered at 430.4 nm in comparison to the conventional 430.5 nm. Our results show that filtergrams centered at 430.4 nm provide higher contrast across varying magnetic environments, particularly at narrow filter widths. This enhancement arises from its slightly higher formation height and greater sensitivity to temperature variations in magnetized regions. These findings indicate that G-band filtergrams centered at 430.4 nm could improve the visibility of magnetic bright points and may serve as a better alternative for narrowband imaging in the photosphere, offering improved effectiveness for magnetic field diagnostics. The obtained results are also relevant and suggest potential applications in stellar contexts, where molecular bands are often used as proxies for magnetic activity.		

ASI2026_701	Mansi .	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Multi - wavelength studies of large amplitude prominence oscillations		
Prominences are cool, dense plasma structures that are supported in the solar corona by magnetic fields in opposition to gravitational force. These prominences can become unstable when triggered by external drivers like CMEs, flares, or jets and sometimes display oscillations. According to the velocity amplitude of these oscillations, they can be small amplitude (<10 km/s) or large amplitude(>10 km/s); and depending on the plasma motions with respect to the prominence axis, they can be transverse or longitudinal. In this study, we investigated large-amplitude oscillations in a quiescent prominence that were triggered by EUV waves generated after a hot-channel eruption. The analysis was carried out using observations from the Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamics Observatory (SDO). Time-distance (XT) maps were constructed along selected slits across the prominence, and Gaussian fitting was applied to the intensity profiles at each time step to determine the prominence center positions. These positions were then modeled with a damped sine function including a linear trend, from which we derived key oscillation parameters such as the initial amplitude, period, damping time, quality factor, and velocity amplitude. In addition to the single-channel analysis, we also performed a multiwavelength study of the same prominence oscillations using different AIA channels. Furthermore, we examined the spatial profile of the oscillations along the prominence to investigate how the oscillatory characteristics varied with height.		

ASI2026_413	Mithun Patra	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Reflected-Light Spectroscopy of Exoplanets with NEXOTRANS: New Pathways to Atmospheric Characterization		
Future space-based direct-imaging missions, such as the Habitable Worlds Observatory (HWO), will enable high-contrast reflected-light spectroscopy of Earth-like terrestrial exoplanets orbiting Sun-like stars. We present NEXOTRANS, an in-house atmospheric forward and retrieval framework designed to characterize exoplanet atmospheres using reflected-light observations. The framework combines Bayesian inference, implemented with PyMultiNest, and a suite of machine-learning regression techniques, including Random Forest, Gradient Boosting, K-Nearest Neighbor, and Stacking Regressor, to efficiently constrain atmospheric compositions. Using physically self-consistent forward models, we quantify the information content of reflected-light spectra and assess the observational requirements for robust molecular detections across different classes of Earth-like planets. Specifically, we explore the dependence of atmospheric retrieval performance on wavelength coverage, spectral resolution, and signal-to-noise ratio relevant to HWO-class instrumentation. NEXOTRANS additionally incorporates wavelength-dependent surface reflectance, enabling the separation of atmospheric signatures from surface		

contributions in reflected-light spectra. Our results provide quantitative guidance on the observational parameter space required for detecting and characterizing molecular species in Earth analogs, and establish reflected-light spectroscopy as a key pathway for advancing comparative planetology and the search for habitable worlds with future direct-imaging missions.

ASI2026_672	Monoswini Chakravorty	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A Comparative Polarimetric Study of 24P/Schaumasse (Short-Period) and C/2016 R2 (Long-Period) Comets		
Polarimetry provides a powerful diagnostic of cometary dust properties, including grain size, morphology, and composition. We present a comparative polarimetric study of two comets from distinct dynamical classes: the short-period comet 24P/Schaumasse and the long-period comet C/2016 R2 (PANSTARRS), observed at phase angles of 41.0° and 7.74°, respectively. Spatial variations in dust properties across the coma were investigated using aperture polarimetry and polarization maps, while the coma structure was analyzed through radial intensity profiles. The short-period comet 24P/Schaumasse exhibits relatively shallow radial intensity slopes (−0.202 and −0.172), consistent with sustained dust emission dominated by slowly dispersing particles. In contrast, C/2016 R2 (PANSTARRS) shows significantly steeper sunward and tailward slopes (−0.555 and −0.395), indicating a rapid decline in brightness and non-steady dust dynamics. Polarimetric measurements reveal marked differences between the two comets that align with their distinct viewing geometries and compositions. At a phase angle of 41°, 24P/Schaumasse exhibits positive polarization (P ≈ 5.22%), typical of dust-dominated scattering at intermediate phase angles. Conversely, C/2016 R2 (PANSTARRS), observed at a small phase angle of 7.74°, exhibits low negative polarization (P ≈ −0.88%). While negative polarization is expected at such low phase angles due to backscattering, this measurement is consistent with the gas-rich and dust-poor environment of C/2016 R2. These results demonstrate the effectiveness of polarimetry in distinguishing dust properties and evolutionary behavior in comets from different dynamical populations.		

ASI2026_639	Mudia. Prashanthi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Geomorphological analysis of small impact craters at the Chandrayaan-3 landing site with implications for regolith properties		
The Chandrayaan-3 mission achieved a successful soft landing in the lunar south polar region, that provides a unique opportunity to investigate surface and near-subsurface regolith properties. Regolith is an upper few meters thick soft sedimentary layer, which throws light on the lunar surface processes. Although many previous studies addressed the nature of materials present at the Chandrayaan-3 landing site, thickness of regolith layer and origins of impact ejecta materials present at the landing site are poorly known. Therefore, this study focuses on investigating regolith thickness at the Chandrayaan-3 landing site using Lunar Reconnaissance Orbiter Camera (LROC) Narrow Angle Camera (NAC) images. Thickness of regolith is calculated using the morphometric measurements of crater rim and floor regions of small sized (roughly 10-100 m diameter) fresh impact craters . The impact craters such as concentric craters, polygonal craters and central mound craters are identified and the measurements of crater diameter and floor diameter are measured. The excavation depths are estimated using standard scaling relationship between crater diameter and depth. The differences in the morphological characteristics of craters in relation to features such as slope, roughness, and surface maturity are examined. In addition, mapping of recently formed impact craters is performed to understand the distribution of freshly excavated materials from the near-surface region of the regolith. These materials can be sampled by future missions. In addition, various sources of ejecta materials present at the landing site are identified. We also identify various surface features such as faults, boulder falls and landslides at the landing site for better understanding of recent surface processes.		

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ASI2026_141	Murchana Khusroo	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Observation of Solitary Signatures in the Vicinity of Interplanetary Shocks Using Solar Orbiter Data		
Interplanetary shocks observed in the heliosphere are typically accompanied by strong magnetic field fluctuations, which are most often discussed in terms of turbulence or linear wave activity. However, less attention has been paid to the possible presence of coherent nonlinear plasma structures in such disturbed environments. Among the most fundamental nonlinear plasma phenomena are solitary waves (or solitons), which arise from a balance between dispersion and nonlinearity and are characterized by their localized, non-dispersive nature. Although solitary structures have been extensively observed and studied in planetary magnetospheres, particularly in Earth's magnetosphere, their occurrence and properties in interplanetary shock-related plasmas remain largely unexplored. In this study, we investigate their formation in the vicinity of interplanetary shocks using in situ observations by analyzing high-resolution magnetic field data from Solar Orbiter. On the basis of their observed temporal and directional characteristics, the detected features are consistent with non-dispersive solitary magnetic structures. To our knowledge, this represents the first observational study explicitly targeting solitary wave signatures in a shock environment using Solar Orbiter data. These observations provide a new perspective on magnetic field variability near collisionless shocks and offer a basis for future, more detailed studies of nonlinear processes in heliospheric plasmas.		

ASI2026_635	Nambram Niroda Devi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Imaging Polarimetry of Comets C/2023 H5 (Lemmon) and 333P/LINEAR		
We report the first R-band (λ = 0.630 μm, $\Delta\lambda$ = 0.120 μm) photopolarimetric observations of comet C/2023 H5 (Lemmon) at low phase angles (9.9°–10.4°) and comet 333P/LINEAR at a high phase angle (62°) using AIMPOL on the 1.04m Sampurnanand Telescope. C/2023 H5 shows shallow intensity slopes (−0.19 to −0.08) and negative polarization (−1.5% to −2.7%), consistent with coherent backscattering, while 333P/LINEAR shows comparatively steeper nuclear slopes (−0.41) and positive polarization up to ∼16%. The 62° observation of 333P/LINEAR is the highest R-band phase angle recorded for cometary polarimetry, providing strong constraints on dust scattering. Polarization maps reveal asymmetric jet-like structures, indicating active regions shaped by solar heating and offering new insights into dust properties and grain-size distributions at extreme phase angles		

ASI2026_786	Parvathy Menon	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Characterisation of Magnetic Activity on the Sun Using Disc-integrated Spectra		
Stellar surface inhomogeneities due to magnetic structures such as spots, plages, and faculae are well recognized as sources of “noise” affecting accurate retrieval of exoplanet properties in stellar radial-velocity measurements. High-energy events, such as solar flares and coronal mass ejections, also leave characteristic signatures in the activity indices derivable from various spectral lines. In this work, we investigate activity-related features seen in the disk-integrated spectra of the Sun using time series of Sun-as-a-star spectral observations by HARPS-N. We trace the temporal evolution of various chromospheric and photospheric lines and the trend of these line indices with sunspot and plage fill factors to identify signatures of high-energy solar events and solar cycle variations in the spectral indices, which in turn help us understand such variations in sun-like exoplanet host stars. We have also calculated the correlation of the S-index with the indices of Balmer lines of varying core width. We examined this behavior to understand the contributions of differences in Hα formation height variations, which affect the Hα and the S-index correlations that have been reported in studies of solar-like stars. To aid the interpretation of the observed behavior, we have also attempted to compare the Sun-as-a-star measurements with synthetic Hα and Ca II 8542 line profiles obtained from realistic 3D radiative magnetohydrodynamic (rMHD) simulations of enhanced network regions.		

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ASI2026_1022	Pawan Kumar	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Investigating Role of Recurrent Magnetic Reconnection in onset of X9.0 class Solar Flare and Quasi Periodic Pulsations		
In this work we aim to investigate the onset mechanism of an X9.0 class solar flare hosted by AR 13842 on 2024 October 3 using a series of Non-force-free-field (NFFF) extrapolated photospheric vector magnetogram and observations. Notably, the extrapolated magnetic configuration before the onset of flare has depicted the presence of key magnetic features, magnetic flux rope (MFR), hyperbolic flux tube (HFT), shear arcades and quasi separatrix layers (QSLs) in the flaring region. Important is the appearance of sigmoidal brightening during the onset of flare, which nearly coincide with the sheared arcades. This suggests that the strong field-aligned currents associated with the sheared arcades lead to the Joule heating of plasma, potentially resulting in emissions corresponding to the sigmoid. Moreover, the sequence of extrapolation indicates a possible initiation of magnetic reconnection within the shear arcades, which enhances the magnetic flux in the MFR, thereby making the rope susceptible to eruption. Furthermore, we observe the movement of the foot points of the HFT in the QSLs regions. Interestingly, the foot points of the HFT nearly aligned with the observed flare brightening during the flare, highlighting the crucial role of slipping reconnection in generating the flare brightening. Additionally, these magnetic reconnection, when repeated over time, are anticipated to give rise to the observed flare ribbons as well as quasi-periodic pulsations (QPPs) with a dominant period of > 1 minutes.		

ASI2026_357	POULOMI PALIT	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Analysis of Two Bidirectional Reflectance Models for Light Scattering by Asteroid Regolith Analogues		
This study compares how well the Lumme–Bowell and Hapke models describe the scattering of light from materials that mimic asteroid surfaces. Reflectance measurements were carried out in the laboratory using a range of asteroid-analogue samples, including silicon carbide, boron carbide, brown corundum, olivine–basalt mixtures, Martian JSC1 simulant, and Oman sand. These samples covered particle sizes from 13 to 600 μm and porosities from 0.37 to 0.72, resemble to real asteroid regolith. The performance of each model was judged by how well it fits the experimental reflectance data, using the normalized chi-square error minimization method. In most cases, the Hapke model provided a better fit, yielding lower chi-square values and thus a closer agreement to the laboratory measurements. However, among the 30 different experiment cases, in three instances the Lumme-Bowell model gave a marginally better fit than Hapke model. The details will be discussed. Across 36 experimental configurations, the Hapke model produced lower chi-square values in most situations, while in 6 cases the Lumme–Bowell model fit slightly better. For all 450 individual cases, 101 followed the Hapke model, 34 followed the Lumme–Bowell model, 246 were consistent with both, and 69 did not clearly follow either model. The total experimental error stayed below 2%, and model reflectances generally remained within the error bars. Keywords: Reflectance, Hapke model, Lumme-Bowell model, Porosity, Light scattering,Asteroid, Regolith		

ASI2026_629	Pritam Das	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Probing CME Internal Kinematics with Optical Flow: Evidence for Velocity Dispersion from Multi-Coronagraph Data		
Understanding CME kinematics in the middle corona is essential for linking their initiation physics with heliospheric evolution. However, conventional height–time tracking along discrete position angles cannot resolve the internal velocity dispersion between CME substructures such as the core, cavity, and front. We present a two-dimensional optical-flow (OF) framework that derives continuous velocity fields directly from coronagraph image sequences, enabling systematic tracking of CME expansion and internal dynamics. The method was validated using LASCO C2 and STEREO/COR1 data, showing strong agreement with conventional techniques despite their lower cadence and spatial resolution. We then applied the technique to Solar Orbiter/METIS and PROBA-		

3/ASPIICS observations after extensive background removal and temporal-Fourier filtering to mitigate current brightness-flicker artifacts around the occulter in PROBA-3's Level-2/3 data. The retrieved flow fields yield both centre-of-motion and expansion velocities for multiple limb CMEs. For example, in the 16 April 2024 METIS event, the average centre-of-motion and expansion speeds were 337 km/s and 196 km/s, respectively. Multi-wavelength analysis using METIS Ly-alpha and FSI 174/304 Å, together with ASPIICS wideband observations, reveals a critical height range of 2.2–2.6 solar radii where systematic velocity dispersion between the core and front first develops. Furthermore, Intensity-based segmentation enables the extraction of internal velocity distributions, revealing significant dispersion within both regions, but with velocity density concentrated near the median. The lower-velocity contributions arise primarily from the CME flanks. Finally, the measured time lag between the core and front velocity profiles, together with their radial separation, implies an information transfer speed of ~3000–3500 km/s. This exceeds both sound and Alfvén speeds, indicating that a fast-mode MHD wave likely mediates momentum coupling between CME substructures. This method also enables automated CME detection through evolving velocity distributions, paving the way for coordinated kinematic studies with current and upcoming missions such as Solar Orbiter, PROBA-3, and PUNCH.

ASI2026_69	Reehana Quadri	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Geomorphological Analysis of Lunar South Polar Region		
The Lunar South Polar Region (LSPR) has been a central point of upcoming robotic and human explorations due to the presence of Permanently Shadowed Regions (PSRs) that serve as cold traps for volatile resources. The distribution of primary impact craters opens a window into the chronology of the lunar highlands. In addition, meteoroid impacts, tectonics and mass wasting features provide important insights into the recent surface changes. In an astronomical context, these regions serve as a historical archive of various volatile materials that were delivered to the Moon by comets or asteroids. A foundational phase for placing future low-frequency radio telescope designed to specifically observe the Cosmic Dark Ages, prevented from Earth's radio interference begins with assessing the stability and shielding properties of polar craters. This study adds to a targeted geomorphological assessment of terrains which are near to the proposed landing sites for future lunar missions. By analysing the transition areas between constantly illuminated ridges and adjacent PSRs, essential data are obtained to ensure mission safety and survivability while enabling the pursuit of high-impact scientific objectives. The current work is a targeted analysis of high-resolution data from Lunar Reconnaissance Orbiter (LRO). In order to perform boulder counting, spatial distribution mapping, and identifying surface hazards at sub-meter scale, Narrow Angle Camera (NAC) images are used. These observations are combined with Digital Elevation Models (DEMs) from the Lunar Orbiter Laser Altimeter (LOLA) to derive slope gradients and topographic parameters. Interpreting the geomorphological characteristics of the lunar surface in a few specific areas in the LSPR would provide important clues to the recent surface processes that affected the Moon, natural hazards, including safe landing of the astronauts and rover mobility in the exploration sites.		

ASI2026_981	Ribanda Marbaniang	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Disk Self-Gravity and the Global Response of Protoplanetary Disks Hosting Multiple Planets		
High resolution observations of protoplanetary disks reveal a wide variety of substructures, including gaps, rings, and non-axisymmetric features like vortices, which are commonly attributed to the presence of embedded planets. Although the interaction between a single planet and the surrounding disk is relatively well understood, recent numerical studies have shown that systems hosting multiple planets can produce wide and shallow gaps, long-lived vortices, and pronounced non-axisymmetric features. Despite this progress, the effects of disk self-gravity are often neglected in studies of multi-planet systems, even though young and massive disks are sufficiently self-gravitating for gravitational forces to influence wave propagation, torque exchange, and disk structure.		

In this work, we investigate the role of disk self-gravity in shaping the substructures induced by multiple embedded planets in protoplanetary disks. Using two-dimensional hydrodynamical simulations, we explore the impact of disk self-gravity on the development of spiral density waves and the redistribution of material. We find that including self-gravity leads to a more pronounced global disk response, with stronger and more extended spiral features and enhanced radial perturbations in the azimuthally averaged surface density profiles compared to non-self-gravitating disks. These results suggest that disk self-gravity plays an important role in shaping the observable appearance of planet-hosting disks and contributes to the diversity of substructures seen in high-resolution observations. Accounting for self-gravity is therefore essential when interpreting disk morphologies and inferring planet properties from observed gaps and non-axisymmetric features.

Keywords: hydrodynamics — protoplanetary discs — planet–disc interactions — methods: numerical

ASI2026_430	Rohan Ginnela	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Comparative studies of Lunar Space Weathering during across Solar Cycle		

Observations of lunar craters across different latitudes have revealed significant morphological and spectral gradients caused by the variations in intensity of the solar wind and micrometeoroid flux. Among the various sources responsible for lunar space weathering, the solar wind plays a dominant role by implanting ions, sputtering surface materials, and facilitating the formation of nanophase iron particles that significantly affect lunar reflectance and maturity. Studies like Asymmetric Optical Maturity, Latitudinal Brightness & Slope Flattening, Polar Softening of Small Craters offer a qualitative analysis of the same. Observations from the Lunar Reconnaissance Orbiter (LRO) have enabled detailed investigations of space weathering effects, like changes in albedo, optical maturation of regolith, development of swirl features, and variations in surface roughness and composition across different geological terrains. In the current work we attempt a comparative study of lunar space weathering process during periods of solar maximum and solar minimum, when a substantial variation in solar wind flux, energy, and magnetic field is observed. Such studies can improve understanding of the temporal variability of space weathering, offering insights into the interaction between solar wind and the evolution of the lunar surface.

ASI2026_911	Rosemin John	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Modelling Reflected Light Spectra of Exoplanet Atmospheres		

Over the past decade, exoplanet science has made great leap towards atmospheric characterization. While modelling approaches for transiting exoplanets are well developed through transmission and emission spectroscopy, reflected-light modelling remains limited. The James Webb Space Telescope(JWST) and upcoming missions such as the Roman Space Telescope and the Habitable Worlds Observatory highlight the need for reflected-light models to interpret planetary albedos, clouds, and atmospheric energy budgets relevant to habitability. Therefore, we present a generalized reflected-light spectra model for exoplanet atmospheres within the Suite of Adaptable plaNetary atmoSphere model And Retrieval (SANSAR) that computes planetary albedo spectra over a broad range of planetary and atmospheric conditions. The model consistently treats wavelength-dependent gaseous and cloud absorption, Rayleigh scattering by atmospheric gases, and cloud scattering described using Mie theory with different phase function formulations. Multiple radiative transfer techniques are implemented within this framework, enabling systematic assessment of how methodological choices influence predicted spectra. By comparing against existing reflected-light models, we identify consistencies and isolate systematic discrepancies arising from radiative transfer assumptions and scattering treatments. The reflected-light spectra model developed in this work can be applied to exoplanets, solar system planets and even the Earth, thus providing a robust tool to plan and interpret reflected light observations from these planetary bodies. In the near future, such a model could also be useful for interpreting Venus observations from ISRO's Shukrayaan mission.

ASI2026_451	S.P. Rajaguru	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Helioseismic inferences on the coupled dynamics of large-scale flows and magnetic fields in the near-surface shear layer.		
Using 14-years of HMI/SDO and GONG data, we present a comprehensive analysis of helioseismic measurements of coupling between active region flows and the global meridional and zonal flows within the near-surface shear layer (NSSL). We also analyse active region magnetic fields, their hemispheric asymmetry and their connections to flow structures revealing new information on the roles of flows near the base of the NSSL for the observed global-scale transport of magnetic flux and build-up in the polar regions over solar cycle time-scales.		

ASI2026_777	Sabarinath M D	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Geophysical Investigation of the Proposed Crater Site: Implications for Large Impact Structures in Planetary Context		
Large impact events play a fundamental role in shaping planetary crusts and are important for understanding long-term planetary evolution. However, the analysis of ancient or deeply modified impact structures remains challenging, particularly when these sites are obscured by sedimentation, volcanism, or tectonic overprinting. In this study, the proposed Shiva crater off the western continental margin of India is studied as a possible buried impact basin. Publicly available satellite gravity, magnetic anomaly, and bathymetric datasets are analysed and compared using a radial-profile and forward-modelling approach to assess whether the observed geophysical signatures are consistent with those expected from a large impact structure. Annulus-averaged radial profiles centred on the proposed impact location reveal a very faint central gravity high, along with mild concentric variations at larger radii that are present across independent datasets. A distinct bathymetric rim is not observed; however, subtle slope variations are present, which may reflect post-impact modification, burial, or long-term thermal subsidence. Forward modelling using simplified density and magnetic contrasts shows that the first-order characteristics of the observed gravity profiles can be reproduced under reasonable assumptions, although uncertainties remain due to data resolution and other inherent factors. Rather than providing a confirmation, this work focuses on demonstrating an easily adaptable geophysical workflow for testing hypotheses related to large, highly degraded impact structures. The approach is directly applicable to planetary bodies such as the Moon and Mars, where erosion-free yet volcanically or sedimentologically modified basins are common and ground truth is limited. The Shiva structure is therefore treated as a case study that highlights both the potential and the limitations of geophysical methods in investigating ancient planetary-scale impacts.		

ASI2026_978	Sanjay Kumar	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A Data Constrained MHD Simulation of Magnetic Reconnection at Hyperbolic Flux Tube and Quasi-Separatrix Layer		
In this work, we identify the magnetic reconnections at the hyperbolic flux tube (HFT), aided by slipping reconnection at quasi-separatrix layers (QSLs), which are pivotal to the occurrence of a confined M2.1 class flare in NOAA active region 12268. The magnetic field topology before the flare's onset is obtained through a non-force-free-field extrapolation scheme that accommodates a non-zero Lorentz force. A key aspect is the presence of an HFT in the computational domain above the flaring region, along with two QSLs at the lower boundary. To simulate the dynamics of the active region, we conduct a data-constrained magnetohydrodynamics (MHD) simulation initiated by the extrapolated field. The dynamics captured in the simulation document the formation of a current sheet within the HFT configuration, leading to magnetic reconnection at the HFT. Additionally, we observe the slipping motion of the footpoints of the magnetic field lines in the QSLs at the bottom boundary, which indicates the occurrence of slipping reconnection in the QSLs. Importantly, the magnetic reconnections at the HFT and the QSLs are suggested to contribute to the development of the intricate flare brightenings and the flare ribbons.		

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ASI2026_499	Sarang Shah	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A unique long period stellar dimming event: ASASSN-24fw		

We present our study of a long-period stellar dimming event, ASASSN-24fw, observed by the All-Sky Automated Survey for SuperNovae. ASASSN-24fw is a main-sequence F-type star that underwent a rapid fading event beginning in late 2024 and lasting until June 2025, with a total duration of approximately 275 days. Prior to dimming, its spectral energy distribution indicates a persistent infrared excess with a fractional luminosity of about 10%. We modeled this excess using a two-component blackbody model, finding effective temperatures of ~1100 K for the warm component and ~400 K for the cold component. Publicly available survey light curves show that ASASSN-24fw is otherwise photometrically stable, indicating that the dimming is caused by an external occulter. While long-period dimming events have become more common in recent years, ASASSN-24fw is distinguished by a unique flat-bottomed light curve lasting nearly 200 days. To constrain the properties of the occulter and the host system, we analyzed multi-band photometric data and spectroscopic observations obtained during and after the dimming event. We applied two independent light-curve modeling approaches. The first parametrizes the light curve morphology and reveals multiple ingress phases, suggesting variations in the density of the occulting material. The second model favors an interpretation in which the occulter is a gas giant, likely a brown dwarf, with a minimum mass of 3.42 M_Jup surrounded by an extended ring system with a radius of approximately 0.17 au. Near-infrared spectra obtained during dimming show enhanced infrared excess and are consistent with a late-type object, likely an M8 brown dwarf. Optical spectra taken during dimming exhibit variable Hα emission, while post-dimming spectra show no evidence of accretion, implying that the variability is associated with the occulter rather than the host star. Systems like ASASSN-24fw are rare and provide valuable insight into circumstellar environments and the evolution of complex occulting systems.

ASI2026_1065	SARDAR SINGH RAO	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
EIA morphology over ±75^0 longitude sectors under storm-modified electro- and neutral dynamics		

This research work emphasizes understanding the equatorial ionization anomaly morphology over the day and night sectors during the episode of the geomagnetic storm of April 23-24, 2023. For this, the latitudinal profile of total electron content over Indian (75°E) and American (75°W) are analyzed along with geomagnetic parameters, neutral winds (TIE-GCM), and CTIP modeled $\sum O/N_2$. Interesting EIA features like latitudinal dispersion (poleward/equatorward bidirectional expansion) over the American sector and longitudinal elongation over the Indian sector under the composite effects of storm-induced electric fields and neutral winds) are observed. Also, an early and late sustained EIA is observed compared to typical noontime EIA.

ASI2026_297	Satish Chandra	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Study of Long Term Radial Differential Rotation using Multi-Wavelength Radio Data		

The Sun emits radiation across a broad spectrum, ranging from long radio waves to short X-rays. These emissions originate at different heights within the solar atmosphere, particularly the transition region and the corona. Solar radio radiation, in particular, serves as a valuable diagnostic tool and potential precursor for understanding solar activity and cyclic variations. Its modulation, observable across radio, ultraviolet, and X-ray wavelengths, provides insights into the dynamics of solar rotation and related phenomena. In this study, the solar rotation period has been estimated by analyzing annual time series of integrated radio flux data recorded at multiple wavelengths, including 30 cm, 15 cm, 10.7 cm, 8 cm, and 3.2 cm. The dataset, obtained from the LASP Interactive Solar Irradiance Datacenter (LISIRD), spans from 1952 to 2025 and encompasses more than six complete solar cycles. Since these emissions originate from different atmospheric layers, they offer a multi-height perspective on solar rotation. To detect periodic oscillations in the flux data, Lomb–Scargle periodogram analysis has been employed. The derived rotational profiles

are systematically correlated with established solar activity indicators, such as the sunspot cycle (Schwabe cycle) and the magnetic Hale cycle. The results validate both radial differential rotation and phases of near-rigid rotation across solar cycles 19 through 25, including the ongoing cycle. Furthermore, the study highlights the interrelationship between solar rotation dynamics and long-term cyclic behavior, reinforcing the role of radio flux modulation as a diagnostic of solar variability.

ASI2026_980	Sayanee Haldar	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Physics-Guided Machine Learning Identification of Sub-Alfvénic Signatures in Magnetic Cloud Passages		
Sub-Alfvénic intervals in the solar wind, most often found within the cores of magnetic clouds during interplanetary coronal mass ejection (ICME) events, can significantly influence solar wind-magnetosphere coupling by modifying energy transfer processes and wave activity. These intervals are uncommon and are typically recognized only after they occur, which limits the ability to investigate their onset dynamics or anticipate related geomagnetic disturbances. In this study, a physics-guided machine learning framework is developed to forecast transitions into sub-Alfvénic flow using upstream solar wind parameters from 1-minute OMNI data. Sub-Alfvénic conditions are identified by the Alfvén Mach number < 1, with event onsets defined at transitions from super-Alfvénic to sub-Alfvénic regimes. For each event, pre-onset phases extending up to 45 minutes before the transition are used to construct labelled samples, allowing the problem to be formulated as probabilistic regime forecasting rather than deterministic onset detection. Features are derived from sliding 60-minute history windows and include trends and variability in magnetic field strength, solar wind speed, proton density, plasma beta, Alfvén speed, and the deviation of Alfvén Mach Number from unity. Baseline machine learning models, including logistic regression and random forest classifiers, are trained using time-blocked cross-validation across multiple magnetic cloud (MC) events and evaluated using precision recall metrics, lead-time versus recall performance, and comparisons with simple physical-threshold predictors. Preliminary results suggest that the physics-guided approach improves the early detection of emerging sub-Alfvénic intervals compared to threshold-based baselines, particularly for gradual transitions characterised by strengthening magnetic fields, reduced plasma density, and decreasing plasma beta. The framework demonstrates a meaningful forecasting capability with lead times of 30 to 60 minutes, offering a promising pathway toward automated detection tools and improved characterisation of solar wind-magnetosphere coupling during magnetic cloud passages. Keywords: Alfvén Mach Number, ICME, Magnetic Cloud, Machine Learning		

ASI2026_245	Shaonwita Pal	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A Comparative Study of Polar Magnetic Precursors for Solar Cycle Prediction		
Accurate prediction of solar cycle amplitude is crucial for understanding long-term solar variability and forecasting space weather. Among various proposed precursors, the Sun's polar magnetic fields near solar minimum have emerged as one of the most reliable indicators of the strength of the subsequent solar cycle. In this study, we reconstruct the long-term evolution of the magnetic field over multiple solar cycles using a data-driven surface flux transport model constrained by observations and perform a comparative analysis of two widely used polar precursors – the polar field strength and the axial dipole moment – to assess their effectiveness in forecasting the amplitude of subsequent sunspot cycles. Our results indicate that the axial dipole moment provides a more consistent and robust indicator of future cycle strength than the polar field alone. These findings support the axial dipole moment as a key magnetic memory of the solar cycle and reinforce its role in solar cycle prediction frameworks based on the Babcock–Leighton solar dynamo theory.		

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ASI2026_680	Soham Dey	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Making Solar Radio Imaging Accessible: Processing a Decade of LOFAR Solar Observations with SIMPL		

Solar radio emissions originate from a wide range of phenomena — from faint gyrosynchrotron emission associated with CMEs, to thermal emission from the quiet Sun, and the intense coherent emissions from solar radio bursts. These emissions can span up to nine orders of magnitude in intensity over small spans in time and frequency, making them a powerful probe of the solar solar corona. Yet, despite their potential, radio images of the Sun remain under-used in solar physics. A major reason is the lack of accessible, feature-rich analysis tools, and the difficulty and steep learning curve associated with adapting standard radio astronomy software to solar data.

To address these, we have developed a robust, fully unsupervised solar calibration and imaging pipeline — the Solar Imaging Pipeline for LOFAR (SIMPL). LOFAR, the Low Frequency Array, is a large European network of radio antennas operating in the frequency range 10 to 240 MHz, capable of imaging the Sun's radio emission with high fidelity at high temporal and spectral resolution. SIMPL delivers images with dynamic range 1-2 orders of magnitude higher than the previous efforts. This is achieved by employing calibration and flagging strategies specifically tailored for solar data like careful selection of data to be used for calibration; a custom radio-frequency interference flagger optimized for solar data; and a self-calibration scheme tuned specifically for the solar case.

This automated pipeline is currently being employed to deliver science ready FITS images of the last decade of LOFAR observations for broader community access. This presentation will outline the design and capabilities of SIMPL, describe how the pipeline and processed data products can be accessed and used by the wider community, and present glimpses of recent scientific results enabled by this pipeline.

ASI2026_500	SOUMIK KAR	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Thermal Structure and Spectral Energy Distributions of Protoplanetary Disks: A Monte Carlo Radiative Transfer Study		

Protoplanetary disks, the birthplaces of planetary systems, composed of dense gas and dust orbiting young stars, also act as reservoirs of organic molecules crucial to prebiotic chemistry. Understanding thermal structure and energy distribution is essential for constraining disk evolution, dust processing, and the physical conditions governing planet formation. Temperature distributions also play a key role in shaping volatile chemistry and dust coagulation pathways. We present a Monte Carlo radiative transfer study of Class II protoplanetary disks spanning a wide range of stellar masses (0.1–3 $M_\odot$), disk masses (10^{-4}–10^{-1} $M_\odot$), and disk sizes from a few AU to several hundred AU. Our self-consistent 2D model computes disk density and temperature structure, capturing transitions between flared and self-shadowed geometries as a function of disk mass and surface density distribution.

We investigate radial and vertical temperature distributions and their impact on broadband SEDs covering optical to millimeter wavelengths. Our models are applied to disk systems in Taurus, Ophiuchus, and Lupus star-forming regions, enabling systematic comparison of how stellar properties, disk mass, and dust distribution influence mid-infrared excess, far-infrared emission, and (sub)millimeter spectral slopes. We explore how disk-to-star mass ratio and dust settling alter thermal stratification and produce observable signatures in multi-wavelength photometry.

Our study shows that both stellar luminosity and disk structure collectively influence the temperature profile of the disk. Additionally, variations in disk mass and dust concentration lead to significant differences in the observed shapes of spectral energy distributions (SEDs). Systems with similar stellar hosts but differing disk properties display dramatically different SED morphologies, especially in the far-infrared range. These findings underscore the need for self-consistent radiative transfer modeling when interpreting disk observations and provide a framework for linking the physical structure of disks to both current and future observations from ALMA, JWST, and ground-based facilities.

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ASI2026_906	Soumya Mishra	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Asymmetry in Sunspot Area Variation: Observational Evidence for Nonlinear Toroidal Flux Loss in the Solar Cycle		
Sunspots provide the most direct observational signature of the Sun's toroidal magnetic field, generated and amplified by dynamo action within the convection zone. In this work, we analyze the statistical properties of sunspot group areas across the past 13 solar cycles (Cycles 12-24), complemented by Bipolar Magnetic Region (BMR) magnetic flux measurements for Cycles 23 and 24 derived from space-based line-of-sight magnetograms. Using a consistent phase separation into rising and declining intervals for each cycle, we compare area/flux distributions to test whether flux emergence leaves a systematic imprint on cycle evolution.We find a clear phase asymmetry: sunspot groups and BMRs are statistically larger and more flux-rich during the rising phase than during the declining phase. This indicates that the rising phase is, on average, more favorable for producing major active regions and therefore has a higher potential to drive severe space weather. Moreover, we show that the mean and median of the sunspot-area distribution during the rising phase correlate strongly with cycle strength, whereas the corresponding statistics during the declining phase are weakly dependent or effectively independent of cycle strength. This cycle-strength independence becomes most pronounced in the final three years of the decline, when activity belts from different cycles converge toward the equator along a common latitudinal trajectory.Taken together, these results provide observational support for nonlinear toroidal flux loss through flux emergence, offering a physical explanation for why solar cycles rise at different rates but decay in a broadly self-similar manner		

ASI2026_608	Soumyadeep Chatterjee	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Probing the large-scale magnetic field inside the Sun from three decades of observed surface magnetograms		
Space-weather and disturbances in the heliosphere are manifestations of the solar magnetic field, which is solely driven by the interior dynamo, and constraining the solar interior magnetic field and its oscillatory behavior is one of the major challenges in solar physics. Observationally, none of the techniques, including helioseismology, are able to provide an estimation of the interior magnetic field. We reconstruct, for the first time, the dynamics of the interior large-scale magnetic fields by assimilating observed line-of-sight photospheric magnetogram data from MDI/SOHO & HMI/SDO along with helioseismic differential rotation data over three decades (1996-2025) into a 3D Babcock-Leighton dynamo model. The assimilation of observational magnetogram data allows us in realistic modelling of Babcock-Leighton mechanism as observed on the Sun without any simplified parameterization. As a result, our data-driven model successfully reproduces key observational features such as the surface butterfly diagram, accurate polar field evolution, and axial dipole moment. The reconstructed interior field dominated by toroidal component exhibits an equatorward migration and reproduces the realistic amplitude and modulation of cycles 23-25. We further find that the non-axisymmetric behaviour of the interior toroidal field becomes less prominent with increasing depth towards the tachocline. A strong correlation between the simulated toroidal field and sunspot number establishes our 3D magnetogram-driven model as a robust predictive model of the solar cycle. In addition, we numerically disentangle the contributions to magnetic field generation from current sources located below and above the photosphere. We will present these findings in detail at the conference.		

ASI2026_186	Soumyaranjan Khuntia	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Tracing the Thermodynamic Evolution of Coronal Mass Ejections: Links to Kinematics, Interactions, and Space Weather		
Coronal Mass Ejections (CMEs) are primary drivers of space weather. While their kinematic evolution has been extensively studied, the internal thermodynamic evolution remains limited. Here, we present a comprehensive multi-event analysis using analytical modeling and observations, including CME-CME interaction and a statistical analysis spanning Solar Cycles 23-25, to investigate how CME thermal properties evolve from the Sun into interplanetary space. Using 3D kinematics as input to the FRIS model, we derive the evolution of the polytropic index (Γ), heating and cooling rates, and internal force balances over 2-20 Rsun, where direct in situ plasma measurements are limited. We find that fast CMEs exhibit three distinct thermodynamic phases: an initial heat release phase, a sustained heating phase, and a transition toward a near-isothermal regime, typically occurring between ~3 and 9 Rsun. These results challenge the commonly assumed constant Γ in CME models and demonstrate that its dynamic evolution is essential for accurately describing CME propagation. A detailed case study of the May 2024 great geomagnetic storm, driven by the interaction of six successive CMEs, reveals a heat-release state in electrons, a bimodal proton thermal distribution, and localized heating regions, indicating that CME-CME interactions strongly modify internal thermodynamic properties of merged ejecta at 1 AU. Notably, electron thermal states, in particular, emerge as sensitive tracers of recent interaction history. Statistically, CMEs across Solar Cycles most exhibit pronounced non-equilibrium thermal behavior, with about 45% remaining in heating states at 1 AU. A solar-cycle dependence is observed, with a shift toward cooling-dominated states during weaker cycles. Interestingly, High-impact ICMEs with enhanced geomagnetic responses show low Γ along with strong magnetic fields, compressed sheaths, rapid expansion, and trailing high-speed streams. These findings highlight the importance of incorporating dynamically evolving thermodynamic states, internal force balance into CME and space weather modelling frameworks.		

ASI2026_1039	Souvik Roy	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Role of Polar Outflows in the Storm-Time Magnetosphere: Results from Multifluid MHD Simulations		
Ionospheric outflows are an important internal source of plasma for the magnetosphere, especially during geomagnetic storms, and they can strongly influence the storm-time plasmasheet. However, the relative roles of ionospheric plasma and solar wind plasma, and the pathways through which these different populations enter and populate the plasmasheet, are still not fully understood. Addressing this problem requires self-consistent global modeling together with physically meaningful diagnostics. In this study, we use the Multiscale Atmosphere–Geospace Environment (MAGE) framework with the multifluid GAMERA global MHD model to simulate a coupled geospace system under storm conditions. The storm is driven by an idealized ICME flux rope at four differenent seasons throughout a year. The model includes separate ionospheric outflow sources from the northern and southern hemispheres and explicitly tracks their transport into the magnetosphere. To examine the plasmasheet response, we develop a physics-based diagnostic that identifies the plasmasheet region using magnetic topology along with plasma properties such as plasma beta and density. This approach allows us to isolate the plasmasheet and quantify its composition in a consistent manner throughout the storm. We focus on how outflowing ion populations originating from different sources contribute to the density and composition of the plasmasheet, and how these contributions change with dipole tilt and storm phase. The results show that ionospheric and solar wind plasma interact in a highly dynamic way, with their relative importance varying over the course of the storm. These findings provide new insight into the role of ionospheric outflows in shaping the structure and evolution of the storm-time magnetospheric plasma environment.		

ASI2026_250	Srinjana Routh	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A Detectron 2 based pipeline for instance segmentation of filaments across datasets		
We present SUITron, a deep learning framework for real-time detection and segmentation of solar features like filaments and active regions . Leveraging the robust architecture of Detectron2, an open-source object detection platform developed by Facebook AI Research, SUITron combines high-quality implementations of Mask R-CNN and related models to deliver state-of-the-art performance on solar data. This pipeline enables rapid identification of critical structures such as active region, plages and filaments to give realtime parameters including area and chirality of which are being integrated into further analyses for space weather prediction in real time. The utility of the model will be demonstrated using GONG datasets. The resulting system offers a scalable toolset for the Aditya-L1 Support Cell, where it is to be integrated in the near future and is expected to facilitate continuous, high-resolution monitoring of solar activity crucial to heliophysics and space mission operations.		

ASI2026_30	Sumanjit Chakraborty	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A user-friendly Neural Network framework for single-to-multi-day prediction of global ionospheric TEC: First Results		
Accurate prediction of global ionospheric Total Electron Content (TEC) is crucial for mitigating the impacts of space weather on satellite navigation, communication, and radio propagation systems. In this work, we present a data-driven framework for single-to-multi-day TEC prediction using a Neural Network (NN) model trained on the drivers related to the Solar wind–Magnetosphere–Ionosphere coupling physics. This model feeds on multi-day solar wind and Interplanetary parameters (magnetic field Bz, bulk velocity Vsw, proton density ρ and temperature Tp), geomagnetic activity index (Ap), the solar activity proxy F10.7 flux, autoregressive TEC terms, and diurnal harmonic components to capture local time dependence. A user-friendly prediction pipeline has been developed that supports seamless ingestion of multiple daily files and robust temporal alignment across heterogeneous data sources. Predictions are generated over any user-defined date ranges, enabling efficient investigation of quiet and disturbed ionospheric conditions. Model performance is evaluated using the coefficient of determination (R^2), and the results (R^2 ~ 0.98) demonstrate that this NN model can successfully capture diurnal variability as well as geomanetic storm-time TEC enhancements/depletions driven by solar wind and geomagnetic forcings. The framework automatically saves all diagnostic figures and numerical outputs using standardized date-based naming conventions, ensuring reproducibility and traceability of results. The flexibility to analyze multi-day to multi-week intervals within a single execution makes the system suitable for event-based studies. Therefore, this work highlights the effectiveness of machine-learning approaches for ionospheric TEC prediction when combined with rigorous data handling and user-oriented design, and it provides a scalable and extensible platform for space weather research with potential applications in real-time ionospheric monitoring and forecasting over the globe.		

ASI2026_482	Sumanth A. Rotti	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Characterization of Hot Onset Precursor Event (HOPE) Features in Solar Flares During Solar Cycle 25		
The Hot Onset Precursor Event (HOPE) phenomenon represents the earliest detectable signature of flare-associated coronal heating. It precedes the onset of strong chromospheric evaporation and the impulsive rise of soft X-ray flux to its peak. In this study, we examine the behavior of the HOPE phase using a statistically filtered set of 62 isolated >=M1.0 flares observed between January 2024 and August 2025. Solar (soft and hard) X-ray data from the Aditya-L1 mission are used to analyze the HOPE phase of flares, and the findings are validated using data from the Geostationary Operational Environmental Satellite (GOES). Reliable plasma parameters, i.e., temperature (T) and emission measure (EM), from Aditya-L1's Solar Low-Energy X-ray Spectrometer (SoLEXS) data are estimated via spectral fitting. Additionally, hard X-ray spectrograms from the High Energy L-1 Orbiting X-ray Spectrometer (HEL1OS) onboard		

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Aditya-L1 are used to examine sub-minute fluctuations in the HOPE phase. For GOES X-ray data, T and EM are determined using the flux-ratio inversion method available within the Sunpy library.
Our results indicate that the HOPE intervals (i) are generally brief (<10 minutes), (ii) have a median flare temperature ranging from 6 to 14 MK, (iii) show impulsive onsets at intermediate temperatures between 8 and 17 MK, and (iv) exhibit mildly nonlinear slopes in the T–EM space. The narrow HOPE phase durations and slope patterns indicate a relatively uniform early reconnection and continued heating process across the samples studied here. At the same time, the observed temperature distributions reflect event-to-event variability in energy deposition. Following the HOPE phase, a peak flare temperature of 10-25 MK is observed, accompanied by a rapid increase in EM. Overall, these findings support the characterization of the HOPE phase as a diagnostically significant stage in flare evolution, indicative of distinct coronal heating mechanisms prior to substantial mass loading.

ASI2026_536	Swathi Raviprakash	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A comparative habitability study : application to Venus-like worlds		

The study of exoplanets is a central focus in present research in planetary sciences and astrobiology. The analysis of extensive planetary datasets from missions such as CoRoT, Kepler, and JWST aims to identify Earth analogs and address the question of exoplanetary habitability. The Earth Similarity Index (ESI) and the Mars Similarity Index (MSI) were developed to identify Earth-like and Mars-like exoplanets. Several studies have hypothesized the existence of possible life forms in the upper atmosphere of Venus. For example, phosphine (PH_3) was detected at approximately 20 parts per billion in Venus's cloud deck using JCMT and ALMA telescopes. PH_3 is considered a potential indicator of microbial activity. This motivated us to develop a new metric for Venus-like exoplanets - Venus Similarity Index (VSI). It is defined as the geometric mean of a planet's radius, density, escape velocity, and surface temperature, all measured in Venus Units (VU). A VSI of 0 implies that the planet bears no resemblance to Venus, while a value of 1 represents perfect similarity. Currently, Venus is a drastically altered and uninhabitable world. As per climate and dynamical models, early Venus and Earth possessed extremely similar habitability parameters. Building on the VSI framework, we also develop the Ancient Venus Similarity Index (A-VSI) to examine how Venus has evolved in comparison to Earth. The A-VSI is defined complementary to the VSI and also ranges from 0 to 1. We have found 620 rocky planets above the threshold for Mars, which has an A-VSI value of 0.68. Our results found that there are 319 rocky exoplanets with VSI > 0.77 (VSI of Earth), 9 rocky exoplanets with MSI > 0.68 (MSI of Earth) and 78 rocky exoplanets with ESI > 0.73 (ESI of Mars), making these potential habitable worlds in comparison to inner rocky planets of our Solar System.

ASI2026_109	Tonmoy Deka	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
NEXOTRANS: A Next-Generation Exoplanet Atmospheric Retrieval Framework Applied to the 0.6–12 μm JWST Spectrum of WASP-39 b		

The James Webb Space Telescope (JWST) has transformed exoplanet atmospheric studies with its broad wavelength coverage and high spectral precision compared to previous space-based observatories. Accurate characterization of chemical composition and atmospheric structure in planets such as WASP-39 b remains challenging due to complex spectral features and high dimensional parameter spaces, requiring novel data analysis techniques and robust models. In this work, we present NEXOTRANS, a next-generation atmospheric retrieval framework that combines Bayesian nested sampling with machine learning models to analyze JWST transmission spectra efficiently and robustly. NEXOTRANS integrates Bayesian inference (e.g., PyMultiNest) with ensemble machine learning algorithms (Random Forest, Gradient Boosting, and k-Nearest Neighbors) to enable fast exploration of parameter space. We apply NEXOTRANS to JWST NIRISS, NIRSpec PRISM, and MIRI transmission spectra observations of the hot-Saturn exoplanet WASP-39 b spanning 0.6-12 μm. Multiple chemistry models (free, equilibrium, hybrid, and equilibrium-offset) were compared to interpret the data. Our retrievals robustly constrain key molecular abundances (H_2O, CO_2,

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CO, H_2S) and reveal evidence for disequilibrium chemistry through retrieved SO_2 signatures, consistent with photochemical processes inferred in previous JWST studies. High-altitude aerosols ($MgSiO_3$, ZnS) influencing the spectrum are also characterized, and we infer supersolar C/O ratios and metallicity. Machine learning retrievals closely match Bayesian posterior constraints, offering a promising avenue for rapid retrievals, particularly valuable for population studies. NEXOTRANS demonstrates an efficient, flexible approach for detailed atmospheric insights and supports future exoplanet studies with JWST and upcoming missions.

ASI2026_533	Ushasi Bhowmick	Poster
Sun, Solar System, Exoplanets, and Astrobiology		

Investigating the impact of instrument noise in characterizing exoplanet atmospheres by transmission spectroscopy.

With more than 6000 confirmed exoplanets detected as of 2025, the field of exoplanet studies has transitioned from detection of exoplanets to the characterization of their atmospheres. This is achieved by transit spectroscopy observations from space-based instruments such as the Hubble Space Telescope and the James Webb Telescope (JWST). With dedicated missions for atmospheric characterization being planned, such as the ARIEL and upcoming ISRO's ExoWorlds mission, understanding the effects of spectral resolution and instrument signal-to-noise ratio (SNR) is paramount for efficient investigation of exoplanets. Multi-transit
observations are necessary for characterizing earth-like planets with JWST. Upcoming dedicated missions will offer the necessary observation time required for large number of transits enabling high sensitivity detections of diverse molecular species.

This study presents a comparative analysis between exoplanets observable with JWST NIRSpec and upcoming instruments such as Ariel and a 2-m class telescope as proposed for the ExoWorlds mission. We simulate SNR figures for JWST-NIRSpec instruments using the Exposure-Time calculator (ETC) Pandeia, and use it as a baseline for comparison against that of upcoming missions. We extend the instrument systematics known for JWST to estimate SNR for Ariel and ExoWorlds, using ETC model ExoRad. We estimate the number of transits required for obtaining JWST-like sensitivity across known systems in the exoplanet catalog. We show the differences in observability of known systems and the impact of integration time, saturation conditions on detection thresholds for key atmospheric species. The preliminary estimates obtained in this study will complement upcoming studies and exposure time calculations for the ExoWorlds mission.

ASI2026_1162	Vaishnav Sankar K	Poster
Sun, Solar System, Exoplanets, and Astrobiology		

A Catalogue of Solar Energetic Particle Events Observed by Chandrayaan-2 CLASS at the Moon

Moon is a globally sought-after destination with the ambitious goal of establishing a sustained human presence in the coming decades. A detailed characterisation of the lunar radiation environment to build the capability to assess risk factors and implement mitigation strategies is an essential step towards this. For long term missions, lunar space weather and its effect on spacecraft and humans cannot be overstated.

We have used the observations of high energy particle events in Chandrayaan-2 Large Area Soft X-ray Spectrometer (CLASS) to identify Solar Energetic Particle (SEP) events during the period from 2019 to 2023. Galactic Cosmic Ray particles constitute the dominant particle background in the lunar orbit that appears as a continuum in the 7-16 keV energy range of CLASS distinct from the lunar X-rays that it primarily measures. Geotail electrons significantly increases the counts in this band during geotail passages once in 29.5 days. We developed a semi-automated pipeline utilizing a moving median filter for dynamic background subtraction and a sigma-thresholding algorithm to identify SEP events from GCR and geotail particles.

We further characterized the events to estimate rise time, decay time and peak flux. The identified events were corroborated using high-energy (>6.5 MeV) proton data from GOES-16 and catalogued Coronal Mass Ejections (CMEs) from SOHO/LASCO. We identify 12 unique events at the Moon not observed in GOES that emphasises the need for such measurements in the heliosphere and in the near planetary environment.

ASI2026_37	Vishwa Vijay Singh	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
On Flare-CME Coupling and Resulting Particle Acceleration: Insights from Aditya-L1, the Udaipur Radio Spectrographs, and the SDO		
The Three-part CME model successfully provides us with a fundamental framework to understand the early CME morphology and dynamics. However, the relation between non-thermal emission with early flux-rope evolution and dynamics remains poorly understood. To probe this aspect, we present a detailed multi-instrument analysis of an X3.3-class solar flare that occurred on 24 October 2024 in Active Region 13872, located at S16E76. This eruptive flare was associated with a superfast halo coronal mass ejection (CME) exhibiting a speed of approximately 2385 km/s. The analysis is carried out using EUV imaging from AIA/SDO, hard X-ray measurements from HEL1OS/Aditya-L1, and low-frequency dynamic spectra from the Udaipur solar radio spectrographs. The flare onset was marked by type III radio bursts between 03:39 UT and 03:41 UT, indicating the escape of electron beams into the heliosphere. This was followed by a type II radio burst from 03:41 UT to 03:58 UT, associated with the CME-driven shock. Concurrently, HEL1OS recorded a significant hard X-ray peak in the 80–150 keV energy band at approximately 03:50 UT, coinciding with the impulsive phase of energy release and particle acceleration. The close temporal correlation between these signatures supports a scenario in which magnetic reconnection in the corona initiates both the flare and CME, leading to rapid energy release and outward propagation of a shock. This work underscores the importance of multi-wavelength observations in understanding the coupling between solar flares and CMEs, particularly for understanding the association between non-thermal flare-associated parameters with early CME dynamics.		

ASI2026_149	Vivek Kumar Singh	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Rotational characteristics of X-ray Solar Corona		
Rotational characteristic of the Sun is still undecided concern of solar physics. Solar rotation can be estimated by methods i.e. helioseismology, tracing of features, spectroscopic analysis and modulation of the emitted solar flux. Sun exhibits differential rotation. Solar rotation varies as function of not only altitude and latitude but also dependent on phases of the solar cycle. Hinode a Japanese's solar mission launched into space in September 2006 to observe how magnetic energy transmitted from photosphere to corona and consequences in the form of volatile energy release. Onboard instrument X-ray telescope (XRT) captures high resolution images of solar corona to study coronal magnetic field. Since its launch into space, Hinode has brought remarkable imagery and important measurements of Sun for last 18 years. In the present work, we use time series analysis on equally separated bins formed on latitude regions of the solar full disc (SFD) images observed by Hinode/XRT that extend from 80oS to 80oN. The flux modulation method traces the track of X-ray feature over the solar disc and periodogram analysis of the annual time series data of the X-ray images (one per day) for the period extends from year 2007 to 2025 gives the coronal rotation period as a function of latitude. Annual rotational profile is fitted with a polynomial equation to find differential rotational coefficients. To estimate variation in solar rotation with different phases of solar cycle, the differential coefficients are plotted with annual sunspot numbers of the study period. The study provides a thorough and systematic evidence of the solar rotation and its variability with latitude as well as with solar activity cycle. It also has been established that solar atmosphere exhibits differential rotation and the differentiality has a substantial temporal variation as well as spatial variation. Detail result would be presented in the paper.		

ASI2026_188	Yatendra P. Singh	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
A Multi-Parametric Comparative Study of Solar Cycles 23, 24, and 25 Using Solar and Interplanetary Disturbance Indices		

This study presents a comprehensive multi-parametric comparison of solar and interplanetary disturbances during Solar Cycles 23, 24, and 25. Using key indices including sunspot number (SSN), solar radio flux (F10.7), Coronal Mass Ejections (CMEs), High-Speed Streams (HSSs), Co-rotating Interaction Regions (CIRs), interplanetary (IP) shocks, Sudden Storm Commencements (SSCs), and Forbush Decreases (FDs), the temporal evolution and relative strengths of the three cycles are examined. The results show that Solar Cycle 23 was the strongest, exhibiting pronounced magnetic activity and frequent eruptive events. Solar Cycle 24 was significantly weaker across all parameters, reflecting reduced solar dynamo efficiency and diminished heliospheric disturbance levels. Preliminary observations of the rising phase of Solar Cycle 25 indicate a moderate recovery, with activity levels exceeding those of Cycle 24 but remaining below those of Cycle 23. The combined comparison highlights a progression from strong to weak to moderate in solar behaviour, providing critical insights into long-term solar variability, heliospheric modulation, and space weather forecasting for upcoming solar activity phases.

Posters in
Stars, Interstellar Medium, and Astrochemistry in Milky Way

ASI2026_824	Aayushi Verma	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Feedback-regulated Star Formation around the Expanding Galactic Mid-infrared Bubble [HKS2019] E71		

We explore the physical environment of the Galactic mid-infrared (MIR) bubble [HKS2019] E71 (hereafter E71) through a multiwavelength approach. E71 is located at the edge of a filamentary structure, as traced in Herschel images (250–500 micron), Herschel column density map, and molecular maps in the velocity range [−20, −14] km/s. It hosts a stellar cluster (radius ~ 1.26 pc, distance ~1.81 ± 0.15 kpc) associated with radio continuum emission, including a centrally positioned B1.5-type massive star (hereafter “m2”), along with an enhanced population of evolved low-mass stars and young stellar objects. MIR images and molecular line maps reveal a photodissociation region surrounding “m2,” exhibiting an arc-like structure along the edges of E71. Regularly spaced molecular and dust condensations are identified along this structure. The position–velocity map of 12CO (1–0) emission suggests an expansion of molecular gas concentrated at the periphery of E71. Near-infrared spectroscopic observations with TANSPEC confirm the presence of the accretion process in a massive young stellar object (MYSO) located near the edge of the bubble. High-resolution uGMRT radio continuum maps uncover substructures in the ionized emission, both toward the MYSO and the center of E71. These findings support that “m2” has shaped an arc-like morphology through its feedback processes. The pressure exerted by “m2” and the velocity structure of the 12/13CO(1–0) emission suggest that the stellar feedback has likely driven out molecular material, leading to the formation of the expanding E71 bubble. Our overall investigation infers that the “collect and collapse” process might be a possible mechanism that can describe the ongoing star formation activities around the E71 bubble.

ASI2026_222	Agastya Sai Ram Likhit Anumanchi	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Developing a Quantitative Framework for ISM Filament Analysis		

Filamentary structures in the interstellar medium (ISM) play an essential role in the star-formation process, as they act as the primary sites for the formation of dense cores. The detection and characterisation of their physical properties, such as filament widths, density profiles, and critical line masses, are essential for connecting cloud-scale structure to the physics of star formation. Although various algorithms exist to detect and estimate filament properties (e.g., FilFinder, DisPerSE), a systematic and qualitative framework to validate filament properties using a single algorithm and quantify the differences between various algorithms is missing. To address this problem, we have developed a statistical framework. We analyse filaments in nearby (100 - 500 pc) molecular clouds using column-density maps derived from Herschel Gould Belt Survey observations covering wavelengths from 70 μm to 500 μm. We estimate mean radial column-density profiles of ISM beam elements, which are fitted with Plummer profiles. We estimate a goodness-of-fit (R^2) and contrast parameter (C0) to define a quantitative score that characterises the overall reliability of the filament skeleton. This score is used to tune the input parameters of filament-detection algorithms (FilFinder and DisPerSE) and estimate optimal values that provide physically consistent and robust filament representations. The framework aims to provide a physically motivated and statistical approach for validating filament skeletons and characterising their properties.

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ASI2026_551	Akash P	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Variability of C-J Type Carbon Stars and Its Implications for Other Carbon Star Subclasses		

C-J type carbon stars form a chemically peculiar subclass of carbon stars, characterized by low $^{12}C/^{13}C$ ratios, lithium enrichment, and a lack of s-process enhancement. While their chemical properties have been studied in detail in earlier works, their photometric variability has received comparatively little attention. Since variability in evolved stars is closely linked to pulsation, mass loss, and evolutionary state, it provides an independent and powerful diagnostic of their physical and chemical nature.

In this work, we investigate the variability properties of a sample of C-J type carbon stars selected from the LAMOST DR4 catalogue using multi-epoch photometric data from ASAS-3, ASAS-SN, KWS, ZTF, and Gaia. We extract and homogenize the light curves, determine periods and amplitudes using Lomb–Scargle and related time-series analysis techniques, and classify the variability types. In color–color (e.g., JHK) and Hertzsprung–Russell diagrams, C-J and normal N-type carbon stars occupy similar regions. Therefore, in addition to their distinct chemical properties, we examine whether these subclasses also differ in their variability behavior. The derived variability properties are systematically compared with those of other carbon-star subclasses, in particular N-type stars.

The aim of this analysis is to test whether C-J type stars occupy distinct regions in period–luminosity space compared to other carbon-star subclasses and whether their pulsation behavior differs from that of classical thermally pulsing AGB carbon stars. If there is such a distinction, it would support the idea that C-J type stars may follow a different evolutionary pathway, potentially involving non-standard internal mixing or binary interaction. We will present our results and discuss how time-domain information can provide an important and complementary constraint on the evolutionary status of chemically peculiar carbon stars and offer new insight into the origin of the C-J subclass within the broader carbon-star population.

ASI2026_198	ALPHESUNNY SARKAR	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Cloud Scale Star Formation and Gas Scaling Relations in the Milky Way		

We investigate the variation of star-formation properties at the cloud scale within the Milky Way using a sample of 45 molecular clouds in the inner Galactic plane spanning a wide distance range of 1.1-14.1 kpc. Cloud masses are derived from CO (J=1-0) line emission. Stellar masses are obtained using the young stellar object (YSO) counting method. In our sample, most of the clouds exhibit star formation efficiency (SFE) below 1 per cent while a few of them show SFE up to 3.5 per cent, consistent with other cloud scale studies. We examine the dependence of SFE and star formation rate (SFR) on cloud mass as well as their variation with Galactocentric distance. We also re-evaluate the scaling relation between star formation rate surface density (Sigma_SFR) and gas surface density (Sigma_gas) commonly known as the Kennicutt-Schmidt law, and obtain a best-fitting power-law slope of 0.41 ± 0.36. Despite the large uncertainty, the derived power-law slope is significantly shallower than the canonical Kennicutt-Schmidt value of 1.4 ± 0.15 measured in external galaxies. Our best-fit slope is also notably different from those reported in other studies on Milky Way molecular clouds (mostly situated away from the Galactic plane) and clumps. This indicates that the clouds in the Galactic plane do not follow the global scaling relation, likely reflecting the influence of local physical conditions or different gas dynamics. The range of vertical heights of our sample with respect to the Galactic plane spans 0.28 to 162.48 pc and we also observe a weakly declining trend of SFE with increasing vertical height.

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ASI2026_468	Amal George Cheriyan	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A Multiwavelength Study of RAFGL2591: Radio Jets, Ionized Regions, and Gas Kinematics in a Massive Star-Forming Environment		
We present a multi-wavelength study of the massive star-forming region RAFGL2591, located at a distance of 3.3 kpc. The region is particularly intriguing due to its complex central environment, which harbours a cluster of protostars, H II regions, and multiple jets. To characterize the physical conditions in this region, we carried out observations in Bands 3, 4, and 5 with the GMRT. Our radio observation reveals an extended east–west protostellar jet that exhibits thermal radio emission from one lobe and non-thermal synchrotron emission in the opposing lobe. In addition, the H II regions exhibit spherical morphologies and positive spectral indices, confirming their thermal free–free nature. Complementary UKIRT H–K band spectroscopy reveals prominent molecular H_2 lines, [Fe II] emission, and CO band-head features, tracing shocked molecular gas, ionized jet-driven shocks, and warm, dense material associated with accretion disks or the inner regions of massive protostars. We further incorporate archival data from UKIDSS, Spitzer, and Herschel to probe the dust and embedded stellar sources. The dust temperatures associated with the H II regions span 20–60 K, indicating both externally heated envelopes and internally heated, evolved sources. Corresponding column densities in the range (0.6–1.6) × 10^{23} cm^{-2} imply the presence of dense, deeply embedded structures, indicating ongoing massive star formation. The derived masses of the H II regions lie between 31- 61 M⨀, with dynamical timescales of 0.4–1.4 Myr, consistent with relatively young, compact ionized regions. We have utilized molecular line observations from ALMA, covering multiple tracers, to study the central protostar VLA 3 using moment maps and PV diagrams. This reveals outflowing gas aligned with the radio jet direction, as well as with the loop-like features, which are also seen in the near-infrared. These kinematic signatures provide a plausible explanation for the origin of the near-infrared loops observed in the central region.		

ASI2026_332	Anamika Sharma	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
NGC 2204: Cluster dynamics and study of Blue Straggler and Red clump stars using Swift/UVOT		
In this study, we examine the presence of unresolved hot companions to blue straggler stars (BSS) and red clump (RC) stars in an intermediate-age (~2.2 Gyr) open cluster NGC 2204 using Swift/UVOT. The cluster is located at a distance of ~4100 pc with metallicity [Fe/H] ~ −0.4 and a color excess of E(B−V) ~ 0.08. We identified 734 stars as cluster members, including 7 BSS and 20 RC stars, using a machine learning based method for open clusters (ML-MOC) on Gaia DR3 data. To know the dynamical state of the cluster, we presented the cumulative radial distributions of different stellar populations. To characterize the BSS and RC stars, we constructed their spectral energy distributions (SEDs) by combining Swift/UVOT photometry with archival data spanning from ultraviolet (UV) to infrared wavelengths. Based on the analysis of SEDs, we found that two BSS and three RC stars have significant UV excess, indicating the possibility of hot companions.		

ASI2026_826	Anirban Bhowmick	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A medium resolution spectroscopic survey to detect northern dLHdC candidates		
Hydrogen-deficient carbon stars are a rare class of carbon-rich supergiants that cannot be explained by canonical single-star evolution due to their unique H-poor composition. Classified into two main observational groups- the dust-producing R Coronae Borealis variables (RCBs) and the dustless HdCs (dLHdCs), they exhibit peculiar abundance patterns: depletion of 13C relative to 12C (Hema et al. 2012) and extreme 18O enrichment relative to 16O (Clayton et al. 2007) compared to H-normal stars. Being extremely rare, the discovery rate of these two categories has historically been contrasting: large-scale photometric surveys have added many new RCBs because their dramatic, irregular dust-decline light curves are easily flagged (Tisserand et al. 2013; Shields et al. 2019). In contrast, for decades, the dLHdC population remained extremely limited with only five confirmed objects, due to their uncharacteristic light curves and		

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weak photometric variability (Geballe et al. 2009). This status changed with the breakthrough Gaia eDR3 study of Tisserand et al. (2022), who confirmed 27 new dLHdCs through spectroscopic follow-up of Gaia-selected candidates, opening the first statistically meaningful view of the class. However, their results were limited to the southern sky, with no systematic counterpart survey having been conducted in the north. To address this, we have initiated a spectroscopic survey of northern HdC candidates using TANSPEC, a medium-resolution (R~2750) spectrograph on the 3.6m Devasthal Optical Telescope (DOT). TANSPEC, with its optical to near-IR coverage, provides a unique opportunity to simultaneously investigate the H-line diagnostics (from the optical) as well as the 12C/13C and 16O/18O (from the near-IR K spectrum). In this study, we present the first results on the promising potential northern dLHdC candidates.

ASI2026_362	Anjali Singh	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Asteroseismic inference of helium abundance in a sample of 77 cool stars		

The internal structure of stars is influenced by their chemical composition. The surface abundances of metals can be reliably measured by spectroscopic observations, but the direct measurement of helium is not possible because the envelope temperature of such stars is inadequate to excite helium. Fortunately, the observed oscillation frequencies of solar-like oscillators are influenced by the helium ionization zone, and hence they can be used to estimate the surface helium abundance. We derive the seismic signal of the helium ionization zone for a sample of 77 solar-like oscillators using high-quality data from multiple sources, including the Kepler LEGACY sample, the KAGES sample, and a few K2 stars. We estimated helium ionization zone parameters of these stars using helium signatures. We computed a dense stellar model grid with up-to-date input physics containing about 30,000 tracks spanning a large parameter space and approximately 19 million models. We fitted observed helium ionization zone parameters along with frequency ratios and spectroscopic observables to the predictions of stellar models in a Bayesian framework and estimated physical parameters such as mass, radius, age, and initial helium and metal mass fractions for all 77 stars in our sample. We use the inferences of initial helium and metal mass fractions, along with age, to study helium enrichment in the Milky Way. In this presentation, I shall discuss the findings of our study.

ASI2026_886	Archana Kumari	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Investigating Photospheric Abundances in the Active Sun Like Stars		

We study the chemical abundances of active Sun-like stars (SLSs) by analysing their photospheric composition using high-resolution optical spectra obtained from the HARPS and UVES instruments mounted on the ESO 3.6-m and VLT, respectively. Accurate abundance determination requires precise estimation of stellar parameters such as effective temperature (Teff), surface gravity (log g), metallicity ([Fe/H]), and microturbulent velocity (vmic). These parameters are derived using both equivalent width and spectral synthesis methods. After applying radial velocity corrections, we obtained refined abundance values for the star. These photospheric abundances will be further used to compare the coronal abundances of the same star.

<table>
<tr><td>ASI2026_28</td><td>Arkaprova Dutta</td><td>Poster</td></tr>
<tr><td colspan="3">Stars, Interstellar Medium, and Astrochemistry in Milky Way</td></tr>
<tr><td colspan="3">Century-long light curves of post-AGB stars from archival photographic plates</td></tr>
<tr><td colspan="3">We present a comprehensive analysis of century-long light curves for a selected sample of post-asymptotic giant branch (post-AGB) stars. These curves were constructed using digitised photographic plates from two independent archival data sets: the Digital Access to a Sky Century at Harvard (DASCH, DR7) and the European Archives of Photographic PLates for Astronomical USE (APPLAUSE, DR4). Our initial sample of 226 candidates was compiled from recent catalogues of Galactic post-AGB stars, leveraging a photometric baseline spanning over 100 years.
We identify long-term brightness trends in 20 sources, which may be associated with real-time stellar evolution following a late thermal flash and/or other variability phenomena with secular time-scales. Among these, 13 sources exhibit significant photometric changes. Notably, two stars show brightenings of 2.929±0.095 mag and 1.760±0.065 mag, respectively. Four other stars demonstrate variations exceeding one magnitude.
While the final crossing of the Hertzsprung gap is expected to result in moderate brightness changes and significant colour evolution, the primary objective of this ongoing work is to determine the underlying cause of the observed variability. We investigate whether these trends represent rapid evolution through the Hertzsprung-Russell Diagram (HRD) or are the result of shorter-term, secular, irregular phenomena. This study highlights the unique utility of the DASCH and APPLAUSE archives in facilitating long-term research on stellar evolution and variability.</td></tr>
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<table>
<tr><td>ASI2026_428</td><td>Ashique T</td><td>Poster</td></tr>
<tr><td colspan="3">Stars, Interstellar Medium, and Astrochemistry in Milky Way</td></tr>
<tr><td colspan="3">Effect of overshoot mixing on black hole mass gap</td></tr>
<tr><td colspan="3">Pulsational Pair Instability Supernovae (PPISNe) and Pair Instability Supernovae (PISN) are predicted to result in a stellar black hole mass gap ranging from $\sim 90\hbox{--}260\,M_\odot$ from single first- and early-generation massive stars as they do not undergo much mass loss. The lower edge of the mass gap corresponds to a maximum mass of $\sim 37\,M_\odot$ for the CO core above which pair instability leads to PPISN, resulting in the loss of the envelope. Here, we explore the effect of overshoot mixing on the mass of the CO core in first-generation non-rotating stars. We find that dredge-up induced by overshoot mixing occurs stochastically in some models, both during and after core He burning. This can dramatically reduce the size of CO cores such that stars of initial mass of $\sim 100\hbox{--}150\,M_\odot$ can have a CO core of $\lesssim 37\,M_\odot$, leading to the entire star, including the envelope, collapsing to a black hole. This dramatically increases the lower edge of the black hole mass gap up to $\sim 150\,M_\odot$ and populates black holes within the purported mass gap. We discuss the impact of this for future gravitational wave detection in LIGO-Virgo-Kagra.</td></tr>
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<table>
<tr><td>ASI2026_404</td><td>Bhaskarjyoti Barman</td><td>Poster</td></tr>
<tr><td colspan="3">Stars, Interstellar Medium, and Astrochemistry in Milky Way</td></tr>
<tr><td colspan="3">Magnetic Field Geometry and Stability in Two Molecular Clouds toward the Galactic Center and Anticenter</td></tr>
<tr><td colspan="3">Molecular clouds provide excellent laboratories for studying the interplay between magnetic fields, turbulence, and gravity in star-forming environments. We present a comparative analysis of two such clouds: L1604, located toward the Galactic anticenter, and L121, situated toward the Galactic center. Using optical R-band polarimetry, supported by near-infrared photometry, Gaia distances, and Herschel SPIRE data, we examine their magnetic field geometries, extinction structures, and physical conditions. L1604 shows an alignment of its envelope magnetic field with the Galactic magnetic field, whereas L121 exhibits a large offset, likely due to local magnetic perturbations. Magnetic field strengths, derived using the Davis–Chandrasekhar–Fermi method, indicate sub-Alfvénic and sub-critical regimes, pointing to magnetic dominance over turbulence and gravity in the envelopes of both clouds. These results suggest that while magnetic fields provide significant support at the envelope scale, the cores may evolve differently, potentially becoming supercritical—a possibility that requires further investigation.</td></tr>
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ASI2026_153	Dipanweeta Bhattacharyya	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Where can we find Black Holes ejected from Globular clusters?		
We study the fate of compact objects like black holes that may be ejected from a dense system like a globular cluster. Such an ejection can be caused by three body interactions or as a result of a {\sl kick} to the remnant due to asymmetric emission of gravitational waves during a merger of black holes and other compact objects. We explore the scenario where the merger remnant in a globular cluster is moving at a significant speed with respect to the cluster centre of mass. Such a study is required as it has been conjectured that a significant fraction of the mergers detected so far reside in globular clusters. We study this in the situation when the kick velocity is higher than the escape velocity in the case of globular clusters assuming a Plummer density profile for the cluster. We study the evolution of the system to study the outcome: whether dynamical friction can trap the black hole within the globular cluster, whether the black hole escapes the globular cluster but ends up in the bulge, and lastly, whether the black hole becomes a halo object. The numerical simulations have been performed by calculating the range of kick velocities for a distribution of spin parameters of the merging black holes as well as using the data obtained from LIGO. We present results for an analysis based on orbital parameters of ten globular clusters using data from GAIA EDR3. We find that if the kick velocity is smaller than 120 km/s then a majority of remnant black holes end up in the bulge. Note that our results in terms of where compact objects launched from a globular cluster end up are applicable to any mechanism, e.g., a compact object ejected due to three-body interactions.		

ASI2026_779	FARHA A A	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Isotopic Ratios as Tracers of Different Nucleosynthesis Processes		
Low- to intermediate-mass stars (LIMS) constitute the dominant stellar population in galaxies. Through a variety of nucleosynthetic reactions, these stars play a crucial role in the chemical evolution of the Universe. Detailed elemental abundances in stars at various metallicities and their interpretation are observational aids for understanding galactic chemical evolution. Despite this, the exact conditions under which nucleosynthetic reactions occur and their contribution to galactic chemical evolution remain an open question. The GCE models generally try to explain the origin and evolution of chemical elements by deriving abundances of chemical elements in stars along with yield predictions from theoretical models. However, most of the chemical elements have multiple stable isotopes and different nucleosynthetic reactions may be contributing to their production. The situation will be more complex in the case of heavy elements produced by different neutron capture processes. The isotopic abundances are thus important to constrain the conditions at which the nucleosynthesis takes place and also to identify the actual isotopic path followed by the different neutron capture processes. This will help us identify the relative contribution of different neutron capture processes to the abundance of individual elements, which is an essential ingredient of the GCE models. Thus the contribution of different astrophysical sites to the overall chemical enrichment of our Galaxy can be estimated with greater accuracy. We selected the high-resolution UVES/ESO spectra for a sample of stars for the analysis. The atmospheric parameters and abundances are then derived under non-local thermodynamic equilibrium (NLTE) conditions using the recent version of the TURBOSPECTRUM radiative transfer code. In this work, we derive isotopic ratios of the neutron-capture elements Eu and Ba, as well as the light element Mg, whose isotopic composition provides key constraints on stellar evolution and nucleosynthesis in LIMS. We will discuss the preliminary results during the presentation.		

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ASI2026_674	Firoza Sutaria	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
The CSM morphology of massive stars from multiband observations of interacting supernovae.		
Stellar mass loss is as a yet a poorly quantified phenomenon, especially for massive stars which may have experienced episodic mass loss. Observationally, circumstellar material (CSM) has been detected around massive ($> 8.3 M_{\odot}$) stars via direct observations, and its presence inferred from the optical spectra of core-collapse supernovae (CC-SNe). In this work, the spectra of several CC-SNe across various classes (type-IIP/L, type-IIb, type-Ib/c) is studied, in order to model the morphology (distribution and density) of the CSM, as a function of progenitor properties (ZAMS mass, metallicity and possible binary interaction), and its post main sequence evolutionary path. It is found that in addition to a CSM with a bi-polar geometry, a multi-shelled CSM cannot be ruled out for very massive progenitors.		

ASI2026_438	Gajendra Pandey	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Abundance analyses of hydrogen-deficient carbon stars		
In a hydrogen-dominated visible universe, a rare class of stars known as hydrogen-deficient carbon stars (HdCs) stand out as supergiants with chemically peculiar atmospheres that are hydrogen-poor and carbon-rich. Unlike normal stars, the optical spectra of HdCs display either extremely weak or absent hydrogen Balmer lines for their corresponding effective temperatures. The mechanism behind their formation and evolution remains an unsolved mystery in stellar astrophysics. Surface elemental abundance provides essential information about stars, offering insights into their formation, evolution, and even their origin. Elemental abundances of HdC stars have not been studied adopting state-of-the-art model atmospheres combined with radiative transfer techniques. The growing number of HdC stars further adds statistical significance to studies focussed on measuring elemental abundances. Hence, photospheric abundance analyses were carried out for four known HdC stars: HD 182040, HD 173409, HD 175893, and HD 137613. We have used high-resolution optical spectra obtained with the Hanle Echelle Spectrograph (HESP) mounted on the 2-m Himalayan Chandra Telescope (HCT) at Hanle, and the fiber-fed, cross-dispersed echelle spectrograph mounted on the 2.34-m Vainu Bappu Telescope (VBT) at Kavalur. Here we present our preliminary results from this analysis involving identification of about 2,800 spectral lines and the derived abundances of key elements such as C, N, and O, as well as light s-process (Sr, Y, Zr) and heavy s-process (Ba, La, Nd, Ce) elements.		

ASI2026_454	Gaurav Singh	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Delayed Dynamical Segregation in NGC 6838: Factors that Influence the Blue Stragglers Radial Distribution		
Star clusters are dynamically active environments where two-body relaxation drives the mass segregation of stellar populations. Blue straggler stars (BSSs), formed through stellar collisions or binary evolution, are more massive than the average cluster star and therefore serve as excellent tracers of a cluster's dynamical history. Factors that may lead to or can influence delay in the dynamical segregation-such as tidal mass loss, core evolution, and the presence of dark remnants-are investigated in this study using realistic N-body simulations of the globular cluster NGC 6838 generated with the MOCCA code. We compare models containing an intermediate-mass black hole (IMBH), a subsystem of stellar-mass black holes (BHS), and a model devoid of both. Our analysis reveals that the degree and timing of BSS mass segregation, quantified by the A+rh parameter, are strongly sensitive to the cluster's internal dynamical state. The IMBH model produces rapid and strong BSS segregation from early times, consistent with its short half-mass relaxation time, whereas the model evolving toward core collapse also shows significant present-day segregation. In contrast, the BHS model-which experiences core expansion due to BH heating-exhibits delayed and weaker segregation, with BSS formation dominated by binary evolution channels. These results directly link measurable BSS radial distributions to the underlying population of dark remnants and the cluster's tidal history, highlighting key factors that influence delays in dynamical segregation.		

ASI2026_917	Gourav Banerjee	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
CAZBeSSP: an upcoming online spectral database for Be stars using the 1-m telescope at VBO, Kavalur		
Classical Be (Be) stars are rapidly rotating, massive, main-sequence, B-type stars showing emission lines of different elements in their spectra, which originate from their surrounding equatorial, gaseous discs. These emission lines provide important information regarding the disc properties of Be stars. These stars are known to display variability of emission lines, extreme cases can lead to the complete disappearance of their circumstellar discs. So continuous spectral monitoring of Be stars is necessary to track the line profile changes that help us to better understand their disc dissipation and formation timescales and different other properties of such exotic stars. However, any online spectral database for Be stars is not known apart from the BeSS (Neiner et al. 2011), which is an accumulation of over 3, 20, 000 optical spectra for 2455 separate Be stars obtained by both amateur and professional astronomers. In this context, we present a new online spectral database of Be stars that have been developed using H-alpha centric spectra obtained from the 1-m CZT facility at VBO, Kavalur since 2009. This is the first online spectral database of Be stars developed using a dedicated professional telescope. Initial characterization of data has been performed for over 1100 spectra of more than 50 separate Be stars that are ready to be uploaded in the database. We plan to update the database on regular basis, which will facilitate the Be star community to download and study these Be stars.		

ASI2026_183	Gurwinder Singh	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
An All-Sky Natural Guide Star Catalog for Adaptive Optics Using Gaia DR3		
Adaptive Optics (AO) is a key enabling technology for ground-based astronomical telescopes, mitigating the effects of Earth's atmospheric turbulence and enabling near–diffraction-limited imaging of celestial sources. For efficient AO performance, a suitably bright natural guide star of known magnitude in a specific wavelength band must be available close to the science target, within the isoplanatic patch. Therefore, knowledge of guide star availability across different photometric bands is essential for assessing sky coverage and AO feasibility, particularly for present and upcoming large optical telescopes such as the European Extremely Large Telescope (E-ELT), Thirty Meter Telescope (TMT), and Giant Magellan Telescope (GMT), which will require guide stars with different magnitude limits for high-order correction and tip–tilt sensing. At present, no complete all-sky guide star catalog exists that is specifically optimized for AO applications in the visible and near-infrared bands (R, J, H, and K). In this work, we present the development of an all-sky natural guide star catalog based on Gaia DR3 data. Broad-band Gaia G-band magnitudes are transformed into standard photometric bands using empirically derived photometric relations. The resulting magnitudes are validated across 15 representative test fields distributed across the sky by comparison with external datasets from Pan-STARRS in the visible and 2MASS in the near-infrared bands. The catalog includes stars down to R ≈ 20 mag, suitable for wavefront sensing, and is curated by excluding extended sources, as well as binary and variable stars that can compromise wavefront stability.		

ASI2026_640	Jagriti Gaba	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A Comparative Study of 56Ni Mass Estimates in Type Ia Supernovae		
Type Ia Supernovae (SNe Ia) are stellar explosions occurring in binary star systems containing white dwarfs (WD). SNe Ia plays a fundamental role as standardizable candles in astrophysics. The radioactive decay of 56Ni, synthesized in the explosion, is the main source of the SN luminosity. Thus, estimation of nickel mass is a crucial parameter for understanding the explosion mechanism. In this work, we have estimated the 56Ni mass for a sample of Type Ia supernovae using two independent methods. The first is Arnett's rule, which gives the correlation between the instantaneous energy input through radioactive decay		

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and the observed bolometric luminosity at maximum light. The second method is based on energy conservation method, which examines the total radioactive energy deposition over the light-curve evolution. We applied both methods to the same dataset to examine their consistency. Our results confirm the robustness of both estimation techniques and establish their consistency in determining the mass of 56Ni synthesized in Type Ia supernova explosions. The close agreement between the two methods reinforces the validity of nickel mass estimates and provides deeper insight into SNe Ia explosion physics and their role in cosmological applications. Keywords: Stars, Supernovae, White Dwarf

ASI2026_834	John Clifford D Souza	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
TESS Variability of Solar Analogs in Gaia DR3 Golden Sample		
Light curves from the Kepler and TESS missions enable measurements of stellar photometric variability, providing insight into magnetic activity and surface phenomena in Sun-like stars. Photometric variability is also relevant for exoplanet studies, as increased stellar variability can reduce the detectability of planetary transits. Previous studies based on Kepler data suggest that the Sun is less photometrically variable than many solar analogs—stars similar to the Sun in effective temperature, surface gravity, and metallicity. In this work, we investigate the photometric variability of solar analogs using archival TESS light curves, leveraging the mission's broader sky coverage relative to Kepler. We construct a sample of well-characterized solar analogs from Gaia Data Release 3, cross-match it with the TESS Input Catalog, and quantify variability using the variability range metric, Rvar. Solar variability is measured using 11 years of data from the VIRGO instrument onboard SOHO, segmented into 27-day intervals for consistency with TESS observations. We compare the distribution of stellar variability with that of the Sun and find that, within this sample, the Sun lies among the least photometrically variable stars, with approximately 20% of solar analogs exhibiting lower variability than the solar value.		

ASI2026_665	Juanita Earlyn Andrew	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Spectral analysis of The Eruptive Transient AT2016blu		
Luminous Blue Variables (LBVs) are massive, unstable stars known for their complex brightness oscillations and variability across multiple timescales, which are driven primarily by internal stellar pulsations and episodes of significant mass loss. They represent a short-lived, unstable phase in the evolution of massive stars, resulting in the creation of a complex circumstellar medium (CSM) seen many interacting supernova. We present here a multi-epoch spectroscopic study of the LBV AT2016blu, which provides a compelling case study of an LBV undergoing quasi-periodic brightening every 113d. Strong, persistent Balmer emission lines including Hα, Hβ, Hγ, Hδ, Hϵ are seen, alongside an aperiodic emergence of C I, O III and S II lines, all with varying intensities. In quiescence, the Balmer (notably Hα) line profiles show a varying structure, possibly suggestive of a pulsating stellar atmosphere. We use our spectral studies to characterize the progenitors and its environment's properties, and investigate the possibility that AT2016blu may be a binary system. Keywords: LBVs, Supernova Imposter, AT2016blu		

ASI2026_169	Jyotirmoy Das	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
GCGPS: Discoveries and New Insights from GMRT Pulsar Searches in Globular Clusters		

Globular clusters (GCs) are dense stellar environments known to efficiently produce millisecond pulsars (MSPs) through frequent stellar interactions. Leveraging the enhanced sensitivity of the upgraded Giant Metrewave Radio Telescope (uGMRT) phased array beam and the steep radio spectra of MSPs, we initiated the Globular Clusters GMRT Pulsar Search (GCGPS) in the 300-750 MHz range (uGMRT Band 3 and Band 4), a largely underexplored frequency regime for GC MSP searches having a complementary sky coverage to the FAST.

To date, GCGPS has discovered seven new MSPs across four globular clusters, none of which had previously known pulsars. This represents the most successful pulsar search in globular clusters conducted with the GMRT. These discoveries have provided precise dispersion measures for the host clusters and revealed a diverse set of systems, including one isolated MSP and one in a moderately compact binary with an orbital period of ~1.56 days, likely an eclipsing redback system with a relatively long orbital period. One particularly interesting system is a highly eccentric relativistic binary with an orbital period of ~19 hours and an eccentricity of ~0.54. For this compact system, we were able to measure a post-Keplerian (PK) parameter, which allowed for a direct estimate of the total system mass.

In this talk, we will present an overview of the GCGPS survey, highlight recent discoveries, and present results from the timing analysis of the newly identified MSPs. We will also outline Phase 2 of GCGPS using multiple post-correlation beam SPOTLIGHT systems targeting wider clusters as well as potential runaway MSPs providing evidence of strong gravitational interactions in dense stellar systems.

ASI2026_126	KARRI VENKATA LAKSHMI	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Theoretical spectroscopic study of aromatic and N-heterocycles: Potential carriers of interstellar AIBs and UV bump at 217.5 nm		

Nitrogen-containing heterocyclic molecules embedded in aromatic frameworks are considered promising contributors to the chemical evolution of the interstellar medium. Polycyclic aromatic nitrogen heterocycles (PANHs) have been proposed as potential carriers of the aromatic infrared bands (AIBs), particularly the 6.2 μm feature, and contributors to the interstellar ultraviolet extinction bump at 217.5 nm.

In this work, we present a theoretical investigation of the microwave, infrared, and ultraviolet/visible spectroscopic properties of selected aromatic and nitrogen-heterocyclic molecules in the gas phase and aqueous environment. Density functional theory calculations are performed at the B3LYP/aug-cc-pVTZ level. For the first time, we report spectroscopic signatures of a tricyclic tetrahydroquinoline and fused polycyclic quinoline systems, including their carboxylic acid derivatives in neutral and ionic states.

Nitrogen incorporation enhances molecular dipole moments, leading to stronger rotational transitions and improved detectability compared to symmetric PAHs. Rotational spectra are simulated under astrophysical conditions, while vibrational and electronic absorption analyses reveal characteristic features relevant to AIBs and the 217.5 nm extinction band. These results support PANHs as viable molecular candidates in interstellar environments.

Keywords: Astrochemistry, Polycyclic aromatic hydrocarbons (PAHs), N-heterocycles, Rotational spectra, Infrared spectra, Electronic absorption spectra.

ASI2026_841	Keerthi Prabhu Shirodkar	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A model for the transient scintillation of B1508+55		

Interstellar scintillation of compact sources, such as pulsars, precisely probes the small-scale electron density structures in the ionised interstellar medium. PSR B1508+55 is a system known to host two screens, with their scattering axes aligned mutually orthogonally. The closer screen (S1) at 127 pc is known to have structures that refract radiation at low radio frequencies (< 150 MHz), which manifest as echoes of the main pulse. Consequently, it exhibits strong scattering coinciding with the line-of-sight crossing of these echoes. Recently, in addition to cessation of strong scattering, we observed episodic scintillation in the Band 3 and Band 4 observations with uGMRT taken in 2023, suggesting the presence of strongly scattering structures in a screen (S2) located at 1940 pc. However, the transient nature of such a scattering event remains poorly understood. The observations reveal a more diffuse, fuzzy feature instead of the typical parallel stripe-like features in the secondary spectrum of scintillation. We propose a preliminary model describing the low modulation observed between episodes of modest scattering within a few minutes, speculating that these effects are caused by the combined effect of the interplay between the scattering on the two screens, mainly on S2, causing this rapid modulation. Our model suggests a range of scales for the structures on S2, in line with expectations, and can explain the observed effects satisfactorily. We also test this model by simulating this unique system that seems to be exhibiting exotic behaviour compared to other systems with similar screen orientation and distance.

ASI2026_803	Keerthy M V	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Diversity of r-process Nucleosynthesis: Abundance Signatures of the Limited r-process in carbon-enriched and carbon-normal metal		

More than fifty percent of the elements in the Universe heavier than iron are created via the rapid neutron-capture process (r-process), whereas the slow neutron-capture process (s-process) makes up the remaining fifty percent. Though the main astrophysical sites of the r- and s-processes are generally understood, a fraction of metal-poor stars shows neutron-capture abundance patterns that differ from the traditional abundance signatures. Particularly, a rare subgroup of r-process-enhanced stars show elevated first-peak elements (Sr, Y, Zr), along with high [Sr/Eu] and [Sr/Ba] and low [Eu/Fe], as opposed to the majority of r-process stars in which first-peak elements are reduced relative to Eu. This distinction indicates that the light neutron-capture elements possibly originated from a nucleosynthetic site different from that accountable for the creation of the second and third r-process peaks. This mechanism, frequently referred to as the limited r-process, is considered to operate under conditions of
reasonably low neutron flux. In this study, we present a detailed abundance analysis of a sample of limited r-process stars, estimating light and heavy neutron-capture element abundances subject to non-local thermodynamic equilibrium (NLTE) conditions. In addition We compare their abundance patterns with those of carbon-enhanced metal-poor with no/mild enrichments of heavy elements (the so-called CEMP-no stars), as some of these stars also display the signatures of limited r-process. We present the results from this analysis offering novel restrictions on the diversity of r-process forming sites in the earlier Galaxy.

ASI2026_373	KUSHAGRA SRIVASTAV	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Unveiling Variable Accretion Processes in Young Stars: A Case Study of PDS 8		

Circumstellar disks play a crucial role in early stellar evolution and planet formation, undergoing mass loss through accretion onto the central star, magnetically driven disk winds, and photoevaporative outflows. Despite their importance, the relative contributions and timescales of these processes remain poorly constrained due to the inherently variable nature of star–disk interactions. To investigate these mechanisms, we are conducting a multiwavelength spectroscopic study of a sample of disk-bearing young stars. In this poster, we present initial results for PDS 8, a young (~4 Myr), nearby (~140 pc) Classical T Tauri star. Using multi-epoch optical and near-infrared spectroscopy data, we characterize its stellar and accretion properties, and identify significant accretion variability, with mass accretion rates ranging from ~10^{-7} to 10^{-8} M⊙ yr^{-1}. In this poster, we will discuss how this variability may be linked to changes in the inner disk structure and/or magnetospheric accretion processes. We will also highlight the importance of coordinated multi-epoch and multiwavelength observations in understanding variable accretion in young stellar systems.

ASI2026_717	Manash Samal	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
From Clumps to Clusters: Star Formation Scaling Laws and Their Implications		

Most stars form in cold, dense regions of molecular clouds, called clumps, located within the spiral arms of galaxies. These parsec-sized clumps, driven by strong gravitational collapse, act as star-forming factories. However, the rate and efficiency of gas conversion into stars across different scales of star-forming systems, from clumps to entire galaxies, remain active areas of research. Key questions focus on how the star formation rate (SFR) and star formation efficiency (SFE) depend on factors such as gas mass, mass surface density, and timescales, relationships collectively known as “star formation scaling laws.” In a recent study, we analyzed nearby star-forming clumps in our Galaxy to determine the SFE in dense regions and to explore these scaling laws, particularly the link between star-formation surface density and gas surface density. Our results revealed a median instantaneous SFE of approximately 20% and an SFE per free-fall time of about 13%. The SFE per free-fall time is significantly higher than the commonly cited universal value of 1%. These findings suggest that both SFE and SFE per free-fall time increase in denser regions. In this presentation, I will discuss these results, the limitations of previous estimates, and the relevance of our findings to star and star cluster formation.

ASI2026_258	Manish Chauhan	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Characterising jet-bearing YSOs and magnetic fields in Cygnus-X		

Jets/outflows are ubiquitous tracers of active star formation. The outflows are primarily driven by YSOs in the early stages of stellar evolution. While various studies discuss the role played by magnetic fields in star formation and its alignment with outflow orientation, both preferred and random alignment of magnetic fields compared to orientation of outflows and filamentary structures in molecular clouds have been observed. In this work, we present the analysis of a large sample of jet-bearing YSOs identified towards the Cygnus-X region spanning 42 sq. deg. by Makin et. al. 2018. Using IR observations from the 2MASS and WISE survey, we fitted the spectral energy distributions to radiative transfer models in order to estimate the mass and luminosity of the driving sources of the outflows. We find that the outflows in the region are predominantly driven by intermediate mass Class 0/1 YSOs. The physical parameters of outflows such as outflow length and luminosity are found to be correlated with physical parameters of driving source. The observed correlations corroborates with the findings of similar research done using the UWISH2 survey. Additionally, we determine the magnetic field strength and orientation for the full study region using Planck polarisation observations. We observe that the magnetic field near the outflows are randomly oriented and no correlation is observed between position angles of the outflows and the orientation of the large scale magnetic field as observed by Planck. Finally, we discuss the alignment of magnetic fields with the structures observed in the Cygnus-X cloud complex.

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ASI2026_768	Manoj Puravankara	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Warm molecular hydrogen in star forming clouds: New insights from the JWST		

Recent JWST observations of young stellar objects have revealed the presence of warm and hot (500–3000 K) molecular hydrogen (H_2) winds, moving at velocities of 20–40 km/s. In addition to the pure rotational transitions of H_2 in the ground vibrational state and v = 1 level, JWST detects a rich set of high-lying ro-vibrational transitions (v = 1–0, 2–1 O(J)) from protostellar outflows. Excitation analyses indicate that this H_2 is predominantly shock-heated and collisionally excited.

Remarkably, the unprecedented sensitivity of JWST has enabled detection of high-excitation H_2 emission even in the ambient cloud material far from the protostar. We detect pure rotational transitions up to v = 0–0 S(18) (E_up = 27,643 K) and ro-vibrational lines such as v = 1–0 O(4), posing a significant question regarding the heating and excitation of this diffuse molecular gas. While irradiation by the interstellar UV field is a possible source, we detect similarly high-excitation H_2 emission even towards relatively isolated molecular environments, with low levels of UV irradiation.

In this contribution, we will present these surprising JWST results and discuss plausible excitation mechanisms, including shock dissipation, turbulent heating, cosmic-ray and particle excitation, and low-level UV pumping, that may contribute to producing warm molecular hydrogen emission in the ambient cloud.

ASI2026_664	Manya Arora	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Why Do Some Protostars Launch Molecular Jets? Insights from JWST IFU Spectroscopy		

Jets and winds are ubiquitous in young stars, particularly powerful in the youngest protostars. Recent high-resolution JWST observations have revealed a nested flow structure in many protostars: fast, highly collimated ionic jets (opening angle $\lesssim$ 5–10°, velocities ~150 km/s) surrounded by a slower (10–20 km/s), wide-angled ($\gtrsim$ 20–30°) molecular wind traced by H_2. However, a few protostars instead show fast, highly collimated molecular jets, whose origin remains unclear and actively debated.

We investigate this question using JWST NIRSpec and MIRI IFU observations of 15 Class 0 protostars in the Orion molecular cloud obtained as part of two JWST GO programs, High Angular Resolution observations of Stellar Emergence in Filamentary Environments (HEFE) and Investigating Protostellar Accretion(IPA). Three sources in our sample stand out as they exhibit fast, collimated H_2 molecular jets. We compare their protostellar, disk, and envelope properties with the rest of the sample and analyze outflow kinematics and energetics using rotational and position velocity diagrams to determine whether these molecular-jet sources are intrinsically distinct. We will present our results and discuss their implications for jet launching and the transition to molecular jet phases in young protostars.

ASI2026_700	Mrinmoy Sarkar	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Asteroseismic Modelling of mild Am delta scuti stars : HD 13038 and HD 13079		

In this work we carry out an asteroseismic study of two mild Am δ Sct pulsators, HD 13038 and HD 13079, using a combination of space-based and ground-based photometry. Multi-sector TESS observations obtained at different cadences were analysed to extract 37 significant pulsation frequencies for HD 13038 and 69 for HD 13079 (SNR > 5). The TESS light curve of HD 13079 is contaminated at the ~15% level by flux from the nearby star HD 13079B, located at an angular separation of 6.48 ± 2.70 arcsec. For HD 13038, we measure a large frequency separation of $\Delta\nu = 6.08$ d^{-1}, and the échelle pattern reveals two near-vertical ridges that are compatible with radial-mode behaviour based on frequency ratios and pulsation constants (Q values). Nevertheless, the asteroseismic age constraints favour the left-ridge solution, identifying radial overtones with orders n = 5 and 7. For HD 13079, the échelle diagram yields $\Delta\nu = 5.15$ d^{-1} and shows a clear radial ridge corresponding to orders n = 1, 2, 3, 4, and 6. In both stars, the observed excited radial overtones extend to higher order than typically expected for their effective-temperature range. Stellar properties were determined by fitting an extensive mass–metallicity (M–Z) model grid using seismic χ^2 minimisation, with the

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identified radial modes applied as key constraints. We also identify possible rotation signals at 0.94 d^{-1} (HD 13038) and 0.86 d^{-1} (HD 13079), implying inclination angles of ~90° and ~42°, respectively. These results provides an important step for the study of chemically peculiar Am stars and understanding the process responsible for the excitation of high-radial overtones.

ASI2026_810	MUHAMMED RIYAS A	Poster

Stars, Interstellar Medium, and Astrochemistry in Milky Way

Actinide tracing in CEMP-rs stars: Thorium and Uranium detection

The detection of heavy radioactive elements like thorium (Th) and uranium (U) in ancient stars offers valuable clues into the astrophysical sites of nucleosynthesis and the early chemical enrichment history of the Galaxy. Among metal-poor stars, the CEMP-r/s subclass shows simultaneous enhancement of both s- and r-process elements, indicating complex formation scenarios. The intermediate neutron-capture process (i-process), operating at neutron densities between those of the s- and r-processes, has been proposed as a possible contributor to these abundance patterns. In this study, we investigate the presence of Th and U in a sample of CEMP-rs stars to test the role of the i-process in the synthesis of actinides. High-resolution, high signal-to-noise UVES spectra of three CEMP-rs stars were used for the analysis. These stars were selected based on the enhancement of neutron-capture elements in their atmosphere and spectral quality in the blue region, where the key Th II and U II lines are located. The stellar parameters and abundances were derived under non-local thermodynamic equilibrium (NLTE) conditions using the latest version of the TURBOSPECTRUM radiative transfer code.

We could detect thorium in all three stars, while uranium, which is much harder to detect due to very weak lines and blending, upper limits are established. These measurements offer new observational evidence that the i-process plays a significant role in actinide synthesis and allow the application of nucleocosmochronometry to estimate stellar ages. In our earlier research, we had shown that i-process nucleosynthesis is also able to produce very heavy r-process elements, such as Tb, Tm, Yb, Ta, Os, Ir, and Ho. In our presentation, we will discuss the observational challenges associated with detecting Th and U and discuss their implications for i-process nucleosynthesis and early Galactic chemical evolution.

ASI2026_787	Nipun Ghanghas	Poster

Stars, Interstellar Medium, and Astrochemistry in Milky Way

A Deep Learning Framework for the classification and characterization of solar-like pulsations from PLATO data

The ESA PLATO (PLAnetary Transits and Oscillations of stars) mission is expected to increase the number of well-characterized main-sequence and subgiant stars with detectable solar-like oscillations by more than a factor of 40 compared to the Kepler Legacy sample. This unprecedented data volume necessitates fast, robust, and automated analysis tools capable of extracting key asteroseismic information at scale.

We present a machine-learning-based asteroseismic pipeline designed to process PLATO power spectra and deliver the essential parameters required for both estimating stellar mass and radius and for estimating oscillation mode frequencies, providing reliable initial guesses for detailed peak-bagging analyses. The pipeline is trained on a large synthetic dataset spanning a wide range of stellar and observational conditions, including stellar inclination, signal-to-noise ratio, and global seismic properties such as v_max and Δv, ensuring robustness across the diverse PLATO target population.

The first stage of the pipeline employs a one-dimensional convolutional neural network (1D-CNN) to automatically classify stars as main-sequence oscillators, subgiants, or non-oscillators. For stars identified as main-sequence solar-like oscillators, the pipeline estimates the global seismic parameters v_max and Δv, which can be used for determining stellar mass and radius through established scaling relations. In subsequent stages, two-dimensional CNNs are used to extract additional asteroseismic observables, such as the phase offset and small frequency separations, which encode information about stellar interior structure and are needed for estimating individual mode frequencies.

This pipeline provides a scalable and physically motivated framework for exploiting PLATO's large asteroseismic sample, enabling efficient stellar characterization and supporting both stellar physics and exoplanet science in the PLATO era.

ASI2026_490	Nishad Prashant Kumar Bunnelal	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
NIR Census Of RR Lyrae stars & Horizontal Branch Morphology in Globular Clusters		
Probing the morphology of Horizontal Branch stars and RR Lyrae variability is important for understanding the Stellar evolution of low-mass stars. We present a census of Horizontal Branch (HB) and RR Lyrae stars in M2, M3, M5, M14, M15, M53, and NGC 6934 Globular Clusters (GCs) for the first time in NIR (JHKs) wavelengths. Our time-series observations have been collected using the WIRCam instrument on the 4-m Canada--Hawaii--France Telescope. We investigate the effect of metallicity and wavelength on HB morphology and RR Lyrae variability in GCs, and explore globular clusters with similar metallicity showing different HB morphologies. The long-standing "second-parameter problem" will be investigated using our observational data and theoretical models generated from the MESA (Module for Experiments in Stellar Astrophysics) Stellar evolution code, focusing on peculiar clusters like NGC 6441 and NGC 6388. We will also present RR Lyrae Period-luminosity relations for the first time with unprecedentedly small scatters of 0.05 mag in clusters of different mean metallicities, establishing their use as population II distance indicators.		

ASI2026_266	Padmavathy P G	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Fundamental parameters and mass function of two young open clusters – Pismis 27 and [IBP 2002] CC04		
We present the preliminary results obtained from the UBVRI photometric study of two young, relatively unexplored open clusters Pismis 27 (NGC 2175s) (α_2000 = 06h 10m 52s, δ_2000 = +20d 36' 45'') and [IBP 2002] CC04 (α_2000 = 07h 00m 32s, δ_2000 = –8d 51' 41'') based on the observational data collected from the Himalayan Chandra Telescope, Hanle. We used data from Gaia DR3 to identify the cluster members, based on their parallaxes and proper motions. This was done using Bayesian inference and Monte Carlo analysis. We followed standard practices of photometric analysis by plotting two-colour diagrams and colour-magnitude diagrams of the member stars. From these diagrams, we estimated the interstellar reddening E(B-V), distances to the clusters, and their ages by fitting the theoretical isochrones of solar metallicity to the cluster main sequence. We found that Pismis 27 lies at about 1.83 ± 0.15 kpc away, while [IBP 2002] CC04 is at 1.67 ± 0.05 kpc. Their cluster radii are 3.75' and 3.33', determined by fitting King's density profile. The reddening values are E(B-V) = 0.41 ± 0.02 for Pismis 27 and 0.36 ± 0.03 for [IBP 2002] CC04, with average extinction values A_V = 1.27 ± 0.06 and 2.40 ± 0.02, respectively. The logarithmic ages of the clusters respectively are 6.7 ± 0.1 and 7.0 ± 0.3. Using Kroupa's form of mass function, we obtained the mass function slopes as -2.27 ± 0.46 for Pismis 27 and -2.33 ± 0.17 for Ivanov 4, which agree well with the standard Salpeter slope of -2.35. Interestingly, Pismis 27 is located near the star forming cloud Sh2-252, while [IBP2002] CC04 is relatively isolated. This contrast gives us an opportunity to investigate the nature of mass function in different environments.		

ASI2026_507	Partha Pratim Goswami	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Discovery of HE 1005−1439: A Missing Link in Neutron-Capture Nucleosynthesis		
Understanding the origin of heavy-element enrichment in carbon-enhanced metal-poor (CEMP) stars remains one of the most persistent and unresolved problems in stellar nucleosynthesis and early Galactic chemical evolution. In this study, we report a groundbreaking discovery identifying HE 1005-1439 as the first known star to provide observational evidence for the coexistence of s-process and i-process nucleosynthesis products within a single star, marking a previously unrecognized class of CEMP stars. A high-resolution spectroscopic analysis was conducted on high-quality SUBARU/HDS spectra of the object at a resolving power of approximately 50,000. We precisely estimated the abundances of ten light elements from C to Ni and twelve neutron-capture elements, including Sr, Y, Ba, La, Ce, Pr, Nd, Eu, Dy, Er, Hf, and Pb. The derived abundance pattern of the object could neither be explained based on the classical s-process predictions nor with the help of i-process models alone. We have performed a detailed parametric-model-based analysis and found that the star is contaminated by the products of both s- and i-processes with similar contributions from both processes. We also note that the radial velocity of the object, obtained from		

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several epochs, has revealed the presence of a binary companion. We, therefore, propose a novel formation scenario for the object in which proton-ingestion episodes in a low-metallicity asymptotic giant branch (AGB) companion trigger i-process nucleosynthesis, followed by subsequent s-process enrichment during later AGB evolution with a few third dredge-up episodes and mass transfer to the observed star. This star is expected to fill an important gap in our understanding of the link between the s- and i-processes.

ASI2026_39	Poojapriyatharsheni J	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Multi-Frequency Radio Recombination Line Analysis of 37 Galactic Plane Positions with Detected [N II] Far-Infrared Emission		

The physical state and structure of the fully ionized interstellar medium (ISM) in the inner Galaxy is governed by star formation, turbulence, and large-scale Galactic dynamics. Hydrogen radio recombination lines (RRLs), combined with radio continuum data, provide an extinction-free probe of the ISM, enabling measurements of electron temperature, emission measure, density, and kinematics. We conducted multi-frequency RRL surveys with the Green Bank Telescope (GBT) at 800 and 340 MHz across the Galactic plane ($|b| \leq 1°$), covering $-5° \leq \ell \leq 32.6°$, a region containing major spiral-arm crossings, prominent HII region complexes, and diffuse ionized gas. The new observations have angular resolutions of 21' and 50' at 800 and 340 MHz respectively and are complemented by an existing 5.8 GHz RRL survey with 2.8' resolution, providing sensitivity to both compact and extended emission.

We analyze RRL emission at 37 positions along the Galactic plane ($b = 0°$), selected to overlap spatially with the Herschel [N II] far-infrared survey (Pineda et al. 2019) . As [N II] fine-structure lines trace ionized gas, a key goal is to relate RRL and [N II] emission.

A custom Python-based spectral analysis pipeline using the lmfit library was developed to perform simultaneous baseline subtraction and Gaussian fitting. Individual RRL components were separated based on velocity centroids and linewidths. Non–local thermodynamic equilibrium (non-LTE) modeling was performed with the RRLpy module, incorporating radio continuum data at 408 and 1420 MHz and constraints from the 5.8 GHz RRL observations to account for beam dilution.

The modeling constrains electron densities, emission measures, and non-thermal velocity dispersions. Monte Carlo simulations quantify uncertainties and validate the results. Cross-comparisons with previous RRL and [N II] studies place new constraints on the physical conditions and spatial distribution of ionized gas in the inner Galaxy.

ASI2026_1107	Prashanth Kumar Kasarla	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Magnetic field orientation and strength in the Perseus arms from optical polarimetry and molecular line observations		

Magnetic fields play a crucial role in regulating the structure and evolution of the interstellar medium and star formation, yet their strength and geometry remain observationally challenging to constrain. We present a study of the plane-of-sky magnetic field orientation and strength in a sample of stellar clusters located along the Galactic anti-centre direction using optical starlight polarimetry combined with molecular line observations. The optical polarisation of background stars traces the magnetic field morphology through dust grain alignment, allowing us to derive the large-scale field orientation and the dispersion of polarisation angles within each cluster field.

To estimate the magnetic field strength, we incorporate molecular line data to obtain the non-thermal velocity dispersion and gas density of the associated molecular clouds. The plane-of-sky magnetic field strength is derived using the Angular Dispersion Function (ADF) method, with corrections applied to account for observational uncertainties and turbulent contributions. Here, I will present the polarisation data of some of the open clusters we observed along with their magnetic field strength and direction.

ASI2026_736	Preeti	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Spectroscopic Analysis of Stellar Winds in the Wolf-Rayet Star WR125		
Wolf-Rayet (WR) stars are evolved massive stars characterized by strong stellar winds and prominent emission lines, which provide critical insights into late stages of stellar evolution and massive star feedback. In this work, we present near-infrared spectroscopic observations of WR 125, a WC9+O III binary system, obtained using the TANSPEC instrument at the 3.6m Devasthal Optical Telescope (DOT). The data were reduced using the standard TANSPEC pipeline, which includes telluric and barycentric corrections, ensuring high-quality calibrated spectra. The spectrum of WR 125 reveals multiple broad emission features that are consistent with its WC9+O III classification. Of particular interest is the detection of a P Cygni profile near 1.083 μm, a diagnostic feature of stellar winds. A Gaussian fitting procedure was applied to the profile, and the Doppler shift between the emission peak and absorption minimum was used to estimate the wind terminal velocity. We derive a terminal velocity of $v_\infty \approx 3176 \pm 116$ km s^{-1}. Additionally, the radial velocity of the system was determined to be -81.32 ± 15.60 km s^{-1}. These results provide direct constraints on the wind velocity and systemic motion of WR 125, reinforcing its classification as a late-type WC star. The high terminal velocity highlights the efficiency of mass loss in the system and serves as a critical input for models of binary interaction and circumstellar environment formation. Future observations will focus on time-resolved spectroscopy to probe wind variability and binary interaction effects in similar kind of stars.		

ASI2026_445	Priyesh Kushwaha	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
PAH Emission Characteristics in Young and Evolved Circumstellar Environments		
Polycyclic aromatic hydrocarbons (PAHs) dominate the mid-infrared spectra of many astrophysical environments, yet their precise carriers and evolutionary behaviour remain debated. T Cha is a nearby pre-main-sequence star surrounded by a transitional protoplanetary disk that shows strong infrared excess and evidence for active disk evolution, making it an excellent laboratory for studying PAHs in young, planet-forming environments. NGC 6302 (“The Butterfly Nebula”) is a highly bipolar planetary nebula with an extremely hot central star and complex dust chemistry, including both PAH emission and silicate features, characteristics of advanced stages of stellar mass loss. Using PAHFIT, we perform spectral decomposition of Spitzer and JWST archival data for the T Cha disk and NGC 6302. The method allowed us to disentangle PAH emission bands from ionic lines, dust continuum, and silicate features with high fidelity. We complemented this analysis with modelling using PAHdb database, comparing observed aromatic infrared bands (3–20 μm) with laboratory and theoretical spectra of PAH molecules and clusters. Our results reveal systematic variations in band profiles and relative intensities between the irradiated protoplanetary disk of T Cha and the evolved Planetary Nebula NGC 6302, reflecting differences in PAH size distribution, ionization balance, and degree of processing in strong radiation fields. In particular, the 6.2, 7.7, and 11.3 μm bands display contrasting trends that trace the transition from predominantly ionized PAHs in the disk surface layers to more neutral and possibly clustered species in the nebular environment. We discuss the implications of these diagnostics for PAH photochemistry, dust evolution, and the lifecycle of carbonaceous grains protoplanetary disks to planetary nebulae.		

ASI2026_320	Pryanshu Basur	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Probing the Interstellar Medium of NGC 7380: Toward a Determination of the Gas-to-Dust Ratio		
NGC 7380 is a young open cluster that is a great laboratory to study the effect of stellar feedback on the natal ISM. Massive stars in these clusters affect their environment in deep ways, and one of the fundamental parameters to understand such a process is the gas-to-dust ratio (GDR). The GDR is thought to be tracking a typical value in the ISM, but it differs vastly in star-forming clouds because of local physical processes such as stellar winds, radiation pressure, and cloud dispersal. In this study, we are conducting a multi-wavelength analysis to derive the GDR across		

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NGC 7380. Molecular gas content is traced through CO observations obtained from the Purple Mountain Observatory, which serve as a proxy for molecular hydrogen. The dust component and its distribution are mapped using a near-infrared colour excess method applied to a stellar catalogue constructed from 2MASS and UKIRT data. This work will deliver the first spatially resolved map of the gas-to-dust ratio in NGC 7380. By quantifying the mean GDR and exploring its variations across the cluster, we aim to provide new constraints on molecular cloud dispersal and the physical state of the ISM in this active star-forming region. Based on the WD01 model, we report a GDR of 85 derived from 12CO and 122 from 13CO, resulting in an average GDR of 104 for the region.

ASI2026_845	Raj Manas	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Reaction mechanism of Pyrrole with functional groups and formation of its derivatives and its spectroscopic properties		

Polycyclic aromatic nitrogen heterocycles (PANHs) are nitrogen substituted analogues of PAHs and are considered promising prebiotic molecules in the interstellar medium (ISM) due to their enhanced reactivity and structural similarity to nucleobases. However, simple PANHs are difficult to detect observationally because their high symmetry and negligible permanent dipole moments render them largely invisible to rotational spectroscopy, while their infrared features are often obscured by spectral overlap with abundant PAHs. In contrast, functionalized PANH derivatives are expected to be more readily detectable, as the addition of substituent groups breaks molecular symmetry and induces significant permanent dipole moments enhancing their rotational activity and produces distinct spectroscopic signatures, making them more favourable targets for astronomical detection than their parent molecules.
In this study, we investigate the reactivity of pyrrole with astrochemically relevant functional groups like cyano (CN), hydroxyl (OH), and amino (NH_2), under both gas phase and water ice surface conditions to simulate diverse interstellar environments. Multiple reaction pathways, including electrophilic substitution and hydrogen abstraction at different sites of the pyrrole ring, are explored. High level quantum chemical calculations are employed to map the potential energy surfaces and to determine whether these reactions proceed via barrierless or activated mechanisms. Transition states are located and validated through intrinsic reaction coordinate (IRC) calculations, allowing identification of the most stable products and dominant reaction channels under typical ISM conditions.
For the most favourable pathways, temperature dependent rate coefficients are calculated using the MESS master equation solver, with input parameters derived from DFT level thermochemical data. The resulting rate coefficients are subsequently fitted to the modified Arrhenius–Kooij expression for use in astrochemical models. In addition, the infrared and rotational spectroscopic properties of the stable pyrrole derivatives will be computed to assess their potential detectability in astronomical observations.

ASI2026_569	Raja Ram Saini	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Delineating the distribution of dust and magnetic fields towards a star forming region NGC 2175		

We present the preliminary results based on the optical polarization observations towards a star-forming region NGC 2175. We aim to investigate the interstellar dust distribution and its properties, and also variation of magnetic field orientation as a function of distance along the line of sight (LOS) of NGC 2175. Polarization (P) data are combined with Gaia-based distance (d) and extinction (Av) data to examine the variation of polarization and extinction as a function of distance (P and Av versus d), and the polarization efficiency (Av vs P/Av) of the dust along the LOS. The P vs d plot shows a gradual increasing trend up to a characteristic distance of 1.54 kpc, beyond which the polarization exhibits either a constant or a slight decreasing trend, indicating depolarisation effect by the dust grains within the star forming region. The Av vs d relation displays a gradual rise followed by a sudden jump at 1.34 kpc and a steeplying increasing trend, identifying the location of the layer of dust associated with NGC 2175. The Av vs P/Av exhibits a broken power law behaviour, with an increasing trend below the Av of 1.2 mag, and beyond which polarization efficiency declines showing a poor dust grain alignment in the regions with high extinction. Optical polarization vector map is compared

with the B-field orientation inferred from 5 arcmin resolution Planck 353 GHz dust continuum polarization data. Consistency between optical and Planck field lines is observed in limited regions, while they mismatch in the majority of the region. We will also present some preliminary results based on the HINSA Zeeman data obtained from the FAST telescope toward one of the Planck Galactic Cold Clumps (PGCC).

ASI2026_487	Rajarshi Barman	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Potential of Gaia XP Spectra in Red Giant Asteroseismology: A Deep Learning Approach		
Red giants are key tracers of stellar evolution and Galactic structure, and their asteroseismic properties, particularly the large frequency separation (Δv), the frequency of maximum oscillation power (v_max), and the dipole-mode period spacing (ΔΠ_1), provide direct insight into their internal structure, masses, and evolutionary states. Until now, seismic inference for large stellar samples has relied primarily on high-quality photometric light curves from missions such as Kepler and TESS, or on moderate-resolution spectroscopy from surveys such as LAMOST (R ~ 1,800) and APOGEE (R ~ 22,500) that preserves information correlated with these seismic quantities. With Gaia XP spectrophotometry (R ~ 15–85), the possibility arises to extend asteroseismic measurements to orders of magnitude more stars despite the much lower spectral resolution. In this work, we assess whether XP spectra retain sufficient information to enable reliable seismic inference for red giants. We develop hybrid convolutional neural network–long short-term memory (CNN–LSTM) models trained on red giants with seismic parameters measured from Kepler photometry. The networks learn subtle spectral signatures, imprinted through global stellar properties, that correlate with Δv, v_max, and ΔΠ_1. We find that all three global asteroseismic parameters can be recovered from Gaia XP spectra with accuracies comparable to those obtained from moderate-resolution spectroscopic surveys, demonstrating that even low-resolution spectrophotometry contains sufficient information for seismic prediction. Saliency analysis reveals wavelength regions most strongly associated with seismic sensitivity and highlights physically distinct spectral behaviour between red giant branch and red clump stars. Applying our models to Gaia DR3, we obtain seismic predictions for more than 2.5 million bright red giants, enabling population-level asteroseismic studies on an unprecedented scale, and identify a small subset of low-Δv red clump candidates with unusual spectral–seismic correlations that may offer new insights into evolved stellar populations.		

ASI2026_49	Sahil Purabiya	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Backyard to Binary: High-Cadence Photometric Follow-Up of a WZ Sge-Type Dwarf Nova in Outburst		
WZ Sge-type dwarf novae are ultracompact, short-period cataclysmic variables that exhibit rare, large-amplitude outbursts and play a key role in probing the late stages of binary evolution near the period minimum, including mass transfer, angular momentum loss, and accretion disk dynamics. We conducted rapid follow up with high cadence photometric monitoring of Gaia DR3 3130088774241620608 within 4 days of its outburst detection to investigate its variability and derive fundamental system parameters. Using a 6-inch f/9 Ritchey-Chrétien telescope (Guan-Sheng Optical) and a ZWO IMX585 CMOS camera, we obtained broad band time-series observations over 11 consecutive nights from Ahmedabad, India. ANOVA period analysis revealed a superhump period of 0.057885 day and an orbital period of 0.056513, yielding an estimated mass ratio of ≈0.114, indicative of a borderline brown-dwarf or highly evolved M-type donor. Gaia DR3 parallax places the system at a distance of ~241 pc, corresponding to an absolute magnitude of ~7.1. We estimate a disk precession period of ≈2.3843 days. This study demonstrates the scientific potential of rapid, ground-based photometry using modest amateur equipment for advancing our understanding of transient, ultracompact binary evolution.		

ASI2026_243	SAMRAT GHOSH	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Magnetic Activity and Flare Statistics of a Solar Analogue AB Dor		

AB Dor A (hereafter AB Dor) is a young, nearby, rapidly rotating and actively flaring K0-type star. As the X-ray source in its quintuple stellar system, AB Dor presents a unique opportunity to study magnetic activity in young solar analogues. With a rotation period of ~0.51 days and intense magnetic behaviour, AB Dor shows short-term variability driven by flares and rotational modulation, as well as long-term variability associated with stellar activity cycles. A shorter "flip-flop" cycle, characterised by periodic shifts between active longitudes, is also reported in similar stars.

We conducted a detailed optical time-series analysis using TESS data. The morphology of the LCs shows spot evolution. We applied spot modelling on each rotational cycle, using a two-spot model, to estimate spot longitudes. Phase evolution was tracked, allowing us to investigate the migration of active longitudes.

AB Dor exhibits very frequent flaring in the data. We analysed the light curves to identify individual flares, estimate their energies, and quantify the frequency of flares. We correlate various flare temporal parameters which indicate self-similar magnetic reconnection physics. The flare frequency distribution reveals the coexistence of two flare populations: frequent, low-energy events and rarer, high-energy flares that collectively dominate the total energy budget.

This study contributes to the understanding of surface magnetic activity and dynamo processes in young, solar-type stars, highlighting AB Dor's value as a benchmark for exploring the early magnetic evolution of the Sun and its analogues.

ASI2026_571	Sanchali Nath Mazumdar	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
On the Magnetic Field Structure and Dust Properties of the Molecular Clouds L1578 and L1607		

Molecular clouds are the principal sites of star formation, and their evolution is strongly influenced by magnetic fields. Consequently, investigating magnetic field morphology is essential for understanding star formation processes. The magnetic field structure in molecular clouds can be traced through measurements of the linear polarization of background starlight passing through the cloud material. In this context, we present an R-band polarimetric study of the dark molecular clouds L1578 and L1607 to examine the magnetic field geometry in their low-density envelope regions. We also evaluate the impact of the Galactic magnetic field on the envelope magnetic field of these clouds and find that the Galactic field dominates in these regions. A deeper understanding of star formation further requires knowledge of the initial physical conditions of molecular clouds, including temperature, density, and dust grain properties. To investigate the dust characteristics, we utilize archival near-infrared data of field stars toward the clouds to construct extinction maps. Additionally, SPIRE observations at 250, 350, and 500 μm from the Herschel data archive are used to derive the temperature and column density distributions. Since accurate distance estimates are crucial for determining key cloud properties and for generating reliable polarization maps, we apply the Near-Infrared Photometric Technique to estimate the distances to the clouds. This yields distances of 1043±36 pc for L1578 and 938±49 pc for L1607.

ASI2026_343	Sanjit Pal	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Emission line diagnostics of evolving supernova remnants		

This work investigates the synthetic observations of supernova remnant simulations performed using the hydrodynamic code, PLUTO. The numerical simulations include a dynamically evolving non-equilibrium ionization network and a frequency-dependent radiation transfer coupled to each other and to the hydrodynamics. The work aims to show the time-dependent relation of the emission line ratios from an SNR on the classical Baldwin, Phillips & Terlevich (BPT) diagram. We present a comparison model with various initial conditions and parameters, such as varying number densities, metallicities, etc., as well as a direct comparison to observational surveys.

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ASI2026_168	SAPAN KUMAR SAHOO	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Hunting Pulsar with the GHRSS Survey: Pipeline Enhancements, Machine Learning, and FFA Techniques		

Millisecond pulsars (MSPs) and normal pulsars are key astrophysical laboratories for studying neutron star physics, testing theories of gravity, probing the interstellar medium, and detecting low-frequency gravitational waves through pulsar timing arrays. Despite more than 4,000 known pulsars, population synthesis studies predict a substantially larger undiscovered Galactic population, particularly at low radio frequencies. The GMRT High Resolution Southern Sky (GHRSS) survey is a blind, off-Galactic-plane pulsar survey conducted with the Giant Metrewave Radio Telescope (GMRT), designed to exploit its high sensitivity and wide bandwidth (200 MHz) at metre wavelengths.

In this work, we present significant enhancements to the GHRSS pulsar search pipeline, incorporating optimised dispersion measure (DM) planning, Fast Folding Algorithm (FFA)-based searches, and machine learning-assisted candidate classification. The modified FFT pipeline extends the DM coverage up to 250 pc cm^{-3}, encompassing nearly 88% of the known pulsar population, while maintaining computational efficiency. To recover long-period and narrow-duty-cycle pulsars missed by traditional FFT methods, an FFA-based search implemented using the RIPTIDE framework is integrated into the pipeline.

Furthermore, we implement a Gaussian Hellinger Very Fast Decision Tree (GH-VFDT) machine learning classifier to automatically rank pulsar candidates, substantially reducing manual inspection load while maintaining high recall. This ML-assisted reanalysis of archival GHRSS data has yielded promising pulsar-like candidates, several of which have been re-observed using GMRT incoherent and phased-array beams for confirmation.

The GHRSS survey has so far resulted in over 30 discoveries, including MSPs, mildly recycled pulsars, and rotating radio transients. Ongoing observations aim to fill remaining sky coverage gaps and extend the survey to higher frequency bands, further improving sensitivity to faint and fast-spinning pulsars. This work demonstrates the effectiveness of combining advanced signal-processing techniques and machine learning to enhance pulsar discovery in large-scale radio surveys.

ASI2026_498	Shashikant Gupta	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
On the Relation between the Near-Infrared Secondary Maximum and the B-band Decline Rate of Type Ia Supernovae		

Type Ia supernovae (SNe Ia) are among the most important cosmological probes at present. Their light curves in the optical and near-infrared (NIR) bands provide crucial information and were instrumental in the discovery of the accelerated expansion of the Universe. The Phillips relation, which links the peak luminosity to the B-band decline rate, has played a key role in calibrating SNe Ia as secondary distance indicators. Subsequent light-curve fitters, such as SALT2 and SNooPy, further improved this calibration by incorporating multi-band photometric observations. Recent studies suggest that NIR light curves can yield more precise distance estimates, as they are less affected by dust extinction. In particular, the J-band light curves of SNe Ia exhibit a prominent secondary maximum, which is believed to arise from changes in the ionization state of the ejecta. The timing of this NIR secondary maximum, denoted as t_2, is expected to correlate with the B-band decline rate parameter Δm_{15}.

In the present study, we investigate this relationship using a sample of 54 SNe Ia with well-defined secondary maxima, drawn from the Carnegie Supernova Project. Our analysis confirms the previously reported anti-correlation between Δm_{15} and t_2. We further employ machine-learning–based regression techniques to capture possible nonlinear behavior in this relation. Our results indicate that the (Δm_{15}–t_2) anti-correlation is not uniform, but instead shows a clear luminosity dependence. A break point at ($\Delta m_{15} \sim 1.2$) is identified, separating the SNe into two distinct groups associated with different host galaxy morphologies. These findings have important implications for improving the calibration of SNe Ia for precision distance measurements.

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ASI2026_553	Shridharan Baskaran	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A Unified JWST/MIRI Perspective on Accretion and Ejection in Class II Protoplanetary Disks		
Understanding the coupled nature of accretion and ejection is fundamental to explaining the dispersal of protoplanetary disks and the subsequent mass budget available for planet formation. However, traditional optical and near-infrared diagnostics are frequently hampered by high extinction in embedded sources and contamination from unrelated emission. To overcome these barriers, we present a comprehensive statistical analysis of over 80 JWST/MIRI archival spectra, providing an unprecedented unified investigation of accretion and outflow processes within the mid-infrared regime. Leveraging MIRI's high sensitivity and spectral resolution, we validate mid-infrared hydrogen recombination lines (spanning upper levels N=6–14) as reliable proxies for accretion. We derive new empirical scaling relations that facilitate accurate accretion-rate estimations even for moderately obscured objects, significantly expanding the parameter space of disk studies. Furthermore, we compile the most extensive mid-infrared census to date of ejection signatures, finding high detection rates for [Ne II] (~80%) and [Ar II] (~40%), while refractory species like [Fe II] and [Ni II] are restricted to high-velocity shocks in strongly jet-driven systems. Crucially, by leveraging MIRI's ability to provide simultaneous measurements of mass accretion and outflow rates, we investigate the fundamental coupling between these two processes and quantify how this relationship evolves over the T Tauri phase. Our results delineate an evolutionary trajectory where younger systems dominated by powerful MHD-driven jets and shocks gradually transition into wind-dominated regimes, eventually giving way to weak photoevaporative flows. This work offers a unified framework connecting accretion-ejection properties in Class II disks and extending them to Class I/0 evolutionary phases.		

ASI2026_137	Shubh Mittal	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
High Resolution Spectroscopy of Type II Cepheids in Milk Way		
Precise distance measurements of variable stars such as Type II Cepheids in the Milky Way fields are crucial for calibrating the first rung of the cosmic distance ladder. An important aspect of this application is the understanding of the effect of metallicities on the absolute luminosities of Type II Cepheids. Using High-Resolution Spectroscopy on the HRS data obtained from the South African Large Telescope (SALT), we calculated radial velocities, stellar atmosphere parameters, metallicity, and elemental abundances of Type II Cepheids. Additionally, we present the "Stellar Atmosphere Parameter Estimation" (SAPE) module, which is used to perform these calculations. SAPE utilizes PyMoog for Kurucz stellar atmospheric models in Local Thermodynamic Equilibrium (LTE) for abundance calculation and spectral synthesis for comparison with the observed spectra.		

ASI2026_617	Shubham Yadav	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Tracing Accretion-Driven Variability in T-Tauri stars Using Spectroscopic and Photometric Observations.		
Young Stellar Objects (YSOs) are highly dynamic systems exhibiting both spectral and photometric variability, driven by non-steady mass accretion and dynamic outflow processes. Multi-epoch spectroscopic observations provide key diagnostics of the physical conditions in these systems, tracing accretion through emission lines such as Brγ, Paβ, He I, and Hα, and probing outflow activity via forbidden lines. Complementing this, multi-band photometric monitoring enables the characterization of brightness variations and short-term flux changes, revealing the temporal behavior of accretion and inner disk processes. In this study, we present a systematic investigation of three YSOs—GM, BP Tau, and V505—combining spectroscopic and photometric data over multiple epochs. The lightcurves constructed in B, V, R, and I bands reveal correlated brightness variations consistent with accretion-driven variability inferred from spectral line changes. Our combined analysis allows us to constrain the temporal evolution of both accretion and outflow processes, providing a comprehensive picture of the dynamic behavior of YSOs.		

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ASI2026_262	Shubhankar Gharote	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Dense Structure Formation in Merging Interstellar Filaments: Hydrodynamic Simulations		

Filamentary structures are a ubiquitous component of the interstellar medium (ISM) and play a central role in regulating star formation in the Milky Way. These filaments frequently undergo mergers, giving rise to complex filamentary systems, including tuning-fork–like morphologies formed by the interaction of two filaments. While recent studies have established links between hydrodynamic simulations and observations of such structures, the statistical impact of key parameters, such as merger geometry and relative velocities on the properties of the resulting clumps and dense cores remains to be explored.

We perform three-dimensional, self-gravitating hydrodynamic simulations of filament mergers using the adaptive mesh refinement code RAMSES, systematically varying merger geometry and velocity of approach. The filaments are initialized in radial hydrostatic equilibrium with the ambient medium, with axial density gradients introduced to ensure merger prior to end-dominated collapse. Controlled bulk velocities are then imposed to drive filament interactions. The physical properties of the resulting clumps and dense cores are quantified.

We find that increasing the velocity of approach promotes the formation of long-lived dense structures up to a critical velocity, beyond which the merged system becomes gravitationally unbound. Merger geometry significantly influences dense structure properties by regulating the effective volume of the interaction region. We construct a two-dimensional phase diagram of clump and core properties as a function of merger velocity and angle, and discuss the implications for filament evolution. Future studies will focus on the role of turbulence and magnetic field as additional influencing factors in filament mergers.

ASI2026_218	Sipra Hota	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Unveiling the nature of massive stars in the Young Open Cluster NGC~654 with UVIT		

The evolution of massive stars is not yet well understood because of their short lifetimes and scarcity. Young open clusters (OCs) provide the best platform to study such stars as they are home to massive stellar populations. NGC 654 is a young Galactic OC with

estimated ages ranging from 16 to 63 Myr and significant differential reddening of $E(B-V) = 0.74–1.16$ mag. It hosts massive stars with a confirmed Be star and an emission-line star. The objective of this work is to study the cluster properties, including age, reddening, and the properties of its individual stars, such as effective temperature, luminosity, radius, evolutionary phase, and multiplicity. Here we present the first-ever far-ultraviolet (FUV) photometric study of NGC 654, using UV data from the UltraViolet Imaging Telescope (UVIT) aboard AstroSat. This is the only other cluster observed along with NGC 663 by UVIT to study the Galactic massive stars in the UV. We identify 68 confirmed members with membership probability more than 50% detected in both FUV filters (F148W and F172M). FUV optical color–magnitude diagrams reveal that the UVIT-detected members are predominantly main-sequence (MS) stars, with the Be and emission-line stars located on the redder side of the MS. Among the 68 members, four previously reported eclipsing binaries are identified. Using the spectral energy distribution (SED) modeling technique, we examine the physical properties and multiplicity of these stars, finding that the majority are consistent with single systems, while a small fraction are identified as candidate binaries. Overall, this study highlights the crucial role of UV observations to characterise the binary fraction among massive stars and provides insights into the evolution of the massive binary systems.

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ASI2026_653	Sneha Nedhath Divakaran	Poster

Stars, Interstellar Medium, and Astrochemistry in Milky Way

AstroSat/UVIT Study of NGC 663: First detection of Be+sdOB systems in a young star cluster

Be stars are rapidly rotating stars surrounded by a disc; however, the origin of these stars remains unclear. Mass and angular momentum transfer in close binaries account for the rapid rotation of a significant fraction of Be stars, as supported by the previous detection of low-mass stripped companions to these stars. The stripped companions can be helium-burning subdwarf OB-type stars (sdOBs) and white dwarfs. The main objective of this study is to characterise the identified Be stars in the young open cluster NGC 663 and search for possible hot companions. We present the first ultraviolet (UV) photometric study of NGC 663 using far-UV and near-UV data from UVIT/AstroSat. We identified 23 previously known Be stars in the cluster. Further, we utilised the spectral energy distribution fitting technique to derive the fundamental parameters and to search for UV-bright companions of the identified Be stars. Our study reveals that 19 out of 23 Be stars show a significant UV excess, indicating the presence of hot companions. Here, we report the first detection of high-mass sdOB companions to Be stars, with 69.5% of them found in binaries within a cluster, offering direct evidence of binary interactions. This study showcases the key role of binary interactions in the formation of Be stars in clusters and provides insights into massive star evolution.

ASI2026_695	Snigdha Sarmah	Poster

Stars, Interstellar Medium, and Astrochemistry in Milky Way

Pre-explosion Variability and Circumstellar Environments of Type II Supernova Progenitors

Red supergiants (RSGs) are widely accepted as the progenitors of hydrogen-rich Type II supernovae, yet their physical state in the final years before core collapse remains poorly constrained. In this work, we investigate the pre-explosion variability and circumstellar environments of eight nearby Type II supernova progenitors using multi-epoch, mid-infrared observations from the Spitzer Space Telescope, supplemented by high-resolution Hubble Space Telescope imaging and ultraviolet data from GALEX. To overcome severe source blending in the low-resolution Spitzer IRAC & GALEX images, we employ template-fitting photometry using HST priors, enabling reliable extraction of progenitor light curves in the 3.6 and 4.5 μm bands. All progenitors exhibit mid-infrared variability, with periods ranging from 179.8 ± 11.2 to 1231.3 ± 140.1 days, derived using Lomb-Scargle periodogram analysis. We place these progenitors on the established red supergiant period-luminosity relation and find that several sources display systematic offsets. In particular, enhanced 4.5 μm emission and redder [3.6] − [4.5] colours relative to Magellanic Cloud RSGs indicate the presence of circumstellar dust formed in the final decades prior to explosion. The mid-infrared colours show a tendency to redden with increasing pulsation period, consistent with episodic mass-loss events in advanced evolutionary stages. We further explore connections between progenitor properties and early supernova observables. For events with well constrained early-time parameters, it is seen that redder progenitors exhibit longer-lasting flash-ionization features, suggesting more extended or denser circumstellar material.

ASI2026_539	Sujay Jadhav	Poster

Stars, Interstellar Medium, and Astrochemistry in Milky Way

Water, water everywhere: H2O in youngest protostars using JWST

Water, a fundamental ingredient for life, plays a crucial role in the earliest stages of star formation. In both gaseous and solid forms, H_2O regulates thermal balance, drives chemical pathways, and traces key dynamical processes in protostellar environments, particularly outflows.

We analyze JWST/MIRI integral-field spectroscopy (5-28 μm) of gas-phase H_2O emission and absorption in five protostars from the JWST Cycle 1 Investigating Protostellar Accretion (IPA) program, spanning masses of 0.1-12 $M_{\odot}$ and luminosities of 0.1-10,000 $L_{\odot}$. In the most luminous sources, HOPS 370 and IRAS 20126, H_2O is detected in the fundamental rovibrational (010–000) band at 5–8 μm. They show spatially extended emission and blueshifted absorption associated with outflows, features largely absent in lower-luminosity protostars. This contrast suggests

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that radiative excitation dominates water emission in high-luminosity systems. We study the morphology, kinematics, and excitation of H_2O emission/absorption by constructing moment maps, channel maps, and excitation diagrams. We extend the analysis to thirteen young protostars from the JWST Cycle 3 program, High Angular Resolution observations of Stellar Emergence in Filamentary Environments (HEFE). Combining both samples reveals a clear increase in H_2O feature strength with protostellar luminosity, highlighting radiative pumping as a key excitation mechanism in the earliest phases of star formation.

ASI2026_637	Sumi Bhattacharjee	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Study of Radial Variation of Extinction in outer periphery and core region of Dark Clouds.		

Dark molecular clouds are isolated, compact regions in the interstellar medium that appear as dark spots in contrast to the bright stellar background. Clemens and Bravainis (Clemens, D. P., & Barvainis, R. 1988, ApJS, 68, 257) ' clouds represent such regions of compact and isolated dark clouds.
Within the sample of 248 clouds, we identify 48 clouds which have isolated and well-defined shapes. For, these selected clouds reliable distance estimates of are collected from existing literature; the distances to the stars along the line of sight are obtained from the Gaia catalogue. Near-infrared extinction measurements are taken from the 2MASS catalogue.
By integrating these data sets, we examine the radial variation of extinction across each cloud. Our analysis reveals a gradual systematic increase of extinction from the cloud's outer peripheral regions towards the dense cloud cores. The observed extinction profiles can be well predicted by using mathematical models incorporating distance and other relevant physical parameters.

ASI2026_829	Swagat Bordoloi	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Using the GALEX Far-Ultraviolet diffuse emission as tracer for Galactic extinction at the North Galactic Pole (NGP)		

We investigate the use of Far-Ultraviolet (FUV) data from Galaxy Evolution Explorer (GALEX) as a tracer for interstellar extinction towards the North Galactic Pole (NGP) of the Milky Way Galaxy. We prepare 6' resolution maps of GALEX. We analyze the region at the high galactic latitudes (b > 70o) with low optical depth (τ < 0.1). We compare the GALEX map to Planck's extinction data and find a moderate correlation between them (ρ = 0.578). Using the fit between GALEX and Planck's, we convert the FUV surface brightness to FUV-derived E(B-V) map, and test the validity of the map. We test our extinction map using quasars observed by Sloan Digital Sky Survey (SDSS) as standard calibrators. We find a better fit between observed colors of the quasar colors and GALEX extinction, to estimate the intrinsic color for increasing redshift (z) for moderate starlight heating intensity (0.4 < Umin < 1.04). We calculate the extinction of quasars using the GALEX extinction map, and compare the extinctions for the quasars using Planck and Schlafly. We find a very good correlation between the quasar extinction estimates (0.986) stating the quasar extinction estimates are consistent with previous works. We finally compare the quasar extinctions, with the GALEX and Planck's normalized value. We find a higher correlation of the quasar extinction values with the GALEX map, than Planck concluding the GALEX is a better tracer of extinction than Planck or Schlegel. To further conclude that our analysis is concrete, we find quasar extinctions using reddening from stellar observations. We find a lower standard deviation and mean difference using the GALEX.

ASI2026_671	Vinay kumar Gundeboina	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Understanding Subdwarf B Progenitors through Algol-Type Binary Evolution		
Subdwarf B (sdB) stars are core helium-burning objects with extremely thin hydrogen envelopes, widely believed to form through binary interactions, yet the evolutionary pathways leading to their formation remain incompletely understood. In this work, we present our current understanding of Algol-type binaries as a potential evolutionary link between interacting binaries and sdB systems. Algol binaries are semi-detached systems undergoing stable Roche-lobe overflow, offering a natural environment for sustained mass transfer without entering a common-envelope phase. The role of mass transfer during the red giant branch in stripping the donor's hydrogen envelope, while leaving a helium-core remnant capable of helium ignition, is examined. Using binary stellar evolution modelling with MESA, we outline how correlations between Algol system parameters and the observed properties of sdB binaries can be explored. This study aims to present a unified framework linking interacting binaries to hot subdwarf formation. Key words: subdwarf B stars, Algol-type binaries, binary stellar evolution, stable mass transfer, MESA		

ASI2026_660	Vinod Chandra Pathak	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Characterizing Jets, Winds, and Accretion Diagnostics in HV Tau C with JWST/MIRI		
The evolution of protoplanetary disks is driven by accretion and ejection processes, where collimated jets and slower wide-angle winds play a central role in angular momentum removal and mass dispersal. We present Mid-Infrared Disk Survey(MINDS) cycle 1 GTO JWST MIRI/MRS observations of the edge-on Class II source HV Tau C, expanding on our previous analysis of its extended molecular (H_2) wind. In this study, we shift focus to the prominent collimated jets and suprathermal OH emission detected in the same dataset. Alongside the H_2 wind, the JWST spectrum reveals a rich set of jet tracers, including fine-structure lines of [Fe II], [Ne II], and [Ar II]. We characterize the morphology and kinematics of these jets and employ shock modeling to constrain their excitation conditions and dynamical properties. We also detect strong emission from suprathermal OH lines, which may arise from UV photodissociation of water in the disk surface or wind. We analyze these lines to investigate their origin and assess their potential as tracers of disk accretion when combined with H I recombination line diagnostics. Our primary goal is to compare the mass-loss budgets of the wide-angle H_2 wind and the collimated jets to determine which component dominates mass ejection in this Class II system, and to test whether trends observed in younger protostars persist at later evolutionary stages. Finally, we outline a program to extend this unified analysis of winds, jets, and disk tracers to other edge-on disks in the JWST archive. This work highlights JWST's unique ability to deliver a comprehensive view of disk–outflow interactions during planet formation.		

ASI2026_191	Vipin Kumar	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Massive star formation in the Hub-Filament system G339.467+0.083		
Hub-filament systems are major sites of star formation, especially massive stars in the interstellar medium, with gas and dust being channeled through elongated filamentary structures to central hubs. Hence, detailed investigation of star formation activity in multiple such systems is needed to be carried out in order to understand the physical processes involved in transport of gas and dust and their collapse leading to the formation of high mass stars. We investigate the star formation activity in a Hub-filament system (HFS) candidate, G339.467+0.083. It is located at a distance of 6.7 kpc and has a vlsr of -110.1 km/s. We identify 9 filaments in the region using multiple filament identification tools (DisPerse, FilFinder, Getsf, Sūtra) employed on the H2 column density map derived from cold dust emission observed by Herschel as well as on the 13CO (2-1) integrated intensity map observed by APEX under the SEDIGISM survey.		

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We find that while most of the filaments are detected in both dust and gas based emissions, some are only detected in the former pointing towards the presence of CO-dark-H_2 in the region. The filament masses range between ~ 340 - 450 $M_\odot$ while their lengths range between ~ 10 - 20 pc. We also study the kinematic properties using the ^{13}CO (2-1) emission where it is observed that filaments have blueshifted velocities and higher dispersions towards the hub. The mean H_2 column density of the region is ~ 2×10^{22} cm^{-2} with the peak column density of 2.6×10^{23} cm^{-2} towards the hub. Multiple density tracers such as HCN, HNC, HCO^+, C_2H are also detected using observations from the MALT90 survey pointing towards active star formation in the region.

Posters in Galaxies and Cosmology

ASI2026_363	Abhijeet Patil	Poster
Galaxies and Cosmology		
Detection prospects of 21-cm dark ages signal from the Moon		
Nearly 4,00,000 years after the Big Bang, the universe contained predominantly neutral hydrogen, and this period is known as the “cosmic dark ages”. 21-cm signal redshifts with the expansion of the Universe, and is expected to be detected in the frequency range of 5-45 MHz during the dark ages. The brightness of the redshifted line is predicted to be ~ 42 mK peaking at ~ 16MHz. The signal from the Dark Ages acts as a sensitive thermometer, potentially capable of constraining the exotic processes involved in explaining the physics of the period before star formation. It offers a unique probe to the standard cosmological model without the uncertainty of the first stars and galaxies. However, at these low frequencies, the foregrounds are extremely bright, T ~ 10,000 K at frequency ~ 30 MHz. The systematics introduced by the instrument itself pose a major challenge, making detection very difficult. Additionally, low-frequency radio astronomy is limited by severe ionospheric distortions below 50 MHz and complete reflection of radio waves below 10–30 MHz. Due to these cut-offs imposed by the ionosphere itself, Earth-based measurements are not possible. The far side of the Moon acts as a physical shield that isolates the lunar surface from radio interference/noises from Earth-based sources, the ionosphere, Earth-orbiting satellites, and the Sun’s radio noise during the lunar night. We investigate a range of instrument models, and assess their suitability for the dark ages signal. In particular, the instrument models include realistic performance in the presence of lunar regolith. The simulated foregrounds as seen by these instruments are then modeled using a Bayesian pipeline, leading to signal detection prospects using Bayesian Evidence. We finally compare the results of extracting the dark ages signal from a range of realistic telescopes and contrast these with elemental telescopes.		

ASI2026_596	Abishek Balakrishnan	Poster
Galaxies and Cosmology		
Formation of supermassive black holes		
Supermassive Black Holes (SMBHs) are believed to be at the center of all massive galaxies, as inferred from observations of Quasars over the years, which places a strong constraint of ∼ 10^9M⊙ at z ∼ 6 on these objects. However, how smaller progenitor seeds for these SMBHs are formed at high redshifts remains an open question. In this work, we investigate the formation of these seeds through the runaway collapse of a dense stellar system. We start with the formation of the dense stellar system itself through a spherical collapse model, which provides a rotationally supported structure that fragments and allows star formation. The evolution of this system is then followed as it contracts and undergoes core collapse, wherein a small region within the core of the system becomes so dense that the general relativistic instability kicks in and the whole region collapses dynamically to give a massive black hole. The system’s evolution is studied by doing a Fokker-Planck analysis in a general relativistic framework, along with solving the Einstein field equations for a non-static spherically symmetric metric describing the system. We provide an estimate for the mass of the seed black hole obtained and the total time for the collapse (and hence a formation redshift) for a set of different initial conditions that helps compare with observations. For a cluster core mass of M_c = 10^3M⊙, we obtain a seed M_seed = 800M⊙, while for a M_c = 10^4M⊙, a seed of M_seed = 5000M⊙ was formed, both within z ≥ 14. Furthermore, we demonstrate how this seed black hole grows through stellar capture and gas accretion using a mass-spin co-evolution model for the black hole. Our results compare well with the observations, including the latest high-redshift JWST objects.		

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ASI2026_844	Aminabi Thekkoth	Poster

Galaxies and Cosmology

Revisiting the Morphological Properties of FR II Quasars through uGMRT Observations

Extended radio AGN are classified as FRI or FRII, where FR II sources consist of a core, collimated jets, large lobes, and bright hotspots at the lobe edges. In some systems, an older pair of outer lobes is also seen, indicating a previous activity episode. A few FRIIs additionally show faint, diffuse emission along a secondary axis, giving them a winged/X-shaped appearance. These features may arise from jet reorientation, instabilities in the accretion disk, or backflow of plasma from the hotspots. Sensitive low-frequency imaging is crucial to test the presence of these features.

In a recent study, Vaddi et al. (2019) analyzed VLA 1.4/5 GHz maps of 11 powerful FR II quasars along with radio galaxies to test orientation effects. The smaller inclination angles inferred for quasars, along with their higher core prominence, support orientation hypothesis. However, quasars also show larger lobe distortions, and the absence of correlations between misalignment angle and radio core prominence suggests intrinsic or environmental influences are significant. Low-frequency 150MHz images of 3C205, 3C208, 3C249, and 3C263 revealed faint extended and X-shaped emission missed in VLA maps. Likewise, GMRT 610 MHz observations of 3C336 and 3 249.1 exposed wing-like relic lobes beyond the 1.4GHz hotspots, pointing episodic activity or jet axis changes.

We are revisiting this study using uGMRT Band 3 and Band 4 observations to detect such features in detail. Initial imaging already shows extended low-frequency emission in some sources. With uGMRT's wide bandwidth, spectral-index mapping combined with VLA data will allow robust estimates of spectral parameters and help to quantify relic and newly restarted emission. We also plan to incorporate optical and X-ray images to explore the role of the surrounding environment and to test whether jet reorientation or environmental factors primarily shape the observed radio morphology.

ASI2026_1045	Amogh Srivastav	Poster

Galaxies and Cosmology

Robust Stellar Kinematics Analysis and New Unified Construction of Galactic Rotation Curve out to the Milky Way Virial Radius

We present a robust stellar-kinematic analysis of the Milky Way and construct a unified galactic rotation curve from ~5~kpc to the virial radius (~250~kpc), including tracers reaching the splashback radius to estimate the post-GAIA virial size and mass and constrain local dark matter density. We compile a homogenized 6D phase-space catalogue of ~4.5 million metal-poor disc and halo stars, combining \textit{Gaia}~DR3 astrometry with spectro-photometric distances and radial velocities from 18 surveys (DESI, SDSS-BOSS, LAMOST, etc.). By prioritizing high-purity tracers (Cepheids, RR Lyrae, blue horizontal-branch stars, and K-giants) across bright ($G<17$) and faint ($G>17$) regimes, we overcome \textit{Gaia}'s geometric parallax limitation beyond ~10~kpc, achieving median uncertainties of $\sim6\%$ in distance and $\sim0.05\%$ in radial velocity. Cross-survey matching is performed using a KD-tree-based multi-dimensional scheme, with duplicate measurements combined via weighted averaging. Survey-specific systematics are mitigated using the Three-Cornered Hat method, and the catalogue is externally validated against globular clusters, dwarf galaxies, and the Sagittarius stream.

Using the resultant homogenized dataset, we implement cylindrical and spherical Jeans equations alongside the tangent-point method and demonstrate that the inferred local dark matter density ρ_0 is critically sensitive to methodology, tracer selection, binning schemes, visible matter assumptions, LSR normalization, and solar motion, naturally explaining the wide literature range ($\rho_0 \sim 0.1$--0.9~GeV\,cm^{-3}). We also explore the scope of dark matter and baryonic velocity anisotropy using the full 6D phase-space information. Rotation curves are modeled via Bayesian nested sampling over eight parameters, adopting different physically motivated dark matter profiles (NFW, Burkert, Einasto, DK14, Dehnen) with baryonic components (stellar disc, gas, bulge); for the NFW halo, we constrain the virial mass M_{200} and concentration c_{200}. From posterior samples, we apply Eddington inversion to self-consistently reconstruct the local dark matter velocity distribution function at $R_\odot = 8.1$~kpc, providing data-driven phase-space inputs with full uncertainty propagation for WIMP direct-detection experiments.

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ASI2026_606	Anindya Ganguly	Poster
Galaxies and Cosmology		
Discovering (Un)Lensed Kilonovae in Rubin-LSST: Simulations and Detection Methodology		
Identification and characterisation of (un)lensed kilonovae (KNe) can be instrumental in improving our understanding of various aspects of cosmology and astrophysics, such as - measuring the Hubble constant, understanding the physics of the binary neutron star (BNS) merger, and studying the abundances of heavy nuclei elements. However, detecting (un)lensed KNe poses unique challenges due to their rarity and low brightness. Upcoming telescopes, such as Rubin-LSST -- with its deep imaging capabilities and wide field-of-view -- will provide a unique opportunity to observe these rare and faint transient events. Rubin-LSST will generate a deluge of data, making it essential to develop fast and efficient methods for identifying genuine (un)lensed events while minimizing false positives. To address this, we realistically simulate both unlensed and lensed KNe and test various strategies for efficiently detecting these events in the simulated light curve and image data. I will present the results of our latest simulations and detection methods.		

ASI2026_315	Anirban Chowdhary	Poster
Galaxies and Cosmology		
Halo Occupation Distribution of Quasars: Dependence on Luminosity, Redshift, Black Hole Mass and Feedback Modes		
The Halo Occupation Distribution (HOD) framework provides a key theoretical bridge between the observed clustering of active galactic nuclei (AGN) and the underlying dark matter halo population. Despite its widespread use, standard HOD prescriptions often assume weak or negligible redshift evolution, an assumption that remains poorly tested for luminous quasars. We use state-of-the-art cosmological hydrodynamic simulations, IllustrisTNG and SIMBA, to investigate the redshift, luminosity, and black hole mass dependence of quasar HODs. Across both simulations, we find that quasar activity is significantly suppressed at a characteristic halo mass scale of 10^13 solar mass, leading to a pronounced departure from commonly adopted HOD models. This quenching becomes increasingly significant at low redshifts for luminosity-selected quasar samples. We demonstrate that neglecting this effect can introduce substantial biases in clustering-based inferences of quasar host halo masses, with errors of up to an order of magnitude in the central occupation and tens of percent in the inferred satellite fraction. While the central occupation is strongly quenched, the satellite occupation retains a power-law–like form, resulting in a satellite fraction that increases monotonically toward low redshift. We also find that, in contrast to luminosity-selected quasars, the halo occupation of mass-selected supermassive black holes exhibits minimal redshift evolution and is well described by a step function plus power-law form, similar to that found for galaxies and low-luminosity AGN. By comparing different feedback implementations in SIMBA, we find that jet-mode feedback plays a central role in quenching central quasar activity. These results highlight the necessity of incorporating redshift-dependent and feedback-driven effects into HOD modeling, with important implications for the interpretation of host halo masses from AGN clustering in the context of forthcoming large-scale survey data. (arXiv:2508.08851v2)		

ASI2026_871	Aniruddha Chakraborty	Poster
Galaxies and Cosmology		
Identification of Wave-optics Lensed Gravitational Waves with Residual Cross-correlation		
The lensing of Gravitational Waves (GWs) due to intervening matter distribution in the universe can lead to chromatic signatures in the wave-optics limit. This makes it challenging to model for the mass distribution of the lens and hence requires a model-free lensing detection technique from GW data. Thus we develop the first model-independent wave-optics lensing search technique mu-GLANCE and deploy it on the GW events observed up to the fourth observation catalog GWTC-4 of LIGO-Virgo-KAGRA. The method tests residual strain for correlated features across the detector		

network via cross-correlation and infers lensing-induced modulations with a Bayesian framework. These unmodelled searches pick up one plausible candidate GW190408 with a slightly above threshold residual amplitude compared to the residual expected from detector noise. However, exploring the wave-optics lensing modulation signatures on this event, we do not find any conclusive evidence of the wave-optics lensing signal in the data. The recently discovered gravitational wave event, GW231123, known for its massive black hole components is hypothesized to be gravitationally lensed. However, our analysis finds no strong evidence for lensing in GW231123, but reveals a potential residual feature that could be consistent with wave-optics lensing. However, we find that waveform systematics for such heavy binary systems are sufficiently large to shadow the lensing signatures in short-duration signals like GW231123, preventing any definitive claim of lensing at this stage. We confidently rule out the presence of any statistically significant wave-optics lensing signal in the events up to GWTC-4.

ASI2026_435	Anisha Hazra	Poster
Galaxies and Cosmology		
Probing the Jet Power of the Blazar OJ 287 from Multiwavelength Broadband SED Modelling		

OJ 287 is one of the best-studied blazars and is well known for its strong and rapid variability across the electromagnetic spectrum. This makes it an excellent source for exploring how relativistic jets are formed, powered, and linked to the central supermassive black hole. In this work, we investigate the jet energetics of OJ 287 using detailed multiwavelength spectral energy distribution (SED) modelling based on quasi-simultaneous observations from the optical/UV to X-ray and high-energy bands.

The observed emission is interpreted within a one-zone leptonic framework using the composite spectral model tbabs * sscicon, where Galactic absorption is accounted for by tbabs and the intrinsic jet emission is produced via synchrotron and inverse Compton processes. To probe the nature of the underlying electron energy distribution and to test the robustness of the inferred jet parameters, we employ multiple spectral parameterizations, including log-parabolic and broken power-law forms, as well as energy-distribution–based accretion-dominated (EDA) and disk-dominated (EDD) scenarios. Both synchrotron self-Compton and external Compton processes are considered to reproduce the observed X-ray and high-energy emission.

By fitting the model to the data, we derive key physical parameters of the jet, including the magnetic field strength, emission region size, bulk Lorentz factor, Doppler factor, and the electron energy distribution. From the best-fitting models, we estimate the total jet power by decomposing it into contributions from relativistic electrons, cold protons, magnetic fields, and radiation output. Our results indicate that the jet of OJ 287 is highly efficient, with kinetic power dominated by relativistic particles and a substantial contribution from magnetic energy. The total jet power is comparable to or exceeds the accretion power inferred from optical–UV emission, supporting efficient jet launching mechanisms in supermassive black hole systems.

ASI2026_958	Anjali Bhatter	Poster
Galaxies and Cosmology		
Strongly Lensed Gravitational Waves as Probes of Lens Populations in Future Detectors		

Gravitational waves (GWs) from the inspiral and merger of compact objects are now routinely detected by the LIGO–Virgo–KAGRA (LVK) collaboration. As they propagate through the Universe, they are deflected by intervening massive structures (eg. galaxies), potentially resulting in multiple “images” of the same source, a phenomenon called strong gravitational lensing.These images exhibit characteristic time delays and relative magnifications that encode information about the lens population, such as their structure and distribution. Although no strongly lensed GW events have yet been confirmed, such detections are expected in the near future with increasing detector sensitivity. In this work, we model lenses using three commonly employed mass profiles: point mass (PM), singular isothermal sphere (SIS), and Navarro–Frenk–White (NFW) halos. For each model, we compute the expected rate of strongly lensed GW events, along with the distributions of image time delays and relative magnifications, for future observing scenarios including LIGO-VIRGO-KAGRA (LVK) O5, O6, and next-generation (XG) detectors. We then develop a Bayesian framework that combines these observables to infer the underlying lens model at different observational epochs. Our results show that the total number of detected strongly lensed events is sufficient to distinguish a PM lens population from extended mass distributions. However, for more realistic lenses such as SIS and NFW halos, the lensed event rates by itself are insufficient and incorporating time-delay and magnification information becomes crucial for model discrimination.

ASI2026_688	Ankita Sarkar	Poster
Galaxies and Cosmology		
Development and Optimization of Galaxy Group Finders for Modern Spectroscopic Surveys: Applications to DESI Data		

Galaxy groups are an important link between individual galaxies and the large scale structure of the Universe. Most galaxies do not live in isolation but reside in groups and clusters, which trace the underlying dark matter halos. Identifying galaxy groups is therefore crucial for understanding galaxy formation and evolution, halo occupation, and the growth of cosmic structure.

However, identifying galaxy groups in modern spectroscopic surveys is challenging. Surveys like the Dark Energy Spectroscopic Instrument (DESI) use fiber-fed instruments, which cannot observe very close galaxy pairs simultaneously due to fiber collision limits. This leads to missing galaxies in dense regions, causing biased group membership, underestimated group richness, and misclassification of central and satellite galaxies. Many traditional group finding algorithms are not designed to properly handle these effects.

In this poster, we focus on evaluating and improving galaxy group finders for modern spectroscopic surveys, with special attention to DESI. We study several existing approaches, with particular emphasis on NESSIE, a recently developed galaxy group finder. NESSIE is based on a Friends-of-Friends approach, where galaxy groups are identified using adaptive linking lengths, taking the sky coordinates and redshift of the galaxies as input.

To address fiber collision effects, we test the group finder using realistic DESI mock catalogues that include survey geometry, selection effects, and fiber collision information. By comparing recovered groups with true halo properties in simulations, we quantify the impact of fiber collisions on group completeness and purity and develop improvements to reduce biases caused by missing galaxies.

Thus this poster aims to produce validated galaxy group catalogues tailored to DESI systematics, enabling robust studies of galaxy environments and large-scale structure.

ASI2026_87	Anoop Krishna	Poster
Galaxies and Cosmology		
Improving 21-cm Signal Inference with Machine Learning and Higher-Order Statistics		

The redshifted 21-cm emission from neutral hydrogen (HI)provides a powerful window into the early universe, particularly the Cosmic, Dark Ages and the Epoch of Reionization (EoR). Detecting this signal is highly challenging, as it is both extremely weak and strongly obscured by foreground radiation from bright astrophysical sources. To address these difficulties, one typically relies on the statistical properties of the 21-cm fluctuations to extract astrophysical and cosmological information. In this work, we make use of machine learning methods to efficiently generate large ensembles of simulations and employ Markov Chain Monte Carlo (MCMC) techniques to constrain the evolution of the neutral hydrogen fraction. Although much of the existing work has been limited to the power spectrum as a first-order statistic, this approach does not capture the full information contained in the signal. By extending the analysis to higher-order measures such as the bispectrum, we demonstrate improved accuracy in parameter estimation and gain a more comprehensive understanding of the reionization process.

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ASI2026_113	Anshul Srivastava	Poster
	Galaxies and Cosmology	
	AstroSat-UVIT Study of Star Formation in Interacting Galaxies of Hickson Compact Groups	

Star formation in galaxies within compact group environments provides valuable insight into the role of interactions and mergers in galaxy evolution. We present a far-ultraviolet (FUV) study of interacting systems in Hickson Compact Groups (HCGs) using high-resolution imaging from the Ultra Violet Imaging Telescope (UVIT) onboard AstroSat. The primary focus of this work is HCG 77, with the analysis extended to additional compact groups including HCG 68, HCG 56, and HCG 92 (Stephan's Quintet). The superior spatial resolution of UVIT compared to earlier ultraviolet surveys such as GALEX enables a detailed investigation of compact star-forming regions and diffuse tidal structures in these dense environments.

In HCG 77, which includes the galaxies PGC 56121 and PGC 56125, the FUV emission reveals several localized regions of recent star formation associated with tidal features. Photometric measurements and FUV contour analysis are used to examine the distribution and properties of star-forming knots across the system. We find evidence for a structure at the end of a tidal feature extending from PGC 56121, whose properties are consistent with those expected for a tidal dwarf galaxy candidate. Color differences between the tidal feature and the parent galaxy further suggest recent star formation linked to interaction-driven processes.

Spectral energy distribution (SED) analysis based on multiwavelength archival data is employed to place broad constraints on stellar mass, dust content, luminosity, and star formation activity. The HCG 77 system studied is generally consistent with low-mass galaxies showing signs of enhanced star formation influenced by their group environment. Extending this UVIT-based approach to other HCGs allows a comparative study of star formation and tidal activity across compact groups at different stages of interaction, highlighting the role of group dynamics in shaping galaxy evolution.

ASI2026_735	Anshuman Borgohain	Poster
	Galaxies and Cosmology	
	Bulges and Spheroids at Cosmic Dawn: Uncovering Structural Assembly at z>6 with JWST	

The rich morphological features observed in present-day galaxies emerge as the collective outcome of various physical processes such as rapid dissipative collapse, mergers, dynamical rearrangement, and feedback, which operate over a wide range of timescales. Recent observations with the \textit{James Webb Space Telescope (JWST)}, however, have revealed indications of structural maturity at epochs previously thought to be too early for such complexity. Thus, the epoch at which, and the mechanisms by which, these structures first assembled remain poorly constrained. In this talk, I present results from deep JWST imaging of spectroscopically confirmed galaxies at z>6, demonstrating that distinct bulge and disk components were already beginning to emerge at these early times. We perform detailed morphological modeling of 190 galaxies and identify 20 systems that are well described by a compact inner Sersic component and an underlying exponential disk. These galaxies exhibit high bulge-to-total light ratios (B/T~0.47) and central stellar mass surface densities ($\sim 2.8 \times 10^{8},M_\odot,\mathrm{kpc}^{-2}$), comparable to those of local quiescent galaxies, indicating rapid central mass assembly. We then extend the analysis to spheroidal systems in the sample and discuss their structural properties in the context of present-day galaxy scaling relations. Together, our findings suggest that the assembly of bulges and spheroids is already well underway by z~6, with important implications for the drivers of early structural assembly and the origin of compact quiescent galaxies observed at z~4-5.

ASI2026_780	Anshuman Tripathi	Poster
Galaxies and Cosmology		
Robust Machine Learning Pipelines for 21-cm Signal Recovery Under Realistic Observational Conditions		

The Cosmic Dawn (CD) and the Epoch of Reionization (EoR) mark pivotal stages in the early evolution of the Universe, occurring within the first billion years after the Big Bang. Despite their importance, the physical properties of the intergalactic medium (IGM) during these epochs remain poorly constrained by observations. Current and forthcoming low-frequency radio experiments, such as EDGES, SARAS, MWA, and the SKA, aim to detect the redshifted 21-cm signal from neutral hydrogen. However, these efforts are challenged by severe foreground contamination, instrumental systematics, and the complexity of accurate foreground removal. Further complications arise from the Earth's ionosphere, which introduces frequency-dependent distortions and beam chromatic effects that significantly impede the detection of the global 21-cm signal. Accurate modelling of these ionospheric effects requires accounting for processes such as refraction, absorption, and thermal emission.

To overcome these challenges, it is crucial to assess the impact of each source of corruption when applying non-parametric signal-recovery methods. In this work, we are developing a robust machine-learning–based regression framework to recover global 21-cm signal parameters from sky-averaged observations that include contributions from astrophysical foregrounds, ionospheric distortions, and instrumental beam chromaticity. The framework also emphasizes the identification of optimal machine-learning models based on a balance between computational efficiency and predictive performance. Overall, this approach shows strong potential to improve ground-based global 21-cm experiments by enabling reliable signal recovery across both the Cosmic Dawn and the Epoch of Reionization, thereby offering new insights into the early Universe.

ASI2026_1036	Aratrik Basu	Poster
Galaxies and Cosmology		
Chandra and multiwavelength observations of NGC 4321 to study the X-ray binary population and hot gas		

NGC 4321 (M100, distance ~ 15.2 Mpc) is a barred spiral galaxy that is a part of the PHANGS Survey (Physics at High Angular resolution in Nearby GalaxieS), which aims to study nearby (distance < 23 Mpc) galaxies in high resolution using multiwavelength data to investigate how global scaling relations behave at local, sub-galactic scales. We use archival Chandra X-ray observations of the diffuse hot gas and X-ray binary population of NGC 4321, studying them in comparison with AstroSat UVIT FUV observations and

HST archival data. We create diffuse X-ray emission maps by removing the point sources, and study the distribution of the diffuse X-ray emission against the Hα map from HST (which traces recent star formation) and the bright clumps identified in the FUV image (which traces star formation on a longer timescale), finding that the correlation is strongest in the nucleus of the galaxy where most of the X-ray gas is concentrated, along with some correlation in the southern arm. We find that the X-ray spectra of the diffuse gas in the central region and the southern spiral arm can be modelled by two-temperature thermal plasmas (kT ~ 0.2 keV and 0.6 keV for the central region, and kT ~ 0.2 keV and 0.8 keV for the spiral arm). We also identify ~ 74 point sources, among which 13 have been identified in a previous study as ultra-luminous X-ray sources (ULXs). We inspect the spectra of some of these point sources as well. Further analyses will aim to investigate the energetics of the diffuse hot X-ray emitting gas in the ISM, studied in relation to star formation traced by FUV and Hα to better understand how feedback processes affect the baryon and energy cycles of galaxies.

ASI2026_714	Arya Venugopal	Poster
Galaxies and Cosmology		
Star formation characteristics of LINER type AGN using UVIT observations		
The majority of massive galaxies in the Universe are known to host massive black holes at their centres. Accretion of matter onto these supermassive black holes triggers AGN activity, resulting in the release of enormous amounts of energy. This energy output can significantly influence the evolution of the host galaxy. Over the past decade growing observational evidence has revealed a close connection between galaxy evolution and black hole growth. In particular the presence of AGN can alter the star formation processes in their host galaxies via feedback processes. Therefore, understanding the connection between nuclear activity and star formation in galaxies is an important problem in astrophysics today. While the impact of AGN feedback on star formation has been investigated in few massive ellipticals and to a limited extent in dwarf systems, its influence on Low-Ionization Nuclear Emission-line Region (LINER) sources is not yet explored. To address this gap, we have carried out a systematic study of the star formation characteristics of a sample of LINERs. The Observational data for the sample were obtained using the Ultra Violet Imaging Telescope (UVIT) on board AstroSat. We derived key star formation parameters and examined their relation to various host galaxy properties. The results of this study will be presented at the meeting.		

ASI2026_740	Brenjit Hazarika	Poster
Galaxies and Cosmology		
UV Luminosity Function at $z \sim 9$ from JWST/CEERS and Dust Constraints from the UV Slope		
The rest-frame ultraviolet luminosity function of high-redshift galaxies provides a key observable for quantifying early galaxy growth and the build-up of the ultraviolet luminosity density during the reionization era. We are studying the evolution of the ultraviolet galaxy luminosity function for galaxies at $z \gtrsim 7.5$ using publicly available James Webb Space Telescope Near-Infrared (NIRCam) imaging from the Cosmic Evolution Early Release Science survey (CEERS). We identified 98 galaxy candidates in the redshift interval $z \simeq 8.5$–9.5 using Lyman-break color criteria, and after refining their redshifts using spectral energy distribution fitting to the multi-band photometry in 10 CEERS NIRCam pointings, covering ~ 90 arcmin2. We quantified incompleteness and selection bias using injection–recovery simulations to derive the ultraviolet luminosity function. We also investigated dust attenuation using the rest-frame ultraviolet continuum slope β and β – MUV relation to constrain how dust may influence the observed luminosity function, especially toward the bright end. We compare the observed β –MUV relation with predictions from new high-redshift galaxy simulations to test dust prescriptions relevant for JWST-era galaxy populations. We will extend this analysis to larger JWST survey areas to improve constraints on the evolution of the UV luminosity function and the corresponding UV luminosity density, which provides an empirical input for reionization-era models.		

ASI2026_878	Chavan Mohan Shende	Poster
Galaxies and Cosmology		
Properties of Halos and their Substructures in self-interacting dark matter Cosmological Simulations		
We study self-interacting dark matter (SIDM) models by exploring the formation and evolution of large-scale structures in such models using N-Body simulations. We aim to investigate observable effects of dark matter-dark matter scattering for different scattering cross-sections in a cosmological simulation. We are using the Gadget-2 code, which we modified to incorporate interactions between dark matter particles for this study. We consider both velocity-dependent and velocity-independent scattering events in an isotropic scattering scenario. We present results in the form of characteristics of halos and subhalos, focusing on the halo density profile and shape, subhalo mass function, and subhalo distribution within the larger halos. We highlight the observational inputs that can be used to put limits on the scattering cross-section.		

ASI2026_322	Debarshi Mukherjee	Poster
Galaxies and Cosmology		
Model Independent Primordial Power Spectrum Reconstruction from CMB Temperature Spectrum		
The primordial power spectrum (PPS) sourced from cosmological inflation provides a direct probe of the physical processes operating in the early universe. Recovering this information from the cosmic microwave background (CMB) observations is an intrinsically ill-posed inverse problem in the context of a non-parametric reconstruction, further limited by cosmic variance, instrumental noise, and the smoothing effects of radiative transfer. In this work, we present a non-parametric reconstruction of the PPS using the Non-linear Iterative Richardson-Lucy (NIRL) method. Unlike conventional iterative deconvolution techniques, NIRL recasts the Richardson–Lucy estimator into a single-step formulation to handle nonlinear biases as well as optimize the uniqueness of the solution. The method constructs the PPS directly from the CMB temperature angular power spectrum without assuming any inflationary model, lensing template, or predefined functional form. Tests on simulated CMB spectra with Planck-like noise show that NIRL reliably recovers both smooth trends and localized features while remaining stable under realistic uncertainties. Our work demonstrates that NIRL offers a simple, robust, and physically transparent route for model-independent studies of primordial perturbations and their cosmological implications.		

ASI2026_23	Debasish Mondal	Poster
Galaxies and Cosmology		
Machine learning based classification schemes for H I 21-cm absorbers		
H I 21-cm absorption traces cold atomic gas and may originate either in intervening galaxies or be associated with the background radio source. Since optical spectroscopy cannot feasibly classify the same for the large numbers of detections from blind surveys, we explore a machine-learning (ML) approach. Using 118 known H I 21-cm absorbers and spectral parameters from the Busy function fits, we train six ML models and find that a random forest provides the best performance (accuracy 89%, F1 = 0.9, AUC = 0.94). The linewidth parameter (w20) emerges as the most significant spectral feature. Moreover, a simplified random forest model using only w20 and the integrated optical depth performs nearly as well (accuracy 88%, F1 = 0.88, AUC = 0.91). Applying this model to 30 new absorbers from recent blind surveys (e.g. FLASH) demonstrates its utility for future large H I surveys with the Square Kilometre Array.		

ASI2026_1064	Debbijoy Bhattacharya	Poster
Galaxies and Cosmology		
Probing AGN feedback on star formation in nearby galaxies with AstroSat-UVIT		
Active galactic nuclei (AGNs) can influence the physical properties of their host galaxies through processes collectively known as AGN feedback. Though theoretical models/simulations suggest a significant impact of AGN activity on the host galaxy, direct observational evidence linking AGN feedback to star formation, particularly in nearby galaxies, remains limited. We primarily utilized high-resolution observations from the UltraViolet Imaging Telescope (UVIT) onboard AstroSat to investigate the possible role of radiative-mode AGN feedback on the star formation properties of the host galaxy. Given the low background counts in UVIT images, we implemented a source detection method that explicitly accounts for the Poisson nature of the UV background. This approach efficiently detects fainter sources compared to conventional methods used for UVIT source detection, yielding 15–90% more sources. Applying this technique, we detected star-forming knots in six AGN-host and four non-AGN barred spiral galaxies to examine the influence of radiative-mode AGN feedback on star formation. We have noticed that the surface densities of the star formation rate and FUV attenuation for the knots decline less rapidly in the outskirts of AGN host galaxies compared to non-AGN galaxies. These results suggest a possible radiative mode positive AGN feedback in the outer disks of low-luminosity AGNs, highlighting a potential role of AGN activity in regulating star formation on galactic scales. Part of this work has been published as B. Ananthamoorthy, D. Bhattacharya et al., 2024, AJ, 168, 22, and B. Ananthamoorthy, D. Bhattacharya et al., 2025, PASA, 42, e154.		

ASI2026_276	DEVIKA P C	Poster
Galaxies and Cosmology		
Evidence of diffuse radio emission from a galaxy group falling into a node of the cosmic web		
Diffuse radio emission provides a powerful probe of non-thermal processes occurring in galaxy clusters and groups, which will contribute to the understanding of hierarchical structure formation along the cosmic web. While such emission is well studied in massive merging clusters, its presence and origin in low-mass systems are poorly understood. According to our hypothesis, low-mass clusters or galaxy groups infalling toward a central massive cluster are expected to host large-scale diffuse radio emission generated by dynamical activity arising from their interaction. So here we are, presenting low-frequency radio analysis of the dynamically complex Abell 2069 system, focusing on its low-mass companion (A2069B), which is interacting with the massive cluster Abell 2069A. Using archival uGMRT Band-3 (300–500 MHz) data combined with 144 MHz LOFAR LoTSS-DR2 images, we investigate the nature and extent of diffuse radio emission associated with both components. We detect large-scale diffuse synchrotron emission associated with A2069B, extending over ~370 kpc—significantly larger than typical radio mini-halos observed in low-mass systems. The integrated spectral index measured between 144 and 400 MHz is $\alpha \approx -1.2$, confirming the diffuse emission is of intra-cluster medium origin. The emission spatially coincides with the galaxy concentration and X-ray emission, indicating a strong connection between the observed radio emission and ongoing dynamical activity. Our results suggest that turbulence generated by the infall of a galaxy group/low-mass cluster along cosmic filaments can efficiently re-accelerate relativistic particles well before core passage. This study highlights infalling groups as important sites of particle acceleration and demonstrates the critical role of lo		

ASI2026_268	Dweepsa Das	Poster
Galaxies and Cosmology		
Constraints on the thermodynamics of galaxy clusters using joint Sunyaev-Zel'dovich and X-ray analysis		
AGN feedback has been considered a key to understanding the cosmic evolution of structures in the Universe. In this work, we utilize the Illustris TNG suite of simulations to investigate the impact of AGN feedback on the thermodynamics of galaxy clusters. We perform a joint fitting of the Sunyaev-Zel'dovich and X-ray signals by combining mock observations from the Atacama Large Millimeter/submillimeter Array (ALMA) and ATHENA/WFI to constrain the thermodynamic properties of the intergalactic medium (IGM) and the intracluster medium (ICM). We propose to use the resulting deprojected radial profiles of electron density, temperature, and pressure to benchmark cosmological volume simulations against real observations obtained from joint ALMA and Chandra analyses. This comparison provides a quantitative test of how efficiently different AGN feedback models redistribute energy and baryons across multiple spatial scales, thereby constraining the impact of different AGN feedback prescriptions on galaxy evolution. Building on previous results obtained from SIMBA (Kar Chowdhury et al., 2022; Chakraborty et al., 2023), we also aim to understand which feedback models best reproduce observed cluster properties, thereby improving the feedback prescriptions used in future cosmological, hydrodynamical simulations.		

ASI2026_1040	Eshna Roy	Poster
Galaxies and Cosmology		
Star formation analysis in the interacting galaxy system NGC 6872 and IC 4970 using AstroSat UVIT		
NGC 6872, also known as the Condor galaxy, is a large barred spiral galaxy in the Pavo constellation. It is of the type SBb pec, located at a distance of 65 Mpc from the Earth. It is in close interaction with IC 4970, which is a small unbarred lenticular galaxy. We present our analysis of this system using archival data obtained from the UltraViolet Imaging Telescope (UVIT) aboard the AstroSat space observatory. The data analysed were obtained in six filters of the		

UVIT, namely - F154W, F169M, F172M in the FUV and N219M, N245M and N279N in the NUV channel. We present the differences between images of the galaxy system in the FUV, NUV, optical and IR filters, and study the underlying reasons.
Using photometry, we present the star formation rates (SFRs) in the large number of star forming regions identified in the galaxy. We also present the spectral energy distributions (SED) of the galaxies, and use it to infer SFR, specific SFR, the stellar mass and the dust mass of the entire galaxy and its neighbour. Finally, we investigate whether the interaction between NGC 7872 and IC 4790 is responsible for triggering or quenching star formation in the larger galaxy, or if it has no major effect on it.

ASI2026_638	Gahan Chattopadhyay	Poster
Galaxies and Cosmology		
On the Emergence of Einstein Gravity from f(R) Gravity by Cosmological Evolution		

f (R)-Gravity, a simple generalization of Einstein's General theory of Relativity has been considered in the context of Cosmology as one of the approaches to explain phenomena such as early-time inflation and late-time accelerated expansion of the Universe purely from the Gravity sector. In this work, we have considered a class of f (R)-Gravity theories with f (R) = R + αR^n and it's dual scalar tensor theory in the Einstein frame. We have shown that in an isotropic and homogeneous background, for both positive and negative integral values of n, the extra scalar degree of freedom of the f (R)-theory (manifested as the scalar field in the Einstein frame action) dynamically freezes out due to cosmological evolution, resulting in the survival of only the Einstein-Hilbert term and a cosmological constant at most. This implies that all gravity models given as R + αR^n inevitably evolve into pure Einstein gravity with a cosmological constant term through cosmological evolution.

ASI2026_425	Gautam Das	Poster
Galaxies and Cosmology		
Matter power spectrum at early epochs using LPT re-expansion		

Current and future surveys aim to map the large scale structure with unprecedented accuracy. Predicting the nonlinear matter distribution in large-scale structure surveys requires balancing theoretical accuracy against computational feasibility. While Numerical Simulations are fairly accurate, they are slow and shot noise limited.
Lagrangian Perturbation Theory (LPT) provides an alternative perturbative description which involves expanding the particle displacement in powers of the initial density field. The late-time
density and velocity are calculated from the evolved displacement. Usually, LPT is applied at first order (Zeldovich approximation) or at second order (2LPT) to set up N-body initial conditions [1]. However, LPT is known to have a finite time of validity for spherically expanding voids [2]; a multi-step re-expansion scheme has been proposed to overcome this limitation [3,4]. In this work, we validate this scheme by comparing with N-body simulations and show that when compared to a single step LPT scheme, the LPT re-expansion scheme gives a more accurate reproduction of the matter power spectrum on quasi-linear scales at early epoch.

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ASI2026_632	GAYATHRI C J	Poster
Galaxies and Cosmology		
Spectral Decomposition of Selected BAL Quasars: Temporal Variations and Inter- Component Correlations.		

Active galactic nuclei (AGNs), powered by accretion onto supermassive black holes, represent the highly energetic centres of massive galaxies. Their extreme luminosities enable detailed observational studies even at high redshifts, providing critical insights into galaxy evolution across cosmic time. Quasar outflows, identified through blueshifted emission and absorption line features, are widely considered manifestations of AGN feedback, a process capable of regulating the energy and momentum budget of the host galaxy. In this study, we investigate the nature of emission and absorption outflows in broad absorption line (BAL) quasars, with particular emphasis on high-velocity C IV emission and absorption features. We analyse multi-epoch spectra of selected sources drawn from a sample of 126 BAL quasars observed as part of the Sloan Digital Sky Survey Data Release 16 Reverberation Mapping (SDSS DR16 RM) program and the Sloan Digital Sky Survey Data Release 19 Black Hole Mapper (SDSS DR19 BHM) program. Spectral decomposition and continuum fitting are performed using the Bayesian AGN Decomposition Analysis for SDSS Spectra (BADASS), an open-source tool optimized for detailed modelling of SDSS spectra. Emission-line strengths are obtained from the decomposition, while absorption strengths are computed independently. A strong correlation between blue-shifted emission and absorption variability would favour a smooth, well-collimated outflow geometry with relatively uniform density, ionization state, and velocity structure, as both components would respond coherently to changes in the ionizing continuum. Conversely, a weakened or absent correlation would indicate a clumpy outflow structure. Additional effects such as light-travel-time delays, ionization stratification, and density or velocity gradients may further dilute the observed correlations.Overall, this study aims to constrain the physical nature and geometry of quasar outflows and to place meaningful limits on their opening angles, thereby improving our understanding of AGN-driven feedback mechanisms.Results will be presented at the meeting.

ASI2026_72	Geetanjali Sethi	Poster
Galaxies and Cosmology		
Variable Chaplygin Gas: Cosmological Constraints		

The Variable Chaplygin Gas (VCG) model has been extensively explored as a unified framework for dark matter and dark energy, offering a dynamical alternative to the standard ΛCDM paradigm. Over the past several years, a broad range of observational probes have been employed to test the viability of this model at the level of background cosmology. In this review, we present a consolidated overview of constraints on the VCG model obtained from Type Ia supernovae, gamma-ray bursts, baryon acoustic oscillations, Hubble parameter measurements, fast radio bursts, and gravitational wave standard sirens.

Beyond summarising background-level constraints, we highlight the limitations of expansion-only probes in fully assessing the cosmological viability of unified dark sector models. In particular, the growth of cosmic structures and the evolution of linear perturbations provide critical tests that are sensitive to the underlying microphysics of dark energy models. Motivated by this, we discuss recent progress in extending the VCG framework to the perturbative regime and outline the role of structure growth observables in breaking degeneracies present in background analyses. Finally, we review emerging constraints from large-scale structure measurements, with particular emphasis on the growth parameter fσ8fσ8 derived from redshift-space distortion surveys. Recent observations from the Dark Energy Spectroscopic Instrument (DESI) represent a significant advancement in this direction, enabling high-precision tests of the VCG model at the perturbation level. This review thus provides a comprehensive account of the current status of Variable Chaplygin Gas cosmology, from background expansion to structure formation, and outlines future directions for testing unified dark sector models with next-generation surveys.

ASI2026_82	HITEN	Poster
Galaxies and Cosmology		
Primordial Magnetic Fields and Early Structure Formation: Implications for the High-Redshift 21 cm Signal		
Primordial magnetic fields (PMFs) can act as an additional source of small-scale density perturbations, thereby enhancing matter clustering at comoving wavenumbers that are significantly higher than those sourced by standard inflationary initial conditions. This excess small-scale power accelerates the collapse of low-mass dark matter halos, advances the onset of star formation, and can therefore modify the radiation backgrounds (Ly-α, X-ray, ionizing UV). The redshifted 21-cm signal from neutral hydrogen during Cosmic Dawn (CD) and the Epoch of Reionization (EoR) is a potential probe of this accelerated structure formation. We use N-body simulations to generate the halo abundance, which are the sites of the first luminous sources, to study the impact of PMFs on the 21-cm signal during the EoR. We find that stronger PMF contributions significantly enhance early halo formation, resulting in an earlier and faster reionization compared to the standard ΛCDM scenario. This ongoing work demonstrates that the 21-cm signal offers a promising avenue for constraining PMF models		

ASI2026_426	Indrajit Paul	Poster
Galaxies and Cosmology		
Tracing the Galactic Magnetic Field in Nearby Spiral Galaxies using VLA and Efflesberg telescope data.		
Magnetic fields play a crucial role in maintaining the structure and dynamics of galactic environments. On kiloparsec scales, galactic magnetic fields are ordered and consist of two components: a large-scale regular (mean) field and an anisotropic random field. Although magnetic fields cannot be measured directly, the ordered component produces polarized radio emission. By using multi-frequency radio polarization observations (Stokes Q and U parameters) between 3 cm and 20 cm from the Very Large Array (VLA) and the Effelsberg telescope, we can probe the magnetic field structure in the galactic plane through the polarization angle. The observed polarization angle has two contributions: an intrinsic component, which traces the orientation of the ordered magnetic field in the plane of the galaxy, and a Faraday rotation component, which depends on the line-of-sight component of the regular magnetic field. Assuming the contribution from the anisotropic random field to be negligible, we model the large-scale magnetic field using a Fourier decomposition in multiple concentric rings, spanning 6–14 kpc for M31 and 2.5–17.5 kpc for IC 342. Our analysis shows that the magnetic fields in both M31 and IC 342 are dominated by the axisymmetric (m = 0) mode. However, higher-order modes are also present, capturing localized variations in the field structure (m = 1, 2, 3 for M31 and m = 1 for IC 342). Notably, the modeled magnetic field successfully reproduces not only the intrinsic polarization angles but also the Faraday rotation component. This result suggests either that the anisotropic random field is significantly weaker than the regular field, contrary to earlier findings (e.g., Beck et al. 2019), or it is preferentially aligned with the regular magnetic field. These findings place strong new constraints on the role of anisotropic turbulence in spiral galaxies and provide critical observational input for refining large-scale galactic dynamo models.		

ASI2026_308	J Saranya	Poster
Galaxies and Cosmology		
Identifying warped disk galaxies with machine learning		
Galaxies observed edge-on allow the study of the vertical distribution of stars, gas and dust, revealing features such as warps. Disk warps are observed in nearly 50% of nearby spiral galaxies and are thought to arise from several formation and evolutionary processes. However, since warps are faint and occur at large galactocentric radii, their origin and evolution remain poorly understood. In this work, we present a supervised deep learning approach to identify warped edge-on galaxies from the Pan-STARRS EGIPS survey. The dataset consists of 5,812 galaxies selected with inclination angles close to 90 degrees. The images were aligned with their position angles and warp angles are measured to generate reliable labels. We use Zoobot, which provides pretrained deep learning models designed for galaxy morphology analysis. The network is fine-		

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tuned for warp classification in edge-on galaxies. Grad-CAM is used as an explainable AI technique to generate heatmaps linking model predictions to physically meaningful galaxy features.
Initial training using JPEG images showed limited improvement beyond 76% test accuracy. Ongoing work explores the use of FITS images, which are expected to better preserve faint structures such as warps. The results will be used to study the intrinsic and environmental properties of warped galaxies and to better understand their evolutionary status. With upcoming sky surveys and high-resolution telescopes, this approach can be used to detect faint disk warps and assist large-scale galaxy morphology studies.

ASI2026_71	Jahaan Thakkar	Poster
Galaxies and Cosmology		
Towards a consistent reionization inference from LAEs		

Lyman-Alpha emitting galaxies (LAEs) are widely used to probe the Epoch of Reionization (EoR), yet recent studies have reported a broad range of neutral-fraction (x_HI) estimates, reflecting differences in datasets, selection strategies, and modelling choices. These variations highlight the need to understand how sensitive LAE-based inferences are to the underlying assumptions of the model. In this talk, I will present our framework that combines large-scale semi-numerical simulations from 21cmFAST with a fiducial LAE model to generate mock LAE populations across $z \sim 5$–14. Intergalactic attenuation is modelled through sightline-based radiative-transfer calculations, and the resulting luminosity functions are compared with recent JWST and Subaru/HSC measurements to infer the evolving neutral fraction. To assess the reliability of these inferences, we explore how the predicted luminosity functions and x_HI constraints respond to variations in key LAE model ingredients, including intrinsic Lyman-Alpha line widths, velocity offsets, UV continuum slopes, and equivalent-width distributions. This sensitivity analysis provides insight into which physical assumptions most strongly influence LAE observability during reionization and helps clarify how differing modelling choices across the literature may contribute to the diversity of reported x_HI values. Our results offer a more transparent understanding of the robustness of LAE-based probes and the extent to which current conclusions about the timing and progression of reionization remain stable.

ASI2026_240	Jatin Tekani	Poster
Galaxies and Cosmology		
Photometric Metallicity Map estimation of the SMC using Gaia DR3		

Metallicity maps and the estimation of radial metallicity gradients are essential for understanding the chemical evolution and formation history of galaxies. Due to its proximity, low metallicity, well-resolved stellar populations, and a history of interaction with the Large Magellanic Cloud and the Milky Way, the Small Magellanic Cloud (SMC) provides an excellent environment for studying the constraints on dwarf galaxy evolution and interaction-driven chemical enrichment. Photometric metallicity indices derived from large-area sky surveys of the SMC, calibrated with spectroscopic data provide an advantage of covering large radial distances ($\gtrsim$ 5 degrees) to estimate high-spatial resolution ($\approx$ 9 x 9 square arcmin or 150 x 150 square parsec) metallicity maps, and radial metallicity gradients from the central region (bar) to outer peripheries that host critical signatures of its interaction history. In this work, we utilise the curvature of the red giant branch (RGB) identified in the Gaia DR3 colour-magnitude diagram (CMD) of small regions in the SMC as an indicator of the mean metallicity of that region. We adapt earlier approaches on photometric metallicity maps in terms of identifying RGB stars in this galaxy from the CMD, use parallax and proper motion and photometric quality cuts and offer improvement in estimating its curvature using a least-squares fit technique, while aiming to correct for the effects of reddening and age variations on metallicity estimates compared with past studies. We calibrate the photometric indices (RGB curvature) using [Fe/H] estimates from Gaia DR3-XP low-resolution spectra and archival spectroscopic data. We will highlight the technique and some of the findings from this ongoing study.

ASI2026_785	Jyoti Prakash	Poster
Galaxies and Cosmology		
Building from a break-up: Non-classical dwarf galaxies at the extremities and tidal bridge in the Galaxy Arp 105		
Galaxy–galaxy interaction and merger remnants provide an ideal laboratory for studying the formation of tidal debris and tidal dwarf galaxies (TDGs). Since TDGs form from baryonic material stripped from interacting parent galaxies, they are expected to contain little or no dark matter, although observational constraints remain limited. We present a multi-wavelength (far-ultraviolet to infrared) analysis of two tidal dwarf galaxy candidates and a tidal bridge in the interacting system Arp 105 at z = 0.029 in the Abell 1185 cluster. Far-ultraviolet observations obtained with the Ultraviolet Imaging Telescope aboard AstroSat reveal strong FUV emission from the tidal features Arp 105N and Arp 105S, indicating recent star formation. In Arp 105N, strong nebular emission lines and large equivalent widths (EW $(H\alpha)$ = 77.6 ± 1.3 ˚A and EW $(H\ \beta)$ = 15.8 ± 1.7 ˚A) imply a dominant starburst age of ∼6-10 Myr under an instantaneous-burst assumption, while the FUV emission suggests star formation sustained over the past several tens of Myr. In addition to this young stellar component, Arp 105N shows evidence for an older stellar population through the detection of Na D2 λ5890 ˚A stellar absorption, indicating a composite stellar population inherited from the parent galaxy and formed in situ. Spectral energy distribution modeling yields stellar masses of 5.7 × 109, 0.8 × 109, and 3.4 × 109, M⊙ for Arp 105N, Arp 105S, and the tidal bridge, respectively. Using the virial theorem and a stellar velocity dispersion corrected for instrumental broadening, σtrue,LOS = (67.0 ± 1.7), km s−1, we estimate a dynamical mass of Mdyn,105N (4Re) = (1.8 ± 0.1) × 1010 $M\odot$. The resulting dynamical-to-baryonic mass ratio of ∼1.5, together with the relatively high metallicity (∼ 2/3, $Z\odot$), is consistent with expectations for a tidal dwarf galaxy with little or no dark matter.		

ASI2026_336	Kanan Virkar	Poster
Galaxies and Cosmology		
Primordial Physics Signatures in 21 cm Signal using Morphological Statistics		
The 21 cm signal from cosmic dawn and the Epoch of Reionization (EoR) encodes important information about both astrophysical processes and primordial physics, such as inflation. In this work, we use morphological statistics to explore the 21 cm signal's sensitivity to inflationary features and EoR dynamics simultaneously. Focusing on primordial features from particle production during inflation we run semi-numerical simulations of the 21 cm signal across redshifts, incorporating these features. Using Minkowski Functionals (MFs), we analyze the morphology of 21 cm fields: density, neutral hydrogen fraction, spin temperature, and brightness temperature. Our results show that MFs can robustly identify inflationary features and distinguish bump models from standard ones. We also explore various EoR scenarios, demonstrating that combining MFs across redshifts helps disentangle primordial signals from EoR effects. This approach opens new avenues for probing inflation with upcoming 21 cm surveys.		

ASI2026_928	Kaustav Bhattacharjee	Poster
Galaxies and Cosmology		
Observations of the 21 cm HI Line from the Milky Way galaxy using a Pyramidal Horn Radio Telescope		
We present the design, implementation, and operation of a pyramidal horn radio telescope built for detecting the Galactic 21 cm neutral hydrogen line emission. The system employs an Software Defined Radio-based pipeline to obtain drift-scan observations, which were calibrated and processed to generate HI line full-sky maps, a Galactic rotation curve upto 8 kpc, and spiral arm features. This demonstrates that this low-cost system is effective both for educational purposes and scientific exploration of Galactic structure at radio frequencies.		

ASI2026_848	Khundongbam Roshan Chenglei	Poster
	Galaxies and Cosmology	
	Investigation on the nature of UV Variability in Fairall 9 Seyfert 1 Active Galaxy	

Active Galactic Nuclei (AGNs) are characterized by strong variability across the electromagnetic spectrum, reflecting complex physical processes taking place in their central regions. In this study, we investigate the nature of the ultraviolet (UV) variability properties of the Seyfert 1 galaxy Fairall 9 using archival data from the International Ultraviolet Explorer (IUE). The analysis focuses on both continuum and prominent emission lines within the wavelength range 1000–3500 Å, covering a long-term monitoring period from 18 June 1978 to 26 December 1994 and an intensive short-term campaign from 28 April 1994 to 26 December 1994. The IUE data were processed using IRAF and IUE Tools to extract calibrated fluxes and derive parameters such as central wavelength, line flux, equivalent width, and full width at half maximum (FWHM) for major UV lines such as Lyα+NV, Si IV, and C IV. Continuum fluxes were measured in UV windows (1325–1375 Å, 1425–1475 Å, and 1800–1850 Å) and analyzed using python codes developed for calculating variability parameters Rmax and Fvar 3.268 ±0.009,2.833±0.008, 2.824±0.007 and 0.364±0.00016,0.326±0.00015,0.316±0.00009 in short-term campaign while 10.324±0.032,9.448±0.025,7.812 ±0.015 and 0.603±0.00012,0.569±0.00012,0.316±0.00009 during long-term monitoring. The results reveal significant variability in both continuum and emission line fluxes, with emission lines showing comparatively higher amplitude variations. The continuum fluxes at different UV windows exhibit strong correlations among themselves, indicating coherent variability. The mean UV spectral index value ($\alpha = -0.96 \pm 0.32$) implies mild steepening toward shorter wavelengths. These results are consistent with earlier studies on other Seyfert 1 galaxies such as NGC 4151, NGC 5548, and 3C 390.3, confirming that Fairall 9 too exhibit similar variability. This study contributes to a deeper understanding of the UV variability behavior and accretion dynamics in Seyfert 1 galaxies.

Key words: Seyfert 1 galaxy, UV fluxes, emission lines, variability, and active galaxies.

ASI2026_1032	Khushi Jirawala	Poster
	Galaxies and Cosmology	
	The Impact of X-ray and Radio Variability on the Fundamental Plane of Black Hole Activity	

We present the analysis of the fundamental plane of supermassive black hole accretion, an empirical correlation between black hole mass (MBH), radio continuum luminosity (LR), and 0.2–10.0 keV X-ray continuum luminosity (LX), which reflects the coupling between accretion processes and jet production. Although this relation has been widely studied, its dependence on the physical properties of active galactic nuclei (AGNs), particularly in the low-luminosity regime, remains poorly understood, and the role of variability is still largely unexplored. In this work, we investigate the stability of the fundamental plane using a carefully filtered sample of quasi-simultaneous, multi-epoch X-ray and radio observations. X-ray data are drawn from XMM-Newton and Chandra, while radio
measurements are obtained from VLA and VLBA. These datasets are cross-matched with the SDSS DR16 catalog to derive black hole mass estimates. X-ray and radio observations are matched within a 50-day time window to minimize long-term evolutionary effects while preserving sensitivity to correlated variability. The final sample comprises approximately 60 sources with multi-epoch coverage. We construct the fundamental plane using these quasi-simultaneous measurements and examine whether the established empirical relation holds consistently for individual sources across different epochs. By tracking source movement within the LR –LX –MBH parameter space, we assess deviations from the canonical relation and explore the impact of variability on the disc–jet connection,
providing new observational constraints on accretion and jet physics in AGNs.

ASI2026_122	Khushi Lalit	Poster
Galaxies and Cosmology		
Fast Bayesian Modelling of Group-Scale Strong Lenses with GIGA-Lens		

Strong gravitational lensing is a powerful probe of the mass distribution in the universe, but galaxy group-scale lenses remain relatively unexplored despite being more common than clusters. These systems are particularly important because baryonic matter and dark matter contribute comparably to the lensing signal, making them sensitive probes of galaxy–halo interactions. A major limitation in studying such systems is the high computational cost of traditional Markov Chain Monte Carlo (MCMC) based lens modeling, which can take many hours or days for a single group/cluster system. This becomes prohibitive given the large number of lenses already discovered and the ~10^5 new strong lenses expected from the Rubin Legacy Survey of Space and Time (LSST).

In this work, I investigate the applicability of GIGA-Lens, a GPU-accelerated Bayesian lens modelling framework, for fast and scalable modelling of group-scale strong lenses. Realistic mock lenses are generated using GLAFIC and analyzed using a three-stage inference pipeline consisting of maximum a posteriori optimization, stochastic variational inference, and Hamiltonian Monte Carlo sampling. The statistical reliability of the inferred parameters is assessed using probability–probability (P–P) plots.

I model a range of simulated group-scale lens systems with varying complexity. The most complex system analysed so far includes one central galaxy and four satellite galaxies, with an effective Einstein radius of ≈ 2.5", for which the Einstein radius is recovered without significant bias. I also develop a method to estimate an equivalent Einstein radius for group lenses, enabling direct comparison with observations.

ASI2026_607	MEEMIK ROY	Poster
Galaxies and Cosmology		
Bow Shock Kinematics and Mass Entrainment in Runaway Supermassive Black Hole Systems		

Supermassive black holes can be ejected from their host galaxies via gravitational-wave recoil or multi-body interactions. These Runaway Supermassive Blackholes (RSMBHs) travel through the circumgalactic medium (CGM) at supersonic velocities (v>1000 km/s), producing characteristic bow shock structures with complex kinematic signatures. Recent JWST observation of a 62 kpc linear feature RBH-1 at $z = 0.96$ (van Dokkum et al., 2025) reveal steep velocity gradients (about 600 km/s over 1 kpc) which are consistent with turbulent mixing of shocked gas with CGM through turbulent entrainment, a phenomenon demanding detailed theoretical characterization. While analytical models of bow shock structure provide qualitative interpretation of these observations, detailed hydrodynamical simulations are needed to connect observational signatures to the underlying physics of shock propagation and radiative cooling in the CGM. Notably, there is a severe scarcity of three-dimensional hydrodynamical simulations of RSMBH systems in the literature; existing theoretical work relies primarily on analytical approximations or simplified models that do not fully capture the interplay between shock dynamics, radiative cooling, and post-shock gas evolution at scales relevant to observations. We present three-dimensional hydrodynamical simulations using AthenaK code with radiative cooling to model bow shock kinematics, post-shock gas dynamics, and mass entrainment mechanisms in RSMBH systems. Our simulations examine shock geometry, velocity structure and the role of radiative cooling in post-shock thermodynamics. By systematically varying RSMBH mass, velocity, and CGM density, we establish scaling relations between RSMBH properties, bow shock morphology, kinematic signatures, and filament mass production. Our simulations provide quantitative predictions for shock velocity measurements, velocity gradients, and cooling signatures observables constraining the impact of runaway SMBH events in galaxy evolution.

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ASI2026_264	Milind Sarkar	Poster
Galaxies and Cosmology		
Dissecting Galaxy Structure and Quenching with Multi-Wavelength Morphologies in HSC		

Consistent multi-wavelength measurements of galaxy structure provide critical leverage for disentangling the processes driving galaxy evolution. Using posterior estimates of bulge-to-total light ratio, effective radius, and flux from the Galaxy Morphology Posterior Estimation Network (GaMPEN), we analyze one of the largest multi-band structural parameter catalogs to date - comprising about 2 million galaxies from the Hyper Suprime Cam Wide survey imaged in g, r, and i bands ($z < 0.75$, $m < 23$). The catalog's consistent measurements and well-defined uncertainties across bands enable us to probe subtle dependencies of morphology on wavelength, color, and environment. Leveraging this unprecedented sample size, we uncover weak and secondary correlations that have remained statistically insignificant in smaller datasets. We investigate trends such as wavelength-dependent size evolution, bulge-to-total variation distinguishing pseudo and classical bulges, and evidence for inside-out quenching - offering new insights into the interplay between structure, color, and environment in shaping galaxy evolution.

ASI2026_81	Mukesh Singh Bisht	Poster
Galaxies and Cosmology		
Revealing the Thermal and Chemical Inhomogeneity of the Milky Way's Hot Circumgalactic Medium		

The presence of virial-temperature gas ($\sim 10^6$ K) in the circumgalactic medium (CGM) of the Milky Way is relatively well established. However, the recent discovery of an even hotter temperature gas, known as ` super-virial' gas ($\sim 10^7$ K), is particularly intriguing. This gas has been detected in both X-ray emission and absorption. While the emitting super-virial gas covers nearly 80% of the sky, absorption detections remain limited to only a few sightlines, suggesting that its spatial distribution and origin are not yet well constrained. The emitting and absorbing components represent physically distinct gas phases: the emitting gas is commonly attributed to stellar-driven feedback from the Galactic disk, whereas the origin of the absorbing component remains unclear. Studying this gas along previously unexplored sightlines is therefore crucial for constraining its properties and understanding its role in the Milky Way CGM.

In this conference, I will present new X-ray absorption measurements of super-virial gas along two independent sightlines through the Milky Way CGM. Along the sightline toward PKS 2155–304, we detect MgXII and SiXIV absorption lines—unambiguous tracers of super-virial gas—together with several lower-ionization species. These observations reveal, for the first time, the presence of four distinct temperature phases along this sightline. We also detect super-virial gas along the sightline toward 3C 273, where X-ray absorption reveals three distinct temperature components, including a super-virial phase. These studies, including this work, show that the X-ray–absorbing super-virial gas is both thermally and chemically inhomogeneous and likely widespread, highlighting the need for detailed absorption studies along multiple lines of sight. These findings place new constraints on the multiphase structure of the Milky Way's CGM and demonstrate the importance of X-ray absorption in probing its hottest components.

ASI2026_85	Nabil Husain	Poster
Galaxies and Cosmology		
Feedback-Driven Heating of the ISM Across Galactic Environments in NGC 3627: A Multiwavelength View		

Studying how feedback shapes the multiphase interstellar medium (ISM) on local scales is essential for understanding how galaxies regulate their baryon and energy cycles. Spatially resolved, multiwavelength observations of nearby galaxies provide a means to examine these processes beyond global scaling relations. In this context, we present a multiwavelength study of the barred spiral galaxy NGC3627 ($D \approx 11.3$ Mpc), focusing on the morphology and energetics of its hot ISM and its connection to recent star formation.

We combine FUV imaging, X-ray observations and optical data to map star formation across the bar and spiral arms and to examine its spatial correspondence with diffuse hot gas. The hot ISM exhibits multi-temperature thermal plasma components with temperatures of $kT \approx 0.1$-0.7 keV. While similar temperature ranges are found throughout the

galaxy, their relative contributions vary with environment: the bar is dominated by a hotter component (kT≈0.6 keV) that accounts for most of the diffuse X-ray luminosity, whereas the spiral arms are dominated by a cooler component (kT≈0.2 keV). Diffuse X-ray emission spatially correlates with regions of enhanced FUV and Hα emission along the spiral arms, consistent with feedback from recent star formation. In contrast, the bar hosts hotter diffuse emission but reduced FUV flux, suggesting significant obscuration.
To further quantify the coupling between star formation and hot gas on local scales, we are extending this analysis to a spatially resolved framework based on star-forming clumps identified in the FUV. These regions are used to derive diffuse X-ray plasma temperatures and luminosities using hardness-ratio–based mapping incorporating Bayesian Estimation of Hardness Ratios (BEHR), together with Hα flux measurements.
Overall, this study highlights how feedback-driven heating of the ISM varies across galactic environments and demonstrates the importance of spatially resolved approaches for understanding the regulation of star formation in nearby galaxies.

ASI2026_815	Nachiket Joshi	Poster
Galaxies and Cosmology		
Reconciling JWST Results with the Physics of Cosmic Reionization and Galaxy Formation		

The reionization of the Universe was largely driven by galaxies undergoing intense bursts of star formation. To explore the galaxies responsible for reionization, we combine recent JWST observations with the cosmological simulation EAGLE, specifically at redshifts greater than 6. We find that an interesting population of galaxies with high specific star formation rates and UV magnitudes brighter than -17, primarily located in halos of a billion solar masses or heavier, are efficient ionizing sources. We further develop models for the escape fraction of ionizing photons, which are best described by a skewed Gaussian function, with a flat tail toward the higher mass end. We incorporate these models into the 21cmFAST code to simulate the evolution of reionization, and the resulting ionized fraction closely matches observational data. Additionally, we compute brightness, spin, and kinetic temperatures, along with their spatial fluctuations, to gain deeper insights into reionization dynamics. A key prediction from our study is a peak in the 21 cm power spectrum at 180 MHz, corresponding to a redshift of about 6.8, which is within the observational reach of the upcoming Square Kilometre Array. Our findings also enable a deeper understanding of the star formation and its efficiency in pre-reionization galaxies detected by the JWST.

ASI2026_256	Nilanjana Nandi	Poster
Galaxies and Cosmology		
The dynamical lineage of ultra-diffuse galaxies from TNG50-1		

The formation and evolution of the ultra-diffuse galaxies (UDGs) continues to remain a puzzle. Similarities and differences in the morphological and the kinematical properties of the UDGs with their possible precursors, namely low-surface brightness (LSBs), L*-type high-surface brightness (HSBs) and dwarf galaxies, may provide crucial constraints on their origin and evolution. We selected samples of UDGs, LSBs, HSBs and dwarfs from TNG50-1. We first obtained a few possible scaling relations involving some mass properties to analyse if the regression fits for UDGs are in compliance with those of the other samples. Then, we studied individual galaxy cutouts to evaluate the intrinsic shapes of their dark-matter (DM) and stellar components, orbital and kinematical properties related to their stellar velocity dispersion. Finally, we constructed the mock IFU data using the SimSpin code to extract the stellar kinematic moment maps. We observe that the UDGs and the dwarf galaxies have nearly similar regression fits in a. stellar-to-gas mass ratio vs gas mass, b. stellar-to-gas mass ratio vs total dynamical mass, c. stellar central surface density vs ratio of stellar-to-total dynamical mass, and d. total baryonic mass vs total dynamical mass parameter spaces. Next, we find that the isolated UDGs are prolate rotators similar to the dwarf population, while the tidally-bound UDGs can exhibit both prolate and oblate-rotating shapes. The DM and stellar velocity anisotropy properties of the UDGs suggest that they reside in a cored, dwarf-like halo and may be classified by early-type galaxies. Finally, the stellar kinematic

properties suggest that both the UDGs and the dwarfs are slow-rotators having low to nearly no-rotations in contrast to the late-type, disc-dominated, fast-rotating LSBs and HSBs. Therefore, we may conclude that the UDGs and the dwarfs possibly have a common dynamical lineage.

ASI2026_345	Niranjan Reji	Poster
Galaxies and Cosmology		
Effects of Lyman Alpha Radiative Pressure on Hydrodynamics and Starbursts		
Recent theoretical work suggests that radiation pressure from Lyman-alpha scattering could be a dominant form of stellar feedback within low metallicity gas, injecting potentially an order of magnitude more momentum into the ISM than ultraviolet continuum radiative pressure. This would imply that Lyman-alpha radiative pressure is dynamically important, especially when studying starbursts and hydrodynamic flows near cosmic dawn. We present a study that couples a Monte Carlo Lyman-alpha radiative transfer solver coupled to the PLUTO hydrodynamics code to assess how Lyman-alpha momentum deposition alters gas dynamics and star-formation outcomes in primordial galactic environments. We use this solver to quantify the conditions under which Lyman-alpha pressure drives outflows or supports gas geometries against collapse, measure its effect on star formation efficiency, and build a clearer understanding of star formation and hydrodynamic feedback in the early universe.		

ASI2026_470	Partha Pratim Deka	Poster
Galaxies and Cosmology		
An "unbiased" view of cold atomic gas associated with radio-loud AGNs from the MeerKAT Absorption Line Survey (MALS)		
The MeerKAT Absorption Line Survey (MALS) has observed 391 telescope pointings at L-band (900-1670 MHz) at declinations < +20 degrees. In this talk, I will present radio continuum images and a catalog of 715,760 unique radio sources detected at SNR > 5 over an area of ~3000 deg^2 across 15 spectral windows (SPWs) within the L-band. We used catalogs at 1.0 and 1.4 GHz to characterize the properties of these sources. With excellent continuum sensitivity (20 microJy/beam) and spectral sensitivity (0.5 mJy/beam per 6 km/s channel), this catalog forms the base for future HI 21-cm and OH 18-cm absorption line searches, addressing the main theme of MALS: evolution of cold gas in galaxies up to z ~ 2. The MALS catalogs and images are publicly available at https://mals.iucaa.in. Moreover, by combining optical spectroscopy from SDSS with radio properties from MALS, we created a sample of 352 low- and high-excitation radio galaxies. The talk will present results from the search for HI 21-cm absorption in these systems, highlighting statistical differences in the properties of cold gas - an aspect currently underrepresented in the literature. Additionally, I will discuss the detection of HI 21-cm absorption associated with a QSO at z = 1.353. By analyzing this source alongside literature samples of QSOs and radio galaxies with HI absorption, we conducted a joint radio and optical analysis to constrain the location and characteristics of cold gas in quasars versus radio galaxies. The talk will conclude with the new opportunities that will be offered by upcoming facilities such as ngVLA and SKA in order to better understand the properties of cold gas associated with AGNs and its evolution across cosmic time.		

ASI2026_599	Pooja Rani	Poster
Galaxies and Cosmology		
Convergence Tests of Monte Carlo Lyman-alpha Radiative Transfer Simulations for 21-cm Cosmic Dawn Modeling		
Interpreting the 21-cm signal from Cosmic Dawn requires accurate modeling of the Lyman-alpha background, yet most theoretical studies rely on ideal-gas assumptions and simplified treatments of multiple scattering. We present convergence tests of a Monte Carlo radiative transfer framework that directly follows Lyman-alpha photons in cosmological simulations, avoiding these approximations. By systematically varying numerical and physical		

parameters—resolution, photon statistics, propagation step length, stopping criteria, and box size—we identify the regimes where the simulated Lyman-alpha background is numerically stable. These results strengthen confidence in 21-cm signal predictions and provide a robust basis for extracting astrophysical and cosmological constraints from upcoming observations.

ASI2026_217	Prajakta Tanaji Mane	Poster
Galaxies and Cosmology		
Testing LSST DIA pipeline to identify lensed transients: tests with HSC and DP1 data		
Gravitationally lensed Type Ia Supernovae (SNe Ia) are uniquely suited to address the Hubble constant problem in cosmology. In addition to obtaining accurate time delays, the standard candle nature of SNe Ia also provides additional constraints on the lens model parameters. Finding such supernovae in the ground-based imaging data from the Rubin Observatory is a challenge. The multiple images of a lensed SN Ia can be identified as newly appearing sources in the difference imaging. However, these lensed supernova images are expected to be unresolved for a majority of the lenses, making it very difficult to identify them from a million nightly alerts. We evaluate the performance of the LSST Science Pipelines' Difference Image Analysis and Association pipeline on real HSC and DP1 images in identifying the injected synthetic lensed SNe Ia. We expect several of these unresolved sources to appear extended in the differece images, and study the measured properties of DI sources that estimate their shapes to find such markers of lensing. We also study whether using any of the DI pipeline flags can help in reducing contamination from unlensed transients. We also run association on the DI sources, and identify and classify various kinds of mis-associations that can impact their identification. Finally, we show the effectiveness of the color-magnitude criterion for identifying lensed SNe Ia with measured photometry of DI sources.		

ASI2026_504	Pranaav S	Poster
Galaxies and Cosmology		
Magnetic Field Evolution in Cosmic Web Nodes		
The most massive gravitationally bound structures in the Universe are galaxy clusters, which reside at the nodes of the cosmic web. Early dark matter simulations revealed the structure of the cosmic web, but a purely gravitational description is fundamentally incomplete. The presence of baryonic matter in the form of tenuous astrophysical plasma composed of charged particles provides a compelling argument for the existence of magnetic fields in the intracluster medium (ICM). This is further supported by observations indicating microgauss-level magnetic fields in cluster environments. Our understanding of magnetic field amplification and evolution in large-scale structures remains incomplete, as existing studies have focused on limited samples of galaxy clusters, and the spatial and temporal evolution of magnetic fields has not been explored extensively. At present, due to the limited availability of observational data, the study of cosmic magnetic fields—particularly their physical origin and evolution—remains highly challenging. However, recent advances in high-resolution cosmological magnetohydrodynamic (MHD) simulations that aim to realistically model physical processes, such as the IllustrisTNG suite of high-resolution MHD simulations, offer new insights. In this study, we implement a physically robust classification of clusters based on their dynamical state using a combination of physically relevant parameters including but not limited to merger mass ratio (ε), Relaxation period (t), Centroid shift (ω) and Virial ratio (η) on a statistically significant sample of galaxy clusters in TNG-Cluster simulation. We analyze their magnetic properties by employing Triangular-Shaped Cloud algorithm to offset Voronoi mesh structure of IllustrisTNG. The analyzed data is further tested for magnetic field amplification mechanisms - Adiabatic compression and models of turbulent dynamo to validate the z = 0 magnetic field of ICM, In this conference we will be presenting the preliminary results of this study.		

ASI2026_323	Prasanta Sahoo	Poster
Galaxies and Cosmology		
Constraints on Momentum-Transferred Dark Energy Model Using DESI DR2		

In this work, we study two scalar field driven dark energy models characterized by the axion potential and the inverse power-law potential, each coupled to dark matter through momentum exchange. By formulating the dynamics as an autonomous system, we identify the equilibrium points and analyze their stability. To constrain these models, we utilize observational data from Pantheon Plus Type Ia Supernovae, DES Y5, DESI DR2 BAO, and Planck 2018 CMB compressed likelihood, employing Markov Chain Monte Carlo (MCMC) methods. Both potential exhibit weak to strong preference over the ΛCDM model, with a particularly strong preference for the momentum-coupled scenario when Supernova data are included in the analysis. Furthermore, we find the coupling parameter to be negative, with no lower bound, for both potentials. This finding agrees with previous studies and suggests that momentum-exchange coupling between the dark sectors cannot be ruled out. From the stability analysis, we observe that for both potentials, the late-time attractor corresponds to a dark energy dominated phase, and the scalar field can behave as a stiff fluid during the early epoch. According to the model selection criteria, the inverse power-law potential is favoured over the axion potential.

ASI2026_708	Pratyush Kumar Das	Poster
Galaxies and Cosmology		
Morphology in Motion: Linking Angular Momentum to Galactic Structure		

The classical Hubble sequence provides a qualitative, visual classification of galaxies. A complementary and physically motivated framework instead uses stellar specific angular momentum (j*) to characterize galaxy structure and assembly. Decades of work have established the tight relation (known as the FALL relation) linking j* and stellar mass (M*), with rotationally supported disks and dispersion-dominated spheroids occupying distinct loci.

I present Spinny, a modular pipeline that operationalizes this relation into a data-driven map of galaxy morphology and evolution. Spinny (i) recovers galaxy geometry from imaging, (ii) constructs smooth stellar mass surface-density models (including bulge+disk decompositions where required), and (iii) derives rotation profiles from spatially resolved spectroscopy to compute integrated j* with controlled uncertainties. The use of physically motivated density and velocity models stabilizes the measurements at large radii, enabling reliable extrapolation of j* beyond the observational footprint.

Applied to the SAMI Galaxy Survey, which spans environments from the field to rich clusters, Spinny yields a component-resolved Fall relation: stellar disks follow a high-j* sequence, while bulges populate a lower-j*, shallower branch. This framework provides a unified quantitative link between ordered rotation, star-formation state, and internal structure.

To further interpret these trends, I employ the symbolic regression Machine Learning model to identify compact, interpretable relations connecting j* with global kinematic, structural, and environmental parameters. This approach reveals low-dimensional functional forms that capture key drivers of angular momentum retention and morphology, offering physically transparent alternatives to purely empirical scaling relations.

Finally, I demonstrate how Spinny is readily transferable to other integral-field spectroscopic surveys such as Hector, MaNGA, and MAGPI, and describe extensions incorporating simulation-informed velocity priors to constrain j* in low-signal outskirts and, ultimately, in high-redshift systems.

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ASI2026_559	Preeti Joshi	Poster
Galaxies and Cosmology		
Thermodynamic study of Ricci Gauss Bonnet Holographic Dark Energy and its application to the framework of f(G) gravity		
Our goal in this study is to present a unified approach of Ricci Gauss Bonnet Holographic Dark Energy (RGB-HDE) that takes thermodynamical behavior and cosmic dynamics into account. Additionally, this paper investigates its realization in f(G) gravity, a modified gravity framework that has been recreated using RGB-HDE. The evolutionary behavior of the equation of state parameter in different dark energy and dark matter interactions has been examined. Three distinct forms of interaction form Q have been investigated in this context, and the validity of the generalized second law of thermodynamics and the resulting equation of state parameter have been examined. Additionally, the viability of the reconstructed f(G) model has been investigated and the model's stability has been tested using the squared speed of sound.		

ASI2026_902	Preeti Kharb	Poster
Galaxies and Cosmology		
S-Shaped Radio Jets & Ionized Gas in Mrk 3: Outflows or Binary Black Holes?		
Markarian 3 is a nearby (z = 0.0135) Compton-thick Seyfert 2 galaxy hosting a 0.3 billion solar mass black hole. Its nuclear region exhibits multiple signatures of dynamical activity. The presence of S-shaped radio jets and [OIII] line emitting gas on parsec to sub-kiloparsec scales, together with double-peaked [OIII] and Hydrogen Balmer lines from HST/STIS spectroscopy, motivates the possibility of jet precession driven by the presence of a binary supermassive black hole in Mrk 3. We present results from new Very Long Baseline Array (VLBA) observations at 15 and 22 GHz probing the parsec-scale radio structure and placing new constraints on the origin of its S-shaped morphology. We place our results in the larger context of parsec-scale radio cores and jets in "radio-quiet" Seyfert galaxies.		

ASI2026_280	Prerana Biswas	Poster
Galaxies and Cosmology		
Investigating Dual Nuclei Systems: Spectral Properties and Supermassive Black Hole Masses from the GOTHIC Survey		
We present a spectroscopic study of galaxies hosting multiple nuclei, dominated by dual-nucleus systems, based on a visually confirmed sample identified using GOTHIC algorithm applied to SDSS-DR16 data. From 949 candidates, we analyse 915 nuclei with high-quality spectra (SNR > 10), obtained through stellar continuum and emission-line fitting using pPXF. This represents one of the largest homogeneous samples of spectroscopically confirmed multi-nucleus galaxies, primarily probing dual-nucleus phase across star-forming, Composite, AGN–Seyfert, and AGN–LINER classes. For each nucleus, we derive stellar velocity dispersion, stellar mass, stellar-age, metallicity, mass-to-light ratio, black hole mass and Eddington luminosity. While overall distributions of these properties broadly resemble those in single-nucleus galaxies, clear differences emerge in their scaling relations. M_BH-M_star relation is preserved overall but shows class-dependent slopes, with steeper trends for AGN–LINERs and shallower ones for Seyferts. Importantly, supermassive black holes in dual AGN systems are systematically more massive than those in single AGN at fixed stellar mass, indicating enhanced black hole growth during galaxy interactions, even before SMBH coalescence. Stellar mass–velocity dispersion relation follows expected virial scaling for massive Composite and AGN hosts, suggesting that global dynamical equilibrium is largely maintained despite presence of dual nuclei. In contrast, mass–metallicity and age-metallicity relations exhibit significant departures from classical single-nucleus trends. Dual-nucleus systems show elevated metallicities at low stellar masses and suppressed metallicities at high masses, along with structured age-metallicity behaviour, particularly in Composite and AGN hosts. These features point to merger-driven gas inflows, metal redistribution, and AGN feedback influencing chemical evolution during close interactions. Analysis of confirmed dual-nucleus pairs further reveals correlated black hole growth but diverse		

stellar population properties between companions. Overall, our results demonstrate that dual-nucleus galaxies retain global scaling relations while exhibiting distinct internal growth and chemical evolution shaped by interactions, making them valuable laboratories for studying galaxy and black hole co-evolution.

ASI2026_284	Protap Halder	Poster
Galaxies and Cosmology		
Investigating the halo-disk shape connection using TNG50		
Dark Matter (DM) halos play a critical role in galaxy formation and evolution. However, observationally it is challenging to probe the properties of DM halos. In high resolution cosmological simulations galaxy DM halos evolve under realistic environments and are used to study DM halo properties for statistically large galaxy samples. We investigate DM halo shapes of a large sample of galaxies (~900) at redshift, z = 0 from the TNG50 cosmo-magneto-hydrodynamical simulations to study the connection between halo shapes and baryonic disk properties. We used the reduced moments of inertia tensor to obtain three important shape parameters, oblateness (s), asymmetry (q) and triaxiality (T) of DM halos and stellar disks at multiple galactic radii. We examine if halo shapes are correlated to galaxy stellar mass, gas mass fraction and stellar disk shapes. At twice the stellar half-mass radius, the halo and disk triaxialities show a significantly positive spearman correlation coefficient R~84%, which further improves to R~87% upon removing the disturbed/interacting galaxies from the sample. The correlation reduces at larger radii. There is a weak but noticeable correlation between halo shape (s, T) and gas mass fraction and baryon surface densities. We also find that the majority of DM halos have oblate shapes close to the baryonic disk or the inner halo. In 90% of the galaxies in our sample, the minor axis of the host DM halo is aligned (within 23 degrees) to the maximum angular momentum axis of their stellar disk. The findings in this study will add to the understanding of disk-halo shape connection and in making comparisons with galaxy observations.		

ASI2026_909	Pushpak Pandey	Poster
Galaxies and Cosmology		
AstroSat UV Deep Field IV. An Extended UV disk around a massive spiral galaxy at z=0.67		
Extended ultraviolet (XUV) emission traces inside-out disk growth through low-efficiency star formation in galaxy outskirts, but such systems have so far been almost exclusively found in the local Universe due to the need for deep UV imaging. Using AstroSat/UVIT, we report the detection of a clumpy XUV disk at $z=0.67$ in a massive, isolated spiral galaxy ($\log(M_*/M_\odot)\approx11.04$). The PSF-corrected rest-frame FUV surface brightness profile reveals a UV disk that is significantly more extended than the optical and near-infrared emission, reaching nearly twice the optical radius. The outer disk hosts a large, UV-bright, low-surface-brightness component, consistent with a Type II XUV disk. The presence of UV clumps without optical counterparts also supports a Type I classification, indicating recent, localized star formation likely driven by gravitational instabilities. Together, these features point to ongoing cold gas accretion onto the outer disk, and from the observed asymmetry in the UV light profile, we estimate a gas accretion rate of $\sim11\ M_\odot,{\rm yr}^{-1}$, providing direct evidence for active disk growth in a massive galaxy at intermediate redshift.		

ASI2026_592	Rachana .	Poster
Galaxies and Cosmology		
Continuum and Emission-Line Variability in NLSy1 Galaxies Using SDSS and DESI		
Narrow-line Seyfert 1 galaxies (NLSy1s) represent an extreme class of active galactic nuclei (AGN), often characterized by strong optical Fe II emission, relatively narrow broad Balmer lines, and high inferred Eddington ratios. Despite decades of study, estimating AGN properties and understanding their evolution in NLSy1s remains challenging. Multi-epoch spectroscopy offers a direct way to quantify intrinsic spectral changes and relate them to the		

physical state of the accretion flow. In this work, we investigate spectral variability in a large sample of 7,728 NLSy1s curated by combining the NLSy1 catalog with SDSS and DESI DR1 spectroscopy. The availability of repeated DESI observations enables a systematic multi-epoch study of continuum and line evolution. Our primary focus is on continuum variability, as traced through changes in the optical continuum spectral slope, which provides a sensitive diagnostic of continuum shape evolution and potential fluctuations in the accretion state. Using consistent spectral modeling of the SDSS and DESI spectra with PyQSOFit, we measure two-epoch changes in the optical continuum slope and in key line diagnostics, including Fe II and Balmer-line properties. We will discuss the distribution of these spectral changes across the sample and their connection to basic AGN parameters such as black hole mass and Eddington ratio.

ASI2026_208	Rahul Verma	Poster
Galaxies and Cosmology		
AGN feedback in Dwarf Galaxies		

During the process of galaxy evolution, AGN (Active Galactic Nuclei) feedback plays a crucial role. This feedback process can affect the star formation characteristics of their host galaxies. The impact of AGN on their host galaxies has been extensively studied in massive galaxies hosting AGN. However, much less is currently known about the prevalence of AGN in dwarf galaxies and their potential role in driving galaxy evolution. In this work, we aim to characterise the impact of AGN on their host dwarf galaxies using spectral energy distribution fitting with CIGALE (Code Investigating GALaxy Emission), applied to UV to mid-infrared photometry of a sample of AGN-hosting dwarf galaxies. The same exercise was also carried out on a control sample of dwarf galaxies without AGN, having the same distribution of redshift and absolute brightness as their AGN counterparts. From a systematic and Homogeneous analysis carried out on a sample of dwarf galaxies with AGN and those without AGN, we found that the star formation activity in dwarf galaxies with AGN is lower than that of dwarf galaxies without AGN. This suggests that the presence of AGN in dwarfs has a negative feedback effect, resulting in quenching of star formation in them. We also studied the radio emission from dwarf galaxies hosting AGN. We found that AGN hosting dwarf galaxies, having observations in radio, have a higher star formation rate compared to the sources that are not detected in radio. Our study shows that the radio emission is primarily associated with star formation, rather than AGN activity. Details of the results will be presented.

ASI2026_64	Ramanpreet Singh	Poster
Galaxies and Cosmology		
Constraints on Tachyonic Dark Energy from SNe and BAO Observations		

Despite being the simplest dark energy model, the cosmological constant explains many cosmological observations, but it faces significant challenges, including the Hubble tension. These shortcomings have motivated the search for alternatives to the cosmological constant. Results from Type Ia supernova cosmology indicate that the universe is not only expanding, but that this expansion is accelerating. In contrast, several recent analyses of Dark Energy Spectroscopic Instrument (DESI) BAO data suggest that the expansion may not be accelerating after all, raising the possibility of a future slow down or even collapse of the universe. Moreover, DESI data indicate a preference for dynamical dark energy models with equation of state (EoS) with a CPL parameterization, over the cosmological constant model.

Motivated by these findings, we investigate a tachyonic dark energy model with an exponential potential using the Pantheon$+$, earlier BAO datasets, and the DESI BAO DR2 data. We take the present-day value of the EoS parameter, $w_{\phi 0} = -1$, as a reference model, and also examine the case where $w_{\phi 0}$ is treated as a free parameter. We find that both classes of datasets predict a turnaround in the evolution of the EoS parameter, irrespective of whether $w_{\phi 0}$ is fixed or allowed to vary. The deceleration parameter likewise exhibits a future turnaround for both datasets. However in the $w_{\phi 0} = -1$ case, it asymptotically approaches -1. Model comparison using the AIC and BIC criteria reveals that the Pantheon$+$ dataset prefers the model with a free $w_{\phi 0}$, whereas BAO type datasets favor the $w_{\phi 0} = -1$ case. This indicates a disagreement between these two classes of datasets regarding the predicted future evolution of the Universe within the tachyonic dark energy model.

ASI2026_241	Ritik Kumar	Poster
Galaxies and Cosmology		
Nature of corona in few bright AGN		

Active galactic nuclei (AGN) are luminous extragalactic sources powered by the accretion of matter onto supermassive black holes at the centre of galaxies. They emit across the entire electromagnetic spectrum with particularly strong emission in the X-ray band. The X-ray emission in the radio-quiet category of AGN is believed to be produced by inverse Compton scattering of UV seed photons from the accretion disk by a population of hot electrons is a compact region known as corona, situated close to the disk. The resulting X-ray spectrum is well described by a power law shape upto a high cut-off energy cut-off beyond which the spectrum steepens. This cut-off energy is directly related to the temperature of the corona. In this work, we aim to characterise the temperature of the corona, examine its variation if any and investigate correlations if any between between coronal temperature and the physical properties of the sources. For this we carried out systematic investigation of a sample of four AGN with multiple epochs of observations from NuSTAR, amounting to a total of 35 epochs. Both phenomenological and physically motivated model fits were carried out on the NuSTAR data to infer the temperature of the corona and other properties of the sources. Our analysis indicates that the temperature of the corona in our sample remains relatively stable during the epochs of observations analysed here. The detailed results of this study will be presented at the meeting.

ASI2026_111	Riya Mullick	Poster
Galaxies and Cosmology		
Unveiling Post-starburst Phase Of Galaxies From A Radio Perspective		

Post-starburst (PSB) galaxies exhibit strong Balmer absorption lines and weak or absent nebular emission lines, indicating a recent, intense starburst that ended about 100–300 Myr ago. We carried out a study of radio emission from 104 PSB galaxies in the redshift range 0.03–0.4 using 144 MHz LOFAR LoTSS2 and 1.4 GHz VLA FIRST imaging. Although only about ~2% of the sample is detected at 1.4 GHz, this detection rate rises to 8.4% at 144 MHz, highlighting the enhanced sensitivity of low-frequency radio observations to faint radio sources. We find that PSBs exhibit systematically flatter radio spectral indices (got α= -0.34 between 144 MHz and 1.4 GHz) compared to typical star-forming galaxies (α= -0.55), and also show significantly reduced radio luminosity in the standard radio–far-infrared correlation (L144MHz–L60 μm plane). For a subset of this PSB galaxies sample, we also conducted follow-up radio observations at intermediate frequencies with uGMRT (Band 4 and Band 5) and at higher frequencies (S, C,X Band) with the JVLA. Detailed modeling of PSB's multi-frequency radio spectral energy distributions (spanning 144 MHz to 1.4 GHz), together with estimates of the emission measure and high-angular-resolution nuclear morphologies from the VLA data, will be presented. The observed spectral flattening interpreted as free–free absorption by ionized gas along the line of sight. By combining our radio results with optical line-diagnostics, we infer that PSB galaxies often host low-luminosity AGN, which can coexist with ongoing star-formation which is dust-obscured. Our study emphasizes the crucial role of radio observations of PSB galaxies in tracing the evolutionary pathways of star-forming systems, probing the link between AGN activity and Star formation, and uncovering residual star formation hidden by dust in PSB galaxies.

ASI2026_996	Rupali Hatte	Poster
Galaxies and Cosmology		
Moustache or M-shaped radio galaxies: A study through RAD@home citizen science		

We present an analysis of three rare M-shaped (or "moustache") radio galaxies discovered through RAD@home citizen-science research. Unlike FR I, FR II, WAT, HT, DDRG, and S/Z/X-shaped radio galaxies, M-shaped radio galaxies remain largely unexplored. In all the cases presented here, the radio jets are launched from galaxies that are in the process of merging with companions. These sources were identified through a network of trained citizen scientists, or e-/i-astronomers. NVSS–DSS–TGSS radio–optical–radio RGB contour images of the large-scale emission show a morphology broadly resembling wide-angle-tailed sources. However, higher-resolution observations with FIRST, VLASS, and RACS reveal finer jet structures near the host galaxies, including a central surface-brightness depression that produces the characteristic M-shape. We interpret this central depression as a consequence of the motion of the host galaxy around the centre of mass of the interacting system. Furthermore, in one case the M-shaped structure is not orthogonal to the large-scale orbital plane of the merging galaxies, which is traced by an extended stellar disk. Since buoyancy effects are unlikely to dominate in this configuration, the observed asymmetries in the small-scale jets are interpreted as interactions with a rotating interstellar medium (ISM), where the jet propagates with the ISM rotation on one side and against it on the other. As demonstrated by the recently discovered case of jet–companion-galaxy interaction (RAD-12) identified by RAD@home, such distortions can be dramatic. How AGN jets or winds couple to the ISM remains poorly constrained in models of galaxy evolution driven by mergers and AGN feedback. Jet distortions observed during galaxy mergers therefore provide compelling evidence that such systems constitute important laboratories for understanding AGN feedback, particularly through coordinated multi-wavelength follow-up observations.

ASI2026_140	RUPAM SARKAR	Poster
Galaxies and Cosmology		
Slow UV Luminosity Function Evolution Driven by evolving Star Formation time scale at $z > 10$		

Recent JWST observations reveal an unexpectedly slow evolution in the ultraviolet luminosity function (UV LF) of galaxies at redshifts $z > 10$. To investigate this phenomenon, we develop a semi-analytical model of the UV LF, calibrated against well-constrained measurements at $z \sim 2-10$. Our analysis identifies a transition in star formation modes across cosmic epochs: at $z \lesssim 5$, a longer characteristic star formation timescale with nearly constant efficiency ($f_\star$) dominates, whereas at $6 \lesssim z \lesssim 10$, shorter timescales prevail without requiring an increase in $f_\star$. For $z > 10$, the slow UV LF evolution is best explained by a shift toward even shorter star formation timescale combined with same star formation efficiency as in low redshift galaxies. Further we show that a dust-free conditions or a top-heavy initial mass function (IMF) alone cannot reproduce the observations, although IMFs with lower mass cutoffs ($10-300~\rm M_\odot$) enhance UV luminosity more effectively than those with higher cutoffs ($50-300~\rm M_\odot$) at $z = 14$. By combining UV LF modeling with stellar mass constraints from \texttt{Prospector}-based SED fitting, we try to break degeneracies between IMF variations and star formation histories. Our results indicate that evolving star formation timescales rather than IMF or dust changes are the primary drivers of the observed high-redshift UV LF evolution, reflecting changing physical conditions during the earliest phases of galaxy assembly. Additionally, we show that moderate AGN activity in high redshift galaxies could further boost UV luminosities at $z \gtrsim 14$, potentially explaining the observed UV LF without changes in stellar parameters, and highlight the need for spectroscopic follow-up to assess AGN contamination.

ASI2026_75	sai wagh	Poster
Galaxies and Cosmology		
Bridging the gap: The statistical study of diffuse radio emission in galaxy groups using AKSAP data		

The discovery of diffuse radio emission in galaxy clusters has been key to understanding the physical non-thermal processes shaping large-scale structures. Although when it comes to galaxy groups, they are not contemplated as distinct astrophysical systems but rather as low-mass extensions of galaxy clusters. In reality, galaxy groups are different from galaxy clusters in many ways. Groups are common yet critical environments for studying galaxy evolution, the nature Intra-group Medium (IGrM), and the large scale structure formation in the Universe. Using Australian Square Kilometre Array Pathfinder's (ASKAP's) deep radio continuum data from the Evolutionary Map of the Universe (EMU) and Deep Investigations of Neutral Gas Origins (DINGO) surveys, we aim to map faint diffuse radio emissions associated with the IGrM, such as halos, relics, fossil plasma, etc. These features may originate from Active

Galactic Nuclei (AGN) activity, shock fronts, or turbulence within the group environment. Our goal is to identify and characterise these emissions across a statistically significant sample, and to study potential scaling relations between diffuse radio emission and group properties. This work will provide critical insights into the role of non-thermal processes in low-mass systems and assess whether the scaling relations observed in galaxy clusters extend into the group regime or not, contributing to a more unified understanding of structure formation across mass scales.

ASI2026_620	Sajida Begum	Poster
Galaxies and Cosmology		
Detection and Analysis of soft X-ray excess in the narrow line Seyfert galaxy observed by XMM Newton		
A large fraction of Seyfert 1-1.5s exhibit an excess of X-ray emission, known as soft excess, below 2Kev. This soft excess provides a useful diagnostic tool to understand the accretion flow mechanism around the active galactic nuclei. In the present work we have conducted a systematic analysis of a XMM newton observation of a Seyfert galaxy as observed by the satellite in November 2016. The object was earlier observed by Chandra, ASCA, ROSAT and RXTE. These previous observations suggest a relatively flat spectrum in the low-energy side of the spectrum. The XMM-Newton observation however suggest clear evidence of presence of soft-excess. So we conducted a detailed spectral analysis of the soft excess using different available models and found that the emission can be equally well explained with the help of the warm corona model and the relativistic reflection models.		

ASI2026_661	Salmoli Ghosh	Poster
Galaxies and Cosmology		
Uncovering the Magnetically Stratified Outflow in the Radio-Quiet AGN NGC 4151		
Radio-quiet (RQ) active galactic nuclei (AGN) dominate the AGN population. Their radio emission is typically faint, compact, and morphologically complex compared to their radio-loud (RL) counterparts that exhibit large relativistic jets. "Feedback" from RQ AGN is generally attributed to radiatively driven outflows. The role of magnetic (B-) fields in launching and shaping these outflows remains poorly understood. We present new high-resolution radio polarimetric observations with the Very Large Array of the well-known Seyfert galaxy NGC 4151, which hosts radio emission on the 1-kpc scale. Our polarimetric imaging of NGC 4151 reveals a stratified B-field structure in an RQ AGN for the first time. The jet `spine' shows predominantly perpendicular B-fields consistent with shocks, while the jet `sheath' exhibits aligned B-fields indicative of shearing due to jet-medium interaction. This structure suggests the presence of a transverse velocity gradient and/or compositional stratification within the radio outflow. We detect a clear transverse rotation-measure (RM) gradient across the outer layer of the outflow, which we interpret as part of a larger, wide-angle biconical `wind' with perpendicular B-field. We further find that these AGN-driven magnetohydrodynamic winds are energetically modest (0.01 - 0.5% of the bolometric luminosity) compared to star-formation-driven galactic winds, limiting their ability to drive galaxy-scale feedback. However, their substantial mass content (10^3 M_sun) implies a significant impact on local circumnuclear environments. Overall, our results demonstrate that magnetic fields play an active role in launching and structuring outflows in RQ AGN.		

ASI2026_685	Sandeep Kumar Kataria	Poster
Galaxies and Cosmology		
Can A Kinematically Hot and Thick Disk Form A Bar? : Role of Highly Spinning Dark Matter Halos		
Recent JWST observations claim the existence of a significant fraction of bars in the kinematically hotter and thicker disk at high redshift Universe. These observations challenge the current understanding of disk stability in galaxies similar to the Milky Way. The analytical work and N-body simulations suggest that the kinematically hot (dispersion-dominated) and thick disk are stable against bar formation. In this work, we perform the controlled N-body simulations of a kinematically hot and thick disk, which is residing in a non-rotating and spinning dark matter halo. We report that the disk, which is classically stable against bar instability in the live and non-rotating halo, leads to bar formation in a		

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spinning halo environment. The spinning halo model is 8 times more efficient in transporting angular momentum from the disk to the halo compared to the non-spinning halo. We claim that Ostriker-
Peebles and ELN bar-formation criteria do not predict bar formation for both the non-roating and spinning halo. The recent criteria from Jang-Kim successfully predict the bar stability for the non-rotating halo model, but not for the spinning halo model. These results provide an important insight into the bar formation processes for thick and hot disks at high redshift.

ASI2026_965	Sanghati Saha	Poster
Galaxies and Cosmology		
Warm Multi-Natural Inflation: The Primordial Power Spectrum and the prediction for (n_s, r) from Planck, ACT, and SPT		
We perform a study of warm inflation in the framework of Palatini gravity with an $R+ \alpha R^2$ extension, investigating how different classes of scalar-field potentials behave with dissipative dynamics and CMB observations. We consider axion-motivated natural and multi-natural forms, and analyze each model under two representative temperature-dependent dissipation coefficients: a linear form $\Upsilon \propto T$ and a cubic form $\Upsilon \propto T^{3}/\phi^{2}$. Within the Palatini formulation, where the R^2 term modifies the inflationary dynamics without introducing an additional scalar degrees of freedom, we compute the background evolution and primordial curvature power spectrum for both the potential--dissipation combination. The strength of dissipation is characterized by the dimensionless ratio $Q \equiv \Upsilon/(3H)$, which provides a uniform classification of the weak ($Q \ll 1$) and strong ($Q \gtrsim 1$) warm-inflation regimes across the different models considered. We have computed the inflationary observables from \textit{Planck}~2018, ACT, and SPT. We have found that warm dissipation systematically enlarges the observationally allowed parameter space relative to the cold-inflation limit. The constraints on scalar spectral index n_s play an important role in discriminating early universe inflationary models, as our predicted values depend on both the inflaton potential and the strength of dissipative effects during inflation. Here, we have constrained the palatini gravity parameter α as well. In addition to highlighting the importance of Palatini modified gravity and warm-inflation dynamics in addressing early-Universe physics with observations, our results show that current CMB data set significant constraints on the dissipation ratio Q.		

ASI2026_461	Sayak Dutta	Poster
Galaxies and Cosmology		
MUSEQuBES: the column density, covering fraction, mass, and environmental dependence of cool H I gas around low-z galaxies		
We investigate cool H I gas traced by Lyman series absorption around 256, galaxies at z ≈ 0.48 (<log (M*/M_sun)>~9) using 15 background quasars (median impact parameter, D = 140 pkpc), as part of the MUSE Quasar-fields Blind Emitters Survey (MUSEQuBES). We find that the H I column density profile around isolated star-forming galaxies spanning ≈ 3 dex in stellar mass is well described by a power law with slope ~ −3 when expressed as a function of normalized impact parameter D/Rvir . The H I covering fraction (k) within the virial radius for log10 (N (H I)/cm−2) = 14 is significantly lower in high-mass passive galaxies than in isolated star-forming galaxies. The κ-profile of isolated star-forming galaxies suggests a characteristic size of the H I-rich CGM of ~ 1.5Rvir across the stellar mass range. The mean H I mass in the outer CGM (0.3–1 Rvir) increases with stellar mass, ranging from ≈ 10^5 to 10^6 M_sun . The b-parameters of the strongest H I components correlate and anticorrelate with specific star-formation rate (sSFR) and mass, respectively, with > 2 sigma significance. Broad Lya absorbers (BLAs) with b > 60 km s−1 are predominantly associated with high-mass galaxies, likely tracing the warm-hot phase of the CGM. The velocity centroids of H I components indicate that absorbers at D < Rvir are largely consistent with being gravitationally bound to their galaxies, independent of stellar mass. Finally, leveraging ~ 3000 galaxies from the wide-field Magellan follow-up of six MUSEQuBES fields, we find that non-isolated galaxies exhibit an H I-rich environment extending roughly three times farther than in isolated counterparts.		

ASI2026_201	Shobha Kumari	Poster
Galaxies and Cosmology		
The Influence of Cluster Environment on Jet Morphology in Megaparsec-scale Radio Galaxies		

Giant radio galaxies (GRGs), extending over megaparsec scales, offer unique opportunities for studying the interaction between active galactic nucleus (AGN) jets and their surrounding intracluster medium (ICM) environment. Using 144 MHz data from the LOFAR Two-metre Sky Survey Data Release 2 (LoTSS DR2), followed up by GMRT, we presented a multi-wavelength study of two peculiar GRGs, J0011+3217 and J1007+3540, highlighting the role of cluster environments and galaxy dynamics in shaping radio morphology and jet evolution.

J0011+3217 exhibits a misaligned primary lobe and an unusually large, one-sided diffuse secondary wing extending up to 0.85 Mpc, nearly 85% of its 0.99 Mpc primary lobe. Located in the Abell 7 cluster environment, the source hosts an AGN at its geometrical centre, with a nearby optical galaxy at a projected separation of 16 kpc, suggesting the possibility of a dual AGN system. XMM-Newton data reveal extended X-ray emission associated with the cluster, while galaxy velocity and spatial distribution suggest that the GRG resides in an offset galaxy group moving relative to the Abell 7 cluster. The pronounced off-axis distortion of the primary lobe is consistent with ram-pressure effects arising from motion through ICM.

To further explore environmental influences on GRG evolution, we studied J1007+3540, a 1.45 Mpc GRG hosted by a massive elliptical galaxy associated with the WHL 100706.4+354041 cluster. Radio imaging reveals clear evidence of recurrent AGN activity, including aged outer lobes (radiative age ≈240 Myr), younger inner jets (≈140 Myr), and a one-sided extended diffuse tail exhibiting a distinct morphological break. These features suggest episodic jet activity coupled with environmental interactions.

Together, these studies demonstrate that cluster environments, relative galaxy motions, and ICM interactions play a crucial role in governing the morphology, spectral ageing, and AGN duty cycles in GRGs on megaparsec scales.

ASI2026_89	Shubham Sati	Poster
Galaxies and Cosmology		
Weak lensing Signal around an Isolated Galaxy		

We present a measurement and modelling of the weak gravitational lensing signal around isolated galaxies using spectroscopic lens data from the Dark Energy Spectroscopic Instrument (DESI) Year 1 Bright Galaxy Survey and background source galaxies from the Hyper Suprime-Cam (HSC) Year 3 weak-lensing shape catalogue. The analysis is based on stacked galaxy–galaxy lensing measurements of the excess surface mass density profile, $\Delta\Sigma(R)$, over projected radii from sub-Mpc to multi-Mpc scales.

A primary technical component of this work is the construction of a clean, isolated lens sample. We define volume-limited subsamples of DESI BGS galaxies and apply isolation criteria based on projected separation (1–3 Mpc), line-of-sight velocity difference, and relative luminosity thresholds for neighbouring galaxies. These cuts are implemented using spatial indexing and neighbour searches to suppress contamination from nearby halos and ensure that the central galaxy dominates the lensing signal.

The weak-lensing signal is measured by pairing each lens with background HSC sources selected via photometric redshifts. Tangential ellipticities are computed relative to the lens–source separation vector and combined using inverse critical surface density weighting and shear responsivity corrections. Radial binning is performed in projected comoving distance, and $\Delta\Sigma(R)$ is estimated as a weighted average over all contributing lens–source pairs.

The measured $\Delta\Sigma(R)$ profiles are compared to predictions from the Singular Isothermal Sphere (SIS) model. Systematic checks, including cross-shear measurements and lensing around random points, are consistent with zero signal. These results demonstrate the robustness of the data selection and measurement pipeline, providing a foundation for future analyses with improved error estimation and larger sample sizes.

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ASI2026_352	Siddharth Dutta	Poster
Galaxies and Cosmology		
Understanding Active Galactic Nuclei in Cosmological Simulations: A Mock Catalog Based Approach		

We present a new framework for generating synthetic galaxies and, specifically, Active Galactic Nuclei (AGN) catalogs from the IllustrisTNG suite of simulations using the spectral energy distribution (SED) modelling code CIGALE (Code Investigating GALaxy Emission). When compared to the traditionally utilised Flexible Stellar Population Synthesis (FSPS) code, CIGALE offers a higher degree of modularity in the components of the synthetic galaxy and a much wider parameter set to explore the effects of astrophysical objects and their physical processes.

In this work, for the first time, we perform a cross-validation study between CIGALE and FSPS to demonstrate that CIGALE-generated SEDs and photometric data show broad agreement with FSPS-based results for the same TNG population. This establishes CIGALE as a robust and accurate alternative to model SEDs for simulation-based mock catalogs. The modularity of CIGALE can then be exploited to explore more nuanced physics like AGN-host galaxy relations. Our work lays the foundation to expand the predictive capabilities of mock catalogs for surveys like DESI while maintaining consistency with existing results.

ASI2026_868	Sonali Borah	Poster
Galaxies and Cosmology		
Observational Constraints on Holographic Dark Energy Models with DESI DR2: Implications for Cosmic Acceleration		

In this study, we investigate a comprehensive empirical investigation of Holographic Dark Energy (HDE) models, inspired by the holographic principle that correlates the quantum degrees of freedom within a volume to its enclosing surface. We present an extensive observational investigation of Holographic Dark Energy (HDE) models employing the most recent cosmological probes, including Type Ia Supernovae, Cosmic Chronometers (CC), and DESI DR2 baryon acoustic oscillation (BAO) measurements. Utilizing a Markov Chain Monte Carlo (MCMC) framework, we perform joint parameter estimation for both canonical and interactive HDE models, methodically including uncertainties and correlations across datasets. Current data impose significant limits on the holographic parameter regulating dark energy dynamics, permitting deviations from the conventional cosmological constant model. Our findings indicate that current large-scale structure and distance measurements are already responsive to the unique signals of holographic dark energy in the expansion history. We further demonstrate that forthcoming high-precision large-scale structure surveys will significantly tighten these constraints, providing a robust method to investigate the physical origin of cosmic acceleration within holographically inspired dark energy models.

ASI2026_329	Sravya Kalachaveedu	Poster
Galaxies and Cosmology		
A study of galaxy evolution along large scale structures at intermediate redshifts		

We study environmental influences on galaxy evolution within the intermediate-redshift cluster Abell 851 (z~0.41). Using Subaru Hyper Suprime-Cam imaging, we probe star formation activity across the large-scale structure, which comprises a dense core, infalling groups, and extended filamentary regions spanning several Mpc. We are able to study the properties of galaxy populations from high-density cores to intermediate-density filaments.

Subaru HSC imaging is deeper and has a wider field of view (~1.5 square degrees) than any previous surveys of the region, which has allowed us to discover new structures surrounding the main cluster core. We quantify star-formation activity using observed galaxy colours and construct colour-magnitude relations as functions of both local density and global environment. In addition, deep narrowband imaging (NB921 and NB926) identifies Hα-emitting galaxies, directly tracing actively star-forming systems at z~0.41. By comparing Hα-derived activity, colours, and specific star-formation rates across environmental regimes, we aim to learn more and provide insights about quenching processes operating in the cluster core, infalling groups, and filamentary structures.

The dual approach of observed colours and Hα emission provides complementary constraints on assembly histories and the role of environment in regulating star formation. The study therefore offers a view of how large-scale structure and local conditions for the galaxies shape their evolution at intermediate redshift.

ASI2026_405	Subhankar Saha	Poster
Galaxies and Cosmology		
A novel approach for investigation of complete dynamical evolution of space-time and scalar field during inflation		

Inflation is incorporated into the standard big bang cosmology as a fundamental mechanism to solve several inconsistances of the theory. The experimental link of inflation is established through an enormous growth of the event horizon in early evolutionary phases of the universe and through the perturbation modes of the CMB power spectrum. The dynamics of inflation is built on a real scalar field, the so called inflaton, and its potential. This field is generally consided as minimally coupled to the space-time by following the Einstein-Hilbert action. From the action, we derive the Einstein equations to explain the mechanics of the field on the specific space-time. In cosmology, the space-time is denoted by the FRW metric to maintain the homogeniety and isotropy of the observed universe. Hence, a time dependent scale factor is multiplied to the spatial directions of a flat Minkowsky metric. Altough the most adopted approach for inflationary model building is to choose a potential for the inflaton field, the scale factor is an alternative and equally fundamental avenue which we focus in this work. The form of expansion of the universe during inflation caused by some basic and yet physically well motivated forms of scale factors are investigated. With the detailed study of the complete slow-roll and beyond slow-roll regime and even during post inflationary period, this work provides a novel and self contained cosmological model for the inflationary epoch. The construction of the model assumes only one minimally coupled real scalar field as inflaton and elaborates to obtain the spectral index and the tensor to scalar ratio as prescribed by the experiments like Planck, BICEP/Keck, and ACT missions.

ASI2026_995	Sumukha R Bharadwaj	Poster
Galaxies and Cosmology		
A Partial Lyman Limit Intervening Absorber Tracing Cold Mode Accretion		

We present a detailed analysis of a partial Lyman limit system at $z = 0.87641$ detected in the \textit{HST}/COS spectrum of the background quasar LBQS~0107$-$0235. The absorber exhibits a simple kinematic structure, with the metal-lines and the H\,\textsc{i} Lyman-series absorption well described by a single component. Photoionization modeling yields a gas metallicity of one-tenth solar and a hydrogen number density of $n_{\mathrm{H}} = 7.8 \times 10^{-4}~\mathrm{cm}^{-3}$. At the absorber redshift, the VLT/MUSE data show two galaxies (G1 and G2) at normalized impact parameters of $\rho / R_{\mathrm{vir}} \approx 0.9$ and velocity separations of $|\Delta v| = 18$ and $99~\mathrm{km~s^{-1}}$, respectively, from the absorber. Both galaxies have rotating disks with stellar masses of $M_{*} \approx 6\times10^{9}$ and $\sim 2.2 \times10^{10}~\mathrm{M}_{\odot}$, and star formation rates of ≈ 2.5 and $2.2~\mathrm{M}_{\odot}~\mathrm{yr}^{-1}$, placing them within the star-forming main sequence at this redshift. The absorber is positioned very close to the projected major axis of both galaxies. The galaxy properties along with the absorber's characteristics agree with tracing a metal-poor inflowing stream. This interpretation is consistent with cosmological simulations in which cold-mode accretion provides the dominant fuel for star formation in galaxies in halos of mass $M_{\mathrm{h}} \lesssim 10^{12}~\mathrm{M}_{\odot}$.

ASI2026_706	Suraj Dhiwar	Poster
Galaxies and Cosmology		
Spectral Energy Distribution Modelling of Lyman Continuum Emitting Galaxies at Cosmic Noon		

Understanding how ionizing photons escape from galaxies is essential for understanding the sources responsible for cosmic reionization. While Lyman continuum (LyC) leakage has been observationally established in galaxies at intermediate redshifts with AstroSat/UVIT, the physical conditions that enable LyC escape remain poorly constrained. In this work, we present spectral energy distribution (SED) modelling of a sample of LyC-emitting galaxies at redshifts $z \sim 1$ – 2, corresponding to the peak epoch of cosmic star formation. The sample is drawn from deep ultraviolet observations using UVIT onboard Astrosat that directly probe rest-frame wavelengths below the Lyman limit, complemented by multiwavelength photometry spanning the rest-frame ultraviolet to infrared. We perform SED fitting using Code Investigating GALaxy Emission (CIGALE) to derive global galaxy properties, including stellar masses, star formation rates, dust attenuation, and ultraviolet continuum slopes.

ASI2026_148	Susnata Chattopadhyay	Poster
Galaxies and Cosmology		
Evolution of bar-induced dark gaps in galaxy discs: evidence of strong bar-driven effects already at $z > 2$		

Stellar bars are one of the most common non-axisymmetric structures in disc galaxies in the local Universe as well as in high redshift ($z \sim 4$) disc galaxies, as recently revealed by the JWST observations. The properties of stellar bars play a crucial role in shaping up the bar-driven long-term evolution in disc galaxies. However, a systematic observational study of redshift evolution of bar properties (such as strength and length) encompassing a wide range of redshifts, is largely missing till date. In this contributed presentation, using a sample of ~ 625 barred galaxies, carefully chosen from SDSS, HST COSMOS and JWST CEERS surveys, I will present a systematic investigation of the evolution of bar properties with redshift ($0.02 < z < 3.2$). I will further show a novel usage of dark gap, a preferential light deficit along the bar minor axis, as an indirect measure of the bar properties (strength and length). I will also demonstrate that the strength and extent of dark gaps show negligible evolution over a major redshift range considered here, with a moderate increasing trend from the higher redshift regime, and a slight decreasing trend only towards the lower redshift regime. I will further discuss the implications of this unprecedented study of redshift evolution of bar properties over such an extensive redshift range in the context of bar formation and the initial rapid growth phase at early cosmic times. (Ref: Chattopadhyay, S., Ghosh, Soumavo et al., 2026, soon to be submitted to the MNRAS)

ASI2026_244	SWARNENDU JANA	Poster
Galaxies and Cosmology		
Study of Multiband Flux and Spectral Variability in BL Lacertae During the 2020 Outburst		

We present the results of recent quasi-simultaneous multiband optical observations (in B, V, R, and I bands) of the blazar BL Lacertae over diverse time-scales. The source was monitored from September to October 2020 using six telescopes located across the globe, yielding a total of about 5800 photometric image frames. The blazar exhibited numerous episodes of significant intraday variability, with the variability amplitude found to increase with source brightness. On short-term timescales, the flux variability amplitudes were measured to be 85.6%, 78.9%, 93.4%, and 67.6% in the B, V, R, and I bands, respectively. The colour–magnitude analysis revealed a dominant bluer-when-brighter (BWB) trend on both intraday and short-term timescales, indicative of particle acceleration processes within the relativistic jet. Strong correlations were detected among the optical bands, with no significant interband time lags. Periodicity analysis using the Lomb–Scargle and weighted wavelet Z-transform methods suggested possible indications of quasi-periodic oscillations in the light curves. Additionally, spectral energy distributions (SEDs) constructed for nights with quasi-simultaneous four-band data yielded spectral indices ranging between 2.9 and 3.2, implying a pronounced jet contribution to the optical emission. The observed variability characteristics are discussed in the context of both intrinsic mechanisms, such as shock-in-jet processes, and potential extrinsic causes.

ASI2026_732	Vaishali R	Poster
Galaxies and Cosmology		
Bayesian Inference of Quadrupolar Statistical Anisotropy in CMB		
The Cosmic Hemispherical Asymmetry observed in the CMB commonly modelled by the Dipole modulation motivates the search for higher order statistical anisotropies using Quadrupole modulation. Violation of the rotational invariance of the primordial power spectrum can lead to non-vanishing L=2 coefficients in the Bipolar Spherical Harmonics (BipoSH), however it was shown in Planck and WMAP analyses that effects of non-circular beams also cause similar signatures. We perform Bayesian parameter inference using HMC on Planck SMICA temperature maps and FEBeCoP simulations for the Quadrupole modulation model in different multipole ranges. From the Planck PR2 map, we find that the inferred quadrupole directions are not consistent across the multipole bins. Motivated by this we then utilise the Beam-BipoSH framework to model Elliptic Gaussian beams and explore their contribution to the L=2 statistical anisotropy.		

Posters in High Energy Phenomena, Fundamental Physics and Astronomy

ASI2026_662	Aditya Pandey	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing Type Ia Supernovae Using Double-Detonation Models		
The progenitors of Type Ia supernovae and the nature of their explosion mechanism remain among the major open problems in thermonuclear runaways. One important pathway to explain the observed diversity of Type Ia events is the double-detonation scenario, in which a surface helium detonation triggers a secondary detonation in an underlying carbon–oxygen white dwarf core. A characteristic and widely discussed observational signature of this scenario is the presence of high-velocity calcium absorption features. In this work, we have computed synthetic spectra for a double-detonation model using a one-dimensional radiative-transfer code, along with density and abundance structures derived from hydrodynamical simulations of sub-Chandrasekhar-mass C/O white dwarfs available in the literature. While the origin of high-velocity calcium absorption remains unclear, the double-detonation scenario provides a natural framework for producing calcium in the outer ejecta at very high velocities. Observationally, several supernovae, including SN 2019eix, exhibit prominent calcium absorption features consistent with expectations from double-detonation models. We directly compare our synthetic spectra with observations of recent Type Ia explosions, whose spectra display strong calcium absorption around 8000 angstroms, and, therefore, can be possible candidates for the double detonation scenarios. However, further multi-epoch spectroscopic analysis, combined with light-curve modeling, is required to robustly assess whether these events can be classified as definitive double-detonation candidates.		

ASI2026_400	Aditya Pawan Saikia	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Selection Effects in Optical Follow-up of Gamma-Ray Bursts Detected by Wide-Field High-Energy Missions		
Wide-field gamma-ray missions such as Fermi detect a large number of gamma-ray bursts (GRBs) at a rate of approximately ~300 per year, providing a statistically rich sample of GRBs. However, the fraction of GRBs with detected optical afterglows remains significantly lower, primarily due to large localization uncertainties and the rapid fading of afterglow emission. These factors limit the feasibility of systematic optical follow-up by small and medium-sized telescopes, introducing selection biases in optically detected GRB samples. We simulate GRB follow-up observations using constraints on localization size, exposure time, limiting magnitude, and number of pointings to estimate detection probabilities for tiled optical observations. By varying observing strategies, we identify response times for which optical afterglow detection probabilities exceed 50% for GRBs with large uncertainty regions, and therefore calculate the afterglow detection rate under a given time constraint. We extend this analysis to GRBs that would be detected by Daksha and other high energy missions to compare follow-up feasibility and detection rates across instruments. Our results provide a framework for optimizing optical follow-up strategies and for interpreting apparent differences between GRB samples detected by different high-energy missions.		

ASI2026_799	Ajaz Mir	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Kinetic Modelling of Solar Radio Bursts Generated by Beam–Plasma Interactions		
Solar radio bursts play a pivotal role in advancing both fundamental plasma physics and space-weather predictions. These emissions are produced by energetic electron beams and shock structures propagating through the solar corona. They encode rich information about nonlinear kinetic processes whose detailed microphysics remain only partially understood. Although magnetohydrodynamic (MHD) models successfully reproduce the large-scale evolution of coronal shocks, mass ejections, and magnetic-field reconfiguration, they are intrinsically limited in their		

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ability to capture the kinetic instabilities, wave–particle interactions, and coherent wave processes responsible for radio emission.

Particle-In-Cell (PIC) simulations provide a powerful framework to bridge this gap by self-consistently resolving beam–plasma interactions, Langmuir turbulence, nonlinear wave–wave coupling, and mode-conversion processes that are widely regarded as the physical origin of Type II and Type III solar radio bursts. In this work, we present preliminary PIC simulation findings demonstrating that the onset of solar radio emission is primarily governed by beam–plasma instabilities. Energetic electrons drive strong Langmuir wave activity, which subsequently undergoes nonlinear coupling, including interactions with backscattered Langmuir modes. These processes lead to the generation of slowly and rapidly drifting electromagnetic emissions that closely resemble the spectral characteristics of observed Type II and Type III radio bursts.

The temporal evolution and frequency drift of the emitted radiation are identified through power-spectral analysis, while their nonlinear and coherent properties are quantified using bispectral diagnostics. Together, these analyses provide compelling evidence that solar radio bursts originate from fundamentally kinetic processes that are inaccessible to fluid-based descriptions.

ASI2026_974	Ajisha C Sajayan	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Precision Optical Astrometry of X-ray sources at the Galactic center using HST Observations.		

The Galactic Center (GC) represents one of the most extreme and dynamically complex environments in the Milky Way, hosting a supermassive black hole, Sgr A*, embedded within a dense nuclear star cluster and a seemingly rich population of compact objects. Precision astrometry enables the measurement of tiny positional shifts over time, allowing proper motions to be determined even for distant sources at the Galactic Center.

We present an optical proper motion study, with milliarcsecond precision, of X-ray sources at the Galactic center, using the Hubble Space Telescope (HST). This proper motion study helps in understanding whether these sources, which include white dwarf and black hole systems, are in the vicinity of Sgr A* or are foreground sources.

ASI2026_971	Akhilesh Ray	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Pion production in the Accretion Disk of rotating blackhole		

As we investigate the dynamics of accretion disks around black holes, it becomes evident that several radiative processes operate as matter falls into the gravitational potential well. During accretion, gravitational energy is progressively converted into thermal energy, leading to a substantial increase in plasma temperature, particularly in the vicinity of the event horizon. This elevated temperature enables a variety of high-energy radiative processes to occur. In the present study, we focus on high-energy interactions in the accretion flow, treating the disk as a hot plasma. In such a highly energetic environment, proton–proton interactions become significant and can result in the production of neutral pion ($\pi 0$) mesons. These mesons are extremely short-
lived and rapidly decay into two gamma-ray photons, thereby contributing to the observable gamma-ray spectrum. Since our work explores accretion onto rotating black holes, the Kerr parameter (spin) plays a crucial role in determining the pair production rate. The efficiency of pion production is strongly dependent on the plasma temperature. As our model extends earlier adiabatic sub-Keplerian accretion models to include black hole rotation, the temperature near the event horizon is expected to increase significantly with increasing Kerr parameter. Consequently, the rate of neutral pion production is enhanced, leading to a stronger gamma-ray emission signature. This study aims to quantify the dependence of the gamma-ray output on black hole spin and to provide theoretical predictions that can be tested against high-energy astrophysical observations.

ASI2026_361	Aman Kaushik	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Characterizing SMC pulsar SXP 46.6		

Be/X-ray binaries (BeXRBs) represent a major subclass of high-mass X-ray binaries (HMXBs) where the companion star is a B-type star with a circumstellar decretion disk. These systems are characterized by regular X-ray outbursts linked to the interaction between the neutron star (NS) and the Be star's disk at periastron. The NS, typically in a wide and eccentric orbit, accretes material as it passes through the dense equatorial disk of the Be star, giving rise to Type I outbursts near periastron. The pulsar SXP 46.6, originally discovered with the Rossi X-ray Timing Explorer (RXTE) in 1997, is one such BeXRB in the Small Magellanic Cloud (SMC). Here, we characterize SXP 46.6 using NuSTAR observations conducted in 2017. We observe that the spin period (P) of this neutron star has
decreased from its discovered value of 46.6 s to a value of 45.984(1) s, indicating a spin-up at the rate of ˙P = −1.13 × 10^(−9) s s−1. This spin-up rate is used to calculate a high pulsar magnetic field value of 2.25 × 10^(13) G. This calculation also provides a low magnetic field value, which we rule out here by constraining the inner accretion disk radius to be less than the radius of the innermost stable circular orbit. The pulse profile shows a double-peaked structure in soft, hard, and broad X-ray bands which hints towards a pencil beam emission from two antipodal hot spots on the neutron star surface. We also perform spin phase-resolved spectroscopy for the first time, revealing spectral variations across different phases of the pulsar's rotation. These results offer new insights into the long-term spin evolution and emission properties of SXP 46.6. (The article has been published in PRD: https://doi.org/10.1103/lwq4-8jz8)

ASI2026_386	Aman Srivastava	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
The Indian Pulsar Timing Array Data Release 2: II. Customised Single-Pulsar Noise Analysis and Noise Budget		

The Indian Pulsar Timing Array (InPTA) exploits the unique capabilities of the upgraded Giant Metrewave Radio Telescope (uGMRT) to observe millisecond pulsars (MSPs) simultaneously in the 300-500 MHz and 1260-1460 MHz bands. In this work, we present results from a customized single-pulsar noise analysis of 27 MSPs from the second InPTA data release (InPTA-DR2). Stochastic red noise processes are modelled using stationary Gaussian processes, and Bayesian inference is employed for model selection, Fourier harmonic selection, and parameter estimation. The reliability of the noise modelling is assessed using the Anderson-Darling test applied to noise-subtracted timing residuals.

We find that all 11 pulsars with time baselines $\lesssim$2.5 yr exhibit Gaussian residuals and show no evidence for red noise, with the exception of PSR J1944+0907, which displays dispersion-measure (DM) noise. PSRs J0437−4715, J1909−3744, and J1939+2134 favour more complex noise models incorporating both achromatic and chromatic red noise components. Among pulsars with baselines $\gtrsim$2.5 yr, only four show significant non-Gaussianity. A comparative study of six pulsars with data removed near solar conjunctions showed deviations from the parameter estimates obtained with the original dataset, indicating potential bias in red noise processes due to unmodeled solar-wind effects.. Overall, our results are consistent with those from InPTA-DR1, with improved constraints on noise properties and additional support for achromatic red noise in PSR J1012+5307 enabled by the extended dataset.

ASI2026_679	Amar Chandra	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Cyclic changes in pulse shape and single pulse properties of PSR J0742-2822		

Though the majority of pulsars have very stable pulse profiles, there are a few that show changes with time, and these can be very important tools for understanding the pulsar emission mechanism. Here, we report on very interesting and rather unique changes in pulse shape and single pulse behaviour of PSR J0742-2822, using simultaneous dual-band observations with the GMRT at 325 MHz and 610 MHz, along with L-band data from the Jodrell Bank Observatory. We find clear evidence of cyclic changes on time scales of about 200 days, in the pulse width and shape in the data at all three frequencies, which can be separated into two distinct profile modes having distinctly different pulse shapes and single pulse properties, as shown by their fluctuation spectra. Decomposing the profile into core and conal emission components, we show varying retardation-aberration effects for the conal components in the two modes. Using this, along with the available knowledge of the rotation geometry of this pulsar, we can make estimates for emission heights of the core and conal components as well as the footpoints of the field lines, in the two modes of emission. We present a detailed characterisation of the possible rearrangements of the emission regions in the magnetosphere, as the pulsar switches between the two states. This makes it one of the few unique pulsars showing profile shape variations, where such a study has been done.

ASI2026_429	AMIT KUMAR	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Investigating temporal features in Swift GRB afterglows: a comparative study of UVOT and XRT data		

This study presents a statistical analysis of optical light curves (LCs) of 200 Ultraviolet/Optical Telescope (UVOT)-detected gamma-ray bursts (GRBs) from 2005 to 2018. We have categorized these LCs based on their distinct morphological features, including early flares, bumps, breaks, plateaus, etc. Additionally, to compare features across different wavelengths, we have also included XRT LCs in our sample. The early observation capability of UVOT has allowed us to identify very early flares in 21 GRBs preceding the normal decay or bump, consistent with predictions of external reverse or internal shock. The decay indices of optical LCs following a simple power law (PL) are shallower than corresponding X-ray LCs, indicative of a spectral break between two wavelengths. Not all LCs with PL decay align with the forward shock model and require additional components such as energy injection or a structured jet. Further, plateaus in the optical LCs are primarily consistent with energy injection from the central engine to the external medium. However, in four cases, plateaus followed by steep decay may have an internal origin. The optical luminosity observed during the plateau is tightly correlated with the break time, indicative of a magnetar as their possible central engine. For LCs with early bumps, the peak position, correlations between the parameters, and observed achromaticity allowed us to constrain their origin as the onset of afterglow, off-axis jet, late re-brightening, etc. In conclusion, the ensemble of observed features is explained through diverse physical mechanisms or emissions observed from different outflow locations and, in turn, diversity among possible progenitors.

ASI2026_618	Amit Kumar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Study of Neutrino dominated accretion flows (NDAF) around rotating black hole (BH)		

We investigate the physical properties of the central engine powering gamma-ray bursts (GRBs), modelled as a stellar-mass rotating black hole accreting through a neutrino-dominated accretion flow (NDAF) at hyper-accretion rates ($\dot{M}\sim 0.001$–$10\,M_\odot\,\mathrm{s^{-1}}$). At such high accretion rates, the disk becomes geometrically and optically thick, inhibiting photon escape, while neutrinos can efficiently escape and cool the flow through radiative emission and annihilation processes. By self-consistently solving the governing hydrodynamic equations, we obtain global transonic NDAF solutions featuring shock transitions and explore them over a wide range of black hole mass ($M_{\rm BH}$), spin ($a_{\rm k}$), and accretion rate. Using these shocked solutions, we estimate the neutrino luminosity (L_ν) and neutrino annihilation luminosity ($L_{\nu\bar{\nu}}$) for both weakly ($a_{\rm k}=0$) and rapidly ($a_{\rm k}=0.99$) rotating black holes, finding good agreement between $L_{\nu\bar{\nu}}$ and the observed energy output of GRBs. Incorporating inputs from numerical simulations of binary neutron star and black hole–neutron star mergers, we further estimate the remnant black hole mass and spin parameters for the predicted range of post-merger disk mass ($M_{\rm disk}$). Our results show that shocked NDAFs can naturally reproduce the observed diversity in GRB energetics, with short GRB luminosities achievable either by low-mass, slowly spinning black holes or by more massive black holes with higher spins. We also identify a robust correlation in which $M_{\rm disk}$ decreases with increasing $a_{\rm k}$, remaining largely insensitive to $M_{\rm BH}$, supporting neutrino-dominated shocked accretion as a viable mechanism for powering GRB central engines.

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ASI2026_178	Ankita Ghosh	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Jitter, Profile Stability, and Single-Pulse Variability in Millisecond Pulsars: Pulsar Timing Arrays in the SKA Era		

Pulse-to-pulse variability in millisecond pulsars (MSPs), driven by intrinsic phase jitter and magnetospheric processes, can fundamentally limit the timing precision required for detecting nanohertz gravitational waves with Pulsar Timing Arrays (PTAs). While single-pulse studies have revealed that jitter noise is a dominant contribution to the timing error budget for many bright MSPs, a systematic, multi-frequency characterization of profile stability and jitter across a wider MSP population remains limited.

We present a comprehensive analysis of pulse-profile stabilization timescales and intrinsic jitter in MSPs using long-term, multi-epoch observations with the upgraded GMRT (uGMRT; 300--750 MHz) and complementary Parkes Ultra-Wideband low-frequency receiver (Parkes UWL; 704--4032 MHz) data for a subset of sources. Using a direct pulse-stacking–based method, we show that stable, ensemble-average profiles typically require integration over $\sim$10$^{5}–10^{6}$ pulses. We find that these stabilization timescales correlate with signal-to-noise ratio, pulse morphology, and surface magnetic field strength, suggesting a link between emission stability and magnetospheric conditions. A complementary single-epoch analysis of bright MSPs reinforces these trends and demonstrates that the slope of the profile-stability curve is strongly correlated with an independently measured jitter parameter, implying that profile-stability analysis can serve as a practical proxy for intrinsic pulse-shape variability in MSPs.

By extending these techniques to MSPs that are key PTA sources, and by probing the frequency dependence of jitter and stability timescales, our study provides a scalable framework for quantifying intrinsic profile variability. For the Square Kilometer Array (SKA) era, where radiometer noise will be dramatically reduced, jitter will become the primary limiting factor for achievable timing precision in bright PTA MSPs. Robust empirical constraints on jitter and stability timescales are therefore crucial for optimizing PTA observing strategies, choosing integration times, refining PTA noise models, and ultimately maximizing the array's sensitivity to nanohertz gravitational waves.

ASI2026_657	Anshika Gupta	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Prompt and afterglow properties of the long duration GRB 210306A		

The long-duration GRB 210306A was detected by the Swift-BAT and Fermi/GBM with a T90 duration of around 9 sec. The Fermi/LAT detected the highest energy photon of 1.2 GeV associated with the GRB event. An uncataloged X-ray and optical source was detected by the Swift XRT and UVOT telescopes. The optical afterglow was observed with several ground-based telescopes. The prompt emission spectrum was best fit with a cutoff power law function with Ep = 60.41 ± 2.54 keV. The wide energy band Fermi-GBM data were used to perform time-resolved spectroscopy during the burst phase to study the evolution of the different parameters, such as the Ep, photon index, and Band function indices (α, β). GRB 210306A follows the long GRB trend in the Amati and Yonetoku correlations. The multiwavelength afterglow evolution of the GRB was modelled using the forward shock model, incorporating Bayesian parameter estimation. The X-ray afterglow light curve shows an early break in the light curve, which is absent in the optical light curves, indicating that the break is not due to a jet break. We constrain the kinetic energy of the burst, the ambient medium density, and the
shock microphysical parameters with the multiwavelength modeling.

ASI2026_689	Anurag Koparkar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Spectral-Polarisation Correlation In Blazars		

Blazars are a subclass of AGN whose relativistic jets are pointed closely to our line of sight. Their spectral energy distribution (SED) shows a unique double hump structure, in which the first hump is due to non-thermal synchrotron radiation. Since synchrotron radiation is polarised, a direct correlation is expected between the spectral and polarization properties in the optical and near-infrared energy range. We investigate this correlation using multi-band (B, V, R, J, K) photometry data from SMARTS Observatory and photo-polarimetric data from Steward Observatory. By comparatively fitting models to SED, we derive spectral parameters that are used to estimate polarization degrees and their evolution over time. A total of eight blazars were identified as common to both observatories, which include both subclasses of blazars, Flat Spectrum Radio Quasars (FSRQs) and BL Lacertae (BL Lac) objects. This sample covers a broad range of spectral and physical characteristics. Our study aims to investigate whether this correlation differs across different classes of blazars. By analysing both flaring and quiescent states, we aim to understand how temporal variability shifts a source along the blazar sequence and how changes in the synchrotron peak influence polarization behaviour. By performing class-wise statistical comparisons and spectral-polarimetric correlation analysis our study aims to answer the dominant physical processes that govern emission in relativistic jets. I will present and discuss preliminary results from this study.

ASI2026_199	Arijit Sar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Variable Corona Height as the Origin of UV–X-ray Lag Variability in NGC 7469		

Past observations have shown that in most active galactic nuclei (AGNs), variability in the X-ray emission from the corona leads that of the UV/optical emission from the accretion disk, consistent with X-ray reprocessing by the disk. However, some Seyfert galaxies exhibit the opposite behavior, with X-ray variations lagging those in the UV. One such source is NGC~7469, for which multiwavelength monitoring over the past three decades has revealed changes in the direction of the UV/X-ray time lag. In particular, simultaneous {\it IUE} and {\it RXTE} observations in 1995 showed X-ray variations lagging the UV by $\sim$3.5 days, whereas more recent campaigns indicate UV emission lagging the X-rays. We present a numerical accretion disk–corona model to simulate UV and X-ray light curves and investigate the origin of these differing lag behaviors. Our model demonstrates that the X-ray lag observed in 1995 can be explained by inward-propagating accretion rate fluctuations combined with a compact corona in a lamppost geometry located close to the central black hole. Conversely, we find that a corona located at a larger height above the disk produces UV emission lagging the X-rays through enhanced X-ray reprocessing. These results suggest that changes in coronal geometry can account for the observed variability and lag reversals in NGC~7469.

ASI2026_197	ARIT BALA	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing the Nature of Magnetic Field in Blazar Jets from Multi-Wavelength Variability		

Blazar emission varies significantly at longer (days to years) timescales across the electromagnetic spectrum and at shorter (sub-day) timescales at optical, X-ray and gamma-rays energies. The longer-timescale variability is usually explained by the injection of energetic particles by shocks propagating down the jet and subsequent radiative cooling of those particles in the shock-in-jet scenario. However, the source of the observed minutes-hours timescale variability has been elusive. We present a numerical model, in which a shock moves down the jet and energizes the previously quiescent electrons in consecutive "cells". The electrons subsequently cool via synchrotron and inverse-Compton processes. In this 'multi-zone' model, the magnetic field in each cell may be different and the electron energy distribution in each cell may evolve independently due to cooling. Our model can reproduce the red-noise nature of the variability and strong correlation among multiple wave bands with zero time delay as observed in blazars. We find that shorter-timescale synchrotron variability, as observed at X-ray and optical emission in many blazars, may be generated by the fluctuations of the magnetic field (few to few tens of percent) in the neighboring cells. We find that short-timescale fluctuations in the GeV emission generated by the external Compton process, which does not depend on the magnetic field, may be produced by imposing equipartition of energy between the magnetic field and particles. A non-zero time lag among, e.g., GeV and optical variability, as observed in a small fraction of blazar flares, may be reproduced in very specific configurations of the magnetic field, for example, if the magnetic field contains large angular variation in its direction among neighbouring cells. Comparison of our model results with observed data, as a tool complimentary to polarization observations, can be effectively used to constrain the nature of magnetic field in blazar jets.

ASI2026_348	Aromal P	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
The 2024 outburst of the neutron star LMXB EXO 0748–676: An investigation of bursts and eclipses with AstroSat		

We present a detailed analysis of the Type-I (thermonuclear) X-ray bursts and eclipses observed during the 2024 outburst of the neutron star low-mass X-ray binary EXO 0748–676, utilizing multi-instrument data from the AstroSat mission (Aromal et al. 2025). Discovered in 1985, the source underwent a 24-year outburst before entering quiescence in 2008; the 2024 activity represents only its second recorded outburst after a 16-year quiescent phase. Our analysis of data from the Large Area X-ray Proportional Counter (LAXPC) identified three thermonuclear bursts, two of which were observed simultaneously with the Soft X-ray Telescope (SXT). Our time-resolved spectroscopy characterizes two of these as photospheric radius expansion (PRE) events, and from their peak flux, we estimate a source distance of 7.42+/-0.53 kpc. Furthermore, we report the first-ever simultaneous observation of a thermonuclear burst with the Ultra-Violet Imaging Telescope (UVIT), providing evidence of X-ray burst reprocessing in the accretion disk. Notably, one burst exhibited a secondary peak approximately 30 s after the primary. This secondary feature, more prominent in the soft X-ray energies, correlates with the evolution of the hotspot radius and exhibits no temperature variations. The burst energetics and ignition conditions suggest a fuel composition of mixed H/He. Furthermore, a detected soft excess during one burst likely results from the interaction of the burst photons with the accretion environment. Finally, we characterize the energy dependence and temporal evolution of the orbital eclipses to probe the local binary environment. These results provide critical insights into the physics of thermonuclear ignition, flame propagation, the burst-accretion interaction, and the evolution of LMXBs.

ASI2026_702	Arushi Kumar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Dust scattering of X-ray photons from Gamma ray bursts		

Gamma-ray bursts (GRBs) are among the most energetic events in the universe. A longer-lasting and multi-wavelength afterglow follows the initial intense and highly energetic emissions in X-rays and gamma rays. When dust lies close to the progenitor, some of the prompt X-ray photons do not travel directly but instead scatter off dust grains before reaching the observer. These scattered X-ray prompt photons reach the observer with a time delay during the afterglow phase. In certain cases, this phenomenon may explain the shape of the observed X-ray afterglow light curves and the softening of the observed spectrum. Studying these effects can provide insights into both the GRB and its surrounding environment.

In this work, we applied a simple dust scattering model to study how different physical conditions affect the scattered emission. We focused on five key parameters: the distance R of the dust layer from the progenitor, the power-law index q describing the dust grain size distribution, the maximum grain size a+, the minimum grain size a-, and the scattering optical depth. We sampled the parameter space and produced synthetic light curves and spectra, to understand the role of the parameters in shaping the light curves and the spectral evolution.

Using the detector response matrix of the Swift XRT, we estimated the parameter ranges that would yield observable dust-scattered emission during the afterglow phase, with particular emphasis on R, the distance of the dust layer from the progenitor. We compare these ranges with the expected distances of dust shells around Wolf-Rayet stars, the most likely progenitors of GRBs.

ASI2026_669	ASHISH NARAYAN	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Searches for Neutrino emission from the Cygnus Region in Ten Years of Public IceCube Data		

We present results of searches for neutrino emission from the Cygnus region using ten years of IceCube public data. The analyses model the source as extended & point-like emitters, employing the unbinned maximum likelihood ratio test to look for directional excesses in neutrinos. The results yield local significances never exceeding 2.9σ. We also employ templates based on gamma-ray observations by HAWC to look for correlated neutrino emission. We comment on recent claims in literature on the topic.

ASI2026_397	ASWATHI V	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Neutron Polarization in Lithium Photodisintegration		

Photodisintegration of lithium is important in the field of Nuclear Physics, Particle Physics and Astrophysics. 7Li is considered as one of the elements that was primordially synthesized in standard Big Bang Nucleosynthesis. Lithium, being fragile, gets destroyed easily at relatively low temperatures. WMAP measurements have inferred that 7Li abundance is two to three times higher than that inferred by the low metallicity halo stars [2]. In stars, lithium exists with two isotopes 6Li as well as 7Li. Series of experimental measurements on the photodisintegration of lithium isotopes are being carried out at High Intensity Gamma Ray Source to study the cross section and angular dependence [3]. In addition, experimentalists are launching the Extreme Light Infrastructure Silicon Strip Array (ELISSA) through a collaborative effort between LNS-INFN and ELI-NP, offering the widest possible angular coverage for studying nuclear reactions relevant to astrophysics. This facility will help improve our understanding of stellar evolution [4]. However, the theoretical studies are still fewer compared to the experimental investigations. Therefore, the purpose of the present contribution is to study neutron polarization in the 7Li + γ → 6Li + n reaction using model model-independent approach. In this study, we have included the role of E1, M1 and E2 multipole amplitudes in 7Li + γ → 6Li + n reaction.

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ASI2026_459	Avijit Chowdhury	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Effect of dark matter halo on transonic accretion onto galactic black holes		

The environment surrounding a black hole or black hole binaries is generally expected to play an essential role in understanding various astrophysical phenomena around them. In this study, we investigate relativistic, low angular momentum, inviscid, and advective hot accretion flow onto a galactic supermassive black hole dressed with a cold dark matter halo. Focusing on different relativistic dark matter distributions with an inner density spike, we analyze the effect of the dark matter halo on the topology and properties of the accretion flow. Our results show enhancement of disk luminosity in the presence of dark matter, which depends on the nature and properties (halo mass and compactness) of the dark matter distribution. Since the dominant contribution to the disk luminosity for compact and massive halo comes from the inner region of the accretion disk, our analysis hints that luminosity measurement can indeed be useful to probe the exact nature of the dark matter density spike. We further comment on how a small but finite viscosity is expected to modify the flow structure and luminosity, without qualitatively altering our main conclusions.

ASI2026_99	Avijit Sen Majumder	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Non-relativistic scattering of a massive spin-2 field via graviton exchange with a spin-0 field and the gravitational potential		

Among the four fundamental forces – strong, weak, electromagnetic, and gravitational – the gravitational force is still unquantized. This makes a significant challenge in theoretical physics as the quantum of gravitational force - called the Graviton, a spin-2 Boson, has yet to be detected. But the mathematical framework for the graviton is well-developed and remains a dynamic area of study. In this work, we calculate the graviton mediated scattering amplitude for tree and higher order Feynman diagrams involving a massive spin-2 Fierz-Pauli field interacting with a massive spin-

0 Klein-Gordon field and the quantum corrected two body gravitational potential in the non-relativistic limit. The massive spin-2 field does not represent gravity here. Rather, the theory of gravity is described by usual massless general relativity, and the massive spin-2 field is taken as a test quantum field coupled to gravity via the standard minimal prescription. We first compute the tree level 2-2 scattering and the leading Newtonian potential, along with subleading spin dependent terms at O(G). We then analyse the next-to-leading order [O(G^2)] scattering, demonstrating the spin independent, spherically symmetric leading part of the two body gravitational potential. Our analysis shows that the tree level potential is inversely proportional to the distance between massive spin-2 and massive spin-0 particles, which agrees with classical Newtonian results. Further quantum corrections to the potential have been calculated up to the inverse square and cube of the distance. This work attempts to calculate the quantum corrected gravitational potential in higher spin field theory, representing an important step toward understanding quantized gravitational interactions.

ASI2026_101	Ayan Kumar Naskar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Correction in light bending angle due to finite size effects in the worldline formalism.		
The phenomenon of light bending due to a massive body has been studied rigorously at both classical and quantum levels. The quantum corrections up to 2PN order including spin effects has previously been calculated. In this work we calculate the leading order correction in light bending due to finite size of a massive object. In the worldline formalism the finite size effect is introduced through the Weyl tensor. The magnetic part of Weyl tensor couples to the odd spin vectors and the electric part couples to the even spin vectors. This structure of finite size effective action has been established previously. Here, we calculate the corrections in the bending angle for a massless scalar (spin-0) probe due to the octupole and hexadecapole vertices, and they turn out to be of the order of 1/b4 and 1/b5, where b denotes the impact parameter. This agrees with the predictions from the corresponding well established potentials. Further extension of this work is under progress where we are trying to calculate the effect of including the quantum spin of the probe (spin ½ and spin 1). To the best of our knowledge, this is a significant step towards understanding the quantum correction in light bending phenomenon.		

ASI2026_33	AYON MONDAL	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
A Two-Decade X-ray and UV Spectral-Timing Study of Mrk 766: Disk Reflection, Outflows, and the Evolution of Fe~Kα Complex		
We present a multi-epoch, primarily X-ray study of the narrow-line Seyfert 1 (NLSy1) galaxy Mrk~766 by combining archival \textit{XMM-Newton} observations spanning nearly two decades together with a \textit{XRISM} observation obtained during its Performance Verification Phase. We analyzed the absorption and emission features in the soft X-ray spectra from RGS and EPIC-pn data, revealing a stratified multi-phase potentially ionised absorber with a varying column density at a timescale of $\sim$1 day. The covering fraction of the absorber shows a systematic increase by a factor of 1.1 while the continuum flux increases by a factor of 3.4, supporting radiation-driven outflows. Mrk~766 exhibits a multi-component Fe Kα emission line as revealed by fits to the \textit{XRISM} data. A quasi-phenomenological model comprising a torus and a broad \textit{diskline} component distinguishes the two components and constrains the inner radius of the potential broad line emitting disk substructure between $R_{in}=40–60~r_{\rm g}$. Analysis of multiple epochs of the Fe Kα complex across \textit{XMM-Newton} observations reveals that the broad component tracks the continuum flux closely and effectively reflects the trend with respect to the continuum. The narrow component is consistent with a distant emitter, potentially the torus. Quasi-simultaneous monitoring with \textit{Swift}-XRT and UVOT further indicates UV emission lagging the X-rays by $5.9^{+4.1}_{-5.7}$ hours, consistent with disk reprocessing of coronal X-ray fluctuations, and corresponds to a light travel distance of up to $10^{3}~r_{\rm g}$. Overall, our analysis maps the extent of the dynamically evolving absorber, the iron line emitter, and the accretion disk in this highly accreting NLSy1 system.		

ASI2026_114	AYUSH GARG	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Time-resolved Spectroscopic study of Ultra-long GRBs		

The ultra-relativistic, highly collimated jets generated by Gamma-Ray Bursts (GRBs) provide crucial insights into particle emission. These jets also reveal the physical mechanisms driving the rapid release of high-energy gamma-ray photons. We discuss time-resolved spectroscopy and flux variability for the ultra-long GRB 220627A. We are also comparing the time-resolved spectroscopy for three different ultra-long GRBs observed by Fermi-GBM/LAT. For each ultra-long GRB, there are two different episodes observed by Fermi and other satellites, which are hundreds of seconds apart from each other. Using time-resolved spectroscopy, we can comment on the spectral contributions from different time-resolved flares in both the temporal and spectral domains. Due to its unique characteristics, GRB 220627A serves as an excellent source for studying particle emission processes, small-scale variability, and the properties of its central engine. To investigate the gravitational lensing of GRB 220627A, the time bins of the first episode were correlated with those of the second episode. A coherent relationship was observed between flux and photon spectral distribution. This relationship was modelled using an exponentially cut-off power law model for both episodes. The discrepancy in MeV-to-GeV fluence detection by LAT further rules out gravitational lensing but suggests that the progenitor is undergoing a burst that evolves into an ultra-long GRB with two episodes. Isotropic energy, spectral signatures, and burst duration parameters for GRB 220627A align with the established limits for a blue supergiant progenitor, as described in the literature.

ASI2026_100	Banibrata Sarkar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Accretion Disk Signatures in Higher-Order Vacuum Gravitational Waves		

Extreme mass-ratio inspirals (EMRIs) are expected to be one of the most prominent sources of gravitational waves for future space-based detectors like LISA and Taiji. However, most waveform models assume vacuum dynamics, while realistic EMRIs are likely to inhabit environments containing accretion disks, dark matter halos, and other material components.

Previous studies have shown that accretion disk effects are generally weaker than the leading-order vacuum gravitational-wave contributions, yet can still produce measurable imprints on the waveform. In this work, we systematically compare the impact of accretion disk–induced modifications with higher-order corrections to vacuum gravitational-wave fluxes. We construct a flux-modulated inspiral model in which additional disk-sourced angular momentum and energy fluxes are incorporated into the orbital evolution.

Using this framework, we compute gravitational-wave phase shifts relative to the vacuum case and assess their detectability with LISA. We further investigate how the accumulated dephasing depends on key accretion disk parameters. In addition, we perform a full Bayesian parameter estimation analysis to quantify the biases that arise when environmental effects are neglected in waveform modelling.

Our results show that disk-induced phase dephasings can accumulate to several radians over a typical LISA observation window, exceeding the threshold for detectability and leading to significant parameter biases if ignored. Accounting for these contributions will be essential for avoiding biases in black hole parameter inference and may even enable probing the properties of accretion disks through gravitational waves coupled with the electromagnetic observations, hence providing a path towards Multi-Messenger Astronomy.

ASI2026_326	Bharathi PK	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
A Comprehensive Study of Thermonuclear X-ray Bursts from Neutron Stars with AstroSat: Probing the Underlying Physics		
Type-I thermonuclear X-ray bursts are observed from neutron star low-mass X-ray binary (NS-LMXB) systems due to unstable ignition of accreted matter on the stellar surface. These events offer an excellent opportunity to investigate physics under extreme conditions of strong gravity and ultradense matter. This study presents a comprehensive investigation of X-ray bursts observed from the NS-LMXBs using the Large Area X-ray Proportional Counter (LAXPC) instrument onboard the Indian multi-wavelength mission AstroSat. We developed a dedicated pipeline for burst search in the light curve, which has resulted in the detection of 63 bursts from 37 different sources to date. We further conduct a profile modelling of the bursts, particularly focusing on the burst decay behavior, and compare the decay characteristics across a variety of bursts from different sources. In many cases, the decay profile deviated from the canonical exponential behavior, and such characteristics can offer insight into the thermodynamic conditions on the surface of the neutron star as the hotspot created during thermonuclear fusion cools. Furthermore, we performed time-resolved spectroscopy of the detected bursts, which led to the identification of several interesting features, including photospheric radius expansion and peculiarly shaped, peaked bursts. Particularly, we detected several cases where peaked features were present during the decay part of the light curve. Our analysis correlates the occurrence of these peaked features with the corresponding hotspot temperature and radius characteristics to probe the origin mechanism of these features. Moreover, we connect the temperature and radius evolution of the hotspot with the thermodynamic conditions indicated by the decay profile analysis. We further estimate the ignition latitude and examine its influence on the burst properties. Such a comprehensive study using bursts detected by AstroSat will shed light on the thermonuclear ignition conditions, accretion rate dependence, flame propagation and hotspot evolution associated with the type-I bursts.		

ASI2026_655	Biki Ram	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing the dynamics of the inner Accretion Disk and Corona in Black Hole Low mass X-ray Binaries		
The QPOs (quasi-periodic oscillations) observed in the power spectrum of black hole low-mass X-ray binary (BH-LMXB) systems are exceptional features for studying the effects of strong gravity and the associated accretion physics. We searched the entire archival data (2016-2024) of BH-LMXBs from AstroSat and found 29 QPOs, along with several associated harmonics and shoulders. We then performed a timing and spectral analysis of these observations to investigate the origin and modulation of the QPOs. Notably, we detect a sign reversal in the average QPO time lag between hard and soft photons around 2 Hz for the high inclination sources during the hard-to-hard intermediate state transition. At lower frequency, the hard lags showed an increasing trend reaching up to ~36 ms, but the soft lags above 2 Hz remained confined within ~10 ms, suggesting the presence of a compact corona. The transition frequency indicates the radius of Lense-Thirring (LT) precession beyond which the corona transits from elongated (jet-like) to a compact corona, leading to soft lags. Furthermore, for high inclination sources, the harmonic lag remains unaffected during the state transition, in contrast to the QPO lag behavior. Conversely, for low inclination sources, the time lag does not exhibit any transition, but the RMS spectral slope changes sign at a similar QPO frequency value. The difference in lag behavior between high and low-inclination sources above 2 Hz arises because relativistic effects become stronger at smaller radii leading to variation of QPO flux, which is not the case at larger radii. The spectral properties are closely correlated with the timing features, exhibiting a positive correlation of the QPO frequency with the photon index and the thermal flux fraction. This study offers critical insights into the transformation of the coronal structure in association with the state evolution of BH-LMXBs.		

ASI2026_794	CHANDAN KUMAR DAS	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
On the Origin of Ultra-High-Energy Neutrinos in Relativistic Blazar Jets		
The detection of very high-energy astrophysical neutrinos provides crucial insight into the most powerful particle accelerators in the Universe. In particular, the ~2 PeV IceCube neutrino event IC35 and the recent KM3NeT event KM3-230213A, with an inferred energy of 220 PeV, place strong constraints on the physical conditions required for neutrino production. Relativistic jets from active galactic nuclei (AGNs), especially blazars, are among the leading candidate sources; however, the mechanisms that can accelerate particles to such extreme energies remain uncertain. In this work, we present a unified theoretical study of high-energy neutrino production in blazar jets. We constrain the relevant physical parameters of the jet environment by systematically comparing particle acceleration timescales with cooling timescales associated with the dominant energy-loss processes. In particular, we focus on photo-pion interactions, which are expected to be the primary channel for producing high-energy neutrinos in astrophysical sources. This timescale-based approach enables us to identify the conditions under which protons can be accelerated efficiently to PeV-EeV energies without suffering significant energy losses, thereby allowing for the observability of this ultra-high-energy neutrino event by KM3NeT. We further apply this framework to a comparative study of two major flaring episodes of the blazar PKS B1424-418. The first flare (2012–2013) is spatially and temporally coincident with the event IC35, whereas a second, brighter gamma-ray flare in 2021 shows no clear neutrino association. By comparing these two flares, we examine how differences in jet parameters influence neutrino production efficiency and assess the conditions required for observable neutrino emission.		

ASI2026_982	CHANDRA KUMAR CHANDRAVANSHI	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Multi-epoch X-ray Spectral and Timing Study of the Be/X-ray Binary SMC X-2		
SMC X-2 is a transient Be/X-ray binary pulsar in the Small Magellanic Cloud that has exhibited multiple giant (Type II) outbursts over the last few decades, reaching super-Eddington luminosities. These episodes provide an excellent opportunity to investigate accretion processes and emission geometry in strongly magnetized neutron stars. We present a comprehensive multi-epoch X-ray timing and spectral study of SMC X-2 using archival observations from RXTE, Swift/XRT, XMM–Newton, NuSTAR, NICER, and AstroSat, covering its major outbursts in 2000, 2015, and 2022. Timing analysis confirms coherent pulsations with a spin period of ~2.37 s across all epochs. Energy-resolved pulse profiles show a clear luminosity-dependent evolution, transitioning from a single-peaked structure at lower luminosities to a double-peaked morphology at higher luminosities. This behavior is consistent with a change in emission geometry from a pencil-beam to a fan-beam pattern as the accretion rate increases. The pulsed fraction is found to increase with both energy and luminosity. Broadband spectral modeling shows a hard Comptonized continuum along with a soft thermal component and iron fluorescence emission. An absorption-like feature detected in the hard X-ray band, around ~27 keV, is interpreted as a cyclotron resonance scattering feature, implying a neutron star magnetic field of the order of 10^{12} G. The centroid energy of this feature tends to fluctuate within 25 to 31.5 keV, with indications of a luminosity-dependent energy shift.		

ASI2026_107	Daneshwar Bhandari	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Spectral and Temporal Analysis of GS 1826-238 with XPoSat/XSPECT		
We present a detailed spectral and temporal study of the low-mass X-ray binary (LMXB) GS 1826-238 using observations from the XSPECT instrument onboard XPoSat in the 0.8-15.0 keV energy range. GS 1826-238 is a well-known neutron-star atoll source and a prototypical clocked burster, exhibiting remarkably regular thermonuclear (Type I) X-ray bursts. Long-term monitoring with MAXI over the past 6-8 years shows that the source has remained persistently active in a soft spectral state.		

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The temporal analysis reveals the presence of Type I X-ray bursts, characterized by a rapid rise and exponential decay profile. The hardness-intensity diagram (HID) indicates that the source predominantly occupies the banana state, which is characteristic of atoll sources accreting at relatively high mass accretion rates. Two Type I X-ray bursts were detected during the observation.
We investigated the evolution of spectral and timing properties along the HID, providing insights into the accretion geometry and emission processes in the soft state. The X-ray spectral properties were studied as a function of position along the banana branch, revealing systematic changes in the continuum parameters that reflect variations in the mass accretion rate. Time-resolved spectroscopy of the Type I X-ray bursts shows a clear evolution of the blackbody temperature and emitting radius during the burst decay, consistent with unstable helium-rich nuclear burning on the neutron-star surface.

ASI2026_600	Debabrata Deb	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Frequency-Resolved Template Generation and Optimal Subbanding for Precision Pulsar Timing		

We present a robust methodology for constructing high-fidelity, frequency-resolved pulsar templates and optimally determining the number of sub-bands required for precision timing at uGMRT frequencies. This methodology is developed and rigorously tested on realistic simulated data generated using our comprehensive pulsar signal simulation framework. Low-frequency timing is challenged by strong frequency-dependent profile evolution and epoch-varying dispersion measure (DM) fluctuations, both of which bias template alignment and DM estimation. Our procedure first identifies a suitable high-S/N template epoch, applies bandshape equalisation to remove instrumental amplitude distortions while preserving intrinsic spectral structure, and then generates noise-suppressed frequency-resolved templates using optimally selected wavelet smoothing. These templates are consistently aligned using a fiducial DM obtained through an iterative timing procedure, and the optimal frequency resolution is determined statistically by evaluating the residuals of adjacent subband profiles and testing their Gaussianity across representative epochs. While most existing PTA collaborations currently employ frequency-averaged templates and subsequently introduce ad-hoc frequency-dependent (FD) parameters to account for chromatic profile evolution during timing analysis, the InPTA consortium uniquely implements frequency-resolved sub-banded templates, thereby modelling the intrinsic evolution at the template level itself. Validation using realistic simulations confirms that our methodology minimises chromatic timing biases and enhances DM stability, enabling reproducible and high-precision frequency-resolved pulsar timing.

ASI2026_269	Debalina Kar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Integrating Multi-Instrument Data to Improve Gamma Ray Burst Classification and Progenitor Constraints		

Gamma-ray bursts (GRBs) are some of the most energetic transients in the Universe and are conventionally classified into short and long populations based primarily on their observed prompt emission duration (T_90). However, duration-based classification alone is often ambiguous due to instrumental effects, energy-band dependence, and the presence of complex temporal and spectral features. In this work, we investigate the limitations of traditional GRB classification schemes and explore a more physically motivated framework by integrating multi-instrument observations from two key missions: Swift and Fermi. We compare prompt emission properties, such as T_90 , spectral hardness, fluence, and variability timescales, across these instruments and identify a population of GRBs whose classifications are inconsistent or ambiguous. We examine correlations among the various parameters and conduct a systematic analysis of the ambiguous burst population, highlighting the uncertainties in their classification. In the future, combining spectral diagnostics along with comprehensive multi-wavelength afterglow modelling of the ambiguous population would provide a more physically motivated GRB classification framework.

ASI2026_849	Deepak Kumar Painkra	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Development of Active Scatterer Detector for a hard X-ray Compton Polarimeter: Plastic scintillator coupled with PMT		

X-ray polarization measurements provide critical insights into the physical processes in astrophysical sources involving compact objects, where extreme conditions prevail, such as strong gravity, intense magnetic fields, high temperatures. While significant advances have been achieved in the soft X-ray regime in recent years, hard X-ray polarimetry has remained largely unexplored. The techniques employed for polarimetry in soft X-rays and hard X-ray differ and Compton-scattering-based polarimeters are suitable for energies above ~20-30 keV.

A typical Compton polarimeter uses a low-Z scatterer surrounded by high-Z absorbers to measure the azimuthal distribution of scattered photons, from which polarization information can be derived. Coincidence of detection of interactions in the active scatterer with the absorbers reduces the background and improves the sensitivity. Low energy detection limit of the active scatterer detector system determines the lowest energy photons that can be measured with the polarimeter. For proposed Solar Hard X-ray Polarimeter (SHXP), we employ plastic scintillator scatterer coupled to PMT as the active scatters and 12 NaI (Tl) scintillators coupled with SiPMs as the absorbers. In addition to the detector characteristics, the noise performance of the scatterer readout electronics is also critical in limiting the lowest photon energy that can be detected.

Here, we present the design and development of the plastic scintillator detector system and its readout electronics. The electronics chain comprises a preamplifier and shaper circuit for improved charge collection, bandwidth, and SNR, along with a voltage divider and filter for stable PMT biasing at 1000 V. An FPGA and comparator-based system enables coincidence detection between scatterer and absorber events. Initial characterization of the scatterer is performed using Compton scattering with Am-241 (59.54 keV) and Cd-109 (22 keV) sources, where a CdTe detector mounted on rotating arm records the scattered photons in coincidence mode. Detailed design aspects and experimental results will be presented.

ASI2026_333	Devanand P U	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
X-ray spectral variability studies of TeV HBL PG 1553+113 using XMM-Newton		

We present a detailed study of TeV HBL PG 1553+113's X-ray spectral variability using data from XMM-Newton's EPIC PN camera in the energy range of 0.6-7.0 keV, covering the observation period from September 2001 to November 2024. We found 14 of the X-ray spectra to be fitted with absorbed log-parabolic (LP) models with local photon index $\alpha \simeq 2.13 - 2.80$, and curvature parameter $\beta \simeq 0.04 - 0.18$. The PL model was sufficient to describe X-ray spectra of 15 of them with photon index in the range $\Gamma \simeq 2.53 - 2.69$. Two observations suggest a strong possibility of the existence of an additional IC component in their X-ray spectra. We fitted joint X-ray+Optical spectra with log parabola models to estimate synchrotron peaks in the energy range vs $\simeq 4.59 - 48.61$ eV. This suggests that spectral variation is likely produced by variations in particle accelerations and subsequent cooling within the jet.

ASI2026_959	DHIRAJ KUMAR DEKA	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Comparative Analysis of Gap Widths in SPH and Grid-Based Simulations		

A protoplanetary disk is an ensemble of gas and dust that rotates around a young star. They are the primary sites for planet formation and hence the focus of intense research. The complex physical and chemical processes occurring in protoplanetary discs pose a significant challenge to comprehension, and hence, researchers rely on numerical simulations to understand disk evolution and observed structures and substructures. Grid-based codes (like FARGO3D) and smoothed particle hydrodynamics codes (like PHANTOM) are two types of tools used to study protoplanetary disks numerically through simulation. While these tools are expected to produce consistent physical

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results, recent studies have identified discrepancies in gap width for single-planet systems. This work expands on previous FARGO3D research, which demonstrated that two-planet systems carve wider gaps than single planets—by simulating a dual-planet configuration in a customised PHANTOM environment. Our comparative analysis reveals significant differences in the gap widths produced by the two numerical methods, leading to notable variations in calculated Keplerian velocities. This anomaly is largely attributed to the absence of particle boundary conditions inherent in SPH frameworks. These findings emphasise the necessity of further cross-code verification to ensure that simulated disk structures accurately reflect physical reality across different computational platforms.

Keywords:
Protoplanetary disks, Planet-disk interactions, Hydrodynamics, Methods: numerical

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ASI2026_346	Dhruv Jain	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Comparing the Rates of Luminous Red Novae to Gravitational Wave Observations		

Luminous Red Novae (LRNe) have been argued to be related to the ejection of common envelopes (CEs) in binary star systems. Ejection of CEs leads to tightened stellar orbits capable of forming compact binaries that merge in Hubble time. As these mergers are seen by gravitational-wave (GW) detectors such as LIGO, Virgo and KAGRA (LVK), we ask what the merger rates of compact binaries in LVK tell us about the fraction of LRNe that lead to the formation of compact binaries that merge in Hubble time. Using the observed volumetric rates of LRNe from the Zwicky Transient Facility (ZTF) and of compact binary mergers from LVK observations, we derive limits on the fraction of LRNe that produce compact binaries that merge in Hubble time. Assuming the LRNe rate closely follows the star formation rate at any redshift, we use the delay time distribution models for compact binaries to compute the compact binary merger rate. A comparison of this merger rate with the latest volumetric rates of compact binary mergers from the fourth GW transient catalog (GWTC-4) at the present epoch of LVK allows us to constrain the above fraction. We find that the majority of the LRNe population will not lead to mergers of compact objects, but other end products, such as stellar mergers.

ASI2026_354	Divyanshu Janghel	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
A Slow-Declining Type IIb: Photometric and Spectroscopic Insights into SN 2019tua.		

A subgroup of core-collapse supernovae (CCSNe) exhibits an early, broad Hα absorption that later fades, while strong He I lines emerge, a distinctive characteristic of Type IIb SNe. These Type IIb events are relatively rare, making up roughly 7% of all SN explosions. We present a detailed photometric and spectroscopic study of the Type IIb SN 2019tua hosted in the galaxy UGC 11860, covering about 2 to 380 days after explosion. Unlike many Type IIb SNe, which exhibit an early, rapidly evolving cooling peak, SN 2019tua does not show this feature, which may be attributed either to its late discovery or the intrinsic absence of such a peak. Photometric analysis reveals a bright main peak ($M_V = -17.88 \pm 0.15$ mag) and a slower post-peak decline compared to other SNe in our sample. The spectral evolution reveals a weakening of Hα features and the emergence of He I lines over time, confirming its classification as a Type IIb SNe. Light-curve and spectral modeling indicate a massive progenitor that retained only a thin hydrogen envelope at explosion, with MOSFiT light-curve fits giving $M_{ej} \approx 1.3 M_\odot$, $M_{Ni} \approx 0.3 M_\odot$ and $v_{ej} \approx 8000$ km s^{-1}.

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ASI2026_1009	Gorakh Nath	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Shock wave in non-ideal dusty gas with heat conduction and radiation heat flux in presence of gravitational and magnetic fields		
The piston generated spherical shock wave in a perfectly conducting mixture of non-ideal gas and micrometer size solid particles under the influence of gravitational and magnetic fields with conductive and radiative heat fluxes are investigated. It is consider that the equilibrium flow-conditions are maintained and variable energy input is continuously supplied by the moving piston. The Fourier's law is used to express the heat conduction, and for an optically thick grey gas model the radiation is considered to be of the diffusion type. The thermal conductivity and the absorption coefficient are assumed to vary with temperature and density. The medium is assumed to be under the influence of gravitational field because of central mass at the origin in presence of magnetic field. The gravitational effect of the mixture itself can be neglected in comparison to the central mass attraction. The effects of the variation of the gravitational parameter, universe square of Alfven Mach number (Shock Cowling number) and non-idealness of the gas in the mixture on the flow variables and on the shock are discussed in details. It is found that the presence of gravitational field increases the compressibility of the medium, due to which it is compressed and therefore the distance between the piston and the shock front is reduced and hence the shock strength increases. It is shown that the shock wave decay due to the consideration of magnetic field or non-ideal gas. The shock waves in dusty gas under the influence of gravitational and magnetic fields can be used in the interpret measurements carried out by spacecraft in the solar wind and in neighborhood of the Earth's surface, in the description of shocks in supernova explosions, in the study of central part of star burst galaxies, nuclear explosion, star formation in shocks and shocks in stellar explosion.		

ASI2026_130	Gargi Manna	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Non-Hermitian Physics : An alternate to Tradition Quantum Physics		
The Hamiltonian H specifies the energy level and time evolution of a quantum system. Standard formulation of Quantum Mechanics requires H to be Hermitian because Hermicity ensure that the energy spectrum is real- and the-time evolution is unitary ensuring probability conservation. PT symmetric quantum mechanics suggests an alternative to this Hermicity condition. The requirement of Hermicity is replaced by a condition of space-time reflection (PT) symmetry. When H has an unbroken PT symmetry , it is found that the spectrum of H is real. In the unbroken PT-symmetric phase, the eigenstates are the simultaneous eigenstates of the PT operator, leading to real eigenvalues and unitary time evolution under a 'suitably' defined inner product. As the system's parameters/couplings are varied, PT symmetry may spontaneously break at exceptional points, where eigenvalues coalesce and become complex, signalling a qualitative change in the system's dynamics. This work introduces the fundamental principles of PT-symmetric quantum mechanics, highlighting the role of non-Hermitian Hamiltonians and related novel developments using an explicit model .		

ASI2026_944	Gargi Sen	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
GRMHD accretion flow around Sagittarius A ∗ in light of EHT observations		
We explore steady state, low angular momentum advective accretion flows around a Kerr black hole within the framework of general relativistic magnetohydrodynamics (GRMHD). By solving the full set of GRMHD equations in steady state, our goal is to develop a detailed understanding of how magnetized plasma behaves in the strong gravity regime near a spinning black hole. We compute the accretion solutions using a set of constant input parameters, including the specific energy ($\mathcal{E}$), angular momentum ($\mathcal{L}$), magnetic flux (Φ), and the isorotation parameter (I). By systematically varying these parameters, we generate a family of global GRMHD accretion solutions that describe the nature of the plasma around the black hole. Using this framework, we examine		

whether the magnetic field strengths inferred by the Event Horizon Telescope (EHT) for Sagittarius A* at different radii can be reproduced. Our results show that, over a wide range of parameters, the model can reproduce the magnetic field strengths reported by the EHT with an accuracy of about 10%, which establishes a self-consistent framework for understanding accretion processes near the event horizon. The results presented here are adapted from our original paper:\href{https://journals.aps.org/prd/abstract/10.1103/v8mp-hks1}{\textcolor{blue}{\textbf{Phys. Rev. D 112, 083047 (2025)}}}

ASI2026_145	Harihar Pradhan	Poster

High Energy Phenomena, Fundamental Physics and Astronomy

Energy conversion and scaling analysis in Sweet-Parker regime of relativistic magnetic reconnection

Relativistic magnetic reconnection plays a key role in the acceleration of charged particles and the generation of high-energy radiation in astrophysical systems such as pulsar wind nebulae, gamma-ray bursts, and relativistic jets. Owing to its strongly nonlinear and multiscale nature, this process is most effectively explored through numerical simulations. In this study, we investigate relativistic magnetic reconnection using relativistic resistive magnetohydrodynamic simulations initialized with a Harris current sheet. We examine the temporal evolution of reconnection rate and Alfven four-Mach number of the outflow. The measured reconnection rate follow Sweet-Parker scaling, in agreement with previous numerical and theoretical results. To characterize energy transfer, we evaluate the J.E term, which quantifies the exchange of energy between the electromagnetic fields and the plasma. By decomposing the electric field into resistive and convective components with respect to the plasma velocity, we show that energy dissipation is initially dominated by the resistive electric field within the current sheet, while the convective electric field becomes increasingly important at later times, particularly near the separatrix regions. Plasma heating is found to occur predominantly inside the current sheet and along the separatrices. To study the scaling behavior, we perform a scan over the magnetization parameter for mildly relativistic plasmas, comparing it with the previously derived laws of non-relativistic inflows. The inflow speed is found to be slower than the predictions, which we attribute to strong plasma compressibility caused by conversion of magnetic energy into thermal energy. We determine and validate the scaling of the compressibility factor, providing a more accurate depiction of inflow dynamics in this regime. Finally, we investigate the influence of a guide field and find that although increasing the guide field strength reduces the reconnection rate, it has little impact on energy partitioning with thermal energy consistently comprising ~90% of the outflow.

ASI2026_816	Harpreet Singh	Poster

High Energy Phenomena, Fundamental Physics and Astronomy

Quantum Aspects of Spacetime Curvature in the Interior of Black Holes

In this talk, we investigate the quantum nature of the Kretschmann invariant in the deep quantum regime that dominates the vicinity of a black hole singularity. To address the difficulties associated with defining a quantum operator corresponding to the Kretschmann invariant, we adopt the Bohmian interpretation of quantum mechanics applied to the Wheeler-DeWitt equation. This equation arises from a Kantowski-Sachs description of the black hole interior.

Using regular wave functions obtained from solutions of the Wheeler-DeWitt equation, we evaluate the expectation value of the Kretschmann operator. Our results show that this expectation value remains well behaved in the deep quantum regime within restricted subregions of the configuration space, characterized by the eigenvalues of the underlying operators.

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ASI2026_253	Ishayu Basu	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
A Look Beyond Birkhoff : An Extension of General Theory of Relativity		

Birkhoff's theorem asserts that any static, spherically symmetric vacuum solution of the field equations of General Relativity must necessarily reduce to the Schwarzschild metric. In this work, we propose a tensorial extension of Einstein's field equations that allows for a local violation of energy–momentum conservation. A modified geometric tensor kY is introduced with non-zero components defined as $kY(0,0) = \alpha\, k\, T$ and $kY(1,1) = \beta\, R$, where T denotes the trace of the stress–energy tensor, R is the Ricci scalar, and α and β are dimensionless deviation parameters.
The modified field equations take the form $G + kY = kT$, representing a geometric extension of classical gravity. Under standard Birkhoff conditions, the model recovers static Schwarzschild-like solutions. However, by relaxing the vacuum constraint ($T \neq 0$), the framework naturally admits dynamical spherically symmetric spacetimes. This unified tensorial approach provides a possible bridge between classical General Relativity and modified gravity theories involving curvature–matter coupling. Such a formulation may offer insights into geometric explanations of singularity behavior and late-time cosmic acceleration without invoking dark energy.

ASI2026_752	Jay Verma Trivedi	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Observational aspects of singularities		

The cosmic censorship conjecture remains one of the most fundamental yet unresolved problems in theoretical astrophysics. Despite decades of study, it has neither been rigorously proven nor precisely formulated. Classical gravitational collapse models have shown that naked singularities can form generically under physically reasonable conditions, posing a direct challenge to the conjecture. However, establishing their physical relevance ultimately requires observational confirmation.
Recent results from the Event Horizon Telescope (EHT) collaboration have highlighted the Joshi–Malafarina–Narayan (JMN1) naked singularity spacetime as one of the most compelling black hole mimickers, motivating a deeper investigation of observable differences between black holes and naked singularities. This makes it crucial to identify robust observational signatures that can distinguish these two classes of compact objects.
In this work, we investigate gravitational collapse scenarios that lead to naked singularities and compare their astrophysical properties with those of black holes. We focus on identifying distinguishable features arising from the spacetime geometry, particularly through the properties of accretion disks. Differences in radiative efficiency, luminosity profiles, and inner disk behavior provide potential observational markers that could help discriminate between black holes and naked singularities.
We also explore the broader astrophysical implications of naked singularities, including their possible impact on galaxy evolution through enhanced energy release and feedback mechanisms. Our results suggest that naked singularities, if realized in nature, may leave observable imprints distinct from those of black holes, providing a promising avenue for testing the cosmic censorship conjecture using current and future astronomical observations.

ASI2026_370	Jibin Jose	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Characterizing Pulse Jitter Noise in InPTA Millisecond Pulsars: A uGMRT Study of J1744−1134		

The second data release of Indian Pulsar Timing Array (InPTA), comprising seven years of high-precision monitoring of 27 millisecond pulsars leveraging the unique low-frequency, high-sensitivity capabilities of the upgraded Giant Metrewave Radio Telescope (uGMRT), has the potential for enabling a more robust stochastic gravitational wave background (SGWB) detection, which necessitates the characterization of the associated systematics. Pulsar Timing Array (PTA) sensitivity is limited by several noise processes, among which jitter noise—especially important for bright pulsars—arises from pulse-to-pulse variations in the amplitude and phase of the pulsar emission. These intrinsic fluctuations introduce stochastic contributions to the timing residuals that are not captured by time-of-arrival (TOA)

uncertainties, ultimately limiting PTA sensitivity. In this work, we focus on the bright millisecond pulsar J1744−1134 from the InPTA sample and estimate the jitter noise using data from uGMRT in the 300–500 MHz band. Using both conventional and Bayesian analysis techniques, we obtain consistent estimates of the jitter amplitude and examine its scaling with the integration time and the bandwidth used for TOA estimation. Furthermore, utilizing low-frequency, wide-bandwidth coverage of uGMRT, we explore the frequency dependence of jitter noise within the 300–500 MHz band and assess the impact of jitter on high-precision dispersion measure (DM) estimates from low-frequency InPTA observations. This quantitative characterization of jitter will aid in optimizing the InPTA observing strategy for nanohertz gravitational waves and improve constraints on jitter contributions to TOA estimates, which is crucial for high-sensitivity timing observations with future facilities such as the Square Kilometre Array.

ASI2026_699	Jitumani Kalita	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Impact of general relativistic accretion on primordial black holes		
We demonstrate that general relativistic corrections to the accretion of relativistic matter onto primordial black holes (PBHs) can significantly enhance their mass growth during the early Universe. Contrary to previous Newtonian treatments, our analysis reveals that PBH masses can increase by an order of magnitude before evaporation, leading to substantial modifications of their lifetime and cosmological imprints. We quantify the resulting shifts in the minimum PBH mass constrained by Big Bang Nucleosynthesis (BBN), the revised lower bound for PBHs surviving today, and the dark matter parameter space allowed by PBH evaporation. Furthermore, we show that the enhanced accretion alters the high-frequency gravitational wave spectrum from PBH evaporation, potentially within the reach of future detectors. Our results provide a comprehensive, relativistically consistent framework to delineate the role of PBHs in early-universe cosmology and dark matter phenomenology.		

ASI2026_865	Kalyanbrata Pal	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Black hole accretion in axially symmetric space time as an analogue gravity model		
We investigate accretion of low angular momentum inviscid hydrodynamical flow for various disk geometry around a Kerr black hole. We formulate and solve the hydrodynamical equations governing the flow and obtain the corresponding stationary integral multi transonic accretion solutions containing shock. We have obtained the multi transonic solution for a steady accretion flow around the black hole. But large scale astrophysical flow onto the black holes are, however, vulnerable to various perturbative events (e.g. star disk interaction). Therefore we have analysed the stability of the accreting matter by perturbing the steady flow. Perturbation of the transonic accretion flow leads to the emergence of a special kind of space time metric, that illustrate the propagation of the perturbation inside the flowing fluid. For linear perturbation the aforementioned space time metric describes the propagation of the acoustic perturbation inside the accretion flow and is called the sonic or acoustic metric. In this work, we also identify the sonic horizon associated with the sonic metric, which is conformally equivalent to a particular representation of the Schwarzschild metric, and study this analogue spacetime in detail using the Carter-Penrose diagram.		

ASI2026_213	Kinjal Roy	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Self-consistent modelling in Galactic ULX pulsar Swift J0243.6+6124		
Our knowledge of Neutron Star (NS) properties has significantly advanced through X-ray spectro-timing analysis using highly sensitive instruments. However, studying the fundamental properties of NS from these observations requires a complete and robust understanding of the accretion mechanisms. Significant questions remain regarding the location		

of hot spots on the NS surface, accretion geometry, and magnetic field structure near the magnetic poles of the NS. A phenomenological model, like a power law, with or without a high-energy cutoff, mimics the Comptonized emission from NS. With the advent of modern high-resolution instruments, self-consistent modelling of the NS spectrum is the need of the hour. It is essential to ground such physical models to understand the origins of broadband NS emission. We report the implications of the physical modelling of Galactic ULX Pulsar Swift J0243.6+6124. The seed photon distribution can originate from either blackbody radiation at the bottom of the accretion column or Bremsstrahlung radiation from the NS surface. We utilise broadband data from current instruments with significantly high spectral sensitivity, such as Swift-XRT, NICER, and NuSTAR, to perform self-consistent modelling of the broadband continuum and reflection line features in NS spectra. We discuss the possible origin scenarios of the iron fluorescence emission using a reflection component, which is seeded by a physically consistent illuminator. We report on the phase-resolved broadband spectral analysis of the source and how the emission mechanism varies with the spin rotation of the NS.

ASI2026_888	Kripa Ram Sahu	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Photometric and spectroscopic studies of Type Ia supernova SN 2011at.		

We present optical UBVRI photometry and spectroscopic observations of Type Ia supernova SN 2011at, from few days before maximum to close to 2 months post-maximum in B-band. The supernova reached maximum light on JD 2455631.1 +/- 0.5, with a B-band apparent magnitude of 14.36 +/-0.04 mag. It's post maximum decline rate of $\Delta m_{15}(B)$ = 1.00 +/- 0.06 mag and absolute peak magnitude of M(B) = −18.48 +/- 0.15 mag, indicated that SN 2011at is marginally under-luminous Type Ia event. From the peak quasi bolometric luminosity of log L = 42.86 +/- 0.06 erg/s, mass of 56Ni synthesized in the explosion is estimated as 0.29 +/- 0.02 solar mass. The spectra were modelled using SYN++ synthetic spectral modeling code, presence of Mg II, Si II, S II, Ca II, Fe II, and Fe III, is confirmed. The ratio of pseudo-equivalent width of the Si II 5972 and Si II 6355 features near maximum light classifies it as a core-normal (CN) event. The photospheric velocity, measured from the Si II 6355 absorption minimum at maximum light, is relatively high (∼12,000 km/s), while the velocity gradient is low (∼30 km/s/day), placing SN 2011at in the low-velocity-gradient (LVG) subclass. The photometric and spectroscopic properties of SN 2011at are consistent with those of spectroscopically normal Type Ia supernovae.

ASI2026_940	Mainak Chatterjee	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
QPO polarization in Black Hole binaries.		

We study the polarization of quasi-periodic oscillations (QPO) in the X-ray emission from accreting black hole binary systems. The QPO, commonly attributed to relativistic precession of the inner accretion flow, has been expected to exhibit a significant polarization modulation. Recent observations from the IXPE mission, however, place upper limits well below the expected levels. In this work, we explore the effects of an additional comptonizing medium in the form of a hot corona surrounding the inner precessing flow, in a geometry inspired by the model of Karpouzas et al. [1,2]. We consider seed photons to originate from a narrow annular region of the precessing inner disk, with an assumed degree of polarization, which are then upscattered by the surrounding spherical stationary corona.

We compute the resulting polarization degree and polarization angle and examine their spectral and temporal variations. Using a weighted Monte Carlo simulation technique, we predict polarization variability and spectral lags as functions of QPO frequency and source state in the hardness-intensity diagram. By combining key elements of QPO origin with the Karpouzas et al. model, this work aims to develop a unified diagnostic linking timing, spectroscopy and polarimetry, and make testable predictions for current and future X-ray polarimetry missions.

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[1] Karpouzas, K., et al. (2020). The Comptonizing medium of the neutron star in 4U 1636–53 through its lower kilohertz quasi-periodic oscillations. Monthly Notices of the Royal Astronomical Society, 492(1), 1399–1415.

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ASI2026_163	Mainak Dutta	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Gravitationally induced entanglement at finite temperature: A memory-driven time-crystalline phase?		

We study the impact of thermal effects on gravity-induced entanglement (GIE) in a system of quantum harmonic oscillators interacting with classical linearly polarized gravitational waves (GWs). Specifically, we model the endpoints of interferometer arms in LIGO-like detectors as two-dimensional oscillators. Following the thermofield dynamics (TFD) approach, our analysis reveals that while thermal effects alone do not generate entanglement between independent oscillator modes, they serve as a catalyst, modifying the dynamical imprint of GWs. Notably, we identify a mixing of Bose-Einstein and Maxwell-Boltzmann
distributions driven by thermal influences, which affects the statistical behavior of the quantum subsystem. Furthermore, gravitational interactions induce a quantum memory effect, leading to emergent periodic behavior in the reduced subsystem. This suggests a novel gravitationally induced breaking of time-translation symmetry, reminiscent of a prethermal time crystal (PTC). Our findings indicate that such effects could provide new theoretical insights into classical gravitational wave interactions.

ASI2026_278	Manish Kumar Gond	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Blazar-neutrino connection: A case study of a possible neutrino candidate PKS 0215+015		

Active Galactic Nuclei are the most luminous objects in the sky. High-energy radiation from active galactic nuclei, particularly blazars (which have jets directed towards the Earth), is emitted due to non-thermal processes occurring in relativistic jets. Relativistic jets of AGN act as particle colliders and produce high-energy gamma rays along with neutrinos, but the underlying mechanism and the acceleration process are not fully understood and are part of ongoing research. In our study, we are trying to answer these long-standing questions, such as the particle content of the jets, the radiation mechanism, and the origin of neutrino sources. This is achieved through the SED modeling of blazars using multi-wavelength data. In this talk, I will discuss one particular case of a possible neutrino association with blazar PKS 0215+015, where a gamma-ray flaring coincided with the IceCube event 220225A. We have performed multi-wavelength hadronic modeling of this source and attempted to explain the blazar-neutrino connection.

ASI2026_444	Manoj Mandal	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Discovery of burst oscillation in millisecond X-ray pulsar SRGA J144459.2-604207		

Burst oscillations during thermonuclear X-ray bursts arise from brightness asymmetries on the neutron star (NS) surface and are typically observed at or near the NS spin frequency. We report the discovery of burst oscillations from the newly discovered accreting millisecond X-ray pulsar SRGA J144459.2–604207, based on a comprehensive timing analysis of 39 thermonuclear bursts observed with NICER, XMM-Newton, and NuSTAR during its 2024 outburst. Significant oscillations were detected at frequencies of 447.7–448.0 Hz, consistent with the known spin frequency of the NS. The strongest signals reached single-trial significances of 5.1σ in the XMM-Newton data and 5.2σ in the NuSTAR data, with maximum Z1^2 powers of ~32. We performed 50,000 Monte Carlo simulations to estimate the null distribution of the maximum power, and none produced a value exceeding the observed maximum, demonstrating that the signal is highly significant. The folded pulse profiles are well described by a sinusoidal function, with fractional rms amplitudes of ~8.5% in the 0.5–10 keV band and ~21% in the 3–40 keV band.
The physical origin of burst oscillations remains uncertain. They are generally attributed to localized hot spots formed during ignition and early flame spreading on the neutron-star surface, although the geometry and propagation of the burning front are poorly constrained. While large amplitudes observed early in bursts are consistent with this scenario, oscillations detected during the burst tail are more difficult to explain and may instead arise from hydrodynamic instabilities in the neutron-star ocean or from global surface modes. It also remains unclear why burst oscillations are observed only in some accreting millisecond X-ray pulsars or why they appear intermittently within a given source. Despite these uncertainties, burst oscillations provide a valuable probe of thermonuclear burning and neutron-star surface physics.

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ASI2026_644	Megha Bansal	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Understanding VHE emission in FSRQs and LBLs/IBLs: SED Peak Shifts and Their Implications		
Blazars are radio-loud AGN having strong relativistic jets pointed towards the observer, characterized by non-thermal emission, polarization, strong variability, and double-humped broadband SED. Very high energy (VHE; E≳100 GeV) gamma-ray emission from blazars is a powerful tool to probe radiative and particle acceleration processes in relativistic jets. In this talk, we present our systematic study of 10 FSRQs detected at VHE, focusing on comparing their spectral behavior during various activity states, such as low- and high-flux states, as well as during the reported VHE behavior and the entire Fermi duration. Our analysis revealed that VHE is associated with brighter flux states and a generally harder spectrum. The MeV-GeV peak shows no to minimal to significant peak upshifts during high and VHE states, and the upshift is more prominent with increasing redshift. We interpret these trends as primarily driven by the extension of the particle spectrum to higher energies, aided by spectral transitions or the emergence of an additional HBL-type component in some cases. Following this, we extended our study to VHE-detected LBL/IBL sources. Interestingly, we find a subset of sources exhibiting peak shifts and spectral evolution, while others display more complex behaviors. These results highlight both the similarities and differences, which will be discussed during the talk.		

ASI2026_337	Mohd Asim Ansari	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Phase Corrections from Line-of-Sight Acceleration in Eccentric Compact Binary Inspirals		
Gravitational-wave observations offer a powerful probe of the astrophysical environments in which compact binary coalescences form. Binaries evolving in external gravitational potentials can experience line-of-sight acceleration, introducing characteristic phase corrections in the inspiral waveform. While such effects have been studied primarily for quasi-circular binaries, realistic systems may retain small orbital eccentricities in the detector band. In this work, we derive the frequency-domain gravitational-wave phase correction due to constant line-of-sight acceleration for mildly eccentric compact binaries, incorporating post-Newtonian corrections up to 3.5 PN order. We show that acceleration-induced phase modulations can mimic the effects of small eccentricity, leading to strong parameter degeneracies when eccentricity is neglected. However, genuine eccentric waveform features break this degeneracy, enabling independent parameter recovery.		

ASI2026_192	Monalisa Dubey	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
SN 2022xus: bridging the gap between Type IIP and IIL supernovae		
We present optical photometric and spectroscopic observations of the Type II supernova SN 2022xus. The SN reached its peak V-band magnitude within ∼7 days of explosion, followed by a plateau phase lasting ∼86 days with a declination rate of ∼1.3 mag/100 day. Early time spectra exhibit broad features caused by the blending of several high-ionization lines, likely arising from relatively weak interaction between the SN ejecta and the surrounding circumstellar medium (CSM). Compared to typical Type IIP SNe, SN 2022xus exhibits a smaller Hα absorption-to-emission ratio (a/e), indicating a relatively less hydrogen envelope mass at the time of explosion. The presence of a double-peaked Hα profile suggests either asymmetric CSM or intrinsic asymmetry in the ejecta. From nebular-phase spectroscopy and bolometric light curve modelling, the progenitor mass is estimated to be in the range of 12 – 15 $M_\odot$. Although several photometric and spectroscopic characteristics place the SN within the Type IIL population, it displays mixed properties of both Type IIP and Type IIL SNe and cannot be cleanly classified into either subclass. We therefore identify SN 2022xus as a transitional event between Type IIP and Type IIL SNe, providing further evidence for a continuum between these two classes.		

ASI2026_936	Monu Singh	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Effect of thermal conduction in relativistic accretion flow around rotating black holes		
We investigate the effects of thermal conduction in relativistic accretion flow around rotating black holes. In doing so, we employ both hydrodynamical and magnetohydrodynamical (MHD) approaches. In this investigation, we consider the toroidal magnetic field, incorporating synchrotron and bremsstrahlung cooling processes. We self-consistently solve the steady-state fluid equations to obtain global transonic solutions for low angular momentum accretion flows in the presence of dissipation. Furthermore, we study the role of thermal conduction on the existence of shock solution and the behaviour of key shock properties including shock location, compression ratio, and shock strength. In addition, we also study the interplay of viscosity, magnetic field, and thermal conduction on the shock properties of the flow. We observe that thermal conduction plays a significant role in governing the properties of transonic accretion solutions. We show that shock-induced global accretion solutions persist for a wide range of model parameters and identify the boundary of the parameter space in the energy-angular momentum plane that admits standing shocks for different dissipation parameters (thermal conduction, radiative cooling). Moreover, we compute the limiting value of the conduction parameter, beyond which shock ceases to exist and found that it depends on the dissipation parameters (viscosity, magnetic field and cooling) and the spin of the black hole. We conclude the study by investigating the spectral energy distribution (SED) of the accretion disc and observe that increased thermal conduction and magnetic field strength lead to more luminous emission spectra from black hole sources.		

ASI2026_1051	Mulchand Kurre	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Optical Photometric and Spectroscopic investigation of Type Ib Supernova SN 2024ahv.		
We present optical photometry and medium-resolution spectroscopy of the Type Ib supernova SN 2024ahv hosted by galaxy NGC 6106. Our observations span from 6.65 to 223 days after first light. The absolute g-band magnitude at peak brightness is estimated as $M_g = -16.84 \pm 0.15$ mag. Spectroscopic analysis reveals prominent features of He I, Si II, Ca II, Mg II, and Fe II, which are successfully reproduced using the spectral synthesis code SYNAPPS/SYN++. The velocities at g-band maximum light, inferred from the Si II and He I 5876 absorption minima, are approximately 7000 km s−1 and 11,000 km s−1, respectively, consistent with values observed in other Type Ib supernovae. From light curve modeling using MOSFiT, the mass of Ni56 and the ejected mass in the explosion are estimated to be $0.10 \pm 0.02\ M_\odot$ and $1.98 \pm 0.28\ M_\odot$, respectively.		

ASI2026_1087	Navya Raj	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Quantifying Burst Mimicry: The Impact of Stochastic Noise on Joint GW-GRB Likelihood Searches		
Extracting faint signals from complex backgrounds remains a significant challenge due to various instrumental and observational limitations of telescopes. When a sub-threshold excess is detected, a crucial question arises: does it correspond to a real astrophysical transient, such as a Gamma-Ray Burst(GRB), or is it merely a statistical fluctuation of the background? In this work, we study how different types of noise—white, pink, and red noise—can resemble a real burst signal in joint multi-messenger searches. We simulate these noise types and carry out a focused joint likelihood analysis using gravitational-wave(GW) triggers to guide the search in time. This method allows us to measure how often random noise can produce a false signal with high statistical significance and to test the reliability of current signal detection methods. Our results provide important limits on the False Alarm Rate for joint electromagnetic and GW detections, improving confidence in identifying real electromagnetic counterparts to GW events in future observations.		

ASI2026_54	NIRAJ KUMAR SAHU	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Simultaneous Optical-to-X-ray spectral view of VHE FSRQs with Swift.		

A special type of Active Galactic Nuclei (AGNs; the central part of the galaxies) called Blazars are jetted AGNs with bipolar relativistic jets pointing to the line of sight at a small angle (≤ 15°). Flat-Spectrum Radio Quasars (FSRQs) are a subtype of blazars, and their optical spectra are characterized by prominent broad emission lines. They are the most powerful and energetic persistent MeV-GeV sources, but to date, only 11 have been detected at very high-energy gamma-ray (VHE; E > 100 GeV) levels. In SED modeling, the explanation of the VHE spectrum often requires an optical-UV synchrotron component extending into the X-ray, which, in general, is explained by Synchrotron-Self-Compton (SSC). Thus, simultaneous joint optical-to-X-ray spectral variability holds a potential clue. Also, X-rays have been argued to be the best band for searching for hadronic emission.

To understand and explore this further, we performed a systematic spectro-temporal analysis of VHE-detected FSRQs using the Swift Observatory's Ultraviolet/Optical Telescope (UVOT) and X-ray Telescope (XRT) observations to probe UV/Optical and X-ray spectral and temporal variability and explore their potential links with VHE activity. Through this work, we are investigating the behavior of VHE-detected FSRQs during VHE-active states and relating them to their non-VHE states. One of the key outcomes is that, by adding UV-optical data, we are able to explain the altered X-ray spectral properties in several VHE-detected FSRQs. We discuss the results on the temporal and spectral properties of VHE-detected FSRQs and their possible implications for understanding the dominant/current emission mechanisms in these extreme jet environments and connection to VHE activity.

ASI2026_721	Nutan Das	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Radiative Cooling and Energy Dissipation in AGN Jets: Implications for Jet Collimation and Feedback		

Active Galactic Nuclei (AGN) jets are powerful drivers of feedback, transporting energy from the central supermassive black hole into the host galaxy and beyond. Through their interaction with the interstellar and circumgalactic medium (ISM/CGM), jets regulate gas thermodynamics and galaxy evolution. While jet dynamics are often modeled as adiabatic, growing observational and numerical evidence indicates that radiative cooling plays a crucial role in governing jet–environment interactions, particularly on kiloparsec scales where jets encounter a dense, multiphase ISM.

As AGN jets propagate, they inflate an over-pressured cocoon that collimates the initially conical outflow and mediates energy transfer to the surrounding medium. Radiative cooling in shocked ISM, shocked jet material, and mixed-phase gas can significantly reduce cocoon pressure. In these dense regions, cooling times can be extremely short, enabling rapid thermal energy losses that may lead to cocoon collapse, jet decollimation, and reduced coupling efficiency between the jet and the ambient.

We present high-resolution hydrodynamic simulations of AGN jets interacting with a realistic multiphase ISM and transitioning into the CGM, incorporating a tabulated radiative cooling function. We study both uniform and vertically stratified ambient media to assess how environmental structure influences jet evolution. In uniform media, shocked diffuse gas and mixed jet–cloud material cool efficiently, leading to strong radiative losses from the cocoon. In contrast, in stratified atmospheres the jet expands into lower-density CGM regions on timescales shorter than the local cooling time, substantially reducing radiative losses and allowing the cocoon to retain higher pressure.

By varying jet power, opening angle, tilt, and ISM clump properties, we examine how radiative cooling and environmental stratification together regulate cocoon pressure, jet morphology, and the overall efficiency of AGN feedback. These results provide new constraints on when AGN jets break out of dense galactic environments versus when radiative losses limit their impact on galaxy evolution.

ASI2026_1025	Prasad Basu	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Quantum Signatures of Modified Gravity: An Investigation into Graviton-Induced Noise and Decoherence		

Recent studies have shown that quantized gravitational waves can induce intrinsic noise and decoherence arising purely from the quantum nature of gravity, potentially observable with future space-based detectors such as LISA or DECIGO. This opens a new avenue for probing quantum gravitational effects at energies far below the Planck scale. In this work, we use this technique to investigate quantum signatures of modified gravity through graviton-induced noise and decoherence within f(R) gravity. Using a novel technique proposed in recent studies. We quantize the theory in the weak-field limit and identify a distinctive signature associated with the additional scalar degree of freedom. Vacuum solutions of f(R) gravity admit a non-vanishing scalar curvature R, and linearization around such backgrounds yields an extra longitudinal gravitational-wave mode. Upon quantization, the corresponding scalar particle (the scalaron) appears alongside the transverse tensor graviton modes.

A variety of classical tests using gravitational wave observations have been proposed to assess the validity of alternative theories of gravity relative to Einstein's general relativity at very strong gravity regime. In this work, we present a complementary approach by probing modified theories at the quantum level. Within the effective field theory framework, quantized gravity at low energies is expected to emerge from the quantization of the correct classical theory of gravity. Consequently, the detection of a distinctive quantum signature associated with a specific gravitational theory would provide evidence for its validity as the appropriate effective classical description of gravity.

ASI2026_379	Priyadarshee P. Dash	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Long-term Temporal and Spectral Analysis of Mrk 530		

Active Galactic Nuclei (AGN) are highly luminous astronomical objects powered by the accretion of surrounding matter onto a Supermassive Black Hole (SMBH) via an accretion disk. The Optical/UV photons emitted by the thermal radiation of this disk undergo inverse Comptonization by a group of hot, relativistic electrons known as the corona, resulting in X-ray production. Recently, a comprehensive long-term multi-epoch X-ray spectral and temporal study was conducted on the AGN Mrk 530 over a period of 24 years (2001-2024) using data from the XMM-Newton and Swift observatories. Timing analysis revealed that the source exhibited largely consistent behaviour over shorter timescales (~10 ks). However, a long-term analysis conducted in 2018 identified a potential quasi-periodic variation in both the UV and X-ray bands, with consistent periods of approximately 90 days and 60 days, respectively. This modulation is likely attributed to the oscillation of the Comptonizing cloud caused by fluctuations in the accretion rate, which initially affects the outer UV-emitting regions and subsequently propagates on dynamical timescales to impact the inner X-ray-emitting regions. Long-term spectral analysis of Mrk 530 indicates significant variations in luminosity and photon index, as well as changes in the soft excess component, which is only detectable in the earlier epochs (2001-2006). Spectral modeling suggests that the soft excess component is due to the presence of an evolving warm corona with an electron temperature of ~0.2 keV. The significant variations observed in spectral parameters are attributed to changes in the mass accretion rate. Higher accretion rates are accompanied by a compact corona and softer spectra, while lower accretion rates correspond to an extended corona producing harder spectra.

ASI2026_505	Priyesh Kumar Tripathi	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Role of Plasma Properties in Stability of Fanaroff-Riley Radio Jets		

The Fanaroff-Riley (FR) dichotomy observed in extragalactic radio jets has been linked to various explanations, including the jet power, the difference in their ambient environment, and the intrinsic properties of jet plasma itself, such as their composition. In this study, we present results from large-scale three-dimensional magnetohydrodynamic (3D-MHD) simulations of low-power, supersonic magnetized jets at kiloparsec scales. By varying the jet injection parameters, including the plasma composition, we investigate their impact on jet stability and on the development of diffuse structures characteristic of core-brightened FR type I sources. Our results demonstrate that the growth of the current-driven kink instability plays a crucial role in destabilizing the jet, leading to the disruption of the jet head. We also show the resulting transition from edge-brightened FR type II morphology to FR type I morphology at different stages of jet evolution using synthetic synchrotron emission maps.

ASI2026_338	RAJDEEP SARKAR	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Multiwavelength study of compact objects in MAVERIC globular clusters		

Globular clusters (GCs) are dense systems in our universe where stars and stellar remnants are held together within a small volume by mutual gravitational attraction. Studies suggested that these clusters contain compact objects (COs), such as neutron stars, white dwarfs, and stellar-mass black holes. To unravel the nature of these COs, we carried out a combined X-ray and optical study of compact objects in a few MAVERIC GCs present in our Milky Way Galaxy. Analyzing the Hubble Space Telescope images of these GCs and the recent Chandra X-ray catalogs, which contain more than 100 low luminosity X-ray sources for each GC, we investigate the nature of the compact objects present in those GCs. Focusing on objects mainly present within the half-light radii of these GCs, as objects within them have a much higher probability of being associated with a given cluster, we found that there exists a mixed population of stellar objects in these clusters.

ASI2026_147	Ravi Seth	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
The Violent Merger Model as a Progenitor for Peculiar Type Ia Supernovae		

The progenitors for type Ia supernovae (SNe) is an area of large debate. Type Ia SNe are widely believed to come from the thermonuclear explosion of white dwarfs. I will give a brief summary on the diversity of type Ia SNe and the plausible progenitor systems. There has been growing evidence towards the violent merger of two white dwarfs being the progenitor for a class of under-luminous (02es-like) and over-luminous (03fg-like) type Ia SNe. These events are rare (<1% of the normal SN Ia rate) but have been recently linked, based on their colour and early flux excess suggesting a common explosion scenario.

I will present a parameter study on the violent merger model by simulating spectra using radiative transfer code TARDIS. My findings showcase the extremely asymmetrical nature of the violent merger model through the synthetic spectrum. I will compare my work to objects that have been classified as 02es-like and 03fg-like type Ia SNe as part of the ZTF DR2 sample and then the extensive range in the literature to better understand if the violent merger model can fully explain the observables in these classes. I hope to extend these methods to find "hidden" violent mergers in the normal type Ia SNe to find a continuum of objects from over to under-luminous type Ia SNe that can all be explained by the violent merger model. This parameter study should show us some of the diversity of SNe Ia that are possible via a violent merger that may not yet have been observed due to the low number of 02es and 03fg-like detections.

ASI2026_232	Ripon Sk	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Multi-Transonic Accretion onto Black Holes in a Galactic Environment		

We present a detailed hydrodynamic study of low-angular-momentum, axisymmetric, inviscid accretion onto a centrally located black hole, focusing on multi-transonic flow behaviour within the vertical equilibrium (VE) disc configuration. The analysis is performed using two distinct thermodynamic equations of state and a set of pseudo-Schwarzschild gravitational potentials to model the black hole spacetime. To construct a more physically realistic framework, we additionally include a multi-component galactic potential that captures the cumulative gravitational effects of the surrounding stellar population, dark matter halo, and diffuse hot gas.

A systematic comparison is carried out between accretion solutions influenced exclusively by the black hole potential and those evolving under the combined action of both black hole and galactic gravitational fields. Our investigation reveals that the presence of the galactic potential leads to appreciable alterations in the flow dynamics and thermodynamics, including shifts in the locations of critical points, changes in the transonic topology, and variations in shock-related flow properties. Furthermore, the galactic environment is found to leave a distinct imprint on the emergent acoustic geometry associated with the perturbed accretion flow.
These results highlight the crucial role of the host galaxy in shaping black hole accretion dynamics and emphasize that galactic-scale gravitational effects must be taken into account for accurate modeling of accretion processes in active galactic nuclei and other energetic astrophysical systems.

ASI2026_1094	Rohan Raha	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Collapse of a massive star leading to a black hole: Supernova Accretion Disk		

Long-duration gamma-ray bursts (GRBs) originate from collapsing massive stars that form rapidly spinning black holes, launching relativistic jets via the Blandford-Znajek mechanism. However, fundamental questions persist: Why do only ~1% of Type Ic core-collapse supernovae produce GRBs? What determines the remarkable diversity in GRB properties—durations spanning 1 to >10^4 seconds, luminosities ranging from 10^{46} to 10^{54} erg s^{-1}, and supernova energies varying by over an order of magnitude?
We present a 3D general relativistic magnetohydrodynamic (GRMHD) parameter survey using H-AMR to simulate selected collapsar models. We systematically vary progenitor density profiles, stellar radii, black hole spin, magnetic field strengths, and angular momentum distributions. Each simulation follows the complete evolution from black hole formation through self-consistent jet launching to stellar surface breakout, covering 10-100 seconds of physical time. Our simulations will provide the first systematic theoretical framework explaining the complete GRB-supernova phenomenology through first-principles calculations. We present preliminary results demonstrating how stellar structure critically determines jet survival and properties, quantify energy deposition mechanisms in supernova ejecta. This work represents a significant step toward understanding the physical origin of cosmic explosions.

ASI2026_986	ROHIT NAIR	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Error Analysis of Rotational Parameter Estimation in High-Energy Pulsars		

Over the past few decades, significant progress has been made in estimating the rotational parameters of high-energy pulsars. However, existing approaches still lack standardized and rigorous mathematical frameworks for quantifying uncertainties. This limitation is especially pronounced for high-energy periodic sources dominated by Poisson noise. In this work, we revisit earlier estimation techniques and present three computationally efficient methods based on the Z n^2 statistic. These methods enable reliable determination of the spin frequency and its first derivative, along with statistically consistent confidence intervals, within a narrow-band search framework. The methodology performs robustly for typical pulsar periods ranging from a few milliseconds to a few seconds, even when the observation duration extends over several thousand seconds. Extensive Monte Carlo simulations demonstrate the robustness of the approach under a wide range of conditions, including variations in signal-to-noise ratio, photon counts, observation duration, and data gaps. The proposed methods remain accurate even in low-count regimes where traditional techniques often fail. We validate our approach on real pulsar data from AstroSat's LAXPC, which operates over a suitable energy range from 3 keV to 80 keV, for Crab Pulsar, ULX Swift J0243.6+6124 and SAX J1808.4-3658. This work emphasizes statistically rigorous error estimation, which is critical for reliable modeling and follow up searches for rotational parameters.

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ASI2026_588	Rushikesh Sonawane	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Spin-Driven Jet Breakout Conditions in Long Gamma-Ray Bursts		

Long gamma-ray bursts (LGRBs) are believed to originate from the rapid core collapse of massive Wolf–Rayet stars, leading to the formation of a spinning black hole. The rotation of the black hole powers a relativistic jet that drills through the stellar envelope, and the prompt gamma-ray emission observed in LGRBs arises once this jet successfully emerges. In this work, we perform an extensive suite of two-dimensional axisymmetric relativistic hydrodynamic (RHD) simulations using the PLUTO code to model semi-self-consistent, accretion-powered LGRB jets launched by Kerr black holes of mass 5 solar masses. We investigate jet breakout conditions in Wolf–Rayet progenitors of 10 and 25 solar masses with corresponding radii of 4×10^{10} cm and 10^{11} cm, respectively. The injected jet power naturally varies with black hole spin. Our results show that black holes with a spin parameter $a>0.001$ successfully launch jets, whereas those with $a \le 0.001$ produce choked jets. For successful jets, the breakout timescale exhibits clear correlations with both jet luminosity and black hole spin, revealing three distinct dynamical regimes: a Newtonian regime at low spin ($a\le0.03$), a relativistic regime at high spin ($a \ge 0.2$), and an intermediate transition regime. These results highlight black hole spin as a critical parameter governing jet formation and breakout in collapsar-driven LGRBs.

ASI2026_48	Saikat Das	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Impact of Cosmic Ray Distribution on Growth and Saturation of Bell Instability		

Nonthermal X-ray and radio observations of supernova remnants reveal magnetic fields of several hundred microgauss, far exceeding typical interstellar values. Such strong fields suggest significant magnetic-field amplification driven by cosmic ray (CR) streaming instabilities. The nonresonant streaming instability (NRSI), also known as the Bell instability, is particularly effective, as it can amplify magnetic fields well beyond background levels. However, most previous studies have focused on mono-energetic CR populations, which differ from the power-law momentum distributions expected in realistic astrophysical environments. In our work, we use one-dimensional kinetic simulations to investigate how mono-energetic and power-law CR distributions influence both the growth and saturation of the NRSI. We find that the linear growth rate depends only on the net CR current and is largely insensitive to the CR distribution. In contrast, the saturation mechanism depends strongly on the distribution: saturation occurs through CR isotropization, which quenches the driving current. Mono-energetic CRs efficiently amplify magnetic fields and isotropize. For power-law distributions, the lowest-energy CRs dominate current relaxation and magnetic growth, while the highest-energy CRs remain weakly scattered, limiting their contribution to saturated fields. When low-energy CRs are absent, high-energy CRs can amplify the field and isotropize. We provide a modified saturation prescription that incorporates these effects and propose a layered CR-confinement scenario upstream of astrophysical shocks, which is relevant to particle acceleration to high energies.

ASI2026_229	Sangita Chatterjee	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Exploring Dark Matter Imprints in GW Signals from EMRI		

Extreme- and intermediate-mass ratio inspirals (EMRIs and IMRIs), formed by the gradual inspiral of a compact object into a massive black hole, are prime targets for space-based gravitational-wave detectors because of their long-lived evolution and the accumulation of a large number of gravitational-wave (GW) cycles in the strong-field regime. This makes them uniquely sensitive probes of relativistic dynamics and the matter distribution surrounding massive black holes.

In galactic nuclei hosting massive black holes embedded in dense dark matter environments, a dark matter spike can form if the black hole grows adiabatically compared to the dynamical timescale of the surrounding halo. The presence of such a spike can cause the orbital evolution of an inspiraling compact object to deviate significantly from the vacuum case, leading to observable modifications in the GW signal.

In this work, we study inspirals, the geodesic motion of which is governed by the Kerr spacetime, embedded in a dark matter distribution described by a Navarro–Frenk–White (NFW) profile. The orbital evolution of the compact companion is influenced by gravitational-wave emission, dynamical friction, and mass accretion. We investigate the resulting modifications to the orbital dynamics and quantify the induced GW phase shifts relative to vacuum Kerr inspirals, with particular emphasis on their detectability by the milli-hertz GW detector LISA. We also examine how enhanced environmental drag affects the rate of orbital circularization.

Our work highlights the importance of environmental effects in GW astronomy and indicates that future space-based detectors, such as LISA, may be sensitive to the distribution of dark matter around massive black holes.

ASI2026_494	Sangita Kumari	Poster

High Energy Phenomena, Fundamental Physics and Astronomy

Multi-band uGMRT Eclipse and Scintillation Study of the Spider MSPs J1810+1744 and J2051--0827

We present a systematic eclipse and scintillation analysis of two spider millisecond pulsars, PSR J1810+1744 and PSR J2051−0827, using full-orbit, multi-frequency uGMRT observations. Direct transverse-velocity estimates from pulsar timing can be difficult for spider MSPs because excess timing noise often contaminates residuals; scintillation provides a complementary and practical route to constraining transverse motion. We measure the diffractive scintillation bandwidth and timescale using two-dimensional autocorrelation functions of the dynamic spectra, and infer scintillation velocities under a thin-screen approximation. For PSR J1810+1744, we report the first scintillation-velocity measurement, obtaining a characteristic speed of $\sim$94 km s^{-1}, while for PSR J2051−0827 we derive a higher scintillation speed of $\sim$170 km s^{-1}. From the decorrelation bandwidth we also estimate scattering timescales and find a frequency scaling shallower than the canonical Kolmogorov expectation. Eclipse diagnostics reveal contrasting behavior: PSR J1810+1744 shows complete eclipses up to ≈1.5 GHz, implying a comparatively large electron column density within the eclipse region, whereas PSR J2051−0827 remains detectable in band 5, placing its eclipse cut-off frequency below 1 GHz. Finally, we quantify the eclipse-width evolution with frequency for PSR J1810+1744 and discuss implications for the dominant eclipse mechanisms in spider MSPs.

ASI2026_641	Saurabh Kumar	Poster

High Energy Phenomena, Fundamental Physics and Astronomy

Properties of the merger sites of dynamically formed LIGO-Virgo-KAGRA binary black holes

We apply a parametric model of forward evolution for black hole populations in dense, cluster-like environments to interpret the properties of the observed LIGO-Virgo-KAGRA (LVK) binary black hole (BBH) population. The detection of BBH mergers with component masses within the pulsational pair-instability supernova gap ($\sim 50\,M_\odot$–$130\,M_\odot$) significantly challenges standard stellar evolution models, while hierarchical mergers in dense stellar systems provide a natural route to populate this regime. We present a hierarchical Bayesian inference analysis of the Gravitational-Wave Transient Catalog 3 (GWTC-3) using our Simple Parametric model for Hierarchical Mergers (SPHM). The SPHM framework evolves BBH populations within gravitationally bound systems by employing numerical relativity fitting formulas for merger remnant masses, spins, and kicks, while accounting for pairing probabilities dependent on both total mass and mass ratio. We perform an end-to-end inference of global population hyperparameters, including the black hole initial mass function, pairing probability exponents, and the redshift-dependent merger rate density, and discuss what these imply for the properties of clusters where they are formed. Unlike previous studies, our analysis extends to $3\mathrm{G}$+$3\mathrm{G}$ generations, enabling a comprehensive reconstruction of the tails in the mass and spin distributions. We find that the multi-modal features and localized overdensities in the GWTC-3 primary mass spectrum—specifically the peaks observed at $m_1 \simeq 10\,M_\odot$, $17\,M_\odot$, and $35\,M_\odot$—can be self-consistently interpreted as contributions from higher merger generations in dense environments. Our results indicate that the observed absence of a sharp cutoff at

$60\,M_\odot$ is consistent with a non-negligible retention fraction of merger remnants. Furthermore, we include branching ratios for various $N\mathrm{g}$–$M\mathrm{g}$ channels within our Bayesian inference, facilitating a direct interpretation of how specific hierarchical sequences contribute to the black hole mass spectrum. Our analysis demonstrates the effectiveness of semi-analytical models constructed from first principles in interpreting the population properties of compact binaries using gravitational wave observations.

ASI2026_371	SAYANTAN BHATTACHARYA	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
On the Origin of Long Outbursts in Short-Period Neutron Star Low-Mass X-ray Binaries		
Neutron star low-mass X-ray binaries (NS LMXBs) with short orbital periods (~hours) typically alternate between outburst and quiescent phases, making them powerful probes of transient accretion processes. These outbursts are commonly explained by the thermal–viscous instability in the accretion disc. However, a small subset of transient systems displays unusually long-lasting outbursts that are difficult to reconcile with this standard framework. One notable example is EXO 0748–676, which remained active for at least 23 years before entering quiescence and later went into another outburst after a gap of 16 years. In this work, we examine whether such extended outbursts can be produced by the conventional disc instability mechanism or whether additional physics is required. We perform a systematic comparison of NS LMXBs with long and short outbursts, restricting our sample to systems with short orbital periods. By analyzing long-term X-ray light curves, we determine outburst durations, estimate mass accretion rates, and infer accretion disc masses. We find that sources with long outbursts are distinctly separated from those with short outbursts across multiple parameter spaces involving accretion rate, disc mass, and outburst duration. This clear separation suggests that the thermal–viscous instability can account for short outbursts but is insufficient to explain the long-duration events. We further discuss the challenges faced by both disc-based and donor-star-driven models in reproducing the properties of long outbursts. Our results place important constraints on the nature of accretion in transient neutron star and black hole X-ray binaries. (https://arxiv.org/abs/2504.07621)		

ASI2026_418	Sayantan Ghosh	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing Exotic Core Phases of Neutron Stars through Spacetime Curvature in Modified Gravity		
Neutron stars (NSs), superdense objects with exceptionally strong gravitational fields, provide an ideal laboratory for exploring general relativity (GR) in the high-curvature regime. They also present an exciting opportunity to investigate new gravitational physics beyond the traditional framework of GR. Thus, investigating modified theories of gravity in the context of superdense stars is intriguing and essential for advancing our understanding of gravitational phenomena in extreme environments. Energy momentum squared gravity (EMSG) is a modified theory of gravity that extends GR by including nonlinear terms involving the energy-momentum tensor $T_{\mu\nu}$. In this study, we investigate the effect of EMSG on the curvature of NSs by using three relativistic mean-field (RMF) equations of state (EOSs) and three hadron-quark phase transition (HQPT) EOSs. This study mainly focuses on the Kretschmann scalar and Full contraction of the Weyl tensor curvature. We have calculated the radial variation and variation with the baryon density of the curvatures by varying the EMSG parameter α, and observed a distinct variation of the curvature invariants near the phase transition region, which may help us to probe the exotic core phases inside NSs.		

ASI2026_737	Shubham Singh	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Pulsars in the Death Valley and Implications on Death Line Models		
In the framework of the coherent curvature radiation model of pulsar radio emission, charged particles responsible for the radio emission are generated on the polar cap in the localized pair cascade processes called sparks. When a pulsar can no longer sustain the sparking process on its polar cap, the coherent radio emission from the pulsar stops, and		

the pulsar is called dead. Most of the conventional death line models expect only a single spark on the polar cap of a dying pulsar. I will present the emission properties of pulsars near the lower boundary of the period-derivative plane of the current pulsar population, which are expected to be dying. The emission properties of most of these pulsars suggest the existence of multiple sparks on their polar caps, contradicting the theoretical estimates. This work demonstrates that pulsars located at the edge of the pulsar death valley do not align with single-spark models of pulsar death, highlighting the gap between theoretical understanding and observed properties related to the pulsar death phenomenon.

ASI2026_392	Shuvajit Khatua	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Broadband X-ray Study of the Low-Luminosity Intermediate Polar DW Cnc		
Intermediate polars (IPs) are a subclass of magnetic cataclysmic variables characterized by magnetic field strengths of 0.1-10 MG. They are asynchronous systems in which the spin period of the white dwarf (WD) is shorter than the orbital period of the binary. IPs with hard X-ray luminosities below about 2.5 x 10^{32} cgs are classified as low-luminosity intermediate polars (LLIPs). The low accretion rates in these systems are expected to produce an extended post-shock region (PSR), resulting in weak or no Compton reflection and neutral Fe K-alpha emission at 6.4 keV. We present a broadband X-ray study of DW Cnc, one of the brightest known LLIPs, using simultaneous observations from XMM-Newton and NuSTAR. Our analysis highlights the key X-ray properties of the system, including a multi-temperature PSR continuum, complex intrinsic absorption, the presence of Fe K-alpha emission lines and detection of Compton reflection. Timing analysis reveals a strong modulation at the WD's spin period, while no significant orbital modulation is detected. The spin modulation exhibits a strong energy dependence, indicating that photoelectric absorption within the accretion flow plays a dominant role in shaping the observed variability.		

ASI2026_415	Shyam Prakash V P	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Spectral nature of Sco X-1 observed using the X-ray SPECtroscopy and Timing (XSPECT) payload onboard XPoSat		
In this work, we present a detailed spectral investigation of the neutron star low-mass X-ray binary, Scorpius X-1 using observations from the X-ray SPECtroscopy and Timing (XSPECT) payload onboard India's first X-ray Polarimetry Satellite, XPoSat. Scorpius X-1 is the brightest X-ray source in the sky and the first X-ray source discovered. Owing to its extreme brightness in the soft X-ray band, studies at low energies have remained extremely challenging in the past. XSPECT, with fast read-out capability, enables high-quality low-energy X-ray observations of bright sources. During the observations the source trace a complete Z-track in its color–color diagram, including the horizontal, normal, and flaring branches. This represents the first resolved Z-track for Scorpius X-1 obtained using low-energy X-ray observations, highlighting the unique capability of XSPECT. We examine the evolution of spectral components along the Z-track to probe changes in the accretion flow geometry. The soft X-ray emission is well described by a multi-colour disc blackbody component, with the inner disc temperature varying between ∼0.6 and 0.8 keV and the hard X-ray emission using Comptonization models, yielding electron temperatures in the range ∼2.4–4.7 keV and optical depths of ∼5–14. Prominent iron Kα and Kβ emission lines are detected at ∼6.6 keV and ∼7.6 keV, respectively, indicating reflection from ionized material in the accretion environment. We observe a significant increase in both the disk and Comptonization fluxes during the flaring branch, accompanied by a rise in the neutron star blackbody and the inner disc temperature. Our results suggest that the Z-track evolution in Scorpius X-1 is primarily governed by variations in the coronal optical depth, Comptonization flux, disc flux, and inner disc temperature. No quasi-periodic oscillations are detected in any branch, implying a connection between QPO formation and higher-energy emission components.		

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ASI2026_915	Sitha K Jagan	Poster

High Energy Phenomena, Fundamental Physics and Astronomy

Investigating Jet Structure in Gamma-Ray Bursts Using Early Rising Optical Afterglows

Early optical afterglows of gamma-ray bursts (GRBs) provide important constraints on the structure of relativistic jets and the angle at which they are observed. Recent work by Chakyar & Resmi (2025) showed that delayed optical peaks and slowly rising light curves can be used to identify off-axis and structured GRB jets, based on a limited sample. Motivated by this study, we present an ongoing analysis aimed at extending these results to a larger sample to understand the distribution of viewing angles and jet structure across bursts.

From an initial sample of 495 GRB afterglows obtained from the SLAC optical afterglow light curve database, we identified 44 well-sampled early-rising light curves with known redshifts through visual inspection of the sample for the present analysis. Optical afterglow light curves for these events have been examined to identify clear rising phases, and rest-frame luminosity–time profiles are being generated to study their rise behaviour, peak times, and luminosity distributions.

The present work focuses on investigating whether systematic trends emerge among GRBs with rising optical afterglows that may be linked to jet structure or viewing angle. In the next stage, we will complete the sample with X-ray and radio data for these GRBs. The multi-wavelength light curves will be modelled using the VEGAS afterglow model, which calculates the synchrotron emission from the afterglow and incorporates Bayesian parameter estimation to infer jet geometry and key microphysical parameters.

GRB jet structure is linked to the jet launching mechanism. Viewing angle constraints are essential to obtain the true rate and energetics of GRBs. This study aims to place stronger constraints on GRB jet structure by combining a statistically meaningful sample with multi-wavelength afterglow modelling, and by linking early optical signatures with the behaviour of GRB afterglows at later times.

ASI2026_593	Soumen Roy	Poster

High Energy Phenomena, Fundamental Physics and Astronomy

The Effect of Secret Neutrino Interaction on The KM3NeT 220 PeV Neutrino Event

Recently, the KM3NeT has detected a $220~\mathrm{PeV}$ neutrino, the highest energetic observed till date. It is likely of extragalactic origin as no sources capable of producing such ultra-high energy (UHE) neutrinos are known to exist in the Milky Way or any nearby galaxies. Thus, this neutrino is expected to propagate over large cosmological distance before reaching Earth, thereby opening a new window to study interesting physics scenarios involving neutrino propagation. One such scenarios is the secret neutrino interaction (NνSI) of UHE neutrinos with cosmic neutrino background (CνB), mediated by a hypothetical massive scalar particle. This NνSI effect is primarily characterized by two model parameters, the coupling constant ($g_{\tau\tau}$) and the mediator mass (M_ϕ). In this study, we analyze the bounds on this NνSI parameter space (M_ϕ and $g_{\tau\tau}$) considering both point and diffuse source origin for the KM3NeT neutrino event. Our analysis incorporates the impact of redshift and neutrino mass ordering. Consequently, we place the strongest constraint on the coupling constant $g_{\tau\tau}$ ($\sim 2.5 \times 10^{-3}$) for $M_\phi \sim 100~\mathrm{GeV}$. In addition, we investigate for any multimessenger correlation of the KM3NeT neutrino event with UHE photons and cosmic rays. Interestingly, our findings indicate a lack of such significant multimessenger correlations implying the possibility of an enigmatic gamma-ray dark source that emits only neutrinos at ultra high energies.

ASI2026_80	Soumil Sahu	Poster

High Energy Phenomena, Fundamental Physics and Astronomy

A Systematic Study of R-mode Oscillations and Gravitational Wave Emission in Neutron Stars

Neutron Stars (NSs) provide a unique laboratory for studying cold dense matter under extreme conditions. Their internal composition fundamentally dictates observable properties, including mass, radius, and oscillation modes. Isolated NSs and NSs in a binary can both be sources of Gravitational Waves(GWs) via non-axisymmetric unstable

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quasi-normal modes. Among various oscillation modes, r-modes are particularly interesting; they are generic to rotating neutron stars and are thought to act as a critical spin frequency regulating mechanism, through the emission of GWs. The stability of these modes is governed by damping via viscosity, which arises from the microphysical interactions-scattering or weak interactions-of the constituent particles.
In this work, we perform a systematic study investigating how the interior physics of NSs influences r-mode stability and the resulting GW signatures. We explore the interplay between various constituent particles, the associated viscosity mechanisms, and the subsequent damping of unstable modes. By utilising state-of-the-art models that align with current experimental nuclear data and recent multi-messenger astrophysical observations, we update previous results.
This study is highly relevant to the ongoing searches by the LIGO-Virgo-KAGRA (LVK) collaboration. By analysing the current non-observation of GWs from r-modes, we derive meaningful constraints on model parameters and r-mode saturation amplitudes. This work aims to refine our understanding of the link between microphysical processes in dense matter and the potential for macroscopic level detection of gravitational radiation in the multi-messenger era.

ASI2026_765	SOURAV BISWAS	Poster

High Energy Phenomena, Fundamental Physics and Astronomy

Maximum mass of singularity-free anisotropic compact stars in Rastall theory of gravity

This research investigates the properties of spherically symmetric anisotropic compact stars within the framework of Rastall gravity. By adopting the Krori-Barua metric ansatz, the study derives a set of singularity-free, relativistic solutions to the Einstein's field equations that remain analytically tractable. All the physical parameters pertaining to the stellar model remain well-behaved. Within this geometry, the best fit equation of state is derived by maximizing the sound velocity at the stellar centre. Through a numerical treatment of the Tolman-Oppenheimer-Volkoff (TOV) equation, the model identifies the maximum mass and corresponding radius of compact objects. Notably, the model yields maximum masses ranging from $2.24~M_{\odot}$ to $2.36~M_\odot$, with corresponding radii between 9.48 km and 10.15 km. Furthermore, the causality, energy conditions and necessary stability criteria are well satisfied which validate the physical acceptability of the present model within the framework of Rastall theory of gravity. The radii of different compact stars may be predicted from the model which are in good agreement with the results obtained from the recent observations.

ASI2026_142	Sree Bhattacherjee	Poster

High Energy Phenomena, Fundamental Physics and Astronomy

Unveiling the spectral evolution of GX 17+2 using observations from AstroSat and NICER

In this study, we analyze the Z-track neutron star X-ray binary GX 17+2 using the data from the AstroSat and NICER mission. The spectrum spread to a wide range of X-ray energies, allowing for a comprehensive analysis of the source's spectral properties. The X-ray spectra is well defined by multicolor-blackbody component and a thermal Comptonized component. To gain insights into how the spectral parameters, such as inner-disk temperature, mass accretion rate, inner-disk radius, and emission components, change with varying flux intensities, we used a flux-resolved spectroscopy method. This helps in probing the evolution of the source following its characteristic Z-track path. Our study mainly focuses on the spectral variations of the source across different Z- branches. We studied the factors responsible for the formation of the flaring branch, which is obtained to be the mass accretion rate, as it sharply increases from the soft apex to the top of the flaring branch by ~46% and being nearly constant in the normal branch. However, in normal branch the scattering fraction and the inner disk radius are obtained to play an important role in the movement of the source. The study also highlights the importance of the broadband spectral analysis to understand the accretion phenomenon.

ASI2026_441	Sridhar Gajendran	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing Long-Period Transients with GMRT Archival Data: Updates from LIGHT		
Long Period Transients (LPTs), one of the most rapidly emerging phenomena in the field of radio transients, are minute to hour timescale periodic events covering a broad energy range, bridging coherent and incoherent regimes. LPTs have the potential to graze the boundary between coherent and incoherent emitters, challenging the understanding of coherent versus incoherent radio emissions . Fewer than a dozen LPTs have been discovered so far, all found within the Galactic plane, and their emission mechanism remains poorly understood. These sources lie beyond the so-called "death valley" in the spin period and period derivative (P–$\dot{P}$) diagram, where normal radio pulsar emission is expected to cease. Interestingly, some LPTs showed optical or X-ray counterparts, suggesting a wide range of possible origins. Proposed models include highly magnetized white dwarfs, binary systems, and ultra-long period magnetars. One remarkable LPT has been active since 1988 but was missed by traditional periodicity search methods. It also shows a possible connection with Fast Radio Bursts (FRBs). Such discoveries highlight the need for systematic studies using both archival and new observations. To explore this population, we have started the LIGHT (Long-period transIents in GMRT arcHival daTa) project using several years of archival uGMRT imaging data. We developed a GPU-accelerated fast imaging pipeline called GARUDA that searches for transients in image cubes and performs a time-domain periodicity search to detect ultra-slow, isolated, repeating bursts. The pipeline has been validated by recovering two known LPTs, J0901-4046 and GPM J1839–10, from archival GMRT data. With the GMRT's unprecedented sensitivity and our new processing capabilities, we aim to probe previously unexplored regions of the transient parameter space. I will present recent progress from the LIGHT project, highlighting new candidate detections spanning both plausible astrophysical events and signals attributable to satellites.		

ASI2026_941	Sudeb Ranjan Datta	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Interaction between disk and extended corona in a general relativistic framework		
The energy equilibrium between the corona and the underlying disk in a two-phase accretion flow sets a lower limit on the achievable photon index. A slab corona may not explain the hard state observations of X-ray binaries (XRBs). We incorporate energy feedback to the accretion disk resulting from illumination by an extended corona, and vice versa. The interaction between these two components allows for the possibility of finding an energetically self-consistent equilibrium solution for a given disk-corona system. We have upgraded the existing Monte Carlo radiative transfer code, MONK, to incorporate the interaction between the disk and the extended corona within the general relativistic framework. We introduce an albedo parameter to specify the fraction of the incident flux that is reflected by the disk, while the remainder is absorbed and added to the intrinsic dissipation. Reflection is modeled assuming a semi-infinite electron atmosphere. We find global equilibrium solutions by iterating interaction between disk and extended slab corona. A higher black hole spin, higher coronal temperature, and higher albedo all lead to harder spectra. For typical coronal temperatures and disk albedo, the lowest achievable photon index with a static slab corona fully covering the disk is approximately 1.7-1.8. With the upgraded version of MONK, we are now able to achieve global energy equilibrium for a given disk-corona system. This approach holds significant potential for constraining the coronal geometry using not only the observed flux but also polarization. A static slab does not appear to be a favorable coronal geometry for the hard state of XRBs, even when global energy balance is taken into account. In future work, we will explore truncated disk geometries and outflowing coronae as potential alternatives.		

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ASI2026_942	Sudip Garain	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Three-Dimensional GRHD Simulations of sub-Keplerian Accretion Disk onto Rotating Black Holes and its Radiative Properties		
Observations of X-ray binaries containing black holes indicate the presence of geometrically thick, hot, dynamic Compton cloud around the black hole to satisfactorily explain certain spectral and temporal properties. In this work, I present results of a few high resolution three-dimensional general relativistic hydrodynamic simulations of such Compton cloud arising out of sub-Keplerian accretion flow onto rotating black holes. I also present the spectral and temporal properties of such Compton cloud, simulated using suitable radiative transfer modules in a post-processing manner.		

ASI2026_770	Suraj Chaurasia	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Long-Term AstroSat Spectral Study of Cygnus X-3		
Recent X-ray polarimetric observations have revealed an unusually high polarization degree in the X-ray binary Cygnus X-3, indicating a reflection-dominated spectrum. Motivated by these findings, we present a long-term spectral study of Cygnus X-3 using AstroSat observations obtained between 2016 and 2019. We analyzed seven AstroSat observations using data from the LAXPC and SXT instruments, dividing the good time intervals into time resolved segments, resulting in a total of 57 spectra. Hardness–intensity diagrams constructed using the 3.0–10.0 keV and 10.0–30.0 keV bands were used to classify the source into soft, intermediate, and hard spectral states. All spectra were modeled using a uniform pure reflection framework in XSPEC, isolating the reflected emission component motivated by recent polarization results. We find that the pure reflection model provides statistically acceptable fits across all segments and spectral states. In the hard state, the spectra are dominated by Comptonized emission, characterized by high electron temperatures, low disk normalization, and a larger covering fraction. In contrast, the soft state is dominated by the thermal disk component, with the electron temperature decreasing to ~5 keV and a significantly reduced covering fraction. The inner disk temperature remains nearly constant across different spectral states. Additionally, we observe strong correlations between disk and Comptonization parameters, indicating a coupled disk–corona geometry.		

ASI2026_1105	Surajit Paul	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
First Unambiguous Detection of Gamma Rays from the Intracluster Medium with 14 Years of Fermi-LAT Data		
In the hierarchical structure formation, massive galaxy clusters ($\sim10^{15}$ M$\odot$) form relatively late in the non-linear regime through major cluster mergers, the most energetic ($\sim10^{64}$ erg) phenomena in the post–Big-Bang era. This enormous energy dissipates via Mpc-scale shocks, analogous to supernova blast waves, as predicted by numerical simulations and observations of ring-like radio relics in merging systems (e.g. Abell3376). Merger-driven turbulence and shocks are expected to accelerate particles to ultra-high energies via Fermi mechanisms, making clusters promising reservoirs of high-energy cosmic rays. Despite strong theoretical motivation, conclusive detection of gamma-ray emission from the intracluster medium (ICM) has remained elusive, raising questions about our physical understanding or the limited sensitivity and localization capability of current gamma-ray telescopes. Additionally, gamma-ray interactions with intergalactic material along the line of sight restrict detectable signals to only a few very nearby, dynamically active clusters, further reducing the accessible test space. Motivated by these challenges, we systematically shortlisted a sample of promising galaxy clusters and performed a comprehensive analysis of 14-years of Fermi-LAT data. In this talk, I will present our recent results reporting the first unambiguous detection of diffuse gamma-ray emission from the ICM of Abell 119 and other well-known systems. The analysis was carried out using Fermipy and the Fermi Science Tools, incorporating detailed spatial and spectral modeling of all potential gamma-ray sources. Using an optimized background estimation strategy, we successfully		

modeled and removed point-like sources, isolating the underlying diffuse emission. A rigorous statistical analysis demonstrates that the detected signal is physically associated with the ICM with high significance (>4σ). From the spatial morphology and spectral behavior, we conclude that the emission originates from non-thermal processes in the ICM, most plausibly hadronic interactions. Finally, our estimated neutrino flux of a few $\times 10^{-10}$ GeVcm^{-2}s^{-1}sr^{-1} provides strong motivation for future observations with next-generation neutrino facilities.

ASI2026_32	Susmita Das	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Long-term Multiwavelength Study of the TeV blazar OP 313 in Low and Flaring States		

We present variability and spectral studies of the most distant TeV-detected blazar OP 313 (z = 0.997) at multiple wavebands from optical to GeV energies during 2019–25. The long-term light curves of this FSRQ contain several flaring phases with a remarkable very high energy flare (> 100 GeV) in December, 2023. The overall flux profile in GeV is better described by log-normal than Gaussian distribution and it shows a typical harder when brighter trend. We successfully model each flare by a double-exponential function which is asymmetric in shape in most cases. A stronger correlation is found between the variability at X-ray and Gev bands during the low flux epoch and there is significant change in the X-ray spectral shape from low to high state. Those suggest a different origin of X-ray emission in the high flux state. We carry out broadband SED modeling during the low flux and individual flares by multi-zones leptonic model considering synchrotron, Synchrotron self-Compton and external Compton emission processes. From the best-fit models, we compare the ongoing emission mechanisms, contributing emission regions and their parameters in various states of activity of the blazar.

ASI2026_378	Swarnim Shirke	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
PSR J0614-3329: A NICER case for Strange Quark Stars		

The physical picture of pulsars remains unclear. Although widely modelled as neutron stars, their correct description requires observations that probe their microphysics. Precise measurements of neutron star masses and radii by the NICER mission impose important constraints on the nuclear equation of state. We use state-of-the-art NICER measurements to date, including the most recent NICER measurement of PSR J0614-3329 that reported an equatorial radius of R_{eq} ~ 10.29 km for a mass of M ~ 1.44 M_{\odot}. We consider a wide range of neutron stars and strange quark stars, composed of deconfined quark matter, derived from both realistic phenomenological and microscopic models, and carry out a Bayesian hypothesis ranking analysis to perform model selection. We find substantial evidence for strange quark stars over physically motivated models of neutron stars that are compatible with this low radius, and also find a hint of the hadron-to-quark phase transition inside neutron stars. Using a wide sample of equations of state, we report the nucleonic neutron star equations of state that best fit current observations and rule out one model of strange quark matter. This analysis presents a compelling case for quark matter in neutron stars and also for the possible existence of strange quark stars, a consequence of the Bodmer-Witten hypothesis, which suggests that they could be considered among the population of compact stars during astrophysical data analyses.

ASI2026_224	Tanuj Datta	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Investigating LMXRBs as plausible progenitors of GC FRB 20200120E		

FRB 20200120E is the nearest repeating Fast Radio Burst (FRB), residing in a globular cluster (GC). No persistent radio source has been detected around it. At 1.5 GHz, the observed FRB radio luminosity(Lr) upper limit on Log10(Lr(erg/s)) is 32.7. Besides, the observed limit on X-ray luminosity(Lx(1-10 keV)) is Log10(Lx) <37.1 erg/s. The location of this FRB challenges the traditional young magnetar-FRB association since GCs host old stellar populations. It is well known that GCs are abundant in accreting compact objects (COs), such as low-mass X-ray binaries (LMXRBs) containing white dwarfs (WDs) or neutron stars (NSs), or black holes (BHs). If FRB 20200120E originates from an LMXRB, our analysis constraints Log10(Lr(erg/s)) <29.7, for BH populations, for Lx(1-10 keV)<37.1 erg/s. Besides, if the LMXRB contains an NS, this upper limit would become 28.7. We found that for both BH populations and NSs, some LMXRBs have been detected above the radio and X-ray limits, e.g., for GX339-4, belonging to the BH population, only around 38% of time it was detected beyond a Log10(Lr) of 29.7 at 1.5 GHz. However, almost 30% of the time, this source was observed above the Lx limit. For another BH LMXRB, V404 Cyg, this statistics is around 61% and 30% for Lr and Lx respectively. Considering all the BH LMXRBs together so far, less than 32% of the simultaneous/quasi-simultaneous Lr and Lx crosses the FRB luminosity upper limits, whereas most of the time they are less bright than these limits, supporting LMXRBs as potential FRB progenitors.

ASI2026_991	Tausif Parvez	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Radio Signatures of Quantum Vacuum Breakdown in Black Hole Environments		

Next-generation radio facilities like the SKA and ngVLA will probe the vicinity of black holes with unprecedented sensitivity, opening a new window into extreme physics. In this work, we investigate whether quantum vacuum effects in these environments can produce observable radio signatures. Focusing on the Magnetically Arrested Disk (MAD) regime, we model the production of electron-positron pairs driven by the rapid temporal evolution of accretion disk magnetic fields (10^4 - 10^8 G). We find that "dynamical pair creation"—a non-perturbative quantum effect distinct from thermal particle acceleration—produces a population of relativistic leptons that emit characteristic synchrotron radiation. Our results predict a unique spectral peak in the MHz-GHz range with flux densities reaching 100 mJy, distinguishing this emission from standard thermal disk radiation. We discuss the feasibility of detecting this "quantum radio signal" using the SKA-Low and LOFAR 2.0, potentially providing the first direct astrophysical evidence of non-adiabatic vacuum breakdown in the strong-gravity regime.

ASI2026_798	Thouheeda Beegum RV	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
SPECTRO-POLARIMETRIC ANALYSIS OF PROMPT EMISSION OF GRB231129C		

A spectro–polarimetric analysis of the bright gamma-ray burst GRB 231129C is presented using observations from Fermi–GBM, Fermi–LAT, and AstroSat–CZTI. A fluence of (8.41±0.04)×10^−5 erg cm^−2 in the 10–1000 keV energy band, measured over a T90 duration of 5.8s, placing it among the brightest GRBs detected by Fermi. A Band plus blackbody model with an extra power-law component is preferred by time-integrated spectral analysis, indicating that LAT (> 100 MeV) represents the onset of afterglow emission. Time-resolved spectroscopy reveals that the prompt emission is best described by a CPL plus blackbody model with a thermal component that contributes 10%–40% of the overall flux and is observed up to 5 sec. In the absence of a direct spectroscopic measurement, the redshift of the burst is estimated to be z = 0.52 using the Amati correlation. Using LAT data, we infer that the radiative efficiency is nearly 44% of the total jet energy released as radiation during the prompt phase. The spectral characteristics are explained within the paradigm of a dissipative photosphere, where a fraction of the thermal emission advected from deep inside the outflow is upscattered to higher energies via the high-energy electrons produced in the dissipation site below the photosphere. The time-integrated and time-resolved polarization analyses of the burst, conducted using the CZTI data, yield no significant polarization detection in the 100–600 keV energy range, with an upper limit of PF < 24%. Thus, the observed emission is consistent with intrinsically unpolarized dissipative photospheric radiation, since the relativistic beaming cone (1/Γ) along the line of sight (θ_V) is much narrower than the jet opening angle (θj), corresponding to either an on-axis configuration (θv/θj <1.3) or a marginally off-axis view (1.3≤ θv/θj ≤1.5).

ASI2026_406	Vincent Paul A	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
A Bayesian method for relating two compact object populations via hierarchical merger		
In dense astrophysical environments, the remnant of a compact binary merger can pair with another compact object and undergo a subsequent merger. Such hierarchical mergers are intriguing astrophysical phenomena that can be probed using gravitational-wave observations, providing insight into their merger histories. If the primary component of a binary population is produced as a consequence of a previous merger, then the source properties of such systems are correlated with those of the parent binaries. These correlations can be modelled using numerical relativity–based fitting formulae that map the properties of a compact binary to the parameters of the merger remnant. We consider the merger rates of two compact-binary populations, where the primary component of one population is the product of a previous merger. We develop a Bayesian framework that relates these two populations by explicitly modelling the redshift evolution of the parent binary merger rate, the time-delay distribution between successive mergers, and the probability that a merger remnant from a previous generation subsequently pairs with another compact object. Without the need to model complex astrophysical processes, this framework enables direct inference of population-level properties of compact binary mergers.We apply this method to potential hierarchical merger candidates GW190425 and GW230529. Using current observational constraints on the local merger rates of the relevant populations from LIGO, we show that meaningful constraints can be obtained on the redshift evolution and the time-delay distribution, while highlighting that existing degeneracies can be broken with improved merger-rate measurements. Finally, we demonstrate that the advent of next-generation detectors and future observing runs, which are expected to place much tighter constraints on the merger rates of different compact-binary populations, will significantly enhance our ability to probe hierarchical merger histories.		

ASI2026_194	Vishva Patel	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing compact objects with and without horizon: theory and observation		
It is evident from the literature that the final fate of a collapsing star can be either a hidden or a visible singularity. The question then arises: How can these two distinct types of singularities be distinguished from one another? In this presentation, I will discuss the observational properties of compact astrophysical objects, with or without an event horizon. First, I will discuss the precession of test particles as they orbit these compact objects. Another aspect is the shadow cast by a black hole or a naked singularity. However, it is important to note that both precession and shadow properties often gives similar observational signatures, making them insufficient for a clear distinction. We will therefore explore how X-ray observations, particularly those involving accretion disk behavior and high-energy spectral features, can provide a more definitive method to differentiate between black holes and naked singularities. Concluding this, we will reflect on the open challenges that remain within this domain.		

ASI2026_924	Vishwas Patel	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Simulating Relativistic Shadows for Blackhole and Naked singularity Spacetimes.		
The recent shadow observations of Sgr A* by the Event Horizon Telescope are most effectively explained by the Joshi-Malafarina-Narayan type-1 (JMN-1) naked singularity and Schwarzschild black hole models, which are currently regarded as observationally degenerate spacetimes. The JMN-1 naked singularity results from the gravitational collapse of spherically symmetric matter with zero radial pressure. It casts a shadow for values of the parameter M0 > 2/3 , where it supports a photon sphere. The observationally verifiable differences between these two metrics are inadequately explored in the literature. Therefore, in our study, we conduct a detailed investigation of the possible differences in shadow images of the Schwarzschild black hole and the JMN-1 naked singularity under optically thin Bondi-Michel accretion using relativistic ray tracing. Using high-resolution image processing, we analyze shadow		

structures in both spatial and frequency domains through spectral analysis techniques, including 2-dimensional fast Fourier transform. Notably, the distinction between the simulated shadow images is more pronounced in the phase of the 2D Fourier transform than in the amplitude. Additionally, we apply error-based, perceptual, and information-theoretic image comparison metrics to quantify the differences in the spatial domain. The shadow image differences, derived from the developed Python framework, are rigorously validated through cross-comparison with independent, publicly available general relativistic radiative transfer codes. Furthermore, we find that the JMN-1 metric with $M0 < 2/3$ produces a ’full-moon’ image which closely resembles the intensity structure of the Little Red Dots (LRDs), which were recently observed with the JWST’s NIRCam instrument. The performed shadow simulations provide valuable insights that can help constrain the nature of ultra-compact objects at galactic centers using observations from the Event Horizon Telescope and future terahertz very long baseline interferometry (VLBI) networks.

ASI2026_14	Vivek Baruah Thapa	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Investigating Oscillation Modes in Dark Matter-Enriched Neutron Stars		

Due to their immense densities and strong gravitational fields, compact astrophysical objects like neutron stars serve as promising environments for capturing dark matter particles. Assuming only gravitational interactions between dark matter and ordinary hadronic matter, we model hybrid stars composed of two distinct fluid components. These models are constructed under the guidance of existing astrophysical bounds on maximum mass and tidal deformability. A broad set of parameters is explored to define the dark matter equation of state, while the hadronic matter is described using the DD-ME2 framework. We analyse how the presence of dark matter influences various stellar properties, including structure, tidal responses, and non-radial oscillation modes, employing the relativistic Cowling approximation. Our results reveal a significant impact on the pressure-driven (p-) modes, with their frequencies often shifting toward the typical range of fundamental (f-) mode frequencies in stars with surrounding dark matter halos. In contrast, the f-mode frequencies exhibit relatively modest changes. We also identify the dark matter parameter values that best align with current observational data.

ASI2026_119	Yogita Kumari	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Prospects of EM follow-up of NSBH mergers in the LIGO-India era		

The detection of Gravitational Waves (GW) from the Binary Black Hole (BBH) merger GW150914 has opened up a new window to observe the universe. So far, detected sources are Compact Binary Coalescence(CBCs). Neutron Star Black Hole (NSBH) and Binary Neutron Star (BNS) may be followed by an electromagnetic (EM) counterpart. The GW signal from these sources
already has luminosity distance information. In the case of EM counterpart detection, one can get redshift information of the event. These events with EM counterparts can serve as standard sirens to obtain an independent value of the Hubble constant, providing a new perspective on the Hubble tension.

In the case of the NSBH merger, whether there will be an EM counterpart or not depends on the mass of the BH, the spin of the BH, and the Equation of State (EoS) of the NS. Even if there is an EM counterpart, it may not be detectable with current EM telescopes. We explore the plausibility of getting EM follow-up for NSBH mergers. We estimate the number of NSBH detections and sky localisation of sources with current ground-based detectors and LIGO India. Using GWEMOPT, we estimate the fraction of these detections, with EM counterparts, that will be detected in EM telescopes, such as LSST, WINTER, and ZTF. From these estimates, we can calculate the time required to obtain tens of detections, which is necessary to determine the Hubble constant with a precision of 2%. EM counterpart of these mergers can be used to draw important conclusions regarding the EoS of neutron stars as well as the Hubble parameter, as there is a possibility of detecting NSBH mergers at greater distances than BNS mergers.

ASI2026_364	Yuvasri G	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Spectral (In)stability of Black Hole Quasi-normal Modes in Perturbed Spacetimes		

Yuvasri G

Gravitational waves emitted during black hole coalescence are described in three phases - inspiral, merger and ringdown. During the ringdown phase, the remnant black hole behaves like a damped oscillator and emits gravitational radiation characterized by complex frequencies known as Quasi-normal Modes (QNMs). Since QNMs depend purely on the intrinsic properties of the black hole such as mass, spin and charge, they serve as black hole footprints. Extracting and analyzing these frequencies to infer black hole parameters is referred as Black Hole Spectroscopy (BHS). The sensitivity of Laser Interferometer Space Antenna (LISA) is expected to strongly support such studies.

In realistic astrophysical scenarios, black holes reside in galactic centers and are influenced by surrounding environments like dark matter distributions. These environmental effects can be modeled by introducing perturbative features, such as bumps, in the effective potential, which may induce spectral (in)stability in the QNM spectrum. However, analyzing such spectral behavior is numerically challenging. In this work, we investigate the QNM spectrum of parametrized spherically symmetric spacetimes in the presence of environmental perturbations. We employ spectral methods based on Chebyshev polynomials to compute both fundamental mode and higher overtones and subsequently use pseudospectrum analysis to assess spectral (in)stability. We aim to systematically study how the modes migrate as the parameters of perturbative feature are varied.

Additionally, we analyze the corresponding time domain characteristics of the system in the presence of environmental features. By combining frequency domain and time domain analyses, we aim to gain deeper insight into the role of the surrounding environment in shaping the QNM spectrum of black hole systems.

Posters in Facilities, Technologies and Data science

ASI2026_46	Abhirami S Raghu	Poster

Facilities, Technologies and Data science

Mid-IR Water-Vapor Seeing: Implications for METIS High-Contrast Imaging from VLTI Data

Mid-infrared (mid-IR) observations from ground-based telescopes are significantly affected by spatial and temporal fluctuations in atmospheric water vapour (WV), which introduce chromatic phase errors that are not corrected by near-infrared adaptive optics. This poses a major challenge for high-contrast imaging (HCI) instruments such as the Mid-infrared Extremely Large Telescope Imager and Spectrograph (METIS), which aims to directly detect thermal emission from exoplanets in the N-band (8–13 μm).

We analyze K-band fringe tracker data from the GRAVITY instrument at the Very Large Telescope Interferometer (VLTI) and derive the optical path difference (OPD) between the group delay and phase delay measurements to quantify wavefront errors induced by WV fluctuations. This OPD is directly linked to the differential WV column density (Σ) above the various telescopes of the interferometric array. In this study, we explored the variability of the Σ and studied its correlation with various atmospheric parameters such as precipitable water vapor (PWV), seeing, wind speed, AH, RH and airmass. The analysis showed that Σ is strongly correlated with PWV, supporting PWV as a robust metric for WV-induced fluctuations. We further explore whether this correlation depends on the vertical profile of PWV across the atmosphere. We then quantify how increasing PWV modulates Σ variability using power-spectral-density analysis. Together, these results provide a quantitative basis for improving the operational capabilities of next-generation mid-IR HCI instruments such as METIS.

ASI2026_775	Abhishek R	Poster

Facilities, Technologies and Data science

An Inverted 150 to 700 MHz Transient Array at Gauribidanur Observatory

Radio transient signals from the Fast transient sources vary their brightness across the spectrum and in time. Several arrays across the globe search for FRB-like transients, typically between 500 and 800 MHz. It will be interesting to study these signals below 500 MHz. As we have the BURSTT telescope out-trigger station in the observatory, we are considering developing a lower frequency follow-up study instrument at the Gauribidanur observatory. The antennas will be configured to form a circular array with non-redundant baselines in a circle of radius about 100 meters. A sophisticated receiver system consisting of Low Noise Amplifiers and RF front end receivers to transmit the signals over optical fiber path are developed. This paper describes the details of a new antenna and instrumentation designed to detect radio transients at low frequencies between 150 MHz and 700 MHz. It will also present the initial test results from observing transient sources (Solar and Pulsars) at the Gauribidanur Observatory.

ASI2026_963	Aditya Sahasranshu	Poster

Facilities, Technologies and Data science

An online tool for making spectral index maps using any two radio survey FITS files

New all-sky surveys are increasingly becoming available with higher sensitivity, resolution, and fidelity (sensitivity to both compact and diffuse emission). At the same time, the scientific exploitation of these open datasets is no longer limited to professional astronomers; trained citizen scientists working outside formal research institutions are also making substantive contributions. To facilitate the analysis of both legacy and newly available radio interferometric data by professional and amateur astronomers alike, we have developed a simple online tool that generates quick-look spectral index maps from any pair of FITS images (https://sites.google.com/view/radiospectralindex/home). The tool is subject to natural limitations arising from the UV-coverage of the input images and a maximum file size of 100

MB. Uploaded FITS files are not stored, ensuring that users can analyse data without compromising the privacy of newly identified radio sources. The service is free to use and is hosted on Google Sites, offering a lightweight interface with backend computations performed on a Streamlit server. The backend utilises established Python libraries such as radio_beam and reproject to implement a rigorous common-resolution workflow. Worst-case beam parameters are automatically derived from FITS metadata of major surveys (e.g. LoTSS, LoLSS, NVSS, TGSS, FIRST, and RACS), and a flux-conserving circular convolution kernel is generated to homogenise angular resolution and eliminate directional bias. Unlike static spectral-index servers, the pipeline allows interactive adjustment of noise thresholds (e.g. 3σ, 5σ). Quick-look images are displayed directly in the browser, and the final spectral index maps can be downloaded in FITS format for further analysis. While the tool is openly available to all users, it is currently being tested and refined through active use by trained citizen scientists from RAD@home India, who are working beyond preliminary RGB–contour-based analyses (https://www.radathomeindia.org/rgbmaker).

ASI2026_560	Alikhan Basheer	Poster
Facilities, Technologies and Data science		
Fabrication & Qualification of Roundel Polishing for TMT at India-TMT Optics Fabrication Facility		

As a partner of Thirty Meter Telescope Project, India agreed to supply 84 Polished Segments to the project. All the 84 segments, which are non-axisymmetric aspheric in shape, need to fabricate within a short period of 4 years. To achieve this milestone in a short timeline, India-TMT transferred a unique technology from Coherent Inc. USA called the Stressed Mirror Polishing (SMP) technology. SMP technology allows to polish thin non-axisymmetric aspheric segments in a faster way compared to the conventional technology. Using the technology and trained manpower, India TMT polished first prototype roundel at India-TMT Optics fabrication facility (ITOFF) located at the CREST campus of Indian Institute of Astrophysics.

The prototype roundel was polished using the Coherent Equipment and met all the TMT requirements in terms of Surface figure, Mid spatial frequency error and surface roughness. All these parameters are verified using various metrology tools and the End Item Data Package (EIDP) was sent to TMT for third party verification. After analyzing the data, the TMT cleared the Fabrication Readiness Review and qualified India-TMT to produce TMT roundels.

The production of TMT roundels at ITOFF is planned in two phases. The Low-Rate Initial Production (LRIP) will begin in April 2026 and extends for 2 years, and the rate of production will be 9 roundels per year. After the completion of LRIP, ITOFF will enter full production, where the production rate will surge to 24 roundels per year. We report the roundel polishing technology, process, challenges, qualification and future plans for the TMT roundel production at ITOFF.

ASI2026_335	Archita Rai	Poster
Facilities, Technologies and Data science		
Laboratory Implementation & Performance Characterization of MOAO system for Astronomical Applications.		

Adaptive optics (AO) is integral to the astronomical instrumentation landscape for all the leading large optical/IR telescope observatories. AO systems have been utilized to improve the astronomical seeing experienced by ground-based telescopes. The system compensates for the wavefront distortions in astronomical images due to the Earth's atmospheric turbulence. Among the various AO approaches, multi-object adaptive optics (MOAO) is particularly suited for applications requiring simultaneous data collection from multiple targets, such as multi-object spectroscopy (MOS). Unlike classical AO, the objective here is not to achieve uniform correction across the entire FoV, but rather to deliver reasonably high Strehl ratios in specific regions of interest. To this end, MOAO architectures utilize multiple open-loop deformable mirrors, correcting specific FoV, aligned with a distinct science direction. We use the spatial light modulator (SLM) to simulate re-configurable atmospheric turbulence under different conditions, such as wind speed, seeing, altitude, etc. In our implementation, we employ both open-loop and closed-loop control configurations. Wavefront sensing is achieved using a Shack–Hartmann wavefront sensor (SH-WFS), which captures

local wavefront slope variations via a lenslet array that samples the pupil into discrete sub-apertures. We implemented the Catkit2 framework, providing the infrastructure to control and synchronize hardware using the shared memory feature in real-time for efficient inter-process communication. In this presentation, we dicuss the detailed aspects and results of the MOAO systems via the implementation of one arm of the MOAO system.

ASI2026_491	Athul C N	Poster
Facilities, Technologies and Data science		
Development of a Shack–Hartmann–Based Atmospheric Turbulence Monitor and Profiler		
Characterization of atmospheric optical turbulence is essential for the design and efficient operation of modern ground-based optical telescopes. The Differential Image Motion Monitor (DIMM) has long served as the standard instrument for measuring atmospheric seeing; however, it provides no information on other key turbulence parameters such as the atmospheric coherence time or the vertical distribution of optical turbulence strength. These parameters are critical for the successful design and operation of adaptive optics systems on large ground-based telescopes. This work presents the development of a turbulence monitor and profiler that extends the DIMM concept by exploiting differential image motion measurements of bright stars using a Shack–Hartmann wavefront sensor in place of the traditional two-hole aperture mask. This approach, implemented in the Shack–Hartmann Image Motion Monitor (SHIMM), enables robust seeing estimates that are largely insensitive to shot noise and scintillation effects. In addition to seeing, SHIMM provides a low-resolution (three-layer) estimate of the vertical turbulence profile and an independent measurement of the atmospheric coherence time. SHIMM is designed as a low-cost, portable instrument built entirely from off-the-shelf components, making it straightforward to replicate and suitable for deployment at remote sites. An end-to-end simulation and analysis framework has been developed to model the instrument and to quantify the response of Shack–Hartmann spot motion to atmospheric turbulence. We present the algorithmic framework, simulation results, and preliminary on-sky measurements demonstrating the instrument's performance.		

ASI2026_545	deekshya roy sarkar	Poster
Facilities, Technologies and Data science		
Design and Development of SIRIS instrument for PRL's 1.2m telescope		
A collimator camera type InGaAs based Short-wave InfraRed Imaging System(SIRIS) in the wavelength range of 800-1700 nm is being developed for the 1.2 m PRL telescope at Mount Abu. This InGaAs detector is operated with TEC cooling achieving acceptable level of dark current giving us benefit over cryogenic cooling.The instrument will have iZ, iJ and iH filters for photometry. The re-imaging optics of this instrument is converting F#13 beam from telescope to F#3.6 beam at the detector plate giving a 4.8 x 4 arc-minutes on the detector. This instrument will be helpful in observation of bright infrared objects, significant number of type-II cepheids and other late type variables and many other science objectives. In this conference, I shall describe the instrument specifications, mechanical design, optical design and some observational results carried out by this instrument.		

ASI2026_144	Gireesh G V S	Poster
Facilities, Technologies and Data science		
A prototype radio interferometer system with commercial dish TV antennas for observations of the solar chromospheric magnetic fi		
We are exploring the possibility of carrying out radio interferometric observations of the solar chromosphere at ≈ 11.2 GHz (λ = 2.68 cm), in both total intensity (Stokes-I) and circularly polarized intensity (Stokes-V), using low-cost commercial dish TV antennas. Here, we present our initial results on the magnetic field strength (B) estimated using data obtained with a prototype set-up, and compare them with similar observations.		

ASI2026_730	Kapil Kumar	Poster
Facilities, Technologies and Data science		
Design and Development of Medium Resolution Spectrograph “SAGAR” to Study the stellar activities in M-Dwarfs		
M-dwarfs dominate the stellar population of the Galaxy and are key targets for exoplanet and habitability studies. However, their strong magnetic activity introduces significant challenges in interpreting planetary signals and assessing atmospheric stability. To address this, we are developing a medium-resolution optical spectrograph optimized for the systematic study of stellar activity in M-dwarfs. The instrument is designed to operate at a spectral resolution of R ≈ 30,000 over a broad wavelength range of 450–920 nm, enabling simultaneous access to key activity diagnostics such as Hα, Ca II infrared triplet, He I, and molecular bands. In this talk, I will present the optical, opto-mechanical, and thermal design of the spectrograph, along with its expected performance and scientific capabilities. This instrument will serve as a dedicated facility for long-term monitoring of M-dwarf activity and as a pathfinder for future high-precision spectroscopic instruments.		

ASI2026_892	Kartik Mandar	Poster
Facilities, Technologies and Data science		
RRIvis: A GPU-Accelerated, Full-Polarization Visibility Simulator for Radio Interferometry		
Precision modelling of instrumental effects is critical for radio interferometry, particularly for 21cm cosmology and Epoch of Reionisation (EoR) experiments, where detecting faint signals requires rigorous foreground subtraction. We present RRIvis, a new open-source Python package designed to address the need for utmost accuracy and flexibility in simulating interferometric visibilities. Built on the RIME formalism, RRIvis provides a framework for modelling the full signal propagation chain. It implements a chain of Jones matrices, covering geometric delays, direction-dependent primary beams, ionospheric effects, polarization leakage, and complex gains. This allows researchers to simulate realistic instrumental systematics with the highest fidelity. A defining feature of RRIvis is its hardware-agnostic acceleration powered by JAX. This enables the code to run transparently on CPUs, NVIDIA/AMD GPUs, and Apple Silicon. The package prioritises usability, type-safe config, compatibility with standard data formats (such as CASA MS), and a modular design that allows users to implement custom Jones terms. We present validation results confirming its accuracy against established simulators and demonstrate its performance benchmarks, offering the community a tool for pipeline verification and experimental planning.		

ASI2026_954	Kaushal Buch	Poster
Facilities, Technologies and Data science		
Recent Developments in the Statistical Analysis and Automated Identification of Powerline RFI at uGMRT		
Radio Frequency Interference (RFI) from high-tension power lines is a significant challenge for the upgraded GMRT (uGMRT). A real-time RFI mitigation system has been developed and is routinely in use at the uGMRT. While this system is successful in mitigating the powerline interference in real-time using a statistical signal processing system,		

we are exploring techniques for further refinements to real-time RFI mitigation. For the next level of techniques, over the last few years, we have been investing efforts towards understanding the powerline RFI signal and its manifestation in the uGMRT receiver. Powerline RFI is a composite signal whose statistical properties vary based on the observing frequency, direction, time of day, season, and propagation effects, making it difficult to generalise its statistical properties. Hence, a large database of high time-resolution signals affected by powerline interference is being gathered to understand its properties. We describe the various components of the signal, their properties, and the variability across different recording runs.
Using this database, we developed a tool to explore and classify powerline RFI as individual RFI events, a 'bunch' of RFI events, or a collection of bunches. Primarily, the algorithm uses a combination of the first-order derivative of kurtosis and an adaptive thresholding technique based on the knee-point method. We show that the accuracy of identifying the bunches on the recorded uGMRT data is 0.8588, with balanced precision (0.8735) and recall (0.8572), resulting in an F1 score of 0.8584. The tool is further extended to explore Deep Learning (DL) using the Convolutional Neural Network (CNN) and feature vector extraction on the bunch-detected data. We are working on expanding the existing RFI database in terms of its size and variety, and also implementing a more comprehensive approach to building a wider and richer database for future algorithm development.

ASI2026_436	Km Nitu Rai	Poster
Facilities, Technologies and Data science		
From Radio to Optical: Extending India's Interferometric Legacy to Stellar Surface Imaging		

India has played a pioneering role in radio interferometry, with facilities such as the Ooty Radio Telescope (ORT) and the Giant Metrewave Radio Telescope (GMRT) delivering internationally competitive science, and with SKA India poised to extend high-angular-resolution radio astronomy to unprecedented scales. However, many fundamental stellar properties surface structure, rotation, limb darkening, and localized inhomogeneities, are most directly probed at optical and near-infrared wavelengths. Achieving comparable angular resolution in the optical remains a major challenge.
Conventional Michelson-type optical interferometers, including facilities such as CHARA, have demonstrated sub-milli-arc-second resolution using baselines of a few hundred meters. Yet extending these techniques to resolve finer stellar surface features faces significant technical and atmospheric limitations. An alternative approach is offered by Hanbury Brown Twiss (HBT) Interferometry, a photon-correlation technique that is inherently robust against atmospheric turbulence and optical path imperfections, and is well suited for ultra-long baselines.
In this talk, I outline a staged strategy toward optical intensity interferometry in India. As an intermediate and accessible step, Speckle Interferometry (SI) using existing CCD/CMOS detectors on modest optical telescopes can already deliver diffraction-limited information and serve as a testbed for high-resolution analysis techniques. Building on this foundation, I discuss the prospects for implementing optical Intensity Interferometry (II) using Cherenkov telescope arrays in India, enabling angular resolutions far beyond current optical interferometers for bright stellar targets.
By integrating speckle interferometry, intensity interferometry, and a distributed optical infrastructure, India has the opportunity to extend its interferometric legacy from radio to optical wavelengths and emerge as a major contributor to high-resolution stellar surface imaging.

ASI2026_696	Kumar Pranshu	Poster
Facilities, Technologies and Data science		
The Transient and Variable Sky over Devasthal: Results from the 4-m International Liquid Mirror Telescope transient survey		
The 4-m International Liquid Mirror Telescope (ILMT) is India's first optical survey telescope, enabling a systematic search for transient and variable sources. The PyLMT transient detection pipeline deployed for transient search, has been operating in near real-time, detecting transient and variable objects in the ILMT images. Using the image subtraction technique, ~3700 images have been analysed by the automated pipeline, generating around 23,000 transient alerts. Around 20,000 of the alerts correspond to known MPC asteroids, ~ 2000 correspond to variable stars (including eclipsing binaries, RR Lyrae, Delta Scuti, T-Tauri, etc), 25 correspond to cataclysmic variable eruptions, 22 supernova candidates (including six new discoveries), and several other interesting candidates. A concise overview of the detections and their significance has been presented, highlighting the survey's potential contributions to a broad class of scientific cases. Also, a Streamlit-based candidate exploration tool called DART has been developed, which enables visualisation and categorisation of detected sources using SIMBAD cross-matches and the pipeline-enabled automated classifications. The tool includes a cone-search feature and provides key metadata of detected candidates through a web application-based GUI, which will soon be publicly accessible.		

ASI2026_956	Maithilee Deshpande	Poster
Facilities, Technologies and Data science		
Design of a compact high-resolution spectrograph for spectroscopic arrays		
This research lays the groundwork for building the Replicated Spectroscopic Array, demonstrating that high-resolution spectroscopy can be achieved using compact, budget-friendly, and easily reproducible instruments for various astronomy projects. Building a cost-effective, compact, high-resolution spectrograph with radial velocity (RV) capabilities enables its use in arrayed telescope concepts and in long-term RV monitoring for exoplanet science cases. Such a facility can make a significant contribution to time-domain astronomy and exoplanet research, particularly in the follow-up of bright targets from TESS and the Vera Rubin Observatory. Our design process combined analytical calculations for the echelle grating and prism cross-disperser with thorough ray-tracing simulations in Zemax. This combination enables us to verify that our theoretical predictions are actually feasible with basic optical components. We developed a comprehensive theoretical model for the echelle grating and prism system, derived from the necessary design equations. The Zemax ray-tracing verification is used to verify several grating and prism design parameters, and it also enables the conclusion of the design configurations used for different grating and prism combinations. We also ensured that we found commercially available components that would meet our performance targets while keeping costs reasonable for building multiple copies. The spectrograph is in a double-pass configuration, providing significantly higher resolving power (R ~ 20,000-25,000) by allowing rays to traverse the cross-disperser twice. This level of performance is crucial for tasks such as accurately measuring radial velocities to detect exoplanets, tracking the changes in stars over time, and conducting large-scale spectroscopic surveys to study the history of our galaxy. The fiber-fed setup maintains stability and compactness, and the cross-dispersed echelle format optimizes the use of the detector. Because the design is scalable, we can build multiple identical units and create a network of distributed telescopes, all connected to affordable, compact echelle spectrographs.		

ASI2026_564	Narendra Nath Patra	Poster
Facilities, Technologies and Data science		
GARUDA: An automated radio data analysis pipeline for the GMRT		
Radio observations are essential for studying galaxy formation and evolution, yet analyzing low-frequency interferometric data is challenging due to radio frequency interference (RFI) contamination and other system issues.		

To streamline this process, we developed GARUDA, an automated pipeline for analyzing GMRT data, employing AI/ML-based algorithms for efficient RFI identification and artifact removal. GARUDA enables fast and consistent data reduction, handling ~10-12 GB GSB data in 20-30 minutes and ~400 GB GWB data in under three hours on standard servers. In this presentation, I will discuss GARUDA's capabilities and showcase results, including some of the deepest GMRT radio continuum images, HI emission in galaxies, and one of the most sensitive galactic HI absorption lines. I will also discuss the future of GARUDA and its extensions towards continuum and spectral-line imaging at work.

ASI2026_303	Narendra S	Poster
Facilities, Technologies and Data science		
PRATUSH - Radio Astronomy from the Farside of the Moon		
Two key events in the evolution of the Universe were the time when the first stars and galaxies formed, known as the Cosmic Dawn (CD), and the epoch over which baryonic matter transitioned from being mostly neutral to almost completely ionized, known as the Epoch of Reionisation (EoR). The 21-cm hyperfine transition of neutral hydrogen, with a rest frequency of 1420 MHz, is a powerful probe to study CD and EoR, with the global or monopole 21-cm signal tracing the average evolution of the gas, and the astrophysics and cosmology of CD and EoR. While the exact timeline is poorly understood, these events are expected to have occurred over cosmological redshifts of 30-6, mapping to redshifted 21-cm frequencies of ~ 40-200 MHz. Detecting this signal with high confidence continues to pose a significant challenge, since the signal is extremely weak with a maximum amplitude of less than 300 mK in brightness temperature and is buried in galactic and extragalactic foregrounds of 100 - 10,000 K. Probing ReionizATion of the Universe using Signal from Hydrogen (PRATUSH) is a proposed space-based radiometer that aims to detect this sky-averaged 21-cm signal from CD, operating in a frequency range of 55 - 110 MHz. Ground-based experiments are confronted with limitations caused by terrestrial radio frequency interference (RFI), ionosphere-induced chromaticity, and modified antenna response in the presence of objects on the horizon and associated terrains. PRATUSH seeks to operate in orbit around the moon, making scientific observations when in the lunar farside shielded from both Earth and the Sun, alleviating the significant challenges faced by ground-based experiments. In this talk, we will present scientific motivation to detect signals from CD/EoR and highlight some of the latest updates from the integrated laboratory concept model tests for receiver qualification, which reached a sensitivity of 12 mK.		

ASI2026_754	Nikitha Jithendran	Poster
Facilities, Technologies and Data science		
Development and Validation of a Modular Python Data-Reduction Pipeline for the PARAS-2 High-Resolution Spectrograph		
The PARAS-2 high-resolution fiber-fed spectrograph at the PRL Mt. Abu Observatory is designed to enable precision radial-velocity studies for exoplanet detection and stellar astrophysics. To support routine operations and reproducible science output, we have developed a comprehensive, modular Python-based data-reduction and radial-velocity extraction pipeline tailored to the instrument architecture and observing modes of PARAS-2. The pipeline implements an end-to-end processing framework incorporating bias calibration, order tracing, optimal and non-optimal spectral extraction, wavelength calibration, drift monitoring, and RV analysis. The architecture emphasizes transparency, logging, and configurability, enabling benchmarking against legacy IDL workflow and facilitating long-term instrument health tracking. During the Python migration, particular attention was devoted to ensuring numerical consistency with the IDL implementation — especially in data type propagation and implicit algebraic operations — which were systematically audited and standardized through cross-comparison diagnostics. Validation using commissioning and early-science datasets demonstrates consistent RV recovery with the earlier IDL pipeline, alongside improved automation, processing efficiency, and calibration repeatability. I will present the design philosophy, key algorithmic components, and performance assessment of the pipeline, which strengthens the data-analysis capability of PARAS-2 and contributes to an indigenous, maintainable software ecosystem for precision spectroscopy.		

ASI2026_294	Nitish Singh	Poster
Facilities, Technologies and Data science		
Optical Design of a Direct Fibre-Fed MOS with an α–β Fiber Positioner for the 2.34 m VBT		
We are designing the optical system of a direct fiber-fed, multi-object, medium-resolution spectrograph for the 2.34 m Vainu Bappu Telescope (VBT). The instrument will simultaneously accept light from 100 optical fibers positioned at the telescope's prime-focus focal plane, which provides a native f/3 beam. An in-house α–β fiber positioner system is being designed and fabricated to accurately place the fibers across the focal plane for efficient multi-object spectroscopy. Each fiber has a core diameter of 100 μm and feeds an f/3 beam directly into the spectrograph, eliminating the need for a traditional entrance slit and improving overall throughput. The spectrograph operates in two channels—blue (350–620 nm) and red (600–1000 nm)—to provide continuous wavelength coverage across the optical band. The design targets a resolving power of R ≈ 3000 in both channels. The expected image quality delivers a full width at half maximum (FWHM) of 2–3 pixels on the detector, where one pixel corresponds to 24 μm, ensuring adequate sampling and stable spectral performance across the full field.		

ASI2026_298	POORVA SINGH	Poster
Facilities, Technologies and Data science		
GONIOPOLARIMETRIC SIMULATIONS FOR SPACE WEATHER RADIO (SWARA) POLARIMETER		
The Space Weather RAdio (SWARA) Polarimeter is a new space payload that aims to perform remote sensing and localisation of radio signatures from geoeffective Coronal Mass Ejections (CMEs) and flares, which can provide early warnings of potential space weather events. The SWARA Polarimeter is being developed at IIT Kanpur in collaboration with the Physical Research Laboratory (PRL). The payload, which is planned to operate from 300 kHz to 30 MHz, will utilise deployable tri-axial antennas and in-situ calibration to improve the accuracy of the detected electric fields, and effectively use them for localisation, using Goniopolarimetry. Goniopolarimetry is a well-established technique for determining the Direction of Arrival (DoA) and polarisation properties of electromagnetic radio waves. Its principal advantage lies in the ability to extract three-dimensional propagation information without the need for large or mechanically steered antenna arrays. By combining phase differences and polarisation measurements, goniopolarimetry enables accurate localisation of radio sources under stringent constraints on mass, power, and deployment. This study aims to simulate goniopolarimetry for different antenna scenarios, which are then used to derive receiver requirements. We plan to derive a generic mathematical framework that will be applicable for different antenna geometries and compare various reconstruction techniques to determine the threshold SNR for localisation accuracies of around ~1 deg. We will also use this to motivate the antenna sizes and the need for in-situ calibration.		

ASI2026_442	Prajath B R	Poster
Facilities, Technologies and Data science		
Commissioning BURSTT FRB Outrigger at Gauribidanur Observatory		
Fast Radio Bursts (FRBs) are short millisecond long bursts of intense electromagnetic radiation that are observed in the radio band. Due to its transient nature, conventional radio telescopes are unable to accurately localise the bursts either due to their low Field of View (FoV) or poor angular resolution. Hence, the nature of their progenitors remains largely unknown. BURSTT (Bustling Universe Radio Survey Telescope in Taiwan) is an array of 256 LPDA (Log Periodic Dipole Array) antennas designed to operate in the frequency range of 300-800 MHz, that will detect and localise FRBs. The localisation is possible because of its outrigger stations situated thousands of kilometers away enabling Very Long Baseline Interferometry (VLBI), providing sub-arcsecond resolution. One such outrigger is coming up at Gauribidanur (GBD) Observatory and we have conducted initial tests of the outrigger system.		

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The LPDA antennas offer a large FoV compared to conventional radio telescopes, maximising the chances of detecting FRBs. GBD observatory currently consists of 16 such antennas, with planned expansion to 64 elements. The front end electronics for each antenna consists of Low Noise Amplifiers and bandpass filter assembly that amplifies the faint radio signals in the frequency band of interest. The amplified signals are fed into an RFSoC (Radio Frequency System-On-Chip) board that samples at a rate of 1600 MHz. A 4096 point FFT is performed by the RFSoC giving a time resolution of 2.56 μs, enough to resolve millisecond long bursts. Finally, the channelised signal is passed through 100 GB ethernet to a server where the data will be buffered.
In this talk, I present a brief overview of the system, its characterization, along with preliminary observations. I conclude with further upgrades and plans for conducting VLBI with the BURSTT outrigger station.

ASI2026_202	Prasad Neelam	Poster
Facilities, Technologies and Data science		
From Concept to Commissioning: Development of a Robotic DIMM for the Mount Abu Observatory		

Atmospheric turbulence plays a crucial role in limiting the performance of ground-based astronomical observations by inducing refractive index fluctuations that result in image distortion and blurring. Accurate and continuous characterization of these effects is essential for site evaluation and observatory operations. The Differential Image Motion Monitor (DIMM) is a well-established technique for quantifying atmospheric seeing by measuring the relative motion of stellar images formed through different sub-apertures of a telescope.
In this work, we present the end-to-end development of a fully robotic DIMM system designed and implemented at the Physical Research Laboratory for deployment at the Mount Abu Observatory in Rajasthan. The presentation covers the complete lifecycle of the instrument, beginning with the conceptual design and optical layout, followed by the development of mechanical, electronic, and control systems, and culminating in system integration, automation, and commissioning at the observatory site. Key design considerations for unattended operation, reliability, and long-term monitoring are discussed, along with initial performance results.
This robotic DIMM provides a robust platform for continuous atmospheric seeing measurements at Mount Abu, serving as an important tool for supporting current and future astronomical instrumentation at the site.

ASI2026_286	Prasanna Deshmukh	Poster
Facilities, Technologies and Data science		
Vibration Measurements on the 2-m Himalayan Chandra Telescope		

The HCT control system upgrade activity is currently underway at the Indian Institute of Astrophysics. As a part of this, a dedicated vibration measurement campaign was conducted on the 2-m Himalayan Chandra Telescope (HCT) in August 2025 using high-sensitivity accelerometers (ADXL355) and a custom-built, high-speed data logger. The accelerometer sensors were installed at structurally significant places on the telescope to capture broadband and transient disturbances caused by the structure, axis motion, wind loading, and other subsystems. By high-rate measurements, we were able to extract the vibration spectra, modal characteristics, coherence between structural components, and temporal evolution under tracking and slewing, which directly impact pointing stability and wave-front quality. The findings provide essential input for optimizing the HCT control system architecture and improving vibration rejection performance. The experiment has also validated the importance of incorporating these vibration sensors as a monitoring and diagnostics system with the HCT control system upgrade.

ASI2026_741	Praveen Kumar	Poster
Facilities, Technologies and Data science		
Development of a compact UV spectrograph for survey of Interstellar medium		

The ultraviolet (UV) spectrum is a rich domain in astrophysics, characterized by a greater density of absorption and emission lines than any other segment of the electromagnetic spectrum. However, due to significant absorption by the Earth's atmosphere, ground based UV observations are limited. Observations can only be made by going to space or near space environments. The goal is to design and develop a UV spectrograph and qualify it for space flight. The primary science objective is to study the physical conditions in extended regions of the sky. The proposed spectrograph would measure atomic and molecular lines in the UV region, covering the range from 1400 to 2700 Å. This band covers spectral lines from many phases of the ISM – the hot gas (for eg. C IV 1548/1550 Å) in supernova remnants (SNR) to the warm gas (N III, 1750 Å) in planetary nebulae. The Interstellar extinction bump at 2175 Å is also covered in this observing band. Given the current state of evolution and directions in the private space sector in India, small

payloads have better chances of obtaining a flight. We have been offered free launch and operations by space startups for small payloads. Based on these considerations and the primary science goals, the preliminary design target would be to fit the spectrograph into a 12U volume (200 x 200 x 300 mm) within a mass budget of 12 kg. A spectral resolution of 0.5 Å is required to separate spectral doublets like the C IV line. The detector will be a solar blind photon counting unit from photek (or equivalent). The science goals can be met within a mission life of about 2 years.

ASI2026_1128	Ramadevi M C	Poster
Facilities, Technologies and Data science		
Characterization of micropore optics for wide-field X-ray imaging spectrometer		

Micropore optics (MPO) offers compact, lightweight focusing for wide-field X-ray imaging and spectroscopy, with applications as X-ray sky monitors to detect transients. At the Space Astronomy Group of URSC, we are exploring MPO to build a wide-field X-ray monitor instrument. We characterize MPO imaging performance and present experimental results on point spread function (PSF), imaging capability, effective area, and their energy dependence in the 0.5–4 keV range. The experimental findings are validated through comparative simulations which incorporate non-ideal aspects such as specular scattering, non-monoenergetic incident radiation, and energy-dependent reflectivity to provide realistic predictions. The PSF is experimentally determined and compared with simulations, showing good agreement in spot size and shape. Focal length estimates from both simulations and experiments also agree well. Current efforts focus on off-axis behaviour, energy-dependent effective area of MPO, and refining simulations to support spectral performance studies. The combined experimental and simulation approach forms the basis for optimizing design and developing an MPO-based wide-field X-ray imaging spectrometer.

ASI2026_895	Ravinder Banyal	Poster
Facilities, Technologies and Data science		
SCALES at Keck: Instrument Overview and Indian Contribution		

Direct imaging and spectroscopy of exoplanets require instruments capable of suppressing stellar glare while capturing faint planetary emission at infrared wavelengths. SCALES (Slicer Combined with Array of Lenslets for Exoplanet Spectroscopy) is a next-generation, high-contrast instrument being developed for the Keck II 10-m telescope, optimized for diffraction-limited imaging and integral-field spectroscopy in the 2–5 μm range. By targeting the thermal emission of young and wide-orbit exoplanets, SCALES will enable detailed atmospheric characterization beyond the reach of existing near-infrared instruments.

SCALES uniquely combines a coronagraphic integral field spectrograph and imaging channel that employs both a lenslet array and an image slicer, offering complementary low- and medium-resolution spectroscopic modes. The instrument is fully cryogenic, with an all-reflective optical design to minimize thermal background and maximize sensitivity in the thermal infrared.

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The Indian Institute of Astrophysics (IIA) is a partner institute in the SCALES collaboration and has contributed several key hardware subsystems. These include the thermal-infrared imaging channel, pupil-mask rotator, and the filter-wheel assemblies for both the spectrograph and imager, all of which were designed, fabricated, and assembled at IIA to meet stringent cryogenic and opto-mechanical requirements. In this poster, I will present an overview of the SCALES with particular focus on the design, implementation, and integration of the IIA-developed subsystems, and their role in enabling SCALES' scientific capabilities.

ASI2026_568	Remya B S	Poster
Facilities, Technologies and Data science		
Sub-Aperture Interferometric Metrology for TMT Roundel Polishing: Qualification of Prototype Roundel at ITOFF		
The Thirty Meter Telescope (TMT) requires 492 primary mirror segments, each a 1.52-m diameter meniscus roundel polished to nanometer precision. Full-aperture interferometry is impractical for such large optics; therefore, accurate surface characterization relies on Sub-Aperture Station (SAS) metrology, where the polished roundel is measured in multiple overlapping 200-mm footprints and numerically stitched to reconstruct the full-aperture wavefront. This metrology capability is central in governing convergence, quality assurance, and final acceptance of TMT segments. We report the successful installation, calibration, and commissioning of the SAS interferometric metrology system at the India TMT Optics Fabrication Facility (ITOFF), CREST Campus, Hoskote. The system measures spatial frequency Bands 2 –5 via stitched sub-apertures and Band-6 through microscopic interferometric mode, covering spatial period from ~200 mm down to 0.8 mm. To obtain Band 2-5 results, data is captured over a 5x5 grid covering a ~500mm x 500mm area on one quadrant of the roundel. The 25 phase maps are stitched together to produce a composite phase map from which Band 2-5 results are extracted. Band 6 metrology (0.8 mm to 50 mm spatial scale) data is captured at 15 pre-identified locations with the 200 mm interferometric footprint on the roundel. The data is analysed using PSD software to extract Band 6 results. The Prototype roundel (SN003P), fully polished in ITOFF, was characterised using the complete SAS workflow. Stitched X+ quadrant results yielded Band-2-5 results, all within TMT specification. High-frequency Band-6, measurements across 15 gave an average value of ~2.0 nm RMS, demonstrating exceptional surface quality. This work marks the first successful TMT roundel metrology completion in India, establishing a fully independent measurement pipeline for production segments. Sub-aperture metrology is now operational, validated against TIO reference data, and forms a key capability for scaling future polishing throughput toward full telescope production.		

ASI2026_1041	SAMEER R BHARADWAJ	Poster
Facilities, Technologies and Data science		
Sources and Mitigation of Radio Frequency Interference at the Ooty Radio Telescope		
Radio Frequency Interference (RFI) poses a serious challenge to the operation of sensitive low-frequency radio telescopes. At the Ooty Radio Telescope (ORT), increasing levels of RFI have begun to significantly affect routine observations. This talk will present an overview of the major interference sources currently impacting ORT operations and the measures taken to curb them. Prominent among these are interference associated with cable television distribution networks, observed across the 50 MHz band centred at 326.5 MHz. Concerted efforts were made through negotiations with local cable TV distribution networks to clear the ORT band of any signals emanating from them. In addition, persistent impulsive broadband emissions originating from electric fencing systems in the surrounding region, occurring at nearly one-second intervals, contaminate the observations. Time–frequency analysis is used to characterize these RFI signatures and assess their impact on astronomical data quality. The study underscores the importance of systematic RFI monitoring and targeted mitigation efforts to sustain scientific observations at ORT. While these are the major sources of RFI at ORT, we have identified and mitigated several other RFI sources in due course. The talk will summarize all of these efforts made to clean the ORT spectrum for sensitive astronomical observations. Both the source identification and the mitigation efforts undertaken at Ooty can be leveraged by other existing and upcoming radio observatories in India.		

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ASI2026_858	Samruddhi Rohokale	Poster
Facilities, Technologies and Data science		
Early Development of the Multi-Feed Antenna and RF Front-End for ARUN-SSW		

Solar radio emission in the centimeter–decimeter bands carries crucial information about magnetic restructuring, plasma heating, and energetic particle acceleration in the chromosphere and low corona. To enable high-cadence monitoring of these processes, the ARUN-SSW initiative includes the development of an indigenous wideband antenna and RF front-end optimized for solar observations in the 1–18 GHz range. The front-end is intended to provide stable, low-noise analogue reception for both disk and limb imaging, addressing the scarcity of microwave solar facilities in the Asian sector.

The initial design focuses on an 11-feed antenna array mounted at the focal plane of the ARUN-SSW dish, enabling multi-directional sampling and improved instantaneous coverage needed for rapid solar snapshot imaging. Each feed element is supported by a dedicated RF chain incorporating band-selection filters, low-noise amplification suitable for integration with high-speed digital backends. Electromagnetic simulations are guiding the optimization of return loss, S-parameters, mutual coupling, and beam shape across the wide operating band. Prototype feed elements are currently being fabricated and evaluated to assess VSWR, inter-element isolation, and noise performance under strong solar signals.

These early front-end developments provide the essential analogue foundation for ARUN-SSW, ensuring that the system can reliably capture wideband solar radio signatures and support the next stages of digital signal processing and imaging.

ASI2026_257	Saurabh Sharma	Poster
Facilities, Technologies and Data science		
3.6m Devasthal Optical Telescope (DOT): Status and Future Directions		

The 3.6-m Devasthal Optical Telescope (DOT), equipped with active optics and located at Devasthal in Uttarakhand, hosts a suite of optical and near-infrared instruments including TANSPEC, TIRCAM2, the 4k Optical Imager, and ADFOSC. Since its commissioning in 2016, DOT has consistently delivered seeing-limited imaging and high-quality spectroscopic data across a wide range of astronomical studies; this presentation reviews its on-sky performance and scientific achievements and outlines future plans for next-generation instrumentation.

ASI2026_951	Savarimuthu P	Poster
Facilities, Technologies and Data science		
Radiometric Calibration of the VELC 5303 Å Channel on Aditya-L1		

We present an independent validation of the radiometric calibration of the Visible Emission Line Coronagraph (VELC) onboard Aditya-L1 for observations of the Fe XIV 5303 Å solar coronal emission line. Space solar coronagraphs generally use observations of stars for flux / intensity calibration. Compared to this, the primary flux calibration in VELC is carried out using measurements of the solar disk itself. The resulting detector response corresponds to a measured count of approximately (1.70±0.06)×108 counts s−1A˚−1, consistent with the expected solar flux at 5303 Å at 1 AU. To verify this calibration, deep-space observations of the bright star Sirius-A were analyzed. Based on its known spectral flux near 5303 Å, the expected detector count was estimated to be ~19±0.7 counts s−1A˚−1, which agrees well with the observed value of ~23±0.4 counts s−1A˚−1 obtained with VELC. This close agreement confirms the reliability of the solar disk based calibration method and supports the conversion of VELC coronal intensity measurements into absolute physical units. In addition, the Sirius-A observations were used to characterize the point spread function of the VELC 5303 Å channel. The observed full width at half maximum is 3.8” compared to the design value of 2.5”. These results demonstrate the robustness of the VELC calibration and its suitability for quantitative studies of the near-Sun corona.

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ASI2026_474	Shatanik Bhattacharya	Poster
Facilities, Technologies and Data science		
Accelerating Peak Bagging of red-giant oscillation spectra using Supervised and Reinforcement Learning		

Red-giants (RGs) exhibit mixed dipolar modes of oscillations, which are highly sensitive to the internal structure and dynamics of their cores – rendering them excellent astrophysical laboratories for probing physical phenomena like differential rotation, internal magnetic fields. Despite the availability of an extensive sample of RGs observed by the Kepler telescope—and the anticipated influx of additional data from missions such as TESS and the forthcoming PLATO—the full scientific exploitation of these datasets remains constrained by the conventional methods which require substantial computational time and resources for detailed analysis.

I will demonstrate how we leverage advanced machine learning techniques, including supervised learning methods (like convolutional neural networks, gaussian process optimization, etc.) and reinforcement learning, to automate and accelerate the process of peak bagging to the observed oscillation spectra of RGs without the need for explicit human intervention, smaller number of iterations and thereby smaller computation time.

ASI2026_219	Shivam Kumaran	Poster
Facilities, Technologies and Data science		
Sutra: A ML based framework for Interstellar medium filament identification and beam-level characterisation		

Filamentary structures in the interstellar medium (ISM) are essential to our understanding of how molecular clouds evolve and form stars. However, current methods for filament identification often require intensive manual parameter tuning or are computationally prohibitive for large-scale surveys. We introduce Sutra, a unified machine learning framework designed to automate the detection and physical characterization of these structures.

Sutra utilizes a U-Net convolution neural network architecture to provide a "parameter-free" identification process. The baseline model is trained on the union of outputs from existing tools (DisPerSE and GETSF), allowing it to detect a broader population of filaments, including faint, diffused structures often missed by traditional algorithms. The modular nature of Sutra allows us to incorporate other identification models, tuned across surveys such as HGBS, Hi-GAL, ATLASGAL as well as Position-Position-Velocity (PPV) data cubes.

From the identified skeleton map, the framework allows for both region wide filament properties characterization as well as detailed analysis of individual filament. To do this, radial profiles are extracted perpendicular to the local filament axis and then grouped into segments matching the given map's beam resolution. This beam-level approach is crucial for studying local variations in linear mass density, local contrast, width, and Plummer p-index along the filament's length, revealing intricate physical changes that occur as filament approaches hub systems or undergo fragmentation.

We will demonstrate the application of Sutra using Herschel and APEX Column density maps, as well as 3D PPV maps. We will showcase Sutra's ability to rapidly measure physical properties and provide a streamlined resource for research related to star formation.

ASI2026_739	SHUBHANGI JAIN	Poster
Facilities, Technologies and Data science		
FISAT :Far-Uv Imaging Satellite (A 4U UV imaging telescope)		

Despite the importance of far-ultraviolet (FUV) observations, relatively few FUV imaging missions are planned in the near future. Large and sensitive UV telescopes are often oversubscribed and are generally unsuitable for observing brighter regions of the sky. To address this gap, we are developing a small Far-Ultraviolet Imaging telescope to enable science cases that are not feasible with larger, more sensitive facilities.

The Far-Ultraviolet Imaging Satellite (FISAT) is a compact FUV telescope designed for daily monitoring of transient phenomena. It features an 80 mm Ritchey–Chrétien (RC) optical design, operating in the 130–180 nm wavelength

range with a 3° field of view, and can detect sources as faint as 19 AB magnitude in 1200 s exposures at a signal-to-noise ratio of 5. Its compact and lightweight design allows it to be flown on a CubeSat platform.
The planned 6–12 month survey will focus on detecting novae outbursts and other transient events. The Andromeda Galaxy (M31), with its high nova rate, is an ideal target for nova studies. Daily FUV monitoring of M31 will produce unprecedented light curves, providing key measurements of nova speed class, peak brightness, and short-lived UV flashes. Current UV surveys are limited in both depth and cadence; however, FISAT's capabilities, combined with complementary optical observations, will enable the discovery of new novae and continuous monitoring of known systems. Daily exposures reaching 19 AB magnitude increase the probability of capturing brief UV flashes that are rarely observed.
Beyond novae, FISAT may detect other transients, including core-collapse supernovae, thermonuclear supernovae, and fast blue optical transients (FBOTs). The mission will also include a Galactic plane survey, broadening its observational scope beyond M31. The small payload size and simplified design significantly reduce development time and overall mission cost. FISAT will be hosted by InterCosmos on an upcoming mission in late 2026 planned.

ASI2026_209	Tanmay Das	Poster
Facilities, Technologies and Data science		
Understanding the ionosphere above the GMRT using GNSS TEC data		

The Giant Metrewave Radio Telescope (GMRT) is located at lat: 19.10°N, long: 74.05°E, geographic; dip: 23°N magnetic. This region lies in the vicinity of the Equatorial Ionization Anomaly (EIA), a dominant low-latitude ionospheric feature which shows significant dynamics and has a considerable impact on trans-ionospheric radio signal propagation. These effects of ionospheric propagation are especially important at the metrewave part of the spectrum where the GMRT operates. Additionally, for linearly polarization studies, ionospheric Faraday rotation (FR) introduces a potentially significant contamination in the measured polarization signals. Global Navigation Satellite System (GNSS) based Total Electron Content (TEC) measurements have long been used in characterizing the ionosphere on a global scale. In this paper we explore the use of GNSS-TEC measurements for addressing the ionospheric challenges for the upgraded GMRT (uGMRT). The International Reference Ionosphere (IRI) empirical model, which has evolved and improved since the 1960s and is a vital resource for ionospheric characterization, has been used as a fiducial reference for this study. This study aims at understanding and quantifying the limitations imposed by the use of simple mapping functions routinely employed across the community to convert the slant-TEC (STEC) measured towards the lines-of-sight to the GNSS satellites to the TEC in the vertical column towards the local zenith, vertical-TEC (VTEC) in the GMRT sector. An effort has also been made to quantify systematic differences, if any, between the data derived from the IRI model and the GNSS datasets. Furthermore, investigation has been made to estimate the range of ionospheric FR contamination by employing these two datasets. The GNSS data used in these studies were obtained from two stations: one located at the uGMRT and the other at NCRA (lat: 18.55°N, long: 73.80°E, geographic; dip: 23°N magnetic), which is approximately 80 km South-East of the uGMRT.

ASI2026_479	Tarun Bangia	Poster
Facilities, Technologies and Data science		
Operational diagnostics and maintenance of hydrostatic bearing system of the 3.6m DOT		

Hydrostatic bearings are suitable for large-aperture optical telescopes due to their ability to sustain heavy loads while maintaining high stiffness and negligible wear. The rotating mass of approximately 125 tons around the azimuth axis of the 3.6m Devasthal Optical Telescope (DOT) is supported by a dual hydrostatic bearing system comprising axial and radial bearings. The axial hydrostatic bearing supports the vertical load of the telescope and consists of 24 pads arranged around the azimuth track. The radial hydrostatic bearing ensures high positioning stiffness of the rotor with respect to the fixed stator and consists of 6 pads that support the lateral motion of the azimuth structure.

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Minute oil leakages were observed during the operation of the 3.6 m Devasthal Optical Telescope at joints associated with few axial and radial oil flow controllers. As the radial oil flow controllers are located close to the azimuth encoder, oil leakage in this region sometimes affects telescope operations. A thorough inspection to identify minute oil leakages and repair or replace faulty joints and seals was undertaken for 3.6m DOT. The servicing work included disassembly of oil flow controller blocks, unmounting of pressure sensors, cleaning of components, along with replacement of O-rings and sealing washers. All the components were reassembled, and no oil leakage was observed during telescope operation. The pressure data was analysed for all axial and radial pads before and after servicing. The pressure variations during azimuth rotation were measured after maintenance to study its operating behaviour. The work presents systematic maintenance, and pressure-based diagnostics in maintaining the good health of the hydrostatic bearings for operational reliability.

ASI2026_766	TJayadev Ashok	Poster
Facilities, Technologies and Data science		
High Accuracy in-situ Antenna reflection coefficient measurement system for the SARAS experiment		
The primary objective of the SARAS (Shaped Antenna measurement of the background RAdio Spectrum) experiment is to detect the global sky-averaged 21 cm emissions from the epoch of reionization (EoR). The hyperfine spin-flip transition of neutral hydrogen produces photons of frequency 1.42 GHz. These photons are redshifted into the 40 to 200 MHz band and may be observed by specially designed radiometers. The signal presents itself as a spectral feature and its detection would provide insight into the physics of the early universe. However, the signal is several orders of magnitude weaker than foregrounds from galactic synchrotron emissions in the same band. Moreover, the band is also heavily contaminated by RFI (Radio Frequency Interference) making detection challenging. The SARAS antenna is designed to have spectrally smooth properties (Beam and Reflection Coefficient) to maximize signal discernability. However, at the levels of sensitivity desired, even slight variations in the system transfer function can hinder signal detection prospects. Hence to further enhance instrument sensitivity, an architecture for high accuracy, in-situ measurement of the antenna's reflection coefficient has been developed. The designed system features novel broadband noise injection, simultaneous measurement of injected and reflected waves to account for gain drifts, optical isolation between receiver and digitizer to avoid standing waves, and precision-load based calibration for characterizing the measurement system itself. A modular prototype system was built and tuned until a required sensitivity of 1 part in 10^5 was achieved. After validation of the architecture, the entire RF chain was miniaturized and integrated onto a PCB. This system was also tested and has achieved the desired level of sensitivity. In this talk I will be presenting the detailed architecture of this system and the results obtained so far.		

Posters in Education, Outreach and Heritage

ASI2026_1049	Amoghavarsha N	Poster
Education, Outreach and Heritage		
IIA COSMOS-Mysuru: Building Astronomy engagement ahead of a next-generation planetarium		

COSMOS-Mysuru is one of the world's first 8K resolution LED Dome planetaria being built by the Indian Institute of Astrophysics in the city of Mysuru. With relatively low prior astronomy activity in the region, a comprehensive education and outreach program was launched three years ago across Mysuru to establish an effective, long-term, district-wide program, catering to both the urban Mysuru city and the rural district. The broad aim was to build enough astronomy engagement in the region for the effective utilisation of the planetarium upon completion.

Following a stakeholder mapping across the district, a diversity of programs were initiated, and this talk will describe some of them, highlighting their contents and the target audiences. These include rural and urban schools, online and offline talks, students and teachers, technical and public talks, English and Kannada, etc. We established collaborations, built networks, and facilitated capacity building. Through more than 150 individual events that were organised over three years, more than 40,000 participants in diverse communities have been reached. Additionally, we host a successful radio program, featuring more than 60 episodes in both Kannada and English. We will discuss the impact of many of our programs and how our continued capacity building has changed the public and student perception of astronomy across the district.

With the impending inauguration of the planetarium, we are planning a transition from these programs to a more structured set of activities that will be based out of our campus, and the challenges of this transition will be highlighted. This includes more academic training workshops on data analysis that use the dome as a pedagogical tool. Lastly, we will also briefly share some technical details of the unique LED Dome planetarium, which will be of interest to the planetarium and outreach community at the meeting.

ASI2026_263	DOOT eMagazine	Poster
Education, Outreach and Heritage		
DOOT: A Student-Led magazine in a Rapidly Evolving Scientific World		

"DOOT", meaning messenger in Sanskrit: दूत [dūta], seeks to bring together diverse factions under one platform, truly embodying its name. In 2020, a group of young astronomers at the Indian Institute of Astrophysics (IIA), Bengaluru, embarked on a journey to bring the wonders of science to readers through a magazine. Our primary objective is to communicate intricate yet exciting developments in science, particularly astronomy, to the general audience, providing the IIA community with a platform to create awareness about the depth and complexities of astronomy and astrophysics. This initiative has grown remarkably, completing its fifth year with 11 issues and over 150 articles. To enhance accessibility and provide an immersive experience, we started the DOOT YouTube channel in 2024, featuring interviews with eminent scientists and outreach programmes. Additionally, we launched a students' podcast series, whose first episode aired in January 2025, involving interviews with senior PhD students who share their experiences and research at IIA. Keeping up with the digital era, we will adopt an additional online platform allowing continuous article submission and publishing throughout the year. The magazine brings forth contributions in the form of research-based review articles, creative works including art, poetry, and satire, interviews with renowned scientists, simplified scientific explanations, shared experiences from the IIA fraternity, career guidance from alumni, stories from field stations, and astrophotography. With a consistent and multifaceted approach, we strive to engage a wider audience and broaden the scope of our e-magazine.

ASI2026_339	Indrendra Sisodiya	Poster
Education, Outreach and Heritage		
Śaṅku Yantra to CCD Astronomy: Confluence of Planetarium & Observatory Driven Astronomy Educational Initiatives in the Ujjain		

Ujjain's prominence in Indian Astronomy dates back to antiquity. The Longitude of Ujjain(Ancient Indian Prime Meridian) served as the reference for timekeeping and calendrical computations. Extending this legacy, the Madhya Pradesh Council of Science and Technology has established an advanced Planetarium and an Observatory in Ujjain. This presentation outlines the recently upgraded Ujjain Planetarium, which is the first of its kind, a 3D-4K-projection with an 11.5-m Dome in Central India. Planetarium's public engagement at various levels, along with the ongoing National Council of Science & Museum collaborative projects on campus, like the upcoming Ujjain-Science Centre (proposed Ujjain-Science City), is discussed.

The Varahamihir Astronomical Observatory is located near Dongla village, 40km North of Ujjain, near the present Tropic of Cancer. Due to this geographically significant location, the Observatory annually hosts its Zero-Shadow-Day outreach celebrations at the Summer-Solstice. The Observatory incorporates a 0.5-meter Optical Telescope, large-format AltaU-9000-CCD and filters for UVBRI-photometry measurements. This poster elaborates on the introductory research-oriented outreach photometric observations(target object:M-42) and engagement activities. Adjacent to the Observatory are latitude-longitude-adjusted models of the classical Ujjain-Jantar Mantar instruments: Śaṅku, Bhitti-Yantra, etc. This Śaṅku-Yantra's cruciality in astronomy education at the Observatory's annual Summer-Winter Solstice outreach events is also discussed here. Pedagogical methodology and results for the determination of Solar Altitude, Observer's Latitude, and the Local Meridian using this Śaṅku-Yantra(Height=30.039inches) during the Winter-Solstice 2025(Solar Noon~12:25PM) outreach at Varāhamihira Observatory are presented within 0.2 degrees of the true altitude value. Thereby, demonstrating a hands-on integration of classical observational methods with positional astronomy education. Finally, this poster expands on the potential role of these facilities by academic research institutions for postgraduate training and the promotion of astronomy education in various capacities around Central India.

ASI2026_66	SHUBHA BS	Poster
Education, Outreach and Heritage		
Visualizing the diagrams in Astronomy manuscripts		

Diagrams played a fundamental role in explaining and visualizing celestial phenomena in astronomical texts. Almost every treatise included a dedicated chapter titled Parilekhana, which laid down systematic procedures for the construction and use of such diagrams. These visual aids were not merely illustrative but served as essential tools for conveying observational perspectives and computational reasoning. This talk presents selected examples from different manuscript traditions to demonstrate the diverse diagrammatic techniques employed by astronomers. The diagrams clearly bring out the perceptual and directional distinctions associated with the east–west axis, which are required for accurate astronomical interpretation of eclipses. In addition, the section on Śṛṅgonnati, concerned with representing the orientation and inclination of the lunar cusps, integrates specialized diagrams that further elucidate the observational framework underlying lunar phenomena.

ASI2026_899	Sibsankar Palit	Poster
Education, Outreach and Heritage		
The Beyonder's Newsletter: Democratizing Astronomy through Space Journalism		
The universe captivates human curiosity, yet access to curated, authoritative learning resources and career pathways in astronomy remains fragmented. The Beyonder's Newsletter, launched by the LIFE-To & Beyond Foundation® under The Beyonder's Initiative, addresses this gap through a peer-reviewed monthly publication synthesising current developments in astronomy, space exploration, and STEAM education. Each issue delivers multifaceted content peer-reviewed blogs, videos, and stories covering cutting-edge astronomical discoveries, rocket launches, scientific missions, and emerging research, while systematically debunking space-related misconceptions. The newsletter distinguishes itself through three pillars: educational and career pathways connecting readers to opportunities in space fields; myth deconstruction addressing astronomy misconceptions; and community recognition celebrating scientists, educators, and organisations advancing STEAM initiatives. A signature feature, "The Beyonder of the Month" profile spotlights transformative career narratives of space professionals and changemakers, humanising pathways to scientific excellence. Complementing editorial content, subscribers receive curated summaries of the Foundation's latest activities and opportunities, creating a dynamic bridge between the astronomy outreach community and the broader space ecosystem. Since its inception two years ago, the newsletter has published 25+ issues on LinkedIn, cultivating 1,700+ active subscribers with sustained engagement. The publication commits to accessibility and inclusivity through jargon-free, open-access content authored by contributors spanning career stages from established experts to emerging voices, ensuring astronomy remains intellectually accessible and relevant to diverse audiences worldwide.		

ASI2026_1076	Team INDUS	Poster
Education, Outreach and Heritage		
The Indian Network for Dynamical and Unified Solar Physicists (INDUS)		
The Indian Network for Dynamical and Unified Solar Physicists (INDUS) is a growing international community of Indian researchers working in solar and heliophysics. The network aims to improve our understanding of the Sun and its influence on the heliosphere. INDUS was formally launched on 15 August 2023 with the goal of connecting early-career scientists and strengthening collaboration across institutions, disciplines, and countries. INDUS provides a common platform for PhD researchers, postdoctoral fellows, and young faculty involved in observational, theoretical, and computational studies of the Sun. The network supports communication and knowledge sharing through regular scientific seminars, mentorship activities, and outreach efforts. INDUS also publishes a free, member-led newsletter that shares recent research highlights, opportunities, and educational resources. In addition, a recently introduced podcast series features discussions with experienced scientists on current research topics, space missions, and career development in solar and heliophysics. With more than 300 members from institutions in over 20 countries, INDUS has become an active forum for collaboration and interdisciplinary research in solar physics. As an important step forward, INDUS will organize its first scientific meeting, the INDUS Symposium on Heliophysics Advancements (ISHA), to encourage focused scientific discussions and strengthen community interaction. Through these activities, INDUS aims to support early-career researchers and contribute to a unified understanding of dynamic solar processes and their heliophysical effects.		

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ASI2026_1038	Vikranth Pulamathi	Poster
Education, Outreach and Heritage		
The Three-Pronged Approach: IIA's Student Engagement Strategy		

The Indian Institute of Astrophysics engages with school students in the country in a number of ways, and in this talk, three particular strategies will be highlighted, along with their strengths and challenges.

The key engagement is in-person, and this takes the form of both one-off group visits to our various campuses (typically 15,000 students visit us every year) as well as more structured programs. The latter primarily takes the form of the novel 2-week-long annual Research Experience for School Students (RESS) School, as well as the continuously running Job Shadowing program. It also includes our recent mentoring efforts at starting astronomy clubs in schools and special programs in schools near our remote field stations.

The second framework is through special campaigns, whereby students are engaged in talks and hands-on activities, e.g. the recent extensive campaign on the 7 Sept total lunar eclipse, or the annual Zero Shadow Day or Asteroid Day programs. The eclipse campaign bears special mention, reaching every single school in Tamil Nadu, and will be described in some detail. Teacher Training is another key component, and we will describe some of our efforts in this context.

The third method is through online interactions, which reach students across the country. We will discuss our #SkySCOPE campaign aimed at disseminating accurate information on astronomical events, as well as other online engagement avenues. We will also describe our efforts in creating some of these resources in multiple languages.

In summary, we will describe IIA's school engagement programs, by its SCOPE section and at its field stations, and discuss our learnings and our future plans.