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ABSTRACT BOOK

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16th February 2025
Plenary Session I
[Chairperson: G. C. Anupama]
[Time: 11:40 – 13:00]

ASI2025_761	Rajeshwari Dutta	Invited
Plenary		
Probing the invisible cloak of gas around galaxies - the Circumgalactic Medium		
The stellar discs of galaxies have been studied extensively for many years, however they represent only the tip of the iceberg. First proposed by astronomers in 1969, it is now well-established that all galaxies are embedded in diffuse gaseous haloes known as the Circumgalactic Medium (CGM). Over the last few decades, significant effort has gone into detecting and characterizing the properties of these diffuse haloes. Lying at the interface between a galaxy and its wider environment, the CGM modulates not only the accretion and ejection of material in the galaxy, but also the interaction of the galaxy with the larger-scale environment. Moreover, the CGM is a major reservoir of baryons in the Universe, and plays a key role in the star formation and evolution of galaxies. Therefore, in order to fully understand the physical processes at work within galaxies, it is crucial to have a robust understanding of the gaseous haloes surrounding them. But how do we probe this diffuse gas? How is it distributed around galaxies? What do we know about the nature of this gas so far? How are the properties of the CGM connected with that of the galaxies and the environment? This talk will address these questions, and present the results from recent works in this exciting field in astronomy.		

ASI2025_763	Shasvath Kapadia	Invited
Plenary		
Rates of gravitational-wave sources and properties of their associated GRB counterparts		
The synergy of Gravitational-Wave (GW) astronomy with electromagnetic (EM) astronomy promises to answer longstanding questions in astronomy and astrophysics. This talk will provide an interesting and important example involving Gamma-Ray Burst (GRB) counterparts to compact binary coalescences (CBCs). It is known that some, if not all, binary neutron star (BNS) coalescences, and a fraction of neutron - star black hole (NSBH) mergers, produce sufficient mass-ejection to power GRBs. However, this fraction, as well as the distribution of beaming angles of BNS-associated GRBs, are poorly constrained from observation. I will show how, by combining observations of gravitational-waves (GWs) and Gamma-Ray Bursts (GRBs), we can constrain the properties of these CBC associated GRBs. I will first overview how the rate of BNSs and NSBHs can be evaluated from LIGO-Virgo-Kagra (LVK) data. I will then show how Fermi/Swift data, that is post-processed and segregated into BNS- and NSBH- clusters with Machine Learning, can be used to estimate the rate of BNS/NSBH associated GRBs. By comparing the GW rates with the GRB rates, I will demonstrate how we can place constraints on the properties of GRB counterparts to CBCs, viz. the beaming angles of BNS-associated GRBs, and the fraction of NSBHs that produce GRBs. I will conclude by pointing out the caveats of our method.		

16th February 2025
Parallel Session - Sun, Solar System, Exoplanets, and Astrobiology I
[Chairperson: S. P. Rajaguru]
[Time: 14:00 – 15:45]

ASI2025_116	Srinjana Routh	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
On the possibility of using Polar Filaments as precursors to understanding the solar cycle using historical data.		
The long-term evolution of solar filaments is closely related to the large-scale solar cycle, with their parameters tracing the solar surface magnetic fields and have been long thought to contribute to the polar fields of the next cycle. In this study, we utilize adaptive intensity thresholding algorithm on the archival carrington maps from Meudon observatory and Mcintosh archive encompassing cycles 16 to 23 to extract polar filaments and their parameters, length and area, to see if polar filaments can be identified as precursors to the succeeding cycle strength. Our study suggests that the polar filament area is a possibly better parameter as a candidate for a precursor to the polar field and hence, the next solar cycle.		

ASI2025_342	Puja Majee	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Unveiling the Coronal Condition for Generation of Type-II Solar Radio Bursts through MHD Simulations and Radio Imaging		
Metric type-II solar radio bursts are plasma emissions, mostly associated with CME-driven shocks, and hence can be used as remote probes for the kinematics and dynamics of the CMEs at lower coronal heights. Association with the potent driver of the space weather, CMEs, makes these radio emissions very interesting from the perspective of space weather. However, not every CME gives rise to these emissions. While the spectroscopic imaging studies of type-IIs are rare, almost all have revealed that the type-II sources are localized on the extended shock front. This implies that certain conditions need to be satisfied to generate these plasma emissions. To explore this aspect, high-fidelity radio image-based information along with EUV, whitelight observations, and coronal density models are essential. While only a few studies have been done regarding this aspect, a majority of them conclude that for the generation of a type-II emission, the shock needs to be supercritical and the shock geometry needs to be quasi-perpendicular, i.e. the angle between the shock normal and the upstream magnetic field should exceed 45o. To verify this, we have carried out a detailed comparison between high-fidelity radio images from the precursor of the low-frequency telescope of the Square Kilometre Array Observatory, the Murchison Widefield Array (MWA) with the simulations from a physics-based, data-driven self-consistent MHD model, Alfven Wave Solar-atmosphere Model (AWSoM) within the Space Weather Modeling Framework (SWMF). The detailed plasma parameters provided by AWSoM allow us to identify expected source regions where the shock is supercritical and has a quasi-perpendicular geometry, along with the local plasma frequency. These two excellent tools thus provide all of the ingredients needed for comparing observations against expectations. This presentation will summarize the results of this effort and mark interesting progress toward understanding the conditions for generating type II radio emissions.		

ASI2025_418	Sushree Sangeeta Nayak	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
flare ribbon dynamics using MHD simulation		
We have studied the properties of magnetic reconnection through flare ribbons dynamics using observations and data-constrained magnetohydrodynamics (MHD) simulation. We have estimated the reconnection flux and reconnection flux rates using flare ribbons observed in 1600 channel in Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamics Observatory (SDO) of an M1.1 flare hosted by the active region 12184 on May 23, 2021 utilizing the technique developed by Qiu et al 2006. We find the reconnection flux and corresponding flux rates to be 10^{20} Mx and flux rate 10^{18} Mx/s respectively. To understand the origin of flare ribbons, we have performed an MHD simulation initiated by the non-force-free-field extrapolated field. Importantly, we have identified a three-dimensional (3D) magnetic neutral point and a flux rope in the flaring region, which are crucial to the flaring activity. The reconnection initiates at the null point. Later, the flux rope appears to reconnect at the null, which is favorable for the eruption of the filament. We trace the footpoint evolution of the field lines lying over the flare ribbons and find a significant matching between the observed flare ribbons and the evolution of footpoints computed from the MHD simulation. From the simulation, we have calculated the reconnection flux and flux rates using the pixels under these footpoints and found one order higher in comparison to their observed values. Interesting is also the enhancement of vertical current density near the flaring ribbons, a signature of successive reconnections near the null point. This is again completed by the presence of high squashing factor in the vicinity of ribbons indicating slipping reconnections of the fan field lines of the null skeleton over the ribbons. The findings from the simulation contribute toward the understandings of ribbon formation in a flaring process as well as involved magnetic reconnection.		

ASI2025_623	Samriddhi Sankar Maity	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Reconnection Flux Evolution in Erupting Magnetic Flux Ropes - perspectives from Observations and MHD Simulations		
Coronal mass ejections (CMEs) are major space weather drivers, with magnetic flux ropes (MFRs) widely recognized as their primary precursors. Yet, the evolution of reconnection flux during MFR eruption remains inadequately understood. In this study, we develop a 3D magnetohydrodynamic (MHD) model to investigate the temporal evolution of reconnection flux in erupting MFRs, using both simulations and observational data. Our initial setup includes an isothermal coronal atmosphere and a potential arcade magnetic field, with an emerging MFR introduced at the lower boundary. As the MFR ascends, it stretches and compresses the overlying magnetic field, leading to the gradual formation of a current sheet and ultimately to the impulsive ejection of the flux rope. We examine the reconnection flux evolution over two consecutive MFR eruptions while continuously emerging a twisted flux rope at the lower boundary. Additionally, we analyze a similar eruptive event using observational data from the Helioseismic and Magnetic Imager (HMI) and Atmospheric Imaging Assembly (AIA). By comparing our MHD simulations with observations, we find that reconnection flux plays a key role in determining CME speeds, with a strong linear correlation between reconnection flux and MFR velocity from initiation to eruption. This simulation provides valuable insights into the complex dynamics of CME initiation and evolution.		

ASI2025_651	Tariq Ahmad Mir	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Significant first digit distribution of Coronal Mass Ejections characteristics		
Benford's Law (BL) is an interesting empirical phenomenon that describes how the first significant digits (FSDs) of many real-world datasets are distributed. Specifically, it states that in a wide range of data, smaller digits—like 1, 2, and 3—appear as the FSDs much more frequently than larger digits, such as 7, 8, and 9. Massive data collected from the observation of different astrophysical phenomena can provide new testing grounds for the ubiquity of this law. In this investigation, we systematically analyze the distribution of FSDs for various characteristics of Coronal Mass Ejections (CMEs) to assess the relevance of BL. The parameters examined include width, mass, acceleration, momentum, force, and kinetic energy, all of which conform to the expected FSD distribution as prescribed by BL. In contrast, the central position angle, measurement position angle, and speeds of the CMEs exhibit significant deviations from this law. These results indicate that while certain CME characteristics adhere to the principles of BL, others reveal substantial departures, thereby revealing the intricate complexities inherent in the numerical distributions of astrophysical phenomena. The deviations observed in above parameters may indicate complexities in the physical mechanisms at play, such as variations in solar magnetic field interactions or differences in the spatial and temporal dynamics of CMEs. By further exploring these discrepancies, we can gain deeper insights into the intricate processes that drive solar activity.		

ASI2025_632	Soham Dey	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Polarization Characteristics of Active Solar Radio Emissions: Insights from SKAO Pathfinders and Precursors		
Solar radio bursts are among the most widely studied phenomena originating in the solar corona, and offer valuable insights into the coronal medium. Their polarization characteristics serve as tracers of coronal magnetic fields for which a direct measure has been, traditionally, very challenging . Despite their potential, the study of solar emissions at low radio frequencies has been constrained by both instrumental limitations and the lack of suitable imaging techniques. As a result, much of the existing research has focused on analyzing dynamic spectra, which, while informative, do not provide any spatial information needed to fully explore the complex behavior of these emissions. The advent of next-generation radio telescopes, such as the Murchison Widefield Array (MWA), LOw Frequency ARray (LOFAR), and the upgraded Giant Metrewave Radio Telescope (uGMRT) — all precursors or pathfinders for the Square Kilometer Array Observatory (SKAO) — marks a significant shift in solar radio astronomy. These instruments, combined with advancements in calibration and imaging techniques, now enable high-fidelity, full-polarimetric imaging of solar radio bursts, offering new opportunities to study the dynamic emission processes with high temporal and spectral resolution in the image plane. In this work, we present recent results from polarization imaging of active solar radio emissions using MWA, LOFAR, and uGMRT. Our findings reveal that these emissions are predominantly circularly polarized, with polarization fractions that vary significantly and remain consistently lower than the theoretical expectations. Notably, we observe that the peaks of the polarized emission sources are often separated by several arcseconds to arcminutes from that for the total intensity sources, and that the polarized emission regions are always more compact than the corresponding total intensity source. This suggests that scattering effects may play a significant role in reducing the observed polarization. We will discuss these results and explore their implications		

ASI2025_44	Dibya Kirti Mishra	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Automatic Detection of Plages using Hand-drawn Suncharts from Kodaikanal Solar Observatory Employing Machine Learning Technique		
The Kodaikanal Solar Observatory (KoSO), one of the oldest solar observatories, possesses hand-drawn suncharts that depict various solar features such as plages, filaments, sunspots, and prominences, each marked with distinct colors. These suncharts are valuable for addressing the data gap in the Ca II K dataset of KoSO from 1980 to 2007, which resulted from plate damage and changes in observational conditions after 1980, leading to a decline in data quality. However, hand-drawn suncharts, available since 1904, provide detailed representations of solar features on Stonyhurst grids. These charts will help fill gaps in the Ca II K data and contribute to the reconstruction of pseudomagnetograms by integrating information on plages and filaments. Currently, we have 6k x 6k scanned images of these suncharts, and we have applied a CNN-based machine learning model to calculate the center, radius, and P-angle from 1904 to 2007. To train the CNN model for identifying plages on the suncharts, we created a training dataset by detecting plages in Ca II K images. This approach will enhance the automatic identification of solar features and assist in analysing historical solar data.		

16th February 2025
Parallel Session - Stars, Interstellar Medium, and Astrochemistry in Milky Way I
[Chairperson: Himadri Sekhar Das]
[Time: 14:00 – 15:45]

ASI2025_113	Amit Pathak	Invited Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Spectroscopy of Interstellar Polycyclic Aromatic Hydrocarbons (I)		
Polycyclic Aromatic Hydrocarbons (PAHs) are an important and ubiquitous constituent of the interstellar medium (ISM) whose signature is seen in a wide variety of environments. Strong emission features at 3.3, 6.2, 7.7, 8.6 and 11.2 μm along with several weak features arising from PAHs have been extensively observed [1]. Recent detection of small cyano-PAHs has confirmed the presence of these molecules [2]. The presence of an associated molecule, fullerene cation, in the ISM has also been confirmed [3]. It should be noted that PAHs are also pervasive in terrestrial conditions. In this talk I will review the observational, laboratory and theoretical studies dedicated to PAHs and how our perspective in understanding these molecules has evolved. I will discuss the signature (spectral) characteristics of interstellar PAHs and variations observed in the spectra. The reasons for these variations will be elaborated based on laboratory and theoretical spectroscopic studies. Recent results from our group will also be presented. References 1. Tielens A.G.G.M., 2008, ARA&A, 46, 289 2. McGuire et al., 2021, Science, 371, 1265 3. Campbell et al., 2015, Nature, 523, 322		

ASI2025_263	Namrata Rani	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Formation of Thioacetaldehyde and Dithiol in the Interstellar Medium: Mechanisms and Binding Energy Analysis		
The chemistry behind sulfur depletion in cold, dense molecular clouds remains poorly understood, with a significant discrepancy between elemental sulfur abundance and detected molecular species in the interstellar medium (ISM). In this study, we explore the formation of thioacetaldehyde—the sulfur analogue of acetaldehyde—through both gas-phase reactions and surface-mediated processes on amorphous solid water (ASW) ice grains. Using high level quantum-chemical methods and the Binding Energy Evaluation Platform (BEEP), we identify favourable reaction sites on ASW, with thioethanol acting as a precursor. Interestingly, our computations revealed an unplanned but thermodynamically more stable by-product, dithiol, alongside the formation of thioacetaldehyde. While thioacetaldehyde is favorable both kinetically and thermodynamically, the unexpected formation of ethane-di-thiol highlights the potential for multiple sulfur-containing species to coexist under ISM conditions. To predict where these molecules might reside, we conduct binding energy calculations to determine their distribution across different snowlines. To gain deeper insights, we also compare the binding energies of thioacetaldehyde and precursor thioethanol with their oxygen analogues, such as acetaldehyde and ethanol. This comparison helps us understand the differences in adsorption behavior and chemical stability between oxygen- and sulfur-bearing molecules on dust grains. The binding energy data suggest that the molecular adsorption strength may vary across snowline regions, potentially leading to the segregation or co-location of sulfur and oxygen analogues on interstellar dust grains. These findings contribute to the understanding of complex sulfur reservoirs in the ISM, proposing a new chemical network for sulfur-bearing organic molecules. Additionally, the potential future detection of both thioacetaldehyde and dithiol, much like acetaldehyde, would provide further evidence of sulfur's incorporation into complex molecular structures, bridging the gap between elemental sulfur and observed molecular forms in space.		

ASI2025_391	Shivam Kumaran	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Segmentation and deblending of filaments and dense cores in the Interstellar medium using CNN and explainable-AI.		
The cold matter in the interstellar medium resides within complex filamentary structures. Submillimetre/Far-infrared observations reveal close association of filaments with dense-cores in star-forming regions, supporting the theory of filament fragmentation to form pre-stellar cores. Intersection of the filaments forms hub-filament systems acting as the origin of high-mass star formation. Large scale identification and characterisation of ISM filaments is essential to establish the link between diffused ISM and the stellar initial mass function. In this work we aim to generate a comprehensive catalogue of filaments and the embedded dense-cores. We develop CNN based model which utilizes parallel architecture for simultaneous extraction of filaments and dense-cores, requiring no manual parameter tuning. The filament identification branch is a derivative of U-Net model and is trained using DisPerSE filaments on Herschel Gould Belt Survey column density maps. It is necessary to deblend dense-cores from filaments as their sharp extremas create breaks in otherwise continuous filament skeleton. Additionally, the blended nature of cores with no clear boundary, makes segmentation based supervised learning difficult. To overcome this, We investigate the use of R-CNN and Grad-CAM based explainable-AI for dense-cores segmentation. A binary classifier is trained on HGBS dense-cores catalogue, to predict the probability of input region containing a source, achieving a validation accuracy of >84%. Grad-CAM is used to generate segmentation map from the classifier predictions. We extract filaments-skeleton and dense-cores for Herschel's HGBS and HOBYS surveys. The radial density profile of model-extracted and DisPerSE filaments have a similar distribution in lower dimension principle-component space. We aim to make the model robust and instrument-agnostic in order to generate filament skeleton map on various galactic -plane surveys in order to create an exhaustive catalogue of hub-filament systems.		

ASI2025_462	Atanu Koley	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
ALMA-IMF XXX: C18O (J = 2−1): Measurements of turbulence in 15 massive protoclusters		
ALIMA-IMF is a large program of the Atacama Large Millimeter/submillimeter Array (ALMA) that aims to determine the origin of the core mass function (CMF) of fifteen massive Galactic protoclusters (∼ 1.0 − 25.0 × 10^3 M⊙, estimated from the dust continuum emission) located towards the Galactic plane. In addition, the objective of the program is to obtain a thorough understanding of their entire physical and kinematic properties. Here we study the turbulence in the protoclusters with C18O (2−1) line using sonic Mach number (M_s) analysis and linewidth-size relation. The probability distribution function (PDF) of the sonic Mach number (M_s) for all of these regions exhibits a similar pattern, peaking between ∼ 4 and ∼ 7 and then extending up to ∼ 30. Values of the sonic Mach numbers (M_s) indicate that turbulence within the protoclusters is supersonic in nature. We also compare the non-thermal velocity dispersions (σ_nth) obtained from the C18O (2−1) line with the non-thermal line widths (σ_nth) of the cores obtained from the DCN (3−2) line and observe that on average, the non-thermal line widths (σnth) of the cores are approximately half compared to the non-thermal line widths (σ_nth) obtained from the C18O (2−1) lines. This suggests that supersonic turbulence dissipates towards the cores, which are on the verge of star formation. In addition, the linewidth-size relation from the C18O (2−1) line is also examined after extracting the structures from the position-position-velocity (PPV) cube analysis. A relatively large number of structures have been obtained in the evolved protoclusters compared to the young and intermediate protoclusters. This suggests a complex dynamic inside the protoclusters, especially when H ii regions may have a significant impact on the surrounding environment. Moreover, the power-law index (p) obtained from the linewidth-size relation is around 0.50, which is steeper than the Kolmogorov law of turbulence and is expected for compressible media.		

ASI2025_318	Shridharan Baskaran	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A New Look at Protoplanetary Disk Accretion: Mid-Infrared HI Line Analysis from JWST-MIRI		
The balance between accretion and ejection of material in protoplanetary disks regulates the mass reservoir available for planet formation. Traditionally, optical and near-infrared (NIR) HI lines, such as Hα, Paβ, and Brγ, have been used to estimate accretion in young stellar objects (YSOs). However, these lines suffer from opacity effects to varying degrees and may originate from different regions, such as winds and jets, complicating their use as reliable accretion indicators. Higher-order HI lines with Nup > 6, originating from dense regions in magnetospheric accretion columns, offer a more reliable alternative. We undertake a large, homogeneous analysis of over 80 JWST/MIRI archival spectra of Class II disks, focusing on HI (Nup = 6–14) emission lines in the MIR range, taking advantage of MIRI's high sensitivity and broad wavelength coverage (5–28 μm). We present our detections of MIR HI lines and identify lines that can serve as accretion indicators. The MIR spectra of Class II disks are also known to be rich in molecular features. We discuss the molecular contamination affecting each HI line and remove their contributions by LTE modeling of the molecular features. We provide calibrated empirical relations to convert MIR HI line luminosities into mass accretion rates, improving upon available optical/NIR proxies. This enables the community to estimate accretion rates directly from JWST/MIRI spectra. Additionally, we compare observed HI line ratios with theoretical models by Kwan & Fischer (2011) to estimate accretion column densities more accurately, extending upon previous studies using Balmer and Paschen series lines. Finally, we explore the correlation between HI lines and fine-structure lines, such as [NeII], [FeII] and [ArII], which trace photoevaporation from the inner disk, allowing for simultaneous measurements of accretion and disk dispersal in Class II disks.		

ASI2025_471	Gautam Das	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Introducing Time Evolution into a Parameterised YSO Accretion Disk Model and Predicting Changes in Observational Signatures		
During star formation, young stars have been observed to be quite dynamic, often associated with accretion disks and termed Young Stellar Objects (YSOs). FUOrs are a class of YSOs characterized by a rise in lightcurve brightness by a few orders of magnitude, followed by fading in decadal to century time scales. When we look at the lightcurves of FUOrs during their outburst epoch, we find that lightcurve profiles are quite different for each star. Thus, modelling the lightcurves of these objects is crucial to understanding how different components of these systems evolve during outbursts. We use a simple parameterized model called YSOpy which couples passively irradiated dust disk, viscously heated gas disk, stellar photosphere and magnetospheric accretion funnel emissions. We develop a pipeline that tracks how various parameters of these emission components couple and evolve to generate the observed lightcurves in optical and near-infrared bands. We use this pipeline for FUOrs like GAIA 17bpi, V960 Mon and HBC 722 to see how observational signatures change with time. This provides important insights into the disk-magnetospheric interactions throughout the cycle by enabling us to predict which parts of the model can be best observed at each point of the outburst cycle. We find that these stars can take very different evolutionary pathways during their transition from low to high state in an outbursting epoch.		

16th February 2025
Parallel Session - High Energy Phenomena, Fundamental Physics and Astronomy I
[Chairperson: Shasvath Kapadia]
[Time: 14:00 – 15:45]

ASI2025_57	Yogesh Maan	Invited Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Origin and Environment of Fast Radio Bursts (I)		
Fast radio bursts (FRBs) are one of the most intriguing discoveries in the transient radio universe happened in the last two decades. FRBs are observed as short, a few milliseconds wide, radio bursts with typical fluences of the order of a few Jy ms. However, their cosmological distances imply that these short-lived events radiate enormous amount of energy, and the exact mechanism and origin of such energy release is still an active topic of research. To date many hundreds of FRBs have been reported to be discovered (the actual number is potentially a few thousands but not published yet). A small fraction of these, called repeating FRBs, have been found to repeat. These repeating FRBs enable their precise localization using sensitive interferometeric telescopes, and hence, a multitude of probes, including multi-wavelength follow ups and deep searches for potential existence of their radiative environments. Such probes have resulted in to detection of persistent radio emission (PRS) associated with a few repeating FRBs so far. The observed PRSs have been found to be highly compact and provide a crucial clue to the central engine that is responsible for the FRB emission. I will provide a brief review of the worldwide efforts towards understanding the origin of FRBs, including our own recent results in this direction.		

ASI2025_633	Yash Bhusare	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Exploring the Local Environments of Repeating FRBs with uGMRT Observations		
Fast Radio Bursts (FRBs) are an enigmatic phenomenon. Since their discovery in 2007 many theoretical models have been proposed. With a rise in the number of FRB detections, observations are helping to constrain theoretical models. The discovery of Persistent Radio Sources (PRSs) associated with three repeating FRBs has provided unique clues about their local environments. We have utilized the upgraded Giant Metrewave Radio Telescope (uGMRT) to conduct deep radio observations of the regions surrounding three highly active repeating FRBs: FRB 20220912A, FRB 20240114A, and FRB 20240619D. By imaging these fields at low frequencies using uGMRT Bands 3 (300-500 MHz) and 4 (550-850 MHz), we have explored the local environments of these FRBs and gain insights into their surroundings. Our observations reveal radio emission in the host galaxy of FRB 20220912A, likely linked to star formation. For FRB 20240619D, no PRS was detected, and we placed upper limits on the local radio emission. In the case of FRB 20240114A, we report the discovery of a potential PRS, supporting the correlation between the FRBs' rotation measure (RM) and their emission. We also used SDSS and WISE public dataset for estimating properties of the host galaxy. Following the developments at higher radio frequencies, this candidate will join a limited group of FRBs which have associated PRSs. We will discuss our findings, their implications for theoretical models, and how they fit into the overall picture of FRB-PRS pairs.		

ASI2025_737	Ajay Kumar	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing Fast Radio Bursts using Deep Learning and GMRT		
Fast Radio bursts are bright dispersed radio pulses of cosmological origin. Currently, several hundred of them are known and published. The population of FRBs are classified as one-off events and repeaters. A small fraction of FRBs are active repeaters which can be studied in great detail to gain insights into their origins and emission mechanism. The discovery rate of FRBs is already a few per day and is expected to increase rapidly with new surveys coming online. The growing number of events necessitates prioritized follow-up due to limited multi-wavelength resources. I will describe Frabjous, a deep learning framework for an automated morphology classifier with an aim towards enabling the rapid follow-up of anomalous and intriguing FRBs and a comprehensive statistical analysis of FRB morphologies. The results obtained from the application of Frabjous on simulated and first CHIME/FRB catalogue and the potential for more accurate and reliable classification will be discussed. I will also present the results from recent observational campaigns of several active repeaters, including FRB220912A and FRB240114A using uGMRT. I will describe their burst properties, energy distributions at lower radio frequencies, host environments, temporal evolution, and frequency-dependent activity. Finally, I will discuss the implications of our results in the context of proposed progenitors models and emission mechanisms for repeating FRBs.		

ASI2025_499	Mukul Bhattacharya	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Fast radio bursts: source properties, emission mechanism and cosmological applications		
Fast radio bursts (FRBs) are energetic millisecond duration pulses, located at cosmological distances, whose physical origin is still debated more than a decade since their discovery. The detection of a Galactic FRB in April 2020 suggested that at least some FRBs can originate from magnetars. Characterizing FRB source population will help optimize future search strategies, and provide valuable insights regarding their progenitor models as well as the source environment. In this talk, I will first describe a generalized framework that can be utilized to constrain properties of the FRB source, host galaxy and intervening medium directly from their multi-band radio observations. Next, I will discuss the mechanism for the production of coherent radio bursts that are likely accompanied by persistent radio emission originating from the magnetized wind nebula surrounding the central neutron star (NS). These late-time radio emission have now been detected for three localized repeating sources and they provide direct constraints on the age, magnetic field, spin period of the NS as well as the energy density of the environment. Lastly, I will discuss how a fluence-limited survey of cosmological FRBs can be used as a potential probe to investigate He reionization history using the dispersion measure distribution of these sources to help reveal energetic processes in the early Universe.		

ASI2025_167	Paras Koundal	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Scientific Highlights from the IceCube Neutrino Observatory		
The IceCube Neutrino Observatory is a cubic-kilometer observatory located at the South Pole. It is designed to probe the universe's most extreme environments, by detecting astrophysical messengers like neutrinos and cosmic rays from their sources. The talk will provide an overview of the IceCube Observatory, and key scientific achievements. Prominent scientific results like identifying astrophysical neutrino sources, mapping of the Galactic Plane in neutrinos, energy spectra of diffuse neutrino flux, and insights into cosmic-ray anisotropy and composition will be highlighted. IceCube's role as a leading multi-messenger observatory and its contribution to particle physics through research areas like neutrino oscillation will also be covered. The talk will also discuss ongoing and planned detector upgrades, such as the IceCube Upgrade and IceCube-Gen2, which will enhance the sensitivity, measurement accuracy, and increase the aperture at the highest energies.		

ASI2025_659	Debabrata Deb	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
The Second Data Release of InPTA: Precise Timing of MSPs and Implications for Gravitational Wave Detection		
We present the second data release (DR2) of the Indian Pulsar Timing Array (InPTA) experiment, which provides precise times of arrival (ToAs) and dispersion measures (DMs) for around 27 millisecond pulsars (MSPs) observed using the uGMRT across Band 3 (300–500 MHz) and Band 5 (1260–1460 MHz). By optimizing sub-band selection and using noise-free, frequency-resolved templates, we eliminate the need for frequency-dependent parameters, enhancing timing precision. The time baselines range from 1.2 to 7.3 years, and recent hybrid observations increased coverage for additional pulsars. Precise DMs, with uncertainties between ${10}^{−4}$ and ${10}^{−6}$ pc cm−3, reveal solar wind effects in certain pulsars and highlight potential DM jumps, e.g., in PSR J1125+7819. This dataset, integrated with other PTA datasets for IPTA DR3, will contribute to gravitational wave detection efforts. Ongoing work includes noise modeling, exploring gravitational wave backgrounds, and studying interstellar medium (ISM) effects. Future plans also include leveraging this data for auxiliary science projects on DM and scattering, as well as continued monitoring until the Square Kilometer Array (SKA) becomes operational.		

16th February 2025
Parallel Session - Galaxies and Cosmology I
[Chairperson: Rajeshwari Dutta]
[Time: 14:00 – 15:45]

ASI2025_603	Ashish Kumar Meena	Invited Talk
Galaxies and Cosmology		
Extremely magnified stars in galaxy cluster lenses		
The first serendipitous detection of a highly magnified star in a spiral galaxy (z=1.49) lensed by a foreground galaxy cluster, MACS1149 (z=0.54), has opened a new window to observe stars at cosmological distances. Since then, several other lensed stars have been detected in HST imaging of various galaxy clusters, and nearly all galaxy clusters observed by JWST revealed lensed star candidates. Observing highly magnified stars at cosmological distances is a combined result of strong- and micro-lensing effects. The presence of point-like masses (such as stellar-mass objects) in the lens leads to the formation of micro-critical curves and micro-caustics in the lens and source planes, respectively. Whenever a star in a strongly lensed galaxy crosses a micro-caustic, it gets highly magnified, which might make it observable briefly as a transient source. In my talk, I will discuss the basic idea behind detecting highly magnified stars in cluster lenses. I will also discuss our recent detection of lensed star candidates at z=4.8 in the MACS0647 galaxy cluster. The number of such lensed stars is expected to increase continuously, assisting us in probing the first stars and understanding the compact dark matter fraction in the intracluster medium.		

ASI2025_331	Ankur Barsode	Contributed Talk
Galaxies and Cosmology		
Detecting a population of strongly lensed gravitational waves		
A small fraction (~0.1 – 1%) of gravitational-wave (GW) signals detectable by ground-based detectors will be strongly lensed by intervening galaxies and clusters, producing multiple detectable copies of the same signal. These signals arrive at the detectors at different times due to characteristic time delays induced by lensing. These time delays differ from those between independent, unlensed GW signals, which might hint at a population of lensed signals in the data. We develop a Bayesian method to constrain the fraction of lensed signals in a population of GW events, based on the time delay between them. We discuss the prospects of detecting strong gravitational lensing through such a measurement by considering various observation scenarios, with potential applications to cosmography.		

ASI2025_385	Aniruddha Chakraborty	Contributed Talk
Galaxies and Cosmology		
GLANCE: Gravitational Lensing Authenticator using Non-modelled Cross-correlation Exploration in Search for Lensed GW Signals		
Gravitational lensing occurs when massive astrophysical objects distort spacetime, causing electromagnetic (EM) waves or gravitational waves (GWs) to deflect from their paths. Depending on the wavelength of the GW in relation to the size of the lensing object, two regimes arise: microlensing and strong lensing. When the GW wavelength is comparable to or larger than the lens, microlensing occurs, leading to frequency-dependent modulations. Conversely, strong lensing arises when the wavelength is much smaller than the lens, yielding frequency-independent effects. By the third observation run, the LIGO-Virgo-KAGRA detector network had detected over 90 GW events, yet no confident lensing events. To address this, we developed GLANCE (Gravitational Lensing Authenticator using Non-modelled Cross-correlation Exploration) to search for lensed GW signals. This is a first-in-class approach to detect lensed GWs through finding the similarities of lensed GW signals at the strain level overlap. GLANCE utilizes distinct cross-correlation methods tailored to each lensing regime. For strong lensing, GLANCE cross-correlates between noisy reconstructions of lensed signals, enhancing the similarity between signals while suppressing noise. A significant deviation from noise cross-correlation indicates a potential lensing candidate. The technique is able to pick up lensed GW signals with a false alarms close to ~0.8/yr, which is very low compared to the pre-existing techniques. For microlensing, GLANCE focuses on residuals obtained by subtracting the best-fit GW from the data. Through testing on simulated data, GLANCE demonstrates a robust false alarm rate at network SNRs around 30. The presence of lensing can bias the inference of the GW source properties. Thus a joint source and lens characterisation was incorporated in GLANCE for their correct inference. Currently, we are applying GLANCE to open GW data, anticipating that with nearly 1000 detections expected from advanced GW detectors and next-generation facilities, at least one lensed GW pair will be identified.		

ASI2025_596	Shreya Mukherjee	Contributed Talk
Galaxies and Cosmology		
Study of Baryonic Effects on Matter Power Spectrum, and Dark Energy Equation of State Parameter using Cosmic Shear		
We present cosmological constraints on dark energy equation of state parameter ‘w’ from the cosmic shear two-point correlation function measured by a the weak lensing analysis of the Subaru HSC survey. When combined with likelihood from Supernovae of type Ia and Baryon Acoustic Oscillation data, our analysis constrains w = -1.144+0.102-0.096 with 68% confidence, which is consistent with the cosmological constant. We also infer the value of the parameter S8, which characterizes the amplitude of clustering or matter density fluctuations, to be 0.751±0.027 with 68% confidence. We also utilize model agnostic prescription of the baryonic feedback processes such as star formation, AGN feedback and their effects on the matter-power spectrum and infer the power spectrum suppression required to explain the cosmic shear data on small scales. This suppression can be tested using the galaxy-galaxy lensing signal from data, to address the degeneracy between cosmological parameters and baryonic feedback effects.		

ASI2025_163	Ayan Nanda	Contributed Talk
Galaxies and Cosmology		
Self-Similarity of Halo Shapes in Cosmological Simulations		
We investigate the shapes of dark matter halos in cosmological N-body simulations in scale free Einstein-De Sitter (EdS) and ΛCDM cosmologies. We use two halo finders, SUBFIND (SF) and ROCKSTAR (RS), to identify bound structures. We compute the shape tensor of well-resolved central halos and obtain their principle axes ($a \geq b \geq c)$. We find that at fixed mass, halos become more spherical with decreasing redshift. The distribution of axis ratios ($q=b/a,s=c/a$) show self-similar behaviour when the mass M is scaled by the non-linear mass M_{nl}, $\left(\frac{M}{M_{\mathrm{nl}}}\right)$, across power-law spectral indices. This leads to the average value of the axis ratios($\bar{q},\bar{s}$) also showing self-similar behaviour as a function of $\frac{M}{M_{\mathrm{nl}}}$ across spectral indices, within uncertainties. However $\bar{q},\bar{s}$ show a tighter self-similar behaviour as a function of peak height $\left(\nu=\frac{\delta_c}{\sigma(M,z)}\right)$. We find that $(\bar{q}(\nu),\bar{s}(\nu)$) are consistent with a universal function, $y=a-b \tanh \left[c \left(\log_{10}(\nu) - d\right)\right]$ across the spectral indices ranging from $n=-1.0$ to $n=-2.2$. When comparing halo finders we see that the the results with RS show a tighter self-similar behaviour compared to those with SF. We extend our analysis of halo shapes for the standard ΛCDM cosmology. However we find a different universal function describing $(\bar{q}(\nu),\bar{s}(\nu)$). The width of the distributions of (q,s) in both, scale-free and ΛCDM, classes of simulations can be reduced further by classifying halos as oblate, triaxial or prolate, each of which are described by self-similarity.		

ASI2025_188	Trupti Patil	Contributed Talk
Galaxies and Cosmology		
Dynamic Dark Energy and the Curvature: A Journey through Datasets		
This paper investigates the effects of spatial curvature in a model where dark matter and dark energy interact. The analysis employs a range of datasets, including CMB, BAO, Type Ia Supernova, $H (z) $ from cosmic chronometers, H_0 measurements from Megamasers and SH0ES, growth rate data and strong lensing time delay measurements, to assess the model's fit and explore the late-time dynamics of the interacting dark sector in a non-flat cosmological framework. The study indicates that introducing curvature does affect the Hubble constant (H_0) and the structure growth parameter (S_8), and also helps in alleviating the tensions between early and late universe observations to some extent. The observational data shows an indication for an open universe. This implies that the presence of curvature and its influence cannot be neglected entirely.		

16th February 2025
Parallel Session - Facilities, Technologies and Data science I
[Chairperson: P. K. Mohanty]
[Time: 14:00 – 15:45]

ASI2025_605	Sanmoy Bandyopadhyay	Contributed Talk
Facilities, Technologies and Data science		
Integral Adaptive Thresholding Inspired Solar Filament Detection		
Filaments are key features on the solar surface. When the magnetic field destabilizes, these filaments erupt as flares and coronal mass ejections (CMEs), releasing stored plasma into space. These eruptions contribute to space weather activities, emphasizing the importance of filament detection for studying the solar magnetic field and predicting space weather events. Solar filaments appear as dark, thin, rope-like structures with low temperatures and high plasma density. They are visible in Hα full-disk solar images at the 656.3 nm spectral line and in ultraviolet at the 393.3 nm Calcium K line. This in turn converts the overall task of solar filament detection into a task of identifying thin and long dark features in solar images. Over time, various supervised and unsupervised computer vision methods have been applied to detect solar filaments, such as global thresholding, local thresholding, artificial neural networks, and deep learning techniques. However, these methods are not universally effective specially for the case of solar images having non-homogeneous distribution of intensity level, on the other hand deep learning approaches, in particular, require extensive labeled datasets. Alongside, the rise in both ground and space-based solar observatories has increased the volume of solar images, necessitating efficient, real-time, and automated filament detection methods. To address this, an integral adaptive thresholding-based unsupervised approach has been developed. This method first segments solar images and extracts dark features using adaptive thresholding, followed by a disconnected component analysis to isolate filament regions from these extracted dark features. Tests on full-disk Hα images from the Big Bear Solar Observatory (BBSO) in 2013 show that this approach achieves an accuracy rate above 99% for most solar images, outperforming traditional object detection algorithms. This adaptive method offers a reliable solution for automated filament detection across a range of solar images.		

ASI2025_222	Anuraag Arya	Contributed Talk
Facilities, Technologies and Data science		
Deep space navigation with X-ray pulsars		
Deep space navigation is essential for coordinating space satellites and future missions, including sending probes beyond the solar system. Methods like radar ranging can give accurate measurements of the radial coordinate of a spacecraft, but are uncertain on other axes. This method also becomes problematic for spacecraft that are far from Earth. One solution to this limitation which has often been discussed in literature is to use pulsars as reference clocks to calculate the inertial position of the satellite on-board, removing any dependence on an Earth-origin signal. X-ray pulsars are ideal for this as high energy detectors can be more compact than radio antennas. To test and demonstrate the principle, we propose a small payload utilizing X-ray detectors to observe millisecond pulsars for faster and more accurate navigation in deep space. The payload will have a small form factor (1.5U) and will be equipped with two Cadmium Zinc Telluride (CZT) detectors, covering an energy range of 20 – 250 keV. Data will be procured using an Artix Cmod-7 FPGA, which will also undertake basic processing. In addition, we will also incorporate a Coded Aperture Mask (CAM) to measure the attitude of the payload. By tracking pulse time delays relative to the Solar System Barycentre (SSB) by analyzing phase shifts, we can estimate the position of CubeSat with respect to SSB. I will describe the payload in detail and show laboratory results of test and calibration. In the future, we will seek launch opportunities to integrate this payload into a larger satellite, or configure it as a stand-alone CubeSat mission.		

ASI2025_473	Prajwel Joseph	Contributed Talk
Facilities, Technologies and Data science		
Arivu: Regenerated High-Level UVIT Data Products		
The Ultra-Violet Imaging Telescope (UVIT) on board AstroSat is unique in its capability for high-resolution ultraviolet imaging (<1.5") and low-resolution ($\lambda/\delta\lambda \approx 100$) slitless spectroscopy, offering a wide field of view of ~0.5 degrees. Now nearly a decade in operation, UVIT remains a key resource, producing data of immense value to the scientific community. We will present an overview of the latest version (7.0.1) of the UVIT pipeline and introduce "Arivu", a newly defined high-level version of UVIT data products. All high-level products generated using pipeline versions with a major version number of seven are now collectively termed "Arivu." This updated pipeline version includes two significant improvements over the previous version (6.3): (a) a higher level of success in combining episode-wise images, and b) a higher level of success and smaller residual errors in the astrometric fit. We will discuss the specific solutions that made these advances possible. The Arivu version of the science-ready UVIT data has been available at the Indian Space Science Data Center of the Indian Space Research Organisation since 01 June 2024.		

ASI2025_328	Aparna Sekhar E R	Contributed Talk
Facilities, Technologies and Data science		
Modeling Optical Performance in Integrated Model of Segmented Mirror Telescopes		
This project presents advanced modeling and simulation studies of the Large Segmented Mirror Telescope utilizing the SMT Integrated Modeling Tool (codeSMT), currently being developed at the Indian Institute of Astrophysics (IIA). A crucial focus of this study is the optical performance modeling of the segmented mirror telescope under dynamic conditions of Atmospheric Seeing. This study will aid in the optimal design and performance prediction of the National Large Optical Telescope (NLOT). In the first phase, we generated atmospheric turbulence phase screen to simulate the impact of atmospheric conditions on the phase of light wavefront as they propagate through Earth's atmosphere. Our analysis reveals the effects of turbulence on point spread functions (PSFs), providing insight into how atmospheric distortions can degrade image quality. In the second phase, we modeled the adaptive optics (AO) system for the NLOT, specifically addressing lower-order aberrations such as tip and tilt. By correcting for tip-tilt aberrations, we demonstrate an improvement in the image quality. This correction is vital, as it effectively mitigates a substantial portion of the atmospheric aberrations that distort incoming wavefront. To implement this correction, we employed a zonal sensing method, which divides the wavefront into multiple zones. The deviations from a plane wavefront are measured using quad-cell photodetectors, whose dimensions are carefully selected to align with the expected PSF size. Our findings underscore the importance of optical performance modeling in optimal design and performance prediction of the large Segmented Mirror Telescopes.		

ASI2025_174	Nagendra Neerudu	Contributed Talk
Facilities, Technologies and Data science		
Scientific Ballooning in India: Recent Activities and Developments at TIFR Balloon Facility		
Scientific ballooning provides numerous opportunities in many science disciplines, particularly in Astronomy, Atmospheric Sciences, and Space Science research at a very low cost. The Balloon Facility of Tata Institute of Fundamental Research (TIFR-BF) is unique in the country and it can provide complete solutions for balloon-borne experiments by custom-designing various types of balloons with volumes ranging from 300 cu.m to 740000 cu.m for carrying 20 - 1000 kg payloads to an altitude of 18 - 42 km. Balloon-borne experiments are more focused and allow researchers/scientists to quickly change over to new technology developments and their tests in a shorter duration. These large-volume plastic/scientific balloons are floated at their intended altitudes with heavy scientific instruments for a few hours, depending on the prevailing wind conditions. The TIFR-BF has developed small polyethylene specially shaped balloons such as spheres and oblate spheroids for supporting the U R Rao Satellite Centre (URSC)-ISRO for testing the satellite communication payloads in a controllable environment as well as other deployable modules of Chandrayaan missions. Recently, TIFR-BF provided launch and payload recovery support to various balloon campaigns in collaboration with national and international research institutes. The TIFR-BF also conducted a balloon-borne Far-Infrared astronomy experiment with a payload weight of 850 kg, which floated at 32 km altitude for approximately 6 hours. In this talk, various kinds of balloons available at the TIFR-BF for user scientists, recent balloon experiments conducted for astronomy, and atmospheric sciences, and support provided to satellite payload testing, etc., will be discussed.		

ASI2025_330	Sakram Korra	Contributed Talk
Facilities, Technologies and Data science		
Recent Developments in Scientific Ballooning and Utilization of Hydrogen as a Lifting gas for Stratospheric Balloons		
Abstract: The Balloon Facility of Tata Institute of Fundamental Research (TIFR-BF), an integral part of the Department of Atomic Energy (DAE), plays a pivotal role in advancing balloon-borne scientific research by providing a robust platform for experiments in astronomy, atmospheric sciences, and other disciplines. Over the years, scientific ballooning has evolved significantly, with advancements in materials, payload design, flight control, and propulsion systems, enabling more complex and high-precision missions. These developments have expanded the scope of high-altitude research and opened new possibilities for stratospheric exploration. One of the most notable shifts in recent years has been the renewed interest in using hydrogen as a lifting gas for stratospheric balloons. Historically, helium was the preferred choice due to its inert nature and safety profile. However, the rising global demand and limited availability of helium have led to sharp price increases, making it increasingly impractical for large-scale or long-term stratospheric missions. This has sparked global efforts to explore hydrogen as a viable alternative, given its abundance, low cost, and environmental sustainability. TIFR-BF has substantial experience in using hydrogen for balloon operations, having developed effective protocols for its safe storage, handling, and flight operations over several decades. The facility's expertise ensures reliable and secure operations, mitigating the risks traditionally associated with hydrogen. This long-standing capability positions TIFR-BF to make meaningful contributions to the evolving global conversation about the feasibility of hydrogen-based ballooning. As the scientific community explores sustainable technologies for high-altitude missions, TIFR-BF's leadership will be instrumental in addressing key safety concerns and operational challenges. Leveraging its extensive experience, the facility is well-prepared to support future stratospheric balloon missions, paving the way for environmentally sustainable, cost-effective scientific research at the edge of space.		

ASI2025_396	Phanindra DVS	Contributed Talk
Facilities, Technologies and Data science		
Fabrication and Characterization of Liquid Crystal Retarders		
Liquid Crystal (LC) molecules can alter the polarization state of incoming radiation by varying the voltage applied to the device. The specialty of these liquid crystal retarders can help replace conventional crystal retarders, enhancing the performance of polarimeters constructed with these devices. However, manufacturing LC retarders is complicated, and the commercially available ones are expensive. Here, we introduce a simple procedure to develop a prototype LC retarder. Commercially available E7 Nematic Liquid Crystal (NLC) is used here to demonstrate the prototype. Nylon suspension, which has good thermal stability with a melting point of 150°C, is used as the aligning layer, a cheaper alternative to the conventionally used polyimide layer. The size of the fabricated LC retarder is 1-inch square with an operational voltage range of 20V. In this presentation, we outline the fabrication procedure of the prototype LC Retarders and their characterization. The uniformity of the fabricated LC retarder is tested using an in-house developed Full-Stokes polarimeter, and these results will also be presented.		

16th February 2025
Talk by Awardees Session
[Chairperson: Sarita Vig]
[Time: 16:20 - 18:15]

ASI2025_335	Shylaja B. S.	Award Talk
Plenary - ASI Zubin Kembhavi Award lecture		
Outreach - after in-reach		
It is generally considered that life in a planetarium is smooth sailing and light. Here I describe the efforts to raise the 'in-reach'; in other words, to create awareness and the utilisation of the planetarium. The story of the raise the footfall from couple of thousands to lakhs. Since literally 'outreach' is not literally possible, the 'in-reach' had to be modified into outreach.		

ASI2025_766	Anupam Bhardwaj	Award Talk
Plenary - Professor M. K. Vainu Bappu Gold Medal lecture		
Stellar route to the Hubble Constant		
The present expansion rate of the Universe, the Hubble constant, is a key cosmological parameter which can provide stringent constraints for the nature of the dark energy that is known to be accelerating the cosmos. Currently, the Hubble constant values based on a variety of standard candles observed with the Gaia/Hubble/James Webb space telescopes and ground-based telescopes, are in an intriguing discord with the measurement from the Planck space mission. This so-called Hubble tension is most dominant at the ~5 sigma level between the Hubble constant values obtained using Cepheid-Supernovae distance ladder and the values inferred with the Cosmic Microwave Background observations from the Planck satellite pointing towards new physics in the cosmological model. I will review the latest local determinations of the Hubble constant based on stellar standard candles and discuss ongoing efforts to provide independent calibrations of the first-step of the distance ladder using stellar populations of different ages and metallicities, and their importance in evaluating the Hubble tension.		

ASI2025_815	Joe Ninan	Award Talk
Plenary - Professor M. K. Vainu Bappu Gold Medal lecture		
Developing new instruments for expanding the discovery space		
Astronomers have a rich tradition of building new instruments to push the discovery space. In this Prof. Vainu Bappu Award talk, I shall highlight some of the key science results from two extreme precision radial velocity spectrographs we built for exoplanet science, and particularly how they helped us in discovering new planets that push the understanding of planet and star formation. I shall also talk about our new ongoing project to build a novel spectrograph, which will be the fastest spectrograph for ultra broad band spectroscopy survey in the world. This instrument, dubbed TA-MOONS will be a next generation instrument on DOT, that will have the unique capability to observe up to 8 targets anywhere in the 12 arc min diameter field of view in the ultra broad band wavelength range of 360 nm to 2.5 micron simultaneously.		

ASI2025_517	Nirupam Roy	Award Talk
Plenary - Laxminarayana & Nagalaxmi Modali Award lecture		
Atomic ISM in galaxies, near and far: Results & Surprises		
The interstellar medium (ISM), from which the new stars are born and to which the old stars inject matter and energy, thereby enriching it, is an integral and important component of the galaxies. Understanding the structure and evolution of the interstellar medium, that involves a diverse range of phenomena and a wide range of scales, is an interesting exercise. I will briefly present how low radio frequency observations and numerical simulations can be utilized to explore a plethora of science cases like the local ISM conditions and the dynamics of nearby galaxies. I will particularly focus on three closely related aspects - the multiphase nature of the atomic ISM, interstellar turbulence and magnetic field - that play crucial roles in shaping the properties of the ISM, and highlight the latest insights and challenges in our understanding of the atomic interstellar medium.		

ASI2025_684	Devojyoti Kansabanik	Award Talk
Plenary - Justice Oak Award for Outstanding Thesis in Astronomy lecture		
Remote sensing the magnetic field of coronal mass ejections in the heliosphere using radio observations		
Space weather (SpWx) refers to the plasma environment in near-Earth space and the heliosphere, primarily shaped by coronal mass ejections (CMEs)—massive plasma ejections from the Sun. The geo-effectiveness of CMEs depends largely on their magnetic field strength and structure, which evolve as they interact with solar structures, other CMEs, and the solar wind. Predicting CME arrival times and the critical southward (BZ) magnetic component at 1 AU remains challenging due to these changes. Accurate measurements of CME magnetic fields are essential for improving SpWx forecasting. Radio observations across MHz to GHz frequencies provide a promising approach for remotely sensing these fields. Gyrosynchrotron (GS) emission imaging can trace magnetic fields from the lower corona to ~10 solar radii, while Faraday rotation (FR) complements this by probing fields in the outer corona and heliosphere. Together, these techniques enable a comprehensive understanding of CME magnetic field evolution. This talk will discuss recent advances in developing optimal observing strategies using next-generation radio telescopes like the MWA, ASKAP, MeerKAT, NenuFAR, etc., and the challenges of calibrating diverse datasets across wide spectral ranges. These efforts aim to provide homogeneous observables for constraining CME magnetic field models from the corona throughout the inner heliosphere and enhancing SpWx forecasting capabilities.		

17th February 2025
Plenary Session II
[Chairperson: Liton Majumdar]
[Time: 09:15 - 11:15]

ASI2025_786	Umesh Kadhane	Invited
Plenary		
Laboratory investigation of nitrogenated aromatics and their role in understating astrochemical evolution of organics		
Occurrence of complex organics in our solar system is challenging the human understanding of the origin of life. Startling results by several space missions are complementing the astronomical observations while improving our knowledge. While the Indian space agency takes on increasingly complex missions, it becomes important that the Indian molecular physics community starts more interest in molecular astrophysics. At the AMP lab in IIST, we have conducted a series of investigations on energetic radiation processing of nitrogenated aromatics. These investigations are aimed at understanding the isomerisation and dissociation processes in these aromatics while trying to connect to their astrochemical relevance. Two main topics of interest are: first, to evaluate a possibility of nitrogenated aromatics as a source of anomalous HNC/HCN ratio in cometary surroundings as well as a source of cyanopolyynes which are common in comets and the upper atmosphere of Titan. And second, a more recent discovery of a strong tendency amongst this class of aromatics to undergo intracluster ion-molecule reactions. While the former topic strongly connects with photodissociation processes under Extreme UV radiation and high energy proton irradiation in planetary ionospheres and comets, the latter is proposed to be a path way of significance in the context of post-sublimation radiation interaction at the boundaries of protoplanetary disks. A brief report will be presented on these investigations at IIST. The last few minutes will be devoted to introduce a pan-India initiative on Organics in Space which was launched in the year 2023. The main goal of this initiative is to create national laboratory network, international collaborative network and direct engagement with the national space agency in collectively trying to understand the molecular origin of life. This will lead to a strong workforce, ground infrastructure and future space missions to address one of the most fundamental questions of humankind.		

ASI2025_783	Sudha Rajamani	Invited
Plenary		
The Astrobiological narrative of life's origin on the 'Pale Blue Dot'		
A central aspect of Astrobiology research pertains to delineating how life came about on our planet. The story is very ancient, intriguing, complex and continues to be one of the most fascinating scientific mysteries. It involves understanding how the transition from chemistry to biology would have occurred on Earth several billion years ago, much before any life as we now know even came about. Though this non-trivial puzzle is still missing many pieces, I will outline the current understanding prevalent in the field. In addition to having important implications for understanding whether there is life elsewhere in the Universe, I hope that this talk will get us thinking even more deeply about the only home we might ever know!		

ASI2025_829	Priyanka Chaturvedi	Invited
Plenary		
Exoplanet Characterization: From Jupiters to Earths - The Way Forward		
The field of exoplanet research has flourished since the first detection nearly three decades ago, revealing a vast diversity of planets across a wide range of stellar types. In this talk, I will highlight some of the most intriguing discoveries and discuss the challenges involved in detecting these planetary systems. Additionally, I will explore key unanswered questions in the field and outline the exciting avenues of research that lie ahead.		

17th February 2025
Parallel Session – Sun, Solar System, Exoplanets and Astrobiology II + Thesis
[Chairperson: Dipankar Banerjee]
[Time: 11:45 - 13:00]

ASI2025_378	Komal Choraghe	Contributed Talk
Thesis		
THE MAGNETOSPHERIC RESPONSE TO DIFFERENT NEAR-EARTH SPACE WEATHER CONDITIONS		
Space weather, originating from the Sun, encompasses a range of disturbances that profoundly impact Earth's surrounding space environment. Solar flares, coronal mass ejections (CMEs), corotating interaction regions (CIRs), and solar energetic particle events are the major drivers of space weather and can disrupt Earth's communication networks, navigation systems, power grids, and satellite electronics. Severe space weather conditions reveal various phenomena, one being geomagnetic storms, primarily driven by interactions between the Sun's and Earth's magnetic fields. Investigating the recovery phase of geomagnetic storms is essential for understanding and predicting these phenomena. Our statistical analysis of 31 extreme geomagnetic storms over the past 30 years reveals a consistent dual-phase recovery pattern: an initial rapid phase followed by a slower phase. This initial recovery is well-modeled by exponential and hyperbolic decay functions, while the slower phase predominantly follows a constant decay function, suggesting a unified process underlying this gradual recovery. Our detailed analysis of ICME-induced extreme storms highlights a unique case where Alfvén waves present during the slow recovery phase contribute to a prolonged storm recovery period. For CIR-driven storms, typically weak to moderate, our study spanning 1996 to 2016 identifies twelve cases of intense storms induced solely by CIRs, with no ICME influence. Notably, in 83% of these events, a planar magnetic structure (PMS) emerged during the main phase, implying that nearly 2D PMS-like structures may strengthen the southward component (Bz) and enhance storm intensity during CIR-driven events. These findings provide crucial insights into the dynamics of extreme and intense storms and highlight specific mechanisms contributing to prolonged recovery and storm intensification.		

ASI2025_175	Manoj Varma Sri Vatchavai	Contributed Talk
Thesis		
The Solar Ultra-Violet Imaging Telescope: Detector characterization and on-board processing for flare studies		
The Solar Ultraviolet Imaging Telescope (SUIT) is one of the payloads onboard the Aditya-L1 mission. SUIT will be imaging the Sun in the near Ultraviolet wavelength range (200 -400 nm) in 11 spectral bands using narrow and medium band-pass spectral filters covering a Field of View (FOV) of 1.5 solar radii. SUIT uses a 4k x 4k CCD sensor for photon detection. One of the important observational goals of SUIT is to obtain high-cadence flare data from the initial stages of the flare evolution. This thesis includes studying, developing, characterizing, and testing different subsystems of SUIT concerning this observational goal. One of the most important subsystems of SUIT is the CCD which is placed at its focal plane. The CCD characterization test setup and procedures are explained and the measured values of various parameters including noise, dark current, gain, linearity, and cross-talk are presented in this thesis. The results show a satisfactory performance from the CCD as well as the readout electronics to meet the specifications required by the SUIT payload. The SUIT onboard intelligence algorithm is the next important step to obtaining high-cadence flare data. The complete intelligence algorithm consists of the HEL1OS flare-trigger module, the flare-localization module, the Region of Interest (RoI) tracking module, and the auto-exposure control module. This thesis explains the working of these modules, their development, and testing. SUIT operation will be carried out by using a set of observation sequences. The testing of these sequences and verifying the output image data is presented in the final part of this thesis.		

ASI2025_241	Vikas Soni	Contributed Talk
Thesis		
The Effect of Metallicity and Vertical Mixing on the Abundance of Major H-C-N-O-bearing Species in the Atmosphere of Exoplanets		
The atmospheric characterization of exoplanets is a central objective in present-day astronomy, especially with the capabilities of JWST and other upcoming observatories. The spectra of exoplanet atmospheres offer insights into their atmospheric composition and thermal structure. Molecules like CO, CO2, CH4, H2O, NH3, and HCN, which are the building blocks for more complex organic molecules and significant reservoirs of elemental C-N-O, have been detected in exoplanet atmospheres. Among various parameters influencing atmospheric composition, metallicity plays a significant role. The effect of atmospheric metallicity on thermochemical equilibrium abundances is reasonably well-constrained, though its effect on the disequilibrium composition needs to be better constrained. This thesis provides a comprehensive study of the effect of atmospheric metallicity on the composition of H2O, CO2, CO, CH4, NH3, N2, and HCN over a large parameter space (temperature: 500-2500 K, pressure: 0.1 mbar - 1 kbar, metallicity: 0.1-1000×solar metallicity) in the presence of disequilibrium processes. We built a 1-D photochemistry-transport model to solve the mass continuity equation for each species at every atmospheric layer. The model includes eddy diffusion and molecular diffusion as transport processes and uses the two-stream approximation of radiative transfer to estimate the photon flux for calculating the photochemical rates. As a more flexible approach for a general study, the quenching approximation method is used to calculate the atmospheric abundance in the presence of vertical mixing. To apply the quenching approximation, we calculated chemical timescales for major HCNO-bearing molecules using a reduced chemical network, with vertical mixing derived via the methodology given by Smith (1998). I will present our findings on how molecular abundances shift with metallicity under thermochemical equilibrium and in the presence of vertical mixing. I will also discuss the implications of the quenching approximation for atmospheric retrieval, focusing on constraining vertical mixing strength and atmospheric metallicity.		

ASI2025_200	Sindhuja Gunaseelan	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Comparative Study of Helium-Rich and Helium-poor Events Observed by the High-Energy Telescope (HET) Onboard Solar Orbiter		
The High-Energy Telescope (HET) onboard the Solar Orbiter mission measures the energy spectra of energetic particles, including helium and protons, in the inner heliosphere. We present a comparative analysis of 7 helium-rich events and 5 helium-poor events observed by HET from July 2020 to October 2024, spanning multiple solar rotations and a variety of solar wind conditions. Helium-rich events are particularly significant as they provide insights into the mechanisms of particle acceleration and transport associated with solar flares and coronal mass ejections (CMEs). The HET instrument, designed to analyze energetic particles in the solar wind, operates in an energy range of ~7 - 500 MeV/nucleon (species dependent). Our analysis aims to elucidate differences in energy spectra and particle composition between helium-rich and non-helium-rich events, thus shedding light on the underlying physical processes governing these phenomena. The Solar Orbiter's unique orbit, with a perihelion of approximately 0.28 AU (42 million kilometers) from the Sun, allows for unprecedented examination of particles accelerated by solar eruptions. Additionally, we present the kinematics of the associated CMEs and flare properties. Our study is expected to enhance understanding of the role of helium-rich events in the solar wind and their potential impacts on Earth's magnetosphere, contributing significantly to the broader comprehension of heliospheric dynamics.		

ASI2025_622	Upasna Baweja	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Investigation of Co-existence of longitudinal and transverse waves in polar plumes		

Magnetohydrodynamic waves play a crucial role in heating the solar corona and generating the solar wind. Recent observations have demonstrated evidence of longitudinal intensity perturbations (using Atmospheric Imaging Assembly (AIA) onboard Solar Dynamic Observatory (SDO)) and transverse wave propagation (using Coronal Multichannel Polarimeter (CoMP)) in polar plumes. Despite these findings, there exists a gap in our understanding due to the lack of simultaneous detection of both wave types within the polar regions using high-resolution imaging techniques. In this study, we aim to investigate the co-existence and excitation mechanisms of the longitudinal and transverse oscillations in the polar regions. We utilise the high spatial and temporal resolution images of Extreme Ultraviolet Imager (EUI) aboard Solar Orbiter. We analysed the north polar data corresponding to Sep 14, 2021, obtained using EUI (17.4 nm) when the spacecraft was at 0.59 astronomical units (AU) from the Sun. Our preliminary results have revealed the signatures of longitudinal oscillations in the polar regions, and we are exploring the transverse oscillation signatures. We are also investigating the consequences of their simultaneous existence in the polar plumes. In this presentation, we will share our initial findings.

17th February 2025
Parallel Session – Stars, Interstellar Medium, and Astrochemistry in Milky Way II + Thesis
[Chairperson: Manoj Purvankara]
[Time: 11:45 - 13:00]

ASI2025_460	Saumya Gupta	Contributed Talk
Thesis		
Decoding Low Mass Star Formation: The Role of Cluster Environment		
Stars are building blocks of the Universe. However, our understanding about star and planet formation process is yet insufficient to comprehend the role of star-forming environment on stellar evolution and related processes. This thesis is an important step to answer the long-standing problem about role of cluster environment on circumstellar disk properties, brown dwarf formation and na- ture of mass distribution in sub-stellar domain. We use the deepest and widest (1.5◦ diameter) Subaru Hyper Suprime-Cam observations to study two stellar feedback-driven massive star forming regions, Cygnus OB2 (in r2, i2, z and Y filters) and IC 1396 (in r2, i2 and Y filters) at < 2 kpcs from the Sun. We obtain good quality HSC sources to find an age of 5 ± 2 Myrs for Cygnus OB2. We adopt a multi-wavelength approach using mid-IR and near-IR data to obtain a substantial population of disk-bearing sources in the region. A low circum-stellar disk fraction (16%) is obtained for the central 18' radius area. We also find 19 new proplyds in Cygnus OB2. Both these results suggest that external photoevaporation drives disk dissipation in Cygnus OB2. Since our next aim is to investigate how stellar feedback affects brown dwarf regime, we study the central 22' radius region of IC 1396 using multi-wavelength data including HSC data. We find 62 brown dwarf members using machine learning techniques and use them to determine mass distribution in the region. A comparative study of star-to-brown dwarf ratio in IC 1396 (∼ 6), along with 14 other star form- ing regions with diverse cluster environments suggests that factors like stellar density and UV flux do affect brown dwarf formation efficiency. This study, with the deepest survey of two prominent regions provides conclusive evidence of how low-mass star population is affected by feedback generating factors and will pave the way for further studies.		

ASI2025_293	Ranjan Kumar	Contributed Talk
Thesis		
Study of UV-bright stars in Galactic globular clusters using Ultraviolet Imaging Telescope (UVIT) observations		
Galactic globular clusters (GCs) are old (~12Gyr) and dense stellar environments consisting of thousands to millions of stars. They host almost entire evolutionary phases of old stellar populations and are ideal for studying the formation and evolution history of low-mass stars. The ultraviolet (UV) emission in GCs is mainly dominated by the hot sources of the cluster which are either evolved (e.g., He-burning horizontal branch (HB) stars, post-HB stars, post-AGB stars, AGB-manque stars, and white dwarfs, etc.) or exotic (e.g., blue straggler (BS) and blue hook (BHk) stars) stellar populations that have formed through the dynamical interactions in the dense environment of the cluster. We have studied the UV-bright sources of five Galactic GCs using four far-UV (FUV: 1500 - 2000 A) and three near-UV (NUV: 2000 - 3000 A) filters of the Ultraviolet Imaging Telescope (UVIT) onboard India's first space observatory, AstroSat. The UV/UV-optical colour-magnitude diagrams (CMDs) were constructed to study the evolutionary status of the UV-bright sources of the observed GCs. The HB, hot post-HB, hot BS, and WD stars dominated the FUV-optical CMDs, whereas the NUV-optical CMDs consist of cooler sources (e.g., main-sequence, SGB, RGB, and AGB stars) along with the sources observed in the FUV-optical CMDs. The He abundances of HB stars in three GCs were estimated by matching the observed and model HB stars on the UV and/or UV-optical CMDs, which were found in the range of 0.247−0.350 dex, 0.252−0.265 dex, and 0.247−0.310 dex for NGC 7492, NGC 5272, and NGC 6205, respectively. We could identify several new hot extreme-HB, post-HB, and extremely low mass WD stars, which have either evolved from HB mass less than 0.55 Msun or evolved in a binary system in the dense cluster environment.		

ASI2025_130	Belinda Damian	Contributed Talk
Thesis		
From stars to brown dwarfs: A journey through diverse star forming worlds		
The formation and evolution of low-mass stars and brown dwarfs is an intricate process orchestrated by the environmental conditions in which they form. While low-mass stars are a dominant product of the star formation process, brown dwarfs occupy a unique position, bridging the gap between low-mass stars and planets. Identifying and exploring these cool objects aids in understanding their dominant formation mechanism and tracing the very low-mass end of the initial mass function (IMF). In this thesis, we explore substellar objects across diverse environments from nearby low-mass clusters to distant feedback-driven massive regions. Using a novel water-band photometry technique, we identify ultra-cool dwarfs with high efficacy, verified through follow-up spectroscopy with facilities like IRTF-SpeX and GTC-EMIR. We also use deep multiband photometry from various facilities, including DOT-ADFOSC, to compare wide-wavelength SEDs with atmospheric models. Spanning a broad mass range, we probe the IMF down to the planetary regime and find its form consistent across environments. Additionally, we analyze the properties of disks around young stellar objects by examining their distribution relative to ionizing sources and their dependence on host star properties. Our findings confirm that feedback from massive stars affects disk evolution and that UV radiation field strength dictates the extent of this influence. In dissecting the formation and evolution of low-mass stars and brown dwarfs across varied environments, this thesis advances our understanding of IMF behavior, brown dwarf formation, and disk evolution, providing a crucial link to planetary formation around low-mass objects.		

ASI2025_363	Gourav Banerjee	Contributed Talk
Thesis		
Optical spectroscopy of classical Be stars in the Galaxy		
A classical Be (Be) star is a massive B-type main sequence star surrounded by a geometrically thin, equatorial, gaseous, decretion disc orbiting in Keplerian rotation. Spectra of Be stars show emission lines of different elements, studying which we can gain insights about their circumstellar discs and the central star itself. Mathew et al. (2011) performed a slitless spectroscopic survey to study the spectral features of 150 Be stars in open clusters. Their study motivated in performing further spectroscopic surveys of Galactic Be stars in different environments. My PhD research focused on the study of field Be stars in the Galaxy using optical spectroscopy, obtaining data from HCT facility, Ladakh and multi-epoch spectra from the 1-m CZT facility, VBO, IIA. We produced an atlas of all major emission lines found in a large sample of 115 Galactic field Be stars (Banerjee et al. 2021) using the HCT facility. Then, we (Banerjee et al. 2024) further explored these stars to better understand their disc properties. Our evaluation of the electron density in Be star discs using Balmer decrement values indicate that their discs are generally optically thick in nature with electron density (n_e) in their circumstellar envelopes (CEs) being in excess of 10^13 cm^-3 for around 65% of the stars. Another study of ours (Banerjee et al. 2022) focused in understanding the disc transient nature of Be stars through continuous monitoring of their Hα line profile variations for 5 consecutive years (2015 -- 2019) using the 1-m facility at Kavalur. Our results suggested that 4 among the 9 sample stars are possibly undergoing disc-loss episodes and one other star might be passing through disc formation phase, rest 4 stars may be hosting a stable disc presently. These results further motivated to start two new projects, which I am currently leading as PI from VBO, Kavalur as a PDF at IIA.		

ASI2025_430	Prerana Biswas	Contributed Talk
Thesis		
Unravelling the kinematics, dynamics and structure of galaxies using HI - 21cm observation		
Several HI-21cm interferometric observations of nearby galaxies in recent decades have comprised a large dataset. To assess the completeness, coverage of these sources and potential of archival data, we created a sample of 515 galaxies from GMRT (Giant Meterwave Radio Telescope) archive, focusing on good-quality HI spectral line data. We plan to analyse this data uniformly to explore different science cases through the GMRT ARChIve Atomic gas survey (GARCIA), starting with an analysis of a pilot sample of eleven galaxies. With the pilot sample, we first identified warm and cold phases in ISM through Multi-Gaussian decomposition method. Our method distinguishes different phases at a lower SNR of 5, unlike previous studies that were limited to SNR 10 or above, enabling better detection of cold gas in outskirts and warm gas in central regions. Further, we present 3D kinematical models of these galaxies by fitting Tilted-ring model to 3-dimensional data cubes and build a robust technique for galaxy mass modelling. For the first time, we combined 3D modelled rotation curve, stellar kinematics derived using Multi-Gaussian Expansion technique and Jeans Anisotropic Modelling, our own-developed method for gas contribution; for doing mass modelling via MCMC optimisation method. Additionally, we investigated kinematic and morphological lopsidedness of galaxies and checked consistency between morphological and kinematic halo perturbation parameters derived from 3D kinematic modelling, unlike previous studies. Moreover, our robust modelling techniques are further applied to a larger number of sources from CALIFA survey, allowing us to revisit Baryonic Tully-Fisher relation, where we observed an indication of a shallower slope. These studies, initially on pilot samples, will be extended to data-products from future batches of GARCIA. Beside that, in upcoming era of large interferometers like Square Kilometer Array (SKA), archival visibility data will facilitate revisiting raw data, applying improved calibration techniques, and exploring new algorithms.		

17th February 2025
Parallel Session – High Energy Phenomena, Fundamental Physics and Astronomy II + Thesis
[Chairperson: Preeti Kharb]
[Time: 11:45 - 13:00]

ASI2025_197	Vivek Kumar Jha	Contributed Talk
Thesis		
Investigating the Nature and Structure of Inner Regions in Active Galactic Nuclei		

The innermost regions of Active Galactic Nuclei (AGN) are critical for understanding galaxy evolution and the dynamics of matter near a Supermassive Black Hole (SMBH). Yet, due to smaller angular projections, it is very difficult to resolve these regions. This thesis explores indirect methods to understand these objects. We use the reverberation mapping technique to estimate accretion disk sizes for a sample of AGN, finding that the computed disk sizes are, on average, 3.9 times larger than the Shakura Sunyev (SS) standard disk model predictions. We also find a weak correlation between the obtained accretion disk sizes and the SMBH mass. We present initial results from a new accretion disk monitoring program to probe the accretion disk structure of Super Eddington Accreting AGN. We report that the disk sizes are about 4 times larger than the SS disk model. We calibrate the narrow-band photometric reverberation mapping (PRM) technique to develop tools for a large systematic narrow-band PRM project. We use simulations to test the effect of cadence, variability of the light curves, and the length of light curves in recovering the reverberation lags. We study the dichotomy between AGNs with and without detected jets using the method of microvariability observed in the accretion disk continuum. We find that AGNs with confirmed jets are about 3 times more variable on short time scales than the AGNs without a confirmed jet. By performing statistical analysis on a large sample of low luminosity AGNs, we find that the NLSy1 galaxies are more likely to have outflow signatures than their broad-line counterparts, hinting toward the disk wind origin of the material in BLR. We find that the principal components for NLSy1 galaxies differ from the BLSy1 galaxies, suggesting that the NLSy1 galaxies could be occupying their own parameter space.

ASI2025_212	Dimple	Award Talk
Justice Oak Best Thesis Award, Honorable Mention Talk		
Multiwavelength studies of gamma-ray bursts and their associated counterparts		

Gamma-ray bursts (GRBs) are one of the most luminous transient astrophysical phenomena in the Universe, with isotropic equivalent energies reaching up to 10^54 ergs. GRB prompt emission spectra typically span the gamma-ray energy range from keV to MeV, exhibiting durations that range from milliseconds to several minutes. GRBs have been detected at cosmological redshifts over 9, offering a window to probe the early universe. Despite several decades of intense observational and theoretical study, fundamental questions regarding the emission mechanisms, progenitor systems, central engines, relativistic jet launching mechanisms, and physical processes governing GRBs remain open challenges. A central yet unsolved problem in GRB research is the classification of these energetic explosions. Different classification schemes based on properties such as duration, fluence, spectral lags, afterglow characteristics, host galaxy types and locations, and other features have been proposed. However, it remains unclear how effectively these classification systems correlate with intrinsically distinct classes of GRB progenitors and central engines. This thesis investigates and critically evaluates various GRB classification methods using a multi-wavelength dataset encompassing observations spanning gamma-ray, X-ray, and optical wavelengths. We also utilised the machine learning algorithms to disentangle various classes of GRBs and to better understand their underlying physical properties, revealing subtle patterns that indicate potential links between fluence, duration, and light curve structures. Our analysis further identified five distinct classes in the GRB population using multiple catalogs and revealed two distinct classes of kilonova-associated GRBs. Future gravitational wave observations will play a crucial role in advancing our understanding of GRBs. By combining gravitational wave observations with electromagnetic observations across the spectrum in the near future, we can gain unprecedented insights into the nature of these enigmatic phenomena.

ASI2025_372	Soumen Mondal	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Observational imprints of accretion disk on observed gravitational wave data from LISA.		
The proposed work aims to investigate and compare the detectability of the effect of massive accretion disks on the emitted gravitational wave from extreme/intermediate mass ratio inspirals for different types of accretion models of the disk, and thereby to check whether they are distinguishable in the LISA band. The hydrodynamic drag of the disk significantly modifies the motion of the companion as a result of the emitted wave changes in amplitude and phase. We found that these changes are detectable through the last few years of observation by LISA (in some cases as small as 6 months) for EMRIs residing within redshift z = 1 from the detector and for the accretion rate of the primary black hole of the order of one Eddington. We further identify the orbital parameters evolving under most general elliptical-orbits in the equatorial plane for which the magnitude of disc-torque is greater and that can potentially enhance detectability of accretion-disc effect on the observed GW-signal. Prioritizing such orbital-configuration, we obtain substantial impact on the dephasing and high signal-to-noise-ratio (SNR) in emitted signals. Employing a threshold-SNR (> 8), we then identify the detectability trend of those systems in LISA-band. Moreover, the drag effect and hence the detectability of the emitted GW is also sensitive to the hydrodynamical model of the disc. Therefore, we vary the disc parameters, accretion rate, and duration of observation of E/IMRIs, and find that in comparison with other disc models, transonic solution offers relatively better observable signatures in detecting the gas-rich E/IMRI's within the LISA band. Hence, the study will be important in understanding the orbital-evolution, predicting orbital-configuration and E/IMRI formation pathways, and finding detectability for such gas-rich E/IMRIs. Such observations will also help one to probe the nature of the accretion flow and verify various paradigms of accretion physics.		

ASI2025_440	Gaurav Waratkar	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Low-latency infrastructure for rapid dissemination of LIGO-Virgo-KAGRA gravitational-wave alerts for Multi-Messenger Astronomy		
The LIGO-Virgo-KAGRA collaboration (LVK) is in the middle of its fourth observing run, detecting a new gravitational wave (GW) event every few days. Rapid searches for the next GW counterpart, including gamma-ray bursts (GRBs) and kilonovae, continues. Semi-automated data products are being publicly broadcast to the world in 30 seconds, providing localization and source properties, enabling multi-messenger and multi-wavelength follow-up observations. I will provide an overview of LVK's low-latency alert infrastructure, highlighting recent upgrades made for this observing run which include reduced latency aimed at pre-merger alerts and the publication of low-significance events. I will also discuss the performance of these data products, validated through the Mock Data Challenges (MDC). To capitalize on the increasing sensitivity of gravitational-wave (GW) detectors and electromagnetic observatories, the LVK collaboration has adopted the RAVEN (Rapid, on-source VOEvent Coincidence Monitor) pipeline. Since the second observing run, RAVEN has enabled real-time coincidence searches between GW events and external signals such as gamma-ray bursts (GRBs). I'll also discuss recent upgrades to the RAVEN pipeline and future plans, including expanded offline capabilities and the integration of new experiments to detect a wider set of transients, such as fast radio bursts and neutrino events, as these sources become available.		

ASI2025_312	Abinash Suklabaidya	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Linking Polarization and Photometry: Advancements in Asteroid Diameter Estimation		
Determining the accurate diameter of asteroids is crucial for understanding their physical properties and dynamical evolution. Traditional methods often rely on empirical relations between diameter, albedo, and absolute magnitude. However, these methods require accurate albedo measurements, which can be challenging to obtain. In this study, we propose a novel approach to estimate asteroid diameters by combining polarimetric and photometric observations. We explore the relationship between asteroid diameter, polarization minimum, and absolute magnitude. By analyzing a comprehensive dataset of asteroids, we have derived an empirical formula that connects these parameters. This new method offers a potential advantage over traditional methods, as it does not require prior knowledge of the asteroid's albedo. Our findings provide valuable insights into the scattering properties of asteroid surfaces and contribute to the development of more accurate techniques for asteroid characterization. This work has the potential to enhance our understanding of the asteroid population and its role in the solar system's history.		

17th February 2025
Parallel Session – Galaxies and Cosmology II
[Chairperson: Sachindra Naik]
[Time: 11:45 - 13:00]

ASI2025_494	Anishya Harshan	Contributed Talk
Galaxies and Cosmology		
Can Dwarf Galaxies Reionise the Universe?		
The identification of the sources of reionisation of the Universe is one of the major goals of JWST. Dwarf galaxies in the epoch of reionisation, with their abundance and high specific star formation rates are thought of as ideal source of reionising photons. The low gravitational potential of dwarf galaxies could also facilitate the escape of these ionising photons to the inter-galactic medium and thus reionising the IGM around them. However, such galaxies prove to be difficult objects to study given their faintness even with ultra-deep surveys with powerful space telescopes. In the CANUCS survey, we harness the magnifying power of the galaxy clusters as gravitational lenses along with JWST to provide a magnified view of the early Universe. In this talk I will present the properties of dwarf galaxies (5<log M*<8) and Lyman alpha emitters selected using medium band NIRCAM filters and followed up with NIRSpec sprectroscopy at redshift z>5. I will present their production efficiency of ionising photons, star formation histories and gas kinematics to understand what Lyman alpha emitters can tell us about the timeline and morphology of reionisation and to answer the question if dwarf galaxies can reionise the universe.		

ASI2025_743	Abhirup Datta	Contributed Talk
Galaxies and Cosmology		
uGMRT constraints on the redshifted HI 21-cm signal power spectrum at z = 9 (EoR)		
The redshifted 21-cm signal from neutral hydrogen is a crucial probe for studying the early Universe, spanning the Cosmic Dawn (CD) to the Epoch of Reionization (EoR). Detecting this faint signal at low radio frequencies is highly challenging due to dominant foregrounds—galactic and extragalactic, ionospheric distortions, radio frequency interference (RFI), and instrumental systematics. Despite these challenges, ground-based telescopes such as LOFAR, MWA, and HERA have made significant progress, bringing the detection of this cosmological signal within reach. In this work, we present observations of the ELAIS-N1 field at Band-2 (120–250 MHz) using the upgraded GMRT, a pathfinder for the SKA. With 32 hours of observations covering a bandwidth of around 100 MHz, we achieved an off-source RMS noise level of 237 μJy/beam and an angular resolution of 11.45 arcseconds in the final image. Our catalog comprises 1027 sources with a flux density threshold of 5σ at a central frequency of 183 MHz. We have derived the source count from this catalog, which is consistent with other observations at different frequencies. We are presenting the first constraints on the 21-cm signal at high redshift z = 9, using the foreground removal technique to mitigate foregrounds. These results are preliminary and demonstrate the capabilities of uGMRT in probing the cosmic HI signal from EoR.		

ASI2025_606	Ananda Hota	Contributed Talk
Galaxies and Cosmology		
GMRT observation of objects discovered by Indian citizen scientists since 2013		
Since its launch in 2013, RAD@home Citizen Science Research (CSR) Collaboratory has trained thousands of participants—from undergraduates to postgraduates and beyond—in foundational astronomy, with a focus on radio continuum astronomy, using publicly accessible data and tools, all without dedicated funding or resources. This pioneering Indian citizen science initiative has enabled participants to develop a strong understanding of extragalactic objects, leading to the discovery of unique objects. Among these are Odd Radio Circle-like radio rings, collimated synchrotron threads, compact jet structures such as burls, radio bubbles from jet-galaxy interactions, episodic feedback signatures during galaxy mergers, rare giant radio spirals from Speca-like disk galaxies, and large relic lobes (100-200 kpc) displaced by ram pressure stripping. These discoveries have pushed the boundaries of our knowledge on AGN jet feedback and merger-driven galaxy evolution, highlighting RAD@home's role in contributing to frontier scientific questions while creating a model for human-resource development at the onset of the SKA era in India. The most significant discoveries, showing potential for groundbreaking insights, were prioritised for dedicated follow-up observations with the GMRT. Through four accepted proposals (GOOD-RAC), RAD@home's team acquired 71 hours of multi-frequency GMRT data for 21 sources, uncovering previously unseen features in each source through high-quality deep GMRT radio maps. In this talk, we will present our initial results from deep GMRT observations, providing new insights into these objects. The multi-frequency data have enabled precise spectral analysis, offering a clearer understanding of their physical properties and raising important questions for future study. These findings have important implications for understanding various radio galaxy types and their environmental interactions, paving the way for future research with the SKA. RAD@home serves as a pioneering citizen science initiative, fostering scientific engagement across India and establishing a sustainable model for public involvement in large-scale astronomy.		

ASI2025_135	Masroor Bashir	Contributed Talk
Galaxies and Cosmology		
Testing Statistical Isotropy and Gaussianity of ACT DR6 Convergence data using Morphological statistics		
We carry out a comprehensive hierarchical multi-scale morphological analysis to test statistical isotropy and deviation from Gaussianity of large scale matter distribution using data of the convergence map provided by the Atacama Cosmology Telescope data release 6. We use a suite of morphological statistics consisting of Minkowski functionals, contour Minkowski tensor and Betti numbers for the analysis. We devise a general methodology for inferring the statistical significance of deviations of morphological statistics based on the persistence of the deviations across threshold ranges and spatial resolutions, and taking into account correlations amongst the statistics and the nature of the information that each statistic carries. From analysis of the full dataset, and hemispherical regions, we find consistency with statistical isotropy. This is not surprising since deviations in smaller sky regions tend to get washed out when averaged over larger regions. A local analysis of smaller sky patches reveals some patches that exhibit statistically significant persistent departures from statistical isotropy.		

ASI2025_541	Mohit Raj Sah	Contributed Talk
Galaxies and Cosmology		
Cosmology of the supermassive black holes using anisotropic nHz gravitational wave background		
The formation and evolution of supermassive black holes (SMBHs) remain an open question in cosmology. Detecting nanohertz (nHz) gravitational waves from supermassive black hole binaries (SMBHBs) via pulsar timing arrays (PTAs) offers a promising method for studying SMBH formation over cosmic time. The gravitational wave (GW) background generated by the superposition of the GWs from individual supermassive black hole binaries (SMBHBs) is expected to be anisotropic in nature. Moreover, since these binaries reside at the center of galaxies, the distribution of the anisotropic signal is expected to follow the galaxy distribution in the universe. Therefore, the study of the angular power spectrum of the stochastic gravitational wave background (SGWB) as well as the cross-correlation of the SGWB signal with galaxy distribution presents a promising avenue for investigating the cosmic evolution of the SMBH. This approach can also help distinguish the origin of the SGWB, whether it is primarily astrophysical or cosmological. In our work, we demonstrate how studying the anisotropy of the SGWB can shed light on both the source of the SGWB and the cosmic evolution of SMBHs.		

17th February 2025
Parallel Session – Facilities, Technologies and Data science II
[Chairperson: Vikram Rana]
[Time: 11:45 - 13:00]

ASI2025_383	Abhinav Narayan	Contributed Talk
Facilities, Technologies and Data science		
GARUDA: A Deep Learning based automated radio data analysis pipeline for the GMRT		
Radio observations are essential for understanding galaxy formation and evolution, yet low-frequency interferometric observations are often hindered by radio frequency interference (RFI) and system failures, making data processing a time-intensive challenge. With next-generation radio telescopes producing increasingly large datasets, the demand for automated data processing solutions has grown critical. We present GARUDA (Generic AI-based GMRT-tUned Radio Data Analysis pipeline), a novel automated pipeline designed for uGMRT data reduction. Written in Python and utilizing modular CASA for calibration, GARUDA includes GNET, our custom Deep Learning based RFI detection model. With only two tunable parameters, GNET ensures flexibility and ease of use across diverse observations and frequency bands. The pipeline handles system issues and performs RFI excision, producing high quality calibrated data ready for imaging. GARUDA processes 10-12 GB GSB data in 20-30 minutes and approximately 400 GB GWB data in under three hours on standard GPU workstations, achieving rapid and reliable results. In this talk, I will discuss GARUDA's capabilities and showcase results, including some of the deepest GMRT radio continuum images at the L-band, HI emission in galaxies, and one of the most sensitive galactic HI absorption lines (using frequency switching observation with GWB).		

ASI2025_510	Viren Mandaogane	Contributed Talk
Facilities, Technologies and Data science		
LiBRA: A Novel Low Frequency Wideband Antenna for Radio Astronomy		
We present the design and performance of the Linearly Polarised Broadband Radio Antenna (LiBRA), a novel low-frequency antenna developed for radio astronomical observations. LiBRA combines multiple bowtie elements with varying flaring angles, achieving wideband performance from 80 to 320 MHz with a return loss below -10 dB. The design was simulated using the FEKO Student Edition, with an optimization algorithm implemented to ensure high radiation efficiency across the entire bandwidth. This innovative design was recognized among the top three in India in the SWAN Antenna Design Challenge 2020-2021. A prototype of LiBRA was constructed and tested, demonstrating optimal performance in a band from 70 to 290 MHz. We summarize the reflection coefficient and radiation pattern results and present observations at low radio frequencies to validate its performance. Additionally, we discuss potential applications of LiBRA across various radio astronomical observations and outline directions for its future development.		

ASI2025_110	Amar Nath	Contributed Talk
Facilities, Technologies and Data science		
QMIST: A Software Pipeline for the Detection of Quasi-periodic Microstructures in Pulsar Emission		
Pulsar radio emission exhibits variations at diverse timescales, spanning from months down to the nanosecond level. One of the shortest timescale variations among these, known as microstructures, is a distinctive feature that has been discovered in emission from a variety of pulsar categories. While these manifest as narrow, often quasi-periodic, features in numerous individual pulses of a pulsar, not all pulses exhibit this characteristic. The study of these structures can provide valuable information to understand the pulsar emission mechanism. However, the manual hunt for these microstructures in an intensity time series containing thousands, and sometimes millions, of pulses is a laborious and time-intensive task. To streamline this process, we have designed and developed a Python-based pipeline, called QMIST, to detect quasi-periodic microstructures in a given radio pulsar time series data. We provide a comprehensive description of the algorithm along with its caveats and further present a survey of microstructure periodicities in 24 young and normal pulsars using this pipeline.		

ASI2025_422	Keerthipriya Sathish	Contributed Talk
Facilities, Technologies and Data science		
Dual polarised Fantail dipole Antenna Design for APSERa an S-band Precision cosmology experiment		
The Cosmic Microwave Background (CMB) radiation serves as a critical source of information in understanding the evolution and composition of our Universe. Theoretical predictions suggest the presence of inevitable faint deviations referred to as 'spectral distortions' in the CMB spectrum from that of a blackbody. One such distortion is the cosmological recombination radiation (CRR), originating from photons emitted during the formation of hydrogen and helium atoms in the Epoch of Recombination (ERA) (redshifts $900 < z < 8000$) in the early universe. In this work, we present a novel scalable broadband dual polarised fantail shaped dipole antenna design motivated by the detection of these distortions within the 2.5–4 GHz range. The antenna has a sensitivity of the order of 1 part in 10^3 over the entire frequency band, offering a sensitivity improvement of over an order of magnitude compared to standard broadband antennas. This sensitivity was validated through a custom-designed pipeline that emulates the convolution and interaction of the sky and ground with the antenna's beam pattern and return loss. While it does not yet achieve the sensitivity required for direct detection of cosmological recombination radiation, the antenna fulfills essential design criteria for experiments targeting absolute sky spectrum measurements at millikelvin level. This can aid in refining foreground models for global detection experiments, and also address the problem of excess radio background at 3.3GHz reported by ARCADE-2 experiment.		

ASI2025_727	Arul Pandian B	Contributed Talk
Facilities, Technologies and Data science		
A Novel LPDA Array for 130 - 350 MHz Pulsar observation at Gauribidanur - Initial Results		
We have developed a new array to make pulsar observations in the 130 MHz to 350 MHz band using evenly spaced log periodic antennas at the Gauribidanur observatory. Large aperture arrays such as the upcoming SKA low-frequency telescope will be implemented with randomly spaced antennas. Such random distribution would work better for large arrays. However, an optimal arrangement of antennas may differ for arrays with fewer elements. For observation at low radio frequencies, covering the upper 200 MHz of SKA1-Low bands at the Gauribidanur observatory, a novel tightly spaced antenna array configuration is developed. We have incorporated a newly built RF pipeline into the existing digital receiver for this array. We have developed a new software backend for real-time data reduction and archival purposes, suitable for transient search and high-time resolution pulsar observations. This new array is designed to be sensitive for meridian transit observations, thus allowing polarimetric observation of all sources in the visible sky in a 24-hour observation while reducing interference arising from the low elevations. Hence, a specific observation strategy is developed considering the instrumental characteristics. A matching data reduction and analysis pipeline is also developed and tested. This talk will present salient features of the work, highlighting the details of the processing pipeline, array sensitivity, and our initial results from observing continuum and transient sources, current status, and future plans.		

17th February 2025
Parallel Session – Sun, Solar System, Exoplanets and Astrobiology III
[Chairperson: Sudha Rajamani]
[Time: 14:00 - 16:00]

ASI2025_629	Soumyaneal Banerjee	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Sulfuric Acid and Sulfur Dioxide vapor concentrations in the lower atmosphere of Venus using the Radio Occultation Technique		
Radio Occultation (RO) experiments by the Akatsuki spacecraft have been used to probe the lower atmosphere of Venus and study the sulfuric acid vapors typically present between the altitudes of 35-50 km, below the Venus cloud deck. H2SO4 and SO2 are two of the major trace species found in the lower atmosphere of Venus. The notoriously high density and opacity of the Venus atmosphere make visible, IR and UV observations practically impossible below the cloud top region of 65-70 km. The stable X-band radio signal (~8.4 GHz) emitted by the transmitter of the Radio Science (RS) payload of the Akatsuki Spacecraft traverses the Venus atmosphere and suffers intensity loss and phase change. The loss in signal intensity occurs due to refractive effects and absorption by the Venus atmosphere. The primary X-band absorber is H2SO4 vapor. The signal attenuation due to refractive effects and absorption by the known X-band absorbers in Venus are subtracted from the total signal loss. The residual absorption loss, due to H2SO4 vapors, is then converted into mixing ratio values, thereby providing the vapor abundance in the region. A new signal processing algorithm has been used to derive the signal attenuation from the raw data files. Additionally, SO2 concentrations from 35-55 km region are also estimated considering our current understanding that H2SO4 vapor concentration decreases exponentially to zero above 50 km altitude, following its saturation vapor pressure curve. This provides the SO2 vapor concentration in the range of a few tens to a few hundred ppm, agreeing with the existing studies.		

ASI2025_345	Saugata Barat	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
First observations of young transiting planet atmospheres: Uncovering signatures of early evolution		
Transiting planets younger than 100 million years offer a unique opportunity to catch freshly baked products of planet formation which are undergoing early evolution. We present first ever atmospheric characterization results for two young (20-30 Myr old) transiting planets (V1298 Tau b and c) using HST (published). We will also unveil the JWST transmission spectrum of V1298 Tau b (submitted ApJ). We will present novel methods to estimate the planet mass directly from the transmission spectrum, which has proven to be critical for young transiting planets where radial velocities are challenging due to stellar activity induced jitter. We will compare the mass and atmospheric composition of the two young transiting planets with their mature counterparts as well as with each other to interpret our findings in the context of early atmospheric evolution. We will also present the first constraints on internal entropy of a transiting exoplanet from our observations and compare with planet formation and evolution models. Ultimately, we will discuss theoretical evolutionary models currently being developed which can reconcile the observed mass, composition and internal entropy of these young transiting planets with the mature exoplanet population		

ASI2025_131	Prakruti Sudarshan	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
How stellar irradiation affects the structure of a planet forming disk		
Protoplanetary disks observed in mm-continuum and scattered light show a variety of substructures. While embedded planets are a common explanation, various physical processes in the disk could also trigger such features. One such possibility that has been previously theorized for passive disks is the irradiation instability: the flaring disk solution may become unstable as directly illuminated regions puff up and cast shadows behind them. This in turn manifests as bright and dark rings in the outer regions of the disk. It has been studied with different methods — time-dependent linear theory, Monte Carlo radiative transfer codes, and in 1+1D. Unfortunately, there is little consensus in previous work involving 2.5D simulations owing to different thermal treatments and equilibrium states. We investigate this problem with global axisymmetric 2.5D hydrostatic+dynamical simulations including realistic radiation transport with frequency-dependent irradiation and flux-limited diffusion. We compare our treatment with the previously used moment transfer methods and the simpler radiation forcing to elucidate the importance of correct numerical treatment for this problem. We also create scattered light images of these disks with RADMC3D and discuss the caveats of substructure induced by such an instability. We finally highlight the role of small grains and dust feedback in this context.		

ASI2025_43	Anuroop Dasgupta	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
The Ophiuchus DIsk Survey Employing ALMA (ODISEA): Complete Size Distributions for the 100 Brightest Disks Across Multiplicity a		
Submitted to ApJ. The size of a protoplanetary disk is one of its most fundamental properties. However, most disks remain unresolved, even in the closest star-forming regions (distance approximately 140-200 parsecs). In this study, we present the complete continuum size distribution for about 100 of the brightest protoplanetary disks (with dust masses greater than approximately 2 Earth masses) in the Ophiuchus molecular cloud, obtained through ALMA Band-8 (410 GHz) observations at a resolution of 0.05 to 0.15 arcseconds (equivalent to 7 to 21 astronomical units). We measure the Half Width at Half Maximum (HWHM) of the dust continuum for each disk, and the radius encircling 68% of the flux (denoted as R68%R68%) using Frank profiles. This results in the largest flux-limited sample of resolved disks in any star-forming region. We find that the full distribution follows a log-normal pattern with an HWHM logarithmic mean of 1.1 (equivalent to 13 astronomical units) and a standard deviation of 0.46 (equivalent to a factor of 2.9). Stars in close binary systems (separation less than 200 astronomical units) have significantly smaller radii, with a logarithmic mean of 0.7 (equivalent to 5 astronomical units), which indicates very efficient radial drift in the outer regions of the disk, as predicted by models of binary systems. The disk size distribution for young embedded objects (SED Class I and Flat Spectrum, with age less than approximately 1 million years) is indistinguishable from that of more evolved Class II objects (with age of a few million years), suggesting that pressure bumps must be present at early stages of disk evolution to halt the migration of millimeter-sized particles at astronomical unit scales.		

ASI2025_411	Trisha Bhowmik	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Understanding planet and satellite formation with ALMA and VLT		
In our solar system, terrestrial and giant planets differ in architecture and chemistry. To understand this, we must study planet-forming disks and their structural variation. As part of the ODISEA project (Ophiuchus DIsk Survey Employing ALMA), I present 55 faint disks at 0.05" (7 au) resolution and 45 brighter disks at 0.2" (28 au) resolution at 400 GHz. This study uniquely analyzes the images and radial profiles of 100 disks in a single molecular cloud, investigating how disk substructures evolve with disk sizes, mass, and SED Class. Theoretically, we anticipate a higher population of young embedded (≤ 1 Myr) featureless disks compared to evolved Class II (a few Myr) featureless disks. However, we observe a similar population of embedded (52%) and Class II (48%) featureless disks (Bhowmik et al in prep.). One explanation could be the presence of pressure bumps that halt grain growth and structural evolution in the disks. Further insight into our solar system's 200+ moons suggests that giant exoplanets may also have exo-satellites. Despite successful high-contrast imaging (HCI) of giant planets and brown dwarfs (BDs), exo-satellites remain undetected. Recently observed triple systems like ε Indi and GJ569 inspire searches for massive exo-satellites, particularly around BDs. We employ a negative fake injection technique to suppress companions' (BD or planet) brightness using observed stellar PSFs in the search for exo-satellites. Our sample includes over ten BDs and exoplanets observed by SPHERE/VLT's integral field spectrograph (IFS), targeting objects like GQ Lup B and PZ Tel B. I will present post-processed residual images treated with angular spectral differential imaging and negative fake injection. I will focus on companion surroundings, contrast curves, and mass-limited plots to identify exo-satellites around these companions.		

ASI2025_386	Vignesh Vaikundaraman	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Dust growth in wind-driven protoplanetary disks		
Recent models show that disk winds efficiently transport angular momentum in the regions where non-ideal magnetohydrodynamic (MHD) effects suppress the Magnetorotational Instability (MRI). Moreover, these winds produce complex gas flows in the disk which are further amplified by non-ideal MHD effects like the Hall effect and its connected processes. Dust evolution and dynamics are connected to the underlying gas dynamics in the disk and it has recently been shown that complex gas flows can enhance the radial diffusion of dust depending on the flow structures. We examine the effect of the complex gas flows due to MHD winds on dust evolution including dust coagulation. We incorporate gas flow structure from a 2-dimensional global, non-ideal MHD simulation into a 2-dimensional Monte Carlo code for dust evolution to perform global simulations of dust evolution in the case of complex gas flows. We observe the formation of dust traps as a natural outcome of the interplay between the gas flows and dust evolution. We compare our results with the traditional viscous evolution models for disk evolution and the recent analytical models describing disk winds. We discuss the conditions for planetesimal formation and its applicability in the dust traps observed in our simulations.		

ASI2025_389	Ushasi Bhowmick	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Lightcurve Inversion: Analyzing the extent of feature embedding of a two-dimensional projected shape on its transit lightcurve.		
The increased sensitivity and resolution of space-based telescopes has led to observations of deviations from spherical exoplanet transits, caused by tidal distortions, disintegrating planets etc. Therefore, a proper understanding of geometrical anomalies in photometric lightcurves is of key importance. The lightcurve inversion problem is considered to be ill-posed, however, it has been addressed in great detail especially in the context of asteroid lightcurves. Since a number of different shapes may give rise to identical lightcurves, we need to identify what features of a two-dimensional (2D) projected shape can be successfully embedded in its transit lightcurve. We generate a large number of arbitrary shapes and their transit lightcurves using Yuti (Bhowmick and Khaire 2024). As a demonstration, we use the complexity parameter defined in Chen and Sundaram 2005 as a scalar metric for characterizing a 2-D shape. We design a Deep Neural Network (DNN) and show that it retrieves the complexity parameter with error <15% from lightcurve alone. The error in retrieval increases for shapes with larger complexity (C>0.3) depicting regimes where shapes are degenerate to transit lightcurves. To capture more complex features, we create a low-dimension latent-space representation (Λ) of the shapes using autoencoders. We train a separate DNN model to retrieve this latent-space from the lightcurves. The capability of the DNN to retrieve Λ from the lightcurves itself reflects the successful embeddings of shape complexity in the lightcurves. The latent-space can be segregated into clusters depicting different ‘classes’ of shapes, based on their detectability from transit. We aim to study the intra-class similarities and inter-class differences in shape features. The lightcurve inversion problem can be reduced to identification of such ‘classes’ which will enable us to narrow-down the geometrical properties of the shape based on transit lightcurves.		

17th February 2025
Parallel Session – Stars, Interstellar Medium, and Astrochemistry in Milky Way III
[Chairperson: Drisya Karinkuzhi]
[Time: 14:00 - 16:00]

ASI2025_587	Saikhom Pravash Singh	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Dust grain alignment and disruption mechanisms in G34.43+0.24 using thermal dust polarization observations from JCMT/POL-2		
Polarization of starlight and thermal dust emission due to aligned non-spherical grains helps us to trace magnetic field (B-field) morphology in molecular clouds and to constrain dust grain properties and their alignment mechanisms. Alignment of grains based on RAdiative Torques (RATs) is the most acceptable mechanism that can explain grain alignment from diffused interstellar medium to star-forming regions. In this work, we study the grain alignment and disruption mechanisms in a filamentary infrared dark cloud G34.43+0.24 which harbors multiple cores using polarized thermal dust emission observations from JCMT/POL-2 at 850 μm in three sub-regions as North having MM3 core, Center having MM1, MM2 cores and South having no core. We find decrease in polarization fraction (P) with increasing total intensity, known as polarization hole or depolarization which can be caused by decrease in grain alignment efficiency or magnetic field tangling due to turbulence or both. To disentangle the effect of magnetic field tangling on polarization hole, we estimate polarization angle dispersion function. Our analysis finds depolarizations in North and Center are dominantly due to decrease in net alignment efficiency of grains in denser regions but in South magnetic field tangling is significant to cause depolarization. To test whether RAT Alignment (RAT-A) mechanism can reproduce the observational data, we estimate minimum size of aligned grains using RAT theory. We find RAT-A can explain depolarization in North and Center where B-field tangling effect is less significant, except the MM3 (North), MM1 and MM2 (Center) cores where we find evidence of RAdiative Torque Disruption (RAT-D) that reduces P. We also estimate the effect of enhanced magnetic relaxation on RAT alignment for second time in a filament and find evidence of Magnetically enhanced RAT (M-RAT) alignment mechanism that can explain the observed high P of around 20% in outer parts of the filament.		

ASI2025_573	Bhaskarjyoti Barman	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Insights from Molecular Clouds: Turbulence, Magnetic Field and other Physical Parameters		
Molecular clouds represent the coldest and densest regions of the interstellar medium, serving as the primary sites for star formation. The intricate process of star formation is influenced by various factors, particularly turbulence and magnetic fields. These factors regulate the development and evolution of molecular clouds and their structures across both low and high-density regions. Our research demonstrates a significant link between turbulence (ΔV, measured from FWHM of 12CO linewidth) and size (L) of the clouds with ΔV∝L^(0.30±0.04) for 22 isolated low-mass molecular clouds, with gravitational forces potentially driving turbulent motions, suggesting a state of near-equilibrium. We have also observed a dependence of turbulence on both mass and density at the clouds and the core of the respective clouds, where we consider FWHM of C18O linewidth as a core tracer. Our study also examines the influence of turbulence on the alignment of magnetic fields within these clouds. Our findings reveal that clouds exhibiting lower turbulence (ΔV<3 km^(-1)) show a stronger alignment with the Galactic Plane, whereas those with higher turbulence (ΔV>3 km^(-1)) display a greater offset. This highlights the dynamic interaction between turbulence and magnetic fields in shaping the evolution of molecular clouds, supported by our theoretical calculations. Understanding these connections is essential for uncovering the complex processes involved in the birth of stars and advancing our knowledge of stellar formation mechanisms.		

ASI2025_368	Anindya Saha	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Direct observational evidence of multi-epoch massive star formation in G24.47+0.49		
Massive stars play a crucial role in the dynamical and chemical evolution of their environment by feeding the ambient interstellar medium (ISM) with material and radiation, especially during its formation stages and late evolutionary phases. This feedback is believed to regulate star formation activities in their vicinity. With their intense UV radiation, massive stars can ionize the surrounding ISM and form HII regions. The expansion of the HII regions leads to two contrasting scenarios: it can either hinder or promote star formation activity in molecular clouds. On the one hand, it can disrupt the natal cloud and inhibit future star formation processes, and on the other hand, this feedback can sweep up surrounding material into dense shells, creating massive fragments that eventually collapse to form subsequent generations of stars at their peripheries. Several studies have found observational evidence of this triggered star formation linking two generations of stars: the ionizing star and the newly formed stars at the peripheries of expanding HII regions. However, gathering evidence for triggered star formation linking multiple epochs of stars around HII regions is challenging as it is difficult to associate evolved massive stars with the next epoch of star-forming regions, each of which must show indications of ongoing star formation activity. As a result, evidence for hierarchical triggering and multi-generation star formation is scarce. In this talk, I will present our study of ring-like HII region G24.47+0.49 using ALMA data from the ATOMS survey and archival VLA 4.86 GHz data. Our analysis reveals an interesting scenario of hierarchical triggering relating three epochs of massive star formation in concentric rings of the HII region. Through detailed molecular gas kinematics analysis, we unveiled, by far for the first time, direct and unambiguous detection of an expanding outer molecular ring encircling the HII region.		

ASI2025_394	Amal George Cheriyan	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Probing the interplay of jets and H II regions in RAFGL2591: Insights from radio, infrared and sub/millimeter observations.		
We present a multiwavelength investigation of the massive star-forming region RAFGL2591, located at a distance of 3.3 kpc. It is particularly intriguing due to its peculiar central region, which harbours a cluster of protostars, H II regions and multiple jets; notably, the extended E-W protostellar jet exhibiting thermal radio emission from one lobe and non-thermal synchrotron radio emission from relativistic electrons in the opposing lobe. To elucidate the physical conditions within this region, we obtained radio images at frequencies of 325, 610, and 1280 MHz using the Giant Metrewave Radio Telescope (GMRT) in India. The radio analysis indicates that all HII regions display spherical morphology and exhibit positive spectral indices, confirming their thermal nature. Additionally, we analyzed archival data from UKIDSS, Spitzer, and Herschel to complement our findings. The dust temperatures associated with the HII regions, as obtained from the analysis of the Herschel images, are found to be in the range of 20 - 60 K. The column densities vary between 0.6 × 10^23 /cm^2 to 1.6 × 10^23 /cm^2. The derived masses of the H II regions span 31 M⊙ to 61 M⊙, with dynamical timescales estimated between 0.4 to 1.4 Myrs. A photometric examination of near and mid-infrared point sources highlights the presence of a young stellar object population associated with the cloud. Furthermore, CO observations, leveraging CARMA and ALMA data, enabled the construction of moment maps that identify gas structures, study turbulence, and distinguish between different velocity components. This provides invaluable insights into the physical and evolutionary states of the sources and the ambient medium, enhancing our understanding of the intricate processes at play in RAFGL2591.		

ASI2025_664	DEBANGAN MAJI	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Cool phase temperature of atomic hydrogen in the Galactic centre region		
The central one-kilo-parsec region of our Milky Way (MW) Galaxy is typically referred to as the Galactic Centre (GC) region. Most of the physical quantities like gas density, velocity dispersion, temperature, etc. in this region are significantly higher than those found in the disk of our galaxy. GC region cannot be seen in optical wavelengths due to large interstellar extinction by dust in the Galactic plane. It can, however, be studied in radio bands. Atomic hydrogen (HI) in the ISM is a two-phase medium (cool & warm phase), which can provide a wealth of information on the interstellar medium (ISM) in the GC region. Given the high temperature of the ISM in the region, we expect the cold HI to have a significantly higher spin temperature than the rest of the Galaxy. HI spin temperature can be measured using 21 cm emission and absorption spectrum. However, the measured spin temperature is the column density weighted harmonic mean of those two phases. Therefore, it is very challenging to separate the contribution of the cool phase, and it can only provide an upper limit. Following Dickey et. al. (2003) and Strasser et. al. (2007), we are separating the contribution of the warm phase, and finding the HI cool phase temperature. For this work, we are using existing archival HI data towards this region. Results from the work will be presented here.		

ASI2025_201	Khushbu K.	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Self-consistent modelling of the ionized and neutral gas in PN NGC 6445		
Planetary nebulae (PNe) are the expanding envelopes of ionized gas and dust ejected by low-to-intermediate mass stars (1-8 $M_{\odot}$) during their final evolutionary stages. Beyond the ionized region where the Lyman α photons decline, a transitional interface exists between the ionized and atomic regions. This interface has photons of energy range 6 - 13.6 eV, which heat and dissociate the region by driving various chemical reactions known as photo-dissociation regions (PDRs). The ionization front is dynamic in PNe because the radius of the Strömgren sphere is significantly larger than the entire optical size of the nebula. As a result, the radiations become trapped, preventing the system from reaching equilibrium. This study focuses on PN NGC 6445, a typical H-rich central star PN with thick PDR and molecular signatures, which allow for a comprehensive model of both photo-ionized regions and PDRs using detailed spectroscopic data. We have used the multiwavelength data ranging from UV to IR, encompassing UV archival data from IUE to account for the photo-electric heating by the very small grains (VSGs), Optical spectroscopic data from HCT-HFOSC spectrograph at two position angles (45 & 90 degrees anticlockwise), and IR data from Spitzer IRS and Herschel. To accurately constrain the central star parameters, we used the 1D Dusty photo-ionization model, integrating the CLOUDY 23.01 spectral synthesis code with the Rauch stellar model atmosphere. We optimized the ionized and neutral gas by defining a density function and variation in the filling factor. Our self-consistent model traps the ionization front effectively at a particular snapshot. The model incorporates two-grain size distributions (MRN and KMH) to study the effects of quantum heating by VSGs. Such a detailed analysis is crucial for understanding stellar evolution and the complex processes occurring within PNe.		

ASI2025_198	Aayushi Verma	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Investigating the Star-forming Sites in the Outer Galactic Arm		
We aim to investigate the global star formation scenario in star-forming sites AFGL 5157, [FSR2007] 0807 (hereafter FSR0807), [HKS2019] E70 (hereafter E70), [KPS2012] MWSC 0620 (hereafter KPS0620), and IRAS 05331+3115 in the outer Galactic arm. The distribution of young stellar objects in these sites coincides with a higher extinction and H2 column density, which agrees with the notion that star formation occurs inside the dense molecular cloud cores. We have found two molecular structures at different velocities in this direction; one contains AFGL 5157 and FSR0807, and the other contains E70, [KPS2012] MWSC 0620, and IRAS 05331 +3115. All these clusters in our target region are in different evolutionary stages and might form stars through different mechanisms. The E70 cluster seems to be the oldest in our sample; AFGL 5157 and FSR0807 formed later, and KPS0620 and IRAS 05331+3115 are the youngest sites. AFGL 5157 and FSR0807 are physically connected and have cold filamentary structures and dense hub regions. Additionally, the near-infrared photometric analysis shows signatures of massive star formation in these sites. KPS0620 also seems to have cold filamentary structures with the central hub but lacks signatures of massive stars. Our analysis suggests molecular gas flow and the hub filamentary star formation scenario in these regions. IRAS 05331+3115 is a single clump of molecular gas favoring low-mass star formation. Our study suggests that the selected area is a menagerie of star-forming sites where the formation of the stars happens through different processes.		

ASI2025_264	Samrat Biswas	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Multi-wavelength photo-polarimetric study of the intermediate age open cluster NGC 1912		
In this study we carried out a comprehensive multi-wavelength investigation of the low-galactic latitude open star cluster, NGC 1912, situated towards the anti-galactic center direction. The cluster has been characterized in context of its fundamental and structural parameters, mass distribution, dust properties, and the star formation dynamics. In order to achieve this goal, rigorous statistical techniques have been incorporated into polarimetric, photometric, and astrometric data. Dynamical mass segregation study revealed a concentration of some apparently massive stars towards the cluster center. Polarimetric analysis in B,V, Rc, Ic wavelength bands showed that the Galactic magnetic field plays a dominant role in this region. Many stars in the region showed potential intrinsic polarization and/or rotation in position angle. Dust studies indicated that grain sizes within the intracluster region are comparatively smaller than that of the general ISM. Possibilities of differential extinction in the cluster region was detected. Interestingly, the Near-Infrared extinction map revealed the existence of a potential ‘interstellar bubble’ located close to the cluster region. Along the periphery of this bubble-like region, 16 young stellar objects (YSOs) were detected, suggesting that triggered secondary star formation events might have occurred in this region.		

ASI2025_454	Poojapriyatharsheni J	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Diffuse Ionized Gas in the Cygnus X region and inner Galactic Plane		

We present results from a large-scale Radio Recombination Line (RRL) survey conducted in the Cygnus X region, a prominent star formation area, and the inner Galactic Plane (−5° to 32° in l and |b| < 1°). Observations were made at 340 and 800 MHz with the Robert C. Byrd Green Bank Telescope, in a survey known as GDIGS-low (GBT Diffuse Ionized Gas Survey at low frequency), with angular resolutions of 45' and 15', respectively. Data from a previous 5.8 GHz RRL survey (GDIGS; Anderson et al. 2021) was also included. All these surveys provide velocity coverage sufficient to detect hydrogen, helium, and carbon lines. Cygnus X harbors young star clusters, massive stellar associations, and stellar nurseries, where new stars form. Our observations centered on coordinates l = 80° and b = 1.4°, spanning ±2.75° in both galactic longitude and latitude. The intense radiation from young stars in this region generates Diffuse Ionized Gas (DIG), confirmed by widespread low-frequency RRL detections. One objective was to detect helium RRLs from the DIG. By averaging spectra and masking HII region emissions, we achieved the sensitivity for the first helium line detection from DIG at 800 MHz. The ratio of ionized helium to hydrogen was 0.7, with an interquartile range of 0.05 to 0.11, aligning with values seen in HII regions around O6 or earlier-type stars. The Galactic plane survey data further examines the relationship between hydrogen RRL emissions and far-infrared NII line emissions observed by the Herschel Space Observatory (Goldsmith et al., 2015; Pineda et al., 2019). Both NII and hydrogen RRL emissions originate from fully ionized gas, but our analysis shows that emission measures (EM) derived from NII lines account for only 5% or less of the EM from RRL data. Further study is needed to explain the low NII emissions from most RRL-emitting ionized gas.

17th February 2025
Parallel Session – High Energy Phenomena, Fundamental Physics and Astronomy III
[Chairperson: G. C. Anupama]
[Time: 14:00 - 16:00]

ASI2025_147	Judhajeet Basu	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
"Shock"-ing results from M31: Detailed analysis of the slow classical nova AT2023tkw (GIT20230919aa)		
Novae are cataclysmic thermonuclear runaway explosions on the surface of white dwarfs accreting matter from a secondary star. Observable signatures include an increase in brightness up to several orders of magnitude across the UVOIR spectrum followed by a decline, characteristic of each nova. Recent studies have demonstrated the power of shocks in driving novae light curves. We present the slowly evolving classical nova in M31, AT 2023tkw, discovered and classified using optical facilities in India and the USA. The successive lightcurve peaks, occurring at increasing intervals, are likely due to a series of internal shocks generated near or within the photosphere. Through spectroscopic and photometric observations, we attribute the observed behavior to shock-induced heating events leading to the expansion and contraction of the photosphere, which led to multiple episodes of mass ejection (Basu et al., submitted). Photoionization models revealed a high ejecta mass, consistent with a slow nova. Eruption observations, together with HST archival data, helped identify the secondary star and shed light on the white dwarf characteristics, accretion properties, and recurrence timescales of the M31 nova.		

ASI2025_414	Anjasha Gangopadhyay	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
A thourough investigation on the evolution of Helium rich interacting (Ibn) supernovae		
Type Ibn supernovae (SNe), a rare subclass of core-collapse explosions, are characterized by unique circumstellar interactions with helium-rich material, producing distinct narrow emission lines. This work presents the studies on two Ibn SN 2019uo; SN 2019wep, and a compiled analysis of a sample of SNe Ibn observed by Zwicky Transient Factory (ZTF) from 2018 - 2024. This provide valuable insights into the nature and diversity within this SN type, revealing variations in progenitor properties, mass-loss history, and CSM interaction. SN 2019uo and SN 2019wep highlight differences in luminosity decline rates (typically around 0.1 mag/day for 30 days) and circumstellar medium (CSM) density, suggesting distinct progenitor characteristics. The compiled sample from the ZTF broadens this perspective by comparing Type Ibn SNe with other interacting supernovae, emphasizing the role of CSM properties in shaping observable features and expanding our understanding of SN explosions in helium-rich environments. We typically infer that the lightcurves are mostly fast risers and decliners with some exceptions. The lightcurves are mostly driven by CSM interaction rather than radioactive decay. Spectroscopically, they show both emission and P-cygni He lines due to different CSM densities and structures. The line strengths hint towards Wolf-Rayet as typical progenitors. The unique CSM interactions and mass-loss rate estimates in Type Ibn SNe offer clues to episodic mass loss before explosion, enhancing our knowledge of core-collapse mechanisms. Continued observation of Type Ibn events is essential to further explore the progenitor diversity and mass-loss dynamics underlying these explosive phenomena.		

ASI2025_277	Shatakshi Chamoli	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Multiwavelength study of novae in M31		
Novae are a class of cataclysmic variables with an accreting White Dwarf (WD) primary and mass-transferring secondary star. These systems go into outburst as a consequence of thermonuclear runaway on the surface of the WD, leading to an increase in brightness. Novae with only one recorded outburst are called classical novae (CNe), while those with repeated outbursts are known as recurrent novae (RNe). Observations of novae in the Milky Way are biased due to our location and dust obscuration towards the centre. Hence we look to our neighbouring galaxies to study novae in different galactic components, such as spiral arms, bulge and halo. M31 is visible for most part of the year, suffers low extinction and has a higher nova rate than the Milky Way making it an excellent site for novae population studies. We present a multiwavelength study of novae in M31 using survey data from GROWTH-India Telescope (GIT) in the g' and r' filters and the AstroSat-UltraViolet Imaging Telescope (UVIT) in the F148W filter. Out of the 92 transients reported in the M31 field between July 2022 and December 2023, we detected 55 in the optical bands, and six close to outburst and 29 during quiescence in the UV. We analysed the multiwavelength light curves of these objects and filtered nova candidates based on their optical light curve morphology and increase in UV flux. We further categorised nova candidates into speed classes wherever possible and identified potential RNe based on the Maximum Magnitude vs Rate of Decline (MMRD) relation. We also report the 2024 outburst of the M31 RN with a recurrence period of 2.5 years, the second shortest known recurrence.		

ASI2025_419	Devanand P U	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
X-Ray Spectral Variability of Thirteen TeV High Energy Peaked Blazars with XMM-Newton		
We present a comprehensive study of the X-ray spectral variability observed in 13 TeV photon emitting high energy peaked BL Lacs (HBLs): 1ES 0229+200, 1ES 0347-121, 1ES 0414+009, PKS 0548-322, 1ES 1028+511, 1ES 0647+250, 1ES 1101-232, 1H 1219+301, H 1426+428, Mrk 501, 1ES 1959+650, PKS 2005-489, and 1ES 2344+514. These data come from 54 XMM-Newton EPIC-PN pointed observations made during its operational period from June 2001 through July 2023. We performed spectral studies in the energy range 0.6--10 keV by fitting X-ray spectra of the pointed observations with power law (PL) and log parabolic (LP) models. We found at 99$\%$ confidence level that 31 of these X-ray spectra were best fitted with a range of LP models with local photon indices (at 1.0 keV), $\alpha \simeq 1.75$–2.66, and convex curvature parameter $\beta \simeq 0.02$–0.25. PL models with photon index $\Gamma \simeq 1.78$–2.6 best described the spectra of fourteen-pointed observations. Nine PN spectra showed resulted in negative curvature parameter in fitting a LP model, and eight among them were significant ($\beta \geq 2 \times \beta_{err}$). We fitted broken power law (BPL) models to these eight X-ray spectra and found spectral hardening in the range of $\Delta\Gamma \simeq 0.06$–0.54 for these observations. EPIC-MOS spectra were also studied for those eight observations to search for similar trends and we were able to find them in only two, one observation each of PKS 0548-322 and Mrk 501. This indicates the possibility of the co-existence of an inverse Compton component along with the dominant synchrotron component for these two observations. We also performed correlation studies between various log-parabolic spectral parameters and briefly discuss their possible implications.		

ASI2025_436	Athira M Bharathan	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing High-Energy Emission Mechanisms in Blazars through X-ray Polarization with IXPE		
The spectral energy distribution (SED) of blazars typically exhibits a characteristic double-peak structure, with a low-energy peak from synchrotron radiation emitted by relativistic particles within the jet and a high-energy peak from inverse Compton scattering. In BL Lacertae (BLL) objects, the X-ray emission generally lies within the high-energy tail of the synchrotron component, whereas in Flat Spectrum Radio Quasars (FSRQs), it is situated in the low-energy segment of the inverse Compton component. These contrasting locations allow X-ray polarization measurements to provide insights into particle acceleration processes within the jets of these blazar types. In this study, we analyze observations of several blazars by NASA's Imaging X-ray Polarimetry Explorer (IXPE), detecting significant polarization in Mrk 421, 1ES 1959+650, and PKS 2155-304, while no X-ray polarization was detected for 3C 454.3. Through polarization analysis, we explore the structure and properties of the high-energy emission regions and examine the differing polarization behaviors between FSRQ and BLL sources, shedding light on distinctions between leptonic and hadronic models of blazar emission.		

ASI2025_247	Susmita Das	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
X-Ray Spectral Evolution and Fourier Time Lags in Two HSP Blazars		
We study X-ray (0.7-20 keV) spectra and light curves of two high synchrotron peaked (HSP) blazars, Mrk 421 and 1ES 1959+650, using simultaneous observations by the SXT and LAXPC instruments onboard AstroSat during 2016-19. We carry out time-resolved spectroscopy to study hours-timescale spectral variation, and find correlation between the variability of the best-fit spectral parameters. Cross-correlation analysis shows the hard and soft X-ray variability are strongly correlated with positive, negative or zero time lag at different epochs. We compute the cross-spectrum between the light curves in order to study the variation of the time lag as a function of Fourier frequency. We find hard-to-soft or soft-to-hard transitions in time lags with increasing Fourier frequency. For HSP blazars, the X-ray emission is dominated by synchrotron radiation by the highest energy electrons, and the energy dependent acceleration and cooling timescale may explain the time lags. We compare our results with a theoretical time dependent multi-zone model of non-thermal emission from blazars. We find that high-energy particles, having a simple power-law energy distribution injected by a shock front moving down the emission region, emitting synchrotron and inverse-Compton radiation in the presence of a turbulent magnetic field can give rise to the above spectral and temporal variability properties. However, partial mismatch in certain spectral properties suggest additional features in the energy distribution of injected particles or emission mechanisms.		

ASI2025_364	Priyesh Kumar Tripathi	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Isolated black holes accreting through dense environments		
We investigate accretion onto an isolated black hole under two wind configurations: (a) uniform winds directed towards the black hole and (b) winds streaming past the black hole. This study employs a non-relativistic 2D simulation code that incorporates the relativistically correct equation of state. A continuous parallel wind having different compositions, such as electron-proton flow or a charge-neutral mixture of electron, positron, and proton, was injected into the simulation domain through an inflow boundary. We found that no disc-like structures form within the accretion flow when uniform winds are directed toward the black hole. However, in the case of winds streaming past the black hole, the flow initially encircles the accretor, creating a disc-like structure. This disc later transforms into a shock cone due to the inflow pressure but reappears at a later time depending on the angular momentum distribution in different cases. These alternating phases of disc-like structure and shock cone significantly affect the bolometric luminosity of the system, causing variation by an order of magnitude.		

ASI2025_463	Pragyan Pratim Bordoloi	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Identification and modelling of optically thin inverse Compton scattering in the prompt emission of GRB131014A		

The mechanism responsible for the prompt gamma-ray emission of a gamma-ray burst continues to remain an enigma. The detailed analysis of the spectrum of GRB 131014A observed by the Fermi gamma ray burst monitor and Large Area Telescope has revealed an unconventional spectral shape that significantly deviates from the typical Band function. The spectrum exhibits three distinctive breaks and an extended power law at higher energies. Furthermore, the lower end of the spectrum aligns with power-law indices greater than -0.5, and in the brightest region of the burst, these values approach +1. The lowest spectral break is thereby found to be consistent with a blackbody. These observed spectral characteristics strongly suggest the radiation process to be inverse Compton scattering in an optically thin region. Applying the empirical fit parameters for physical modeling, we find that the kinetic energy of the GRB jet of bulk Lorentz factor, $\Gamma \sim 400$, gets dissipated just above the photosphere, approximately at a radius of ~ 1014 cm. The electrons involved in this process are accelerated to a power-law index of $\delta = -1.5$, and the minimum electron Lorentz factor, γ_{min} , is approximately 3. In summary, this study provides a comprehensive identification and detailed modeling of optically thin inverse Compton scattering in the prompt emission of GRB 131014A.

17th February 2025
Parallel Session – Galaxies and Cosmology III
[Chairperson: Abhirup Datta]
[Time: 14:00 - 16:00]

ASI2025_250	Rakshit Chauhan	Contributed Talk
Galaxies and Cosmology		
Effect of interaction on the star forming properties of dwarf galaxies		
One of the key drivers of galaxy evolution is interaction between galaxies and these interactions are expected to occur among galaxies of all mass range. Although dwarf galaxies constitute the most dominant population of galaxies across all redshifts, and majority of mergers are expected among them, studies exploring the effects of interactions in these systems are rare compared to that of massive galaxies. In this context, we have conducted a FUV study for a large sample of 6176 dwarf galaxies (195 interacting and 5981 non-interacting isolated galaxies within the stellar mass range of 10^7–10^10M⊙ and redshift range of 0.00 – 0.12) using GALEX archival data in order to understand the impact of dwarf-dwarf interactions on their star formation. We find clear evidence for enhanced star formation rate in interacting dwarfs with respect to their non-interacting counterparts when compared across different stellar mass and redshift bins. Further, in order to understand the effect of interactions on the spatial distribution and properties of star-forming clumps in interacting dwarfs, we performed a FUV study of 26 dwarfs (19 interacting and 7 non-interacting) undergoing different stages of interactions in stellar mass range of 10^6 − 10^8M⊙, in the Lynx Cancer Void, using higher resolution UVIT observations (∼ 3 times better spatial resolution than GALEX). Enhancement in star formation rate and star formation rate density for the clumps in the interacting dwarfs compared to the non-interacting galaxies was observed. We also find clear indications of star formation in tidal tails/bridges between interacting galaxies. In this talk, I will present the results from these studies and discuss future prospects using multi-wavelength studies to understand the overall evolution of low-mass galaxies.		

ASI2025_71	Chandan Watts	Contributed Talk
Galaxies and Cosmology		
A Tale of NGC 3785: The formation of an ultra-diffuse galaxy at the end of the longest tidal tail		
We present the discovery of an extended and faint tail associated with the galaxy NGC 3785 in an isolated environment. When galaxies interact, they produce tidal features based on the nature of the interaction and the fraction of gas involved. During this process, gas and stars are extracted in the form of tidal tails and streams (Watts et al. 2024). Studies indicate that these tidal tails are blue, and most of the gas accumulates near the tip of the long tails, which results in the formation of tidal dwarf galaxies during gas-rich mergers (Duc et al. 2004). In this work, we studied the nearby galaxy NGC 3785, which possesses lenticular (S0) morphology, and we observed a long extended tail associated with it. This tail is visible in the Dark Energy Camera Legacy Survey (DECaLS), Sloan Digital Sky Survey (SDSS), and Panoramic Survey Telescope and Rapid Response System (Pan-STARRS) images. However, it is most clearly seen in the DECaLS observations due to their higher sensitivity. We created a detection map using the optical g-band and used the boundaries of this map to measure the length of the tail through the cubic spline fitting method. The projected length of the tail is ~390 kpc, making it the most extended tail observed in an isolated environment so far. This study also provides observational evidence supporting the formation of ultra-diffuse galaxies (UDGs) at the end of the tail. We proposed two possible scenarios for the formation of the tail and one of the scenarios indicates that this tail resulted from the interaction of the NGC 3785 with a gas-rich galaxy, which leads to the formation of a UDG at the terminus of the tail.		

ASI2025_340	Saili Keshri	Contributed Talk
Galaxies and Cosmology		
Kinematic Misalignments and Remnant Features in Early-Type Galaxies: Insights from SDSS-MaNGA Data		
We present an analysis of 53 early-type galaxies (ETGs) using SDSS-MaNGA IFU data to investigate their stellar and gas kinematics, focusing on kinematic misalignments as indicators of merger activity. We examine the occurrence of these kinematic features across diverse environments and their position on the specific star formation rate (sSFR)–stellar mass plane. Most ETGs are found in intermediate-density environments, with smaller fractions in high- and low-density environments, suggesting a unique presence of ETGs in intermediate densities given ETGs' typical association with high-density environments. Kinematic analysis reveals that most ETGs show significant stellar-gas misalignment with higher misalignment rates in intermediate-density environments, likely due to favorable conditions for gas accretion. ETGs are distributed across the sSFR–mass plane, with the majority being quenched, while comparable fractions occupy the star-forming and green valley regions. Misaligned ETGs predominantly populate the quenched region, though some star-forming cases suggest recent merger events. Additionally, most ETGs in our sample display shell structures, and the majority of shell galaxies are kinematically misaligned. These shells, alongside other remnant features, are primarily found in intermediate-density environments, underscoring the significant role of both intermediate- and high-density environments in shaping ETG evolutionary pathways. ———— ——		

ASI2025_47	Mukesh Singh Bisht	Contributed Talk
Galaxies and Cosmology		
Origin of hot gas in the Circumgalactic Medium of the Milky Way		
The recent detection of hot gas, referred to as ` super-virial' gas ($\sim 10^7$ K), in the Circumgalactic Medium (CGM) of the Milky Way has raised intriguing questions about its origin, geometry, and spatial distribution. This gas has been observed both in X-ray emission and absorption; in emission, it appears alongside ` virial' gas ($\sim 10^6$ K), while in absorption, it has been identified through the detection of highly ionized species like SiXIV, NeX, and OVIII in the spectra of Quasars. Notably, the ` emitting' super-virial gas and the ` absorbing' super-virial gas have different origins. To demystify the origin and characteristics of hot gas, we have developed models for both emitting and absorbing super-virial gas. For the emitting gas, we adopt a ` puffed-up disk' geometry based on the observed anticorrelation between Emission Measure (EM) and sin(b), where b is the Galactic latitude with a typical scale height of 1 kpc and scale radius of 5 kpc. This disk-like model explains the observed correlation between the EM of the super-virial and virial gas. We have also conducted hydrodynamical simulations of supernova (SNe)-driven disk-wide outflows to connect the origin of this gas to the outflows from SNe in the Milky Way's disk. For the absorbing super-virial gas, we propose that it originates from shocked ejecta in supernova remnants (SNRs) located in the extra-planar region surrounding the Milky Way's disk. The reverse shock in the supernova can heat the α-enriched ejecta to very high temperatures ($\sim 10^7$ K). This model effectively accounts for the high column densities of H-like ions observed in absorption when the line of sight intersects such SNRs in the halo. Additionally, the supernova model explains the non-solar composition of the observed super-virial gas, as the shocked ejecta is \(\alpha\)-enriched and likely has super-solar characteristics.		

ASI2025_305	Shashank Gairola	Contributed Talk
Galaxies and Cosmology		
Tracing Hierarchical Star Formation out to Kiloparsec Scales in Nearby Galaxies		
Star formation is a hierarchical process, as revealed by the observations of its several gaseous and stellar tracers. Supersonic turbulent motions in molecular clouds produce scale-free, hierarchical density structures which undergo gravitational collapse during star formation and result in a hierarchical distribution of stellar matter in galaxies. To explore this hierarchy, we use the FUV and NUV observations of 4 nearby spiral galaxies from the Ultra-Violet Imaging Telescope (UVIT). By employing two-point correlation statistics, we find that the young star forming clumps (SFCs) in galaxies are arranged in a fractal-like, hierarchical distribution. However, this hierarchy is only observable till a maximum scale of order ~1 kpc and does not extend to the entire galaxy size. Hierarchical star formation can be sustained up to this scale by ISM turbulence originating from sources such as gravitational instabilities, cloud collisions and stellar feedback. The hierarchical distribution of SFCs randomizes over 10-50 Myr which is caused by the SFCs migrating away from their birthplaces with increasing age. We find that unlike the often-quoted, universal hierarchical properties of molecular gas, the resulting hierarchy of star formation is not universal rather, it depends on the host galaxy properties such as the nature of spiral arms, stellar mass and galactic shear. Turning our investigation towards gaseous tracers of star formation, we also analysed HII region distribution in a sample of 19 neighbouring galaxies and observed that HII regions show only mild signatures of being part of a hierarchy. Hereby, we are observing stark differences in the spatial distribution of stellar and gaseous tracers of star formation in galaxies. Through these projects which I will elucidate in my talk, we are actively investigating the role of gravity, turbulence and galaxy environment on the hierarchical star formation process in order to better understand the baryon cycle in galaxies.		

ASI2025_10	TANYA TRIPTY	Contributed Talk
Galaxies and Cosmology		
AN UNBIASED MHI and MStar SCALING RELATION IN THE LOCAL UNIVERSE.		
The various processes and evolutionary phases experienced by galaxies show emissions spanning the entire electromagnetic spectrum. Consequently, a comprehensive understanding of these phenomena requires a multi-wavelength approach. In this work, I used the 100% ALFALFA catalog in conjunction with its optical counterparts(Durbala et al. 2020). Optical counterparts have been matched in SDSS, GALEX and WISE. These can be used in conjugation to give better estimates for the stellar mass. We have Stellar Mass Estimates derived with Kcorrect based on optical ugriz bands, and GSWLC-2 mass estimates(Salim et al. 2016) which utilize all three surveys in optical, UV, and infrared bands.GSWLC provides more accurate stellar mass estimates because of two additional bands. We use non-parametric method to constrain the stellar mass function of gas-rich galaxies in the ALFALFA 100% sample for both stellar mass estimates and compare their results. The data is consistent with the Schechter function with the best-fit parameters Mstar , ϕstar /103 and α(=10.85,2.84,-1.22). Additionally, we look at the contribution to the total stellar mass function of these galaxies from the red(=10.82,2.19,-1.03) and blue(=10.73,1.39,-1.32) population of galaxies. Compared to the overall population, the red population is 60% of the total stellar mass while blue pop- ulation contributes rest. The gas-rich population of galaxies consists of 15% of the total stellar mass. In this process, we have developed a method to predict the stellar mass function and can extend it to other optical properties. We have then used Stellar Mass Function to determine the underlying scaling relation between MHI and Mstar across different galaxy populations, including complete samples, as well as blue and red galaxies. This approach helps us understand how the relationship between cold gas and stellar mass changes across different types of galaxies in an unbiased manner.		

ASI2025_317	Atharva Mirashi	Contributed Talk
Galaxies and Cosmology		
HI Observations of Dark Matter Deficient Dwarfs Galaxies		
Recent discoveries of Dark Matter-Deficient galaxies in the local universe challenge the current understanding of galaxy formation and evolution models. Guo et al. (2020) identified 14 such galaxies using the SDSS and Arecibo ALFALFA survey data. They used single-dish HI spectra and optical inclination to estimate the velocity widths and dynamical masses of these galaxies. However, the single-dish observations often can get contaminated for several reasons, and the optical inclinations might not be consistent with the inclination of the HI disk. We conducted interferometric observations of six galaxies from their sample with the uGMRT to resolve this issue. With our observations, we have been able to produce the rotation curve of these galaxies. Our preliminary result indicates that some of these galaxies indeed show a deficiency in dark matter. For example, the ratio of dark matter to baryonic matter in UGC6438 is found to be about 3.6, which is considerably lower than what is seen in other dwarf galaxies (~ 10 or more). In this presentation, I will describe the results for all our sample galaxies and discuss how they pose a challenge to the current understanding of galaxy formation and evolution in the context of the Lambda-CDM model.		

ASI2025_702	Yogesh Chandola	Contributed Talk
Galaxies and Cosmology		
Neutral atomic hydrogen in nearby compact starburst galaxies		
Compact starburst galaxies such as Blue Compact Dwarf galaxies (BCDs), Green Peas and Blueberry galaxies at nearby redshifts act as local laboratories to understand star formation in the early primordial Universe. Studying atomic HI gas content and gas depletion time scales can provide insights into the evolutionary processes of these galaxies. In this talk, I will present our recent work on, actively star-forming, blue compact dwarf galaxies (BCDs) and blueberry galaxies from 21 cm observations with the Arecibo Observatory, Giant Metrewave Radio Telescope (GMRT) and Five hundred metre Aperture Spherical radio Telescope (FAST). Of the 11 BCDs observed with the Arecibo telescope, HI emission was detected in six sources. For comparison, we used the HI data of additional dwarf irregulars (dIs) and BCDs in the literature. BCDs observed with the Arecibo have HI mass-stellar mass relation similar to that from earlier observations which implies that HI gas dominates the baryons at lower stellar masses. BCDs observed with the Arecibo Observatory have significantly lower median HI depletion timescales of $\sim$ 0.3 Gyr than depletion scales of other dIs/BCDs in literature. I will also present the results from follow-up deep HI observations of two BCDs with GMRT where we find that star formation takes place in high HI gas density regions. After that, I will present the results of our recent HI study of 28 blueberry galaxies with FAST. We have detection towards only two sources and a low median depletion timescale upper limit of ~0.5 Gyr from non-detections. We find blueberry galaxies tend to have a lower gas fraction (HI-to-stellar mass ratio) than expected from gas fraction-stellar mass relation for main-sequence galaxies. I will conclude with the prospects for HI studies with the Square Kilometer Array (SKA) pathfinders such as GMRT, FAST, MeerKAT and SKA in future.		

17th February 2025
Parallel Session – Facilities, Technologies and Data science III
[Chairperson: Blesson Mathew]
[Time: 14:00 - 16:00]

ASI2025_764	Vikram Rana	Invited Talk
Facilities, Technologies and Data science		
X-Ray Astronomy: a Unique Observational Window to Study Astronomical Sources (I)		
X-rays are the signatures of the high-energy Universe. The X-ray photons being produced in extreme conditions, provide unique opportunity to probe regions close to the Black Holes, Neutron stars and White Dwarfs. Hence making it possible to study such exotic objects in the Universe, thereby allowing the exploration of physical processes in extreme conditions. Many X-ray missions and instruments were realised since 1960s that contributed to the present understanding of the physics of X-ray emission in various astronomical sources. A steady progress in technological development has put X-ray astronomy in the mainstay of astronomy and astrophysics. In this talk, I will provide an overview of the observational X-ray astronomy as well as current and future X-ray missions that have provided some path breaking scientific results to shed new lights on the nature of various astronomical sources as well as the physical mechanisms by which the X-rays are emitted. I will briefly mention about India's only X-ray polarimetry instrument POLIX onboard XpoSat satellite.		

ASI2025_257	Tarun Bangia	Contributed Talk
Facilities, Technologies and Data science		
Development and Prototype Testing of a Monitoring System for 3.6m DOT Equipment		
The development of an effective monitoring system for equipment supporting telescope operations is crucial for ensuring reliable operation and preventing equipment malfunctions. The present work presents the development and prototype testing of a monitoring system designed for equipment of 3.6m Devasthal Optical Telescope (DOT). The system is tailored to track two key performance indicators viz. thermal stability and vibration levels of mechanical equipment supporting telescope operations. The system incorporates sensors, data acquisition and diagnostics to monitor equipment health, enabling early fault detection and predictive maintenance. The system can be monitored in real-time remotely to streamline operations. Prototype testing of a part of the system was conducted for a few equipment to assess the system's performance under operational and environmental conditions. Raspberry Pi, DS18B20 temperature sensors and wireless vibration sensors, etc. were employed for taking sample data. Key testing objectives included the collection of data and data processing to track the abnormal conditions. Temperature metrics and vibration spectrums were obtained for equipment. A shock pulse signal was also used to determine the bearing condition and faults within the rotating machinery. The analysis will be useful in the detection of early signs of mechanical issues involving misalignment and bearing faults etc. The prototype tests demonstrate the system's capacity to detect and diagnose potential issues in components of equipment before they lead to failures, enhancing equipment longevity and supporting optimal functionality. Early warning signals will be useful in initiating proactive maintenance activities. The findings contribute valuable insights into the development of monitoring solutions for equipment supporting telescope operations.		

ASI2025_714	Kuntal Misra	Contributed Talk
Facilities, Technologies and Data science		
Initial results from the 4-m International Liquid Mirror Telescope (ILMT)		
The 4m International Liquid Mirror Telescope (ILMT) is the first optical survey telescope in Devasthal, India. The telescope achieved its first light on 29 April 2022. The primary mirror is made of liquid mercury, continuously spinning to achieve a paraboloid shape. It constantly scans a 22 arcmin wide strip of the zenithal sky and records the images in three broadband filters (g', r' and i') using a 4k X 4k CCD camera in Time Delay Integration (TDI) mode. In about 10-12 hours of observations during a single night, approximately 15 GB of data volume is generated. To process this data, different automated pipelines are developed to perform the astrometric and photometric calibration, image subtraction to detect new transients and machine learning based tools to classify these transients. In this talk, I will give a brief overview of the ILMT and its science drivers, the initial results and the availability of data to the users.		

ASI2025_640	Kiran Jayasurya	Contributed Talk
Facilities, Technologies and Data science		
GEM-TPC Soft X-ray Polarimeter: Demonstration of Polarimetric Capability		
The Soft X-ray Polarimeter (SXP) is a Gas Electron Multiplier (GEM) based Time Projection Chamber (TPC) type polarimeter being developed in the 2-10 keV energy band by the Space Astronomy Group, U R Rao Satellite Centre. X-ray photons enter the gas chamber between a cathode and a standard GEM in the direction parallel to an anode strip readout below the GEM. The photons undergo photoelectric absorption in the gas volume and produce an electron charge cloud which drifts towards the GEM under the influence of an electric field. The charge cloud gets amplified via avalanche multiplication across a GEM and a signal is induced at the anode strip readout. The time of drift and the strip number at the readout gives the projection of the electron track in the azimuthal plane with respect to the incident photon beam. The tracks are then reconstructed to get the initial photoelectron emission directions and thereby, the phase angle of polarization. A distribution of the phase angles can be fit with a cosine function to get the modulation curve and thereby the polarization properties of the beam. Here, we present the results from the lab model of SXP and the modulation obtained for polarized X-ray input at 4.0 and 6.15 keV energies. Further progress is being made to optimize the operating parameters and maximize the modulation factor within the energy band of interest.		

ASI2025_503	Prasad Neelam	Contributed Talk
Facilities, Technologies and Data science		
The 2.5M Telescope and backend instruments suite		
Commissioned at Guru Shikhar in October 2022, the 2.5m telescope at Mount Abu is one of India's notable developments in astronomy. This modern facility is one of the most developed observatories in the country, featuring high-tech equipment for high-end observation and data acquisition. The initial 'first light' instrument set includes the PARAS-2, an in-house developed, high-resolution, fiber-fed spectrograph. PARAS-2 plays a vital role in exoplanet detection and other high-resolution spectroscopic studies, showcasing the expertise of Indian engineers and scientists in cutting-edge instrument design. In addition to PARAS-2, the telescope is equipped with a Speckle Imager, essential for high-contrast imaging, and a 4k CCD Imager (Faint Object Camera-FOC) for imaging studies. From 2023 to 2024, two instruments developed in the institute were also installed on the telescope: The Low-Resolution Spectrograph (LRS) and Proto-pol. The LRS allows a wide range of low-resolution spectra studies, essential in observing fainter objects or features with a more comprehensive spectral range. Proto-pol, in turn, adds to performing polarization studies and low-resolution spectroscopy by the instrument. In my talk, I will provide a brief yet comprehensive overview of the 2.5m telescope and its suite of back-end instruments. Each instrument is pivotal in expanding our understanding of the cosmos.		

ASI2025_388	Kalpesh Chillal	Contributed Talk
Facilities, Technologies and Data science		
Challenges in Upgradation and Testing of IFOSC CCD Controller		
The IGO telescope, equipped with the IFOSC (IUCAA Faint Object Spectrograph & Camera) instrument, is a back-end instrument for astronomical observations at optical wavelengths. The IFOSC supports imaging, spectroscopy, and polarization studies, and it includes additional systems such as a calibration unit, CCD Dewar and camera, a Common Control Unit (CCU), and control software. This paper examines how these components are designed and how they improve the telescope's ability to observe. Integrating these systems provides a comprehensive view of advanced instrument design for astronomical purposes. Key challenges in testing these systems and the methods used to ensure reliable calibration and accurate data capture are addressed. A discussion on the current specifications of the CCD controller, which uses analog CDS (Correlated Double Sampling) technology and receives astronomical data through fiber optic connectors, highlights hardware issues. These issues, particularly data transmission and performance consistency, present significant difficulties, necessitating careful troubleshooting and innovative solutions. As technological advances continue, the need for instrument upgrades becomes essential. This paper highlights the contributions of IDSAC (IUCAA Digital Sampler Array Controller) hardware and software, which are crucial in enhancing instrument performance and data accuracy. The new controller features increased clock speeds, three gain settings, and Ethernet-based data transmission, improving image quality and observational efficiency. This study provides valuable insights into the design, testing, and optimization of advanced astronomical instruments, establishing a framework for future enhancements in telescope instrumentation.		

ASI2025_670	Rahul Gopalakrishnan	Contributed Talk
Facilities, Technologies and Data science		
Data processing pipeline of SUIT onboard Aditya-L1		
The Solar Ultraviolet Imaging Telescope (SUIT) onboard Aditya-L1 observes the Sun from Lagrange point 1. It generates about 100 Gb of data per day in the default observation mode, capturing Region of Interest (ROI) and full-disk images as per the planned observations. In this presentation, we explain the data flow through the pipeline and the corrections applied to the images during processing. SUIT produces two levels of data products: Level 1, which will be made available within 24 hours of data reception, and Level 2, which will be made available within one week. Outreach images and daily movies are also regularly produced and will be available to the public. We elaborate on the processing steps involved in producing these outputs.		

ASI2025_528	Manish Chauhan	Contributed Talk
Facilities, Technologies and Data science		
Long-term analysis of meteorological parameters over Indian astronomical sites		
The Earth’s atmosphere adversely affects most ground-based astronomical observations. Observations in the visible and the Infrared are affected by cloud cover and atmospheric turbulence which can lead to a degradation in the atmospheric seeing. In addition, ground based observations are severely impacted or influenced by atmospheric water vapour. Atmospheric water vapour is of particular importance in the sub-millimeter regime where even slight increase in water vapour can significantly decrease the atmospheric transmittance. This is of particular relevance for SAC-ISRO’s proposed submm/THz telescope at a high altitude site, Hanle, Ladakh. In this study, we analyse and discuss the long-term trends (1975 - 2023) and statistical analysis of these meteorological parameters using the ERA5 reanalysis dataset over 10 Indian astronomical observations sites. These sites cover diverse atmospheric and climatic conditions with varying background conditions. These trends are studied over different timescales (months and seasons). Over the historical period, we observe an increase in columnar water vapour and 2m air temperature over various observational sites in certain time periods. We also discuss the trends observed in cloud cover, 10 m wind speed and total columnar ozone. Additionally, we will present climate projections from the future climate scenarios over these sites. Studying these long-term trends and climate projections are of particular importance for site characterization of upcoming Indian astronomical observatories.		

ASI2025_559	Thubstan Rinchen	Contributed Talk
Facilities, Technologies and Data science		
Design & Development of mechanism for Mirror Panel Maintenance for MACE Telescope		
MACE (Major Atmospheric Cherenkov Experiment), an imaging atmospheric Cherenkov telescope is operational at Hanle in Ladakh to explore the very high energy gamma ray universe. The telescope is equipped with a large, 21 m diameter quasi-parabolic optical reflector. The tessellated light collector comprises of 356 mirror panels of each 0.984m X 0.984m supported on basket frame structure on three ball joint pivots. Each mirror panel consists of 4 mirror facets of size 0.488m × 0.488m, grouped to obtain a single reflecting surface. Maintenance of the mirror panels is necessary due to the gradual misalignment of mirror facets, reduced reflectivity, and issues with mechanical connections. The primary challenge in maintaining these mirror panels arises from the substantial size of the light collector, a limited position of telescope under which we can conduct the maintenance and constrained space available for maintenance due to high fill factor of light collecting surface. To address this, a mechanism has been developed for replacement of mirror panels on the basket frame. This mechanism encompasses a device for securely holding the mirrors, a mechanism for projecting them, and a device for collecting the mirrors. It allows for the extension of mirror panels beyond the reflective surface by 240 mm, accomplished through a lead screw system affixed to the basket in place of the existing pivot clamps. This projection of the mirror panels greatly simplifies the process of disassembly and reassembly. The collection of mirrors onto an aerial access platform is facilitated by a mirror holder frame attached to basket of Ariel access platform and a vibration isolator to avoid the transfer of gravity movement of Ariel access platform to the telescope basket. The mechanical design and the outcomes of the testing for this mechanism will be presented during the meeting.		

18th February 2025
Plenary Session III
[Chairperson: Jessy Jose]
[Time: 09:15 - 11:15]

ASI2025_765	S. P. Rajaguru	Invited
Plenary		
Solar Interior Dynamics and Helioseismology		
Continuous helioseismic observations over the last three decades, from space (SOHO/MDI and SDO/HMI) as well as from ground (GONG), have enabled studies of variations in large scale flows in the solar interior, especially that in rotation (zonal) and meridional flows. These measurements are crucial to constrain dynamo models and hence to understand the origin and maintenance of solar magnetism. We summarise recent progress in such helioseismic studies of solar interior, focussing on the dynamics of near-surface shear layer (NSSL) as well as the tachocline, and their connections to magnetic fields and the solar cycle.		

ASI2025_785	Manoj Puravankara	Invited
Plenary		
Star and Planet Formation Studies in the New Millennium: Key Insights from Infrared Space Missions		
The past two decades have been transformative for our understanding of star and planet formation, driven by the unprecedented capabilities of infrared space observatories. This talk highlights key insights from the Spitzer Space Telescope, the Herschel Space Observatory, and the James Webb Space Telescope (JWST), which together have reshaped our view of how stars and planets form in the cosmos. Spitzer provided the first comprehensive mid-infrared census of protostars, enabling detailed characterization of protostellar evolution and addressing the long-standing “protostellar luminosity problem.” Its groundbreaking discovery of transitional disks, along with detailed studies of the disk chemical composition, structure, and evolution, established a foundation for understanding planet formation. Herschel extended this understanding into the far-infrared, probing the cold dust and gas in star-forming regions, unveiling the most embedded, reddest and youngest protostars. It provided well characterised spectral energy distributions even for the deeply embedded protostars, enabling us to study the earliest stages of star formation, providing detailed views of protostellar environments and revealing the interaction between energetic outflows and the protostellar envelopes, thus allowing us to study mechanical and radiative feedback. JWST is now revolutionizing the field with its unparalleled spatial and spectral resolution. JWST’s ability to observe protostellar jets and winds in unprecedented detail has provided new insights into their launching, propogation and feedback mechanisms, leading to a new paradigm in which disk winds drive accretion thereby making star formation possible. Additionally, JWST’s rich spectra of protoplanetary disks are revealing the chemistry of planet-forming regions, offering crucial insights into the building blocks of planetary systems. This talk will synthesize these transformative discoveries, demonstrating how Spitzer, Herschel, and JWST have collectively advanced our understanding of the formation and evolution of stars and planetary systems, setting the stage for future explorations in the field.		

ASI2025_477	Yogesh Chandra Joshi	Invited
Plenary		
Exploring Open Clusters to Unravel Galactic Structure		
Recent advancements have enhanced our understanding of the Milky Way formation and evolution through various stellar populations. Open star clusters, which populate the Galactic disk and trace the spiral arms with their younger stars, play a key role in such a study. A significant number of open clusters have been identified in the Milky Way through both optical and infrared observations, resulting in a significant enhancement in the open cluster sample and over 6,000 open clusters are already catalogued so far. This comprehensive data catalogue not only sheds light on the general characteristics of the open cluster system but also provides a great insights into the Galactic structure in our solar neighborhood. In this review talk, I will explore the Galactic open cluster systems and their role in understanding the structure of our galaxy.		

18th February 2025
Parallel Session – Sun, Solar System, Exoplanets and Astrobiology IV
[Chairperson: Priyanka Chaturvedi]
[Time: 11:45 – 13:00]

ASI2025_627	Sourav Chatterjee	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Dynamical Processes Can Explain the Orbital Architectures of Kepler's Multis		
We now know of over 6000 confirmed exoplanets thanks to a large number of surveys. In particular, the Kepler, K2, and TESS missions dominate the number of discovered planets. Interestingly, a large fraction of these planets are in multi-transiting architectures with closely-packed compact orbits. On one hand, the compact nature of the orbits increases the chance for dynamical instabilities. On the other hand, the multi-transiting nature which requires very low mutual orbital inclinations led people to think that dynamical instabilities may not have played an important role for these systems. Recently, several studies have indicated that the separations between orbits in known multiplanet systems may indicate past dynamical morphing. We show that indeed, dynamical instabilities previously more compact systems with higher number of planets not only can simultaneously explain all observed distributions of exoplanet properties, many correlations between these properties naturally emerge as a result of such instabilities without any input from formation theories. Our results thus suggest that most observed trends in the multis may not have been acquired by birth, but by nurture through a variety of dynamical processes after birth. In my presentation I will talk about the various dynamical processes that may have shaped the orbital architectures of these multiplanet systems.		

ASI2025_284	Jagabandhu Panda	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Martian clouds and their association with atmospheric dust distribution, dynamics and thermodynamics		
Martian clouds are distinctive in nature compared to Earth’s atmosphere. They appear in the tropics as Aphelion Cloud Belt (ACB) or tropical cloud belt (TCB), as water ice clouds over volcanos, as polar hood clouds over poles, etc., in Martian atmosphere. The atmospheric dusts interact with these clouds in an interesting manner, i.e., either dynamically and microphysically. Also, atmospheric thermodynamic characteristics play a significant role in governing these interactions. The objective of this study is to comprehend the Martian cloud characteristics in general and elucidate its association with dust distribution and atmospheric thermodynamics. Observations from Mars Climate Sounder (MCS) and Mars Color Imager (MARCI) onboard Mars Reconnaissance Orbiter (MRO), and Mars Color Camera (MCC) onboard Mars Orbiter Mission (MOM) would be used besides the numerical modeling outputs from MarsWRF. The satellite observations helped in understanding the sub-seasonal, seasonal and inter-annual variability of clouds and the microphysical interaction between dust and water ice enabling the analysis of TCB evolution. Besides, the influence of upper tropospheric dust is realized for the northward evolution of TCB. A strong association of high altitude dustiness with orographic clouds relating to Arsia and Olympus Mons. Thick and thin clouds observed in the volcanic mountainous regions of Arsia and Olympus Mons have distinct characteristics. While the thick clouds are realized to be part of ACB, the thin clouds are found to be influenced by vertical advection. MarsWRF helped in isolating this type of dynamical influence of dust-laden vertical transport supported by mountain-induced regional circulation during the perihelion season. Besides upper tropospheric dustiness, the atmospheric thermodynamics is realized to have an association with ACB and TCB’s evolution too. The study also comprehended an indirect impact of global dust loading in the north polar atmosphere during a global dust storm scenario.		

ASI2025_55	SHRADDHA BISWAS	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Investigating the Potential Causes of Transit Timing Variations for TrES-2b in the Era of TESS.		
Transit timing variations (TTVs) have emerged as a crucial methodology in the field of exoplanetary science, allowing researchers to detect and characterize exoplanets by examining fluctuations in their transit times. In our investigation of the TTVs associated with the hot Jupiter TrES-2b, we compiled data from 64 high-quality transit light curves obtained from all seven sectors of NASA's Transiting Exoplanet Survey Satellite (TESS). This dataset was further enhanced with 60 optimal light curves sourced from the Exoplanet Transit Database and integrated with 106 mid-transit times from previous research. Our comprehensive analysis of these transit timings indicated a significant improvement in the orbital ephemerides of TrES-2b; however, we did not detect any short-period TTVs that would suggest the presence of an additional body in the system. The lack of observable short-term TTVs encourages a deeper investigation into long-term TTVs, which could be influenced by phenomena such as orbital decay, apsidal precession, the Applegate mechanism, and the Rømer effect. Among these potential causes, orbital decay emerged as the most plausible explanation for the observed TTVs, supported by a ΔBIC value of 4.32. We estimate that the orbital period of TrES-2b is decreasing at a rate of approximately –5.58 ± 1.81 ms yr^{-1}. Assuming that this decay is primarily a result of tidal dissipation within the host star, we calculated the stellar tidal quality factor to be approximately 9.9×10^3. This value is 2–3 orders of magnitude lower than theoretical predictions for other hot Jupiter systems, suggesting a more efficient tidal dissipation mechanism at play within the host star. To further elucidate the underlying causes of the observed changes in the orbital period, additional precise photometric and radial velocity measurements will be necessary.		

ASI2025_15	Anirban Mandal	Contributed Talk
Sun, Solar System, Exoplanets, and Astrobiology		
Analysing the growth and evolution of two regional dust storms using MRO-MCS, Curiosity, and Perseverance observations		
Dust storms on Mars have a complex relation to the dynamics and thermodynamics of the atmosphere. Although the formation of storms is known, simultaneous orbital and ground-based observations are required for a comprehensive understanding. This study analyses the growth and development of two regional dust storms using orbital measurements and ground based observations. The said dust storms were observed in MY 36 around LS=153°-156° (RDS-A) and 310°-330° (RDS-B). Observations from the Rover Environmental Monitoring Station (REMS) onboard the Curiosity rover, the Mars Environmental Dynamics Analyzer (MEDA) onboard the Perseverance rover, and the Mars Climate Sounder (MCS) instrument from NASA's Mars Reconnaissance Orbiter (MRO) have been used in this study. Both storms showed an eastward expansion, while RDS-B additionally exhibited a southward expansion. The MCS observation-based vertical variation of stability indicates convection at the lower altitudes (0-5 km) in the latitude range 40°S-90°N for RDS-A. For RDS-B, strong convection is observed in the latitude range 90°S-40°N at altitudes 0-10 km. The dust mixing ratio from MCS observations indicates higher availability of dust at 30-55 km in the latitude range 40°S-40°N for RDS-A and at 20-60 km in the latitude range 90°S-45°N for RDS-B. The temporal variability of pressure from the MEDA and REMS observations shows a major variation in its amplitude for both storms, indicating baroclinic wave activity. The decrease in MEDA and REMS temperature for both storms indicates dust at higher altitudes, and the decrease in volume mixing ratio suggests prominent cooling during night time. Thus, the present study sheds light on the complex dust-lifting mechanisms and helps improve the understanding of the Martian atmosphere and dust cycle.		

18th February 2025
Parallel Session – Stars, Interstellar Medium, and Astrochemistry in Milky Way IV
[Chairperson: Devendra Ojha]
[Time: 11:45 – 13:00]

ASI2025_608	Drisya Karinkuzhi	Invited talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Neutron capture processes and Galactic chemical evolution (I)		
Elements heavier than iron are primarily produced by two neutron capture processes, the slow neutron-capture process (s-process) and the rapid-neutron capture process (r-process). As low and intermediate stars reach the end of their lives, their physical conditions are suitable for the s-process, which produces half of the heavy elements. A second half of the heavy elements are formed when neutron stars or black holes merge under more exotic conditions. An intermediate neutron-capture process is introduced to explain the double enrichment of s- and r-processes observed by a group of carbon-enhanced metal-poor (CEMP) stars, which occurs at conditions intermediate between those of s- and r-processes. Although most heavy elements have a fairly well-defined origin, the presence of multiple stable isotopes with different nucleosynthetic origins still makes it unclear what role and contribution neutron capture processes play in their production. Additionally, peculiar behaviors shown by key elements such as C and N, have not yet been properly explained with the existing theories of stellar evolution and nucleosynthesis. Our recent attempts, based both on elemental abundances and isotopic abundances, to understand the role of different neutron capture processes on the production of heavy elements and also on the overall chemical enrichment of the galaxies will be discussed in my presentation.		

ASI2025_260	Ashish Kalyan	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
VLBA Pulsar Astrometry of J0332+5434 and J1136+1551: Insights into Ionospheric Distortions		
Determining astronomical distances has significant challenges, with different distance scales relying on different methods. A parallax method is a direct approach for distance estimation, forming the foundation of the so-called distance ladder, but its utility is limited to a few kpcs due to small parallax contributions at large distances. The most precise model-independent distance measurements come from VLBI parallax campaigns. VLBI provides the highest angular resolution achievable with ground-based radio telescopes, providing correspondingly precise positions. Relative astrometry offers more precise distances, determining the target position with respect to a background reference source at multiple epochs. In relative astrometry, the possible differences in the atmosphere sampled by the target and calibrator dominantly affect the precision of the position and, hence, the parallax measurements. Fortunately, numerous calibration techniques have been developed to reduce its effect (e.g., In-Beam calibration, 1D, 2D interpolation, and PINPT). Apart from the thermal noise in the measurements, the primary contribution to systematic uncertainties in L-band VLBI astrometry originates from the ionosphere, which depends on the separation between the target and the calibrator. Recently, a modified mapping function (Petrov23), which converts vertical total electron content (TEC) to slant TEC, aims to better compensate for the dispersive delays. The effectiveness of new approaches to correct dispersive delay using global ionospheric maps on astrometry is still questionable. In the talk, I will discuss the above-mentioned calibration technique, refined astrometric parameters of the mentioned pulsars, and the effectiveness of the Petrov23 mapping function.		

ASI2025_323	Rahul Sharan	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Detection of nulling in millisecond pulsars using uGMRT observations		
Nulling pulsars are characterized by the absence of detectable pulsed signals. These are mostly seen in normal pulsars, and none of the millisecond pulsars (MSPs; pulsars with a spin period less than 30 ms) are known to show nulling to date. With a wide frequency coverage from 300-1500 MHz and a large collecting area, uGMRT becomes an ideal telescope for nulling studies on MSPs. We present results from an investigation, showing that the MSPs are exhibiting nulling phenomena using uGMRT observations. Our observations captured nulling in a few MSPs (J2144-5237, 0248+4230, J1646-2142 to name a few) in multiple observing epochs. We note that the effect of ionospheric scintillation is manifested in flux density variation over time and frequency, which can create confusion while identifying the underlying mechanism for nulling. We developed a new algorithm for searching nulls in time-pulse phase space, and compared our results with previous algorithms (Ritchings 1976, Kaplan et al. 2018) applied on normal pulsars. Since MSPs are intrinsically faint sources, they are classified as Intermittent Nuller (as per Konar & Deka 2019), which show nulling in a few seconds but single pulse nulls are not detected. We averaged for a few seconds and estimated the Nulling fraction (NF) and Nulling lengths (NL) of the MSPs. Finally, our study indicates that the phenomenon of nulling was not previously detected for the MSPs because of their faint nature; sensitive observations with upcoming and ongoing facilities aided with careful searching for nulling would enable us to increase the sample of nulling MSPs. This will be an important step for understanding the emission mechanism of MSPs and judging the likenesses of similar emission mechanisms for normal pulsars and MSPs.		

ASI2025_579	Zenia Zuraiq	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Explaining unusual observations using magnetized white dwarfs		
Magnetic white dwarfs (WDs) are a significant fraction of observed WDs, present in both isolated and binary cases. The surface fields of these magnetized WDs can range from 10^3 to $10^{10} \ G$. These magnetic fields can lead to various interesting effects on the WD structure. As shown by our group in previous work, high magnetic fields can lead to the modification of the Chandrasekhar mass limit through both classical and quantum effects. This can lead to the super-Chandrasekhar WDs inferred from the observations of peculiar over-luminous type Ia supernovae (e.g. SNLS-03D3bb). Magnetized WDs can also be linked to other unusual sources that do not satisfy conventional explanations. These include extremely slow rotating pulsars (e.g. J0901-4046, GLEAM-X J162759.5–523504.3). These could be WD pulsars, analogous to the confirmed case of AR Scorpii. Another class of unusual pulsars is the soft gamma-ray repeaters (SGRs) and anomalous X-Ray pulsars (AXPs). These are hypothesized to be highly magnetized neutron stars. However, a few of these (e.g. SGR 0418+5729) show lower magnetic fields than that expected from the neutron star based model. In this work, we explore time-dependent simulations of the evolution of main sequence stars to magnetized WDs. We provide a link between these unusual observations (peculiar overluminous type Ia supernovae, extremely slow rotating pulsars, lowly magnetized SGRs/AXPs) and magnetized WDs.		

18th February 2025
Parallel Session – High Energy Phenomena, Fundamental Physics and Astronomy IV
[Chairperson: Indranil Chattopadhyay]
[Time: 11:45 – 13:00]

ASI2025_609	Bhargav Vaidya	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Simulating Astrophysical and Space Plasma Jets in the Era of Multi-messenger Astronomy.		
Particle acceleration is a prevalent phenomenon observed in astrophysical and space plasma jets, particularly in our Sun, young stars, and Active Galaxies. Various mechanisms energize particles in these environments, interacting in a complex, non-linear manner across different time and length scales, making it challenging to identify the physical processes that drive particle acceleration. Specifically, jets from Active Galactic Nuclei (AGN) are relativistic beams of plasma that encounter magnetic instabilities, leading to shocks, turbulence, and reconnection events within the jet. These processes are essential for regulating the primarily non-thermal emission across multiple wavebands from AGN jets.In my presentation, I will share recent research aimed at elucidating the relationships between these phenomena. Our findings use a hybrid Eulerian and Lagrangian modeling framework that captures large-scale jet dynamics while integrating micro-physical aspects like particle acceleration and radiative cooling at a sub-grid level. The interaction of shock and stochastic acceleration mechanisms will be discussed, based on axisymmetric simulations of radio lobes conducted within this framework. Additionally, I will describe our study of unusual radio features in AGN jets, showcasing high-resolution, three-dimensional relativistic magnetohydrodynamic (MHD) simulations. These simulations compare the ribs and tethers observed in the "MysTail" radio galaxy from the Abell cluster 3266, as part of the MeerKAT Galaxy Cluster Legacy Survey. The role of kink instability-driven phenomena in producing these features will also be emphasized. Finally, I will present initial results from a novel 3D relativistic MHD simulation of a plasma column, focusing on reconnection zones and their implications for driving rapid variabilities in TeV emissions		

ASI2025_466	Vivek Baruah Thapa	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Inferring the Equation of State for Dense Matter in Neutron Stars: A Bayesian Perspective on Antikaon Condensation		
This work employs the Density-Dependent Relativistic Hadron (DDRH) model in a Bayesian framework to study dense matter in neutron stars with antikaon (K^- and $\bar{K}^0$) condensation. By constraining parameters through nuclear properties and observations of pulsars and the GW170817 event, we estimate the antikaon potential to be around -129.36 MeV, aligning with values from previous studies. Antikaon condensation notably softens the equation of state (EOS), reducing the maximum mass of neutron stars to around 2M$_\odot$ and lowering the speed of sound. While K^- condensation is unlikely in standard neutron stars, both K^- and $\bar{K}^0$ are feasible in higher-mass stars, revealing insights into the EOS and neutron star properties in dense matter.		

ASI2025_621	Santabrata Das	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Relativistic hot accretion flows around black holes		
We examine relativistic viscous advective accretion flows around black holes, focusing on the formation and dynamics of shock waves in these extreme environments. As matter spirals into the black hole, relativistic effects significantly alter the flow, leading to shock formation due to the interplay between attractive and repulsive forces acting on the inflowing material. By solving hydrodynamic and magnetohydrodynamic equations, we analyze how these shocks influence temperature and density profiles, enhancing energy dissipation and driving high-energy radiation emissions. Space-based X-ray observations play a crucial role in validating these models, as the high-energy radiation produced by such shocks is often observed in the X-ray spectrum, especially in active galactic nuclei, X-ray binaries and ultra-luminous X-ray sources. Our findings contribute to a deeper understanding of accretion processes in strong gravitational fields, offering insights into the energetic phenomena observed in these astrophysical systems.		

ASI2025_693	Nafisa Aftab	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
ECLIPSE DOES NOT HIDE, BUT REVEALS: Comprehensive X-ray Reprocessing Studies in High and Low Mass X-ray Binaries with XMM-Newton		
X-ray reprocessing serves as a vital diagnostic tool for gaining insights into the environments of X-ray binary systems. However, the study of X-ray reprocessing encounters challenges arising from the blending of intense primary radiation from the compact star with the reprocessed radiation from the surrounding. Eclipsing X-ray binaries offer a unique opportunity to investigate pure reprocessed X-rays, as the companion star effectively shields the intense primary X-rays. We carried out first comprehensive studies of X-ray reprocessing in most of the eclipsing High Mass X-ray Binary (HMXB) and Low Mass X-ray Binary (LMXB) systems by comparing their X-ray spectra during and outside of eclipse using XMM-Newton. We found ample diversity in the X-ray reprocessing characteristics in HMXBs, which implies significantly dynamic wind structure surrounding the compact objects in HMXBs. Significant differences observed in X-ray reprocessing characteristics in LMXBs despite all being dipping and eclipsing sources, suggest large dependencies of X-ray reprocessing on the inclination angle, scale height of the accretion disk, relative size of the accretion disk with respect to the companion, binary separation, mass ratio between the neutron star, the companion etc. Our studies revealed unexpected X-ray behaviors. For instance, (i) we observed high equivalent widths of Fe emission lines in both SgHMXBs and SFXTs during eclipse, indicating high Fe abundance, contrary to earlier findings showing low equivalent widths in SFXTs outside of eclipse. (ii) Cen X-3 showed a lower Fe Kα equivalent width during eclipse than outside, unlike other SgHMXBs. (iii) In 4U 1538-522, low-energy X-rays were not obscured during eclipse as expected. (iv) LMXBs showed a smaller out-of-eclipse to eclipse flux ratio than HMXBs, suggesting greater reprocessing despite less dense stellar winds. Overall the studies deepen our understanding of the intricate interplay between X-ray reprocessing and the diverse mechanisms within X-ray binary systems.		

ASI2025_589	Sandeep Rout	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Discovering hidden variability components in Cygnus X-1 using AstroSat/LAXPC		
The power spectrum of an X-ray binary can be decomposed into a multi-Lorentzian model that are coherent in different energy bands but incoherent with each other. By simultaneously fitting the power spectra in two bands and the real and imaginary parts of the cross spectrum with such a model one can also predict the phase lag and coherence. By using this novel technique on NICER observations of black-hole binaries, recently it has been shown that there exists variability components that have a strong imaginary part but a weak real part, hence are not significant in the power spectrum. A characteristic feature of this “hidden” imaginary component is an abrupt drop in coherence and rise in the phase lag within a narrow frequency band. These imaginary components in the cross-spectrum were initially thought to arise only due to the soft X-ray coverage provided by NICER. In this work we carry out a systematic search of these components in Cygnus X-1 with data from AstroSat/LAXPC during the 2016-17 state transition. In order to reduce the dead-time effects at higher frequencies, we evaluated all the Fourier products from the cross-spectra between two LAXPC units (also called co-spectra). This resulted in a much improved correction of Poisson noise compared to the traditional methods. By analyzing ten observations during the transition from the hard to soft state we discovered, for the first time, the aforementioned narrow imaginary components in the cross-spectral products of higher energy bands, i.e. 3-5 and 6-20 keV. The frequency of these components spanned 0.01-0.1 Hz and increased with decrease in hardness. The presence of these components suggest that the power spectrum likely consists of several independent additive components originating from different regions, thus providing important implications for the various models of variability.		

ASI2025_658	Vivek Kumar Agrawal	Contributed Talk
High Energy Phenomena, Fundamental Physics and Astronomy		
Initial science results from X-ray Spectroscopy and Timing (XSPECT) instrument.		
XSPECT is an X-ray Spectroscopy and Timing payload, on-board XPoSat, launched in January 2024. XSPECT is sensitive in the energy band 0.8 - 15 keV with moderate spectral resolution (<180 eV at 6 keV) and time resolution (~1ms). The instrument is carrying out long duration observation of select bright X-ray sources which includes: Neutron Star low-mass X-ray binaries, X-ray Pulsars and black-hole X-ray binaries. In this talk, I will highlight some initial science results obtained using the data from this payload.		

18th February 2025
Parallel Session – Galaxies and Cosmology IV
[Chairperson: Yogesh Chandola]
[Time: 11:45 – 13:00]

ASI2025_320	Shivam Burman	Contributed Talk
Galaxies and Cosmology		
Unveiling Galactic Magnetism: Probing Magnetic Field Profiles with Background Quasars		
Understanding the magnetic fields in distant galaxies is key to exploring how these galaxies evolve and interact with their surroundings. By utilizing the rotation measure (RM) of the background quasars, we have developed a radial profile of the magnetic field in a typical high redshift galaxy. We used Mg II absorption systems to identify these intervening galaxies by implementing redshift matching criteria in which the spectroscopic redshifts must lie within 3σ of the photometric redshifts, followed by visual checks. We obtained a sample of 59 quasar-galaxy pairs. The quasar line-of-sights passes through various impact parameters (D) up to 160 kpc, covering the circumgalactic medium of a typical Milky-Way type galaxy. Utilizing the galactic RM removed residual rotation measure (RRM) of these sightlines, we estimated the excess in RRM dispersion, which translates to the magnetic fields by considering a typical electron density. Our findings showed that the magnetic fields are stronger closer to the galaxy's disk, averaging about 2.39 μG up to 50 kpc, and decreasing to 1.67 μG beyond 50 kpc. This observation fits well with the studies based on simulations and sheds light on how magnetic fields behave not just in the dense parts of galaxies, but also in their more diffuse outer regions. Our technique offers a promising approach for future surveys like LOFAR and the Square Kilometre Array (SKA), which could help us in understanding even more detailed structures of galactic magnetic fields in high redshift galaxies.		

ASI2025_681	PRALAY BISWAS	Contributed Talk
Galaxies and Cosmology		
Identification and study of the Optically invisible galaxy population with JWST		
At z > 3, the Hubble Space Telescope (HST) struggles to capture the rest-frame optical light from galaxies, limiting our comprehension of star-forming galaxies in this epoch. As a result, much of our knowledge relies on rest-frame ultraviolet observations, leaving us in the dark about certain galaxy populations—specifically, the UV-faint, dust-obscured, and quiescent galaxies. These elusive entities, referred to as HST-dark or HST-faint galaxies, have previously been identified through Spitzer/IRAC or ALMA submillimeter observations, but their precise redshifts and spectral energy distributions (SEDs) remain uncertain due to insufficient photometric data. For a complete understanding of the early galaxy evolution processes, detection and study of the physical properties of HST-dark galaxies are necessary. Using recent JWST wide and medium band NIRCam photometry from 0.6 to 5 μm, we can now obtain unprecedentedly reliable redshift and SED properties. We simultaneously estimated redshift and SED properties of around 22000 galaxies from the JWST UNCOVER survey using Bayesian Analysis of Galaxies for Physical Inference and Parameter EStimation (BAGPIPES). Applying a colour cut of F160W–F444W > 2.0 and restricting the sample to F160W > 27, we identify around 100 HST-dark galaxies. As expected, these colour-selected HST-dark galaxies are dusty with 25% having strong dust attenuation, AV > 2. The UVJ diagram commonly used to classify dusty and quiescent galaxies also corroborates that. Previous studies of HST-dark galaxies show that these galaxies are massive with moderate SFRs. However, our sensitive JWST data show that HST-dark galaxies could be less massive with a low star formation rate. Apart from very few quiescent HST-dark galaxies, they largely follow the star-forming main sequence. Our analysis shows that dusty galaxies at z > 3 are more numerous than previously thought and provide crucial information about the lower mass galaxies missed previously due to the limited sensitivity of high redshift surveys.		

ASI2025_402	Salmoli Ghosh	Contributed Talk
Galaxies and Cosmology		
Understanding Radio-quiet AGN Jet Morphologies and Feedback Mechanisms from Parsec to Kiloparsec Scales		
The discovery of kiloparsec-scale radio structures (KSRs) in radio-quiet (RQ) AGN offers a unique opportunity to address questions about the origins of radio emission in RQ AGN, differences in radio-loudness, and why RQ jets are typically confined within host galaxies compared to radio-loud (RL) jets, which can extend into the IGM. Using interferometric telescopes worldwide with resolutions spanning parsec to kiloparsec scales allows us to investigate these phenomena in unprecedented detail. For instance, near the jet-launching region, ~80% of flux is lost from milliarcsecond to arcsecond scales, indicating a decrease in emission compactness with distance (e.g., Orienti & Prieto 2010). We are primarily focused on identifying the causes of jet de-collimation or widening. Our study examines nine KSRs, including Seyferts and LINERs from the CfA and extended-12micron samples, using a suite of telescopes, namely, VLBA, EVN, eMERLIN, VLA, uGMRT to probe jet-medium interactions at multiple scales. We report findings on phenomena such as jet-bending, jet-braking, jet-flaring, and instances of multiple restarted activities. These results are consistent with theoretical simulations (e.g., Saxton et al. 2005; Mukherjee et al. 2018), providing key constraints on jet dynamics and the surrounding medium's properties. In a broader sample of RQ AGN, our analysis also includes polarization, total intensity, and spectral index imaging at kiloparsec scales, revealing dependencies of jet kinetic power on black hole mass that potentially inform jet-launching mechanisms. Observed magnetic field orientations suggest significant AGN-driven contributions, including AGN winds, while optical emission near the radio regions indicate gas entrainment, evacuation, and ionization—signifying both positive and negative feedback. We will present observational results from a multi-scale, multi-band study of RQ AGN providing insights about jet-medium interaction for these sources.		

ASI2025_187	Pradyumna Sadhu	Contributed Talk
Galaxies and Cosmology		
Satellites galaxy abundances in clusters of galaxies within ΛCDM: from ultrafaints to ellipticals		
Current cosmological simulations lack the resolution to make reliable predictions for faint and ultra-faint dwarf satellites, which will become a crucial test of the LCDM model in the upcoming era of the Vera Rubin Observatory and the Roman Space Telescope. To this end, we utilize an analytical model fitted to high-resolution controlled simulations to extend the predictions of the TNG50 cosmological numerical simulations to ultrafaint dwarf regime. We focus on 3 clusters with virial masses ~1e14 Msun, comparable to the Virgo and Fornax clusters, and characterize their luminous satellite population from ultrafaint dwarfs to massive elliptical galaxies. We find that under the assumption of cuspy dark matter halos such as NFW profiles, the majority of all satellite galaxies survive within cluster environments, expecting 10-100 thousand luminous satellites within the virial radius of such clusters. This is contrary to the results directly from the simulation where satellites get merged artificially due to poor numerical resolution. We determine the radial distribution of satellites, finding massive satellite (Mstar > 1e8 Msun) to align well with matter distribution of the cluster while dwarfs display a cored profile. Additionally, tidal evolution drives evolution of satellites along the canonical size-mass relation observed for Local Group and Virgo satellites.		

ASI2025_537	Anilkumar Tolamatti	Contributed Talk
Galaxies and Cosmology		
Observations of high redshift gamma-ray blazars with MACE		
High redshift blazars are the most powerful gamma-ray sources with central supermassive blackholes (SMBH) in excess of billion solar masses. They are the extraordinary probes to cosmological evolution blazars' SMBH and their connection with powerful relativistic jets. Detection of more than 3500 blazars by the space-based Fermi -Large Area Telescope (LAT) in the high energy (HE, above 100 MeV) band reveals that a significant amount of power carried by the relativistic plasma jets in blazars is dissipated at gamma-ray energies. However, a small fraction of only less than 3% are detected at very high energies (VHE, above 30 GeV) by the ground-based Cherenkov telescopes. Therefore, their detection at the highest possible energies is extremely important to understand the blazar-phenomenon in the Universe. In this paper, we report observational results obtained from the recent monitoring of a sample of high redshift ($z > 0.3$) blazars with the Major Atmospheric Cherenkov Experiment (MACE) in the energy range above $\sim$ 80 GeV. We also use the Fermi -LAT measurements to constrain their gamma-ray emission behaviour.		

18th February 2025 WGGE Session [Time: 14:00 - 15:10]

ASI2025_804	Jessica Dempsey	Invited
Plenary		
Solving the science equity problem: psychology and statistics		
The answer to systematic gender equity across the science disciplines lies in a holistic approach. Mapping the representation at all levels of advancement, tracking retention, and modelling the potential solutions have been shown to drive science organisations to better representation. Sustaining diversity, accelerating women's careers, requires overcoming the psychological resistance to change and prioritising creation of inclusive academic and work environments.		

18th February 2025
Parallel Session – Stars, Interstellar Medium, and Astrochemistry in Milky Way V
[Chairperson: T. Sivarani]
[Time: 17:00 – 18:00]

ASI2025_631	Lupamudra Sarmah	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Asteroseismic insights into Barium stars: Probing companion information and formation pathways		
Barium (Ba) stars are a group of G-K-type stars found across dwarf and giant phases that exhibit unusually enhanced abundances of slow (s) neutron-capture elements. This enhancement is often attributed to binary mass transfer from an asymptotic giant branch (AGB) companion, which has now become a CO white dwarf (WD). However, the accretion and mass transfer in these systems remains poorly understood. In this study, we have performed a detailed asteroseismic analysis of a sample of 20 Ba dwarf and giant systems with known orbital parameters in the TESS (Transiting Exoplanet Survey Satellite) field. We derived precise seismic masses of the primary Ba stars and then estimated companion WD mass and their progenitor AGB masses. Our results show that Ba stars have two populations of AGB companions, with the majority having low-mass AGB companions but showing a wide range of [s/Fe]. This suggests that dilution after mass transfer may play an important role. Interestingly, the masses of the WDs also revealed 3 peculiar Ba stars (2 giants and 1 dwarf) with Helium (He) WD companions (<0.5M⊙). This finding contradicts the standard mass-transfer hypothesis, as the progenitors of He WDs do not go through the AGB phase. In this talk, I will present these findings and discuss the possible alternative formation pathways for these peculiar cases of Ba stars.		

ASI2025_458	Susmita Das	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
An updated theoretical scenario of BL Herculis stars		
We present theoretical period-luminosity (PL), period-Wesenheit (PW) amd period-radius (PR) relations at multiple wavelengths (Johnson-Cousin-Glass bands UBVRIJHKLL'M and Gaia passbands GGBPGRP) for a fine grid of convective BL Herculis models computed using the non- linear radial stellar pulsation tool MESA-RSP. The non-linear models were computed for periods typical for BL Her stars, i.e. 1≤P (days)≤4 covering a wide range of input parameters: metallicity (-2.0 dex≤ [Fe/H]≤ 0.0 dex), stellar mass (0.5M ⊙ -0.8M ⊙), luminosity (50L ⊙ -300L ⊙) and effective temperature (full extent of the instability strip; in steps of 50K). We investigate the impact of four sets of different convection parameters on multi-wavelength properties. Most empirical relations match well with the theoretical PL, PW and PR relations from the BL Her models computed using the four sets of convection parameters. No significant metallicity effects are seen in the PR relations. We carry out a robust light curve optimization technique to obtain the best observed-model pairs for the BL Her stars in the LMC. We also extend our study to include theoretical relations in the Rubin-LSST passbands. In addition, we also explore the mass of the prototype BL Herculis itself using simultaneous fitting of the observed light curve and radial velocity curve with those from the model that exhibits the best goodness-of-fit.		

ASI2025_216	Muhammed Riyas A	Contributed Talk
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Dissecting r-Process Elemental Abundance Trends in CEMP Subclasses		

Metal-poor stars formed in the early universe reveal crucial information about early chemical evolution. Many of these stars, especially in the Milky Way's halo, are enriched in carbon ([C/Fe] > 1.0) and are known as Carbon-Enhanced Metal-Poor (CEMP) stars. CEMP stars are categorized into CEMP-r, CEMP-s, and CEMP-rs types based on their heavy element enrichment via the slow (s-process) and rapid (r-process) neutron capture processes. The s-process occurs in low- to intermediate-mass stars, while the r-process likely occurs in neutron star mergers or specific supernovae. However, the origin of CEMP stars enriched in both s- and r-process elements (CEMP-r/s stars) remains uncertain. Increasing evidence suggests that the intermediate neutron capture process (i-process) may explain this dual enrichment by producing r-process elements in conditions between those of the s- and r-processes. These, studies focus mainly on elements like Eu, Gd, and Dy, while extreme r-process elements, such as Tb, Tm, Yb, Ho, Ta, and Th, remain unexplored due to their sensitive lines falling in the near-UV range. In our recent analysis we derive the abundances of extreme r-process elements in a samle of CEMP-rs stars using their bluer spectra acquired using UVES spectrograph connected to 8m VLT. Our analysis indicates that extreme r-process elements can also be produced by the i-process. We confirm our results by comparing observed abundances with nucleosynthetic predictions from low-metallicity, low-mass asymptotic giant branch (AGB) stars, a potential sites for the origin of CEMP-s and CEMP-rs stars (Karinkuzhi et al. 2021; Choplin et al. 2021), after including extended networks for both s-process (Goriely & Siess 2018) and i-process (Choplin et al. 2021) reactions.

19th February 2025
Plenary Session IV
[Chairperson: Ajit Mohan Srivastava]
[Time: 9:15 - 9:55]

ASI2025_792	Pravata Mohanty	Invited
Plenary		
Recent results from the GRAPES-3 Experiment		
The GRAPES-3 experiment located in Ooty, Tamil Nadu recently discovered a hardening in the cosmic ray proton spectrum above 165 TeV which disfavours single power law description of the spectrum up to the Knee energy (~3 PeV). The measurements were performed over an energy range of 50 TeV to 1.3 PeV using the data collected with a high density array of plastic scintillators and a large area muon telescope, bridging the gap between space-based and ground-based measurements. Furthermore, two significant small-scale anisotropic structures in the cosmic ray arrival distribution were detected at a median energy of 16 TeV, consistent with results from the HAWC and ARGO-YBJ experiments. Both these results could enhance our understanding of cosmic ray sources and acceleration mechanisms. This presentation will highlight these findings, along with updates on the status of the detector upgrade and future plans.		

Posters in
Sun, Solar System, Exoplanets and Astrobiology

ASI2025_611	Aditya Jain	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Rossby wave instability and vortex properties in turbulent protoplanetary disks		
Several millimeter/sub-mm observations have shown the presence of non-axisymmetric structures in protoplanetary disks. Gravitational coupling of young planets with the proto-planetary disks can give rise to spiral density waves. These spiral density waves manifest observationally in form of non-axisymmetric structures like rings, gaps and crescent like shapes. These structures may be a result of vortex formation which in turn are excited by Rossby wave instabilities. The lifetime of the vortex present in the protoplanetary disk is an important parameter in planet formation through dust entrapment and collection. There are several factors such as disk temperature, magnetic fields, disk turbulence and other instabilities which can influence vortex stability. In this work, we study the impact of thermal and viscous properties of disk on vortex lifetime through 2D hydrodynamic simulations. We introduce thermal properties in the disk through a non-isothermal process. Through these simulations, we find that the thermodynamic and viscous properties of the disk affect the vortex lifetime in a competing manner. We also explore the role of MHD driven winds in the protoplanetary disk and it's role in planet-disk interaction.		

ASI2025_624	Anshu Kumari	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Spatial Fragmentation in Solar Flares Investigated through Radio Emission		
Type III solar radio bursts are fast frequency-drifting emission features, typically from higher to lower frequencies at the rates up to 100 MHz per second. These bursts, spanning a broad frequency range from 10 kHz to 1 GHz, are commonly associated with active regions and solar flares, and they are the most frequently observed solar radio phenomena. Type III bursts signify beams of energetic electrons propagating through the solar corona along open magnetic field lines. In this study, we analyzed a series of co-temporal type III radio bursts and Hα flare events using a combination of datasets from the Nançay Radioheliograph (NRH, in imaging mode); and e-CALLISTO (observing in Sun-as-a-star mode), the Global Oscillation Network Group (GONG), and the Multi-Application Solar Telescope (MAST) at the Udaipur Solar Observatory (USO) . We used NRH's high temporal resolution imaging to locate the spatial centroids of Type III radio burst sources and correlated these with MAST's Hα observation. We compared radio burst locations with the corresponding active regions where flares originated. This simultaneous tracking of active region and corresponding radio emission in two different layers of the solar atmosphere, the middle chromosphere (Hα) and the middle corona (radio), was used to investigate the spatial fragmentation of energy release during solar flares.		

ASI2025_31	Arkaprova Dutta	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Exoplanets Around Sub-Giant Stars		
Evolved stars, particularly sub-giants, have been underrepresented in most planet search surveys, which traditionally focus on solar-type main-sequence stars. The quest for exoplanets around sub-giant stars offers crucial insights into planet formation and evolution in the context of evolved stellar environments. This study comprehensively reviews well-studied exoplanets around sub-giant stars, emphasizing their detection methods, orbital properties, and atmospheric characterization and compares them with well-studied properties of exoplanets around the main sequence stars. We also discuss the broader implications of our findings for understanding exoplanet frequency and migration mechanisms across different spectral types. This work lays the groundwork for our long-term planet search project, wherein we curate a candidate list for potentially suitable stars to host planets using homogeneous properties from the GAIA DR3 catalogue to follow up using high-resolution spectroscopy aimed at detecting new exoplanets around sub-giant stars (including the stars in the list with limited or no high-precision radial velocity measurements) and modelling their orbits. We anticipate that the outcomes of this research will significantly contribute to the growing body of knowledge regarding planetary systems and their formation histories.		

ASI2025_283	Ashish Devaraj	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Observational Evidence Contrasting the Linear PSD Model: Non-Linear Correlations of Solar EUV/FUV Radiation with Lunar Sodium		
Photon-stimulated desorption (PSD) is a non-thermal process where high-energy photons release surface-bound atoms, such as sodium, from planetary bodies like the Moon. To examine the link between solar Extreme Ultra-Violet (EUV) radiation above 8.8 eV and sodium release from the lunar surface through PSD, we use simultaneous measurements of EUV photon flux and Na optical spectral line flux from the lunar exosphere. Data were collected using the high-resolution (R$\sim$72000) Echelle Spectrograph on the 2.34-m Vainu Bappu Telescope during first-quarter lunar phases (January-March 2024), observing NaI D2 and D1 flux below $\sim$590 km. Simultaneous EUV and FUV data were obtained from the GOES-R Extreme Ultraviolet Sensor (EUVS), and NUV data from the Total and Spectral Solar Irradiance Sensor-1 (TSIS-1) on the ISS. We correlated the Na spectral line flux with EUV photon flux in six EUVS bands spanning 256-1405 $\AA$ (48.5-8.8 eV) and NUV data (2000-4000 $\AA$) from TSIS-1. Our results reveal a non-linear increase in lunar exospheric sodium with rising EUV and FUV fluxes between 8.8-48.5 eV, contrasting with previous linear PSD models. We confirm that EUV radiation above 10 eV contributes to sodium release via PSD, with wavelengths 256-304 $\AA$ playing a significant role. Additionally, we observe a positive correlation between NUV flux and sodium optical line flux, supporting NUV involvement in sodium release. The line-of-sight column density averages 5.71×10^{9} atoms cm^{-2}, with Chamberlain temperatures averaging 6721 $\pm$ 127 K and scale heights of 1494 $\pm$ 28 km, consistent with non-thermal processes. Higher temperatures and sodium densities during solar activity suggest an enhanced Na release during solar flares. These findings indicate a need to revise the PSD model for photon energies above 8.8 eV and establish more precise constraints on the PSD cross-section in this range.		

ASI2025_361	Asif Mohamed Mandayapuram	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Simultaneous observations of elemental abundance evolution during solar flares using InspireSat-1 DAXSS and Chandrayaan-2 XSM		
Solar Flares are powerful bursts of radiation from the solar atmosphere caused by the sudden reorganization of magnetic topology. Soft X-ray (0.1-10 nm) spectroscopic observation is an excellent probe for the elemental composition of 5-30 MK plasma formed during solar flares. The time cadence and sensitivity of soft X-ray spectroscopic instruments such as InspireSat-1 Dual Aperture X-ray Solar Spectrometer (DAXSS) and Chandrayaan-2 Solar X-ray Monitor (XSM) make it possible to investigate the evolution of plasma during various phases of the flare, in particular how the abundances of low First Ionisation Potential (FIP) elements vary during solar flare. Here, we investigate how various flare parameters, namely flare temperature, emission measure, and elemental abundances, vary during the flare for a sample of 15 flares (C to M class) that have simultaneous X-ray spectroscopic observations from DAXSS and XSM. X-ray spectra during flares are modeled as the sum of emissions from two isothermal temperature components with common elemental composition to obtain estimates of abundances of Mg, Si, S, Ar, Ca, and Fe along with the temperature and emission measure of individual components. We find that the temperature, emission measure, and variation in elemental abundances, as estimated from DAXSS and XSM, agree quite well for most of the studied flares. Our results show that the elemental abundances show a decrease from coronal values and towards photospheric values for low-FIP elements at the peak of the flare and start to recover during the decay phase of the flare, similar to recent previous reports for smaller events. We discuss the analysis results and their implications for understanding processes such as chromospheric evaporation during solar flares.		

ASI2025_62	Avinash Salguneswaran	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Updated Ephemeris of WASP-18 b and Investigation Into the Existence of WASP-18 c		
We present an updated ephemeris for the exoplanet WASP-18 b and investigate the potential existence of a second planet, WASP-18 c. Utilizing 140 transit light curves from the Transiting Exoplanet Survey Satellite (TESS), Exoplanet Watch, and the Exoplanet Transit Database (ETD), we derived a refined ephemeris for WASP-18 b, resulting in a mid-transit time of 2460298.55709±0.000026 BJDTDB and an orbital period of 0.941452404 ± 1.4 × 10−8 days. This improved ephemeris reduces uncertainty in future transit predictions, which is essential for scheduling space-based observations like JWST and ARIEL. Additionally, we analyzed 67 radial velocity (RV) observations from the CORALIE and HARPS spectrographs to search for periodic signals indicative of an additional planetary body. Our analysis revealed no significant transit timing variations (TTVs) or RV signals supporting the existence of WASP-18 c. The absence of detectable periodic signals in the TTV and RV data suggests that any potential second planet does not produce strong perturbations on WASP-18 b's orbit within current observational limits. This work enhances the understanding of the WASP-18 system and provides a valuable resource for future observational campaigns.		

ASI2025_539	Ayanabha De	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Detectability of Snow-lines in protoplanetary disks and photometric variation of directly imaged exoplanets using SCALES		
Context: SCALES (Slicer Combined with Array of Lenslets for Exoplanet Spectroscopy) is the first exoplanet-dedicated integral field unit (IFU) planned to be commissioned on Keck in 2025. Backed by the best adaptive optics and the 10m aperture of Keck, SCALES shall provide a unique and powerful opportunity to spectrally characterize exoplanet atmospheres and study protoplanetary disks in more detail than ever at 2-5 microns wavelength ranges. Aim: This work explores the feasibility of two different science cases with SCALES. 1) Detectability of snow lines (e.g. of water, CO2 and CO) in face-on protoplanetary disks from scattered light at IR wavelengths - Several planet formation theories rely on the existence of snow-line, which separates molecules of certain types in the gas phase from the ice phase. However, snow lines have never been observed due to instrument limitations. 2) Detectability of photometric variation of directly imaged rotating exoplanets due to large cloud structures or transiting/eclipsing exomoons - This could pave the way for studying planetary clouds and measuring their rotational period. Additionally, this method holds the tantalizing possibility of detecting exomoons around young, bright exo-Jupiters. Methods: We define inhomogeneous exoplanetary atmospheres and model their spectra at different rotational phases using the PICASO radiative transfer code. For the protoplanetary disk, we obtain dust temperature maps from RADMC3D and interface it with LIME to get the gas and ice absorption lines in the scattered light spectrum. We then consider all primary noise sources (photon shot, speckle, detector crosstalk, etc.) to compute the allowed error budget for detecting our science targets with significant confidence with SCALES.		

ASI2025_451	Bestha Manjunath	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Simulation of High-Resolution Multi-Object Transmission Spectroscopy		
The atmospheric characterization of exoplanets has traditionally relied on space-based low-resolution transmission spectroscopy, ground-based multi-object low-resolution spectroscopy (LRTS), and high-resolution transmission spectroscopy (HRTS). Both low and high-resolution time-series observations from ground-based facilities hold the potential to reveal an exoplanet's atmospheric composition by examining transit depth at different wavelength bins using LRTS and by analyzing resolved spectral lines using HRTS. However, HRTS is a double-differential technique, leading to normalization degeneracy. This degeneracy poses a challenge in retrieval analysis, where changes in cloud properties can offset variations in abundance, complicating the determination of precise atmospheric parameters such as temperature, abundance, and cloud opacity. Mitigating this issue involves combining low-resolution transmission spectra with high-resolution spectra. However, performing both types of observations under different environmental conditions introduces additional systematics. To address this, we propose the use of multi-object high-resolution transmission spectroscopy (Mo-HRTS), which has not been extensively explored. In this project, we simulate Mo-HRTS using the existing Maroon-X spectrograph. Here, we present our findings and demonstrate the potential of this approach for improving atmospheric retrievals of exoplanets.		

ASI2025_63	Bhupendra Kumar Tiwari	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Study of solar activities associated with Cosmic Ray Modulation		
Abstract Solar activities controls structure of the heliosphere and cosmic ray modulation. Necessary experimental data to study interplanetary transport of cosmic rays during transient events at different space / time scales, based on the observation from Omniweb data centre for Solar- interplanetary causes and yearly / monthly mean count rate of Cosmic Ray Intensity (CRI) variation data from Oulu / Moscow neutron monitors . It is observed that the during minimum Solar activity , the strength of the IMF has been minimum and Sun is quiet , it's 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- , Cosmic ray intensity (CRI), Interplanetary Magnetic Field (IMF), Solar Wind velocity (Vsw)		

ASI2025_610	Deepan Patra	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
An Automated Trigger for Solar Radio Bursts Imaging Observation using the Yamagawa spectrograph and the MWA		
Spectroscopic snapshot solar imaging at radio wavelengths can yield detailed understanding of the emission processes responsible for solar radio bursts associated with massive eruptive events like flares and coronal mass ejections (CMEs). Cutting-edge radio interferometers, e.g. Murchison Widefield Array (MWA), are exceptionally well-suited for this purpose. However, spatially resolved observations of solar radio bursts from these instruments remain rather limited. Despite the availability of exquisite imaging instruments, most studies of solar radio bursts are still based on non-imaging observations using solar dedicated instruments. This is because the observing time of these versatile cutting-edge radio interferometers tends to be oversubscribed. This, coupled with the fact that solar activity is inherently unpredictable, leads to few events of interest being captured in the limited solar observing time available. Enabling observations of a large number of solar radio bursts with these new-generation instruments requires a robust and reliable automated near-real time observing trigger. Using precious observing time only when some solar activity is known to have just taken place, can vastly increase the efficiency of limited available observing time to capture solar activity. With observatories like the Square Kilometre Array Observatory (SKAO) on the horizon, the need for such a system is even more imperative. We present such a system for the SKAO-low precursor, the MWA, based on near-real time data from the Yamagawa spectrograph which observes the Sun daily from rise to set in the band from 70 MHz to 9 GHz and is located at similar longitude as the MWA. We have devised, implemented and tested algorithms for this automated triggering system using archival Yamagawa data. End-to-end tests of triggered observations have successfully been carried out at the MWA. This real time triggering has now been operationalized at the MWA, a very timely development in view of the ongoing solar maxima.		

ASI2025_723	Devang Agnihotri	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Understanding Hanle effect in Ca I 4227 A line using magnetohydrodynamic simulations of the Solar atmosphere		
Scattering polarization in strong resonance lines such as the Ca I 4227 Å, formed in the chromosphere can probe the chromospheric magnetic fields via the Hanle effect. Predominantly one-dimensional (1D) semi-empirical model atmospheres were used to study the linear polarization in this line. Recently, Harsh et al. (2024) studied the resonance scattering polarization in Ca I 4227 Å using magnetohydrodynamic (MHD) simulations of the solar atmosphere from the Bifrost code, along a slanted ray with heliocentric angle μ=0.3. In this work we include the effect of weak magnetic fields (Hanle effect) on the polarization profiles and compare them with the non-magnetic cases.		

ASI2025_6840	Devojyoti Kansabanik	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Heliopolarimetry: A Remote Sensing Observing Tool to Measure Magnetic Fields of Coronal Mass Ejections in the Heliosphere		
Magnetic field measurements in the outer corona and inner heliosphere using remote sensing observations are crucial for improving space-weather prediction. However, routine observations using white-light heliospheric imagers cannot provide these measurements. At radio wavelengths, changes in the polarization angle of background linearly polarized astronomical sources can estimate line-of-sight (LoS) integrated magnetic fields when a plasma blob intercepts that LoS. To date, this technique has been limited at coronal heights <15 R_sun using high-frequency telescopes with lower sensitivity to magnetic field strength and narrow fields of view (FoV), such as the JVLA. Over the past two decades, new-generation ground-based radio telescopes like MWA, LOFAR, ASKAP, and MeerKAT have become operational. These telescopes offer wide FoVs and lower observing frequencies, which can overcome previous limitations. Despite their capabilities, these instruments face challenges in calibration and trigger time-of-opportunity observations for space-weather events. This talk presents our recent efforts to address these challenges by utilizing these leading radio telescopes and preparing for upcoming new-generation radio telescopes (like ngVLA, SKAO) for heliospheric magnetic field measurements using radio polarimetry, a technique we call "Heliopolarimetry." By leveraging these advancements, along with other white-light missions (like PUNCH), we aim to enhance space-weather research and prediction capabilities.		

ASI2025_534	Divya Oberoi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Enabling Solar and Heliospheric Studies with a SKA-Mid precursor - MeerKAT		
The first phase of the Square Kilometre Array Observatory (SKAO) is expected to become operational towards the end of this decade. The high dynamic range high fidelity snapshot spectro-polarimetric imaging the SKAO is expected to deliver will go a long way in realizing the well recognised potential of radio observables for solar and heliospheric studies. However, the Sun is the brightest source at SKA-Mid frequencies and its emission can simultaneously be extremely variable across the axes of time, frequency, brightness temperature and polarization properties. So observing the Sun with an instrument optimized for synthesis imaging of sources orders of magnitude fainter comes with a considerable set of challenges. These challenges span the domains from configuring the instrumental signal path such that all parts of it remain in their linear regimes, to developing robust unsupervised imaging pipelines necessary for spectropolarimetric snapshot imaging. While considerable work has been done, over the last decade or so, for preparing for observations with SKA-Low, the similar efforts for SKA-Mid, using its precursor - MeerKAT, have started only recently. Here we summarize the progress which has been made in enabling solar observations with MeerKAT, present some of the first solar images with this instrument along with some illustrative simulations done to build expectations for the expected imaging performance.		

ASI2025_382	Goldy Ahuja	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Estimating the Nuclear Size of Long-Period Comets		
Comets, composed of volatile ice and dust, are found in the different reservoirs far from the Sun. As these bodies come close to the Sun, their volatile surfaces start sublimating, forming an atmosphere of gas and dust known as the cometary coma. The size of the visible cometary coma is of the order of 10^4 km. The brightness of the coma presents a significant challenge in observing the nucleus. In the case of asteroids, R-band photometry has been used to estimate their radii. This technique is also beneficial for calculating the size of short-period comets when they are at a large distance from the Sun (when they do not have a well-developed coma). The long-period comets, which spend a small percentage of their orbital period time in the inner solar system, usually have a significant amount of volatiles, which can show or cause activity at distances larger than 5 AU, resulting in a coma. Hence, it is difficult to calculate the nuclear magnitude of these comets. In this poster, we will explain the various methods used for estimating the nuclear size of cometary bodies. One is to use the brightness function and extrapolate the magnitudes to a zero pixel to get the nuclear radius of a comet. Another method uses non-gravitational forces like the Yarkovsky effect, which is responsible for the non-gravitational acceleration. This non-gravitational acceleration is related to the radius of the comet. We applied these methods to get the radius of four long-period comets, i.e., C/2020 V2, C/2019 L3, C/2022 E3 and C/2023 A3. These long-period comets were observed from the Faint Object Camera (FOC) instrument mounted on the 2.5 m PRL telescope and the HFOSC instrument mounted on the 2 m Himalayan Chandra Telescope (HCT).		

ASI2025_177	Karan Sahu	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Solar coronal origin of solar wind periodic proton number density structures using PSP and STEREO Observations		
Observation of solar wind at 1 AU reveals discrete variations in its proton number density that occur periodically and more frequently at particular temporal or radial length scales, re- ferred to as periodic density structures (PDS). The PDS originate locally in the interplanetary medium near 1 AU by different dynamic processes, or they can originate in the solar corona and be convected outward to 1 AU. Earlier studies utilizing in-situ measurements of the solar wind at 1 AU found PDS to be associated more often with slow (undisturbed) solar wind(speed < 500 km/s) than fast. In combination with remote imaging solar corona observations, PDS is suggested to have originated from the Corona. Here, we conducted a case study of four PDS events to investigate the origin of PDS associated with the slow solar wind, observed at L1 by Wind spacecraft between 2019-2023 when near-Sun Parker's Solar Probe (PSP) observations were available and encountered the same slow solar wind stream as Earth. The slow solar wind is less turbulent, and the plasma density parcels remain unchanged with the radial distance dur- ing their transit to 1 AU. Thus, when analyzed using the PSP observations and cross-correlated with the near-Earth PDS, the corresponding PDS near the Sun showed a strong correlation. Us- ing a Fourier spectral analysis, common periodicities of a few minutes were found in solar wind proton densities measured by PSP (near-Sun) and Wind (near-Earth). Further, with the remote imaging observations of the PDS from STEREO-A, we confirmed that the events originated in the solar corona, then frozen in the solar wind, and finally convected out to 1 AU.		

ASI2025_397	Lokesh Manickavasaham	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Addressing Wavelength-Correlated Systematics in Exoplanet Transmission Spectroscopy: A 2D Gaussian Process Approach		
Ground-based transmission spectroscopy is often dominated by systematics, obstructing us from leveraging the advantages of larger aperture sizes compared to space-based observations. These systematics could be time-correlated, uniform across all spectroscopic light curves, or wavelength-correlated, which could significantly affect the characterization of exoplanet atmospheres. Gaussian Processes (GPs) were introduced in transmission spectroscopy by Gibson et al. (2012) to model correlated systematics in a non-parametric way. The technique uses auxiliary information about the observation and independently fits each spectroscopic light curve to provide robust atmospheric retrievals. However, this method assumes that the uncertainties in the transmission spectrum are uncorrelated in wavelength, which can cause discrepancies and degrade the precision of atmospheric retrievals. To address this limitation, we explore a 2D GP framework to model both time- and wavelength-correlated systematics. By combining the spectroscopic light curves to create a 2D grid, the GP simultaneously fits for the transit depth with the hyperparameters shared across wavelengths. While this method is computationally intensive, it recovers the full covariance matrix of the transmission spectrum and improves the accuracy of atmospheric retrievals. It can potentially eliminate the need for 'common-mode' correction, which produces an offset in the transmission spectrum. We present the detailed framework and its application to ground-based observations, including those obtained from the 2m Himalayan Chandra Telescope (HCT). As we move towards detecting smaller and cooler planets, developing new methods to address complex systematics becomes increasingly essential.		

ASI2025_282	Madhu Kashyap Jagadeesh	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
(Re)-Defining Planets -- the Fundamental Planet Plane		
More than 5500+ planets are detected using various techniques, with expectations of billions in our Galaxy alone. They are called super-earths, hot earths, mini-neptunes, hot neptunes, sub-neptunes, saturns, jupiters, hot jupiters, jovians, gas giants, ice giants, rocky, terran, subterran, superterran, ... This prompted many recent works on taxonomy, or classification, of exoplanets. However, there is no basic, fundamental definition of `What is a planet?', opposing to stars/asteroids/moons. Additionally, IAU 3rd law of planets states that a planet has to clear the neighbourhood around its orbit, which is still very difficult to determine even for closest exoplanets. The first ambitious task here is to establish if there is a limit on the size/mass of a planet. The lower mass limit may be assumed as of Mimas (0.03 EU) – ~min mass required to attain a nearly spherical hydrostatic equilibrium shape, following IAU 2nd law of planets. But the smallest exoplanet Kepler-37b is only 0.01 EU. The upper mass limit may be easier – there is a natural lower limit to what constitutes a star: ~0.08 SU. But then there are brown dwarfs: IAU has defined brown dwarfs as objects that exceed the deuterium burning limit (~13 JU), and giant exoplanets generally have masses of ~0.3 to ~60 JU. The resolution requires assembling the basic physical parameters that define planets quantitatively. Mass and radius are two fundamental properties and we propose a third correlated parameter: the moment of inertia. Based on these, we create the fundamental planet plane where, just like a galactic plane, the two parameters are correlated with the third. We propose to add the lower limit by plotting the moment of inertia versus log mass, where we are looking for a threshold or a turn-off point to define a planet. A fundamental planet plane will demonstrate the upper limit.		

ASI2025_576	Mangesh Daspute	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Machine Scientist for Understanding and Mitigating Stellar Activity in Exoplanet Detection		
Stellar activity produces noise in radial velocity data, which hinders Earth-mass exoplanet detection. Radial velocity jitter is a complex nonlinear combination of effects of stellar spots, faculae, p-mode oscillation, and granulation which also works on different timescales. We use a data-driven approach to determine the effect of stellar activity on radial velocity. We used the normalised flux of multiple absorption lines from HARPS-N solar spectra as input and radial velocity in a heliocentric rest frame as output for the machine learning model. To model stellar activity, we used a Bayesian Machine Scientist. It finds the simplest best fitting equation that relates properties of absorption lines and activity induced radial velocity. By predicting and subtracting the effect of stellar activity on radial velocity we were able to reduce the standard deviation in the noise in the data to 1.2 m/s and 1.6 m/s of effect was modelled out.		

ASI2025_544	Mayank Rajput	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Metric Type II Radio Emission associated with Coronal Mass Ejections of Large Angular Widths: Some New Insights		
Coronal Mass Ejection (CME) driven shocks can accelerate charged particles up to relativistic speeds, producing Type II solar radio bursts. The CME directly impacts Earth, so studying them becomes important from a space weather perspective. Due to the association of Type II bursts with CME, it is important to study them and the correlation of different properties of Type II with that of the CME. This study analyzed a correlation between the frequency bandwidth of Type II radio bursts in the frequency range 127–20 MHz, obtained from an e-CALLISTO spectrograph, and the angular width of the associated CMEs. To obtain the true angular width of the CMEs, we used a forward-fitting model known as the Graduated Cylindrical Shell model. The dynamic spectrum obtained from e-CALLISTO was used to calculate the frequency bandwidth of the Type II bursts. Our investigation found that the frequency bandwidth of Type II bursts is anti-correlated with the angular width of the associated CMEs with a correlation coefficient of ~74%, indicating that the CMEs with large angular width can produce narrow-band Type II emissions. This starkly contrasts a recent report that the CMEs with large angular widths produce broad-band Type II emission. To locate the Type II radio burst to CME-driven shock front, we further estimated the Type II burst height at the burst-onset time and compared it with the deduced height of the associated CMEs/shocks. For all of the Type II burst events, it was found that the height of the Type II burst was less than the CME height, indicating that the Type II emissions are produced in the flank region of the CME-driven shock. This suggests there could be narrow-band Type II emission as the condition for generating Type II bursts satisfies in a narrower region in the flank of the CMEs.		

ASI2025_215	Pooja Devi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Eruption of a quiescent filament and associated EUV loop contraction		
Solar filaments are cool and dense plasma material suspended in the solar corona against gravity. Their eruptions are crucial from the space weather point-of-view. Here, we present observations of a quiescent filament eruption that occurred on 13 July 2015. The eruption was associated with a clear two-ribbon GOES B7 class flare. The successful eruption produced a CME with a speed of ~ 552 km s-1 and a deceleration of ~ 14 m s-2. To understand the origin of the filament eruption, we have computed the magnetic flux at different locations near the filament and conclude that magnetic flux cancellation could be the cause of this eruption. During the eruption, the nearby EUV loops contract, which is explained in light of existing theories and simulations.		

ASI2025_691	Pritam Das	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Kinematics of CMEs in the Middle Corona		
The middle corona, spanning from 1.5 to 6 solar radii from the solar disk centre, is a critical transition zone between the inner and outer corona, bridging two distinct physical regimes. Though its boundaries have been debated for years, recent community efforts (West, M.J. et al., 2023) have established this standard definition. This region is known for hosting some of the most dynamic solar phenomena, particularly Coronal Mass Ejections (CMEs), whose impulsive acceleration often occurs within the middle corona. Despite its significance, this region has been understudied due to observational challenges faced by major solar missions. In our study, we leverage data from SUVI-ECI (GOES-R), Kcor (MLSO), and LASCO (SOHO). The off-pointing campaign of SUVI-ECI provides EUV observations up to 5 solar radii, offering valuable overlap with Kcor and LASCO in white light. Our results reveal distinct kinematic profiles of CMEs in EUV versus white light, underscoring the different dynamics across wavelengths. Additionally, we employ a state-of-the-art optical flow technique to analyze the velocity profiles across different CME locations. This method generates a heat map of velocity magnitudes and overlays flow vectors directly onto the CME images, providing a detailed view of the dynamics within the middle corona. We plan to enhance this approach with a machine learning model, which will ultimately serve as a robust tool for automated CME detection—advancing real-time monitoring capabilities for eruptive solar phenomena.		

ASI2025_346	Rahul Bandyopadhyay	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Polycyclic aromatic hydrocarbon abundances in T Chamaeleontis		
We investigate the protoplanetary disk around the T Tauri star T Chamaeleontis (T Cha). A significant amount of "see-saw" variability, i.e., relative decrease and increase of the fluxes short-ward and long-ward of 10 microns, respectively, is observed by comparing the mid-IR spectra of T Cha taken using Spitzer-IRS and JWST-MIRI-MRS. Multiple polycyclic aromatic hydrocarbon (PAH) bands around 6.2, 7.7-8.6, 11.3-12.7 microns can be prominently observed in the JWST spectrum compared to a faint 11.3-micron band in the Spitzer spectrum. We perform radiative transfer modelling to reproduce the mid-IR JWST spectrum and the photometric fluxes ranging from optical to far-infrared. We re-establish the geometric structure of the disk - an inner and an outer disk separated by a gap - as inferred from earlier Spitzer, VLT, and ALMA observations. We find that the reduction of the inner disk mass and scale height results in an increase of the outer disk irradiation and therefore, the increase in the outer disk emission, including the PAH bands, which supports the earlier explanation of "see-saw" variability observed in disks. We provide a new estimation of the PAH abundances in the disk of T Cha by fitting the PAH bands fluxes in a self-consistent way from the disk model. We put strong constraints on the PAH abundances by exploring a large range of physical conditions and structural parameters of both the inner and outer disk. We estimate a higher flaring index than the earlier models, which might result from the enhancement in the PAH emission and hence, increased gas heating than during the time of Spitzer observations. Our estimated PAH abundance also implies that the disk of T Cha might be undergoing FUV photoevaporation driven by its central star, providing possible constraints on the planet-formation time scale around T Cha.		

ASI2025_291	Raj Kumar	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Study of Solar Energetic Particles, their Source Regions and Associated CMEs during Solar Cycle 23-24		
We present here a study of association of solar active regions with 152 solar energetic particle events (SEPs), Coronal mass ejections (CMEs) and solar flares for the solar cycles (SCs) 23-24 (1997 - 2017). For our study, we have used the GOES data available online at Coordinated Data Analysis Workshops (CDAW) center in the energy channel > 10 MeV having flux ≥ 10 pfu. For the associated activities, we have analyzed the data from SOHO/LASCO. We found a moderate correlation (55%) between SXR flux and sunspot area. A weak correlation (46%) was found between SEP intensity and SXR flux and correlation of SEP intensity with different classes of SXR flares was found to be increased from weak (C-class) to strong (X-class) flares. 80% of the SEP events are originated from western hemisphere and 20% from eastern hemisphere. We found that most of the SEPs are originated from the magnetically complex active regions i.e., hale class βγδ and β. Very few events were associated with unipolar active regions. We found that maximum average SEP intensity (2051 pfu) was found corresponding to active region βγδ. In the data set used, we found only 10% SEPs impulsive in nature, while the remaining 90% are gradual in nature. All the impulsive SEP events were originated from western hemisphere. All the impulsive events had SEP intensity less than 100 pfu and most of the CMEs associated with these events were decelerated CMEs.		

ASI2025_217	Ramesh Chandra	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Filament Eruption and EUV Loop Dynamics		
Here, we present the observations of filament eruption and the nearby loop dynamics of of 16 March 2013 in active region (AR) NOAA 11690. The event was observed by the Solar Dynamics Observatory and Solar Terrestrial Relations Observatory. The erupting filament height is fitted with the sum of a linear and exponential function. These two phases evidence the tether-cutting reconnection as well as magnetic instability. Close to the erupting filament, a stable filament remains in the core of the AR. The EUV loops, located above the nearly joining ends of the two filaments, first contract in phase, then expand and reach a new stable configuration. These observations cannot be explained by the models that interpreted contraction within a bipolar magnetic configuration. New simulations are required to broaden the complexity of the configurations studied.		

ASI2025_636	Rohan Bose	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Morphological Study of Polar Coronal hole Jets		
Solar jets are transient events ubiquitous across the solar atmosphere. They are thought to play a crucial role in coronal heating and in the transfer of mass and energy through different atmospheric layers, including into the solar wind. Small-scale jets are generally classified into two types: (i) Standard jets, characterized by inverted Y-shaped structures, and (ii) Blow-out jets, which have broader spires and are often linked to mini-filament eruptions. In this work, we analyzed standard polar coronal hole jets using high-resolution data from the High Resolution Imager (HRI) onboard Solar Orbiter (SoLO). Our observations revealed a filament-like structure interacting with a jet, and we tracked the evolution of the jet and the filament material. The jets were also visible in the cooler temperature channels of the Atmospheric Imaging Assembly (AIA) and the Interface Region Imaging Spectrograph (IRIS), indicating the presence of both cooler and hotter plasma. The jets' energy is in the nanoflare range, typically associated with jets reaching heights of up to 5-10 Mm, but in this case, the jets extended up to 30 Mm above the limb. Additionally, we have analyzed the base of the jets to look for propagating blobs contributing to the dynamics of the jet.		

ASI2025_161	Sabarinath M D	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Minor Element Mapping On Lunar Surface using CLASS Data		
Minor element analysis of the lunar surface provides crucial insights into the Moon's geological history and formation processes. Transition elements like Mn, Cr, and V are important in this study because their properties can indicate the presence of distinct lunar rock types and thermal history. We use lunar X-ray data from Chandrayaan-2 Large Area Soft X-ray Spectrometer (CLASS) to map the minor elements on the lunar surface. The primary focus is on detecting minor elements such as Chromium (Cr), Manganese (Mn), and Vanadium (V) through X-ray fluorescence (XRF) spectroscopy. A novel approach applying peak detection and spectral modelling was applied to detect signatures of these elements in CLASS spectra during strong flares. To ensure accurate element identification, a solar flare-based ultra-filtration mechanism was employed. This mechanism filtered out regions which had very distinct peaks of minor elements in the XRF line spectra. Then the Gaussian fitting algorithms were applied to extract peak parameters such as width and centre, from smoothed spectral data. These peaks corresponded to characteristic X-ray energies emitted by the targeted elements. The intensity of these elements was normalised against Silicon, which is uniformly distributed across the lunar surface. This normalisation allowed for the accurate mapping of element distribution while minimising geometric effects caused by variations in the solar zenith angle. We have generated spatial maps of Cr, Mn, and V across the lunar surface. The maps suggest a higher abundance of the detected minor elements in the lunar highlands and polar regions. These maps are first of its kind and could potentially provide new insights into the minor element composition of the lunar surface, and offer valuable contributions to the field of lunar geochemistry.		

ASI2025_349	Sankalp Srivastava	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
The relation between solar spicules and magneto-hydrodynamic shocks		
Spicules are thin, elongated jet-like features ubiquitously seen shooting upwards in observations of the solar atmosphere, appearing to protrude into the corona before (mostly) falling back to the solar surface. These features exhibit highly complex dynamics during their short lifetimes of 5-10 minutes and seem to be a necessary connecting link between the cooler, denser solar chromosphere and the extremely hot, tenuous corona. In this work, we explore the spatial and temporal relation between solar spicules and magneto-hydrodynamic (MHD) shocks using data from a 2D radiative MHD (rMHD) simulation of the solar atmosphere driven by realistic solar convection that was earlier reported by Dey et al. 2022. This model was able to self-consistently excite a forest of spicules with heights in the range of 6–25 Mm and speeds in the range 30–80 km/s, in agreement with observations. In this work, we demonstrate that slow MHD shocks, which propagate along magnetic field lines, are regions of strong positive vertical acceleration of the plasma that forms the tip of the spicule material during its rise phase. We further show that the strength of these shocks may play a vital role in determining the heights of the spicules, supporting the idea that shocks act as drivers of spicules. In addition, we report some results on the presence of structures similar to propagating coronal disturbances (PCDs) in the simulation, linked with the spicules.		

ASI2025_142	Saurabh Tripathi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Investigation of Source Regions of Geo-effective Coronal Mass Ejections (CMEs)		
This study investigates the origins, characteristics, and impacts of Geo-effective Coronal Mass Ejections (CMEs) on Earth's space environment during solar cycle 24 th (2009-2019), with a focus on their contribution to space weather phenomena. Specifically, we examine Interplanetary Coronal Mass Ejections (ICMEs) detected at the first Lagrangian point (L1), analyzing key features such as enhanced magnetic field strength, magnetic field rotation, and reduced proton temperatures,Plasma-β ratio particularly within Magnetic Clouds. Our work emphasizes CMEs that triggered significant Geomagnetic disturbances, identifying their heliospheric distribution and solar source regions. Using data from Large Angle and Spectrometric Coronagraph (LASCO), Solar Dynamics Observatory (SDO), Advanced Composition Explorer (ACE), Geostationary Operational Environmental Satellites (GOES), and catalogs such as Cane and Richardson's ICME list, CDAW, ARIES, and the HESSI Flare Catalog, we trace the Solar origins of these ICMEs through the Graduated Cylindrical Shell (GCS) model and Jhelioviewer software. This research also investigates the characteristics of solar flares associated with Geo-effective CMEs, offering insights into the link between solar activity and space weather. By analyzing the variation in major Geo-effective CMEs over the solar cycle, our findings enhance the understanding of solar-terrestrial interactions and improve predictive capabilities for space weather events.		

ASI2025_347	SOUMIK KAR	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Simulating Temperature and Spectral Energy distributions in Protoplanetary Disks		
A protoplanetary disk is a rotating circumstellar disk composed of dense gas and dust surrounding a young star. The study of protoplanetary disk structure and composition is crucial to understanding the processes of planet formation. Over the years, several models have been proposed to describe the chemical and hydrodynamical processes in these disks. In this work, we introduce a radiative transfer model designed to characterize the distribution of temperature and spectral energy throughout a disk. Our approach presents an efficient method for achieving radiative equilibrium in Monte Carlo Radiative Transfer (MCRT) simulations, specifically for systems with temperature-independent opacities, such as dusty astrophysical environments. This approach utilizes the MCRT's capacity to track individual photon packets, allowing precise determination of energy absorption sites and subsequent adjustment of the local cell temperature. To maintain radiative equilibrium, each absorbed packet is immediately re-emitted, with its frequency selected to correct the cell's thermal spectrum. The re-emitted packets continue to undergo scattering, absorption, and re-emission until they escape, enabling the system's temperature and spectral energy distribution (SED) to reach equilibrium without iteration. This process conserves energy exactly, eliminates convergence issues, and requires no additional computation time compared to pure scattering models. We present initial results toward a comprehensive understanding of temperature and SED distributions in protoplanetary disks.		

ASI2025_240	SOUMYARANJAN KHUNTIA	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Investigating the Thermodynamics of CMEs and Insights From the Successive CMEs Driving the 11 May 2024 Great Geomagnetic Storm		
Coronal mass ejections (CMEs) are gigantic expulsions of magnetized plasma from the Sun that significantly drive the space weather. While previous research has primarily focused on the kinematics of CMEs, more exploration of their thermodynamic evolution needs to be done. Our study presents a comprehensive analysis of the thermodynamic evolution of multiple fast and slow CMEs, including a detailed case study of the great geomagnetic storm on 11 May 2024. We have implemented the Flux Rope Internal State (FRIS) model to analyze distance-dependent variations in the polytropic index, heating rate, temperature, and internal forces of CMEs. The 3D kinematic data used as input for the FRIS model is derived from the Graduated Cylindrical Shell (GCS) model. Our findings indicate that fast CMEs release heat during their early stages of rapid deceleration and absorb heat during their near-constant acceleration phase. Slow CMEs, on contrast, exhibit mixed thermodynamic profiles--some undergoing heat absorption throughout their observed heights, while others display thermal behavior similar to fast CMEs. Our analysis reveals that although various CMEs show differential heating, they experience heat absorption at later propagation heights, approaching the near-isothermal state. Notably, CMEs with higher expansion speeds exhibit a less pronounced initial temperature drop before getting an isothermal state. Furthermore, the estimated 3D kinematics of responsible interplanetary CMEs (ICMEs) for the great 11 May 2024 storm case study suggest their en-route interaction, further confirmed by using in-situ measurements at 1 AU. Interestingly, for the case study, we note that electrons exhibit distinct thermal behaviors for pre and post-ICME (heat absorption) compared to those within the ICME (heat release), and ions show a bimodal thermal distribution inside the ICME. Our study highlights the importance of successive interacting CMEs towards the storm's severity and the need to understand their thermodynamic evolution better.		

ASI2025_35	Souvik Das	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Analytic investigation of collective fluctuation dynamics in nonthermal solar plasmas		
A rich variety of waves and oscillations are ubiquitously found in the entire solar plasma spatiotemporal regime. The non-radial longitudinal helioseismic modes are one kind of these waves providing solid diagnostic tools to probe the solar interior. A local spherical (non-planar) linear perturbation analysis on the kappa-modified viscoturbulent nonthermal solar plasmas is herein methodically carried out. It yields a unique linear cubic dispersion relation for the self-gravitationally bounded solar plasma system. The multi-parametric dispersion signatures sensitively depend on the electron nonthermality, electronic temperature, fluid dynamic viscosity, thermal conductivity, and geometrical curvature effects. Diverse modal features of the helioseismic gravity mode (g-mode) and acoustic mode (p-mode) are analytically explored. The low-frequency g-mode dominates only in the deeper constituent concentric layers of the Sun. The high-frequency p-mode propagates throughout the Sun up to its surface. The existence of the solar five-minute oscillation is theoretically confirmed. The electron nonthermality spectral index, plasma temperature, and thermal conductivity serve as modal velocity accelerating agents. The dynamic viscosity plays the role of a decelerating one. The radially outward photospheric p-mode energy flux density is estimated analytically as 1-100 kW per unit area. Sufficient leakage of this longitudinal p-mode energy flux contributes significantly to the chromospheric transverse spicule oscillation formation through mode conversion processes. From several observational data, the spicule oscillation energy is obtained as 10 kW per unit area. The proposed analysis justifiably and reliably corroborates with numerous solar observational and theoretical modal signatures existing in the literature.		

ASI2025_720	Susanta Kumar Bisoi	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Inner-heliospheric signatures of steadily declining solar magnetic fields and their possible implications		
We have examined solar photospheric magnetic fields for the solar cycles 21-25, covering the period 1975-2024. The unsigned photospheric magnetic fields at low latitudes (0-45 degrees), known as solar toroidal fields, have shown a solar cycle variation, with the field strength being stronger during the maximum of cycle 25 than during the maximum of cycle 24. However, the unsigned field strength of photospheric magnetic fields at high latitudes (45-78 degrees), known as solar polar fields, has shown a significant steady decline since the mid-1990s. The unsigned field strength of solar polar fields, after an increase during 2015-2020, declined again until 2024, continuing the declining trend for a long 30 years. Also, we have examined the solar wind microturbulence levels in the inner heliosphere (0.2-0.8 AU), using interplanetary scintillation observations at 327 MHz, covering the period 1983-2022, that has steadily declined since the mid-1990s and continued until 2022, synchronously with the solar polar fields. We have found that the floor level in both solar toroidal fields and solar wind magnetic fields has been reduced during the minimum of cycle 23 and recovered back during the minimum of cycle 24. In addition, a hemispherically asymmetric solar polar reversal was evident in the signed (axial) solar polar fields during cycles 21-25, with the reversal in cycle 25 for the northern hemisphere already completed. Still, the same for the southern hemisphere is yet to be completed. We discuss the implications of such a long declining trend and other anomalies in solar cycle activities during the solar cycles 21-25.		

ASI2025_421	Sushmita Deb	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Exploring the structural composition of habitable exoplanets		
Examining habitability and interior composition of exoplanets is a key subject for exploring the life sustaining possibility of the extrasolar worlds. Characterizing the planetary structure and atmospheric evolution provides insights regarding the surface condition and long term habitability of these planets. In this study, we conducted a comprehensive analysis of exoplanets in the mass and radius range of Rp ≤4$R\oplus$ and Mp ≤15$M\oplus$ and confirmed 15 of them lying within the extended habitable zone boundaries. We provide the stellar parameter analysis of the host stars and giving a constrained estimation of the stellar physical properties. We employed the MIST isochrones along with the estimated stellar parameters to determine the age of these systems. We also performed the interior structure modeling of the planets to infer their possible composition and structure, constraining the mass fractions of all the four layers: iron core, silicate mantle, water or ice layerand atmosphere. Our model analysis confirms iron-rock core composition for LHS 1140b and TOI 1452b, whereas supports a water rich composition for TOI-1266c, LTT-3780c, LP 791-18c and K2-18b. Futhermore, assuming the exoplanets capable of accreting a gaseous layer, we modelled the initial envelope fraction of the habitable exoplanets to examine their ability to sustain a stable atmosphere over time. The results, obtained from our analysis, provides new insights into the structural and atmospheric properties of the exoplanets lyingwithin the habitable boundaries of their systems.		

ASI2025_160	Tisyagupta Pyne	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
The 10 pc Neighborhood of Habitable Zone Exoplanetary Systems: Threat Assessment from Stellar Encounters & Supernovae		
The habitability of a planet is influenced by both its parent star and the properties of its local stellar neighborhood. Potential threats to habitability from the local stellar environment mainly arise from two factors: cataclysmic events such as powerful stellar explosions and orbital perturbations induced by close stellar encounters. Among the 4,500+ exoplanet-hosting stars, about 140+ are known to host planets in their habitable zones. In this study, we use Gaia DR3 data to investigate the 10 pc stellar neighborhood of the 84 habitable zone systems (HZS) closest to the Sun. We assess the possible risks that local stellar environment of these HZS pose to their habitability. In particular, we find that HD 165155 has a high stellar density around it, making it likely to experience at least one flyby encounter within a span of 5 Gyr. We also identified two high-mass stars (M≥8M$\odot$) as potential progenitors of supernovae, which could threaten the long-term survivability of habitable zone systems HD 48265 and TOI-1227. Further, to quantify the similarity between habitable zone stars and the Sun, as well as their respective 10 pc stellar environments, we employ various astrophysical parameters to define a Solar Similarity Index (SSI) and a Neighborhood Similarity Index (NSI). Our analysis suggests that HD 40307 exhibits the closest resemblance to the solar system, while HD 165155 shows the least resemblance.		

ASI2025_278	Trinesh Sana	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Effect of Solar Activity on The Lunar Plasma Environment		
The Sun greatly influences the plasma environment around the Moon. Without any significant atmosphere and global magnetic field, the Moon's surface is directly exposed to the solar wind and/or magnetospheric plasma and solar photons. Under exposure to dominant solar radiation, the sunlit lunar surface (and floating dust) generally acquires a positive charge and generates photoelectrons. The emitted photoelectrons and floating charged dust form a dusty photoelectron sheath in the vicinity of the lunar surface, which is a major component of the lunar dusty plasma environment. In contrast, plasma electrons typically predominate on the night side, and the surface acquires a negative charge and forms a classical plasma sheath. The complex electric potential/ field structures and dust dynamics within the lunar photoelectron sheath significantly depend on the solar vacuum ultraviolet (VUV; < 200 nm) radiation. The solar activity is highly variable in the range of 70–100 nm. Since the photoemission efficiency (quantum yield) of the lunar surface peaks in this range, the photoemission current and subsequent sheath characteristics significantly vary with solar activity. Here, we present a quantitative estimate of lunar photoelectron sheath characteristics using the high-resolution solar UV spectrum for different solar activity measured at 1 AU from the Flare Irradiance Spectral Model 2 (FISM2) and lunar photoelectron yield measured from sample return by the Apollo missions. This data will be used as the input parameters for a comprehensive photoelectron sheath model to derive the electric potential/field and population density profiles of the sheath constituents. The results demonstrate that under extreme solar flare conditions, the photoemission current increases significantly, which results in stronger potential and electric fields in the vicinity of the lunar surface. As a result, in extreme solar flare conditions, the electrostatic mobilization of lunar dust is anticipated to increase significantly.		

ASI2025_456	Varghese Reji	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Modelling the vertical velocity gradient to disentangle stellar activity from exoplanet signal		
Extreme precision radial velocity (EPRV) measurements are critical for discovering habitable planets and estimating planet mass. Modern EPRV instruments are intrinsically stable at a few cm/s, 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. Stellar activity signals are spurious Doppler shifts measured in the spectrum of a star due to any changes in the fluid flows of the photosphere. The formation of active regions and star spots, or the suppression of the convection flow, causes spurious disc-averaged radial velocity shifts in the order of m/sec. Disentangling this signal from Doppler shifts due to a planet is the central problem in the planet discovery field. Since the spurious radial velocity shifts are driven by the changes in the average flow velocities in the stellar photosphere, we expect to see signatures of this in the radial velocity measured at different heights of the stellar atmosphere. 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 atmosphere. Based on this idea, we are developing a method to disentangle stellar activity signals and planetary signals in radial velocity data. We first model the spectra generated from various depths of the photosphere, then calculate the radial velocity associated with that. We will use the NEID solar data to fit our models and test the ability of the algorithm to disentangle the photospheric velocities from the planetary signal. Here I shall present our model and the progress so far.		

ASI2025_98	Vinod Chandra Pathak	Poster
Sun, Solar System, Exoplanets, and Astrobiology		
Characterizing Molecular Winds from Protoplanetary Disks: New Perspectives from JWST		
Understanding the physical processes, such as outflows (winds, jets) and the accretion of dust and gas around newly born stars, and their successive evolutionary stages, is essential for advancing our knowledge of star and planet formation. We have investigated the role of molecular disk winds in the evolution and dispersal of protoplanetary disks, in low-mass ($M^* = 0.5 - 1\ M_\odot$) young stars in the nearby star-forming regions with the JWST. Pure-rotational molecular hydrogen lines in the mid-infrared wavelength range (5-28 microns) serve as valuable probes for disk winds. We analyzed publicly available data from 72 protoplanetary disks obtained from various Cycle 1 GO and GTO programs of JWST MIRI MRS to characterize outflows in protoplanetary disks. For the first time, we are detecting extended pure-rotational H_2 lines due to the high spectral resolution and sensitivity of the JWST MIRI MRS instrument. Molecular H_2 emission was detected in 46 out of the 72 disks, with 17 exhibiting extended emission indicative of outflowing material. For the remaining disks, the emission arises from the unresolved inner disk regions. We have carried out a detailed study of the outflow morphologies, and velocity distributions, and have measured dynamical timescales, mass-loss rates, momentum rates, and mechanical luminosities of the molecular winds from these protoplanetary disks. Additionally, we have characterized the physical conditions of the emitting H_2 gas, including its temperature, density, total disk wind mass, and the ortho-para ratio. Our preliminary analysis suggests that the mass-loss rates and momentum rates for these molecular disk winds are to those observed for protostars in the earliest evolutionary phases. The unprecedented sensitivity and spectral resolution of JWST MIRI MRS reveal detailed kinematics and dynamics of disk winds, uncovering new aspects of disk evolution and planet-formation by detecting extended H_2 emission in 17 disks.		

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

ASI2025_570	Aardra S	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Gas Kinematic Investigation of Cometary Globule - LBN 437 using TRAO Observations		
Bright-rimmed, cometary-shaped star-forming globules, associated with HII regions, are remnants of compressed molecular shells exposed to ultraviolet radiation from central OB-type stars. The interplay between dense molecular gas and ionizing radiation, analyzed through gas kinematics, provides insights into the nature and dynamic evolution of these globules. We present the kinematic study of the cometary globule, Lynd's Bright Nebula (LBN) 437, focusing on the first rotational transition of the 12CO and C18O molecular lines, observed using the Taeduk Radio Astronomy Observatory (TRAO). The kinematic information retrieved from the spectral-line maps traces the gas dynamics in LBN 437. The averaged 12CO spectrum shows a slightly skewed profile, suggesting the possibility of a contracting cloud. The molecular line profiles reveal signatures of infalling gas in the cometary head of LBN 437, indicating the initial stages of star formation. We also estimate the infall velocity and mass infall rate towards the cometary head of LBN 437. The estimated mass infall rate aligns well with the previous studies on intermediate or high-mass star formation, indicating that the cometary head of LBN 437 is a potential site for high-mass star formation.		

ASI2025_598	Advik Gupta	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Detailed asteroseismic modeling and precise inferences of the physical properties of the benchmark subgiant μ Herculis		
The measurements of pressure mode and the so-called mixed mode oscillation frequencies of subgiant stars provide us with a unique opportunity to investigate the physical conditions in their deep interiors and also infer their global properties precisely. We present a detailed asteroseismic study of the benchmark subgiant μ Herculis based on the latest data from the SONG network. Since mixed mode frequencies are very sensitive to stellar internal structure and evolution, we computed a dense grid of stellar models and corresponding adiabatic oscillation frequencies. We carried out the glitch analysis to extract the properties of the helium ionization zone. The oscillation frequencies and measured helium glitch properties, along with effective temperature and metallicity, were fitted using Bayesian statistics. We find the mass, radius, and age of μ Herculis to be 1.11^{+0.05}_{-0.02},1.71^{+0.03}_{-0.02} and 8.4^{+0.4}_{-0.1} respectively. The inferred surface and initial helium mass fractions are 0.24^{+0.01}_{-0.02} and 0.29^{+0.01}_{-0.03} respectively. We also observe a significant discrepancy between the observed extent of the helium ionization zone and that predicted by the stellar models, highlighting potential shortcomings in the models. In this presentation, I will discuss the application of asteroseismology and the corresponding stellar modeling approach for our target μ Herculis subgiant star.		

ASI2025_243	Ajay Kumar Saini	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Detection of Enhanced Germanium in a New Cool Extreme Helium Star A980: Insights and Implications		
Hydrogen-deficient carbon stars (HdCs), as the name suggests, are characterized by atmospheres that are poor in hydrogen and rich in carbon. When compared to a normal star, HdCs' optical spectra show very weak presence or absence of hydrogen Balmer lines for their effective temperatures. The process that is responsible for the origin of these stars, which transforms a normal star into a H-poor HdC star, is still a mystery. For several decades, there were just about 5 known HdCs. However, note that there exists yet another class of hydrogen-deficient stars known as R Coronae Borealis stars (RCBs). Unlike HdCs, RCBs exhibit remarkable photometric variability by undergoing unpredictable light decline (up to about 9 mag in visual). It is heartening that a recent survey has reported about 27 new HdCs, a sixfold increase in their number than the earlier known (Tisserand et al. 2022). Warner (1967) provides the abundances of five earlier known HdC stars but with outdated observational methods and abundance analysis techniques. And, there are no measurements available for the elemental abundances of newly discovered HdC stars to date. Detailed abundance analysis serves as a crucial observational constraint on theoretical models concerning the formation and evolution of stars. In this regard, we conducted a fine abundance analysis of a new warm HdC star, A980 (2MASS 18113561+0154326), using a high-resolution spectrum obtained from Hanle Echelle Spectrograph (HESP), mounted on 2-m Himalayan Chandra Telescope (HCT) in Hanle, India. I will present the findings from our analysis which includes (a) a confirmation of A980 as an Extreme Helium (EHe) star that was earlier classified as an HdC star, (b) discovery of germanium transitions and its enhancement in A980, a cool EHe, suggesting synthesis of germanium in A980's evolution, and (c) strongest s-process enhancement measured in A980 among the other cool EHes.		

ASI2025_219	Akash P	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Investigating the Physical and Chemical Characteristics of C-J type carbon stars		
Carbon stars serve as an important class of stars that can provide valuable insight into the evolution of stars and nucleosynthesis at various stages of their evolution. In general, carbon stars are classified as intrinsic stars, which produce carbon internally, and extrinsic stars, which gain carbon through binary mass transfer. Additionally, carbon stars are further classified based on their spectral characteristics into four subgroups: C-H, C-N, C-J, and C-R. Every subgroup represents a specific stage of stellar evolution. Among these subgroups, C-J and C-R carbon stars are the least explored. C-J and C-R stars often lack heavy elements associated with neutron-capture processes, which suggests their unique origins, in contrast to typical carbon stars that formed during the Asymptotic Giant Branch (AGB) phase. We investigated the origin and evolutionary state of C-J-type carbon stars in a recent study. We selected a sample of 300 C-J stars from Lamost data release 4. As a first step toward understanding their origin, we explored their chemical and kinematic properties. In addition, their binarity is assessed using the Renormalised Unit Weight Error (RUWE) of the GAIA survey. The preliminary results from our analyses will be presented during the meeting.		

ASI2025_359	Amrit Mishra	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Investigating the fragmentation and kinematics in the massive, filamentary cloud IRAS 18337-0743		
High-mass star-forming clouds exhibit filamentary structures extending to $\gtrsim$ 1 pc and containing $\gtrsim$ 10^3 solar masses of the dense gas that fragments along the major axis. These massive filaments are often characterized by strong turbulence and outflows, indicating a dynamical environment. Embedded within these filaments are dense cores of mass $\lesssim$ 10 solar masses. For these dense cores to form massive protostars, they must accrete gas from the ambient medium. Such accretion processes are characterized by velocity gradient along the (sub-)filaments and signatures of infall. We present an in-depth fragmentation analysis and kinematic study of the massive filamentary cloud IRAS 18337-0743, located at a distance of 3.8kpc. For this analysis, high-sensitivity and high-resolution ALMA Band 3 (3mm) and Band 6 (1.3mm) dust continuum and molecular line transitions (NH2D and H13CO+) are used. The large number of detected cores are classified into pre-stellar and protostellar cores, and the influence of protostellar feedback is also investigated.		

ASI2025_171	ANJALI SINGH	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A regularisation technique to precisely infer limb darkening using transit measurements: Can we estimate stellar magnetic field?		
The high-precision measurements of exoplanet transit light curves that are now available contain information about the planet properties, their orbital parameters, and stellar limb darkening (LD). Recent 3D magneto-hydrodynamical (MHD) simulations of stellar atmospheres have shown that LD depends on the photospheric magnetic field, and hence its precise determination can be used to estimate the field strength. Among existing LD laws, the uses of the simplest ones may lead to biased inferences, whereas the uses of complex laws typically lead to a large degeneracy among the LD parameters. We have developed a novel approach in which we use a complex LD model but with second derivative regularisation during the fitting process. Regularisation controls the complexity of the model appropriately and reduces the degeneracy among LD parameters, thus resulting in precise inferences. The tests on simulated data suggest that our inferences are not only precise but also accurate. This technique is used to re-analyse 43 transit light curves measured by the NASA Kepler and TESS missions. Comparisons of our LD inferences with the corresponding literature values show good agreement, while the precisions of our measurements are better by up to a factor of 2. We find that 1D non-magnetic model atmospheres fail to reproduce the observations while 3D MHD simulations are qualitatively consistent. The LD measurements, together with MHD simulations, confirm that Kepler-17, WASP-18, and KELT-24 have relatively high magnetic fields (>200 G). This study paves the way for estimating the stellar surface magnetic field using the LD measurements.		

ASI2025_140	Anju Panthi	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
UV-based study of an open cluster NGC 2627 using AstroSat		
We investigate the intermediate-age open cluster NGC 2627, located at ~ 2 kpc, using UVIT/AstroSat and other archival data. By applying the machine learning algorithm ML-MOC on Gaia DR3 data, we identify 422 cluster members, which include four blue straggler stars (BSSs), one yellow straggler star (YSS), one blue lurker (BL), one red clump (RC) star, and two binary candidates detected in both the UVIT/F148W and UVIT/F169M filters. We characterize these stars using multiwavelength spectral energy distributions (SEDs). Among the nine sources mentioned above, one BSS, the BL, and one binary candidate were found to have sources within 3'' radius, so we did not fit their SEDs. Of the remaining six sources, we successfully fit two with single-component SEDs and four with the binary-component SEDs. The parameters derived from these binary-component SEDs suggest that the hot companions of the BSSs, YSS, RC star, and one binary candidate are extremely low-mass white dwarfs, confirming that at least four out of the nine stars (44%) are formed via mass transfer. We fit King's profile to the high-probability cluster members (p > 0.8) and determine the core radius (rc) to be 3.84' and the tidal radius (r t) to be 36.85'. Our analysis shows that equal-mass binaries are most concentrated near the cluster center, followed by single massive stars and single low-mass stars. Additionally, the BSS population is located within a radius of ~10 times r c , indicating that the cluster is dynamical evolved.		

ASI2025_424	Dipang Vaishnav	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Spectroscopic Study of Type-II Supernovae in Progenitors with Extended H-envelope		
Type-II supernovae in progenitors with an extended H-envelope follow a light curve with three distinctive phases: (a) an initial cooling peak (b) a recombination plateau, as the ionized hydrogen recombines, and finally, as the event enters the nebular phase, (c) a long tail fueled by radioactive decay of 56Ni → 56Co → 56Fe. We present here a spectroscopic study of three type II events– the radiobright SN2018ivc, SN2024exw and SN2024ggi– observed at similar epochs. The early spectra reveal prominent emission lines, including Hα, Hβ, Hγ, Hδ, Hϵ, He I, C IV, and Fe I, II, and III, and absorption features of Na I, all with varying intensities as the SNe evolves. In the late nebular stage, the Ca II and [Ca II] NIR lines and other metal lines also emerge. We present a detailed analysis of the Balmer line profiles, notably Hα, which retain their characteristic P-Cygni structure well into the nebular phase. We use our spectral studies to characterize the progenitor's and its environment's properties (e.g. mass, local metallicity, etc.), and to quantify the dynamics of shock-ejecta interactions as a function of the progenitor characteristics. Key words: Type-II SNe, H-envelope, SN2018ivc, SN2024exw, SN2024ggi, P-Cygni , mass, metallicity		

ASI2025_648	Firoza Sutaria	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
An optical study of interacting supernovae.		
Mass loss during the evolutionary lifetime of stars plays a crucial role in determining their final stages, but the true rate of mass loss, and the evolutionary stage at which it occurs, remains largely unknown, especially in the case of massive, low metallicity stars. Supernovae with massive (M>10 M_sun) progenitors reveal the existence of a circumstellar medium (CSM), the nature and morphology of which appears to depend on the progenitor properties, as well as on the properties of the star-forming region associated with the progenitor. We present here optical studies of several type-IIn supernovae, (with focus on SN2023usc) at epochs ranging from early cooling to late nebular stage, and explore the inferred variations in the CSM's physical properties and geometry. We find that an asymmetric distribution of CSM, either via a disk, bipolar or even a multi-shelled morphology, greatly influences the spectral line profiles, especially early in the event's temporal evolution. We find that the class of interacting supernovae with dense CSM (type-IIn) consists of at least two sub-types -- the long lived, super luminous type-IIn events like SN2017hcc, which remain intrinsically bright for up to several years, and the short lived ones (e.g. SN2023usc) which reach nebular stage within a few $\times$ 100 d. This suggests that there may be multiple factors, including progenitor mass, metallicity, and even binarity which may be responsible for optical properties of this relatively rare class of supernovae.		

ASI2025_138	Himanshu Tyagi	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
IPA: Unveiling a New Era of Protostellar Winds with JWST		
Protostellar jets and winds play a crucial role in the evolution of protostellar systems by removing angular momentum and enabling accretion, while also regulating star formation rates through feedback on their parent molecular clouds. However, the mechanisms driving jet and wind formation, as well as their feedback effects, remain poorly understood. We will present the latest results from the JWST Cycle 1 GO program Investigating Protostellar Accretion (IPA) that observed five Class 0 protostars across a broad luminosity range (0.2 to 10,000 Lsun). Our high angular resolution spectral imaging from JWST offers unprecedented insights into the morphology, kinematics, and dynamics of these wide-angle winds traced by the molecular hydrogen (H_2) emission. We observe complex emission structures, with JWST revealing a wide hourglass-shaped outer boundary in multiple ro-vibrational and pure-rotational H_2 lines. Complementary ALMA 12CO observations, which trace the broader wind cavities, align with JWST's scattered light data, showing that H_2 winds are more narrowly confined than the low-J CO winds—indicating that H_2 likely traces disk winds. Additionally, our findings suggest that the wide-angle winds are not driven by atomic jets. We will discuss the implications of these results for our understanding of protostellar wind launching mechanisms and their impact on molecular clouds.		

ASI2025_600	JONMONI DUTTA	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Nonlinear normal acoustic modes in nonthermal star-forming clouds with moderative extra-negative ionic effects		
The presence of negative ions in the space and astrophysical environment is inevitable [1]. It plays a significant role in triggering non-local gravitational collapse dynamics for the bounded structure formation mechanism in complex clouds of infinite extension [1]. We herein develop a theoretical model formalism to explore the nonlinear normal acoustic modes excitable in spherically symmetric tridust molecular clouds (TMCs). The partially ionized complex TMC is composed mainly of lighter species, such as electrons, positive ions, and negative ions. Its heavier species include bipolar charged dust grains alongside partial ionization. The TMC model is presumed to form initially a quasi-neutral hydrostatic homogeneous equilibrium configuration [2]. The spatial behavior of the high-energetic lighter compositions, such as electrons, positive ions, and negative ions, is described by the κ-deformed Kaniadakis distribution laws [3]. The novelty of this distribution function lies in its ability to offer a robust model for studying high-energy particles in the astrophysical context where relativistic effects are significant [3]. The thermal pressure behavior of constitutive dust fluids is formulated in the framework of the Larson logatropic equation of state. The application of a standard reductive perturbation method yields a unique pair of extended Korteweg-de Vries (KdV) equations with dissimilar nonlinear and dispersion effects. It is seen analytically that the characteristic behavior of the nonlinear structural patterns depends on the diverse equilibrium plasma parameters. A detailed numerical analysis characterizing the elaborate modal features in a conjugational form is in progress. References [1] T.J. Millar, C. Walsh, and T.A. Field, “Negative ions in space”, Chemical reviews, 117, 3, February 2017, pp. 1765-1795. [2] C.B. Dwivedi, A.K. Sen, and S. Bujarbarua, “Pulsational mode of gravitational collapse and its impact on the star formation”, Astronomy and Astrophysics, 345, May 1999, pp. 1049-1053. [3] G. Kaniadakis, “Statistical mechanics in the context of special relativity”, Physical review E, 66(5), 2002, pp. 056125(1-17).		

ASI2025_642	Komail Murtaza	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
BVRI Photometric Study of star clusters UBC207, UPK402, UPK398 and BE28		
BVRI Photometric Study of star clusters UBC207, UPK402, UPK398 and BE28 Komail Murtuza, Priya Hasan We present BVRI photometry of stars in the field some poorly studied clusters UBC207, UPK402, UPK398 and BE28 using HCT data obtained in November 2022. By determining the stellar membership using Gaia data, we identify the probable cluster members in these clusters. We use our sample to obtain robust cluster parameters using ASteca. We find the mass functions of these clusters.		

ASI2025_290	Koshvendra Singh	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Modelling the Accretion Hotspot of Low-Mass Young Stars: Insights into Thermal and Spatial Structure		
Low-mass young stars undergo magnetospheric accretion where disk matter follows stellar magnetic field lines and freely falls on the star creating a shock-heated region with ∼104K temperature, called hotspot. The hotspot can be regarded as a 2-dimensional (2D) slice at the stellar surface of a 3D accretion dynamics across the disk and star. It carries imprints of the variable accretion dynamics (Espaillat et al. 2021, Singh et al. 2024). The hotspot is very responsible for the thermal-chemical-mineralogical evolution of the irradiated disk. However, the thermal and spatial structure of the hotspot is not well understood. In this talk, I will present our recent work on modeling the thermal-spatial structure of the hotspot. We modeled the thermal profile along the two spherical coordinates by 'Gaussian-like' symmetric functions, motivated by the results of sophisticated 3D MHD simulations of magnetospheric accretions from Kulkarni and Romanova 2013. These profiles are further motivated by the analytical equation of the spatial distribution of accreting matter based on the star-disk geometry. The model observables are time-lag among lightcurves, indicating the temperature distribution in hotspots, peak-to-peak lightcurve amplitude, reflecting temperature ranges in it, as well as mass-accretion rate. We fit our model onto the observations of the dynamically and morphologically evolving hotspot of a young star named EX Lupi, during its outburst in March 2022. The thermal structure of the hotspot provides the extent of the stellar surface covered by density contours, providing insights into which parts of the disk are more efficiently cou- pled to the accretion. As the hotspot evolves over accretion variation as shown by Singh et al 2024, this model will provide insights into why specific regions of the disk are more prone to accretion than others leading to a better understanding of the accretion-outflow relation and its effect on the star-disk system.		

ASI2025_269	Laksh Gupta	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Study of white dwarfs in NGC2808 using Near-Ultraviolent and optical data from the Hubble Space Telescope		
NGC2808 is a highly unusual Galactic globular cluster (GC) that supposedly underwent more than one episode of star formation and hosts distinct stellar sub-populations and a significant number of binaries. This study analyzes the white dwarf stars (WDs ~ 500 stars) in NGC2808 using deep near-ultraviolet and optical data (F275W and F336W filter systems) from the Hubble Space Telescope UV Globular Cluster Survey (HUGS). Recently discovered slowly cooling WDs (SCWDs) in only two GCs - M13 and NGC6752 have greatly impacted our understanding of WDs as cosmic chronometers, given that it contradicts the canonical definition of WDs as objects that simply cool. To investigate this, we analyzed the color-magnitude diagrams (CMDs) of NGC2808 using various combinations of filters. We performed star count-crossing time analysis to estimate the theoretical star counts of main sequence turn-off and WDs stars by comparing the completeness-corrected observed counts. We used various isochrones, evolutionary tracks, and BASTI CO-core/H-envelope 0.54 $M_{\odot}$ cooling models of WDs and adopted reddening and distance modulus values from the literature to find the crossing times of evolutionary phases. We inferred a significant excess of WDs from the analysis and WD luminosity function plots, which suggests that these could be slowly cooling Hydrogen envelope WDs or He-core WDs in the cluster.		

ASI2025_593	Manash Samal	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Exploring star clusters using with the 2.5m Mt. Abu telescope: the case of NGC 5053		
Star clusters are ideal laboratory for testing stellar evolution of stars in the crowded environment. We explore, a few rich star clusters using the faint object camera (FOC) mounted on the 2.5m telescope of the Mt. Abu observatory. Here, we present a detailed analysis of the one of the observed star clusters, NGC 5053, using g, r, and I filters obtained with the exposure time of 1200 s, 900 s, and 900 s, respectively. The NGC 5053 cluster is an old and extremely metal-poor globular cluster situated in the Galactic halo at a distance of 17.5 kpc. We could achieve the photometric depth of 23.0 mag, 22.7 mag, and 22.6 mag in g, r, and I bands, respectively, with an uncertainty of 0.1 mag each. The g, r, and I filter magnitudes were used to construct the colour-magnitude diagrams (CMDs) to identify stars of various evolutionary phases present in the cluster. We could identify sources in the red-giant branch (RGB), sub-giant branch (SGB), main-sequence turn-off (MSTO) and main sequence (MS) phases. We derived the age of the cluster as 12.5 Gyr by fitting the PARSEC isochrones on the SGB, MSTO, and MS stars in the CMDs. We find the turn-off mass of the cluster as 0.76 Msun. We were able to identify the sources down to 0.6 Msun in the cluster using deep photometry in the g-band. We also observed a few exotic stellar populations in the cluster, e.g., blue straggler and blue lurker stars. Their multi-wavelength photometric fluxes combing (UV, optical, and near-IR) suggest that they are young (age: 3.5 Gyr to 10 Gyr) and massive (0.8 Msun to 1.13 Msun) relative to the cluster age and turn-off mass, respectively; and few of them are in binary system revealing their formation in the cluster through collision/merger as well as through mass-transfer channels.		

ASI2025_151	Mrinmoy Sarkar	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Asteroseismology of the mild Am delta Sct star HD 118660: TESS photometry and modelling		
We present the results of an asteroseismic study of HD 118660 (TIC 171729860), a chemically peculiar (mild Am) star exhibiting delta scuti pulsations. It is based on the analysis of two sectors of time-series photometry from the space mission TESS (Transiting Exoplanet Survey Satellite) and seismic modelling. It yielded the detection of 15 and 16 frequencies for TESS sectors 23 and 50, respectively. The identified pulsation modes include four radial (l = 0) and five dipolar (l = 1) ones. The radial modes are overtones with order n ranging from 3 and 6. Such high values of n are theoretically not expected for stars with the effective temperature of HD 118660 (Teff ≈ 7550 K) located near the red edge of the delta scuti instability strip. To estimate the asteroseismic parameters, we have generated a grid of stellar models assuming a solar metallicity (Z = 0.014) and different values for the convective overshooting parameter (0.1 ≤ αov ≤ 0.3). We conclude that the analysis of the radial modes is insufficient to constrain αov and Z for delta scuti stars. The value for the equatorial velocity of HD 118660 derived from the seismic radius and the rotational frequency is consistent with values found in the literature.		

ASI2025_509	NAMBRAM NIRODA DEVI	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Exploring the Umov Effect in Dust Aggregates: Influence of Material Composition and Size Distribution		
This study investigates the Umov effect—an inverse correlation between reflectivity and the degree of linear polarization of scattered light—within the context of aggregate dust models. We analyze both polydisperse and monodisperse aggregates, employing the multisphere T-matrix (MSTM) code to simulate light scattering by various dust compositions, including carbonaceous materials, silicates, and Halley-like dust. The research highlights the impact of particle size distribution on the Umov effect and explores the optical properties of different aggregate types over a range of refractive indices. Our findings contribute to a deeper understanding of light scattering in cosmic dust environments.		

ASI2025_315	Narendra S	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
An X-band study of ultra-compact HII regions using radio recombination line observations		
Ultra-compact HII (UCHII) regions are small (< 0.1 pc) and dense (> 10^4 cm-3) regions of hot ionised gas surrounding young O-B stars embedded in dusty molecular clouds. These Galactic UCHII regions are considered one of the best tracers for studying high-mass star formation and the evolution of the interstellar medium. They are also useful secondary calibrators for submillimeter telescopes. UCHII regions are bright in radio and submillimeter frequencies, with emission dominated by free-free broad-band continuum, molecular lines and hydrogen radio recombination lines (RRLs). These RRLs can be used to determine the electron temperature and density of HII regions, providing useful information in their physical properties and in probing the environment around hot young massive stars. We present the X-band study of three UCHII regions, namely IRAS 17271-3439 (ATCA), G34.26+0.15 and W51d (VLA). We report the presence of Hα (H85α to H90α) and Hβ (H107β to H113β) RRLs in the band of 8.776 GHz to 10.824 GHz from the sources. IRAS 17271-3439 was observed with a single window of 2048 channels and a resolution of 1 MHz; G34.26+0.15 and W51d had 16 spectral windows, each of 64 channels and a resolution of 2 MHz. The data was analysed following standard reduction procedures on CASA, making continuum images and spectral cubes for each RRL. IRAS 17271-3439 and W51d were unresolved. G34.26+0.15 was resolved with two nearby hypercompact HII regions in the field, across which we observed Hα RRLs. With the observed RRLs and using the Helium-to-Hydrogen abundance ratio from the literature, we infer the electron temperature, emission measure, mean electron density, and other physical properties of these UCHII regions.		

ASI2025_236	Narendra Bhatkar	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Numerical modelling of the molecular region towards Herschel 36		
The Herschel 36 stellar system is an important part of the Lagoon Nebula. The interstellar medium associated with this sightline has been probed extensively and has been found to host many atomic and molecular species. In particular, H 2 has been detected by Far Ultraviolet Spectroscopic Explorer (FUSE) in multiple vibrational levels through its absorption lines against the spectrum of the bright background source. Such high excitation of H2 is rarely observed in interstellar studies. In this project, we perform numerical modelling using the spectral synthesis code CLOUDY to constrain the physical conditions in the Herschel 36 environment. CLOUDY performs self-consistent calculations to determine the ionization, thermal, and chemical state of the modelled cloud, while incorporating a detailed treatment of the microphysics of H2 along with dust grain physics. We match our model predictions of the H2 rotational and vibrational level population against the corresponding H2 observational data previously reported in literature. This leads us to insight into the density, temperature, cosmic ray ionization rate, and spectral energy distribution of the incident radiation field. We infer density conditions typical of diffuse to slightly dense molecular gas, irradiated by intense UV and X-ray radiation.		

ASI2025_581	Nipun Ghanghas	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Inferring Asteroseismic Parameters from Short Observations Using Deep Learning: Application to TESS and K2 Red Giants		
Asteroseismology is the study of resonant oscillations of stars to infer their internal structure and dynamics. It is also a powerful tool for precisely determining stellar parameters such as mass, radius, surface gravity, and age. Additionally, the mixed modes in red giants carry information from the core, which places strong constraints on stellar evolution. Using these mixed modes, we can estimate the period spacings of gravity modes, which is directly related to the core mass. The ongoing TESS mission, with its nearly complete sky coverage, presents a unique opportunity to uniformly probe stellar populations across the Milky Way. TESS is estimated to have observed more than 300,000 oscillating red giants, most of which have one to two months of observations. Given the scale of this dataset, we need a fast, efficient, and robust way to analyse the data. In this work, our objective is to develop a machine learning based method to infer asteroseismic parameters from short-duration observations. Specifically, we focus on two global seismic parameters, the large frequency separation (Δν) and the frequency at maximum power (νmax), from one-month- long TESS observations of red giants. Meanwhile, for K2 data, our focus extends to inferring the period spacings of dipolar gravity modes (ΔΠ1), in addition to Δν and νmax. Our findings demonstrate that our machine learning algorithm can accurately infer Δν and νmax for approximately 50% of samples created by taking one-month Kepler and K2 observations. For TESS one sector data however, we recover reliable Δν for only about 10% of the stars. Additionally, we get reliable ΔΠ1 inferences for about 90 young red-giants from K2. For these ΔΠ1 inferences, we see a good match with the well known Δν–ΔΠ1 observed in Kepler red-giants.		

ASI2025_517	Nirupam Roy	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Pinching the Galaxy: The Impact of Molecular Cloud Complexes on Atomic Interstellar Medium		
The Milky Way is a spiral galaxy composed of billions of stars, gas, and dust. Within this cosmic expanse, molecular clouds, dense regions of gas and dust, play a crucial role in the formation of new stars. These clouds, often grouped into massive complexes, exert a significant gravitational influence on the surrounding interstellar medium. A fascinating phenomenon, known as the "pinching effect," occurs when these molecular cloud complexes compress the surrounding atomic hydrogen (H I) gas, reducing its vertical scale height. This gravitational force effectively flattens the gas layer, making it thinner and more concentrated. Recent observational studies have provided compelling evidence for this pinching effect. By analyzing multi-wavelength observations of the Milky Way, we have identified molecular cloud complex that exhibit a clear impact on the surrounding H I gas. These observations reveal a distinct reduction in the vertical extent of the H I layer in the vicinity of the complex. The pinching effect has profound implications for our understanding of galactic structure and evolution. By altering the distribution of gas, these molecular cloud complexes can influence star formation rates and the overall dynamics of the galactic disk. Furthermore, the study of this phenomenon can provide valuable insights into the interplay between gravity, gas, and stars in galaxies.		

ASI2025_401	Omkar Jadhav	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Understanding the Interplay of Magnetic Fields and Gas Dynamics in the G47 filamentary cloud		
Several studies have shown that filamentary clouds are associated with the star formation activities. However, the overall process of star formation remains highly complex due to the interplay among gravity, turbulence, magnetic field (B-field), and stellar feedback. Among these the role of B-field in the process of star-formation remain the least understood. To understand the role of B-field in star formation processes, we present a multi-wavelength study of the filamentary cloud G47 (hereafter G47; d ∼4.44 kpc) containing mid-infrared bubbles, N98, B1, and B2. The SMGPS 1.3 GHz continuum map detected radio emission toward N98, B1, and newly depicted emission from B2. SOFIA/HAWC+ 214 μm polarization data show that the plane-of-the-sky B-field toward G47 is mostly perpendicular to the cloud's major axis, though some regions exhibit a curved structure. The position-position-velocity (PPV) diagram of 13CO reveals a U-shaped structure toward the N98 HII region, with a blue-shifted component near 52.3 km/s and a red-shifted component around 63 km/s. The red-shifted component is spatially associated with the curved B-field morphology. This U-shaped structure in PPV space suggests that N98 may be a new candidate for a bipolar HII region with a nearly face-on geometry. The energy budget calculations suggests that the B-field dominates over turbulence and gravity in the G47. Furthermore, the radial column density and velocity profiles of G47 show the signatures of converging flows in a sheet-like structure in the G47. The analysis of the relative orientations between the B-field and local gravity suggests that G47 may undergo gravitational contraction along the B-field lines once it becomes magnetically supercritical. Overall, these findings suggest that B-fields have a significant influence on the star formation processes in G47. During this presentation, I will discuss these results in more detail.		

ASI2025_184	Ranjana Jaiswal	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Investigation Of Young Open Clusters NGC 1582 and NGC 6604		
Abstract: We present the results of optical photometric observations of two open clusters NGC 1582 and NGC 6604 using 1.3-m Devasthal Fast Optical Telescope (DFOT) along with archival photometric data Gaia DR3 and 2MASS. We determine structural and fundamental parameters such as cluster centre, cluster extent, reddening, age and distance of the selected region. 316 most probable members in NGC 1582 and 362 members in NGC 6604 have been identified with membership probability higher than 80%. Mean proper motions in RA and DEC are estimated as (1.99+0.084, -1.42+0.061) and (-1.55+0.036, -2.44+0.031) mas yr−1 for NGC 1582 & NGC 6604 respectively. A comparison of observed CMDs with the theoretical isochrones leads to age of these two clusters as 8.4 Myr for NGC 1582 and 6.8 Myr for NGC 6604. We found distances to be 1.1 Kpc and 1.6 Kpc for open clusters NGC 1582 & NGC 6604 respectively using parallax of member stars and isochrone fitting method. We have derived mass function slope in the cluster region. Evidence of mass segregation is also observed in both the open clusters. Keywords: Star Cluster, membership probability, mass segregation		

ASI2025_374	Rittik Bhattacharjee	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Integrated Modeling of Diffuse FUV and Dust Processed IR Emissions in the 30 Doradus Star Forming Region		
The extinction of starlight in molecular clouds is crucial for understanding dust evolution within the interstellar medium (ISM). Far-ultraviolet (FUV) emissions provide insights into how starlight scatters off interstellar dust grains, while infrared (IR) emissions reveal details about dust composition and distribution. These observations are particularly valuable in HII regions experiencing starburst activity, as they help trace star formation processes and feedback mechanisms within these dense, active areas of the ISM. This study focuses on modeling the diffuse, dust-scattered FUV emissions surrounding the R136 star cluster, located at the heart of the 30 Doradus HII region—one of the most active star-forming regions in the Local Group, situated within the Large Magellanic Cloud (LMC). Using the SKIRT radiative transfer code, which employs a Monte Carlo algorithm, we simulate FUV emissions and compare them with observational data from the Far Ultraviolet Spectroscopic Explorer (FUSE). Our model incorporates a 3D distribution of 305 stars within a 70 parsec radius, identified through the VLT Flames Tarantula Survey (VFTS) and the Hubble Tarantula Treasury Project (HTTP). To represent the stellar population, we employ the Starburst99 (SB99) model, which includes the Kroupa mass function. Our findings suggest that accurately positioning radiation sources significantly improves the precision of FUV and IR simulations. Additionally, initial results indicate that varying the mass concentration within clumps in the model affects the UV emission, with a higher concentration resulting in more intense UV emission . We also observe that dust grain size distribution, modeled through SKIRT's ability to categorize silicate, graphite, and PAH particles by size, strongly impacts IR emissions.		

ASI2025_568	Rohit Chaudhary	Poster
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		
We present the results based on the sub-mm polarization observations conducted with JCMT SCUBA2/POL2 data towards the S104 region. We have delineated the magnetic field (B-field) morphology in clumps formed as a consequence of the "collect and collapse mode of triggered star formation." We aim to understand the relative importance of the B-field in comparison to turbulence, gravity, and electron thermal pressure induced by the HII region. The analyses show both parallel and perpendicular B-field patterns with respect to the direction of the I-front. The power-law fit over intensity versus polarization data yields an index of $\alpha = -0.65 \pm 0.06$, suggesting efficiently aligned dust grains across various depths of a massive clump in S104. This implies that the observed polarized dust emission traces B-field morphology even in the denser parts of the clump. We estimate the B-field strength by making use of the DCF method and structure-function analyses. Along with these results, we will also discuss the relative importance of magnetic field, turbulence, ionized gas pressure, and gravity on the stability of the formed clumps. Finally, we will compare these results with the MHD simulation results for understanding the star formation at the borders of the HII regions.		

ASI2025_595	Rupesh Behera	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A comprehensive X-ray study of Cygnus Loop.		
Supernova remnants (SNRs) are a mix of ejected material in a supernova explosion and interstellar material swept up by the shock wave. SNRs offer a unique opportunity to study the interactions between relativistic ejecta and supernova shock waves with the local interstellar medium (ISM). These nebular structures are crucial in shaping the structure and thermodynamic properties of the ISM. Surprisingly, much remains unknown about how they eventually mix with the ISM, leading to its chemical enrichment. In our study, we examined various segments of the Cygnus Loop using proprietary X-ray and UV observations from SXT and UVIT, respectively. Additionally, we incorporated archival X-ray data from other observatories. The Cygnus Loop is thought to have originated from a core-collapse supernova; however, no compact stellar remnant has been confidently identified. We performed X-ray spectroscopy on 17 regions spanning most of this extended 3x4 degree object. We fitted the spectra with composite thermal models, and the best fit model was analyzed by creating distribution maps. This allowed us to investigate variations in parameters such as temperature and elemental abundances with prominent emission lines in the soft X-ray spectrum. Our analysis revealed notable differences in properties between the eastern, western, and southern regions of the Cygnus Loop, which were evident directly from the spectra as well. Additionally, we explored the inter-correlations among these parameters by running the MCMC chain on the best fit model. Previous studies focusing on select regions of the Cygnus Loop indicated the possible presence of charge-exchange (CX) emission in the soft X-ray band and enhanced abundances of certain elements. Our best-fit models similarly showed enhanced abundances across multiple regions. Due to the low resolution of the spectra, it is nearly impossible to identify each of the CX emission lines and highly resolved X-ray spectra will be required.		

ASI2025_744	SAMRAT GHOSH	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Dynamic Photometric Variability in Three Young Brown Dwarfs in Taurus: Detection of Optical Flares with TESS data		
We present I-band time-series photometric variability studies of three known nearby (∼ 140 pc) and young (∼1 Myr) brown dwarfs (BD) in the Taurus star-forming region in the Perseus Molecular Cloud. From 10 nights of ground-based observations over a time span of 10 years, with a typical run of 3 to 6 hours each night, we estimated that the BDs show unstable short-scale periodicity from 1.5 to 4.8 hours. Using the long-term photometry from the Transiting Exoplanet Survey Satellite (TESS), we have conducted a time-resolved variability analysis of CFHT-BD-Tau 2 and CFHT-BD-Tau 4, revealing orbital periods of ∼ 0.96 days and ∼ 3 days respectively, consistent with earlier studies. We also found two superflares in TESS data for CFHT-BD-Tau 4 and estimated the flare energies in the 10^35 - 10^36 erg range. A magnetic field of ∼ 1.66 kG is required to generate such flare energies on this BD. We performed spot modelling analysis on CFHT-BD-Tau 2 and CFHT-BD-Tau 4 to address the variability detected in the data using the package BASSMAN. The sources ' spectral energy distribution and infrared colours suggest sufficient circumstellar material around them.		

ASI2025_558	Sanchali Nath Mazumdar	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Exploring the dependence of outflow direction on the orientation of magnetic field		
The magnetic field plays a significant role in shaping dark molecular clouds and may regulate cloud fragmentation, leading to star formation, making it a subject well worth studying. The magnetic field along with other elements affects the characteristics of the phenomena of high-velocity mass ejection from molecular clouds known as the molecular outflow that are associated with the newborn stars. Numerous studies have shown that the outflows typically tend to line up with the cloud-scale magnetic field while various other studies contradict it. So, the relationship between them still remains a subject of debate. This study aims to address these uncertainties by integrating observational data with theoretical models. In our study, we consider 22 molecular clouds in order to make a collective study of the dependence of bipolar outflow direction on the orientation of the magnetic field. The outcome indicates a correlation between the orientation of the magnetic field and the position angle of bipolar outflow. This is also supported by a statistical analysis indicating a minimal projection effect. Additionally, we uncover potential significances of the Galactic magnetic field, magnetic field strength, inclination angle of outflow and the position angle of the minor axis. Through this analysis, our study aims to broaden the knowledge of star formation processes and the early phases of stellar system evolution.		

ASI2025_298	Sanmesh Deshmukh	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Study of an open cluster Berkeley 21 using UVIT/AstroSat		
We present the study of an intermediate age (~ 2.18 Gyr) open cluster, Berkeley 21, located at a distance of 5 kpc towards the Galactic anticentre direction using ~ UVIT/AstroSat data along with the other multiwavelength archival data. It is possibly the lowest metallicity ([Fe/H] = -1.3 dex) object in the open cluster sample studied. We ~ apply a machine learning algorithm, ML-MOC, on Gaia DR3 data, and identify 325 cluster members, out of which we detect nine sources in UVIT/F172M filter on performing the PSF photometry. These nine sources include three blue straggler stars, five main-sequence stars, and one red clump star. We will construct the multiwavelength spectral energy distributions of these sources in order to characterize them and discover the hot companions associated with them, if any. The characterization of the hot companions will then be used to determine their nature and unravel the formation channels of the above- mentioned objects.		

ASI2025_645	SAPAN KUMAR SAHOO	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Probing regularity of the time-ticks from neutron star with high-precision timing of GMRT-discovered millisecond pulsars.		
Pulsars are highly magnetized, rotating neutron stars emitting beams of electromagnetic radiation that when swept by line-of-sight these beams, look like a pulse of radiation, hence the name 'pulsar'. Millisecond pulsars (MSPs), with periods under 30 milliseconds, are exceptionally stable, making them ideal for gravitational wave detection and as components in pulsar timing arrays (PTAs). Pulsar timing involves measuring the time of arrivals (ToAs) and timing residuals over an extended period, to disentangle the phenomena that affect them like rotation, motion, and the influence of gravitational forces, with applications in detecting gravitational waves. The Giant Metrewave Radio Telescope (GMRT), covering a wide radio frequency range of 120 to 1460 MHz, has demonstrated excellent capability in precise low-frequency timing measurements. This study extends the timing baseline of MSP J0248+4230 and MSP J1207-5050, discovered by the Giant Metrewave Radio Telescope (GMRT), from 5 to 11 years, using uGMRT observations. Achieving an rms deviation of 13.658 microseconds and 12.793 microseconds, we measured the spin period at 2.60083478563372 milliseconds with extraordinary precision. This implies the period will shift only 5 nanoseconds over 10,000 years, making it a highly stable timekeeper. For the first time, we also detected proper motion (μ_T = 1.35 ± 0.35 mas/year and μ_T = 7.13 ± 0.47 mas/year) for J0248+4230 and J1207-5050, indicating transverse velocities of 15.3 ± 4.4 km/s and 43.9 ± 5.3 km/s respectively. With an improved residual rms of 6.328 microseconds (50% improvement) and 6.336 microseconds (58% improvement), this study aligns with standards seen in MSPs listed in the European PTA. Extending this analysis could help qualify J0248+4230 and J1207-5050 for PTA projects, illustrating GMRT's potential for advancing fundamental physics research.		

ASI2025_117	SHIVANI MISHRA	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Rotational and vibrational investigation of substituted PAH clusters		
Several astronomical objects within the Milky Way and in external galaxies exhibit mid-infrared spectra characterized by prominent features at 3.3, 6.2, 7.7, 8.6, and 11.2 μm, collectively known as the unidentified infrared (UIR) bands. These emission features align closely with the vibrational modes of polycyclic aromatic hydrocarbon (PAH) molecules, as shown by Tielens (2008). To fully understand the origins and characteristics of the UIR bands, it is crucial to obtain comprehensive spectroscopic data on a range of PAH species, including pure PAHs, ionized PAHs, functionalized PAHs, and PAH clusters. Given the limited existing data on these clusters, the present work focuses on the investigation of the vibrational and rotational spectra of functionalized PAH clusters containing oxygen and nitrogen groups. We aim to explore how the introduction of various functional groups affects the spectral characteristics and stability of PAH clusters. Advanced computational methods will be employed to generate and analyze the infrared (IR) and microwave spectra of these functionalized PAH clusters, with the computed spectra being compared to observational data from astronomical sources.		

ASI2025_335	Shylaja B S	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Search for records of eruptions of T Coronae Borealis in the 17th and18th centuries		
The recurrent nova T Coronae Borealis is expected to erupt shortly as inferred from recorded eruptions of 1946 and 1866 and a periodicity of 80 years. Schaefer, 2023 provided the earliest record in 1217 and another in 1787. We searched for records the star dials of astrolabes. The exhaustive catalogue (Sarma, 2023) provides details on the star dials along with unidentified and misidentified stars. We were able to zero in on four astrolabes; however, two of them serve as possible records. There are many doubtful identifications on star globes as well. The difficulties associated with this unconventional source of star lists and overcoming the disadvantages of poor resolution are discussed. The results point to one eruption just before 1641 and another of 18th century. References: Sarma S., 'A Descriptive Catalogue of Indian Astronomical Instruments', (2023) online https://srsarma.in/catalogue.php Schaefer, B. A., "The B & V light curves for recurrent nova T CrB from 1842–2022, the unique pre- and post-eruption high-states, the complex period changes, and the upcoming eruption in 2025.5 ±1.3", Monthly Notices of the Royal Astronomical Society, (2023), Volume 524, Pages 3146-65		

ASI2025_615	SMRUTI SASWATA HOTA	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Transient nature study of classical Be stars using Hα variability		
Study of classical Be (Be) stars provide a unique opportunity to investigate circumstellar discs since their spectra display emission lines of different elements that originate from the surrounding gaseous, equatorial discs of these massive main-sequence B-type stars. A distinctive property of almost all Be stars is variability in their emission line profiles. In extreme cases this leads to the complete loss of their discs, thereby giving such stars an appearance of a normal standard B-type star. This 'transient nature' of certain Be stars can be tracked through continuous monitoring of their Hα line profile variability. The existing literature shows that any acceptable consensus regarding the disc formation and dissipation timescales for Be stars has not arrived yet. So Banerjee et al. (2022) performed such a study for 9 transient Be stars and further extended the study to start a continuous monitoring program of a larger sample of such Be stars using the 1-m CZT facility at VBO, Kavalur. In this work, I performed thorough literature survey to identify more such interesting Be stars that have shown transient nature at least once in their lifetime taking data from Barnsley & Steele (2013) who presented the Hα line profile variability for 55 Northern Be stars. Looking through existing literature, we identified 19 among these 55 stars have shown transient nature in the past at least once, thus increasing the sample size of the present monitoring program considerably. Our study also detected that while one star HD 170682 might have shown a disc loss and formation episode within around two years during 1998 to 2000, another star, HD 171406 might have passed through a cycle of disc-loss to disc formation followed by again disc dissipation episodes within a timescale of two decades from 1998 to 2020.		

ASI2025_405	Snigdha Sarmah	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Probing Stellar Variability in Spitzer Bands: Insights into Type II SNe Progenitors		
This work investigates the variability of Type II SN progenitors using mid-infrared data from the Spitzer Space Telescope's IRAC channels, providing insights into the late stages of massive star evolution. A sample of SNe, all located within 15 Mpc and having exploded in the last decade, was chosen based on pre-explosion IRAC observations covering several epochs. Photometric techniques were applied to extract light curves of the progenitor stars, enabling a detailed analysis of their variability over time. The Lomb-Scargle periodogram was employed to search for periodic signals, revealing possible pulsational behavior in the progenitors. Additionally, the post-explosion light curves for a few of these SNe were examined, offering a comparative look at the progenitors before and after the explosions.		

ASI2025_170	Subharthi Dasgupta	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
On the origin of multiperiodic variability in B-type supergiant Epsilon Ori (HD 37128)		
B-supergiants exhibit significant photometric and spectroscopic variabilities. Their origin is not fully understood but pulsation has been suggested as a possible cause . HD 37128 (Epsilon Orionis) is a very luminous B-type supergiant located in the constellation Orion. The variability of this star has been observed across several wavelengths; however it has been most extensively studied in the optical domain. In several studies, the star has been observed to exhibit line profile variations in both photospheric and wind lines with periods of the order of a few days. In order to understand the origin of these variabilities, we have constructed models of HD 37128 in the mass range of 30 to 70 solar mass and performed non-adiabatic linear stability analysis. Low order radial modes are found to be unstable in the considered models. Mode interactions are present in models having mass below 36 solar mass which is an indication for the presence of strange mode instabilities. From the linear stability analysis, we deduce that the determined periods are consistent with observed periods. Nonlinear numerical simulations in the considered models with mass greater than 50 solar mass lead to finite amplitude pulsations with periods in the range of 1 to 3 days. The presence of multiperiodic variability together with mass-loss in HD 37128 makes it a suitable candidate for asteroseismic analysis and to study the connection between pulsation and mass-loss.		

ASI2025_548	Sugyan Parida	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
On the stability and pulsation in models of B[e] star MWC 137		
B[e] type stars are characterized by strong emission lines, photometric, and spectroscopic variabilities and unsteady mass-loss rates. MWC 137 is a galactic B[e] type star situated in the constellation Orion. Recent photometric observation of MWC 137 by TESS has revealed variabilities with a dominant period of 1.9 d. The origin of this variability is not known but suspected to be from stellar pulsation. To understand the nature and origin of this variability, we have constructed three different set of models of MWC 137 and performed non-adiabatic linear stability analysis. Several low order modes are found to be unstable in which models having mass in the range of 31–34 $M_\odot$ and 43–46 $M_\odot$ have period close to 1.9 d. The evolution of instabilities in the non-linear regime for model having solar chemical composition and mass of 45 $M_\odot$ leads to finite amplitude pulsation with a period of 1.9 d. Therefore, in the present study we confirm that this variability in MWC 137 is due to pulsation. Evolutionary tracks passing through the location of MWC 137 in the Hertzsprung–Russell diagram indicate that the star is either in post main sequence evolutionary phase or about to enter in this evolutionary phase.		

ASI2025_319	SUJAY JADHAV	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Characterizing H_2O in IPA sources using JWST		
A central question in contemporary astrophysics is how material within galaxies transforms into stars and planetary systems. This process begins with the collapse of molecular cloud cores under self-gravity, triggering star formation, while planet formation arises as a secondary outcome. Water is a key ingredient for life as we know it, and plays a crucial role in the earliest stages of star formation - specifically, the protostellar phase. In both its gaseous and solid phases, water influences the thermal balance, chemistry, and dynamics of the protostellar environment, acting as a critical coolant and a tracer of physical processes in the dense regions where stars take shape. We examine the presence of H_2O in the five JWST - IPA (Investigating Protostellar Accretion) sources with a broad range of masses (0.1 - 12 solar masses), luminosities (0.1 - 10,000 solar luminosities), and distances (150 pc - 1.6 kpc). Observations in the JWST MIRI wavelength range of 5 - 28 microns reveal H_2O in the fundamental ro-vibrational band (010 - 000) at 5 - 8 microns across all sources. Thanks to JWST's exceptional spatial resolution, we identify an extended outflow pattern, both in emission and absorption, in the two most luminous sources - HOPS 370 and IRAS 20126. This pattern is barely detected in the other three less luminous sources which is strongly indicative of a non-collisional excitation mechanism. JWST's unprecedented sensitivity and resolution provide valuable insights into the kinematics and dynamics of these H_2O lines, shedding new light on star formation processes. We aim to discuss our results in this talk.		

ASI2025_507	Vasudha Choudhary	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
A comparative study of SN2023ixf from early to late nebular phases.		
We present a spectroscopic study of type II supernova SN 2023ixf, tracing its evolution into the very late nebular stages. Initial theoretical models and immediate post-explosion spectra proposed that the progenitor star underwent substantial mass loss before the supernova explosion; however, subsequent analyses categorized SN 2023ixf as a typical Type II supernova, prompting further investigation into its characteristics. Besides the evolving profiles of the Balmer lines, indicating the initial influence of CSM, our observations reveal other significant spectral features, including the emergence of multiple metal lines in the very late nebular spectrum, whose profiles reveal the progenitor interior and dynamics of the explosion. By comparing SN 2023ixf with the well-documented Type II supernovae SN 2017eaw and SN 2017gmr, we aim to investigate how variations in progenitor environments and mass loss affect spectral properties throughout different evolutionary stages. The possibility of late-time shock-CSM interaction is investigated. Our findings aim to bridge gaps in the current literature regarding the long-term behavior of Type II supernovae.		

ASI2025_45	Venkata Lakshmi	Poster
Stars, Interstellar Medium, and Astrochemistry in Milky Way		
Theoretical anharmonic infrared and ultraviolet spectroscopic study of interstellar PAHs upto ten hexagons		
The present study reports a comparison of theoretical harmonic and anharmonic infrared and optical absorption spectra of 01 to 10 hexagons PAHs in their neutral and ionic states with observations. The PAHs (polycyclic aromatic hydrocarbons) which is the most abundant and play an important role in the physics and chemistry of the astronomical environment. They are primarily responsible for the aromatic infrared bands (AIBs) observed in various regions of the interstellar medium (ISM). This study will be focus is on identifying the potential carriers of the AIBs and understanding their significance in the 217.5 nm astronomical UV bump. The 01 to 10 hexagon structural arrangements are considered in cata- and peri-condensed form. All these structures are optimized at the B3LYP/6-311++G (d) level of theory to confirm the lowest energy structure. The analysis of harmonic to anharmonic vibrational spectra computations results in minor changes in PAH MIR spectral characteristics. We use the advanced capability of MIRI JWST telescopes to obtain observational data for the comparison. This study gives the understanding of the physical and chemical processes of cosmic dust and PAHs in diverse astronomical environments. We have also compared the UV bump features at 217.5 nm with the obtained electronic absorption spectra of 01 to 10 hexagons in their neutral and their ionic states using time-dependent density functional theory (TDDFT) at the same level of theory.		

Posters in
High Energy Phenomena, Fundamental Physics and Astronomy

ASI2025_79	Abhijnan Kar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Evolution of neutron star spin frequency and other parameters in LMXBs and its implications for observed AMXPs.		
A low mass X ray binary system (LMXBs) has neutron star (NS) accreting matter from the companion/donor star which causes the NS to spin fast and become millisecond pulsars (MSPs). These LMXBs and MSPs hosted there are excellent tool to probe fundamental physics of NS and for that purpose detailed theoretical modelling is required. Here, we use numerical stellar evolution code MESA and systematically compute NS parameters' evolution including its spin frequency. With computations using a range of initial parameter values, we predict the general trajectory of the NS spin frequency evolution, which is governed by various initial binary and stellar parameters. We show how the evolutionary trajectories depend on these initial parameter variation in order to produce LMXB constraints. Further, using our general evolution results, we indicate the formation channels and evolutionary scenario for few AMXPs by exactly matching with current observational parameters of NS spin frequency, orbital period etc. We also indicate plausible evolutionary scenario and initial parameter space for other AMXPs and try to model spin frequency of these systems for the first time. Further, we discuss current challenges with our general evolution models to predict initial parameter space for some AMXPs in late-stage evolution. Reference: Abhijnan Kar, Pulkit Ojha, Sudip Bhattacharyya, Long-term evolution of spin and other properties of neutron star low-mass X-ray binaries: Implications for millisecond X-ray pulsars, MNRAS, Volume 535, Issue 1, November 2024, Pages 344–358, 2024; https://doi.org/10.1093/mnras/stae2346		

ASI2025_620	Abhiram K	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Automatic Classification and Anomaly Detection of Supernova Spectra in ZTF Bright Transient Survey		
The Zwicky Transient Facility (ZTF) Bright Transient Survey (BTS) represents a significant effort in identifying and characterizing extragalactic transients through a comprehensive and unbiased spectroscopic approach. One of the primary missions is to acquire optical spectra to classify extragalactic transients, including subclasses of Supernovae and Tidal Disruption Events (TDEs). We develop an automatic supernovae classification tool using machine learning by designing a series of binary classifiers to classify different types of supernovae using ensemble classifiers, primarily the Random Forest Classifier and XGBoost Classifier. A hierarchical tree classifier is also designed by chaining various binary classifiers to achieve multi-class classification of different supernova subtypes. Furthermore, the extensive collection of spectra from the survey and the community would allow the detection of rare and new classes of transients that can deepen our understanding of the evolution of stars and activities of supermassive black holes. We employ an unsupervised Isolation Forest algorithm and various dimensionality reduction techniques to identify these novel, unusual events through spectroscopy. This approach allows for the detection of significant anomalies, potentially revealing rare and extraordinary supernovae within the dataset. Future surveys, such as 4MOST, DESI-II, and MSE, promise to expand the transient dataset significantly, making manual inspection impractical. Automated, robust classification pipelines, such as those developed in this work, will be essential for managing and fully utilizing these unprecedented datasets.		

ASI2025_231	AJITH BALU	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Study of X-ray absorption characteristics of high-mass X-ray binaries in different intensity levels with MAXI/GSC		
High-mass X-ray binaries (HMXBs) are luminous X-ray sources that emit electromagnetic radiation by gravitationally accreting matter from its companion star. The X-ray, originating near the NS, can get absorbed/reprocessed by the environment, especially the stellar wind of the companion star. An all-sky monitor such as MAXI/GSC, which has been in operation for over a decade, has significant sensitivity to study the long-term characteristics of HMXBs. Such sources can also exhibit periodic and aperiodic intensity variations. We performed orbital-phase-resolved spectroscopy for both the intensity-averaged and intensity-resolved data to explore any intensity-dependent characteristics of the source. Any orbital-phase-dependent spectral characteristics found in the long-term data of MAXI/GSC must be persistent in the binary system. For Cen X-3, we found clear asymmetric variation in photoelectric absorption, with respect to mid-phase (ϕorb = 0.5), across the orbit of the source. Asymmetric absorption features cannot originate from a symmetric stellar wind. The absorption column density is a tracer of binary matter distribution, so any asymmetry should result from an asymmetric distribution of matter in the binary system. While the matter distribution is more symmetric at higher intensity levels, we find that the asymmetry in matter distribution is most pronounced for the lowest intensity level of Cen X-3. The differences in the orbital-phase-dependence of absorption for different intensity levels suggest the presence of asymmetric features like an accretion wake, photoionization wake, or tidal stream, which are most prominent at the lowest intensity level for Centaurus X-3. We will also discuss results from a similar study carried out in another HMXB called SMC X-1.		

ASI2025_409	Aman Upadhyay	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Spectral variability between flaring and non-flaring spectra in ULX M74 X-1		
We conducted an extensive long-term spectral and timing study on the Ultraluminous X-ray source M74 X-1, using data taken between 2001 and 2021 by Chandra and XMM-Newton X-ray observatories. Our analysis reveals variations in the presence of flares across different observations. Flaring observations exhibit two-component spectra at a lower average flux level. On the other hand, the non-flaring observations display single-component spectra at a higher average flux level. These spectra are best described by the diskbb+comptt, diskbb+diskbb, and diskpbb models. With the diskbb+comptt model, we obtain a low plasma temperature (Te ~ 2.0 keV) and a high optical depth of the corona, typical of ULXs, in contrast with the high temperature and low optical depth seen in Galactic Black Hole Binaries. Using the diskbb + diskbb model, we get cool and hot temperatures of Tin(cool) = 0.38^{+0.08}_{-0.06} keV and Tin(hot) = 1.67^{+0.18}_{-0.13} keV, respectively, suggesting two temperature emitting regions indicating possible presence of outflowing wind along with the accretion disk. We found a Gaussian feature at E_{line} = 0.96^{+0.05}_{-0.11} keV with sigma = 0.11^{+0.13}_{-0.06} keV in flaring observations, indicative of powerful optically thick outflows, which is not significant in non-flaring observations. This variation can be explained by changes in wind funnel geometry with the accretion rate. Additionally, using the hot diskbb component from the diskbb + diskbb model, we estimate the mass of the compact object to be M = 7.1^{+1.4}_{-1.3} Mo, classifying it as a stellar-mass black hole and confirming super-Eddington accretion in the system.		

ASI2025_410	Aman Kaushik	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
The 2022 outburst of SAX J1808.4–3658.		
Accretion powered millisecond pulsars (AMXPs) are fast rotating neutron stars orbiting in binary systems and are believed to be the predecessors of radio millisecond pulsars. The intriguing observation of rapidly spinning radio pulsars with weak magnetic fields (~ 10^8 G) in the 1980s prompted the hypothesis that these are “recycled” pulsars. This theory of “recycling scenario” was confirmed with the observation of an actively accreting millisecond pulsar in a binary system, namely SAX J1808.4–3658. We investigate the spectral and timing properties of SAX J1808.4–3658 during its 2022 outburst using the observations with NICER and AstroSat. Our spectral modelling suggests that the emission from the source can be well described by a combination of multicolour blackbody disk and thermal Comptonization by a cloud of hot electrons. Studying the evolution of the spectral parameters showed that covering fraction and photon index (Γ) were degenerate. Additionally, the evolution of disk and corona flux showed that majority of the estimated flux is provided by the disk but at higher energies corona flux dominates. The aperiodic timing analysis hinted at the presence of two broad components with characteristic frequencies varying within 0.63 ± 0.02 to 1.40 ± 0.08 Hz and from 9.22 ± 1.58 to 51.27 ± 22.98 Hz as the source evolves during the outburst. We assume that these high frequency fluctuations are caused by the corona. We also observe that 1.5–10.0 keV energy band lags behind the 0.5–1.5 keV band (hard lag) by a few milliseconds for 0–2 Hz frequency range and almost no lag for 10–100 Hz frequency range, indicating that the low energy and low frequency fluctuations from the disk are propagating into the corona and are getting up-scattered into higher energies. We will describe the evolution of the system connecting it with our spectral and timing results, (Kaushik et al. 2024 in prep).		

ASI2025_719	Amar Deo Chandra	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Long-term spin-down and low luminosity regime in the Be/X-ray binary pulsar GX 304-1		
We carry out timing and spectral studies of the Be/X-ray binary pulsar GX 304-1 using NuStar and XMM-Newton observations. We construct the long-term spin period evolution of the pulsar which changes from a long-term spin-up to a long-term spin-down trend during a low luminosity state (~ 10^(34–35) erg/s). A prolonged low luminosity regime (L_X~ 10^(34–35) erg/s) was detected during 2005-2010 and spanning nearly five years since December 2018. The XMM-Newton and NuStar spectra can be described with a power law plus blackbody model having an estimated luminosity of ~2.5× 10^33 erg/s and ~3.6×10^33 erg/s respectively. The inferred radius of the blackbody emission is about 100-110 m which suggests a polar-cap origin of this component. From long-term ultraviolet observations of the companion star, an increase in the ultraviolet signatures is detected preceding the X-ray outbursts. The spectral energy distribution of the companion star is constructed which provides a clue of possible UV excess when X-ray outbursts were detected from the neutron star compared to the quiescent phase. We explore plausible mechanisms to explain the long-term spin-down and extended low luminosity manifestation in this pulsar. We find that sustained accretion from a cold disc may explain the prolonged low luminosity state of the pulsar since December 2018 but the pulsar was undergoing normal accretion during the low luminosity period spanning 2005-2010.		

ASI2025_586	Amit Kumar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Exploring Origin of Ultra-Long Gamma-ray Bursts: Lessons from GRB 221009A		
The brightest Gamma-ray burst (GRB) ever, GRB 221009A, displays ultra-long GRB (ULGRB) characteristics, with a prompt emission duration exceeding 1000 s. To constrain the origin and central engine of this unique burst, we analyze its prompt and afterglow characteristics and compare them to the established set of similar GRBs. To achieve this, we statistically examine a nearly complete sample of \swift-detected GRBs with measured redshifts. Categorizing the sample to Bronze, Silver, and Gold by fitting a Gaussian function to the log-normal of \tninty duration distribution and considering three sub-samples respectively to 1, 2, and 3 times of the standard deviation to the mean value. GRB 221009A falls into the Gold sub-sample. Our analysis of prompt emission and afterglow characteristics aims to identify trends between the three burst groups. Notably, the Gold sub-sample (a higher likelihood of being ULGRB candidates) suggests a collapsar scenario with a hyper-accreting black hole as a potential central engine, while a few GRBs (GRB 060218, GRB 091024A, and GRB 100316D) in our Gold sub-sample favour a magnetar. Late-time near-IR (NIR) observations from 3.6m Devasthal Optical Telescope (DOT) rule out the presence of any bright supernova associated with GRB 221009A in the Gold sub-sample. To further constrain the physical properties of ULGRB progenitors, we employ the tool MESA to simulate the evolution of low-metallicity massive stars with different initial rotations. The outcomes suggest that rotating (Omega > 0.2 Omega_{c}) massive stars could potentially be the progenitors of ULGRBs within the considered parameters and initial inputs to MESA.		

ASI2025_157	Anirban Dasgupta	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Constraining Einstein-Maxwell-Dilaton-Axion Gravity from observed quasi periodic oscillations in black holes.		
The general theory of relativity (GR) has fundamentally transformed our understanding of spacetime, offering a profound framework to describe gravitational interactions. Through its exceptional predictive power and mathematical elegance, GR has explained diverse phenomena, from planetary orbits to the bending of light by massive bodies. However, the theory encounters notable challenges, especially in addressing spacetime singularities—regions where physical laws cease to apply—and in accounting for the universe's "dark sector," which comprises dark matter and dark energy. Such limitations prompt the exploration of alternative theories of gravity. Among these, the string-inspired Einstein-Maxwell-dilaton-axion (EMDA) framework is particularly intriguing due to its pivotal role in both inflationary cosmology and the accelerated expansion of the current universe. In this study, we explore the charged, rotating Kerr-Sen black hole solution within the EMDA framework. Unlike the Kerr black holes predicted by GR, Kerr-Sen black holes possess a unique non-zero dilaton charge, introducing novel dynamics that could potentially align with observed astrophysical phenomena. To investigate this further, we utilize high-frequency quasi-periodic oscillations (HFPQOs) detected in five prominent black hole sources—GRO J1655-40, XTE J1550-564, GRS 1915+105, H 143+322, and Sgr A*. We evaluate eleven distinct HFPQO models, comparing their predictions for QPO frequencies with observational data to assess whether these black holes exhibit a non-vanishing dilaton charge. This approach allows us to place constraints on the dilaton charge for each model, potentially signaling deviations from GR. This investigation into the Kerr-Sen solution not only aids in exploring the EMDA theory's relevance to astrophysics but also provides a promising avenue for addressing foundational issues in GR. Our findings have the potential to offer new perspectives on black hole physics and spacetime structure, contributing to the broader search for a more comprehensive theory of gravity.		

ASI2025_254	Anirban Saha	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Relativistic strange stars in f(R,T) gravity admitting a density dependent B- parameter		
The article elucidates a spherically symmetric and isotropic model of a strange star within the framework of the f(R,T) theory of gravity. In this formalism, the function f(R,T) is assumed to be a linear function of the Ricci scalar R and the trace of the energy-momentum tensor T i.e. f(R,T)=R+2βT, where, β is the coupling parameter. To acquire a solution of the field equation, the element g_{rr} of the metric potential has been assumed to conform to the Tolman-IV type ansatz. The MIT bag model equation of state with a density-dependent B-parameter has been employed to describe the interior matter of the strange star. With the aid of the solution, the physical properties of several potential strange star candidates have been investigated. The radii of compact objects have also been predicted from the condition that pressure vanishes at the boundary of a compact object. The maximum mass of a strange star has been attained by numerically solving the TOV equation, which is as high as 3.51 $M_{\odot}$ assuming the B-parameter as a density-dependent one. The variation of energy per baryon with energy density indicates that the compact objects may have a 3-layered structure in which the core is composed of stable strange quark matter. The outer layer is made of unstable quark matter supported by an intermediate thin layer of metastable quark matter. The validity of the stellar model has been verified through different stability criteria.		

ASI2025_443	ANKAN ROY	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
TeV gamma-rays from photo-disintegration/de-excitation of nuclei in LHAASO J0621+3755		
Very high-energy (VHE) gamma rays are traditionally attributed to two well-known mechanism, purely electromagnetic (EM) synchrotron emission and inverse Compton scattering or hadronic processes such as pion production. They can be also generated through photo-disintegration followed by photo-excitation of daughter nuclei as earlier predicted by Luis A. Anchordoqui and John F. Beacom. This mechanism has been identified as a potential production channel for observed VHE photon events in the Halo J0621 + 3755, associated with the pulsar PSR J0622 + 3749. A unique feature of this process is the production of gamma rays in the energy range of 1 TeV to 100 TeV. Recently, observations from the Large High Altitude Air Shower Observatory (LHAASO) - Kilometres Square Array (KM2A) and the High Altitude Water Cherenkov Observatory (HAWC) have reported photon events in the energy range 10 TeV to 200 TeV and 1 TeV to 10 TeV respectively. With the extended emission of gamma rays from LHAASO J0621 + 3755 Halo, the photon counts follow our model with a spectral index value of 2.32. As the pulsar J0622 + 3749 is a Geminga-like pulsar, assuming the interstellar medium photon temperature akin to the Geminga pulsar, our model's P-value, calculated with best-fit parameter, is greater than 0.43, confirming its validity. Additionally, our analysis demonstrates the model's stability across various nuclei types. This work underscores the importance of photo-disintegration and photo-excitation processes in gamma ray astronomy, offering a novel perspective on VHE gamma ray generation in PWNe and Halos.		

ASI2025_701	Anshika Gupta	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
The multi-wavelength evolution of GRB 190829A		
Gamma Ray Bursts (GRBs) are one of the most energetic cosmic explosions in the Universe. A significant number of GRBs have afterglow detections in X-ray and optical bands, but for only about ~ 30% of the GRBs, radio afterglows have been detected. The early evolution of radio afterglows (below 4 GHz) is through the optically thick regime. Therefore, the light curve peak corresponds to the transition from an optically thick to a thin regime. Hence, radio frequencies are unique in probing the evolution of the self-absorption frequency (va), which in turn can constrain the physical parameters. The long-duration GRB 190829 (z=0.0785) was the third GRB for which the H.E.S.S. observatory detected very high energy (VHE) photons. The Gamma Ray Burst (GBM) instrument on the Fermi mission detected the burst. The Large Area Telescope (LAT) onboard Fermi also detected the high-energy photons from the GRB. Due to the vicinity of the GRB, it was observed extensively with several telescopes and thus has a rich multi-wavelength afterglow data spanning across optical, X-ray, and radio wavelengths. At low radio frequencies (below 1.4 GHz), the afterglow was detected and observed by the upgraded Giant Meterwave Radio Telescope (u-GMRT) in Khodad, NCRA, Pune. Between 400 and 1300 MHz, the afterglow was observed at several epochs, from nearly 3 days to 200 days after the burst. The afterglow was also observed at higher frequencies, like 15.5 GHz, with the Arcminute Microkelvin Imager (AMI) telescope. The presence of the reverse shock component can be observed in the AMI light curves. The rise to the peak is noticed in both the high and low-frequency radio light curves. Combining the multi-wavelength dataset, we performed the afterglow modeling, which allowed us to put constraints on the ambient medium density, collimation angle, shock microphysical parameters, and kinetic energy of the burst.		

ASI2025_186	Anurag Bhaisare	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Reconstruction of compact binary sources in a network of gravitational wave detectors		
Gravitational waves are the ripples in the space-time fabric that occur due to the inspiral merging of compact binary objects. Laser Interferometer Gravitational-wave Observatory (LIGO) detects these waves and records the data that contains glitches and noise with a gravitational wave signal. Glitches do affect the parameters of sources having gravitational wave signals. The technique that will be used is known as “regularised maximum likelihood” which will help to reduce the effects of glitches on the Bayesian inference. This thesis aims to provide a good estimation of the parameter distribution of compact binary sources by neglecting such glitches.		

ASI2025_355	Archana Singh	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Study of Anti-Correlated Optical Polarization and Flux Variability in the Blazar 1ES 1959+650		
Blazars are characterized to exhibit non-thermal variable emission over entire electromagnetic spectrum from radio to very high energy gamma rays. The optical emission from these sources shows strong linear polarization along with a significant variability over different time scales. In this work, we report results from the long term optical observations of the blazar 1ES1959+650 using over a decade data from the Steward Observatory. The degree of linear polarization measured in the wavelength range 500 nm to 700 nm is highly variable with a fractional variability amplitude of ~39% during the whole period. The polarization angle is found to change randomly with a mean value of ~144 degree. The photometry data in V and R bands are found to be less variable and show an anti-correlation with the degree of linear polarization during few epochs. Results from this study indicate synchrotron emission produced by a power law distribution of relativistic electrons gyrating in a spherical region permeated with chaotic and ordered magnetic fields.		

ASI2025_123	Aryabrat Mahapatra	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Partial tidal disruption of White Dwarfs in off-equatorial planes around intermediate mass spinning black holes		
We present the results of a suite of numerical simulations to study partial tidal disruption events (TDEs) of white dwarfs (WDs) in off-equatorial planes in intermediate mass spinning (Kerr) black hole backgrounds. We carry out this analysis for both parabolic and eccentric WD orbits and also take into account possible initial WD spins. Our objective here is to quantify the differences in variables like the mass of the self-bound core, the peak fallback rate of debris and gravitational wave signature in off-equatorial orbits compared to equatorial ones. The analysis is carried out using a hybrid numerical scheme, one which involves integrating the exact Kerr geodesics while adopting a Newtonian formalism for the stellar fluid dynamics, justified by our choice of simulation parameters. We find that the physics of TDEs in off-equatorial orbits present several interesting and novel features due to black hole spin, which in some cases enhances when coupled with the rotation of the WD. However, numerical values of observable quantities in TDEs involving off-equatorial orbits cannot possibly distinguish between such orbits from equatorial ones. We further comment on the genericness of our results and argue that these should extend to a general TDE scenario involving a spinning BH.		

ASI2025_715	Aswin Nair	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Numerical Simulation of accretion onto compact objects with hard surface		
Accretion onto a weakly magnetized compact object is studied analytically as well as numerically. We use pseudo-Newtonian potential to mimic strong gravity. Relativistically correct Chattopadhyay-Ryu (CR) equation of state is used to describe the thermodynamics of the relativistic gas. We analytically derive the conditions which demarcate accretion onto a compact object with and without a hard surface. We then regenerate these solutions numerically and at the same time ensuring the formation of a steady terminal shock close to the surface of the star. It is expected that if the flow is transonic then at least one terminal shock will form, but can additional shocks form? We are going to investigate that in case additional shocks do form, then what would be the observational signature of these shocks.		

ASI2025_32	Athira S	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Kaonic dense matter inside stellar compact object from SU(3) symmetry		
Observations of massive pulsars suggest that the central densities of compact stars can far exceed nuclear saturation density, potentially forming exotic matter like hyperons, meson condensates, and quark matter. Anti-kaon (K^-) condensation, a key candidate among meson condensates, is not fully understood in terms of kaon-meson interactions. Using SU(3) flavor symmetry, we calculate hadronic couplings in the mesonic sector, refining earlier quark model approaches. Key parameters—mixing angle (θ_v), octet-to-singlet coupling ratio (z), and symmetric-antisymmetric weight factor (α_v)—are determined, with α_v treated as a free parameter. Our results show that higher α_v values stiffen the equation of state, delay K^- condensation, and increase neutron star masses. K^- condensation occurs via a second-order phase transition, with its onset highly sensitive to α_v.		

ASI2025_199	Athira Nandakumar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Powering Mechanism of the Ultraluminous X-ray Source NGC 4395 X-1		
Ultra-luminous X-ray sources (ULXs) are off-nuclear sources having unusual luminosity in X- rays, nearly or higher than the Eddington limit. Though they have been studied extensively using data from different observatories, their powering mechanism is still a topic of debate. It is believed that stellar mass black holes (BHs) accreting in the super-Eddington limit, intermediate mass BHs accreting in the sub-Eddington regime or accreting in the super- Eddington regime with lower accretion efficiency can power such systems. In this work, we studied X-ray spectral variability of the ULX NGC 4395 X-1 using two decades of XMM-Newton observations from 2002 to 2022. It is one of the nearest ULXs detected outside our Galaxy at a distance of ~5 Mpc. The X-ray luminosity of this source is (1-3)x10^39 erg/s. This source also exhibited variability and X-ray flaring activities over time. All available spectra of the source are fitted using both phenomenological and physical models. Investigating these variability properties of NGC 4395 X-1 provided us with valuable insights into the dynamics of accretion and the central compact object. In this poster presentation, I will discuss the progress of the work in understanding the powering mechanism and the intrinsic properties of the central black hole from different model fitted parameters.		

ASI2025_156	Atul Pathania	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Identification of gamma-ray pulsar candidates among the unassociated sources in the Fermi-LAT catalog using Random Forest		
More than 7100 high-energy gamma-ray sources are reported in the 4th Fermi-LAT catalogue (4FGL-DR4) using 14 years of all sky observations. However, exact astrophysical nature of a significant fraction (~34%) of these sources remains largely unknown and group of such astrophysical objects is referred to as unassociated sources. In this work, we employ Random Forest based machine learning algorithm to classify the unassociated sources into two broad classes viz. pulsars and active galactic nuclei. This study involves feature selection, hyper-parameter optimization and finally identifying the plausible pulsars and active galactic nuclei candidates. Pulsars being relatively faint sources in comparison to active galactic nuclei, only ~10% of total discovered pulsars are high energy gamma-ray pulsars with only 4 are being detected in the very high energy range (E > 30GeV). Hence, the predicted pulsar candidates in the present work can set a pathway for other waveband observations, which can finally help in increasing the number of pulsar candidates for further populations studies.		

ASI2025_19	AYON MONDAL	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Spectral Energy Distribution Modeling of BL Lacertae During a Large Submillimeter Outburst and Low X-Ray Polarization State		
In 2023 October-November, the blazar BL Lacertae underwent a very large amplitude submm outburst. The usual single-zone leptonic model with the lower energy peak of the SED fit by the synchrotron emission from one distribution of relativistic electrons in the jet and inverse-Compton (IC) scattering of lower energy photons from the synchrotron radiation in the jet itself (synchrotron self-Compton or SSC) or those from the broad line region and torus by the same distribution of electrons cannot satisfactorily fit the broadband SED with simultaneous data at submm--optical--X-ray--GeV energies. Furthermore, simultaneous observations with IXPE indicate the X-ray polarization is undetected. We consider two different synchrotron components, one for the high flux in the submm wavelengths and another for the data at the optical band, which are supposedly due to two separate distributions of electrons. In that case, the optical emission is dominated by the synchrotron radiation from one electron distribution while the X-rays are mostly due to SSC process by another, which may result in low polarization fraction due to the IC scattering. We show that such a model can fit the broadband SED satisfactorily as well as explain the low polarization fraction at the X-rays.		

ASI2025_268	Ayushi Shrivastava	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
A Timing study of PSR J1840+1102: The Fastest GMRT-discovered Millisecond Pulsar		
Pulsars are highly magnetised rotating neutron stars which emit beams of electromagnetic radiation, detectable in radio band as pulsations. High precision studies are required to delve into properties of pulsars. Pulsar timing is one such study which helps in precise modeling of the intrinsic properties (such as spin period, spin period derivative, etc.) as well as the binary parameters and companion properties, if the pulsar is in a binary system. Once a reliable solution from pulsar timing is established, a pulsar can also be used to test gravitational theories, study Interstellar medium and also detect gravitational waves and the stochastic gravitational wave background using the Pulsar Timing Array (PTA) experiments. We will present an initial timing solution for the fastest GMRT-discovered pulsar: PSR J1840+1102, which has a spin period of 1.6 ms and an orbital period of 1.69 days. Various parameters have been fitted iteratively using different techniques and softwares. The timing residual of around 3 microseconds was achieved after fitting the data over a span of more than 1 year. In addition to precisely estimating several of the pulsar's intrinsic parameters, we have also explored and eliminated different types of binary companions based on mass and binary parameters constrained by the timing model. The high signal-to-noise ratio of the average profile, short spin period and precise pulse arrival times make PSR J1840+1102 a promising candidate for PTA. We will present various results obtained from our timing analysis as well as an assessment on this pulsar's suitability for inclusion in the PTA experiments.		

ASI2025_508	Biki Ram	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Unveiling State Transitions and Inner Disk-Corona Dynamics in Black Hole X-ray Binaries Using Power-Color and QPO Analysis		
The power spectra of Black Hole (BH) Low-Mass X-ray Binaries (LMXBs) evolve systematically across states, influenced by the fluctuations in the corona and accretion disk. We used an innovative power-color technique based on the ratio of variability amplitude at distinct frequency ranges to estimate spectral states using hue, representing angular positions on the power-color wheel. This method provides a promising alternative to the standard Hardness-Intensity Diagram (HID) method, which is often ambiguous. In this study, we analyzed the power spectra of ten BH-LMXB sources using archival AstroSat data during outburst phases. By employing a root-mean-square (RMS) variability versus hue analysis, we identified distinct states. Quasi-periodic oscillations (QPOs) in LMXBs provide valuable insights into the emission mechanisms of the inner accretion disk, constraining parameters in the strong field regime. We detected multiple such QPOs and associated harmonic in our sample and conducted a study of their energy dependence. We observed the evolution of QPO RMS spectra with both hue and QPO frequency, shedding light on the inner accretion disk dynamics and disk-corona geometry in various states. A notable finding was the detection of a sign reversal in the average QPO time lag between hard and soft photons near a QPO frequency of 2 Hz, concurrent with the hard to hard-intermediate state transition. Our analysis further revealed a change in the slope of the QPO RMS spectra around this same frequency and hue value. This observed time lag reversal (hard to soft) which occurs during this state transition phase is consistent with a transition from an elongated jet-like corona (responsible for the hard lag) to a compact corona (responsible for soft lags through reverberation) model. The transition frequency may signify the critical radius for Lense-Thirring precession, above which the state transition occurs. This study offers insights into the state evolution of BH-LMXB.		

ASI2025_296	Chandranathan Anandavijayan	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Spectral evolution in decaying MHD turbulence: Implications for early-universe magnetic fields		
Magnetic fields are pervasive across the universe, existing even in cosmic voids. Observations of TeV blazar spectra in these voids indicate the presence of a magnetic field of approximately $10^{-15} G$, likely of primordial origin. Such primordial magnetic fields can significantly influence the evolution of cosmic plasma, impacting processes such as Big Bang nucleosynthesis and recombination. In the early universe, magnetic fields may have been generated during inflation or phase transitions. Their subsequent non-linear decay is characterized by a decay timescale and is constrained by a conserved quantity. It is currently agreed that this decay proceeds via magnetic reconnection. In ideal magnetohydrodynamics (MHD), magnetic helicity is conserved; however, in the absence of magnetic helicity, it cannot constrain the decay, even though it remains conserved. This has led to debate regarding the relevant conserved quantity in this scenario. It was proposed that conservation of magnetic helicity fluctuations is relevant, but our prior work critically analyzed this claim and demonstrated that conservation of anastrophy (square of the vector potential) is the true constraint. In this study, we analytically calculate the evolution of the magnetic spectrum using piecewise power laws. To validate our results, we perform numerical simulations with the pseudo-spectral solver DEDALUS. The resulting scaling relations confirm the true conserved quantity. This finding is significant not only for advancing our understanding of decaying MHD turbulence but also for early-universe physics.		

ASI2025_118	DEBADRI BHATTACHARJEE	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Structure and stability of dark energy stars in Rastall theory of gravity		
The concept of dark energy offers a promising approach to preventing the gravitational collapse of compact objects, thereby avoiding the formation of singularities. In this article, we focus on developing a novel, singularity-free relativistic solution to the Einstein field equations for dark energy stars, framed within the Rastall theory of gravity. To examine this model, we consider the Low-Mass X-ray Binary (LMXB) 4U 1608-52, with a mass of $1.74~M_{\odot}$ and a radius of 9.3 km (T. G"uver et al., Astrophys. J. {\bf 712}, 964 (2010)), as a potential candidate for a dark energy star. The analysis begins with the dark energy equation of state, in which dark energy density is linked to an isotropic perfect fluid distribution through a coupling parameter, α. We derive the induced metric and extrinsic curvature tensors at the star's surface to determine the unknown constants within the model. A detailed analysis is carried out to explore how the physical behaviour of the system depends on the Rastall parameter, ξ. Notably, we identify a possible phase transition from dark energy to baryonic matter, sensitive to both α and ξ. Additionally, we compute the proportion of dark energy in the model by varying ξ, while for a fixed ξ, the variation of dark energy percentage with stellar mass reveals a dependence on both mass and radius. The model satisfies causality and energy conditions, affirming its physical plausibility. Stability of the stellar structure is confirmed through a comprehensive stability analysis. The graphical representation of physical parameters and the results of the theoretical study demonstrate that the proposed model is free of singularities and represents a stable, realistic stellar configuration that incorporates both dark energy and baryonic matter.		

ASI2025_146	Debojit Paul	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing Modified Gravity through Orbital Dynamics: From the Galactic Center Black Hole to the Solar System		
Orbits serve as a natural probe for testing gravitational theories across various scales. By studying orbits, predictions of different gravitational models can be tested under various conditions of the gravitational potential. In this work, we study the stellar orbits near the Galactic Center (GC) black hole as well as the planetary orbits in the solar system in a modified theory of gravity. We develop a rotating axially symmetric metric within the framework of f(R)-scalaron gravity. The metric is subjected to astronomical tests near the GC black hole through stellar orbits. The predictions of the metric are found to be consistent with very high spin value of GC black hole and is complemented by recent observations. In the solar system, the theory is further tested using observational data for six planets(upto saturn) as well as Trans Neptunian objects(TNOs), Centaurs and Scattered Disk Objects(SDOs) orbital data. The theory is found to be consistent in the inner solar system but is found to deviate from general relativity towards the outer solar system. The cosmological implications of the theory are also highlighted. References: 1. Paul D., Bhattacharjee P., Kalita S., 2024, ApJ, 964, 127 2. Paul D., Kalita S., 2024, arXiv:2406.00351 3. GRAVITY Collaboration et al. 2020, A&A, 636, L5 4. Kalita, S. 2018, ApJ, 855, 70		

ASI2025_527	Debojoti Kuzur	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Topological Defects and Neutron Star Glitches		
Rotational irregularities are one of the prominent observational features that most pulsars exhibit. These glitches, which are sudden increases in spin angular velocity, remain an open problem. In this study, we have investigated the potential role of nontrivial topological defects, specifically in the form of Nambu-goto-type cosmic strings, concerning spin irregularities. Such cosmic strings which are one-dimensional topological defects formed during various symmetry-breaking and phase transition scenarios, can interact with neutron stars, influencing their rotation. In this work, we see that the appearance of such topological defects trapped within the neutron star can lead to the coupling of the string tension with the angular velocity, leading to the abrupt rotational changes observed as pulsar glitches. The unique tension and topology of cosmic strings, combined with the extreme spacetime curvature around neutron stars, offer a plausible mechanism for these spin-up events. We have further studied how these coupling may generate detectable gravitational waves as a mixture of continuous and burst signals. The evolution of cusps of cosmic strings trapped within neutron stars and the neutron star's mass quadruple moment change due to rotation could produce distinctive gravitational wave signatures, well within the noise cutoff of advLIGO. Our study highlights a potential connection between topological defects, pulsar glitches, and gravitational wave emissions, offering a possible avenue for observationally testing the presence of cosmic strings and their astrophysical effects.		

ASI2025_710	Dhruv Jain	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Rates and Beaming Fractions of Gamma Ray Bursts associated with Compact Binary Coalesences		
Some, if not all, binary neutron star (BNS) coalescences, and a fraction of neutron - star black hole (NSBH) mergers, are thought to produce sufficient mass-ejection to power Gamma-Ray Bursts (GRBs). However, this fraction, as well as the distribution of beaming angles of BNS-associated GRBs, are poorly constrained from observation. Recent work applied machine learning tools to analyze GRB light curves observed by Fermi/GBM and Swift/BAT. GRBs were segregated into multiple distinct clusters, with the possibility that one of them (BNS cluster) could be associated with BNSs and another (NSBH cluster) with NSBHs. As a proof of principle, assuming that all GRBs detected by Fermi/GBM and Swift/BAT associated with BNSs (NSBHs) lie in the BNS (NSBH) cluster, we estimate their rates. We compare these rates with corresponding BNS and NSBH rates estimated by the LIGO-Virgo-Kagra (LVK) collaboration from the first three observing runs (O1, O2, O3). We find that the BNS rates are consistent with LVK's rate estimates, assuming a uniform distribution of beaming fractions estimated in the literature. Conversely, using the LVK's BNS rate estimates, assuming all BNS mergers produce GRBs, we are able to constrain their beaming angle distribution. We similarly place limits on the fraction of GRB-Bright NSBHs with Fermi/GBM (Swift/BAT) data.		

ASI2025_46	Gunindra Krishna Mahanta	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Modeling Particle Acceleration in Pulsar Wind Nebulae as a cosmic PeVatron: A Two-Zone Approach		
PeVatrons are the extreme galactic accelerators capable of accelerating particles up to PeV energies. The exact nature of PeVatrons remains uncertain, but the potential PeVatron candidates include supernova remnant, pulsar wind nebulae, gamma-ray bubble, microquasars and star clusters. While the Crab Nebula being the first PeVatron detected by LHAASO, LHAASO also detected nearly 40 sources at > 100 TeV energies. In this study, we develop a two-zone model to explain acceleration of particles up to PeV energies and emission of radiation from pulsar wind nebula. The model considers the acceleration of particles at the termination shock of PWN and the particles are further accelerated by second order Fermi acceleration in the nebula. Particles emit radiation through the synchrotron and inverse Compton processes in the nebula. This work provides constrains the parameters and conditions necessary for particle acceleration in PWNe to PeV levels.		

ASI2025_643	Hrishav Das	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Photometric and Spectroscopic Study of Type Iax Supernova SN 2022eyw		
Type Iax supernovae (SNe Iax), also known as SN 2002cx-like supernovae, are the most diverse class of "peculiar" thermonuclear supernovae. With ongoing high-cadence, deep supernova searches, the sample size of SNe Iax is increasing, and around 100 SNe have been classified as type Iax. To understand the diversity and its origin within this class, it is important to study individual objects in detail. In this poster, we present results on a type Iax supernova, SN 2022eyw, hosted by an active galactic nucleus candidate, MCG+11-16-003. A detailed spectroscopic and photometric study of SN 2022eyw is carried out using data obtained with the Himalayan Chandra Telescope (HCT). SN 2022eyw is a bright SN Iax with a peak g-band absolute magnitude of −17.64 ± 0.07 mag at a distance of ~37.15 Mpc. Based on the observed light curves and spectra, the light curve decline rate and expansion velocity are estimated. An analytical fit to the bolometric light curve is used to estimate the mass of Nickel-56 synthesized during the explosion. These parameters provide a deeper insight into the progenitor and explosion mechanisms of these events. We also compare the spectra and light curves of SN 2022eyw with those of other SNe Ia and Iax to highlight their differences and diversity.		

ASI2025_297	Jay Kanabar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
A New Mystery : M82X-2 and violation of Eddington limit		
M82X-2 the first pulsating ultra luminous X-Ray source discovered in 2014 by NASA's NuSTAR telescope particularly a neutron star has raised many questions. In 2023 NuSTAR observations confirmed that the M82X-2 violated the Eddington limit. In my study I give a theoretical model which explains the strange behaviour of M82X-2 and other ULX sources.		
ASI2025_655	Jyotishree Hota	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Multi-wavelength study of EHBL source 1ES 0229+200		
We present a comprehensive analysis of the broadband spectral energy distribution (SED) of the extreme high-energy peaked BL Lac (EHBL) source, 1ES 0229$+$200. Our study utilizes near-simultaneous data collected at various epochs between September 2017 and August 2021 (MJD: 58119$-$59365) from different instruments, including {\em AstroSat}$-$UVIT, SXT, LAXPC, {\em Swift}$-$UVOT, {\em Fermi}-LAT, and MAGIC. We investigate the one-zone synchrotron and synchrotron self-Compton (SSC) model, employing diverse particle distributions such as the log parabola, broken power law, power law with a maximum electron energy γ, energy-dependent diffusion (EDD), and energy-dependent acceleration (EDA) models to fit the broadband SED of the source. Our findings indicate that both peaks in the SED are well described by the one-zone SSC model across all particle distribution models. We estimate the jet power for different particle distributions. The estimated jet power for broken power law particle distributions is found to be on the order of 10^{47} (10^{44}) erg s^{-1} for a minimum electron energy γ_{min} $\sim$10 (10^4). However, for intrinsically curved particle energy distributions (e.g., log parabola, EDD, and EDA models), the estimated jet power is $\sim$10^{44} erg s^{-1}. The SED fitting at five epochs enables us to explore the correlation between the derived spectral parameters of various particle distribution models. Notably, the observed correlations are inconsistent with the predictions in the power-law with a maximum γ model, although the EDD and EDA models yield the correlations as expected. Moreover, the estimated physical parameter values are consistent with the model assumptions.		

ASI2025_479	Kinjal Roy	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Iron fluorescence line as a tracer of reprocessing environment		
Iron fluorescence emission is ubiquitous in HMXB systems. Iron fluorescence emission is ubiquitous in HMXB systems. The iron fluorescence is produced by reprocessed emission from the binary environment populated by the dense clumpy wind of the companion stars in the HMXB systems. A large collecting area and excellent sensitivity near the iron fluorescence band make XMM−Newton an ideal instrument for studying the phase variation of the reprocessing environment in these systems. We undertook a systematic study of several bright HMXB pulsars observed with XMM−Newton. Among these sources, GX 301-2, Vela X-1, Her X-1 and Cen X-3 were bright with long exposure and significant iron line equivalent width. I used these data sets to study the variations in iron emission with the spin phase of the NS at different orbital and super-orbital phases. The high collecting area and excellent spectral resolution of XMM-Newton not only allow us to distinguish the neutral and ionized iron emission lines but also allow us to perform a detailed study of the spin variation of these emission lines. Pulse-phase resolved analysis from all the sources shows significant variation of iron fluorescent emission with phase. We discuss the results from the observations. The pulsed nature of the fluorescence emission is not expected from a homogeneous and isotropic binary environment. In GX 301-2, clumpy winds can explain the observed variation of iron fluorescence.		

ASI2025_252	Koushik Ballav Goswami	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Isotropic cold compact objects in f(R,T) gravity admitting CFL equation of state modified by a non-minimal QCD correction factor		
This article presents a method to find exact solution of field equations in $f(R,T)$ theory of gravity for isotropic cold compact objects in hydrostatic equilibrium. In this particular case, the function $f(R,T)$ is assumed to be a simple linear combination of Ricci scalar (R) and the trace of the energy-momentum tensor (T). The interior of these compact objects is modeled using a colour-flavour locked (CFL) equation of state, which describes the behaviour of deconfined quarks. To simplify the calculations, a specific form of the metric, proposed by Vaidya and Tikekar, is adopted. This metric describes a 3-spheroidal geometry embedded in a flat four-dimensional space. The CFL equation of state is generalised by incorporating a QCD correction term (c_{cor}), which significantly influences the equation of state and the energy per baryon of quark matter. This modification allows the model to accommodate a wider range of compact objects, including EXO 1745-248, LMC X-4, PSR J0740+6620, and even the recently observed binary neutron star merger GW 230529$_{-}$181500. The calculated radii of these objects from the model are consistent with the observed values.		

ASI2025_235	KRIPA RAM SAHU	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Photometric and spectroscopic studies of Type Ia supernova SN 2011ae.		
We present optical UBVRI photometric and medium resolution spectroscopic observations of the Type Ia supernova SN 2011ae during -6 to +119 days relative to its B band maximum. SN 2011ae reached its maximum brightness in the B band on JD 2455621.43 ± 0.20, with an apparent magnitude of 13.46 ± 0.05 mag. This corresponds to peak absolute magnitude M(B) = -18.88 ± 0.22 mag. The post-peak decline is characterised by Δm15(B) of 1.02 ± 0.01 mag. The peak quasi-bolometric luminosity for SN 2011ae is logL= 42.85 ± 0.02 erg/s. The mass of 56Ni synthesized in the explosion is estimated as 0.30 ± 0.05 solar mass. The spectrum obtained around maximum brightness shows absorption due to Si II, S II, Ca II, Fe II, and Fe III, consistent with the characteristics of type Ia SNe. The expansion velocity of the ejecta around the maximum, estimated using the Si II 6355 line, is found to be ~ 11000 km/s.		

ASI2025_459	Kunj Panchal	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Probing the impact of astrophysical parameters on the properties of lensed gravitational waves		
Around 100 Gravitational Waves have been detected by current generation GW detectors. With the next generation GW detectors, there are high chances of detecting gravitationally lensed gravitational waves. Lensed gravitational waves, even if rare, provide a good opportunity to study cosmology and astrophysics. In particular, the statistical properties of lensed GWs from compact binary coalescences show a characteristic distribution in their lensed image properties such as the time delays and magnifications. These characteristic lensed image distributions can be used in myriad of ways such as probing Cosmology, gaining insights into astrophysics of merging progenitors or using the distributions as priors in techniques used to search and identify lensed GWs. In this work, we study the impact of variations in the cosmological parameters and astrophysical models on the characteristic statistical distribution of lensed images of GWs. In particular, we study the impact of using different Hubble constant , Binary Black Hole mass distribution, galaxy velocity dispersion function and galaxy mass profiles chosen from different studies in the literature. We find that the tested variations in parameters or models result in time delay distributions that are statistically similar for the LIGO and VIRGO detectors at current (O4) sensitivity.		

ASI2025_553	Manoneeta Chakraborty	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Spectro-temporal Investigation of Quasi-periodic Oscillations From Black Hole X-ray Binary 4U 1630-472 Using NICER		
We present a comprehensive analysis of the spectro-temporal characteristics of the X-ray variabilities from black hole X-ray binary 4U 1630–472 during its three outbursts (2018, 2020, and 2021) as observed by NICER. We detected 27 Quasi-Periodic Oscillations (QPOs), out of which 25 were observed during the 2021 outburst. In this study, we specifically focus on the relationship between spectral and timing parameters and the frequency of type-C QPOs in the 2021 outburst of the black hole binary 4U 1630–472 during its rising phase. We found strong correlations between the photon index of the non-thermal emission and the QPO frequency. We also observed a critical frequency at ∼ 2.31 Hz, above which the behavior of the Q-factor of the QPO changed significantly with the QPO frequency. We further identified two events characterized by a surge in the total flux, corresponding to the disappearance of type-C QPOs. Although the first event appeared like an X-ray flare, during the second event, the source reached a state with a total flux higher than 10^{−8} erg/cm2 /s and exhibited a different type of QPO with lower frequencies and weaker amplitudes. We compare our results with the previously reported QPO characteristics for black hole outbursts and discuss the various models that could interpret the critical frequency and potentially explain the origin and evolution of these type-C QPOs.		

ASI2025_12	Param Joshi	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
High Frequency Wideband Study of FRB20240114A with the Allen Telescope Array		
FRB 20240114A, a bright repeating fast radio burst, was initially reported by the CHIME/FRB collaboration on January 26th 2024. High fluence emissions (> 10 Jy-ms) from this source have been reported by numerous radio telescopes. This FRB was detected at a DM of 527.7 pc cm^-3 and is localized to a host galaxy at redshift Z = 0.42. Previous surveys indicate that the bursts exhibit highly band-limited or narrowband emission characteristics, spanning less than ~100 MHz. In this presentation, I will report on our wideband study of FRB 20240114A using the upgraded Allen Telescope Array (ATA) of the SETI Institute, USA. Our observations cover two independent 672 MHz spectral bands, which were incrementally stepped to uniformly cover the 1 to 7.5 GHz range. We conducted approximately 1200 hours of observations, representing one of the largest follow-up campaigns of repeating FRBs across the widest frequency ranges. Thus far, 42 bursts have been detected in the frequency range of 1 to 3 GHz. Notably, our findings reveal that, in contrast to previous observations, FRB 20240114A exhibits wideband emission, with five bursts covering an unprecedented total bandwidth of approximately 800 MHz. I will also discuss various burst properties such as width, fluence, spectral occupancy, burst rate, etc. This presentation will also address the energy budget of these broadband bursts, which can help scrutinize various emission mechanism models given its distance and host galaxy environment.		

ASI2025_688	Pinku Routaray	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Impacts of Dark Matter on the properties of Static and Rotating Neutron star		

This research explores the combined effects of dark matter (DM) and rotation on the structural and dynamical properties of neutron stars (NSs). Utilizing a self-interacting dark matter model inspired by the neutron decay anomaly, the study integrates DM within the relativistic mean-field (RMF) framework, modeling static and rotating NSs to observe the impact of varying DM interaction strengths and angular velocities. The Hartle-Thorne formalism is employed to model rotating stars, examining key properties, including mass, radius, central energy density, and eccentricity, across a range of DM and rotation conditions. Results reveal that DM significantly influences the neutron star's equation of state (EOS), generally softening it and reducing the star's mass and radius. In contrast, rotational effects increase mass and radius due to centrifugal forces. Higher DM fractions reduce the NS's eccentricity, indicating less deformation from rotation compared to DM-free stars. Additionally, variations in the DM interaction strength alter the star's mass-shedding limit, with low DM fractions allowing higher rotational speeds before mass-shedding occurs, thus supporting larger mass and radii under rotation. For fixed DM fractions, high angular velocities lead to positive deviations in mass and radius from the baseline (DM-free) values, indicating enhanced deformation, while low angular velocities result in reduced mass and radius due to DM's influence. By comparing DM-admixed and DM-free models, the study also examines the relative deviations in maximum rotational mass and equatorial radius, showing that both DM and rotation substantially modify these properties. The findings underscore the interplay between DM content and rotation in defining NS characteristics, offering insights for interpreting observations of highly dense, rotating astrophysical objects. The results align well with current observational constraints, including NICER and XMM-Newton data, providing an avenue for future studies on DM's role in the behavior of ultra-dense matter within NSs.

ASI2025_106	Praduman Pandey	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Detection of Markarian 501 flare from MACE and multwavelength analysis		

Markarian 501, a high frequency peaked blazar at a redshift of z = 0.0337, is well known for its frequent flaring episodes across multiple wavelengths, from radio to very high energy (VHE) gamma-rays. MACE telescope detected a VHE gamma-ray emission with ~90% increase compared to the preflare state on 27 June 2022. Quasi-simultaneously, an X-rays flaring episode from Markarian 501 was detected by Swift-XRT in the same month with the peak X-ray flux increasing up to ~80% above its average preflare level. In this work, we present a comprehensive multiwavelength analysis of Marakarian 501 using the data from the MACE observations, high energy (HE) data from Fermi LAT and X-ray data from Swift XRT and UVOT. The X-ray variability and its correlation with the HE/VHE gamma-ray emission will be investigated.

ASI2025_311	Prasanta Bera	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Relativistic oblique shock reflection: numerical study		
Shock is very common in astrophysics, especially in high-energy emission physics. Most studies in the literature deal with one-dimensional propagation. Here, we numerically study the interaction of a relativistic fluid and the propagation of a relativistic shock in two dimensions. We consider the oblique incidence of a shock with an idealized reflecting wall. The perpendicular velocity component of the fluid adjacent to the wall vanishes, forming a discontinuity/shock with the incident flow. Depending on the properties of the incident flow, a uniform post-shock region develops, indicating a regular reflection. We find that the transition from regular reflection to irregular (Mach) reflection coincides with the sonic condition.		

ASI2025_495	Probit Kalita	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Exploring the impact of the σ-cut scheme on neutron star oscillations and thermal relaxations		
The σ-cut scheme was recently proposed as a method of stiffening the neutron-star equation of state (EoS) at high densities without altering its behavior around the nuclear saturation density. We use the σ-cut scheme to describe the dense matter containing hyperons and kaons, enabling us to obtain high-mass neutron stars without having to modify the relativistic mean field (RMF) model parameters. Using three different parametrizations of the RMF model, we investigate the effects of the σ-cut scheme on particle populations, tidal deformability, nonradial oscillations, and thermal evolution of neutron stars. Our investigations yielded promising results, supporting the use of the σ-cut scheme as a viable method for incorporating additional exotic degrees of freedom in neutron-star matter. This is particularly evident in the thermal evolution calculations, where it significantly enhances the alignment between the theoretical predictions and the observed temperatures of neutron stars.		

ASI2025_259	Raj Prince	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Dissecting the broad-band emission from γ-ray blazar PKS 0735+178 in search of neutrinos		
The origin of the diffuse flux of TeV–PeV astrophysical neutrinos is still unknown. The γ -ray blazar PKS 0735+178, located outside the 90 percent localization region at 2.2deg from the best-fitting IC-211208A event, was found to be flaring across all wavebands. In addition to leptonic synchrotron (SYN) and SYN self-Compton (SSC) emission, we invoke photohadronic (pγ) interactions inside the jet to model the spectral energy distribution (SED) and neutrino emission. We analyze the 100 d γ -ray and X-ray data and 10 d around the neutrino event are chosen to generate the broad-band SED. The temporal light curve indicates that the source was in a high state in optical, UV, γ -ray, and X-ray frequencies during the neutrino detection epoch. In the one-zone lepto-hadronic model, the SSC photons do not provide enough seed photons for pγ interactions to explain the neutrino event. However, including an external photon field yields a neutrino event rate of 0.12 in 100 d, for the IceCube detector, using physically motivated values of the magnetic field, an external photon field peaking at optical wavelength, and other jet parameters. The radiation from secondary electrons at X-ray energies severely constrains the neutrino flux to a lower value than found in previous studies. Moreover, the flux of high-energy γ -rays at GeV energies from the decay of neutral pions is sub-dominant at the high-energy peak of the SED, suggesting a higher correlation of neutrino flux with X-ray flux is plausible. I will also show the result of other possible blazar found in connection with IceCube neutrinos.		

ASI2025_227	Rohit Mandal	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Diffuse X-ray Emission Around Ultraluminous X-ray Sources: A Systematic Search Using Archival X-ray Data		
Accreting black holes (BHs) and neutron stars (NSs) in binary systems are among the universe's most powerful X-ray sources. Ultraluminous X-ray sources (ULXs), the most extreme version of these systems, exhibit X-ray luminosities 100–1,000 times brighter than standard X-ray binaries. At such high accretion rates, theoretical and numerical studies indicate powerful outflows, which have been detected either as outflowing gas or as large (~100 parsec) cavities blown into the surrounding medium. Most studies of these cavities have been conducted in optical and radio bands. However, the recent detection of diffuse X-ray emission around a ULX (Belfiore et al. 2020) demonstrates the potential of X-ray observations to probe these structures. Despite this, no systematic search for such cavities in the X-ray band has been conducted. In this study, to identify potential cavities or diffuse structures we are conducting a systematic search for extended X-ray emission around ULXs by comparing observations with realistic point spread function PSF simulations. In cases of detection, we are modeling the wind energetics and accretion history from the spectral and spatial data to provide new insights into ULX feedback mechanisms. For sources where no extended emission is detected, we place upper limits on the luminosity of the diffuse X-ray component. We are undertaking a systematic study to look for extended emission, by comparing observations with realistic PSF simulations.		

ASI2025_555	Rupak Roy	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Asymmetry in superluminous supernovae		
Supernovae (SNe) are catastrophic explosions through which massive stars die. Considering the progenitors' initial angular momentum and the geometry of the early neutrino-burst, one may expect these explosions to be asymmetric to some extent. Moreover, signatures of this asymmetry are expected to be imprinted in the geometry of the ejected material as well. Observationally this can be probed through spectropolarimetry. The Hydrogen deficit superluminous supernovae (SLSN-I), which are 10-100 times more luminous than normal SNe, should be more asymmetric. Investigation of such systems through spectropolarimetry will help us to understand the asphericity in SLSNe, and how the nature of asymmetry varies in different types of stellar explosions from low-mass progenitor stars to high-mass progenitors. Here I will present the results of spectropolarimetric observations of three SLSN-I - namely SNe 2018bsz, 2018ibb, 2019szu. These events are unique as it was proposed that they originated from different physical processes (SNe 2018bsz, 2019szu are from due to spin-down Magnetar / CSM interaction, while SN2018ibb is from the pair-instability process). On the basis of polarization data, I will discuss the possible physical processes that may have produced these SLSNe. Here I will also compare the polarization of these events with that of other SLSNe, hydrogen-deficit SNe, and Gamma-Ray Bursts (GRBs) to get a more generalized picture of asymmetry in stellar explosions.		

ASI2025_49	Samik Dutta	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Multiple Emission Regions in Jets of the Low-Luminosity Active Galactic Nucleus in NGC 4278		
The Large High Altitude Air Shower Observatory (LHAASO) has detected very-high-energy gamma rays from the low-ionization nuclear emission-line region galaxy NGC 4278, which has a low-luminosity active galactic nucleus (LLAGN) and symmetric, mildly relativistic S-shaped twin jets detected by radio observations. Few LLAGNs have been detected in gamma rays due to their faintness. Earlier, several radio-emitting components were detected in the jets of NGC 4278. We model their radio emission with synchrotron emission of ultra-relativistic electrons to estimate the strength of the magnetic field inside these components within a time-dependent framework after including the ages of the different components. We show that the synchrotron and synchrotron self-Compton emission by these components cannot explain the Swift X-ray data and the LHAASO gamma-ray data from NGC 4278. We suggest that a separate component in one of the jets is responsible for the high-energy emission, whose age, size, magnetic field, and the spectrum of the ultra-relativistic electrons inside it have been estimated after fitting the multiwavelength data of NGC 4278 with the sum of the spectral energy distributions from the radio components and the high-energy component. We note that the radio components of NGC 4278 are larger than the high-energy component, which has also been observed in several high-luminosity active galactic nuclei.		

ASI2025_128	Sanjeeva Rao Prattipati	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
sGRBs similar to GW/sGRB170817A in γ-ray emission		
The rate of gravitational waves from neutron star-neutron star mergers detected by the Laser Interferometer Gravitational-Wave Observatory (LIGO; B. P. Abbott et al. 2017) indicates the existence of even more short gamma-ray bursts (sGRBs) similar to GW/sGRB 170817A among the total gamma-ray bursts (GRBs) recorded by satellite detectors such as BATSE, Fermi-gamma-ray burst monitor(Fermi-GBM), and Swift. We investigated sGRBs in the Fermi-GBM database based on the γ-ray emission characteristics of sGRB170817A, the first GRB with an electromagnetic counterpart detected by LIGO. We adopted a multifaceted approach to identify analogous sGRBs, which involved computing the Hardness Ratios HR1 and HR2, followed by clustering via the K-means algorithm. This process resulted in identifying over 40 sGRBs like (A. von Kienlin et al. 2019), including the reference sGRB170817A, after which we analyzed the spectrum features using GBM techniques. Our study shows the presence of few such events in Fermi-GBM data.		

ASI2025_280	Saptarshi Sarkar	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Giant pulse detection from a transitional millisecond pulsar		
Giant pulses (GPs) are intense, sporadic bursts emitted by a subset of radio pulsars, offering key insights into high-energy processes in pulsar magnetospheres. We will present the first detection of GPs from PSR J1227-4853, a rare transitional millisecond pulsar (tMSP) and one of only three known tMSPs, discovered with the Giant Metrewave Radio Telescope (GMRT). Over 162 hours of observation, we detected 204 GPs from PSR J1227-4853, establishing it as a new GP source. Our results reveal a correlation between GP emissions and the pulsar's image flux density, as well as both its orbital and pulse phases, with most GPs occurring near eclipse boundaries—suggesting potential plasma lensing effects. We observed significant flux density variations across different pulse phase components, with one component displaying a power-law fluence distribution, a characteristic shared with other GP-emitting pulsars. Uniquely, no GPs were detected in the interpulse region, distinguishing this source from other pulsars where GPs are emitted at both main and interpulse phases. The waiting time distribution during an exceptionally active epoch showed clustered emissions with a Weibull index and power-law fluence distribution similar to those observed in fast radio bursts (FRBs), such as FRB 20200120E located within a Globular Cluster. This similarity in both Weibull and power-law indices supports the hypothesis that GP-emitting tMSPs may serve as progenitors for certain FRBs. Our findings provide new insights into the mechanisms of GP emission and their potential links to FRBs, advancing our understanding of extreme astrophysical phenomena within pulsar magnetospheres.		

ASI2025_249	Sayantan Ghosh	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Effects of Energy-Momentum Squared Gravity on Neutron Stars		
We study the effects of energy-momentum squared gravity (EMSG) on the properties and behaviour of neutron stars (NSs) with the variation of the free parameter, α. We derive the hydrostatic equilibrium equations in EMSG and solve them numerically to obtain the neutron star mass-radius relations for soft, stiff, and intermediate equations of state (EOS). We use the existing observational measurements of the masses and radii of NSs to constrain the tidal deformability, compactness, and f-mode frequency of the NS model. We find that the Stiff EOS undergoes the phase transition at the highest energy densities and pressures, followed by the Intermediate and Soft EOSs, demonstrating the differing characteristics of these models. This behaviour allows us to compare the effect of the chosen EOS on the star's sound speed profile, reaffirming the physical validity of the models across different parameter values.		

ASI2025_370	Sayantan Bhattacharya	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
High-Resolution XMM-Newton Spectroscopy of EXO 0748-676's Latest Outburst after Prolonged Quiescence		
EXO 0748–676, a well-studied neutron star low-mass X-ray binary, has re-entered its outburst following 16 years of quiescence. We present the findings from 55.5 ks of XMM-Newton observations, using high-resolution spectroscopy with the Reflection Grating Spectrometer (RGS), which also provided impactful results about the source during the previous outburst. The XMM-Newton European Photon Imaging Camera (EPIC) light curve captures a type I X-ray burst, which leads to an optical burst by three seconds. To investigate the burst's impact on ionization structure, we categorize spectra into burstless, pre-, and post-burst phases, with additional analysis of dip and non-dip intervals. Across all phases, a broad O VII recombination line dominates the spectrum, accompanied by velocity-broadened O VIII, N VII, and Ne IX features. Particularly, the Ne IX line shows variation in ionization states between pre-burst (11.65 A) and post-burst (13.56 A) spectra, while dips also significantly influence the line profiles. Similarities with the previous outburst are observed, including a similar spectral state, ionization structure, and same elemental lines, indicating stable, long-term accretion characteristics across these two outbursts. This work highlights the consistency in EXO 0748–676's spectral properties, providing insights into its accretion and ionization properties even after prolonged quiescent periods.(https://arxiv.org/abs/2408.02715)		

ASI2025_602	SHREE SUMAN	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
On the physical origin of X-ray variability in Seyfert galaxies using Fourier -frequency dependent covariance spectral modeling		
In low-mass, bright, accreting AGN, X-ray reverberation has been proven to be a crucial technique for understanding the inner accretion geometry around black holes but what drives the soft and hard X-ray flux variations across a range of luminosites is still elusive.In this work, we have taken an unconventional approach to modeling the Fourier frequency-dependent X-ray covariance spectra to answer this question.We have extracted X-ray covariance and rms spectra of two highly variable low-mass Seyfert galaxies, MCG 6-30-15 and NGC 4593, using long-look XMM-Newton EPIC-pn observation and they are modeled as a function of photon energy for different Fourier frequencies. Motivated by the fact that the X-ray flux variation is either caused by the variation in absorption, direct non-thermal emission or reprocessed emission-like reflection, we have used a physical model to fit covariance spectra in different frequency regimes. We found that complex absorption, relativistic reflections, and variable power-law are essential to fit the 0.3-9 keV covariance spectra of MCG-6-30-15: at higher frequency (25-40 × 10 ^−6 Hz), spectra are dominated by the variability of reflection component with inner accretion disk radius between 1-5 R _ISCO while at lower frequency (7.75-11 × 10^ −6 Hz), the variability is dominated by the direct non-thermal component while the inner disk radius receded to a distance of 5.7-25.8 R_ISCO , where R _ISCO is the radius of the innermost stable circular orbit. While transiting from a lower to a higher frequency regime, normalization of the variability caused by reflection increases by ∼2.75 times. However, no change in the complex absorption is observed. Similar results are obtained for NGC 4593. Our analysis suggests that low frequency, low flux variability is dominated by the power-law component while high frequency, high flux variability is dominated by the relativistic reflection component.		

ASI2025_344	Siddhant Manna	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Search for Dark Matter Annihilation to gamma-rays from SPT-SZ selected Galaxy Clusters		
We search for dark matter annihilation from galaxy clusters in the energy range from 1-300 GeV using nearly 16 years of Fermi-LAT data. For this purpose, we use 350 galaxy clusters selected from the 2500 deg2 SPT-SZ survey. We model the dark matter distribution using the NFW profile for the main halo along with the Einasto profile for the substructure. The largest signal is seen for the cluster SPT-CL J2021-5257 with a significance of around 3σ. The best-fit dark matter mass and annihilation cross-section for this cluster are equal to (60.0±11.8) GeV and ⟨σv⟩=(6.0±0.6)×10^−25 cm^3 s^−1 for the $b^{-}b$ annihilation channel. However, this central estimate is in conflict with the limits on annihilation cross-section from dwarf spheroidal galaxies, and hence cannot be attributed to dark matter annihilation. Three other clusters show significance between 2−2.5σ, whereas all the remaining clusters show null results. The most stringent 95\% c.l. upper limit for the WIMP annihilation cross-section among all the clusters is from SPT-CL J0455-4159, viz. ⟨σv⟩=6.44×10^−26 cm^3 s^−1 for m_χ=10 GeV and bb^{-} annihilation channel.		

ASI2025_179	Siddharth Kumar Sahoo	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Imprints of Einstein-Maxwell-dilaton-axion gravity in the observed shadows of Sgr A* and M87*		
The Kerr-Sen metric represents the exact, stationary, and axisymmetric black hole solution of Einstein-Maxwell-dilaton-axion gravity. Such a black hole is characterized by the angular momentum a acquired from the axionic field and the dilatonic charge r2 arising from string compactifications. We study the role of spin and the dilaton parameter in modifying the shape and size of the black hole critical curve, which is associated with the projection of the spherical null geodesics on the sky. We compare the theoretically derived critical curve with the Event Horizion Telescope results related to the images of M87* and Sgr A* to obtain constraints on the dilaton parameter r2. We take into account the errors in mass and distance of M87* and Sgr A* while deriving their theoretical critical curve. Our analysis reveals that the image of M87* exhibits a preference toward the Kerr scenario when the critical curve angular diameter is calculated with the central value of mass and distance. When errors in mass and distance are taken into account the allowed range of r2 turns out to be $0 \lesssim r2 \lesssim 1$. For Sgr A*, the preferred range of r2 is $0.1 \lesssim r2 \lesssim 0.4$ when central values of mass and distance are used to calculate the theoretical critical curve. When error bars in mass and distance are used to calculate the theoretical critical curve of Sgr A*, the preferred range of r2 turns out to be $0 \lesssim r2 \lesssim 0.5$. Thus the image of M87* favors the Kerr scenario and allows the Kerr-Sen scenario only when errors in the mass and distance are taken into consideration while the image of Sgr A* favors the Kerr-Sen scenario and allows general relativity when errors in the mass and distance are taken into account.		

ASI2025_70	Soma Mandal	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Broadband spectral and temporal properties of the atoll source 4U 1702-429 using AstroSat-NICER		
We present the broadband spectro-temporal analysis of the atoll source 4U 1702-429 using an AstroSat observation and another simultaneous observation by AstroSat and NICER at two different epochs separated by a year. The photon spectra of both observations can be described by a thermal Comptonization component whose seed photons arise from a black body spectrum, a disk emission and a non-relativistic reflection component. For the first observation, the coronal temperature ~7 keV is smaller than the second ~13 keV, and the disk is truncated at a larger radius, ~150 km, compared to the second, ~25 km, for an assumed distance of 7 kpc. A kHz QPO at ~800 Hz is detected in the first and is absent in the second observation. Modeling the energy-dependent r.m.s and time lag of the kHz QPO reveals a corona size of ≤ 30 km. A similar model can explain the energy dependence of the broadband noise at ~10 Hz for the second observation. The results suggest that kHz QPOs are associated with a compact corona surrounding the neutron star and may occur when the disk is truncated at large distances.		

ASI2025_261	Sonali Sahoo	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Observability of SSA emissions from GRBs with Daksha		
The combined analysis of GRB140512A (Oganesyan et al. 2017) with data from the\textit{ Swift}-XRT energy range of 0.5-10 keV, the \textit{Swift}-BAT energy range of 15-150 keV, and Fermi-GBM 8 keV-1 MeV, suggests a change in the spectral slope at a few keV (nearly at 8 keV), indicating a spectral break. The study also claims the spectrum change could have resulted from synchrotron self-absorption (SSA). We analyzed the synchrotron and SSA emission modeling for GRB 140512A. Our preliminary modeling indicates that the SSA emission occurred during the \textit{Swift}-XRT observations. The upcoming observations with Daksha– a proposed space mission to detect high-energy counterparts of gravitational wave sources at 1 keV to 1MeV(Bhalerao et al. 2024) would be a suitable candidate for constraining the SSA modeling of GRBs.		

ASI2025_38	Soumya Gupta	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Investigating Spectral Width Evolution in Gamma-Ray Bursts		
Even with tens of thousands of Gamma-Ray Burst (GRB) detected on an average of one per day, the emission process of these highly-energetic phenomenon is unclear. Additionally, the GRB prompt-phase spectrum can be reproduced by multiple empirical functions within the statistical significance adding further dubiety. The scepticism can be resolved, at least partially, by studying the spectral width W of the prompt spectra while comparing with the physically motivated emission models like thermal/synchrotron/inverse Compton. This can be further scrutinized by studying the evolution of the spectral width in the light of these emission models. We select an ensemble of bright GRB prompt spectra and study their spectral width evolution under a modified thermal emission scenario arising from the rapid cooling of a thermal fireball. The statistical treatment of this study is made viable by constructing a mathematical model of the physical scenario and coupling it with the 3ML statistical fitting package.		

ASI2025_166	Suman Bala	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
The Gamma-ray Targeted Search (GTS); A generalized method to find sub-threshold Gamma-ray bursts combining different instruments		
The Fermi Gamma-ray Burst Monitor (GBM) Targeted Search has demonstrated remarkable efficiency in recovering weak signals from untriggered Continuous Time Tagged Event (CTTE) data. We estimate that this method could significantly increase the volume of the universe in which gravitational wave (GW) counterparts—like GRB 170817A—can be detected, potentially expanding it by nearly an order of magnitude. To further this progress, we are excited to introduce a versatile, open-source tool: the Gamma-ray Targeted Search (GTS). Leveraging the newly developed Gamma-ray Data Tools (GDT), the GTS enables users to conduct custom searches for sub-threshold signals within GBM CTTE data at specified times (GW event times). Importantly, because the GTS is built on the GDT framework, it can also analyze GBM-like data from other missions, including BurstCube, Glowbug and the upcoming StarBurst mission. In this discussion, we will highlight the GTS's capabilities, recent significant results, and outline future enhancements aimed at creating a multi-mission targeted search. This expanded functionality would integrate the strengths of various gamma-ray instruments, facilitating deeper and more comprehensive explorations of the gamma-ray sky.		

ASI2025_24	Yogeesh N	Poster
High Energy Phenomena, Fundamental Physics and Astronomy		
Modelling large glitches with core superfluidity in mixed phase region		
Many pulsar exhibit a peculiar behaviour in their pulse profile of sudden increase in their rotational period, which is popularly known as pulsar glitch. Some of them shows giant glitches with relative amplitude $\Delta\Omega/\Omega \sim 10^{-6}-10^{-5}$. With the model of pinned neutron vortices inside the the neutron star (NS) crust, this large glitch can not be explained so far. However, the increasing evidence of massive pulsars indicates the appearance of exotic degrees of freedon in the inner core of the pulsars. In view of this we consider the pulsar as a hybrid star (HS) with quark core surrounded by nucleonic matter with a mixed phase region. This model opens up the possibility of votex-pinning inside the core too in the mixed phase region of quark and nucleonic phase. It is believed that at densities $>2\rho_0$ first order phase transition of hadron to quark matter occurs. Under the Gibbs equilibrium conditions it is possible for hadrons and quark phase to coexist.Owing to global charge neutrality condition, quarks pasta structures are formed in the background of hadronic matter. We consider these pasta structures as pinning sites of superfluid vortices which store enough angular momentum to account for larger glitches. Consideration of unpinning of the vortices from this region in addition to the contribution form the crust may lead to large glitches of the pulsars. We show that considering the core contribution the amplitude of glitch is coming to be of the order of $\Delta\Omega/\Omega \sim 10^{-6}$ which is close to the observations showed by Vela pulsar (PSR B0833-45).		

Posters in
Galaxies and Cosmology

ASI2025_64	Abhinna Sundar Samantaray	Poster
Galaxies and Cosmology		
Be Stars in the Small Magellanic Cloud (SMC)		
Star clusters, once thought to be simple, coeval systems, often harbor multiple stellar populations with distinct chemical compositions and ages. In this talk, I will discuss the role of stellar rotation in driving this phenomenon, with a focus on how rotational mixing and mass loss can create chemical and evolutionary diversity within clusters. I will discuss how rapidly rotating Be stars - characterized by their hydrogen emission lines (Hα and Hβ), decretion gas disks, and high rotational velocities can contribute to the formation of multiple populations through mechanisms such as chemical enrichment, rotationally-induced evolutionary differences, and material ejection. We conducted a search for Be star candidates in the star clusters (SCs) (and in the field) in the Small Magellanic Cloud (SMC) and the Bridge using the STEP survey, carried out with the VLT Survey Telescope (VST). With the help of STEP deep Hα photometry, we retrieved numerous new Be star candidates in the 64 Young SCs and their field, compared to the literature-based observations. Serendipitously, during our Be star hunt, we confirmed some known Planetary Nebulae (PNe) (and some other emission stars like Herbig Ae/Be stars, C stars, Mira variables, etc.), and found some new PNe candidates with extremely high Hα emission using STEP photometry.		

ASI2025_584	Abhisek Swain	Poster
Galaxies and Cosmology		
The end of the End of Greatness: Exploring the scale of homogeneity of our Universe		
The Cosmological Principle serves as a foundational concept in modern cosmology, shaping our understanding of the universe's structure and evolution. This principle asserts that, on large scales, the universe is isotropic and homogeneous. Homogeneity entails that the universe appears uniform when observed on sufficiently large scales, whereas isotropy implies that it looks the same in all directions from any given point. We placed constraints on the size of the largest possible scale of homogeneity in our universe. Specifically, we found a lower bound for the largest homogeneous patch in which our observable universe resides. A large-amplitude inhomogeneity on that scale would manifest itself as temperature fluctuations on the CMB sky map and would thus have a contribution in the temperature anisotropy power spectrum via the Grishchuk-Zel'dovich effect. The GZ effect is the contribution of an extremely large scale adiabatic density disturbance to the anisotropy of the microwave background. By setting a condition that the contribution to the quadrupole from the GZ effect cannot be greater than the WMAP upper limit on the quadrupole value, we can place constraints on the size of this inhomogeneity. We employed two models to describe large amplitude peaks in the primordial power spectrum, yielding two distinct lower bounds. For a delta peak function, we obtained L_(GZ)>2727L_0, where L_(GZ) and L_0 represent the size of the homogeneous patch and the current particle horizon, respectively, considering the Integrated Sachs-Wolfe effect. For the second model, which physically translates to a universe that is inhomogeneous and anisotropic when observed within a spherical shell of scale length between L_2 and L_1, we found L_2=L_(GZ), extending to 2196 times the observable universe, assuming L_1 approaches infinity.		

ASI2025_583	Amrutha S	Poster
Galaxies and Cosmology		
Understanding Stellar Initial Mass Function in the different regions of NGC 628 using MUSE and UVIT observations		
We present a pilot study on the high-mass end of the stellar initial mass function (IMF) in NGC 628. We focus on variations across the arm, interarm, and spur regions. Our research emphasizes Hα emission primarily detected from O stars, using VLA/MUSE, as well as UV emissions from both O and B stars obtained with UVIT in star-forming clumps (SFCs). We estimated the populations of O stars and massive B stars (mass above 10 solar mass). Subsequently, we found the median stellar IMF index for each region. Our findings indicate that the IMF index steepens when SFCs are populated with O stars of mass up to 100 solar mass. Notably, the interarm region exhibits a steeper, bottom-heavy IMF than the arms and spurs across all cases. Furthermore, the ratio of massive to less massive B stars (with masses ranging from 3 to 10 solar mass) yields a consistent IMF value, even when O stars are populated differently, making B star mass ratios a more reliable indicator of the IMF. We also present variations of the IMF with different properties of the SFCs, which gives crucial results in understanding the IMF.		

ASI2025_285	Ansha Ans	Poster
Galaxies and Cosmology		
Spectropolarimetric study of superluminous supernova SN2018bsz		
Supernovae and Superluminous supernovae are expected to be asymmetric in nature to some extent. In this study, we analyzed the spectropolarimetric data of the nearest superluminous supernova SN2018bsz to investigate the geometry of the ejected material and probed the asymmetric nature of this explosion. 2D spectral data have been reduced and analyzed using tools like IRAF to extract the 1D spectra. Further analysis has been done using Python-based routines. We delve into 2D spectral data to understand elemental composition, interactions with the circumstellar medium (CSM), and asymmetry in this SLSN explosion. By analyzing the spectropolarimetric observations, we have detected distinct polarisation patterns that shed light on the asymmetry and structural properties of this SLSN ejecta. Our analysis contributes to a broader understanding of SLSN evolution.		

ASI2025_108	Arav Bhaskaran Jayaprasad	Poster
Galaxies and Cosmology		
A model of constrained violent relaxation to quasi-stationary states of spherical halos		
Collisionless self-gravitating systems, such as galaxies and dark matter halos, undergo violent relaxation during their formation. The potential oscillations that drive this relaxation damp after a few dynamical times, leading to an incompletely relaxed quasi-stationary state (QSS) that slowly evolves on relaxation time scales. Simulations of dissipationless collapse from cold initial conditions have shown that violently relaxed QSSs have several quasi-universal properties, which might explain the ubiquitous properties of elliptical galaxies. Following a picture of short-lived large amplitude oscillations that lead to a dynamically constrained phase space density, we introduce a class of anisotropic spherical distribution functions (DFs) that depend on energy E, pericenter r_p, and a free parameter ξ_s which modulates the region of violent relaxation. A DF of these quantities, with a cutoff in pericenter $\phi(r_p, \xi_s)$, chosen to be of the Fermi-Dirac form, generalizes the model of Mangalam et al. (1999) and leads to QSS configurations. Based on the dynamical constraints of incomplete and confined relaxation (Tremaine 1987), we discuss two variants of DFs of this type that suppress orbits with high radial periods with a factor proportional to the radial frequency. These models possess several desirable properties that match well with dissipationless cold collapse simulations, including a density that falls off as r^{-4}, velocity dispersions that fall off as $\sigma^2\propto r^{-1}$, an isotropic core with a radially anisotropic halo, pseudo phase space density $\rho/\sigma^3\propto r^{-5/2}$, and an increasing energy distribution with a finite value at $E=0$. In addition, the surface brightness law follows the $R^{1/4}$ law that agrees with observed profiles of elliptical galaxies. We also discuss testing the stability of these models and their extension to axisymmetric systems.		

ASI2025_612	Archis Mukhopadhyay	Poster
Galaxies and Cosmology		
The 21-cm signal from the Cosmic Dawn: Comparing the statistical properties from the 21cmFAST and GRIZZLY simulations		
The 21cm signal of neutral Hydrogen is set to revolutionize our understanding of the astrophysics of the high redshift Universe. Several attempts have been made to model this signal using numerical, semi-numerical, and analytical approaches. In this work, we compare the outcomes of two simulations, GRIZZLY and 21cmFAST, in the Cosmic Dawn. 21cmFAST is a semi-numerical code that generates the density, ionization, peculiar velocity, and spin temperature fields to produce the differential 21-cm brightness temperature. On the other hand, GRIZZLY is a 1-D radiative transfer code, assuming every galaxy to be a spherically symmetric source of photons. We use the same density fields and source properties for both algorithms to ensure a consistent comparison. We explore the variation in the specific X-ray luminosity per unit star formation (L_X / SFR) and the turnover halo mass for efficient star formation and compare the statistical properties of the signal, such as the power spectrum, bispectrum, and HII bubble morphology descriptors.		

ASI2025_189	Arihant Tiwari	Poster
Galaxies and Cosmology		
Spectroscopic Quasar Anomaly Detection (SQuAD) I: Rest-Frame UV Spectra from SDSS DR16		
We present the results of applying anomaly detection algorithms to a quasar spectroscopic sub-sample from the SDSS DR16 Quasar Catalog, covering the redshift range $1.88 < z < 2.47$. Principal Component Analysis (PCA) was employed for dimensionality reduction of the quasar spectra, followed by hierarchical K-Means clustering in a 20-dimensional PCA eigenvector hyperspace. To prevent broad absorption line (BAL) quasars from being identified as the primary anomaly group, we conducted the analysis with and without them, comparing both datasets for a clearer identification of other anomalous quasar types. We identified 1,888 anomalous quasars, categorized into 10 broad groups. The anomalous groups include C IV Peakers—quasars with extremely strong and narrow C IV emission lines; Excess Si IV emitters—quasars where the Si IV line is as strong as the C IV line; and Si IV Deficient anomalies, which exhibit significantly weaker Si IV emission compared to typical quasars. The anomalous nature of these quasars is attributed to lower Eddington ratios for CIV Peakers, super-solar metallicity for Excess Si IV emitters, and sub-solar metallicity for Si IV Deficient anomalies. Additionally, we identified four groups of BAL anomalies: Blue BALs, Flat BALs, Reddened BALs, and FeLoBALs, distinguished primarily by the strength of reddening in these sources. Further, among the non-BAL quasars, we identified three types of reddened anomaly groups classified as heavily reddened, moderately reddened, and plateau-shaped spectrum quasars, each exhibiting varying degrees of reddening. The detected anomalies are presented as a value-added catalog.		

ASI2025_746	Arpan Krishna Mitra	Poster
Galaxies and Cosmology		
Barrow Holographic Dark Energy in Brane World Cosmology		
Cosmological features of Barrow Holographic Dark Energy (BHDE), a recent generalization of original Holographic dark energy with a richer structure, are studied in the context of DGP brane, RS II brane-world, and the cyclic universe. It is found that a flat FRW scenario with pressure less dust and a dark energy component described as BHDE can accommodate late time acceleration with Hubble horizon considered as infrared cut off even in the absence of interaction between the dark sectors. Statefinder diagnostic reveals that these model resemble ΛCDM cosmology in future. It is found that BHDE parameter Δ, despite its theoretically constrained range of values, is significant in describing the evolution of the universe, however, a classically stable cosmological model cannot be obtained in the RS-II and DGP brane. Viability of the models is also probed with observed Hubble data.		

ASI2025_408	Arpit Kottur	Poster
Galaxies and Cosmology		
A Streamlined Model for Simulating Galactic Rotation Curves with Observational Validation		
In this work we present a streamlined yet robust simulation framework for generating galactic rotation curves, optimized for computational efficiency while retaining fidelity to observed data. The model integrates contributions from a galaxy's bulge, disk, and dark matter halo, represented by Hernquist, exponential, and NFW profiles, respectively, to replicate realistic galactic rotation dynamics. Validated against observed rotation curves from galaxies such as the Milky Way and Andromeda, the simulation captures primary rotation curve characteristics and provides a close approximation of mass distribution within these galaxies. While minor discrepancies are present, primarily due to simplified profile assumptions, the model effectively balances accuracy with simplicity, offering a practical tool for galactic dynamics research. This accessible framework serves as a foundation for further studies in galaxy structure and evolution and is adaptable for educational applications.		

ASI2025_628	Barenya Dev	Poster
Galaxies and Cosmology		
A Multi-Frequency Investigation of the S-shaped Radio Galxy IC2402: A Restarted or Precessing Jet?		
Double-double radio galaxies (DDRGs) represent a unique subclass of restarted radio galaxies, with two distinct episodes of active galactic nucleus (AGN) activity, manifested as two pairs of radio lobes which are usually co-linear. However, disentangling this restarting jet activity from the complex structures formed due to jet/counter-jet precession (twisted or knotted jets) is challenging as it needs sensitive and high-resolution multi-frequency data. The previous studies of the radio source J0847+3147, hosted by the brightest cluster galaxy IC 2402 in the relaxed cluster WHL J084759.0+314708 at a redshift of $z = 0.067$, have classified it as a DDRG based on a low-sensitive VLA FIRST image. However, archival Giant meterwave Radio Telescope (GMRT) data (325 MHz) and Very Large Array Sky Survey (VLASS) data (3 GHz) rather indicates a twisted/bent jet type of morphology for this source. In this study, we present upgraded GMRT (uGMRT) observations of the S-shaped radio galaxy IC 2402 at 650 MHz and 1.4 GHz. A detailed morphological analysis reveals inner jets resembling a Fanaroff-Riley type II (FRII) structure, multiple jet knots, and diffuse outer lobes. We conduct a multi-frequency spectral aging analysis and incorporate a kinematic jet precession modeling to investigate the source's activity history, and S-shaped morphology.		

ASI2025_115	BIBHUPRASAD MISHRA	Poster
Galaxies and Cosmology		
Detection and properties of Lyman Break Galaxies at redshift 2 < z < 3.		
We present results of a search for bright Lyman break galaxies (LBGs) at $2 \leqslant z \leqslant 3$ in the GOODS-North field using dropout technique in combination with color selection using CANDELS observation. We apply two set of selection criteria to identify F275W and F336W-dropout to get a sample of 114 and 194 LBG candidates at z ~ 2.1 and z ~ 2.7 respectively. We use multi-wavelength imaging combined with available spectroscopic and photometric redshifts to carefully access the validity of our UV-dropout candidates. We divide the samples of bin size z = 0.1, and estimate LBG candidate ages, masses, and star formation rates from fitting CIGALE synthesis evolution models. We track the growth of mass and size of galaxies from z~3 to z~2. Overall, we can show that LBGs are low massed compact structures with half-light radii of only a few kpc. A true Lyman break criterion at $z \sim 2$ is therefore, more directly comparable to the populations found at $z \sim 3$, which contains a red fraction.		

ASI2025_76	Chandra Shekhar Murmu	Poster
Galaxies and Cosmology		
Forecasting the CO-21cm cross-correlation signal from the EoR using line-intensity mapping surveys		
Line-intensity mapping (LIM) is expected to be a promising tool for probing the Epoch of Reionization (EoR) via accumulating cumulative flux of line emissions from galaxies. However, the instrumental noise of the LIM surveys will contaminate the LIM signal and, therefore, the observable summary statistics and degrade the detectability of the LIM signal. One possible method to tackle this is to cross-correlate with a different tracer of the high redshift universe, such as the HI 21cm signal from the neutral IGM. In this work, we forecast the CO-21cm cross-power spectrum from the EoR and its detectability. We consider a HI 21cm survey with AARTFAAC and a CO emission survey by COMAP, with an overlap of 12 deg^2 of the survey area. We use the outputs of a combination of N-body and radiative transfer simulation to obtain the mock 21cm and CO signals. Considering the planned COMAP-pathfinder survey, which will detect the CO(2-1) signal from the EoR and 1200 hours of observation time on AARTFAAC, we find that all four CO emission models considered in the analysis are detectable in cross-correlation, where the model with the weakest signal, is not detectable in auto-correlation. The scenario improves for 2400 hours of observation with AARTFAAC, where the weakest CO emission model is detectable with ~2sigma significance in cross-correlation. For the planned COMAP-EoR survey, set to detect the CO(1-0) signal from the EoR, one might achieve close to 3sigma detection significance for the weakest model. We also considered a broad range of CO emission models and found that compared to the CO auto-power spectrum, the CO-21cm cross-power spectrum can detect a more extensive range of CO models, including weak ones. Therefore, cross-correlation can improve the detection of the LIM signals from the EoR.		

ASI2025_738	Debasis Sahu	Poster
Galaxies and Cosmology		
Present Matter Density Constraint on Black Hole Formation		
Black holes mass evolution depend on accretion of surrounding energy-matter and the quantum mechanical Hawking evaporation. In this work, we consider the availability of black holes in the framework of standard cosmology. The density of the black holes as compared to total density of the universe can be evaluated from many astrophysical processes. One of them is the present matter density of the universe. Considering this theory, we have evaluated the upper limit on the initial mass fraction of the black holes in different accretion efficiencies and found quite interesting results. Moreover, we have discussed the results in comparison with Brans-Dicke theory.		

ASI2025_406	Dhanush S R	Poster
Galaxies and Cosmology		
Tracing the change in structure and kinematics of the Small Magellanic Cloud due to interactions		
We present a detailed kinematic model of the Small Magellanic Cloud (SMC) using the Gaia DR3 proper motion (PM) data for distinct stellar populations, including young and old stars and star clusters. Our model reveals an almost edge-on SMC aligned across the north-south directions. Notably, the center-of-mass PM of the 1–2 Gyr old population exhibits a larger southward drift than other age groups. The kinematic structure varies with age, showing a flattened ellipsoidal distribution for older stars, while the younger stars form a rotating, elongated disk. We find substantial line-of-sight depth for the SMC, reaching over 30 kpc, with the eastern side closer to us. Residual PM maps highlight anomalies in the eastern, southeastern, southern, and western regions, with the newly detected anomaly in the southeast. Our analysis of the internal rotation in the young population shows pronounced tangential anisotropy in the RA direction relative to Dec. Our models suggest a significant influence of the Large Magellanic Cloud (LMC) on the SMC's present structure, where the LMC-SMC interactions play a great role in shaping the SMC's morphology.		

ASI2025_80	Divya Pandey	Poster
Galaxies and Cosmology		
Star formation exists in all early-type galaxies -- evidence from ubiquitous structure in UV images		
Recent surveys have demonstrated the widespread presence of UV emission in early-type galaxies (ETGs), suggesting the existence of star formation in many of these systems. However, potential UV contributions from old and young stars, together with model uncertainties, makes it challenging to confirm the presence of young stars using integrated photometry alone. This is particularly true in ETGs that are fainter in the UV and have red UV-optical colours. An unambiguous way of disentangling the source of the UV is to look for structure in UV images. Optical images of ETGs, which are dominated by old stars, are smooth and devoid of structure. If the UV is also produced by these old stars, then the UV images will share this smoothness, while, if driven by young stars, they will exhibit significant structure. We compare the UV and optical morphologies of 32 ETGs (93 per cent of which are at $z<0.03$) using quantitative parameters (concentration, asymmetry, clumpiness and the Sérsic index), calculated via deep UV and optical images with similar resolution. Regardless of stellar mass, UV-optical colour or the presence of interactions, the asymmetry and clumpiness of ETGs is significantly larger (often by several orders of magnitudes) in the UV than in the optical, while the UV Sérsic indices are typically lower than their optical counterparts. The ubiquitous presence of structure demonstrates that the UV flux across our entire ETG sample is dominated by young stars and indicates that star formation exists in all ETGs in the nearby Universe.		

ASI2025_221	Dweepsa Das	Poster
Galaxies and Cosmology		
X-ray and Sunyaev-Zeldovich Studies of AGN Feedback		
AGN feedback has long been known to have a significant impact on galaxy evolution. In this work, we use the Illustris-TNG simulations to study the effect of AGN feedback on the intergalactic medium (IGM) and the intra-cluster medium (ICM) by estimating the Sunayaev-Zeldovich (SZ) and X-ray properties of gas in the vicinity of AGN. The SZ signal and X-ray emission offer complementary probes for the thermodynamic properties of IGM. From the theoretical 2D projection of the SZ and X-ray maps, we propose to compare our simulation with the equivalent results obtained from SIMBA (Kar Chowdhury et al. 2022, Chakraborty et al. 2023) and develop a theoretical template for extracting cross X-ray-SZ signals from cosmological volume simulations and utilizing them for interpreting current and future observations.		

ASI2025_126	Gaurav Gawade	Poster
Galaxies and Cosmology		
Investigating Dual AGN/SMBH: A Study of Dual AGN Mrk739 in High Energy Astrophysics		
Active Galactic Nuclei (AGN) are energetic centers of galaxies, driven by supermassive black holes (SMBHs). While each galaxy typically hosts one AGN/SMBH, recent observations indicate the possibility of galaxies containing dual AGN/SMBHs. These dual systems arise from the collision or merger of massive galaxies, resulting in dual AGN that can sometimes evolve into compact configurations known as binary AGN. Binary AGN are gravitationally bound dual AGN systems, which, in later stages, can emit gravitational waves. This study focuses on the image analysis of dual AGN. Our primary target is the dual AGN system Mrk 739 (Markarian 739), where we aim to gain deeper insights into its properties using data from Swift, NuSTAR, XMM-Newton, and Chandra observatories. The study involved image analysis to estimate the projected angular separation between the two AGN. We conducted a comparative analysis of the observatories' capabilities and their contributions to the study of dual AGN, with a focus on the dual AGN Mrk 739. Our findings estimate the projected nuclear separation of the dual AGN in Mrk 739 to be about 3.6 kpc. This research also discusses other prominent dual AGN systems and candidates, particularly the well-documented binary AGN, NGC 6240. By utilizing a multifaceted approach, we not only advance our understanding of dual AGN but also contribute to the broader field of galactic dynamics. This work lays the foundation for future studies aiming to identify and analyze more dual (and multiple) AGN systems, potentially unveiling further insights into galaxy evolution and dynamics.		

ASI2025_711	Gourab Giri	Poster
Galaxies and Cosmology		
Bridging Simulations & Observations: Insights into Large-Scale Environments and the Radio Galaxy Origins		
In a limited fraction of extragalactic jets, a captivating phenomenon manifests as they deviate from their straight-line trajectories, forming mirror-symmetric (TAILED) and inversion-symmetric (WINGED) structures. The complexity deepens with the discovery of resembling galactic microquasars. Extended jets that follow a straight-line trajectory, in certain circumstances, grow to giant scales (GRG), reaching the edge of the large-scale structures they inhabit. The origins of these distinct geometries remain intensely debated, especially with present-day observations challenging prior predictions. In this context, my works focus on modeling these sources using recently developed tools to unravel their topological origins. It examines the intricate interconnection of jet morphology with their ambient environment alongside complex processes within the central AGN. Emphasizing microscale processes, this investigation explores the impact of particle cooling and reacceleration on spectral and polarization maps, elucidating perplexing properties, e.g., anomalous spectral behavior in winged sources. This presentation thereby outlines novel scientific inquiries, and provides likely future directions for such jetted sources.		

ASI2025_542	Joseph P J	Poster
Galaxies and Cosmology		
Kernel dependence of the Gaussian Process reconstruction of late Universe expansion history.		
In this talk, I will discuss model-independent reconstruction of the expansion history of the late Universe. We use Gaussian Process Regression to reconstruct the evolution of various cosmological parameters such as H(z) and distance modulus of Type Ia supernovae using observational data to train the GP model. We look at the GP reconstruction of these parameters using stationary and non-stationary kernel functions. We examine the effect of the choice of kernel functions on the reconstructions. We find that non-stationary kernels such as polynomial kernels might be a better choice for the reconstruction if the training data set is noisy (such as H(z) data) as it helps to avoid fitting the error in the data. We also look at the kernel dependence of other cosmological parameters such as the redshift of transition to the accelerated expansion. This has been achieved by reconstructing the derivatives of the expansion history (H(z)) such as the deceleration parameter. We then compare the results with other datasets including the Type Ia supernova distance modulus.		

ASI2025_133	Kanan Virkar	Poster
Galaxies and Cosmology		
Probing primordial physics signatures in 21 cm signal using morphological statistics		
21 cm signal from the cosmic dawn and epoch of reionization, when detected, will provide information about the primordial universe and the physical processes that took place during this time period, such as formation of the first stars and ionizing sources, the rate of clustering of matter to form galaxies and subsequent structures. Using simulated 21 cm signal in this redshift range using the publicly available 21cmFAST code we probe the signatures of primordial physics on this epoch by using morphological statistics, namely, Minkowski functionals, Minkowski tensors and Betti numbers. Compared to the traditional power spectrum these statistics contain additional information since they are higher order statistics. In particular we study the signatures of a phase of particle production during inflation on the 21 cm signal.		

ASI2025_380	Kanishka Arora	Poster
Galaxies and Cosmology		
Understanding the large distance scale correlation between Metal Line Absorbers and Galaxies using Hydrodynamical simulations		
Understanding the distribution of gas around galaxies and its evolution over cosmic time is crucial to our knowledge of galaxy formation and evolution. Spectra of distant quasars offer a powerful tool to detect the intervening galaxies and intergalactic medium (IGM) via hydrogen and metal absorption lines. Recent studies have shown that strong, saturated metal absorption lines are effective tracers of enriched gas in and around galaxies, extending even to intra-group and cluster media. By combining deep imaging and spectroscopic surveys, we can now correlate metal absorption seen along the line of sight to quasars with foreground galaxies, allowing us to probe the extent of metal-enriched gas around these galaxies. We aim to reproduce these observational findings through semi-analytical and hydrodynamical simulations, focusing on the gas distribution around galaxies and the statistical properties of metal line absorbers. We will investigate how gas is distributed within galaxy halos and larger structures, and later analyze how this distribution evolves, leveraging simulations with known galaxy distributions and halo assignments. This approach will enable us to interpret the connection between galaxies and their surrounding enriched gas in unprecedented detail, helping to unveil the role of metal absorbers in tracing the cosmic web and galactic environments across different redshifts.		

ASI2025_398	Khushi Dixit	Poster
Galaxies and Cosmology		
Classification of Gravitational Wave Signals from LIGO Dataset		
The detection of gravitational waves has revolutionized astrophysics, providing a novel way to observe cosmic events such as binary black hole mergers and neutron star collisions. This project aims to develop a robust machine-learning model for classifying gravitational wave signals using the Gravity Spy dataset from Kaggle. The dataset contains 31,868 images divided into 22 categories, including both true gravitational wave events and various types of noise interference. Our objective is to accurately distinguish between genuine gravitational wave signals and noise, while minimizing false positives and missed detections. To address this, we designed a comprehensive preprocessing pipeline to manage class imbalance, ensuring that the model is trained on a representative sample of signals. We also applied feature extraction techniques to emphasize key waveform characteristics. Through extensive experimentation, deep neural networks (DNNs) were identified as the most effective approach for differentiating between noise and true gravitational wave signals. The model was evaluated using metrics like accuracy, precision, and F1 score, focusing on optimizing performance through careful tuning of parameters. In addition, the project explored real-time detection enhancements, essential for astronomers to observe cosmic events more quickly and with greater precision. Ultimately, transfer learning models were incorporated to further boost performance, leveraging pre-trained networks to refine the classification of gravitational waves. This work not only advances automated gravitational wave classification but also lays the groundwork for improving real-time detection systems, which is critical for the growth of multi-messenger astrophysics.		

ASI2025_39	Milind Sarkar	Poster
Galaxies and Cosmology		
Multi-Wavelength Structural Parameter Analysis for 8 Million Galaxies in the Hyper Suprime-Cam Wide Survey		
Structural parameters for large numbers of galaxies, when determined simultaneously at multiple wavelengths, enable us to disentangle and understand the various physical processes involved in the formation and evolution of galaxies — e.g., understanding star formation and quenching across different environments. We use the Galaxy Morphology Posterior Estimation Network (GaMPEN) to estimate posterior distributions (i.e., values and uncertainties) for the bulge-to-total light ratio, effective radius, and flux of 8 million galaxies in Hyper Suprime-Cam (HSC) Wide survey. We determine the structural parameters in the g, r, and i-bands of HSC and include galaxies with z<0.75 and m<23. GaMPEN had been used previously to estimate structural parameters using imaging at single wavelength bands. With this work, we demonstrate that GaMPEN can be effectively used to perform a multi-wavelength structural parameter analysis. We are currently using this catalog to study the variation of star formation in bulges and disks across the wide variety of environments included in HSC-Wide. In the summer of 2025, we will be publicly releasing our entire catalog of multi-wavelength structural parameters.		

ASI2025_556	Narendra Nath Patra	Poster
Galaxies and Cosmology		
AGNs in dwarf galaxies		
Feedback is likely to play an essential role in the evolution of dwarf galaxies. Only stellar feedback processes have been thought to be active in dwarf galaxies, as large AGNs were seen to be hosted only by larger galaxies. However, recent observations identified a considerable number of dwarf galaxies with AGNs; hence, the AGN feedback processes could be important for the evolution of dwarf galaxies. These AGNs are primarily identified and studied using optical spectroscopic observations, with almost no radio observations. In this work, we present low-frequency, multi-band uGMRT observations of four AGN-hosting dwarf galaxies (J0100-01, J0906+56, J0954+47, and J1005+12), known for their bright and fast gas outflows. We detect radio emissions from AGNs in these galaxies and also observe potential jet-ISM interactions through HI observation in two of them. In this presentation, I will discuss the radio signatures of the low-powered AGNs in dwarf galaxies and their impact on the evolution of dwarf galaxies through feedback in the ISM.		

ASI2025_148	Narendranath Layek	Poster
Galaxies and Cosmology		
Investigating the temporal and spectral behavior of the Seyfert 1.5 AGN Mrk 6.		
We present an extensive temporal and spectral study of the Seyfert 1.5 AGN Mrk 6 using 22 years (2001–2022) of observations from XMM-Newton, Suzaku, Swift, and NuSTAR observatories for the first time. From the timing analysis, we found that the source exhibited variability of below 10 per cent for the shorter time scale (∼60 ks) and above 20 per cent for the longer time scale (∼weeks). A complex correlation is observed between the soft (0.5–3.0 keV) and hard (3.0–10.0 keV) X-ray bands of different observation epochs. This result prompts a detailed investigation through spectral analysis, employing various phenomenological and physical models on the X-ray spectra. Based on the overall results obtained from X-ray spectroscopy, we found that the nature of the Compton cloud changed with time. Although Mrk 6 displays characteristics of a changing-look AGN from optical observations, our X-ray spectral analysis did not show any significant variation in the X-ray (Lx∼10^42 erg/s) and Eddington ratio (λEdd∼0.008) over a period of 22 years 22 years. This indicates that in the X-ray regime, the source did not change its behaviour during the observational period. We observed a complex variable structure of the obscuring absorber of Mrk 6, with two distinct types of partial absorbers: one neutral and the other ionized. The partially ionized absorber displays a dynamic behaviour characterized by a rapid change in its location. The neutral absorber, situated at a considerable distance from the central engine, remained relatively stable. Our long-term X-ray study of Mrk 6 provides valuable insights into the dynamic behaviour of the Compton cloud and the overall spectral characteristics of this changing-look AGN. It highlights the complexity of the obscuring material in the vicinity of the supermassive black hole.		

ASI2025_717	Nasmi S Anand	Poster
Galaxies and Cosmology		
Exploring the Diffuse Emission in Low-Mass Galaxy Cluster : A Multifrequency Approach		
The hierarchical structure formation model proposes that cosmic structures evolve through the accretion of matter and mergers, ultimately forming galaxy clusters. To comprehend the evolution of the universe, it's vital to study the formation and evolution of these clusters. When a galaxy cluster with a mass of 10^{14}solar masses undergoes major or minor merging, it dissipates potential energy through various mechanisms, including heating the intracluster medium (ICM), generating shock waves, inducing turbulence, and gas sloshing. These shock waves and turbulence can accelerate or re-accelerate electrons and protons, which then emit radio waves via synchrotron radiation when interacting with magnetic fields, exhibiting steep spectra (α<−1). Such emissions can be observed in the MHz to sub-GHz range and manifest as radio halos and relics in disturbed clusters, as mini-halos in relaxed clusters, and as radio phoenixes which can be present in both relaxed and disturbed clusters . Studying these emissions aids in understanding the evolution of magnetic fields and the particle acceleration mechanisms during mergers. The main theories for the acceleration of cosmic particles responsible for synchrotron radiation are turbulent and shock acceleration mechanisms or the hadronic origin of secondary particles. Increasing the number of observed diffuse emissions will enhance the statistical robustness of these theories. In the past, research has primarily focused on high-mass clusters (M>5*10^{14}solar mass) due to the limitations of earlier instruments. However, the uGMRT, with its extensive coverage area, offers exceptional sensitivity and resolution. Here, we have used archival data from the uGMRT band-3 observations of galaxy clusters along with their complimentary observations at MeerKAT L-band, ASKAP-low and TGSS archival images. We will present an update on one particularly interesting source of Abell 13 galaxy cluster with results both in radio and x-ray wavelengths.		

ASI2025_109	Pavan Khadekar	Poster
Galaxies and Cosmology		
Effect of cluster environment on the formation of Hybrid Morphology Radio Sources		
The sharp boundary in the Fanaroff-Riley classification of radio sources arising from AGN has been blurred by recent observations using LOFAR, MeerKAT, uGMRT, and JVLA. These high sensitivity and high resolution observations have shown that some FR I and FR II sources have luminosities on the wrong side of the dividing line. The existence of a set of sources – Hybrid Morphology Radio Sources (HyMoRS) – containing within them exhibiting FR I and FR II structures on opposite side of the same active nucleus makes the situation even more intriguing. We are studying a sample of HyMoRS selected from the MeerKAT Galaxy Cluster Legacy Survey (MGCLS) with (i) known spectroscopic redshift, differing from that of the redshift of the host cluster by no more than 1000 km s–1 (ii) angular size $>$4 arcmin (iii) declination range [0, –50] degrees , and (iv) located at different distances from the center of the cluster. Radio images of the sample using the GMRT and MGCLS are being used to investigate the influence of the environment on the morphology. Here, we present preliminary results of these observations.		

ASI2025_709	Prajnadipt Ghosh	Poster
Galaxies and Cosmology		
On the origin of X-shaped radio galaxies: dual/binary AGN?		
X-shaped radio galaxies (XRGs) are enigmatic radio galaxies showing two pairs of radio jets, unlike the normal radio galaxies with canonically one pair of radio jets. One hypothesis for this unusual structure is that the jets are launched by a pair of active supermassive black holes (SMBHs) or the secondary lobes are simply relics of a previous jet actively, possibly resulting from a galaxy merger. Such mergers can fuel gas accretion into SMBHs, potentially leading to the formation of dual or binary AGNs, depending on the separation of the nuclei. This makes such sources primary candidates for detecting gravitational waves. Binary or dual AGNs have significant implications for merger dynamics, star formation, and AGN-driven outflows, underscoring the importance of studying these systems. We examine the hypothesis that galaxy mergers contribute to the X-shaped morphology and explore the potential of XRGs hosting dual or binary AGNs using the largest existing dataset of known X-shaped radio galaxies. Through emission-line fitting supported by our Very Long Baseline Interferometry (VLBI) observations, we have identified 39 AGNs with dual peaks and X-shaped morphology, positioning them as ideal candidates for binary black hole systems. The results warrant future multifrequency VLBI observations to ascertain whether these sources indeed contain binary AGNs.		

ASI2025_741	Pranjal Chaturvedi	Poster
Galaxies and Cosmology		
Study of ELAIS N1 deep field using UVIT		
The young massive stars are very bright sources of UV photons in early galaxies. The UV photons are emitted by heating up the surrounding gas to extremely high temperatures. This makes the UV photons a very good tracer for determining Star Formation Rate in the early universe. In deep fields, the UV photons from AGNs appear the same as UV photons from young massive stars. One important aspect of this study is to separate Active Galactic Nuclei (AGNs) and Star Forming Galaxies (SFGs). To achieve this, we use multiwavelength data and photometric redshifts of the deep field. The UV data of the multiwavelength observation was taken from Ultraviolet Imaging Telescope (UVIT) aboard the AstroSat. SDSS DR18 data for optical observations, IRAC SWIRE data for infrared observations and uGMRT data for radio observations. Here, we present the latest results from the radio and UV observations of ELAIS-N1 field done with uGMRT and ASTROSAT-UVIT. We show the analysed deep field in UV observations and present the catalogue of the sources. Using the catalogue we have performed the classification of SFGs and AGNs. We also derived the Star Formation Rate (SFR) using FUV data and the global SFR by performing SED fitting. The extinction-corrected SFR is derived at FUV wavelengths. These will be compared to different SFR derived from IR and radio in future studies, preliminary results will be presented.		

ASI2025_613	Prasun Machado	Poster
Galaxies and Cosmology		
New structures in radio galaxies with RAD@home Citizen Science		
Radio galaxies demonstrate varied morphologies when relativistic jets, which are launched by accretion on to super massive black holes (SMBH), interact with the surrounding circumgalactic or intra cluster medium. Jets expanding outwards experience various processes like lateral ram pressure, vorticity and turbulence. Most of these morphologies can be easily classified as FR I, FR II, XRG, DDRG, WAT, NAT ,etc. Here, we present four unusual morphologies which do fall out of the standard categories of radio galaxies. They have been identified from the low frequency surveys like the LoTSS with LOFAR and TGSS with GMRT. (1) An unusual "collimated synchrotron thread (CST)" of linear size ~ 600 kpc was observed. It's the third ever found CST, as per our literature survey. (2) We observe a rare doughnut-shaped swirl/ring at the end of linear radio filament. The linear size of this ring is ~ 90 kpc. (3) A radio jet "burl" is observed, at one of the lobes of an edge brightened FR II structure. The linear size of this burl is ~50-75 kpc. The "burl" is neither located at the extreme tip of the lobe nor near the core. The structure of this "burl" is very compact but different from U-shaped kinks (4) A diffuse blob of linear size ~420 kpc was observed at the northern side of a double lobed radio galaxy. Structure and alignment suggest it to be a relic lobe however the southern relic lobe counterpart is missing. We are presenting these four radio sources with an analysis based on multiwavelength data and the process of discovery through citizen science research collaboratory approach.		

ASI2025_417	Pratik Lonare	Poster
Galaxies and Cosmology		
The Globular Cluster System of NGC 5018 Galaxy Group Using Deep, Multi-band Optical Imaging From The VST Telescope		
Globular clusters (GCs) are compact stellar systems that trace galaxy formation and evolution, revealing key characteristics of their host galaxies. However, photometric studies of extragalactic GCs often face challenges from contamination, limited field coverage, and lack of multi-passband data, complicating the acquisition of complete, accurate samples. This work presents an analysis of the GC system in the NGC 5018 galaxy group using deep, multi-band data from the VST Elliptical GAlaxies Survey (VEGAS). Through advanced tools and techniques developed for GC identification in large-scale optical imaging, we confirm prior findings that NGC 5018, the brightest member in the group, hosts a relatively poor GC population. The 2D GC distribution map reveals a large intra-group GC population that aligns with bright galaxies and the intra-group light. The Radial GC density profile of NC 5018 shows an excess at a radius corresponding to a transition in diffuse light components, aligning with a nucleated low-surface brightness galaxy, likely an Ultra-Diffuse Galaxy candidate. This alignment, along with an observed GC plume extending from NGC 5018, suggests tidal interaction between these two galaxies. While other bright galaxies in the group lack significant GC populations, the radial profiles of NGC 5022 and NGC 5006 hint at GC systems blending into the intra-group population at large galactocentric radii. The GC color distribution in NGC 5018 lacks the typical bimodality; however, this feature appears in the intra-group population, with blue GCs extending further than red, suggesting tidal dispersion. Our findings provide important insights into the NGC 5018 group evolutionary history, highlighting the importance of extragalactic studies in understanding galaxy formation. This work sets the stage for future studies with Euclid and the Legacy Survey of Space and Time, which will offer deeper insights into galaxy assembly in the Local Universe.		

ASI2025_475	Preeti Kharb	Poster
Galaxies and Cosmology		
Are Jets in Low Luminosity AGN the same as Jets in Radio Powerful AGN?		
The existence of jets in active galactic nuclei (AGN) at the lowest luminosity end is not fully established. When jet-like features are detected in high resolution radio telescope images, it still remains unclear if they are the same type of jets that are observed in radio galaxies or quasars. I will present observational results on "jets" in low luminosity AGN and discuss how similar or different they are from jets observed in the small minority of powerful AGN. These results are based on observations from a large range of radio telescopes going from VLBI arrays (VLBA, EVN, MERLIN) to the EVLA and GMRT which map spatial scales from milli-arcseconds to tens of arcseconds. The relationship between radio jets and emission-line gas will also be highlighted for the various AGN sub-classes, and whether this is the primary difference between different types of jets will be discussed.		

ASI2025_549	Protap Halder	Poster
Galaxies and Cosmology		
EFFECT OF DIPOLE MODULATION IN CMB IN ESTIMATING THE WEAK GRAVITATIONAL LENSING		
There is a clear indication of Cosmic Hemispherical Asymmetry (CHA) from the inferences of the data captured by both Planck Mission and WMAP. Basically, in one hemisphere there are more fluctuations in compare with other hemisphere in the observed CMB Maps. This indicates a clear statistical isotropy violation which can be incorporated mathematically by introducing Bipolar Spherical Harmonics with BipoSH Multipole L = 1 . This mode(L=1) is known as Dipole Modulation in CMB Temperature map. In the standard Cosmology, CMB Temperature is considered to be Statistically Isotropic which contains its complete information in the CMB Temperature power spectrum. CMB Temperature is redistributed due Weak Gravitational Lensing while it is evolving in time by the effects of distributed matters which are gravitationally interacting with CMB photons. In Standard Cosmology , Projected Lensing Potential field is also considered to be statistically isotropic which contains its complete information in the lensing power spectrum. In my project , I am working with the power law in Dipole Modulation which is scale dependent. BipoSH Spectra is the generalization of power spectra which includes statistical non-isotropy. We have calculated the corrections in the BipoSH Spectra while introducing both the CMB Temperature and Weak lensing to be statistically non-isotropic in general. In the general expression, we have used a specific case of isotropy violation which is Dipole Modulation to estimate the effect of it on Weak Lensing field. I have made some computations and got some results and this research is under progress. We hope we will better estimate the weak lensing field by doing the corrections which will be valuable for further research in the field where Projected Lensing Potential field will be used.		

ASI2025_209	Rahul Panchal	Poster
Galaxies and Cosmology		
The Circumgalactic Environment of a High HI Column Density Absorber at z = 0.614962		
Probing the circumgalactic medium (CGM) is expected to improve our un- derstanding of the missing baryons and metals problem at the galactic scale. Galaxies harbour a much smaller fraction of baryons than the expected value given by the cos- mological ratio Ωb/Ωm . They are also seen to possess a fraction of the metals they produce over their lifetime. Using a combination of HST /COS far-ultraviolet spectrum of a background quasar and V LT /MUSE integral field spectroscopic data, we study the as- trophysical origin of a high HI column density absorber at z ≈ 0.61 which seems to trace the extended gaseous envelopes of more than one galaxy at that redshift. By modeling the chemical and physical properties of the absorbing gas, and through comparisons of the morphology, orientation, SFR, stellar masses, and kinematics of the galaxies with the absorber properties, we present our conclusions on the most likely scenario responsible for the absorption.		

ASI2025_687	Rahul Musale	Poster
Galaxies and Cosmology		
Neutral hydrogen gas and the unification scheme in compact radio AGNs		
In the orientation-based unification scheme, the dusty torus surrounding the central active galactic nucleus (AGN) obscures a direct view of the nucleus when the line of sight intersects it. In a sample of 85 compact steep- and peaked-spectrum radio AGNs (projected linear sizes < 20 kpc), we examined the unification scheme using the fraction of core radio emission as a statistical parameter for the orientation and HI 21-cm absorption properties to probe the neutral atomic hydrogen residing either in the torus or the interstellar medium. We find that the sources classified as Quasars have high core fractions, low HI detection rates, and column densities compared to those classified as high-excitation radio galaxies (HERGs). For HERGs the detection rate and HI column density increase with the increasing core fraction. We also find that sources classified as low-excitation radio galaxies (LERGs) have the highest core fraction, but HI absorption detection rates and column densities are higher than Quasars. We discuss these results in the context of the unification scheme. The compact sources are believed to reside in dense, inhomogeneous, and potentially asymmetric gaseous environments. Asymmetries could arise due to both the orientation effect and the inhomogeneous gas environment. We looked into asymmetry by estimating symmetry parameters such as lobe separation ratio, flux density ratio of lobes, and misalignment angle. We find no significant dependence of HI properties on symmetry parameters.		

ASI2025_258	Rahul Verma	Poster
Galaxies and Cosmology		
Star formation characteristics of dwarf galaxies hosting active galactic nuclei via SED fitting		
An important area of current research is the role of active galactic nuclei (AGN) activity in galaxy evolution. AGNs are known to have an impact on the galaxies that host them via a process called feedback. This feedback process can have an effect on the star formation characteristic of their host galaxies. The impact of AGN on their host galaxies has been extensively studied in massive galaxies that host AGN. However, much less is known currently about the prevalence of AGN in dwarf galaxies, and their potential role in driving galaxy evolution. Simulations also invoke supernova feedback in dwarf galaxies. Only very recently There is growing observational evidence of the presence of AGN in dwarf galaxies. While it is natural to expect the AGN in dwarfs to have an effect on the star formation characteristics of their hosts, similarities and differences, if any, on the impact of AGN on massive versus dwarf galaxies are unknown. In this work, we aim to characterise the impact of AGN on their host dwarf galaxies through spectral energy distribution fitting using CIGALE applied to UV to mid-infrared photometry of a sample of dwarf galaxies. The same exercise was also carried out on a control sample of dwarf galaxies without AGN, which had 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 about a factor of two lower that of dwarf galaxies without AGN. This suggests that the presence of AGN in dwarfs has a negative feedback effect on their hosts, with quenching of star formation in them. Details of the results will be presented.		

ASI2025_667	Rashmikanta Mantry	Poster
Galaxies and Cosmology		
Cosmological implications of the chain early dark energy model		
There is a tension between the Hubble constant values derived from observations of the early universe and those from the late universe. The early dark energy (EDE) models propose to relax the above tension by increasing the Hubble constant value obtained from the early universe observations. The EDE behaves as a slowly varying vacuum energy in the early universe. The energy density of EDE is initially negligible, then reaches the maximum around the matter-radiation equality, and then starts to dilute away after that. The Chain Early Dark Energy model is one of the models of EDE in which multiple phase transitions take place from a false vacuum to the nearest lower false vacuum by quantum tunnelling. In this work, we test the Chain Early Dark Energy model with cosmological observations.		

ASI2025_65	Reena Chaudhary	Poster
Galaxies and Cosmology		
Baryonic ecosystem around galaxies (BEINGMGII): Unveiling the Nature of Galaxies Harboring Cool Gas Reservoirs.		
Galaxy formation and evolution is tied to the physical state of gas in the circumgalactic medium (CGM) and its interface with the intergalactic medium (IGM), which is determined by the complex interplay between inflows from the IGM and galaxy feedback. Therefore, a comprehensive understanding of the physical conditions of gas within and surrounding galaxies is of paramount importance to understanding the physical processes that regulate galaxy formation and evolution. Numerous efforts to trace the diffuse gas seen in the quasar absorption line have revealed that intervening metal absorbers arise from multiple pathways, including gas inflows and outflows, the intragroup medium, and cool stripped gas from environmental processes. In particular, MgII absorbers, which trace cool, 10^4K, metal-rich gas, are frequently observed across a wide range of impact parameters, up to 200 kpc. However, the notion that the absorption is caused by galaxies at close impact parameters remains viable because it is highly challenging to find such faint galaxies in the glare of a bright background quasar. I will discuss the possible origin of intervening metal absorbers, the distribution of gas in the circumgalactic medium, and how it relates to the absorber properties in general over a wide range of redshifts of $0.4 < z < 1.0$ and stellar masses from on our recent efforts based on SDSS survey and imaging data from DESI Legacy Imaging Surveys.		

ASI2025_641	Renu Devi	Poster
Galaxies and Cosmology		
Understanding the role of stellar bar in quenching star formation in galaxies		
Around two-third of disk galaxies host bars. In their later stages of evolution, bars can suppress star formation in the central regions of disk galaxies leading to internal quenching. Our aim is to understand the mechanisms of bar-driven quenching by studying barred galaxies (redshift < 0.06) at various stages of star formation (within the bar region) and evolutionary phases. Using spatially resolved UV-optical color maps , (NUV-r) color radial profiles & SED fitting, our goal is to infer the role of the bar in halting star formation. We analyze a sample of around 30 centrally quenched barred galaxies and find that the internal regions exhibit redder colors (NUV-r > 4 mag, indicating the age of stellar population in these regions to be older than >1 Gyr) and are quenched up to the bar length with their disks to be bluer in color establishing a direct link between the presence of the bar and internal quenching. Most barred galaxies in our sample host pseudo bulges and do not host AGN, indicating that the most probable reason for the internal quenching of these galaxies is the action of stellar bar. Additionally, we compare our findings with two control samples: star-forming barred galaxies and fully quenched barred galaxies, which evidently signify the role of the bar in internal quenching. Our results suggests that bars in their later stages of evolution turn the inner regions of galaxies redder, leading to quenching, with the effect being most prominent up to the ends of the bar and creating a region dominated by older stellar population. This may occur because bars have already funneled gas to the galactic center and the period of intense star formation is over. Individual galaxies from the above sample are further examined with deeper multiwavelength data providing a more comprehensive view of their star formation histories and structural evolution.		

ASI2025_392	Robin Thomas	Poster
Galaxies and Cosmology		
Investigating the role of interaction events in galaxy evolution		
Interaction between galaxies significantly influence their evolution, particularly affecting ongoing star formation in spiral galaxies. Interacting galaxy pairs are ideal for exploring these impacts. We study a sample of interacting galaxies in field environments at various interaction stages and are nearly face-on: NGC 1512/1510, NGC 2207/IC 2163, NGC 4017/4016 and NGC 7753/7752. Using the UltraViolet Imaging Telescope (UVIT), we identified and analyzed star-forming regions in these galaxies, correlating these areas with neutral hydrogen (HI) distribution. Our analysis reveals localized enhancements in star formation surface density, aligned with HI distortions, likely indicating the influence of past and ongoing interactions on the star formation characteristics in these galaxies. We found convincing proof of the combined secular and environmental actions that contributed to the evolution of NGC 1512. We also found that galaxies in our sample exhibit an SFR enhancement on the global scale. We expanded our study to a broader sample of interacting galaxies to understand if such enhancements hold true for a wider sample of interacting galaxies. We observed a moderate increase in star formation rate (SFR) with interaction class, reaching a peak enhancement factor of 1.8 in galaxies classified as mergers. We examined how SFR enhancement varies with pair mass ratio and pair separation. We observe a strong anti-correlation between the SFR enhancement and pair mass ratio and no linear correlation between the enhancement and pair separation, implying that while pair separation may limit SFR enhancement, mass ratio plays a more influential role. With this study, we present a comprehensive framework to understand the role of interaction in galaxy evolution. References: Robin et al. (2024a, b)		

ASI2025_137	Romeo Pallikkara	Poster
Galaxies and Cosmology		
Ultraviolet Luminosity Function of Very High-Redshift Galaxies Using James Webb Space Telescope		
The luminosity functions of high-redshift galaxies offer critical insights into early galaxy formation, star formation efficiency, and the progression of hydrogen reionization. We are studying the evolution of the ultraviolet galaxy luminosity function from redshift 7.5 to 15 using photometric and spectroscopic data from the James Webb Space Telescope (JWST). Our analysis utilizes archival images from the JWST Near-Infrared Camera, covering 7 wavebands across a 90-square-arcminute area of the sky. We identified ~51 galaxies within the redshift range $7.5 < z < 8.5$ through Lyman break selection, with redshifts confirmed via spectral energy distribution fitting to photometric data. To measure the luminosity function, we applied completeness corrections across all observed fields, using injection-recovery simulations to account for observational limitations and biases. Where available, some photometrically selected galaxies were cross-referenced with NIRSpec spectroscopic data for validation. Using our measured luminosity function, we estimated a star formation rate density consistent with recent studies. Building on this, we plan to extend our analysis to even higher redshifts, up to $z = 15$, to explore the evolution of the galaxy luminosity function, star formation rate density, and their influence on hydrogen reionization.		

ASI2025_506	Sachindra Naik	Poster
Galaxies and Cosmology		
Properties of a low-mass active galactic nucleus UGC 6728		
We performed a comprehensive analysis of data from 15 years of X-ray observations of a low mass bare AGN, UGC 6728. Our study encompasses both spectral and temporal aspects of this source. The spectral properties of this source are studied using various phenomenological and physical models. From our study, we conclude that (a) the observed variability in X-ray luminosity is not attributed to the hydrogen column density N_H as UGC 6728 exhibits a bare nucleus, implying a negligible N_H contribution along the line of sight, and (b) the spectral slope in the X-ray band demonstrates a systematic variation over time, indicating a transition from a relatively hard state to a comparatively soft state. We propose that the underlying accretion dynamics around the central object account for this behavior. By performing X-ray spectral fitting, we estimate the mass of the central supermassive black hole in UGC 6728 to be 7.13 +/- 1.23 x 10^5 M_Sun. Based on our spectral and temporal analysis, we suggest that UGC 6728 lacks a prominent Compton hump or exhibits a very subtle hump that remains undetectable in our analysis. Furthermore, the high-energy X-ray photons in this source are likely to originate from the low-energy X-ray photons through inverse Compton scattering in a Compton cloud, highlighting a connection between the emission in two energy ranges. We noticed a strong soft excess component in the initial part of our observations, which later reduced substantially. This variation of soft excess is explained in view of accretion dynamics.		

SI2025_565	Sameer Salunkhe	Poster
Galaxies and Cosmology		
Unveiling a Cosmic Giant: First uGMRT Detection of a Radio Megahalo in Galaxy Cluster PLCKG287.0+32.9		
This study reports the first detection of a radio megahalo in the massive merging galaxy cluster PLCKG287.0+32.9, using deep, wide-band uGMRT observations at 300-850 MHz. The cluster exhibits a complex array of diffuse radio emissions, including a large radio halo, two relics, and filamentary structures, which provide insights into the dynamics of merger-driven particle re-acceleration. These sensitive observations reveal the radio halo extending to $\sim$ 3 Mpc, doubling the previously known extent and reaching the cluster's R500 radius along an intergalactic filament. The radial surface brightness profile shows the halo is two component halo - inner component is typical giant radio halo and outer one is megahalo, both possibly energised by merger induced turbulence. These findings represent the first megahalo detection at frequencies above 144 MHz, paving the way for further high-frequency studies to enhance our understanding of the origins and evolution of megahalos in merging galaxy clusters. Along with this, the detected relics exhibit asymmetric positions relative to the cluster centre, with the northern relic showing an unusual "inverted" structure, spectral steepening on both sides, and signs of re-energised plasma from a nearby radio galaxy. This relic's atypical orientation and spectral features likely result from an in-falling substructure bending the outgoing shock inward, as suggested by optical studies identifying substructures within the cluster.		

ASI2025_578	Sana Begum Shaikh	Poster
Galaxies and Cosmology		
Galaxies in Dense Cluster Environment		
We calculated the Stellar Mass Functions (SMF) of the field galaxies and cluster galaxies to see the impact of the cluster environment on the galaxy evolution. SMF is the number density of galaxies as a function of their stellar masses, it depends on factors such as the galaxy's redshift and environment, whether it resides in a field or a cluster. To study the effect of the environment on the SMF of galaxies we used the galaxy data set containing around 31 million galaxies from KiDS+VIKING-450 (KV450) covering ∼341 deg sq. area distributed over five patches on the sky and the cluster data from the eFEDS survey with coverage of ∼140 deg sq. area. eFEDS overlaps with one of the five patches of KV450 called G9, from this overlap we defined cluster galaxy samples for a total of 105 clusters with redshifts ranging from (0.385, 0.8) as they have KV450 galaxy coverage within 5R500, we considered the galaxy as a part of a cluster if it's within the cluster-centric radial bin and cluster redshift range z±Δz. We calculated the SMF of KV450 using the 1/Vmax method (Schmidt 1968) at different redshift bins and observed the shape of the SMF. We estimated the cluster volumes by creating the HEALPix map of the surveys. Using the cluster volume calculated the SMF for cluster galaxies in two redshift bins considering the median redshift within different cluster-centric radial bins and compared to quantify the environmental effect on SMF of cluster galaxies as we move away from the cluster center, also calculated the SMF by dividing the clusters depending on their masses and luminosity to see the effect of cluster's total mass and luminosity on cluster galaxy SMF.		

ASI2025_531	Sandeep Kumar Kataria	Poster
Galaxies and Cosmology		
How do the successive buckling events affect a galaxy bar and stellar disc? Potential observables for spotting buckling		
Until now, observations have caught up only a handful of galaxies in ongoing buckling action. Interestingly, N-body simulations over the past several decades show that almost every bar buckles or vertically thickens as soon as it reaches its peak strength during its evolution and leads to box/peanut/x (BPX) shapes. In order to understand the effect of multiple buckling events on the observable properties of galactic bars and discs, we perform an N-body simulation of a Milky Way-type disc. The axisymmetric galaxy disc forms a bar within a Gyr of its evolution and the bar undergoes two successive buckling events. We report that the time-spans of these two buckling events are 220 Myr and 1 Gyr, which have almost similar strengths of the bending modes. As a result of these two buckling events, the full lengths of BPX shapes are around 5.8 and 8.6 kpc, which are around two-thirds of the full bar length at the end of each buckling event. We find that the first buckling occurs at a smaller scale (radius ~ 3 kpc) with a shorter time-span affecting the larger length-scales of the disc, which is quantified in terms of changes in m=2 and m=4 Fourier modes. While the second buckling occurs at larger scales (radius ~ 6 kpc) affecting the inner disc the most. Finally, we provide observable kinematic signatures (i.e. quadrupolar patterns of the line-of-sight velocities), which can potentially differentiate the successive buckling events.		

ASI2025_286	Satyapriya Das	Poster
Galaxies and Cosmology		
Impact of AGN Feedback on Star-formation: A Multiwavelength Study of NGC 4258		
NGC 4258 (M106) is a Seyfert 1.9 SAB(s)bc type galaxy, distinguished by its striking dual spiral arms extending in a north-south orientation. Multi-wavelength observations have revealed two additional “anomalous” arms that begin aligned in the north-south direction but curve northeast and southwest, displaying bifurcations in both X-ray/radio wavelengths. In this work, we use multi-wavelength data to understand the impact of AGN feedback on the star formation and ISM in the galaxy. We use AstroSat/UVIT observations to estimate the star-formation rates and stellar ages of the star-forming regions across the galaxy. Furthermore, we employ the JWST IR data to investigate the spatial distribution and kinematics of molecular/ionised gases and PAHs in the galaxy. In this poster, we present the results from a comprehensive multi-wavelength assessment of the dynamic interplay between star formation and AGN in NGC 4258.		

ASI2025_89	Shreya Pithva	Poster
Galaxies and Cosmology		
Systematics of the Multi-Frequency Properties of Accreting Supermassive Black Holes in the Local Universe		
Supermassive black holes (SMBHs), with masses over 10^6M⊙ (where M⊙ represents the Sun’s mass), tend to reside in the centres of most galaxies and understanding their physics is essential to our understanding of galaxy evolution. A significant characteristic of SMBHs is the M−σ relationship, i.e., the correlation of the SMBH mass (M) with the stellar velocity dispersion (σ) of the bulge of the host galaxy. This empirical relation suggests a profound connection between black hole growth and galaxy growth, implying co-evolutionary processes that drive the formation of both the galaxy’s bulge and its central SMBH. Accreting supermassive black holes (ASMBHs or Active Galactic Nuclei-AGN), i.e., SMBHs that are actively drawing in mass from their surroundings, adhere to similar scaling relationships. During accretion, ASMBHs release intense radiation and powerful outflows, influencing the host galaxy by regulating star formation and gas dynamics, potentially reinforcing the M−σ relationship. Application of the Baldwin, Phillips & Terlevich (BPT) diagnostics to the analysis of the emission lines can be used to discern the ionization processes in galaxies with ASMBHs, highlighting how SMBHs influence the overall galaxy characteristics, especially in the circumnuclear environment. Our current work investigates about 130 galaxies with ASMBHs at redshifts less than 0.02 that have spectroscopic images of their circum-nuclear environments obtained using an Integral Field Unit. Using multi-frequency and multi-scale follow-up data, we examine the relationship between galaxy morphology, gas excitation, star formation, and the characteristics of their synchrotron jets. This analysis aims to enhance our understanding of the mechanisms driving SMBH scaling relationships and the role of feedback mechanisms in shaping galaxy structure and evolution.		

ASI2025_237	Silpa Sasikumar	Poster
Galaxies and Cosmology		
Event Horizon and Environs (ETHER) Database: Imaging Jet Bases in the Gold Sample		
Low-luminosity AGNs (LLAGNs) are characterized by low Eddington accretion rates, quasi-spherical accretion inflow in the innermost tens of gravitational radii (R_g), and bipolar relativistic jets launched within 100 R_g of the supermassive black hole (SMBH). LLAGNs vastly outnumber ordinary AGNs, making them vital for demographic studies of structures and physics in the innermost hundreds of R_g, as well as for measurements of BH masses, spins, and shadows. We are currently developing a curated database of potential LLAGN targets for the Event Horizon Telescope (EHT) and the next-generation Event Horizon Telescope (ngEHT) studies: Event Horizon and Environs (ETHER). Originally built for target selection, ETHER leverages the transformative science emerging from M87 and Sgr A* to inform demographic studies of the local SMBH population and potentially resolve more BH shadows. ETHER's large size (~4 million objects, with ~3 million having BH mass estimates), and extensive multi-frequency radio and X-ray flux data and SED information, make it valuable for a wide range of scientific goals. From this parent sample, we have identified a "Gold Sample" consisting of the largest SMBH rings with the brightest estimated EHT fluxes from their jets and accretion flows. This sample, which we have been monitoring using VLBA, GMVA, EHT, and ALMA, covers a range of BH masses, Eddington accretion fractions, jet powers, and orientations. It will help trace the merger and accretion history of SMBHs and their shadows, providing strong and unique tests of gravity. I will introduce the ETHER sample and present preliminary results from modeling the jet bases of the Gold targets. These models will help test theoretical models of jet physics, predict observable properties for ongoing and future EHT observations, test the limits of EHT capabilities, and assess the feasibility of near-future ngEHT observations.		

ASI2025_29	Sipra Hota	Poster
Galaxies and Cosmology		
Morphology and kinematics of young population in the Small Magellanic Cloud: Insights from UVIT/AstroSat		
The Small Magellanic Cloud (SMC) is one of the nearest gas-rich dwarf satellite galaxies, on its first passage around the Milky Way (MW). Its evolution is significantly influenced by interactions with the Large Magellanic Cloud (LMC) and the MW, particularly due to its much smaller dynamical mass compared to these larger galaxies. The SMC is characterized by active star formation in a metal-poor environment, and studying the SMC in the ultraviolet (UV) band is crucial for understanding its recent evolution amid these interactions. In this work, we present a catalog of ∼ 76,800 far-ultraviolet (FUV) sources observed towards the SMC using the Ultra Violet Imaging Telescope (UVIT) onboard AstroSat. From these observations, we compiled a catalog of ∼ 62,900 probable SMC members, which are primarily main-sequence, giant, and subgiant stars. We identified four young stellar populations (Young 1 (Y1), Young 2 (Y2), Young 3 (Y3), and Blue Loop (BL) stars) from the Gaia optical color- magnitude diagram to investigate the morphology and kinematics of the young population of SMC. These populations reveal a clumpy morphology characterized by a broken bar, a shell-like structure, and the inner SMC Wing. A two-dimensional kinematic analysis using proper motion (PM) data reveals that the Y2 and Y3 populations consist of two kinematically distinct sub-populations with low and high PM dispersion. In contrast, the Y1 and BL stars display two distinct groups with low PM dispersion. Notably, a kinematic disturbance is observed in the Right Ascension direction for stars younger than approximately 150 Myr in the eastern region, while no significant disturbance is detected along the declination. These findings provide valuable insights into models of LMC-SMC interaction.		

ASI2025_637	Sourav Das	Poster
Galaxies and Cosmology		
Etherington distance-duality relation using SN and BAO		
The Etherington distance-duality relation, relates the luminosity distance D_L and angular diameter distance D_A by redshift z such that D_L = D_A*(1+z)^2. This relation is derived purely under the assumptions of photon number conservation and a metric theory of gravity. In the absence of such non-standard mechanisms, the Etherington relation can be used to test for systematic errors in cosmological data. The luminosity distance D_L is obtained from Type-Ia supernovae, which serve as standardizable candles, while the angular diameter distance D_A is derived from Baryon Acoustic Oscillations (BAO). Recently the DESI collaboration has claimed a deviation of dark energy from a cosmological constant. In light of this, we present results on a test of the different Supernova and BAO data used in the DESI cosmological analyses.		

ASI2025_302	Sukanta Ghosh	Poster
Galaxies and Cosmology		
Evolution of Galactic Magnetic Fields and Scaling Relations in Radio Continuum		
Magnetic fields are ubiquitous in the universe, with galaxies hosting large-scale ordered magnetic fields and small-scale random fields, typically with micro-Gauss (μG) strength. Dynamo theory provides a theoretical framework for the amplification and maintenance of these magnetic fields. The dynamo mechanism depends on various galaxy properties, which vary significantly across galaxies and evolve with time, making it essential to consider these variations while studying their magnetic field evolution. A comprehensive understanding of galactic magnetic fields thus requires statistical analysis of large galaxy samples both locally and at high redshifts. For this study, we examine statistical scaling relations between galactic magnetic field observables and fundamental galaxy properties. By combining GALFORM, a semi-analytic galaxy formation model, with MAGNETIZER, a dynamo model that produces a 1D ISM model over millions of galaxies, we investigate the evolution of magnetic fields in galaxies from a statistical perspective. Our study focuses on synchrotron flux density (SI), a key observable linked to the emission from relativistic electrons spiralling around galactic magnetic fields, and its correlation with galaxy properties such as star formation rate (SFR) and rotational speed (Vrot) of the flat part of the rotation curve. We aim to generate theoretical predictions and synthetic data that can be directly compared to observations.		

ASI2025_644	Sumana Nandi	Poster
Galaxies and Cosmology		
A new population of DDRG: several episodes of jet activity in multiple directions		
For most double-double radio galaxies (DDRGs), two distinct pairs of radio lobes and their common central active galactic nuclei (AGNs) are aligned along the same axis. The change in the direction of the new restarted jets have been observed in the case of misaligned DDRGs. These DDRGs are small in number, but are important to study as they can be hosted by a merger system of supermassive binary black holes. Using high frequency and low frequency radio surveys, we identified a new sample of jet reorientation candidates characterized by 20 to 90 degree misalignment between the successive jet outflows. We carried out low and high frequency radio observations of these sources with GMRT, VLA and VLBI. The optical spectroscopy data were collected through the HCT and DOT and SDSS. The GMRT images detect extremely faint, outer lobes. VLA and VLBI images help to detect inner double structure and resolve central core. The estimated spectral indices, spectral age confirms their episodic nature. The emission line splitting in the optical spectra, the bulge disk decomposition of the host galaxy indicates the possibility of merger of the host. The radio structure, applied kinematic jet precession model, variation of the flux density, and spectral shape can potentially be consistent both with the signature of a young radio source or a binary black hole at the center of these sources. Our study revealed that the misaligned DDRG population may represent the pre-merging stage where two nearby black holes interact at small separation due to dynamical friction. While the DDRGs with linear outflow are in the post merging stage.		

ASI2025_514	Suraj Kumar Pati	Poster
Galaxies and Cosmology		
Cosmological Dynamics and Accelerated Expansion in Starobinsky-Type Metric f(R) Gravity		
The discovery of accelerated expansion of the universe has become one of the most profound phenomena in modern cosmology. To account for this unexpected observation, two primary approaches are widely discussed in the scientific literature. The first approach involves postulating the existence of an unknown form of energy with negative pressure, referred to as "dark energy". But its nature and origin remain largely unknown and extend beyond the explanatory power of general relativity. The second approach seeks to explain accelerated expansion by modifying the fundamental theory of gravity itself. In this framework, alternative gravitational theories aim to account for observed cosmic acceleration without invoking dark energy. Due to the unresolved nature of dark energy, these modified gravity theories have gained attention as a promising alternative for explaining the accelerated expansion of the universe In the present work, we investigate the implications of the currently observed accelerated expansion of the universe on its evolution within the framework of power-law-based Starobinsky-type metric f(R) gravity. Particularly, our study focuses on the evolution of the universe through key cosmological parameters, such as Hubble parameter, deceleration parameter and jerk parameter etc. Our analysis reveals that the phenomenological constant M^2 in the Starobinsky model has a very small value of 0.6538t_0^(-2), where t_0 represents the current age of the universe. Additionally, we identify that the transition from a decelerated to an accelerated phase of expansion likely occurred around 0.711t_0. This accelerated phase is predicted to persist well into the distant future, with an increasing rate of expansion as suggested by the monotonic behavior of the jerk parameter. Our results provide insights into the cosmological dynamics governed by modified gravity, indicating that the universe's accelerated expansion will continue to evolve at an accelerating rate.		

ASI2025_560	Suryakanta Swain	Poster
Galaxies and Cosmology		
Effect of Interacting Dark Energy on the Evolution of Schwarzschild Black Hole in Loop Quantum Cosmology		
General theory of relativity and quantum theory are the two most successful and well trusted theories of modern physics. General theory of relativity provides the idea about gravitational force and its implication in cosmological scales whereas the quantum theory deals with the physics of matter in microscopic scales. None of these theories, however, can fully explain this complex issue, like the singularity problem, that arise in standard cosmology. In the present scenario it is often believed that quantum gravity theory plays a leading role to solve this above problem. Loop Quantum Gravity (LQG) is one of the unique features of quantum gravity theories. LQG is completely non-perturbative, explicit background independent approach to quantum gravity. Generally, implication of LQG on cosmology for the study of our universe is called as Loop Quantum Cosmology (LQC). On the other hand, a black hole is a region of space where the gravity is strong enough that not even light can escape from it and Schwarzschild black hole is the simplest kind of black hole, which is characterized by its mass only. In this work, we try to explain the evolution of Schwarzschild black hole by taking interacting dark energy approach in loop quantum cosmology. Our analysis predicted that in the theory of LQC, the evaporation time of a Schwarzschild black hole is quicker and hence its life span decreases in the presence of interacting dark energy. Again we have found that the accretion efficiency is ineffective in the interacting dark energy based LQC. Further, we have investigated the limits on black hole formation imposed by observed astrophysical constraints.		

ASI2025_512	Suvajit Sardar	Poster
Galaxies and Cosmology		
Decoding the morphology and kinematics of the neutral gas in the Sacred Mushroom collisional ring galaxy system		
Collisional Ring Galaxies (CRGs) are a rare class of galaxies that form when an intruder galaxy passes through the disk of the target galaxy, creating a characteristic ring-like structure. They are thus a result of galactic-scale drop-through perturbation experiments. The 21cm neutral hydrogen line (HI) is a powerful tracer that can probe the gas kinematics of the neutral phase spanning the interstellar medium (ISM), inner circumgalactic medium (CGM) and the intra-group medium (IGrM). The relatively simple interaction configurations of CRGs allow us to investigate how galactic interactions impact star formation, gas kinematics, morphology, and the larger baryon cycle shaping galaxy evolution. Yet, the study of HI in CRGs remains limited, leaving key questions about the large-scale changes that happen to their gas-star formation cycles unanswered. The MeerRings program using the SKA-mid-precursor, MeerKAT radio telescope, will perform the first census of the HI in a substantial sample of CRGs in the local universe. In this work, we present results from the HI study of the Sacred Mushroom CRG, which hosts a stellar disc that spans 40 kpc across the major axis. MeerKAT's unparalleled sensitivity and resolution enable us to map, for the first time, the distribution and kinematics of HI down to $\sim 3 \times 10^{19}$ cm^{-2} at $\sim$ 5.4 kpc spatial and $\sim$ 5.5 km/s spectral resolutions. Based on our resolved analysis of the gas morphology and kinematics, we present our hypothesis on how the galaxy interaction has led to the exchange of gas between the target galaxy and the intruder, and the subsequent ring formation resulting from the density waves triggered by the perturbation.		

ASI2025_445	Vaishali R	Poster
Galaxies and Cosmology		
Inference of our Local Motion from CMB Polarization - A Bayesian Approach		
The dipole is the biggest fluctuation observed in the Cosmic Microwave Background(CMB). This is caused by the motion of our frame, the observer frame. The aberration and modulation of the CMB photons due to our motion also introduces violation of Statistical Isotropy(SI) which can be seen in the non-diagonal covariance matrix of the signal. The correlations in the adjacent multipoles can be elegantly quantified by the dipolar spectra of the Bipolar Spherical Harmonics(BipoSH). In this work the covariance matrix along with the signal is inferred using Hamiltonian Monte Carlo(HMC) method, a Markov Chain Monte Carlo(MCMC) algorithm. We first do this on a simulated map and then extend the analysis to polarization data maps. This work is a first step in exploring the violation of SI in CMB polarization.		

ASI2025_287	Vijayakumar H Doddamani	Poster
Galaxies and Cosmology		
Slitless Spectroscopy of Nearby Milky Way Satellites Using Himalayan Chandra Telescope		
Multi-object spectroscopy is crucial for efficient satellite observations, optimizing telescope time usage. Telescopes lacking multi-slit or multi-fiber capabilities can employ slitless spectroscopy to cover wide fields of satellite galaxies. Slitless spectroscopy eliminates the need for traditional slitmasks and enables comprehensive spectroscopic examinations of all the sources within a field without significant pre-planning. Our study conducted slitless observations of nine nearby Milky Way satellite galaxies utilizing the 2-meter Himalayan Chandra Telescope - Hanle Faint Object Spectrograph and Camera (HCT-HFOSC). We experimented with various filter and grism combinations to mitigate one of the main drawbacks of slitless spectroscopy: the spectral overlap. We present a semi-automated Python routine to reduce the slitless data. Furthermore, we discuss the challenges and constraints of slitless spectroscopy using the 2-m class telescope of different observational configurations used in our study.		

ASI2025_696	VINEET OJHA	Poster
Galaxies and Cosmology		
Temporal and spectral variability in gamma-ray and non-gamma-ray detected Seyfert 1 galaxies: Insights from optical and infrared		
Variability across the electromagnetic spectrum is a hallmark of active galactic nuclei (AGNs), offering unique insights into their emission mechanisms on spatial scales that are currently inaccessible to direct imaging. This variability serves as a powerful diagnostic tool, revealing critical information about AGN physics, including the spatial and temporal structure of emitting regions, accretion disk dynamics, and the properties of the central supermassive black hole. This study presents a systematic investigation of flux and color variability in optical and infrared wavelengths for a redshift-matched sample comprising gamma-ray-detected Narrow-line Seyfert 1 galaxies (gNLS1s), non-gamma-ray-detected NLS1s (ngNLS1s), and a control sample of gamma-ray-detected Broad-line Seyfert 1 galaxies (gBLS1s). Utilizing multiband light curves from the Zwicky Transient Facility (ZTF) in the optical domain and the Wide-field Infrared Survey Explorer (WISE) in the infrared, we observe that both gNLS1s and gBLS1s exhibit significant variability over timescales ranging from days to years across both wavelength regimes. In contrast, ngNLS1s display minimal variability, even on extended timescales. Our high-cadence color variability analysis using ZTF data reveals “bluer when brighter” (BWB) and “redder when brighter” (RWB) trends in 20% of gBLS1s, while 53% of gNLS1s exhibit a BWB trend. Similarly, 43% of ngNLS1s display a RWB trend. In the WISE W1-W2 color variability analysis, we find that a small fraction (13%) of gNLS1s and 30% of gBLS1s show BWB trends, whereas a predominant fraction (93%) of ngNLS1s exhibit BWB trend. These findings point to distinctive physical mechanisms in each AGN class, which appear to influence their flux and color variability across wavelengths. We will discuss potential physical mechanisms driving the observed flux and color variability in gamma-ray- and non-gamma-ray-detected Seyfert 1 subclasses, providing a deeper understanding of the complex processes shaping AGN variability in the optical and infrared.		

ASI2025_571	Vishal Sanjay Kale	Poster
Galaxies and Cosmology		
Mechanical AGN feedback in RXCJ1558.3-1410 cluster and its connection with radio mini-halo		
Abstract This systematic study of a RXCJ1558.3-1410, cool core cluster based on X-ray and radio data aimed to investigate role of the AGN in the cluster environment. This analysis confirms a previously reported X-ray cavity at ∼ 36 kpc and reports a newly detected X-ray cavity at ∼ 42 kpc north-west of the X-ray peak. This analysis also identifies the presence of a cold front at ∼ 72 kpc and a sloshing arm, probably due to the minor merger. The surface brightness reveals a sharp edge at the location of the cold front and exhibits discontinuity in the temperature profile. The broken power law analysis confirms its association with the cold front. The mechanical power deposited in the form of X-ray cavities ∼ 6.0 ×10^44 erg s−1 is capable enough to heat the ICM and correlates well with the 1.4 GHz radio power, further compensating to offset radiative losses. Considering the morphological properties of the extended radio emission at 325 MHz, we classify RXCJ1558.3-1410 as a host to a radio mini halo. Key words: galaxies: clusters: individual: RXCJ1558.3-1410 X-rays: galaxies: clusters, galaxies: clusters: intracluster medium, radio continuum: general		

Posters in
Facilities, Technology and Data Science

ASI2025_638	Abhay Kumar	Poster
Facilities, Technologies and Data science		
Development of a 1-D position sensitive absorber for a Compton X-ray polarimeter		
The scientific potential of polarimetry has long been recognized, but due to the challenges in measuring polarization, the field, especially in hard X-rays, still remains largely unexplored. With the recent developments in detector technologies, it is, however, now possible to develop sensitive hard X- ray polarimeters. One such example is the Compton X-ray Polarimeter (CXPOL), a prototype developed at the Physical Research laboratory in India, which consists of a plastic scintillator as an active scatterer surrounded by CsI(Tl) scintillators in a cylindrical array with Si photomultiplier (SiPM) readout from one side. The sensitivity of the instrument can be improved significantly by the use of faster and better light yield scintillators like NaI as absorbers. Further, a position-sensitive scatterer surrounded by position-sensitive absorbers can also provide spectroscopic information by estimating the interaction position along the length and from the known energy depositions in the detectors. The measurement of the polar scattering angle also improves the polarimetric sensitivity of the instrument by reducing the systematic effects introduced by the off-axis events in the azimuthal distribution of photons. The main components of the absorber are 100x20x5 mm3 NaI(Tl) scintillator readout by an array of SiPMs at both ends working in co-incidence. We characterize an absorber and investigate the variation in energy, position resolution, and light yield with the change in the irradiation position along the length of the absorber and the reduction in SiPM noise in co-incidence. In this talk, I will present the first results of the position sensitive absorber design and discuss the experimental results in the context of improvement in the polarimetric sensitivity of the Compton polarimeter.		

ASI2025_703	Abhishek R	Poster
Facilities, Technologies and Data science		
FRB detection at low frequencies		
Detection of Radio transients such as the FRB is typically carried out using offline processing techniques. In upcoming instrumentation, such as the SKA and SPOTLIGHT, realtime processing using high-performance computing accelerators such as GPU is planned. Such transient searches at lower radio frequencies are still more complex due to the more significant DM-related delays. This paper will review the transient detection techniques used for the Fast Radio Bursts in the existing Radio telescopes worldwide and describe a novel soft-realtime (Analog and Digital) approach for detecting transients being planned at Gauribidanur Observatory using a new infrastructure. An FRB out trigger station is already being planned in the same Gauribidanur observatory that operates in a higher frequency range between 400 to 800 MHz. We planned to establish a trigger functionality to enable low-frequency follow-up capabilities between the 150-350 MHz band. This paper will outline the details of the detection techniques in both analog and digital domains using the existing and upcoming infrastructure in Gauribidanur.		

ASI2025_425	Akshay M S	Poster
Facilities, Technologies and Data science		
Studying cross-dispersion options for a near-infrared echelle spectrographs		
Near-Infrared Echelle Spectrographs with high spectral resolution (R~30000-60000) offers unique insights into several astrophysical phenomena. Several science cases like probing exoplanet atmospheres through transit spectrometry , observing YSOs and using radial velocity techniques for M-dwarf companions are some of the few science cases among many that can be uniquely targeted using near-infrared spectrographs. One of the main challenges of near-infrared echelle spectrograph design is finding the right cross dispersion elements to achieve the best slit size and fiber multiplexing in case of fiber based spectrographs. In this study we use Zemax and study the cross -dispersion with several configurations of single-pass prisms, double-pass prisms and Grisms. We use primarily infrared materials like ZnS and Fused Silica for these studies. We also explore using grism configurations to understand the best and simple model in various echelle configurations. This study will be useful for infrared spectrograph designers and is planned for use with our design of a near-infrared echelle spectrograph for HCT or DOT.		

ASI2025_588	Akshaya V G	Poster
Facilities, Technologies and Data science		
RFSoC-based digital 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 additive ripples in the Cosmic Microwave Background spectrum. 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 APSERa element 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 8 high-speed 12-bit ADCs, each capable of sampling at up to 4.096 GSPS, of which 2 ADCs are used for digitization of bandwidths of about 2 GHz. The correlation spectrometer is realized inside the RFSoC using 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. Complex Multiplier and Accumulator performs on-chip integration of the FFT spectra for about 16.77 ms to produce two autocorrelation spectra and one cross-power spectrum. This data is streamed via 1-gigabit ethernet to a laptop. In this talk, the architecture of the digital correlation spectrometer implemented on the RFSoC and the preliminary results from this digital receiver will be presented.		

ASI2025_686	Amirul Hasan	Poster
Facilities, Technologies and Data science		
Study of High-Efficiency Fore-Optics Design for the High-Resolution Optical Spectrograph (HROS) on the Thirty Meter Telescope		
The Thirty Meter Telescope (TMT) is expected to be one of the most powerful ground-based observatories of the next decade that is carefully designed to answer the pressing scientific questions of Astronomy. India plays a crucial role in the TMT project, contributing significantly to its development and taking the lead in designing the second-generation seeing limited High-Resolution Optical Spectrograph (HROS). This spectrograph, proposed based on a white-pupil design, incorporates both slit and fiber-fed options and spans a wavelength range of 310 nm to 1100 nm. With observing modes offering resolutions from 20,000 to 100,000, HROS stands out for its ability to capture emissions in the ultraviolet range, particularly valuable for studying hot stellar objects. HROS is uniquely designed to address a range of key science drivers, including stellar archaeology, inter- and circumgalactic medium (IGM/CGM) studies, exoplanet transit spectroscopy. Its ability to observe down to 310nm and the resolution range it offers, makes it a unique spectrograph in comparison to similar spectrograph designs, ArmazoNes high Dispersion Echelle Spectrograph (ANDES) at the Extremely Large Telescope (ELT) and the GMT-Consortium Large Earth Finder (GCLEF) at the Giant Magellan Telescope (GMT). HROS achieves various resolution settings solely through fore-optics modifications, eliminating the need for complex reconfigurations. This efficient fore-optics design enables high throughput, especially at UV wavelengths critical to HROS's objectives. This paper presents a detailed exploration of the current state of high-resolution spectrograph optics and presents an optimized fore-optics design configuration for HROS, enhancing its performance for challenging observations in the 310 nm regime.		

ASI2025_207	Arijit Maiti	Poster
Facilities, Technologies and Data science		
On-sky Characterization of ProtoPol: a medium resolution echelle spectro-polarimeter for PRL telescopes		
ProtoPol is a medium-resolution echelle spectro-polarimeter initially conceived as a prototype instrument for the currently under development M-FOSC-EP (Mt. Abu Faint Object Spectrograph and Camera-Echelle Polarimeter) instrument - a two-channel multimode instrument which is currently being designed for PRL 1.2m and 2.5m telescopes at Mt. Abu. Though ProtoPol was initially conceived to evaluate the development methodology of the spectro-polarimetric arm of M-FOSC-EP with commercially available off-the-shelf components, it was later elevated to the level of a full-fledged back-end instrument for PRL telescopes. ProtoPol was designed on the concept of echelle and cross-disperser gratings to record the cross-dispersed spectra in the wavelength range from 390 to 940 nm with a resolution ($\lambda/\delta\lambda$) in the range of 7000-8000. ProtoPol has been successfully developed and commissioned on PRL 1.2m and 2.5m telescopes since December 2023, and a variety of observations are being carried out for instrument characterization and scientific purposes. Observations of standard unpolarized stars conducted during on-sky characterization revealed an instrumental polarization of 0.1-0.2 %. ProtoPol achieved a spectral resolution of 7000-8000, with a polarimetric accuracy of $\delta P < 0.2\%$ for linear polarization. Preliminary results of the observed polarization profiles of Hα line for Be stars and the observed continuum polarization of red giant stars are also presented. A dedicated fully-automated spectro-polarimetric data reduction pipeline was developed to help in the analysis process of the spectro-polarimetric data. The pipeline takes raw echelle spectro-polarimetric data frames as input and gives the variation in polarization as a function of wavelength at output. The pipeline can be used for data-reduction of any such similar echelle spectro-polarimeters and/or echelle spectrometers. In this proposed talk, the speaker shall discuss the design and features, laboratory, and on-sky performance of ProtoPol along with the development of a dedicated echelle spectro-polarimetric data reduction pipeline.		

ASI2025_36	Chaitanya Rajarshi	Poster
Facilities, Technologies and Data science		
Design, assembly, integration, and laboratory testing of the WALOP-South Polarimeter		
The Wide-Area Linear Optical Polarimeter (WALOP)-South is the first optical-wavelength polarimeter with wide-field and survey capabilities. Set for commissioning in early 2025, it will be installed on the 1-meter SAAO telescope at South Africa's Sutherland Observatory to conduct the PASIPHAE sky survey. The PASIPHAE initiative aims to produce the first polarimetric sky map in optical wavelengths, covering over 2,000 square degrees of the southern Galactic region. WALOP-South's advanced design allows it to capture linear polarization (Stokes parameters q and u) in a single exposure, spanning a 35×35 arcminutes-squared field of view (FoV) with SDSS-r broadband and narrowband filters in the 500-750 nm range, and achieving a polarization accuracy of 0.1%. The instrument's ambitious objectives demand stringent engineering standards, particularly in the optical, polarimetric, optomechanical, and electronic subsystems, all of which have been carefully engineered to meet specific performance requirements. By September 2024, all optical and mechanical subsystems had been assembled and were undergoing testing and integration, with full lab-based testing and characterization expected to conclude by November 2024. In this paper, we discuss (a) the design and development of WALOP-South and its key subsystems, with a special focus on the opto-mechanical design, which has not been previously detailed, and (b) the lab-based assembly, integration, and preliminary results from its characterization process.		

ASI2025_321	Deekshya Roy sarkar	Poster
Facilities, Technologies and Data science		
Development of a Wide-Field Imager for telescopes at PRL Mt Abu Observatory		
The Wide-Field Imager System (WFIS) is an imaging system primarily for use with the 50cm telescope at PRL Mt Abu Observatory in Rajasthan. It has a 33 x 44 arcmin field of view on the 50cm telescope. It is equipped with 50x50mm square optical broadband (U, B, V, R, I) and a few narrowband filters with the possibility of using six filters at a time on a filter wheel. The camera and filter wheel are controlled using the INDI and Kstars software running on a Linux embedded compact mini PC. The system is designed to be a complete imaging solution to provide good photometric accuracy and is important for studies of science cases like comets, near earth objects, blazars among others. In this poster, we shall describe the instrument specifications, design, and some example observations of a few science cases and their results.		

ASI2025_617	Kapil Kumar	Poster
Facilities, Technologies and Data science		
Indigenous Innovations for Achieving Sub m/s Precision in High-Resolution Spectroscopy with PARAS-2		
Achieving the precision required to detect Earth- to super-Earth-sized planets via radial velocity (RV) measurements demands an accuracy range of 10–30 cm/s, which necessitates exceptional long-term instrument stability in high-resolution Doppler spectroscopy. This work introduces the optical and opto-mechanical design and implementation of a double scrambler integrated with octagonal fibers, developed for the PARAS-2 high-resolution spectrograph (R ~100,000) at the Physical Research Laboratory (PRL) in Ahmedabad. The scrambler delivers significant scrambling gains (SGs), ensuring uniform and stable slit illumination by minimizing input-induced illumination variations on the fiber output. Consequently, this innovation enhances the stability of the spectrograph's instrument profile, leading to improved Doppler precision. Additionally, the system is equipped with an Atmospheric Dispersion Corrector (ADC), utilizing counter-rotating prisms in the Cassegrain unit to counteract atmospheric dispersion effects. Operating successfully since May 2023, the ADC stabilizes RV accuracy under varying atmospheric conditions, advancing the capabilities of PARAS-2 for precise RV measurements in exoplanet detection. This development exemplifies India's technological advancements under the "Make in India" initiative, contributing significantly to high-precision astronomical instrumentation.		

ASI2025_483	Karthic Kumar	Poster
Facilities, Technologies and Data science		
Development of Metrology Station an XYZ gantry for the Sub Aperture Interferometer in Thirty Meter Telescope Project.		
This paper presents the design, development, installation, and testing of the Metrology Station—an XYZ gantry system developed to support a Sub-Aperture Interferometer, which performs surface frequency validations for the mirror segments of the Thirty Meter Telescope (TMT). TMT employs Stressed Mirror Polishing technology to polish its mirror segments, transforming spherical meniscus glass blanks into precise aspheric forms by applying forces around the mirror edges with warping arms and polishing under stress. Following this shaping process, the segments are cut into hexagonal forms, necessitating strict surface accuracy validation through metrology tools. The Sub-Aperture Interferometer plays a critical role in measuring mid-spatial frequency ranges from 50 mm to 80 mm, essential for these verifications. The India TMT Coordination Centre (ITCC) developed the XYZ gantry to support an interferometer weighing approximately 350 kg on a platform with a travel range of 2500 mm along the X-axis and 2000 mm along the Y-axis. This movement is powered by two synchronized servo motors on the Y-axis and one servo motor on each of the X and Z axes. Designed for high precision, the system provides an overall positioning accuracy of 50 microns and an incremental accuracy of 10 microns, achieved through optical encoders placed on both the X and Y axes. Fully programmable, the gantry includes a camera for aligning polished mirrors with respect to its axes and a pen on the Z-axis to make precise markings on the polished mirror required to perform the interferometric inspection, ensuring seamless integration and optimal performance for the interferometer inspection.		

ASI2025_204	Kevikumar A. Lad	Poster
Facilities, Technologies and Data science		
Mirror Coating Plant for PRL 2.5m Telescope		
Mirrors are the telescope's most critical components, serving as primary light-gathering elements. To enhance the light-gathering capabilities, mirrors for the ground-based telescopes are coated with a thin film of metallic layer. For our PRL 2.5m Telescope, primary and secondary mirrors are coated with a thin film of bare aluminium, which degrades over time after being exposed to the local environment for a long period of time. To address this issue, a new mirror coating facility has been developed and installed at the PRL Mount Abu Observatory for the 2.5m telescope, marking a significant milestone as the first of its kind in India under the MII (Make in India) initiative. This innovative facility was developed in collaboration with Hind High Vacuum Pvt. Ltd (HHV), Bangalore, employs the resistive-heating-based thermal evaporation technique, allowing for the coating to be carried out in the upward-facing mirror configuration for a 2.5m diameter mirror. This technological advancement ensures superior uniformity in deposition thickness across the mirror's surface, thereby enhancing performance.Furthermore, a dedicated mirror coating removal and cleaning station has been specifically developed for the 2.5m telescope mirrors. The facility became operational in October 2023. This achievement is a significant contribution towards maintaining the long-term excellence of the telescope mirrors. The first time re-coating of the primary mirror and secondary mirror of the PRL 2.5m Telescope was successfully performed with the plant in 2023. The quality of the thin film of bare aluminum coating on both mirrors indicates the successful operation of the plant. We will present the design and development of a thin-film mirror coating plant for a recently installed PRL 2.5m Telescope.		

ASI2025_325	Mahesh Dalavi	Poster
Facilities, Technologies and Data science		
End Item Data Package Management System (EMS) for Thirty Meter Telescope.		
As a key partner in the Thirty Meter Telescope (TMT) Project, the India TMT Coordination Center (ITCC) is responsible for the manufacturing, assembly, testing, and shipment of various telescope subsystems. These subsystems include M1CS Actuators (1526 units), Edge Sensors (3284 units), Segment Controller & Cabling (SCC) (9080 units), Segment Support Assemblies (SSA) (580 units), and Polished Mirrors (84 units). In addition to production and supply of hardware subsystems, ITCC is also tasked with delivering comprehensive documentation for each component, collectively termed as the End Item Data Package (EIDP). EIDP contains a range of critical documents, including Certificates of Conformance (COC) for raw materials, special processes, and bought-out items (BOI), as well as calibration certificates for all measuring instruments used in inspections, part inspection reports (IR), machine-generated IR, non-conformance reports, assembly logs, etc. All these documents received from vendors, gets reviewed by ITCC before submitting it TIOPO. To streamline EIDP management, ITCC has developed the EIDP Management System (EMS), an online tool that facilitates the upload, review, and tracking of each EIDP document. It automatically verifies IRs against the drawing requirements and flags error. Also the IRs are checked wrt the associated COCs and calibration certificates, indicating any issues with calibration expirations or incorrect COC entries. This helps vendors to catch dimensional non-conformances, typographical mistakes and issues with traceability during submission. EMS also allows ITCC members to review each document with an Accepted/Not Accepted response, streamlining the feedback loop. Once all documents are accepted, ITCC can access the complete EIDP with a single click. This system has decreased the time required for document review by approximately 90% and reduced the error percentage to nearly zero. In this paper I will provide an overview of the India-TMT EMS document flow, various login types, module details, tool performance and future scope.		

ASI2025_228	Mani Khurana	Poster
Facilities, Technologies and Data science		
DIOS: An Image Cleaning Method to improve MACE sensitivity		
Ground-based atmospheric Cherenkov telescopes play a crucial role in detecting very high energy (VHE) gamma rays, providing key insights into non-thermal energetic phenomena and the acceleration processes occurring under extreme astrophysical conditions. Detection of VHE γ ray photons is inherently challenging due to the presence of huge cosmic ray background. Cosmic ray background events can mimic gamma-ray signatures, making it difficult to distinguish true VHE gamma-ray signals. Therefore, it is critical to implement a robust image cleaning that can effectively remove the cosmic ray background. Here, we present a new image cleaning method DIOS (Denoising Image of Shower) for the Major Cherenkov Atmospheric Experiment(MACE), which enhances the cleaning of the event data, improves the signal-to-noise ratio and allows for more precise measurements of the gamma rays properties. Proper image cleaning not only enhance the detection of faint gamma-ray signals but also ensures that the reconstructed images are reliable, leading to a more accurate understanding of the underlying astrophysical phenomena. This advancement due to DIOS method compared to the standard cleaning method directly leads to an increase in the sensitivity of the MACE telescope. The workings of the DIOS method and its importance will be discussed in detail.		

ASI2025_630	Nikitha Jithendran	Poster
Facilities, Technologies and Data science		
Speckle Interferometry with speckle imager on PRL 2.5m telescope		
Speckle imaging is a powerful technique to achieve near-diffraction-limited imaging with ground-based telescopes, overcoming the atmospheric distortions that degrade image quality due to air turbulence. By capturing very short exposures (2-10 ms) when the atmosphere is relatively stable, we can reduce the effects of turbulence and, through cumulative co-adding, achieve high-resolution images close to the diffraction limit of the telescope. Integrating speckle imaging with radial velocity (RV) measurements further enhances the study of exoplanet candidates and stellar systems by disentangling signals from planets and stellar companions, leading to more accurate characterizations of these systems. We have designed and developed a speckle imager specifically for the PRL 2.5m telescope at the Mount Abu Observatory, Gurushikhar, Rajasthan. Installed on side port-1 of the telescope, this speckle imager provides a field of view (FOV) of 1.5' x 2.0' and supports exposure times of 2-50 ms in the fixed V-band. It can resolve stars as close as 0.3-0.4 arcseconds. A custom Python-based data reduction pipeline has been developed for analyzing speckle interferometric data. This instrument has already been used for speckle interferometric studies of exoplanet host stars, including TOI-6651b, the first exoplanet discovered using PARAS-2 on the PRL 2.5m telescope, and other discoveries that are already in the pipeline. It has also been successfully applied in resolving close binary systems. In this presentation, I will provide an overview of the speckle imager, describe the data reduction and analysis pipeline, and discuss our initial results.		

ASI2025_125	Nitish Singh	Poster
Facilities, Technologies and Data science		
Design, Fabrication, and Performance Analysis of a Wide-Field Camera for the VBT Prime Focus		
Over the past few decades, newer and more efficient telescopes have been built worldwide at sites with good seeing conditions. When discussing older-generation telescopes, it becomes imperative to focus on enhancing their efficiency and integrating new technologies to keep them competitive and relevant in modern astronomy. The Vainu Bappu Observatory is home to 0.5 to 2-m class telescopes, including the Vainu Bappu Telescope (VBT). The VBT is a 2.34m reflecting telescope that comprises parabolic primary and hyperbolic secondary mirror systems. To enable wide-field imaging and multi-object spectroscopy, telescopes require a large FoV and a substantial light-collecting area that ensures high image quality across the entire field. To achieve this, a system of optical elements known as the Wide-Field Camera (WFC) is essential. The Indian Institute of Astrophysics (IIA) has designed, developed, and fabricated a compact, lightweight, three-element WFC using spherical lenses for the 2.34-meter VBT prime focus in its laboratory. This WFC enables a wider FoV of 0.5 degrees, with an optional Atmospheric Dispersion Corrector (ADC) that reduces aberrations across the wide field without requiring additional optical elements. The WFC has already been fabricated, and its mount has been constructed in the IIA laboratory. We conducted laboratory tests of the WFC, including wavefront error measurements using a ZYGO interferometer and spot size analysis with a combination of lenses and a CMOS detector, which demonstrate that the WFC delivers sharp images over a 0.5-degree FoV. We are now preparing to install the WFC at the VBT's prime focus and will present preliminary photometric results following its installation. In this conference, I will present the design, fabrication, and testing results of the WFC.		

ASI2025_341	Prasanna Deshmukh	Poster
Facilities, Technologies and Data science		
Integrated Modelling of 6.2m Wide-Field Telescope for Spectroscopic Survey.		
The upcoming large astronomical telescopes are trending towards the Segmented Primary Mirror due to technological advancements & manufacturing feasibility. We have designed a wide-field optical IR spectroscopic survey telescope that can deliver spectra of several millions of astronomical sources. The baseline design of this telescope is a 6.2 m segmented primary mirror with 19 hexagonal segments of 1.44m size, 84 edge sensors, and 57 soft actuators. The telescope is designed to provide a 2.5deg FOV achieved through a system of wide field corrector lenses with a design residual <0.2". Also, it delivers an f/3.6 beam suitable for directly feeding optical fibres. A mechanical concept of the telescope is designed with a truss-based mirror cell to support the segmented primary mirror and keep the deformation to a minimum. As the primary mirror is segmented, the deformation due to different disturbances like wind, vibration, thermal effects must be corrected to a nanometer accuracy to make it act like a monolithic primary mirror. This is achieved through an active control system using three actuators and six intersegment edge sensors. In addition to these disturbances atmospheric seeing also degrades the image quality which can be corrected by using Adaptive Optics. An integrated model using codeSMT telescope simulation tool, is built. It is based on the state-space model of a soft actuator with Multiple-Input Multiple-Output (MIMO) capability to incorporate dynamic wind disturbance from the IAO Hanle site, thermal and vibration effects. A detailed error multiplier analysis is performed numerically using this tool and is in good agreement with analytical calculations. A parameter sensitivity analysis is performed to fine-tune the primary mirror control system variables. This paper presents the integrated modeling based performance analysis of a 6.2m wide-field telescope currently under conceptual design.		

ASI2025_708	Sahana Bhattramakki	Poster
Facilities, Technologies and Data science		
FFT beamforming implimentation on RFSOC		
As part of SKA-Low development, we are increasing the number of simultaneous beams formed by the SKA Tile processing module to 48, which will help create the sensitive beams for FRB search, pulsar search and pulsar timing with the SKA-Low Telescope. The SKA-Low arrangement will have 1,31,072 LPDA-based antenna elements to be deployed in Australia. As the tile beamforming cannot be easily verified in a local site, such as the Gauribidanur observatory, without having such a large number of antennas in place, we are investigating alternative schemes, including an FFT-based beamforming option that will work well for smaller-scale aperture arrays that may be deployed elsewhere, such as the upcoming LPDA arrays in the Gauribidanur observatory. If the antennas can be evenly spaced, the FFT-based beamforming offers a more efficient way to create multiple uniformly spaced search beams in the sky. These are especially helpful for transient searches, like the upcoming investigation into Fast Radio Bursts (FRBs) at the observatory. This new beamforming is planned to be implemented in a new RFSoC FPGA platform. The paper will present the salient features of this work, highlighting the results obtained and describing the future expansion plans.		

ASI2025_271	Shubhangi Jain	Poster
Facilities, Technologies and Data science		
The FUV Imaging Satellite (FISAT)		
The FUV Imaging Satellite (FISAT) is a compact Far UV telescope designed for daily transient monitoring. It features an 80 mm Ritchey–Chrétien (RC) design, operating in the 130–180 nm range with a 3° field of view. FISAT has a peak effective area of 2.5 cm^2 and can detect objects as faint as 18 AB (1200 s, SNR = 5). Its spatial resolution is ~6 arcseconds at the field center, combining resolution and compact design to meet the 3.4U size and mass constraints. The 6-12 month survey will focus on capturing novae outbursts and other transient events.Novae, explosive events in cataclysmic binaries caused by thermonuclear runaway reactions on white dwarfs, provide valuable insights into accretion processes, particle acceleration, binary evolution, and galactic chemical evolution. The Andromeda Galaxy (M31), with its high nova rate, is an ideal target for nova studies. Monitoring M31 daily in the far-ultraviolet (FUV) will produce unprecedented light curves, providing key data on nova speed class, peak brightness, and UV flashes. Current UV surveys are limited in depth and cadence, but FISAT's capabilities, alongside optical observations, will enable the detection of new novae and continuous monitoring of known novae. Daily exposures can detect FUV sources up to 18 magnitudes, increasing the chances of observing short-lived UV flashes, which are rarely captured.FUV surveys can also refine estimates of nova rates and populations, and offer insights into supernova type Ia progenitors. Beyond novae, FISAT may detect other transients like core-collapse supernovae, thermonuclear supernovae, and fast blue optical transients (FBOTs). Additionally, the survey will include a Galactic plane survey, broadening its observational scope beyond M31.		

ASI2025_432	Somnath Dutta	Poster
Facilities, Technologies and Data science		
Localization of fast radio bursts: An outrigger station of BURSTT-Taiwan at RRI-India		
Fast radio bursts (FRBs) are brief radio pulses lasting only milliseconds and originating from distant galaxies. They present some of the most intriguing mysteries in astronomy due to the challenges involved in detecting and localizing their sources. To date, astronomers have only managed to localize a few dozen FRBs. The Bustling Universe Radio Survey Telescope in Taiwan (BURSTT) is an innovative radio array specifically designed to tackle this issue by both detecting and accurately localizing FRBs. BURSTT's unique capability for near-all-sky monitoring (covering 10,000 square degrees) combined with sub-arcsecond localization (less than 1 arcsecond) distinguishes it from existing FRB telescopes, allowing it to localize hundreds of FRBs each year. To enhance localization accuracy, BURSTT is expanding its network by establishing international outrigger stations. One crucial station is located at the Raman Research Institute in Gauribidanur, Bangalore, India. The distance between the main BURSTT station in Taiwan and Gauribidanur is approximately 5,000 kilometers, enabling us to achieve a high level of accuracy (around 0.1 sub-arcseconds) in localizing FRBs. This precision will not only help identify the host galaxies of FRBs but also pinpoint their exact locations within those galaxies, representing a significant advancement in understanding their origins and the environments surrounding them. In Phase I of the project, we plan to install 16 antennas along with one RFSoC in 2024, which will be expanded to 64 elements by 2025. Additionally, we are conducting very long baseline interferometry (VLBI) tests between BURSTT-RRI and BURSTT-Taiwan.		

ASI2025_34	Sonika Piridi	Poster
Facilities, Technologies and Data science		
The First Data Release of Ultra Violet Imaging Telescope (UVIT DR1)		
The Ultraviolet Imaging Telescope (UVIT) onboard AstroSat observes pointed observations simultaneously in far-UV (FUV) and near-UV (NUV). It has observed around ~1800 observations, including stellar clusters, galaxies, and nebulae. We present UVIT DR1, the first release of the comprehensive catalog for the observations taken during the first two years of its launch. UVIT DR1 encompasses an area of ~58 square degrees in 291 fields. We use the CCDLAB pipeline to reduce the L1 data and source-extractor for source detection. UVIT DR1 provides photometric magnitudes measured using different procedures such as aperture (for three different apertures), Kron, Isophotal, and point-spread function techniques. We verify our catalog by cross-matching with GALEX and Gaia source catalogs. The FUV depth in the magnitude where most of the sources are detected is found to be 22.75, 22.25, 21.75, and 20.75 mag for CaF2, BaF2, Sapphire, and Silica, respectively, while for NUV, this ranges from 23.75, 20.75, 22.25, 21.25, and 20.25 mag for Silica15, NUVB15, NUVB13, NUVB4, and NUVN2 filters, respectively. There are 239,520 unique sources in the combined UVIT DR1, of which 70,488 sources have FUV magnitudes and 211,410 have NUV magnitudes. UVIT DR1 would further help in various multi-wavelength analyses of UV sources.		

ASI2025_625	Tsewang Stanzin	Poster
Facilities, Technologies and Data science		
Development of a Customized Automatic Weather Station as an Auxiliary Instrument of the DIMM Seeing Monitor.		
To characterize sites in and around Hanle a DIMM seeing monitor has been installed. To make this seeing monitor completely robotic, few critical environmental parameters such as cloud coverage, rain drop, sky brightness, wind speed, wind direction, temperature and relative humidity (RH) are required. Commercially available Automatic Weather Station (AWS) does not provide two most important parameters which DIMM system requires and they are cloud coverage and the sky-brightness. By making use of a precision sensors of different types, we have designed and developed a customized AWS at Indian Astronomical Observatory (IAO) Hanle, Ladakh. The sensors output have gone through rigorous calibration process and its data quality has also been cross checked. Our customized AWS provide all required environmental parameters to the DIMM system on the real time. Then the DIMM software uses these info to assess the weather condition and on event of cloudy sky, high winds, excessive humidity, and/or precipitation, the system automatically suspends DIMM operations to safeguard sensitive equipment. Once conditions improve, including clear skies and low wind speeds, the AWS autonomously resumes DIMM activities, ensuring minimal downtime and enhancing data collection efficiency without requiring manual intervention. In this paper, we present the technical details of our AWS as well as well some sample data collected using the same.		

ASI2025_733	Vishwajeet Swain	Poster
Facilities, Technologies and Data science		
Rapid follow-up of gravitational wave events with a robotic meter-class optical telescope		
The GROWTH-India Telescope (GIT) is India's first fully robotic telescope, set up as a part of the international GROWTH network. The primary goal of GIT is rapid-response time-domain observations of gamma-ray bursts, novae, supernovae, fast optical transients, near earth objects, and, particularly, follow-up of EMGW sources. Our location allows us to fill a longitude gap between major observatories, providing critical continuous coverage for rapidly varying sources. To ensure rapid response, GIT monitors Kafka-based prompt GW alerts from General Coordinates Network (GCN) and automatically triggers neutron star mergers based on specific pre-defined criteria. Based on the localisation area, GIT may undertake observations in one of three modes: (a) tiling the entire localisation, (b) galaxy catalogue weighted observations (c) follow up of candidates reported by other telescopes. A custom dashboard allows us to monitor telescope operations. All data are automatically reduced, including image subtraction and photometry. A machine-learning pipeline trained on our data identifies transient candidates served on an interface for human vetting. The entire software for telescope operations, data processing, and transient identification was developed in-house by a team of students. The system worked well in the O4a observing run of the International Gravitational Wave Network and has since been enhanced based on lessons we learned. I will present our workflows, lessons learnt, and key results from our follow-up efforts.		

ASI2025_102	Vrishali Murudkar	Poster
Facilities, Technologies and Data science		
Simulation & optical design optimization studies for a proposed dual mirror Schwarzschild Couder Cherenkov Telescope at Hanle.		
Ground-based Imaging Atmospheric Cherenkov Telescopes (IACT) utilizing a single light collector dish are employed for the study of gamma-ray sources. These telescopes detect Cherenkov light produced by extensive air showers, initiated by gamma & cosmic rays. However, their performance can be compromised by optical aberrations. Recent study has shown that using an aspheric dual-mirror system, such as the Schwarzschild-Couder Telescope (SCT), can significantly mitigate these aberrations. In addition to reducing optical distortions, the design ensures improved angular resolution and field of view (FoV) of the telescope. Using an in-house-developed code, we conducted ray tracing simulation studies on a ~4m SCT system to optimize the dimensions of the primary and secondary mirrors, as well as the positioning of the camera and the distance between the secondary mirror and the camera. As aspheric mirrors are employed in SCT design, these are essentially characterized by a sagitta (sag) function, a measure of the surface shape with respect to a plane. Optimizing the sag function coefficients of the aspheric primary and secondary mirrors, has led to a spot size of <5mm at the camera plane, which is comparable to the spot size of similar telescope operated by other groups. Given the challenges associated with fabricating a single ~4m aspheric mirror, we explored a tessellated primary mirror design composed of 12 segments. Here the segment consists of 22 mirrors, each with a diameter of ~230mm, resulting in 264 aspheric facets. We will present the results pertaining to spot size before and after the optimization of the sag coefficients and the tessellated mirror design during the meeting. Additionally, we will also compare the performance of the dual mirror SCT with single mirror IACTs of same size operational elsewhere.		

Posters in
Education, Outreach and Heritage

ASI2025_455	Antony Arupara	Poster
Education, Outreach and Heritage		
Table Top Teaching Aid for Exoplanet Detection using Transit Photometry		
Exoplanet detection has advanced significantly through various observational techniques, including radial velocity, direct imaging, and gravitational microlensing. Among these, the transit method—which detects exoplanets by observing the temporary dimming of a star as a planet transits across its face—has been particularly effective, accounting for many exoplanet discoveries. In this work, we introduce a tabletop model designed to simulate the transit detection process, offering an engaging educational tool for teaching this technique. The model consists of a rotating "planet" that periodically orbits a fixed "star," with variations in light intensity demonstrating the transit effect. Users can adjust orbital parameters and planet size, allowing hands-on exploration of how different planetary characteristics produce distinctive transit signatures. The setup is controlled wirelessly via a web interface hosted on an ESP32 microcontroller, providing a simple, accessible user experience. To support replication and foster educational outreach, we provide all necessary resources, including 3D-printable CAD files and source codes, enabling educators and enthusiasts to build and operate the model. By making complex astrophysical concepts accessible and interactive, this model is a practical introduction to exoplanetary science, enhancing theoretical understanding through a hands-on, experiential approach.		

ASI2025_502	Ashmita Tribedi	Poster
Education, Outreach and Heritage		
Impact of Observatory Visit programs in spreading astronomy awareness among young students: a case study		
In the past few years, astronomical observatory visit programs have been initiated by some amateur astronomy organizations in India as an initiative to spread awareness about astronomy among young students and general public. This is done mostly through the efforts of some amateur organization's passionate members along with collaborative hands from the respective research institutions of astronomy and astrophysics, such as IIA, IUCAA, ARIES, NCRA, etc. Jyotirvidya Parisanstha (JVP), the oldest amateur astronomy organization in India has recently started a nationwide program to facilitate educational visits at different major astronomical observatories to promote astronomy education among larger mass. This is a case study which highlights the impact of such observatory visit programs among Indian young students as observed from JVP's initiatives. The initial results from a survey among students who participated in these programs for the past 3 years are presented. These results further highlight the importance of organizing such fruitful educational trips more often by other organizations too.		

ASI2025_304	Gobinda Das	Poster
Education, Outreach and Heritage		
SOLAR OBSERVATIONS AS EDUCATIONAL TOOLS FOR STUDENTS		
A great majority of the students community don't get even a little knowledge on astronomy or astrophysics in their school and college education. It is also noteworthy that , the interest of the students in basic sciences is on the wane. It is not a good sign. The pursuit of science is essential for the progress and development of a nation. A teacher has to take role in this crisis. If a teacher stimulates interest in a subject the students likely develop an interest in that subject. Solar observations may be very handy tools to expose the students to the joy of research . Thus the students will be able to appreciate the physics of the sun and extend it to the stars in general. Our present work is devoted to the following studies. To find the rotation period of the sun, the daily images of the sun from SOHO are downloaded. Limb-darkening can be measured by observing the intensity of light across the sun's diameter during a solar eclipse. Identification of elements in solar spectrum, available online. Finding the ratio of the distance of the sun from the Earth when maximum (Aphelion) to the distance when minimum (Perihelion), eccentricity of the Earth's orbit is measured. A variety of experiments on the sun are possible during a Venus transit. Solar observations provide excellent opportunities for understanding the physics of the sun and stars in general among the students. This can make the students interested in basic sciences also. Keywords: sunspots ------ observations------rotation period------limb darkening------solar spectrum-----eccentricity		

ASI2025_736	Indulekha Kavila	Poster
Education, Outreach and Heritage		
22 Srutis: Indian Scientific Music and Extended Chords for the Sonification of Astronomical Data		
The ancient Indian theory of ragas (melodic structures) are built on what are called srutis, with 2/3/4 sruti tones and twenty-two srutis to the octave. Knowledge was both written down as well as orally transmitted in the tradition, since, presumably, written material does not survive for long in the hot, tropical climate; for the convenience of memorization information encoding was extensively used, necessitating explanations for deciphering and getting an understanding of the information content, which was transmitted in an unbroken chain called the guru-ziSya-paramparA. However, under invasions and/or infusions extending over a millennium, the chain was broken and, first North India and, in the period 1300-1400 CE, South India lost the link between practice and theory. gItagovindam (12th c. CE) is the last composition sung in the same fashion all over India. Over the last few centuries, several scholars have attempted to decipher the 22 sruti theory of melody. The notion of consonance is one of the guiding principles that has been applied for the purpose. Consonance is also the principle behind considering harmony as an essential component for enriching melody, as developed over two-and-a-half centuries in Western Europe starting from the Renaissance. Here, we examine information on the 22 srutis, that is available in the texts and present a systematic method for generating extended chords suitable for the sonification of astronomical data.		

ASI2025_59	Shubha BS	Poster
Education, Outreach and Heritage		
History of Astronomical manuscripts from ORI Mysore		
The study of manuscripts talks about the development of astronomy from ancient days till today. The details hidden in these manuscripts refer to the golden period of astronomical progress in India. Some of the manuscripts under study are Laghu-Manasa-vyākhyā, Vasishta-siddhānta, Graha-ganita-Bhāskara, bhūgola nirnayaha, nakṣatra ghaṭikā and many more. We have studied a few of these in detail and some are being studied. Palm leaf manuscripts are approximately 400year old; while the paper manuscripts are 200year old. The reading, translating and analysis appear to be a challenge. Here we summarize the highlights of some manuscripts which are analyzed partly or completely.		

ASI2025_524	Triptesh Acharjee	Poster
Education, Outreach and Heritage		
Accelerating Astronomy: Simplified Data Access for Faster Discoveries		
Across various conferences, discussions often centre around the availability of new international astronomy databases and strategies for accessing them. However, many researchers report ongoing difficulties in navigating and utilizing these resources effectively. This lack of accessibility can limit research potential, especially for those newer to the field. To address this, a user-friendly app-based platform is proposed to simplify astronomical data access for researchers at all levels. This tool would streamline data retrieval, visualization, and analysis, eliminating technical barriers and enhancing productivity. With an intuitive interface, researchers could bypass complex systems, access critical datasets more readily, and concentrate on discoveries rather than logistical hurdles. With this platform, research speed and discovery rates could increase tenfold, allowing astronomers to explore the cosmos as conveniently as observing from their backyard. This app could foster a more inclusive and accessible research environment, attracting a diverse community to astronomy. In turn, it would support greater collaboration, faster discoveries, and a more vibrant exchange of ideas across the field. In essence, this tool has the potential to transform astronomy, making research faster, more efficient, and accessible to a global community eager to push the boundaries of space exploration.		

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