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THE ASTRONOMICAL SOCIETY OF INDIA

ABSTRACT BOOK

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Awards Session [Chairperson: Divya Oberoi]		
Saturday, 20 February 2021 from 10.30 - 12.30		

ASI2021_660	Shriharsh Tendulkar	Invited
Vainu Bappu Award Lecture		
Understanding Fast Radio Bursts		
<p>The decreasing cost of computational power has now allowed us to explore phase spaces of fast transient phenomena that were not previously accessible. Fast radio bursts (FRBs) are one such phenomena that has shown up in the past decade --- a class of millisecond radio transients that seem to arise from cosmological distances, making them at least a trillion times more luminous than radio pulsars. The propagation of FRBs through the intergalactic medium makes them promising probes of the electron and magnetic field distributions in the Universe. The mechanisms that produce FRB signals are unknown and the subject of active debate. Distinguishing between these models, requires a careful understanding of the population, characteristics, and environments of FRBs. The Canadian Hydrogen Intensity Mapping Experiment (CHIME) with its FRB-searching backend, is uniquely powerful due to its high sensitivity and a large 250 sq. deg. field-of-view. In the past year of operations, CHIME/FRB has discovered over a thousand new FRBs, including several dozen new repeating FRB sources, a Galactic FRB, and a repeater with periodic activity. In this talk, I will review some of the recent results from CHIME/FRB and how they help us understand the origins and distributions of FRBs. I will discuss how precise localizations of nearby FRBs, as well as multi-wavelength, multi-telescope observations are required to uncover their astrophysical origins and how future facilities can achieve this goal.</p>		

ASI2021_270	Poonam Chandra	Invited
ASI Laxminarayana & Nagalaxmi Modali Award Lecture		
Lives of massive stars: exploring the aspects of magnetism		
<p>Hot, massive OB stars are the energetic and chemical engines of galaxies. They seed the galaxies with heavy elements, help trigger new generations of star formation, and drive strong, high-speed stellar wind mass outflows. These stars also end their lives as one of the biggest explosions in the universe, i.e. supernovae or gamma-ray bursts, either by their gravitational collapse, or assisted by a nearby companion. Currently 10% of known massive stars are known to host kG dipolar magnetic fields, the origin of which remains contradictory. While stellar evolution models have generally accounted for mass-loss, rotation and metallicity, the aspects of magnetism are in their infancy, even though they may have important implications in their evolution and end products as magnetars and magnetic white dwarfs. The stellar wind properties of OB stars with magnetic fields</p>		

are modified in important ways as compared to the winds of non-magnetic stars, introducing significant changes across the entire electromagnetic spectrum. VLAWe are carrying out systematic studies of these stars in radio bands using the uGMRT and the VLA. Our studies have shown that radio observations of magnetic massive stars probe most critical aspects of the physics of these stars. In addition, we have discovered a rare electron cyclotron maser emission (ECME) phenomenon from a subset of these massive stars. While stars with ECME have given us deep understanding via unveiling their plasma environments, 3D magnetic topology and nature of magnetic fields, several new results have thrown us by surprise.

Navnirmithi Group	Vivek Monteiro	Invited
ASI Zubin Kumbhavi Award Lecture		
Universalizing the Universe, with Daytime Astronomy and the People's Science Movement		
<p>"Universalizing the Universe" was a slogan given during IYA 2009 by the People's Science Movement (PSM) in India. Universalization of good quality education, the Right To Education Act 2009 and NCF 2005 set up the mandate, a challenge and a framework for attempting this. I will describe the efforts of the Navnirmithi team to develop and use Daytime Astronomy pedagogy and work with PSM campaigns towards this objective.</p>		

ASI2021_823	Samir Dhurde	Invited
ASI Zubin Kumbhavi Award Lecture		
Organised Outreach that reaches - the mantra of IUCAA SciPOP		
<p>Outreach isn't something we do only to inform and explain our work, but also to inspire and elevate the next generation's achievements. Such an important effort needs an organised approach to succeed, especially in the Indian context. In this talk we consider how IUCAA's outreach "brandname" SciPOP has evolved as a goal-oriented and effective model, and how such models can fit organisations and projects looking to reach the masses.</p>		

Parallel Session Stars, ISM and Galaxy I [Chairperson: Manash Samal]
Saturday, 20 February 2021 from 13.30 - 15.00

ASI2021_330	Jeewan Pandey	Invited
Colliding stellar winds in Wolf-Rayet binaries		
<p>Wolf-Rayet (WR) stars possess powerful outflows of matter from their surfaces, fed by their extreme radiation fields in the form of stellar winds. The presence of these potent outflows gives rise to many observational signatures, which can be observed over a wide range of the electromagnetic spectrum. The high wind velocities and high mass-loss rates of WR and O stars suggest that the colliding stellar wind region is a luminous X-ray source. WR binaries with O-type companion are expected to be brighter than the single WR stars which were also found to be true in the X-ray surveys of WR stars. In this talk, I will present X-ray investigations of colliding stellar winds from wide as well as close WR+O binaries. Two temperature plasma is required to explain the X-ray emission from binaries in which cooler plasma could be due to small scale shocks in a radiation-driven outflow and the high-temperature plasma could be due to the collision of winds. With other important recent results, I will also discuss the dependence of X-ray flux with binary separation for eccentric binaries.</p>		

ASI2021_324	VIPIN KUMAR	Oral
Optical and near-infrared spectroscopy studies of a very slow Nova V2891 Cyg		
<p>Nova V2891 Cyg (also transient AT2019QWF) had been discovered in September 2019 and later classified as a nova of Fe II class. The subsequent photometric monitoring of the object revealed it to be a very slow nova with a rather unusual, nearly flat, light curve. Only a few novae prior to this have shown similar photometric behaviour, and its slow spectral evolution presented a rare opportunity to study such "flat-topped" novae. The multiple re-brightening in its light curve was found to be consistent with the idea of the periodic mass ejection, and there is evidence of a possible rare reverse hybrid transition (He/N to Fe II class) as noticed in its earliest optical/NIR spectra. While for a long time (~240 days) the optical spectra showed a slower spectral evolution, it eventually evolved into an emission rich nebular spectrum by May 2020. The coronal lines were seen in the spectrum of September 2020, thereby commence the coronal phase after a year of the outburst. The nova had been followed in optical wavelengths with indigenously developed MFOSC-P instrument on PRL 1.2m Mt. Abu telescope along with other facilities for its optical and near-infrared spectra of selected epochs. This 15 months-long observing campaign resulted in a wealth of information deduced preliminary from the optical/NIR spectroscopy. In this talk, we shall present a comprehensive spectroscopy study of the evolution of this nova V2891 Cyg over the last</p>		

15 months. This work has been done in collaboration with U.Munari, INAF, Italy; C.E. Woodward, Univ. of Minnesota, USA and A.Evans, Keele University, UK.

ASI2021_498	Tirthendu Sinha	Oral
Pre-main sequence variables in young open clusters		
<p>The evolution of pre-main sequence (PMS) star involves a set of complex physical processes such as evolution of circumstellar disks, accretion processes, bipolar jets and outflows, evolution of angular momentum etc. Study of variability and their causes in young open clusters can give us some clue about these process. Several mechanisms are known to induce these variability, for example irregular distribution of cool spots on stellar photosphere, variable hot spots, obscuration from dust, instability in disk, change in accretion rate etc. The evolution of disks and the accretion rates may play a prominent role in the non-periodic variability whereas due to the presence of cool and hot spots on the photosphere, rotation of the stars may produce periodic/quasi-periodic changes in their light curve. The period of the light curve of a rotating stars is direct indicator of it's rotation period and hence related to angular momentum. With the help of HR diagram we can constrain the physical parameters such as age and mass of PMS stars and it is easy to check the correlation of different physical parameters (period/amplitude, accretion rate etc.) with age and mass. In our survey of PMS stars, many main sequence field stars are also detected as variables. Our study suggests that in a typical cluster we get as many as 30-40 periodic variables and 20-30 non periodic variables. Period of periodic variables ranges from few hours to 15-20 days while amplitude ranges from 0.05 mag to 2 mag. The amplitude of variables increases with IR excess where as rotation speed seems to slow down with IR excess. We will show the results of few clusters obtained in our study.</p>		

ASI2021_449	Sadhana Singh	Oral
A multi-band linear polarimetric study toward the cluster NGC 2345		
<p>To get the information about properties of the dust (such as: shape, size, alignment of grains and polarization efficiency of dust grains) associated with the interstellar matter (ISM), we are studying polarization due to ISM by selecting the open star cluster. According to Davis & Greenstein (1951), the polarization of starlight is caused by the selective extinction due to the elongated dust grains aligned in space possibly due to the magnetic field. As the grains are thought to align due to the local magnetic field, the observed polarization vectors will help to map the general geometry of the magnetic field. I would like to present a multi-band optical linear polarimetric study in the region of the cluster NGC 2345. Observations have been carried out using the ARIES imaging polarimeter mounted on the 104-cm telescope of Aryabhata Research Institute of observational Sciences, Nainital, India. The polarization is found to be wavelength dependent. The foreground</p>		

interstellar dust grains appear to be main source of linear polarization of starlight towards the direction of NGC 2345. The average value of position angle in V-band of 153 degree is found to be near to the direction of Galactic Parallel in the region, indicating that the dust grains in the direction are probably aligned by Galactic magnetic field. The maximum value of the degree of polarization is estimated to be 1.67% for members of the cluster using the Serkowski relation. The average value of wavelength corresponding to the maximum polarization of 0.55 micron indicates that the size distribution of dust grains in the line of sight is similar to that of the general interstellar medium. The existence of dust layer near 1.2 kpc is also identified in the line of sight of the cluster. We also approached towards membership based on polarimetric technique.

ASI2021_445	Harmeen Kaur	Oral
THE ANALYSIS OF MASER SOURCE 2MASX J04183258+5326027 IN THE PHYSICAL ENVIRONMENT OF YOUNG OPEN CLUSTERS S208 AND WAT 01		
<p>Maser emission plays an important role as a tool in star formation studies. It is widely used for deriving kinematics, as well as the physical conditions of different structures, hidden in the dense environment very close to the young stars. Cosmic masers are one of the first observed signpost of high-mass star formation. It was relatively well established from earlier surveys of masers in our Galaxy that massive star-forming regions can be associated with OH, H₂O and Class II CH₃OH masers. However, there is still a great need for verifying what is the relation between specific stages and classes of star formation and different masers. In this work we study the maser source 2MASX J04183258+5326027 to understand the star formation scenario in the local environment of young open clusters s208 and wat01. For this work we use the NIR data from TANSPEC instrument newly installed on 3.6 DOT telescope of ARIES Nainital India, with multiwavelength data sets.</p>		

Parallel Session Instrumentation and Techniques I [Chairperson: S. Seetha]
Saturday, 20 February 2021 from 13.30 - 15.00

ASI2021_609	V Girish	Invited
Five years of AstroSat		
<p>AstroSat is ISRO's first multi-wavelength observatory class satellite dedicated for astronomy. AstroSat carries a total of five scientific payloads covering a broad energy range from UV to high energy X-rays. Four of the five payloads onboard AstroSat are co-aligned and capable of simultaneous measurements from UV to X-ray bands. AstroSat is operated as a proposal based observatory and has recently completed its designed life of five years. In this talk, I will be talking about various processes involved in AstroSat mission operations, from proposal submission, selection, observation planning to final data dissemination to the proposers.</p>		

ASI2021_485	Padmakar Parihar	Invited
Creating a Large Optical-NIR Observing Facility in India: Challenges and Solutions		
<p>Having a large optical-NIR telescope on Indian soil is a long cherished dream of the Indian astronomers. The growing astronomical community and India's participation in mega projects such as SKA, TMT, MSE and LSST further make a strong case for building a 10m class optical-NIR observing facility in India. Despite many attempts made over more than three decades, not much progress has happened toward building the large optical telescope. In this presentation I will provide a brief review of the efforts made in the past as well as on going activities. Indigenously building a 10m class telescope is indeed a big challenge. It not only require huge investment but we need large number of highly skilled scientists, engineers and technicians, strong industrial backing, professionally trained managers as well as R&D supports from various technological institutions. The success of the project lies on the capacity building exercise and a very serious and thoughtful efforts are needed on this front. The project of this scale and complexities also requires very active cooperation and the collaboration at national as well as international levels. I will briefly discuss the challenges as well as suggest possible solutions to over come the problems which we may face while building such a large telescope within the country.</p>		

ASI2021_47	SRINATH REDDY PATTI	Oral
Optical Fourier Transform and its application in low latency LIGO data analysis		
<p>Fast Fourier Transform (FFT) is a ubiquitous tool in many signal analysis applications. It is also an essential part of the low latency (online) LIGO data analysis algorithms. These algorithms find a correlation between the incoming gravitational wave (GW) signal (if present) and the templates using the matched filters. Currently, the LIGO data computing system uses several processor cores for parallel computing of thousands of GW templates. This step includes a computing algorithm for the correlation by utilizing electronic devices like GPUs and CPUs. Each such computation would involve an FFT operation. Several studies have demonstrated that that Optical Fourier Transform (OFT) is faster than digital FFT. It would be advantageous to use optical computing methods wherever they provide higher speeds than electronic counterparts. Implementation of OFT could improve the GW signal detection speed, which could expedite trigger generation for Electromagnetic (EM) wave follow-up observations and thereby achieve maximum science gain in Multi-messenger astronomy. In this talk, I would explore the feasibility of OFT, an optical signal processing tool, for enhancing the speed of FFT operation in low latency LIGO data analysis.</p>		

ASI2021_227	Mani Khurana	Oral
Feasibility study of Duty cycle for MACE gamma-ray Telescope under partial Moonlit.		
<p>Major Atmospheric Cherenkov Experiment (MACE) is a ground-based gamma-ray telescope recently installed 4.3 km above sea level, Hanle, Ladakh. The MACE telescope equipped with a 21 meter diameter light reflector and an imaging camera with 1088 pixels (photo-multiplier tubes) at the focal plane, is expected to explore the gamma-ray Universe in the energy range 20 GeV to 5 TeV. The imaging Cherenkov telescopes like MACE are generally operated during clear and moonless dark nights to avoid the damage of photo-multiplier tubes due to excessive light. As, astronomical observational site, Hanle provides about 260 spectroscopic clear nights per year for gamma-ray observations. Therefore, the duty cycle of telescope is limited to about 18%. In this work, we present the results from a feasibility study of operating the MACE telescope under partial moon-light conditions which lead to a very significant enhancement in the effective duty cycle up to about 30% per year. We use a model for moon brightness to estimate the total light of night sky flux in the wavelength range 300-700 nm. The light of night sky flux is convoluted with the wavelength dependent mirror reflectivity and quantum efficiency of photo-multiplier tubes to estimate the anode current as function of moon-phase for a given angular separation between a gamma-ray source and the moon. Details of the effect of increase in the anode current on the operating parameters of MACE telescope under relaxed partial moonlit conditions will be presented.</p>		

Parallel Session Extragalactic Astronomy I [Chairperson: Nissim Kanekar]
Saturday, 20 February 2021 from 13.30 - 15.00

ASI2021_255	Neeraj Gupta	Invited
MALS early science: evolution of cold gas in galaxies		
<p>The primary goal of large survey project "MeerKAT Absorption Line Survey" (MALS) is to carry out a dust-unbiased search of HI and OH absorption lines and better determine the occurrence of atomic and molecular gas in galaxies and their circumgalactic medium. The observations are well underway (~500 hrs completed; raw data 0.5 PB). I will introduce key science themes and data processing challenges of the survey, and present early science results based on MALS, and uGMRT/SALT follow-ups.</p>		

ASI2021_542	Main Pal	Oral
X-Ray/UV view of an NLS1 NGC 4748		
<p>We present a detailed timing and spectral study of an extremely variable narrow-line Seyfert 1 galaxy NGC 4748 using observations in the year 2017 and 2014 performed with AstroSat and XMM-Newton, respectively. Both observations show extremely variable soft and hard X-ray emission that are correlated with each other. In the 2014 data set, the source retains its general behaviour of "softer when brighter" while the 2017 observation exhibits a "harder when brighter" nature. Such changing behaviour is rare in AGNs and is usually observed in the black hole binary systems. The "harder when brighter" is confirmed with the anti-correlation between the photon index and the 0.3-10 keV power-law flux. This suggests a possible change in the accretion mode from standard to the advection-dominated flow. Additionally, both the observations show soft X-ray excess below 2 keV over the power-law continuum. This excess was fitted with a single or multiple blackbody component(s). The origin of soft excess during the 2017 observation is likely due to the cool Comptonization as the photon index changes with time. On the other hand, the broad iron line and delayed UV emission during the 2014 observation strongly suggest that X-ray illumination onto the accretion disk and reflection and reprocessing play a significant role in this AGN.</p>		

ASI2021_535	GANESH N	Oral
Dynamical Modelling of Spiral Arms in Low Surface Brightness galaxies		
<p>Low surface brightness galaxies (LSBs) are galaxies with central B-band surface brightness lying between 23 and 26 mag arcsec⁻² with a low star formation rate of $0.001 - 0.1 M_{\odot} \text{ yr}^{-1}$ in spite of being gas-rich with $M_{\text{HI}}/L_B \sim 1$, possibly due to the suppression of dynamical</p>		

instabilities by a dominant dark matter halo. We study the formation of local spiral arms by the swing amplification mechanism for a sample of spiral LSBs modelled as a 2-fluid system in the force field of a dark matter halo. For two of our sample LSBs, we also study the formation of a global spiral pattern as driven by a density wave as well as by the superposition of transient modes using the N-body simulation, with the galaxy modelled as a stellar disk embedded in the gravitational potential of the gas and the dark matter halo in both cases. Our results indicate that the high value of the multi-component disc dynamical stability against local axi-symmetric stabilities as indicated by $Q_N(Q_N^{\min} > 2.4)$ inhibits the growth of local spiral features by swing amplification, and the density wave theory study predicts a lower growth rate (0.012 M yr^{-1}) when compared to high surface brightness galaxies 0.021 M yr^{-1} . Interestingly, the N-body simulation seems to model the spiral features of comparable strength and pitch angle as seen in the observed images of these LSBs.

ASI2021_521	Sanna Gulati	Oral
Multiwavelength studies of active galaxies NGC 1275 and Pictor A		
Active galaxies with large jet inclination angles are called Misaligned active galaxies (MAGN). Though gamma-ray emission, which primarily originates in the jet, is expected to fall off rapidly with increasing jet inclination angle, Fermi gamma-ray space telescope (Fermi) detected ~ 50 MAGNs in gamma-rays till date. We have carried out a detailed study of two gamma-ray detected MAGNs utilising observations from Fermi, Swift and AstroSat. While carrying out a decade-long study of one of the brightest MAGN in gamma-rays, NGC 1275, we noticed a long-term multiband flux increase. Also, a significant shift of the synchrotron peak frequency was noticed during the AstroSat observing period when the source was in high gamma-ray activity state. We also carried out a detailed study of a nearby radio galaxy, Pictor A, which exhibits a prominent north-western hotspot in IR, optical and X-ray bands. We detected the hotspot for the first time in both near-UV and far UV bands utilising observations from AstroSat-UVIT. Detailed findings of these two sources will be discussed.		

ASI2021_299	Silpa Sasikumar	Oral
A radio polarization study of III Zw 2 revealing a composite jet and wind outflow		
The origin of radio emission in radio-intermediate quasars (RIQs) is poorly understood. Radio polarization observations can help to distinguish between the possible contenders such as winds (starburst-driven or AGN-driven) and AGN jets, based on the differences in their degree of polarization, magnetic (B-) field structures and rotation measures. We will be presenting the results from our multi-frequency radio polarization study of the RIQ, III Zw 2, with the uGMRT at 685 MHz and the VLA at 5 and 34 GHz. We detect a kpc-scale outflow in III Zw 2, harbouring toroidal B-fields. The outflow in III Zw 2 appears to be a combination of an AGN jet and a magnetically-driven AGN wind. Both uGMRT and EVLA images of III Zw 2 reveal B-fields to be aligned with the edges of the lobe, consistent with B-field amplification due to shock compression, similar to radio-loud quasars. The bow-shock-like morphology of the jet terminal regions is consistent with restarted jet activity in III Zw 2, which is in turn consistent with its "sputtering" nature.		

Parallel Session Stars, ISM and Galaxy II [Chairperson: K. Indulekha]
Saturday, 20 February 2021 from 16.00 - 17.30

ASI2021_219	Aruna Goswami	Invited
Metal-poor stars and Galactic chemical enrichment		
<p>The early low-mass, long-lived metal-poor Population II stars are formed from the enriched material left behind by the first stars. These stars preserve the chemical imprints of the gas from which they formed, provided their surface chemical composition are not altered significantly either by any internal mixing processes or by any external processes despite their old age. The chemical abundances of these stars can therefore be used to trace back the early nucleosynthesis and the astrophysical sites of their occurrence. Low mass metal-poor stars contribute significantly to the Galactic chemical enrichment and can be used as powerful tools to address a wide variety of astrophysical issues. Some results obtained from our recent studies will be discussed.</p>		

ASI2021_76	Swastik Chowbay	Oral
Host-star Metallicity of Directly Imaged Planets		
<p>Planets discovered in wider orbits (≥ 10 AU) by high-contrast imaging belong to a different region of star-planet parameter space. The star-planet properties and their interdependence is well known for a large number of planetary systems discovered by radial velocity and transit methods. However, host-star properties of the directly imaged planets (DIP) are not very well documented in exoplanet literature. In this work, we used high-resolution spectra from public archives to uniformly determine the atmospheric parameters and metallicity of 18 DIP hosts. The total 22 DIP hosts (other 4 taken from literature) analyzed in this work show a large scatter in metallicity with the median being closer to the Sun. Upon dividing our stellar sample into three mass bins, we noticed a decreasing metallicity trend with increasing mass from Jupiter type planets ($MP \leq 5MJ$) to super-Jupiter ($5MJ \leq MP \leq 13MJ$) and beyond $> 13MJ$. Using Gaussian-mixture model (GMM), we also show that the metallicity trend in DIP host stars is consistent with the large population of the giant planet and brown-dwarfs found around main-sequence stars.</p>		

ASI2021_120	MANAMI ROY	Oral
Gamma-Ray and Radio Background Constraints on Cosmic Rays in Milky Way Circumgalactic Medium		
<p>Galaxies have three components: galactic disk, dark matter halo and diffuse gaseous halo which is also known as Circumgalactic medium (CGM). Conventionally the CGM is thought to be in hydrostatic equilibrium under the influence of gravitational potential of dark matter halo by</p>		

means of only thermal pressure. This implies that the density of cold (10^4 K) phase to have higher density than hot phase ($\geq 10^6$ K). However observation suggests that the density of cold phase follows the hot gas density which is contrary to the above expectation. This motivates the introduction of non-thermal pressure components e.g magnetic field, cosmic rays (CR) etc. which can add to the thermal pressure. However the amount of CR population in the CGM is highly debated. Recent simulations with different CR transport prescription suggest $\eta = P_{\text{CR}}/P_{\text{th}}$ to lie in a wide range, from 1 – 100, which represents the uncertainty in the amount of CR population in CGM. We address this issue in the light of the observations of indirect tracers of CR: isotropic γ -ray background and radio continuum. CR protons undergo hadronic collision with CGM protons, creating neutral pions which in turn produces γ -rays, whereas CR electrons in the Galactic magnetic field produce synchrotron emission in radio band. We incorporate CR component in two widely-studied theoretical models : Isothermal (IT) and precipitation (PP) model. The radio continuum does not put any constrain on CR population in both the models, however the IGRB flux puts an upper limit of $\eta \leq 3$ and $\eta \leq 230$ in case IT and PP model respectively. Although anisotropy consideration rules out any CR population in CGM for IT model, it puts a lower limit of $\eta \geq 100$ in the case of PP model.

ASI2021_170	Gargi Shaw	Oral
Roll of Polycyclic Aromatic Hydrocarbons on the Cosmic-Ray ionization rate in the Galaxy		
<p>The cosmic-ray ionization rate (ζ, s^{-1}) plays an important role in the interstellar medium. It controls ion-molecular chemistry and provides a source of heating. Here we perform a grid of calculations using the spectral synthesis code Cloudy along nine sightlines towards, HD 169454, HD 110432, HD 204827, λ Cep, X Per, HD 73882, HD 154368, Cyg OB2 5, Cyg OB2 12. The value of ζ is determined by matching the observed column densities of H_3^+ and H_2. The presence of polycyclic aromatic hydrocarbons (PAHs) affects the free electron density, which changes the H_3^+ density and the derived ionization rate. PAHs are ubiquitous in the Galaxy, but there are also regions where PAHs do not exist. Hence, we consider clouds with a range of PAH abundances and show their effects on the H_3^+ abundance. We predict an average cosmic-ray ionization rate for H_2 ($\zeta(\text{H}_2) = (7.88 \pm 2.89) \times 10^{-16} \text{ s}^{-1}$) for models with average Galactic PAHs abundances, ($\text{PAH}/\text{H} = 10^{-6.52}$), except Cyg OB2 5 and Cyg OB2 12. The value of ζ is nearly 1 dex smaller for sightlines toward Cyg OB2 12. We estimate the average value of $\zeta(\text{H}_2) = (95.69 \pm 46.56) \times 10^{-16} \text{ s}^{-1}$ for models without PAHs.</p>		

ASI2021_221	Supriyo Ghosh	Oral
Characterisation of cool giants from low-resolution near-infrared spectra		
<p>Precise estimation of fundamental parameters (e.g. T_{eff}, $\log g$, $[\text{Fe}/\text{H}]$) is a long-standing and challenging problem in astronomy, especially for cool giants because of their molecular near-photospheric environment, however, is essential to characterise the stellar populations in the</p>		

Galactic and extragalactic environments. In this presentation, we present new empirical tools for the determination of fundamental parameters for cool giants covering a wider metallicity range ($-2.5 \text{ dex} < [\text{Fe}/\text{H}] < +1.0 \text{ dex}$) than in previous works. Using fairly low-resolution near-infrared spectra ($R \sim 1200$), we showed that such tools are quite capable of deriving fundamental parameters (a typical accuracy of 100 K in T_{eff} and 0.2 dex in $[\text{Fe}/\text{H}]$) of cool giants without any knowledge of the reddening and distance to the objects. We also found that the empirical relations based on the solar-neighborhood stars can incorporate large uncertainty in evaluation T_{eff} for metal-poor or metal-rich stars. In addition, we will show how to deploy Bayesian inference for estimating any possible systematics between different measurement techniques in the absence of any common stars in different data sets. Furthermore, we will present the implication of our established empirical tools for deriving fundamental parameters of Kepler red-giants observed with a newly installed TANSPEC instrument on 3.6-m DOT.

Parallel Session Instrumentation and Techniques II [Chairperson: Bhal Chandra Joshi]
Saturday, 20 February 2021 from 16.00 - 17.30

ASI2021_614	Subhadeep De	Invited
Optical Atomic Clocks to Probe Fundamental Science		
<p>Probing fundamental science is very important to find yet unanswered questions in nature: Astronomy-Astrophysics & Atomic-Optical Physics are two important and closely connected pathways for such investigations. Starting from Galileo's time until today, observational astronomy covers almost the entire electro-magnetic (EM) spectrum and gravitational waves (GW). Associated state-of-the-art instruments for the present observational astronomy are based on classical technologies. The future demands incorporating quantum-enhanced technologies in the present detectors, such as squeezed states of light that is planned to be used in Advance-LIGO. Further, worldwide heroic efforts are going on to develop quantum-phenomena based novel sensors for ultra-sensitive measurements, such as optical atomic clocks and atom interferometers, nano/micro fabricated opto-electro-mechanical systems, etc. There are several existing proposals to measure quantum gravity, dark matter, dark energy, CMB, GW using these quantum devices, which are yet to be realized. This lecture shall focus on optical atomic clock development at the Precision and Quantum Measurement lab (PQM-lab) at IUCAA that is planned to be used to study fundamental science. In present days' optical atomic clocks are accurate to few parts in 10^{-19} that corresponds to missing of just one "tick" over 34 billion years. Such clocks have been realized by accurate measurement of the highly forbidden atomic transition frequencies (clock transition) in the optical domain. There are two different systems: neutral atoms stored in an optical lattice and single atomic-ion trapped in an electrodynamic trap; for experimental measurement of the clock transitions with extreme precision. Both of these clocks use sophisticated technologies and only a few countries are able to develop them so far. Other than applications of such clocks for accurate timekeeping, which is a requisite for advanced technologies such as navigation, communication, surveillance, meteorology, and so on, the scientific community is always enthusiastic to develop optical atomic clocks since they are useful to reveal unanswered questions in science. The present advanced communication technologies together with the long-distance transfer of the optical photons allow intercomparison of the geographically distributed state-of-the-art optical clocks. Optical atomic clocks and networking among them uplift the capability to probe fundamental aspects of science such as the constancy of the dimensionless fundamental constants, violation of the fundamental symmetries, geodetic measurements, and so on.</p>		

ASI2021_250	Radhika Dharmadhikari	Oral
Phasing Segmented Primary Mirror using the Dispersed Fringe Technique		
<p>The segmented mirror technology is being extensively used these days to build large astronomical telescopes, so that higher resolution and sensitivity can be achieved with the lower manufacturing costs. In order to achieve diffraction limited image quality, the alignment and phasing errors of segments, should be minimized. We have extensively explored the Dispersed Fringe Sensor (DFS) with an aim to use it for phasing the primary mirror made of small segments. In the presence of the phase error, the DFS phasing technique, which uses a broadband light source and dispersive element, forms fringes in the continuum spectra. These fringes are manifestations of coherent summing of the reflected light from two segments, subjected to the piston error. The number of the fringes (frequency) and their visibility is a measure of the piston error. A python code has been developed to simulate the fringe spectra based on the basic principle of DFS. Then after the simulation tool has been used to study the effects of various parameters on the fringe spectra. Also the effect of various noises, including the photon noise and the CCD introduced noises were studied. The curve fitting tool in python was used to extract the piston value from the simulated fringe images. We have also attempted to design the optics of the DFS instrument, planned to be used in Prototype Segmented Mirror Telescope for the purpose of phasing as well as coarse alignment. In my presentation, I will briefly describe the DFS technique, the algorithm used in the simulation as well as some results obtained. Efforts made towards designing the optics of the DFS instrument is also briefly covered in my presentation.</p>		

ASI2021_495	Kushagra Upadhyay	Oral
Observations of solar activities at low radio frequencies by CALLISTO at USO/PRL.		
<p>e-CALLISTO is a worldwide network of radio spectrometers. It is used for the observation of solar radio bursts and radio frequency interference monitoring for astronomical sciences. At Udaipur Solar Observatory (USO), Physical Research Laboratory (PRL), we are regularly monitoring solar radio activities since October 2018 using CALLISTO radio spectrograph. This paper presents a detailed description of various subsystems of the radio spectrograph. In the front-end system, a log periodic dipole antenna (LPDA) is designed for the frequency range of 40-900 MHz. In this paper LPDA design, its modifications, and simulation results are presented. We will also discuss some prominent observations taken by CALLISTO at Udaipur over the past two years.</p>		

ASI2021_596	Bela Dixit	Oral
L-band Aperture Array Beamformer: Prototype Implementation and Testing		
<p>The Expanded GMRT (eGMRT) is a proposal to investigate three possible expansions to the Giant Metrewave Radio Telescope (GMRT) - increasing the field-of-view (FoV) using the Focal Plane Array (FPA), the angular resolution and the sensitivity to extended radio emission. This paper discusses the</p>		

development of an aperture array beamformer as a step towards FPA beamforming. The aim is to develop a multi-element, multi-beam prototype beamformer and perform an integrated testing with the 144-element (Vivaldi dipole elements) ASTRON L-band FPA. Through architectural optimization and use of FPGA re-configurability, we have implemented a 32 MHz bandwidth, 32-input, 5-beam beamformer on a single Virtex-5 FPGA. While in operation, initially, a 32-input correlator design which provides a full correlation matrix is programmed. The correlator output is processed offline for deriving weights for optimal beamforming. The FPGA is then re-programmed with appropriate weights to function as a real-time beamformer. The FPGA design can also packetize ADC voltages from the FPA elements and send these over the 10 Gigabit Ethernet for offline correlation and beamforming. The verification of aperture array beamformer is performed using experimental measurements in the free-space test range located at the GMRT site. This test range consists of a narrow-beam transmitting antenna and the aperture array as the receiving element. The aperture beam was steered across the beam of the transmitting antenna for broadband noise radiation (1.1 - 1.7 GHz). We have developed tests to form beams at boresight using the maxSNR technique which accounts for the coupling between the elements. A comparative analysis of the signal-to-noise ratio (SNR) improvement for the phased-array beamforming (ignoring mutual coupling between the elements) and the maxSNR techniques was carried out. This paper shall describe the above-mentioned aspects in detail along with ongoing efforts towards implementation of a wideband (300 MHz) beamformer and spectrometer on Xilinx RFSoc (RF System-on-Chip).

ASI2021_469	Harsha Avinash Tanti	Oral
Update on the IIT Indore Radio Interferometer (IIRI)		
<p>We present the first results from the DST-SERB sponsored IIT Indore Radio Interferometer (IIRI) project. Currently, the interferometer consists of four elements and operates at 1.42 GHz with a bandwidth of 110 MHz. The four antennas are 4.5-meter dishes, with wideband feeds (Saje et al. 2017), with a ~ 2.7-degree field-of-view, and operable through an on-site control system with a pointing accuracy of ± 2 arcmin with tracking capability. Front-end electronics consist of room-temperature low noise amplifiers (LNAs), with a 110 MHz bandwidth bandpass filter. Backend electronics consist of a superheterodyne receiver, which provides an IF centered at 140 MHz, and a bandwidth of 110 MHz. The digital backend consists of an FPGA-based electronics board (with 4 inputs) designed by the CASPER community, which enables reconfigurable hardware design through a visual programming platform. The results from tests of the interferometer, conducted using a broadband noise source, and the sun. The results confirm that the interferometer yields fringes as expected, and can be used to make drift-scan and tracking images of the sky. We aim to improve on the total gain and sensitivity of the receiver systems to enable observations of diffuse emission in the L and C bands. The digital backend produces a 600 MHz bandwidth spectrum and we intend to design and deploy wider bandwidth filters to enable wideband observations in the two bands. We also aim to improve the pointing accuracy to ~ 30 arcsec. This interferometer will mainly be used for academic programs like the M.Sc. (Astronomy) and Ph.D. programs of the Department of Astronomy, Astrophysics and Space Engineering, IIT Indore.</p>		

ASI2021_184	Dorje Angchuk	Oral
Upgrading an old 50cm telescope for the robotic operation: The Current Status and the Plan for the Future.		
<p>A 50cm Ritchey-Chretien (f/10 cassegrain) equatorial mount telescope manufactured by Torus Inc, is being refurbished at Indian Astronomical Observatory, Leh. The telescope has served as a good learning tool for the engineers at IAO to develop their own indigenous PSOC based motion control system and Observatory Control Software. The hardware control architecture consists of several microcontroller units, interfaced over local area network by making use of the CAN bus. The Telescope Control System (TCS) handles two primary telescope drive axes, focuser, filter wheel as well as the enclosure. Our emphasis has been to minimise the over all budget but at the same time have an equally good and robust motion control system. The TCS which is developed entirely from the scratch facilitate precise pointing as well as tracking. The secondary focus is actively compensated for any change in the ambient temperature. In order to protect the telescope and its equipment's from the dust, rain/snow, a sliding roof enclosure is also designed & built. We plan to put this telescope in action at IAO Hanle and make it a fully robotic telescope so that it can be effectively used to carry out observations of transients objects of different kinds. At present telescope is going through rigorous testing as well as re-commissioning phase. In my presentation, I will briefly explain the effort made toward upgrading the telescope as well as present some observational results indicating its performance.</p>		

Parallel Session Extragalactic Astronomy II [Chairperson: Yogesh Wadadekar]
Saturday, 20 February 2021 from 16.00 - 17.30

ASI2021_259	Smriti Mahajan	Invited
An insight into multi-wavelength star formation rates		
<p>Star formation is critical for galaxy evolution. Stars have created almost all the elements heavier than Helium in the universe and play a key role in recycling dust and metals in galaxies. Hence the rate at which a galaxy forms stars is one of the most important drivers of its evolution. Recently, many authors have employed multi-wavelength data in a variety of wavebands to study the relationship between star formation rates (SFR) estimated using luminosity in a single waveband. In this talk, I will provide a brief overview of our current understanding of the relationship between SFR tracers ranging from radio to ultraviolet (UV) wavelengths. In the nearby ($z \sim 0.1$) universe, many studies yield mutually consistent estimates of SFR within statistical uncertainties for most galaxy samples. For a far infrared-selected sample of galaxies, the scatter is found to be even smaller for the intermediate luminosity galaxies, than the scatter in the complete sample. Moreover, in agreement with other studies, these data also prefer a non-linear relation between the 1.4GHz luminosity and other SFR measures. Along with the recent results on SFR metrics using multi-wavelength data, I will also discuss the role of extinction corrections based on bolometric luminosity, UV spectral slope and the nuclear Balmer decrement in estimating the total SFR for different galaxy populations.</p>		

ASI2021_322	Shishir Sankhyayan	Oral
Optical Identification and Radio Source Counts in the Saraswati Supercluster Region		
<p>Saraswati, with a mass of $\sim 2 \times 10^{16} M_{\odot}$ and size ~ 200 Mpc at redshift ~ 0.28 containing at least 43 clusters, is one of the most massive superclusters discovered in the Universe. Supercluster environments are hard to study due to the rarity of such structures in the Universe. The nearest most well known supercluster is the nearby Shapley supercluster ($z \sim 0.04$) that has provided first insights on such environments. As all structures, superclusters too have evolved through redshifts and a higher redshift analogue of the Shapley, which is Saraswati, will be an ideal laboratory to study and compare such environments. For this purpose, we have been observing the Saraswati supercluster through uGMRT at 402 MHz in phases under the project – Galaxy Evolution and Magnetization of the Saraswati Supercluster (GEMSS). This is the first deep radio observation of this supercluster reaching an rms noise value of ~ 40 microJy/beam. Here, we present the optical identification and source counts of radio sources of the first phase of GEMSS covering a sky area of $\sim 6 \text{ deg}^2$. We have identified ~ 5000 radio sources in our observations and cross-matched them</p>		

using the galaxy and QSO data available in the Sloan Digital Sky Survey (SDSS) and cluster data available in WHL cluster catalog. Our study of the full observation of the Saraswati supercluster will explore if the supercluster environment plays any role in governing the physical properties of galaxies and clusters and their evolution or not at an intermediate redshift of $z \sim 0.3$.

ASI2021_315	Abhisek Mohapatra	Oral
Physical conditions and redshift evolution of low- z C III absorbers		
<p>We present the details analysis of 99 optically thin C III absorption systems obtained from background quasar spectra at redshift, $0.2 < z < 0.9$ associated with neutral hydrogen column densities in the range, $15 < \log N(\text{H I}) < (\text{cm}^{-2}) < 16.2$. Using photoionization models, we infer the physical conditions of these intervening optical thin absorbers. We combine the low-z and previously reported high-z ($2.1 < z < 3.3$) optically thin C III systems to study the redshift evolution and various correlation between the derived physical parameters. We find significant redshift evolution in number density, metallicity and line-of-sight thickness. We compare the redshift evolution of metallicity in C III systems with those of various types of absorption systems and find that the slope of $[\text{C}/\text{H}]$ vs. z for C III absorbers is stepper compared to the redshift evolution of cosmic metallicity of the damped Lyα sample (DLAs) but consistent with that of sub-DLAs. We see evidence of two distinct $[\text{C}/\text{H}]$ branch C III populations (low-$[\text{C}/\text{H}]$ branch and high-$[\text{C}/\text{H}]$ branch) in the combined C III sample when divided appropriately in the L vs. $N(\text{C III})$ plane. Further studies of C III absorbers in the redshift range, $1.0 < z < 2.0$ is important to map the redshift evolution of these absorbers and gain insights into the time evolution physical conditions of the circumgalactic medium.</p>		

ASI2021_239	Harsh Kumar	Oral
Small Telescope Big Dreams: An effort to find kilonova with GROWTH-India Telescope.		
<p>The mergers of compact objects like binary neutron stars(BNS) & black hole - neutron star (BH-NS) are among the most energetic events in the universe. These events provide us a glimpse into some of the most extreme physical processes. Merger events of BNS and BH-NS are believed to be the key to solving several open questions in astrophysics - including the sites of formation of r-process elements, progenitors of short gamma-ray bursts (GRBs), the equation of state of ultra-dense matter, and can even provide an independent estimate of the Hubble constant. During its first-half run of O3, LIGO has detected ten events with at-least one neutron star as a merger object. We followed Six events out of these ten with GROWTH-India Telescope(GIT) in either "Tiled" / "Targeted" mode. The localisation regions put up by LIGO-Virgo were huge for most of the events. One of these events, named "S190426c," was well suited for tiled follow-up. We collaborated with GROWTH collaboration and covered 22 sq. degrees area of localisation consisting of 17.51 % of total probability. I present the detailed follow-up of GW events with India's first robotic telescope, "GIT," primarily the "S190426c," along with the pipeline development during the analysis of this event.</p>		

ASI2021_91	Shasvath Kapadia	Oral
Of Harbingers and Higher Modes: Improved gravitational-wave early-warning of compact binary mergers		
<p>A crucial component to maximizing the science gain from the multi-messenger follow-up of gravitational-wave (GW) signals from compact binary mergers is the prompt discovery of the electromagnetic counterpart. Ideally, the GW detection and localization must be reported early enough to allow for telescopes to slew to the location of the GW-event before the onset of the counterpart. However, the time available for early warning is limited by the short duration spent by the dominant ($\ell=m=2$) mode within the detector's frequency band. Nevertheless, we show that, including higher modes - which enter the detector's sensitivity band well before the dominant mode - in GW searches, can enable us to significantly improve the early warning ability for compact binaries with asymmetric masses (such as neutron-star-black-hole binaries). We investigate the reduction in the localization sky-area when the $\ell=m=3$ and $\ell=m=4$ modes are included in addition to the dominant mode, considering typical slew-times of electromagnetic telescopes (30–60 sec). We find that, in LIGO's projected "O5" ("Voyager") network with five GW detectors, some of the neutron-star-black-hole mergers, located at a distance of 40 Mpc, can be localized to a few hundred sq. deg. ~ 45 sec prior to the merger, corresponding to a reduction-factor of 3–4 (5–6) in sky-area. For a third-generation network, we get gains of up to 1.5 minutes in early warning times for a localization area of 100 sq. deg., even when the source is placed at 100 Mpc.</p>		

Public Lecture by G. Srinivasan [Chairperson: Dipankar Bhattacharya]
Sunday, 21 February 2021 from 09.30 - 11.00

Formerly at Raman Research Institute	G. Srinivasan	Invited
Of Stars and Singularities		
<p>The 2020 Nobel Prize for Physics was awarded jointly to Sir Roger Penrose, Andrea Ghez and Reinhard Genzel for their discoveries related to Black Holes. “Black Stars” were first predicted in 1783 by John Michell, but this remarkably prescient discovery was soon forgotten. Within a month of the publication of the General Theory of Relativity by Einstein, Karl Schwarzschild discovered an exact solution for the geometry of spacetime surrounding a spherically symmetric star. This solution predicted that no radiation can escape from a star once its radius contracts to a critical value. This rigorous conclusion was soundly rejected by Einstein. And yet, there is mounting evidence for the existence of countless number of black holes in our Universe. In this Public Lecture, I shall trace the key developments pertaining to Black Holes of General Relativity, highlighting, in particular, the remarkable discoveries by Penrose, Zeldovich and Hawking. The lecture will be nontechnical and is intended for a general audience.</p>		

Plenary Session 1 - Transient Astrophysical Phenomena [Chairperson: G. C. Anupama]		
Sunday, 21 February 2021 from 11.15 - 12.45		

ASI2021_403	Nayantara Gupta	Invited
Transient Astrophysical Phenomena		
<p>The transient and variable astrophysical sources have drawn much attention of the astrophysics community in the recent past. With the successful operation of many multi-wavelength telescopes across the globe it has become possible to get spectral energy distributions of many of these sources even over short time intervals. Various radiative processes (synchrotron, inverse Compton scattering) lead to their multi-wavelength emission. However, their dynamic nature indicates more interesting physical phenomena which are yet to be explored. I will discuss about some of the transient and variable sources, their underlying physics (known and unknown) and the future prospects in this field.</p>		

ASI2021_270	Poonam Chandra	Invited
Transient phenomena in radio bands - critical insights into lives and deaths of massive stars		
<p>Massive stars end their lives as one of the biggest explosions in the Universe, supernovae and gamma-ray bursts. Around 10% massive stars are magnetic and a subset of them display a highly transient and coherent electron cyclotron maser emission, which allows us to understand their 3D magnetic topology and decipher the plasma properties surrounding these stars. These have important implications in stellar evolution, their mass-loss rates and the final demise. On the other hand, study of transient radio emission from their explosions via circumstellar interactions allow us to peep into their progenitor lives thousands of years before their demise. In this talk, I will present study of sub-GHz transient emission from massive stars and their end products, supernovae and gamma ray bursts. I will summarise how these studies have helped us gain critical understanding of these transient phenomenon and their implications for stellar evolution.</p>		

ASI2021_458	Amit Shukla	Invited
Spinning black hole powers jet by magnetic flux		
<p>Accreting black holes are suspected of converting rotational energy into Poynting flux escaping along their rotation axes. The high-energy emission of blazars allows to study the regions where the jets dissipate energy by accelerating particles to ultrarelativistic energies. A transient peak-in-peak variability pattern in blazar lightcurves was predicted from kinetic simulations of relativistic magnetic reconnection. The pattern is associated with the dissipation of magnetic energy through plasmoids undergoing relativistic reconnection. This variability pattern has now been found on time scales of minutes in the gamma-ray lightcurve of the blazar 3C 279 using Fermi-LAT data shedding new light on the riddle of jet launching. The study is consistent with the jet of 3C 279 initially being magnetic-energy dominated before it turns into the kinetic-energy dominated flow imaged with very-long baseline radio interferometry on parsec scales.</p>		

Thesis Session 1 [Chairperson: Tushar Prabhu]
Sunday, 21 February 2021 from 13.30 - 15.15

ASI2021_711	Prantika Bhowmik	Invited
Data Constrained Models for Solar Activity Predictions		
<p>Solar variability governs the electromagnetic, radiative, and particulate environment in the heliosphere creating hazardous weather in space through eruptive events such as solar flares, coronal mass ejections. Moreover, modulation in solar output in terms of solar irradiance defines space climate. Both the short and long-term solar variabilities are closely associated with and mostly dominated by the Sun's magnetic cycle. Thus, in the context of space weather studies, understanding and predicting the Sun's magnetic field evolution has gained significant impetus in recent times - the same has been the focus of the research performed in this thesis work. Through utilising a newly developed observational data-driven computational model along with two other existing models, we present predictions of the space weather and space climate in the next decade. Moreover, our work successfully reproduces the past solar activity during the last century and provides a physical explanation of the distinct characteristics observed in the Sun. Altogether the work done in this thesis imparts a deeper understanding of the complex processes within the Sun and in other stars.</p>		

ASI2021_88	Anshu Kumari	Oral
Radio Polarimetric Imaging of the Solar Corona at Low Frequencies		
<p>Measurements of the coronal magnetic field strength particularly in the radial distance range $\sim 1.1 - 2.0 R$, (where R is the radius of the solar photosphere) is presently difficult because of practical reasons. Polarization observations, by measuring the Stokes-V parameter of the received radio signal, are generally used as a tool to measure the magnetic field strength associated with the radio emission; the latter is one of the widely pursued areas of research in the solar coronal physics, in addition to the currently available but limited methods of estimating the magnetic field strength using simultaneous radio imaging and spectral observations. This work includes: i) design of a new wideband, low frequency antennas, ii) design, development and characterization of a high temporal and spectral resolution multi frequency polarimetric receiver system for solar observations at low radio frequencies, iii) studies of the solar radio bursts observed with these instruments and their counterparts as observed in multi frequencies with other space and ground-based instruments.</p>		

ASI2021_337	Ajay Vibhute	Oral
Statistical estimation of source properties for indirect imaging methods in Astronomy		
<p>The direct imaging techniques based on reflective optics are not available at higher energies, but indirect imaging methods allow observing the sky at higher energies. One such indirect imaging technique, addressed in this thesis is Coded Mask Imaging. Coded Mask Imaging is an ideal technique to observe the sky for hard X-ray sources. Coded Mask telescopes provide larger Field of View (FOV) and allow simultaneous measurement of source and background signals. India's first dedicated astronomical observatory AstroSat employs two coded mask telescopes, namely the Cadmium Zinc Telluride Imager (CZTI) and the Scanning Sky Monitor (SSM) to observe the sky for high energy X-ray sources. An essential part of the coded mask instrument's operations involves ground calibration, in-flight calibration, and performance verification. Coded Mask imaging requires special methods for image and spectrum reconstruction. This thesis presents various image reconstruction methods implemented to carry out CZTI on-ground, in-orbit imaging calibration, and calibration results. The mask weighting is one commonly used spectrum reconstruction technique used for coded mask instruments. In mask weighting, each photon is assigned a weight proportional to the probability of photon belonging to the target source. Such weighting techniques work well only if there is a single strong source present in the FOV. In reality, there can be many strong sources in FOV. In this thesis, we propose a spectrum reconstruction technique based on Bayesian inference to reconstruct the spectrum of the sources in a crowded field. CZTI acts as an open sky detector at higher energies and allows transient events detection. To extract the signature of such transients from the CZTI data in a fast and uniform manner, we have developed an automated method which we present in this thesis.</p>		

ASI2021_147	Avrajit Bandyopadhyay	Oral
Study of Milky Way Halo stars and connection to globular clusters		
<p>The thesis aims to study the chemical abundances of very metal poor Milky Way halo stars and Globular cluster stars, to understand their possible common origin. Halo stars and globular clusters belong to the oldest stellar population of the Galaxy and detailed Chemical tagging of these populations can address several intriguing problems in the area of galaxy formation and globular cluster formation and evolution. In this study, we have used low and high resolution spectroscopic abundance analysis to address the possible connection between halo stars and globular clusters. In order to achieve this, We carried out high resolution spectroscopic survey using the Hanle echelle spectrograph at 2m Himalayan Chandra telescope. We also use low resolution spectra of Halo stars and globular clusters from Sloan Digital Sky Survey (SDSS). The thesis describes detailed abundances analysis of about 50 stars, in the metallicity range of halo and Globular clusters. These are selected from bright SDSS-MARVELS pre-survey data. All these objects are newly discovered VMP or EMP stars and their detailed chemical abundances are</p>		

studied for the first time in this work. The results include discovery and analysis of EMP & CEMP-no stars in the metallicity range < -3.0 and several other (~ 35) VMP stars in the metallicity range $-3.0 < [\text{Fe}/\text{H}] < -2.0$. We also studied Li which is found to have a similar distribution among CEMP-no and EMP stars however a subtle difference was found in the trends with heavier elements. The other interesting results of the study are the discovery of globular cluster escapees that show the typical light-element anomalies associated with second generation GC stars and several r-process enhanced stars. We also studied the nature of the progenitor populations and sites for the different classes of r-process enhanced stars. The detailed results will be presented in the talk.

ASI2021_283	Sindhu Pandey	Oral
Multiwavelength study of old open clusters: NGC 188 and M67		
<p>The thesis focuses on understanding the single and binary stellar evolution in the old open clusters, M67 and NGC 188 using multiwavelength photometric data. We have used images from the Ultra-Violet Imaging Telescope (UVIT) on ASTROSAT, the first Indian space observatory and combined them with other photometric data from 0.14-11.5 μm wavelength range and spectra in the ultraviolet (UV) range. In NGC188, using the first light data of UVIT, we have discovered a hot companion to a blue straggler star (BSS). The estimated fundamental parameters of the components suggest that the BSS is formed as a result of a recent mass transfer (MT) from a post AGB/HB star. A deep UV study of the M67 was performed using GALEX images to reveal the presence of a large number of stars with far-UV (FUV) and/or near-UV (NUV) excess. Some of these stars were found to be in binaries and many are single stars. These indicate that a large number of Sun like stars in this cluster may be chromospherically active. We detect a few main-sequence + white dwarf (MS+WD) binaries in M67, which could be progenitors of Cataclysmic variables. We created multiwavelength spectral energy distributions (SED)s of 45 interesting candidates and estimated their fundamental parameters. We classified BSSs into three groups and suggest that they are formed between 400 Myr - 2 Gyr, more or less continuously. The multi-filter FUV images of M67 from UVIT were used to study 9 bright BSSs. The SEDs of 6 BSSs were found not to fit well with single star spectra, but fitted well with a hot + cool composite spectra, consistent with IUE and HST spectra. The estimated parameters suggest the hot companions to be WDs, and this is the first confirmed detection of WD companions to BSSs in M67.</p>		

ASI2021_416	SANDEEP KUMAR KATARIA	Oral
The Formation and Evolution of Bars, and its impact on Galaxy Dynamics		
<p>In the first part, we have used two types of N-body galaxy models, one with dense bulges and another with rare bulges, in order to see the effect of both bulge mass and bulge concentration on bar formation. We derive a generalized criterion for bar formation which states that if the ratio of the radial force due to the bulge component and the radial force due to total galaxy exceeds a value of 0.35, the galactic disk is stable against bar instability. We also performed an observational study to test the applicability of this criterion. We find that most of the galaxies agree with our criterion with only a few outliers. In the second part, we have also looked at the effect of bulge mass on the pattern speeds of disk galaxies with the motivation being to understand the origin of slow and fast bars along the Hubble sequence. We find that there are two important factors; 1) the rate of slow down of bar rotation increases with bulge mass and 2) bar formation time scales are delayed when the bulge mass increases. We discuss the physical processes that lead to these effects. Finally, we have also examined whether bars in galaxies can provide insights into the core-cusp problem of LCDM cosmology. We show that as a bar rotates in the disk, it transfers angular momentum from the disk to the dark matter halo component and as a result slows down. This transfer of angular momentum is sufficient to alter the dark matter profile which depends on the resolution of the simulations. We conclude that the time scale for cusp to core transition is too large in barred disk galaxies to be meaningful for resolving the core-cusp problem of LCDM cosmology.</p>		

Parallel Session Sun and the Solar System I [Chairperson: Piyali Chatterjee]
Sunday, 21 February 2021 from 16.00 - 17.30

ASI2021_251	Nishant Kumar Singh	Invited
Solar Magnetic Fields on Large and Small Scales		
<p>The Sun offers to be a unique laboratory where various predictions of the mechanisms responsible for the generation of the magnetic fields can be observationally tested. It has proved to be challenging to understand the origins of solar magnetism at large, viz, the global fields revealing a butterfly pattern, and at small scales, e.g., the appearance of sunspots and active regions. We will discuss some latest developments on these topics based on recent numerical and observational studies.</p>		

ASI2021_207	Hirdesh Kumar	Oral
Study of seismic emission in sunspots associated with Lorentz force changes accompanying major solar flares		
<p>Solar flares are known to generate seismic waves in the Sun. With a motivation to study seismic emission in sunspots accompanying flares, we have used high resolution photospheric Dopplergrams and LOS magnetograms at a cadence of 45 s, along with vector magnetograms at a cadence of 135 s obtained from HMI instrument aboard SDO spacecraft. For information concerning the flare ribbons and hard X-ray footpoints location, we have used H-alpha and hard X-ray images in 12-25 keV band obtained from GONG and RHESSI instruments, respectively. Fourier power maps in 2.5-4 mHz band have been constructed for the identification of seismic emission location in the sunspots for pre-flare, spanning flare and post-flare epochs. We have identified concentrated locations of acoustic power enhancements in sunspots accompanying major flares. In the power maps, we have selected only those locations which are away from the flare ribbons and hard X-ray footpoints. These regions are believed to be free from any flare related artifacts in the observational data. Our investigation provides evidence that abrupt changes in the magnetic fields and associated impulsive changes in the Lorentz force could be the driving source for these seismic emissions in the sunspots during flares. Moreover, the estimation of work done by change in Lorentz force and the observed acoustic energy over the seismic emission location reveal that change in Lorentz force of the order of 10^{21} - 10^{22} dyne is sufficient to drive these seismic waves in the sunspots. Such seismic emissions in the sunspots are essential to study because these 'magnetic-jerk' driven seismic waves can propagate from the photosphere to higher solar atmospheric layers along the magnetic field lines in the form of magnetoacoustic waves and thereby can contribute to the heating of the solar atmosphere.</p>		

ASI2021_515	Ram Ajor Maurya	Oral
Subsurface Flow Structures and Dynamics Underneath the Flaring and Quiescent Regions		
<p>Solar active regions are intense magnetic field areas responsible for explosive events such as flares and CMEs. However, some of them are found to be highly energetic as compared to other regions. We have analyzed several such areas from solar cycles 23 and 24. In the descending phase of the solar cycle 23, two complex active regions NOAA 10486 and 10488, appeared on the earthside. The first one produced several energetic flares of unprecedented magnitudes such as X10/2B, X17/4B, and X28 during its disc passes in the Carrington rotation 2009. The observations show that it lasted much longer than a typical active region on the visible solar disc. Being super active and lasting longer makes it a particular type of area. To investigate the distinct characteristic properties of these ARs, we analyzed and compared the p-modes and sub-surface flow structures and dynamics over three Carrington rotations. We found that the emergence of magnetic flux in the active region NOAA 10486 was started in the previous Carrington rotation 2008 when it was on the solar disc's far side. In the next Carrington rotation 2010, it was named NOAA 10508 and lasted on the far side. One of the exciting results with this region is that the energetic flares occurred during the decay phase of sub-photospheric flow twists. The detailed results from the other ARs will be presented in the meeting.</p>		

ASI2021_206	Abhinav Prasad	Oral
Role of Heating cooling imbalance in Non-Adiabatic solar coronal loops.		
<p>We study the damping of standing slow MHD waves in solar coronal loops by deriving a new dispersion relation taking into account the effect of thermal conductivity, viscosity, radiative cooling and heating cooling imbalance. We systematically solved the dispersion relation and provided a comprehensive study for a wide range of loop parameters viz., density, temperature, loop length. The role of thermal conductivity was found to be dominant for a wide range of loops, however, viscosity became dominant for super-hot ($T=20-30\text{MK}$) and short loops ($L=50\text{Mm}$). Heating cooling imbalance enhanced the damping by thermal conductivity for Long ($L=500\text{Mm}$) and Hot loops ($T<10\text{MK}$) whereas it did not play significant role in super-hot regime of loops. In the case of shorter loops at the super-hot regime of the temperature, the increment in the loop density enhanced the damping of the fundamental modes due to thermal conductivity when the viscosity is absent, however, when the compressive viscosity is added the increase in density substantially weakens the damping. We also gave a new scaling law for the damping time and period which matched quite closely with the SUMER/SDO observations and heating cooling imbalance brought the theoretical data points closer to the observations in comparison to the case with constant background heating.</p>		

ASI2021_503	Vasantharaju N	Oral
REVISIT OF MAGNETIC IMPRINTS OF SOLAR FLARES: AN OBSERVATIONAL STUDY		
<p>The abrupt, permanent changes of photospheric magnetic field in the active regions (ARs) due to the changes in coronal magnetic field structure during solar flares have been observed for more than two decades. The well known “coronal implosion” model is assumed to explain such flare associated changes of photospheric magnetic field but the complete physical understanding is still missing and debatable. In this study, we made a systematic analysis of flare related changes of photospheric magnetic field during 12 flares using the high cadence of 135 s vector-magnetogram data obtained from Helioseismic Magnetic Imager onboard Solar Dynamics Observatory. We observed the change of Lorentz force implied by the rapid step-wise enhancement of the horizontal component of magnetic field during all flares in the sample. The integrated change of fields and total change of Lorentz force over an area signifying the strength of magnetic imprints are well correlated with the flare strength and the CME momentum. It appears that the strength of magnetic imprints are not stronger for eruptive flares in comparison with non-eruptive flares. Further, the amount of decrease in free energy during the flares has a strong positive correlation (0.8) with downward impulse resulted from the total change of Lorentz force indicating that the part of energy released during flares would penetrate into the photosphere. These results strongly favor the idea of significant feedback from corona to photosphere during flares. On contrary to these results, we observed the simultaneous step-wise increase and decrease of horizontal magnetic field during flares led to the cancellation of impulsive Lorentz force, thought to provide the CME momentum. These contradictions indicate that present understanding of flare associated magnetic field changes is limited and hints the need for improvement of coronal implosion model.</p>		

Parallel Session Stars, ISM and Galaxy III [Chairperson: Bhaswati Mookerjee]
Sunday, 21 February 2021 from 16.00 - 17.30

ASI2021_494	Manoneeta Chakraborty	Invited
Investigations of magnetar flares and their implications		
<p>Neutron stars offer the most extreme magnetic field in the universe, which is crucial in governing such objects' radiative behaviour and temporal evolution. Such dense objects display a wide plethora of observational features carrying the direct signatures of the complex extreme magnetic field and the strong gravity field. Extremely energetic flares lasting from few fractions of a second to 100s of seconds are observed from magnetars- the strongest magnetic neutron stars. Such bursts are proposed to originate from sudden fracturing of the neutron star crust due to building up magnetic stress or from magnetic reconnection in a highly magnetized environment. The burst properties vary widely from repetitive short bursts to super-Eddington giant flares. During these episodes, the spectral and temporal properties were found to be distinctly different from the magnetar persistent emission. Understanding the observational features during such transient events can probe the flaring mechanism and the corresponding energetics. We investigate the energetics and spectral properties of the flares to identify the trigger mechanism, examine the emission and radiative physics at the flare origin site, and infer about the complex magnetic field morphology from the concurrently occurring spectral lines. Finally, our results show that the most energetic magnetar flares offer the most natural explanation for the observed properties like - temporal and spectral features, energy, statistical correlations - of a short gamma-ray burst (sGRB). This indicated a giant flare origin for at least a fraction of the observed sGRBs establishing a strong connection between them.</p>		

ASI2021_98	Shyam Sunder	Oral
Wide-band Timing of Millisecond Pulsars with GMRT		
<p>Extreme rotational stability of the millisecond pulsars allow these to be used for pulsar timing array experiments aiming to prove nanoHertz Gravitational waves. Goal of this project is the estimation of precise time of arrivals (TOAs) for wide-band observations, which is of utmost importance for the pulsar timing experiments. The advent of new wide-band receivers with larger fractional bandwidth, like the upgraded GMRT, introduces new challenges due to non-negligible frequency dependent effects. In order to be benefited by the larger instantaneous observing bandwidth of the radio telescopes, the pulsar timing experiments requires modelling of pulse profile as function of radio frequency while estimating TOAs (Pennucci et al. 2016; Pennucci & Demorest 2018). Pennucci et al. 2014 presented an algorithm which enables us to simultaneously</p>		

measure TOA and line of sight dispersion measure (DM) from the wide-band observations. We have implemented this method of wide-band timing for the frequency range 300-500MHz of upgraded GMRT to improve TOA precision while accounting for profile evolution with frequency and epoch to epoch DM variations. I'll present recent results from timing studies of a bunch of MSPs highlighting the advantage of the newly implemented wide-band timing method over the conventional narrow-band approach.

ASI2021_236	Gangadhara R T	Oral
The Coherent Radio Emission Mechanism of Pulsars		
<p>Although almost 50 years have passed since the pulsar discovery, their radio emission mechanism still remains unknown. This is one of the most challenging problems of modern astrophysics. Curvature radiation seems to be the most natural and practically unavoidable emission process in the pulsar magnetosphere. By considering relativistic plasma motion in curved magnetic fields, we have deduced the analytical formulation for coherently emitted curvature radiation in the radio band. The pair plasma is generally believed to support the excitation of plasma waves of large amplitude, which intern phase the particles to radiate resonantly and coherently in the dipolar magnetic field of pulsars. We have developed a coherent curvature radiation model for the radio pulsars based on the implications of the tangent model. We numerically simulated the polarization profiles of pulsars by considering different viewing conditions in the pulsars having an oblique dipolar magnetic field, and estimated the flux density. We discuss (1) the emission frequency mapping into radius and (2) whether sub-pulses and micro-pulses are temporal or angular features.</p>		

ASI2021_260	Ashwin Devaraj	Oral
NuSTAR view of the cyclotron line source, XTE J1946+274		
<p>XTE J1946+274 is a transient Be/X-ray Binary that has shown significant activity three times in the last two decades, undergoing type-II outbursts in 1998, 2010, and 2018. During these outbursts, it was observed using several X-ray observatories such as RXTE, BeppoSAX, Suzaku, and NuSTAR. It is among a subset of sources that exhibit a Cyclotron Resonance Scattering Feature in the hard X-ray spectra, at 38 keV. These cyclotron lines are the best diagnostic tool that we have access to in determining the magnetic field strength near the Neutron Star. A variety of cyclotron line sources have exhibited a positive correlation between their cyclotron line energy with the luminosity at which they were observed, a few showing no correlation and some showing a negative correlation. Since the cyclotron lines indicate the magnetic field strength at the region where they're formed, theories have been put forward attributing these correlations to be due to the variation in the height (above the surface of the NS) at which these lines are formed. Over the two decades, XTE J1946+274 has been seen over a wide range of luminosities,</p>		

nearly two orders of magnitude, but shows no clear variation with the luminosity. From the phase-resolved analysis of the 2018 outburst of this source using the NuSTAR observatory, we find that the cyclotron line is significantly observed in certain phases while it is absent in others. This result is in corroboration with the disappearance of the secondary peak in the double-peaked structure of the energy-resolved pulse profiles in the range of 32-42 keV.

ASI2021_213	Jayashree Roy	Oral
Study of recent outburst in the Be/X-ray binary RX J0209.6–7427 with AstroSat: a new ULX pulsar in the Magellanic Bridge?		
<p>We present the timing and spectral studies of RX J0209.6–7427 during its rare 2019 outburst using observations with the Soft X-ray Telescope (SXT) and Large Area X-ray Proportional Counter (LAXPC) instruments on the AstroSat satellite. Pulsations having a periodicity of 9.29 s were detected for the first time by the NICER mission in the 0.2–10 keV energy band and, as reported here, by AstroSat over a broad energy band covering 0.3–80 keV. The pulsar exhibits a rapid spin-up during the outburst. Energy resolved folded pulse profiles are generated in several energy bands in 3–80 keV. To the best of our knowledge, this is the first report of the timing and spectral characteristics of this Be binary pulsar in hard X-rays. There is suggestion of evolution of the pulse profile with energy. The energy spectrum of the pulsar is determined and from the best-fitting spectral values, the X-ray luminosity of RX J0209.6–7427 is inferred to be 1.6×10^{39} erg/s. Our timing and spectral studies suggest that this source has features of an ultraluminous X-ray pulsar in the Magellanic Bridge. Details of the results are presented and discussed in terms of the current ideas.</p>		

Parallel Session Extragalactic Astronomy III [Chairperson:]
Sunday, 21 February 2021 from 16.00 - 17.30

ASI2021_523	Rupjyoti Gogoi	Invited
Investigating Interstellar Dust Grains through Correlation Studies in the Magellanic Clouds		
<p>Studies of interstellar dust grains have always got attention as dust plays a vital role in determining the astrophysics of the Interstellar Medium. Important information about interstellar dust grains can be extracted from correlation studies. Therefore, one effective way to understand interstellar dust grain properties is through study of the observational data in different bands of the electromagnetic spectrum and to look for possible correlation among different wavebands. In our group, we are trying to estimate various physical properties of the interstellar dust in both the Magellanic Clouds in comparison to our Galaxy. As Large Magellanic Cloud and the Small Magellanic Cloud can be considered as ideal nearby laboratories to study dust properties and abundances, we are trying to explore the same through correlation studies at different wavebands using available observational data from missions like Spitzer, AKARI, FUSE, GALEX etc. After having a preliminary understanding of the properties of interstellar grains at different environment, we try to model the dust distribution in those galaxies.</p>		

ASI2021_527	Abinaya O O	Oral
Gaia view of a stellar sub-structure in front of the Small Magellanic Cloud		
<p>Recent observational studies identified a foreground stellar sub-structure traced by red clump (RC) stars (~ 12 kpc in front of the main body) in the eastern regions of the Small Magellanic Cloud (SMC) and suggested that it formed during the formation of the Magellanic Bridge (MB), due to the tidal interaction of the Magellanic Clouds. Previous studies investigated this feature only up to $4.^\circ 0$ from the centre of the SMC due to the limited spatial coverage of the data and hence could not find a physical connection with the MB. To determine the spatial extent and properties of this foreground population, we analysed data from the Gaia Data Release 2 (DR2) of a ~ 314 sq. deg region centred on the SMC, which cover the entire SMC and a significant portion of the MB. We find that the foreground population is present only between $2.^\circ 5$ to $\sim 5^\circ - 6^\circ$ from the centre of the SMC in the eastern regions, towards the MB and hence does not fully overlap with the MB in the plane of the sky. The foreground stellar population is found to be kinematically distinct from the stellar population of the main body with ~ 35 km s$^{-1}$ slower tangential velocity and moving to the north-west relative to the main body. Though the observed properties are not fully consistent with the simulations, a comparison indicates that the foreground stellar structure is most likely a tidally stripped counterpart of the gaseous MB and might have formed from the</p>		

inner disc (dominated by stars) of the SMC. A chemical and 3D kinematic study of the RC stars along with improved simulations, including both tidal and hydro-dynamical effects, are required to understand the offset between the foreground structure and MB. (Ref: <https://doi.org/10.1093/mnras/staa3085>)

ASI2021_77	Souradeep Bhattacharya	Oral
The recent formation history of Andromeda (M31) revealed from Planetary Nebulae		
<p>Andromeda (M31) is the nearest giant spiral galaxy to our Milky Way (MW) and the most massive member of our Local Group. A plethora of substructures have been photometrically identified in its inner halo revealing its tumultuous recent formation history. M31 is thus a prime laboratory for the study of hierarchical formation of spiral galaxies and in sharp contrast to the MW which has had no major galaxy mergers over the past 10 Gyr. Uniform measurements of kinematics and chemical abundances over the entire disc and inner halo of M31 is essential to understand its structure and evolutionary history. Given its large angular size and contamination from MW halo stars, such measurements are only possible from discrete tracers firmly in the M31 system. Planetary Nebulae (PNe), bright emission-line nebulae in the late-phase of stellar evolution, are excellent discrete tracers of light, chemistry and motion in galaxies. We carry out a 54 sq. deg. uniform deep narrow-band OIII survey with MegaCam@CFHT to identify ~5000 PNe in M31. Spectroscopic follow-up of a subsample of the PNe in the M31 disc was carried out with Hectospec@MMT. The identified PNe were separated into high- and low-extinction samples having average ages of ~2.5 Gyr and ~4.5 Gyr, forming the dynamically colder thin and dynamically hotter thick discs of M31 respectively. The two discs are also found to be chemically distinct from PN argon abundance distributions and thus have distinct origins. This is the first identification of the kinematically and chemically distinct thin and thick discs in M31. We find that the age-velocity dispersion relation in M31 is consistent with a single major merger that occurred 2.5-4.5 Gyr ago with a merger mass ratio ~1:5. The cannibalised satellite, about twice as massive as M33, was then the third largest member of the Local Group.</p>		

ASI2021_370	Sioree Ansar	Oral
A pilot study to determine halo spin and concentration for the galaxy UGC 5288 using simulations		
<p>We conduct a pilot study to estimate the halo properties- spin and concentration of a low luminosity dwarf barred galaxy UGC-5288 using the observed HI rotation curve and N-body/SPH simulations. These galaxies are rich in gas but show little star formation. They are found to have diffuse stellar disks, large HI gas content and very massive dark matter halos that are thought to have high angular momentum as suggested by galaxy formation theories and simulation studies in the literature. We use the neutral hydrogen (HI) rotation curves to estimate the halo mass and</p>		

concentration, and use near-infrared images of the optical disks to determine stellar disk mass and sizes. We simulate galaxies with the same structural and dynamical properties as the observed galaxy UGC 5288. We estimate the bar length and ellipticity using the SDSS i-band and z-band images and use them to match the bar's properties in our simulated models of UGC 5288. We determine the region in the halo properties' parameter space - spin and concentration, and disk parameter - scale height, which best represents the structural and dynamical properties of our sample galaxy. We are developing an automated pipeline that can estimate the halo properties for a larger number of observed galaxies using the method presented in this work. We further study the evolution of halo spin distribution with radius and compare the final halo spin at the radius r_{200} , to the theoretically estimated spins for different halo profiles.

ASI2021_522	Neeraj Kumari	Oral
X-ray and UV/optical variabilities in Mrk 509		
<p>In this work, we performed a detailed spectral and timing analysis of the Seyfert~1 galaxy Mrk~509 using data from the SWIFT observatory spanned over ~13 years. To study the variability properties from the Optical/UV to X-ray emission, we used a total of 275 observations in this work. The average spectrum over the entire duration exhibits a strong soft X-ray excess above the power-law continuum. The soft X-ray excess is well described by two thermal components. The warm thermal component is likely due to the presence of an optically thick and cool warm Comptonizing plasma in the inner accretion disc. The fractional variability amplitude is found to be decreasing with increasing wavelength i.e. from soft X-ray to UV/Optical emission. However, the hard X-ray (2-8 keV) emission shows a very low variability. The strength of the correlation between the hard X-ray and UV/optical emission is investigated and found to be lower compared to that of between the UV and Optical bands. These are confirmed by using the flux-flux positive offset method. These results clearly suggest that the emitting regions of the X-ray and UV/Optical emission are likely distinct or partly interacting. After removing slow variations, we find that the lag spectrum is well described by the 4/3 rule for the standard Shakura-Sunyaev disk when we omit X-ray lags. Observed zero lags among UV bands are possibly due to stratified regions in the disk. All these results suggest that the UV emissions are likely reprocessed in the accretion disk to give X-ray and the Optical emission.</p>		

Plenary Session 2 - Sun and Heliosphere [Chairperson: P. Sreekumar]
Monday, 22 February 2021 from 09:30 – 11:00

ASI2021_709	Sankarasubramanian Kasiviswanathan	Invited
Sun and Heliosphere: Remote Sensing with Aditya-L1		
<p>Aditya-L1 is India's first dedicated and approved observatory class mission for solar studies. The satellite will be placed at the Sun-Earth Lagrangian – L1 in order to observe the Sun uninterruptedly. The main scientific objective of this mission is to study the solar coronal and chromospheric dynamics. This mission carries seven payloads with four remote sensing and three in-situ instruments. While the remote sensing payloads observe the chromospheric and coronal dynamics, the in-situ payloads measure the particles and magnetic fields at L1 point which are modified by the activities originating from the Sun. In this presentation, the science capabilities of four remote sensing payloads will be discussed, especially the solar drivers for the heliosphere. As we know the heliospheric (between sun and Earth and beyond) conditions are governed by the solar drivers (Solar wind, Coronal Mass Ejections and Solar Flares). Solar wind will be studied using the in-situ experiments. The CMEs and Flares are the primary space weather drivers due to their sheer size, volume, magnetic field, and density. The four remote sensing payloads on Aditya-L1 would provide data sets which can study both CMEs and Flares together in a single space mission which has not been done so far. Uniqueness of science which can be carried out with these remote sensing payloads will be listed out. The overall combined science aspects from observations with multiple remote sensing payloads (apart from the individual science cases of each payload) will be described. Finally, the enhanced science which can be carried out with data from this mission in combination with other ground- and space-based observatories will be explored. Contents of the Talk: (i) What is Aditya-L1 and Science Advantage of being at L1 (ii) Science goals of individual remote sensing payload and its capabilities (iii) Unique science compared to other missions from individual payloads (iv) Science cases by combining payloads on-board Aditya-L1 (v) Enhanced science capabilities by combining data from Aditya-L1 and from other ground- and space-based observatories.</p>		

ASI2021_422	Dibyendu Chakrabarty	Invited
Why are in-situ measurements from Aditya-L1 important?		
<p>The Aditya-L1 mission is India's first dedicated mission to observe the Sun round-the-clock. In addition to the experiments targeted to understand the solar and coronal processes, the mission also includes a number of in-situ experiments. These experiments are Aditya Solar Wind Particle Experiment (ASPEX), Plasma Analyzer Package for Aditya (PAPA) and Magnetometer</p>		

(MAG). Through these experiments, the solar wind (ions and electrons), supra-thermal and solar energetic particles as well as magnetic field will be measured in multiple directions from the first Lagrangian point (L1) of the Sun-Earth system. Such measurements can throw light on a number of complex processes (like origin, acceleration, seed population, anisotropy etc.) that are not comprehensively understood till date. Understanding on such processes are of paramount importance to connect the solar processes to the space weather conditions prevalent around our planet. The talk will highlight a few such exciting and unresolved scientific issues that can be addressed based on the in-situ measurements and combining these with measurements by other payloads on-board Aditya-L1.

ASI2021_399	Bidya Binay Karak	Invited
Recent Developments in the Babcock-Leighton Solar Dynamo Theory		
<p>The magnetic field of the Sun increases and decreases in time with a polarity reversal every 11 years. The most interesting aspect here is that the amplitude of the field does not grow all the time, although there is a considerable variation in time. It is believed that a dynamo mechanism, operating in the convection zone of the sun, is responsible for producing these peculiar features in the magnetic field. Based on the limited observations of the solar magnetic field in the 1960s, Babcock and Leighton proposed a mechanism for the maintenance of the solar cycle. However, due to insufficient observational facts, scientists barely recognised this idea, rather tried to model the magnetic cycle through MHD convection simulation which eventually gave a little success. In recent years, long-term data produced from different observatories (including century-old Kodaikanal Solar Observatory) enabled us to validate the original idea of Babcock and Leighton. After giving some historical developments of this idea in this presentation, I shall discuss how well the solar cycle can be explained through the dynamo models developed based on the Babcock-Leighton mechanism. I shall also highlight different nonlinear mechanisms responsible for regulating the solar cycle amplitude, causes for making the cycle irregular, and the scope for prediction.</p>		

Thesis Session II
[Chairperson: Dipankar Banerjee]
Sunday, 21 February 2021 from 13.30 - 15.15

ASI2021_815	Panini Singam	Invited
Design and development of Multilayer mirrors for astronomical applications		
<p>The recent progress in the development of multilayer mirrors has revolutionized the field of astronomical X-rays optics. A variety of multilayer mirrors are now being developed for several unique applications such as hard X-ray imaging telescopes and soft X-ray polarimeters. Technology development to fabricate good-quality multilayer mirrors carries significant importance for the realization of next-generation X-ray instruments. In this thesis, we have presented our progress in fabricating and characterizing high-quality W/B4C multilayer mirrors for various applications. We have also discussed the design and development of two X-ray instruments using the combination of grazing incidence X-ray concentrator and multilayer mirrors. We fabricated W/B4C multilayer mirrors with varied design parameters using a magnetron sputtering technique. We studied the performance and structural stability of these mirrors over time and by subjecting these mirror to the temperature variation analogous to the satellite in low earth orbit using soft X-ray, hard X-ray reflectivity as well as scanning electron microscopic studies for estimating the contamination and surface quality. We observed that multilayers with small thickness are more stable than the large thickness multilayers. We designed a multilayer mirror-based soft X-ray polarimeter to operate at energies less than 1 keV. We proposed this design coupled with a hard X-ray polarimeter as a simultaneous back-end instrument to a hard X-ray telescope. For this application, to make multilayer mirrors transparent to hard X rays, we etched the Silicon substrate of the mirrors to reduce the absorption. We observed that the etching process significantly degraded the performance of large thickness multilayers (~ 5 nm) while the process did not affect the performance of short thickness multilayers (~ 3 nm).</p>		

ASI2021_307	Chayan Mondal	Oral
Multi-wavelength study of star formation in nearby galaxies		
<p>The thesis presents one of the first studies highlighting the unique capability of the instrument Ultra-Violet Imaging Telescope (UVIT) in identifying star-forming regions in nearby galaxies up to smaller length scales ($\sim 10 - 25$ pc for a distance up to 1 - 4 Mpc). This improvement in the spatial limit has helped us characterize the structure and the hierarchical nature of star-forming clumps in UV better than the GALEX. Our study demonstrates that the FUV and NUV fluxes together can help to characterize (i.e., age, mass) unresolved stellar clumps of age up to a few hundred Myr in nearby galaxies. We studied two dwarf irregular (WLM, IC\sim2574) and two</p>		

spiral (NGC~7793, NGC~300) galaxies using multi-band data and understand that the star formation in these galaxies has some connection with different feedback, such as stellar feedback or spiral density wave, or ram pressure. The stellar feedback is found to play a crucial role in controlling the recent star formation and redistributing the neutral ISM in both the dwarf systems. We noticed both the spiral galaxies to support the inside-out disk growth scenario with enhanced star formation along the spiral arms. We found the sizes of the star-forming regions detected by the UVIT in these galaxies have a range between $\sim 10 - 150$ pc, which is similar to the sizes of OB associations in nearby dwarf and spiral galaxies. We also noticed that star formation is favoured mostly in locations with H I column density greater than 10^{21} cm^{-2} .

ASI2021_433	Dipanweeta Bhattacharyya	Oral
Cosmic evolution of black holes and the $M_{\bullet} - \sigma$ relation		
<p>The thesis is devoted to a study of the evolution of black holes and the $M_{\bullet} - \sigma$ relation. We have considered realistic elliptical (spherical) galaxy profiles that are taken to follow a single power-law density profile or the Nuker intensity profile. Assuming a proportionality relation between the black hole mass and bulge mass, $M_{\bullet} = f_b M_b$, and applying this to several galaxies, we found the best fit global σ and f_b, by minimizing χ^2, which are consistent with the observed ranges. We have built an evolution model of the central black hole that depends on the processes of gas accretion, stellar capture, mergers, and electromagnetic torque. In the case of gas accretion in the presence of cooling sources, the flow is momentum-driven, after which the black hole reaches a saturated mass; subsequently, it grows only by stellar capture and mergers. We model the evolution of the mass and spin with the initial seed mass and spin in ΛCDM cosmology. For stellar capture, we have assumed a power-law density profile for the stellar cusp in a framework of relativistic loss cone theory that includes the effects of black hole spin, Carter's constant, loss cone angular momentum, and capture radius. We have considered the merger activity to be effective for $z \lesssim 4$, and we self-consistently include the Blandford--Znajek torque. We calculate these effects on the black hole growth individually and in combination, for deriving the evolution. Before saturation, accretion dominates the black hole growth ($\sim 95\%$ of the final mass), and subsequently, stellar capture and mergers take over with roughly equal contributions. The applications of this model include the evolution of the $M_{\bullet} - \sigma$ relation, black hole archaeology, and formation of supermassive black hole seeds from stellar-mass black holes by stellar capture.</p>		

ASI2021_446	RUBINUR KHATUN	Oral
A Radio and Ultraviolet Study of Dual Nuclei in Galaxies		
<p>Supermassive black hole (SMBH) binaries form due to galaxy mergers . When the SMBHs are accreting, they form dual or binary AGN and can give rise to double-peaked emission lines in the optical spectra of the merger remnant. The double-peaked emission lines could also be due to jet-ISM interaction or rotating disks. One of the best ways to confirm dual/binary AGN in double-peaked AGN (DPAGN) is by using high resolution radio observations. We have observed a sample of 20 DPAGN at two or more frequencies using the Karl G. Jansky Very Large Array (VLA). We have detected dual radio structures at separation of $<\sim 10$ kpc in three of our sample galaxies. Using the spectral index maps and optical spectra of the sources, we have confirmed that one of them is a dual AGN (DAGN), while the other two can be dual AGN or AGN+ star-forming nuclei pairs. Of the remaining sources, two have clear core-jet structure. The remaining 13 sources are single cores while one source is not detected at any frequency. We find that for our dual AGN detection, the DPAGN emission lines do not originate from the dual/binary AGN. Hence, we conclude that DPAGN identified in low resolution SDSS spectra are not good indicators of DAGN. On the other hand, closely interacting galaxies or merger remnants are good candidates for detecting dual/binary AGN. We started ultra- violet imaging observations of a sample of ~ 10 dual nuclei galaxies to detect the UV emission from their nuclei as well as star formation from the surrounding regions. We have used the high resolution ultra-violet imaging telescope (UVIT) which is mounted on the Astrosat satellite for these observations. For one of the sources MRK 212, we have done followup multi-wavelength (VLA, GMRT, HCT, UVIT) studies to confirm the nature of the nuclei.</p>		

ASI2021_479	Priyanka Rani	Oral
Temporal and Spectral Characteristics of Active Galactic Nuclei in X-rays using NuSTAR		
<p>The primary X-ray emission in active galactic nuclei (AGN) is believed to originate in a compact region called the corona situated very close to the central supermassive black hole (SMBH) and the accretion disk. The very central region of AGN is also very difficult to probe directly, as it is beyond the reach of any direct imaging telescopes. The motivation behind this thesis is therefore to probe the central regions of AGN via timing and spectral analysis of the hard X-ray emission received from them. Towards this, data in the 3-79 keV band from the Nuclear Spectroscopic Telescope Array (NuSTAR) was used. For timing analysis we used data for a total of 335 AGN (557 sets of observations) that comprises of 24 BLLac objects (BL Lacs), 24 flat spectrum radio quasars (FSRQs), 20 Narrow Line Seyfert 1 (NLSy1) galaxies, 121 Seyfert 1 galaxies and 146 Seyfert 2 galaxies. Our analysis indicates that on hour like time scales, blazars (that includes FSRQs and BL Lac objects) are more variable than their radio-quiet counterparts namely the Seyfert galaxies, which is attributed to the contribution of relativistic jets to the observed X-ray emission in blazars. We also found brighter AGN to be less variable as well as</p>		

AGN powered by more massive black holes to be less variable. For spectral analysis we carried our several model fits to a sample of 12 sources to derive the cut-off energy (E_{cut}) as it carries information on the physical characteristics of the corona. In this thesis we derived first time E_{cut} measurements for 11 sources and an upper limit for one. Details of the work will be presented.

ASI2021_473	Ranadeep Sarkar	Oral
Solar Origin of Space Weather		
<p>Coronal mass ejections (CMEs), the gigantic clouds of magnetized plasma that routinely erupt from the Sun, are recognized as one of the major solar origins of space weather disturbances. If the magnetic field inside an Earth-directed CME has a component (B_z) opposite to Earth's magnetic field, then it can lead to severe geomagnetic storms. Therefore, it is crucial to predict the strength of B_z inside an Earth impacting interplanetary CME (ICME). Based on the observational and modelling efforts, in this thesis, we explore the origin and evolution of CMEs aiming to forecast its space weather impact on Earth. Our studies on the source region characteristics of CMEs reveal the conditions leading to CME eruptions and also carry significant implications for the forecasting of recurrent large eruptive events from the same AR and hence the chances of interaction between the associated CMEs. Our studies on the CME initiation in lower corona and its subsequent evolution in interplanetary space provides the important observational constraints on the CME evolution. Combining the knowledge of CME evolution and its near-Sun properties, we developed a model, the INterplanetary Flux ROpe Simulator (INFROS), which shows promising results in forecasting of B_z in real time and is advantageous in many aspects compared to the existing B_z forecasting models. The novel techniques to predict the magnetic field vectors of ICMEs as explored in this thesis build the stepping stones towards the forecasting of intensity of the associated geomagnetic storms at near-Earth space.</p>		

Parallel Session Sun and the Solar System II [Chairperson: Shyama Narendranath] Monday, 22 February 2021 from 16.00 - 17.30
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ASI2021_472	Shashikiran Ganesh	Invited
Minor bodies and their composition		
<p>Minor bodies are an important constituent of the solar system. As leftovers from the time of formation of the planetary system, they can provide key insight into the formation and further evolution of the system. At PRL, we have been involved in observations of the minor bodies of the solar system over several decades starting with polarimetric observations. We have, in recent times, added spectroscopy to the repertoire. Many comets and asteroids have been studied with spectrographs such as LISA (on the 1.2 m and 50 cm telescopes at Mount Abu) and the HFOSC and HESP (on the HCT). Recently we were also successful in obtaining images and spectra of the first interstellar comet 2I/Borisov using the Indian facilities. Results show that there is a similarity in the spectroscopic behaviour of this interstellar comet with that of the Solar system comets. The polarimetric database for comets has a large contribution from PRL's facilities. Taking advantage of these, we have recently constructed a dust model and simulated the polarisation phase curve for several comets. This simulation was done using PRL's Vikram-100 High-Performance Computing (HPC) facility. We shall present some of the results of our observations and the simulations in the talk.</p>		

ASI2021_50	Vishal Goyal	Oral
Effects of size of sinking iron-blobs on lunar core formation		
<p>Moon is unique among terrestrial planetary bodies. Compared to other terrestrial bodies, the Moon has a low metallic content (1-1.5%). Further, the Moon is volatile-depleted. Also, the Earth-Moon system possesses a high angular momentum. These observations contraindicate the traditional models, like cogenetic accretion, fission hypothesis, and capture hypothesis, of planetary formation for the Moon's case. Therefore, the giant impact hypothesis is considered the most plausible hypothesis for lunar formation [see, e.g., Salmon and Canup 2014]. The giant impact hypothesis involves the collision of two proto-planetary bodies resulting in Earth with a hot debris disk. This debris disk later produced moonlets on a timescale of a few hundred years. The moonlets then accreted on each other to finally form our Moon. Based on the scenario, we had studied (Sahijpal and Goyal 2018) the early evolution of the Moon. Afterward, we recently developed a novel numerical code in Python to incorporate physicochemical processes more realistically. These improvised models include several advancements, viz. incorporating local Rayleigh numbers, radially varying Stoke's flow, gravitational energy released, optical heat diffusion, and composition modification from modified H-chondrites to LPUM. Based on these improvised models, we will discuss the effects of the size of sinking iron-blobs on lunar core formation.</p>		

ASI2021_420	Sana Ahmed	Oral
Modelling the atmosphere of comets with different volatile compositions		
<p>Comets are the most numerous objects of the Solar System, and are made up of frozen volatiles and refractory dust grains. They move in elliptical orbits about the sun, and solar heating causes the sublimation of the volatile ices, forming the cometary atmosphere or the coma. The volatile composition of the coma is generally diverse, but H₂O is a primary constituent in most of the cases. This is followed by CO and CO₂, whose abundance percentage with respect to H₂O varies between 1% to 30%. Trace amounts of other species such as CH₄, CH₃OH, O₂, and NH₃ are also present. In some comets, the observed CO/H₂O ratios are $\gg 1$. One such comet that has a coma dominated by CO outgassing is C/2016 R2 (PanSTARRS). Solar UV radiation causes photodissociation of the sublimated parent volatile species in the coma, creating ions and radicals that drive the coma chemistry. The density in the inner region of the coma (~ 10000 km) is high enough to treat the coma gas as a fluid. We have constructed a fluid model, using the principles of conservation of mass, momentum and energy, in order to study the chemistry and dynamics of the coma. We have used the model to study comets having different volatile compositions. The model results show that when the dominant parent volatile changes from H₂O to CO, there is significant alteration in the coma chemistry and dynamics. Varying the percentage of CO₂, and other trace volatiles also changes the ion chemistry of the coma.</p>		

ASI2021_266	RITESH Kumar MISHRA	Oral
Evidence of multiple episodes of superflares during the birth of Our Sun		
<p>Determination of intensity and frequency of flares during the birth and neo-natal stage of the Sun are one of the most important unknowns in Solar system studies with implications for unique features of our solar system and several other questions including the origin and evolution of life. Sun-like stars during pre-main sequence stages (class 0-III) exhibit multiple episodes of variable and high intensity of activity of effusion of mass and radiation that are key determinant in the final architecture of any planetary systems. Study of short-lived now-extinct radionuclides (SLRs) present in the primitive meteorites provide evidences of these early solar system events and processes. A recent study of ⁷Be ($t_{1/2} = 53$ days) and ¹⁰Be ($t_{1/2} = 1.38$ Ma) SLRs that decay to ⁷Li and ¹⁰B respectively provided the first evidence of a super flare from our Sun during its nascent age of ~ 0.5 Ma about 4567 Ma ago [1]. In the present ⁷Be-⁷Li and ¹⁰Be-¹⁰B isotopic study of one of the first forming solids of the Solar system called Calcium-aluminum-rich inclusion (CAI) from Vigarano meteorite, a well resolved excesses in the daughter nuclides of ⁷Li and ¹⁰Be that correspond to initial ⁷Be/⁹Be of $(4.3 \pm 3.5) \times 10^{-3}$ and ¹⁰Be/⁹Be of $(1.4 \pm 1.2) \times 10^{-2}$ (2σ) were obtained from in-situ isotopic studies using high-resolution secondary ion mass spectrometer. The observed abundances of these radionuclides in the CAI that formed during the fiducial birth of the Solar system (0.07 ± 0.08 Ma; inferred from previous ²⁶Al-²⁶Mg isotopic study) implies (1) multiple episodes of super flares from our Sun (2) the inferred intensity of super flare during</p>		

the particular event was $L_x = \sim 5 \times 10^{32}$ erg/sec, (3) the intensities of solar flares were higher and probably reached its maximum during the class I and II stage of the pre-main sequence. [1] R. K. Mishra, K. K. Marhas Nature Astronomy, 3, 498-505, 2019.

ASI2021_528	Biswajit MONDAL	Oral
Soft X-ray spectroscopy of the quiet solar corona and elemental composition with Solar X-ray Monitor (XSM) onboard Chandrayaan-2		
<p>To understand the formation, structure, and evolution of the Sun and the solar system as a whole, a thorough knowledge of solar elemental abundances is essential. The energy transport mechanism from the solar surface to its upper atmosphere can also be understood by studying the elemental compositions at different atmospheric layers of the Sun. Elements with low FIP (≤ 10 eV) are seen to be two to four times more abundant in the corona compared to the solar photosphere. This phenomenon is known as the “FIP effect” and is yet to be understood well. However, theoretical understanding suggests magnetic field may play an important role in the abundance enhancement. Here we present the high energy-resolution soft X-ray spectroscopic observations with the solar X-ray Monitor (XSM) onboard Chandrayaan-2 during the quietest solar minima of the last century. We derive the absolute elemental abundances of Mg, Al, and Si in the quiet solar corona. During our observation, most of the X-ray emission is seen to have originated from the X-ray bright points (XBP) associated with the weak magnetic fields present on the solar disk. The observation suggests a lower FIP effect for the on-disk XBPs and demonstrates the role of magnetic fields in enhancing the coronal abundances.</p>		

Parallel Session Stars, ISM and Galaxy IV [Chairperson: Jeewan Pandey]
Monday, 22 February 2021 from 16.00 - 17.30

ASI2021_574	Bharat Kumar Yerra	Invited
Evolution of Lithium in low-mass stars: an observational perspective		
<p>Lithium is a fragile element and a sensitive probe to non-standard processes occurring in stellar interiors--lithium anomaly found in different phases of low mass star's evolution. The overabundance of lithium in low-mass red giants has been a topic of interest for over four decades. Low-mass stars expected to destroy lithium gradually throughout their lifetimes. Against this expectation, about 1% of red giants in the Galaxy show anomalously large Li which, in the literature, are known as lithium-rich giants. The advent of large-scale stellar surveys enabled to find important clues about Li enhancement origin in red giants. These new studies suggest Li enhancement is mostly associated with the red clump phase, post-He-flash of low mass star's life. Recently, we found that all red clump stars are having high levels of Li. In this talk, we will describe our recent results along with current updates in the field.</p>		

ASI2021_448	SHANTI PRIYA DEVARAPALLI	Oral
Period Variations in Active Flaring Binary BX Tri - Magnetic Activity Cycle or Tertiary Companion?		
<p>Flaring activity in the Sun and Sun like stars are not only prominent features to study but can also act as tools to quantify the magnetic activity and magnetic activity cycles in the stellar systems. For more than a decade BX Tri has been studied for its flaring activity. The current paper presents the preliminary results of long-term period variation studies on eclipsing binary with M-type components-BX Tri, using the literature and the latest data available from TESS database. A total of 33 times of primary minima collected from TESS along with 71 times of minima from the literature, spanning more than a decade, have been used to obtain the Eclipse Timing diagram. Results obtained from the best fit are discussed. In addition, flaring activity of the binary components are studied for the data obtained from TESS and other archival databases. The results are compared with other flaring binaries to understand the nature of magnetic activity/activity cycle in flaring binaries, and validate or invalidate the magnetic activity-binarity relation.</p>		

ASI2021_325	Susmita Das	Oral
Period-luminosity and period-radius relations for MESA-computed BL Her models		
<p>We present new multiwavelength (UBVRI JHKLL'M) period-luminosity (PL) and period-radius (PR) relations 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. $1 \leq P(\text{days}) \leq 4$ covering a wide range of input parameters - metallicity ($-2.0 \text{ dex} \leq [\text{Fe}/\text{H}] \leq 0.0 \text{ dex}$), stellar mass ($0.5M_{\odot} - 0.8M_{\odot}$), luminosity ($50L_{\odot} - 300L_{\odot}$) and effective temperature (full extent of the instability strip; in steps of 50K). We study the effect of metallicity and four sets of different convection parameters on the PL and PR relations at mean light. The theoretical PL and PR relations obtained using our computed BL Her models match well with empirical relations. However, PL slopes of the models with radiative cooling provide a better match to empirical relations for BL Her stars in the LMC in the HK bands. For each set of convection parameters, the effect of metallicity is negligible in infrared bands, consistent with empirical results. No significant metallicity effects are seen in the PR relations.</p>		

ASI2021_75	Nazma Husain	Oral
Detection of mHz frequency break in weak low/hard state of GX 339-4 using AstroSat data		
<p>Using AstroSat data, we report the detection of a characteristic mHz low-frequency break in the power density spectrum (PDS) of GX 339-4 in weak low/hard state, when the source luminosity was 0.002 that of the Eddington value. The source was at the beginning of a failed outburst in 2017. The X-ray spectral continuum could be well described by an absorbed power-law with photon index ~ 1.57. Addition of a reflection component in the spectral modelling improves the chi-squared fit, showing the possibility of weak broadened reflection features in the energy spectrum. We perform timing analysis by studying the PDS with data from detectors LAXPC 10, LAXPC 20 and SXT of AstroSat. The PDS exhibits band-limited noise with a mHz low-frequency break in all three detectors, which are the two typical features of low/hard state in Blackhole systems. When compared to earlier low luminosity observations of this source, our result fits in a positive correlation found between break frequency and unabsorbed flux. Also, the mHz break frequency may be associated with the viscous time scale of the truncation radius at ~ 142 gravitational radii.</p>		

ASI2021_179	Anusha R	Oral
Identification of new Classical Ae stars in the Galaxy using LAMOST DR5		
<p>We report the first systematic study to identify and characterize a sample of classical Ae stars in the Galaxy. The spectra of these stars were retrieved from the A-star catalog using the Large sky Area Multi-Object fiber Spectroscopic Telescope (LAMOST) survey. We identified the emission-</p>		

line stars in this catalog from which 159 are confirmed as classical Ae stars. This increases the sample of known classical Ae stars by about nine times from the previously identified 21 stars. The evolutionary phase of classical Ae stars in this study is confirmed from the relatively small mid- and far-infrared excess and from their location in the optical color-magnitude diagram. We estimated the spectral type using MILES spectral templates and identified Classical Ae stars beyond A3, for the first time. The prominent emission lines in the spectra within the wavelength range 3700 -- 9000 Å are identified and compared with the features present in classical Be stars. The H-alpha emission strength of the stars in our sample show a steady decrease from late-B type to Ae stars, suggesting that the disc size may be dependent on the spectral type. Interestingly, we noticed emission lines of FeII, OI and Paschen series in the spectrum of some classical Ae stars. These lines are supposed to fade out by late B-type and should not be present in Ae stars. Further studies, including spectra with better resolution, is needed to correlate these results with the rotation rates of classical Ae stars.

Parallel Session
General Relativity and Cosmology I
[Chairperson: Tirthankar Roy Choudhury]
Monday, 22 February 2021 from 16.00 - 17.30

ASI2021_510	Sriramkumar L.	Invited
Signatures of enhanced scalar power on small scales		
<p>The primordial scalar power spectrum is well constrained on large scales, primarily by the observations of the anisotropies in the cosmic microwave background. However, the current bounds on the scalar power spectrum at small scales are considerably weaker. In this talk, I shall outline as to how a sharp rise in the scalar power on small scales leads to enhanced formation of primordial black holes and produces secondary gravitational waves of higher and, possibly, detectable amplitudes. I shall present the inflationary scenarios we have examined that can generate increased power on small scales. I shall also describe the inflationary scalar non-Gaussianities generated in such scenarios and discuss its implications for the strength of the secondary gravitational waves. Moreover, I shall illustrate the difficulty in generating enhanced power on small scales from squeezed initial states. Finally, I shall conclude with a brief summary and scope.</p>		

ASI2021_67	Shikhar Mittal	Oral
Lyman- α coupling and heating at Cosmic Dawn		
<p>The global 21-cm signal from the cosmic dawn is affected by a variety of heating and cooling processes. We investigate the impact of heating due to Lyman-α ($\text{Ly } \alpha$) photons on the global 21-cm signal during cosmic dawn using an analytical expression of the spectrum around the $\text{Ly } \alpha$ resonance based on the so-called 'wing approximation'. We perform a short parameter study by varying the $\text{Ly } \alpha$ background intensity by four orders of magnitude and establish that a strong $\text{Ly } \alpha$ background is necessary, although not sufficient, in order to reproduce the recently detected stronger-than-expected 21-cm signal by the EDGES Collaboration. We show that the magnitude of this $\text{Ly } \alpha$ heating is smaller than previously estimated in the literature by two orders of magnitude or more. As a result, even a strong $\text{Ly } \alpha$ background is consistent with the EDGES measurement of the global 21-cm absorption signal.</p>		

ASI2021_143	Aritra Kundu	Oral
Cosmic recombination history in light of EDGES measurements of the cosmic dawn 21-cm signal		
<p>Cosmic Dawn is one of the most important epoch in the early Universe, which can be studied using the hydrogen 21-cm line. The recent EDGES measurements of the global 21-cm signal from the cosmic dawn suggest a possibility of the kinetic temperature of the inter-galactic medium</p>		

(IGM) being significantly lower compared to its expected value. The colder IGM directly affects the hydrogen recombination of the universe during the cosmic dawn and dark ages by enhancing the rate of recombinations. Here, we study and quantify, the impact of the colder IGM scenario on the recombination history of the universe in the context of dark matter-baryon interaction model which is widely used to explain the depth of the EDGES 21-cm signal. We find that, in general, the hydrogen ionization fraction gets suppressed during the dark ages and cosmic dawn and the suppression gradually increases at lower redshifts until X-ray heating from the first stars turns on. However, accurate estimation of the ionisation fraction requires knowledge of the entire thermal history of the IGM, from the epoch of thermal decoupling of hydrogen gas and the CMBR to the cosmic dawn. It is possible that two separate scenarios which predict very similar HI differential temperature during the cosmic dawn and are consistent with the EDGES 21-cm signal might have very different IGM temperature during the dark ages. The evolution of the ionization fraction in these two scenarios are quite different. This prohibits us to accurately calculate the ionization fraction during the cosmic dawn using the EDGES 21-cm signal alone. We find that the changes in the ionization fraction w.r.t the standard scenario at redshift $z \sim 17$ could be anything between $\sim 0\%$ to $\sim 36\%$. This uncertainty may be reduced if measurements of HI 21-cm differential temperature at multiple redshifts are simultaneously used.

ASI2021_183	Arnab Chakraborty	Oral
First multi-redshift limits on post-Epoch of Reionization (post-EoR) 21 cm signal from $z = 1.96 - 3.58$ using uGMRT		
<p>Measurement of fluctuations in diffuse HI 21 cm background radiation from the post-reionization epoch ($z < 6$) is a promising avenue to probe the large scale structure of the Universe and understand the evolution of galaxies. We observe the European Large-Area ISO Survey-North 1 (ELAIS-N1) field at 300-500 MHz using the upgraded Giant Meterwave Radio Telescope (uGMRT) and employ the ‘foreground avoidance’ technique to estimate the HI 21 cm power spectrum in the redshift range $z = 1.96-3.58$. Given the possible systematics that may remain in the data, we find the most stringent upper limits on the spherically averaged 21 cm power spectra at $k \sim 1.0 \text{ Mpc}^{-1}$ are $(58.87 \text{ mK})^2$, $(61.49 \text{ mK})^2$, $(60.89 \text{ mK})^2$, $(105.85 \text{ mK})^2$ at $z = 1.96, 2.19, 2.62$ and 3.58, respectively. We use this to constrain the product of neutral HI mass density (Ω_{HI}) and HI bias (b_{HI}) to the underlying dark matter density field, $[\Omega_{\text{HI}} * b_{\text{HI}}]$, as $0.09, 0.11, 0.12, 0.24$ at $z = 1.96, 2.19, 2.62, 3.58$, respectively. To the best of our knowledge these are the first limits on the HI 21 cm power spectra at the redshift range $z = 1.96 - 3.58$ and would play a significant role to constrain the models of galaxy formation and evolution.</p>		

ASI2021_124	Susmita Jana	Oral
Constraints on the non-minimal coupling of Electromagnetic fields from astrophysical observations		
<p>Strong gravity regions, like the neighborhood of black holes or neutron stars, can induce non-minimal couplings between electromagnetic fields and gravity. In these regions, gravitational fields behave as a non-linear medium in which the electromagnetic fields propagate. For a system of mass M and size L, the surface potential scales as M/L. Pulsar timing array, Double pulsar Shapiro delay, and Event horizon telescope probe that largest surface potentials [$10^{-4} - 10^{-2}$]. With many future experiments, it is possible to constrain the non-minimal coupling between electromagnetic fields and gravity. As a step in this direction, we consider the non-minimal coupling of electromagnetic EM field tensor through Riemann and Ricci tensors. The non-minimal coupling leads to a modified dispersion relation of photons, leading to a different photon arrival time for the two polarizations. We compare the analytical results with the current astrophysical observations to constraint the non-minimal coupling parameters to Riemann and Ricci tensors.</p>		

ASI2021_546	Kamal Bora	Oral
Constraints on the variation of fine structure constant from joint SPT-SZ and XMM-Newton observations		
<p>We search for a variation of the electromagnetic fine structure constant ($\alpha \equiv e^2/\hbar c$) using a sample of 58 SZ selected clusters in the redshift range ($0.2 < z < 1.5$) detected by the South Pole Telescope, along with X-ray measurements using the XMM-Newton observatory. We use the ratio of the integrated SZ Compto-ionization to its X-ray counterpart as our observable for this search. We first obtain a model-independent constraint on α of about 0.7%, using the fact that the aforementioned ratio is constant as a function of redshift. We then look for logarithmic dependence of α as a function of redshift: $\Delta\alpha/\alpha = -\gamma \ln(1 + z)$, as this is predicted by runaway dilaton models. We find that $\gamma = -0.046 \pm 0.1$, which indicates that there is no logarithmic variation of α as a function of redshift. We also search for a dipole variation of the fine structure constant using the same cluster sample. We do not find any evidence for such a spatial variation.</p>		

Plenary Session 3 - Star formation, Galaxies and ISM [Chairperson: Annapurni Subramaniam]
Tuesday, 23 February 2021 from 09:30 – 11:00

ASI2021_359	Kanak Saha	Invited
AstroSat detection of Lyman continuum photons from a galaxy at $z=1.42$		
<p>One of the outstanding problems of current observational cosmology is to understand the nature of sources that produced the bulk of the ionizing radiation after the Cosmic Dark Age. Direct detection of these reionization sources is practically infeasible at high redshift due to the steep decline of the intergalactic medium transmission. Not surprisingly, only a handful of ionizing sources are discovered to date. In this talk, I report the detection of Lyman continuum photons with high escape fraction ($> 20\%$) from a low-mass clumpy galaxy, called AUDFs01 at $z=1.42$, in the middle of a redshift range where no detection has been made before. The detection of extreme ultraviolet radiation from a distant galaxy at rest-frame 600 Angstrom opens up a new window to constrain the shape of the ionisation spectrum. Further observations with AstroSat should substantially increase the sample of Lyman-continuum leaking galaxies at Cosmic Noon.</p>		

ASI2021_404	Liton Majumdar	Invited
From Molecular Clouds to Planetary Systems: A new era of ALMA and JWST		
<p>One of the most exciting developments in astronomy is the discovery of planets around stars other than our Sun. More than four thousand exo-planets have now been detected. But how do these planets form, and why are they so different from those in our own solar system? Which ingredients are available to build them? Thanks to powerful ground-based telescopes such as the Atacama Large Millimeter Array (ALMA) and soon the James Webb Space Telescope (JWST), we are now in a position to address these age-old questions scientifically. The formation of stars and planetary systems takes place in "molecular clouds". These dense ($\sim 100,000$ H₂ molecules per cc), cold (~ 10 K), dust enshrouded regions of the interstellar medium exhibit a high degree of molecular complexity. I will discuss how this complexity develops in molecular clouds, and how far it progresses before the molecules are incorporated as ices into planetesimals in protoplanetary disks and delivered to planets in the habitable zone. I present recent spectroscopic observations carried out using IRAM-30m telescope, NOEMA, and ALMA interferometers. I also discuss prospects for continuing such studies using JWST.</p>		

ASI2021_288	Sarita Vig	Invited
Star Formation and its effect on the surrounding interstellar medium		
<p>Stars are born deeply embedded in cocoons of gas and dust in dense molecular clouds. In the process of star formation, the surrounding interstellar medium is influenced in multiple ways due to feedback from the evolving young stellar objects. These effects include the impact of protostellar jets on the ambient medium, and expansion of HII regions around young massive stars, among others. I will present our current understanding of star formation and few of these feedback processes, drawing examples from observations and theory. Assimilating these feedback effects is pivotal to our understanding of star-formation and its evolution on large scales.</p>		

Parallel Session Sun and the Solar System III [Chairperson: Abhishek Kumar Srivastava] Tuesday, 23 February 2021 from 11.45 - 12.45
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ASI2021_462	Girjesh R Gupta	Invited
Heating of small-scale loops by solar UV bursts		
<p>Solar ultraviolet bursts (UVBs) are intense, short-lived, and compact brightening events observed at $\sim 10^5$ K. Their intense emission with highly complex Si IV line profiles and optically thin formation provides unique diagnostic opportunities for studying the dynamics and heating of lower solar atmosphere. In this talk, few studies of UV bursts which lead to the brightening of associated overlying small-scale short-lived hot and cool loops will be presented. Density estimates suggest that these bursts are occurring at low/mid chromospheric heights. Some of these bursts are associated with photospheric magnetic flux cancellation sites, thus suggesting that these bursts are probably small-scale magnetic reconnection events. We will also discuss estimates on available magnetic energy, and thermal and kinetic energy released during the bursts.</p>		

ASI2021_178	Vishal Upendran	Oral
Quiet sun coronal heating by nanoflares		
<p>The solar corona consists of a million degree Kelvin plasma. To understand the heating of the solar corona, the Quiet Sun regions must be studied, and the feasibility of possible heating mechanisms evaluated. In this work, we assume an impulsive heating forward model to infer the flaring frequency, flaring timescale and power-law slope α. We perform the inversion for parameters using a neural network, while quantifying the uncertainties in the inversion. We find nanoflares to be a viable source of heating for intensities observed in all of our selected passbands. We then explore various relations between these free parameters, which are explained using simple scaling relations and prior observations. Furthermore, we find the average nanoflare energy increases with photospheric magnetic field strength for < 100 Gauss, confirming that the energy indeed comes from the photospheric magnetic field.</p>		

ASI2021_58	Devojyoti Kansabanik	Oral
Estimating plasma parameters of coronal mass ejections at higher coronal heights using high fidelity low-frequency radio images		
<p>Coronal Mass Ejections (CMEs) are large scale explosive eruptions of magnetised plasma from the Sun into the Heliosphere. Measuring the physical parameters of CMEs is crucial for understanding their physics and for assessing their geo-effectiveness. Radio observations offer</p>		

the most direct means for estimating these plasma parameters when gyrosynchrotron (GS) emission is detected from the CME plasma. However, since the first detection by Bastian et al. (2001), only a handful of studies have successfully detected GS emission from CME plasma. This is usually attributed to the challenges involved in obtaining the high dynamic range imaging required for observing this faint gyrosynchrotron emission in the vicinity of active solar emissions. The newly developed imaging pipeline (Mondal et al., 2019) designed for the data from Murchison Widefield Array (MWA) marks a significant improvement in metrewave solar radio imaging. We now expect to routinely detect GS emission from CME plasma. We present an example where we have successfully detected radio emission from CME plasma, modelled it as GS emission, leading to reliable estimates of CME magnetic field and the distribution of energetic electrons. In a different example, we find that the observed spectra are not always consistent with simple GS models. For this CME we detect the CME radio emission out to as far as 8.3 solar radii. This highlights that more complicated physics might be at play and points to the need for building more detailed models for interpreting these emissions. These are the weakest detections of GS emissions from CME plasma reported yet. Polarimetric imaging is expected to further improve this approach to estimating CME magnetic fields and other physical parameters. Here we also present our first attempts at polarimetric imaging and modeling of CME gyrosynchrotron emission.

ASI2021_286	Sindhuja G	Oral
A Study of the Observational Properties of Coronal Mass Ejection Flux Ropes near the Sun		
<p>We present the observational properties of coronal mass ejection (CME) flux ropes (FRs) near the Sun based on a set of 35 events from solar cycle 24 (2010-2017). We derived the CME FR properties using the Flux Rope from Eruption Data technique. According to this technique, the geometrical properties are obtained from a flux-rope fit to CMEs and the magnetic properties from the reconnected flux in the source region. In addition, we use the magnetic flux in the dimming region at the eruption site. Geometric properties like radius of the FR and the aspect ratio are derived from the FR fitting. We found that the mean values of the poloidal flux, toroidal flux, axial magnetic field strength (at 10 solar radii) and the radius of the flux rope are 4.3×10^{21} Mx, 7.3×10^{20} Mx, 18.8 mG and 4.6 Rs, respectively. The reconnected flux exhibits a positive correlation with flare fluence in soft X-rays (SXR), peak flare intensity in SXRs, CME speed, and kinetic energy, with correlation coefficients (cc) 0.78, 0.6, 0.48, and 0.55, respectively. We found a moderate positive correlation between magnetic flux in the core dimming regions and the toroidal flux obtained from the Lundquist solution for a force-free FR (cc=0.43). Furthermore, we correlate the core dimming flux and CME mass (cc=0.34). The area of the core dimming region shows a moderate correlation with the radius of the FR (cc=0.4). Thus, we infer that greater magnetic content (poloidal and toroidal fluxes) indicates a more energetic eruption in terms of flare size, CME speed, kinetic energy, mass, and radius of the FR, suggesting important implications for space weather predictions. In addition, to this results, I will discuss the application of Visible Emission Line Coronagraph (VELC) onboard ADITYA-L1 data for this kind of studies.</p>		

ASI2021_177	Aditya Priyadarshi	Oral
Implementation of machine learning for analysis and extraction of solar filaments from the hand-drawn KoSO data		
<p>Kodaikanal Solar Observatory (KoSO) is an abundant source of solar archival data. It includes observation taken at different wavelengths such as in white light, Ca II K, and Hα beginning from 1905 to till date. These observations are taken in photographic film/plates. In addition to that, KoSO has stored so-called 'suncharts' (hand-drawn solar observations) that constitute composite data from all wavelengths. These drawings are made on Stonyhurst latitude and longitude grid, and all solar features are marked on it. For our analysis, we have used data for a period of 23 years (1954-1976). These suncharts are digitized using industry level scanner and are stored in digital format ('.tif'). We started with filaments and implemented the detection algorithm. Filaments are solar features that are formed along polarity inversion lines. Here, we have extracted these features (generally marked in red color) using an unsupervised machine learning algorithm known as the k-means clustering technique. Apart from this, the solar disc, with its corresponding center and radius, are extracted from the suncharts. Binary maps of extracted filaments were further used to form the Carrington maps, to have a detailed comparison with previously generated Kodaikanal Hα Carrington maps from plates. They had a remarkable match, and the results were quite promising. Further, we will compare these maps with the Meudon database. Filament parameters like tilt angle, length, perimeter, and area were deducted for further analysis. Butterfly diagram is confirmation of our detection technique. A clear sign of a polar rush is observed in the butterfly diagram. The study shows a clear increase in filament length and area, as we move higher in latitude. Our next step would be to go for other solar features.</p>		

<p>Parallel Session</p> <p>Extragalactic Astronomy IV</p> <p>[Chairperson: Abhirup Datta]</p>
Tuesday, 23 February 2021 from 11.45 - 12.45

ASI2021_201	Nagendra Kumar	Oral
Wind outflow region in thin accretion disk in LLAGNs, as a favourable site for recombination line		
<p>Wind outflow is inevitable in Low-luminous active galactic nuclei (LLAGNs). X-ray emission of LLAGNs is explained by radiatively-inefficient accretion flow (RIAF, situated in inner region) and its double peaked (red-blue shifted) hydrogen-alpha line reveals a thin accretion disk in outer region. Recently, Sgr A* exhibits a double peaked H30-alpha recombination line, to explain this one needs a $10^4 K$ thin disk $\sim 10^4 R_g$ (R_g: gravitational radius), which is unexpected with very low mass-accretion rate. Thermal irradiation induced wind outflow (is an equatorial wind with small opening angle, is capable to generate double peaked emission/absorption line; Kumar and Mukhopadhyay 2020) can provide a favourable environment for recombination line in windy site. Briefly, the model is applicable in the outer region of the disk, mainly in the gas pressure dominated region. Wind solution is always subsonic, basically sonic point conditions predict that the fluids arrive to the equipartition of energy state (precisely the pressure gradient becomes equal to the gradient of the kinetic energy per unit volume) or to an isobaric regime. It launches from the sonic point when radial component of pressure gradient is comparable to the radial gravitational force otherwise fluids are rotationally bound. We start the accretion flow from the Bondi accretion radius with Bondi mass-accretion rate, compute the variation of mass-accretion rate with radius. With constraint of energetics (supplied V_s requirement), and of outer mass-accretion rate for RIAF, we find that in thin accretion disk, wind can launch from the radius $r > 2000 R_g$ and corresponding wind ejection height ranges from $0.1r$ to $0.2r$. Wind density is always 8 orders lesser than disk midplane density and its associated temperature is approx 20 times larger than midplane temperature. Particularly, at a windy site ($r \sim 10^4 R_g$) wind hydrogen number density is $\sim 10^3 \text{cm}^{-3}$ and temperature is $> 10^4 K$.</p>		

ASI2021_319	Abhijit Kayal	Oral
AstroSat/LAXPC hard X-ray observations of Compton-thick AGN		
<p>X-ray emission in Active Galactic Nuclei (AGN) arising mainly from the accretion disk and corona is believed to be absorbed and scattered by circumnuclear material. The geometry of reprocessing material is conventionally thought to be of a toroidal-shaped gaseous and dusty structure. However, more recent observations favor a clumpy obscuring medium composed of an equatorial thin disk and a polar-extended cone-like structure. Broad-band X-ray spectral</p>		

modelling can give us important insights as it carries imprints of absorption and scattering caused by the circumnuclear reprocessing material. Using AstroSat/LAXPC and NuSTAR observations, we attempt to understand the nature of reprocessing material by modelling the broad-band X-ray spectrum of a nearby Compton-thick AGN, namely Circinus galaxy. We find that the broad-band hard X-ray spectrum can be fitted with a model considering the reprocessing of X-ray emission from a putative torus viewed edge-on with column density much higher than the Compton-thick limit ($N_H > 1.2 \times 10^{24} \text{ cm}^{-2}$). AstroSat and NuSTAR observations also allow us to investigate hard X-ray flux and spectral variability on various time-scales. In this talk, I shall discuss the importance of our AstroSat/LAXPC observations in unveiling the nature of heavily obscured AGN termed as Compton-thick AGN.

ASI2021_604	Vikram Khaire	Oral
Searching for the Imprints of AGN Feedback on the Lyman-alpha Forest		
<p>One of the biggest unsolved problems in galaxy formation is the physical mechanism that quenches star formation in massive galaxies, giving rise to the observed dichotomy between blue star-forming galaxies and red-and-dead ellipticals. In order to reproduce it, all modern cosmological simulations implement some variant of AGN feedback, driving powerful galactic-scale outflows that suppress star-formation in massive galaxies at late times. Simulations show that these outflows can expel baryons into the circumgalactic and intergalactic media (IGM and CGM) resulting in Mpc-scale bubbles of tenuous hot ($T > 10^6 \text{ K}$) gas surrounding massive galaxies. Therefore the distribution of gas in the CGM and IGM and its physical conditions can provide important hints to the actual feedback mechanism. Using state-of-the-art cosmological simulations and realistic mock data, we show that the abundances of hydrogen Lyman-alpha forest lines in the IGM and around massive galaxies at impact parameters of 0.1 to 10 pMpc can provide a precision probe to the AGN feedback models. The author will also discuss the feasibility of such a study with archival Lyman-alpha forest data from the Hubble Space Telescope.</p>		

ASI2021_331	Labani Mallick	Oral
Discovery of soft and hard X-ray time lags in extremely low-mass active galactic nuclei		
<p>The scaling relations between the black hole (BH) mass and soft lag properties for both AGN and BH X-ray binaries (BHXRBs) indicate the same underlying physical mechanism at work in accreting BH systems spanning a broad range of mass. However, the low-mass end of AGN has never been explored. In this work, we extend the existing scaling relations to lower-mass AGN, which serve as anchors between the normal-mass AGN and BHXRBs. For this purpose, we construct a sample of extremely low-mass AGN from the XMM-Newton archive and measure frequency-resolved time delays between the soft and hard X-ray emission. We report that the soft band lags behind the hard band emission at high frequencies, which is interpreted as a sign of reverberation from the inner accretion disc in response to the direct coronal emission. At low frequencies, the hard band lags behind the soft band variations, which we explain in the</p>		

context of the inward propagation of luminosity fluctuations through the corona. We find that the X-ray source for the sample extends at an average radius of around 6 gravitational radii and a median height of around 8 gravitational radii above the disc plane, consistent with gravitational microlensing observations. Our results confirm that the scaling relations between the BH mass and soft lag amplitude/frequency derived for higher-mass AGN can safely extrapolate to lower-mass AGN, and the accretion process is indeed independent of the BH mass.

ASI2021_525	Yogesh Wadadekar	Oral
Teaching machines to study galaxies		
<p>Large area surveys over the last two decades in the UVOIR and radio bands have led to an explosion in the availability of imaging data on galaxies. Sample sizes of a million are now common, making it difficult to classify, let alone study individual objects. In such a data-rich situation, machine learning algorithms based on neural networks have emerged as powerful tools for both classification and regression problems. A specific machine learning architecture called deep learning with many hidden layers in the network has proved particularly effective. Excellent implementations of deep learning techniques are also freely available. We have applied supervised deep learning algorithms to address three specific problems in extragalactic astronomy (1) predicting star-formation histories of galaxies using flux measurements in 21 broad bands from UV to far-infrared (2) predicting the bulge-to-total luminosity ratio of galaxies from gri color composite images and (3) classifying radio galaxy images into subclasses - compact, FR-I, FR-II, and bent tail. In all these applications, our deep learning models are able to make robust predictions with low error rates and in real-time once the model has been trained. We highlight the challenges faced in terms of data size, availability, features, processing ability, and importantly, the interpretability of results for these specific problems. In the coming years, as the data tsunami in astronomy, grows exponentially with the commissioning of facilities like the SKA and the LSST, we will highlight how increased use of machine learning to understand the underlying physics in the information captured will maximise the scientific return.</p>		

ASI2021_417	Sourav Palit	Oral
Monte Carlo study of Earth's Albedo response to Prompt GRB observations in X-ray		
<p>Apart from blocking most of the X-rays and gamma ray photons from extra-terrestrial sources, the Earth's atmosphere also redirects some of them through Compton scattering. This reflected high energy photons are readily detected by the space born X-ray/gamma ray detectors. The observation of Gamma Ray Burst (GRB) spectra are supposed to be affected by the reflected contribution of the same by Earth's atmosphere. Though there are some rigorous studies of the possible X-ray/gamma ray background contribution from secondary photons (albedo) originated from Cosmic Gamma ray Background (CXB) and Cosmic ray particles, the study of the reflected or albedo contribution in prompt GRB observation from Earth's atmosphere is rare. We aim to study the same through rigorous Monte Carlo simulation program and propose a mechanism for correction of the observed spectrum to effectively remove the albedo contribution. This article describes the Monte Carlo simulation results on the possible albedo contributions on prompt GRB spectral observation through space born high energy detectors.</p>		

<p>Parallel Session Stars, ISM and Galaxy V [Chairperson: Ranjeev Misra]</p>
Tuesday, 23 February 2021 from 11.45 - 12.45

ASI2021_438	Prerna Rana	Oral
A geometric origin for temporal properties of black hole systems		
<p>We present a generalized relativistic precession model (GRPM) which associates the fundamental frequencies of the non-equatorial (with Carter's constant, $Q \neq 0$) and eccentric ($e \neq 0$) particle trajectories around a Kerr black hole with the frequencies of Quasi-periodic oscillations (QPOs) observed in the X-ray light curves of black hole X-ray binaries (BHXBs) and active galactic nuclei (AGN). We study cases of BHXB M82 X-1, GRO J 1655-40, XTE J 1550-564, 4U 1630-47, and GRS 1915+105, and extract the parameters $\{e, r_p, a, Q\}$, where r_p is the periastron distance of the orbit, and a is the spin of the black hole. We find that the non-equatorial eccentric solutions for QPOs, when taken together, span a torus region and give rise to a strong QPO signal. We also show that the eccentric orbit solution fits the PBK correlation. Our analysis of the fluid flow in the relativistic disk edge suggests that instabilities cause QPOs to originate in a torus. We also find that the 3:2 ratio of high-frequency QPOs observed in BHXBs corresponds to a single leaf zoom-whirl 3D periodic orbit with two azimuthal whirls. We also apply the GRPM to QPOs observed in the Narrow-line Seyfert 1 galaxies 1H 0707-945, RE J 1034+396, 2XMM J123103.2+110648, MS 2254.9-3712, Mrk 766, and MCG-06-30-15. The origin of these QPOs is attributed to the plasma motion in the corona region. By applying the lighthouse model, we propose a kinematic origin of the jet based γ-ray and optical QPOs, in a relativistic MHD framework. We also present the relativistic orbit model (ROM) for Fourier power spectral density (PSD) shape observed in certain AGN and we show that PSD has a break corresponding to the energy at ISCO.</p>		

ASI2021_280	Pallavi Bhat	Oral
Magnetic field generation in closed and open domains		
<p>The origin of large-scale magnetic fields in most astrophysical systems like the Sun, stars and galaxies remains a challenging open problem. Dynamo action in the underlying turbulent fluid is thought to be responsible for the emergence of coherent magnetic fields. Due to the enormity of magnetic Reynolds numbers in these astrophysical systems, current theoretical models of the turbulent dynamo struggle to generate large-scale field on fast dynamic timescales. The conservation properties of magnetic helicity can constrain the nonlinear evolution of the dynamo. We have performed direct numerical simulations of the turbulent dynamo to investigate if employing open boundaries relaxes the constraint imposed by magnetic helicity</p>		

conservation. We find that in the open systems a net magnetic flux (or system-scale fields) of significant strength arises and provides a hint of alleviation of the magnetic Reynolds number dependence in the nonlinear evolution of the large-scale fields. A large part of the answer involves understanding the behaviour of the current helicity. We provide both an analytic and numerical look at how current helicity influences the evolution of the magnetic helicity.

ASI2021_567	Ankita Bera	Oral
Primordial magnetic fields during the cosmic dawn in light of EDGES 21-cm signal.		
<p>We study the prospects of constraining the primordial magnetic field (PMF) and its evolution during the dark ages and cosmic dawn in light of EDGES 21-cm signal. Our analysis has been carried out on a ‘colder IGM’ background which is one of the promising avenues to interpret the EDGES signal. We consider the dark matter-baryon interactions for the excess cooling. We find that the colder IGM suppresses both the residual free electron fraction and the coupling coefficient between the ionised and neutral components. The Compton heating also gets affected in colder IGM background. Consequently, the IGM heating rate due to the PMF enhances compared to the standard scenario. Thus, a significant fraction of the magnetic energy, for $B_0 < 0.5 \text{ nG}$, gets transferred to the IGM and the magnetic field decays at a much faster rate compared to the simple $(1+z)^2$ scaling during the dark ages and cosmic dawn. This low PMF is an unlikely candidate for explaining the rise of the EDGES absorption signal at lower redshift. We also see that the PMF and DM-baryon interaction together introduces a plateau-like feature in the redshift evolution of the IGM temperature. We find that the upper limit on the PMF depends on the underlying DM-baryon interaction. Higher PMF can be allowed when the interaction cross-section is higher and/or the DM particle mass is lower. Our study shows that the PMF with B_0 up to $\sim 0.4 \text{ nG}$, which is ruled out in the standard model, can be allowed if DM-baryon interaction with suitable cross-section and DM mass is considered.</p>		

ASI2021_594	Atanu Koley	Oral
The magnetic field in dense photodissociation region of DR21		
<p>Measuring interstellar magnetic fields is extremely important for understanding their role in different evolutionary stages of interstellar clouds and of star formation. However, detecting the weak field is observationally challenging. We present measurements of the Zeeman effect in the 1665 and 1667 MHz (18 cm) lines of the hydroxyl radical (OH) lines toward the dense photodissociation region (PDR) associated with the compact HII region DR 21 (Main). From the OH 18 cm absorption, observed with the Karl G. Jansky Very Large Array, we find that the line of sight magnetic field in this region is $\sim 0.13 \text{ mG}$. The same transitions in maser emission toward the neighbouring DR 21(OH) and W 75S-FR1 regions also exhibit the Zeeman splitting. Along with the OH data, we use [CII] 158 μm line and hydrogen radio recombination line data to constrain the physical conditions and the kinematics of the region. We find the OH column density to be $\sim 3.6 \times 10^{16} (\text{Tex}/25 \text{ K}) \text{ cm}^{-2}$, and that the 1665 and 1667 MHz absorption</p>		

lines are originating from the gas where OH and C⁺ are co-existing in the PDR. Under reasonable assumptions, we find the measured magnetic field strength for the PDR to be lower than the value expected from the commonly discussed density–magnetic field relation while the field strength values estimated from the maser emission are roughly consistent with the same. Finally, we compare the magnetic field energy density with the overall energetics of DR 21's PDR and find that, in its current evolutionary stage, the magnetic field is not dynamically important.

ASI2021_332	SUMAN BALA	Oral
A possible physical explanation of the observed anharmonic ratio between the cyclotron line energies of Cep X-4		
<p>We present a physical explanation of the anharmonic ratio between the cyclotron line energies of Cep X-4 observed by Suzaku during 2014 outburst. In this work, we offer a theoretical framework for predicting cyclotron line shapes, assuming the presence of an accretion mound at the polar cap of the neutron star. The accretion mound is considered to be in a steady-state equilibrium supported by the magnetic field. The structure of the mound in magnetostatic equilibrium is solved numerically to obtain the matter density configuration and the magnetic field distribution. The local magnetic field at the mound surface is computed, which is then used to generate the expected cyclotron lines' profile. This is done for a range of mound masses and magnetic field strengths, all the computed profiles are then cast in the form of a Table Model, to be used for spectral fitting using the XSPEC software package. We have attempted fitting this model to explain the observed anharmonic ratio between the observed cyclotron line energies of Cep X-4. We have demonstrated that the observed anharmonic ratio can be explained either as a distorted fundamental line or two harmonics affected by the magnetic field distortion caused by the formation of an accretion mound at the polar cap. We find that the latter can better explain the observed feature in Cep X-4.</p>		

ASI2021_279	Akash Garg	Oral
Modelling the energy dependent fractional rms and time lags in MAXI J1535-571 as observed by AstroSat		
<p>Numerous timing studies in the past have shown that Blackhole X-ray binaries possess rapid X-ray variability during their outburst period. In Fourier space, such variations are seen as narrow peaks known as Quasi-periodic oscillations (QPOs) along with broadband noise component. There have been attempts to explain observed behavior either by geometric origin or by identifying radiative components that can give rise to them. For the latter one, it is needed to carry out the spectral analysis and determine spectral parameters which then needs to be translated into physical ones to obtain interpretation for accretion disk around black holes in the systems. The variations in these parameters can then be chosen numerically to produce the energy-dependent properties related to QPOs. Since LAXPC and SXT onboard AstroSat provides a broad energy range for spectral analysis along with better timing resolution of LAXPC, we chose AstroSat observations of low-frequency QPOs in MAXI J1535-571 and fitted the observed behaviour with the theoretical one. We found that variations in accretion rate, inner disk radius, coronal optical depth, and heating rate along with time delays between them can explain the variability.</p>		

Parallel Session Sun and Solar System IV [Chairperson: K. Sankarasubramanian] Tuesday, 23 February 2021 from 13:30 - 15.00

ASI2021_157	Durgesh Tripathi	Oral
A unified scenario for the heating of the corona in quiet Sun, coronal holes and formation of Solar Wind		
<p>We study the similarities and differences between quiet Sun and coronal holes using the $\text{Si IV } \lambda 1394 \text{ \AA}$ line recorded by the Interface Region Imaging Spectrograph (IRIS). We combine these observations with the magnetic field distribution on the photosphere measured by the Helioseismic and Magnetic Imager (HMI). We find that for the regions with identical magnetic flux densities, the Si IV line intensities obtained in CHs are lower than those obtained in QS and that the difference increases with increasing magnetic flux. Also, QS line profiles are more redshifted than those measured in CHs. Moreover, with increasing magnetic flux density, the blue shifts measured in CHs increased, as opposed to the QS. However, the non-thermal velocities in QS, as well as in CHs, did not show any significant difference. We have used these results to propose a unified model that helps us explain the heating of the corona in the QS and CHs and the solar wind formation.</p>		

ASI2021_580	Bhuwn Joshi	Oral
A low intensity, long-duration solar eruptive flare and associated type-I solar radio storm: SDO and PRL-CALLISTO observations		
<p>We explore the magnetic configuration and energy release process of a C-class long duration event (LDE). The investigation utilizes data from AIA and HMI on board SDO and PRL-CALLISTO solar radio spectrograph installed at the Udaipur Solar Observatory. This low SXR intensity event is characterized by typical features of LDE flare, viz. extended flare arcade and two-ribbon structures along with a quite prolonged period of soft X-ray emission of ≈ 3.5 hours. The event displayed two distinct phases of energy release, manifested in terms of both temporal and spatial scales. The GOES soft X-ray time profiles clearly show gradual variations during both the phases that peak at an interval of ≈ 20 min. The EUV images reveal that the site of energy release progressively changed within the coronal sigmoid during the course of the flare evolution. From multi-channel SDO images, we find that coronal region of the first reconnection event corresponds to a stronger photospheric field showing compact sunspot groups while the second event is associated with weaker and dispersed magnetic field region in the photosphere with no visible signatures of any sunspot. The low frequency radio observations obtained from PRL-CALLISTO system indicates radio emissions to be associated with the second phase of the event only, in the form of type I radio storm in the frequency range of $\approx 50\text{--}180$ MHz that sustained for</p>		

≈7 min. The synthesis of multi-wavelength observations along with magnetic field extrapolation reveals that flare accelerated electrons trapped near the apex of large-scale coronal loops rooted at the location of flare ribbons of the second phase, caused plasma emission as a type I radio storm.

ASI2021_443	Pooja Devi	Oral
Variation of chromospheric features as a function of latitude and time using Ca-K spectroheliograms for solar cycles 15 – 23		
<p>We analyse the Ca-K images obtained at Kodaikanal Observatory as a function of latitude and time for the period of 1913 – 2004 covering the solar cycle number 15 to 23. We classify the chromospheric activity as plage, Enhanced Network (EN), Active Network (AN), and Quiet Network (QN) areas to differentiate between large strong active and small weak active regions. The plage areas are found to follow the ~11-year solar cycle up to 50 deg latitude belt. This variation is also shown by weak activity represented by EN, AN and QN with significant amplitude up to about 50 deg latitude in both the hemispheres. The amplitude of variation is minimum around 50 deg latitude and again increases by small amount in the polar region. In addition, the plots of Plages, EN, AN and QN as a function of time indicate the maximum of activity at different latitude occur at different epoch. The cross-correlation coefficients are computed to see the phase difference between the variations at different latitudes with that of 30-40 deg latitude belt. The activity is found to be shifted from mid-latitude belts towards the equatorial belts at fast speed at the beginning of solar cycle and at slower speed as the cycle progresses. This speed is found to vary from ~19 to 3 m/s considering all the data for the observed period. This speed can be linked with speed of meridional flows those believed to occur between convection zone and the surface of the Sun.</p>		

ASI2021_313	SOUVIK ROY	Oral
Magnetohydrodynamical Understanding of the Interactions Between Coronal Mass Ejections and Earth's Magnetosphere		
<p>Coronal mass ejections (CMEs), the large scale transient eruptions from the Sun, interact with the Earth's magnetosphere while travelling into the heliosphere. The energetic interplanetary CME (ICME) at 1AU not only creates geomagnetic storms and disrupts the magnetic field structure around the Earth but also impacts the plasma environment, causes strong aurorae, and disturbs the radio and electrical transmission massively. We use 3D compressible magnetohydrodynamic simulation of a star-planet system and study the interesting magnetohydrodynamic processes like bow-shock, magnetopause, magnetotail, planet-bound current sheets, magnetic reconnections, atmospheric mass loss as well as particle injection, etc.,</p>		

when an ICME flux rope crosses the Earth at 1 AU. We use the uniformly twisted force-free flux rope model proposed by Gold and Hoyle in 1960 to initiate the ICME and vary the flux rope properties using actual observational data. We observe a change in magnetopause's shape and the stand-off distance to the magnetopause. We notice twist helicity injection inside the magnetotail current system. We discover comparative increment in both the rates of atmospheric mass out-flow and solar wind in-flow in the vicinity of Earth during the geo-storm. Such studies will help us understand how energetic magnetic storms from a host star impact planetary magnetospheres and atmospheres with implications for planetary and exoplanetary habitability.

ASI2021_148	Arghyadeep Paul	Oral
Solar wind modelling and its impacts on planetary magnetospheres		
<p>Planetary magneto-spheres are highly dynamic structures constantly affected by incoming solar or stellar wind. Often, shocks driven by CMEs and high-speed solar wind streams tend to drastically change the overall structure of the magnetosphere. These shocks are also known to produce highly energetic particles that eventually make their way into the magnetosphere. Our goal is to develop a state-of-the-art Space Weather Modelling Framework using hybrid MHD code addressing both, the global dynamical aspects, e.g., background solar wind velocities, solar wind magnetic polarity at Earth's magnetopause, CME arrival times and its propagation and also smaller scale micro-physical aspects, like magnetic reconnection in the magnetosphere and the associated particle acceleration. In this presentation, I will summarize our initial results of the background solar wind model and its properties along with the simulation results of test particle acceleration in complex magnetic reconnection environments. The initial results from ensemble modelling of solar wind and magnetic field assessment show good agreement with the observed values from ACE and WIND data with low statistical errors. The results from our test particle simulations in magnetic reconnection environments also demonstrates the effect of direct electric field in acceleration of particles in a manner to produce power-law spectrum. Furthermore, we observe a positive feedback on reconnection rate due to small shear flow, however, super-alfvenic shear has a negative feedback on the rate of reconnection.</p>		

ASI2021_246	Muthu Priyal	Oral
Periodic and Quasi-Periodic Variations in the Ca K Index During the 20th Century Using Kodaikanal Data		
<p>We have digitized the Ca K images obtained at Kodaikanal Observatory with a pixel resolution of 0.86 arcsec and 16-bit readout to achieve better spatial and photometric accuracy. In addition to the general photometric analysis procedure carried out on the data, we have corrected these digitized images for instrumental effects. Then, we have normalized all the images considering</p>		

their intensity distribution. Afterwards, we separate the images into two groups considering the width of the intensity distribution and their visual quality. Group I contains uniform time series of images taken at the center of the Ca K line and the other group contains the remaining images. We study the variation in the Ca K index with time for both data sets. Comparing the results we find that it is necessary to select the images to generate uniform time series to investigate periodic variations. We find that uniform time series termed as “Good” shows well-defined 11-year periodicity in the Ca K average intensity. In addition, the fast Fourier transform and wavelet analysis of the data show a quasi-periodicity of ≈ 3 years that may be due to the duration of the active phase of the solar cycle. The time series with non-uniform images termed as “Okay” shows a large scatter in the average intensity and affects the amplitude of the activity. This series also shows a number of mid-term quasi-periodicities of short duration in the wavelet analysis, probably due to the non-uniform quality of the images. This methodology will be also useful to combine the data from different observatories and generate a uniform time series with less gaps in the data.

Parallel Session Extragalactic Astronomy V [Chairperson: Hum Chand]
Tuesday, 23 February 2021 from 13:30 - 15.00

ASI2021_531	DEBBIJOY BHATTACHARYA	Oral
Multi-band study of different flaring and low-activity states of blazar 4C+21.35		
<p>Blazars, a class of active galactic nuclei emit over the entire electromagnetic spectrum and modelling of their broadband spectral energy distribution (SED) is the key to constrain the underlying emission mechanisms. Here we present the one-zone leptonic emission modelling results of the blazar 4C +21.35 using multi-wavelength data spanning over 2008 - 2018. Broadband SED modelling using gamma-ray data from Fermi-Large Area Telescope, X-ray data from Swift-XRT, AstroSat, UV-Optical data from Swift-UVOT, AstroSat, and Catalina Real-Time Transient Survey was carried out at seven different epochs, including three gamma-ray flaring episodes and four quiescent periods (three long-term averaged ones and one during AstroSat observing period). Our SED modelling suggests that two compact emission regions originating at a different time outside the broad-line region and moving away from the core with variation primarily in the jet electron spectra can explain the emission from the high, moderate, and low activity periods. The emissions from high and first low activity states are likely to have originated in the first region. The moderate and second low activity states are likely due to the second emission region with fresh particle acceleration/injection at a later time. The findings of this work have been published recently (https://doi.org/10.1093/mnras/staa2958).</p>		

ASI2021_396	Gaurav Waratkar	Oral
The Search for Fast Transients with AstroSat-CZTI		
<p>The Cadmium Zinc Telluride Imager on AstroSat has proven to be an effective all-sky monitor in the hard X-ray regime, detecting over 300 GRBs and putting highly competitive upper limits on X-ray emissions from gravitational wave (GW) sources and fast radio bursts (FRB) over the past 5 years. We introduce CIFT: the CZTI Interface for Fast Transients, a framework used to streamline searching for such transient sources in CZTI data, and for calculating upper limits in case of non-detections. We present, in detail, the algorithms used for searching for these transients in CZTI data and the methods used for placing upper limits on flux in case they are not detected. We also discuss the performance of our algorithms as compared to the other searches, including the details of 88 new transients detected in CZTI data. The addition of these 88 new GRBs to the already known count of 325 takes the GRB tally detected by CZTI to ~83 per year, comparable to ~92 per year detected on-board by Swift-BAT. Non-detections in the follow-up of some FRB and</p>		

GW sources leading to stringent upper-limits are presented. Some future improvements to the interface, algorithms, and software that are currently ongoing are also discussed.

ASI2021_505	VINEET OJHA	Oral
Comparative intranight optical variability study of radio-loud narrow-line Seyfert 1 galaxies with and without radio jets		
<p>To establish stronger intranight optical variability (INOV) with high duty cycle (DC) as evidence of the presence of jet in an AGN, a direct approach has been pursued by carrying out a first comparative INOV study of two samples of radio-loud narrow-line Seyfert 1 galaxies (RLNLSy1s) with and without radio jets, confirmed based upon their Very Long Baseline Array (VLBA) observations. Our unbiased sample consists of 15 and 8 RLNLSy1s with the presence and absence of radio jets, respectively. We have monitored these two sets of RLNLSy1s in 37 and 16 sessions of a minimum of 3.0 hours duration each. The INOV duty cycles for these two sets are found to be 41% and 20%, respectively for a typical INOV amplitude (ψ) detection threshold of $> 3\%$. The higher DC of the jetted-RLNLSy1s sample in comparison to the sample of non-jetted-RLNLSy1s supports the scenario that jetted-AGN are more amenable to show INOV, thus INOV detections with higher INOV DC can be used as indirect evidence of the presence of jet even also in the case of low-luminous high accreting AGNs such as NLSy1s in which dilution of the AGN's nonthermal optical emission by the (much steadier) optical emission contributed the nuclear accretion disc is quite likely. We have detected an unexpected remarkable flare in a non-jetted-RLNLSy1 galaxy, J163401.94+480940.2, whose rapid brightening phase is shown to imply a minute like doubling time of ~ 22 minutes, thereby approaching to the extremely fast minute like variability, observed from FSRQ PKS 1222+21 at 400 GeV.</p>		

ASI2021_346	Aditi Agarwal	Oral
Multi-band behaviour of the TeV blazar PG 1553+113 in optical range on diverse timescales		
<p>The TeV BL Lac object PG 1553+113 is one of the primary candidates for a binary supermassive black hole system. We study the flux and spectral variability of PG 1553+113 on intra-night to long-term timescales using (i) BVRI data collected over 76 nights involving nine optical telescopes and (ii) historical VR data (including ours) obtained for the period from 2005 to 2019. We analysed the light curves using various statistical tests, fitting and cross-correlation techniques, and methods for the search for periodicity. We examined the colour-magnitude diagrams before and after the corresponding light curves were corrected for the long-term variations. Our intra-night monitoring, supplemented with literature data, result in a low duty cycle of $\sim (10-18)\%$. In April 2019, we recorded a flare, which marks the brightest state of PG 1553+113 for the period from 2005 to 2019: $R \simeq 13.2$ mag. This flare is found to show a clockwise spectral hysteresis loop on its VR colour-magnitude diagram and a time lag in the sense that the V-band variations lead the R-band ones. We obtain estimates of the radius, the magnetic field strength, and the electron energy that characterize the emission region related to the flare. We find a median period of (2.21 ± 0.04) years using the historical light curves. In addition, we detect a secondary period of about 210 days using</p>		

the historical light curves corrected for the long-term variations. We briefly discuss the possible origin of this period.

ASI2021_541	Pankaj Kushwaha	Oral
Deciphering the Nature of the Re-emerged Broadband Emission seen during the 2020 Multi-wavelength Activity of Blazar OJ 287		
<p>OJ 287 is a BL Lacertae object – a subclass of active galactic nuclei that has a powerful relativistic jet of plasma roughly directed towards us but lacks any strong emission line features. The most intriguing observational aspect of this source is a recurrent outburst in optical bands every ~ 12-yr. This recurring outburst is the basis of the claim of the source being a binary black hole system with recurring flares resulting due to the interaction dynamics leading either to jet precession or increased accretion. In April 2020, the source underwent a strong optical to X-ray flux enhancement, reaching its second brightest recorded X-ray flux. Our multi-wavelength spectral and temporal study shows that strong enhancement is due to a drastic change in the X-ray spectrum of the source. The concurrent MeV-GeV emission also shows a strong change in the spectrum and the modified broadband infrared to MeV-GeV emission appears like that of an additional high-energy-peaked blazar emission component. However, our systematic spectro-temporal evolution shows that the high-energy end of the emission component, responsible for an extremely soft X-ray spectrum, is highly dynamic – changes from a power-law spectrum to one like a cutoff over a duration of few days. We will present our results from a detailed and systematic exploration of this new emission component, its nature, connection with the recurring ~ 12-yr optical flares, and its implications on the proposed models of the recurring optical flares.</p>		

ASI2021_223	Arkadipta Sarkar	Oral
Origin of multi-waveband flares in 3C 454.3		
<p>We have performed an extensive study to understand the origin of the multi-waveband flares in the blazar 3C 454.3. We identified three multi-waveband flares in the long-term light curve of the source, and our analysis was restricted to 150 days around its peak. Bayesian block algorithm was used to model the structure of the flare and to quantify its variability. We then generated broadband spectral energy distributions in each of the blocks and modelled it using a one-zone leptonic model under the assumption that a single blob is responsible for the entire emission during the flare period. The evolution of physical parameters of the blob could then be traced along the duration of the flares. We found that emissions from a blob filling the cross-section of a conical jet could not explain the observed multi-waveband emission. The statistically favorable model involves a non-linear motion of the blob inside the jet which changes jet related parameters (like Doppler boosting and magnetic field) thereby changing the observed flux. Other models considered include one where the particle injection parameters change over time for a blob moving in a conical jet, and one where both the particle injection parameters and jet parameters change. We have also tried to recreate the multi-waveband light curve from the model.</p>		

Parallel Session
General Relativity and Cosmology II
[Chairperson: Harvinder Jassal]
Tuesday, 23 February 2021 from 13:30 - 15.00

ASI2021_554	A Gopakumar	Invited
Modeling gravitational waves from black hole binaries in non-circular orbits		
<p>Black hole binaries in non-circular orbits are astrophysically relevant sources for the operational hecto-Hz and rapidly maturing nano-Hz gravitational wave observatories. I will summarize our on-going efforts to develop computationally efficient inspiral-merger-ringdown waveform families, both in the time and frequency domains. How we adapted these efforts to model Pulsar Timing Array signals due to gravitational waves from inspiraling supermassive black hole binaries in relativistic eccentric orbits will be explained. Additionally, a brief description of our on-going efforts to model and search for gravitational wave burst signals, associated with compact binaries in relativistic hyperbolic/ parabolic orbits will be presented.</p>		

ASI2021_607	Indranil Chattopadhyay	Invited
Particle production in accretion discs around black holes		
<p>Accreting matter around black holes can flow to the central object, in various modes. Various models of accretion discs are discussed in this talk. Out of these the advective discs are trans-relativistic in nature and can be quite hot. We study various methods by which particles can be created in these discs and show that pair production can be significant in flows at distance of few Schwarzschild radii from the central hole. These are the regions which are supposed to launch the jets, and therefore these new particles may contaminate the external environment.</p>		

ASI2021_208	BHASKAR BISWAS	Oral
GW190814: On the properties of the secondary component of the binary		
<p>We show that the odds of the mass-gap (secondary) object in GW190814 being a neutron star (NS) improve if one allows for a stiff high-density equation of state (EoS) or a large spin, when employing a nuclear parameterization of the EoS. Since its mass is $\sim (2.50, 2.67) M_{\odot}$, establishing its true nature will make it either the heaviest neutron star or the lightest black hole (BH), and can have far-reaching implications on neutron star EoS and compact object formation channels. When limiting oneself to the NS hypothesis, we deduce the secondary's properties by using a Bayesian framework with a nuclear-physics informed model of NS equation of state and combining a variety of astrophysical observations. For the slow-rotation scenario, GW190814 implies a very stiff EoS and a stringent constraint on the equation of state specially in the high-</p>		

density region. On the other hand, assuming a conservative maximum mass for nonrotating neutron stars requires rapid rotation and we constrain its rotational frequency to be $f = 1143^{+194}_{-155}$ Hz, within a 90% confidence interval. In this scenario, the secondary object in GW190814 would qualify as the fastest rotating neutron star ever observed. However, for this scenario to be viable, rotational instabilities would have to be suppressed both during formation and the subsequent evolution until merger, otherwise the secondary of GW190814 is more likely to be a black hole.

ASI2021_537	Nirban Bose	Oral
A model-independent phenomenological constraints on the eccentricity for binary black hole systems		
<p>Compact binary systems with black holes are primary sources of interferometric gravitational wave detectors like LIGO, Virgo and Kagra. Though it was believed that isolated binaries may circularize before entering the interferometric band, recent detections suggest that binary systems with appreciable non-zero eccentricity are possible in the dense stellar environment like globular clusters and galactic nuclei. With increasing sensitivity of the interferometric gravitational wave detectors, the eccentric binaries are plausible and important candidates for the gravitational wave window. In this work we develop a phenomenological approach to constrain the eccentricity of eccentric binaries in the advanced detector era. We obtain a phenomenological relation between the chirp mass and eccentricity in the stellar mass and eccentricity space. Further, we also estimate the bias in recovering the chirp mass using circular waveforms for eccentric binary signals in simulated data. This bias, along with the chirp mass estimated from the time-frequency map is used to constrain the eccentricity using the phenomenological fits. This heuristic approach has direct application in the model independent eccentricity estimation for the generic stellar mass eccentric systems in the upcoming observational runs.</p>		

Posters in
Sun and solar System

ASI2021_484	Abhishek Kumar Srivastava	Poster
On the Forced Magnetic Reconnection in the Solar Corona		
<p>In the astrophysical plasma, the reconnection is defined as a self-reorganisation of the magnetic fields in their relaxed state and associated release of the stored magnetic energy. In the solar corona, the magnetic reconnection is considered to be one of the major candidates to heat its atmosphere locally, and also to generate the eruptive phenomena (e.g., flares and coronal mass ejections). However, some major scientific aspects of this spontaneous magnetic reconnection are still debated despite significant scientific progress both in theory and observations since last several decades. The few we can delineate specifically that are required to be understood in greater details, e.g., the formation mechanism of the current sheet; appropriate reconnection rate; establishment of the natural diffusion region and its physical properties, etc. During inquisition of the crucial physical aspects of the magnetic reconnection, we firstly directly observed “the forced magnetic reconnection” in the large-scale solar corona. It is triggered in the corona when two oppositely directed magnetic field lines forming an X-point and/or current-sheet are clearly perturbed (or pushed) by the external disturbances. The forced reconnection was only reported hitherto in theory, however, it had never been directly observed in the Sun's large-scale corona. Our observations of the forced reconnection regions and corresponding numerical model elucidate that it can rapidly and efficiently occur at higher rates in the solar corona to heat it locally. We conjecture that the forced magnetic reconnection has an ample physical implications in the magnetised plasmas at diverse scales including the laboratory scales.</p>		

ASI2021_291	Abhishek Rajhans	Poster
Hydrodynamics of Hi-C brightenings		
<p>Small transient brightenings that occur in the solar atmosphere may play a significant role in coronal heating. An accurate understanding of the energetics of such events observed in the corona will help us understand the physics of their origin and thereby address the problem of solar coronal heating. In this work, we have studied the energetics of some of smallest brightenings ever observed by Hi-C, using 0-D hydrodynamical simulations using the Enthalpy Based Thermal Evolution of Loops (EBTEL). We find that these brightenings can be modelled with physically reasonable hydrodynamic loops, of some lengths and heating budgets. We find conduction to be the dominant cooling mechanism for these events in their initial phase, similar to that for flares, microflares, and nanoflares. This is suggestive of similar underlying physical mechanism for these brightenings as the flaring events.</p>		

ASI2021_294	Aishawnnnya Sharma	Poster
Amplitude modulation of Propagating Intensity Waves as observed by AIA/SDO		
<p>In this talk, we will present our recent results on observation of wave amplitude modulations along a fan loop system as recorded by the Atmospheric Imaging Assembly on board the Solar Dynamics Observatory. We employ time-distance analysis technique to study the spatio-temporal evolution of propagating intensity disturbances (PIDs) observed along the fan loops. The time-distance maps provide clear presence of 3-min intensity disturbances in all the coronal EUV channels except AIA 94 and 335 Å. We measure the phase speeds of the PIDs and determine their nature as slow-magnetoacoustic waves. The time-distance map at AIA 171 Å, as well as the de-trended light curves at different spatial locations of the map, show an increase and decrease in the amplitude of the propagating oscillations over time. Fourier power spectrum indicates several frequency-power peaks within 2-3 minutes, along with many other smaller peaks within 1-5 minutes. Wavelet analysis shows a variation of 3-min oscillating power simultaneous to the amplitude variations with time, with a modulation period in the range of 20-30 minutes. Our results provides the viability of occurrence of phenomenon like 'Beat' in the solar atmosphere giving rise to the observed wave amplitude modulations. This study may provide valuable insights into the understanding of the behaviour and possible coupling of slow-magnetoacoustic waves propagating along fan loops.</p>		

ASI2021_165	Arghya Mukherjee	Poster
Plasma heating and generation of Kelvin-Helmholtz vortex via the phase mixing of nonlinear shear Alfvén waves		
<p>Our nearest star Sun remains a source of many scientific mysteries and an assortment of challenging physics problems. To identify the physics behind the coronal heating mechanism is one of the unresolved issues in solar physics and is primarily concerned with how the energy is transported up into the corona and finally converted into heat? The phase mixing of Alfvén waves serves as one of these promising mechanisms thought to be responsible for the coronal plasma heating. We present 2.5-D numerical simulations of the physical processes occur when a nonlinear shear Alfvén wave propagates through a medium, comprising a density gradient along the transverse direction of the applied magnetic field - which ultimately leads to the phase mixing. By performing MHD simulations it is found that due to the gradient in local Alfvén speed, the neighbouring perturbations gradually become out of phase and the wave loses its coherence. As a result higher and higher order modes are generated. Studies have been further extended by injecting test particles into the simulation domain. It is shown that the higher Fourier modes interact with the wave and get accelerated to higher energy. As a result, after a certain time period, the initial wave energy gets converted to the thermal energy of the particles and the plasma reaches a state of higher temperature. The effect of applied magnetic field on the final temperature, attained by the plasma, has been shown. Moreover it is found that the motion of the test particles and their phase space evolution exhibit the</p>		

development of Kelvin-Helmholtz vortices, which are generated at the velocity antinodes of the wave, due to the local velocity shear.

ASI2021_321	Arpita Roddanavar	Poster
Modelling Switchback Structures in the near-Sun environment.		
<p>The Sun's outermost atmosphere, the Corona powers a flow of charged particles into interplanetary space known as the solar wind. This plasma wind carries the Sun's magnetic field, which permeates the heliosphere. These field lines appear to move approximately radially outwards from the Sun along Parker spirals. Observations from satellites, e.g., the Parker Probe, reveal local magnetic polarity inversions and folds in the magnetic field termed switchbacks. Velocity spikes are also observed in the vicinity of these structures. We propose that these structures may be created by vortical solar wind turbulence that twists the embedded magnetic field lines. We perform proof of concept numerical simulations to test this hypothesis. We reproduce magnetic switchback structures with our simple model and analyse how local vortices' properties influence the size, length-scale and time-scales of the simulated switchback structures. Our preliminary findings are reported here.</p>		

ASI2021_126	Arun Kenath	Poster
Planet Nine – Primordial black hole or a Dark Matter object: A comparative study		
<p>The study of Planet Nine has received a lot of attention of late. Planet Nine is a hypothesized planet lurking in our solar system far beyond the orbit of Neptune inferred by a peculiar clustering of six TNO. Earlier it was suggested that Planet Nine could be a degenerate object constituted of DM particles with its characteristic properties. The DM particles could form degenerate objects at earlier epochs which provided a motivation to consider Planet Nine to be such a DM object. If made up of mostly DM particles, such objects would not emit any radiation and therefore not be seen in the usual observational searches. It was also estimated that there could be one such object in the solar system (Oort cloud) volume. Currently there is a lot of ongoing discussions as to whether this Planet Nine is actually a planet or possibly a primordial black hole. PBH are black holes that are created in the early Universe right after the big bang and since they are not formed by the stellar gravitational collapse their masses are much smaller compared to stellar mass black holes. So, for a definitive observation of Planet Nine we need instruments as in the Wide-field Infrared Survey Explorer (WISE) and Pan-STARRS. Here we give a comparative study of the two different possibilities i.e. Planet Nine being either a PBH or a DM object. This would be relevant for future observations of Planet Nine. We show that if Planet Nine is a PBH, it will be extremely difficult to detect it due to its small size, angular size, luminosity, etc. On the other hand the signature of the corresponding DM object would be more easily evident.</p>		

ASI2021_241	Ayan Biswas	Poster
Understanding Solar WINQSEs		
<p>The outermost layer of the solar atmosphere, the Corona, has a temperature of about a million K. In contrast, the photosphere, which is the lowest layer of the solar atmosphere, is only at 5800 K. The origin of this high temperature in the corona has been a mystery for decades, and is referred to as the 'Coronal Heating Problem'. One possible mechanism of generation and transportation of heat is provided by the 'Nanoflare hypothesis'. According to this hypothesis, numerous small flares of energies $\sim 10^{24}$ ergs are happening throughout the corona all the time due to small scale magnetic reconnections and collectively maintain its million degree temperature. These magnetic reconnections are expected to produce non-thermal electrons which in turn can produce coherent plasma emissions that can be detected in the radio band. Mondal et. al. (2020), reported the first detection of such emissions from the quiet sun using the MWA (Murchison Widefield Array). These emissions, now termed as WINQSEs (Weak Impulsive Narrowband Quiet Sun Emissions), were found to be ubiquitous in the quiet solar corona and their statistical properties satisfy the necessary conditions for them to be the radio counterparts of the hypothesised "nanoflares" and hence might be an important clue for understanding coronal heating. It is hence important to verify if these events are indeed present in different solar conditions, and how their statistical characteristics change with time. Here we present the study of nanoflare events during a period of extremely low solar activity and some improvements on the original analysis. We find many similarities and also some interesting differences from the original results, indicating a time variable statistical nature of WINQSEs.</p>		

ASI2021_456	Binal Patel	Poster
Investigation of DH type II solar radio bursts during solar cycle 23 and 24		
<p>Type II solar radio bursts are caused by magneto-hydrodynamic shocks which propagate through the solar corona and interplanetary medium. The type II bursts in decameter-hectometer (DH: $30 \text{ MHz} \leq f \leq 300 \text{ kHz}$) region are of particular interest due to its association with the energetic and wider Coronal Mass Ejections (CMEs) that frequently cause space-weather manifestations. We present the characteristics of DH type II bursts for the solar cycle 23 and 24. The bursts are classified according to their end frequencies into three categories, i.e. High Frequency Group (HFG; $1 \text{ MHz} \leq f \leq 16 \text{ MHz}$), Medium Frequency Group (MFG; $200 \text{ kHz} \leq f < 1 \text{ MHz}$), and Low frequency Group (LFG; $20 \text{ kHz} \leq f < 200 \text{ kHz}$). We find that the sources for LFG, MFG, and HFG events are homogeneously distributed over the active region belt. Our analysis shows a drastic reduction of the DH type II events during solar cycle 24 which includes only 35% of the total events (i.e. 179 out of 514). Despite having smaller number of DH type II events in the solar cycle 24, it contains a significantly higher fraction of LFG events (34% vs. 23%). This result suggests that cycle 24 is rich in terms of producing CMEs that are able to drive shocks up to larger heliocentric distances in comparison to cycle 23. The profiles relating CME heights with respect to the end frequencies of type II bursts suggest that for HFG and MFG categories, the location for majority of CMEs ($\approx 65\%-70\%$) is in well compliance with ten-fold Leblanc</p>		

coronal density model, while for LFG events a lower value of density multiplier (≈ 3) seems to be compatible. The properties of the type II associated CMEs and flares are explored for each group in detail for both the solar cycle.

ASI2021_526	Chandan Joshi	Poster
Cross wavelet analysis of solar flare and magnetic field		
We present here cross wavelet analysis of flare occurrence and global magnetic field to test the coherency.		

ASI2021_32	Divya Oberoi	Poster
Spectroscopic snapshot imaging of solar type II bursts : A new tool for exploring coronal propagation effects		
<p>Type II bursts are the strongest active solar radio emissions. They are usually seen at metrewaves as a pair of drifting emission bands, at frequencies corresponding to the local plasma frequency at the site of origin and its harmonic. They are associated with the faster, more energetic coronal mass ejections (CMEs) and believed to arise from the locations of shocks on the CME front. As the shocks propagates out through the corona, the emission drifts from higher to lower frequencies. These emissions are clearly of great interest from a space weather perspective. However the vast majority of the studies of these bursts have relied on non-imaging observations from solar radio spectrographs, which tends to limit their utility. This emission is highly structured in both time and frequency, and hence their imaging studies require a spectroscopic snapshot imaging capability. This has possible only comparatively recently with the new generation instruments like the Murchison Widefield Array (MWA). We present the first detailed spectroscopic imaging study of a type II burst with the MWA. We find the type II source to be only marginally resolved implying the presence of a localised shock. Very interestingly, for the first time, these high signal-to-noise observations show the location of the type II source to show small scale motions which are very coherent across neighbouring time and frequency slices, but seem quasi-random over larger spans in time or frequency. It is evident that this cannot arise simply because of the motion of the shock through the coronal medium. We believe that these apparent motions arise due to the propagation effects (refraction and scattering) encountered by the plasma emission originating from a compact source as it traverses the highly structured and turbulent corona. These observations hold considerable promise to provide a novel approach to studying coronal turbulence.</p>		

ASI2021_209	Gautham Gururajan	Poster
Generalized Lomb-Scargle analysis of ^{123}I and $^{99\text{m}}\text{Tc}$ decay rate measurements		
We apply the generalized Lomb-Scargle periodogram to the ^{123}I and $^{99\text{m}}\text{Tc}$ decay rate measurements based on data taken at the Bronson Methodist Hospital. The aim of this exercise was		

to carry out an independent search for sinusoidal modulation for these radionuclei (to complement the analysis in Borrello et al) at frequencies for which other radionuclei have shown periodicities. We do not find evidence for such a modulation at any frequencies, including annual modulation or at frequencies associated with solar rotation. Our analysis codes and datasets have been made publicly available.

ASI2021_211	Govind Nampoothiri	Poster
Electron velocity distribution functions at 1 AU during the halo CME event on 25 July 2004		
<p>In this paper, we analysed the kinetic properties of the electron velocity distribution functions during the passage of a halo Coronal Mass Ejection (CME) using in situ measurements from the plasma analyzers at 1 AU. The halo CME erupted on 25 July 2004 (Carrington rotation 2019) from the active region NOAA AR 10652 (N04W30) and the ICME reached at the L1 point 31 hrs after the eruption. Solar wind electron data from three dimensional plasma instrument (3DP) on board WIND spacecraft and the CME data from Large Angle and Spectroscopic Coronagraph (LASCO) on board solar and heliospheric observatory (SOHO) have been used for performing the present study. ENLIL with cone, A time dependant 3-dimensional Magnetohydrodynamic model by Community Coordinated Modelling Center (CCMC) is also used to simulate the evolution of the ICME through the heliosphere. The velocity distributions of electrons observed at the L1 point, show distinct features representing the passage of the ICME plasma and the associated magnetic cloud. Relative to the ambient solar wind condition, the suprathermal halo electron populations were enhanced more than that of the core electron populations. Following the CME's forward shock and sheath plasma, a bi-directional electron streaming (bi-directional strahl electrons) representing a possibly closed magnetic flux rope is observed. The non-equilibrium Boltzmann entropy analysis of the event shows an enhanced entropy along the bi-directional electron streaming, parallel to the magnetic field.</p>		

ASI2021_464	Hema Kharayat	Poster
Origin of fast coronal mass ejection and associated M-class flare from transient coronal sigmoid in active region NOAA 11909		
<p>We present a multi-wavelength and multi-instrument analysis to investigate the formation and disruption of a coronal sigmoid from the active region (AR) NOAA 11909 on 07 December 2013. The sigmoid formation initiated ≈ 1 hour before its eruption, through a coupling between two twisted coronal loop systems. Due to its short life-time, this sigmoid can be regarded as 'transient' sigmoid. A comparison between coronal and photospheric images suggests that the coronal sigmoid was formed over a magnetically dispersed and simple β-type AR. With the observations from Helioseismic magnetic imager on board Solar Dynamics Observatory, we noticed the moving magnetic features and significant decrease in the photospheric magnetic field of the AR during the extended pre-eruption phase, which suggests the tether-cutting reconnection as a possible triggering mechanism.</p>		

Successful eruption of the sigmoidal structure (flux rope) results a two- ribbon M1.2 flare and a fast halo CME (with a linear speed of $\approx 1085 \text{ km s}^{-1}$). A typical “sigmoid-to-arcade” transformation is observed during the evolution of the flare. During the precursor phase of the flare, flux rope undergoes a slow rise ($\approx 15 \text{ km s}^{-1}$) which subsequently transitions into a fast eruption ($\approx 110 \text{ km s}^{-1}$). The two-phase evolution of the flux rope shows temporal associations with the soft X-ray precursor and impulsive phase emissions of the M-class flare, respectively, thus pointing toward a feedback relationship between magnetic reconnection and early CME dynamics. Radio observations reveal type III and type II radio bursts in meter wavelengths during the impulsive phase of the flare.

ASI2021_429	Jaidev Sharma	Poster
Hemispheric Rotational Asymmetry and Solar Activity		
<p>Using the observations of STEREO-A instrument, we present the results of hemispheric asymmetry in coronal rotation and its relation with solar activity. For this purpose, we used the images at 30.4, 19.5 and 28.4 nm during the period from 2008 to 2018 covering 24th solar cycle. Here, we applied flux modulation method on the solar full-disk (SFD) images having size 512×512 pixels. We have extracted the time series of hemispheric Extreme Ultraviolet (EUV) intensity variation for both the hemispheres (North and South). Each hemispheric EUV flux is auto-correlated up to lag 150 days and first peak of autocorrelogram is fitted by Gaussian function. The time value of Gaussian function fitted to the first secondary maximum represents the synodic rotation period. Present investigations show that in solar maximum period i.e. from 2011 to 2014, hemispheric asymmetry in rotation rate is highest and this gradually drops on both sides of maximum phase towards minimum phases (i.e. from 2008 to 2011 and 2014 to 2018). Moreover, hemispheric asymmetry in rotation rate leads the sunspot numbers by ~ 18 months. This indicates that hemispheric rotational asymmetry may be contributing in the formation of sunspots.</p>		

ASI2021_153	JAIN JACOB P. T.	Poster
Evidence for Torsional Motion and Short-Period Oscillations in a Solar Prominence		
<p>Solar prominences are consist of hot ionized gases embodied over magnetic field lines anchored into the photosphere and extended to coronal heights. We have studied the dynamical properties of a large scale prominence using high-resolution observations provided by the Atmospheric Imaging Assembly (AIA) onboard Solar Dynamical Observatory (SDO) and Interface Region Imaging Spectroscopy (IRIS). Using time-slices of intensity images across the prominence legs and Local Correlation Tracking (LCT) of SDO/AIA observations, we investigated torsional motions in one of the prominence legs. That leg of the prominence exhibit clockwise rotation followed by an anti-clockwise movement indicating torsional motion. We found large scale rotation confirmed by the blue and redshift in the Doppler velocities in the prominence's upper part. To study the oscillatons within the prominence structure, we constructed the power spectrum using IRIS slit-jaw imaging observations of Mg II k 2796\AA and Si IV 1394\AA. The wavelet analysis also showed the oscillatory motion of 7-11 minutes, which may be associated with Alfven waves propagating along magnetic flux tubes.</p>		

ASI2021_431	Lakshitha Nama	Poster
Spectral evolution of flare plasma parameters with Solar X-ray Monitor on Chandrayaan-2		
<p>Solar flares are among the most exciting and widely studied phenomena on the Sun. A solar flare occurs when magnetic energy that has built up in the solar atmosphere is suddenly released. It is a dynamic phenomenon that is associated with the release of enormous energy of the order of 10^{26} to 10^{32} ergs, along with plasma and particles, in a very short time of 100 to 1000 seconds. These particles move through the Sun's corona into outer space. Even though radiation is emitted in all the wavelengths, the peak is in X rays. As the flare evolves, along with intense brightness variations, its plasma parameters such as temperature, emission measure and chemical abundance also change. By modelling the X-ray spectral data, it is possible to calculate all the plasma parameters. In the low solar activity period of 2019, several small flares in the A-B class are observed with the Solar X-ray Monitor (XSM) onboard Chandrayaan 2. The disk averaged solar spectrum in the 1.3 to 20 keV is measured at high time resolution from the lunar orbit. We present the evolution of temperature, emission measure and chemical abundances for several low-intensity flares and compare them to values at quiet times.</p>		

ASI2021_142	MAHENDER AROORI	Poster
A statistical study of Low-frequency Solar Radio Type III Bursts		
<p>We have studied low-frequency (45 – 410 MHz) type III solar radio bursts observed using the e-Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (e-CALLISTO) spectrometer located at Gauribidanur Radio Observatory, India, during 2013 – 2017. After inspecting 1531 type III bursts we found that 426 bursts were associated with flares, while the others might have been triggered by small scale features/weak energy events present in the solar corona. In this study, we have carried out a statistical analysis of various observational parameters like start time, lower and upper-frequency cut-offs of type III bursts and their association with flares, variation of such parameters with flare parameters such as location, class, onset, and peak times. From this study, we found that most of the high frequency bursts (whose upper-frequency cut-off is > 350 MHz) originate from western longitudes. We interpret that this could be due to the fact that Parker spirals from these longitudes are directed towards the Earth and high frequency bursts are more directive. Further we report that the number of bursts that reach Earth from western longitudes is higher than from eastern longitudes.</p>		

ASI2021_496	Mithun N. P. S.	Poster
Observation of Non-Active Region Microflares with Chandrayaan-2 Solar X-ray Monitor		
<p>Solar flares are events associated with the impulsive release of energy due to magnetic reconnection in the solar corona. The released energy ranges over several orders of magnitudes for different classes of flares from A-class to X-class. It is now well known that these strong but infrequent flares cannot provide the required energy to maintain the coronal temperature. However, it is theorized that much weaker magnetic reconnection events termed as 'nanoflares' with typical energies of $1e24$ erg, if happening at sufficiently high</p>		

frequency all over the solar corona, may keep the temperature high. One of the ways to predict the frequency of occurrence of nanoflares is by direct observations of events having intermediate energies termed as 'microflares' that is achievable by the current generation of instruments, and then extrapolating down to the nanoflare regime. Here we present, for the first time, a comprehensive analysis of a large sample of microflares occurring outside active regions observed in the soft X-ray energy band by the Solar X-ray Monitor (XSM) of the Chandrayaan-2 mission. By combining the X-ray spectral information of these events from XSM with the imaging observations in EUV using the SDO-AIA, the frequency distribution of these flares' energy content is derived, providing insights into the total energy input via the weak reconnection events.

SI2021_547	Pappa Kalaivani P	Poster
Prediction of occurrence rate of radio-loud CMEs and Halo CMEs in Solar Cycle 25 using the correlation analysis with sunspots		
<p>The coronal mass ejections (CMEs) from the Sun are known for their space weather and geomagnetic consequences. Among all CMEs, the shock associated CME (radio-loud CME: RL CME) and halo CMEs are considered the most energetic and they are important to predict. In the paper, the occurrence rates of RL and halo CMEs in solar cycle (SC) 25 are predicted. We found that good positive correlations between the numbers of RL and halo CMEs in each year and the yearly mean sunspot numbers (SSN) for the SC 23 and SC 24. The predicted values of sunspot numbers in SC 25 by NOAA/NASA were considered as representative indices and the corresponding numbers of RL and halo CMEs have been determined using linear relations. Our results show that the maximum number of RL and halo CMEs will be around 39 ± 3 and 44 ± 4, respectively. The peak values of front-side RL and halo events have been estimated to be around 31 ± 3 and 29 ± 3 respectively.</p>		

ASI2021_519	Prabir Mitra	Poster
On the Cause of Extremely Repetitive and Energetic Flare Productivity of Solar Active Region NOAA 12673		
<p>It is well accepted that solar transient phenomena e.g., flares, prominence eruptions, solar jets etc., are powered by catastrophic release of magnetic free energy. Therefore, a quantitative analysis of magnetic characteristics of the solar active regions (ARs) is extremely important to explore the physics of solar eruptions and their short term predictions. A few statistical surveys carried out so far, have elucidated that activities produced in ARs, in view of their frequency of occurrence and corresponding energetics, significantly depend on strength, configuration and topology of magnetic fields. In this work, we look into the detailed evolution of the exceptionally flare productive active region NOAA 12673, in order to understand the factors responsible for its extremely active nature. Notably, this active region appeared during solar minimum phase and produced 4 X-class and 27 M-class flares including the largest flare of the solar cycle 24, within a period of seven days. Our analysis revealed that this active region appeared as a simple α-type active region but quickly became complex and eventually evolved into the most complex δ-type active region. Further, its overall activity can be characterized by few distinct periods which were temporarily well separated. The</p>		

analysis of Non-linear Force Free Field extrapolation complemented by computation of quasi-separatrix layers and twist numbers, suggest development and subsequent decay of complex coronal configuration including null points and separators in different locations within the active region volume and a number of highly twisted flux ropes to be responsible for its periodic activity. Additionally, we calculate the evolution of current and magnetic free energy stored in the active region which provides important insights in flare productivity of active regions in general.

ASI2021_159	Prithish Halder	Poster
A comet dust model based on the findings from the Rosetta mission.		
<p>The morphology of dust particles observed by the Rosetta/MIDAS and COSIMA instruments reveal the presence of fluffy aggregated dust particles having hierarchical structure called Hierarchical Aggregates (HA) with smallest unit or monomer size of $0.1\mu\text{m}$ ($\sigma = \pm 0.02\mu\text{m}$ to $\pm 0.035\mu\text{m}$). In this work we construct HA using Ballistic Cluster Cluster Agglomeration (BCCA) algorithm having mean size of $0.1\mu\text{m}$ and polydispersity (σ). We also construct Solids (dust with low porosity) using the algorithm for agglomerated debris (porosity $< 10\%$) and a mixed morphology having mixture of HA and Solids called Fluffy Solids (with moderate porosity). The three morphologies are used as light scattering targets for light scattering simulations using Multi-Sphere T-Matrix (MSTM) and Discrete Dipole Approximation (DDA) codes, considering inhomogeneous mixed composition of silicate minerals and carbonaceous materials having power law size distribution index (n) in the range 2.0 – 3.0. The degree of linear polarization obtained from the light scattering computations over the modelled dust particles allow us to simulate the polarization-phase curve, observed in the case of the comets 1P/Halley, 67P/Churyumov-Gerasimenko, C/1995 O1 Hale-Bopp and C/1996 B2 (Hyakutake). The dust model is verified by the polarimetric color profile which exhibits a positive trend as obtained by previous studies. Also, the model recreates the wavelength dependence of polarization observed in the case of the comet Hale-Bopp. Finally, the model agrees with the idea that long-period comets may have a high percentage of loose particles, retaining the morphology from the proto-planetary phase, while the short-period comets possess a high percentage of solid particles with low porosity. This difference in the dust properties could be due to frequent and/or higher magnitude of weathering by solar radiation during the relatively more frequent passages close to the Sun by the short-period comets. This computational study extensively used the Vikram-100 HPC facility at PRL, Ahmedabad.</p>		

ASI2021_562	Rahul Yadav	Poster
Stratification of physical parameters in a C-class solar flare using multi-line observations		
<p>We present high-resolution and multi-line observations of a C2-class solar flare, occurred in NOAA AR 12740 on May 6, 2019. The rise, peak, and decay phases of the flare were recorded continuously and quasi-simultaneously in the Ca II K line with the CHROMIS instrument, the Ca II 8542 Å and Fe I</p>		

6173 Å lines with the CRISP instrument at the Swedish 1-m Solar Telescope. A non-LTE STiC inversion code was employed to infer the temperature, magnetic field, line-of-sight (LOS) velocity, and microturbulent velocity stratification in the flaring atmosphere. The temporal analysis of the inferred temperature at the flare footpoints shows that the flaring atmosphere from $\log \tau_{500} \sim -2.5$ to -3.5 is heated up to 7 kK, whereas from $\log \tau_{500} \sim -3.5$ to -5 the inferred temperature ranges between ~ 7.5 kK and ~ 11 kK. During the flare peak time, the LOS velocity shows both upflows and downflows around the flare footpoints in the upper chromosphere and lower chromosphere, respectively. Moreover, the temporal analysis of the LOS magnetic field at the flare footpoints exhibits maximum change of ~ 600 G. After the flare, the LOS magnetic field decreases to the non-flaring value, exhibiting no permanent or step-wise change. Our analysis suggests that a fraction of the apparent increase in the LOS magnetic field at the flare footpoints may be due to the increase in the sensitivity of the Ca II 8542 Å line in the deeper layers, where the field strength is relatively stronger. The rest can be due to magnetic field reconfiguration during the flare. In the photosphere, we do not notice significant changes in the physical parameters during the flare and non-flare time. Our observations illustrate that even a less intense C-class flare can heat the deeper layers of the solar chromosphere, mainly at the flare footpoints, without affecting the photosphere.

ASI2021_226	Reetika Joshi	Poster
Twist Transfer to a Solar Jet from a Remote Fluxrope		
<p>Solar jets often have a helical structure containing ejected plasma that is both hot and also cooler and denser than the corona. Various mechanisms have been proposed to explain how jets are triggered, primarily attributed to a magnetic reconnection between the emergence of magnetic flux and environment or that of twisted photospheric motions that bring the system into a state of instability. Multi-wavelength observations of a twisted jet observed with the Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamics Observatory and the Interface Region Imaging Spectrograph (IRIS) were used to understand how the twist was injected into the jet. This region is the result of the collapse of two emerging magnetic fluxes (EMFs) overlaid by arch filament systems that have been well-observed with AIA, and IRIS. In the magnetic field maps, we found evidence of the pattern of a long sigmoidal flux rope (FR) along the polarity inversion line between the two EMFs, which is the site of the reconnection. Before the jet, an extension of the FR was present and a part of it was detached and formed a small bipole with a bald patch (BP) region, which dynamically became an X-current sheet over the dome of one EMF where the reconnection took place. At the time of the reconnection, the Mg II spectra exhibited a strong extension of the blue wing that is decreasing over a distance of 10 Mm (from -300 km/s to a few km/s). This is the signature of the transfer of the twist to the jet. A comparison with numerical magnetohydrodynamics simulations confirms the existence of the long FR. We conjecture that there is a transfer of twist to the jet during the extension of the FR to the reconnection site without FR eruption.</p>		

ASI2021_278	Ritesh Patel	Poster
A Statistical Study of Plasmoids associated with post-CME Current Sheet		
<p>We investigate the properties of plasmoids observed in the current sheet formed after an X-8.3 flare followed by a fast CME eruption on September 10, 2017 using Extreme Ultraviolet (EUV) and white-light coronagraph images. The main aim is to understand the evolution of plasmoids at different spatio-temporal scales using existing ground- and space-based instruments. We identified the plasmoids in current sheet observed in the successive images of {\it Atmospheric Imaging Assembly} (AIA) and white-light coronagraphs, K-Cor and LASCO/C2. We found that the current sheet is accompanied by several plasmoids moving upwards and downwards. Our analysis showed that the downward and upward moving plasmoids have average width of 5.92 Mm and 5.65 Mm, respectively in the AIA field of view (FOV). However, upward moving plasmoids have average width of 64 Mm in the K-Cor which evolves to a mean width of 510 Mm in the LASCO/C2 FOV. Upon tracking the plasmoids in successive images, we observe that downward and upward moving plasmoids have average speeds of $\sim 272 \text{ km s}^{-1}$ and $\sim 191 \text{ km s}^{-1}$ respectively in the EUV passbands. We note that the plasmoids become super-Alfvénic when they reach at LASCO FOV. Furthermore, we estimate that the null-point of the current sheet at $\approx 1.15 R_{\odot}$ where bidirectional plasmoid motion is observed. We study the width distribution of plasmoids formed and notice that it is governed by a power law with a power index of -1.12. Unlike previous studies there is no difference in trend for small and large scale plasmoids. The presence of accelerating plasmoids near the neutral point indicates a longer diffusion region as predicted by MHD models.</p>		

ASI2021_167	SAFNA BANU K	Poster
Observations of Flare induced Fast Propagating Waves and Coronal Loop Oscillations		
<p>Coronal loops are closed magnetic structures embedded in the hot coronal plasma. Using high-resolution observations provided by the Atmospheric Imaging Assembly (AIA) onboard Solar Dynamic Observatory (SDO), we investigated the flare induced oscillations in coronal loops and fast propagating waves during an X-class flare observed on 10th September 2017. We found that a pre-flare triggered the main flare. AIA observations showed that the reconfiguration of magnetic field lines started after the initiation of the pre-flare. After the burst, we found fast propagating waves and loop oscillations. The time series analysis across the coronal loops shows oscillations with periods of $T = 5\text{--}6$ minutes and a damping time of $\tau = 25\text{--}28$ minutes. The loop length is measured as $L = 193.06 \text{ Mm}$. We found fast propagating EUV waves with a speed of $1072 - 1287 \text{ Km/s}$. Detailed results will be presented in the paper.</p>		

ASI2021_127	Sanjay Kumar	Poster
Magnetic reconnections in the presence of quasi-separatrix layers and three-dimensional magnetic nulls		
<p>Three-dimensional (3D) magnetohydrodynamic simulations are carried out to explore magnetic reconnections in the presence of quasi-separatrix layers (QSLs) and 3D magnetic nulls. The initial magnetic fields are generated by superposing uniform vertical magnetic fields of two different magnitudes on a linear force-free field. The interior of the numerical box contains two 3D nulls with separatrix domes separated by a quasi-separator (or hyperbolic flux tube) with QSLs. In the first simulation, the uniform vertical field is so large that the nulls are located at low heights and the domes are separate. Initially unbalanced Lorentz forces drive rotational flows that form strong electric currents and strong torsional fan reconnection at the 3D nulls and weak QSL reconnection at the hyperbolic flux tube. Flipping or slipping of field lines is observed in both cases. In the second simulation, with a weaker vertical field and larger domes, the separatrix surfaces meet at the central quasi- separator and their rotation drives stronger QSL reconnection than the first simulation.</p>		

ASI2021_328	Satish Chandra	Poster
Long term variation in solar rotation and its dependence on solar cycles		
<p>Variations in solar rotation (temporal and spatial both), is still an arguable concern of solar physics that can also be estimated by the flux modulation method. The work presented here is an effort to investigate the long term variations (more than four solar cycles) in the solar rotation by analyzing the radio emission that escapes from various altitudes above photosphere of solar atmosphere. The radio flux data at various frequencies (245-15400 MHz) recorded during years 1967 to 2010 at Sagamore Hill Solar Radio Observatory, Massachusetts, USA and other observatories are used to generate time series. The periodicities present in the time series can be estimated through various statistical methods. Here in our case, Lomb-Scargle Periodogram (LSP) is used to estimate rotation period present in the time series, due to its ability to deal with unevenly sampled data. The rotation period estimated through LSP analysis shows continuous temporal and spatial variation throughout the years. The smoothened rotation period shows the presence of ~ 11-yr and ~ 22-yr periodic components in the time series. The ~ 22-yr component must be linked to the solar magnetic field reversal (Hale) cycle and the ~ 11-yr component, obviously to the sunspot (Schwabe) cycle. Besides these two components, random components are also prominently present in the analyzed data. The cross-correlation between the yearly averaged sunspot number and the rotation period obtained shows strong and almost in phase correlation with 11-yr Schwabe's and 22-yr Hale cycle. The detail outcome of study would be presented in the paper.</p>		

ASI2021_249	Shabbir Bawaji	Poster
The shapes of solar WINQSEs		
<p>The perplexing mystery of what maintains the solar coronal temperature at about a million K, while the visible disc of the Sun is only at 5800 K, has been a long standing problem in solar physics. A recent study by Mondal et al. (2020, ApJ, 895, L39) has provided the first evidence for the presence of numerous ubiquitous impulsive emissions at low radio frequencies from the quiet sun regions, which could hold the key to solving this mystery. These Weak Impulsive Narrowband Quiet Sun Emissions (WINQSEs) occur at rates of about five hundred events per minute, and their strength is only a few percent of the background steady emission. Based on earlier work with events of larger flux densities and theoretical considerations, WINQSEs are expected to be compact in the image plane. To characterise the spatial structure of WINQSEs, we have developed a technique based on an unsupervised machine learning approach. This involves identifying peaks in the solar radio images, classifying them as isolated or clustered, fitting them with Gaussians or quasi-Gaussians, then using statistical and heuristic filtering criteria to obtain robust fits for a subset of these WINQSEs. We find that the vast majority of WINQSEs can be described by well behaved compact Gaussians. By its very design, this approach is focused on morphological characterisation of these weak features and is better suited for identifying them than earlier attempts. We present here our first results of the observed distributions of intensities, sizes and axial ratios of the Gaussian models for WINQSEs arrived at from analysis of multiple independent datasets.</p>		

ASI2021_313	SOUVIK ROY	Poster
Magnetohydrodynamical Understanding of the Interactions Between Coronal Mass Ejections and Earth's Magnetosphere		
<p>Coronal mass ejections (CMEs), the large scale transient eruptions from the Sun, interact with the Earth's magnetosphere while travelling into the heliosphere. The energetic interplanetary CME (ICME) at 1AU not only creates geomagnetic storms and disrupts the magnetic field structure around the Earth but also impacts the plasma environment, causes strong aurorae, and disturbs the radio and electrical transmission massively. We use 3D compressible magnetohydrodynamic simulation of a star-planet system and study the interesting magnetohydrodynamic processes like bow-shock, magnetopause, magnetotail, planet-bound current sheets, magnetic reconnections, atmospheric mass loss as well as particle injection, etc., when an ICME flux rope crosses the Earth at 1 AU. We use the uniformly twisted force-free flux rope model proposed by Gold and Hoyle in 1960 to initiate the ICME and vary the flux rope properties using actual observational data. We observe a change in magnetopause's shape and the stand-off distance to the magnetopause. We notice twist helicity injection inside the magnetotail current system. We discover comparative increment in both the rates of atmospheric mass out-flow and solar wind in-flow in the vicinity of Earth during the geo-storm. Such studies will help us understand how energetic magnetic storms from a host star impact planetary magnetospheres and atmospheres with implications for planetary and exoplanetary habitability.</p>		

ASI2021_110	Suman Dey	Poster
Effects of streaming instability in leaking O ⁺ and H ⁺ from upper ionosphere of Venus		
<p>It is well established that the Hydrogen and Oxygen ions are leaking from the atmosphere of Venus. The lack of global internal magnetic field of Venus causes the solar wind plasma directly stream into its atmosphere. As a result, higher parts of its ionosphere may encounter multi-stream instabilities. Destabilized plasma waves may accelerate the ions to velocities greater than their escape velocity. This can along with many other explanations can be a possible reason for leak of ions from the Venus's atmosphere. We have considered non-magnetized plasma with 3 components – O⁺, H⁺, and streaming solar wind electrons, all with suprathermal distributions. We have obtained the dispersion relation and studied the streaming instability and calculated the growth rate of the instability. Then we have used parameter values from VEX (Venus Express) for both dayside and nightside to determine whether or not the instability is enough to accelerate ions to escape velocities and hence leave the atmosphere of Venus.</p>		

ASI2021_140	Sumanjit Chakraborty	Poster
Response of the Ionosphere under the influence of a CIR-induced Geomagnetic Storm during the descending phase of a solar cycle		
<p>Geomagnetic storms are caused as a result of the Earth-directed Interplanetary Coronal Mass Ejections (ICMEs) that pass the Earth frequently at an average rate of about one-two bursts per month and the change in the polarization of the north-south component (B_z) of the Interplanetary Magnetic Field (IMF) from northward to southward causing magnetic reconnection at the Earth's magnetic field. The occurrences of such events are higher during the ascending phase and the maximum phase of a solar cycle. CMEs from the solar corona generally impact the Earth's magnetosphere causing intense geomagnetic storms that perturbs the upper atmosphere. However, often overlooked, the other type of geomagnetic storm drivers, the Co-rotating Interaction Regions (CIRs), that originate when High Speed Solar Wind (HSSW) streams from a coronal hole interact with the slow solar wind creating shocks which cause recurrent geomagnetic storm effects on the terrestrial environment, tend to occur mostly in the descending to minimum phase of a solar cycle. Although, the intensity of a CIR-driven storm is weaker compared to the ICME-induced ones, their impacts on the magnetosphere-ionosphere system is quite significant and can cause disruptions in the modern day sophisticated communication systems, electric power-grids and space-based navigational satellite systems. In this work, the impact of a CIR-induced storm of October 2016, over the low-latitude ionization of the Indian subcontinent, has been studied in details. This holistic study, for the first time, shows that geomagnetic storm induced electrodynamics, as a result of a CIR/HSSW event during the descending phase of a solar cycle, can enhance the diurnal maximum values of the ionospheric Total Electron Content (TEC) upto 50 TECu (1 TECu = 10¹⁶ electrons per m²) over the quiet time average values, thus causing detrimental effects and degrading the performance of precise navigation by satellite systems.</p>		

ASI2021_579	Suraj Sahu	Poster
First detection of HXR emission from an activated flux rope and initiation process of the associated coronal mass ejection		
<p>In this work, we present a comprehensive study of the evolutionary phases of a major M6.6 long duration flaring event with special emphasize on its pre-flare phase. The event occurred in active region NOAA 12371 on 2015 June 22. A remarkable aspect of the event was an active pre-flare phase lasting for about an hour during which a hot EUV coronal channel was in the build-up stage and displayed cospatial hard X-ray (HXR) emission up to energies of 25 keV. This is the first evidence of the HXR coronal channel. The coronal magnetic field configuration based on nonlinear-force-free-field modeling clearly exhibited a magnetic flux rope (MFR) oriented along the polarity inversion line (PIL) and cospatial with the coronal channel. We observed significant changes in the AR's photospheric magnetic field during an extended period of ≈ 42 hr before the flare in the form of rotation of sunspots, moving magnetic features, and flux cancellation along the PIL. Prior to the flare onset, the MFR underwent a slow rise phase (≈ 14 km/s) for ≈ 12 minutes, which we attribute to the faster build-up and activation of the MFR by tether-cutting reconnection occurring at multiple locations along the MFR itself. The sudden transition in the kinematic evolution of the MFR from the phase of slow to fast rise (≈ 109 km/s with acceleration ≈ 110 m/s²) precisely divides the pre-flare and impulsive phase of the flare, which points toward the feedback process between the early dynamics of the eruption and the strength of the flare magnetic reconnection.</p>		

ASI2021_245	Surajit Mondal	Poster
Detection of sausage MHD modes using radio observations of solar noise storms		
<p>Type I solar noise storms are among the most common active radio emissions, especially in the metric wavelengths. The presence of magnetohydrodynamic (MHD) waves in type I noise storms is now well accepted and are usually inferred from observations of quasi-periodic pulsations (QPPs) at time scales timescales ranging from a few seconds to several minutes (e.g. Nakariakov et al. 2009 and, Carley et al. 2019). Mohan et al. (2019) recently reported simultaneous observation of QPPs in a type III radio burst along with a strong anti-correlation between the observed source size and the integrated flux density of the burst source. They argued both of these observations can be simultaneously explained by modulation of the nonthermal electron electron beams at the reconnection site. We note that detection of QPPs in a time series necessarily requires the sustained presence of pulsations at a dominant time scale. However, the anti-correlation between the morphological parameters of burst source is expected to remain observable even when either no dominant QPP is present or multiple periodicities are simultaneously present. Using high fidelity solar radio images from the Murchison Widefield Array, we investigate this possibility. We find robust evidence for the existence of such anti-correlations for a weak type I noise storm even during its quiescent phase, implying the presence of sausage oscillation modes. Here we will present the results from this study and showcase this as a novel approach, made possible by modern instruments, to uncover previously unappreciated aspects of dynamics of well observed emissions like type I noise storms.</p>		

ASI2021_116	VIJAYALAKSHMI P	Poster
Analysis of halo CMEs and their solar source active region properties.		
<p>We investigate the dependence of the occurrence rates of X-ray solar flares (X, M and C-classes) and front side halo coronal mass ejections on the active region (ARs) properties observed from 2010-2016 in the solar cycle 24. A set of 60 active regions (ARs) properties was included. First an analysis of their properties and relationship between them are made. A moderate correlation is obtained between active region properties and CME properties. Second we found that, there are 13% of X-class flare, 52% of M-class flare, 35% of C-class flare. Third we found that many of flares were produced by δ & δ Halo –type sunspot group and Ekc/Dkc/Fkc McIntosh sunspot class. (Key words: Halo coronal mass ejection, Active region, Flare, Sunspot.)</p>		

ASI2021_194	Vivek Singh	Poster
A comparison between autocorrelation and Lomb-Scargle periodogram analysis techniques in estimating solar rotation		
<p>Solar rotation, accountable for the solar activity cycle is one of the most important characteristics. Due to advancement of techniques and availability of data, the studies on rotation of Sun and other stars are increasing. Sun is only star whose rotation is investigated in detail and result is served as reference for estimation of rotation of other sun like stars. Sun exhibits differential rotation as a function of latitude as well as altitude both. To determine solar rotation rate different methods as, tracking of tracers, spectral analysis, heliosiesmology and flux modulation are used. In flux modulation method, a time series is generated for the period of study. The harmonics present in the time series are estimated by various statistical methods as autocorrelation (Vats et. al. 1998, 2001, Bhatt et. al 2017, 2018), wavelet analysis (Hempelmann A., 2002, Freitas, D.B. et. al. 2010), Fast Fourier Transform (Hempelmann A., 2002, Kuker M. 2008) and Lomb Scargle periodogram (Giordano S., 2008, Mancuso S., 2020, Li et. al 2020). Present work is a comparison between autocorrelation and LSP to estimate periodicities present in a time series. A typical time series is generated for the radio flux data observed at Segamore Observatory for year (1972) and X-ray (SFD) data observed by HINODE for year (2013). Harmonics present in the time series are evaluated by autocorrelation and LSP method both. Five different time series are generated by artificial data chosen randomly with 5%, 10%, 15%, 20% and 25% data gaps. The time series generated by these datasets are used to find periodicities by autocorrelation and LSP method. The estimated rotation periods are compared with a result obtained by a time series generated with continuous data. The result suggests LSP is able to deal the time series with data gaps also. The detail comparison results would be presented in the paper.</p>		

ASI2021_553	Wageesh Mishra	Poster
Investigating the Thermodynamic State of a Coronal Mass Ejection during its Propagation in the Solar Wind		
<p>Several earlier studies have attempted to estimate the thermodynamic properties of Coronal Mass Ejections (CMEs) either very close to the Sun or at 1 AU. However, our study attempts to investigate the evolution of the thermodynamic state of CMEs during their propagation in the solar wind. For this purpose, we use the flux rope internal state (FRIS) model which is constrained by the kinematics of the CMEs. The kinematics of the CME is estimated using the STEREO coronagraphs (CORs) and heliospheric imagers (HIs) observations in combination with drag based model (DBM) of CME propagation. In our analysis, we have selected a few Earth-directed CMEs which are launched with different speeds into different solar wind conditions. We also attempt to compare the estimated thermodynamic properties of the CMEs from the FRIS model with the in situ observations of the CMEs taken at 1 AU. We focus on estimating the polytropic index of the CME plasma, heating/cooling rate, entropy changing rate, Lorentz force and thermal pressure force acting inside the CME. The talk will discuss the approximations made in our study and the potential reasons of the observed discrepancies between the observations and model derived results.</p>		

Posters in
Stars, ISM and Galaxy

ASI2021_460	Aditya Pandya	Poster
Galaxy Rotation Curve of Milky-Way & its Structure		
<p>The Green Bank Observatory was remotely used to Observe the doppler spectrum of the 21 cm hyperfine line of interstellar medium from galactic longitude 0° to 235° in the galactic plane of the Milky Way galaxy. The galactic data is used to plot the velocity curve of the galaxy as the function of the radius using the tangent point method. The results are compared with previously plotted curves with different galactic constants R_0 & V_0. [Burton and Gordon (1978), Clemens (1985), Sofue et al. (2009), McGaugh et al. (2018)] respectively. The obtained galactic data from the rotation curve is used to construct some features of the spiral arm structure of the Milky Way and various boundary conditions involved in the method are discussed.</p>		

ASI2021_56	Akshat Singhal	Poster
Analysis in Error in measuring Pulsar period		
<p>Period measurement on a photon deprived high energy source signal is computationally expensive. An accurate error propagation on those methods can be quite challenging. We present an empirical error analysis using epoch folding and Z-square method for range pulsar profile as a function on different parameters. We used simulated and real data for this study</p>		

ASI2021_368	Alaxender Panchal	Poster
PHOTOMETRIC AND SPECTROSCOPIC ANALYSIS OF FOUR CONTACT BINARIES		
<p>We present the photometric and spectroscopic analysis of four W UMa binaries CRTSJ015829.5+260333, CRTSJ030505.1+293443, CRTSJ102211.7+310022 and KW Psc. The VRI-band photometric observations are carried out with the 1.3-m Devasthal Fast Optical Telescope (DFOT). For low resolution spectroscopy, we used the 2-m Himalayan Chandra Telescope (HCT) as well as the archival data from 4-m LAMOST survey. The systems J0158 and J0305 show a period increase rate of 5.26×10^{-7} days/yr and 1.78×10^{-6} days/yr. The period of J1022 is found to be decreasing with a rate of 4.22×10^{-6} days/yr. The period analysis of KW Psc by showss no change in period. We have used PHOEBE package for the photometric light curve modeling and the basic parameters like luminosity, mass and radius of the components are evaluated with help of GAIA parallax. The asymmetry of light curve maxima at phase -0.25 and 0.25 is explained with the assumption of cool spots at specific positions on one of the components of the system. On the basis of temperatures, mass ratios, fill-out factors and periods, we identify J0305, J1022 and KW Psc as W-subtype systems. The J0158 is most likely to be A-subtype system. To probe the</p>		

chromospheric activities in these W UMa binaries, H_{alpha}, H_{beta} and Ca triplet lines are compared with the known inactive stars of same spectral type using spectral subtraction technique. The subtracted spectra shows emission in these lines. To understand the evolutionary status of these systems, the components are plotted in mass-radius and mass-luminosity planes with other well characterized binary systems. The secondary components of all the systems are away from ZAMS which indicates that secondary is more evolved than the primary component.

ASI2021_425	Ambreesh Khurana	Poster
Solving the mystery of the production of wide extremely low-mass white dwarf binaries		
<p>Extremely low-mass white dwarfs (ELM-WDs; $M \lesssim 0.3 M_{\odot}$) cannot be produced via single stellar evolution within a Hubble time. These strange WDs are thought to be remnants of stars whose evolution got cut off when it was in the red giant branch (RGB) due to mass transfer (MT) to a close companion. Almost all observed ELM-WDs have companions in tight orbits with a median orbital period $P \approx 5.4$ hr (Brown et al. 2016) giving credence to the above theoretical understanding of their formation. A recent detection of an ELM-WD in a wide orbit ($P \approx 450$ day) with a $1.1 M_{\odot}$ main-sequence star (Masuda et al. 2019) challenges this understanding. Its semi-major axis is at least an order of magnitude too large for it to have formed via MT during RGB. We propose that a typical ELM-WD binary formed inside a star cluster got dynamically modified and subsequently ejected from the cluster to create the observed wide ELM-WD--MS binary. Using millions of N-body simulations we show that strong non-resonant double exchange binary-binary encounters inside a star cluster can convert a typical tight-orbit ELM-WD binary into a wide ELM-WD binary similar to the one observed. We show that star clusters of mass $\sim 10^4 M_{\odot}$ are most efficient for our scenario. We further find that the production rate of wide ELM-WD binaries is $1.6 \times 10^{-6} \text{ Gyr}^{-1}$ per regular ELM-WD binary inside a cluster of mass $10^5 M_{\odot}$. I will present our key results in my talk.</p>		

ASI2021_375	Anindya Ganguly	Poster
On the formation of the Black Hole – Red Straggler binary in M10		
<p>The role of stellar dynamics in dense star clusters in forming merging binary black holes (BHs) detectable via gravitational wave detectors have created immense interest in BHs inside globular clusters (GCs). The BH-red straggler (RS) binary detected in M10, M10-VLA1, is among the best studied stellar-mass BHs in a GC. This source is particularly fascinating because RSs, as well as BHs are rare species in a GC. We study the formation channel for M10-VLA1 using a large grid of detailed binary stellar evolution models using MESA. We find that magnetically-inhibited convection inside a star can create RSs with properties very similar to the observed system. The required decrease in convective mixing length to produce M10-VLA1-like RSs matches well with asteroseismic constraints. We further show that other, previously proposed RS formation</p>		

channels, such as tidal heating of an initially eccentric BH-star binary, mass transfer from a red giant star to a BH primary, and tidal envelope stripping by the BH, while can produce RSs, but those RSs are too blue compared to the RS in M10-VLA1. I will talk about our key results.

ASI2021_175	Anshuman Acharya	Poster
How Robust are the Inferred Density and Metallicity of the Circumgalactic Medium?		
<p>It has been suggested that studying the circumgalactic medium (CGM) of galaxies will lead to a better understanding of galaxy evolution and feedback mechanism. The quantitative estimates of the basic properties of CGM, such as the density and metallicity that are directly related to the size and mass of CGM gas, depend on the spectrum of incident UV background radiation. The models of UV background are known to have large variations, mainly because they are synthesized using poorly constrained parameters, which introduces variations in the inferred properties of the CGM. With rigorous analysis, we quantify such a variation in the inferred density and metallicity of the CGM gas for the first time. For that, we use a large set of new UV background models (Haardt & Madau 2012, seven models from Khaire & Srianand 2019, Puchwein et al. 2019, and Faucher-Giguere 2020) with physically motivated toy models of the metal-enriched CGM gas and Bayesian analysis to recover the densities and metallicities. We find that on average, the density and metallicity of the photoionized CGM gas vary by a factor of 4 and 2.5 (i.e. 0.6 and 0.4 dex), respectively. In the case of collisionally ionized warm-hot gas, we find that the inferred metallicities do not show any significant variation, but the density shows a similar variation of a factor of 4. These estimates are independent of the redshift (for $z < 1$), and the number and species of metals used for the inference. Such a considerable variation in density and metallicity may severely limit the studies of CGM and demand more constraining observations of the input parameters used in synthesizing the UV background models.</p>		

ASI2021_538	Anuj Gupta	Poster
EVOLUTION OF INTERSTELLAR DUST MASS ACROSS OUR GALAXY		
<p>Interstellar dust, that traps the non-volatile elements in significant amount, is an essential constituent of baryonic matter distribution in the galaxies. The origin of the dust grains is possible only in stellar environments, but their reprocessing and evolution takes place in the interstellar medium (ISM) after their injection into the ISM. Dust grains do not behave like a passive audience but contribute in the various physicochemical processes occurring in distinct astrophysical environments. These processes include their role in the interstellar chemistry, the formation of hydrogen molecule, the process of stellar formation, the commencement of planetary formation etc. In this work (doi:10.1093/mnras/staa897), we have deduced a novel mass-balance formalism to understand the abundance evolution of the distinct types of interstellar dust grains in our Milky-Way Galaxy over the Galactic time-scales. The Galaxy is evolved in terms of elemental</p>		

evolution resulting from stellar nucleosynthetic contributions of several generations of stars and the various condensable elements are redistributed into various grain constituents during the Galactic evolution. Thus, we have attempted to assess the relative abundances of the major constituents of interstellar dust and computed the normalized mass distributions of distinct dust grain components for the distinct epochs over the entire Galaxy. This is perhaps a novel attempt to estimate the bulk dust mass budget in the evolving Galaxy. As we move away from the Galactic center, the normalized Galactic dust mass is predicted to decrease. Therefore, the dust mass is more in the inner annular rings of the Galaxy. However, the Galactic dust mass is predicted to be increasing with the temporal evolution which can be understood on the basis of the enrichment of ISM with heavier and refractory elements by successive stellar generations.

ASI2021_451	Arpan Ghosh	Poster
Initial Spectroscopic results of a sample of FUOrs as obtained from the TANSPEC and ADFOSC instruments mounted on 3.6m DOT.		
<p>Recently, the 3.6m Devasthal Optical Telescope has become operational providing medium resolution optical to Near Infra Red (NIR) spectroscopic facilities through TIFR ARIES Near Infrared Spectrometer (TANSPEC) and low resolution optical spectroscopic facility via ARIES Devasthal - Faint Object Spectrograph & Camera (ADFOSC). In the first observational run of 3.6m DOT we managed to observe a set of 5 FU Orionis objects using TANSPEC and ADFOSC. FU Orionis objects are low mass pre main sequence stars that undergo episodes of enhanced accretion separated by quiescent stages. Here, we present the initial spectroscopic results of the 5 FU Orionis objects observed with 3.6m DOT. We will report the accretion rates, the disc turbulence parameters, the outflow parameters and the presence/absence shock regions as observed for these sample of sources.</p>		

ASI2021_343	ARUN ROY	Poster
Clustering of low mass YSOs around Herbig Be stars - Case of IL Cep		
<p>Herbig Ae/Be stars are intermediate mass premain sequence stars with spectral types ranging from B0-F5. The early type Herbig stars are reported to have a clustering of low mass YSOs around them. We use the high precision Gaia EDR3 data to identify the young stars associated with early Herbig stars. The early type Herbig Be star IL Cep is a member of the Cep OB3 association. The ~ 0.1 Myr star at 797 pc and has a "cavity" associated with it. We have identified 78 co-moving stars of IL Cep using the Gaia EDR3 astrometric analysis. The Gaia color-magnitude diagram confirms that the stars are mostly coeval to IL Cep (~ 0.1 Myr). We analyzed the 2MASS and IRAC colors of the co-moving stars and classified 26 stars as Class II objects. The stars without disc (Class III) are 65 % of all the co-moving stars, which is consistent with previous studies. There are 9 intense Hα emission stars identified among the co-moving stars using narrowband Hα</p>		

photometry from IPHAS. HD 216658, a B0V type star that occupies the center of the "cavity" is identified as associated with IL Cep co-moving association and the "cavity". The Gaia EDR3 distance confirms that, HD 216658 as the initial trigger in mass dispersal and the creation of a "cavity" in the region. The pressure components of HD 216658 are estimated and found that the star is capable of producing the "cavity". Dendrogram analysis on the Hydrogen column density map identified 10 molecular clump structures on the expanding "cavity" around IL Cep making it an actively star-forming region.

ASI2021_190	Belinda Damian	Poster
Testing the dependence of disk evolution on external UV radiation in W5 clusters		
<p>The circumstellar disks (or protoplanetary disk) are a natural by-product of the star formation process. The evolution of these disks can be attributed to the accretion of the disk gas and dust onto the star, accretion into planets, photoevaporation due to the central protostar or due to external UV radiation from nearby massive stars. Studies have shown that the evolution of disks is dependent on the stellar mass and that the disk frequencies around solar to high-mass stars are lower in comparison to the disk frequencies around low-mass stars. This correlation between the disk fraction and stellar mass indicates that the time available for planet formation around massive stars is less. Hence, it is important to understand the relation between disk fraction versus age as a function of stellar mass and the dependence of disk frequency on environmental factors. In this regard, the young clusters (age ~ 2 Myr) IC1848-East and West located at a distance of ~ 2.2 kpc in the W5 giant molecular cloud complex with negligible extinction ($A_V \sim 1.5$ mag) serve as ideal targets. Using deep multiband photometry from CFHT (Megaprime), PanSTARRS, Mayall Telescope (Newfirm) and Spitzer (IRAC, MIPS) we compare the disk fraction as a function of mass and UV flux between the two clusters through SED analysis. We also study the effect of age, mass and UV flux on the disk color excess. Since the two target clusters are located at the same distance with similar age and negligible foreground extinction but experience varying amounts of external radiation from the massive stars, this comparative study can provide evidence for the role of environmental factors on disk evolution.</p>		

ASI2021_466	Blessy Baby	Poster
Swift J173.5-0127 : Understanding the accretion geometry through frequency resolved spectroscopy		
<p>The Black Hole Binary source Swift J175.5-0127 remained in outburst for ~ 12 years from May 2005 to April 2017. For most part of the outburst the source remained in the Low Hard State (LHS) displaying transitions to softer states only towards the end of the outburst for short periods of time. A soft thermal component was required to model the spectrum in LHS which does not conform to the generally accepted disc truncation theory. Here, we attempt to obtain a clearer</p>		

picture of the accretion disk geometry using frequency resolved spectroscopy on select observations. Type-C Quasi-Periodic Oscillations (QPO) are observed in the Power Density Spectrum (PDS). We obtain the QPO rms spectrum of the source during the bright-hard state and model it with physical components. We find that the QPO rms spectrum can be described only by a comptonization component with no contribution from the thermal disc. This indicates that the variability observed in the PDS originates in the comptonization component and the evolution of the QPOs can be attributed to physical changes in this component rather than disc truncation.

ASI2021_224	Chatrik Mangat	Poster
Quasi-stationary evolution of HMNS with exotic EoS		
<p>Neutron Stars (NS) are considered to be one of the most exotic objects found in this universe. The extremely dense conditions which prevail inside the neutron stars make them astrophysical laboratories of physics at extreme conditions. The recent merger event of two such neutron stars i.e. GW170817, has given an impetus to the study of the Binary Merger Remnant (BMR). A BMR is often classified as a Hyper Massive Neutron Star (HMNS). It is intuitive to discern that a rotating neutron star can support more mass than a static (non-rotating) neutron star. Building on this, a differentially rotating neutron star can support even more mass than an uniformly rotating one. Our study primarily focuses on the effect of strangeness in the evolution of an HMNS. For this, we consider both nucleonic NS, as well as NS with exotic components such as hyperons in its core. Our set of Equation of State (EoS) is compatible with the NS mass, radius and tidal deformability constraints. We assume the newly born NS to be differentially rotating initially with the maximum possible frequency. We study the same star sequence rotating uniformly at mass-shedding limit and for the static (non-rotating) case. It is theorised that a rotating NS slows down and ends up as a static star by the loss of energy and momentum via electromagnetic or gravitational radiation. Finally, we probe the quasi-stationary evolution of an HMNS between these three equilibrium sequences; along which the rest mass remains constant.</p>		

ASI2021_444	Chirag Chawla	Poster
Gaia may detect hundreds of black holes		
<p>A large fraction of stellar-mass black holes (BHs) are expected to be in detached binaries with luminous companions (LCs). These BHs are not detectable via traditional methods, e.g., detection via X-ray, radio, or gravitational-wave (GW) emission. We simulate highly realistic models of BH--LC binaries in the Milky Way (MW) using a publicly available binary-population synthesis code COSMIC. We find that Gaia can discover a hundred to a few hundreds of detached BH--LC binaries by monitoring the motions of the LCs during its 10 year observation baseline. Proper motion, parallax, and magnitude of the LCs would also be known from Gaia data, hence, LC properties, such as mass, luminosity, age, and metallicity can be determined relatively easily. Follow-up radial</p>		

velocity observations to better constrain the BH mass and BH--LC properties are also possible for a majority of these candidates. If found, these BHs will be the first where their mass as well as the metallicity and age of their progenitors will be known almost model-independently. A null result will also provide strong constraints on initial binary properties of high-mass stars and supernova physics. In my talk, I will share our exciting key results.

ASI2021_287	CHIRANJEEVI PALLERLA	Poster
Understanding the Inner Structure of Accretion disk in GX 17+2: AstroSat's Outlook		
<p>We report the timing and spectral studies of a Z source GX 17+2 observed from Astrosat LAXPC instrument. We have done Cross-Correlation function (CCF) study using soft (3-5 keV) and hard (16-40 keV) X-ray bands across the hardness intensity diagram (HID) and found correlated/anti-correlated hard and soft lags. We performed spectral analysis for few of these observations and found no consistent variation in the spectral parameters during the lags. We detected HBOs around ~ 25 Hz and ~ 33 Hz along with their harmonics using AstroSat LAXPC data. We suggest that the detected lags are readjustment time scales of corona close to the NS and constrained its height to be around a few ten to hundred kms. The detected lags and no significant variation of inner disk front across the HID strongly indicate that structural variation in corona is the most possible cause of Z track in HID.</p>		

ASI2021_171	Devendra Bisht	Poster
An Investigation of Poorly Studied Open Cluster NGC 4337 Using Multicolor Photometric and Gaia DR2 Astrometric Data		
<p>We present a comprehensive analysis (photometric and kinematical) of the poorly studied open cluster NGC 4337 using 2MASS, WISE, APASS, and Gaia DR2 databases. By determining the membership probabilities of stars, we identified the 624 most probable members with membership probability higher than 50% by using proper motion and parallax data taken from Gaia DR2. The mean proper motion of the cluster is obtained as $\mu_x = -8.83 \pm 0.01$ and $\mu_y = 1.49 \pm 0.006$ mas/yr. We find the normal interstellar extinction toward the cluster region. The radial distribution of members provides a cluster radius of 7.75 arcmin (5.63 pc). The estimated age of 1600 ± 180 Myr indicates that NGC 4337 is an old open cluster with a bunch of red giant stars. The overall mass function slope for main-sequence stars is found as 1.46 ± 0.18 within the mass range 0.75–2.0 M_{\odot}, which is in fair agreement with Salpeter's value ($\alpha=1.35$) within uncertainty. The present study demonstrates that NGC 4337 is a dynamically relaxed open cluster. Using the Galactic potential model, Galactic orbits are obtained for NGC 4337. We found that this object follows a circular path around the Galactic center. Under the kinematical analysis, we compute the apex coordinates (A, D) by using two methods: (i) the classical convergent point method and (ii) the AD-diagram method. The obtained coordinates are (Aconv, Dconv) = $(96^{\circ}.27 \pm 0^{\circ}.10, 13^{\circ}.14 \pm 0^{\circ}.27)$ and (A0, D0) = $(100^{\circ}.282 \pm 0^{\circ}.10, 9^{\circ}.577 \pm 0^{\circ}.323)$ respectively. We also computed the Velocity Ellipsoid Parameters, matrix elements (μ_{ij}), direction cosines (l_j, m_j, n_j), and the Galactic longitude of the vertex (l_2).</p>		

ASI2021_418	Gayathri Raman	Poster
Detection of thermonuclear X-ray bursts in Cyg X-2 using AstroSat		
<p>Accreting compact objects are some of the brightest galactic X-ray emitters. In particular, weakly magnetized neutron stars, accreting from a low mass companion, are observed to undergo tremendously luminous flashes known as thermonuclear X-ray bursts. In my talk, I will present our latest results on the detection of six X-ray bursts from the low mass X-ray binary system, Cyg X-2, using AstroSat instruments. Detailed energy resolved burst analysis indicates that the bursts were Helium fueled flashes. We infer that during these observations, Cyg X-2 was present in an early Flaring Branch (FB) with a puffed up accretion disk and a clumpy coronal structure while undergoing medium-to-high levels of accretion. I will further discuss the implications of these results on our current understanding of accretion state transitions and thermonuclear detonation in Low Mass X-ray Binaries (LMXBs).</p>		

ASI2021_185	Gourav Banerjee	Poster
Spectroscopic studies of Galactic Classical Be stars to understand their disc transient nature		
<p>Classical Be stars (CBe) are massive B-type main-sequence stars with luminosity classes III-V showing emission lines of different elements in their spectra. These emission lines are produced in the gaseous, circumstellar disc that surrounds CBe stars. Many CBe star discs are known to show transient nature within timescales of months to decades. The disc loss and reappearing phases can be identified by studying the Hα line profiles of CBe stars on a regular basis. So we selected 12 bright CBe stars in the Galaxy which are identified to show transient nature. We obtained 236 medium resolution spectra of these stars using the UAGS instrument fitted with the 1.0-m reflecting telescope, situated at the Vainu Bappu Observatory (VBO), Kavalur, India. Continuous monitoring of these 12 stars was carried out since 2017 in the wavelength range 6200 - 6700 Å, particularly centred at Hα. We collated these multi-epoch observations and performed time series analysis to check how Hα line is evolving. In addition to studying the transient behavior of Hα line, we also observed variability in other spectral features such as Fe II 6282, 6516, Si II 6347, 6371 and He I 6678 Å absorption lines while analyzing the multi-epoch spectra. Our results indicate that a possible decline of disc material might have occurred between September 2015 - November 2017 for the star HD 4180. For the star HD 60855, we found that the disc formation has taken place within a timescale of 8 years, from 2008 – 2016. Another 3 stars are identified to be weak emitters with Hα EW < -5 Å. Our study will help in characterizing the evolution of Hα line profiles for our program stars, thus providing a better understanding about the transient nature of CBe stars.</p>		

ASI2021_611	Harikrishna Sripada	Poster
STUDY OF THE SUDDEN QPO TRANSITION EVENTS IN THE BLACK HOLE SOURCE H1743-322		
<p>We have analysed five outbursts of a BHXB H1743-332 and found rapid transitions of quasi-periodic oscillations in eight events. Four of them are type-B at ~ 4.5 Hz, one with type-A at 3.5 Hz and the remaining are type-C at ~ 9.5 Hz. In spectral investigation, it is clear that power law indices are varying though inner disk parameters remain almost stable which indicates either corona or jet might be responsible for the transition. Based on this we have estimated the ejection radii of corona using a plasma ejection model. Quasi-simultaneous study of X-ray and Radio observations indicate that type-B QPOs related to transient/weak jets and type-C QPOs are caused by the base of strong jet structures.</p>		

ASI2021_136	Harish Kumar	Poster
Effect of Accretion on White Dwarf of Different Abundance of Carbon and Oxygen		
<p>Context: Type Ia Supernovae (SNe Ia) are among the most important cosmological probes. SN Ia explosion takes place when a Carbon-Oxygen (CO) White Dwarf (WD) accretes matter from its companion and its mass approaches $1.4 M_{\odot}$. The explosion mechanism has not been fully understood and computer simulations are required to gain further understanding. Problem: We wish to study the effect of Helium accretion on the WD properties such as its size, surface gravity and the onset of He ignition; and, the effect of variation in Carbon-Oxygen abundance on these properties. Method: The stellar evolution code "Modules for Experiments in Stellar Astrophysics" (MESA) has been used to perform numerical simulations to study various properties of CO-WD during the accretion. In this study WD with different abundances of carbon and oxygen were subject to accretion of Helium at a slow rate $5 \times 10^{-10} M_{\odot}$. The initial mass of the WD was $0.6 M_{\odot}$ with different abundances by mass fraction. Results: Variation of surface gravity (g) has been calculated and plotted as the accretion progresses. As expected the size of WD decreases and g increases, however, towards the end of the run g drops sharply due to helium ignition. The temperature profile and luminosity have been calculated which also indicate a sudden expansion of WD due to helium ignition. It is also observed that accretion phase lasts longer in the WD with higher abundance of Carbon before the onset of helium ignition.</p>		

ASI2021_362	Himanshu Tyagi	Poster
Crystalline silicates in the Protostars		
<p>The silicate dust in the interstellar medium from which stars and planetary systems form is predominantly in an amorphous state. However, young protoplanetary disks show evidence for the presence of a significant amount of crystalline dust. When and how crystallization happens during the formation of stars and planetary systems is only poorly understood. High crystallinity has recently been reported in a protostar, HOPS 68 (Poteet et al., 2011), suggesting the possibility</p>		

of crystallization in the early protostellar phase. This is, however, surprising because protostars are cold ($T_{\text{bol}} \sim < 100$ K) objects, and thermal annealing that can convert amorphous silicates into crystalline dust require temperatures above 1000 K. We have carried out a systematic search for crystalline silicates in embedded protostars in the nearby star-forming regions to investigate if crystallization of amorphous dust occurs early in the protostellar phase. We have analyzed the Spitzer mid-IR (5-40 micron) spectra of these protostars to quantify the mass fraction of crystalline dust in these systems. This is a preparatory study for the upcoming JWST. We will present our results and discuss the evidence for the crystallization of silicate dust in protostars.

ASI2021_182	Jagriti Gaba	Poster
Estimation of ^{56}Ni mass of Type Ia Supernovae		
<p>One of the most important extra-galactic distance indicators the Type Ia Supernovae (SNe Ia) have played a crucial role in the discovery of dark energy. However, the physics of explosion mechanism is not fully understood. The light curves (LC) of SNe Ia are characterised by a sharp rise, reaching a peak and a slow decline after that. The decline phase is powered by the radio-active decay of ^{56}Ni and ^{56}Co which are produced via nuclear reactions in the explosion along with the other intermediate mass elements. The amount of ^{56}Ni decides the decline rate and hence the width of LC. Modeling the LC and measuring the mass of ^{56}Ni is still a challenging issue despite the several attempts made through observations and numerical simulations. However, the IR light curves show a secondary maxima after the prominent bolometric peak. It is suggested that the time of the secondary peak (t_2) is correlated with the bolometric luminosity of the first peak. We fit a cubic spline to obtain the peak luminosity from t_2. Now the Arnett's rule with a fixed rise time is implemented to calculate the ^{56}Ni mass. For a sample of 58 SNe Ia, the relation between peak luminosity and t_2 is applied. The Carnegie Supernova Project is the main source of the data for SNe Ia. The ^{56}Ni mass calculated using the above method is in good agreement with the literature. The advantage of the method is that it is un-affected by the reddening.</p>		

ASI2021_125	Jithesh V	Poster
Detection of Type-1 Bursts from NS LMXB 4U 1705-44 using Simultaneous AstroSat and NICER observations		
<p>The neutron star low mass X-ray binary, 4U 1705-44, was simultaneously observed with AstroSat and NICER observatories on 2020 September 18 with 20 and 14 ks exposure time, respectively. We found a steady source intensity during these observations, with three distinct Type-1 bursts detected. The first burst was detected only with the Large Area X-ray Proportional Counter (LAXPC) instrument onboard AstroSat. In contrast, the second burst was seen only with the X-ray Timing Instrument (XTI) of NICER and lasted for 28 seconds. The third burst was observed with both LAXPC</p>		

and XTI detectors. In the second burst, we observed a double-peaked structure, where the peak intensity during these peaks differed by $\sim 7\%$. The observed count rate of both the peaks was comparatively fainter in the soft ($< 3\text{keV}$) X-rays. The extracted power density spectra from these observations did not show the quasi-periodic oscillations, and we did not find the burst oscillations during the rising phase of the burst. We performed the broadband spectral analysis with the variable persistent flux method (fa-method) using SXT, LAXPC, and NICER spectra. Two blackbody components can describe the burst spectra along with the persistent emission model and the fa varied between the bursts. I will discuss the detailed broadband spectro-timing results in this talk.

ASI2021_312	Jyotishree Hota	Poster
Understanding the X-ray spectral curvature of MKN 421 using broadband AstroSat observations		
<p>We present a detailed X-ray spectral study of the high energy peaked blazar MKN421 using the simultaneous broadband observations from the LAXPC and SXT instruments on-board AstroSat. The data was obtained as ToO observation during the period 3rd January 2017 – 8th January 2017. The X-ray spectrum of Mkn 421 showing significant spectral curvature is usually described by log-parabola model, however, the model fails to give the information of underlying physical parameters as the exact relationship of model parameters with the underlying physical quantities is not clear. Therefore in order to obtain the information of underlying physical parameters, we reproduce the X-ray spectrum with the analytical models viz. energy-dependent electron diffusion model (EDED) and the power law with γ-max model. Our study showed that both the models fit the X-ray spectrum reasonably good, EDED model provides a better reduced-χ^2 values. Moreover, we studied the correlation between EDED model parameters (norm, ξ_0 and κ) and the observed quantities using the Spearmanrank correlation method. A significant anti-correlation is observed between κ and ξ_0 with $r_s = -0.95$ ($\text{prs} = 2.99 \times 10^{-17}$) and similar anti correlation is also obtained for the case of ξ_0 and $F(0.5-18.0)$ with $r_s = -0.89$ ($\text{prs} = 3.21 \times 10^{-12}$). The strong anti correlation between model parameters and observed quantities allows us to constrain the underlying physical parameters viz. source magnetic field (B) and jet Doppler factor (δ)</p>		

ASI2021_412	Kaustubh Roy	Poster
High Mass-ratio Binary Population of Open Clusters and their radial segregation		
<p>Binary stars in open star clusters are important to study dynamical evolution and binary evolution. Binary stars lead to many exotic stellar systems and open cluster provide a testbed to study such systems and binary fraction. Binary fraction through spectroscopy is laborious. The Gaia DR2 colour-magnitude diagrams of cluster members can be used to easily identify high mass-ratio binaries and their dynamical impact through radial distribution. For this study, photometric data of 23 open clusters were obtained from Gaia DR2. We constructed the colour-magnitude diagrams of these clusters and fitted them with PARSEC isochrones. The unresolved binaries were isolated</p>		

from the distinct second sequence above the main sequence ($q > 0.75$). We plotted radial profiles for each cluster to observe how the radial binary segregation changes with cluster age and metallicity. We also divided the stars in each cluster into magnitude bins to observe how the binary segregation changes with the mass of the stellar population. We define a new parameter (B^+) to quantitatively measure radial segregation of binaries with respect to the reference single-star population. In general, we observe that massive binaries are more segregated compared to less massive binaries. Many small and young clusters show no binary segregation; while the oldest clusters show significant binary segregation.

ASI2021_601	Ketan Rikame	Poster
Discovery of Quasi Periodic Oscillations in the Accreting Binary X-ray Pulsar LMC X-4		
<p>We report for the first time, the discovery of quasi-periodic oscillations (QPOs) in the High Mass X-ray Binary (HMXB) pulsar LMC X-4 in its non-flaring (persistent) state using observations with XMM-Newton. In addition to the 74 mHz coherent pulsations, the steady-state light curve shows a QPO feature in the frequency range of 20-30 mHz. QPOs in X-ray binaries are generally thought to be related to the rotation of the inner accretion disk. Any inhomogeneous matter distribution or blobs of material in the inner disk may result in QPOs in the power spectrum. In HMXBs such as LMC X-4 where the compact object is a neutron star with a high magnetic field, the radius of the inner accretion disk is determined by the mass accretion rate and the magnetic moment of the neutron star. As the accretion disk can't exist inside the magnetosphere, the radius of the inner accretion disk is equal to the radius of the magnetosphere. Assuming the beat frequency model for the QPOs and a Keplerian disk, the radius of the inner accretion disk can be determined from the observed QPO frequency. We use the X-ray luminosity and the magnetospheric radius to have an approximate value of the magnetic field strength of the neutron star in LMC X-4. Key words: X-ray Binaries, Neutron Stars, Accretion Disk, Quasi Periodic Oscillations, LMC X-4</p>		

ASI2021_311	Khushboo Kunwar Rao	Poster
Determination of A^+ for open clusters		
<p>The sedimentation level of blue straggler stars (BSS) has been shown to be a great tool to investigate the dynamical states of globular clusters. In this work, we estimate the area enclosed between the cumulative radial distributions of BSS and a reference population, A^+, for 12 open clusters as a measure of the sedimentation of BSS in these open clusters. We study the correlation of A^+ with other dynamical and structural parameters of OCs. From this analysis, we comprehend that independent of the nature of a stellar system, A^+ always represents the dynamical state of the cluster. However, only OCs containing reasonable numbers of BSS, allow an estimation of A^+ without a large error associated with this estimation.</p>		

ASI2021_334	Malu S	Poster
Spectro-temporal studies of the Atoll source 4U 1705-44: Investigating the inner region of the accretion disk		
<p>We performed spectro-temporal analysis of the atoll source 4U 1705-44 using AstroSat SXT and LAXPC in order to understand its inner accretion disk region. The source was found to be in the banana state during the observations. Power density spectral studies revealed the presence of a peaked broad low frequency noise (LFN) component from 5.0--13.5 Hz in the 3-10 keV energy band, with the most prominent feature detected with a Q factor of ~ 1.6. This feature was absent in the 10-20 keV energy band. We constrained the height/radius of a viscous shell within the inner accretion disk region by assuming this LFN component to be oscillations originating within such a shell. Cross-Correlation Function study (CCF) between the 3-5 keV (LAXPC), 0.8-2 keV (SXT) and 15-30 keV LAXPC data showed CCF lags of the order of few tens to hundred seconds. Previous studies have shown that these lags can be used to constrain the coronal height as they can be interpreted as the readjustment timescales of this coronal structure. Coronal height was constrained to be of the order of few tens of kms. Spectral studies indicated a variation in the power-law index as the source traversed along the Banana branch and it was found that the source was close to the last stable orbit. Results of these spectro-temporal studies show similarities to those performed on Z sources.</p>		

ASI2021_258	MAMATHA RANI GADDAM	Poster
Possible period variations and detection of third bodies in contact binaries using Kepler and ASAS data		
<p>We studied contact binary systems which go through a phase of mass transfer from primary to secondary or vice versa. Contact binaries are a class among binaries which has the lowest angular momentum and least understood in terms of their evolution. We collected the data of contact binaries from Kepler K2 (campaign 15) and ASAS survey. We found few tens of contact binaries which have lightcurves in both ASAS and K2 database whose periods are in the range of 0.2 to 1.5 d. We studied the lightcurves of selected contact binaries and their O-C diagrams which included the times of minima of Kepler's K2 mission and ASAS database. Seven of them are showing increasing trends i.e. period is increasing, 3 are showing decreasing trends i.e period is decreasing and remaining are not showing any systematic variations. We derive the mass transfer rate and period change of these binaries and study their evolution. We also show the possible detection of third bodies in these systems and derive their orbital binary parameters.</p>		

ASI2021_237	Mudasir Raja	Poster
Membership of Star Cluster using a supervised clustering model with Machine Learning		
<p>GAIA DR2 has a very strong influence on the membership of star clusters. This is one of the most crucial parameters in studies of star clusters. In the present study, we use membership data from Cantat-Gaudin et al(2018) based on GAIA DR2 as a training set. Membership probability of a larger sample of stars, which was once a major impediment, can now be addressed with 6-D data of GAIA to substantially improve the number of member stars. We run our algorithm for a sample of 9 clusters and compare our results and precision in membership.</p>		

ASI2021_384	Naman Joshi	Poster
High Mass Binary Population in Galactic Open Clusters		
<p>Binary star fraction plays a vital role in understanding the dynamics and evolution of star clusters and finds application in various research fields in astrophysics. The main objective of this study was to calculate the binary fraction (BF) of open clusters in our galaxy using photometric data obtained from GAIA DR2. We constructed the Colour Magnitude Diagrams (CMDs) of 23 Galactic open clusters and used various parameters like distance modulus, metallicity, extinction and reddening along with TOPCAT and python programs to fit theoretical isochrones to CMDs. We identified the binary systems based on their location on CMD and calculated the BF for mass-ratio greater than 0.75. We observed the BF values of 0.13 to 0.39 for a variety of clusters, with an average of 0.20. There is a weak positive correlation between integrated cluster magnitude and BF. The mean cluster BF is similar to BF among stars with 0.9-1.2 Msun mass range, whereas more massive stars showed larger BF and fainter stars typically have a lesser BF. The reducing BF for lower mass stars is similar to what is observed in field binary population indicating open cluster binary population is similar to primordial binaries.</p>		

ASI2021_507	Neelam Panwar	Poster
Star Formation and Evolution of the HII Region Sh2-112		
<p>Here, I will present the observational results of our multiwavelength study of an HII region Sh2-112 that is powered by the massive O8V-type star BD +45 3216. The surface density distribution and minimum spanning tree analyses of the young stellar object (YSO) candidates in the region reveal their groupings toward the western periphery of the HII region. We found a GMRT radio continuum emission peak toward the northwest boundary of the HII region that is investigated as a compact/ultracompact HII region candidate powered by a B0-B0.5-type star. Toward the southwest direction, a prominent curved rim-like structure is found in the Hα image and GMRT radio continuum maps, where the H₂ and 13CO emission is also observed. These results suggest the existence of the ionized boundary layer (IBL) on the surface of the molecular cloud. This IBL is found to be overpressured with respect to the internal pressure of the surrounding molecular</p>		

cloud. This implies that the shocks are propagating/propagated into the molecular cloud, and the young stars identified within it are likely triggered due to the massive star. We also found that this region is ionization-bounded toward the west and density-bounded toward the east. Based on the distribution of the ionized gas, molecular material, and YSO candidates, we proposed that the Sh2-112 HII region is a good candidate for the blister-type HII region that has been evolved on the surface of a cylindrical molecular cloud.

ASI2021_348	NIDHI SABU	Poster
A Spectroscopic study of Herbig Ae/Be stars identified from LAMOST DR5		
<p>Herbig Ae/Be stars (HAeBe) are intermediate-mass ($2-10 M_{\odot}$) pre-main sequence (PMS) stars, which are found in the early evolutionary phases with spectral type ranging from late O type till F5. The presence of emission lines in its spectrum and IR excess confirms a gaseous-dusty circumstellar disk around the star. HAeBe stars have been vastly studied for its photometric nature while very few studies are there in literature for its spectroscopic nature. A survey program was initiated with the Large Sky Area Multi-Object fiber Spectroscopic Telescope (LAMOST) which assimilated millions of spectra of stars over a period of time. We made use of the infrared-optical photometric data and the spectroscopic data from the LAMOST to identify HAeBe stars in the Galaxy. In the present study, we identified new HAeBe stars, which are not yet reported in the literature. Some of these are in the Galactic anti-center direction which is a less explored region in HAeBe research. For the majority of the sample, the stellar parameters are determined, allowing to estimate mass accretion rates of HAeBe stars and compare it with existing literature values. Also, a major analysis on the optical-emission line data of the sample is done which opens a window to study the emission line mechanism of HAeBe stars.</p>		

ASI2021_145	Nilam Navale	Poster
Spectroscopic Study of the Dipping LMXB NS XB 1254-690 using AstroSat		
<p>XB 1254-690 is a low-mass X-ray binary (LMXB) dipping source hosting a neutron star with an orbital period of 3.88 hrs. In this work, we have done the broadband spectroscopic analysis of the source observed during the banana branch using observations from SXT and LAXPC instruments onboard AstroSat. XB 1254-690 was observed in May 2018 and its light curve showed evidence of flaring. A detailed study of the flares for this source has not been reported earlier. From our studies, the combined SXT+LAXPC spectrum of the flares can be explained using an absorbed thermally Comptonized continuum model. We will report results from flux resolved spectroscopy analysis to study the evolution of the flares in the source.</p>		

ASI2021_511	Pallavi Saraf	Poster
Exploring the origin and formation sites of r-process rich metal poor stars		
<p>Nearly half of the elements beyond the iron peak in the periodic table are expected to have been made through rapid neutron capture process (r-process). However, the astrophysical sites of the r-process are not well known. Mergers of neutron stars are thought to be potential sites for r-process production. However, the presence of r-process rich, very metal-poor stars in the Halo and Milky Way satellite galaxies require r-process production at a very early time in the Galaxy, well before the NS-merger evolution timescales. Here, we present a study of the detailed chemical abundances of four relatively bright r-process enhanced stars initially studied by Bandyopadhyay et al. (2020). In this study, we use high signal-to-noise spectra using the 10-m Gran Telescopio CANARIAS (GTC) Spain, which has enabled us to connect the abundances of lighter elements with that of the elements at different r-process peaks. We also present a possible connection between different classes (r-I, r-II, and limited-r) of r-process rich metal-poor stars to understand the origin of r-process in the early Milky Way.</p>		

ASI2021_500	Parul Janagal	Poster
Wide-band studies of the sub-pulse drifting phenomenon in PSR J1822-2256		
<p>Pulsars are nature's premier laboratories for extreme physics, e.g., physics under extremely high gravitational and magnetic fields. Their emission mechanism is still an outstanding problem. The phenomenon of sub-pulse drifting, whereby systematic shifts are observed in the pulse phases of substructures within the main pulse(i.e., subpulses) and nulling(where pulsar emission temporarily ceases), can potentially provide an important key for unlocking the mystery of how pulsars work. Intending to investigate the underlying emission physics, we have undertaken phased-array observations of a number of pulsars that exhibit sub-pulse drifting, simultaneously covering the 300-500 MHz and 550-750 MHz frequency bands using the upgraded Giant Metrewave Radio Telescope (uGMRT). Our observations and analysis thus exploit the GMRT's high sensitivity, wide bandwidths, and sub-array capabilities. Three of the pulsars (PSR J1543+0929, PSR J1820-0427, and PSR J1834-0426) were also observed commensally with the Murchison Widefield Array that operates at frequencies below 300 MHz, thus providing simultaneous frequency coverage from 170 MHz to 750 MHz. I will present new results emerging from the wide-band investigation of single-pulse properties of a bunch of pulsars. I will particularly concentrate on interesting results obtained from the first wide-band study of PSR J1822-2256 with the uGMRT, which include the detection of a new mode of drifting, existence of disconnected driftbands, bimodality in P3 (i.e., vertical separation between two driftbands), as well as a possible detection of varying spectral index between its different drift modes. I will also report the interaction between observed sub-pulse drifting and nulling properties for PSR J1822-2256. This project, presenting one of the first wide-band studies of single-pulse properties, sheds some light on the frequency dependence of single-pulse characteristics of pulsar emission. Finally, I will discuss the implications of these results for the carousel model of pulsar beam emission.</p>		

ASI2021_483	Prasanta Bera	Poster
Does elasticity stabilize a magnetic neutron star?		
<p>The configuration of the magnetic field in the interior of a neutron star is mostly unknown from observations. Theoretical models of the interior magnetic field geometry tend to be oversimplified to avoid mathematical complexity and mainly based on axisymmetric barotropic fluid systems. These static magnetic equilibrium configurations have been shown to be unstable on a short time-scale against an infinitesimal perturbation. Given this instability, it is relevant to consider how more realistic neutron star physics affects the outcome. In particular, it makes sense to ask if elasticity, which provides an additional restoring force on the perturbations, may stabilize the system. It is well known that the matter in the neutron star crust forms an ionic crystal. The interactions between the crystallized nuclei can generate shear stress against any applied strain. To incorporate the effect of the crust on the dynamical evolution of the perturbed equilibrium structure, we study the effect of elasticity on the instability of an axisymmetric magnetic star. In particular, we determine the critical shear modulus required to prevent magnetic instability and consider the corresponding astrophysical consequences.</p>		

ASI2021_514	Prasanta Kumar Nayak	Poster
A study of UV properties of T Tauri stars with UVIT/AstroSat		
<p>T Tauri stars (TTS) are low-mass pre-main-sequence (PMS) stars. Accreting TTS are known as Classical TTS (CTTS) and are characterized by strong H-alpha line emission and significant excess emission in the UV and IR over photospheric values, whereas non-accreting disk-less TTS are called as weak-lines TTS (WTTS) as they show weak H-alpha emission. Emission from strong accretion shocks are thought to be the reason for the UV excess in CTTS, whereas comparatively low UV excess in WTTS is due to chromospheric activity. Though there have been many studies on TTS in optical and IR regions, their UV properties are relatively less studied despite the importance of UV photons in disk heating and influencing gas chemistry within the disk. We will present preliminary results from multiband UVIT observations of young TTS and discuss what the UV properties of young stars can tell us about accretion and disk evolution.</p>		

ASI2021_93	Prince Sharma	Poster
Broad-band spectral analysis of LMXB XTE J1710–281 with Suzaku		
<p>This work presents the first broad-band time-averaged spectral analysis of neutron star (NS) low-mass X-ray binary, XTE J1710–281 up to 30 keV by using the Suzaku archival data. The source was in a hard or an intermediate spectral state during this observation. A detailed analysis of the persistent emission spectra of XTE J1710–281 has been done with improved constraints on its spectral parameters. By simultaneously fitting the X-ray Imaging Spectrometer and the HXD-PIN data, we have modelled the persistent spectrum of the source with models comprising a soft</p>		

component from accretion disc and/or NS surface/boundary layer and a hard Comptonizing component. The 0.6–30 keV continuum with neutral absorber can be described by a multicolour disc blackbody with an inner disc temperature, which is significantly Comptonized by the hot electron cloud. A more complex three-component model comprising a multicolour disc blackbody, single-temperature blackbody, and Comptonization from the disc, partially absorbed by an ionized absorber describes the broad-band spectrum equally well.

ASI2021_240	Priya Hasan	Poster
THE YSO DISTRIBUTION IN THE MID-GALACTIC PLANE WITH GAIA- EDR3		
Using Gaia EDR3 distance estimates, we identify groups of young stellar objects (YSO) candidates associated with the Local Arm, the Sagittarius-Carina Arm, and the Scutum- Centaurus Arm. We use the SPICY: The Spitzer/IRAC Candidate YSO Catalog for the Inner Galactic Midplane which contains $\sim 120,000$ Spitzer/IRAC candidate YSOs based on surveys of the Galactic midplane between $l \sim 255^\circ$ and 110° , including the GLIMPSE I, II, and 3D, Vela-Carina, Cygnus X, and SMOG surveys (613 square degrees), supplemented by near-infrared catalogs. We made a deep study of the three-dimensional structure of YSOs and the progress of star formation in these regions.		

ASI2021_534	Raghubar Singh	Poster
Li evolution in low mass red giants stars		
Here, we present our recent work on Li abundance evolution in low mass red giants. Li, a fragile element, produced in big bang nucleosynthesis, is known to be destroyed in stars. However, a small fraction of low mass giants are found to have excess Li in their photospheres. Explaining excess Li in low mass giants has been a long standing problem. This is mainly because of the lack of information on Li-rich giants exact evolutionary phase. Based on precise Gaia astrometry, spectroscopically determined [C/N] ratios and gravity mode period spacing from Kepler data, our study suggests that all the Li rich giants belong to the red clump phase and the site for Li enhancement lies at RGB tip during the He-flash phase.		

ASI2021_432	Ranjan Kumar	Poster
Ultraviolet Imaging Telescope (UVIT) observation of the Galactic Globular Cluster NGC 7492		
We present detailed ultraviolet (UV) photometric observations of the Galactic globular cluster NGC 7492 using the data obtained with two far-ultraviolet (FUV: 1300 - 1800 Å) and three near-ultraviolet (NUV: 2000 - 3000 Å) filters of Ultraviolet Imaging Telescope (UVIT) on-board the AstroSat satellite. We confirmed the cluster membership of the extracted sources using GAIA data release 2 (Gaia DR2) proper motion data. We have used color-magnitude diagrams (CMDs) using UVIT and GAIA filters to separate out different evolutionary stages of the stars present in the cluster. We have identified a new extreme horizontal branch (EHB) star at the core of the cluster		

using UV and UV-optical CMDs. The estimated distance-modulus of the cluster is 16.95 ± 0.05 obtained by fitting BaSTI isochrones with cluster parameters, $[Fe/H] = -1.8$ dex and age $\tau = 12.0$ Gyr on the $V - I$ vs V CMD. Interestingly, only the EHB star and blue horizontal branch stars (BHBs) among the UV-bright hot sources are detected in FUV filters of UVIT. We have derived the effective temperature of BHBs using color-temperature relation and spectral energy distributions (SEDs) of multi-band filters, which are in the range from 8,000 K to 10,500 K. We find a variation of He abundance of BHBs by fitting the BaSTI ZAHB. The range in the He abundance of the BHBs corresponding to the best fit isochrones is 0.247 to 0.350. We have estimated various physical parameters of the newly identified EHB star in the cluster using SED fit and post-HB evolutionary tracks. We have studied the radial distribution of all the sources of the cluster detected in UVIT. The sources detected in FUV filters extend beyond the half light radius ($1.15''$) of the cluster, whereas the sources detected in NUV filters extend beyond the tidal radius ($9.2''$) of the cluster.

ASI2021_96	Rose Maria Mathew	Poster
Physical Conditions of 6.7 GHz Methanol Maser Hosts		
<p>The process of massive star formation is still poorly understood, in part due to the difficulty in identifying massive star-forming regions in early phases. One of the signposts of the early phases of massive star formation is the presence of the $5_1 - 6_0$ A+ maser line of methanol at 6.7 GHz. We have carried out observations of thermal lines of methanol at 96 and 241 GHz using the MOPRA and APEX telescopes respectively towards a sample of 6.7 GHz methanol masers detected by the Arecibo Methanol Maser Galactic Plane Survey. Physical parameters of the 6.7 GHz methanol maser hosts were derived from the spectral line modelling of the sources assuming local thermodynamic equilibrium (LTE) and non-LTE conditions. The derived excitation temperatures suggest subthermal excitation of the lines. Kinetic temperature and hydrogen density derived from 241 GHz data are found to be in the range 12 – 86 K and $10^5 - 10^6 \text{ cm}^{-3}$ respectively. For a few sources, the kinetic temperature is higher than in infrared dark clouds (IRDC) suggesting that these regions are comparatively more evolved than the IRDCs.</p>		

ASI2021_45	Sachin Kaothekar	Poster
Effects of Neutral Collisions and Radiative Heat-Loss Functions on Thermal Instability of Partially-Ionized Plasma		
<p>The effect of neutral friction and radiative heat-loss function on the thermal instability of viscous two-component plasma has been investigated incorporating the effects of finite electrical resistivity and thermal conductivity. A general dispersion relation is obtained using the normal mode analysis method with the help of relevant linearized perturbation equations of the problem and a modified thermal condition of instability is obtained. We find that the thermal instability condition is modified due the presence of radiative heat-loss function, thermal conductivity and</p>		

neutral particle. For the case of longitudinal propagation we find that the condition of thermal instability is independent of the magnetic field strength, finite electrical resistivity and viscosity of two-components, but depends on the radiative heat-loss function, thermal conductivity and neutral particle. From the curves we find that the temperature dependent heat-loss function, thermal conductivity and viscosity of two-components shows stabilizing effect, while density dependent heat-loss function and finite electrical resistivity shows destabilizing effect. The effect of neutral collision frequency is destabilizing. These results are helpful in understanding the process of star formation and structure formation in HI region.

ASI2021_439	Sagarika Paul	Poster
Astrometry and Internal Rotation of 47 Tucanae using Gaia DR2		
<p>The Gaia DR2 and Early DR3 (EDR3) provide a huge repository of data for the study of globular clusters with their 5-parameter astrometric solution of Right Ascension, Declination, parallax and proper motion components. For the globular cluster (GC) of 47 Tucanae (NGC104), DR2 was limited in the core region due to high density and brightness. EDR3 improves on that but the core data is still incomplete. Using parametric data for 47 Tucanae from the center out to a radius of 42 arc-seconds, outliers have been filtered on the basis of parallax, proper motion and magnitude. This data has then been fitted to find the cluster tidal and core radius and the astrometric study of the cluster has been carried out to calculate the total proper motion, distance and tangential velocity of the cluster. Gaia has made precession astrometry possible and aided the study of the kinematic properties of Milky Way GCs. Using line of sight velocity, the radial and tangential component of proper motion is calculated which shows whether expansion/contraction of the GC is present or not and whether there is internal rotation of the cluster on the plane of the sky.</p>		

ASI2021_436	Sandeep Rout	Poster
X-ray spectroscopy of MAXI J1631-479: Evidence for non-thermal emission and a massive black hole		
<p>MAXI J1631-479 is a galactic black hole binary which went into outburst for the first time in December 2018. In the talk I will present the results of our joint spectral analysis of the source using XRT and NuSTAR. During the soft state of the outburst, an excess beyond 50 keV suggests the presence of non-thermal emission. Using a hybrid plasma model, we confirm emission from non-thermal pairs, the signatures of which are rarely detected below 100 keV. We also fit the joint spectrum with relativistic reflection models and constrain the spin and inclination to high values. We further fit the soft state spectrum with general relativistic disk models to constrain the mass. Considering the optical observations as a limit for the disk emission, we constrain the distance to the source to be greater than 4 kpc and consequently a lower limit on mass of the black hole around 20 Msun. This puts the source among the most massive stellar mass black holes in the galaxy.</p>		

ASI2021_407	Saumya Gupta	Poster
Circumstellar Disk Evolution in Cygnus OB2: A deep multi-wavelength study of a Galactic proto-globular cluster		
<p>Circumstellar disk evolution plays a key role in the growth of stars and formation of planetary systems. And yet it is one of the many interesting yet unanswered questions posed to the astrophysical community. Deep, large-scale studies of various star-forming regions are required to understand the effect of cluster environment on disk evolution, their dispersal and hence, on the planet formation. At 1.6 kpc distance from the Sun and with ~ 150 OB-stars, Cygnus OB2 is an ideal laboratory to study the role of feedback-driven environment on disk evolution in one of the most massive regions outside the solar neighborhood. We have obtained the deepest and the widest optical photometry with 8m Subaru Hyper Suprime-Cam (HSC) of a 1.5 deg diameter region centred at Cygnus OB2. We combine our deep optical photometry with near-IR (UKIDSS) and mid-IR (Spitzer) photometry to study the pre-main sequence population ($\sim 10^5$ sources) reaching down to brown-dwarf limit including a significant census of disk-bearing objects. We identify circumstellar disk population in the target region and analyze the disk evolution as a function of age and mass by dividing the data into constant mass and age bins. We estimate the spatial variation of disk fraction across the region as a function of incident UV flux and thus quantify the role of external photoevaporation on disk evolution. We further aim to identify the sub-stellar population and obtain the IMF in the low-mass regime in one of the most massive regions outside the solar neighborhood.</p>		

ASI2021_380	SD Gouse	Poster
Orbital period variations in contact binaries based on TESS and ASAS databases		
<p>We studied various binary star systems that go through a phase of orbital period change using “TRANSITING EXOPLANET SURVEY SATELLITE (TESS) and ASAS databases. Earlier Kepler satellite-based studies unveiled that nearly 10% of the contact binary star systems show the existence of a third body which explained their low angular momentum configuration. We have collected 100 variable stars data from TESS to perform an O-C diagram, whose orbital period is less than 5 days, but the present study was performed on those binaries whose orbital periods are less than one day. O-C studied were performed and calculations were done after obtaining ‘Time of Minima’ through the Period04. Change in the orbital period is the key point to understand the mass transfer among the components of contact binary systems. We found that few studies do show the presence of third bodies whereas other systems exhibit only increasing/decreasing period change. We derive mass transfer rate, orbital period change, and the orbital parameters of a possible third body in these systems.</p>		

ASI2021_308	Shridharan Baskaran	Poster
Catalog of Hot Emission Line stars from LAMOST DR5		
<p>We present a catalog of 3340 hot emission-line stars identified from 451,695 OBA- type spectra, provided by the LAMOST DR5 catalog. We developed an automated python routine that identified 5437 spectra having an H-alpha peak between 656.1 and 656.8 nm. False detections and bad spectra were removed, leaving 4139 good emission line spectra of 3340 unique emission-line objects. We re-estimated the spectral type of 3309 spectra as the LAMOST Stellar Parameter Pipeline did not provide accurate spectral types for emission line spectra. Since Herbig Ae/Be stars show higher excess in near-infrared and mid-infrared wavelengths than Classical Be/Ae stars, we used 2MASS and WISE photometry to distinguish them. Finally, we report 1094 Classical Be, 243 Classical Ae, and 58 Herbig Ae/Be stars identified from the LAMOST DR5. 81\% percent of the ELS present in our sample are new detections and were not present in the SIMBAD database. Identification of such a large, homogeneous set of emission-line spectra will help the community study the emission phenomenon in detail without worrying about inherent biases from various sources.</p>		

ASI2021_115	Shubham Singh	Poster
Searching for Long Period Pulsars in data from the GHRSS Survey		
<p>Despite five decades of pulsar searches, the fraction of long-period pulsars is very small in the current population. Only ~8% of all pulsars discovered till date have periods longer than 2 seconds. This could be due to selection biases that are inherent in our current search paradigms, which are based on the conventional frequency-domain searches using Fast Fourier Transform (FFT). The Discovery of new long-period pulsars will populate the pulsar period versus period derivative diagram putting additional constraints on the theoretical death-line, a line predicted by pulsar emission models where radio emission is expected to cease. For example, ultra-slow pulsars PSR J2144-3933, with a period of 8.5 seconds, and PSR 0250+5854 with a period of 23 seconds are situated very near to the death line, restricting the pulsar death line. In addition, investigation of single-pulse properties such as sub-pulse drifting and nulling of the relatively long period pulsars are particularly useful to constrain pulsar emission models. Ongoing pulsar surveys (e.g. PALFA, SUPERB) have implemented a time-domain approach based on the Fast Folding Algorithm (FFA) to enhance the detection significance of pulsars with relatively higher periodicities. We have implemented this approach on the ongoing GMRT High-Resolution Southern Sky (GHRSS) survey, which is an off-Galactic plane survey at 300-500 MHz. This survey resulted in the discovery of 24 pulsars, out of which only 2 are slower than a second. We are now reprocessing ~4000 square-degree archival GHRSS data, along with new data that is coming in from ongoing observations. I will present a comparison of the two techniques (FFT and FFA) over a range of parameters such as period, duty-cycle, profile shape as well as the instrumental red-noise contribution. The results (including new discoveries) from the FFA search of GHRSS survey data will also be reported.</p>		

ASI2021_129	Sneha Prakash Mudambi	Poster
Spectral characteristics of the black hole X-ray binary 4U 1957+115 using AstroSat and SWIFT		
<p>4U 1957+115, a persistently active black hole X-ray binary, has always been observed in the soft state since its discovery in 1973. Although the source has been studied in Optical and X-rays by most of the leading missions, precise measurements on the black hole mass and distance are yet to be achieved. In this work, we have carried out broadband (0.3-20.0 keV) spectral studies of the source using archival data from AstroSat. Modelling the combined spectra with a multicolor blackbody emission (diskbb) and a Comptonization component (simpl) revealed the presence of a standard accretion disc with a relatively high inner temperature ($kT_{in} = 1.37-1.64$ keV) close to the black hole ($N_{disk} \sim 8.83$). Asymptotic power-law index ($\Gamma \sim 2.5$) indicated that the source was in the high soft state. The best fit values of absorption column density ($0.14 \times 10^{22} \text{ cm}^{-2}$) indicated the presence of a low absorption column in the line of sight of the source. Fitting the thermal disc emission with a relativistic model (kerrbb) for different combinations of mass and distance revealed that the system probably hosts a maximally spinning black hole. Furthermore, we carried out joint spectral fitting of SWIFT and AstroSat data for one of the Epochs using the same model combinations described above and found a good agreement between the results of joint SWIFT+AstroSat data analysis and AstroSat data analysis which in turn agrees with the previous results.</p>		

ASI2021_265	Soma Mandal	Poster
Spectro-temporal analysis of four atoll sources in the AstroSat archive		
<p>We performed the spetro-temporal analysis of the AstroSat archival data of four atoll sources 4U 1728-34, 4U 1820-30, 4U 1735-44 and 4U 1705-440 observed with Soft X-ray telescope (SXT) and Large Area X-ray Proportional Counter (LAXPC) of AstroSat. With the aim of studying the quasi-periodic variability as a function of accretion regime, we also carried out the systematic search of the quasi periodic oscillations (QPOs) in the X-ray time series of theses systems. The result obtained from the analysis will be presented.</p>		

ASI2021_468	Sonika Piridi	Poster
Study of Galactic Structure using UVIT star counts		
<p>The Ultra-Violet Imaging Telescope (UVIT) onboard the Astrosat satellite carries out simultaneous observations in Far-UV (FUV) and Near-UV (NUV). Out of the various filters, we use the F154W (BaF2) and N263M (NUVB4) filters to obtain the star counts at different galactic regions. Observations in the UV region help us in identifying the hot sources such as white dwarfs (WDs) and Blue Horizontal Branch stars (BHBs) which are otherwise scarce in other wavebands. We use the star counts method along with the infrared (IR) color cut method to separate out the extra-galactic sources from the point sources. We chose regions at the Galactic center (GC), Galactic</p>		

Anti-center (GAC), and one at the South Galactic pole (SGP) and verified our obtained UV star counts with the Besancon model, a population synthesis model. We consider the double exponential density law to find the scale height and scale length of the galaxy. Finally, we fit the density function to our observed star counts and obtained two distinct physical components owing to the two-disc components of our galaxy.

ASI2021_300	Sreelekshmi Mohan	Poster
Radio spectra of protostellar jets : A study of thermal and non-thermal emission		
<p>Star formation proceeds by the accretion of mass from dense envelopes around them. The accretion progresses by the release of angular momentum, launching bipolar jets along the rotation axis. Jets serve as an important tool in the study of star forming regions which are embedded in large clouds of gas and dust. These regions can be studied well in longer wavelengths and at higher angular resolutions, making radio observations very relevant for their understanding. Radio emission from ionized jets have been detected towards a number of protostellar objects of which few exhibits negative spectral indices and polarized emission suggesting the presence of synchrotron emission from relativistic electrons. We develop a numerical model for jets, that incorporate both free-free and synchrotron emission mechanisms, comprising of an inner thermal jet, and a combination of thermal and non-thermal contributions along the edges where it interacts with the interstellar medium. We attempt to model the spectra of few well-known sources that exhibit negative spectral indices by exploring the parameter space to also understand the impact of various physical conditions within the jet on its spectrum. With the help of this model we can also constrain the physical parameters associated with these sources.</p>		

ASI2021_78	Suchira Sarkar	Poster
Dynamical effects of non-isothermal stellar vertical velocity dispersion on the vertical structure of the Milky Way		
<p>The vertical density distribution of stars in a galactic disc is traditionally obtained assuming an isothermal vertical velocity dispersion of stars. But recent observed data from Gaia, LAMOST, RAVE show that this dispersion increases with height from the mid-plane. We theoretically study the dynamical effects of such non-isothermal dispersion on the vertical distribution of the thin disc stars in the Galaxy. We apply a linear gradient of +6.7 km/s/kpc in the dispersion values based on the observed data. We find that the mid-plane density is lower, and the scale height is higher in the non-isothermal case than the corresponding values for the isothermal distribution, by ~35% in the solar neighbourhood for a stars-alone disc. The non-isothermal distribution shows a wing at high z, in agreement with observations, and is fitted well by a double sech^2, which could be mis-interpreted as the existence of a second, thicker disc, specially in external galaxies. Further, the total mid-plane density i.e, Oort limit value, calculated using the realistic multi-component system of stars, gas in the field of dark matter halo, is reduced by 16% in the non-isothermal model. For details of this work, see- Sarkar & Jog, MNRAS, 499, 2523 (2020).</p>		

ASI2021_39	SUDESHNA PATRA	Poster
Testing Dense Gas Star Formation Relations in the Outer Milky Way		
<p>Studying star formation in the outer part of the Milky Way (galactocentric radius > 8.5 kpc) is an excellent way to study the early phase of galaxy evolution and properties of dwarf galaxies in a zoomed way since the environmental conditions are more or less the same. The Milky way gives the best landscape to study the effects of low metallicity and low gas surface density in star formation as it has a metallicity gradient, which decreases with increasing Galactocentric distance. We are leading a large scale observational survey of star-forming regions in the outer Milky Way intending to understand the role of environmental conditions (such as metallicity and Galactocentric distance) on the outcome of the star formation process such as star formation rate (SFR), star formation efficiency (SFE), initial mass function (IMF) etc. We present the results obtained from analysis of dense molecular line tracers (HCN (1-0) and HCO+(1-0)) along with other tracers like millimeter continuum emission (1.1 mm), extinction derived from ^{13}CO, and dust continuum data from Herschel for star-forming regions located in the outer Galaxy, with a broad science goal to understand the star formation activities in them.</p>		

ASI2021_593	Sushan Konar	Poster
The Curious Case of Nulling Pulsars		
<p>Radio pulsars are strongly magnetized rotating neutron stars characterized by short spin periods ($P \sim 10^{-3} - 10^{-2}$ s) and large inferred surface magnetic fields ($B \sim 10^8 - 10^{15}$ G). Powered by the loss of rotational energy, they emit coherent radiation in narrow emission pulses. Abrupt cessation of this pulsed emission for several pulse periods, observed in a small subset, is known as nulling. It has been suggested that nulling pulsars are likely to be close to the death line, being active only when favourable conditions prevail. A comprehensive list of nulling pulsars has recently been compiled by Konar & Deka (2019). The data appears to suggest that pulsars with extremely curved magnetic fields and for which the emission comes predominantly from the polar cap are likely to experience nulling episodes. Because these nulling pulsars are bounded (in the spin-period -- magnetic field plane) by the death-line corresponding to such conditions. However, there exist quite a few active radio pulsars in the surrounding region of this death line which are not known to have experienced nulling episodes. Since pulsars in this region are slow objects with no apparent significance they have mostly not been studied in detail. However, it is quite clear that if these objects are carefully monitored, we would have a direct and definitive indication of the conclusion drawn in the above work. With this in mind, we have also initiated a program, of targeted observation of slow pulsars in the above mentioned region with the Giant Meterwave Radio Telescope (Konar, Roy, Bhattacharya 2020).----- 1. Radio Pulsar Sub-Populations (I) : The Curious Case of Nulling Pulsars, Sushan Konar & Uddeeta Deka, <i>Astrophys. J.</i> (2019) 40, 42 2. An investigation into nulling pulsars, Sushan Konar, Jayanta Roy & Bhaswati Bhattacharyya, GMRT Proposal, Cycle-38 (2020), observation completed</p>		

ASI2021_248	TUHIN MALIK	Poster
New equation of state involving Bose-Einstein condensate of antikaon for supernova and neutron star merger simulations		
<p>We compute a new equation of state table including Bose-Einstein condensate of K^- mesons for core-collapse supernova and neutron star merger simulations. Nuclei and interacting nucleons in the non-uniform matter is described in an extended version of the nuclear statistical equilibrium model including excluded volume effects whereas the uniform matter at higher densities is treated in the relativistic hadron field theory with density-dependent couplings. The equation of state table is generated for a wide range of density (10^{-12} to $\sim 1 \text{ fm}^{-3}$), positive charge fraction (0.01 to 0.60) and temperature (0.1 to 158.48 MeV). The impact of antikaon condensate is investigated on different thermodynamic quantities for example free energy per baryon, entropy per baryon, pressure as well as compositions of matter. Furthermore, critical temperatures of antikaon condensation and the phase diagram of matter are also studied in this article.</p>		

ASI2021_453	Unnati Kashyap	Poster
Testing nature of ultra-luminous X-ray source by UV-X-ray variability study of Holmberg II X-1 using AstroSat.		
<p>The physics of ultraluminous X-ray sources (ULXs) are yet unexplained and there is no strong evidence to distinguish between their two competing models: intermediate-mass black holes (IMBHs) and supercritical accretion disks (SCADs) despite intensive studies. According to the first model, they may represent a special and elusive class of black holes (BHs) - intermediate-mass black holes (IMBHs) with masses between stellar-mass and supermassive BHs ($\sim 10^{3-4}$ Solar Mass) and a standard accretion disk. The second model explains ULXs to be stellar-mass BHs (~ 10 Solar Mass) with supercritical accretion disks (SCADs) accreting at super-Eddington rate. In this case, UV radiation is thought to be formed in the disk wind from the collimated X-ray radiation in the supercritical disk funnel. We performed simultaneous X-ray/UV observations of one of the most luminous ULX - Holmberg II X-1 with SXT and UVIT onboard ASTROSAT over multiple epochs. The main goal is to test the UV responses to the X-ray variability of the ULX. The X-ray spectra was well described by a multi-colored blackbody model and the evolution of the temperature and inner disk was obtained from the spectral fitting. Our observations show a possible correlation between X-ray and UV fluxes that indicated to either a black hole binary with the supercritical disk or a precessing disk. Thus if ULXs are SCADs, then they are the first extragalactic supercritical disks that can be observed directly. A study of such ULXs may provide a better understanding of stellar as well as supermassive black holes in supercritical regimes and also shed light on the physics of ULXs.</p>		

ASI2021_317	VIJAYA A	Poster
Photometric and spectroscopic observations of few Selected Beta Lyrae type binaries		
<p>We present the photometric solutions of few Selected Beta Lyrae type binaries using the ASAS and TESS data. We modelled the light curves using WD method and constrain the various parameters including mass ratio and inclination of the systems. Since these systems are going through mass transfer phase, we performed the period variation studies. Some of them show strong signature of period change of the order of $dp/dt \sim 10^{-8}$ s/yr. Spectroscopic observations of these Beta Lyrae type binaries were performed from VBT, IIA during the years 2018 and 2019. We calculated the Ews of H alpha line of these systems and correlated with orbital period and mass ratio. Overall, the evolution of these systems are studied and investigated.</p>		

ASI2021_374	Vikrant Jadhav	Poster
A Catalogue of Galactic Blue Stragglers in Gaia EDR3		
<p>Blue stragglers are the most massive stars in clusters which are products of binary/multiple stellar interactions. Due to their peculiar position in the colour-magnitude diagram, proper motion membership is needed for their confirmation. We used Gaia EDR3 astrometric and photometric data to identify and classify blue stragglers in open clusters. Approximately 2000 blue straggler candidates are identified in more than 300 open clusters with ages ranging from 100 Myr to 7 Gyr. Additionally, we have also created the first catalogue of yellow stragglers, which are evolved from blue stragglers. A homogeneous catalogue of blue and yellow stragglers can shed light on the binary evolution mechanisms in clusters with various age and density.</p>		

ASI2021_518	VINEET RAWAT	Poster
Near-infrared and radio analysis of IRAS 23545+6508: a cluster in the process of making.		
<p>It is believed that the majority of stars form in clusters. Despite many theoretical and observational studies, no global consensus has been achieved yet on the formation and evolution of star clusters. In particular, how mass assembles at the cluster location, what governs the shape of the initial-mass-function (IMF), and what defines the star formation rate and efficiency at the cluster scale. IRAS 23545+6508, located at a distance of 1 kpc, is a probable cluster candidate inferred from the nebulosity seen in the shallow 2MASS observations. Literature results show that the cluster is a part of a dark cloud and is host to ionized and molecular outflows, implying that the cluster is indeed very young. With aim to understand the above-mentioned problems of clusters at their very early phases, we have obtained deep JHK images of the cluster with the TANSPEC camera mounted on the 3.6-m DOT. In this work, deep near-infrared images of the cluster will be presented. Along with the analysis of high-resolution radio continuum archival data obtained with VLA, the fundamental properties, evolutionary status, shape of the IMF, and the formation history of the clusters will also be discussed.</p>		

ASI2021_318	Yash Bhargava	Poster
Measuring spin of MAXI J1820+070		
<p>MAXI J1820+070 is a recently discovered X-ray binary with the compact object as a black hole. The brightness of the source triggered multi-wavelength campaigns of this source from different observatories. Here we analyze the Power Density Spectra obtained from high cadence observations of the source in the hard state using NICER. The evolution of the characteristic frequencies is obtained by modelling the PDS. The correlation of the characteristic frequencies observed has been interpreted as variability occurring at a particular radius and exhibiting different relativistic precessional frequencies. Tight constraints on the spin of the black hole have been obtained by fitting the Relativistic Precession Model to the observed QPO and broad noise components.</p>		

Posters in
Extragalactic Astronomy

ASI2021_122	Abhradeep Roy	Poster
Multiwavelength Study of Quiescent States of Brightest Blazars detected by Fermi -LAT		
<p>The regular monitoring of flat-spectrum radio quasars (FSRQs) in γ-rays by <i>Fermi</i>-Large Area Telescope since past 12 years indicated six sources who exhibited extreme γ-ray outbursts crossing daily flux of 10^{-5} photons $\text{cm}^{-2} \text{ s}^{-1}$. We obtained nearly-simultaneous multi-wavelength data of these sources in radio to γ-ray waveband from OVRO, Steward Observatory, SMARTS, <i>Swift</i>-mission and <i>Fermi</i>-LAT. The time-averaged broadband Spectral Energy Distributions (SEDs) of these sources in quiescent states were studied to get an idea about the underlying baseline radiation processes. We modelled the SEDs using one-zone leptonic synchrotron and inverse-Compton emission scenario from broken power-law electron energy distribution inside a spherical plasma blob, relativistically moving down a conical jet. The model takes into account inverse-Compton scattering of externally and locally originated seed photons in the jet. The big blue bumps visible in quiescent state SEDs helped to estimate the accretion disk luminosities and central black hole masses. We found a correlation between magnetic field inside the emission region and the ratio of emission region distance to disk luminosity, which implies that magnetic field decreases with increase in emission region distance and decrease in disk luminosity, suggesting a disk-jet connection. High energy index of the electron distribution was also found to be correlated with observed γ-ray luminosity as γ-rays are produced by high energy particles. In most cases, kinetic power carried by electrons can account for jet radiation power as jets become radiatively inefficient during quiescent states.</p>		

ASI2021_238	Aditi Krishak	Poster
Independent search for annual modulation in DAMA/LIBRA, COSINE-100 and ANAIS-112 data		
<p>DAMA/LIBRA, COSINE-100 and ANAIS-112 are dark matter detection experiments aimed to detect annual modulation induced by scatterings due to dark matter particles. The movement of the sun in the galaxy with respect to the Local Standards of Rest, along with the Earth's revolution around the sun, should cause the detection of a peak flux of dark matter-induced interactions in June and a minimum in December, leading to a sinusoidal annual modulation in residual count rates of the experiments. For each experiment, we test the hypothesis that the data contains a sinusoidal modulation against the null hypothesis that the data consists of only background. We compare the significance using four different model comparison techniques, including frequentist, Bayesian, and two information theory-based criteria (AIC and BIC). For the DAMA/LIBRA data, we find that the sinusoidal model is decisively favored over the constant model using all the three techniques. For COSINE-100, the information theory-based tests mildly prefer a constant background over a</p>		

sinusoidal signal with the same period as that found by the DAMA collaboration, while the Bayesian test strongly prefers a background model. In case of ANAIS-112, we find that according to the Bayesian model comparison test, the null hypothesis of no modulation is decisively favored over a cosine-based annual modulation for the non-background subtracted dataset in the 2–6 keV energy range, while none of the other model comparison tests decisively favor any one hypothesis over another. This is the first proof of principle demonstration of application of Bayesian and information theory based model comparison techniques to assess the significance of annual modulation in DAMA/LIBRA, COSINE-100 and ANAIS-112 data. All our analysis codes along with the data used in this work are publicly available.

ASI2021_408	Aishrila Mazumder	Poster
Study of the Lockman Hole Region at 325 MHz		
<p>This work presents the characterization of astrophysical sources in the Lockman Hole region using 325-MHz data from the Giant Metrewave Radio Telescope. A 6deg X 6deg map with RMS reaching 50 microJy per beam is produced. Source catalogue with the Euclidean normalized differential source counts have been derived from it, consistent with previous observations as well as simulations. The angular power spectrum (APS) of the diffuse Galactic synchrotron emission is determined for three different Galactic latitudes using the tapered gridded estimator. The values of the APS lie between ~ 1 and $\sim 100 \text{ mK}^2$. Fitting a power law of the form $A l^{(-b)}$ gives values of A and b varying across the latitudes considered. This work demonstrates, for the first time, the behaviour of the diffuse emission at very high Galactic locations. It follows the same trend that is seen at locations near the Galactic plane, thus emphasising the need for low-frequency observations to develop better models of the diffuse emission.</p>		

ASI2021_87	Amar Aryan	Poster
Revisiting the type Ib supernova (SN) 2015ap using MESA, STELLA and SNEC		
<p>Type Ib supernovae (SNe) are classified on the absence of prominent Hydrogen(H)-features in their early spectra. Two progenitor scenarios have been proposed for these catastrophic events. The first case involves a relatively low mass progenitor ($> 12M_{\text{sun}}$) in binary system, where the primary star lost its H-envelope through the transfer of mass to the companion star. The second case considers massive Wolf-Rayet (WR) star (> 20 to $25M_{\text{sun}}$) that lost mass via stellar winds. On the basis of observed photometric and spectroscopic properties, we compute a $12M_{\text{sun}}$ zero-age main-sequence (ZAMS) model as the possible progenitor for supernova (SN) 2015ap and evolved that model up to the onset of core-collapse using MESA. Thereafter, the synthetic explosions of the evolved model are produced using STELLA and SNEC. The comparisons between the STELLA and SNEC produced luminosity and velocity evolutions with the observations show good agreement. Thus a</p>		

combination of MESA, STELLA, and SNEC prove to be a great boon to the supernova community for understanding the possible progenitors of core-collapse SNe.

ASI2021_367	Amit Kumar	Poster
Photometric and spectroscopic study of H-deficient superluminous supernovae.		
<p>Superluminous supernovae (SLSNe) are nearly 2-3 magnitudes brighter than the classical core-collapse SNe (CCSNe) radiating total energy of the order of 10^{51} erg and exhibiting characteristic W-shaped O II features towards blue in the near-peak spectra. SLSNe are a rare class of events and were not known before SN 2005ap. They encompass ~ 0.01 % of normal CCSNe, and only 150 objects have been spectroscopically confirmed so far. Hydrogen deficient SLSNe (SLSNe I) appear to have slow- and fast-evolving behavior based on their different photometric and spectroscopic properties. The physical mechanisms giving rise to the high peak-luminosity feature in most of the SLSNe I remains debatable. The most trending physical mechanism of radioactive decay (RD) of Nickel-56 to explain the light-curves of H-deficient CCSNe is found to be inefficient in explaining observed high peak-luminosity in most of the SLSNe I. Various other plausible models are also proposed to explain the relatively wider and luminous bolometric light-curves of these Ultra-Violet bright cosmic events, including Circumstellar Matter Interaction (CSMI), Spin-down Millisecond Magnetar (MAG), and their possible combinations, termed as "HYBRID" models, e.g., CSMI+RD, CSMI+MAG, CSMI+RD+MAG. But, deeper investigations are required to explore the underlying physical mechanisms, possible progenitors and environments hosting such rare and energetic explosions. In order to understand the nature of these cosmic explosions based on the photometric and spectroscopic observations, a thorough discussion of slow evolving SLSN 2010kd and a fast-evolving SLSN 2020ank will be the main motive of the presentation.</p>		

ASI2021_310	Ananda Hota	Poster
The Sharpest Ultraviolet view of the star formation in an extreme environment of the nearest Jellyfish Galaxy IC 3418		
<p>We present the far ultraviolet (UV) imaging of the nearest Jellyfish or Fireball galaxy IC3418/VCC 1217, in the Virgo cluster of galaxies, using Ultraviolet Imaging Telescope (UVIT) onboard the ASTROSAT satellite. The young star formation observed here in the 17 kpc long turbulent wake of IC3418, due to ram pressure stripping of cold gas surrounded by hot intra-cluster medium, is a unique laboratory that is unavailable in the Milkyway. We have tried to resolve star forming clumps, seen compact to GALEX UV images, using better resolution available with the UVIT and incorporated UV-optical images from Hubble Space Telescope archive. For the first time, we resolve the compact star forming clumps (fireballs) into sub-clumps and subsequently into a possibly dozen isolated stars. We speculate that many of them could be blue supergiant stars which are cousins of SDSS J122952.66+112227.8, the farthest star (~ 17 Mpc) we had found earlier surrounding one of these</p>		

compact clumps. We found evidence of star formation rate ($3 - 6 \times 10^{-4} M_{\odot} \text{ yr}^{-1}$) in these fireballs, estimated from UVIT flux densities, to be increasing with the distance from the parent galaxy. We propose a new dynamical model in which the stripped gas may be developing vortex street where the vortices grow to compact star forming clumps due to self-gravity. Gravity winning over turbulent force with time or length along the trail can explain the puzzling trend of higher star formation rate and bluer/younger stars observed in fireballs farther away from the parent galaxy.

ASI2021_203	Anilkumar Tolamatti	Poster
Multi-wavelength study of the optical flaring episode from high redshift blazar PKS 1502+106		
<p>High redshift ($z > 1$) blazars represent a small population of the most powerful sources in the Universe. Study of powerful emissions from such objects can help in understanding the cosmological evolution of blazars. In this work, we present the results from the multi-wavelength study of an optical dominated flaring episode observed from the blazar PKS 1502+106 ($z = 1.8385$). A long duration outburst in the V and R bands from this source was measured by the Steward Observatory in 2017. We use near simultaneous data from the Fermi-LAT, Swift-XRT, Swift-UVOT and OVRO-15GHz observations to explore the properties of broadband emission during the optical flaring activity of the blazar PKS 1502+106. The Swift-UVOT data show coincidence with the observations from the Steward Observatory during the outburst, whereas emissions in other wavebands indicate relatively low activity state of the source. The broadband spectral energy distribution of the source during this epoch can be broadly reproduced by a simple one zone leptonic synchrotron and external Compton model. Details of the characteristics of multi-wavelength light curves and modeling of time averaged broadband emissions will be discussed in the presentation.</p>		

ASI2021_430	Anirban Dutta	Poster
Observational Study of nearby type Ia Supernova 2019np for over 400 days		
<p>We present optical/UV broadband photometry and low resolution spectroscopy of nearby type Ia Supernova (SN) 2019np. The SN exploded near the spiral arms of the galaxy NGC 3254 and has been observed through the 2.0 m Himalayan Chandra Telescope, 0.7 m Growth-India Telescope, 3.6 m Devasthal Optical Telescope for over 400 days since maximum light in B-band. The SN has also been extensively monitored in near UV by the Neil Gehrels Swift Observatory. The decline rate in B-band is 0.89 ± 0.03 mag with a peak absolute magnitude of -19.26 ± 0.1 mag. By fitting the observed light curve with standard fitting methods such as MLCS2k2 and SALT2 we estimate the distance modulus of the SN to be 32.60 ± 0.04 mag. One dimensional radiation diffusion model fit to the quasi-bolometric light curve indicates $0.41 M_{\odot}$ of 56-Nickel has been synthesized in the explosion. The early phase spectra shows traces of unburned material in the form of C and also prominent absorption lines due to intermediate mass elements. The velocity evolution calculated from the Si II absorption minimum which acts a good tracer of the photospheric velocity is 50 km/s/day which</p>		

places SN 2019np among the low velocity gradient objects. We also fit the early and near maximum light spectra of SN 2019np with one-dimensional spectral synthesis code TARDIS to understand the explosion channel and put constraints on the ejected mass of different elements above the photosphere.

ASI2021_434	Anjasha Gangopadhyay	Poster
SN 2019wep: Bridging the gap between type Ibn and Ib supernova		
<p>Supernovae (SNe) that are embedded in dense circumstellar medium (CSM) remain an interesting yet unexplored category of transients. We present here, the optical studies of a peculiar SN 2019wep that initially showed narrow emission lines of He (type Ibn) but later on transitioned to a normal type Ib SN. SN 2019wep is also one of the rare type Ibn showing signatures of flash ionisation (He II, C III, N III) features in its early spectra owing to the recombination of CSM. Even though the light curves show decay rates consistent with type Ibn SNe, the colour evolution lies between the type Ibn and extreme type Ib SNe. While the early spectral comparison plots of SN 2019wep shows similarity with type Ibn SNe, the late-time comparison plots shows similarity with other type Ib SNe. SN 2019wep belongs to the "P~Cygni" sub-class of SNe Ibn and shows faster evolution in velocities compared to the "emission" sub-class. The predominance of He lines including the transitioning phase hints towards a Wolf-Rayet progenitor scenario for this peculiar SN.</p>		

ASI2021_513	Ankit Kumar	Poster
Effect of Flyby Interactions on the Bulge and Disk of the Galaxy		
<p>There are two types of interactions in galaxies: mergers and flybys. There has been a lot of study of mergers in literature but flybys are largely ignored. Recent cosmological simulations suggest that mergers and flybys play an equal role in the formation and evolution of the galaxies at low redshift. Both processes produce enhanced star formation, extended tidal features, bars, spiral arms and warps in the disks of galaxies. The results of galaxy interactions depend on many factors such as galaxy mass ratios, the distance of the closest approach, gas content and orientation of the interacting galaxies. In this study, we investigate the minor interactions of two disk galaxies with mass ratio 10:1 and 5:1 in flyby encounters that do not lead to a merger. In our N-body simulations, we generate two disk galaxies having three components; dark matter halo, disk, and bulge. We vary only the pericenter distances to see the effect of minor flybys on the bulge and disk of the major galaxy over the course of the trajectory. For the detailed study of the bulges, the simulation has been performed for both classical and pseudo bulges. At different time steps of the evolution, we did two dimensional fittings of disk, bulge and bar of the major galaxy to trace the variation in the sersic index and mass of the bulge. The effects of tidal force on the disk are characterized in terms</p>		

of spiral strength, disk scale radius, and disk scale height. In this conference, we shall present the basics of simulations and our findings of flybys interactions in late universe.

ASI2021_364	ANSHU CHATTERJEE	Poster
Flare States Modeling and Spectral Study of PKS B1222+216		
<p>In twenty first century, high energy gamma-ray astronomy has become a potential branch of high energy physics to explore the extreme energetic events in the universe. Blazars are special kind of active galactic nuclei (AGN) with jet oriented at small angles to our line of sight. The relativistic motion of plasma along the jet axis increases luminosity of the jet radiation which makes blazars one of the most rapidly varying class of objects over a broad energy band (radio to γ-ray). PKS B1222+216 (4C +21.35; $z = 0.432$) is one of the brightest blazars observed in GeV energies. The multi wavelength data taken from different publicly available telescopes which includes SMARTS, SPOL-CCD of Steward observatory, Swift-XRT, Swift-UVOT and Fermi-LAT is analysed. The spectral and temporal evolution of flare state has been studied in details. This includes the study of flux-index variation, rise and decay time analysis, hardness ratio, discrete correlation between different light curves in GeV band and spectral modeling of both X-ray and GeV data. The broadband non-thermal emission from jet and thermal emission from disk produce a conventional double hump structure. The leptonic model with one emission region, moving relativistically along jet, is considered to explain the observed spectral energy distributions (SEDs). It is generally assumed that the lower energy peak comes from synchrotron and thermal emission and the high energy one is the result of inverse Compton scattering of low energy seed photons (SSC or External component). The modeling of broad band SED provides some insight about the intrinsic parameters which help us to understand the nature of different emission mechanisms inside the jet.</p>		

ASI2021_506	Arunima Banerjee	Poster
Dynamical parameters of interacting galaxies using CNN		
<p>Constructing dynamical models for interacting galaxies constrained by their observed structure and kinematics crucially depends on the correct choice of the values of their relative inclination (i) and viewing angle (θ) (the angle between the line of sight and the normal to the plane of their orbital motion). We construct Deep Convolutional Neural Network (DCNN) models to determine the i and θ of interacting galaxy pairs, using N-body N-body Smoothed Particle Hydrodynamics (SPH) simulation data from the GALMER database for training. GalMer simulates only a discrete set of i values (0°, 45°, 75° and 90°) and almost all possible values of θ values in the range, $[-90, 90]$. Therefore, we have used classification for i parameter and regression for θ. In order to classify galaxy pairs based on their i values only, we first construct DCNN models for (i) 2-class ($i = 0^\circ$, 45°) (ii) 3-class ($i = 0^\circ, 45^\circ, 90^\circ$) classification, obtaining F_1 scores</p>		

of 99\% and 98\% respectively. Further, for a classification based on both δ and θ values, we develop a DCNN model for a 9-class classification using different possible combinations of δ and θ , and the F_1 score was 97\%. To estimate θ alone, we have used regression due to the availability of continuous values, and obtained a mean squared error value of 0.12. Finally, we also tested our DCNN model on real data from Sloan Digital Sky Survey. Our DCNN models could be extended to determine additional dynamical parameters, currently determined by trial and error method.

ASI2021_247	Avinanda Chakraborty	Poster
Studying the Sunayev-Zel'dovich effect and X-ray Emission from Quasar Feedback		
<p>The thermal Sunyaev-Zeldovich (SZ) effect is the spectral distortion of the cosmic microwave background (CMB) radiation by energetic electrons. The SZ effect can be used as a direct potential probe of energetic outflows (known as feedback) from quasars which are responsible for heating the intergalactic medium. In this work, we use the GADGET-3 simulations which include dark matter and gas dynamics, radiative cooling, star formation, black hole growth, and energy-driven feedback (MassiveBlack-II) to compute the SZ effect arising from quasar feedback. From these theoretical simulations, we perform mock observations of the new generation Very Large Array (ngVLA) and the Atacama Large Millimeter Array (ALMA) to characterize the feasibility of direct detection of the quasar-SZ signal. We also compare the simulated ALMA maps of SZ distortion with that of the mock Chandra X-ray maps around the same quasars to perform a joint analysis of these systems. Our work for the first time provides a machinery to perform direct joint X-ray-SZ observations of quasars and extract the feedback energy from them.</p>		

ASI2021_520	B Ananthamoorthy	Poster
Study of AGN feedback in the active galaxy NGC 1566		
<p>Active Galactic Nuclei (AGN) and its jet can influence the star formation activities of the host galaxy via radiation energy or mechanical outflows, which may quench (negative AGN feedback) or enhance the star formation (positive AGN feedback). This feedback, in turn, can affect the activity of AGN. However, observational evidence for such feedback effects is very limited. The emission in the ultra-violet (UV) band of the electromagnetic spectrum is one of the direct tracers of recent star formation. We have initiated a study of AGN feedback in one of the active galaxies, NGC 1566, utilizing high-resolution UV observation from UltraViolet Imaging Telescope (UVIT) onboard AstroSat. The preliminary findings of this study will be presented here.</p>		

ASI2021_293	CHANDAN KUMAR DAS	Poster
Flux and spectral variability of QSO B0208-512		
<p>Active Galactic Nuclei (AGN), one of the most luminous objects in the universe, are a sub-class of galaxies that emit extremely bright radiation from their nuclear region. We studied the gamma-ray flux variability of BL Lac object QSO B0208-512 ($z=1.003$), an AGN using FERMI-LAT data between the period MJD 58700 to MJD 59100. During this period source was found to be extremely variable, and a few bright flares were detected. Flux variability and the source's spectral modeling are used to constrain the particle acceleration processes in the blazar jet.</p>		

ASI2021_409	DEEPAK CHANDRA JOSHI	Poster
A multi-frequency study of the radio halo in the merging galaxy cluster PLCKESZ G171.94-40.65		
<p>Clusters of galaxies are the largest gravitationally bound systems in the universe that contain dark matter, galaxies and the intra-cluster medium (ICM). The ICM is mainly very hot thermal plasma (detected as X-ray emission from galaxy clusters) but also contains large scale magnetic field and cosmic rays that elude detection in most frequency bands. The relativistic electrons in presence of the magnetic field produce synchrotron emission detectable in radio bands. The extended diffuse radio sources in galaxy clusters are direct probes of the magnetic field and cosmic ray electrons. It has been observed that massive galaxy clusters ($M_{500} > 5.0 \times 10^{14}$ solar masses) are more likely to have this large scale diffuse radio sources spread around the centre called radio halos but their origin and evolution is still a matter of debate. One such giant radio halo was discovered in the merging galaxy cluster PLCKESZ G171.94-40.65 (Giacintucci et al 2013) using NRAO VLA Sky Survey and short GMRT observations. We present the images of this cluster with deep GMRT data at 235, 325 and 610 MHz and the VLA-C and D at 1-2 GHz. The integrated spectral index of the radio halo is -1.4 placing it on the border line between normal and ultra-steep spectrum radio halos. We also present the spectral index map of the radio halo. We will discuss the relation between the ongoing merger and the radio halo properties in the context of the theoretical models.</p>		

ASI2021_117	Dharam Lal	Poster
Evidence for AGN as the source for electron reservoir in a newly discovered radio relic source		
<p>We report the discovery of a radio relic emission at the peripheral cluster region using upgraded GMRT. The spatially resolved radio relic emission show an elongated, bar-shaped structure, whose size is 72 kpc x 152 kpc. Our study with the multi-wavelength GMRT data and Chandra data shows that across the radio relic there is a hint of a surface brightness edge in the hot X-ray gas. We also detect flattening of the radio spectral index as the old plasma at the near end of surface brightness edge is reinvigorated by the passage of shock and shows the expected change in radio emission characteristics. We suggest that the radio relic has been seeded by the lobes of the AGN, demonstrating the connection between AGNs and radio relics.</p>		

ASI2021_119	GOPIKA K	Poster
Scaling relations for dark matter core density and radius from Chandra X-ray cluster sample		
<p>A large number of studies have found that the dark matter surface density, given by the product of the dark matter core radius (r_c) and core density (ρ_c) is approximately constant for a wide range of galaxy systems. However, there has been only one systematic study of this ansatz for galaxy clusters by Chan (arXiv:1403.4352), who found that the surface density for clusters is not constant and $\rho_c \sim r_c^{-1.46}$. We carry out this test for an X-ray sample of 12 relaxed clusters from Chandra observations, implementing the same procedure as Chan, but also accounting for the gas and star mass. We find that $\rho_c \propto r_c^{-1.08 \pm 0.055}$, with an intrinsic scatter of about 18%. Therefore, the dark matter surface density for our cluster data shows deviations from a constant value at only about 1.4σ</p>		

ASI2021_202	GOURAB GIRI	Poster
The curious case of X-shaped radio galaxies: Back-flow model		
<p>Extended radio galaxies show the presence of radio jets that are well-collimated plasma flows ranging up to Mpc scales. In some cases, we see significant distortion occurring in these large-scaled radio jets and resulting in X-shaped morphologies. They can be identified from the presence of two double-lobed jet structures aligned at an angle to each other (wing and active lobe). The back-flow model and the merger model have gathered some attention in describing these galaxies, beside the models which consider the presence of dual active galactic nuclei, jet precession and even buoyancy. The goal of this work is to study the formation of X-shaped radio galaxies due to the back-flow model. In this regard, we have performed high-resolution axisymmetric simulations of jet propagation from triaxial galaxies and have shown the role of magnetic field strength and pressure gradient in shaping the extent of the secondary lobe (wing). Further, we have used state of the art Eulerian-Lagrangian framework to demonstrate the variation of spectral index and polarization in the radio band for these sources. The vital role of viewing orientation in determining the relative extent of primary and secondary lobe from synchrotron emission will be showcased using our 3D simulations along with its implications on the possibility of the existence of a universal formation mechanism of X-shaped sources.</p>		

ASI2021_543	HIMANSHU .	Poster
Studying galaxy clusters using the Sunyaev-Zel'dovich effect		
<p>A well-known way to study clusters of galaxies is the Inverse-Comptonization of Cosmic Microwave Background(CMB) photons by Intra-Cluster medium(ICM), popularly known as Sunyaev-Zel'dovich effect (SZE). For hot ICM gas, relativistic effects must be taken into account. In this work, we have used SZpack, a numerical library which takes into account of these effects and allows high-speed and accurate calculations of SZ signals (0.001% at frequencies $>1000\text{GHz}$) up to high</p>		

temperatures($\geq 75\text{KeV}$). We have simulated SZ flux maps of galaxy clusters with a given morphology of thermal electron population and temperature, in order to compare them with actual observations made in the cm-wave range using the current generation of radio telescopes. The combination of these simulations and observed data will allow the mapping of pressure in the ICM, which is especially useful for studying the dynamics of cluster mergers.

ASI2021_512	Hum Chand	Poster
Probing the environment and central engine of AGN at different length scales		
<p>Various observational probes of the central engine and environment of AGN over a range of redshift play a key role in our understanding of the formation and evolution of proto-galaxy at high redshift. In this context, we will summarise our recent results of comparative studies of Narrow line Seyfert I (NLSY1) and Broad-line Seyfert I (BLSY1) using the X-ray/optical studies to constraint the emission mechanism of the central engine in the kpc scale. Further, we will summarise the environment of the AGN on kpc to Mpc scale using the analysis of Lyman alpha forest using a large sample of QSOs pairs (projected at <1.5 arcmin separation in 2-3 redshift). Finally, we will discuss our understanding of the typical AGNs outflow feedback detected as a blue-shifted broad absorption line (BAL, $\sim 0.1c$ velocity) in AGN spectra, especially for the SDSS sample of a newly emergent BAL trough in BALQSOs.</p>		

ASI2021_406	Indu Kalpa Dihingia	Poster
Jets, disk winds and oscillations in general relativistic magnetically driven flows from thin accretion disc		
<p>Relativistic jets and disc-winds are often observed from many BH-XRBs, and AGNs. However, the theoretical understanding of jet launching and driving of disc-wind from underlying accretion disc is still minimal. In this study, we try to understand the role of the magnetic field and its structure in launching jet and disc-wind. Subsequently, we explore the possible connection between jet, wind, and the accretion disc around the central black hole. To do that, we study GRMHD accretion flow in 2.5D using AMR numerical setup. We supply a steady-thin accretion disc as our initial condition for the simulation. We perform an extensive parametric study by choosing different combinations of plasma-β parameter and the poloidal magnetic field's inclination parameter (θ_m). Our study finds relativistic jets driven by the Blandford & Znajek (BZ) mechanism, and the disc-wind driven by the Blandford & Payne (BP) mechanism. We also find that due to the poloidal field lines' reconnection events, plasmoids are formed, and these plasmoids advect with disc-winds. As a result, the tension force due to the poloidal magnetic field is enhanced in the inner part of the accretion disc, resulting in disc truncation and oscillation. These oscillations are responsible for flaring activities in the jet. We find simulation runs with a lower</p>		

value of the plasma- β , and lower inclination angle parameter ($\sin i$) are more prone to the formation of plasmoids and inner disc oscillation. Our models provide a possible template to understand transition phenomena in BH-XRBs.

ASI2021_271	Juhi Tiwari	Poster
Hercules cluster in X-rays with XMM-Newton and Chandra		
<p>We present for the first time a detailed X-ray study of the central subcluster of the nearby ($z \sim 0.0368$) Hercules cluster (Abell 2151) identified as A2151C, using high-resolution data from the XMM-Newton and Chandra space observatories. A2151C shows a bimodal structure. A bright clump of hot gas with X-ray emission extending to radius $r \sim 304$ kpc and X-ray luminosity $L_X = 3.03 \{+0.02; -0.04\} \times 10^{43} \text{ erg s}^{-1}$ in the 0.4--7.0 keV energy range is seen as a fairly regular subclump towards the west (A2151C(B)). An irregular, fainter and cooler subclump with radius $r \sim 364$ kpc is seen towards the east (A2151C(F)) and has $L_X = 1.13 \{+0.02; -0.02\} \times 10^{43} \text{ erg s}^{-1}$ in the 0.4--7.0 keV energy band. The average temperature and elemental abundance of A2151C(B) are $2.01 \{+0.05; -0.05\} \text{ keV}$ and $0.43 \{+0.05; -0.05\} Z_{\text{solar}}$ respectively, while these values are $1.17 \{+0.04; -0.04\} \text{ keV}$ and $0.13 \{+0.02; -0.02\} Z_{\text{solar}}$ for A2151C(F). Low temperature $\{1.55\} \{+0.07; -0.07\} \text{ keV}$ and a short cooling time (~ 0.81 Gyr) within the central 15 arcsec region confirm the presence of a cool core in A2151C(B). We identify several compact groups of galaxies within A2151C(F). We find that A2151C(F) is a distinct galaxy group in the process of formation and likely not a ram-pressure stripped part of the eastern subcluster in Hercules (A2151E). X-ray emission from A2151C shows a region of overlap between A2151C(B) and A2151C(F) but without any enhancement of temperature or entropy in the two-dimensional (2D) projected thermodynamic maps that could have indicated an interaction due to a merger between the two subclumps.</p>		

ASI2021_349	Jyoti Yadav	Poster
UVIT-MUSE view of star formation, AGN activity and ionized outflows in Southern Interacting Galaxies		
<p>Interactions and mergers of gas rich galaxies can trigger star formation in their nuclear and disk regions, leading to starbursts and active galactic nuclear (AGN) activity. Galaxy mergers also lead to the formation of supermassive blackhole binaries that may start accreting gas and become single or dual AGN. The enhanced star formation will ultimately lead to bulge growth accompanied by starburst/AGN feedback activity. Apart from these effects, tidal dwarf galaxies may also form in the extended arms. These processes are all important for galaxy evolution and need to be understood in detail. Our study aims to understand these diverse processes using UV, optical and NIR observations of a sample of southern interacting galaxies for which we have obtained deep, near-IR observations using the SAAO. We use UVIT, NIR SAAO observations and MUSE archival data to find signatures of AGN activity and study its connection with the surrounding star formation. The</p>		

UVIT images also show star formation in the tidal tails and is important for understanding tidal dwarf galaxy formation. The star formation is also visible in H α images obtained from MUSE. We present some preliminary results on the galaxy IC5110, whose BPT plot shows that it has a LINER like object but the MUSE data reveals that the emission is from a retired galaxy which has similar line ratios as those of a LINER, as well as a few other galaxies for which NIR, optical and UVIT data have been obtained. We also found signatures of outflows from central region and star formation along bar in NGC 7733.

ASI2021_437	K ADITYA	Poster
GMRT HI 21cm observations of the superthin galaxy FGC1440		
<p>Superthin galaxies are low surface brightness, bulges disc galaxies, characterised by optical discs with strikingly high values of planar-to-vertical axes ratios ($b/a > 10$), the physical origin and evolution of which continue to be a puzzle. We present GMRT HI 21cm radio-synthesis observations of FGC1440, an extremely thin disc galaxy with an axial ratio b/a equal to 20.4, with a spectral resolution of 1.7 km/s (8.138kHz), a spatial resolution of $15.9'' \times 13.5''$ and an rms equal to 1.01mJy/beam. We construct a three-dimensional tilted ring model of the HI distribution to derive the kinematic properties of FGC 1440 using Fully automated Tilting (FAT). Our results indicate that FGC 1440 has a slowly rising rotation curve with an asymptotic rotational velocity equal to 142 km/s, an inclination equal to 88.5 degrees and position angle of 53.6 degrees. The HI distribution is asymmetric on the approaching and the receding sides. By manually comparing the PV diagrams at different offsets, we find that the HI velocity dispersion lies in between 5 and 15 km/s, and the scale height corresponding to the HI disc less than 1.8 kpc. Further, the galaxy might possibly host a line of sight warp.</p>		

ASI2021_168	Koshy George	Poster
Bar quenching as a possible formation mechanism for passive disk galaxies in the local Universe		
<p>Galaxies in the local Universe can be classified as star-forming or passive based on the rate at which stars are being formed from the gas reservoir available. Several theoretical scenarios have been proposed, which alone or in tandem can convert an active star-forming galaxy to a passive galaxy. Many recent N-body/hydrodynamical simulations of galaxy formation and evolution show the importance of dynamical effects from the action of stellar bars controlling the star formation in the bar region of disk galaxies. Based on a detailed multi-wavelength analysis of barred disk galaxies in the local Universe, we found observational evidence for this scenario. Our study suggests that the redistribution of gas, due to the dynamical effects of the stellar bar, makes the bar region devoid of fuel for star formation and eventually quenches star formation in the bar region.</p>		

ASI2021_335	Krishna Mohana A	Poster
A long-term study of 3C 66A and PKS 0208-512: an exhibition of baseline activity change and decade long stay at very low-state		
<p>Blazars are known to exhibit variations of different time scales across the waveband. We report a presence of two long-term activity states with a factor of two difference in average γ-ray flux from the 11 yr of γ-ray lightcurve of 3C 66A with transition timescale of the month. The first activity state was for ~ 3 yr, followed by a change in the baseline activity during 2011 May, which further continued for the next 8 yr. Also, a similar change in baseline flux was noticed in the optical band. From the construction and modeling of broad-band SEDs during the different activity states of 3C 66A, we found a decrease in the Doppler beaming factor could explain the observed reduction in the average flux. We speculate either a bending jet scenario with an increase in the jet inclination angle by $\sim 1^\circ$ or slowing down of the jet by $\sim 25\%$ during the later state. From the Fermi-LAT γ-ray lightcurve, we noticed that the activity of another source PKS 0208-512 reduced significantly during the first 10 yr of Fermi operation (2008-2018) compared to its average flux as observed by its predecessor EGRET during its first five years of observation (1991-1995). During the last two years, the source activity has increased noticeably, reaching the high gamma-ray flux level observed during EGRET time. We have observed this source through AstroSat during low and very high activity states. The results of multi-band study of 3C 66A and PKS 0208-512 during their different activity states will also be presented here.</p>		

ASI2021_345	Majidul Rahaman	Poster
Investigating the origin of diffuse radio emission in galaxy clusters using Chandra X-ray observations		
<p>Collisions between galaxy clusters provide a unique opportunity to study matter in a parameter space that cannot be explored in our laboratories on Earth. Cluster formation is hierarchical, and clusters grow mostly by merging. Mergers of two massive clusters are the most energetic events in the Universe after the Big Bang; hence they provide a unique laboratory to study cluster physics. The two main mass components in clusters behave differently during collisions: the dark matter is nearly collisionless, responding only to gravity, while the gas is subject to pressure forces and dissipation, and shocks and turbulence are developed during collisions. Cluster mergers stir the intracluster medium creating shocks and turbulence, which are illuminated by diffuse radio features called halos, relics, and radio phoenixes. However, shocks and turbulences are detected via signatures in the thermal X-ray emission. Disturbed morphologies in X-ray surface brightness and temperatures are direct evidence for cluster mergers. Therefore, the study of the X-ray observations can lead to a deeper understanding of the origin of diffuse radio emissions in the galaxy clusters. We present results from multi-wavelength (radio and X-ray) observations of two merging galaxy clusters AS1063, A1914, and A85. We produce thermodynamic maps for all the clusters using the ACB, WVT, and Contour binning method from Chandra X-ray archival data. We report the detection</p>		

of three shock waves in the A1914 cluster and investigated if these shocks are related to the origin of radio phoenix and radio halo present in the cluster. In A85, low-frequency GMRT observations (325 MHz) have revealed a complex and filamentary diffuse radio phoenix at the place of the infalling southwest subcluster. We also detect an X-ray shock near the radio phoenix. We find the observational evidence of the possible connection between an X-ray shock and the radio phoenix for the first time.

ASI2021_576	Mamta Gulati	Poster
Ram Pressure Striping and its efficiency to remove gas from galaxies.		
<p>Ram Pressure Striping (RPS) and its related processes have been extensively studied as a mechanism to remove gas from galaxies since its introduction by Gunn and Gott more than four decades ago. The amount of gas present directly relates to star formation and the evolution of galaxy. We shall discuss a comparative analysis of effectiveness of RPS as a gas removing mechanism. Present work focuses on the dependence of RPS on ambient medium, redshift, and galaxy properties like asymmetries in galaxies, spiral arms and magnetic field. We use a simple analytical model which gives an upper limit of the gas removed via RPS. Some limitations of the model will be discussed towards the end.</p>		

ASI2021_608	Md Arif Shaikh	Poster
Probing evolution of compact binaries using higher modes of gravitational wave		
<p>Ground-based gravitational-wave (GW) detectors like the LIGO and Virgo have been successfully detecting GWs from compact binary mergers. Being sensitive in the frequency band $\sim 10 - 10^3$ Hz, these detectors nominally detect GWs generated only during the last stages of their inspiral and subsequent merger. However, GW signals from asymmetric mass binaries can contain appreciable contributions from higher-order (non-quadrupole) modes of the radiation. Since these higher modes are generated at higher multiples of the orbital frequency, higher modes generated during the earlier stages of the inspiral can fall in the detectors' sensitive frequency band. They contain the signatures of the early evolution of the binary's orbit (e.g., signatures of orbital eccentricity which might not be measurable during the late inspiral, since the binary would have circularized by then due to effects of radiation reaction). We show that measurement of the higher modes in the detected signal allows us to probe the early evolution of the compact binary, and will potentially allow us to infer its astrophysical formation channel.</p>		

ASI2021_347	Megha Rajoria	Poster
Opportunities amid pandemic in citizen science research via #RADatHomeIndia in Radio Astronomy		
<p>When the world crumbled due to COVID 19, we all, including ASI, IAU, SKA promptly informed the public about online opportunity for astronomy learning while locked down at home (#AstroAtHome). As planetariums and auditoriums were closed, all talks were hosted in Youtube (Live) and student/public interactions happened mostly via Zoom, Google-Meet. Launched in 15th April 2013 RAD@home Collaboratory has been well-established by this time and SKA, IAU, ASI etc. advised the public to take opportunity of joining RAD@home the Nationwide Inter-University citizen science research collaboratory for every present/past University student and absolutely free of cost. The Collaboratory has been growing at a rate of nearly 2 new members every day and is now over 4500 members strong. Out of them over 3000 are “Active” in learning astronomy over the last one year (500-1000 active every month). Supported by 25 research and educational institutes it has trained 150 citizen-scientists (e-astronomers) in one week-long RAD@home Discovery Camps and nearly 1000 i-astronomers in One Day RAD@home Astronomy Workshops including short sessions (#DiSeDiscovery) at SKA-weeks of DAE-DST-NCSM Vigyan Samagam @Mumbai, @Bangalore, @Kolkata and @Delhi. These e-astronomers guide new members and continue astronomy discussion during the weekly evening Live e-class every Thursday 8-9 pm. These e-classes, discussing specific astronomical targets as defined under #DailyGalaxyRGB , attract nearly 200 text and UV-Optical-IR-radio RGB-contour #RGBviaNASAnRADatHomeIndia image comments. Our activity of this year includes 1000 separate posts, 8000 image/text comments and 18,000 reactions. This online activity, over the years, has nurtured and recommended over 35 MS/PhD students, mostly in USA/Europe. They have won, as Co-Investigators, GTAC-approved observation time in GMRT and co-authored journal publications. For a future pandemic-ready, SKA- and TMT-prepared India, there is need to strengthen citizen-science research in multi-wavelength astronomy.</p>		

ASI2021_276	Mousumi Das	Poster
Star formation in Low Stellar Density Environments in Galaxies		
<p>Star formation generally occurs in the inner disks of galaxies where the stellar disk surface density is high and there is copious amounts of dense molecular hydrogen gas. However, young star forming regions have been discovered in low density environments where there is HI gas but only a diffuse stellar disk. The star formation processes in these metal poor, low stellar density regions is not well understood. I will present two examples of such star formation, extended UV (XUV) disks and low surface brightness (LSB) galaxies. XUV galaxies are spirals that show filamentary/diffuse star formation in the outer parts of their optical disks. These regions have low stellar surface densities, low metal content and are adverse environments for star formation. Previous studies by GALEX found that surprisingly 30% of nearby spiral galaxies have XUV disks. It</p>		

maybe driven by galaxy interactions, gas infall, or accretion from the IGM. We present a study of three XUV galaxies using the UVIT. We compare the properties of the star forming complexes inside and outside the optical radius. Our observations suggest that they formed due to local disk instabilities and that their distribution is well correlated with the HI gas distribution, and the HI holes. We then present a UVIT study of the LSB galaxy UGC9024, which appears to show the highest star formation rate compared to other low redshifts LSB galaxies. We discuss the SFCs and compare it with our GMRT HI observations of this galaxy. We discuss the SFCs and compare it with our GMRT HI observations of this galaxy.

ASI2021_400	Nabanita Das	Poster
Contribution of X-ray Reprocessing in the Longterm Optical Variability of the Radio Galaxies 3C 120 and 3C 111		
<p>The optical and ultraviolet radiation of active galactic nuclei (AGN) originates from the accretion disk and the X-rays are presumably produced at a tenuous distribution of high energy electrons called the corona. The mechanism of the coronal X-ray emission is believed to be inverse-Compton scattering of the optical-UV photons generated in the disk. Part of the optical-UV emission may be due to the reprocessing of the coronal X-rays at the disk. The origin of the optical-UV emission variability has been extensively debated in the literature in the last decade, the main candidates being intrinsic fluctuation of the disk and variability of the X-rays which are reprocessed in the disk. We analyze the long term (few years) time variability of the optical emission of the broad line radio galaxies 3C 111 and 3C 120 in the context of the above disk-corona connection. We have considered the lamp-post model, in which the corona is thought to be a point source above the plane of the disk. We find, for a large parameter space of the model, that reprocessing of the 2-10 keV X-ray emission alone without any intrinsic fluctuation of the accretion disk is not enough to reproduce the optical variability amplitude and flux level in either of the two sources. We model the variability of the underlying disk emission and the X-ray reprocessing in order to reproduce, approximately, the observed variability and the flux levels in the observed R-band light curves. In such a model with a variable disk emission, the reprocessed fraction contributes a minor part, approximately 15%, of the total R-band emission.</p>		

ASI2021_158	Narendra Nath Patra	Poster
Thick disc molecular gas fraction in NGC 6946		
<p>Several recent studies reinforce the existence of a thick molecular disc in galaxies along with the dynamically cold thin disc. Assuming a two-component molecular disc, we model the disc of NGC 6946 as a four-component system consisting of stars, HI, thin disc molecular gas, and thick disc molecular gas in vertical hydrostatic equilibrium. Following, we set up the joint Poisson-Boltzmann equation of hydrostatic equilibrium and solve it numerically to obtain a three-dimensional density</p>		

distribution of different baryonic components. Using the density solutions and the observed rotation curve, we further build a three-dimensional dynamical model of the molecular disc and consecutively produce simulated CO spectral cubes and spectral width profiles. We find that the simulated spectral width profiles distinguishably differ for different assumed thick disc molecular gas fractions. Several CO spectral width profiles are then produced for different assumed thick disc molecular gas fractions and compared with the observed one to obtain the best fit thick disc molecular gas fraction profile. We find that the thick disc molecular gas fraction in NGC 6946 largely remains constant across its molecular disc with a mean value of 0.70 ± 0.09 . We also estimate the amount of extra-planar molecular gas in NGC 6946. We find $\sim 50\%$ of the total molecular gas is extra-planar at the central region, whereas this fraction reduces to $\sim 15\%$ at the edge of the molecular disc. With our method, for the first time, we estimate the thick disc molecular gas fraction as a function of radius in an external galaxy with sub-kpc resolution.

ASI2021_128	Nour Dergham	Poster
Correlation studies of Broad and Narrow line vs the X-ray producing regions in a sample of unobscured AGNs		
<p>We modelled continuum and emission lines for a sample of unobscured Type I Active Galactic Nuclei (AGNs) using SDSS data (DR12). After removing the effects caused by galactic extinction, redshift and the contribution of host galaxy, we calculated various parameters of Hα, Hβ and OIII emission lines. We used two component model to get the properties of Hα and Hβ and calculated the luminosity and EW of these lines. Correlation studies were carried between the optical and X-ray luminosity (2-10 keV) as well with power-law index for few of the AGNs. We found that the broad components of emission lines show the best correlation with hard X-ray luminosity when compared with narrow component and this agree with the picture that broad line region (BLR) has the closest link with the AGN's compact X-ray emission. [OIII] emission line show relatively strong correlation with X-ray luminosity. We found that only Hβ broad component is exhibiting a negative correlation with X-ray power-law index, whereas other components of other spectral lines does not show any correlations. We briefly discuss these results which clarifies the picture of association of inner region of accretion disk and regions producing the spectral lines.</p>		

ASI2021_252	PARTHA PRATIM DEKA	Poster
A pair of UV nuclei or a compact star forming region near the active nucleus in Mrk 766?		
<p>Here we present the methodology and results of an analysis carried out on AstroSat/UVIT images of Mrk 766 in near and far UV bands. In both the bands, we discovered a compact and bright ultraviolet source at a projected separation of 1.1 kpc from the known active galactic nucleus (AGN) in the galaxy. Using radial profile analysis we derived the UV flux almost free from the</p>		

nearby contaminating sources for both the primary AGN and the new source. The actual AGN is about 2.5 and 5.6 times brighter than the new source in the far and near UV bands. Visually they appear as a pair of nuclei in the central region of the galaxy. The new source's nature was investigated based on its UV, X-ray, and optical emissions. Because of its lack of X-ray emission, the new source is highly unlikely to be another accreting supermassive black hole in Mrk 766. By measurement of UV/Optical flux of the new source at four different bands, we found that it closely follows the shape of a standard starburst galaxy's spectrum, which strongly suggests that the new source is a compact star-forming region.

ASI2021_504	Parveen Kumar	Poster
Optical micro-variability in radio-loud narrow line Seyfert 1 galaxies (RL-NLS1s).		
Recent studies have revealed that radio-loud Narrow-line Seyfert 1 galaxies (RL-NLS1s) possessing powerful radio jets are likely to be more common than that thought earlier. Therefore, RL-NLS1s present a challenge for the relativistic jet paradigm, which states that powerful radio jets are associated exclusively with very high SMBHs. RL-NLS1s known to host low black hole masses with high accretion rates are suitable candidates for the probes on the formation of powerful radio jets in a regime different from broad-line radio-loud AGN. Also, unlike blazars, radio jets in RL-NLS1s can be viewed at much larger angles, and therefore it unclear if all RL-NLS1s are intrinsically radio-loud or appear radio-loud due to beaming effect. Optical monitoring can be used as a complementary tool to infer the presence of relativistic jets in RL-NLS1s. AGN with relativistic jets aligned close to the line-of-sight are expected to exhibit Intra-night optical variability (INOV) due to the beaming effect. In my presentation I aim to focus on the recent observational attempts to detect and understand INOV in a variety of RL-NLS1s.		

ASI2021_215	RAHUL GUPTA	Poster
Observational properties of VHE detected GRB 180720B, GRB 190114C, and GRB 190829A		
Recent observations of very high energy (VHE) photons from Gamma-ray bursts (GRBs) afterglows using MAGIC and HESS telescopes has open a new window in the field of GRBs research. By now, at least three GRBs (GRB 180720B, GRB 190114C, and GRB 190829A) have confirmed VHE detections. It is still an unsolved question whether VHE detected GRBs require special environments for this VHE emission to occur at sufficient strength to be observable or whether all GRBs have VHE emission (and we missed due to the observational limitations) and it is solely related to the released GRB emission. In this work, we present the results of a detailed investigation of the prompt and afterglow emission of all three VHE detected GRBs based on multi-wavelength observations. We find some similarities between GRB 180720B and GRB 190114C, however, GRB 190829A is a peculiar low luminous burst. GRB 190829A consists of two isolated sub bursts or episodes, separated by a quiescent phase. The first episode, which has a higher spectral peak of 120 keV and low isotropic		

energy 10^{50} erg is an outlier to the Amati correlation and marginally satisfies the Yonetoku correlation. However, the energetically dominant second episode has lower peak energy and is consistent with the above correlations. We compared this GRB to other low-luminosity GRBs (LLGRBs). We also analyzed the late time Fermi-LAT emission that encapsulates the H.E.S.S. and MAGIC detection for these VHE detected GRBs. Some of the LAT photons are likely to be associated with the GRBs and they could have an Inverse Compton mechanism origin. Furthermore, our results show that teraelectronvolt-energy photons seem common in both high-luminosity GRBs and LLGRBs.

ASI2021_342	Ramij Raja	Poster
Origin of diffuse radio emission in the Phoenix and SPT-CL J2031-4037 galaxy cluster		
<p>Clusters of galaxies are the largest gravitationally bound objects in the present Universe, located at the nodes or the intersections of the filaments of the cosmic web. They form and grow by accreting mass from the filaments via small and large scale mergers. Radio observations of the clusters have revealed the presence of Mpc scale radio emission which are not associated with cluster radio galaxies. These diffuse radio objects provide information about the dynamical state of the clusters, which are important probes to the cluster evolutionary stages, helping us in our understanding of the structure formation processes in the Universe. Here, we present diffuse radio emission from clusters that are either in a relaxed, intermediate and merging state. The Phoenix cluster is a relaxed cool-core cluster that hosts a radio minihalo. We found two cold fronts as well as spiralling cool gas around the cluster center, indicating the presence of gas sloshing. We argue that this sloshing is likely providing the necessary turbulence to reaccelerate in-situ cosmic rays, resulting in the observed radio minihalo. The SPT-CL J2031-4037 is a cluster that is in between merging and relaxed state, hosting a radio halo of the size ~ 0.7 Mpc. The ICM disturbance in the X-ray image correlates with the radio halo morphology, indicating the possible merger axis. We speculate based on cluster dynamical state and halo spectral index distribution that this radio halo is probably the result of a past less energetic merger event.</p>		

ASI2021_356	Ravi Pratap Dubey	Poster
Study of Dynamical and Emission Properties of Dual AGN Candidates		
<p>Radio Loud Active Galactic Nuclei (RLAGNs) show the presence of extended jets that are well-collimated plasma flows. Sometimes, they show significant distortion in their structure, leading to an S-shaped morphology. These winged sources are one of the rare radio structures in the sky and are predicted to be the outcome of a precessional jet. The existence of the dual AGN at the center of these galaxies is proposed as one of the plausible mechanisms in order to explain the precession. The goal of this work is to study the formation of S-morphology due to the precessional jet through</p>		

numerical means. In this regard, we have performed a full-scale 3D MHD simulation of jet propagating in an ambient galaxy and have shown that a precessional jet can lead to the formation of a distinct S-shape. The parametric restrictions under which this S-morphology forms will be presented along with the effect of the magnetic field in the dynamical evolution. Further, the implication of the parameter study on emission properties and age determination will be discussed, which will help to understand the spectral properties of S-shaped radio sources.

ASI2021_499	Raya Dastidar	Poster
Transitional type II Supernovae (SNe): A case study of SN 2016B		
<p>Type II SNe, the hydrogen-rich explosions in massive stars, are classified as 'plateau' (IIP) and 'linear' (IIL) based on the presence of a roughly constant luminosity phase or a linearly declining photospheric phase, respectively, in their light curve, at epochs post peak brightness. However, there has been much debate over this sub-classification, with some authors advocating a distinct separation of classes and others arguing in favour of continuity. In this work, we present the early light curve analysis of SN 2016B, a type II SN displaying characteristics of both the type IIP and IIL subclasses. The early light curve features serve as a handle in constraining the progenitor properties of SNe. By modelling the light curve of SN 2016B, we estimated a ZAMS mass of 16 Msun and an external radius of 1600 Rsun suggesting that the presence of a dense circumstellar medium close to the progenitor is the sole factor responsible for the diversity in the light curve of type II SNe.</p>		

ASI2021_397	Ritaban Chatterjee	Poster
Blazar Variability: A Study of Non-stationarity and the Flux-RMS Relation		
<p>We have analyzed the X-ray light curves of the blazars Mrk 421, PKS 2155-304, and 3C 273 using observations by AstroSat and archival XMM-Newton data. We use light curves of length 30-90 ks each from 3-4 epochs for all three blazars. In this talk, we shall show that the power spectral density (PSD) of the X-ray variability of the individual blazars are consistent within uncertainties across the epochs. This implies that the construction of broadband PSD using light curves from different epochs is accurate. However, using certain properties of the variance of the light curves and its segments, we show that the blazars exhibit hints of non-stationarity beyond that due to their characteristic red noise nature in some of those observations. We shall also demonstrate that there is a linear relationship between the root-mean-squared amplitude of variability at shorter timescales and the mean flux level at longer timescales for light curves of Mrk 421 across epochs separated by decades as well as light curves spanning 5 days and 10 years. The presence of flux-rms relation over very different timescales may imply that, similar to the X-ray binaries and Seyfert galaxies, longer and shorter timescale variability are connected in blazars. This work has been published in the Astrophysical Journal in 2020 ("Blazar Variability: A Study of Non-stationarity and</p>		

the Flux-RMS Relation”, Bhattacharyya, Souradip; Ghosh, Ritesh; Chatterjee, Ritaban & Das, Nabanita 2020, ApJ, 897, 25. arXiv: 2005.05230). The submitted abstract is from that paper.

ASI2021_490	Ruta Kale	Poster
Upgraded GMRT view of the highest redshift radio halo cluster El Gordo		
<p>We present new results from the multi-band observations with the Upgraded Giant Metrewave Radio Telescope (uGMRT) towards the extreme galaxy cluster named El Gordo. It is the most massive cluster at the redshift of 0.87 and was discovered through Sunyaev-Zeldovich surveys. It is a merging cluster with the distribution of X-rays that shows presence of two filamentary features called "tails". The radio halo and radio relics were discovered at 1.4 GHz. I will present the most sensitive low frequency images of the radio halo and the relics in this cluster using the Upgraded GMRT using our data analysis pipeline called "CAPTURE". We spectrally characterise the radio halo and the relics in this system for the first time over the wide band and interpret the results in the context of the particle re-acceleration models at work at this high redshift.</p>		

ASI2021_99	Samuzal Barua	Poster
Observational evidence for the variation of coronal temperature in AGN		
<p>The measurement of coronal temperature in active galactic nuclei (AGN) has been difficult due to the lack of instruments with high sensitivity at high energies. However, the high spectral resolution of NuSTAR above 10 keV has now allowed the measurement of the coronal temperature by spectral fitting. These direct measurements provided us with an exceptional opportunity to study the variation of the coronal temperature with flux. We performed flux resolved spectroscopy on the NuSTAR observations of two AGN, Ark 564 and ESO 103–035. While For Ark 564, we observed a decrease in the coronal temperature as the flux increased, the opposite was seen for ESO 103–035 where the coronal temperature increased as the flux increased. In this talk, I will describe the results and discuss the possible mechanism responsible for this different behavior of these sources.</p>		

ASI2021_517	Saroon S	Poster
U - Shaped Stellar Warp of the Large Magellanic Cloud		
<p>Warps are vertical distortions of stellar and/or gaseous disks of galaxies. One of the proposed scenarios for the formation of warps is the tidal interaction with external galaxies. A recent study identified a stellar warp (directed away from us) in the outer regions of the South-Western disc of the Large Magellanic Cloud. Due to limited spatial coverage of the data, the previous study could not investigate the counterpart of this warp in the North Eastern region, which is essential to obtain a conclusive picture about the nature and origin of this warp. In this work we study the structure of the LMC disk and the nature of the outer warp using the Gaia DR2 and recently released Gaia EDR3 data, which cover the entire Magellanic system. Our study identified the counterpart (for the South</p>		

Western outer warp) in the North Eastern disc which is also in a direction away from us, suggesting a U-shaped stellar warp in the LMC disk. This U-shaped warp could have formed during the mutual tidal interactions between the Large Magellanic Cloud and the Small Magellanic Cloud.

ASI2021_216	Savithri H Ezhikode	Poster
Correlation between reflection fraction and photon index in AGN		
<p>The primary X-ray emission from Active Galactic Nuclei (AGN) is believed to be produced by the Comptonisation of the optical/UV photons from the accretion disc by the hot electrons in the corona. This primary power-law continuum irradiates the accretion disc and the circumnuclear material producing reflection features in the X-ray spectrum. The reflection features arising from the inner regions of the disc could be significantly modified by the relativistic effects near the black hole. Furthermore, the area of the reflecting medium and the location of the X-ray emitting region can affect the amount of reflection. Here, we investigate the relationship between the relativistic reflection fraction (R_f) and the hard X-ray photon index (Γ) of a NuSTAR sample of Seyfert 1 galaxies. The X-ray spectra of the sources are modelled using RELXILL code which directly provides the reflection fraction of a relativistically smeared reflection component. R_f depends on the amount of Comptonised X-ray emission intercepted by the inner accretion disc and is defined as the ratio of the coronal intensity that illuminates the accretion disc to that observed directly. We found a strong positive correlation between Γ and R_f in our sample. Seed photons from a larger area of an accretion disc entering the corona will increase the cooling of the coronal plasma, giving rise to steeper X-ray spectrum. Also, the corona irradiating a larger area of the disc will enhance reflection fraction. Thus, the observed R_f–Γ correlation is most likely related to the changes in the disc–corona geometry of AGN.</p>		

ASI2021_447	Sayan Kundu	Poster
Numerical Modelling to study interplay of particle acceleration processes in astrophysical plasma		
<p>AGN Jets are observed to possess various sites for particle acceleration, which gives rise to the observed non-thermal spectra. Diffusive shock acceleration and stochastic turbulent acceleration are claimed to be the candidates for producing very high energetic particles. The stochastic turbulent acceleration is a random energization process, where the interaction between cosmic ray particles and electromagnetic fluctuations could lead to both particle acceleration and deceleration. Due to this randomness in energy gain, the stochastic turbulent acceleration is usually modelled as a biased random walk in energy space with a Fokker-Planck equation. Due to the ubiquitous nature of plasma fluctuations, stochastic turbulent acceleration gives rise to diffuse emission, whereas shock acceleration leads to localized emission. In astrophysical systems, different acceleration processes work in an integrated manner along with various energy losses. Here I will present our novel method of implementing stochastic acceleration in the hybrid Eulerian-Lagrangian framework</p>		

that accounts for diffusive shock acceleration in the presence of radiative processes like synchrotron and IC emission. The focus would be to showcase the interplay between the particle acceleration process due to shocks and turbulence. Further, I will also present the application of these acceleration mechanisms in governing the non-thermal emission from AGN jets and also their role in controlling particle spectra in blazars.

ASI2021_73	Sayantan Bhattacharya	Poster
What's The Mass of IC 10 X-1 ?		
<p>IC 10 X-1 is a high mass X-ray binary (HMXB) that consists of a black hole (BH) and a Wolf-Rayet (WR) star with an orbital period of 34.9 hours. In a series of Chandra and XMM-Newton observations, eclipses were discovered with a duration of ~ 5 hours. The source shows consistent variability around an X-ray luminosity of $7 \times 10^{37} \text{ erg s}^{-1}$, in which the optical radial-velocity (RV) measurements from the He II line showed a phase shift compared to the X-ray ephemeris of the system. This observation put in question the mass determination of the BH -- either the He II line originates in a shadowed region of the stellar wind (hence it does not trace directly the motion of the WR star), or the BH is eclipsed by a trailing shock or plume. A shock front must be forming where the WR wind collides with wind emanating from the BH and its accretion disk. To understand the influence of X-rays on the WR optical spectrum, we used CMFGEN to model a spectrum with X-rays embedded in the WR wind. CMFGEN takes into account non-LTE atmospheres and solves for the radiation field in comoving coordinates, but it uses a spherical geometry that does not account for asymmetries. We are using archival optical spectra in order to generate RV plots from other lines originating deeper inside the WR photosphere and compare them to those obtained from the current model. We hope that this investigation will lead to a more accurate determination of the BH mass in this HMXB.</p>		

ASI2021_59	Shashank Dattathri	Poster
Stellar Capture Rates in Galactic Nuclei Containing a Supermassive Binary Black Hole		
<p>We study the stellar capture rates in galactic nuclei containing a supermassive binary black hole with a primary supermassive black hole (SMBH), secondary SMBH, and field stars in a power-law cusp around the primary, representative of the late stages of a galaxy merger. The secondary black hole inspirals toward the center, at first due to dynamical friction, and later due to three-body effects. There is a short period of time during the binary evolution when the field stars exhibit angular momentum oscillations, that include the Lidov-Kozai mechanism, general relativistic effects, and stellar cusp precession. These oscillations can significantly increase the feeding into the loss cone. Our results show that the capture rate enters an enhanced phase with a peak of order 0.01/yr when the binary separation is about 0.1-1 pc, which is at least two orders of magnitude higher than isolated SMBH capture rates. The dependence of the peak rate and the enhanced</p>		

phase's duration on the mass of the primary SMBH, the mass ratio, and the power-law index of the stellar cusp are presented. Enhanced tidal disruption event (TDE) rates in galactic nuclei can be used as a method to identify minor mergers. Multiple TDEs originating in a nucleus observed during a survey, like the LSST, indicate the possibility of a binary black hole.

ASI2021_516	Smitha Subramanian	Poster
Probing assembly process of dwarf galaxies		
<p>According to Lambda cold dark matter model, galaxies grow in mass through hierarchical assembly of smaller systems. These interactions create tidal features (stellar and gaseous streams), trigger star formation activity and eventually build up the outskirts of their host galaxy. Theoretically this kind of assembly process is scale-free. Though the processes regulating star formation and the interstellar medium in pairs of interacting massive galaxies in the local universe have been studied extensively, similar studies to understand the impact of interactions between low mass, dwarf galaxies (stellar mass $\sim 5 \times 10^9$ solar mass) are very limited. The effect of interactions on the scales of dwarf galaxies can be best studied in low-density environments where the effects of nearby massive galaxies are minimal. In this context, to understand galaxy interactions and associated star formation on smaller scales, we study and compare the star formation properties of nearby interacting and isolated dwarf galaxies in low-density environments using UV data. Results from this study will be presented.</p>		

ASI2021_107	Snehasish Bhattacharjee	Poster
Do galactic bars depend on environment?: An information theoretic analysis of Galaxy Zoo 2		
<p>We use an information theoretic framework to analyze data from the Galaxy Zoo 2 project and study if there are any statistically significant correlations between the presence of bars in spiral galaxies and their environment. We measure the mutual information between the barredness of galaxies and their environments in a volume limited sample ($M_r \leq -21$) and compare it with the same in datasets where (i) the bar/unbar classifications are randomized and (ii) the spatial distribution of galaxies are shuffled on different length scales. We assess the statistical significance of the differences in the mutual information using a t-test and find that both randomization of morphological classifications and shuffling of spatial distribution do not alter the mutual information in a statistically significant way. The non-zero mutual information between barredness and environment arises due to the finite and discrete nature of the dataset which can be entirely explained by mock Poisson distributions. We also separately compare the cumulative distribution functions of the barred and unbarred galaxies as a function of their local density. Using a Kolmogorov-Smirnov test, we find that the null hypothesis can not be rejected even at 75% confidence level. Our analysis indicates that environments do not play a significant role in the formation of a bar, which is largely determined by the internal processes of the host galaxy.</p>		

ASI2021_149	Sriyasriti Acharya	Poster
Impact of Kelvin-Helmholtz instability on the non-thermal synthetic emission observed in magnetized jets		
<p>AGN jets exhibit multi-timescale variability and a broadband non-thermal spectrum extending from radio to gamma-rays. These jets remain stable up to large scales in spite of suffering multiple magneto-hydrodynamic instabilities during their propagation in space. The main focus of this work is to bridge the gaps in our understanding of the underlying physical processes responsible for the above emission signatures. To achieve this, we perform high-resolution 3D MHD simulations of plasma columns at kilo-parsec scales in the non-relativistic regime that are prone to the Kelvin-Helmholtz instability. We investigate the dynamical and emission properties of jet configurations with different magnetic field profiles, jet speeds, and density contrast. From our study, we find that in a configuration with a dominant axial magnetic field, the shocks produced due to KH instability can strongly affect the jet dynamics. The inclusion of a helical magnetic field hinders the vortex growth at the shear surface, thereby stabilizing the jet column. The high energy electrons accelerated in the vicinity of freshly formed shocks in the configurations with dominant axial magnetic field can possibly explain the origin of spectral hardening in the high energy band.</p>		

ASI2021_131	Suchetana Chatterjee	Poster
Halo Occupation Distribution of Quasars: Evolution with Redshift		
<p>Quasar clustering offers a great probe to understand structure formation in the high redshift Universe and provide us information on the co-evolution of quasars along with their host dark matter halos. One of the best tools to understand clustering of quasars and the quasar-halo connection happens to be a technique, known as the halo occupation distribution (HOD). The HOD formalism, when applied to quasars provide us a full knowledge of the host halo mass distribution of quasars over a range of redshifts. Currently, in most of the HOD studies of quasars, the HOD has been assumed to depend weakly on redshift, since there is a paucity of theoretical studies on the redshift evolution of the quasar HOD. In this work we perform the first study to understand the redshift evolution of the quasar HOD from a cosmological hydrodynamic simulation (MassiveBlack-II) and show that, given the current status of observations, the redshift evolution of the quasar HOD do not affect clustering studies or studies that involve stacking analysis of quasars.</p>		

ASI2021_297	Sundar M N	Poster
Nuclear environment of accreting supermassive blackholes in their host galaxies- a multi-frequency investigation		
<p>The supermassive black hole scaling relationships imply that there exists a strong connection between the accreting supermassive black hole at the centre of galaxy and its host galaxy through</p>		

feedback mechanisms. The feedback mechanisms are expected to leave their footprints in the nuclear regions of the host galaxies. In an attempt to understand the interaction between accretion, synchrotron emitting bipolar jets, star formation regions and extended gas regions in nuclear environments, we have carried out an investigation of about 130 nearby active galaxies (Siding Spring Southern Seyfert Spectroscopic Snap-Shot Survey (S7)) including IFU observations and multi-wavelength follow ups. We present our most recent results based on the multi-frequency data, including observations of a supermassive binary black hole precursor.

ASI2021_82	Sushant Dutta	Poster
Population of Remnant Radio Galaxies in Deep Radio Surveys		
<p>Remnant radio galaxies (RRGs) represent the last phase of radio galaxy life-cycle and is characterized by the “switch off” of AGN activity and the termination of jets supplying energetic plasma to the radio lobes. Despite the termination of jets, radio lobes can still be seen for a relatively short duration (10⁵ – 10⁶ years) before they disappear due to radiative losses. This makes RRGs short-lived and rare. Previous generation radio surveys have shown that the population of RRGs is even rarer than that predicted by evolutionary models. Recent deep low-frequency radio surveys are ideally suited to detect the population of RRGs because of the presence of steep spectral curvature in their integrated radio spectrum. In our work, we attempt to search for the population of RRGs using deep 325 MHz GMRT radio survey and auxiliary radio surveys. We find that the fraction of RRGs is much lower (~7%) than that predicted by radiative models, which in turn implies that the extended radio emission in lobes tends to fade quickly once AGN-jet activity switches off. In this presentation, I shall emphasize the need for deep multi-frequency radio surveys to constraint the fraction of RRGs and AGN duty-cycle.</p>		

ASI2021_111	Sushmita Agarwal	Poster
Study of gravitationally lensed Gamma-ray emitting Quasar PKS 1830-211		
<p>PKS 1830-211 is a known gamma ray emitting quasar at redshift $z=2.507$. The source is gravitationally lensed by a lensing galaxy at $z=0.89$ and has been detected at High energy and Very High energy by FERMI-LAT and H.E.S.S.. Observations in Optical and radio passband shows two compact images on a diffuse Einstein Ring. The two images are expected to have a lag of 20-27 days and a magnification ration of 1.5. Data from FERMI-LAT is analyzed to better understand the High energy emission from such gravitationally lensed extragalactic objects.</p>		

ASI2021_296	SUSMITA DAS	Poster
Short-Timescale Variability of the Blazar Mrk 421 from AstroSat and Simultaneous Multi-Wavelength Observations		

We study the multi-wavelength variability of the blazar Mrk 421 at minutes to days timescales using simultaneous data at gamma-rays from Fermi, 0.7-20 keV energies from AstroSat, and optical and near-infrared (NIR) wavelengths from ground-based observatories. We compute the shortest variability timescales to be approximately 1.1 ks at the hard X-ray energies and increasingly longer at soft X-rays, optical and NIR wavelengths as well as at the GeV energies. We estimate the value of the magnetic field to be 1.3 Gauss and the Lorentz factor of the emitting electrons to be approximately 100,000 assuming that synchrotron radiation cooling drives the shortest variability timescale. Blazars vary at a large range of timescales often from minutes to years. These results as obtained here from the very short end of the range of variability timescales of blazars are a confirmation of the leptonic scenario and in particular the synchrotron origin of the X-ray emission from Mrk 421. This particular mode of confirmation has been possible using minutes to days timescale variability data obtained from AstroSat and simultaneous multi-wavelength observations.

ASI2021_533	Swathi B	Poster
Construction of UV source catalogue using UVIT observations		
<p>The field of observational astronomy in the ultraviolet (UV) band got a massive boost after the launch of the UV Imaging Telescope (UVIT) onboard AstroSat. UVIT observes the universe in both near-UV (NUV) and far-UV (FUV) bands with different filters. With almost three times better resolution than its predecessor Galaxy Evolution Explorer (GALEX), UVIT is expected to discover many more new sources, and it also provides an excellent platform to carry out detailed studies of extended sources. Here, we will present the detailed methodology of the construction of the UV source catalogue utilising available UVIT data. We will also present the preliminary UV source list constructed for a few UVIT fields.</p>		

ASI2021_275	Tek Prasad Adhikari	Poster
Multiphase medium in the centre of Centaurus A		
<p>We investigate the multiphase medium in the vicinity of the active galactic nucleus Centaurus A (Cen A) by using combined high-resolution observations with the Atacama Large Millimeter/submillimeter Array (ALMA) and Chandra X-ray Observatory. Our study indicates that the hot X-ray emitting plasma coexists with the warm and cold media in Cen A. We utilize the images from the two instruments covering the nuclear region (diameter of 10 arcsec, i.e. ~ 180 pc) to study the conditions for plasma thermal equilibrium and possible coexistence of cool clouds embedded within the hot gas. We show that the multiphase medium originates naturally by the thermal instability induced due to the interaction of the radiation field from the center with the ambient gas and dust. We demonstrate that cold gas clouds can coexist in the mutual contact with hot plasma, but even colder dusty molecular clouds have to be distanced by several hundred pc from the central hot region. We propose a 3D model of the appearance of the hot plasma and the CO line-emitting</p>		

regions consistent with the Chandra image, and we derive the emissivity in specific molecular lines observed by ALMA from this model. To reproduce the observed images and the CO line luminosity the dusty shell has to be ~ 420 pc thick and located at ~ 1000 pc from the centre.

ASI2021_497	Ujjwal Krishnan	Poster
UVIT view of secular evolution in NGC 628		
<p>Recent star formation activity sheds light on the formation and evolution of galaxies in the local Universe. Secular and environmental effects play a significant role in regulating the star formation rate and hence the evolution of the galaxies. Since, the UV flux is a direct indicator of the star formation in galaxies, the UltraViolet Imaging Telescope (UVIT) onboard ASTROSAT enables us to characterize the star-forming knots in the galaxy (within angular scales less than $1.5''$). In this study, we are focusing on the secular evolution of NGC 628, a well-studied galaxy in the local universe. Recent studies suggest that the propagation of star formation across the galaxy varies from region to region which is directly correlated with the evolution of the galaxy. The star formation in NGC 628 follows different trends in the disk, bulge, and spiral arms of the galaxy. Star-forming regions in the UV images are characterized and their properties are correlated with the relative distribution and the properties of the galaxy. The headlight cloud present in the disk of the galaxy attained important recognition in recent researches. The headlight cloud is also studied using UVIT and the properties are explained.</p>		

Posters in
General Relativity and Cosmology

ASI2021_361	Aadarsh Pathak	Poster
Using the largest cluster statistics on 21 cm maps to constrain reionization models		
<p>The topological distribution of the ionized and neutral regions during different stages of the Epoch of Reionization (EoR) can provide us a great wealth of information about the properties of the ionizing sources during this era. In this project, we have used an algorithm, SURFGEN2 on a suite of simulated 21-cm maps from the EoR to characterize the evolution of the shape and size of the largest ionized region in these maps. This specific method of characterizing any field is known as tracing the Largest Cluster Statistics (LCS). We perform a comparative study of the LCS of ionized regions for seven different simulated reionization scenarios. Our study reveals that the shape of the LCS of ionized regions and hence their topology varies significantly in all seven cases. Particularly the global neutral fraction at which percolation between all ionized regions occur is different for different reionization scenarios. Further, we find that LCS of ionized regions is a robust statistic that can differentiate between the fundamentally inside-out and outside-in reionization scenarios. The neutral fractions at which the percolation takes place for inside-out and outside-in reionization varies considerably from each other. We also find that the largest ionized region is mostly filamentary in nature for all reionization scenarios, especially after the instant when different ionized regions merge together to become a single inter-connected ionized region. Further, as a part of this project we would like to study the impact of cosmic variance, system noise and residual foregrounds in the 21-cm maps on our inferences drawn from LCS of ionized regions. We would also like to explore whether LCS can be used to put constraints on reionization history via the future SKA observations of the EoR.</p>		

ASI2021_264	Anirban Chowdhary	Poster
Direct Measurement of Mean Occupation Function of Quasars		
<p>According to the current model of AGN unification, obscured and unobscured quasars are believed to be part of the same population, while only having a different orientation with the line-of-sight of the observer. According to this simple orientation-based unification model, clustering properties of obscured and unobscured quasars are likely to be similar, being independent of their large scale environments. In this work we use the Halo Occupation Distribution (HOD) formalism to calculate the mean number of quasars as a function of the halo mass for both obscured and unobscured populations. In this technique, we cross-correlate quasar and cluster catalogs and directly calculate the moments of the quasar HOD. A simple power law fit to our observed mean occupation function (first moment of the HOD) hints toward a deeper picture of AGN unification.</p>		

ASI2021_95	Ashu Kushwaha	Poster
Helical magnetic fields from Riemann coupling		
<p>We study the inflationary generation of helical magnetic fields from the Riemann coupling with the electromagnetic field. Most models in the literature introduce nonminimal coupling to the electromagnetic fields with a scalar field, hence, breaking the conformal invariance. In this work, we show that nonminimal coupling to the Riemann tensor generates sufficient primordial helical magnetic fields at all observable scales. We explicitly show that one of the helical states decays while the other helical mode increases, leading to a net nonzero helicity. Our model has three key features: (i) the helical power spectrum has a slight red tilt for slow-roll inflation consistent with bounds from observations and free from backreaction problem, (ii) the energy density of the helical fields generated is at least one order of magnitude larger than the scalar-field-coupled models, and (iii) unlike the scalar-field-coupled models, the generated helical fields are insensitive to the reheating dynamics. We show that our model generates the magnetic field of strength 0.01 pG over the Mpc scale.</p>		

ASI2021_63	Barun Maity	Poster
Inclusion of inhomogeneous recombination and feedback in SCRIPT		
<p>One of the least understood phases in the Universe is the epoch of reionization (EoR) when the hydrogen (mainly) in the Universe got ionized by ultra-violet radiation from first stars. In spite of having a wealth of observational data at different wavelengths from different telescopes, there is no clear understanding of the physical processes that were relevant in this epoch. The precise extent of this phase is still unknown. This regime can be tracked via redshifted 21 cm signal coming from neutral hydrogen atoms. In general there are two possible ways to model the 21 cm signal i.e using the full radiative simulations and using semi-analytical/semi-numerical techniques. The second method includes some physically motivated assumptions/approximations but computationally less expensive than the full radiative simulations and hence is useful for probing the unknown parameter space. The most popular technique for computing the 21 cm signal using the semi-analytical method is based on excursion sets. These models, however, do not conserve the number of ionizing photons which result in non-converging power spectrum with respect to the resolution of the simulation. More recently, these difficulties have been solved in an explicitly photon-conserving semi-numerical model which is named as SCRIPT (Semi Numerical Code for Reionization with PhoTon Conservation (Choudhury & Paranjape, 2018). The present implementation of SCRIPT does not include physical processes like the inhomogeneous recombination and radiative feedback. These effects can play important roles in deciding the reionization history. In this work, we incorporate these two effects in SCRIPT and study the consequences. This allows us to obtain constraints on reionization in the presence of the two effects.</p>		

ASI2021_377	Chandra Shekhar Murmu	Poster
Towards quantifying the Light-cone effect for EoR CII Line Intensity Mapping experiments		
<p>One of the major goals of modern cosmology is to probe and understand the Cosmic Dawn and Epoch of Reionization (CD-EoR). Various proposed techniques to do so includes probing the neutral hydrogen (HI) of early intergalactic medium (IGM) via 21 cm signal, and probing the early galaxies from EoR through a technique called Line Intensity Mapping (LIM). The CII line is one of the best tracers of early galaxies and many LIM experiments (e.g. CONCERTO) will probe the EoR via observation of the CII line. The properties of the signal obtained, will vary with the observed frequency (across the line of sight), which is otherwise known as the light-cone effect. One of the major goals of this proposed work is to quantify this light-cone effect with respect to various statistics, e.g. the power-spectrum, for future CII LIM experiments. Choosing an optimal bandwidth for estimating the target statistics from LIM experiments is crucial in order to minimize the effect of light-cone on the target signal statistics. Accurate simulations of light-cone boxes from CII maps is thus an indispensable tool to put constraints on the chosen bandwidth. Other quantities of interest relevant to CII LIM are the 21 cm-CII cross-correlations. We plan to analyse the light-cone effect on these cross-correlation studies as well in a similar fashion.</p>		

ASI2021_401	Darshan Singh	Poster
Cosmological Analysis of Long Gamma Ray Bursts using calibrated $E_{p,i}$ -Eiso correlation.		
<p>Gamma Ray Bursts (GRBs) are powerful astronomical transient events; the high luminosity in the prompt emission makes them detectable up to very high redshift. Thus, GRBs can provide vital information about the high redshift universe. Correlations among various GRB parameters are required to calibrate the GRBs for cosmological applications. Amati relation is one such correlation between the isotropic equivalent energy (Eiso) and the peak energy (E_{Peak}) of Long GRBs. Since GRBs span a long range of redshifts, it is important to know if the GRB properties and the Amati relation depend on the redshift. The Eiso and E_{Peak} of 162 Long GRBs are available in the literature. We calculate the Amati parameters for the data and further divide the data into different redshift bins. Our results show that the Amati parameters and hence the properties of Long GRBs evolve with redshift.</p>		

ASI2021_229	Farrukh Chishtie	Poster
Fourier Transform of Continuous Gravitational Wave Signal from a Pulsar		
<p>Gravitational Wave (GW) detection from pulsars is an anticipated discovery, however, given the exceedingly weak signals, detection is quite challenging. To address some of these challenges, in this talk, I present a recent derivation of the Fourier transform of continuous gravitational wave signal with easy to implement algorithm for computing peak heights and locations arising from features in frequency evolution of gravitational wave signal. Though our main aim was application of our approach to gravitational wave signals, the results and the analysis presented here can be applied to any signals of this form.</p>		

ASI2021_200	Haveesh Singirikonda	Poster
Model comparison of LambdaCDM vs $R_h=ct$ using cosmic chronometers		
<p>In 2012, Bilicki and Seikel (Mon Not R Astron Soc 425:1664, 2012) showed that $H(z)$ data reconstructed using Gaussian Process Regression from cosmic chronometers and baryon acoustic oscillations, conclusively rules out the $R_h=ct$ model. These results were disputed by Melia and collaborators in two different works (Melia and Maier in Mon Not R Astron Soc 432:2669, 2013; Melia and Yennapureddy in JCAP 2018:034, 2018), who showed using both an unbinned analysis and Gaussian Process reconstructed $H(z)$ data from chronometers, that $R_h=ct$ is favored over LambdaCDM model. To resolve this imbroglio, we carry out model comparison of LambdaCDM versus $R_h=ct$ by independently reproducing the above claims using the latest chronometer data. We perform model selection between these two models using Bayesian model comparison. We find that no one model between LambdaCDM and $R_h=ct$ is decisively favored when uniform priors on LambdaCDM parameters are used. However, if we use priors centered around the Planck best-fit values, then LambdaCDM is very strongly preferred over $R_h=ct$.</p>		

ASI2021_220	Janakee Raste	Poster
Implications of the $z \sim 5$ Lya forest for the EoR 21-cm power spectrum		
<p>Most ongoing experiments targetting the fluctuating 21-cm cosmological signal aim to look for the signal at redshifts well above 6. This strategy is motivated by the traditional assumption that reionization ends at $z > 6$. However, recent constraints from Lyman-alpha and CMB data prefer a significantly delayed reionization scenario in which reionization is 50% complete at redshifts as low as $z \sim 7$. In these models, reionization ends at $z \sim 5$, with large 100 Mpc "islands" of cold, neutral hydrogen persisting in the IGM well below $z = 6$. We study the effect of these neutral hydrogen islands on the 21-cm power spectrum by analysing outputs of a state-of-the-art radiative transfer simulation of the IGM calibrated to the CMB and Lyman-alpha forest data. We calculate the 1D and cylindrical 2D power spectra of the 21-cm signal from this simulations and compare them with a more traditional reionization model in which reionization is completed by $z = 6$. Contrary to previous models, we find that thanks to the late end of reionization the 21-cm power continues at be high ($\sim 1 \text{ mK}^2$) at $k \sim 0.1 \text{ h/cMpc}$ at $z = 5-6$. At $z = 5.5$, for example, the power spectrum can be two orders of magnitude higher than the traditional models. This enhanced 21-cm power spectrum signal should be easily detectable by HERA and SKA1-LOW for reasonable integration times, assuming optimistic foreground subtraction. We argue that the redshift range $z = 5-6$ is very attractive for 21-cm experiments due to easier thermal noise characteristics and synergies with abundant multi-wavelength observations.</p>		

ASI2021_268	JOSEPH P J	Poster
Cosmological perturbations in the interacting dark sector: Mapping fields and fluids		
<p>I will discuss the dark energy - dark matter interaction in the late universe. Demanding that the interaction strength in the dark sector must have a field theory description, we obtain a unique form of interaction strength. I will show the equivalence between the fields and fluids for the $f(R, \chi)$ model where f is an arbitrary, smooth function of R and the scalar field χ, which represents dark matter. Up to first order in perturbations, we show that the one-to-one mapping between the field theory description and the phenomenological fluid description of interacting dark energy and dark matter exists only for this unique form of interaction. Then I will discuss the background evolution of the universe with interacting dark sector including the stability analysis of the background solutions. (arXiv:2006.04618, submitted to Phys. Rev. D.)</p>		

ASI2021_477	Kanhaiya Pandey	Poster
Constraints on primordial curvature perturbations using LIGO O2 data		
<p>Primordial density perturbations generate a stochastic background of gravitational waves through non-linear mode couplings upon their horizon reentry. For primordial perturbations in the range of comoving wavenumbers 10^{16}–10^{18} Mpc^{-1}, the stochastic gravitational wave background falls within the LIGO detectors' sensitivity band. In this presentation I'll talk about the results of a search for such a stochastic GW background in the data of the two LIGO detectors during their second observing run (O2). In this work we assume a lognormal shape for the power spectrum and Gaussian statistics for the primordial perturbations, and vary the width of the power spectrum to cover both narrow and broad spectra. As a result of this analysis we derive upper limits (95% cl) on the amplitude of the primordial power spectrum for the aforementioned wavenumber range as ~ 0.01–0.1. Also as a byproduct, we are able to infer upper limits on the abundance of the ultralight primordial black holes ($M_{\text{PBH}} \simeq 10^{-20}$–$10^{-19}$ solar mass) at the time of their formation to be $\lesssim 10^{-25}$. If Hawking evaporation is discarded, this can be translated to constraints on the fraction of dark matter today in the form of such ultralight primordial black holes, which can be as stringent as $\sim 10^{-15}$–10^{-5}.</p>		

ASI2021_489	Kazuyuki Furuuchi	Poster
Large-Field Inflation Models from Dimensional Deconstruction		
<p>I will discuss new large-field inflation models based on deconstructed extra dimensions. A crucial ingredient in our model is the field range enhancement by the number of lattice points which enables large-field inflation. Some explicit models are compared with the CMB observations. References [1] K. Furuuchi, S. S. Naik and N. J. Jobu, "Large Field Excursions from Dimensional (De)construction," JCAP 06 (2020) 054. [2] K. Furuuchi, N. J. Jobu and S. S. Naik, "Extra-Natural Inflation (De)constructed," [arXiv:2004.13755 [hep-th]].</p>		

ASI2021_144	Kiren OV	Poster
Dark matter primordial planets: Effects of baryonic admixture		
<p>Dark matter (DM) is theorized as one of the basic constituents of the Universe, five times more abundant than ordinary matter. Several astronomical measurements have confirmed the existence of DM, leading to experiments worldwide to observe them directly. The interaction of these particles with the ordinary matter has proven so weak that they have escaped direct detection. In our earlier work we had discussed the possibility of primordial planets composed entirely of DM to be the main reason for not detecting DM particles. These DM particles are heavier compared to ambient hydrogen and helium atoms and are accreted much earlier since they are not coupled to background radiation. It has been suggested that primordial planets could have formed in the early Universe and the missing baryons in the Universe could be explained by primordial free-floating planets of solid hydrogen. The number of such planets in the Milky Way is enormous ($\sim 10^{14}$). Many such planets were recently discovered around the old and metal poor stars and such planets could have formed at early epochs. Another possibility of missing baryons in the Universe could be that these baryons are admixed with DM particles inside the primordial planets. Here we discuss the possibility of admixture of baryons to the DM primordial planets discusses earlier. We consider gravitationally bound DM objects with the DM particles constituting them varying in mass from 20-100GeV. Different compositions of DM particles mixed with baryonic matter in forming the primordial planets are discussed. For the different mass range of DM particles forming DM planets, we have estimated the radius and density of these planets with different compositions of DM and baryonic particles. It is found that for heavier mass DM particles with the admixture of baryonic particles, the mass of the planet increases and can reach Jupiter mass.</p>		

ASI2021_130	Louise Rebecca	Poster
Modification of Newtonian Gravity: An extension to Galaxy Clusters		
<p>The presence of dark matter, though well established by indirect evidences is yet to be observed directly. Various dark matter detection experiments running for several years have yielded no positive results so far. In view of these negative results, we had proposed alternate models by postulating a minimum field strength (minimum curvature) and also minimum acceleration avoiding the introduction of DM and an ad hoc fundamental acceleration (to account for DM), since it naturally follows from the minimal acceleration. These postulates lead to the modified Newtonian dynamics and modified Newtonian gravity. The observed flat rotation curves of galaxies were accounted for through these postulates. Here we extend these postulates to galaxy clusters and model out the dynamical velocity-distance of such large-scale structures. These curves are found to consist of three regions. The region close to the center of the galaxy cluster, where the matter density dominates and is uniform giving a linear increase in velocity with distance. For regions away from the centre, as the matter density falls off with distance and the gravitational self-energy term</p>		

dominates which gives a velocity that is independent of distance implying a flat region in the rotation curve (which is usually attributed to the presence of vast amounts of dark matter (DM)). As dark energy begins to dominate, the velocity is found to increase linearly with distance. In the case of the Virgo cluster, the dark energy is found to dominate from a distance of 20 Mpc from the centre. At this distance, the curve shifts from flat to linear. This is found to be consistent with observations. Our model is in complete agreement with observations, for instance, the plot obtained for Virgo cluster matches with that observed.

ASI2021_486	Madhurima Choudhury	Poster
Extracting the 21cm signal using artificial neural networks		
<p>The redshifted 21-cm signal of neutral Hydrogen is a promising probe into the period of evolution of our Universe when the first stars were formed (Cosmic Dawn), to the period where the entire Universe changed its state from being completely neutral to completely ionized (Reionization). The most striking feature of this line of neutral Hydrogen is that it can be observed across an entire frequency range as a sky-averaged continuous signature, or its fluctuations can be measured using an interferometer. However, the 21-cm signal is very faint and is dominated by a much brighter Galactic and extra-galactic foregrounds, making it an observational challenge. We have used different physical models to simulate various realizations of the 21-cm Global signals, including an excess radio background to mimic the amplitude of the EDGES 21-cm signal. First, we have used an artificial neural network (ANN) to extract the astrophysical parameters from these simulated datasets. Then, mock observations were generated by adding a physically motivated foreground model and an ANN was used to extract the astrophysical parameters from such data. The R2 score of our predictions from the mock-observations is in the range of 0.65-0.89. We have used this ANN to predict the signal parameters giving the total observed sky temperature of the EDGES detection, as the input. We find that the reconstructed signal closely mimics the amplitude of the reported detection. The recovered parameters can be used to infer the physical state of the gas at high redshifts. We also present some constraints on the astrophysical parameters from simulated 21-cm PS experiments.</p>		

ASI2021_94	Mukesh Kumar Singh	Poster
Improved inference of binary-black-hole population models using higher modes of gravitational radiation		
<p>Gravitational waves (GWs) provide a unique opportunity to probe the populations of binary black-holes and their formation channels. Constraining models of these populations relies on the accurate and precise inference of parameters of individual binary black holes (BBHs), such as their masses and luminosity distances. To that end, the inclusion of higher modes of GWs, in addition to the dominant mode routinely used in BBH parameter-estimation, are expected to reduce the bias of</p>		

inferred parameters, especially for asymmetric mass systems with inclined orbits. Focusing on realistic parametrized populations of non-spinning BBHs, we show that, while a large fraction of the individual BBHs has parameter-biases that are relatively small when inferred using only the dominant-mode waveforms, the resulting bias on the BBH population model-parameters can be significant, thus advocating the use of subdominant modes for model-parameter inference.

ASI2021_141	Ranbir Sharma	Poster
Reconstruction of Late-time cosmology from Principal Component Analysis		
<p>We employ the technique of Principal Component Analysis(PCA) for the reconstruction of late-time cosmology. Two different approaches are adopted in the present work to reconstruct the equation of state parameter. The first one is the derived-approach where we reconstruct the Hubble parameter as well as distance modulus as a function of redshift, from the data sets using PCA analysis and subsequently, reconstruct the allowed equation of state parameter of dark energy. In the direct-approach, we reconstruct the dark energy equation of state parameter directly from the data sets without any intermediate reconstruction. We show that a combination of PCA algorithm and calculation of correlation coefficients can be used as a reconstruction and selection tool, which also gives us the best reconstruction variable. The derived approach is found to be statistically preferred over the direct approach. We carried out the analysis with both simulated and real data sets of Hubble parameter measurements and distance modulus measurements of type Ia supernova. The reconstructed equation of state indicates a time-evolving nature of dark energy.</p>		

ASI2021_336	Shantanu Desai	Poster
Shapiro Delay of photons, neutrinos, and gravitational waves		
<p>In 1964 Irwin Shapiro pointed out that the speed of any cosmic messenger depends on the gravitational potential along the line of sight. This effect is known in the community as "Shapiro delay", and has been measured in both solar system and binary pulsars, and widely used for astrophysical measurements as well as tests of GR. Here, we shall discuss the line of sight cumulative Shapiro delay experienced by any cosmic messenger (photon, neutrinos, gravitational wave) as it reaches the Earth from a distant source. We shall point out constraints on fundamental Physics and modified theories of gravity from this light of sight Shapiro delay from multimessenger observations, such as GW170817 and IceCube-170922A.</p>		

ASI2021_135	Shashikant Gupta	Poster
Does Hubble Tension Really Exist?		
<p>The Hubble constant (H_0) is one of the most important cosmological parameters as it represents the expansion rate and sets the age of the Universe. The recent measurements of H_0 using the distance ladder methods such as Type Ia Supernovae (SNe Ia) are significantly higher than the CMB measurements by Planck. The difference indicates a crisis in cosmology termed as Hubble tension. We present a review of the problem and analyze different data sets to test if the Hubble tension is real. We compare H_0 measurements from various data sets including different calibration schemes of SNe Ia and analyze the BAO data using the Bayesian approach. Our analysis suggests that the Tension between different data sets is real however, the difference is smaller than 3σ.</p>		

ASI2021_354	Shreejit Jadhav	Poster
Improving significance of binary black hole mergers in Advanced LIGO data using deep learning : Confirmation of GW151216		
<p>We present a novel Machine Learning (ML) based strategy to search for compact binary coalescences (CBCs) in data from ground-based gravitational-wave (GW) observatories. This is the first ML-based search that not only recovers all the binary black hole mergers in the first GW transients catalogue (GWTC-1), but also makes a clean detection of GW151216, which was not significant enough to be included in the catalogue. Moreover, we achieve this by only adding a new coincident ranking statistic (MLStat) to a standard analysis that was used for GWTC-1. In CBC searches, reducing contamination by terrestrial and instrumental transients, which create a loud noise background by triggering numerous false alarms, is crucial to improving the sensitivity for detecting true events. The sheer volume of data and a large number of expected detections also prompts the use of ML techniques. We perform transfer learning to train 'InceptionV3', a pre-trained deep neural network, along with curriculum learning to distinguish GW signals from noisy events by analysing their continuous wavelet transform (CWT) maps. MLStat incorporates information from this ML classifier into the standard coincident search likelihood used by the conventional search. This leads to at least an order of magnitude improvement in the inverse false-alarm-rate (IFAR) for the previously 'low significance' events GW151012, GW170729 and GW151216. We also perform the parameter estimation of GW151216 using SEOBNRV4HM_ROM. Considering the impressive ability of the statistic to distinguish signals from glitches, the list of marginal events from MLStat could be quite reliable for astrophysical population studies and further follow-up. This work demonstrates the immense potential and readiness of MLStat for finding new sources in current data and the possibility of its adaptation in similar searches.</p>		

ASI2021_295	Soumyadip Basak	Poster
Constraining The Fraction of Compact Dark Matter Using Gravitational Lensing of Gravitational Waves		
<p>Massive halo compact astrophysical objects (MACHOs) are a potential candidate of dark matter, the presence of which in the interstellar medium can cause deflection of gravitational waves (GWs), a phenomenon called gravitational lensing. If we do not find any lensing signature in the LIGO-Virgo data of gravitational waves, then we can put an upper cut-off on their abundance in a certain mass range (10-10^5 solar mass). We use Bayesian analysis which helps us determine the lensing signature of GWs and the absence of which helps us constrain the upper limit of the MACHOs.</p>		

ASI2021_197	Sourabh Nampalliwar	Poster
Black holes shining light on theories of gravity		
<p>Einstein's theory of gravity, known as the theory of general relativity, is the leading framework for describing gravitational phenomena at present. The theory, since its proposition in 1915, has gone through a plethora of tests and emerged as the theory most suitable for our universe. While successes abound, some features and implications of general relativity, both on the theoretical and the observational front, lead to questions on its suitability as the ultimate theory of gravity. This has led to many extensions and modifications to general relativity, and testing the predictions of these theories is the new frontier in both astronomy and theoretical physics. Historically, a majority of tests of general relativity had been performed in the so-called weak-field regime. But recently, tests in the strong-field regime have become possible and black holes are at the forefront of this effort owing to their compact size, simplicity within general relativity, and ubiquity in the universe. To perform these tests, various experimental techniques are used, leading among which are gravitational wave astronomy, x-ray spectroscopy, and black hole imaging. I make computational models to perform tests of gravity using these techniques, and examine the validity of alternative theories with observed and simulated data. In this talk, I will present the latest results on theory-independent constraints on deviations from black holes of general relativity obtained with the current instruments, like LIGO, NuSTAR, and EHT, and give an outlook on the improvement expected with future instruments, like LISA, eXTP, and Athena.</p>		

ASI2021_57	Suvedha Naik	Poster
Particle productions in large field inflation models based on dimensional (de)construction and observational imprints		
<p>We propose inflation models based on the dimensional (de)construction of massive gauge theory. "Zero mode" of a component of the gauge field in (de)constructed extra dimension is identified as inflaton in this model. In the low energy effective theory, the field range of the inflaton was</p>		

enhanced by a factor $Nd/2$, where N is the number of lattice points in each (de)constructed extra dimension and d is the total number of extra dimensions, achieving trans-planckian inflaton field excursion. The burst of particle productions in these models may result in features in primordial density perturbations, which we constrain using the latest CMB data. References: 1. Furuuchi, K. (2016). Excursions through KK modes. JCAP, 1607(07):008. 2. Furuuchi, K., Naik, S. S., and Jobu, N. J. (2020a). Large Field Excursions from Dimensional (De)construction. JCAP, 06:054. 3. Furuuchi, K., Jobu, N. J., and Naik, S. S. (2020b). “Extra-Natural Inflation (De)constructed,” [arXiv:2004.13755 [hep-th]].

ASI2021_478	TEJINDER SINGH	Poster
Dark energy as a large scale quantum gravitational phenomenon		
We make the case that dark energy is not a classical source, but rather the non-classical, quantum gravitational state of extremely light particles with wavelength of the order of Hubble radius. The presence of such particles is motivated by the holographic principle, which shows that the number of fundamental degrees of freedom in the universe far exceeds the number inferred from visible and dark matter. The energy associated with these Hubble scale particles effectively amounts to the source being a cosmological constant consistent with the observed value. Reference: Modern Physics Letters A35, 2050195 (2020) arXiv:1911.02955 [gr-qc]		

ASI2021_81	Vladimir Dergachev	Poster
Results from all-sky searches for continuous waves		
Continuous waves from non-axisymmetric neutron stars are orders of magnitude weaker than transient events from black hole and neutron star collisions. As continuous waves from galactic sources are expected to persist across an observing run the searches are carried out by integrating months of collected data. This greatly increases sensitivity, with a corresponding increase in analysis complexity. Loosely coherent searches are designed to cover large parameter spaces, trading off potential sensitivity of a single-target search for greater chance of detection. We will present results of all-sky search for neutron stars and other sources carried out by Falcon pipeline utilizing loosely coherent algorithms.		

Posters in
Instrumentation and Techniques

ASI2021_509	Abhay Kumar	Poster
Exploring Sub-MeV Sensitivity of AstroSat-CZTI for ON-axis bright sources		
<p>The Cadmium Zinc Telluride Imager (CZTI) onboard AstroSat is primarily designed for imaging and spectroscopy in the energy range of 20-150 keV. The 5 mm thick CZT detector provides sufficient Compton scattering probability above 100 keV. The Compton energy response of the CZTI can be used for spectroscopy up to 380 keV. Further, it has been observed that about 20% pixels of the CZTI detector plane have low gain, and they are excluded from the primary spectroscopy. With the inclusion of the low gain pixels, the single event and 2-pixel Compton event spectroscopic capability of CZTI can be extended up to 500 keV and further upto 700 keV with better gain calibration. Here we explore the methodology of single and Compton spectroscopy and shows the present calibration status of the CZTI using Crab observations to enhance the spectroscopic sensitivity of CZTI up to the sub-MeV region.</p>		

ASI2021_428	Bharat Chandra	Poster
Low-Cost RPi Star Sensor for Small Space Missions		
<p>A star sensor onboard a satellite determines the orientation of the satellite in space. It provides very accurate orientation information compared to a sun-sensor or a magnetometer, but star sensors are too expensive and some times bulky for use in small satellite missions. In this poster, we will discuss the development of a low-cost star sensor using Raspberry Pi and COTS components for small satellite missions. Also, we will describe the geometric voting algorithm implemented in our star sensor. Our star sensor will be launched on a PSLV stage 4 platform to a low Earth orbit(LEO), where its in-flight performance will be measured.</p>		

ASI2021_508	Binukumar Gopalakrishnan	Poster
Structural and thermal analysis of SING		
<p>The Spectroscopic Investigation of Nebular Gas (SING) is a Near Ultraviolet (NUV) (1400-2700Å) imaging spectrograph being designed and developed at the Indian Institute of Astrophysics (IIA). SING was selected by the United Nations Office for Outer Space Affairs (UNOOSA) under an announcement of opportunity to fly scientific payloads onboard the upcoming Chinese Space Station (CSS). Opto-mechanical design, optimization and tolerancing of the SING have been completed. Designs of payload adapter assemblies and robotic arm interface are in progress; stringent volume considerations restrict the optomechanical design of various subsystems. In this work, we present the finite element analysis and thermal modelling of the SING payload and its interfacing units.</p>		

ASI2021_569	Debangana Sarkar	Poster
Real-time Weather Monitoring Software for MACE Gamma ray Telescope		
<p>Major Atmospheric Cerenkov Experiment (MACE) is a ground based gamma ray telescope setup at Hanle, Ladakh India. The telescope consists of various subsystems like Telescope Control Unit, Active Mirror Alignment System, Camera Electronics and Signal Processing System, MACE Operator Console, Weather Monitoring System (WMS), Sky Monitoring System etc. WMS comprises of Weather Station data logger which gives the details of the weather conditions at the observational site. WMS provides parameters which are used as an interlock for telescope operation. The major challenge was to integrate the WMS hardware components with MACE Operator Console and monitoring of the weather data parameters like temperature, humidity, wind speed etc, in real time. WMS Server software was designed and implemented to interact with the WMS hardware components and MACE OC. MACE OC sends commands for retrieving weather information and weather interlocks are checked before proceeding with observation. WMS Server Software sends weather data at 1min interval to MACE OC for continuous monitoring of the weather conditions. For real time monitoring of the weather data, GUI based Real-Time Data Analyzer is developed using QT. The data analyzer represents weather parameter visualization, calculates hourly average weather parameter variations of parameters. The Data Analyzer stores the data in SQL database for future data analysis. It provides a feature for populating the databases which is used to generate yearly and monthly minimum, maximum and average values of different weather parameters. The Server software and Data Analyzer are installed at telescope site and operational. In this paper we shall present the software design and implementation of the WMS Server software and QT based Real time weather data analyzer.</p>		

ASI2021_253	Dimple Panchal	Poster
Characterisation of the 4k x 4k CCD camera		
<p>We perform a detailed characterisation of the 4K x 4K CCD camera developed for the ADFOSC backend instrument on the 3.6m DOT. The performance of the CCD is characterised in the ARIES laboratory and based on the experiments different parameters were tuned to obtain the optimum performance for both single and four-port readout modes in different gain settings. We also perform sky tests to test the optimum performance obtained in the lab. The CCD has a linear response up to saturation and has an optimum gain setting of 1. Also, the CCD camera acts as a nominal grade-0 CCD below -110 deg C. Bias level is quite stable. Dark current is negligible below 115 deg C for long integration times.</p>		

ASI2021_395	Divita Saraogi	Poster
CZTI polarisation study of GRB180427A and GRB180806A		
<p>Polarimetric studies of the prompt emission of gamma ray bursts (GRB) in the Gamma ray and X-ray band are highly prized for testing and constraining various theoretical models of GRBs. Polarization studies are difficult owing to the diversity, variability and brevity of these events as well as the photon hungry nature of the field of high energy polarimetry. As a result, studies carried out in hard X-ray bands till date are inadequate to constrain these models. The CZTI instrument onboard AstroSat is an instrument designed mainly for spectroscopic study of astronomical objects in energy band 20keV to 200keV. The 5mm thick pixelated CZT detectors in this instrument lead to a high probability of Compton scattering and detection of the scattered photon: enabling us to use CZTI as a Compton polarimeter in energy range 100–300keV. The Polarization measurements can be made by measuring azimuthal distribution of simultaneous events in two adjacent pixels. Polarization measurements of several GRBs by CZTI have been reported in literature. Here, we discuss the detailed polarization analysis for two new bursts: GRB180427A and GRB180806A. We find that the bursts do not show any statistically significant polarization, and discuss the implications of this result.</p>		

ASI2021_570	DVS Phanindra	Poster
Design and Development of a dsPIC-based Versatile Controller Card		
<p>A controller card based on Microchip's dsPIC33FJ128MC802 microcontroller was designed and developed, which extensively utilises the dsPIC's features. The dsPIC has a 16-bit architecture with 128KB program memory and 16MB SRAM. One of the features of the dsPIC, which adds versatility to our controller card is its Programmable Peripheral Select (PPS) feature. The card can provide pulses to two stepper motor drivers via its two MOTOR ports and simultaneously read two encoders via its two ENCODER ports. Although the board is designed to work with a stepper-motor driver, it can be programmed to control DC motors by designing an add-on card. With the microcontroller's PPS feature, this card can interface with Quadrature and SSI encoders from the same ENCODER port with a minor change in the firmware -adding to the card's versatility. It is capable of transferring data and receiving commands from the PC via RS232 port. It is also capable of controlling 16 slave cards through its RS485 port. Each of these slave boards can be programmed with a hardware address from the onboard 4-bit DIP switch. Other features, provided with PPS in multiplexed mode include 10-bit, 1.1 MSPS or 12-bit 500 MSPS ADC on four channels, PWM, three external interrupts, two SPI and I2C interfaces, LEDs for status indication, with most peripherals supporting DMA. Testing of some of these interfaces is under progress. Using these interfaces, a PID controller can be implemented on this card. The card runs from a 9V supply with a maximum current of 500mA. All the ICs used in the design are DIP and are readily available in the market so that the card can be serviced easily in the field. The components used in the controller have equivalent MIL-grade versions in case the card needs to be deployed in extreme environmental conditions.</p>		

ASI2021_467	Ekta Singh Chauhan	Poster
Effects of slot onto microstrip patch antenna with defected ground structure		
<p>The antenna structure has demonstrated the evolution of producing defects as well as incisive slots of any shape and sizes on the microstrip patch antenna (MPA). The presented work has been designed with a rectangular shape of defect on the ground of MPA and has a rectangular slot of dimension (1.25mm × 3.75mm) on the goblet shape of the patch with dimension (10.71mm × 41.5mm × 1.5mm) the microstrip antenna. The component of the designed system is studied with the help of HFSS. This structure is convenient to operate at frequency 2.2GHz. In this work the repercussion of putting slot on the patch of the MPA has been examined. The arranged structure can be applied in various fields of satellite communication, in weather surveillance, in the field of agriculture engineering etc.</p>		

ASI2021_463	Kaushal Buch	Poster
Online Broadband RFI Excision for the Upgraded GMRT: Techniques, Results, and Performance Aspects		
<p>The recently upgraded Giant Metrewave Radio Telescope (uGMRT) provides a near-seamless observing in the range of 130 - 1450 MHz with a maximum receiver bandwidth of 400 MHz. One of the impairments affecting the quality of astronomical data is the broadband Radio Frequency Interference (RFI) from high-power transmission lines and associated systems. We describe the implementation and testing of a robust filtering technique which operates on Nyquist-sampled digital time-series per antenna and polarization. This online RFI filtering technique uses robust estimation of signal dispersion using Median-of-MAD (MoM) for detecting longer bursts of interference. Using threshold-based detection, the RFI samples are replaced by digital noise with statistical properties similar to the parent distribution. After undergoing a rigorous system-level testing, the online excision feature is available for use during uGMRT observations. As part of the RFI excision system testing, relative improvements in signal-to-noise ratio (SNR), uncertainty in the cross-correlation function and closure phase relation were measured in the different uGMRT bands. Test observations on calibrator radio sources and extended sources showed improvement in the spatial cross-correlation spectrum (visibilities) at short baselines in the form of reduced standard deviation by a factor of two or more and qualitatively as improved image fidelity. For time-domain signals, pulsar observations in the incoherent array mode show SNR improvement by a factor of three over the unfiltered signal. We describe the tests specifically designed to address the finer aspects of excision and the results achieved. This paper shall deal with the above-mentioned aspects of the system in greater detail along with other ongoing efforts for improving it.</p>		

ASI2021_261	Kirti Khandelwal	Poster
Verilog code for cross-correlation of two images		
<p>Cross-correlation of two-dimensional digital images is fundamental to solar adaptive optics computations. It can be used in a simple tip-tilt correction system to compensate for the global image motion as well as in correlating sub-aperture images of a Shack-Hartmann wave-front sensor. The typical frequency of computation is about 1 kHz. While the software-based optimized cross-correlations may be sufficient when a small number of sub-apertures are used, hardware-accelerated (FPGA) correlations will be required when a large number of sub-aperture images are involved, for example in the case of the proposed National Large Solar Telescope (NLST). In this poster, we describe our hardware implementation of a basic two-dimensional correlation of two images, which has been designed in Verilog.</p>		

ASI2021_146	Manan Agarwal	Poster
ML-MOC: Machine Learning based Membership Determination for Open Clusters		
<p>Open Clusters are the ideal laboratories to study the formation and evolution of stars as they provide us chemically homogeneous groups of stars that are of the same age, share the same kinematics (proper motion and radial velocity), and are located at approximately the same given distance from us. Accurate membership determination of open clusters is crucial to their studies as it directly influences the estimation of the fundamental physical parameters of clusters. We present a new machine learning based algorithm, ML-MOC, to identify members of open clusters using the Gaia DR2 data (and now using EDR3 as well). Our algorithm uses the combination of k-Nearest Neighbours algorithm and the Gaussian Mixture Model on the high-precision proper motions and parallax measurements from Gaia data to determine the membership probabilities of individual sources down to $G \sim 20$ mag. To validate the developed method, we have applied it on thirteen open clusters: M67, NGC 2099, NGC 2141, NGC 2243, NGC 2539, NGC 6253, NGC 6405, NGC 6791, NGC 7044, NGC 7142, NGC 752, Berkeley 18, and IC 4651. These clusters differ in terms of their ages, distances, metallicities, extinctions and cover a wide parameter space in proper motions and parallaxes with respect to the field population. The extracted members produce clean colour-magnitude diagrams and our astrometric parameters of the clusters are in good agreement with the values derived by the previous works. The results show that our method is a reliable approach to segregate the open cluster members from the field stars.</p>		

ASI2021_350	MANAS PRATIM DAS	Poster
Simulation studies of TACTIC for sensitivity optimisation		
<p>The main challenge with Imaging Atmospheric Cherenkov Telescope(IACT) is to retrieve gamma ray signal from a huge background of cosmic rays, which is ~ 1000 times more abundant than gamma ray. This huge background of cosmic ray events can be reduced significantly by using characteristics features of images of their air showers. The process of shower development & image formation can be studied using Monte Carlo simulation. For this, we have generated ~ 20 millions of air showers initiated by gamma and hadrons for TACTIC(Mt Abu, Rajasthan) in energy range (600GeV-20TeV) using CORSIKA package. Primarily, the gamma & cosmic ray segregation is made using moment analysis of images in terms of Hillas parameters. Secondly, Radial Basis Function(RBF) technique was applied on the Hillas parameter distributions and hence better gamma-hadron separation was obtained. We also employed the 4th moment(Kurtosis) distribution for the generated shower images, which suppressed the background even further. By application of the above mentioned tools altogether better signal sensitivity was achieved compared to conventional method. The results obtained with observed data will be discussed in this meeting.</p>		

ASI2021_196	Narsireddy Anugu	Poster
A study of astronomical long-baseline optical interferometry in India		
<p>The next major milestone in extrasolar planet studies is the characterization of Earth analogs, hoping to detect life through atmospheric biomarkers. Although transit spectroscopy has made a lot of progress in this direction, direct imaging enables efficient characterization by resolving the planet and suppressing the host starlight. Current coronagraphic instruments SPHERE, GPI, and SCExAO deliver landmark results. Still, they are fundamentally limited by the inner working angle of a few λ/D and the sensitivity required for the Earth analog detection and characterization. Near-infrared interferometry leveraging on the long baselines up to hundreds of meters offers some advantages by providing: (i) inner-working angle at the orders of a few milliarcseconds, (ii) speckle suppression through spatial coherence allowing isolating the light of a planet from the host star, and (iii) high astrometric precision at the orders of tens of microarcseconds for determining exoplanet mass and its orbit. For instance, VLTI/GRAVITY interferometer has demonstrated breakthrough results with a record-breaking spectrum and astrometric precision of any directly imaged planet to date. GRAVITY also contributed to the 2020 physics Nobel Prize studying our Galactic Center black hole. This presentation studies the advantages of an optical interferometry facility in India. Leveraging India's leadership and experience in building large interferometry observatories, GMRT and IndIGO, perhaps, the time has come to invest in optical interferometry. Space-based optical interferometry is inevitable for future space exploration -- a preparation in this direction is vital by exploiting the advances in the field triggered by the LISA and Starlink satellites. I will outline a couple of interferometric projects, VLTI/GRAVITY and CHARA/MIRC-X, and their breakthrough scientific results.</p>		

ASI2021_66	Nitesh Kumar	Poster
Spectral interpolation using Artificial Neural Network(ANN)		
<p>To determine the atmospheric parameters of the star, the observed spectrum of the star is compared to a spectrum interpolated or approximated, over a grid of theoretical model spectra. This interpolation is a critical aspect of the process. We are interpolating the spectra using the state of the art machine learning method, a multi-layer feed-forward neural network, commonly referred as artificial neural network or ANN, and we are focusing our effort at characterizing the biases due to the interpolation. The goal is that the interpolation remains a minor contribution to the total error budget. Our goal is to define mathematical criteria for an interpolator that must be fulfilled in terms of precision. We implement these defined criteria that prevents overfitting while meeting the desired precision using artificial neural networks which takes the known atmospheric parameters(or some function of it) and the corresponding spectra as input. We investigated several different preprocessing schemes, which make the task of interpolation/approximation computationally efficient, such as normalising the spectra to bolometric flux(simplification), normalisation the spectra with a blackbody of corresponding effective temperature(variance reduction) before training the neural network. Once the network is trained, the output from ANN is multiplied by the effective temperature black-body radiation in the post-processing method named as variance restoration. In our work, we are using the Gottingen spectral library as the input grid to train and tune the ANN and the trained ANN can be used as the spectral interpolator and can work with full-spectrum fitting software like ULySS to determine the atmospheric parameters from the observed spectrum of the stars.</p>		

ASI2021_55	Prasanna Deshmukh	Poster
Warping Harness actuator for the Thirty Meter Telescope Primary Mirror segments		
<p>The Thirty Meter Telescope (TMT) Primary Mirror (M1) is composed of 492 hexagonal aspheric segments. In order to compensate for residual polishing errors, installation errors, gravity effects and parasitic forces in the whiffletree support, each segment is equipped with 21 Warping Harness (WH) mechanisms, which allow low order corrections to the optical surface. The primary mirror segment aberrations after shape corrections with warping harness have been identified as the single largest error term in the Thirty Meter Telescope (TMT) image quality error budget. The WH mechanism consists of a Linear Actuator, Ball Link, and a Leaf Spring with a strain gauge sensor. The Warping Harness key requirements are: high positioning accuracy, 50 years operational lifetime with minimum maintenance, low cost, high reliability, high resolution, low hysteresis, high stability in an unpowered state, large operational temperature range, low power dissipation, vacuum compatibility, and survival of accidental condensing conditions. Smoothmotor has developed a robust, low-cost linear actuator for the TMT M1 Warping Harness. A WH Accelerated Life Cycle Test with increased temperature extremes was successfully completed. Acceleration factors were calculated with the Coffin-Manson model for temperature. Compliance with the technical requirements for the WH system has been demonstrated.</p>		

ASI2021_589	Richa Rai	Poster
Ground calibration, contamination control and assembly plans for SING payload		
<p>The Spectroscopic Investigation of Nebular Gas (SING) payload is a near ultraviolet (NUV) imaging spectrograph, which is designed to operate in the wavelength range from 1400 Å to 2700 Å, with a spectral resolution of ~ 2 Å at 2200 Å. The Observational Targets for SING are supernova remnants, planetary nebulae, star formation in nearby galaxies along with emission from their extended halos. In this poster, we will present opto-mechanical alignment and ground calibration plans of SING spectrograph. In addition, we will also discuss about the possibility of contamination during the alignment, calibration, storage and transportation operations, which could affect the optical performance of the telescope.</p>		

ASI2021_210	Saraswathi Kalyani Subramanian	Poster
Solar Multi-conjugate Adaptive Optics		
<p>With increasing telescope sizes, adaptive optics (AO) systems are essential to counteract the effects of atmospheric turbulence. Single Conjugate AO systems provide correction only over a limited field-of-view (10 -15 arcsec). Multi Conjugate Adaptive Optics (MCAO) systems overcome this by correcting for the turbulence in different layers of the atmosphere and increasing the corrected field-of-view to about 1-2 arcmin. A MCAO system will be required to achieve high contrast images over the full 3 arc-minutes field of view of the proposed National Large Solar Telescope (NLST). The development of a MCAO system requires detailed understanding of the distribution of the strength of the atmospheric turbulence over the atmosphere. We are initiating a project to study and understand the turbulence distribution over Kodaikanal and Merak. We start with a Python and MATLAB based simulations to understand the intricacies involved in such an endeavour.</p>		

ASI2021_344	Sarvesh Mangla	Poster
Study of equatorial ionosphere with Giant Metrewave Radio Telescope (GMRT)		
<p>In recent times, radio interferometers are not only used to study astronomical sources but have also been used to study Earth's Ionosphere. For sub-GHz frequencies observations, Earth's ionosphere is dynamic, and it is hard to calibrate the effects on radio frequencies observations. We have used a bright point cosmic radio source with GMRT to study the ionosphere at a sub-GHz frequency to demonstrate this telescope's capability. GMRT array configuration and its geographic location make this interferometer study geophysically sensitive regions between the magnetic equator and the equatorial ionization anomaly's northern crest. In this study, we have shown that this interferometer can measure differential total electron content (TEC) between antenna pair with an accuracy of \sim mTECU. The TEC gradient has also been computed using two methods. One shows the gradient over the full array, and other is equipped to measure small-scale fluctuations</p>		

in two dimensional TEC gradient surface. Furthermore, we introduce a method to do spectral analysis on these measured TEC gradients to detect and characterize travelling ionospheric disturbances (TIDs). As a result, we have shown that a sensitive interferometer like GMRT is well equipped to observe and characterize ionospheric disturbances.

ASI2021_306	Sonam Jorphail	Poster
Development of a complete telescope controller using an inexpensive PSoC based microcontroller		
<p>We report our effort to develop a complete telescope controller based on an efficient SoC device “PSoC® 5LP equipped with ARM® Cortex®-M3 processor”. A distributed control architecture using CAN bus allows to control many subsystems in very modular fashion. At present the controller handles two mount axes which require very precise pointing and tracking, focus and filter wheel as well as the sliding roof enclosures. The control algorithm comprise the close loop PID and the motion profile, which ensure very precise pointing and tracking performances. After optimum tuning of the PID gains, we could achieve the best performance which otherwise one can expect only in large telescopes. The controller is presently being used with 50cm equatorial telescope. However, it is developed in very generic way so that it can be used in any mid-size telescopes. Since the 50cm telescope is aimed to work in robotic mode, therefore in near future we have plan to incorporate many safety features and inter-locks.</p>		

ASI2021_491	Tarun Bangia	Poster
Telescope Enclosures at ARIES		
<p>ARIES is well known for its astronomical sites at Devasthal and Manora Peak in Nainital. It has set up various telescopes at its sites for observations of celestial objects to carry out stellar and solar research activities. Devasthal site with sub-arcsecond seeing capability has got India’s largest 3.6m optical telescope, 1.3m Devasthal fast optical telescope and 4m International liquid mirror telescope. 1.04 m Sampurnanand telescope, 0.5m Baker-Nunn Schmidt telescope and 0.15m Solar telescope are installed at Manora Peak site. Various types of enclosures such as cylindrical dome, hemispherical steel dome and motorized roll-off roof etc. were built for meeting operational requirements of different telescopes at sites to support scientific observations. With advancements in telescopes at ARIES, selection of appropriate size and structural materials of these enclosures has provided compactness and low thermal mass along with environmental protection to maintain their image quality. Present article reviews different types of telescope enclosures in operation at ARIES and advancements in their technologies for meeting telescope demands.</p>		

ASI2021_352	Tsewang Dorjai	Poster
Design and development of the roll-off roof enclosure for the IAO 50 cm telescope.		
<p>We present the conceptual design of the enclosure for the IAO 50cm telescope which is currently being upgraded for the robotic operation. Considering simplicity in operation, ease in manufacturing as well as maintenance, we have decided to choose the roll-off roof option. The robotic operation of the telescope demands many safety mechanisms as well interlocks need to be incorporated in the enclosure design. A very sturdy pier with provision for the fine polar alignment has been also designed and implemented. Through, structural as well as CFD based wind loading analysis we assured that telescope will withstand in windy environment. Care is also taken to maintain the natural seeing of the site. We will briefly describe the design as well as provide the current status of the enclosure development work.</p>		

ASI2021_282	Tsewang Stanzin	Poster
Development of the telescope control system and observatory control software for the robotic operation		
<p>We report the design and development of the telescope control system (TCS) and observatory control software (OCS) for the robotic operation of the 50cm telescope. The primary tasks of the TCS is to facilitate very precise pointing and tracking of the main axes as well as handle peripheral sub systems such as secondary focus and the filter wheel. The TCS uses a computer and PSOC based controller. Many TCS related high level calculations such as topocentric and geocentric corrections and the pointing model etc. are carried out in a dedicated computer system, whereas low level control program runs in the PSOC. The OCS which is the top most layer in the control architecture, handles the filter wheel, the detector, the enclosure, the weather station as well as many safety mechanism. The OCS combined with the scheduler tool also facilitate un-maned robotic operation of the telescope. The entire software is based on client-server architecture and there are separate servers for the each sub-systems.</p>		

ASI2021_415	VISHNU UNNI. C	Poster
Estimation of Fried's Parameter from solar H-alpha data		
<p>Estimation of the atmospheric coherence diameter (popularly known as the Fried's parameter) is of paramount importance in characterizing any site. The possibility of estimating it from long exposure H-alpha telescope data has been previously demonstrated [1]. The large statistics of estimated values of Fried's parameter from archival data from Merak H-alpha telescope is presented. References: [1] Sridharan Rengaswamy, B Ravindra, and Prabhu Kesavan, Measurement of astronomical seeing using long exposure solar images. Solar Physics, 294, 01 2019. doi: 10.1007/s11207-019-1393-y.</p>		