# ASI 2019 ABSTRACT BOOK

XXXVII MEETING OF THE ASTRONOMICAL SOCIETY OF INDIA

CHRIST (DEEMED TO BE UNIVERSITY), BENGALURU

18 - 22 FEBRUARY 2019

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# 19th February 2019

**ASI-2019 Parallel Session**
**Stars, ISM and the Galaxy I - Time: 14:00 - 15.30**
**Venue: Room 911, 9th Floor, Central Block**
**Stars, ISM and the Galaxy I [Chairperson: Manoj Puravankara]**

| ASI2019_67 | Shantanu Rastogi | Invited |
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| Shantanu Rastogi | | |
| Interstellar molecules in understanding astrophysical environments | | |
| From the discovery of diatomic molecules in the nineteen thirties, today there are more than 200 molecules confirmed in the interstellar and circumstellar medium. Most of these molecules are carbonaceous and detected in very different astrophysical environments. Besides specific molecules there is a whole group of polycyclic aromatic hydrocarbon molecules that are expected to be in the interstellar space. The processes that induce growth of molecules and exciting their spectroscopic signatures depend on the physical and chemical state of the astrophysical environment. Understanding this relationship enhances our knowledge of stellar evolution. Molecules are also important in understanding the atmospheres of exoplanets and may also lead us to understanding evolution of life. All these aspects of studying molecules in space will be reviewed. | | |

| ASI2019_422 | EKTA SHARMA | Oral |
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| Maheswar Gopinathan, Chang Won Lee, Shinyoung Kim, Archana Soam | | |
| Molecular filament formation and filament-hub interaction: LDN 1172/1174 dark nebula | | |
| The LDN 1172/1174 complex represents a cometary shaped hub-filament morphology containing a number of clumps all along the filament and towards hub around HD 200775. NGC 7023 is a well known reflection nebula in LDN 1174 which is illuminated by an intermediate mass Herbig Be (B3) star HD 200775, in the Cepheus constellation at a distance of $\sim$ 340 pc. These clumps in the filaments might collapse into stars depending on the interplay of magnetic field, gravity and turbulence. The studies on the origin of filaments pose a crucial step in deciding the evolution of these clumps. Being relatively isolated star forming region, L1172/L1174 gives us an opportunity to get a glimpse of filament formation. We have made magnetic field maps of the cloud using polarization measurements using Aries Imaging Polarimeter (AIMPOL), ARIES of background stars projected on the cloud. To understand the dynamics of filament and its relation with magnetic structures on the periphery of cloud, kinematical studies over the whole filament have been conducted using molecular line observations of 12CO, C18O, N2H+(1-0) and CS (2-1) that trace different density regimes of the clouds. The 14-m single dish telescope at Taeduk Radio Astronomical Observatory (TRAO), KASI Korea have been used to complete molecular line spectroscopy of the cloud. In this talk, I will discuss the kinematics of this particular filament with respect to the magnetic field orientation at the outer periphery of the cloud. | | |

| ASI2019_142 | Eswaraiah Chakali | Oral |
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Eswaraiah Chakali (NAOC, China), Shih-Ping Lai (NTHU, Taiwan), Jia-Wei Wang (NTHU, Taiwan), Manash R. Samal (PRL, India), Di Li (NAOC, China)

## Probing magnetic fields at the footprints of the bipolar bubbles - a case study towards Sh201 with JCMT/SCUBAPOL2

The influence of magnetic fields (B-fields) in the formation and evolution of bipolar bubbles, that are formed in the filaments hosting HII regions, is not been well-studied yet. In addition to the anisotropic expansion of I-fronts into the filament, strong B-fields permeating the filaments are also expected to introduce an additional anisotropic pressure which might favor expansion and propagation of I-fronts to form the bipolar bubble. Since the optical and near-infrared polarizations of background stars probed B-fields confined only to the outer low-density parts of the star-forming regions, we have conducted 850-micron dust emission polarimetry using JCMT/SCUBAPOL2 towards the clumps, densest parts located at footprints of the bipolar bubbles, of Sh201. This star-forming region hosts a filament, bipolar bubbles, and an HII region. Based on the observed morphologies of B-fields, HII region, and clumps, and the estimated various physical parameters, we suggest that B-fields are strong enough to shield the clumps from being dispersed by the expanding HII region thereby supporting the clumps from being the collapse. In addition, B-fields also found to be capable of redirecting the direction of the expanding ionization fronts at the footprints of the bipolar bubbles.

| ASI2019_263 | Gulafsha Choudhury | Oral |
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Gulafsha Begom Choudhury Tanuj Kumar Dhar Himadri Sekhar Das Biman J. Medhi

## Study of Magnetic Field Geometry of Some Star Forming Clouds

Polarimetric study of dark clouds makes it possible to map the magnetic field geometry onto the plane of the sky as well as to scale the magnetic field structure. In this study, three nearby clouds viz. CB17, CB24, and CB27 are studied in optical wavelength in order to map the magnetic field over that region of the sky in a wide field of view. The optical polarimetric observations of CB17, CB24, and CB27 in R-band are carried out from 1.04-meter Sampurnanand Telescope, ARIES, Nainital, India on 9th March 2016, 22nd and 23rd December 2017 respectively. These clouds are situated at galactic latitudes of b=3.39$^{o}$ (CB17), b=5.90$^{o}$ (CB24) and b=-5.18$^{o}$ (CB27), lying almost along the same galactic plane. From the optical polarimetric study of these clouds, we have found a very interesting result that the local magnetic field of all the three clouds are aligned along the orientation of galactic magnetic field over that region of the sky, which shows that the galactic magnetic field is very much dominating over a large range of that region of the sky. In literature, two more nearby clouds at the same galactic latitude viz. CB25 (b=5.84$^{o}$) and CB26 (b=5.99$^{o}$) are found to have the same dominance of galactic magnetic field over the local magnetic fields of these clouds.

| ASI2019_431 | Anju Maurya | Oral |
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Anju Maurya, Shantanu Rastogi

## Study of nitrile substituted PAHs in relation to mid-infrared emission bands

Polycyclic aromatic hydrocarbons (PAHs) are thought to be widespread throughout the universe, because these molecules are probably responsible for the observed aromatic infrared bands (AIBs). AIBs are a set of emission features seen in numerous galactic and extragalactic sources in mid-infrared at 3.3, 6.2, 7.7, 8.6, 11.2 and 12.7 μm. The profile variation in these features points towards the presence of variety of PAHs in different astrophysical environments. To understand the population of PAHs in different objects, emission modeling is done using plane PAHs. In the absence of simultaneous matching of all AIBs, it is essential to consider a wider set of PAHs in emission models. Studies on substituted PAHs, hydrogenated ones, and PAHs with nitrogen heterocycles have been reported with none or partial success. The discovery of benzonitrile (c-C6H5CN), the simplest nitrogen-bearing aromatic molecule, in the interstellar medium, in TMC-1 (Tarus Molecular Clouds) points towards the presence of PAHs with nitrile side-group in astrophysical environments. In the present work vibrational study of nitrile-PAHs is done using DFT methods. The effect of nitrile substitution on the vibrational bands of parent molecule is studied. Attempt is made to identify any correlation with the observed AIBs.

**ASI-2019 Parallel Session**
**Extragalactic Astronomy I - Time: 14:00 - 15.30**
**Venue: Room 105, First floor, Central Block**
**Extragalactic Astronomy I [Chairperson: K S Dwarakanath]**

| ASI2019_365 | Apurba Bera | Oral |
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Apurba Bera, Jayaram N. Chengalur, Nissim Kanekar & Jasjeet S. Bagla

## Atomic hydrogen and star formation in galaxies at intermediate redshifts

Understanding the evolution of galaxies over cosmic time is one of the most important goals of modern astrophysics. In the recent past a number of deep optical studies of high redshift galaxies have provided information on the evolution of the stellar mass, star formation rate, luminosity function and morphological properties of the galaxy population. However, these studies provide no information about the evolution of the neutral atomic hydrogen (HI) content of galaxies. Since atomic hydrogen provides the primary reservoir of the material required for star formation, understanding its evolution is fundamental for understanding galaxy evolution. The atomic hydrogen content of galaxies is best probed by their HI-21cm emission. The upgraded Giant Metrewave Radio Telescope (uGMRT) with its L-band (1.0-1.4 GHz) receivers is an excellent instrument to measure the HI-21cm emission from galaxies out to redshift of $z < 0.4$. Deep radio observation can also be used to estimate the star formation rates of high redshift galaxies from their radio continuum emission using the well established radio-FIR correlation, which gives a dust free estimate of the total star formation rate, unlike the optical/UV continuum or spectral lines which are subject to dust extinction. Comparing the radio derived star formation rates to that estimated from optical/UV indicators , it is possible to study the dust extinction suffered by different indicators as functions of redshift and different physical parameters of the galaxies. We are carrying out a deep uGMRT survey of the Extended Groth Strip with the L-band receivers to measure the HI content in the star forming galaxies at redshifts of $z < 0.4$ in the field. In this talk I will present the preliminary results on HI mass measurements and radio-derived star formation rates, from this study.

| ASI2019_241 | Pranav Kukreti | Oral |
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Pranav Kukreti (IISER Mohali), Jasjeet Singh Bagla (IISER Mohali), Nissim Kanekar(NCRA-TIFR, Pune)

## Study of star formation in the EGS at z ~ 1 using the GMRT

We have used the GMRT to image the central 625 sq. arcmin of the Extended Groth Strip (EGS) field at 1.4 GHz. The image has an RMS noise of 7.5 μJy at the centre and is one of the two lowest noise deep low-frequency radio continuum image available of the EGS. We have used the DEEP2 redshift survey to identify sources for a stacking analysis. The well known radio-FIR correlation has been used to convert the stacked luminosity to the star formation rate(SFR). We find a 16.32 σ resolved emission corresponding to an SFR of 20.19±1.24 solar mass/yr at z =1.061. We study the behaviour of SFR and specific SFR (sSFR = SFR/stellar mass) with redshift, stellar mass and the colour of the galaxies for a redshift range z = 0.2-1.45. We find the SFR and sSFR to be decreasing with redshift (from $z \approx 1.035 - 0.2$) as a power law of (1+z) with the exponent = 4.02±1.02 and 3.12±0.65 for SFR and sSFR, respectively. We also observe a tight correlation between SFR and stellar mass (main sequence) with a slope =0.75±0.05 . We have also studied the evolution of the slope and intercept of the main-sequence with redshift. We found the dust attenuation factor(DAF) to be decreasing with redshift (from $z \approx 1.035 - 0.2$) and that the DAF was dependent on stellar mass as $\log(DAF) = (0.41 \pm 0.07)\log(M) - 3.85 \pm 0.77$. The SFR and sSFR were found to be dependent on colour (c) as $\log(SFR) = (1.25 \pm 0.22)c + (1.71 \pm 0.05)$ and $\log(sSFR) = (-0.80 \pm 0.19)c - (0.25 \pm 0.05)$.

| ASI2019_155 | Poonam Chandra | Oral |
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Poonam Chandra A. J. Nayana

## Inhomogeneous shock structure in supernovae revealed via low frequency radio observations

Low frequency radio observations with the Giant Metrewave Radio Telescope (GMRT) in some core collapse supernovae have revealed inhomogeneous shock structure. Due to these inhomogeneities, the optically thick spectra of supernovae will evolve with flatter index than of expected from the free-free or synchrotron absorption mechanisms. While this mechanism has some analogy to compact AGN cores with relatively flatter spectral indices, and has been talked about in moderate details in literature (Bjornsson 2013, Bjornsson & Keshavarzi 2017), the observations evidence has been suggested in a handful of cases only (Bjornsson 2013). I will show some examples where early GMRT observations have revealed this phenomenon directly. In particular I will talk about MASTER OT J120451.50+265946.6, a Type Ib supernova, where the radio data reveal that the radio emission is arising from a shock with inhomogeneities mainly in the magnetic field distribution (Nayana, Chandra, Bjornsson et al. 2018, accepted for publication in ApJ). I will also discuss the predictions of such models. With low frequency sensitive telescopes like SKA, upgraded GMRT, such studies will be possible for a large number of supernovae in the future.

| ASI2019_314 | Mousumi Mahato | Oral |
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Pratik Dabhade, Mousumi Mahato, Joydeep Bagchi, Madhuri Gaikwad, Huub Rottgering, Ishwar Chandra, Francoise Combes, DJ Saikia, KG Biju, Shishir Sankhyayan.

## Multifrequency radio properties of Giant radio quasars using GMRT

The extreme rarity and enormity (≥ 0.7 Mpc), as well as high redshift and high luminosity, have made giant radio quasars (GRQs) an unprecedented beacon to leaf through the tide of years to unveil the history of our Universe. To understand the evolutionary scheme of radio sources, eventually leading to their unification scheme, it is inevitable to understand the lifetime of jet forming activity of AGN and the stability of jets. Till date, no study of giant radio quasars has prospectively considered the spectral ageing analysis & estimation of the magnetic field. Our study for the first time focuses on multifrequency radio properties of 3 GRQs. GMRT provides high-resolution radio maps at low frequencies enabling us to perform spectral analysis (dissecting radio core, lobe, jet & backflows). Multifrequency observations provide us with information on break frequency as well as the spectral index in the significant regions under consideration from the power law spectrum. The spectral index profile gives us an idea about the equipartition energy density and magnetic field profiles (classical: 1.1 - 7.7 microgauss and revised: 1.6 - 11.6 microgauss) which along with the break frequency yield in spectral ages of the aforesaid regions. The spectral ages (classical and revised) are in the range of 30 - 83 Myr. We have also estimated the jet kinetic power of the sources (10^43 - 10^44 erg/s). The results from the numerical analysis are quite consistent with the results obtained from simulation-based analytical model (Hardcastle 2018). Apart from this, the star formation rate (SFR) of our 3 GRQs (4 - 66 Msun/yr), computed using mid-infrared (24 micrometres) luminosity comes out to be high. It gives an insight into the feedback mechanism of the most powerful AGNs in the Universe.

| ASI2019_359 | Amitesh Omar | Oral |
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Amitesh Omar (on behalf of a larger collaboration)

## Observations of high redshift radio galaxies with 3.6-m Devasthal Optical Telescope

We will present 3.6-m Devasthal optical telescope detections of a probable z~5 radio galaxy, previously detected in GMRT-TGSS images at 150 MHz. The flux density of the galaxy is estimated to be ~1 microJy in optical i-band. The galaxy is not detected in optical r-band within a depth of ~0.5 microJy, making it a highly probable r-drop out galaxy. The optical image appears slightly extended. The observed field seems to have some more faint objects which are detected in i-band but not in r-band in vicinity of the radio galaxy. It suggests presence of some clustering of sources likely in a distant cluster. The observations were made using the faint object spectrograph and camera, which is optimized for observations in the red bands (r,i, and z) with efficiency of 40-45% in r/i bands and ~20% in z-band. The camera is expected to have efficiency of ~4% even at 1 micron wavelength. High redshift radio galaxies identified by their steep spectral index are the prime targets for optical identification and subsequently follow-up spectroscopic observations to confirm redshift with large apertures optical telescopes. The 3.6-m aperture should be suitable for optical identification down to ~26 mag in r/i bands. We will also present our ongoing efforts to obtain deep images with the 3.6-m telescope. This work is being carried out in collaboration with Leiden extra-galactic astronomy group.

| ASI2019_465 | Ankit Singh | Oral |
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| Ankit Singh, IISER Mohali, Smriti Mahajan, IISER Mohali, Jasjeet Singh Bagla, IISER Mohali | | |
| Study of filament galaxies in EAGLE simulation | | |
| The environment of galaxies is crucial to their evolution. Small-scale as well as the large-scale environment is known to influence galaxy observables like colours, the rate of formation of stars etc. Recent studies (Mahajan et. al. 2018, Cybulski et. al. 2014) using multi-wavelength data have shown that large-scale filament environment quenches star formation of galaxies residing in them. In this work, we use EAGLE (Evolution and Assembly of GaLaxies in their Environment) cosmological simulation to study properties of galaxies residing in large-scale filament environment. We do a stacked analysis of various mock observations generated from the snapshot at z=0.1. We compare and contrast our results with the observations. | | |

**ASI-2019 Parallel Session**
**General Relativity and Cosmology I - Time: 14:00 - 15.30**
**Venue: Council Room, Ground Floor, Central Block**
**General Relativity and Cosmology I [Chairperson: Harvinder Jassal]**

| ASI2019_313 | Avinash Singh | Oral |
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| Avinash Singh and H. K. Jassal | | |
| Growth of Structure in the Presence of Perturbed Tachyon Dark Energy | | |
| Non-canonical scalar field models, one of which is known as the tachyon dark energy model, are a viable candidate for dark energy. We study tachyon dark energy model as an alternative to the Lambda-CDM model. Not only this model is capable of explaining present-day accelerated expansion it is able to alleviate the fine-tuning problem which Lambda-CDM model suffer from. We use two different potentials, inverse square potential and exponential potential, to find the constraints on the parameters of this model in light of new data sets and find that this model is compatible with latest cosmological observations (e.g. Planck-2015). We also study perturbations in tachyon dark energy. We find that dark energy perturbation although less significant at smaller scales, it becomes significant at Hubble and super-Hubble scales. We study the growth of structure when tachyon dark energy work as smooth background as well as when it allowed to be perturbed. We also investigate the integrated Sachs-Wolfe effect and compare it with other models. With respect to the Lambda-CDM model, the thawing tachyon model does not deviate much but the freezing model shows significant deviations. | | |

| ASI2019_523 | Atanu Guha | Oral |
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Atanu Guha, Bhupal Dev, Prasanta Kumar Das

## Constraints on light Dark Matter fermions from relic density consideration, SN1987A cooling and the role of Tsallis statistics

Dark Matter(DM) fermions pair produced due to the annihilation of the electron-positron pair inside supernova SN1987A core, contribute to its energy loss rate. Similar type of DM fermions (having similar interaction to the electron-positron pair) could have contributed to the relic density of the Universe as well. Working with an effective leptophilic coupling (coupling between the electron-positron pair and the DM fermions due to a four-fermi interaction) we obtain an upper bound on the effective scale Λ using the relic density of cold non-baryonic matter Ωh^2 = 0.1186±0.0020 and a lower bound using Raffelt's criterion on the emissivity $\dot{\epsilon} \leq 10^{19}$ erg g^{−1} s^{−1} for any new physics channel. A consistent lower bound has also been obtained using the optical depth criterion where we considered that the DM fermions are freely streaming out of the outer 10% of the SN1987A core without being trapped due to the scatterings. We worked in a scenario where the temperature fluctuation and other non-equilibrium conditions which may arise inside supernova core (because the explosion is abrupt and happens only within 10 seconds), has been taken care of using a non-equilibrium statistics, namely Tsallis statistics. Tsallis statistics can play a vital role during the early era of the Universe as well to take care of the non-equilibrium conditions at early stages. The effective degrees of freedom of the early Universe gets affected due to non-equilibrium conditions, which in turn affects the bound obtained on the energy scale of the effective theory from the relic density of non-baryonic matter. All the limits mentioned above has been compared with several direct detection bounds like XENON10, SuperCDMS and LBECA bounds.

| ASI2019_147 | Madhurima Choudhury | Oral |
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Madhurima Choudhury, Abhirup Datta

## Extracting the 21cm Global Signal using artificial neural networks

Observations of HI 21 cm transition line would be an important and promising probe into the cosmic Dark Ages and Epoch of Reionization. Detection of this redshifted 21 cm signal is one of the key science goals for several upcoming and future low-frequency radio telescopes like Hydrogen Epoch of Reionization Array (HERA), Square Kilometer Array (SKA) and Dark Ages Radio Explorer (DARE). One of the major challenges for the detection of this signal is the accuracy of the foreground source removal. Several novel techniques have been explored already to remove bright foregrounds from both interferometric as well as total power experiments. Here, we present preliminary results from our investigation on the application of Artificial Neural Networks to detect faint 21cm global signal amidst the sea of bright galactic foreground. Following the formalism of representing the global 21cm signal by the tanh model (Mirocha et al. 2015), this study finds that the global 21cm signal parameters can be accurately determined even in the presence of bright foregrounds represented by 3rd order log-polynomial (Harker 2015) or higher. This presentation also deals with results of foreground removal in presence of instrumental noise. We have also dealt with extracting the signal when the parametric form of the signal is not taken into consideration, and have got some interesting results.

| ASI2019_368 | Suvedha Naik | Oral |
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Suvedha Suresh Naik, Kazuyuki Furuuchi

## Probing primordial features using red-shifted 21 cm line

Cosmic Microwave Background (CMB) observations reveal tiny inhomogeneities in temperature which indicates perturbation of density existed in the beginning of the universe called Primordial Density Perturbation (PDP). Near future observations of red-shifted 21 cm line from neutral hydrogen will open up a new and exciting window for probing cosmology and fundamental physics. Future observations (such as SKA) of red-shifted 21 cm will provide new data of matter distribution in the redshift range $z < 27$. The observational data of CMB and large scale structures are well explained by the standard ΛCDM model which assumes an almost scale invariant power spectrum of PDP. The new particle physics model of cosmic inflation predicts bump like features in the power spectrum of PDP. This model arises from a compactification of higher dimensional gauge theory. Observations of 21 cm line fluctuations are expected to be a promising tool to test such inflation models. These futuristic observations of red-shifted 21 cm line can be compared with predictions of theoretical models using simulations of cosmological 21 cm signal. We simulate cosmological volumes of 21 cm line fluctuations using semi-numeric code 21cmFAST. We modified the initial power spectrum template by adding a feature parameterized by the amplitude A and scale k in 21cmFAST. We present the impact of modifying the feature parameters on simulation outputs such as power spectrum of differential brightness temperature.

| ASI2019_461 | Prateek Gupta | Oral |
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Prateek Gupta, Department of Physics, S P Pune University, Pune Surajit Paul, Department of Physics, S P Pune University, Pune Reju Sam John, IUCAA, Pune

## Detection possibilities of 'Galaxy groups' using Numerical modelling of Radio emission & Large Scale Cosmological Simulation

Galaxy groups are usually called the scaled-down versions of Galaxy clusters. The observed steep mass scaling of radio power from the available high mass galaxy clusters has ruled out the prospect of detection of ’galaxy groups’. But, reported simulations and observations of thermal emissions suggest groups are merger prone, thus non-virialised, indicating better visibility in the non-thermal emissions. Detection of non-thermal radio emissions from them would help us to understand the scale-dependent effectiveness of particle acceleration mechanisms, as well as, being younger and cooler, groups can be a unique laboratory to test the models of cosmic magnetism. They can also be the potential source of Warm-Hot Intergalactic Medium (WHIM). So, in this work, we present a simple model for computing magnetic field and for the first time a model for radio synchrotron emission combining the diffusive shock acceleration (DSA) and reconnection mediated turbulent re-acceleration (Turbulent Reconnection Acceleration: TRA) electrons using Adaptive Mesh Refinement (AMR), grid-based hybrid (N-body + Hydro-dynamical) cosmological simulations. From a sample of more than 600 simulated objects in wide mass range ($\geq 10^{13}$ to $2 \times 10^{15}$ Msun), we found that the total radio power from TRA and DSA electrons can only fit reasonably well to all the observed ‘radio halos’ at high masses. This significantly improves our understanding of radio halo emission and allow us to extend the results to further smaller masses. We got a new mass scaling of $P_{1.4\ GHz} \propto M_{500}^{2.39\pm0.04}$ and a correlation scale of $P_{1.4\ GHz} \propto L_X^{1.31\pm0.04}$. Also significantly, groups below $10^{14}$ Msun reveals the existence of 10s of nano-Gauss to a sub-μG magnetic field and radio power of about $10^{19-23}$ W/Hz, much higher than what existing mass scaling predicts, indicating possible detection by existing and aplenty with the future radio telescopes.

| ASI2019_299 | Soumen Mondal | Oral |
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| Author: Soumen Mondal, Department of Physics, Jadavpur University, Kolkata. | | |
| On the properties of dissipative shocks in relativistic accretion flows around black holes. | | |
| In the present work, we study the effects on the accretion and wind flows due to the energy dissipation from the post-shock region (or from the Compton cloud ). Results of our previous work (Das, Chakrabarti, Mondal, 2010) motivate us to explore the various features of the standing and dissipative shocks in the accretion and wind flows using exact relativistic equations. Thus, the results could significantly be different from that found in the previous works based on Pseudo Newtonian treatment. As the radiative processes crucially depend on its hydro-dynamical features of the accretion disk, therefore, the results of our study would be extremely useful in providing a rigorous interpretation of EM-spectrum coming from the disk. Moreover, the oscillation of the shock location could be important to excite the quasi-periodic oscillations (QPOs) in the emitted radiation. Such an evolution of QPOs has been observed in several black hole candidates during their outbursts e.g. XTE 1550−564 and GRO J1655−40. Motivating from the current scenario, in the present study, we would like to focus on the following issues: (i) we study the properties of standing and dissipative shocks in the accretion flow using exact general relativistic framework and study the spin effect on the shocks (ii) then considering a wide range of the parameters namely energy, angular momentum of the flow and spin parameter of the black hole, we wish to investigate, the maximum percentage of total energy (iii) further, we would also like to find the effects on the mass outflow rates from the accreting matter. | | |

**ASI-2019 Parallel Session**
**Stars, ISM and the Galaxy II - Time: 16.30 - 18.00**
**Venue: Room 911, 9th Floor, Central Block**
**Stars, ISM and the Galaxy II [Chairperson: Manoj Puravankara]**

| ASI2019_102 | Yogesh Joshi | Oral |
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| Yogesh Joshi | | |
| Optical characterization and Radial velocity monitoring of stellar candidates having Exoplanet or low-mass EB companion | | |
| Recently, large catalogue of exoplanet and eclipsing binary candidates are reported in the Kepler archival data. At Nainital, we have initiated a long-term observing program comprising optical characterization and radial velocity monitoring of stellar candidates which may have exoplanet or low-mass star as their companion. We initially target our study on few bright candidates for which radial velocity monitoring is going on through available high-resolution spectrographs. Along with high-precision photometric observations using small-size telescopes at ARIES, Nainital, we shall determine their physical parameters with a great precision. Having enough sample of low-mass stars, we aim to understand stellar mass-radius relation which is still debated towards lower-mass regime. Furthermore, if transit happens to be during the period of spectroscopic monitoring, it may also help to study the Rossiter-McLaughlin effect which play an important role to understand the characteristic of the low-mass companion star/planet. In this talk, I will elaborate our efforts in this direction and future plan under this project. | | |

| ASI2019_228 | Soumya Sengupta | Oral |
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Soumya Sengupta and Sujan Sengupta (Indian institute of Astrophysics)

## Model transmission and Reflected Spectra of Exoplanets

Since the discovery of the first Extra-solar planet around a solar type star 51 Pegasi (Mayor & Queloz,1995) astronomers started systematic search by using ground and space bound telescope and till date about 3800 exoplanets of a wide variety are discovered. Once the physical parameters such as radius, surface gravity, mean density, albedo, equilibrium temperature are available the focus is now shifted to probe their atmosphere. Modelling the transmission spectra of planets would provide valuable information on the molecular abundances and the ambient environment of the planets when observed transmission spectra will be available by the forthcoming next generation ground as well as space-bound telescopes. In the present work, we have modelled the temperature-pressure (T-P) profiles for exoplanets with different equilibrium temperature T_eq and surface gravity by considering different molecular abundances (e.g. H2O, CH4, NH3 etc.). Using these T-P profiles we have calculated the transmission as well as the reflected spectra of exoplanets with a wide range of T_eq. For this purpose, we have used the Exo-Transmit code (Kempton et al. 2016) and the radiative transfer code (Sengupta et al. 2010). The modelled spectra are compared with the available observed spectra taken by different telescopes such as Spitzer, HST etc. Our model transmission and reflected spectra for various type of exoplanets will be useful to interpret data to be obtained by the latest and upcoming missions like TESS, Twinkle, ARIEL, JWST etc.

| ASI2019_393 | Aritra Chakrabarty | Oral |
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Aritra Chakrabarty (IIA), Sujan Sengupta (IIA)

## Precise Transit Photometric Observation of the Extra-solar Planets Using Indian Astronomical Facilities

Transit photometry is a key tool for the detection and characterization of the extra-solar planets (exoplanets). Precise determination of the transit properties of the exoplanets calls for high precision photometry. For this purpose, we have used the 2m Himalayan Chandra Telescope and the 1.3m Jagadish Chandra Bhattacharyya Telescope leveraging their large apertures to achieve high photometric SNR and observed some confirmed planet-hosting stars to record the transit events of a few hot Jupiters such as WASP-33b, WASP-50b, WASP-12b, HATS-18b and HAT-P-36b. After the necessary reduction, we performed differential photometry to get precise transit light curves for the host stars which will be shown in the presentation. Then we modelled the transit light curves with the transit template light curve given in Mandel & Agol 2002 using Markov Chain Monte Carlo (MCMC) algorithm to get the transit parameters with high precision. Further, to reduce the noise due to stellar activity, varying sky brightness and other systematics we first applied Wavelet Denoising to the light curves and then modelled the remaining fluctuations in the denoised light curves with Gaussian correlated noise and subtracted from the original light curves. A comparative study of our results with the already published results confirms the improvement in the determination of the transit parameters which will also be shown in the presentation. This motivates us to conduct the search for exoplanets around the stars with no planet reported till date and extend our search to the system of terrestrial planets around solar-type of stars or brown dwarfs. For this purpose, the forthcoming national large-aperture ground-based telescopes such as the 3.6m Devasthal Optical Telescope or the space-bound telescopes will be undeniably useful.

| ASI2019_269 | Shashanka Gurumath | Oral |
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| 1) Shashanka R. Gurumath 2) Hiremath K.M. 3) Ramasubramanian V. 4) Kinsuk Acharyaa | | |
| Study on Angular Momentum of G-Stars and Their Exoplanets | | |
| In order to understand the distribution of angular momenta of Solar system objects, we estimate the spin angular momentum (J⋆) of host stars that follow a power law 10^(42.33±5.40) (M*/MΘ)^(4.18±0.53) with stellar mass (M*/MΘ). The orbital angular momenta (Lp) of exoplanets are estimated, and the best fit yields 10^(42.66±1.79) (Mp/MJ)^(1.26±0.05) with the exoplanetary mass (Mp/MJ), suggesting that Solar system planets have high orbital angular momentum compared to those of exoplanets. In order to match these momenta to the average orbital angular momentum of the exoplanets, the present mass of all solar terrestrial planets has to be increased, suggesting that a mass in the vicinity (≤ 1.5 AU) of the Sun is missing. Furthermore, the total (spin and orbital) angular momentum (J_tot) of the stellar system is computed, and a power law of the form J_tot = 10^(43.11±6.82) (Mp/MJ)^(0.94±0.14) is obtained. This study suggests that Jupiter and Saturn migrated outward during the early history of Solar system formation. We find that the probability of detecting Earth-like planets is more likely for host stars that have total angular momentum ∼ 1042 kg m2 s−1. Finally, the relationship between masses of the exoplanets and their orbital distances reveals clues about the missing mass in the vicinity of the Sun. | | |

| ASI2019_275 | Gayathri Viswanath | Oral |
|---|---|---|
| Gayathri Viswanath, Mayank Narang, Manoj Puravankara, Blesson Mathew | | |
| Star-Planet Interactions: a study in UV using GALEX and GAIA | | |
| Most (>80%) of the ~3800 confirmed exoplanets known today orbit very close to their host stars, within 0.5 AU. Planets at such small orbital distances can result in significant interactions with their host stars. Through gravitational/tidal and/or magnetic interactions, planets can induce increased activity levels in host stars; host stars can also affect and shape planetary properties via stellar irradiation. Such interactions and their observable consequences are best studied in the ultraviolet regime. In this work, we study the star-planet interactions in the UV using a large sample of GALEX detected host stars with confirmed exoplanets and making use of the improved host star parameters from Gaia DR2. We find that the variation of planet radius with insolation flux from the host star shows a tuning fork trend: beyond a threshold flux, the planet radius increases with increasing insolation flux for giant planets (Rp > 8 R_Earth) and decreases with increasing insolation flux for small planets (Rp < 4 R_Earth). A clear dearth of planets between 4-8 R_Earth also shows up as a sub-Saturn desert. A similar trend is seen in a multi-wavelength analysis of the planet radius variation with FUV, NUV, Visual and NIR flux from the host star at the planet location. Our analysis indicate that either a wavelength independent inflation mechanism is operating or an even higher energy flux contributes more significantly to the planets' atmospheric heating. We further examined if the star-planet interactions enhance the UV activity of stars hosting massive close-in planets. We do not see any clear evidence for enhanced UV activity in stars with close-in planets compared to those with far-out planets, contrary to the claims made by previous studies. | | |

| ASI2019_259 | Namitha Issac | Oral |
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| Namitha Issac, Anandmayee Tej | | |
| Initial phases of high-mass star formation: A case study of Extended Green Object, G12.42+0.50 | | |
| The large-scale Spitzer Galactic Legacy Infrared Mid-Plane Survey Extraordinaire (GLIMPSE), detected the presence of a significant population of objects displaying enhanced and extended emission in the IRAC 4.5 µm band that were later christened as 'green fuzzies' or 'extended green objects' (EGOs). Various studies have speculated the association EGOs with shocked-excited H2 line and/or CO band- heads in protostellar outflows. We, here, present the multiwavelength study of the EGO, G12.42+0.50, with dedicated spectroscopic studies at near infrared, using the spectra obtained from UKIRT-UIST. The associated ionised, cold dust and molecular components of this source are studied in detail employing various observations at mid-, far-infrared, submillimeter and radio wavelengths. The radio continuum emission mapped at 610 MHz and 1390 MHz using GMRT, India, estimates that this region is ionised by an early-B type star(s). The far-infrared studies using Herschel data associate G12.42+0.50 with massive molecular clouds. The kinematic study of the molecular gas using the data from the MALT90 survey and the archives of JCMT reveals signatures of infall as well as outflow activity towards this region. | | |

**ASI-2019 Parallel Session**
**Extragalactic Astronomy II - Time: 16.30 - 18.00**
**Venue: Room 105, First floor, Central Block**
**Extragalactic Astronomy II [Chairperson: K S Dwarakanath]**

| ASI2019_491 | Amit Shukla | Oral |
|---|---|---|
| Amit Shukla | | |
| Implications of observed short-timescale gamma-ray variabilities on blazars jets | | |
| The locations of emission of gamma-ray radiation in active galactic nuclei jet are highly debated and it ranges from light-hours to a few light-years in quasar jets. The situation is more complex in the case of flat spectrum radio quasars, where the gamma-rays photons above 10 GeV may interact with the UV radiation from a broad line region and get absorbed. I will be talking about the recent detections of high energy photons during the minute-scale variability at gamma-ray energies from flat spectrum radio quasars. The minute-scale variability and detection of high energy photons from blazar jets challenge the standard shock-in-jet scenario where gamma-ray emission of blazars is commonly assumed to be associated with shocks traveling down the jet. The observed fast variability indicates dissipation of magnetic islands from the base of the jet encountering the turbulent plasma at the end of the magnetic nozzle. | | |

| ASI2019_390 | Jithesh V | Oral |
|---|---|---|
| V.Jithesh and Ranjeev Misra | | |
| Long-term X-ray spectral variability of the ultra-luminous X-ray source M81 X-6 | | |
| We present the long-term X-ray spectral variability of the ultra-luminous X-ray source (ULX) M81 X-6 using {\it Suzaku} and {\it XMM-Newton} observations performed during 2001--2015. The observed spectra were first fitted by a standard multi-temperature disk plus a thermal Comptonization component which revealed spectral variability of the source with a change in the optical depth of the Comptonizing component similar to the other ULXs. We further investigated the spectral evolution of M81 X-6 using the relativistic accretion disk emission plus a power law component. The parameters for the black hole mass and spin were found to be degenerate, but the high spin and larger mass (20 - 100 solar mass) solutions provided near Eddington accretion rates consistent with the assumptions of the model. The source exhibits three different spectral shapes during these observations and the spectral variation is found to be driven by accretion rate changes, where the derived mass accretion rate varies by more than an order of magnitude in these observations. Thus, these results indicate the presence of a dominant relativistic disk emission component in some of the spectral states of the source. | | |

| ASI2019_480 | Rukaiya Khatoon | Oral |
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| Rukaiya Khatoon (Tezpur University, Assam), Dr. Rupjyoti Gogoi (Tezpur University, Assam), Prof. Ranjeev Misra (Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune), Dr. Sunder Sahayanathan (Bhabha Atomic Research Centre (BARC), Mumbai), Dr. Atreyee Sinha (APC, AstroParticule et Cosmologie, Université Paris Diderot, France), Dr. Soma Mandal (Government Girls' General Degree College, Kolkata, West Bengal), Nilay Bhatt (Bhabha Atomic Research Centre (BARC), Mumbai) | | |
| The flux distribution of individual blazars as a key to understand the dynamics of particle acceleration | | |
| The observed lognormal flux distributions in the high-energy emission from blazars have been interpreted as being due to variability stemming from non-linear multiplicative processes generated dynamically from the accretion disc. On the other hand, rapid minute scale variations in the flux point to a compact emitting region inside the jet, probably disconnected from the disc. In this work, we show that linear Gaussian variations of the intrinsic particle acceleration or escape time-scales can produce distinct non-Gaussian flux distributions, including lognormal ones. Moreover, the spectral index distributions can provide confirming evidence for the origin of the variability. Thus, modelling of the flux and index distributions can lead to quantitative identification of the micro-physical origin of the variability in these sources. As an example, we model the X-ray flux and index distribution of Mkn 421 obtained from ∼9 yr of MAXI observations and show that the variability in the X-ray emission is driven by Gaussian fluctuations of the particle acceleration process rather than that of the escape rate. | | |

| ASI2019_68 | Rudrani Kar Chowdhury | Oral |
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Rudrani Kar Chowdhury, Suchetana Chatterjee, Anto. I. Lonappan, Nishikanta Khandai, Tiziana DiMatteo

## Effect of AGN feedback on the simulated galaxy groups and clusters

Feedback from active galactic nuclei (AGN) has a very profound effect on structure formation. By studying the X-ray properties of simulated galaxy groups we evaluate the effect of AGN feedback on the gas in the intra-cluster (group) medium. We compute the X-ray flux in the vicinity of an AGN and find a decrement of the average flux when compared with a scenario where AGN is absent. It can be explained in terms of the feedback from the central engine, which is displacing the gas from the centre of the group/cluster resulting in a reduction of the X-ray flux. We show that the average X-ray flux in the central region of a galaxy group/cluster follows a broken power-law type behaviour with AGN luminosity at z=1. We also find that black hole growth gets suppressed at halos of mass higher than 10^13 M_{sun} which indicates the self regulatory growth of the AGN. From our result downsizing of the AGN luminosity with halo mass is clearly observed which supports the results obtained from clustering studies of AGN. For the first time we use a fully cosmological-hydrodynamic simulation to evaluate the global effects of AGN feedback on X-ray observables and propose that non-gravitational effects such as AGN feedback might be the leading cause for suppressing black hole growth as has been previously suggested. We propose future observations of high redshift AGN through which this paradigm can be robustly tested.

| ASI2019_257 | Bhoomika Rajput | Oral |
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Bhoomika and C.S.Stalin

## Gamma-ray flux variability and spectral characteristics of Fermi blazars

Blazars are radio-loud active galactic nuclei (AGN). These sources with their relativistic jets pointed close to be observer show flux variations over the entire accessible electromagnetic spectrum from low energy radio to high energy gamma-rays. As of today, our knowledge on the gamma-ray flux variability and spectral characteristics of blazars is limited to a few number of sources discovered by EGRET onboard the Compton Gamma ray Observatory. However, a complete characterization of the gamma-ray flux variability and spectral nature of blazars is now possible with the availability of many hundreds of blazars discovered by the Fermi gamma-ray space telescope launched in 2008. Blazars also dominate the extragalactic gamma-ray sky revealed by Fermi. We have carried out a systematic study on spectral characteristics and gamma-ray flux variability of about one thousand blazars discovered by Fermi. For flux variability analysis and gamma-ray average spectra, data from Fermi covering about 9 years was used. The analysis was carried out separately for flat spectrum radio quasars (FSRQs) and BL Lac objects (BL Lacs). Details of the results will be presented.

| ASI2019_371 | Krishna Mohana | Oral |
|---|---|---|
| Krishna Mohana A, Debbijoy Bhattacharya | | |
| Multiwavelength timing studies of blazar subclasses | | |
| Blazars are a class of radio-loud (RL) active galactic nuclei (AGN) with relativistic jet making very small angle with the line of sight of observer. Due to the small jet to line of sight angle, the emission from jet is significantly Doppler boosted and exhibits high luminosities. Blazars emit radiation throughout the electromagnetic spectrum and their observed flux exhibits variations at different time intervals. Observationally, blazars are further subclassified as Flat Spectrum Radio Quasars (FSRQs) and BL Lacertae (BL Lac) objects. BL Lacs are further classified low-synchrotron peaked (LSP), intermediated-synchrotron peaked (ISP) and high-synchrotron peaked (HSP) BL Lacs. This study is primarily focused on the short-term behaviour of sources from different subclasses of blazars in multi-waveband. List of blazars are selected with adequate coverage across electromagnetic waveband. A systematic study is carried out across the different blazar subclasses to examine their nature of variability. The observations in γ-ray band from Fermi-LAT, X-ray and UV band from SWIFT-XRT and UVOT, optical data from SMARTS optical near IR monitoring program and Catalina sky survey and other space and ground observatories are used in this work. The preliminary results of our study is presented here. | | |

**ASI-2019 Parallel Session**
**General Relativity and Cosmology II - Time: 16.30 - 18.00**
**Venue: Council Room, Ground Floor, Central Block**
**General Relativity and Cosmology II [Chairperson: Harvinder Jassal]**

| ASI2019_662 | Archana Pai | Invited |
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| Archana Pai, IIT, Bombay | | |
| First Gravitational Wave transient catalog | | |
| The first two observing runs of the Advanced ground based detector networks with LIGO and Virgo have significantly enhanced our understanding of compact binaries in the universe. A total of 11 compact binary mergers were observed with ten black hole binaries and one neutron star binary system. This talk will summarise the observations and new insights we received from these observations. | | |

| ASI2019_497 | Haris MK | Oral |
|---|---|---|
| K. Haris (ICTS-TIFR), Ajit Kumar Mehta (ICTS-TIFR), Sumit Kumar (AEI, Hannover), Tejaswi Venumadhav (IAS, Princeton), Parameswaran Ajith (ICTS-TIFR) | | |
| Identifying strongly lensed gravitational wave signals from binary black hole mergers | | |
| Based on the rate of gravitational-wave (GW) detections by Advanced LIGO and Virgo, we expect these detectors to observe hundreds of binary black hole mergers as they achieve their design sensitivities. A small fraction of them can undergo strong gravitational lensing by intervening galaxies, resulting in multiple images of the same signal. To a very good approximation, the lensing magnifies/de-magnifies these GW signals without affecting their frequency profiles. We develop a Bayesian inference technique to identify pairs of strongly lensed images among hundreds of binary black hole events, demonstrate its performance using simulated GW observations and apply it on the first binary black hole events detected by LIGO and Virgo. | | |

| ASI2019_71 | Ashish Meena | Oral |
|---|---|---|
| Jasjeet Singh Bagla | | |
| Gravitational Lensing of Gravitational Waves | | |
| We investigate the finite wavelength effects in gravitational lensing of gravitational waves. In our study, we use a wide range of gravitational lenses, i.e., microlenses, galaxy lenses, and cluster lenses, to estimate the correction terms arising in the amplification factor due to the finite wavelength of the gravitational waves. | | |

| ASI2019_368 | Suvedha Naik | Oral |
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| Suvedha Suresh Naik, Kazuyuki Furuuchi | | |
| Probing primordial features using red-shifted 21 cm line | | |
| Cosmic Microwave Background (CMB) observations reveal tiny inhomogeneities in temperature which indicates perturbation of density existed in the beginning of the universe called Primordial Density Perturbation (PDP). Near future observations of red-shifted 21 cm line from neutral hydrogen will open up a new and exciting window for probing cosmology and fundamental physics. Future observations (such as SKA) of red-shifted 21 cm will provide new data of matter distribution in the redshift range $z < 27$. The observational data of CMB and large scale structures are well explained by the standard ΛCDM model which assumes an almost scale invariant power spectrum of PDP. The new particle physics model of cosmic inflation predicts bump like features in the power spectrum of PDP. This model arises from a compactification of higher dimensional gauge theory. Observations of 21 cm line fluctuations are expected to be a promising tool to test such inflation models. These futuristic observations of red-shifted 21 cm line can be compared with predictions of theoretical models using simulations of cosmological 21 cm signal. We simulate cosmological volumes of 21 cm line fluctuations using semi-numeric code 21cmFAST. We modified the initial power spectrum template by adding a feature parameterized by the amplitude A and scale k in 21cmFAST. We present the impact of modifying the feature parameters on simulation outputs such as power spectrum of differential brightness temperature. | | |

| ASI2019_199 | Abhimanyu Susobhanan | Oral |
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Abhimanyu Susobhanan, Prakash Arumugasamy, Manjari Bagchi, Avishek Basu, Suryarao Bethapudi, Arpita Choudhary, Kishalay De, Shantanu Desai, Lankeswar Dey, Neelam Dhanda, Achamveedu Gopakumar, Yashwant Gupta, Bhal Chandra Joshi, M.A. Krishnakumar, Yogesh Maan, P.K. Manoharan, Arun Kumar Naidu, Dhruv Pathak, Ashis Paul, Siraprapa Sanpa-arsa, Mayuresh Surnis, Sai Chaitanya Susarla

## The Indian Pulsar Timing Array Experiment

The Indian Pulsar Timing Array (InPTA) is an experiment aimed at contributing to the International Pulsar Timing Array (IPTA) efforts to detect gravitational waves (GWs) in the sub-microHertz frequency range by observing an ensemble of millisecond pulsars (MSPs). Matured IPTA will be sensitive to both stochastic GW background as well as GWs from individual sources such as supermassive black hole binaries (SMBHBs). Our InPTA uses the upgraded Giant Metrewave Radio Telescope (uGMRT) and the Ooty Radio Telescope (ORT) to observe a carefully chosen sample of 20 MSPs at a bi-weekly cadence. InPTA has been now operational for the last three years providing a baseline for advanced statistical Gravitational Wave analysis similar to other international experiments and the first limits on stochastic GW are expected in the next six months. The wide frequency coverage provided by the uGMRT and the ORT should enable very accurate characterization of dispersion measure (DM) variations seen in some of the IPTA MSPs. At present, we are able to achieve time-of-arrivals (TOAs) with microsecond uncertainties and efforts are on to achieve TOAs with 100 ns uncertainties. This presentation will showcase the timing residuals and timing solutions obtained from our data, apart from preliminary results on individual pulsars. Additionally, we are pursuing several IPTA-relevant efforts such as developing prescriptions to search for nano-Hz GWs from SMBHBs in eccentric orbits and to characterize effects on the puslar signal due to diffractive interstellar scintillation. We also contribute to the IPTA by providing theoretical inputs, which include post-Newtonian-accurate timing residuals arising due to SMBHBs, an efficient method to solve the reactive orbital evolution equations to the leading order, as well as an improved binary model for compact nearly-circular pulsar binaries.

# 20th February 2019

## Plenary Session 1
## Early Universe and Epoch of Reionisation

| Ravi Subrahmanyan | Plenary |
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Ravi Subrahmanyan, RRI, Bengaluru

### Towards detecting radio signatures of cosmic dawn

As first light from the first stars transforms the universe from the dark ages into cosmic dawn, the history may be traced in redshifted 21-cm from neutral hydrogen in the gas. Efforts to build precision radiometers over the 40-200 MHz band to detect this faint signal are beginning to yield results of significance to the theory, thus constraining the starlight of the earliest galaxies. I will review the field and discuss the problems and progress.

| Tirthankar Roy Choudhury | Plenary |
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Tirthankar Roy Choudhury, NCRA-TIFR, Pune

### Epoch of reionization: probing cosmology and the first stars

Studying the epoch of reionization is of immense importance because of its direct connection to the formation of the first stars in the Universe. Research in this area received a big boost due to the availability of a variety of observational data accumulated over the past few years. Further progress is expected soon from a number of different ground-based and space-borne experiments. In this talk, we will review our understanding of the physical processes related to cosmic reionization based on available data and also discuss future prospects.

| Harvinder Jassal | Plenary |
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Harvinder Kaur Jassal

### Dark energy: Current status and future prospects

More than two thirds of the energy budget of the Universe is due to a exotic component called dark energy. Understanding the nature of dark energy is of fundamental importance in present day cosmology. Various promising methods exist for exploring the source of this component. Due to lack of a fundamental theory, the approach to this understanding is phenomenological. In this talk, I will present constraints on different classes of dark energy models using different observations. I will also discuss how we can go beyond pure distance measurements and explore structure formation in the universe if dark energy clusters. I will describe prospects for further improvement in constraints from ongoing and future surveys.

**ASI-2019 Thesis Presentations I - Time: 11:30 - 13:00**
**Venue: KE Auditorium**
**Thesis Presentation I [Chairperson: Jayaram N Chengalur]**

| ASI2019_320 | Tanmoy Chattopadhyay | Invited |
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Tanmoy Chattopadhyay (Penn State), S. V. Vadawale (PRL), A. R. Rao (TIFR), Dipankar Bhattacharya (IUCAA), team members of AstroSat-CZTI

### Observational Aspects of Hard X-ray Polarimetry

CZT Imager onboard AstroSat is primarily a hard X-ray spectroscopic instrument but provides sensitive polarization measurements in the energy range of 100 – 300 keV. Crab and Cygnus X-1 are the two potential targets for CZTI polarimetry. With an accumulated 800 ks of observation, CZTI provided till date statistically the most significant polarization measurement for Crab (32% for all-Crab and 40% for the off-pulse). Phase resolved polarimetry of the pulsed radiation of Crab has also been attempted for the first time in X-rays. Another important characteristic of CZTI is the increasing transparency of the support structure in hard X-rays, which enables it to function as a wide field hard X-ray monitor providing an unique opportunity for GRB detection and polarization measurement. In a sample of 50 GRBs detected by CZTI in 1 year after the launch, we attempted polarization measurement for 11 bright GRBs. A large sample of such polarization measurements is supposed to shed more light into the emission mechanism of GRB prompt emission. Currently, we are implementing a few new techniques in the polarization analysis to improve the sensitivity of the instrument for both ON and OFF-axis sources. These techniques enable polarization measurement all the way to 600 keV, which is critical for BH X-ray binaries like Cygnus X-1 to resolve the mystery of corona vs jet origin of X-rays beyond 100 keV. I would briefly present the basics of CZTI polarimetry along with the new techniques and the recent findings.

| ASI2019_37 | Reju John | Oral |
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Reju Sam John

### Study of Energy Distribution in Evolving Dynamical States of Galaxy Clusters and Groups

Galaxy clusters are known to be the reservoirs of Cosmic Rays (CRs), mostly inferred from theoretical calculations or detection of CR derived observables. Though CR electrons have been detected through radio emissions, CR protons and its derivative gamma rays remained undetected. CR acceleration in clusters is mostly attributed to its dynamical activities that produce shocks. Shocks in clusters emerge out of merger or accretion but, which one is more effective? at which dynamical phase? and why? So, in quest of answers, we study the detail evolution of cosmic ray emission in the galaxy clusters using cosmological simulations with enzo code. Defining appropriate dynamical states using the concept of virialization, we have studied a sample of merging and non-merging clusters. We report that the merger shocks (Mach, M = 2-5) are the most effective CR producers in clusters. Clusters once merged, permanently deviate from CR and X-ray mass scaling of non-merging systems, enabling us to use it as a tool to determine the state of merger. Through a temporal and spatial evolution study, we found a strong correlation between cluster merger dynamics and CR injection. We have observed that the brightest phase of X-ray and CR emission from clusters occur respectively about 1.0 and 1.5 Gyr after every merger. This finding of delay in CR injection peaks can be a useful information to shed light upon the brightest phase of gamma-rays from clusters of galaxies. This may also be a guiding information to select appropriate targets for gamma-ray detection from clusters. Not only that, but we have also shown that galaxy groups that are supposed to be Gamma quiet are rather comparatively more active than we thought and follow different scaling laws than the clusters and they can also be seen in non-thermal energies.

| ASI2019_446 | Somnath Dutta | Oral |
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Somnath Dutta

## MULTI-WAVELENGTH STUDIES ON GALACTIC H II REGIONS

The formation of a star cluster is a topic of considerable interest since most stars in our Galaxy form in clusters. Several environmental conditions can breed young clusters such as: fragmentation of the swept up matter in the shells of the expanding H II regions, external compression of pre-existing clumps by nearby massive stars, matter sandwiched between bubbles, at the collision point of molecular clouds and at the junction of converging filaments or hub of filamentary systems. With an objective to understand better the star formation, I have investigated star formation activities of three distant star-forming regions e.g., PGCC G108.37-01.06 (hereafter, PG108.3), NGC 2282 & Cygnus OB7 (CygOB7) using multiwavelength data. The IPHAS images reveal H-alpha emission at various locations around our target, and optical spectroscopy at 2m HCT of the bright sources in those zones of H-alpha emission disclose massive ionizing sources. Based on the stellar surface density map constructed from the deep near-infrared (NIR) CHFT or UKIDSS observations, we find prominent star clusters in those molecular clouds. Using IR colour-colour criteria and H-alpha emission properties, we have identified the candidate YSOs in the region, which include the Class II, Class I YSOs. Our I-band time-series photometry at 2m HCT and 1.3m DFOT of two young clusters NGC 2282 and CygOB7 reveals that 50-65% of the variable stars are Pre-Main Sequence and candidate members of the cluster. A careful inspection of JCMT CO molecular data exhibits that the massive cluster is associated with a number of filamentary structures. Based on the distribution of ionized, molecular gas and young stellar objects (YSOs), we suggest the cluster formation (particularly in PG108.3) is primarily due to filamentary inflows to a hub potential system. However, our observational evidence does not favour any feedback from massive stars to the next generation star formation.

| ASI2019_184 | Soumavo Ghosh | Oral |
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Soumavo Ghosh; Chanda J. Jog & Tarun Deep Saini (PhD supervisors)

## Dynamical Imprint of Dark Matter Halo and Interstellar Gas on Spiral Structure in Disk Galaxies

Spiral arms play a pivotal role in secular evolution and shaping up the chemo-dynamical structure in disk galaxies - this is well-known. Spiral arms scatter stars off the disk mid-plane resulting in heating up the disk, participate in transferring angular momentum from one region to another facilitating the gas inflow in the central regions and influencing the central star formation activity, and also make the stars to migrate from their birth-place. In this doctoral thesis, I have investigated the impact of two structural components, namely, the dark matter halo and the interstellar gas, on the origin and persistence issue of the spiral arms. These studies have been carried out under two well-known paradigms for generation of spiral arms, namely, the density wave theory and the swing amplification mechanism. The basic theoretical model of the galactic disk used involves gravitationally-coupled two-component system (stars and gas) embedded in a rigid and non-responsive dark matter halo. Based on the studies reported in this thesis, the dark matter halo and the interstellar gas are shown to have opposite dynamical effect on the origin and persistence of spiral structure in disk galaxies. Using observational inputs for a sample of dark matter dominated low-surface-brightness galaxies and dwarf irregular galaxies with extended HI disks, I showed that dominant dark matter halo suppresses both the small-scale and large-scale spiral instabilities in disk galaxies. On the other hand, the interstellar gas is shown to decrease the group velocity of a wavepacket of density wave in Milky Way-like galaxies and thus help the spiral features to survive for a longer time-scale (several billion years). Also, using observed rotation curves and measured pattern speeds of spiral arm for three gas-rich disk galaxies, I showed that the interstellar gas is necessary for getting a stable density wave for observed pattern speed.

| ASI2019_59 | Swagat Das | Oral |
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Swagat Ranjan Das

## Observational Studies of Galactic Star Forming Regions

Massive stars, with their radiative, mechanical and chemical feedback, are key players influencing the local and global dynamical and chemical state of the interstellar medium through ionization and radiation pressure, stellar winds, outflows and supernovae. These stars are therefore fundamental and crucial for unravelling the astrophysics of the formation, sustenance, and dissipation of structures ranging from the largest, Galactic scales, to giant molecular clouds, disks, and planetary systems. The need for a complete and consistent picture of the processes involved in the formation of the high-mass stellar population is evident from the lack of consensus and the various theories proposed. This is compounded with the challenges in observing this regime. Motivated by the above scenario, this thesis presents multiwavelength studies focussed towards a selected sample of Galactic massive star-forming regions. With the aim to gain a better insight into the formation mechanism of massive stars and their feedback on the surrounding interstellar medium, we selected two infrared dust bubbles (S10, CS51) and two H II regions (G346.077−0.056 and G346.056−0.021). Towards north east of the bubble S10, an extended green object EGO G345.99−0.02 is located at an angular distance of ∼ 5′, which is also studied along with S10. In addition, a statistical investigation of cold dust emission towards a large sample of seventeen IR dust bubbles has been achieved.

| ASI2019_154 | Veena VS | Oral |
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Veena V. S

## IRDCs to Star Clusters: In Depth Study of Structure, Evolution and Kinematics of Few Southern Massive Star Forming Regions

The formation and the evolution of massive stars are found to dominate the fate of their parental clouds and the host galaxies. This is primarily due to the enhanced feedback mechanisms from these stars that alter the environments on local, global and cosmic scales. While theoretical formulations have been proposed to explain their formation, observational studies of the early phases remain limited. Most of these observational works are designed to examine the large scale properties of a sample of massive star forming regions. While there are studies that focuses on individual regions, majority of them probe the northern Galactic sky. In this context, we have carried out a multiwavelength study towards three massive star forming regions in the southern Galactic sky. Our intention was to examine the properties and initial conditions related to the formation of massive stars and how these properties change with evolution. Radio observations serve as a powerful tool to discern regions associated with newly formed massive stars as well as identifying the nature of the ionising sources. Far-infared and millimeter continuum data traces the emission from the cold and dense regions of molecular clouds that often appear as dark extinction features in the optical images. Near and mid-infrared data on the other hand, are useful in examining the warm dust emission and young stellar objects in these regions. Spectral line data such as radio recombination lines and molecular lines are excellent to probe the complex kinematics of the ionised gas and molecular cloud. Using the multiwavelength approach, objects in different evolutionary stages are identified, from quiescent cores in infrared dark clouds, to evolved star clusters. The results reveal that an interplay of various feedback mechanisms and cloud density structure govern the observed morphologies, kinematics and star formation activity in these regions.

# 21st February 2019

## Plenary Session 2
## ASTROSAT Science results

| Dipankar Bhattacharya | Plenary |
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Dipankar Bhattacharya, IUCAA, Pune

### AstroSat observations of Compact Stars

The Indian space mission AstroSat is a powerful observatory for compact stars, given its broad band X-ray coverage and fast timing capability. Observations of systems containing white dwarfs, neutron stars and black holes carried out with AstroSat have yielded new insight on accretion flows around compact objects as well as radiation mechanisms involved in both isolated and accreting compact stars. This talk will present an overview of the capabilities of AstroSat for observations of compact stars, the results obtained so far and future plans.

| Koshy George | Plenary |
|---|---|

Koshy George, Christ (Deemed to be University), Bengaluru

### Ultraviolet view of star formation quenching in galaxies

Spiral galaxies like our own Milky Way maintains a constant star formation in the disk through continuous replenishment of gas supply from infall and accretion. The ongoing star formation in a spiral galaxy can however be quenched due to internal and external processes. AGN feedback (internal) and ram pressure stripping (external) are the two efficient processes that are hypothesised to be responsible for star formation quenching in spiral galaxies. This talk presents an ongoing ultraviolet survey of spiral galaxies in dense environments using ASTROSAT/UVIT where we see evidences of AGN feedback and ram pressure stripping simultaneously quenching star formation in a spiral galaxy.

| Ritaban Chatterjee | Plenary |
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Author: Ritaban Chatterjee Co-authors: Agniva Roychowdhury (Presidency University, University of Maryland Baltimore County), Sagnick Mukherjee (Presidency University), Souradip Bhattacharya (Presidency University), Ritesh Ghosh (Visva-Bharati University)

### Detailed Time Variability Properties of Blazars Using AstroSat

While the X-ray time variability at hours to years timescale of a large sample of Seyfert galaxies have been carried out using observations from RXTE and XMM-Newton, similar study for blazars is not very common. We have used 5-day-long light curves of the blazar Mrk 421 from AstroSat-SXT and AstroSat-LAXPC, along with archival observations from Swift to calculate very detailed power spectra, and inter-band correlation and time lags. We find that the power spectrum has a break, i.e., the slope changes at a certain timescale. This property is similar to Seyfert galaxies and Galactic black hole X-ray binaries (BHXRBs) where such break is present in many cases and the break timescale is related to the BH mass. However, in those sources the X-rays are from the accretion disk-corona region while in the blazars it is from the jet. Therefore, a similar power spectrum may indicate that changes in the accretion disk, which may be the source of the break timescale are translating into the jet, where the X-rays are produced. We model the non-thermal emission from the jet assuming certain modes of its connection with the disk to test if the resultant variability produces power spectra similar to that

obtained from the data. Furthermore, we correlate the X-ray variability at multiple energy bands and calculate the phase spectrum and coherence function. The results of these analyses are consistent with the properties of non-thermal emission in blazars jets. We compare the short-timescale (hr-days) X-ray power spectrum of Mrk 421 with those obtained from similar archival data to test if the shape and slope of the power spectra stay stationary at the timescale of years.

**ASI-2019 Thesis Presentations II - Time: 11:30 - 13:00**
**Venue: KE Auditorium**
**Thesis Presentation II [Chairperson: Suchetana Chatterjee]**

| ASI2019_244 | Vedavathi P | Oral |
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Vedavathi P and Vijayakumar H Doddamani

## Emission line and continuum variability study of active galaxies for redshift 0 < z ≤1.0

IUE satellite launched in 1978 has made very successful spectroscopic observations of active galaxies till 1997 for the redshift 0.001 to 3.2. We have undertaken spectroscopic analysis of nearly 110 objects for their continuum and emission line variability characteristics in this thesis. We have found only a small fraction of the NGC catalogued AGNs to be satisfying the generally accepted characteristics of active galaxies. The emission lines Lyα, Si IV, C IV, He II, C III], and Mg II have been observed as the strong and broad emission lines in most of the active galaxies. We have standardised the UV continuum and line flux variability by Rmax and Fvar parameters as many of these active galaxies (~ 30 %) were observed repeatedly. We have found the highest Fvar to be 0.311 at 1325 Å continuum in the case of MRK 478 from long term monitoring observations and small amplitude variability of 9% at 1325 Å in the case of NGC 4151 from the most constraining shortest time scale (1 hour) observations. We have found the line flux ratio C IV/C IIII] ranging between 3 - 7 and is consistent with the prediction of Kwan and Krolik (1981) model for Seyfert 1 galaxies. We have found no appreciable delay among continuum-continuum flux correlations. However a small zero-lag delay of 0.02 days has been found in the case of line-line flux correlations in NGC 4151 implying smaller geometry of BLR region compared to the 4 ±3 days size by Clavel et al (1990). The implications of these results on the UV variability characteristics of Seyfert galaxies and Quasars are discussed in greater detail in my talk. Key Words: Active galaxies, Seyfert1 galaxies, Quasars, UV variability.

| ASI2019_514 | Ajanta Datta | Oral |
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| Ajanta Datta | | |
| Waves in Solar Atmosphere and their Role in Dynamics of the Corona | | |
| In this thesis we have studied few coronal phenomena with different spatial and time scales and studied their roles in coronal dynamics We have used simultaneous imaging and spectroscopic data from JOP 165 to understand the nature of the propagating disturbances (PDs). We have detected and shown that there might be quasi-periodic up flows near the footpoint of an active region coronal loop, while in the upper part of loop, waves are dominant. By using emission lines of different layers we have also shown that these waves propagate from the lower atmosphere to the corona. We have studied the wave damping along polar plumes which are open magnetic structures. Using the images from AIA on SDO, frequency dependence of slow wave mode have been studied and found out that the thermal conduction may not be the main source for damping. We have filtered the Hi-C images, which enabled us to see the finer structures at the braided region of active region moss. We have found periodic intensity variation with 30-60s. time period. We also find repeated plasma flows in this region, which is a signature of repeated reconnection. We have confirmed the presence of large amplitude, high frequency transverse waves. These high frequency dynamics could contribute significantly to the energy balance of the moss regions within active region. We have reported and analysed twisting/untwisting motions during and after a prominence eruption. We have shown that anticlockwise twist of both the footpoints propagated along the spine and induced large scale twist. We have also found that a large amount of twist is transferred to the CME. In this study we have shown the possible magnetic energy transfer through different layers of solar atmosphere. | | |

| ASI2019_271 | Gopal Hazra | Oral |
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| Gopal Hazra, Supervisors: Prof. Arnab Rai Choudhuri & Prof. Dipankar Banerjee | | |
| Understanding the behavior of the Sun's large scale magnetic field and Its relation with the meridional flow | | |
| In this thesis, various studies leading to better understanding of the 11-year solar cycle are performed using theoretical dynamo models. Although this is primarily a theoretical thesis, there is a part dealing with the analysis of observational data. The various proxies of solar activity (e.g., sunspot number, sunspot area and 10.7 cm radio flux) from various observatory including the sunspot area records of Kodaikanal Observatory have been analyzed to study the irregular aspects of solar cycles and an analysis has been carried out on the correlation between the decay rate and the next cycle amplitude. The theoretical analysis starts with explaining how the magnetic buoyancy has been treated in the flux transport dynamo models, and advantages and disadvantages of different treatments. It is found that some of the irregular properties of the solar cycle in the decaying phase can only be well explained using a particular treatment of the magnetic buoyancy. Next, the behavior of the dynamo with the different spatial structures of the meridional flow based on recent helioseismology results has been studied. A theoretical model is constructed considering the back reaction due to the Lorentz force on the meridional flows which explains the observed variation of the meridional flow with the solar cycle. Finally, some results with 3D FTD models are presented. This 3D model is developed to handle the Babcock-Leighton mechanism and magnetic buoyancy more realistically than previous 2D models and can capture some important effects connected with the subduction of the magnetic field in polar regions, which are missed in 2D surface flux transport models. This 3D model is further used to study the evolution of the magnetic fields due to a turbulent non-axisymmetric velocity field and to compare the results with the results obtained by using a simple turbulent diffusivity coefficient. | | |

| ASI2019_179 | Vaibhav Pant | Oral |
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Vaibhav Pant

Dynamics of coronal transients as seen from space observations

The Sun is our nearest star. Due to the presence of magnetic field, the solar atmosphere is highly structured and manifests a myriad of transients of different spatial and temporal scales. From spicules to coronal mass ejections (CMEs), transition region jets to sunspots; transients of different spatial and temporal scales are found in the solar atmosphere. In spite of decades of observations, our understanding of the solar transients is still poor. Some of the long debated issues are the nature and sources of propagating disturbances (PDs) in the solar corona, drivers of transverse and longitudinal oscillations in the coronal loops, monitoring CMEs in the heliosphere and estimating their arrival times on the Earth etc. In my PhD thesis, I attempted to study the properties of a few small and large-scale transients combining multi-wavelength observations using space-based instruments hoping to address some of the long-standing problems. The first part of the thesis is focussed on the study of the dynamics of the small-scale coronal transients in the solar atmosphere and their interaction with other magnetic structures. The second part of the thesis is focussed on the study of the large-scale coronal transients such as CMEs which are the eruptions of magnetic field and plasma from the atmosphere of the Sun into the heliosphere. In this talk, I will outline some of the major results of my research work done during my PhD tenure.

**ASI-2019 Parallel Session**
**Stars, ISM and the Galaxy III - Time: 14:00 - 15:30**
**Venue: Room 911, 9th Floor, Central Block**
**Stars, ISM and the Galaxy III [Chairperson: Mousumi Das ]**

| ASI2019_280 | Bhaswati Mookerjea | Invited |
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Bhaswati Mookerjea

Photon Dominated Regions: The secrets they reveal

Photon Dominated Regions or Photo Dissociation Regions (PDRs) have emerged as a class of astrophysical objects by virtue of their ubiquity and prominent presence in the infrared sky. These are one of the most magnificent manifestations of the impact of the radiation from massive stars on the surrounding interstellar medium. The PDRs play an important role in structure formation by cooling the gas and also have been identified to trace a significant amount of molecular gas otherwise not traced by CO. Availability of sensitive and high-resolution spectrometers in the far-infrared during the last decade has vastly improved our understanding of the physical structure and kinematics of gas affected by the radiation from massive stars in our Galaxy. In this talk I will present an overview of the results of our recent observations of a few Galactic PDRs with the Stratospheric Observatory for Far Infrared Astronomy (SOFIA).

| ASI2019_316 | Tapas Baug | Oral |
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T. Baug (KIAA), L. K. Dewangan (PRL), D. K. Ojha (TIFR)

## Influence of stellar wind of Galactic Wolf-Rayet stars on parent molecular clouds

Wolf-Rayet (W-R) stars (>20 Msun) are at the intermediate phase of the evolution descended from their early O-type progenitors. They have the ability to influence their surrounding molecular gas for producing new generation of star formation through their high mass-loss rates and high speed stellar winds. They may develop wind-blown expanding shells of parsecs-to-ten-parsec scales with typical expansion velocities of a few km/s, and ``Collect and Collapse'' triggering process may occur at the boundary of expanding molecular shells. We investigate four Galactic sites associated with W-R stars using a multi-wavelength approach. Signature of the cavity in the parent molecular cloud is found by a trough in between two emission peaks in the 13CO spectrum constructed along all four W-R stars. Spectro-photometric distances of all W-R stars agree well with kinematic distances corresponding to velocities of troughs. Presence of expanding molecular shells with expansion velocities from 2-5 km/s is inferred by the presence of ring-like structures in the position-velocity (p-v) diagrams of 13CO data. Also, W-R stars are located towards the center of these structures in the p-v diagrams indicating them to be the primary driving sources. Estimation of pressure components reveals that the pressure due to stellar wind dominates over the radiation pressure by an order of magnitude, and has the ability to influence the molecular gas within ~10 pc. Active star formation is traced in all selected sites inferred by the presence of rich cluster of young stellar objects (YSOs) within 10 pc of the W-R stars. Generally, clusters of YSOs are found to be associated with dense C18O (or 13CO) molecular condensations. Details of this study will be presented in the talk.

| ASI2019_17 | Suchira Sarkar | Oral |
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Suchira Sarkar, co-author- prof. Chanda J. Jog, IISc

## Vertical distribution of stars and flaring in the Milky Way

We study the vertical stellar distribution of the Milky Way thin disk in detail with particular focus on the outer disk. We treat the galactic disk as a gravitationally coupled system of stars and gas in the gravitational field of the dark matter halo and obtain the vertical distribution of stars and gas for the radial range of 4-22kpc. We show that the gravitational fields of gas and halo play dominant role in constraining the thickness of the stellar disk in inner and outer Galaxy respectively. The disk thickness is reduced by a factor of 3–4 in the outer Galaxy due to the force field of the halo, which may help the disk resist distortion at large radii. Despite this constraining effect we find that the thickness of the disk increases steadily with radius, flaring steeply beyond 17 kpc. This shows that flaring is a generic result in the outer Galaxy. For details of this work, please see- S. Sarkar and C. J. Jog A&A 617, A142 (2018)

| ASI2019_289 | Deepak | Oral |
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Deepak; Bacham E. Reddy; David L. Lambert

## The Galactic Halo: Stellar Populations and Formation History

The halo of the Milky Way is understood to be formed early on from a mixture of dissipative collapse and accretion. Chemically, it is predominantly metal-poor and enriched in the alpha-elements. It has been shown to split into two chemically distinct components. Recent studies have reported the presence of alpha-poor stars in halo samples. These studies have shown that the alpha-poor sequence is distinct in kinematics, ages, and other chemical elements (e.g., C, Na, and Cu) compared to the alpha-rich sequence. The alpha-rich stars may have formed in situ. It is thought that the alpha-poor sequence is assembled through the accretion of satellite galaxies. Kinematically, this population tends to move on retrograde orbits with rather small values of the vertical component (W) to the Galactic velocity but a large spread in the velocity component (U) toward the Galactic center. In this talk, we plan to present preliminary results from our ongoing study of the galactic halo using large spectroscopic and astrometric surveys. Depending on these results we also plan to speculate on its formation and evolution history.

| ASI2019_407 | Bharat Kumar Yerra | Oral |
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Y. Bharat Kumar, G. Vigeesh, Raghubar Singh

## Identifying Li-rich giants from LAMOST low resolution spectra using machine learning

Less than 200 giants are known to show anomalous high Li abundances in their photospheres, indicating the rarity of Li-rich giants in the universe. LAMOST survey provides millions of low resolution (R$\sim$1800) spectra of stars in the Milky Way, which enables to perform systematic search for these rare class of giants. Based on Li abundances derived from line ratio method (Kumar et al. 2018) we selected 1000 good quality spectra of Li-rich giants with Li abundances ranging from 1.7 to 4.5 dex. We use this as a training set to fit a supervised classification model and estimate Li abundances for 1 million spectra of giants from LAMOST. Results increased the Li-rich giant candidates to 10 fold to the existing catalog of Li-rich stars, which puts strong constraints on statistical distribution of Li in giants. The candidates present in this new catalog would be worthwhile exploring for detail abundance analysis of various elements based on high resolution spectra, which will put constraints on Li origin in giants and Galactic Li evolution.

**ASI-2019 Parallel Session**
**Extragalactic Astronomy III - Time: 14:00 - 15:30**
**Venue: Room 105, First floor, Central Block**
**Extragalactic Astronomy III [Chairperson: Sushmita Chakraborty]**

| ASI2019_462 | Chayan Mondal | Oral |
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| Chayan Mondal, Annapurni Subramaniam, Koshy George | | |
| UVIT view of IC 2574 : Are the star formation driven by expanding and colliding shells? | | |
| We present a deep FUV imaging study of a nearby dwarf irregular galaxy IC 2574 using the Ultraviolet Imaging Telescope (UVIT). We identified 38 FUV bright star forming regions in the galaxy and explored their connection with the present H~I shells. The FUV emission is mostly found to be co-located with the average H~I surface density more than $10^{21} cm^{-2}$. The size and mass of the identified single star forming clumps are found to have a range between 40 - 220 pc and $10^4 - 10^6 M_{\odot}$ respectively. We report two resolved components for the remnant cluster of shell 35 and estimated their masses. The star formation rate of IC 2574 is found to be 0.57 $M_{\odot}$/yr, which is slightly higher compared to the average value of nearby dwarf irregular galaxies. We found $\sim$ 90\% of the star forming regions to be present either along the rim of an H~I shell or in between multiple shells which suggests the expansion or collision of present H~I shells driving the star formation. | | |

| ASI2019_169 | CHRISPHIN KARTHICK | Oral |
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| Chrisphin Karthick | | |
| Photometric Study of Starburst Galaxy NGC 2403 | | |
| This study presents about the photometric study of star-forming regions of star burst Galaxy NGC 2403. We identified 12 star forming regions through narrow band photometry and estimated its star-formation rates (SFR) using H alpha flux. The magnitude and colours of the knots has been estimated. Then each star forming regions has been discussed in detail with respect to their mutual distances and star forming rates within the galaxy. This study helps to understand more about the physical properties and evolution of starburst galaxies. | | |

| ASI2019_304 | Prasanta Nayak | Oral |
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Prasanta. K. Nayak, A. Subramaniam, S. Subramanian, S. Sahu, C. Mondal, Maria-Rosa L. Cioni, C. Bell

## UVIT-HST-GAIA study of star cluster KRON 3 in the Small Magellanic Cloud: A cluster with a large spread in metallicity

A good number of massive intermediate age (∼ a few Gyr) metal poor star clusters in the Magellanic Clouds (MCs) show extended main-sequence turn-off, that cannot be explained by photometric errors or stellar binarity. Kron 3 is one of such cluster, located in the west to the main body of the Small Magellanic Cloud (SMC). In this study, we have demonstrated the power of UVIT-HST-GAIA combination to study star clusters in the Magellanic Clouds. We take advantage of the resolution of the HST in the central region of the cluster and the coverage of GAIA for outer region, to combine with the UVIT data. We have estimated the radius of the cluster Kron 3 as 2.0 arcsec from the UVIT and GAIA data. For the first time, we report the identification of NUV bright red clump (RC) stars and the extension of RC stars over two magnitudes both in colour and magnitude axis in NUV vs NUV−optical CMD. We find that the extension of RC is an intrinsic property of the cluster. With the help of theoretical isochrones, we suggest that Kron 3 exhibits multiple stellar populations with a possible age range of 6-8 Gyr and a metallicity range of [Fe/H] = -2.0 to -1.0. We included VISTA data to cover the IR region and studied the spectral energy distribution of RC stars, which confirms the metallicity spread for RC stars. The temperature of RC stars fall in the range of 5000 to 5500 K. We recommend a spectroscopic study of RC stars can put more light into the metallicity spread present in the cluster. Variable mass loss of stars in RGB can also contribute partially to the identified extension in RC.

| ASI2019_424 | Ashish Devaraj | Oral |
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J. Hutchings, S. N. Tandon, A. Devaraj, P. Joseph, C. S. Stalin, and Others

## Identification of quasar candidates behind the SMC fields observed by UVIT

Small Magellanic Cloud (SMC) being the nearest irregular dwarf galaxy, makes it a perfect candidate for a wide variety of scientific analysis that among other things includes stellar population studies. Some regions of SMC were observed by the Ultra-Violet Imaging Telescope (UVIT) as part of calibration activities. These fields are being analysed with the main motivation of the generation of a UV catalog of the sources identified by UVIT in the SMC fields. One of the scientific problems that is being carried out using this new UV catalog is the identification of active galactic nuclei (AGN) candidates behind SMC using two independent techniques, namely UV colour-colour diagram and UV variability. Details of this work will be presented.

**ASI-2019 Parallel Session**
**General Relativity and Cosmology III - Time: 14:00 - 15:30**
**Venue:Council Room, Ground Floor, Central Block**
**General Relativity and Cosmology III [Chairperson: Anupreeta More]**

| ASI2019_96 | Ranbir Sharma | Oral |
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Ranbir Sharma, IISER Mohali, Punjab Dr. Ankan Mukherjee, IISER Mohali, Punjab Dr. H K Jassal, IISER Mohali, Punjab

### Dark energy equation of state reconstruction by Principal Component Analysis

Principal Component Analysis (PCA) is an eigenvector-based multivariate analysis technique, used to find trends and features from a particular data-set. It has been applied to a vast variety of problems, in many diverse fields, from image processing to reconstruction of cosmological quantities. We use the PCA technique to the reconstruction of Hubble parameter, distance modulus and equation of state parameter (EoS) of dark energy. Dark energy is that negative pressure which drives the acceleration of the universe, and EoS dictates its effect on the dynamics of the Universe. We show that a combination of correlation tests and the PCA algorithm can be applied as a powerful reconstruction tool and also can be used to find out a (semi)analytical form of the underlying curve of a given data-set without any prior biases. For this analysis, we consider Supernova type Ia and Hubble parameter data. We carry out reconstruction of EoS of dark energy with two different approaches: direct reconstruction of the dark energy EoS, and, reconstruction of this by reconstruction of the Hubble parameter and distance modulus as a function of redshift using the Hubble parameter data and distance modulus of supernovae of type Ia. We test both these approaches with the simulated lcdm data-set. We show that the data allows only small deviations from the lcdm model at low redshifts.

| ASI2019_34 | Arun Kenath | Oral |
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Arun Kenath; S B Gudennavar; C Sivaram

### Alternate to Dark Matter: MOND, MONG or MORG

Dark matter (DM) is supposed to constitute about 90% of the mass of typical galaxies and about a third of the density of the universe. Several candidates have been proposed for dark matter, from WIMPS to axions and many more. The postulated candidates for DM cover a range of about eighty orders of magnitude. Though there is indirect evidence for the presence of DM in the universe, it is still undetected and its nature still unknown. Several experiments to detect DM running for many years have yielded no positive results so far, only lower limits for their fluxes (for different DM particle masses) are set. Even the upgraded XENON1T has set most stringent limit on dark matter interaction cross-section but detection still remains elusive. This may necessitate the need for alternate models to DM. Modification of Newtonian Dynamics (MOND) was initially proposed as an alternative to account for the flat rotation curves of spiral galaxies, without invoking DM in the halo. The theory required an ad hoc introduction of a fundamental acceleration ~10^-8cm/s^2, below which Newtonian dynamics is modified to an effective force law. We consider another possible explanation for the flat rotation curve of the spiral galaxies by modifying the Newtonian gravity (MONG), where the gravitational potential will take a logarithmic form, giving a constant velocity dispersion. We also explore the relativistic theory of MOND which gives a new Tensor-Vector theory like MORG (Modification of Relativistic Gravity). Another possible way in which the need for DM may be avoided is explored by modifying the Einstein-Hilbert action. These theories have severe constraints from CMBR anisotropy and lensing. Here we set constraints on these theories based on observations and show that these modified models might be indistinguishable from the Newtonian case.

| ASI2019_309 | Sangita Chatterjee | Oral |
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Sangita Chatterjee, Soumen Mondal, Prasad Basu

## Impact of accretion disk on the gravitational wave-profile emitted from binary merger.

Supermassive black holes in our galactic centers are likely to contain large massive accretion disk. This disk may exert non negligible hydrodynamic drag on the compact objects rotating around the central black hole. Hence, the gravitational wave signal emitted from an extreme and intermediate mass ratio inspirals may be modified due to the modified motion of orbiting companion by the influence of hydrodynamic drag of the disk. In the present work we investigate this issue using full general relativistic formalism. We wish to estimate precisely the change of the amplitude and frequency of the gravity wave signal due to the effect of the accretion disk and find out the possible error introduced in the estimation of mass of the central black hole.

| ASI2019_373 | Kazuyuki Furuuchi | Oral |
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Kazuyuki Furuuchi

## Weak Gravity Conjecture and Bottom-Up Inflation Model Building

The Weak Gravity Conjecture (WGC) had been proposed to constrain Effective Field Theories (EFTs) with Abelian gauge symmetry coupled to gravity. I study the WGC from low energy observers' perspective, and revisit the issue of to what extent the WGC can actually constrain EFTs. For this purpose, for a given EFT, I introduce associated idealized low energy observers who only have access to the energy scale below the UV cut-off scale of the EFT. In the framework of EFT, there is a clear difference between the particles lighter than the UV cut-off scale and the particles which are heavier than the UV cut-off scale, as the lighter particles can be created below the UV cut-off scale while the heavier particles are not. This difference implies that the knowledge of the low energy observers on the stable heavy particles can be limited, as the availability of the stable heavy particles is determined by the environment prepared by some UV theory unknown to the low energy observers. The limitation of the knowledge of the low energy observers regarding the stable heavy particles whose mass is above the UV cut-off scale of the EFT leads to the limitation of the WGC for constraining EFTs. To illustrate these points in an example, I analyze a model proposed by Saraswat which respects the WGC at high energy, but which may appear to violate the WGC for the low energy observers. Implications of the analysis to the bottom-up inflation model building are discussed.

**ASI-2019 Parallel Session**
**Instrumentation and Techniques I - Time: 14:00 - 15:30**
**Venue: Seminar Hall, Block II Ground Floor**
**Instrumentation and Techniques I [Chairperson: Dipankar Bhattacharya]**

| ASI2019_195 | Ravindra B | Invited |
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| Ravindra B | | |
| Imaging Instruments for Large Solar Optical Telescopes | | |
| Imaging of the solar photosphere started in the beginning of the 17th century and continued for next three centuries. In early 20th century the spectrograph and scanning systems were built to study the solar chromosphere. By the mid 20th century, several telescopes with reasonably large size could make the observations of the solar photosphere and chromosphere at high-resolution. Furthermore, to probe the Sun at ultra-high resolution (50-70 km spatial scale), building of larger aperture telescopes continued well into the 21st century. Newly built/planned telescopes are equipped with state-of-the art back-end instruments capable of making solar photospheric and chromospheric observations simultaneously at high spectral and temporal resolutions. In my talk, I will review the status of new generation large solar telescopes with emphasis on a variety of back-end instruments planned/built to achieve various science goals. | | |

| ASI2019_360 | RajaBayanna Ankala | Oral |
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| R. Sridharan P. Venkatakrishnan S. K. Mathew | | |
| Fizeau Mask Interferometry of Solar Features using the Multi Application Solar Telescope at the Udaipur Solar Observatory | | |
| Efforts are made to demonstrate high-resolution observations of the solar atmosphere using spatial interferometry. Covering the telescope pupil with a Fizeau mask consisting of two small circular apertures separated by a vector distance known as baseline is the first step towards interferometric imaging. Two apertures of 7 cm in diameter separated by a distance of 19 cm are placed in the re-imaged pupil of the Multi-application solar telescope at Udaipur solar observatory. Fringe pattern observed in the image plane signifies the presence of solar structures with sizes smaller than the fringe period of 0.5 arcsec, which is well known by now from the observations obtained from various high-resolution telescopes. The study is extended by using Fizeau masks with increase in base-line to 29 cm and 38 cm. It is observed that, increase of the base-line causes the reduction in the fringe period and the fringe contrast. Observations were obtained in two spectral lines (656.3 nm and 820.0 nm) using filters of bandwidth 1 nm and 400 nm, respectively. It is also observed that the larger bandwidth causes reduction in the fringe contrast. | | |

| ASI2019_178 | Govinda KV | Oral |
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Govinda KV, P. Madan Mohan Kemkar, Harimohan Varshney, Ravindra B

## Concept design of retractable dome for the proposed 2m class National Large Solar Telescope

The National Large Solar Telescope (NLST) is a proposed 2 m class telescope dedicated for making high resolution solar observations. A suitable site has been identified at Merak village, near Pangong Tso Lake in Jammu & Kashmir state, India. It has been observed that installing a telescope near the lake produce good images during the day time observations. At the same time the open dome conditions help to reduce the “dome seeing effect”.The absence of dome around the telescope also ensures that no temperature gradient is created around the telescope and the cool breeze without any obstruction, helps to cool the telescope structure and mirror. In this paper, we present a number of design concepts of retractable dome for NLST, their functionality, time taken to open and close the dome, power requirement, weights etc.

| ASI2019_471 | Hemanth Pruthvi | Oral |
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Hemanth Pruthvi K. Nagaraju B. Ravindra

## Solar Scanning Polarimeter at Kodaikanal Tower-tunnel Telescope for Ca II 854.2 nm line

Study of Chromospheric magnetic fields is of great importance in the context of inferring coronal magnetic fields. Solar Scanning Polarimeter is designed and developed to study the active regions at Chromospheric level. Zeeman effect in Ca II 854.2 nm is considered for the magnetic field diagnostics. It is installed at Kodaikanal Tower-tunnel Telescope of Kodaikanal Solar Observatory. It is stepped-rotating wave-plate based polarimeter. Design aspects of the instrument and modulation aspects of the polarimetry are described. Instrumental polarization is addressed with analytical and ZEMAX modelling. Instrument controls, software and data reduction pipeline are briefly discussed. Results of polarimetric calibration and observations are presented with sample Stokes profiles.

**ASI-2019 Parallel Session**
**Stars, ISM and the Galaxy IV - Time: 16.30 - 18.00**
**Venue: Room 911, 9th Floor, Central Block**
**Stars, ISM and the Galaxy IV [Chairperson: Mousumi Das ]**

| ASI2019_160 | Shejeelammal J | Oral |
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Author: Shejeelammal J, Co-Author: Aruna Goswami

Chemical and Kinematic analysis of metal-deficient Barium stars

Observations show that the neutron-capture elements in the Galaxy show puzzling diverse abundance patterns. Detailed chemical composition analysis of stars with the atmosphere enriched by these ele- ments can throw light on the origin and chemical evolution history of these elements.. Metal-deficient Ba stars form useful candidates for conducting such studies. Most of the barium stars are known to be binary systems and they are believed to have received via binary mass transfer mechanisms the products of the companion stars produced during their AGB phase of evolution. Hence, the chemical composition of this class of objects can be used to trace back the AGB nucleosynthesis occurring in the companion stars. Over the past few observing cycles, we have acquired the spectra for a set of barium stars using HESP attached to 2m-HCT. We have performed detailed chemical and kinematic analyses of the sample based on the HESP spectra as well as 8.2m VLT/UVES and ESO-MPI/FEROS spectra. Some recent results obtained from this study will be presented in this talk.

| ASI2019_477 | Raghubar Singh | Oral |
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Raghubar Singh, B. Eswar Reddy, Bharat Kumar Yerra

Spectroscopic and asteroseismic study of Li-rich giants

Lithium is a light and fragile element which got synthesized during Big Bang nucleosynthesis together with deuterium and He. Due to the low dissociation energy of Li, it gets destroyed above 2.5 million Kelvin which is much lower than stellar core temperature. Post main sequence star faces first dredge up (FDU) and as a result, the chemical abundance of different elements gets changed in the surface. The elements synthesized during the main sequence appear on the surface of the red giant. The abundance of N, 13C, 3He increases and abundance of Li reduces post-FDU. During further evolution along the red giant branch an extra mixing has been hypothesized which is well-established observationally. It is expected theoretically that Li should be low in RGB branch post-FDU. There are a small fraction of red giants having Li abundance higher than ISM value. This is puzzling since the discovery of first Li-rich evolved star HD112127 by Wallerstein and Sneden in 1982. There are the different hypothesis to explain this event but exact explanation of this phenomena always hampered by lack of precise evolutionary state determination. But now we are having multiple ways of determining evolutionary state of the star based on HR diagram, Asteroseismology and spectroscopically determined CN abundances. We have selected a sample of the evolved star from GAIA dr2 catalog. Which gives a huge number of the star. Final sample contains a magnitude-limited collection of stars with available low-resolution spectra. There is a small group of these stars which overlaps in the Kepler field for which evolutionary state based on asteroseismology is known. We found that these evolved low mass stars are core He-burning stars. In this talk, I would like to explain our recent results based on the spectroscopic study of these stars and asteroseismic study from literature.

| ASI2019_112 | Meenakshi P | Oral |
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Author : Meenakshi P (1,2) , Co-authors : Aruna Goswami (1) , Vijayakumar H Doddamani (2), 1 : Indian Institute of Astrophysics, Koramangala, II block, Bangalore, Karnataka, 560034., 2 Department of Physics, Bangalore University, Jnana Bharathi Campus, Karnataka, 560056.

## Abundance of neutron-capture elements in extrinsic Carbon-Enhanced Metal-Poor stars

Carbon-Enhanced Metal-Poor (CEMP) stars are stars with [Fe/H] ≤ −2 and enriched in carbon ([C/Fe] > 0.7) as well as neutron-capture elements. CEMP stars are classified into different categories based on the nucleosynthetic origin of the heavy elements. CEMP stars are either subgiants or giants and hence the observed enhancement of heavy element abundances are generally attributed to an extrinsic source. Extrinsic carbon stars usually exhibit low value of carbon isotopic ratio compared to instrisic carbon stars due to the changes in the surface chemical composition caused by mass transfer and internal mixing. We have performed a detailed abundance analysis of two CEMP stars CD−28 1082 and CD−38 2151. Both the stars are found to exhibit enhancement of carbon, nitrogen and heavy elements. We have estimated carbon isotopic ratios ( 12^C/ 13^C) for the two objects with values 16 for CD−28 1082 and 11.2 for CD−38 2151. Luminosity estimates indicate that these objects are in the ascending giant branch phase where CD−38 2151 is found to be above the RGB bump. Hence the observed low value of 12^C/13^C can also be explained in the frame work of first drege-up. Thermohaline mixing and other distinct mixing episodes occuring after the RGB bump may be other possible reasons leading to low value of carbon isotopic ratios. In this talk, we will present some recent results obtained from high resolution spectroscopic analysis of CD−28 1082 and CD−38 2151.

| ASI2019_57 | Devika Divakar | Oral |
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Devika K Divakar, Sivarani Thirupathi, Vijayakumar H Doddamani

## Study of Horizontal Branch stars in the faint Milky Way satellite galaxies

Horizontal branch(HB) stars belong to old and metal poor stellar population. They are one of the most luminous old population that can be probed to large distances. HB populations are found in Globular clusters, Halo and in many MW satellites. HB population displays a variety in their morphology in a color magnitude diagram. It is found to be sensitive to metallicities, age and helium abundances. Hence, they can be used to study the details of star formation history and environment of star formation. Similarly, RR Lyrae stars, which are a subset of HB stars, show different Oosterhoff types among various stellar systems. Here, we present complete census of HB stars among faint MW galaxies based on GAIA, GALEX and other optical surveys. We also present results from deep UVIT (onboard ASTROSAT, an Indian space mission) imaging for Reticulum-II satellite.

| ASI2019_358 | Gayathri Raman | Oral |
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| Rahul Kashyap, Gayathri Raman, Ajith Parameshwaran | | |
| Are kilonovae standardizable candles? | | |
| Kilonovae are electromagnetic transients produced by merging binary neutron stars. They are modeled using the fireball model in which radioactive decay of synthesized neutron-rich elements heat up the ejecta and power the light curve. This model is consistent with the recent observations of the binary neutron star merger GW170817. Interestingly, Type Ia supernova are also powered by radioactive decay of Nickel-56, a major fraction of which is produced from binary white dwarf mergers. Although the complex physics of Type Ia supernovae is not well understood, empirically found correlations in their light curves allow us to use them as standardizable candles. It is natural to ask whether kilonovae also show such correlations that can be used to make them standard candles. We investigate this for a range of binary neutron star masses to find the systematic behavior in their light curve and their possible astrophysical applications. | | |

| ASI2019_470 | Pavana M | Oral |
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| M. Pavana and G. C. Anupama. | | |
| Modelling the ejecta of Galactic Nova, ASASSN-16ma | | |
| We report the results of photo-ionization and morpho-kinematic modelling of ASASSN-16ma. This object was monitored from Vainu Bappu Observatory (VBO) and the Indian Astronomical Observatory (IAO) in the range of 380 to 900 nm. The spectral evolution of this system is studied in detail. The spectra obtained at different phases of the outburst are modelled to obtain the corresponding synthetic spectra, and to study the evolution of the physical conditions using the 1D photo-ionization code, CLOUDY. The best-fit modelled parameters obtained from 1D CLOUDY like the elemental abundances, temperature, luminosity and density are used to obtain 3D ionized structure of the ejecta using pyCloudy. The 3D morpho-kinematic structure is obtained using the observed H-alpha velocity profile using SHAPE. The 3D ionized structure is bipolar conical and the morpho-kinematic structure is also bipolar conical one with equatorial ring-like structures. The evolution of the geometry of the ejected shell obtained using both the methods at different phases of the system is also reported. | | |

**ASI-2019 Parallel Session**
**Extragalactic Astronomy IV - Time: 16.30 - 18.00**
**Venue: Room 105, First floor, Central Block**
**Extragalactic Astronomy IV [Chairperson: Sushmita Chakraborty]**

| ASI2019_251 | Anupreeta More | Oral |
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| Anupreeta More, Anton Jaelani, Alessandro Sonnenfeld, Ken Wong and HSC collaboration members | | |
| SuGOHI: Strong lens systems from Hyper Suprime Cam-Survey | | |
| I will discuss various techniques adopted to discover over 200 strong gravitational lens systems from the Hyper Suprime Cam on the 8-m Subaru Telescope. I will also present some early results on the line-of-sight environments, stellar mass initial-mass function of the early-type lensing galaxies and mass distribution of galaxy groups. | | |

| ASI2019_231 | Ishwara Chandra CH | Oral |
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| Ishwara-Chandra CH, Stefano Andreon and Claudia Cicone | | |
| Deep uGMRT 400 MHz observations of XMMLSS region | | |
| Here we present the deep upgraded GMRT (uGMRT) band-3 (250 - 500 MHz) observations of the high-redshift cluster, JKCS01 in the field of XMMLSS. The field was observed with uGMRT band-3 for 25 hours using a bandwidth of 200 MHz with band center of 400 MHz. The data was analysed using the casa based pipeline in nearly automated way. The final resulting image has an rms of 15 microJy/beam at band center of 400 MHz, making this the deepest image at this band, at a resolution of about 6 arcseconds. This rms is within a factor of two of thermal noise, achieved through routine processing using standard features in CASA. We are re-processing the data using advanced flagging algorithms and direction dependent calibration with an aim to reach final rms of 10 microJy/beam. Even with the current already achieved rms noise of 15 microJy/beam, the source density is about 1500 sources per square degree. Several faint submJy sources have optical counterparts with photo-metric redshift larger than 1. We will present the image, source catalog, optical counterparts of submJy sources and other science results from this image. We will also discuss how such a deep, high resolution image at 400 MHz is an excellent preview of science possibilities with SKA1-mid band. | | |

| ASI2019_487 | Avinash Singh | Oral |
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| Brajesh Kumar, D.K. Sahu, G.C. Anupama | | |
| SN 2016gfy: A slow-declining, luminous type II-P SN | | |
| We present the optical broadband photometric and low-resolution spectroscopic observations of the type II-P supernova 2016gfy observed from the 2-m Himalayan Chandra Telescope situated in Hanle. Template subtraction was performed on the object images to eliminate the contamination from the nearby HII region as the SN exploded in the spiral arm of a face-on spiral galaxy NGC 2276. Preliminary results indicate a slow-declining (s2 ~ 0.1 mag/100 d) and luminous (Mv ~ -17.6 mag) type II-P SN with clear signatures of hydrogen in the spectra. We obtain a nickel mass of 0.044 solar mass, which is consistent with its mid-plateau luminosity. A bump is seen in the apparent magnitude VRI light curves of SN 2016gfy post the mid-plateau phase which is typically seen only in the I-band in most other Type II-P. Even with the peculiar bump around 80 d, the photospheric velocity evolution and the colour evolution of SN 2016gfy do not show any considerable peculiarity when compared with other Type II-P SNe. In addition, we observe Ca II NIR triplet in the photospheric phase and the beginning of the nebular phase similar to other type II-P SNe, however, Ca II triplet disappears in the late-nebular phase (~200 d). SN 2016gfy adds to the peculiarities seen in the class of Type II-P SN. | | |

| ASI2019_255 | Rahul Gupta | Oral |
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| RAHUL GUPTA,S. B. Pandey,Amit Kumar,Amar Aryan | | |
| Multiwavelength Investigation of the Gamma Ray Burst Afterglow | | |
| Gamma-ray bursts (GRBs) are short and intense pulses of gamma-rays observed from the sky in arbitrary directions. GRBs are generally followed by long-lasting high-wavelength afterglow emission. Recent observations confirm that long GRBs (last for more than 2 seconds) are possible outcome of the gravitational collapse of massive stars (mass > 15M⊙) and short GRBs (last for less than 2 seconds) are possible outcome of mergers of compact objects in binary systems (it may be merger of two neutron stars or a black hole and a neutron star). Multiwavelength investigation of afterglow of the GRBs can provide clues about possible progenitors as well as emission mechanisms which are not unambiguously established for GRBs. Multi-wavelength studies including optical data of afterglows can give solution to many mysteries related to these brightest explosions of the Universe. We present multiwavelength analysis of afterglow data of long GRBs. Broadband fitting of GRBs afterglows data gives us burst explosion parameters and the synchrotron radiation related parameters. We have measured explosion energy and circumburst density of GRBs afterglows using broadband fitting. These parameter provide important clues to the nature of the progenitor and burst environment. These studies are very much helpful in understanding the origin of the Universe as well. | | |

| ASI2019_66 | Sagnick Mukherjee | Oral |
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Sagnick Mukherjee (Presidency University, Kolkata), Kaustav Mitra (Presidency University, Kolkata), Dr. Ritaban Chatterjee (Presidency University, Kolkata).

## THE ACCRETION DISK-JET CONNECTION IN BLAZARS

The power spectral density (PSD) of the X-ray emission variability from the accretion disk-corona region of black hole X-ray binaries and active galactic nuclei has a broken power-law shape with a characteristic break timescale. If the disk and the jet are connected, the jet variability may also contain a characteristic timescale related to that of the disk-corona. Recent observations of the blazar Mrk 421 have confirmed the broken power-law shape of the PSD of its jet X-ray variability. We model the time variability of a blazar, in which emitting particles are assumed to be accelerated by successive shock waves flowing down the jet with a varying inter-shock timescale. We find that the PSD of the variability has a characteristic timescale connected to the average inter-shock timescale. We investigate the possible relation between the break timescale in the disk and jet variability based on the above model, along with mathematically and physically simulated disk variability. We simulate disk light curves based on a broken power-law shaped PSD and use its dips as times of shock launching down the jet. We show that the break timescale of the jet PSD is independent of the break timescale of the disk PSD. We conclude that both the PSD of the jet and that of the disk variability may have a broken power-law shape but the break timescales are not related. The break in the jet and disk PSD are connected to the interval between large amplitude outbursts in the jet and to the viscous timescale in the disk, respectively. In frequency bands where multiple emission processes are involved or emission is from lower energy particles, the break in the PSD may not be prominent enough for detection. This work has been submitted to MNRAS and is undergoing the refereeing process now.

**ASI-2019 Parallel Session**
**Sun and the Solar System I - Time: 16.30 - 18.00**
**Venue: Council Room, Ground Floor, Central Block**
**Sun and the Solar System I [Chairperson: Divya Oberoi ]**

| ASI2019_235 | Ishan Sharma | Invited |
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| Ishan Sharma | | |
| Mechanics of granular minor planets: Getting to know our small neighbors. | | |
| Earth's immediate neighbourhood in space offers a scientifically challenging, but economically attractive resource opportunity in the form of minor planets. A minor planet is a Solar System object that is not a planet. Thus, moons, asteroids and trans-Neptunian objects (TNOs) fall in this category. Study of these objects has technological importance: e.g. space mission planning, locating and harvesting of natural resources; is crucial for disaster management: e.g. impact of Earth-crossing asteroids; prompts challenging scientific questions: e.g. understanding Solar System's formation and cometary processes, texturing on asteroids. and surface grain flow. A study of these objects requires a coming together of sophisticated continuum mechanics, massive parallelized simulations, observational astronomy, and, novel lab-/space- based experiments.<br>Several of these objects, most noticeably near-Earth asteroids and the small moons of the giant planets, are suspected to be granular aggregates — or "rubble-piles" — held together primarily by self-gravity. This suspicion is based on many observational indicators. These objects are meters to several kilometers in size, and it is remarkable that their very low self-gravity can keep them together; e.g. the asteroid Itokawa's surface gravity is a mere 0.1 mm/s 2.<br>In this talk, I will summarize progress made over the past decade in understanding the mechanics of granular minor planets. I will conclude with a list of open questions that have become ever more relevant today. | | |

| ASI2019_235 | Deepthi Ayyagari | Oral |
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| Deepthi Ayyagari, Sumanjit Chakraborty, Abhirup Datta | | |
| Ionospheric response to space weather events using IRNSS and GPS TEC observations from Indore. | | |
| A comparative analysis of Total Electron Content(TEC) between the Indian Regional Navigational Satellite System(IRNSS) and Global Positioning System(GPS) constellation satellites has been made to study the ionospheric response over the central region of the Indian subcontinent with respect to space weather events, particularly at Indore (Lat: 22.52 N, Lon:75.92 E Geographic; Magnetic dip:32.23 N). The analysis was carried out using the data during September 2017, where the Disturbance storm time(Dst) index dropped to a minimum due to occurrence of an intense and a moderate geomagnetic storm. This analysis reveals a similar diurnal variation of TEC recorded from the GPS and the IRNSS satellites which states that the TEC values recorded by the IRNSS receiver is consistent with the GPS receiver. | | |

| ASI2019_290 | Anuj Gupta | Oral |
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Anuj Gupta and Sandeep Sahijpal

## Thermodynamical Equilibrium Condensation Calculations in Primitive Solar Gas

The gravitational collapse of a presolar molecular cloud around 4.56 billion years ago initiated the formation of our solar system. In the cooling primitive solar gas, condensation of early solar dust grains took place in distinct localised regions which in turn commenced the formation of the planetary system. In order to deal with the thermodynamics of the dust grain condensation, we have developed a numerical code in which detailed thermodynamical equilibrium calculations have been performed. The thermodynamics associated with the condensation of dust grains produces different condensation sequences in different scenarios that differ in temperature, pressure and relative abundances of the elements. The presence of the wide range of chemical composition of the interstellar dust grains separated from the meteorites reflect the elemental traces of various nucleosynthetic processes operating within the evolving stars. Thus, the dust grains provide us the opportunity of studying a state of matter that cannot be attained in the laboratory. The numerical simulations performed in the present work predicted the condensation sequence, condensation reactions and the distribution of the major elements between solid and vapour in the considered stellar atmosphere. The physico-chemical conditions obtained through the model are found to be consistent with the observations deduced from various meteorites.

| ASI2019_272 | Anshu Kumari | Oral |
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Anshu Kumari, R. Ramesh, C. Kathiravan, T. J. Wang

## Estimation of Strength of the Solar Coronal Magnetic Field using Contemporaneous Radio and Whitelight Observations

Estimation of the magnetic field strength (B) in the solar corona is one of the widely pursued areas of research in observational solar physics. We estimated the coronal magnetic field strength during the 23 July 2016 coronal mass ejection (CME) event using i) the flux rope structure of the CME in the whitelight coronagraph images and ii) the band splitting in the associated type II burst. No models were assumed for the coronal electron density (N (r)) used in the estimation. The results obtained using the above two independent methods correspond to different heliocentric distances (r) in the range ≈ 2.5 – 4.5Ro, but they show excellent consistency and could be fitted with a single power-law distribution of the type B(r) = 5.7r^{−2.6} G, which is applicable in the aforementioned distance range. The power law index (i.e. −2.6) is in good agreement with the results obtained in previous studies by different methods, for example, using Faraday rotation observations of the linearly polarized carrier signals of the HELIOS spacecraft and using observations of similar signals from extragalactic radio sources occulted by the solar corona.

| ASI2019_44 | Hariharan Krishnan | Oral |
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Hariharan Krishnan

## Study of Fine Structures in Solar Radio Emission

Solar radio emission an be broadly categorized as : i) continuum emission and ii) transient emission. The former is composed of a non-variable stationary component considered to be due to the free-free emission from the inherent electron distribution in the corona and a “slowly-varying” component due to the extreme density condensations above “Active Regions”. At times the radio emission from the Sun can be impulsive in nature and are often referred as “radio bursts”. The solar radio bursts are often identified and classified based on their spectro-temporal characteristics seen in the frequency-time plane. These transient phenomena are observed to occur over a broad range of frequencies from a few kHz up to a few GHz, and show very high brightness temperatures in the range 10^12 -10^14 K. The impulsive radiation is often associated with the solar transients, viz. Flares, Coronal Mass Ejections (CMEs), etc. which are the consequences of large scale magnetic energy releases that take place on the Sun. With the advent of digital technology and improved radio instrumentation techniques the next generation of very sensitive radio telescopes offer the capability of spectroscopic imaging observations covering many octaves of the radio frequency band with very high spectral and temporal resolution. This has paved way for in-depth studies of weak and fragmented emission features in the solar radio radiation particularly during the solar minimum period. Detailed observational studies of such phenomenon give us a better understanding of coronal physics. High sensitivity radio telescopes (viz. LWA1, LOFAR, uGMRT, MWA, MUSER) with wide instantaneous bandwidth at high spectro-temporal and angular resolutions are ideal for such observational studies, particularly during periods of low solar activity. In this talk, I will describe some of our recent high “resolution” observations of fragmented radio emission from the Sun and their usefulness in understanding the solar corona.

**ASI-2019 Parallel Session**
**Instrumentation and Techniques II - Time: 16.30 - 18.00**
**Venue: Seminar Hall, Block II Ground Floor**
**Instrumentation and Techniques II [Chairperson: Dipankar Bhattacharya ]**

| ASI2019_225 | Mudit Srivastava | Oral |
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Mudit K. Srivastava, Mohan Lal, Vipin Kumar, Ankita Patel, Vaibhav Dixit, S.N. Mathur, B.S. Munjal (SAC-ISRO), Hemant Arora (SAC-ISRO) and Tejas Mavani (SAC-ISRO)

## The Development of Mt. Abu Faint Object Spectrograph and Camera - Pathfinder (MFOSC-P) for PRL 1.2m Mt. Abu Telescope

Mt. Abu Faint Object Spectrograph and Camera-Pathfinder (MFOSC-P) is soon to be commissioned instrument on PRL 1.2m Optical-Near Infrared Telescope at Mt. Abu. Envisioned as a pathfinder for a bigger and more complex next generation instrument on upcoming PRL 2.5m telescope, MFOSC-P has been fully designed and developed in-house. It offers options for both the imaging as well spectroscopy within the same optical chain in visible waveband (4500-8500 angstroms). The optics has been designed to provide seeing limited imaging in astronomy standard Bessell's B, V, R and I filters. Three modes of spectroscopy with resolutions (lambda/delta_lambda) 2000, 1000 and 500 around 6500, 5200 and 6500 angstroms are achieved with three plane reflection gratings. Opto-mechanical system of the instrument had been designed and successfully evaluated for its structural integrity using finite element analysis prior to its fabrication. The motion and other control aspects of the instrument are being taken care by an in-house developed control system based on off-the-shelf motion controllers and stepper driver modules and using Python-Qt based open source software. MFOSC-P is currently going through its assembly-integration-testing (AIT) phase in the laboratory and has been successfully verified for its image quality. Two posters presentations are requested by concerned team members in the ASI-2019 that would illustrate the detailed designs of various sub-systems of the instrument, AIT procedures and results of various characterization tests. However a talk is requested here to present the overall design, development, characterization, commissioning and scientific aspects of the instrument to the astronomy community as MFOSC-P has a great potential to be replicated on various 1-2 m class of telescopes in the country as a general purpose user's instrument with quick development cycle and limited financial budget.

| ASI2019_243 | Brijesh Kumar | Oral |
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Brijesh Kumar, Saurabh Sharma, Tarun Bangia, T. S. Kumar, A. C. Gupta, A. K. Pandey, Amitesh Omar, B. Krishna Reddy, Hum Chand, Jayshreekar Pant, M. K. Joshi, Mukeshkumar Jaiswar, Nandish Nanjappa, Neelam Panwar, Sanjit Sahu, S. B. Pandey, Shobhit Yadav, Sneh Lata, Wahab Uddin

## Update on performance of 3.6m Devasthal Optical Telescope and prospects for science observations

The 3.6m Devasthal Optical Telescope with active optics technology has been installed at Devasthal, Nainital and it was commissioned and made operational in March 2016. The 3.6m DOT is being used for optical studies of a wide variety of astronomical topics including follow-up studies of sources identified in the radio region by GMRT and UV/X-ray by ASTROSAT. The telescope is capable of providing seeing-limited images of celestial sources at visible and near-infrared wavelengths. Recently, the telescope was used for a detailed charactrisation of a few back-end instruments viz. TIRCAM2, 4k Optical Imager, and FOSC. The analysis of data recorded by different instruments mounted at focal plane of the telescope re-affirms the imaging capabilities of the telescope recorded at the time of commissioning in year 2016. We could measure the FWHM of stellar PSF to be 0.45 arcsec at K-band using TIRCAM2 Instrument. Meanwhile, the Primary Mirror of the Telescope was recoated in September 2018 and we have achieved the reflectivity values as per the specified standards. In this contribution, we present an overview of the performance of the instruments on telescope, the M1 coating process and future prospects for observations with the telescope.

| ASI2019_425 | Krishna Reddy | Oral |
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B.Krishna Reddy, Amitesh Omar, T.S. Kumar, Jayshreekar Pant

## Different observing modes in faint object spectrograph and camera on 3.6-m Devasthal optical telescope

The faint object spectrograph and camera (FOSC) designed and developed for the 3.6-m Devasthal optical telescope (DOT) can have several modes of science observations. It has been used for some science observations on DOT and the performance is found to be satisfactory and as per the expectations. It is primarily designed for deep spectroscopy and imaging studies of faint celestial objects. The new observing modes presently being implemented in FOSC are (i) fast multi-color imaging/spectroscopy using a frame-transfer camera, (ii) seeing measurements using a DIMM-type setup and a wedge prism at the pupil plane, (iii) polarimetry and spectro-polarimetry mode, (iv) autonomous monitoring of sky parameters along with science observations. The status update of instrumentation and upgradation activities on FOSC will be presented. The images and spectra obtained using FOSC on DOT will also be presented.

| ASI2019_172 | Sreekanth Reddy | Oral |
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| Sreekanth Reddy V, Ravinder Kumar Banyal, Sridharan R, Suresh Venkata, P U Kamath | | |
| Development and on-sky performance analysis of tip-tilt adaptive optics system | | |
| A tip-tilt adaptive optics (AO) system has been developed for 1.3 m telescope, Kavalur. It is designed for visible band (480-700 nm) of the electromagnetic spectrum and has spatial resolution of 0.08" with field-of-view (FOV) of 1.2'. To evaluate the performance of the instrument, it is tested on multiple pairs of stars with angular separation of few arc-seconds (~ 2") to several arc-seconds (<60") and of magnitude (mv) brighter than 6. The tilt corrected images have shown an ~ 47% improvement in image resolution and > 100% improvement in the peak intensity over an integration time of 5 minutes. A closed loop correction bandwidth of ~6-8 Hz has been achieved. The rms image motion has been reduced, approximately, by a factor of two. In this conference we present the design and development of the tip-tilt instrument and its performance on the telescope. | | |

| ASI2019_473 | Ramya Anche | Oral |
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| Ramya Anche, G C Anupama, S Sriram and K Sankarasubramanian | | |
| Polarization effects due to the segmented primary mirror of the Thirty Meter Telescope | | |
| The instrumental polarization (IP) and crosstalk (CT) due to the telescope optics affect the accurate polarimetric measurements. The next-generation telescopes such as Thirty Meter Telescope (TMT) consists of segmented primary mirror and inclined Nasmyth mirror. The effect of these two mirror configurations on the polarimetric measurements need to be estimated. Towards that, a polarization model for TMT has been already developed with primary mirror approximated as a monolith. Here, we present the results based on a more realistic approach considering the effect of individual segments. For the modelling, a total of 492 hexagonal segments are divided into six sectors with each sector having 82 unique segments. We have performed the polarization ray tracing in Zemax for this configuration. We have analysed the cases of missing segments and their effect on the Mueller matrices. We find that as the number of missing segments increases, though the I-> Q and U->V does not change considerably, the I->U, I->V and Q-> V components appear in the Mueller matrices. As a part of coating non-uniformity study, we generated six different coating recipes with 5-10% variation in the refractive index of silver. The Mueller matrices showed changes in the IP and CT elements. Along with these, the cases of random segment tilts and piston error on the Mueller matrices have been estimated. The variation in the piston of the segments is found to have no effect on the polarization measurements where as tilt in x and y directions causes changes in some of the Mueller matrix elements. As, none of the first-generation instruments for the telescope have a polarimetric capability, these estimations would help in the design aspects of a second-generation instrument with the polarimetric capability. | | |

| ASI2019_403 | Varun Kumar | Oral |
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Varun Kumar, Padmakar Parihar, Suraj Kumar, Sai Prabhat, Arjun Manoharan, Maria Joseph and Merin George

## Testing the Performance of Inductive Edge Sensor Against Environmental Changes.

Edge sensor plays a very critical role in any segmented mirror telescope (SMT). It measures any relative displacements between mirror segments and provides a feedback signal to the primary mirror control system. The edge sensors are designed to have a very high spatial resolution (few nanometers), large range, ability to sense multiple dimensions simultaneously and should have minimal effect of environmental changes. As a part of National Large Optical Telescope (NLOT) project, we have been working to develop an inductive edge sensor. Our continuous effort from the past three years has resulted in a working inductive edge sensor which is very close to meet the performance requirement of any mid-size seeing limited SMT. These edge sensors once installed at the telescope, are exposed to the open environment, and any change in the environmental parameters like temperature, humidity, may affect the sensor performance. Therefore, one of the critical requirement for any edge sensor is that sensor reading should be almost invariant during intra-night as well as well seasonal changes. Additionally, a requirement which makes task further difficult is that sensor should not also get affected by any dust settle on its active surface. From initial laboratory testing, we noticed that our sensor has high-temperature sensitivity as well as some signature of the presence of hysteresis. This behavior of the sensor is of great concern as sensor output must remain stable for a week time or so. We have extensively studied the temperature behavior both by simulation and experimentation and came up with a solution. Here we report the efforts made in diagnosing and solving the temperature problem as well results of the very extensive environmental testing of our edge sensor.

# 22nd February 2019

## Plenary Session 3
## Star Clusters and Galaxy Dynamics

| Sourav Chatterjee | Plenary |
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Sourav Chatterjee, TIFR, Mumbai

### The Intertwined Stories of Globular Clusters and Their Black Holes

Dense and massive star clusters such as the globular clusters (GCs) are efficient factories for stellar exotica including GW sources similar to those detected by LIGO and Virgo. I will describe the BBH formation process inside typical GCs and discuss why GCs are so efficient in producing short-period binary black holes (BBHs). I will discuss some of the key detectable properties of BBHs dynamically assembled inside GCs. I will further show how the fates of a GC and its black holes are intimately connected making the retention fraction of BHs in today's GCs very interesting. I will describe the challenges for observationally constraining the retention fraction of BHs in today's GCs and possible ways to overcome them. One common uncertainty in predicting the rate of GW detections comes from the lack of constraints on the distribution of natal kicks for BHs. I will describe how this uncertainty could potentially be alleviated with the help of Gaia.

| Seshadri Sridhar | Plenary |
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S. Sridhar, Raman Research Institute, Bengaluru

### Stalling of Globular Cluster Orbits in Dwarf Galaxies

A globular cluster orbiting a dwarf galaxy is expected to in-spiral to the centre of the galaxy within the age of the Universe, according to the Chandrasekhar dynamical friction formula. But globular clusters are found well away from the centres of some dwarf galaxies, arousing concerns about the applicability of the formula in the cores of dwarf galaxies. The manner of its failure has been investigated by numerical simulations but a dynamical explanation has been absent. Karamveer Kaur and I used the Tremaine-Weinberg theory of dynamical friction to solve this problem. The retarding torque (`drag') on the cluster is exerted by stars whose orbital frequencies are in resonance with the globular cluster's orbit, and given as a sum over the infinitely many resonances by the Lynden-Bell—Kalnajs (LBK) formula. We classified core resonances as a function of the cluster's orbital radius, and found that there is a progressive loss of strong resonances at smaller radii. Hence the LBK torque is highly suppressed, by factors of 100 to 10,000, when compared with the Chandrasekhar torque. Therefore an in-spiralling globular cluster would appear to stall outside of a characteristic `filtering' radius of about 220 pc.

**ASI-2019 Parallel Session**
**Stars, ISM and the Galaxy V - Time: 11:30 - 13:00**
**Venue: Room 911, 9th Floor, Central Block**
**Stars, ISM and the Galaxy V [Chairperson: Priya Hassan]**

| ASI2019_350 | Biplab Bijay | Oral |
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Biplab Bijay, B.C. Joshi, Sushan Konar, Yashwant Gupta, Manjari Bagchi, Debades Bandyopadhyay, Sajad A. Bhat, Dipankar Bhattacharya, Aditya Choudhury, Avinash Deshpande, Biprateep Dey, Vishal Gajjar, Boris Kalita, Sanjay Kudale, Yogesh Maan, Satyam Mishra, Alak Ray, Mayuresh Surnis, Gururaj Wagle, Gaurav Waratkar

### A pilot survey for pulsars with uGMRT

The upgraded GMRT (uGMRT) with its increased sensitivity due to the combination of wider bandwidths and improved technology receivers, is expected to be an excellent tool for conducting more sensitive pulsar surveys, particularly in Band-3 (250 to 500 MHz) and Band-4 (550 to 750 MHz). We describe here a pilot survey, which was initiated at Band-3 (using 200MHz bandwidth) covering a sky area of 315 square-deg (9◦

| ASI2019_310 | Aru Beri | Oral |
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Aru Beri, Diego Altamirano (University of Southampton), James F. Steiner,(MIT, U.S.A), Zaven Arzoumanian (NASA, U.S.A) + NICER Team

### NICER and AstroSat Observations of Swift J1658.2-4242 during its 2017 Outburst

Swift J1658.2-4242 (J1658) is a newly discovered X-ray transient which was preliminarily classified as a black hole candidate based on the radio/X-ray properties and an assumed distance larger than 3kpc. During its outburst, J1658 was regularly monitored with the Neutron star Interior Composition Explorer (NICER). During this talk, we will present a comprehensive spectral study in 0.4-12 keV band using all the observations made with NICER. Contrary to previous claims, preliminary results based on spectral decomposition suggest that J1658 is a neutron star X-ray binary. As a part of several X-ray and radio monitoring campaigns of J1658, the Indian space facility AstroSat observed J1658 between February 20, 2018, and February 21, 2018. The observations made with LAXPC onboard AstroSat revealed the presence of a strong QPO at around 2.46 Hz with a quality factor of 8.2\pm0.5. We found that the energy-dependent time-lag spectra show a soft lag (soft photons trail behind hard photons) at the QPO frequency and the fractional rms of the QPO increases with the photon energy. During this talk, we will also discuss these results in the context of detailed broadband spectral study based on AstroSat data from the SXT and LAXPC instruments.

| ASI2019_150 | Chandrashekhar Kalugodu | Oral |
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Kalugodu Chandrashekhar, Abhishek Kumar Srivastava, Dipankar Banerjee et,.al.

## Study of Quasi-Periodic Pulsations in Super-flares : QPP analysis of post-flare light curves of AB-Dor

Flares on the Sun and other stars are caused by a fast explosive release of the magnetic energy stored in the solar/stellar corona. Solar flares and flare-related coronal mass ejections affect significantly the physical conditions in the near-Earth space and can disrupt operations of spacecraft and energy and communications systems. Flares on other stars have been observed many times in different spectral ranges; some of them are known as “superflares” because their energies exceed the energies of the largest known solar flares by orders of magnitude. X-ray observations are one of the main diagnostic tools for solar and stellar flares. The observations covering a wide range of energies are especially valuable. The soft X-rays (at a few keV and below) provide information about the characteristics and dynamics of the hot thermal plasma in the flares. AB Dor is a quadruple system and is a magnetically active young dwarf-star of spectral type K0, located at a distance of ∼15 pc from the Sun as a foreground star of the Large Magellanic Cloud (LMC). It is a very rapid rotator with a period of P = 0.514 days. We have studied flare light curves from AB Dor using XMM-Newton instruments and detected quasi-periodic pulsations(QPPs). I will present the preliminary results of the investigation we are presently carrying on QPPs.

| ASI2019_76 | Athira Unni | Oral |
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Athira Unni & Sivarani Thirupathi

## Precision chemical abundances of exoplanet host stars

It is now known that the exoplanet atmospheres and the host stars show a large diversity in their chemical composition. There has been several observational efforts to identify possible correlation between the host star chemical abundances the planet properties. One of the well known correlation is the occurrence of gas giants and the high metallicity of the host star (Gonzalez 1997, Gonzales 1998, Santos et al. 2001, 2003, Reid 2002, Fischer and Valenti 2005). These observational data is taken as a support the core accretion model of planet formation, in which a core is formed that helps in fast accretion of gas in the proto-planetary disk in forming a gas giant. This primordial versus self enrichment scenario (Gonzalez 1997) can be distinguished by comparing abundances of refractory elements (Fe group,alpha elements etc.) to volatile (C, N, O, S, Zn). We studied, differential abundance analysis of stellar twins in binary system. This offers a unique possibility to study accurate differential abundances that provide clues to the planet formation process. We also looked into the statistical study of the abundance of different elements in the Kepler-MARVELS survey. Here, we present preliminary results from both the studies.

| ASI2019_482 | Arka Chatterjee | Oral |
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| Arka Chatterjee, Dusmanta Patra, Broja G. Dutta and Sandip K. Chakrabarti | | |
| Discovery of Jet Induced Soft Lags for Galactic Black Holes and AGNs | | |
| Time lags of Galactic black hole candidates and AGNs are becoming more and more important in the last few years. Some of the intriguing features of lag properties are discovered in recent years. However, the nature of lag variations remain unknown mostly because of the non-linear physical mechanisms that are originating the lag of the photons which are coming from the accretion disks. The hard lag contribution is found to be originated from the inverse Comptonization and disk reflection mechanism. But, the exact reason for soft lags are yet to be unveiled. We discover a perfect correlation between the radio flux of various candidates where soft lags are found. The correlation strongly suggests that in the event of massive radio flares, soft lags are produced for both black hole candidates and AGNs. | | |

**ASI-2019 Parallel Session**
**Extragalactic Astronomy V - Time: 11:30 - 13:00**
**Venue: Room 105, First floor, Central Block**
**Extragalactic Astronomy V [Chairperson: Smitha Subramanian ]**

| ASI2019_397 | Susmita Chakravorty | Invited |
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| Susmita Chakravorty | | |
| Winds in Active Galactic Nuclei | | |
| Active galactic nuclei (AGNs) represent the growth phases of the super-massive black holes (SMBHs) in the center of almost every galaxy. The famous M-sigma relationship, correlating the black hole mass with the stellar velocity dispersion of the host galaxy, hints that the SMBH regulates the evolution of the galaxy via some feedback mechanism. Wind-outflows in AGN is one of the key components of this feedback loop. I will avoid detailed aspects of the feedback and galaxy evolution and rather, focus on the wind itself. The multi-wavelength high resolution spectra of AGN show a diaspora of wind signatures as absorption lines, for example, the powerful ultrafast (~ 0.05 c) outflows and narrow warm absorbers in soft X-rays, the narrow absorption lines and the broad and fast (~ 0.2 c) absorption lines in ultraviolet and optical, the molecular outflows in infrared, etc. These different components of the winds in AGN carry mass and momentum away from the black hole and are significant contributors to the mass energy budget of the whole AGN system. To get a holistic picture of the AGN feedback mechanism, it is important to pay attention to the physics of these wind components – what are the physical mechanisms responsible for launching and accelerating the outflowing gas, are the different components different manifestations of the same outflow or different physical mechanisms are at play, is the mass energy budget of the wind components enough to account for the required feedback to maintain the galaxy evolution cycle, etc. etc. I shall also briefly discuss the accretion disk winds in stellar mass black holes – can we extract better understanding of disk winds in the "cleaner" X-ray binary black holes and then extend that knowledge to accretion disk winds in AGN. | | |

| ASI2019_357 | Amit Kumar Mandal | Oral |
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Amit Kumar Mandal, Suvendu Rakshit, C. S. Stalin, Blesson Mathew, Ram Sagar

## Estimation of the size and structure of the broad line region in AGN using Bayesian approach

Active galactic nuclei (AGN) believed to be powered by accretion of matter onto super-massive black holes at their centres are known to show continuum and emission line flux variations since their discovery. Also, correlation between such continuum and emission line flux variations were recognized within the first 10 years of the discovery of quasars a category of AGN. This correlation has been understood in terms of the response of the broad emission line (BLR) clouds present in an AGN to continuum flux changes. This concept has since then been termed as reverberation as the emission line reverberates in response to the continuum variations. The method of reverberation mapping has since then been used as a standard tool to probe the structure and kinematics of the BLR. This method assumes that the BLR responds linearly to the optical-UV continuum flux changes from the accretion disk, however, the presence of a non-linear response of the line emission to the optical-UV continuum changes cannot be ruled out. Towards this objective, we carried out a Markov Chain Monte Carlo analysis based on Bayesian statistics on reverberation data in a homogeneous manner on a sample of 64 AGN. We found a strong BLR size luminosity correlation with a slope of alpha = 0.583 +/- 0.025 and 0.471 +/- 0.084 for H_beta and H_alpha lines respectively. Details of this first homogeneous analysis on the large sample of AGN will be discussed.

| ASI2019_234 | Biny Sebastian | Oral |
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Biny Sebastian, Preeti Kharb, Chris O'Dea, Stefi Baum, Jamie Farnes &Jack Gallimore

## Understanding Outflows in LLAGN through Polarimetry

The origin of kilo-parsec scaled radio structures (KSRs) in low-luminosity AGNs (LLAGNs) is still a debated issue. Several studies attribute their origin to starburst winds or accretion disk driven winds while many others suggest a AGN-jet driven outflow. We try to investigate the role of star formation versus that of jets in the formation of these outflows. We observed a sample of KSRs along with a sample of starburst galaxies using the EVLA. We aim to do a systematic study of the two populations by comparing their polarization and spectral index properties. Specifically we would be looking for differences in magnetic field structures, rotation measures and fractional polarization in these matched sub-samples. We will present some early results for a few of the galaxies in the sample.

| ASI2019_200 | Prajwel Joseph | Oral |
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P. Joseph, K. George, P. Sreekumar, K. T. Paul, C. S. Stalin

## UVIT view of Centaurus A

Centaurus A is the nearest Active Galactic Nucleus at a distance of 3.4 Mpc with star-forming knots observed around the galaxy. It has been argued in the literature that the AGN and/or galactic stellar winds may be shaping the star-forming regions around the galaxy. Ultraviolet imaging observation can directly probe the ongoing star formation in regions around the galaxy and to quantify star-forming rate. We made use of the Ultra-Violet Imaging Telescope to attain the highest ever spatially resolved imaging data on Centaurus A in the far-ultraviolet and near-ultraviolet. The derived star formation properties are complemented with the multi-wavelength observations from radio, submm, far infrared and optical to constrain the dependence of the jet power and stellar wind induced star formation in this archetypical galaxy.

| ASI2019_245 | Savithri Ezhikode | Oral |
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| Savithri H. Ezhikode Gulab C. Dewangan Ranjeev Misra Ninan Sajeeth Philip | | |
| Multi-wavelength studies of Mrk 0926 and Mrk 0110 with AstroSat | | |
| The multi-wavelength studies are of great importance in AGN that emits over a wide range of the electromagnetic spectrum. AstroSat provides the opportunity to observe AGN in the multi-wavelength regime. We have observed the nearby Seyfert Type 1 AGN Mrk 0926 and Mrk 0110 with Astrosat. We study the spectral and temporal properties of the sources using the simultaneous UVIT, SXT and LAXPC data. We have modelled the broadband X-ray spectra as well as the multi-wavelength (UV to X-ray) SEDs of the sources with physical models. We obtained light curves of the sources and found that Mrk 0110 shows short term variability in the soft X-ray band. We also focus on the long term spectral and temporal variability of the objects using the archival data from other missions. | | |

**ASI-2019 Parallel Session**
**Sun and the Solar System II - Time: 11:30 - 13:00**
**Venue: Council Room, Ground Floor, Central Block**
**Sun and the Solar System II [Chairperson: Piyali Chatterjee]**

| ASI2019_442 | Paul Rajaguru | Invited |
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| S.P. Rajaguru (1), H.M. Antia (2), K. Mandal (2), S.M. Hanasoge (2) (1). Indian Institute of Astrophysics, Bangalore, India (2). Tata Institute of Fundamental Research, Mumbai, India | | |
| Meridional circulation in the solar convection zone: current consensus from helioseismology | | |
| A key component of solar interior dynamics is the meridional circulation (MC), which has been well observed on the surface and near-surface layers. A modeled deep structure for MC also plays a central role in flux transport dynamo models -- the most successful ones to date in explaining the global solar magnetism and the solar cycle. Helioseismic observation of the deep structure of MC, however, has been prone to large uncertainties and conflicting inferences from different groups/researchers. Here, we present a survey of all the existing results, including the authors' latest ones, that favor a deep single-cell MC. We also present results on the temporal variations, which point to dependences on the surface magnetic activity (and hence the phase of the solar cycle). We discuss possible implications of our results for models that relate the differential rotation, MC and magnetic fields. We also provide a critical assessment of the different estimates, and discuss a plausible consensus that can be reached as of now given the systematics and noise involved. | | |

| ASI2019_325 | Shanwlee Sow Mondal | Oral |
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| Shanwlee Sow Mondal, Dr. Aveek Sarkar | | |
| Understanding the solar spicules through numerical simulation | | |
| High resolution observations from Hinode mission reveal that type-II spicules can be one of the prime candidates responsible for the million degree solar corona. Spicules are chromospheric jet like features, ubiquitous in the solar atmosphere. Type-II spicules probably get generated in the lower chromosphere, but understanding how they deposit energy in the corona is still a challenging task. We perform a two dimensional magnetohydrodynamic simulation of type-II spicules in the solar corona. We also produce emission measure through forward modelling to compare it with the real observations. The energy budget calculated from the simulation data seems to indicate that spicules alone perhaps cannot keep the corona to million degree kelvin. | | |

| ASI2019_119 | Shyama Narendranath | Oral |
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| S. Narendranath , P. Sreekumar , Netra S Pillai , S. Panini , K. Sankarasubramanian | | |
| FIP bias variations in solar flares using soft X ray spectroscopy | | |
| The coronal plasma is known to have elemental abundances different from that of the photosphere. Time resolved soft X ray spectroscopy allows estimation of elemental abundances in the coronal plasma during flares. We present new results on FIP bias variations during flares from analysis of spectra from XSM on SMART-1 and SAX-MESSENGER. We show that FIP bias reduces during the peak of the flare indicative of a deeper mixing of the plasma with that of the lower layers of the Sun. These results are first of its kind and point to the need for imaging high resolution spectroscopy of the Sun especially in the < 2 keV region (see abstract on " A quiet Sun imager: Design and Science prospects). | | |

| ASI2019_321 | Aarti Fulara | Oral |
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| Aarti Fulara, Ramesh Chandra, Ivan Zhelyazkov, A.K. Srivastava, Wahab Uddin | | |
| On the Dynamics and Energetics of two EUV Waves on 11 April 2013 | | |
| We present the observations of two Extreme Ultraviolet (EUV) waves associated with an M6.5 flare on 11 April 2013. The estimated linear velocities are 600 and 200 km/s. We interpret them as fast mode MHD wave and slow EIT wave. As the fast EUV wave progresses, it creates oscillations in a coronal loop lying at ~ 225 Mm from the flare site. Using coronal seismology, we have computed the minimum energy of the fast EUV wave transferred to the oscillating loop. The study of dynamics reveals another interesting feature. We found that the fast EUV wave encounters various Quasi-Separatrix Layers (QSLs) and leaves stationary fronts at these QSLs. The event is associated with CME and type II radio burst. | | |

**ASI-2019 Parallel Session**
**Instrumentation and Techniques III - Time: 11:30 - 13:00**
**Venue: Seminar Hall, Block II Ground Floor**
**Instrumentation and Techniques III [Chairperson: Brijesh Kumar]**

| ASI2019_544 | Vikram Rana | Invited |
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| Vikram Rana, RRI, Bengaluru | | |
| Hard X-ray Focusing Optics: A Unique Tool to Probe the Extreme Universe | | |
| Sensitive observations at X-ray energies provide a unique opportunity to study some of the exotic celestial objects, thus allowing us to explore physical processes in extreme conditions. Technologocal advancement during last couple of decades for efficiently detecting and focusing X-rays have significantly contributed to present understanding of the physics of various astronomical sources. X-ray telescopes have evolved significantly from the Einstein X-ray observatory (1978) to NuSTAR (2012) and AstroSat (2015). X-rays need grazing angle incidence to get focused unlike the optical light that can be focused using normal incidence. High-energy X-rays (above 10 keV) pose a strong technological challenge when it comes to focusing them, as they need to bounce from a smooth surface at very small (i.e. grazing incidence) angles. Hard X-ray optics, such as on-board NuSTAR, overcome this challenge by utilizing a novel technique of multi-layer depth-graded coating of high-Z and low-Z materials. In my talk, I will review state-of-the-art techniques to efficiently focus and detect X-rays with emphasis on most recent hard X-ray focusing intrument on-board NuSTAR space observatory and its important astronomical discoveries. | | |

| ASI2019_429 | Kuldeep Yadav | Oral |
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| Kuldeep Yadav for HiGRO collaboration | | |
| Status update of MACE gamma-ray telescope | | |
| MACE (Major Atmospheric Cherenkov Experiment) is a 21-m diameter imaging atmospheric Cherenkov telescope being set up at Hanle (32.80N, 78.90E, 4270m asl) in the Ladakh region of North India for the study of very high energy cosmic gamma-ray sources. The telescope is designed to detect sources largely in the unexplored energy region 10-100 GeV and beyond with high sensitivity. The installation of the mechanical assembly of the telescope along with various sub-systems has been completed and the telescope is in an advanced stage of commissioning. Recently, test runs of the telescope with 50 mirror panels of light collector and imaging camera using 1024 photo-multiplier tubes have been conducted. A status update of the telescope including details of the preliminary results obtained so far during the trial runs will be presented in this meeting. | | |

| ASI2019_293 | Nilesh Chouhan | Oral |
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N Chouhan, V K Dhar, T Rinchen, S Norlha, Keshvanand, C P Kushwaha, A K Tickoo, R C Rannot, R Koul, N Gupta, M B Patil, V Sanadhya

## Mirror panel alignment procedure for the MACE Telescope

The reflecting surface of 21m diameter MACE Telescope comprises a large area tessellated light collector, made up of 356 mirror panels of size ~984mm x 984 mm with each panel consisting of 4 diamond turned spherical mirrors of size ~488mm x 488 mm. The 4 mirror facets are assembled and pre-aligned in such a manner that the resulting reflecting surface behaves like a single spherical reflector. Each of the 356 mirror panels is supported on three ball joint pivots; two of these supports have linear actuators with a travel of ± 25mm which corresponds to an angular movement of about ± $2^{o}$ for the panel. The Active Mirror alignment Control System (AMCS) provides for small adjustments in the orientation of each mirror panel so that image formed by them is at the center of the imaging camera. AMCS is also required to correct for gravity induced deflection of the telescope basket at different zenith angles. The correction data for individual mirror panels as a function of zenith angle of the telescope will be stored in a look-up table prepared offline and the alignment corrections will be applied during observation using this look-up table. The telescope is at an advanced stage of installation at Hanle, Ladakh and 50 mirror panels have been installed on the telescope. The mirror panels have been aligned by pointing the telescope towards Polaris and adjusting their orientation. The D80 spot size of ≤ 26mm (~3.6 arc min) has been achieved with 50 mirror panels. Details of the procedure followed for the mirror panel alignment and the results obtained during MACE telescope assembly with 50 mirror panels will be presented in the paper.

| ASI2019_107 | Sonal Patel | Oral |
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S. R. Patel, V. R. Chitnis, S. S. Upadhya, K. S. Gothe, B. K. Nagesh, B. B. Singh, S. K. Rao and S. Duhan

## Expected performance parameters of the G-APD (SiPM) based imaging atmospheric Cherenkov Gamma-ray telescope

The HAGAR group in TIFR is developing 256-pixel camera with G-APDs as photo-sensor for 4m class ground based imaging atmospheric Cherenkov Gamma-ray telescope. G-APDs are chosen instead of PMTs, for unbiased monitoring of bright blazars, as G-APD based telescope has longer duty cycle than the PMT based one. In order to understand the performance of the camera, Monte Carlo simulations of extensive air showers are carried out for very high energy Gamma-rays and cosmic rays. Various topological trigger criteria are examined to decide the optimum operating trigger condition. The shower information are extracted by parameterization of the recorded images in the camera using Hillas parameters. We have calculated two more parameters, viz., Time RMS and Time gradient, which make use of arrival time information of Cherenkov photons, besides the information of photo-electron distribution over the camera plane. Along with the performance parameters like energy threshold, collection area, trigger rates, sensitivity is also estimated, which largely depends on how well the rejection of predominant background of cosmic rays is achieved. The conventional Gamma-Hadron separation methods namely supercuts and dynamic supercuts, along with multivariate method like Random Forest which helps in better rejection of cosmic rays, will be discussed.

| ASI2019_509 | Debdutta Paul | Oral |
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| Debdutta Paul; A. R. Rao; Ajay Ratheesh | | |
| Detection and Characterisation of Cosmic Rays in AstroSat-CZT Imager data | | |
| The Cadmium Zinc Telluride Imager (CZTI) on-board AstroSat consists of pixelated CZT detectors, which are triggered by individual photons bombarding them, and records each such trigger separately as an individual 'event' with information about its time, detector co-ordinates, and channel that scales with the energy of the photon. This makes it prone to detect not only photons from astrophysical sources of interest, but also to a number of other events. Preliminary analysis of the CZTI data already revealed the presence of cosmic rays. In this work, it is shown that in addition, it is also bombarded with higher energy cosmic rays, which produce signatures previously seen in the PICsIT detector on-board INTEGRAL. An algorithm to automatically detect them is presented. It is optimized to not eliminate known 'double-events', which are genuine photons and their Compton-scattered counterparts used for measuring polarization of astrophysical sources. The robustness of the algorithm is highlighted by using examples of Gamma Ray Bursts as target sources. The importance of using such an algorithm is highlighted for the detection of short-hard Gamma Ray Bursts. | | |

**ASI-2019 Parallel Session**
**Stars, ISM and the Galaxy VI - Time: 14:00 - 15:30**
**Venue: Room 911, 9th Floor, Central Block**
**Stars, ISM and the Galaxy VI [Chairperson: Priya Hassan]**

| ASI2019_91 | Radhika D | Oral |
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| Radhika D. (Author), Anuj Nandi, Aneesha U., Samir Mandal, H. Sreehari | | |
| AstroSat observations of persistent black holes GRS 1758-258 and 1E 1740.7-2942 | | |
| We present the results of the analysis performed for the AstroSat observations of the persistent black holes GRS 1758-258 and 1E 1740.7-2942. Broad-band observations of these sources were performed by AstroSat during the different AO cycles. GRS 1758-258 was observed for a total duration of 30 ksec (October 2016), 20 ksec each (July & September 2017), while 1E 1740.7-2942 was looked into for a total of 10 ksec duration during October 2016. SXT observations of GRS 1758-258 in the energy range of 0.3 – 6 keV, shows spectral state transition along-with aperiodic variability signatures in the light curve. During the first day of observation, the source exists in the dim soft state as indicated by a dominating Keplerian disc component of temperature 0.45 keV, while the transition to the hard intermediate state with a photon index of 2.0 is observed around 270 days later. This is followed by another spectral softening within another 100 days. For the source 1E 1740.7-2942, from the combined SXT (0.3 – 6 keV) and LAXPC (3 – 80 keV) spectra, we observe significant spectral transition within the duration of a day. The spectral photon index is observed to vary from 2.6 (soft) to 1.7 (hard) in 4 hours duration. Such spectral transition occurring within a shorter duration has not been observed previously in this source. We also observe temporal variability in the source light curve & power spectra. We find significant variabilities in the source characteristics during short duration observations (within a day), and also long-term (spanning over several months). We will be discussing the spectral and temporal variations observed for these sources, considering the scenario of accretion disc dynamics. | | |

| ASI2019_121 | Sabhya Hebbar | Oral |
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Sabhya H. (1), Sneha Prakash M. (1), S. B. Gudennavar (1), S. G. Bubbly (1) and R. Misra (2) (1) Department of Physics and Electronics, CHRIST (Deemed to be University), Hosur Road, Bengaluru-560029, India. (2) Inter-University Centre for Astronomy and Astrophysics, Ganeshkind, Pune-411007, India.

### Temporal properties of the black hole candidate MAXI J1820+070 using AstroSat

The black hole candidate MAXI J1820+070 was first detected during its outburst in March 2018. Located at a distance of ~ 3 kpc, it is one of the brightest X-ray novae detected till date. Since its detection, the source has been continuously monitored by MAXI. Unlike other X-ray transients, this source has shown rapid and frequent spectral state transitions (soft-hard-soft). During one such spectral state transition, the source was observed by AstroSat from 30th to 31st March 2018. In this work, we present the results of the first temporal studies of MAXI J1820+070 in the energy range 3-80 keV as seen by Large Area X-ray Proportional Counters (LAXPC) on-board AstroSat. We have done comprehensive timing studies to understand the behaviour of energy dependent time-lags and root mean squared variability at different frequencies. Fitting the data empirically to explain the observed behaviour, revealed that the hard energy photons lag the soft energy photons in the order of milliseconds. We have computed the power spectra to study Quasi Periodic Oscillations (QPOs) and the power spectra shows three broadened peaks. Preliminary results of our temporal analysis suggest that MAXI J1820+070 is a black hole and further investigation are underway to support this claim.

| ASI2019_165 | Blessy Baby | Oral |
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Blessy E.B., V. K. Agrawal, Ramadevi M.C., Tilak Katoch, Anuj Nandi.

### Spectro-Temporal Analysis of 4U 1630-472 during its 2018 outburst with AstroSat

4U 1630-472 is classified as a black hole candidate based on its spectral and timing properties. It is a recurrent X ray transient which undergoes regular outbursts with a period between 600 and 730 d. This source was recently in an outburst as detected by MAXI and Swift on the 4th of June, 2018. The Hardness Intensity Diagram(HID) of the source obtained from MAXI observation of 2018 outburst, shows that the source does not undergo canonical state transitions. Under ToO campaign, the source was observed with AstroSat during the period of August 04 to September 17, 2018. We analysed all the data available with SXT and LAXPC observations in the energy range 0.7-50 keV, with the aim of discerning the evolution of the source during the outburst.The broadband spectra were fitted with the phenomenological models. The source is mostly found to be in the soft state with photon-index(Γ) ranging from ~ 2.0 – 3.0. The inner disk temperature is found to vary between 1.25 and 1.40 kT. Rms variability of < 3% is seen in the range 0.01 – 10 Hz, but no QPO's are detected in all the obervations. In this work, we present a comparison between the spectral and timing evolution of the latest outburst observed with Astrosat and that of the 1999 outburst observed with RXTE. We also comment on the possible physical scenarios to explain the observed spectral and timing properties.

| ASI2019_260 | Aneesha U | Oral |
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Aneesha U, Dr Samir Mandal, Sreehari H

### Study of long term evolution of accretion dynamics of GX 339-4

We study the dynamical behaviour of the outbursting black hole source GX 339-4 during 2002-2011 outbursts using XMM-Newton, SWIFT, and RXTE archive data. As this source has undergone frequent outbursts and passed through all the four spectral states, it becomes an ideal source to study accretion dynamics. We have considered four complete outbursts (2002/03, 2004/05, 2006/07, 2010/11) during the period 2002-2011, studied the spectral evolution of the source using these data and discuss the similarities/differences between outbursts. The dynamical evolution of accretion parameters has been studied by modelling the individual observed spectrum with two component accretion disc model which is an established physical model. Also, a generic mathematical model has been proposed to understand the evolution of accretion parameters for sources with longer rising time like GX 339-4.

| ASI2019_398 | Debabrata Adak | Oral |
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Debabrata Adak, Tuhin Ghosh, Francois Boulanger, Urmas Haud, Peter MW Kalberla, Flavien Vansyngel, Tarun Souradeep.

### Dust Polarization Modelling at Large Scale Using Planck and EBHIS Data

The primary limiting factor in the quest for the primordial CMB B-mode polarization is submillimetre polarized emission from Galactic dust. We need to characterize and separate the Galactic polarized foreground accurately to search for such a faint signal. Therefore dust polarization modelling is an essential step to build a component separation method to separate CMB B-mode from polarized foreground with high accuracy. The Planck and HI emission data together show at high Galactic latitude dust and HI intensities are tightly correlated. Also, the Planck data reveals a line-of-sight depolarization arises due to the turbulent magnetic field. Our paper presents the modelling work on dust polarization over a low column density regions at the Northern Galactic cap taking into account the Planck and EBHIS data together. We provide a model which incorporates a phenomenological magnetic field model and physically motivated HI templates. This seven-parameter model can reproduce all statistical properties over 66% sky of the Northern Galactic cap integration over least number (N = 3) of HI layers along line-of-sight. Our work is an important step towards dust polarization modelling which is useful to assess the accuracy of component separation methods and to quantify the confidence level of separating Galactic polarized foreground and CMB B-mode in present and future CMB missions.

| ASI2019_394 | Sananda Raychaudhuri | Oral |
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Sananda Raychaudhuri,Bose Institute, Kolkata; Mukesh K. Vyas, ARIES, Nainital; Indranil Chattopadhyay, ARIES, Nainital

### Simulation of radiation driven winds from Keplerian disk

It is widely accepted phenomena that the mass accretion rate and the outflow from accretion disks are tightly coupled, both in galactic and extragalactic length scale. With the technical advancement of X-ray astronomy a new era has begun for the study of galactic outflows and in this context, Microquasars are a potential candidate. We simulate the winds driven by radiation from the Keplerian disk around microquasars. All components of radiative moments are incorporated in the governing hydrodynamic set of equations. We use a 2D, finite volume code based on TVD algorithm which is a second-order-accurate explicit scheme. We estimate the mass outflow rate depending on the Eddington parameter and compare our simulation result with the observations, as well as the fraction of mass being ejected to that being accreted onto the Black Hole is also calculated.

**ASI-2019 Parallel Session**
**Extragalactic Astronomy VI - Time: 14:00 - 15:30**
**Venue: Room 105, First floor, Central Block**
**Extragalactic Astronomy VI [Chairperson: Smitha Subramanian]**

| ASI2019_344 | Sameer Salunkhe | Oral |
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Sameer Salunkhe, Surajit Paul, Abhirup Datta and Huib T. Intema

### Low-frequency radio study of MACS clusters using the GMRT at 610 and 235 MHz

Studies have shown that galaxy cluster mergers produce shocks and turbulence in the intra-cluster medium, the possible event responsible for creating observed radio relics as well as the halo structures. Observed radio halos and relics thus can help us to trace back the cluster formation history. In order to understand the formation dynamics, as a pilot project, we have observed four candidates from the MACS (MAssive Cluster Survey) catalogue in radio. Clusters are chosen from their disturbed morphology in X-ray and weak lensing study to ensure their merging state. Observations were carried out simultaneously at 610 and 235 MHz with the GMRT. Among the proposed four clusters, three of them have been detected with expected diffuse radio emissions. We report an unusually flat spectrum giant radio halo at a low frequency of a previously known halo-relic cluster MACSJ0014.3-3022. Our observations have also revealed an ongoing second merger along with a close-by high-speed (about 1800 km/s ) merger-shock. This shock has been estimated to have formed recently (not beyond 400 Myr), thus providing a clue to the flat spectrum of the halo. We also report the detection of diffuse and very faint (with sizes about 0.4-0.5 Mpc) radio relics in MACSJ0025.4-1222 and MACSJ0152.5-2852 clusters. In both the clusters, the relics are found well inside the virial radius instead of their usual peripheral location and we also find the upper limit for radio halo for these two clusters. These high-redshift objects (z=0.584 and 0.413) are thus the example of one of the few earliest and youngest known merging galaxy clusters. We also report the non-detection of any diffuse radio emission from the MACSJ1931-2635 cluster at the reported rms levels in our study.

| ASI2019_167 | Majidul Rahaman | Oral |
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Majidul Rahaman, Ramij Raja, Dr. Abhirup Datta, Prof. Jack O. Burns

### Lessons from High Fidelity X-ray Temperature Maps of sample of HIFLUGCS galaxy clusters

Galaxy clusters are assembled through large and small mergers which are the most energetic events since the Big Bang. Cluster mergers stir the ICM creating shocks and turbulence which are illuminated by Mpc-sized radio features called relics and halos. These shocks heat the ICM and are detected in x-rays via thermal emission. Disturbed morphologies in x-ray surface brightness and temperatures are direct evidence for cluster mergers. Here, we present X-ray temperature maps of 12 HIFLUGCS galaxy clusters by creating 2D temperature maps using archival Chandra data. These include cool-core(un-disturbed morphology) as well as non-cool-core clusters (disturbed morphology). These maps allow us to probe the temperature structure of galaxy clusters beyond the usual radial profile methods used in most of the current studies. Analysis techniques including statistical tests and simulations to characterize the radial asymmetry and substructure in temperature have been developed and are being applied to the combined archival data. X-ray flux maps for each cluster also allow for pseudo entropy and pressure maps. This in turn allows for more advanced analysis like asphericity in the temperature and entropy maps.

| ASI2019_110 | Anwesh Majumder | Oral |
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Anwesh Majumder, Kaustav Mitra, Ritaban Chatterjee, CD Bailyn, CM Urry, Prantik Nandi

## Physical Inference from γ-ray, X-ray and Optical/IR Time Variability of a Large Sample of Fermi Blazars

Blazars are a class of active galactic nuclei with a bright relativistic jet pointed within few degrees of our line of sight. We present cross-correlation studies of γ-ray (0.1-300 GeV), X-ray (0.2-10 keV) and optical (R-band) variability of a sample of ∼15 blazars during 2008-2016 using publicly available light curves from the Fermi-LAT, Swift-XRT, and Yale-SMARTS blazar monitoring program, respectively. We stack the discrete cross-correlation functions of the blazars so that spurious peaks in individual sources average out while the consistent features of the population become more prominent in the final result. We find that, on average, the variability at multiple bands are strongly correlated with time lag consistent with zero in both flat spectrum radio quasars (FSRQ) and BL Lac objects (BLL). However, in some individual BLLs the γ-ray/optical correlation is weak or absent while in two FSRQs the γ-ray/optical time delay is much longer (> 50 days). We develop a model of non-thermal emission from blazar jets including synchrotron radiation by relativistic electrons and inverse-Compton scattering of synchrotron photons as well as photons external to the jets, e.g. from the broad line region and dusty torus by the same electrons. By comparing the model results with that from the actual data we find that the model light curves and the strength and time delay of inter-band cross-correlation are consistent with an emission region of size ∼0.1 pc within the broad line region for FSRQs. We rule out large changes of magnetic field (> 0.5 Gauss) across the emission region or very small values of magnetic field (< 0.2 Gauss).

| ASI2019_181 | Prasun Dhang | Oral |
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Prasun Dhang, Prateek Sharma

## A numerical study of MRI driven dynamo in RIAFs

Accretion powers the most energetic sources (e.g., XRBs, AGNs) in the Universe. The most successful model of accretion disc proposed by Shakura and Sunyaev (1973) assume that an emergent turbulent viscosity is responsible for the outward angular momentum transport. However, a convincing source of turbulence was unknown until Balbus and Hawley (1991) drew attention to a weak field instability, namely, magneto-rotational instability (MRI). While linear MRI guarantees outward angular momentum transport, its study in the non-linear regime is essential to explain observed luminosity, time variability, jets etc. We study MRI driven turbulence in geometrically thick (H/R ∼ 0.5) radiatively inefficient accretion flows (RIAFs) using 3D global ideal MHD simulations and a pseudo-Newtonian gravity. In saturation, we observe dynamo-generated large-scale magnetic fields, a necessary component to produce jets. The dynamo cycles observed in the geometrically thick RIAFs are intermittent, unlike the very regular cycles seen in the global thin disc (H/R << 1) simulations. The irregularity is due to the sub-Keplerian nature of the angular velocity (for which the shear parameter q = 1.7). We find signatures of two kinds of dynamos– one is the direct dynamo close to the mid-plane, and another being a Parker-type dynamo away from the mid-plane. Away from the mid-plane, the back reaction of the Lorentz force plays an important role in causing the suppression of kinetic helicity by the magnetic helicity of a similar magnitude.

| ASI2019_55 | Abhisek Mohapatra | Oral |
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Abhisek Mohapatra (NIT Rourkela), R. Srianand (IUCAA), Vikram Khaire (UCSB), Ananta C. Pradhan (NIT Rourkela)

### Physical conditions in high-z triply ionized carbon: origin and evolution

We present detailed photoionization models of well-aligned optically thin triple ionized carbon (C III) absorption components at 2.1 < z < 3.4 analyzed by Kim et al. (2016). Using our models we estimate density (nH), metallicity ([C/H]), total hydrogen column density and line-of-sight thickness (L) in each C III components. From our fiducial model, we find that most of the absorbers do not follow hydrostatic equilibrium and line-of-sight thickness for such absorbers are below 1 kpc. Our inferred nH and overdensity (Δ) are much higher and favor the absorption originating from gas associated with circumgalactic medium (CGM). High-metallicity branch absorbers in our sample seem to be originated from extended disks, inner halos or outflowing gas of intervening galaxies, while low-metallicity absorbers are produced by galactic halos or the surrounding IGM filament. We show L vs. [C/H] correlation can be well reproduced if L is governed by the product of gas cooling time and sound crossing speed as expected in the case of cloud fragmentation under thermal instabilities. Studying the optically thin C III absorbers over a large z range and probably correlating their z evolution with global star-formation rate density evolution can shed light into the physics of cold clump formation and their evolution in the CGM.

**ASI-2019 Parallel Session**
**Sun and the Solar System III - Time: 14:00 - 15:30**
**Venue: Council Room, Ground Floor, Central Block**
**Sun and the Solar System III [Chairperson: Piyali Chatterjee]**

| ASI2019_109 | Pankaj Kumar | Oral |
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Pankaj Kumar, Judith T. Karpen, S.K. Antiochos, P.F. Wyper, C.R. DeVore, C.E. Deforest

### MULTIWAVELENGTH STUDY OF EQUATORIAL CORONAL-HOLE JETS

Jets (transient/collimated plasma ejections) occur frequently throughout the solar corona, and contribute mass/energy to the corona and solar wind. By combining numerical simulations and high-resolution observations, we have made substantial progress recently on determining the energy build-up and release processes in these jets. Here we describe a study of 27 equatorial coronal-hole jets using SDO/AIA and HMI observations during 2013-2014. Out of 27 jets, 18 (67%) are associated with mini-filament eruptions and 9 (33%) do not show mini-filament eruptions but do exhibit mini-flare arcades and other eruptive signatures, indicating that every jet in our sample involved a filament-channel eruption. Potential field extrapolations of the source-region photospheric magnetic fields reveal that all jets originated in the fan-spine topology of an embedded bipole associated with an EUV coronal bright point, and are in agreement with the breakout model of solar eruptions. We present selected examples, and discuss the implications for the jet energy-buildup and initiation mechanisms.

| ASI2019_187 | Yamini Rao | Oral |
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Yamini K. Rao1, A. K. Srivastava1, P. Kayshap2, K. Wilhelm3 and B. N. Dwivedi1 1Department of Physics, Indian Institute of Technology (Banaras Hindu University), Varanasi, India 2Institute of Physics, University of South Bohemia,370 05, Ceske Budjovice, Czech Republic 3Max-Planck-Institute for Solar System, Gottingen, Jesus-von-Liebig-Weg 3, 37077, Germany

## Characterization of cool loop systems using multiple datasets as observed by Interface Region Imaging Spectrograph (IRIS)

The loop structures present in the chromosphere and transition region of the solar atmosphere have low connectivity and low temperatures as compared to the coronal loops and commonly known as cool loop systems. Interface Region Imaging Spectrograph (IRIS) covers a broad range of inner atmosphere starting from photosphere to the transition region (TR) with high resolution. These cool loop structures are also considered as the manifestation of the highly dynamic plasma confined to the magnetic field lines present in the lower atmosphere. In order to study the plasma flows in the cool loop systems, we investigate the Doppler velocity for three different datasets using different spectral lines having different formation heights covering from near photosphere to the TR (Ni I (2799.47 A), Mg II k (2796.20 A), C II (1334.5 A), and Si IV (1402.77 A)). The radiance, Doppler velocity and FWHM maps are used to infer the various physical characteristics of such loop systems. The domination of blueshifts and redshifts at the footpoints of the cool loop systems show the plasma flow pattern there. The height dependent Doppler velocity variation has been studied using optically thick as well as optically thin lines. The multi-spectral study gives the mechanism of the formation of cool loop systems qualitatively. We obtain the inversion of the flows between Mg II k and Si IV line consistently in all three observational data sets related to the cool loop systems.

| ASI2019_40 | Nancy Narang | Oral |
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Nancy Narang, Vaibhav Pant, Tom Van Doorsselaere, Dipankar Banerjee

## High-Frequency Dynamics of an active region moss as observed by IRIS

The high temporal, spatial and spectral resolution of IRIS has provided a new insight into the understanding of different small-scale processes occurring at the chromospheric and transition region heights. We study the dynamics of high-frequency oscillations of an active region (AR 2376) moss as recorded by simultaneous imaging and spectral data of IRIS. Power maps generated from slit-jaw images in Si IV 1400 Å passband and sit-and-stare spectroscopic observations of Si IV 1403 Å spectral line reveal the presence of high-frequency oscillations with 1-2 minutes periods. The presence of such low periodicities is further confirmed by intrinsic mode functions (IMFs) as obtained by empirical mode decomposition (EMD) technique. We find the high-frequency oscillations possess significant power in the small localized regions within the bright moss, which indicates finer structuring in the active regions moss. These high-frequency oscillations could be due to the presence of magnetohydrodynamic (MHD) waves, or quasi-periodic flows, or a combination of both and can be reasonable candidates for coronal heating.

| ASI2019_508 | Sangeetha CR | Oral |
|---|---|---|
| Sangeetha C. R., Durgesh Tripathi, Ravindra B., Sargam Mulay | | |
| Magnetic and Kinetic helicity changes during M-class X-ray flares | | |
| The enormous amount of energy released during flares and their signatures have been observed over the entire electromagnetic spectrum. But the physics behind this is still not fully understood and the questions remain such as, what is the trigger for the flares, where do these flaring active regions get the energy from and their contribution to the coronal heating. In this work, we studied the changes observed in the photospheric magnetic and kinetic helicities before and during five M-class X-ray flares using the Helioseismic and Magnetic Imager (HMI) on board Solar Dynamics Observatory (SDO). The flare evolution was studied using 193 and 1600 Ang channels of the Atmospheric Imaging Assembly (AIA) instrument. We investigated whether these physical quantities have any contribution to the trigering of flares. We have found that the magnetic helicity was decreasing where as the kinetic helicity was increasing in the active region before the flare starts. During the flares, a significant changes in these quantities were not observed. Since the magnetic helicity is a conserved quantity, the increase in the kinetic helicity could be due to the transfer of magnetic helicity to the fluid motions. These physical quantities provided important insights into our understanding of solar flares and could be used for flare prediction. | | |

| ASI2019_348 | Sargam Mulay | Oral |
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| Dr. Sargam Mulay, Prof. Durgesh Tripathi | | |
| Temperature structure of sigmoids | | |
| The on-disk UV/X-ray observations prior to CME eruptions have often shown S-shaped topology, which are known as 'Sigmoids'. These sheared and twisted coronal structures are considered to be the key elements of CME eruptions. Observationally they are considered as tracers for flux ropes. In this work, we carried out a statistical study of on-disk sigmoids observed between 2010 and 2018 using the X-ray Telescope (XRT) on board Hinode and the Atmospheric Imaging Assembly (AIA) on board the Solar Dynamics Observatory (SDO) to understand the thermodynamic evolution of such structures by employing the techniques of differential emission measure and filter ratios. The results obtained from such study shall provide important ingredients for the thermodynamics modeling of CME source regions and their eruptions. | | |

## List of Posters

### Posters
### Sun and the Solar System

| SSS - 1 | ASI2019_191 | Aishawnnya Sharma | Poster |
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Aishawnnya Sharma, Durgesh Tripathi and Gazi Ameen Ahmed

**A study on the thermal nature and non-thermal velocity of active region fan loops**

One of the important diagnostic for heating of the solar corona is the accurate measurement and variation of non-thermal width of the spectral lines in coronal loops with height. Such measurements, so far, have been obtained by subtracting the thermal broadening that is obtained under the assumption that the spectral line is formed at its peak formation temperature. However, the ionization equilibrium curves suggest us that the spectral lines could form within a range of temperature, thereby affecting the measured non-thermal width. In this work, first, we have measured the temperature at each location by employing the techniques of EM-Loci and have used these measured temperatures for the determination of the thermal widths. For this study, we have used the observations from Hinode EIS. We shall present some preliminary results.

| SSS - 2 | ASI2019_507 | AK Srivastava | Poster |
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A.K. Srivastava

**On the New Heating Candidates for the Atmosphere of The Magnetic Sun**

In this focused review talk, first I will describe briefly the scientific developments about possible coronal heating mechanisms, broadly the role of magnetic reconnection, and magnetohydrodynamic (MHD) waves. Although with the advent of the high-resolution spectrographs and imaging telescopes commissioned both in space and ground (e.g., instruments onboard SoHO, TRACE, Hinode, SDO, IRIS, etc; and SST, ROSA etc), there were remarkable developments in the understanding of the solar atmospheric heating since last two decades. However, still over all scenario remains a mystery that how various candidates impart energy to the corona, and in what ways they are evolved in the complex solar atmosphere. The concept of uniform solar atmospheric heating is an old concept now, and the scenario of the localized heating is now much appropriate in the current state-of-art. The most recent developments are the discoveries of new heating candidates (e.g., high frequency torsional waves, see: https://www.nature.com/articles/srep43147; Pseudoshocks, see: https://www.nature.com/articles/s41550-018-0590-1). These new candidates have supported the concept that the Sun's coronal heating is basically enforced from the lower solar atmosphere (i.e, photosphere and/or chromosphere), and that the chromospheric heating is linked with the coronal heating in a very significant manner. Such recent scientific developments are going to provide new detailed scenario about the chromospheric/coronal heating along with the advent of the next generation high resolution observatories both in ground and space (e.g., 4m- DKIST; 4m-EST; 2m-NLST; Parker's Probe; Solar Orbiter, Aditya-L1 etc.).

| SSS - 3 | ASI2019_100 | Debiprasad Choudhary | Poster |
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Debi Prasad Choudhary, California State University, Northridge Christian Beck, National Solar Observatory, Boulder

## Properties of the Inverse Evershed Flow around Sunspots

The properties of the Inverse Evershed Flow (IEF) around a sunspot in the Active Region 11809 were studied using spectropolarimetric observations in photospheric Fe I lines at 1565 nm and the chromospheric Ca II IR line at 854.2 nm acquired at the NSF's Dunn Solar Telescope. The data were recorded with the Spectropolarimeter for Infrared and Optical Regions (SPINOR) and adaptive optics under excellent seeing conditions. The photospheric and chromospheric Stokes profiles were inverted using the SIR and CAISAR inversion codes, respectively, to obtain the stratifications of temperature, velocity and magnetic field over the line forming regions of the solar atmosphere. We find that the flow fibrils that harbor the IEF make an angle of 30°– 60° to the local vertical, tilting away from the umbra. The temperature near the down-flow points in and near the penumbra is enhanced by 200 K at log τ ~ -2 and up to 2000 K at log τ ~ - 6 compared to the quiet Sun, without any signature in the low photosphere. The flow speed reduces from 5-15 km / s to about zero over a distance of less than 1 Mm at the down-flow points. Our results are consistent with a critical, i.e., sonic, or supersonic siphon flow along super-penumbral flux tubes in which accelerating plasma abruptly attains subsonic velocity through a standing shock at upper photospheric heights in or near the penumbra. In this paper, we present magnetic and thermodynamic properties of the flow channels.

| SSS - 4 | ASI2019_392 | Divya Oberoi | Poster |
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Divya Oberoi

## Exploring the Sun using the Murchison Widefield Array

The diagnostic ability of solar radio observations, especially at low radio frequencies (< 300 MHz) have long been recognized. Much of this emission arises at the low to mid coronal heights, which are not easily accessible in other wavebands. The emission mechanisms involved are sensitive, among other things, to the local magnetic fields, providing the possibility of direct measurement of (average) coronal magnetic fields. The nonthermal emission mechanisms involved give rise to coherent emissions, producing very large observational signatures and enabling studies of processes involving much lower energies than what is possible at higher wavebands. Low-radio frequency observations tend to show a lot more variability, even during what is conventionally regarded at quiet times, demonstrating the sensitivity of these observations to phenomena not yet seen at other frequencies. In spite their obvious utility, the use of radio observations in the solar physics community has remained comparatively limited. A large part of the reason is that solar radio observations are very challenging, and till recently, our instrumentation was not a good match to the needs of solar imaging. The new generation of instruments, like the Murchison Widefield Array (MWA), have benefited from the enormous advances in technology and represent a quantum leap in our ability to gather data suitable for solar physics. We have been working on systematically developing a deeper understanding of these data and the necessary software tools required for their analyses. Our work is now enabling interesting science science results in areas ranging from looking for evidence for weak nonthermal emissions to studying coronal magnetic fields. I will present some science highlights from our work, and summarize our current status and future plans.

| SSS - 5 | ASI2019_193 | Govind Nampoothiri | Poster |
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Govind.G.Nampoothiri, R.Satheesh Thampi, Abhishek J.K

## Electron Velocity Distribution Functions in the Solar Wind at 1 AU During Solar transient events

The velocity distribution functions (VDFs) of Solar wind electrons carry signatures of the various dynamical processes undergone by the solar wind starting from the coronal heights to the larger heliocentric distances. The observed electron velocity distribution functions (EVDFs) in the solar wind at 1 AU have shown a Maxwellian thermal core and a non-maxwellian suprathermal tail. In this paper, we analyzed the signatures of solar transient events such as coronal mass ejections (CMEs) on the electron velocity distribution functions observed in the ambient solar wind at 1 AU. We analyzed the effects of 60 Earth-directed CMEs and quantified the enhancements in the EVDFs in the core electron population as well as in the suprathermal electron population in the ambient solar wind during event effective periods. Effects of transient events (CMEs) on thermal core and suprathermal halo electron populations are delineated. Details of the analysis and results are discussed in the paper. Solar wind electron data from three dimensional plasma instrument (3DP) on board WIND spacecraft, CME data from Large Angle and Spectroscopic Coronograph (LASCO) on board Solar and Heliospheric Observatory (SOHO) and the Solar flare data from Geostationary Operational Environmental Satellite (GOES) have been used for performing the present study.

| SSS - 6 | ASI2019_213 | Javaraiah J | Poster |
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J. Javaraiah

## Variations in north-south asymmetry of solar maximum and minimum

Study of north-south asymmetry in solar activity is important for better understanding solar dynamo processes and solar variability. We analyzed the sunspot group daily data of Greenwich Photoheliographic Results (GPR) during the period 1874-1976 and Debrecen Photoheligraphic Data (DPD) during the period 1977-2015 and studied north-south asymmetry in the maxima and the minima of the solar cycles 12-24. We derived the time-series of the 13-month smoothed monthly mean corrected whole-spot areas of the sunspot groups in the Sun's whole sphere (WSGA), northern hemisphere (NSGA), and southern hemisphere (SSGA). From these smoothed time series we obtained the values of the maxima and minima, and the corresponding epochs, of the WSGA, NSGA, and SSGA cycles 12-24. We find that variation in the north-south asymmetry of the solar minimum is more pronounced than that of the maximum. There exist 130-140-year and 44-66-year periodicities in the north-south asymmetry of maximum and minimum, respectively. The ratio of the large to the small numbers of sunspot groups is generally smaller in the minimum than that in the maximum of a solar cycle. That is, the epochs of the minima and maxima of solar cycles comprise relatively small and large numbers of large sunspot groups, respectively. The magnetic structures of large and small sunspot groups may be rooted at relatively deep and sallow layers of the solar convection zone. Hence, the long-term periodicities of north-south asymmetry in the solar maximum and minimum might originate at relatively deep and sallow layers of the solar convection zone, respectively. Therefore, there exits a difference in the long-term variations of solar maximum and minimum and in the corresponding north-south asymmetry.

| SSS - 7 | ASI2019_50 | Kaushal Singh | Poster |
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| Kaushal Singh | | | |
| The Dark (Matter and Energy) | | | |
| The Two largest pieces of the universe. Dark Matter and Dark Energy are two that we know the least about, yet nothing less than the ultimate fate of the universe will be determined by them.. The Dark Energy that tends to drive the universe apart while, The Dark Matter tends to Drive the universe together... Both the mysterious things still unknown but something new which is revealed in this poster.. | | | |

| SSS - 8 | ASI2019_32 | KM Hiremath | Poster |
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| Hiremath, K. M and Shashanka Gurumath | | | |
| Spin angular momentum of sun like stars that harbor planets: Inference of sun's core rotation | | | |
| Recent ground and space based precise photometric and radial velocity observations discovered many stars that harbor planets. In the present study, sun like stars that harbor planets are considered, with the following three cases, spin angular momenta are estimated: (i) whole star rotates rigidly, (ii) convective envelope rotates differentially, core rotates independent of latitude but its radial rotation rate decreases from surface to core and, (iii) convective envelope rotates differentially, core rotates independent of latitude but its radial rotation rate increases from surface to core. With these three cases, spin angular momenta of host stars (that harbor) planets are computed and inferences regarding low surface spin of the sun and magnitude of solar core rotation rate are obtained. It is confirmed that: (i) during the early history of the solar system, sun might have transferred its spin angular momentum (simultaneously mass accretion on to the sun) to the proto planets and, (ii) sun's core rotates nearly 4 times faster compared to the surface rotation. | | | |

| SSS - 9 | ASI2019_216 | Manjunath Hegde | Poster |
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| Manjunath Hegde, Subhamoy Chatterjee, Dipankar Banerjee and Ravindra B | | | |
| Study of the solar filaments from H-alpha spectroheliograms of the Meudon Observatory | | | |
| Solar filaments are one of the proxies for understanding the magnetic activity of the Sun. H-alpha spectroheliograms obtained from Meudon Observatory during the period (1980-2017) are processed to study the evolution of solar filaments. We generate Carrington maps for the entire time duration and detect solar filaments using semi automatic technique. From individual filaments, centroids, tilts etc, are extracted. Butterfly diagram of filaments is produced to study the distribution of filaments. The dataset is compared with filaments extracted from Kodaikanal data for cross calibration. While using different data sources,we generate a combined, calibrated data series for the long term study of the sun. The potential of such cross-calibrated data series will be highlighted. | | | |

| SSS - 10 | ASI2019_336 | Manu Gupta | Poster |
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1) Manu Gupta 2) Dibyendu Nandy 3) Soumyaranjan Dash

## A study of solar corona using nonlinear force-free field model

Dynamics in the solar magnetic field gives rise to myriads of eruptive phenomena like flares and coronal mass ejections. These violent eruptions spew highly energetic plasma into interplanetary medium. If oriented towards the earth these stream of particles can impact our telecommunication systems, power grids and space assets adversely. To understand the origin and formation of these solar eruptive events we need to know the three-dimensional structure of the solar coronal magnetic field. Given the scarcity of direct observational measurements of solar coronal magnetic field, we rely on theoretical models and simulations to understand the evolution of the solar corona. We study the magnetic field structures in the solar atmosphere by developing a three-dimensional computational model that generates magnetic field configurations of the corona satisfying the force-free condition. This model is based on extrapolation techniques while utilizing the vector magnetic field measurements of the solar photosphere. Such a model is known as nonlinear force-free field extrapolation model.

| SSS - 11 | ASI2019_404 | Neeraj Tiwari | Poster |
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Neeraj K. Tiwari*, S. K. Goyal, A. R. Patel, A. Sarada, T. Ladiya, S. V. Vadawale, M. Shanmugam, D. Chakrabarty, P. Janardhan, A. Sarkar, P. Kumar, P. R. Adhyaru, M. Shah, H. Adalja, S. B. Banerjee, K. P. Subramanian, B. Bapat

## Design and development of Supra-thermal & Energetic Particle Spectrometer (STEPS), subsystem of ASPEX, onboard Aditya-L1 mission

Many aspects of the origin, acceleration and anisotropy of energetic particles in the interplanetary medium are poorly understood till date. These energetic particles (energy ranging from a few tens of keVs to a few tens of MeVs) are originated during solar flares, during the passage of interplanetary coronal mass ejections (ICME) or corotation interaction regions (CIR) through the heliosphere and produced by the terrestrial bow shock. As a consequence, these energetic particles can arrive at the first Lagrangian point (L1) of the Sun-Earth system from many directions. In order to understand the origin, acceleration and anisotropy of the energetic particles, it is, therefore, essential to have multi-directional measurements of both low and high energetic particles. Aditya Solar wind & Particle EXperiment (ASPEX) experiment has been selected to fly onboard Aditya-L1 mission, at Sun-Earth L1 point. ASPEX will make the in-situ, multidirectional measurements of the slow & fast solar wind, supra-thermal particles and solar energetic particles in the energy range of 100 eV to 20 MeV/n using its two sub-systems: Solar Wind & Ion Spectrometer (SWIS) and the Supra Thermal & Energetic Particle Spectrometer (STEPS). The STEPS instrument will measure energy spectrum of high energetic particles from six direction covering the energy range of 20 keV/n to 20 MeV/n. STEPS instrument consists of six detector-units to differentiate directional information of incoming flux. Out of six detector-units, three units will measure energy spectrum with identification of the species (H+ and He++) and rest three will measure integrated energy spectrum. The measurements of He++ and H+ fluxes will also be used to test the efficacy of the alpha-proton ratio in the solar wind as a possible precursor for the arrival of ICME, CIR at the earth's orbit. In this paper, overall configuration of the STEPS instrument and preliminary results will be presented.

| SSS - 12 | ASI2019_146 | Panini Singam | Poster |
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S. Narendranath, P. Sreekumar, K. Sankarasubramanian, Sarthak Choudhary , Ravindra B

## A quiet sun imager : Design and science prospects

The soft X ray spectrum of the Sun has often been approximated to an isothermal plasma emission embedded with emission lines. It is now well known that the flare plasma is multithermal and the emission line strengths varying pointing to the need for soft X ray spectroscopy in the less than 2 keV region. This region in energy has several closely spaced lines at low temperatures which would help us probe the plasma during quiet periods of the Sun. We present a novel design of a solar imager targeting the faint sun regions in soft X rays. This instrument works in two modes: a) a high-resolution imager with parabolic and hyperbolic profiles Wolter type I optics during faint sun phase to observe micro flare formation and to study the pre-flare conditions of the sun. b) During bright solar events (flares brighter than C- class flare), the configuration will be modified to act as a high-resolution spectrometer from (0.5 keV to 6.5 keV) using multilayer mirrors. For the spectrometer, a mosaic multilayer mirror with laterally varied layer thickness is placed at focus at 6^o with respect to the optics axis and detector is placed along the reflected beam at the defocused image plane. As the incident beam of broadband X-rays on multilayer mirror is in a range of angles (due to convergence from the optics), the reflected beam is spectrally separated (by the nature of multilayer mirrors). Since the detector is defocused the spectral separation is correlated to the spatial distribution on the detector which can act as a spectrometer.

| SSS - 13 | ASI2019_175 | Paniveni Udayashankar | Poster |
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U.Paniveni

## Latitudinal dependence of supergranular Area and Fractal dimension

The complexity of supergranular cells is studied by using intensity patterns from Kodaikanal solar observatory. The turbulent aspect of the solar supergranulation can be studied by examining the interrelationships amongst the parameters characterizing supergranular cells namely size, horizontal flow field, lifetime, Area, Perimeter and its Fractal dimension. The Data consist of visually identified supergranular cells, from which a fractal dimension D for supergranulation is obtained according to the relation $P \propto AD/2$ where A is the area and P is the perimeter of the supergranular cells. I find a fractal dimension close to about 1.3 which is consistent with that for isobars and suggests a possible turbulent origin. The findings are supportive of Kolmogorov's theory of turbulence. A dependence of of the area of supergranular cells with respect to the Latitude is also studied and it is found that the cells are situated symmetrically about the 25◦ latitude. Fractal dimension of the supergranular cells also shows a latitudinal dependence, variation being in the range 1.7 -1.8 in the latitudinal limits of 30◦ . Since supergranular cells are essentially a manifestation of convective phenomena, they can shed light on the physi- cal conditions in the convection zone of the Sun. Moreover, supergranules play a key role in the transport and dispersal of magnetic fields as it is an important step in our quest to understand the Solar cycle.

| SSS - 14 | ASI2019_162 | Pooja Ramani | Poster |
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| Pooja Ramani, K.Prabhu, Dipankar Banerjee, B.Ravindra, K.E.Rangarajan | | | |
| Solar seeing in the incursion site of Pangong Lake in Merak | | | |
| National Large Solar Telescope (NLST) is a proposed ground based 2-m class optical solar telescope in India. A site with optimum atmospheric properties is very essential for the successful implementation of NLST. One of the primary criteria for site selection is presence of good seeing over long periods of time with clear skies. In this Poster, we present the diurnal variation of solar seeing measured in terms of Fried's parameter (r0) obtained by Solar Differential Image Motion Monitor (SDIMM) instrument installed near Pangong Tso Lake in Merak located at an altitude of 4258 m. The requirement of continuous good seeing is a key factor for adaptive optics to function. Therefore, we have derived statistics for annual sunshine hours, annual hours with Fried's parameter r0 larger than 7 cm and 12 cm at 500 nm wavelength and number of blocks having continuous spell of 1, 2 and 4 hour duration of good seeing, larger than 7 cm. We also present the comparison of these parameters with the other sites which hosts the large solar telescopes. | | | |

| SSS - 15 | ASI2019_129 | Prabhu Kesavan | Poster |
|---|---|---|---|
| Prabhu, K., Sridharan, R., Ravindra, B., Tundup Stanzin | | | |
| H-alpha Observations of the Solar Chromosphere from Indian Astronomical Observatory, Merak | | | |
| An H-alpha telescope has been commissioned near the Pongong Tso lake in Merak (Leh/Ladakh) in August 2017. The telescope consists of a 20-cm size refactor controlled by automatic tracker, guider and finder instruments. A Lyot filter centered at 656.2 nm with a pass-band of 0.05 nm and a free spectral range of 5.1 nm, capable of isolating the Balmer line of the hydrogen spectra allows the recording of the solar chromospheric images. In this poster, we report the installation of the telescope, observational data and the preliminary results on the seeing measurements at the site using long exposure images obtained from this telescope. | | | |

| SSS - 16 | ASI2019_164 | Prabir Mitra | Poster |
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Prabir K. Mitra and Bhuwan Joshi Udaipur Solar Observatory, Physical Research Laboratory, Badi Road, Udaipur-313001, Rajasthan, India

## Evolution of solar magnetic fields and large-scale reconnection events in extremely complex solar active region NOAA 12673

Solar active region NOAA 12673, appeared from 28 August 2017 to 10 September 2017, produced the largest flare of solar cycle 24 of class X9.3 on 6 September. Surprisingly, this enormously complex and dynamic active region emerged during the minimum phase of the solar cycle. In this work, we explore the magnetic field evolution in NOAA 12673 which produced 4 X-class and 27 M-class flares besides several smaller C-class events. The AR first appeared in the eastern limb of the Sun on 28 August, gradually evolved into a complex network of ‘δ-spots’ on September 6 and remained so until its disappearance on the western limb. During the peak flaring phase, this unusually north-south oriented active region contained excessively high non-potential energy which fuelled toward its frequent large-flare producing capability. We particularly focus on the triggering and dynamical evolution of an interesting event in which a small fluxrope structure from the northern region of the AR partially erupted in association with two very impulsive M-class flares on 7 September. The ejecting plasma, at first, was collimated and then, strikingly, changed its motion to almost opposite direction to constitute a coronal mass ejection (CME) with medium speed and angular width. Non-linear-force-free-field (NLFFF) extrapolation clearly indicates the presence of another, larger fluxrope in the active region which remained quiet during the activity whereas the small fluxrope erupted partially. Our analysis suggests that the ejected material from the erupting fluxrope proceeded through a narrow passage of high magnetic decay index which explains its abnormal dynamics. We further present a detailed comparison of the magnetic configuration of AR between 6 and 7 September to explore the circumstances that gave rise to the largest flare (X9.3 flare on 6 September) of the solar cycle 24.

| SSS - 17 | ASI2019_209 | Ritesh Patel | Poster |
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Ritesh Patel, Amareswari K., Vaibhav Pant, Dipankar Banerjee, Sankarasubramanian K., Amit Kumar

## Automated detection of Coronal Mass Ejections in Visible Emission Line Coronagraph (VELC) on-board ADITYA-L1

ADITYA-L1 is India’s first space mission to study the Sun from the Lagrange 1 position. The Visible Emission Line Coronagraph (VELC) is one of seven payloads on the ADITYA-L1 mission, which is scheduled to be launched around 2020. One of the primary objectives of the VELC is to study the dynamics of coronal mass ejections (CMEs) in the inner corona. This will be accomplished by taking high-resolution (≈2.51 arcsecpixel^(−1)) images of the corona from 1.05 R⊙--3 R⊙ at a high cadence of 1 s in the 10 Å passband centred at 5000 Å. Because telemetry at the Lagrangian 1 position is limited, we plan to implement an onboard automated CME detection algorithm. The detection algorithm is based on intensity thresholding followed by area thresholding in successive difference images that are spatially rebinned to improve the signal-to-noise ratio. Since no existing space-based coronagraph has a FOV similar to VELC, we have created synthetic coronal images for the VELC FOV after including photon noise and injected CMEs of different types. The performance of the CME detection algorithm was tested on these images. We found that for VELC images, the telemetry can be reduced by a factor of 85% or more while maintaining a CME detection rate of 70% or higher at the same time. Finally, we discuss the advantages and disadvantages of this algorithm. The application of such an onboard algorithm in future will enable us to take higher resolution images with an improved cadence from space and simultaneously reduce the load on limited telemetry. This will help to understand CMEs better by studying their characteristics with improved spatial and temporal resolution.

| SSS - 18 | ASI2019_186 | Ritika Solanki | Poster |
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Ritika Solanki, Abhishek K. Srivastava, Yamini K. Rao, Bhola N. Dwivedi

## Partial Eruption of a Quiet-Sun Blowout Jet due to the Kink Instability

We have studied a coronal blowout jet eruption observed on 16 May 2014 in the quiet Sun region using observations from the Solar Dynamics Observatory (SDO). The intensity profiles in the different SDO/AIA filters show the multi-temperature plasma evolving at the base of the blowout jet. The magnetic flux cancellation signature as seen by Helioseismic Magnetic Imager (HMI) line of sight (LOS) magnetograms most likely triggers the initial plasma eruptions associated with the jet. The north-ward part of the blowout jet is driven with an apparent velocity of 310 km s-1. The rest part of the jet rises above and then falls back due to the evolution of a kinked fluxtube, which traps the associated plasma. The north-ward segment of the blowout jet is subjected to the plasma twisting, which crosses the threshold value in order to realize the kink instability. The distribution of velocity field in and around the footpoint of the jet Fourier Local Correlation Technique (FLCT), demonstrates the presence of shearing motion which further triggers the high twist, and associated kink instability in the north-ward part of the blowout jet. While the rest of the plasma eruptions associated with the blowout jet is subsided, its kink unstable north-ward part is subjected to partial eruption in the corona. To our knowledge, this is the first observational case study of the partial eruption of kink-unstable quiet-Sun blowout jet, which may further shed light on the triggering mechanism (s) of such giant jets.

| SSS - 19 | ASI2019_206 | SAHEL DEY | Poster |
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Sahel Dey and Dr. Piyali Chatterjee

## A realistic simulation of solar atmosphere with subsurface three dimensional magnetic field structure

To understand solar activity, space weather and their overall impact on human life, one of the best method is to study the magnetic activity of the Sun. Here, using HMI sharp series vector magnetogram data, we have constructed a 3-dimensional subsurface magnetic topological structure for active region 11158. To introduce curvature effect of the photo-sphere, we use Cylindrical Equivalent Area (CEA) projection to vector magnetogram data for our Cartesian coordinate system. Next, we have investigated the photospheric plasma velocity profile through Differential Affine Velocity Estimator for Vector Magnetogram (DAVE4VM) package. Using these 3d structures of magnetic and velocity field, we run realistic 2.5d and 3d simulations in a higher order finite difference code (Pencil-Code). We analyze what kind of waves (Alfven / Magneto-acoustic or both) can transport energy from the convection zone to the upper solar atmosphere or it is the magnetic reconnection. Here, our ultimate goal is to observe what are the potential candidates to sustain the constant million kelvin temperature in the solar corona.

| SSS - 20 | ASI2019_475 | SATABDWA MAJUMDAR | Poster |
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Satabdwa Majumdar, Vaibhav Pant, Ritesh Patel, Dipankar Banerjee

## CONNECTING CMEs TO THEIR SOURCE REGIONS, AND UNDERSTANDING THEIR 3-D EVOLUTION: A PREPARATORY STUDY FOR THE ADITYA L1 MISSION

Coronal Mass Ejections (CMEs) are the main drivers of space weather and therefore it is important to understand their kinematics in the solar corona. We are yet to have a good understanding of the kinematics of CMEs in the lower corona (1 R_sun to 3 R_sun). The properties of CMEs such as width, tilt angle, aspect ratio also varies rapidly in the lower corona. In this work, we back propagate the CMEs on to the solar disk and associate them to their source regions. We segregate the CMEs based on their speeds (as fast and slow CMEs) and on their associated source regions (Active Regions, Quiescent Prominences and Active Prominences) and try to understand the distribution of fast and slow CMEs with different source regions and how do the source regions affect their kinematical properties. With the help of the Graduated Cylindrical Shell (GCS) model, we try to understand the 3-D evolution of CMEs, the variation of width, tilt angle by stereoscopic observations with the data from STEREO A and STEREO B. We also try to understand how the solar wind interacts with fast and slow CMEs and how CMEs get deflected as it propagates through the corona to the outer space. We finally aim to come up with a complete 3-D kinematical profile of CMEs from the Sun to the Earth, which will help in arrival time prediction of CMEs on Earth. This study will provide valuable inputs for the observation plan of the ADITYA mission which has the VELC on board.

| SSS - 21 | ASI2019_388 | Satish Chandra | Poster |
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Vivek Kumar Singh, Sanish Thomas & Satish Chandra

## Estimation of Solar Rotation using Radio Emissions originated from Chromosphere and Corona

Besides X-ray and ultraviolet radiations which originate from corona and chromosphere, respectively, radio emissions emerged at different frequencies is also a source of information to study these solar atmospheric layers. We used the integrated radio flux recorded daily at 245, 410, 606, 1415, 2695, 4995, 8800 and 15400 MHz frequencies through radio telescopes situated at Segamore Hill Solar Radio Observatory, Massachusetts. The radio flux radiation at different frequencies originates from different layers of the solar upper atmosphere. The data available from 1966 to 2010 was analysed to give information about the variation in equatorial solar rotation of corona and chromospheres at different altitudes. The altitudinal and temporal variation in solar rotation period has been study for the whole observed period. A systematic interrelation has also been seen in rotational variation with altitude and also with the phases of solar cycle.

| SSS - 22 | ASI2019_152 | Subhamoy Chatterjee | Poster |
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Subhamoy Chatterjee, Dipankar Banerjee, Scott W. McIntosh, Robert J. Leamon, Mausumi Dikpati, Abhishek K. Srivastava

## Signature of Extended Cycles from Digitised Ca II K Data of Kodaikanal Observatory

Kodaikanal Solar Observatory (KoSO) has archived 100 years of full-disc Ca II K spectroheliograms which have been digitised recently. From the Carrington maps generated from calibrated Ca II K we detected supergranule boundaries called the network. Subsequently we excluded the plages areas to consider only quiet sun (QS) and detected small scale bright feature through intensity thresholding over the QS network. Those features we named as `network bright elements'. Latitudinal density of network bright elements could clearly depict the existence of overlapping cycles with equatorward branches starting at latitude ~ 55 degrees and taking about 16-17 years to reach the equator. We performed superposed epoch analysis to depict the similarity of those extended cycles. We believe the clear temporal overlap between two equatorward branches and its correlation with sunspot cycles starting at about 40 degree latitude can provide vital inputs to dynamo theory.

| SSS - 23 | ASI2019_188 | SUDHEER MISHRA | Poster |
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Sudheer K. Mishra, A.K. Srivastava

## On the Development of MRT Unstable Plumes in An Eruptive Prominence

We analyze the observations from the Solar Dynamic Observatory (SDO) onboard the Atmospheric Imaging Assembly (AIA) of an eruptive prominence in the lower corona on 18th November 2014. This eruptive prominence consists of self-similar magnetic Rayleigh-Taylor unstable plumes. We observed that a cavity has been developed within the prominence which grew vertically first. The perturbations have developed on the boundary of the cavity and the first MRT unstable plume is initiated at 05:15 UT on the top of the cavity. It passes through the overlying prominence along with strong upflows. Additional perturbations have been developed on the boundary of the cavity, which further trigger an another MRT unstable plume like structure. The self-similar plume formation shows the linear, and in later phase the single mode MRT plume formation exhibits the non-linear phase of MRT instability as it is converted into the mushroom like structure in it’s final stage of the development. We have analyzed the temporal and spatial evolution of these MRT unstable plumes and estimated the observational growth rate of the MRT instability which is found to be 1.05×10−3 and 1.11×10−3 s −1. The Differential Emission Measurement (DEM) technique has been used to estimate the density within the bright plume regions and dark cavity regions lying below. The separation between two consecutive plumes gives the characteristic wavelength of MRT instability. The estimated theoretical growth rate 3.08×10−3 s−1 is found in good agreement with the measured observational growth rate.

| SSS - 24 | ASI2019_144 | Sumanjit Chakraborty | Poster |
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Sumanjit Chakraborty and Abhirup Datta

## Ionospheric Total Electron Content analysis during descending phase of solar cycle 24

The equatorial ionosphere presents some of the highest Total Electron Content (TEC) values in the world. The Equatorial Ionization Anomaly (EIA) region, which comprises of almost two-thirds of the density of global TEC, has crests at around ±30 about the magnetic equator. Indore falls near to the northern anomaly crest and as a result sharp latitudinal gradient exists in and around this region. Hence analysis of TEC over this region becomes very necessary to characterize the equatorial ionosphere. It is also well known that TEC is strongly affected by solar activity and any enhancement in the ionospheric TEC due to the influence of this solar activity may cause dramatic increase in the pseudo-range error. In the present work, TEC over Indore has been analyzed using a dedicated python pipeline, as huge amount of data handling is necessary for such time series analysis during the present low activity phase of the Sun. Observations have been made when there had been disturbances due to geomagnetic storms during this period

| SSS - 25 | ASI2019_474 | Suraj Sahu | Poster |
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Suraj Sahu, Bhuwan Joshi, and Prabir K. Mitra; Udaipur Solar Observatory, Physical Research Laboratory, Udaipur 313001, India

## Thermal & non-thermal processes caused by large-scale restructuring of coronal magnetic fields driven by the flux rope eruption

We present a multi-wavelength analysis of a partially erupting filament associated with an M6.7 flare from the active region NOAA 12371 on 2015 June 22. The prominence eruption evolved into a huge, ultrafast, halo coronal mass ejection. In this study, we combine observations from the Atmospheric Imaging Assembly and Helioseismic Magnetic Imager on board the Solar Dynamics Observatory, RHESSI and Big Bear Solar Observatory. GOES 1-8 \AA\ soft X-ray (SXR) flux indicates this flare to be a typical long duration event (LDE), causing prolonged thermal emission for >3 hours. The flare light curves in SXR and extreme ultraviolet (EUV) energy bands suggest distinct peaks during pre-flare and precursor phases which is associated with triggering reconnection and heating of a pre-existing quasi-stationary flux rope. Interestingly, the main phase of the flare was associated with two distinct peaks separated by \sim15 minutes. The \beta\gamma type active region consisted of two spatially well separated sunspot groups with the leading and trailing groups showing unipolar and bipolar magnetic structures on the photosphere, respectively. Chromospheric H\alpha and EUV observations suggest the bipolar sunspot to be associated with a filament lying over the polarity inversion line which partially erupted giving rise to the impulsive emission with strong non-thermal characteristics, causing the first SXR peak. The filament eruption was followed by intense diffused emission from the newly formed post-flare arcade giving rise to the gradual, second SXR peak. In the gradual phase of the flare, we find emission from a second layer of post-flare arcade which was situated high in the corona connecting the positive portion of the bipolar sunspot with the unipolar negative polarity sunspot. We have carried out magnetic field modeling of the active region corona to explain our observations in the light of breakout versus thether cutting models of solar eruptions.

| SSS - 26 | ASI2019_510 | Surajit Mondal | Poster |
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Surajit Mondal, Divya Oberoi, Kamen Kozarev, Atul Mohan

## Measuring the magnetic field of CMEs using spectroscopic snapshot imaging with the MWA

Most studies on Coronal Mass Ejections (CMEs) using radio data were done with the dynamic spectrum and mainly concentrated on the intense type II plasma emission arising due to electron acceleration at the shock fronts. This limits their utility for studying the CME plasma itself and the regions of CME away from the shock front. Gyrosynchrotron emission from the electrons accelerated during the CME initiation process trapped in the magnetised CME plasma has long been expected, but has remained hard to observe. This emission was first detected by Bastian et al. (2001). Using the spatially resolved spectra of the detected CME radio loop, they quantified the CME magnetic field as well as the non-thermal electron population responsible for this emission. Not only are these parameters inaccessible by any other means, they also play a very important role from a space weather perspective. Here we present the detection of a white light CME using radio data from the Murchison Widefield Array (MWA). Imaging was done at nine spectral bands, each 2 MHz wide, spanning 108 MHz to 240 MHz. Unlike earlier studies, we find a clear structural correspondence between the observed radio structure and the white light CME. We are also able to detect the flux rope for a longer duration and out to a larger distance, as compared to earlier studies. By modelling the spectra, we are able to constrain the magnetic field and energy distribution of the nonthermal electrons in a spatially resolved manner. Finally, we present a comprehensive comparative analysis of all the earlier studies where similar measurements were made. We comment on why, we believe, that the MWA with its high imaging dynamic range and wide bandwidth can make a significant impact in advancing our understanding of CMEs.

| SSS - 27 | ASI2019_48 | VASANTHARAJU N | Poster |
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N.Vasantharaju, B.Ravindra, P.Vemareddy and V.H.Doddamani

## Temporal evolution of magnetic field parameters leading to the largest flare (X9.3) of Solar cycle 24

Solar Active region(AR) NOAA 12673 produced 4 X-class, 27 M-class and 45 C-class flares during its solar disk passage from 29 August 2017 to 10 September 2017. It produced two consecutive major flares, X2.2 at 8:57 UT and X9.3 at 11:53 UT on 6 September 2017. The X2.2 flare remained confined and helped in the build up of magnetic flux rope system, which eventually erupted during X9.3 flare as a Halo CME. The X2.2 flare likely weakened the magnetic topology facilitating the eruptive X9.3 flare. We used SHARP series of vector magnetogram data of Helioseismic and Magnetic Imager (HMI) on board Solar Dynamics Observatory (SDO) as the boundary condition to estimate the background field by potential field approximation. Our initial results of the temporal evolution of background field confirms the above said scenario. Also, we studied the temporal evolution of different magnetic field parameters like Total Magnetic flux, Degree of Net-vertical-current neutralisation (NVCN), average alpha and Magnetic free-energy during the AR transformation from simple α-configuration (2 September 2017) to complex βγδ-configuration (7 September 2017) and found that the AR has the fast emerging flux rate, presence of strong non-neutralised currents and highly sheared configuration leads to build up of magnetic free-energy favours the conditions for strong eruptivity of AR. In my talk, results related to the evolution of non-potentiality of AR leading to strong flares will be presented.

| SSS - 28 | ASI2019_338 | Venkata Raman | Poster |
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V. Venkata Raman & R. Satheesh Thampi

## Investigation of the solar wind and its interaction with Martian atmosphere using MAVEN

Solar wind interacts directly with the upper atmosphere of Mars due to the lack of global magnetic field. Neutral particles in the upper atmosphere are predominantly ionized by extreme ultraviolet (EUV) photons and through interactions with solar wind charged particles, resulting in the formation of ionosphere. Reactions involving recombination of electrons and ions between different ions determine the chemistry and composition of the upper atmosphere and the photochemical escape of atmospheric gases in to space. The Mars Atmosphere and Volatile EvolutioN (MAVEN) mission has the suite of instruments to study these processes. The solar wind flux provide one of the key energy inputs that can drive atmospheric escape from the Martian system via non-thermal mechanism. The solar wind ion fluxes and the electron energies at the Martian environment are measured using Solar Wind Ion Analyzer (SWIA) and Solar wind Electron Analyser (SWEA) respectively. The effect of solar activity on the escape rate of volatiles will be discussed using the observations from Imaging Ultraviolet Spectrograph (IUVS), Neutral gas and Ion Mass Spectrometer (NGIMS) and SupraThermal And Thermal Ion Composition (STATIC) instruments on board MAVEN.

| SSS - 29 | ASI2019_253 | VIVEK SINGH | Poster |
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VIVEK KUMAR SINGH SANISH THOMAS SATISH CHANDRA

## Study of Coronal Rotation using Radio Flux data (2695 MHz)

The present work is an attempt to look into any possible long-term variations in the solar coronal rotation by analysing the solar radio emission data at 2695 MHz frequency for the period 1966–2010. We used the time series radio flux data recorded at Sagamore Hill Solar Radio Observatory, Massachusetts. The rotation period estimated through statistical analysis shows continuous variation in its value. The variation in rotation period shows evidence of three components in the variation; first one is the ~22-yr component, which may be linked to the solar magnetic field reversal (Hale's) cycle, second one is the ~11-yr component, obviously related to the Solar activity cycle and other one is a prominent random component. The cross-correlation between the annual average sunspot number and the coronal rotation period observed shows strong correlation with 22-yr Hale's cycle and 11-yr solar cycle.

**Posters**
**Stars, ISM and Galaxy**

| SIG - 1 | ASI2019_339 | Abinash Sahoo | Poster |
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Abinash Sahoo, Prof. Ananta Charan Pradhan, NIT, Rourkela & Prof. Jayant Murthy, IIA, Bangalore

Modelling interstellar radiation field in UV

We have developed a model to generate the interstellar radiation field(ISRF) in UV (912 \AA - 3000 \AA) within 500 parsecs of the Sun using Hipparcos stellar catalog. We have compared the model generated ISRF with the previous models and the observations of the TD-1 satellite. We found that B type stars contribute mostly to the total ISRF and constitute $\sim$7\% of the total number of stars in our model at distances between 0 pc and 500 pc. Stars farther away than 500 pc from the Sun contribute very less to the total ISRF as a result of attenuation by dust.

| SIG - 2 | ASI2019_340 | Akant Vats | Poster |
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Ekant Vats, Gauri Devi, Mridusmita Buragohain, Amit Pathak

Theoretical vibrational study of Nitrogenated PAHs: Astrophysical implications

Infrared fluorescence in large aromatic molecules known as Polycyclic Aromatic Hydrocarbon (PAH) results in infrared emission features that dominate the spectra of the interstellar medium (ISM) of most Galactic and extra galactic objects (Tielens 208). Interstellar PAHs show ubiquitous infrared (IR) spectrum from 3 to 20 µm and this spectrum is full of intricate features. Strong emission features are observed at 3.3, 6.2, 7.7, 8.6, and 11.2 µm. The bands in the 6-9 µm range are dominated by the emission of ionized PAHs. There are spectral variations in the peak position and profile of the 6.2 µm C-C stretch feature because this band is not a single band but two or more bands, one centered near 6.2 µm and the other near 6.3 µm or beyond (Peeters et al., 2002). The 6.3 µm band is explained by varying the size of the PAH molecule but the 6.2 µm remains unexplained. The substitution of one or more nitrogen atoms within the interior of PAH cation (replacing one or more carbon atoms) induces a blue shift in the position of the C-C stretch feature and this feature now appears at 6.2 µm (Hudgins et al., 2005). Here we present the vibrational spectra of PANH, HPANH and DPANH molecules in their various ionized forms. Apart from discussing the 6.2 µm feature, we try to explore new features that are contributed by these molecules. We also discuss the dipole moment of these species and whether these are feasible to be detected by radio astronomy techniques. Standard density functional theory (DST) is used for calculating various physical parameters of these molecules.

| SIG - 3 | ASI2019_72 | Akshara Viswanathan | Poster |
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Ms.Akshara Viswanathan, Prof.Dr.Sara Ellison

## Quantification of the merger fraction in local AGN hosts

The objective of the research was to find the possible connection between the Active Galactic Nuclei(AGN) and Galaxy Mergers using the data pipe-lined from Canada France Imaging Survey(CFIS) and Sloan Digital Sky Survey(SDSS). Starting from a list of known AGN identified in the SDSS based on optical emission line diagnostics, quantifying the fraction of galaxies in on-going or recent mergers was carried out with tile images pipe lined from respective CFIS Data. The same calculation was performed with a set of mass and red-shift matched non-AGN (or the control sample) in order to infer whether there is an excess of merger morphology in the AGN sample. With a sample of 972 AGN, it was inferred that high luminosity AGN is undergoing interaction more and more in comparison to low luminosity ones, highly massive AGN have interactions more, ie., they dominate in interacting pairs and post mergers, galaxies that are closer, dominate in post mergers whereas it is the vice versa in case of interacting pairs and it is also visible that in isolated, control galaxies are dominating, but as the interaction level increases, the difference in domination of AGN by control is decreasing, but still AGN is dominating in all morphologies of merger interactions. This type of study could in future be repeated for other AGN selection methods, e.g. in the mid-IR, radio or X-ray and various other research.

| SIG - 4 | ASI2019_176 | Akshaya SubbannaMS | Poster |
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M. S. Akshaya, Christ (Deemed to be Unviversity), Bengaluru Jayant Murthy, Indian Institute of Astrophysics, Bengaluru S. Ravichandran, Chrirt (Deemed to be University), Bengaluru

## COMPONENTS OF THE DIFFUSE ULTRAVIOLET BACKGROUND RADIATION

Diffuse background is present at all the wavelengths of the electromagnetic spectrum. The component of this background in the ultraviolet (UV) regime mainly has contributions from the dust scattered star light and the extragalactic background light (EBL) coming from galaxies, QSOs and the intergalactic medium. But there is also some part of this background radiation whose source is as yet unidentified. We will be presenting the work carried out in quantifying the various known contributors to this diffuse background and our estimates of the offsets with unknown origin in the far-UV and near-UV bands of the Galaxy Evolution Explorer (GALEX) by studying the UV surface brightness in the regions of the Galactic poles. The estimates were also tested by modeling the UV surface brightness observed from a Galactic cirrus cloud near the north Galactic pole where we find that our dust model fits well with the observed UV surface brightness after taking into account the estimated contributions from EBL and the unidentified offsets.

| SIG - 5 | ASI2019_363 | Alaxender Panchal | Poster |
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Alaxender Panchal, Yogesh C. Joshi

## Photometric study of three short period eclipsing binaries

At ARIES Nainital, we have started a photometric monitoring program to study eclipsing binary (EB) and EB candidates to understand their nature and determine their accurate parameters. In recent times, we have carried out photometric analysis of three short period EBs which are low mass contact binary stars. The photometric variability of these EBs is ~1 mag and periods are typically short about 6 hours. In the first phase of our program, we selected J163321.3+543928, J152450.7+245943 and J163720.4+172047 from the Catalina Surveys periodic variable stars Catalog for our analysis using 1.3m telescope. Because of their short period, we were able to cover their full orbit on a single night, easily. For first two sources we give light curves in B, V and I bands while in case of third system we provided light curves in V, R and I band. We used PHOEBE and WD code for determination of parameters from their light curves. Multi-band Photometric analysis of these 3 objects is done for first time.

| SIG - 6 | ASI2019_303 | ANAND MY | Poster |
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M.Y.ANAND, B.A. Kagali

## A study of wind blown bubble around HD 148937

HD148937 is a massive early type star surrounded by ellipsoidal filamentary nebulosity interpreted as a stellar windblown bubble. This study has been made using IUE high resolution spectra which shows many singly ionised dominant species like Si II, Fe II and others, also highly ionised species like Al III and CIV have been seen in the spectra. Estimated radial velocity of these line, have been identified with the swept up region around the HD148937. From the study we have derived the age of the bubble to be 1.31x10^5 years, which is less than the age of the central star (3-4 Myr).

| SIG - 7 | ASI2019_267 | Anindita Mondal | Poster |
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Anindita Mondal, Ramkrishna Das, G. C. Anupama, Soumen Mondal

## Study of quiescence phase spectra of novae

Studies of quiescence phase of novae are crucial to understand many aspects of the nova outburst and evolution; for example, the nature of the secondary and other components of the system; interaction among the binary components, effects of the outburst on the accretion disk, mass transfer rate, etc. In order to understand quiescence phase property of novae, I have observed a few quiescent novae using the 2m HCT. The spectra show prominent emission features of hydrogen, helium, iron and oxygen features of low ionization; few novae show absorption feature due to the cool secondary component. The absence of higher ionization lines can be accounted for by the absorption and softening by reradiation of all direct photons from the accretion disk. I have modeled the spectra using photoionization code CLOUDY. For modeling, I have considered 3 components: the hot WD, surrounded by a cylindrical accretion disk and the secondary companion. The modeled spectra were then matched with the observed ones using chi-square minimization technique. From the modeling of quiescence phase spectra, we determined the type of the secondary, estimated elemental abundances and other parameters related to the system.

| SIG - 8 | ASI2019_419 | Ankit Kumar | Poster |
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Ankit Kumar, Mousumu Das, Sandeep Kumar Kataria

## Bulge Growth of Disk Galaxy in Fly-by Interaction

The hierarchical model of the universe suggests that galaxies have formed through the merger of small galaxies. Mergers were more frequent in far past when the universe was small in size. The morphological and kinematic properties of a galaxy depend on what kind of mergers it has gone through. This is the motivation of our present work. When two galaxies with different mass come close enough then a huge gravitational force of major galaxy disrupt the minor galaxy, collision between gas clouds produce a burst of star formation, loss of the angular momentum of stars and gas increase the size of the bulge and supermassive black hole and sometimes produce high energy jets. We are doing the numerical N-body simulation of the interaction of two galaxies with varying pericenter distance, initial orientation, and mass ratios etc. We used GalIc code to generate initial conditions of two isolated galaxies. By putting both galaxies together on parabolic orbits, we are evolving them with open source code Gadget-2. The objective of this project is to see the growth of the bulge in the different configuration of interaction and to find the favorable conditions for bulge growth of disk galaxy in fly-by interaction.

| SIG - 9 | ASI2019_328 | Arun Roy | Poster |
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Arun R., Blesson Mathew, Manoj P., Ujjwal K., Mayank Narang, Gayathri Viswanath, Sreeja S. Kartha

## Gaia view of Herbig Ae/Be Stars: Estimating the stellar parameters from Gaia DR2 data

The accurate determination of stellar parameters such as mass, radius, and age of Herbig Ae/Be (HAeBe) stars are critically dependent on the distance to the source. Taking advantage of the latest release of Gaia data, Gaia DR2, we estimated ages and masses of 100 HAeBe stars. The stellar parameters are derived from the Gaia color-magnitude diagram with the help of accurate astrometric and photometric measurements from Gaia DR2 and using MIST isochrones and evolutionary tracks. We derived the mass accretion rates for HAeBe stars using the refined stellar masses and distances, and used it as a tool in investigating the physical properties of the stars and their disk. From the exponential decay of mass accretion rate with stellar age, we estimated disk dissipation timescale of $\tau = 1.7 \pm 0.1$ for the full sample of HAeBe stars. We estimated the best fit for mass accretion rate and stellar mass which exhibits a power law as $\dot{M}_{acc} \propto M_{\odot}^{(3.4 \pm 0.2)}$ for the full sample. We also found a distinct behavior in the infrared spectral index for HBe and HAe stars.

| SIG - 10 | ASI2019_342 | Ashlin Varghese | Poster |
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Ashlin Varghese, Manash Samal

## Jets and outflows of the W51 complex as revealed by the UWISH2 survey

Jets and outflows are one of the first signposts of stellar birth. Emission in the H2 1-0S(1) line at 2.122 micron is a powerful tracer of shock excitation in these objects. Here we present the analysis of 1.3 x 0.9 square degrees data from the UK Widefield Infrared Survey for H2 (UWISH2) in the 1-0S(1) line to identify and characterize the outflows of the W51 complex. We found 39 individual knots in the complex. We identified driving source candidates of the outflows and found that most of them are protostars. We fit SED models to the candidate outflow driving sources and conclude that the outflows of our sample are mostly driven by moderate-mass YSOs that are still actively accreting from their protoplanetary disc. We discuss that several of our newly identified outflow candidates are excellent targets for follow up studies to better understand very early phase of protostellar evolution

| SIG - 11 | ASI2019_502 | Avrajit Bandyopadhyay | Poster |
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Avrajit Bandyopadhyay, Sivarani Thirupathi

## New discoveries of globular cluster escapees and other results from GOMPA(Galactic survey Of Metal Poor stArs) survey

We present early results of metal poor stars observed by the Hanle Echelle SpectrograPh (HESP) at spectral resolution R=30000 & 60000. We have studied about 50 stars in the metallicity range of halo Globular clusters, that includes 8 new EMP ([Fe/H] < -2.5) stars, 24 new VMP stars. We have identified three globular cluster escapees that show the typical light-element anomalies(CH-CN,Na-O,Mg-Al anticorrelations) associated with second generation GC stars. Two of them are RGBs and one is a blue straggler star, which is a rare class of object among halo stars. The blue straggler shows strong overabundances of Na([Na/Fe]=+1.50) along with a very depleted Mg and Ca([Mg/Fe]=-0.30;[Ca/Fe]=-0.50). Li could also be detected in these GC escapees which is very important to constrain the nature of the original polluters of the GC. Detailed study of these objects is very helpful in determining the self-enrichment and pre-enrichment in GCs which is otherwise difficult. Additional interesting objects include an r-II star with [Eu/Fe]=+1.02 and [Th/Fe]=1.28 and six R-I stars with +0.30<[Eu/Fe]<+1.2. We also identified 3 CEMP-no stars and one CEMP-s star. We have conducted a comparative study of CEMP-no and EMP stars in their heavy element enrichment. Lithium was detected in many of the stars which include giants and dwarfs and they exhibit the expected depletion from Spite plateau as they ascend the giant branch. We found Lithium to have a similar distribution among CEMP-no and EMP stars. Identification of bright EMP stars is useful for detailed isotopic abundances and key waiting point nuclei to probe the nucleosynthesis sites. The current study is limited to SDSS MARVELS pre-survey with Vmag=8-13, that primarily targets the low latitudes for exoplanet studies.

| SIG - 12 | ASI2019_333 | Barnali Das | Poster |
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Barnali Das, Poonam Chandra, Gregg A. Wade, M. E. Shultz

## HD 142990: The third main-sequence magnetic star with coherent emission

Until last year, CU Vir was the only known main-sequence magnetic star to show periodic pulses which are of coherent nature. Our discovery of the second such star HD 133880 ruled out the possibility that this phenomenon is unique to CU Vir. Note that the observation of coherent emission can help us in constraining certain physical parameters like the stellar rotation period and hence such observations are quite useful. Recently, Lenc. et al. (2018) discovered another star, HD 142990, that show characteristics of coherent emission at 200 MHz. We have observed this star at 610 MHz with the Giant Metrewave Radio Telescope (GMRT) and confirmed that this star indeed has coherent emission mechanism in play. In my talk, I will describe the discovery of this third star and the role of our observation in that. I will also discuss how our observations point out towards some of the shortcomings of the current model of coherent emission from hot magnetic stars.

| SIG - 13 | ASI2019_226 | Belinda Damian | Poster |
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Belinda Damian, Jessy Jose et al.

## Luminosity functions of young clusters in massive stellar environments

The study of Initial Mass Function (IMF) is important to understand star formation. The role of external feedback in the form of luminosity function and initial mass function is yet to be understood. In this study, we present the luminosity functions and initial mass functions of 10 young clusters of age 2 to 3 Myr which are embedded in massive stellar environments. These clusters are selected based on their well defined pre-main sequence band in J vs J-H color-magnitude diagrams, which essentially implies uniform reddening within the clusters. We use the deep near-IR archival data from United Kingdom Infrared Deep Sky Survey (UKIDSS), Visible and Infrared Survey Telescope for Astronomy (VISTA) and Kitt Peak National Observatory (KPNO) in 1.2, 1.6 and 2.2 micrometer pass-bands along with GAIA DR2 data for the analysis. We study the luminosity functions and initial mass functions of these clusters down to the brown dwarf limit in order to understand the role of massive stellar feedback in the formation and evolution of young clusters.

| SIG - 14 | ASI2019_182 | BRYAN MIRANDA | Poster |
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Bryan Rithesh Miranda(Bangalore University), Annapurni Subramaniam (Indian Institute of Astrophysics, IIA), Ram Sagar (Indian Institute of Astrophysics, IIA), Vijayakumar H. Doddamani (Bangalore University)

## Study of UV bright stellar populations in King 2

King 2 is a rich open star cluster located at a distance of 5.75 kpc and is 6 Gyr old. This open cluster has a large number of interesting UV bright candidates. Observation of this cluster in the UV band was carried out by Ultra Violet Imaging Telescope (UVIT) onboard the ASTROSAT satellite. The UV magnitudes in one FUV (CaF2) and one NUV (B15) filter is obtained by Point Spread Function (PSF) photometry, using the DAOPHOT package in IRAF. The Colour Magnitude Diagrams (CMDs) both optical and UV - optical for this cluster is generated using the coordinate crossmatch of the the optical and UVIT photometric data. The Flexible Stellar Population Synthesis (FSPS) model is used to generate the isochrones for the optical and UVIT filters. In this study we have identified 34 UV bright objects including a Red Giant and a few Blue Straggler stars. Combining the photometric data from Two Micron All Sky Survey (2MASS) (J,H,K), Isaac Newton Telescope (INT) Photometric Hα Survey of the Northern Galactic Plane (IPHAS) (R, I) and the optical study, we have constructed Spectral Energy Distribution (SED) for 34 stars and their stellar parameters (L⊙, Teff, R⊙, M⊙) have been tabulated. In an attempt to study this cluster in multiwavelength, we have found the presence of binaries.

| SIG - 15 | ASI2019_287 | BS Shylaja | Poster |
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Shylaja B S

## Records of Supernovae in Stone Inscriptions

Extensive searches for the possible records of supernovae have been carried out by earlier investigators in astronomical texts from India. However the results have been negative. A study of the inscriptions has indicated a possible record of the 1054 event. We have shown that these inscriptions have documented many celestial events like eclipses, solstices and conjunctions. Since these are not written by professional astronomers only a description of the new star in the sky is recorded. We have identified two cases of metaphors for the description of the supernovae of 1054AD and 1604AD. We have also identified other indirect references in literature.

| SIG - 16 | ASI2019_252 | Chinnathambi Muthumariappan | Poster |
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B.M. Amrutha

## Photoionization models of planetary nebulae with WR-type central stars

Around 25% of the central stars of Planetary Nebulae (PN) show Wolf-Rayat (WR) phenomena similar to massive stars. Though their precursors are AGB stars, the evolutionary path difference of [WR]PNe from those normal PNe is not known. The ionization structures of [WR]PNe will bring out the mass-loss history of these objects and in turn will help us to understand their evolutionary stage. We derive the ionization structures of a few PNe with [WR] and normal central stars from low resolution spectra obtained with VBT and using CLOUDY modelling. We discuss our preliminary results. We suggest that [WR]PNe are likely to have centrally condensed cores, unlike the normal PNe.

| SIG - 17 | ASI2019_353 | Debasish Saha | Poster |
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Debasish Saha and Sabyasachi Pal

## Study of Galactic micro-quasars with Astrosat

Micro-quasars are known to show variable emission from a wideband emission regime ranging from low-frequency radio emission to high energy gamma-ray emission. We have used data from India's first multi-wavelength space-mission Astrosat to study broad-band properties of few selected micro-quasars from our Galaxy. LAXPC data (3-80 keV) is used to study X-ray emission from the accretion disk of these binary systems while Ultra Violet Imaging Telescope (UVIT) data is used to study UV counterpart of the binary star of the black-hole/neutron star binaries. We have detected different flaring activities in the X-ray emission of sources with a wide range of time-scales (few minutes to days). Quasi-periodic emission is detected from few of the sources. We have also detected state transition of these sources. Spectrums from these sources are fitted with different models. While possible, we have also studied multi-wavelength observation of these sources using simultaneous observations of ground based instruments in radio and optical wavelengths.

| SIG - 18 | ASI2019_406 | Dhanya JS | Poster |
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Dhanya J S(MNIT Jaipur 302017) Lokesh Kumar Dewangan(PRL,Ahmedabad 380 009) D. K. Ojha (TIFR, Mumbai 400 005)

## STUDY OF A SYSTEM OF H II REGIONS ASSOCIATED WITH N36 BUBBLE AT THE GALACTIC BAR - NORMA ARM INTERFACE

With the help of multi-wavelength approach, we present an investigation of a system of HII region associated with a mid-infrared bubble N36 (extension ∼35 pc, distance=6.0 kpc) toward l = 24.8, b = 0.1. The system is found to be situated at the interface of Galactic bar and Norma Galactic arm in the Milky Way where one may expect the collisions of molecular clouds due to the bar potential. Each of the HII regions (dynamical age ∼0.4-1.3 Myr) in the system is powered by a radio spectral type of O star and is associated with the warmer emission (Td ∼23-32 K). Several ATLASGAL dust continuum clumps at 870 µm are observed toward the system and their masses vary between 185 and 7635 Msun.Many of the clumps have high bolometric luminosities (>10^3 Lsun) and are found toward the ionized regions in the system.Three 6.7 GHz Class II methanol masers are observed in the system, suggesting the presence of early phases of massive star formation (< 0.1 Myr). Using the Spitzer photometric data, we find noticeable protostars towards the H II regions, tracing the ongoing star formation activity in the system. In order to study the kinematics of molecular gas in the system, the GRS 13CO line data analysis is performed, which reveals two velocity components (around 109 and 113 km/s) in the direction of the system. These components are also interconnected in the velocity space. Signatures of massive star formation are investigated at the common zones of the two clouds, where four HII regions, massive clumps (> 10^3 Msun), two 6.7 GHz methanol masers, and embedded protostars are also traced. Taken into account of all these observational results, the presence of the system of HII regions, and the formation of the O-type stars appear to be explained by the interaction of molecular clouds at the Galactic bar-Norma arm interface.

| SIG - 19 | ASI2019_485 | Firoza Sutaria | Poster |
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F. Sutaria (IIA, Bangalore), K. P. Singh (TIFR/ IISER Chandigarh), J. Murthy (IIA, Bangalore), N. K. Rao (IIA, Bangalore), and, A. Ray (TIFR/HBSCE, Mumbai)

## Studying shock dynamics in the Cygnus SNR with Astrosat/UVIT.

Narrow band filters in the UVIT/FUV and UVIT/NUV instruments are used to study shock dynamics in Cygnus SNR. Coupled with Astrosat/SXT data, and archival optical data, we examine segments of the loop to trace shock-ISM interaction, and determine the physical properties of UV-bright gases trapped between the Balmer dominated shocked filaments, and the x-ray hot gases trapped within the Cygnus "bubble". We use our results to explore the possibility that this SNR comprises of the remnants of multiple historical supernovae explosions.

| SIG - 20 | ASI2019_401 | Jayanand Maurya | Poster |
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Jayanand Maurya

## Astrometric and photometric study of open clusters NGC 381 and King 21 using ground based and archived Gaia DR2 data

The study of open star clusters is important to understand star formation process in the Galaxy. A precise knowledge of cluster parameters such as age, distance, chemical composition as well as stellar population distribution and cluster mass function at the time of star formation play a key role in understanding the star formation history. At ARIES, Nainital, we have been carrying out a long-term observational programme to search and characterize the variable stars in some poorly studied open star clusters. A UBVRI photometric study and Gaia DR2 kinematic study of two such open clusters NGC 381 and King 21 is presented here which has been carried out using the observations taken from 1.3-m DFOT telescope at Devasthal, Nainital and space born GAIA telescope. By deriving the stellar membership probabilities of the stars in the cluster fields, we identify the probable cluster members in order to determine the most accurate cluster parameters. To estimate the physical cluster parameters like distance, age, and reddening of the clusters, we used stellar isochrones fitting method in the observed (B − V)/V and (V − I)/V CMDs, and TCDs. We derived the luminosity functions and the mass functions for both the clusters. I will discuss the results of our survey which were derived through the photometric data taken at Nainital along with the archival 2MASS and GAIA surveys.

| SIG - 21 | ASI2019_302 | Jayashree Roy | Poster |
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Jayashree Roy, Manojendu Choudhury, P. C. Agrawal

## Timing and Spectral Study of IGR J19294+1816 with RXTE: Discovery of Cyclotron Feature

Rossi X-ray Timing Explorer (RXTE)/Proportional Counter Array (PCA) observations of IGR J19294+1816 covering two outburst episodes are reported. The first outburst happened during MJD 54921-54925 (2009 C.E.) and the second one happened during MJD 55499-55507 (2010 C.E.). In both the cases the PCA observations were made during the decay phase of the outburst, with the source exhibiting temporal and spectral evolution with the change in flux. At the bright flux level an absorption feature at 35.5 keV is detected in the spectra which may be attributed to Cyclotron Resonance Scattering Feature corresponding to a magnetic field of B = 4.13*10^12 Gauss. This is also detected at a lower significance in two other observations. In addition an Fe line emission at 6.4 keV is prominently detected during the highest flux. X-ray pulsations are detected in 9 out of 10 observations; no pulsations were found in the observation with the lowest flux level. During this observation with the lowest flux the pulsation phenomenon becomes detectable only at the soft X-ray bands.

| SIG - 22 | ASI2019_14 | Jyothy S Nair | Poster |
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S. N. Jyothy, N. V. Sujatha & Narayanankutty Karuppath

## Diffuse UV Background From The Southern Low Galactic Latitudes

We present the results of the primary analyses of the observed diffuse UV background from a Southern low Galactic latitude region (b < 10 degree; 25 degree < l < 40 degree) using the GR6/GR7 GALEX data. The airglow emission contributes negligibly less (< 5 PU) to the observed UV backgrounds in the region while the NUV zodiacal light is about 380 - 560 PU. The median diffuse FUV and NUV backgrounds in the region are estimated to be 2770 and 2200 PU respectively, with standard deviations less than 40 PU. The observed UV backgrounds in the region are negatively correlated with IR 100 µm emission as well as the N(H) emission which are quite interesting and may be attributed to the peculiar dust distribution in the line of sight. We suspect the presence of multiple layers of dust in the line of sight resulting in such negative correlations. More detailed studies and modeling are required for a complete understanding of the dust distribution and the observed FUV and NUV emissions from the region, which we are concentrating on now.

| SIG - 23 | ASI2019_434 | KABITA DEKA | Poster |
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Ms.KABITA DEKA, Prof. RANJEEV MISRA & Dr.GAZI AMEEN AHMED

## The Flux distribution study of Cygnus X-1 to understand its long term temporal behaviour

Cygnus X-1 is one of the brightest x-ray sources. It’s consist of a blue supergiant star and a black hole that orbit around each other. The source shows variability on different time-scales ranging from seconds to months. The variability could be due to variation in the mass accretion rate which may be due to a multiplicative process or due to an additive one. If it is additive the flux distribution would be a Gaussian while if it is multiplicative it would be a lognormal one. We will study and report on the flux distribution of Cygnus X-1 using the RXTE/ASM (Rossi X-Ray Timing Explorer/ All Sky Monitor) and MAXI data in order to understand the distributions. Cygnus X-1 is known to have two spectral states and we will study whether the distributions are the same or different in the two states. Moreover, we will also report on the flux distribution as a function of the energy of the photon.

| SIG - 24 | ASI2019_214 | KHUSHBOO KUNWARRAO | Poster |
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Khushboo Kunwar Rao, Research Scholar,Department of Physics, Birla Institute of Technology and Science Pilani,Pilani Campus. Dr. Kaushar Vaidya, Assistant Professor, Department of Physics, Birla Institute of Technology and Science Pilani,Pilani Campus.

## A Gaia DR2 Study of Selected Open Clusters

We characterize the stellar populations of seven rich but relatively poorly studied open clusters, located at distances 900-2600 pc using the Gaia DR2 data. The unprecedented precision of the Gaia DR2 proper motions and parallaxes, when possible combined with the radial velocity information available in the literature, allows for secure membership determination for the stars in clusters. We report our estimate of the fundamental cluster parameters such as the age, distance, and the metallicity. The numbers of identified members in these clusters range approximately from 200 to 950. A distinct equal-mass binary sequence is visible in each of these cluster's color-magnitude diagrams. The fraction of these binary systems range from 10-15%. Five of these clusters also show a number of blue stragglers. We study the mass-luminosity functions of these clusters. We examine the signatures of dynamical evolution in these clusters, such as the mass segregation, tidal stripping of the lower-mass stellar populations if any, radial distribution of the binary systems, and the blue stragglers, as compared to the reference population such as the red-giant branch.

| SIG - 25 | ASI2019_156 | Krishna Kumar Kowshik | Poster |
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Krishna Kumar Kowshik, Sujatha S, Swati Routh

## A 2MASS Study of Two Embedded Open Clusters

We present the basic results of a study conducted using archival data from the Two-Micron All Sky Survey (2MASS) on two embedded clusters in galactic 2nd quadrant. The first object is identified as FSR2007-0541 (l = 126.66$^o$, b = -0.76$^o$; α2000 = 01h23m06s, δ2000 = 61d51m23s). It lies in the direction of Cassiopeia constellation. Although it appears as a dark nebula in the optical wavelengths, several stars are seen in the infrared wavelengths. We obtained the data in JHKs filters from 2MASS and plotted the colour-magnitude diagrams of stars with good photometric quality. By fitting the theoretical isochrones to JHKs color-magnitude diagrams we estimated the interstellar reddening to be E(J-H) = 0.4±0.05 mag, obtained the distance as 2.4 ±0.5 kpc and found the log(age) to be 8. The second object is identified as G169.857+1.925 (l = 169.857$^o$, b = 1.925$^o$; α2000 = 05h27m08s, δ2000 = 38d31m16s). It appears as a small group of stars embedded in a cloud. The analysis colour-magnitude diagram for this object yielded an interstellar reddening value of E(J-H) = 0.45±0.05 mag, the distance as 5.84±0.5 kpc, and log(age) of 7. Both of clusters appear to be deeply reddened in the optical wavelengths and may contain many young stellar objects.

| SIG - 26 | ASI2019_307 | Madhu Kashyap Jagadeesh | Poster |
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Madhu Kashyap Jagadeesh*, Paul K T, Blesson Matthew and Annapurni Subramaniam** Department of Physics and Electronics, Christ (Deemed to be University), Bengaluru-560029. **Indian Institute of Astrophysics, Bengaluru -560034 *madhu.kashyap@res.christuniversity.in

## Survey program to identify classical Be stars in open clusters older than 100 Myr

We carried out a survey program with Himalayan Chandra Telescope using slitless spectroscopy technique, to identify Be stars in Open Clusters older than 100 Myr. The motivation for this survey was to understand how disk is formed in classical Be stars (Be Phenomenon). Although various mechanisms such as rapid rotation, non-radial pulsation, have been proposed to understand Be phenomenon, no consensus has emerged yet. Also, it needs to be understood whether, the Be star is ejecting mass during the early or latter phase of their main sequence life time. We identified 13 Be stars in 11 open clusters in emission and 8 Be stars, belonging to 4 open clusters, in transient phase from our slitless spectroscopy survey program. This study, when combined with our previous analysis on clusters younger than 100 Myr can provide insights in understanding Be Phenomenon in classical Be stars.

| SIG - 27 | ASI2019_445 | Mamta Gulati | Poster |
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Meenu Prajapati

## Slow modes in self-gravitating coupled collisionless stellar and gas disc.

Self-gravitating nearly Keplerian discs supports slow modes which can dominate the overall appearance of the disc (Tremaine 2001). All the previous studies on slow modes for galactic discs are done assuming the disc to be composed of zero pressure fluid (gas) disc (Tremaine, 2001; Sridhar & Saini, 2010; Gulati, Saini & Sridhar , 2012) or collisionless disc composed of stars (Jalali & Tremaine, 2012, Gulati & Saini, 2016). However in case of galaxies the gas and the stellar discs exists together and are coupled to each other. A natural question to ask at this point is: What is the nature of slow modes if both gas and particle discs are coupled together and are bound to each other gravitationally? Recently Jalali (2013) have done a similar problem applicable only to protoplanetary discs and found such systems to be unstable. In the present work we study the nature of slow modes if both gas and particle discs are coupled together and are bound to each other gravitationally. In near-Keplerian discs these can be the reason for the observed non-axisymmetric features in galactic discs.

| SIG - 28 | ASI2019_305 | Manoj Puravankara | Poster |
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Manoj Puravankara (TIFR), Mayank Narang (TIFR), Ravinder Banyal (IIA), Gayathri Viswanath (Christ Univ.), Blesson Mathew (Christ Univ.), Sireesha Chamarthi (IIA), T. Sivarani (IIA), Athira Unni (IIA) & S. P. Rajaguru (IIA)

## Demographics of exoplanetary systems: A tale of three different planet populations

The current count of confirmed exoplanets is set to cross 4000. It is now possible to carry out statistically meaningful demographic studies of exoplanets. Based on the planet properties (e.g. radius, mass) and planetary system architecture (e.g. orbital period), exoplanetary systems roughly separate into three different populations: (1) gas giants and rocky planets around main sequence stars at orbital distances of < 1 AU; (2) gas giants around evolved stars (subgiants and red giants) at orbital distances of a few AU; (3) super-Jupiter planets at few tens of AU around relatively young stars. Most of the studies so far have been focussed on the first population, and the other two populations that probe different but complementary parameter space are only poorly studied as a group. We have been carrying out a comparative study of the occurrence, architecture and host star properties of these three planet populations. Preliminary results suggest that the results obtained for the first population of compact planetary systems orbiting main sequence stars do not hold for the other two populations. In this contribution, I will present our main results and discuss their implications for the formation and evolution of planetary systems.

| SIG - 29 | ASI2019_211 | Mayank Narang | Poster |
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Mayank Narang (TIFR, Mumbai), Gayathri Viswanath (Christ Univ, Bangalore), Manoj Puravankara(TIFR, Mumbai), Blesson Mathew (Christ Univ, Bangalore), Ravinder Banyal (IIA, Bangalore), Sivarani Thirupathi (IIA, Bangalore), Rajaguru, S. P. (IIA, Bangalore)

## Planetary systems around evolved stars: a different planet population?

Most studies on exoplanets so far have focussed on planets orbiting main sequence stars. Planetary systems around evolved stars (sub-giant and red giant stars), on the other hand, are not as widely studied. Detailed studies of such systems can provide valuable clues about the late evolution and the final fate of the planetary system as the host star evolves off the main sequence. In this work, we investigate the difference between planet properties around main sequence and evolved stars. We show that the planets around evolved stars occupy a parameter space very different from those around main sequence stars. The planets around evolved stars tend to be more massive and orbit further out than their main sequence counterparts. The metallicity of the evolved stars, on average, is lower than the main sequence stars, and, yet they host massive Jupiter-like planets. This is quite contrary to what is found for planets around main sequence stars, where massive planets are preferentially found around metal-rich stars. Also, recently it has been shown that the mass of the planets orbiting evolved stars scales almost linearly with the host star radius. The reason for this correlation is not known. In this contribution, we will present our main results and discuss their implications for the formation and evolution of planetary systems.

| SIG - 30 | ASI2019_277 | md alam | Poster |
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Md Shah Alam, Jayashree Roy, Dipankar Bhattacharya, A. R. Rao, Ajay Ratheesh, Ajay Vibhute, Sudip Chakraborty, Varun Bhalerao, Chaitrali S. Mulay

## Absorption dips in Cygnus X-1

XMM-Newton observed the source for the longest duration between 27 May and 2 June 2016. AstroSat also observed the source for the largest duration up to now, ~ 256 ks from 15 May 2016-18 May 2016. It gives us the opportunity to study the distribution of absorption dips with binary phase. Both XMM-Newton and AstroSat have the capability to observe the source in low energy bands (below 2 keV), it improves the statistic very much as we know that short duration absorption dips in Cygnus X-1 occur due to photoelectric absorption of X-ray photons from accretion disk. We find ~ 227 and ~ 10 dips with XMM-Newton and AstroSat respectively. We detect the absorption dips by studying the increment in hardness ratio during dip time. A peak of the distribution of absorption dips is found to be slightly shifted from zero phase. We establish the clumpy nature of absorber by studying the variation of CvrFrac and log(xi) parameter of ZXIPCF model. During dip time, log(xi) decreases and CvrFrac increases. Decreases in log(xi) (xi=L/nr^2) can be attributed to an increase in density of absorber which is the characteristic of clumpy matter. Spectral properties of both XMM Newton and AstroSat observation are consistent with the low/hard state. Power-law index of all the four XMM-Newton observation is $\sim$ 1.55. Break energy in AstroSat spectrum is at $9.31_{-0.62}^{+0.59}$ keV, as expected. Slopes below and after the break are $1.78_{-0.010}^{+0.010}$ and $1.50_{-0.032}^{+0.030}$, consistent with the system being in the low/hard state.

| SIG - 31 | ASI2019_324 | MRIDUSMITA BURAGOHAIN | Poster |
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Mridusmita Buragohain, Amit Pathak

DFT STUDY OF INTERSTELLAR PAH MOLECULES WITH ALIPHATIC SIDE GROUPS

Polycyclic Aromatic Hydrocarbon (PAH) molecules have emerged as a potential constituent of the Interstellar Medium (ISM) that emit strong features at 3.3, 6.2, 7.7, 8.6, 11.2 and 12.7 µm with weaker and blended features distributed in the 3-20 µm region. These features are proposed to arise from the vibrational relaxation of PAH molecules on absorption of background UV photons. These IR features also known as Aromatic Infrared Bands (AIBs) have been observed towards almost all types of astronomical objects; say HII regions, photodissociation regions, reflection nebulae, planetary nebulae, young star forming regions, external galaxies, etc. Astrophysical PAHs are proposed to exist in various forms, viz, ionized, both substituted and unsubstituted. Some interstellar PAHs are also identified to carry an aliphatic component that gives rise to 3.4 µm feature near the aromatic 3.3 µm feature. The 3.3 and 3.4 µm features are characteristics of stretching of an aromatic and aliphatic C-H bond in a PAH molecule. Despite the extensive research and wide acknowledgement of PAH molecules as carriers for AIBs, the identification of exact form of carriers still faces major challenges. In this work, we consider PAH molecules with aliphatic side groups to see any spectral similarities with the observed UIR features. This work reports a Density Functional Theory calculation of PAHs with -H, -CH3 , -CH2-CH3 , -CH-CH2 to determine the expected region of emission features and to find an aliphatic/aromatic ratio from moderate to large PAHs. We also include a deuterium (D) component in the aliphatic side group to see any possible consequences. We present a detailed analysis of the IR spectra of these molecules and discuss the possible astrophysical implications.

| SIG - 32 | ASI2019_237 | Neal Thomas | Poster |
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Neal Titus Thomas, Shivappa B. Gudennavar, Bubbly S. G., Ranjeev Misra,

Comprehensive spectral and temporal variability studies of Scorpius X-1 using RXTE data

Neutron star low mass X-ray binaries (NS-LMXBs) are comprised of a weakly magnetized neutron star as the compact object and a donor star having mass ~ 1 - 2 $M_\odot$. They are traditionally divided into two main categories based on their correlated spectral and timing properties and the pattern they trace out in the colour-colour diagram: the so-called Z sources which are further classified as Cyg-like and Sco-like Z sources; and Atoll sources. The exact nature of the physical mechanisms that drive the Z and Atoll type of patterns are not known. Although increased mass accretion rate is thought to be one of the causes, it is yet to be established firmly. One such NS-LMXB is Scorpius X-1; which is the first identified X-ray extrasolar source and the brightest persistent X-ray source in the sky. It is a prototype of Sco-like Z sources and shows a distinct flaring along with strong and frequent increases in X-ray intensity. In addition to this, Scorpius X-1 exhibits a strong hard tail in its X-ray spectrum, which for a long time was considered to be a unique signature of black hole systems. The origin of this tail remains unclear and needs to be investigated further. The power density spectrum of Scorpius X-1 shows several aperiodic features like QPOs and noise. Several attempts have been made to explain their origin, however, consensus regarding it has not been reached. In order to study the long-term variability of the source, we have carried out comprehensive spectral and temporal variability studies on about six hundred observations spanning from January 1996 to December 2012 obtained from the publicly available archival data of Rossi X-ray Timing Explorer (RXTE) mission. These results will be presented.

| SIG - 33 | ASI2019_238 | Noble Abraham | Poster |
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Catherine George, Rojesh Johnson Alex and Noble P. Abraham

## Spectroscopic Variability of Be Binary Star $\beta$ Lyrae

We have carried out an extensive study on Be binary star $\beta$ Lyrae. Spectral data obtained from BeSS database over different years, months and days were used for the analysis. They were graphically analyzed for various parameters such as V/R ratios, Barycentre, Intensity against dates of observation. It was found that V/R ratio and intensity have an inverse relationship. It is also noted that, at the maximum V/R ratio there is a wine bottle structure with low intensity. The relation of the Be phenomenon with the Golden ratio was also apparent in the study.

| SIG - 34 | ASI2019_94 | PARTHAPRATIM GOSWAMI | Poster |
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Author: Partha Pratim Goswami, Co-Author: Prof. Aruna Goswami

## Chemical analysis of HE 0308-1612 and HE 0017+0055

Recent results obtained from high resolution spectroscopic analysis of two stars HE 0308-1612, and HE 0017+0055 classified as potential CH star candidates (Goswami 2005, Goswami et a. 2010) are presented here. The classification was based on low resolution spectroscopy, and, follow-up high resolution spectroscopic analysis was essential to confirm their classification. CH stars form important probes as halo tracers. They belong to spectral class giant or sub-giant, but majority of them show surface chemical composition with enhanced abundances of s-process heavy elements. As stars in their giant or subgiant phases are not expected to produce heavy elements, the origin of the enhanced heavy elements observed in these stars are atributed to s-process nucleosynthesis occurring in a binary companion. From a detailed analysis of the elemental abundance estimates and abundance patterns we have confirmed the classification of these objects. While HE 0308-1612 is found to be mildly metal-poor with [Fe/H]=−0.73, and enhanced in carbon with [C/Fe]=0.78, HE 0017+0055 is found to be more metal-poor with [Fe/H]=−2.59. Carbon is also highly enhanced in this object with [C/Fe]=2.71. Further, this object also shows high abundance of r-process element (i.e., Eu) indicating that the origin of the heavy elements may be i-process nucleosynthesis. Such a possibility is discussed at length. A detailed analysis of the observed abundance patterns is also conducted based on several other existing nucleosynthesis theories for a better understanding of the origin and evolution of these stars.

| SIG - 35 | ASI2019_114 | Prathamesh Dash | Poster |
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Prathamesh Dash

## Effect of rotation and mixing on Pre-Supernova stellar models

We model stars in the 15-25 Solar Mass range, with light, medium, and high surface rotational velocities at different metallicities and explore the variability in different properties using the stellar modelling code MESA. We determine and list out the number of RSGs, BSGs and YSGs present at the end and quantitatively present the stellar and burning lifetime of the star and, the core masses during different steps of the evolutionary cycle. We also present the mass coordinates of various nuclear burning shells and the extent of convective and radiative zones. We find interesting results for extremely low metallicity models and observe that mass loss is more prominent for massive stars while rotational mixing is prevalent for lower mass stars.

| SIG - 36 | ASI2019_261 | Preetha Saha | Poster |
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Preetha Saha, Department of Physics and Centre for Theoretical Studies, Indian Institute of Technology, Kharagpur ; Nirupam Roy, Department of Physics, Indian Institute of Science; Mukul Bhattacharya, Department of Physics, University of Texas at Austin

## On estimating the atomic hydrogen column density from the H\,{\sc i} $21$ cm emission spectra

The $21$ cm hyperfine transition of the atomic hydrogen (H\,{\sc i}) in ground state is a powerful probe of the neutral gas content of the universe. This radio frequency transition has been used routinely for decades to observe, both in emission and absorption, H\,{\sc i} in the Galactic interstellar medium as well as in extragalactic sources. In general, however, it is not trivial to derive the physically relevant parameters like temperature, density or column density from these observations. Here, we have considered the issue of column density estimation from the H\,{\sc i} $21$ cm emission spectrum for sightlines with a non-negligible optical depth and a mix of gas at different temperatures. The complicated radiative transfer and a lack of knowledge about the relative position of gas clouds along the sightline often make it impossible to uniquely separate the components, and hinders reliable estimation of column densities in such cases. Based on the observed correlation between the $21$ cm brightness temperature and optical depth, we propose a method to get an unbiased estimate of the H\,{\sc i} column density using only the $21$ cm emission spectrum. This formalism is further used for a large sample to study the spin temperature of the neutral interstellar medium.

| SIG - 37 | ASI2019_173 | Priya Hasan | Poster |
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Priya Hasan, Scott Wolk, Hans Moritz Gunter

## Diffuse Xray Emission in NGC 281

The Pac Man Nebula, NGC 281, was observed with Chandra for 100 ksec using the Advanced CCD Imaging Spectrometer (ACIS) supported by data from the Spitzer IRAC and MIPS instruments. We detected the spectral signature of extended diffuse emission centered around HD 5005. The diffuse emission has plasma temperatures of about 100 eV for the soft component and as high as 4 keV for the harder component with a luminosity of 1.2−5.8×10^33 erg s^{−1} . The derived electron density can range from ∼ 1−30 cm^{−3} depending on model assumptions. We compare the properties of the diffuse emission to recent X-ray results for other star forming regions which find evidence of charge exchange and also for evidence of radiative recombination. This helps understand the interplay between star forming regions and their surrounding ISM.

| SIG - 38 | ASI2019_349 | RAGHU PRASAD | Poster |
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RAGHU PRASAD M, RUKMINI J, D SHANTI PRIYA

First Photometric and Spectroscopic study of a pre-contact binary TYC 809-569-1

Pre-contact binaries are important sources lying in a key evolutionary stage of the mass transfer in close binary systems and thus are good targets to study. From the studies correlating metallicities and ages, it is hypothesized that contact binaries need a long term pre-contact evolution ranging from few hindered million to billion years, while the formation and evolution of these systems are modelled by study but slow angular momentum loss via magnetic breaking, eventually leading to deep contact and mergers. Photometric and spectroscopic investigation of variable TYC 809-569-1 is studied and presented. The photometric data was analysed using WD method which shows that the variable is a pre-contact binary. The object displays a peculiar O'Connell effect with a mysterious spot activity. The phase dependent H-alpha variation and its correlation with spot activity is discussed. The evolutionary state of the binary is discussed with respect to the absolute parameters and existing evolutionary models. Key words: Pre-contact binary, O' Connell effect, Photometry and Spectroscopy.

| SIG - 39 | ASI2019_517 | Rahul Bandyopadhyay | Poster |
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Rahul Bandyopadhyay, Ramkrishna Das and Soumen Mondal

Modeling the Morphology and Ionization Structure of Planetary Nebulae

Planetary nebulae (PNe) form around low- to intermediate-mass stars when they shed their outer layers into interstellar space around them during the late phase of evolution. Study of PNe sheds light on the chemical and dynamical evolutionary history of the progenitor. Accurate physical models that theoretically represent the object of study gives a complete picture along with precise determination of the parameters. In this work we construct 3D morphological and photoionization models of PNe PB1 and PC19, for which we use archival (Hubble Space Telescope) HST image and optical spectra obtained using 2 m Himalayan Chandra Telescope (HCT), Hanle, India. We perform multicomponent 3D re-construction of the PNe with reference to the 2D images and determine several important structural parameters (e.g., radii, dimensions, density, orientation). We estimate the elemental abundances of the PNe and significant physical parameters of the central star (e.g., temperature, luminosity) and the nebula (e.g., density) as the result of the photoionization modeling and thus analyze the ionization structure of the PN. We also discuss the implication of the models towards understanding the PNe in chemical and dynamical evolutionary aspects.

| SIG - 40 | ASI2019_436 | Ranjeev Misra | Poster |
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M. Bari, M. Sneha Prakash, R. Misra, J. S. Yadav, S. B. Gudennavar, S. G. Bubbly, A. Rao, S. Jogadand, M. K. Patil, S. Bhattacharyya, K. P. Singh

AstroSat observation of Cygnus X-1: Spectro-Timing Results

The bright persistent black hole system, Cyg X-1 has been observed several time by AstroSat providing unprecedented information about the temporal properties of the source and has become a test case to demonstrate AstroSat's capabilities. We will present results from several observations and in particular highlight the energy dependent fractional r.m.s and time lag as a function of Fourier frequency. These results can be quantitatively fitted by empirical as well as theoretical models, which reveal the dynamic behaviour of the inner accretion flow around the black hole.

| SIG - 41 | ASI2019_240 | Ruchi Pandey | Poster |
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Ruchi Pandey, Ramkrishna Das

## Analysis of dusty nova using photoionization code CLOUDY

Out of a large number of novae discovered, only a few (about 20%-25%) have been found to form dust in the ejecta. The event of formation and destruction of dust grains in the ejecta takes place within few days to ~40 days. This gives a better opportunity to understand the formation and destruction of grains and their properties in a short timescale. As a part of this work, we have studied two dust forming novae, V1280 Sco (Optically thick dust forming Nova), and V476 Scuti (Optically thin dust forming Nova) using the photoionization modelling of the optical and NIR spectra. We used the photoionization code CLOUDY c17.00 for modelling observed optical and near-IR spectra. We generated several spectra by varying associated parameters; the best-fit spectra was chosen by minimization technique. From the best fit model, we estimated various parameters, viz., the temperature and luminosity of the central hot white dwarf, elemental abundances etc. From model output spectra, we also identified the spectral features in more details.

| SIG - 42 | ASI2019_354 | Rukmini Jagirdar | Poster |
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J.Rukmini, D.Shanti Priya and G. Vinay Kumar

## Long term Photometric and spectroscopic study of EPIC 211778150 with interesting period and activity variations

Short-period contact binaries are important source for determining stellar physical parameters and modelling their evolution. They are known to often show high levels of magnetic activity. In the classification of contact binaries, W-types are defined to be having more massive, intrinsically hotter primary component with high density of stellar spots, lowering their average surface brightness in comparison to the less massive, cooler secondary component. Study of one such variable EPIC 211778150 with a rapid and periodic activity variations is being presented. The observed variations could be due to longitudinal drifts of spots on the surface of one or both the components. Owing to the strange behavior in the light curves from K2 data, it was chosen for photometric and spectroscopic monitoring. The photometric data was analyzed using WD method and the spot distribution with respect to the activity was studied. The observed spectra were compared to synthetic spectra and equivalent widths of H alpha profile were measured. Since the imprints of surface activity was observed both in photometric and spectroscopic results, the variable was further tested for period variation studies. The results of the same are presented to build a conclusive model of the variable. Key words: contact binaries, K2 database, spot activity, period variation studies.

| SIG - 43 | ASI2019_381 | RULEE BARUAH | Poster |
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RULEE BARUAH Kalpana Duorah, H. L. Duorah

## ABUNDANCES OF SUPERHEAVY ELEMENTS IN EXPLOSIVE ASTROPHYSICAL ENVIRONMENT : A THEORETICAL APPROACH

Dynamical astrophysical event like Supernova is believed to be one of the most probable site for the production of heavy elements by r-process nucleosynthesis. Here at extremely high temperature and density, the neutron capture is much faster than beta decays and heavy and superheavy neutron rich elements are formed which are otherwise not possible by fusion reactions . The particular model we have used is the beta delayed explosion of massive stars powered by neutrino energy deposition in a hot-bubble. Astrophysical parameters needed for our analysis are temperature (> 109 degrees K) and neutron number density which we take to be greater than 1020 cm-3. In the later expansion stages after SN explosion where the neutron density supposedly falls, the r-process nucleosynthesis produces the heavy elements which subsequently beta decays and the r-process path forms. The experimental data of observed elements are found to be in agreement with our calculated ones along the path. It is found that the superheavy elements' (Z > 105) formation along the r-process path is highly favored with the increase in temperature. Later ejecta are neutron-rich (Ye < 0.5) and leaves behind a compact neutron star . We note that the element 98Cf 254 shown by the SN light curves is found in our classical astrophysical condition of T = 1.9× 109 K and nn = 1020 cm-3. Also we note an element of mass 273 corresponding to atomic number 115, at temperature 3.0 × 109 K and neutron density 1020 cm−3. It is found that the dynamical timescale of the final collapse is dominated by electron capture on nuclei and not on free protons.

| SIG - 44 | ASI2019_369 | Sabyasachi Pal | Poster |
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Sabyasachi Pal and Soumen Bera

## Low frequency radio emission from extra-solar planets as seen from TIFR GMRT Sky Survey

All magnetized planets in the solar system emit radio emission through synchrotron and cyclotron maser radiations. Like Jupiter, most of the extra-solar giant planets are probably magnetized and they should also emit radio emission. We have searched for possible radio emission towards all known extra-solar planetary systems using the TIFR GMRT Sky Survey Alternative Data Release at 150 MHz. Radio emission is not detected from most of the extra-solar planets but it is detected from few star systems which harbor Jupiter size extra-solar planet. A strong magnetic field is required for sustained radio emission from planets and magnetic field in planet may be important for life to exist in the surface of the planet as it keeps away effects of energetic particles of cosmic rays, stellar winds and stellar flares. Here we will briefly summarize our findings.

| SIG - 45 | ASI2019_115 | Saumya Gupta | Poster |
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Saumya Gupta, Jessy Jose, Swagat Ranjan Das et. al.

## Pre-main sequence population in Cygnus OB2 using Subaru Hyper Suprime-Cam

Abstract: Young massive clusters are the most prevalent hubs of star formation activity in the Universe. Cygnus OB2 association is the closest massive young association to the Sun at a distance of ~1.4 kpc and is less hampered by extinction effects. Study of Young Stellar Objects (YSOs) in such clusters helps in understanding the evolution of low mass stars in the feedback driven environment of nearby massive stars. We present a multi-wavelength analysis of Young Stellar Objects within an area ~ 1.3 x 1.3 square degrees centred at Cygnus OB2, in optical, near-infrared and mid-infrared bands using Subaru-Hyper Suprime-Cam (HSC), United Kingdom Infrared Telescope Infrared Deep Sky Survey (UKIDSS) and Spitzer data sets. We present the classification and follow up analysis of the young stellar population in Cygnus OB2 down to brown dwarf limit. This is a premier rigorous work to analyze one of the most massive star forming regions (~(4-10)×10^4 Msun) in the Milky Way, down to very low mass-end of the Initial Mass Function (IMF).

| SIG - 46 | ASI2019_286 | Sindhu N | Poster |
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Sindhu N (Indian Institute of Astrophysics, Bengaluru & Dept. of Physics, School of Advanced Sciences, VIT, Vellore), Annapurni Subramaniam (Indian Institute of Astrophysics, Bengaluru) and C Anu Radha (Dept. of Physics, School of Advanced Sciences, VIT, Vellore)

## Ultraviolet stellar population of the old open cluster M67 (NGC 2682)

We present the results of ultraviolet (UV) photometry of the old open cluster M67 obtained using Galaxy Evolution Explorer in far-ultraviolet (FUV) and near-ultraviolet (NUV) bands. UV detections of 18 blue straggler stars (BSSs), 3 white dwarfs (WDs), 4 yellow straggler stars, 2 sub–subgiants, and 25 X-ray sources are presented. We demonstrate the capability of UV colour–magnitude diagrams (CMDs) along with the UV isochrones to identify potential stars which defy standard stellar evolution in this well-studied cluster. We also detect a few main-sequence turn-off and subgiant branch stars with excess flux in the FUV and/or NUV. UV continuum excess as well as Mg II h + k emission lines from the IUE archival spectra for two red giants are detected, suggestive of their chromospheric activity. We suggest that a large number of stars in this cluster are chromospherically active, whereas the bright BSS are unlikely to be active. We also estimate the fundamental parameters luminosity, radius, and effective temperature of the BSSs and 15 FUV bright stars by constructing the spectral energy distribution (SED) using multi-wavelength data. We identify three groups among the BSSs, based on their properties. The H–R diagram of BSSs with isochrones suggests that the BSSs in M67 are formed in the last 2.5 Gyr–400 Myr, more or less continuously. We identify 7 potential MS + WD candidates based on large UV excess from a probable 11, based on SEDs.

| SIG - 47 | ASI2019_337 | Soumen Bera | Poster |
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Soumen Bera, Sabyasachi Pal, Tapan Kumar Sasmal and Soumen Mondal

## Radio Emission from planetary nebulas using TGSS Data

Planetary Nebula emits radio emission due to free-free radiation. We have searched for reliable radio emission from planetary nebulas using the TIFR GMRT Sky Survey Alternative Data Release (TGSS ADR1) at 150 MHz which covers 90% of the radio sky upto -53 degree declination. We discovered radio emission from 170 planetary nebulas with 3 sigma lower limit (i.e. 17.5 mJy). We have studied various statistical properties of radio emission from these planetary nebulas.

| SIG - 48 | ASI2019_345 | Sriram Krishna | Poster |
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N. Kameswara Rao, S. Krishna, J. Murthy, F. Sutaria, A. Ray, R. Mohan

## UV imaging of the born-again planetary nebula A30

The central star of A30 is believed to have undergone a very late thermal pulse that caused ejection of hydrogen deficient material, prominently seen in the light of [O III] lines, about 850 years ago. The inner parts of the nebula are filled with this material whereas the outer rim of the nebula is of H-normal composition and of about 12,500 years of age. A30 is also an x-ray source showing both a diffuse source covering the inner few arc seconds region covering the hydrogen deficient knots and a point source located on the central star. To see the correspondence with the x-ray emission as well as with hydrogen deficient ejecta, we imaged A30 with UVIT (Ultraviolet imaging telescope) on board of Indian Astronomical satellite ASRTROSAT, in 3 FUV and 2 NUV filters. Two FUV filters, F154M (and F169M ($\lambda_e$ 1608) allow the high excitation lines of He II, C IV etc. The other FUV filter F172M ($\lambda_e$ 1717) allows mostly the nebular continuum. The NUV filters N219M ($\lambda_e$ 2196) and N279N2 ($\lambda_e$ 2796) allow mostly low excitation lines or continuum. In the present work We contrast the UV images with both X-ray contours as well as ground based [O III] and H-alpha images. The most surprising result of our UV imaging is the presence of FUV halo in two FUV filters, F154M and F169M, extending beyond the known optical and NUV nebular size. The FUV halo might be a result of H2 molecular fluorescent emission (from the AGB ejecta). Despite the presence of very hot central star ($T_e$ of 115,000 K) and an earlier excursion to hot PN stage (born-again), the nebula seems to possess still some unionized molecular gas.

| SIG - 49 | ASI2019_352 | Subhadeep Ghosh | Poster |
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Subhadeep Ghosh and Sabyasachi Pal

## Search for periodicity and pseudo-periodicity from High Mass X-ray binaries using wavelet techniques

High mass X-ray binaries are known to exhibit periodic and pseudo-periodic temporal variation of different time-scales due to different emission mechanisms and geometric properties of binary systems. We have used a wavelet-based technique to efficiently look for various periodicity and pseudo-periodicity in X-ray emission from High Mass X-ray binaries using publicly available data from various space-based instruments such as Chandra, XMM, Swift and NuSTAR. We have detected periodicity of the order of a few days from a black hole binary system which is probably linked with the orbital motion of the system. We have also discovered pseudo-periodicity in emission from few black-hole binary systems which may be due to different reasons such as shock instability in the accretion disk, the presence of black hole spin etc.

| SIG - 50 | ASI2019_410 | Subhankar Patra | Poster |
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Subhankar Patra, Gajendra Pandey

## The atmospheres of cool hydrogen-deficient carbon stars

Abundance analyses of cool hydrogen-deficient carbon stars are being conducted using the state of art model atmospheres and the LTE radiative transfer code. In the literature, the abundance analyses of these stars are based on spectra recorded on photographic plates combined with the classical curve of growth analysis. Our aim is to measure the accurate surface abundances of these stars based on modern techniques and study their cool atmospheres. High-resolution CCD spectra will be used for determining their stellar parameters and surface composition. The line-blanketed model atmospheres for HdC stars combined with LTE radiative transfer code for line formation calculations will be used. We expect that a detailed study of the surface abundances of these stars would provide us with valuable insights to their origin and evolution including their connection to the other stars like DY Per stars, RCB stars, and EHe stars.

| SIG - 51 | ASI2019_351 | Subhradeep Patra | Poster |
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Subhradeep Patra and Sabyasachi Pal

## Radio emission from brown-dwarfs

Brown dwarfs are not massive enough to sustain a thermo-nuclear fusion of hydrogen at their centers but are different from gas-giant planets by their ability to burn deuterium. Brown dwarfs older than ∼10 Myr are expected to possess short-lived magnetic fields and to emit weak radio and X-rays emission. So far, radio emission is detected from only a handful of brown-dwarfs (such as LP944-20). Here we present a study to systematically look for radio emission from various brown-dwarf systems using various existing surveys. We also present a study of overall radio emission from the all known brown-dwarfs location using stacking.

| SIG - 52 | ASI2019_38 | Tanazza Khanam | Poster |
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Tanazza Khanam and Varun Bhalerao

## Accreting Neutron Stars As Continuous Gravitational Wave Sources

Recent direct observations of gravitational waves have been seen in rare transient mergers (black hole-black hole, neutron star-neutron stars). However, these direct detections of gravitational waves are also predicted from accreting neutron stars, which would serve as continuous gravitational waves sources. There exist many such systems in our galaxy itself, which are emitting gravitational waves and with the advancement in technology, we would not need to wait for mergers to happen in order to detect gravitational waves as the number of mergers being detected is very less. The main reason of generation of gravitational waves from such systems is asymmetry of mass, leading to ellipticity and internal oscillations. Using the current available data of accreting Low-Mass X-ray binaries (LMXBs) from AstroSat's Scanning Sky Monitor (SSM), we quantify the detectability for known accreting NSs. The detectability depends on the spin and orbital parameters of NSs and if these persistently bright sources emit gravitational waves at a rate matching the torque from accretion, then they would be detectable by Advanced LIGO as well. My work involved in identifying most promising targets through data analysis of SSM's data and listing specific actions that would lead to significant improvement in the detection probability. The ephemeris of accreting NSs will aid the search of continuous gravitational waves from such sources and a report of the same has been submitted to IndIGO-An Indian Gravitational Wave Collaboration.

| SIG - 53 | ASI2019_201 | Tanuja Singh | Poster |
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Tanuja Singh, Amit Pathak

## Astrophysical PAHs: vibrational spectra

The ubiquitous presence of polycyclic Aromatic Hydrocarbon (PAH) molecules and its variants in the ISM is confirmed by the widespread observations of the mid-infrared bands at 3.3, 6.2, 7.7, 8.6, 11.2 and 12.7 µm. These bands, also known as 'Aromatic Infrared Bands (AIBs)' arise from the vibrational relaxation of PAH molecules on absorption of background UV photons. However, the exact form of PAH molecules that are responsible for the AIBs is still ambiguous. We discuss different possible form of interstellar PAH molecules as carriers for AIBs. Density Functional Theory (DFT) calculation on several classes of PAHs is employed to study its spectral characteristics in infrared. We compare our results with observations in quest of any correlation that establishes its presence in the ISM.

| SIG - 54 | ASI2019_440 | UJJWAL KRISHNAN | Poster |
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Ujjwal Krishnan, Sreeja S. Kartha, Anjusha Balan, Blesson Mathew, Raksha S

## Assessing the membership probability of moving group candidates from Gaia DR2 data

Moving groups are incredibly sparse and loosly bound groups of stars spread over thousands of cubic parsecs in space. The study of stars in nearby young moving groups has attracted lot of interest since they are prime laboratories to understand star formation and cluster dispersion mechanisms. In this study, we analyzed the sample of well studied moving group members using the Gaia DR2 data. The error in the astrometry during pre-Gaia period was poor and hence some stars are identified to be part of two different moving groups. With precise distance and proper motion measurements listed in Gaia DR2 catalogue, it is possible to have a final say about the membership of the moving group. We propose a good box criterion for each moving group based on the calculation of UVW space velocities from proper motion and radial velocity information. From the analysis, we identified a confirmed list of members for all well-studied eight nearby moving groups. Further, the evolutionary phase of these candidates are estimated with the aid of pre-main sequence isochrone fitting. We used the dispersion in the proper motion values of stars in each moving group to identify new moving groups.

| SIG - 55 | ASI2019_294 | Vikrant Jadhav | Poster |
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Vikrant Jadhav, Annapurni Subramaniam, N. Sindhu

## What does ASTROSAT reveal about M67?

M67 is an old open cluster featuring variety of stellar population. We observed M67 using UVIT (Ultra Violet Imaging Telescope) on ASTROSAT. Our Far-UV observations detect member stars which include 16 Blue Straggler Stars (BSSs) candidates, 3 white dwarfs, 13 SB1 (Single-lined spectroscopic binaries) and 4 SB2 (Double-lined spectroscopic binaries including 2 triple systems). We constructed the Spectral Energy Distribution (SED) using UVIT, KPNO, 2MASS and WISE photometry to characterize the stars detected in UVIT. Star which show large UV excess are identified to have possible hot companions. Two component SED fits were performed and the best fitting SEDs are used to estimate Surface temperatures and radii of stars as well as those of the companion WDs. We identify and characterize many optically sub-luminous hot companions to a few BSSs and main-sequence stars, which are mostly classifies as SB1 systems. UVIT has thus helped to detect a large number of WD companions for many BSS and MS stars. We discuss the implication of this result for the formation pathways of BSSs.

| SIG - 56 | ASI2019_479 | Yashwant Gupta | Poster |
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Yashwant Gupta, Kishalay De, Krishna Shende, Vinayak

## Some new results from the study of pulsar microstructure with the GMRT

Radio emission from pulsars exhibits various time scales, ranging from seconds, milliseconds, and down to microseconds. The last kind, referred to as ``microstructure'' is the most difficult to study as it requires the highest sensitivity at the shortest time scales, and requires precise correction of interstellar dispersion effects. The GMRT, with its large collecting area at metre and centimetre wavelengths, combined with the availability of modes that allow the more accurate coherent dedispersion technique to be applied to the beamformer data, provides an excellent instrument for the study of pulsar microstructure. Furthermore, by using a combination of modes with the legacy and upgraded GMRT receivers, we are also able to study the microstructure emission simultaneously at fairly widely separated frequencies such at 325 and 650 MHz. We report here some of the new results from our ongoing study of pulsar microstructure for a sample of bright pulsars, including some for which microstructure has been seen for the first time. We probe in detail properties such as the broadband nature, the temporal and spectral behaviour, the variation across the emission window, as well as the polarisation properties of microstructure emission, and bring out some interesting new results.

## Posters
## Extragalactic Astronomy

| EA - 1 | ASI2019_137 | Abhijit Kayal | Poster |
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Abhijit Kayal, Veeresh Singh

### Nature of Obscuring material around AGN using X-ray observations

X-ray emission in Active Galactic Nuclei (AGN) is believed to arise from the accretion disk around the supermassive black hole (SMBH). The obscuring material along the line-of-sight to AGN can be traced by X-ray spectra as it causes photoelectric absorption to the soft X- ray photons (0.5 – 10 keV). Therefore, X-ray spectral modeling of obscured AGN is expected to yield high equivalent hydrogen column density (N_H > 10^22 cm^–2 ), high equivalent width of Fe Kα line and strong reflection component. We present the modeling of X-ray spectra of a sample of AGN with the aim to understand the nature of the obscuring material around AGN.

| EA - 2 | ASI2019_498 | Aditi Agarwal | Poster |
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Aditi Agarwal (IIA, Bangalore), G. C. Anupama (IIA, Bangalore), C. S. Stalin (IIA, Bangalore), A. Mangalam (IIA, Bangalore), P. Mohan (SHAO, China), Markus Boettcher (Centre for Space Research, South Africa)

### Multiwavelength studies of blazars over diverse timescales

Blazars are characterized with luminous core, rapid variability over entire electro magnetic (EM) spectra, high radio to optical polarization, superluminal motion, non thermal emission and a Doppler boosted relativistic jet pointing < 10 degrees with the line of sight (LOS). To provide a detailed understanding of blazar and its environment, we study variability over diverse timescales using various statistical methods. As optical flux variations in blazars are often followed by spectral changes, thus we examine their colour – magnitude relationship on diverse timescales which helps us to understand the origin of variability. Flux variations in different frequencies may or may not be correlated. Thus search for the presence or absence of correlation among multiple frequencies, characteristic variability timescales in the light curves or a quasi-periodic oscillation (QPO) can be used to infer the origin of variability, constraint the size of emitting region and also derive SMBH mass. For this, we have developed a suite of time series analysis techniques namely, Structure Function, Discrete Correlation Function, Lomb-Scargle periodogram, Wavelet analysis and Power Spectral Density which we apply to analyze blazar light curves. Further, to study the core-jet morphology of blazars, we developed a piecewise Gaussian fit analysis technique. Using this, we are able to find spectral indices, time lags, core position offset, core radius, mean magnetic field strength, and other jet parameters. In essence, we explore complex phenomena governing blazars through the analysis of observational data and its applications using various theoretical models which further helps us to understand the physics of the inner regions of blazars.

| EA - 3 | ASI2019_149 | Aishrila Mazumder | Poster |
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| Aishrila Mazumder, Arnab Chakraborty, Abhirup Datta | | | |
| Epoch of Reionisation with the Square Kilometer Array: Challenges | | | |
| One of the key science goals of the upcoming Square Kilometer Array (SKA-1) Low is to detect the redshifted 21-cm signal from the Cosmic Dawn and Epoch of Reionisation(EoR). The major challenge for detecting the HI 21-cm line from Cosmic Dawn, EoR and post-reionization epoch is to mitigate the bright Galactic and extragalactic foregrounds present in the form of diffuse emission as well as compact sources. Considering the huge data volume from anticipated EoR observations with the SKA, it is essential to develop calibration pipelines that would remove compact sources above a predefined flux, to reduce data volume. In this work we investigate the necessary levels of accuracy for such calibration and source removal algorithms which would be used in EoR signal detection. We simulate the effect of known errors and show their effects on power spectrum recovery from EoR. | | | |

| EA - 4 | ASI2019_254 | Amar Aryan | Poster |
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| Amar Aryan, Amit Kumar, Rahul Gupta | | | |
| Photometric and Spectroscopic study of Type I Supernovae. | | | |
| Supernovae are transient astrophysical phenomenon that occur during last stages of stellar evolution,whose destruction is marked by one final,massive explosion. Out of various types of supernovae(SNe), type I are those which do not show Hydrogen lines in their spectra. In type I, type Ia are those which do not show Helium lines but have a characteristic Silicon absorption features, type Ib have unambiguous signature of Helium in their spectra, type Ic have no Hydrogen or Helium features but both, type Ib and type Ic show strong features of Oxygen, Magnesium and Calcium in their spectra.Type Ia SNe are important distance indicators, element factories, cosmic ray accelerator, kinetic energy(K.E) source in galaxy evolution and endpoints of stellar binary evolution.The early time flux decay of these SNe at Optical and NIR frequencies are very important to understand the underlying physical mechanism behind these energetic explosions. The very early time optical observations are helpful to understand the shock-break out phase. Observed peak and the temporal decay nature of these SNe at optical frequencies tell about peak luminosity, ejected Nickel (Ni) mass and the K.E of the explosion.The multi -band temporal and spectral monitoring of these SNe also provide information about underlying extinction thus reveals the ambient environment of the progenitors. | | | |

| EA - 5 | ASI2019_190 | Amit Kumar | Poster |
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Amit Kumar, Shashi Bhusan Pandey, Rahul gupta and Amar Aryan

## Investigating the behavior of Super luminous supernovae(SLSNe-I) and their connection with long gamma ray bursts(GRBs).

Progenitors of some of the long Gamma Ray-Bursts (GRBs) and H-stripped supernovae (SNe) could perhaps be narrowed down to massive stars with rapid spin, relatively low metallicity, and stripped of their hydrogen and helium envelopes. Deep researches of SNe associated with long-GRBs have been confirmed after 1997. It is very interesting to note that first three pairs of GRBs and supernova those are observed to be connected (1.GRB 980425- SN1998bw, 2. GRB 030329- SN2003dh, 3. GRB 031203- SN2003lw) have all three type Ic BL SNe. Also, H-stripped super luminous supernovae (SLSNe-I) are identified by their observed high peak luminosity. These SNe can be distinguished from normal-luminosity SNe solely from their spectra over a wide range of light-curve phases. From the list of all SLSNe, we have analyzed photo-metric data of those SNe having light curves in UBVRI/ugriz bands. By fitting different models on the bolometric light curves, we have find out different parameters and possible progenitor of these SNe. We have also analyzed spectroscopic data of this sample of SLSNe by fitting SYN++ which allows us tracing the evolution of layers expansion in detail. We tentatively group objects by how well they match either SN 2011ke or PTF12dam and discuss the possibility that physically distinct events may have been previously grouped together under the SLSN-I label. By doing all this study we got a lot of information about the progenitors, physical mechanism and environment of these events.

| EA - 6 | ASI2019_377 | Anil Kyadampure | Poster |
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Anil T. Kyadampure1, Sonali K. Kadam2, Madhav. K. Patil3 1 Sanjeevanee Mahavidyalaya, Chapoli, Latur – 413 513, India. 2,3. School of Physical Sciences, Swami Ramanand Teerth Marathwada University, Nanded - 431 606, India.

## Heating and Cooling mechanism in FR II radio galaxy 3C320

We present the results obtained from a detailed analysis of a deep Chandra observation of the bright FR II radio galaxy 3C320 cluster at redshift z=0.342. A pair of X-ray cavities are detected along East and West directions from the centre of 3C320 at an average distance of ~40 kpc respectively. X-ray and radio images of the cluster reveal peculiar positioning of cavities. Radio lobes and X-ray cavities are apparently not spatially coincident and exhibit. Radial temperature and density profiles reveal the presence of a cool core in the cluster. Imaging and spectral studies showed the removal of substantial amount of matter from the core of the cluster by the radio jets. Detection of inflating cavities at an average distance of ~40 kpc from the centre implies that the central engine feeds a remarkable amount of radio power (~6.3 X 10^44 erg/s) into the intra-cluster medium over ~10^7 yr, the estimated age of cavity. The cooling luminosity of the cluster was estimated to be ~3.40 X 10^43 erg/s, which confirms that the AGN power is sufficient to quench the cooling.

| EA - 7 | ASI2019_341 | Anilkumar Tolamatti | Poster |
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A Tolamatti, B Ghosal, M P Das, K K Yadav,, A K Tickoo, R C Rannot, P Chandra, M Kothari, A Goyal, P Marandi, N K Agarwal, K K Gour, N Kumar, K K Singh, S Godiyal, S Debangana , N Chouhan, V K Dhar, M K Koul, R. Koul, K Venugopal, C Borwankar, S Bhattacharyya, N Bhatt, S Sahayanathan, M Sharma, S Godambe, N Mankuzhiyil, K Chanchalani, S V Kotwal.

## Multiwaveband Analysis of the flat spectrum radio quasar 3C 279

The flat spectrum radio quasar 3C 279 (z=0.536) is known to be strongly variable over the entire electromagnetic spectrum. The source has been observed in TeV energy range with TACTIC telescope located at Mt.Abu (24.6◦ N, 72.7◦ E, 1300m asl), Rajasthan. The analysis of TACTIC data results in non-detection of the source, accordingly an upper limit of the of the integral flux has been estimated. We have also analyzed the Fermi-LAT data in the energy range 100 MeV to 300 GeV and Swift-XRT data in 0.3-10 keV energy range for the period 2012-2018. Details of multiwavelength analysis of 3C 279 will be presented in the meeting.

| EA - 8 | ASI2019_489 | Anjana C | Poster |
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Anjana C and Dr. Jithesh. V (Post-Doctoral Fellow, IUCAA, Pune)

## BROADBAND X-RAY SPECTRAL STUDY OF ULTRALUMINOUS X-RAY SOURCE M81 X–6

Ultraluminous X-ray sources (ULXs) are the fascinating class of X-ray sources with isotropic luminosity > 10 39 erg s −1 . Their properties have been widely explained in terms of accreting stellar-mass black holes (SMBHs), intermediate-mass black holes (IMBHs) or neutron stars (NSs). We investigated the broadband X-ray spectral properties of ULX M81 X–6 using simultaneous Suzaku and NuSTAR observations. In order to understand the spectral shape and nature of the source, we fitted the 0.6–20 keV spectrum of the source with different models, which include the single-components, phenomenological models, and pulsating NS models. Single-component models provide satisfactory fit in many cases but failed to provide realistic fit and constrain the parameters. However, two-component model fit gives a more reasonable description of the data. Among them, disk-Comptonization model suggests that source is in the ultraluminous state and this ULX may have cool accretion disk which is surrounded by an optically thick corona. The spectral fitting with accreting magnetic NSs continuum model provides a statistically acceptable fit, and the spectral parameters and X-ray colours are consistent with other pulsating ULXs, suggest that M81 X–6 is another candidate for pulsating ULXs.

| EA - 9 | ASI2019_457 | Anshuman Borgohain | Poster |
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Anshuman Borgohain, Prof. Kanak Saha, Dr. Rupjyoti Gogoi

## Study of Blue Compact Dwarfs in the GOOD-South Field

There is still not a clear standalone picture for the evolution of dwarf galaxies which are important in the study of galaxy evolution. The possible evolutionary connection amongst dwarf galaxies have different explanations and a few successful pictures in this context are given for the local Universe and in clustered environments. But the same is not well understood in isolated environments. Here we take a sample of Blue Compact Dwarfs (BCDs) which mimic the systems of the early Universe and try to see how the most plausible driver of evolution in isolated galaxies; i.e star formation might be playing its role in this regard. In this talk we would like to present the results obtained by Spectral Energy Distribution (SED) fitting of the sample under study.

| EA - 10 | ASI2019_81 | Arnab Chakraborty | Poster |
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Arnab Chakraborty and Abhirup Datta, Samir Choudhuri, Nirupam Roy, Huib Intema, Madhurima Choudhury, Somnath Bharadwaj

## Detailed study of the ELAIS N1 field with the uGMRT - I. Characterizing the 325 MHz foreground for redshifted 21 cm observation

The major challenge for detecting the redshifted 21-cm signal of neutral hydrogen from Cosmic Dawn, Epoch of Reionization (EoR) and post-reionization epoch is to mitigate the bright Galactic and extragalactic foregrounds. Here, we present initial results of newly upgraded Giant Meterwave Radio Telescope (uGMRT) observation of European Large-Area ISO Survey-North 1 (ELAIS-N1) at 350 MHz. This is the first paper of this series, where we present only recent observation of ELAIS-N1 with 32 MHz bandwidth. In later papers, we will present results from the entire bandwidth of observations of 200 MHz of the same field. We have calibrated the data with and without direction-dependent calibration techniques. We present detailed comparison between these two approaches. We have found that DGSE dominates the sky, after point source subtraction, across the angular multipole range $1115 < l < 5083$ and $1565 < l < 4754$ for direction-dependent and -independent calibrated visibilities respectively. The statistical fluctuations in diffuse Galactic synchrotron emission (DGSE) has been quantified as a power law. The best fitted values of amplitude and power law index are (62 +/-6 mK^2, 2.55 +/- 0.3) and (48 +/- 4 mK^2, 2.28 +/- 0.4) for these two different calibration approaches. We have also shown that higher tapering of sky response is required to suppress the effect of bright sources for direction-independent calibration technique in comparison with direction-dependent one. For both the cases the slope is consistent with the previous measurements of DGSE in other parts of sky.

| EA - 11 | ASI2019_317 | Asif Ahangar | Poster |
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Asif Iqbal (RRI, Bangalore), Ruta Kale (NCRA, Pune), Biman B. Nath (RRI, Bangalore), Subhabrata Majumdar (TIFR, Mumbai)

## Correlations of the Non-gravitational energy and BCG radio luminosity in galaxy clusters

We discuss the excess entropy and the corresponding non-gravitational feedback energy (E_feedback) in the intra-cluster medium (ICM) by considering a sample of 38 galaxy clusters using Chandra X-ray and NRAO VLA Sky Survey (NVSS)/Giant Metrewave Radio Telescope (GMRT) radio observations. We show a moderate correlation of the feedback energy and brightest cluster galaxy (BCG) radio luminosity (LR) with the various cluster thermal properties. We conclusively find that the active galactic nucleus (AGN) is more effective in transferring feedback energy to the ICM in less massive clusters. We find that within 0.3r500, the feedback energy correlates with cluster temperature as E_feedback ∝ Tobs^0.98 ±0.37. Moreover, for radio detected BCG sample we find that BCG radio luminosity at 1.4 GHz scales with gas mass as LR∝ mg,obs ^1.76\±0.71 and with X-ray luminosity as LR∝ LX,obs^0.94±0.35. Finally, we discuss the implications of our results with regard to feedback in clusters.

| EA - 12 | ASI2019_274 | Avinanda Chakraborty | Poster |
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Avinanda Chakraborty,Presidency University, Dr.Anirban Bhattacharjee,Sul Ross State University, Dr. Suchetana Chatterjee,Presidency University, Miranda Gilbert,Sul Ross State University

## Hβ emission line properties of high velocity quasars and correlation between the origin of radio emission and optical emission

Surveys have shown radio-loud (RL) quasars constitute 10%-15% of the total quasar population [ Among quasars most have weak or no jets (radio-quiet) and some have powerful radio-emitting jets (radio-loud). It is also said that radio-loud quasars were an aligned version of radio-quiet quasars]. In a previous work, we have observed that this radio-loud fraction (RLF) increases with increasing full width half maximum (FWHM) of Hβ emission line velocity (http://adsabs.harvard.edu/abs/). In this poster we present the results of Hβ emission line properties of quasars from Shen et al. 2011 catalog, having FWHM of greater than 15000km/s [RLF is basically the ratio of radio fluxes (at 6cm) to optical fluxes (at 2500Å) ].We have plotted L2500Å [optical luminosity at 2500Å] and Lrad [radio luminosity at 6cm or 5GHz] within different redshift intervals to see radio luminosity dependence on L2500Å. We have found negative slope for higher redshift for higher velocity objects but all the slopes including this one and the errors are consistent with zero so we can conclude that Lrad and L2500Å are independent. We have also compared the various properties of RL and RQ quasars in this sample space. We have found that for the continuum luminosity at 5100Å RQ's are less luminous than RL's in higher redshifts. Acknowledgement-I am funded through the Department of Science and Technology through the SERB Early Career Research Grant

| EA - 13 | ASI2019_73 | Ayesha Anjum | Poster |
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Ayesha Anjum, C. S. Stalin, S. B. Gudennavar, Suvendu Rakshit, S. G. Bubbly

## Variability studies of Fermi LAT Blazars

Active Galactic Nuclei (AGN), one of the most luminous objects in the universe, emit radiation over a wide wavelength range. Among AGN, blazars, that comprise both flat spectrum radio quasars (FSRQs) and BL Lac objects (BL Lacs), are known to show flux and polarization variability. Though blazars have been studied for flux variations over a wide range of wavelengths, their variability nature in the infrared region is less explored. We therefore have carried out a systematic study on the infrared variability characteristics of a sample of about 1500 blazars that are detected by the Large Area Telescope (LAT) instrument on board the Fermi Gamma-ray Space Telescope using data from the Wide field Infrared Survey Explorer. Objects are found to show infrared variations both within a day and between days. Variability analysis was also carried out for various sub-classes of blazars such as the low synchrotron peaked blazars, the intermediate synchrotron peaked blazars and the high synchrotron peaked blazars. No significant differences in the infrared variability characteristics were noticed among the various subclasses of blazars. Details of the results will be discussed.

| EA - 14 | ASI2019_117 | Bhuvana GR | Poster |
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G. R. Bhuvana1, Neal Titus Thomas1, S. B. Gudennavar1, S. G. Bubbly1 and R. Misra2 1 Department of Physics and Electronics, CHRIST (Deemed to be University), Hosur Road, Bengaluru-560029, India. 2 Inter-University Centre for Astronomy and Astrophysics, Ganeshkind, Pune-411007, India.

## A comprehensive spectral and timing analysis of LMC X-2 using RXTE data

LMC X-2, located in the Large Magellanic Cloud, is the first extra-galactic neutron star low mass X-ray binary (NS-LMXB) that has been classified as a Z source. This Sco-like Z source has a very high luminosity (~0.5–2 Ledd) which makes it the brightest LMXB ever known. Unlike the usual Z type NS-LMXBs, which are persistent in nature, the analysis of the long-term light curve of this source reveals a transient nature. Previous studies with hardness intensity diagram (HID) and colour-colour diagram (CD) have shown that the source exhibits 2.5 –10 % secular shift which is intriguing as such shifts are rare in Sco-like Z sources. In addition, QPOs, which are prominent temporal features of Z-type LMXBs, have not been found in LMC X-2 which is unusual. In order to understand this unusual behaviour, we have undertaken a comprehensive study of LMC X-2 using 132 observations during 2001-2002 on LMC X-2 by PCA on-board RXTE. The present work focuses on spectral and timing analysis of this source to understand its long-term variability in X-ray light curve. The results of our analysis on the degree and timescale of the observed secular variations, and the temporal signatures of this source will be presented.

| EA - 15 | ASI2019_97 | Brajesh Kumar | Poster |
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Brajesh Kumar, Avinash Singh, D K Sahu and G C Anupama

## Optical monitoring of Type IIb Supernova 2017gkk

We present Bessell UBVRI imaging and low-resolution optical spectra of the nearby supernova (SN) 2017gkk, discovered in NGC 2748. The follow-up observations were initiated a few days after the discovery and span ~200 days. During this period we obtained 34 epoch photometric and 21 epoch spectroscopic data points using 2m Himalayan Chandra Telescope. The event was classified as a Type IIb SN based on the spectra taken around 11 days before maximum light. The H and He line velocities are around 15000 and 10000 km/sec, respectively at this phase. Preliminary analysis indicates that light curve of SN 2017gkk reaches B-band maximum about 23 days after the explosion and resembles SN 2015as and SN 2011dh but evolves slowly in comparison with SN 2011fu. The light curve and spectral analysis is under progress and final results will be presented during the meeting.

| EA - 16 | ASI2019_380 | Debbijoy Bhattacharya | Poster |
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Debbijoy Bhattacharya

## Unusual long term low activity state and long term variability of Blazars

Blazars, a subclass of active galactic nuclei (AGN), exhibit large ɣ-ray luminosities which sometimes extends to TeV energies. Blazars show variability in ɣ-rays over different time-scales ranging from flares as short as ~1 hr to flares extending for days or months. Blazars are also variables on still longer time-scales of years or decades. While there have been several studies regarding the rapid variability and flaring activity of blazars and their possible connection to varying jet parameters, reports on their long-term ɣ-ray variability are limited. A detailed study of long term variability of EGRET blazars using EGRET and Fermi observations has been carried out and a long term low activity state in ɣ-ray is noticed in few blazars. In addition, an unusual long term flaring activity in ɣ-rays along with short term flares is noticed in blazar 4C +21.35. Similar trend of long term flare was also observed in optical band. This source was also observed on April 25, 2018 by ASTROSAT. Here, the long term variability of blazars will be presented.

| EA - 17 | ASI2019_268 | Divya Pandey | Poster |
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Divya Pandey,Dr. Ananta C. Pradhan,Dr. Kanak Saha

## Multi-wavelength analysis of void galaxies

We are doing a multi-wavelength analysis of a sample of void galaxies present in Boötes Void. We have obtained photometric observations in UV, optical and near infrared for these galaxies using UVIT, SDSS and 2MASS data, respectively and then derived their Spectral energy Distribution (SED). We are also studying their structural evolution, and star formation rate and various other parameters.

| EA - 18 | ASI2019_468 | GAUTAM SAIKIA | Poster |
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Gautam Saikia (1), Vivek B. Thapa (2), P. Shalima (3) and Rupjyoti Gogoi(1). (1) Tezpur University, Napaam, Assam 784028, India (2) Indian Institute of Technology Jodhpur, Rajasthan 342037, India (3) Regional Institute of Education Mysore, Mysuru, Karnataka 570006, India

## Probing the PAH abundance in the Small Magellanic Cloud

The difference in the extinction curve of the Small Magellanic Cloud (SMC) with respect to that of the the Milky Way (MW) and the Large Magellanic Cloud (LMC) has been a subject of interest and the source for various silicate--graphite--Polycyclic Aromatic Hydrocarbon (PAH) based dust models over the years. In this work, we have studied the diffuse dust emission in the SMC using observations made in the far-ultraviolet (FUV: 1000--1750 Angstrom) and subsequently compared this diffuse emission with observations made in the infrared for the same locations, in an attempt to constrain the dust component responsible for the observed emissions. Since the weakness or absence of the 2175 Angstrom feature in the SMC extinction curve is associated with the absence of PAH molecules, we have tried to explain the selective absence of this feature in the SMC using our observed correlation trends.

| EA - 19 | ASI2019_301 | Karamveer Kaur | Poster |
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Karamveer Kaur and S. Sridhar

## Stalling of Globular Cluster Orbits in Dwarf Galaxies

We apply the Tremaine-Weinberg theory of dynamical friction to compute the orbital decay of a globular cluster (GC), on an initially circular orbit inside a cored spherical galaxy with isotropic stellar velocities. The retarding torque on the GC, T(rp) < 0 , is a function of its orbital radius rp . The torque is exerted by stars whose orbits are resonant with the GC's orbit, and given as a sum over the infinitely many possible resonances by the Lynden-Bell Kalnajs (LBK) formula. We calculate the LBK torque T(rp) and determine rp(t), for a GC of mass Mp = 2 x 10^5 M_sun and an Isochrone galaxy of core mass Mc = 4 x 10^8 M_sun and core radius b = 1000pc. (i) When rp > 300 pc many strong resonances are active and, as expected, T = T_C , the classical Chandrasekhar torque. (ii) For rp < 300 pc, T comes mostly from stars nearly co-rotating with the GC, trailing or leading it slightly; Trailing resonances exert stronger torques. (iii) As rp decreases the number and strength of resonances drop, so |T| also decreases, with |T| < 10^{-2} |T_C| at rp = r* = (Mp/Mc)^{1/5} b = 220 pc , a characteristic `filtering' radius. (iv) Many resonances cease to exist inside r* ; this includes all Leading and low-order Trailing ones. (v) The higher-order Trailing resonances inside r* are very weak, with |T| < 10^{-4} |T_C| at rp = 150 pc. (vi) Inspiral times for rp(t) to decay from 300 pc to r* far exceed 10 Gyr.

| EA - 20 | ASI2019_247 | Kasturi Warang | Poster |
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Kasturi V. Warang, TIFR; Sudip Bhattacharyya, TIFR; K.P. Singh, IISER, Mohali; Sunil Chandra, NWU,South Africa, Gulab Dewangan, IUCAA; Gordon Stewart, Leicester University; Kallol Mukerjee, TIFR.

## Timing and Spectral Analysis of GX 13+1 using SXT/AstroSat and LAXPC/AstroSat

GX 13+1 is a neutron star low mass X-ray binary. This source has been analysed previously and has shown thermonuclear bursts, energy dependent dips, quasi-periodic oscillations, etc in X-rays. The study of continuum spectrum has revealed the presence of absorption lines. We analysed the data for GX 13+1 using the observations from SXT/AstroSat and LAXPC/AstroSat obtained on 12 October 2016 and studied its timing and spectral properties.

| EA - 21 | ASI2019_460 | KRISHAN CHAND | Poster |
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Krishan Chand, Hum Chand, Amitesh Omar

## AGN Reverberation Monitoring: Probing AGN Black-hole Masses And Broad Line Regions.

Spectro-photometric reverberation mapping (RM) is a useful tool to find the black mass of Active Galactic Nuclei (AGN). Being it resource expensive, as an alternative, we have explored the use of photometric reverberation mapping (PRM) where the flux of emission line is observed in the narrowband filter instead of taking its spectra. In our PRM experiment, we have monitored MCG+09-16-013 using ARIES 1.3m telescope in V, B broad-band for continuum flux and in SII narrow-band filter for its H-α flux. For this source, our measured PRM based broad-line region lag is found to be 3.0±0.22 light day resulting in its black hole mass of (2.87±0.45)×10^7 M_solar . This is found to be consistent with the conventional spectroscopic RM. This experiment demonstrates the feasibility of using ARIES 1.3 m for PRM experiment, and hence can be extended to a larger sample of low-luminosity AGNs, as we are planning in near future, with an aim to validate the conventional luminosity-radius relation in the unexplored low luminosity regime.

| EA - 22 | ASI2019_414 | Krishna Shende | Poster |
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Krishna Moreshwar Shende (NCRA-TIFR, Pune), Dr. Ruta Kale (NCRA-TIFR, Pune), Dr. Viral Parekh (Physics and Electronics Department, Rhodes University, Grahamstown and Square Kilometer Array Office, Observatory, Cape Town.)

## A Mini-Halo in a Massive Galaxy Cluster in the Southern Sky

Mini-halos are faint, diffuse radio emission that surrounds the central brightest galaxies in about half of the cool-core galaxy clusters. They are about 500kpc in size, having low surface brightness and steep spectra, making them a challenge for detection. So far, about 20 mini-halos have been discovered and have been proposed to be a result of hadronic collisions and turbulent re-acceleration. However, the physical mechanism behind the origin of minihalos is not understood well due to the small number of such sources known. SPT-CLJ0232-4421 is a galaxy cluster at a spectroscopic redshift of 0.284, with a mass of 8.9*10**14 solar masses and X-ray Luminosity of 6.4*10**44 erg/sec. We have observed this cluster with the Giant Metrewave Radio Telescope at 610MHz with 33MHz bandwidth. We detect diffuse emission around the central bright galaxy which we classify as a candidate mini-halo. We will present the radio properties of the candidate mini-halo and discuss its origin in the light of the multi-wavelength properties of the galaxy cluster itself.

| EA - 23 | ASI2019_355 | Lopamudra Ojha | Poster |
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Lopamudra Ojha, Sabyasachi Pal and Dusmanta Patra

## Spectral ageing study of southern hemisphere radio galaxies

We report the spectral ageing analysis of FR-II type radio galaxies collected from GaLactic and Extragalactic All-sky MWA (GLEAM) survey using Murchison Widefield Array (MWA). GLEAM survey was conducted in the low-frequency range from 72 MHz to 231 MHz. We have used available radio maps in this frequency range to perform the spectral ageing analysis. We have used two widely used models for spectral ageing, namely, the Kardashev-Pacholczyk (KP) and Jaffe-Perola (JP) models. The above two models are based on a single electron injection energy distribution at the hot-spots of the radio galaxy. In the KP model, the assumption is that the pitch angle is constant for each individual electron but different for different electron while in the JP model it is assumed that the pitch angles are to be scattered and isotropised in a time-scale which is much smaller in comparison with the spectral age of the source. We have made a statistical study of spectral ageing properties of these radio galaxies to understand properties of FRII radio galaxies in general. We have also studied the magnetic field and jet power of these radio galaxies.

| EA - 24 | ASI2019_453 | MANASPRATIM DAS | Poster |
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M P Das, A Tolamatti, K K Yadav, B Ghosal, A K Tickoo, R C Rannot, P Chandra, A Goyal, P Marandi, N K Agarwal, K K Gour, N Kumar, M Kothari, S Godiyal, S Debangana , N Chouhan, V K Dhar, M K Koul, R. Koul, K Venugopal, C Borwankar, S Bhattacharyya, N Bhatt, S Sahayanathan, M Sharma, S Godambe, N Mankuzhiyil, K Chanchalani, S V Kotwal, K K Singh.

## Observation of 1ES1959+650, 1ES 1011+496 and PG 1553+113 using TACTIC gamma-ray telescope.

We have observed three extragalactic TeV gamma-ray sources 1ES1959+650, PG 1553+113 and 1ES 1011+496 using TACTIC telescope at Mt. Abu, Rajasthan (24.6 N, 72.7 E, 1300 m asl). The observations were made during the period November, 2015 – June, 2016, March – April, 2015 and February – April, 2014 from the 1ES1959+650, PG 1553+113 and 1ES 1011+496 respectively. Upperlimits on the integral VHE flux from these sources will be presented in the meeting.

| EA - 25 | ASI2019_476 | Mousumi Das | Poster |
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Mousumi Das, Rahna P.T., Deepthi Prabhu, Jayant Murthy

## UVIT Observations of Star Formation in the Outer Disk of the Isolated galaxy NGC6946

We present UVIT far-UV observations of star formation in the extended disk of the nearby galaxy NGC6946. It is one the few galaxies in our local Universe that shows Halpha emission in its extreme outer disk. It is an isolated galaxy and is located in the interior of a nearby void. Earlier studies have shown that it it has filamentary HI associated with its outer disk, which could be due to cold gas accretion from the intergalactic medium or the infall of high latitude clouds onto its disk. In this presentation we use archival HI and near-infrared data to correlate the star formation traced by FUV emission with the stellar and gas disk in NGC6946. Our goal is to understand the nature of star formation in the metal poor outer disk and compare it with the star forming complexes in the inner regions. We present some early results of our study.

| EA - 26 | ASI2019_223 | Nagendra Kumar | Poster |
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Kumar Nagendra, Kushwaha Pankaj, Mukhopadhyay Banibrata

## A continuous Jet Leptonic model for Blazar SEDs - a Monte Carlo study for cylindrical Jet

The broadband spectra (or spectral energy distribution SED) of blazar is extended from radio to gamma-ray energy band. The radio observations of blazar establish that blazar have core-jet structure, and the observed apparent superluminal motion of jet show that radio-emitting plasma (synchrotron-emitting electrons) has relativistic speed and beamed towards the observer. It is believed that gamma-ray emission is due to the same relativistic electron population which is responsible for radio. Also during gamma-ray flaring the core radio emission is correlated with gamma-ray emission. We aim to discuss a model for blazars SED in continuous jet scenario (i.e., relativistic electrons are in outflow which is contrary to the favorable ``one-zone model''), where the radiative process for lower peak of the blazar SED (in $\nu$F$_{\nu}$ plot) is a synchrotron emission and high-energy peak is due to a inverse Compton process (similar to the one-zone model). In addition to the outflowing relativistic electrons we assume that these electrons also have comparatively low random speed. As we are dealing with two components of electrons velocity simultaneously, so for inverse Compton process we consider a generalized bulk Comptonization (in this formalism, both velocities can have random directions). For computing the generalized bulk Comptonized spectra we adopt a Monte Carlo methods and consider a cylindrical geometry of the emission region. We find that for reasonable range of the ratio of height to radius of cylindrical geometry (H/R) the blazars (FSRQ and BL Lacs objects) SED can be SSC (synchrotron self Compton) dominated only.

| EA - 27 | ASI2019_467 | Olag Bordoloi | Poster |
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Olag Pratim Bordoloi (1), Anshuman Borgohain (1), Gautam Saikia (1), P. Shalima (2) and Rupjyoti Gogoi (1). (1) Tezpur University, Napaam, Assam 784028, India (2) Regional Institute of Education Mysore, Mysuru, Karnataka 570006, India

## Mapping Hydrogen Column Densities towards N11 Complex in the Large Magellanic Cloud

Study of the properties of HII regions, the sites of massive star formation, in a variety of extragalactic environments provides insight into stellar evolution as a whole. Determining the amount of hydrogen is very useful for the study of initial conditions for star formation as it is the fuel for all stars. However, it cannot be detected directly and hence indirect methods like studying the dust distribution of molecular clouds is used. In this work, we study a sample of early O-B type stars towards the N11 star forming region in the the Large Magellanic cloud (LMC) and thereby infer the abundance of hydrogen in this region. We have mapped the hydrogen column density towards the N11 complex at various distances from the Milky Way (MW) and obtained a higher concentration of hydrogen towards lower longitude (gl) regions of the nebula.

| EA - 28 | ASI2019_219 | Pooja Bhattacharjee | Poster |
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Pooja Bhattacharjee (Centre for Astroparticle Physics and Space Science, Bose Institute, Kolkata), Sayan Biswas (Raman Research Institute, C.V. Raman Avenue, Sadashivanagar, Bangalore), Pratik Majumdar(Saha Institute of Nuclear Physics, HBNI, Kolkata) Partha S. Joarder (Centre for Astroparticle Physics and Space Science, Bose Institute, Kolkata)

## Analysis of 9 years of Fermi -LAT data from Tucana-II: Possible constraints on the Dark Matter models

Tucana-II (Tuc-II), a recently discovered and confirmed Ultra Faint Dwarf Spheroidal galaxy, has a high mass to light ratio as well as a large line-of-sight stellar velocity dispersion, thus making it an ideal candidate for an indirect dark matter (DM) search. In this paper, we have analyzed nine years of γ-ray data obtained from the Fermi-LAT instrument from the direction of Tuc-II. The fact that a very weak significant γ-ray excess ($\sim 2.5\sigma$) over the background of Tuc-II have been detected from the location of this galaxy. We have observed that this excess of γ-ray emission from the of location Tuc-II rises with longer periods of data. If WIMP pair annihilation is assumed for this faint emission, for $b\bar{b}$ annihilation channel the test statistics (TS) value peaks at DM mass $\sim$ 14 GeV and for $\tau + \tau -$ annihilation channel it peaks at DM mass $\sim$ 4 GeV. It is then called for an estimation of the 95% confidence level upper limit of the possible velocity weighted self-annihilation cross-section of the DM particles (WIMPs) within Tuc-II by fitting the observed γ-ray flux with the DMFit function. The estimated upper limits of the cross-sections from Tuc-II are then compared with two other dwarf galaxies that are considered to be good DM candidates in several studies. We have also compared our results with the cross-sections obtained in various popular theoretical models of the WIMPs to find that our results impose reasonable tight constraints on the parameter spaces of those DM models. (Follow up work of arXiv:1804.07542v2)

| EA - 29 | ASI2019_281 | Pradeep Chandra | Poster |
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P Chandra, R C Rannot, K K Yadav, A K Tickoo, M P Das, A Tolamatti, B Ghosal, K K Singh, P Marandi, N K Agarwal, K K Gour, N Kumar, M Kothari, A Goyal, S Debangana, N Chouhan, V K Dhar, M K Koul, R. Koul, K Venugopal, C Borwankar, S Bhattacharyya, N Bhatt, S Sahayanathan, M Sharma, S Godambe, N Mankuzhiyil, K Chanchalani, S V Kotwal, S Godiyal.

## Detection of TeV flare from Mrk 421 using TACTIC during 2017-2018

The extragalactic TeV blazar Mrk421 (z = 0.030) has been observed at Very High Energy (VHE) energies using TACTIC gamma-ray telescope at Mt. Abu, Rajasthan (24.6 N, 72.7 E, 1300 m asl) during the period 16th Dec 2017 to 18th April 2018 for 240.4 hours. Preliminary data analysis indicates an excess of 1895 ± 131 gamma-ray like events from the source direction with a statistically significance of 14.46 sigma above 850GeV. The source was also detected in high emission state by FACT and HAWC in January, 2018. We have detected an enhanced gamma-ray flux from source direction on the night of January 17, 2018. Analysis of the recorded data collected for ~5.6 hours indicates that the average flux during the night ; MJD 58135.7822 - 58136.0273 was around 5 times the flux of Crab nebula above 850 GeV. The telescope has also detected the source on hourly basis at a significance level of ~5 sigma with a peak flux of ~7.7 times the Crab nebula flux during MJD 58135.9375 - 58135.9792. Results of detailed analysis of VHE observations will be presented in the meeting.

| EA - 30 | ASI2019_490 | Pranjupriya Goswami | Poster |
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Pranjupriya Goswami(1), Sunder Sahayanathan(2), Ranjeev Misra(3), Atreyee Sinha(4) and Rupjyoti Gogoi(1) ; (1) Tezpur University, Napaam-784028, India (2) Bhabha Atomic Research Centre, Mumbai-400085, India (3) Inter-University Centre for Astronomy and Astrophysics, Pune-411007, India (4) APC, AstroParticule et Cosmologie, Université Paris Diderot,75205 Paris Cedex 13, France

## Synchrotron spectral curvature of blazars as probe to understand electron diffusion

X-ray spectra of blazars show significant spectral curvature and have been a matter of considerable interest in recent years. For high energy peaked blazars(HBLs), the spectral component at X-ray energies are often well fitted by a log parabolic model. However, log-parabola model fails to explain the low energy spectra as we extend the energies towards optical. We report the study of synchrotron spectral curvature of HBL object Mkn421 using simultaneous observations from Swift-XRT -- NuSTAR and XMM-Newton observations. We investigate whether this smooth curvature can be attributed to the energy dependence of the escape timescale from the main acceleration region. The semi-analytical model developed under this scenario can fit the observed synchrotron spectra in a wide range of energies. Notably, our results show a clear anti-correlation between the energy dependence parameter and the spectral index which can have interesting implications regarding the acceleration processes and the inherent properties within the jet environment. The physical interpretation on the model parameters is extensively discussed in this work.

| EA - 31 | ASI2019_437 | Preeti Kharb | Poster |
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| P. Kharb | | | |
| A Multi-scale Study of Radio Outflows in Radio-Quiet AGN | | | |
| We will present results from parsec-, sub-kpc and kpc-scale radio observations of "radio-quiet" AGN viz., Seyfert and LINER galaxies. These observations are revealing collimated or semi-collimated outflows on parsec- and sub-kpc-scales, and wind-like broad outflows on kpc-scales. Sensitive high-resolution observations are hinting at the presence of binary supermassive black holes on parsec scales. These results are observed irrespective of whether the AGN are dual-emission-line-peaked AGN or not, suggestive in turn of a close jet-emission-line-region (ELR) connection or complex ELR kinematics. We will place these results in the larger context of why radio-quiet do not have powerful radio outflows. | | | |

| EA - 32 | ASI2019_86 | Ramij Raja | Poster |
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| Ramij Raja, Majidul Rahaman, Abhirup Datta | | | |
| Hunting for diffuse radio emission in high redshift Sunyaev--Zel'dovich-selected clusters of galaxies | | | |
| Radio halos are Mpc scale diffuse radio synchrotron emission found mostly in the merging galaxy clusters. Their Mpc scale size indicates (re)acceleration of in situ electron population in the presence of large scale magnetic field. Whereas, radio mini-halos are similar to that of giant halos but are found in some relaxed, cool-core clusters with typical size of ~ 100--500 kpc indicating (re)acceleration via turbulence induced by gas sloshing generated from minor merger events. Here we present 5 SZ selected SPT cluster observations and their diffuse radio emission signature in L-Band. We have found some amount of diffuse synchrotron emission in 2 of the 5 clusters. One of them is well known Phoneix cluster (SPT-CL J2344-4243), the most distant radio mini-halo known. We classified the other one (SPT-CL J2031-4037) also as a radio mini-halo. The rest does not show any diffuse radio emission in this frequency. Radio--X-ray correlation for these clusters is discussed along with temperature maps with the available data. | | | |

| EA - 33 | ASI2019_478 | Rathnakumar S | Poster |
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Authors: S. Rathna Kumar (1) and Hum Chand (1) Affiliations: (1) ARIES, Nainital

## Testing simple analytical approaches to model lensed quasars through TDLMC

Strongly lensed quasars with measured time delays offer an independent method to constrain cosmological parameters, mainly $H_0$, which is complementary to other cosmological probes. Recent studies have demonstrated that it is possible to constrain $H_0$ to 3% precision from only four time delay lenses. The number of time delay lenses is growing rapidly. As the precision on $H_0$ keeps improving, it is important to ensure that the systematic errors remain sub-dominant. With the aim of assessing the present day capabilities of lens modeling codes and assumptions and to test the level of accuracy achievable on $H_0$ inference from realistic mock datasets, a group of scientists from Dark Energy Science Collaboration (DESC) have invited community members to participate in a Time Delay Lens Modeling Challenge (TDLMC), wherein they are required to model a set of simulated Hubble Space Telescope (HST) observations of 50 mock lenses. The systems are organized in three rungs with the realism and complexity of the mock lenses increasing as one goes up the ladder. The goal of the challenge is to infer $H_0$ for each rung, given HST observations, time delay measurements, and a stellar velocity dispersion measurent of the deflector, of the mock lenses in the rung, for a fixed background cosmology. The challenge is still ongoing, with Rung1 having been completed recently. We present our results for Rung1 mock systems obtained from following a simple analytical modeling approach and explore strategies for improving the precision, while keeping the systematic errors under control.

| EA - 34 | ASI2019_288 | Rupak Roy | Poster |
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Rupak Roy

## Bumps in the lightcurves of Superluminous Supernovae

Development on supernova research in last decade has confirmed that there is a distinct class of events which are more luminous (-21 mag) with broader peak than canonical core-collapse supernovae (CCSNe). These are superluminous supernovae (SLSNe). The powering mechanism of SLSNe is yet not resolved. Interaction of SN-shock with circumstellar medium (CSM), the presence of a spin-down Magnetar or pair-instability (PISNe) are the proposed theories. Recently we have also found SNe with peak luminosity in between CCSNe and SLSNe. Often, these intermediate luminous transients and SLSNe show bumps in their lightcurves before and after the principal-peak. Origins of these bumps are not well-known and may not be similar. Early bump is probably related to the activity of the central-engine which is most likely a Magnetar, while post-maximum bump is probably related to the shock-CSM interaction. Here, I will discuss the origins of different bumps and their importance in the understanding of the mechanisms of SLSNe. For this work, I have used the optical lightcurve data of all known SLSNe from the literature for which we have both early and late observations. I have also used the archival data for UV and X-ray observations. Here, I will also discuss the correlations between bumpy-lightcurves and spectral features of super and intermediate luminous supernovae.

| EA - 35 | ASI2019_158 | SAFNA PZ | Poster |
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SAFNA PZ, Dr C S Stalin, Dr Blesson Mathew .

## Multi-wavelength variability characteristics of Fermi blazars .

Multi-wavelength variability characteristics of Fermi blazars . Blazars a sub-class of active galactic nuclei are often very luminous and show violent flux variations over the entire electromagnetic spectrum from low radio to high energy gamma-rays . The near continuous monitoring capability of the Large Area Telescope (LAT) instrument on board the Fermi Gamma-Ray Space Telescope has provided the opportunity to study the high energy flux variations . Such variations when coupled with the flux variations at other wavelengths will give the unique opportunity to probe the physical processes happening close to the central regions of blazars . Towards this we have carried out a systematic analysis of the multi-wavelength flux characteristics of 37 blazars using data that spans over 10 years in the optical BVR and the infrared JK bands . Our analysis includes characterizing flux variability at various wavelengths, including gamma-rays, spectral variations, and time delay between flux variations in different wavebands. Details of this work will be presented .

| EA - 36 | ASI2019_222 | SANDEEP KATARIA | Poster |
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SANDEEP KUMAR KATARIA

## A possible solution to small scale problem with Lambda CDM model; namely core-cusp problem

We know that one of the major and long standing problem with widely accepted Lambda CDM cosmological model is the core-cusp problem. Observations show a flat dark matter profile in the inner regions of galaxies while cosmological simulations show that inner parts of galaxies are having steep or cuspy dark matter profile. There have been many attempts to approach the solution of this problem through supernova feedback, internal dynamics of galaxies etc. Further work is required to have a concrete solution to this problem. In this work we approach the problem through secular evolution of disk galaxies which have an initial cuspy dark matter potential. We look for the effect bars and effect of gas in transition of cusp to core nature of dark matter through N-body/SPH simulations. Early results show that bar plays a potential role in transferring angular momentum to central halo particle and make it flat within few Gyr of evolution. Further the effect of gas fraction in flattening the central cusp is under investigation which also plays an important role in angular momentum transfer.

| EA - 37 | ASI2019_372 | Sanna Gulati | Poster |
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Sanna Gulati, Debbijoy Bhattacharya, C.S. Stalin

## Short-term optical variability in misaligned active galaxies

The Large Area Telescope (LAT) on-board Fermi Gamma-ray Space Telescope has detected gamma-ray emission from ~5500 sources utilising 8 years of observations (2008-2016). Majority of the identified sources belong to the blazar class (jet inclination angle < 10 degree) of active galactic nuclei (AGN). Blazars exhibit extreme short term optical variability, known as intra-night optical variability (INOV) which is expected to have jet origin. Since gamma-rays are originated in the jet and jet emission falls off with increasing jet to line-of-sight angle, the sources with large jet inclination angles are expected to be gamma-ray weak and/or exhibit weak/no signature of INOV. However, Fermi has detected gamma-ray emission from 24 misaligned active galaxies (MAGN: angle >~ 10 degree) which indicates a presence of strong jet in these sources. Therefore, in the scenario of jet origin of INOV, one would expect these gamma-ray bright MAGN to exhibit strong INOV. However, till date no study on the INOV nature of these gamma-ray bright MAGN has been reported. In this work, short-term optical variability of gamma-ray bright MAGN is studied using observations from 1.3 m JCB Telescope (Kavalur) and Himalayan Chandra Telescope (Hanle). Scaled C-test and power enhanced F-test were used to quantify the variability of the 8 sources observed till date over multiple epochs. Strong presence of INOV with high duty cycle in few of the gamma-ray detected MAGN is detected. The results of this ongoing observation program will be presented here.

| EA - 38 | ASI2019_65 | SAUGATA BARAT | Poster |
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Saugata Barat PG-1,Presidency University Dr. Suchetana Chatterjee Asst. Proffessor, Presidency University

## Characterization of X-ray source population in high redshift galaxies

X-ray population studies have been carried out at low redshift (Anderson et. al 2013 ,Grimm et. al 2002) where individual point sources can be resolved, but to carry out such studies at high redshift, is a challenging task. In this work we attempt to characterize the X-ray source population at high redshift (z=0.1-1.4) by studying the hardness ratios (HR) using stacked X-ray maps of galaxies. We have used data from the All Wavelength Extended Groth Strip International Survey (AEGIS) and corresponding redshifts from the Deep Evolutionary Exploratory Probe (DEEP) optical survey. Our full sample consists of 14121 non-AGN galaxies. We have performed a stacking analysis based on stellar mass and star-formation rates cuts to investigate the dependence of HR on redshift. We have observed a peak in the derived HR-z relation obtained from our stacking analysis around z=0.6. To model the observation we have used a linear combination of a hard power law emission with photon index 1.56 which is a typical value for X-Ray binaries and the Astrophysical Plasma Emission Code (APEC) which models the soft x-ray emission from the hot gaseous halo present in the galaxy. Our study provides the first estimate for the redshift evolution of gravitational wave source population statistics using X-ray imaging data.

| EA - 39 | ASI2019_332 | Silpa Sasikumar | Poster |
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Silpa Sasikumar, Jayaram N. Chengalur, Manisha Samble

## Kinematics and dynamics of dwarf galaxies

Although the dynamics and total mass content of galaxies have been an area of research for the last few decades, the number of galaxies with well-measured rotation curves and detailed angular momentum studies is still small. This is particularly the case at the low mass end of the galaxy population, i.e. for dwarf irregular galaxies. Data for nearly 270 galaxies are available in the GMRT archive. Reduced data cubes at multiple resolutions are now available for most of them. However, only a small fraction of them have had detailed rotation curve analysis and subsequent studies like mass modelling and measurements of their angular momentum done. We have selected galaxies with reasonably smooth velocity fields and absolute B-band magnitude of < -19.0 from the archive and derived rotation curves by 3D modeling of their data cubes via newly available packages such as FAT and 3DBAROLO. We have tried to understand the differences between the rotation curves derived using these softwares. We shall also present the measurements of baryonic mass and specific angular momentum for a small number of dwarf galaxies from the archive.

| EA - 40 | ASI2019_103 | SNEHA MUDAMBI | Poster |
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## Broadband spectral studies of LMC X-1 using AstroSat

LMC X-1, a persistent high mass black hole binary system, has been monitored by all major X-ray missions till date in its high soft state. Since its discovery in 1969, LMC X-1 has never transitioned to a low hard state. Interestingly, LMC X-1 is highly luminous, however its luminosity does not follow Stefan’s law. Its ability to maintain a constant luminosity of ∼ 0.16 LEdd, despite showing significant fluctuations in the rms amplitude of its power density spectrum, has intrigued researchers over the last three decades. Though several models - relativistic disk model, perturbation propagation model - have been put forward to explain this unusual behaviour, none of them are successful. In this work, we will report the results of the first broadband spectral studies of the LMC X-1 as observed by Soft X-ray Telescope (SXT) and Large Area X-ray Proportional Counters (LAXPC) instruments aboard AstroSat. Unlike, most other X-ray binaries, the distance to the source is well constrained and hence the broad band spectral studies (0.3-30 keV) would provide an accurate measurement of the system's accretion rate. Likewise, the flux resolved spectroscopy will provide the information about how the high energy component, arising from a Comptonizing medium surrounding the disk, varies with accretion rate, thereby giving insights to the dynamical geometry of the inner most regions close to the blackhole. This work will also demonstrate AstroSat's capability to do broad band (0.3-30 keV) timing studies for such faint (~ 20 mcrab) source by cross-correlating the light curves from the two instruments- SXT and LAXPC.

| EA - 41 | ASI2019_488 | SREELAKSHMI M | Poster |
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SREELAKSHMI M,ANUPAMA M

SEARCH AND ANALYSIS OF RADIO GALAXIES IN GMRT LOW FREQUENCY RADIO SURVEY

From the low-frequency radio data obtained from XMM-LSS and Super-CLASS 325MHz surveys by GMRT, I have catalogued all the Radio Galaxies(RGs) in it.RGs with size 700 Kpc or more are known as Giant Radio Galaxies. Giant Radio Galaxies (GRGs) are the largest structures associated with single galaxies. My aim was studying the properties of RGs in this low-frequency radio surveys. For that, I have computed the redshift, linear size, radio power, radio flux, spectral index, velocity dispersion etc.The linear size in arcminutes determined by using SAO Image DS9 . Using CASA radio fluxes were calculated.Redshift for host galaxy is found out from SDSS. Using redshift, comoving and luminosity distances were computed from NED Wright cosmological calculator. The linear size of the radio galaxies in Mpc and radio power are calculated with the help of appropriate relations. IRSA catalogue provided the WISE magnitudes for the RGs.From the data P-D diagram, WISE colour-colour plot, different histograms etc. are plotted and studied.

| EA - 42 | ASI2019_62 | Suchetana Chatterjee | Poster |
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Suchetana Chatterjee, Priyanka Chakraborty, Anwesh Majumdar, Kaustav Mitra, Mike DiPompeo, Ryan Hickox, Rudrani KarChowdhury, Nishikant Khandai, Adam Myers, Jonathan Richardson and Zheng Zheng

Supermassive Black Holes and their Host Dark Matter Halos

Through a plethora of observational results we now know that there is a supermassive black hole (SMBH) at the center of every galaxy in the Universe with a fraction of them harboring an active accretion disc and are known as active galactic nuclei (AGN). Thus in the paradigm of structure formation we like to address the question of relating SMBH with their host dark matter halos. Observationally by studying the spatial clustering of SMBH or AGN we can infer about their dark matter hosts. AGN clustering can be characterized within a powerful theoretical framework known as the Halo Occupation Distribution (HOD). We present the HOD modeling of AGN using a fully cosmological simulation and show that the underlying theoretical model fits the two-point correlation function (2PCF) of different types of AGN. This provides us an evolutionary picture of AGN along with dark matter halos over cosmic time. References: 1. "Mean Occupation Function of High Redshift Quasars from the Planck Cluster Catalog", Chakraborty, P. et al., 2018, 130, 988, PASP 2. "Halo Occupation Distribution of Obscured Quasars: Revisiting the Unification Model", Mitra, K. et al., 2018, 477, 1, MNRAS 3. "A Direct Measurement of the Mean Occupation Function of Quasars: Breaking Degeneracy of Halo Occupation Distribution Models", S.Chatterjee et al., 2013, 779, 147, ApJ 4. "The Halo Occupation Distribution of X-ray-bright Active Galactic Nuclei: A Comparison with Luminous Quasars", J. Richardson et al., 2013, 774, 143, ApJ

| EA - 43 | ASI2019_46 | Suman Bhattacharyya | Poster |
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Suman Bhattacharyya and Dr. Jyoti Prasad Saha (Professor at Physics dept of Kalyani University.)

## Reconstruction of the Hubble diagram using redshift and relative distant data from SDSS spectral data of elliptical galaxies.

We have studied the data of over 55 galaxy clusters taken from SDSS DR14 database and derived the redshift (z) vs apparent magnitude relation for our sample to show that the recent DR14 data is efficient enough to predict the Hubble constant (Ho) value well (galaxies with z around 0.2). Our analysis show that the slope of the line is 0.1972 where the Hubble line should have a slope of 0.2 . We have farther used the SDSS data to determine the expansion of the Universe by reconstructing the Hubble diagram which shows that the Universe is not just expanding but expanding in an ordered manner. This rate of expansion is approximately constant till a range of distance, beyond which the rate is not constant anymore (points can't be plotted on the Hubble line). Since the distance is in approximation so relative distance unit has been used for distance measurement using the magnitude of the elliptical galaxy in a specific Galaxy cluster.

| EA - 44 | ASI2019_451 | SUMANA NANDI | Poster |
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Sumana Nandi, Mousumi Das and Dwarakanath K.S.

## ULIRGs are the possible progenitors of the powerful radio galaxies

Ultraluminous infrared galaxies (ULIRGs) with enormous bolometric luminosity (L>10^12 Lsun) are mostly formed through the merging of gas-rich spirals. Multiwavelength observations suggest that the power of ULIRGs are associated with starburst and AGN activities. Radio observations of ULIRGs are unaffected by the heavy dust obscuration and have the potential to probe the central structures. We performed GMRT 1280 MHz radio continuum observations of three ULIRGs in order to resolve their core- jet/outflow radio structures and hence to examine their evolution into radio loud elliptical galaxies. Here we present our results of these ULIRGs which are merger remnants and possible progenitors of the powerful radio galaxies. These GMRT observations detected extended diffuse emission which represents the outflows in these systems. The radio spectrum of one ULIRG shows characteristic, similar to that of compact steep spectrum or gigahertz peaked spectrum like sources. This result further represents that the source is going through an early stage of evolution of a classical double-lobed radio galaxy.

| EA - 45 | ASI2019_180 | Sundar MN | Poster |
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Sundar M.N. (JU), P. Shastri (IIA), M. Dopita (ANU) and The S7 Team

## Probing the Interaction between Nearby AGN and their Host Galaxies using Multi-wavelength data

The blackhole mass scaling relation suggests that the accreting supermassive black hole at the centre of an active galaxy and its host galaxy interact with each other, suggesting a feedback mechanism. We present some results from the Siding Spring Southern Seyfert Spectroscopic Snap-shot Survey, which aims to study this interaction using multi-wavelength data of a sample of nearby AGNs, with reasonable spatial resolution in optical and radio wavelengths.

| EA - 46 | ASI2019_464 | Surajit Paul | Poster |
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Surajit Paul*, Prateek Gupta, Reju Sam John and Shubham Bhagat

## `Bullet' cluster event and its observed properties: A reality check in $\Lambda CDM$ model using cosmological simulations

The cluster 1E 0657$-$55.8, also known as the `Bullet cluster', is an extreme and rare merging event in the universe. Unlike the usual situation where baryons remain trapped inside the dark matter halos, multi-wavelength observations of `Bullet' cluster show an offset of gravitational potential and X-ray peak, indicating a clear separation of baryons from the dark matter (DM), which, by some researchers, thought to be a challenge to the $\Lambda$CDM cosmology. In the last decade, several attempts were made to simulate such systems to understand the underlying physics of this extreme event, but, mostly with artificial mergers. Here, we present a maiden attempt of numerical modelling of a 3D, realistic `Bullet' like event and possible observables (i.e. X-ray and radio emissions) in a full cosmological ($\Lambda$CDM) environment with dark matter plus baryons. We report a simulated `Bullet', a fine replica of the observed one with reproduction of reported extremities such as speed of 2700 km s$^{-1}$, supersonic bow shock of Mach $M>3$ and a clear evidence of temporal separation of dark matter and baryons found just within a (128 $Mpc\;h^{-1}$)$^3$ co-moving volume, assuring no challenge to $\Lambda$CDM cosmology from the `Bullet' event as of now. Further, we present a time evolution study of thermal (X-ray) and computed radio properties (non-thermal) of our simulated `Bullet' event to match the observational morphologies as well as to understand the full event, formed inside a filamentary cosmic structure using animated visualisation.

| EA - 47 | ASI2019_135 | Sushant Dutta | Poster |
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Sushant Dutta, Veeresh Singh

## Extended X-ray emission in radio galaxies

In recent years, several radio galaxies have been found to emit diffuse X-ray emission in the region corresponding to their radio-lobes. The extended X-ray emission from radio-lobes is interpreted as the inverse-Compton scattering of the cosmic microwave background (CMB) photons by the relativistic electrons in the radio-lobes. Notably, powerful radio galaxies are often found in galaxy clusters which also give rise to extended diffuse X-ray emission from the intra-cluster hot gas, and therefore contribution to X-ray emission from radio-lobes is still not well understood. We present the study of extended X-ray emission in radio galaxies with aim to understand the energetic and magnetic field in radio galaxies.

| EA - 48 | ASI2019_111 | Susmita Barman | Poster |
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Susmita Barman, Naslim Neelamkodan

## Physical conditions of HII regions in Superbubble N44 in the LMC

The superbubble N44 region is an active high mass star-forming region in the Large Magellanic Cloud galaxy (LMC). The LMC (metallicity Z=0.5 solar ) at a distance of 50 kpc with a half solar metallicity is an appropriate site to study the physical properties of high-mass star-forming regions in a metal-poor environment. About 50 massive hot stars have been found in associated with the superbubble N44. We aim to carry out a detailed study of the HII regions in N44 by using optical and infrared data. We use Hα, [SII] and [OIII] emission maps which are obtained as part of the Magellanic Cloud Photometric Survey (MCPS). We also use the Spitzer photometric and spectroscopic data obtained as part of Surveying the Agents of Galaxy Evolution (SAGE). Spitzer photometric and spectroscopic data are used to trace the properties of dust feature. We present our preliminary study of electron density, ionizing photon flux, Stromgren radii, intensity of interstellar radiation field and the morphology of N44. Our study shows that the electron density of N44 varies from 6.5 to 39 cm^-3. The Lyman continuum photon luminosity of each ionizing star in the region is found to be 0.28X10^49 photons/s to 3.99X10^49 photons/s. We use [SII]/Hα and [OIII]/Hα ratios to distinguish shock induced and photoionized gas in N44.

| EA - 49 | ASI2019_326 | Swapnil Singh | Poster |
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Swapnil Singh, S. Vig, M. Ashby, S. K. Ghosh

## Low-frequency GMRT observations of Dusty Star-Forming Galaxies

The coldest and faintest dust component in molecular clouds dominates their dust masses, so understanding their cold dust content is necessary for understanding star formation in galaxies in general. To obtain accurate dust masses, we need to estimate the radio (thermal and non-thermal) components of the overlapping millimeter emission where dust emission dominates. To this end, we have carried out GMRT observations of four SPT- and IRAS-detected galaxies at frequencies between 310 and 1300 MHz, which we combine with SUMSS 843 MHz imaging. The radio fluxes were used to estimate the non-thermal spectral indices as well as star formation rates in our galaxy sample.

| EA - 50 | ASI2019_384 | Swati Deshmukh | Poster |
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S.P.Deshmukh, M.K.Patil

## Star formation and AGN activity in a sample of Blue ETGs

Observational evidences favors the presence of recent star formation activity in early-type galaxies and the effect of AGN on the star formation process in a galaxy is a matter of conjecture. We wish to perform a comparative study of the star formation rate, stellar and dust content in a sample of Blue ETGs including SFs, Seyferts, and LINERs. We carried out SED fitting on UV-Optical-IR data of Blue ETGs using MAGPHYS and SED3FIT codes. From the best fit SED model, we derived various physical parameters of sample galaxies. Also, we have derived the central black hole mass in these ETGs using M BH - K magnitude relationship. We observed a declining trend of SFR, sSFR and the dust content over the sequence SF-Seyferts-LINERs. A tight anti-correlation has been observed between the age of recent merger induced starburst and the sSFR with a correlation coefficient of -0.72. A marginal correlation has been observed between SFR per unit dust mass and the temperature of cool ambient ISM with the temperature of cool ISM decreasing over the sequence SF-Seyfert-LINER galaxies. We observed a positive correlation between specific BH mass and sSFR with Spearmans ρ value 0.45. Declining trend of star formation rate and the dust content of sample galaxies over SF-to-Seyfert-to-LINERs suggests the possible evolutionary sequence of Blue ETGs from SF-to-Seyfert-to-LINER galaxies. The decreasing trend of median values of temperature of cool ambient ISM over this sequence suggest no effect of central AGN on the diffuse ISM rather it is found to be affected by the star formation activity in sample galaxies. A positive correlation between specific BH mass and specific SFR suggest a common origin of the triggered star formation activity and the growth of central BH through accretion.

| EA - 51 | ASI2019_334 | Tapan Sasmal | Poster |
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Tapan Kumar Sasmal, Sabyasachi Pal, Soumen Bera and Soumen Mondal

## Discovery of three new cluster of galaxies by using Head Tailed Radio Sources as tracer

Tailed radio galaxies are classified according to luminosity and the angle between the radio tails. The Narrow Angle Tail (NAT) radio sources are featured by tails bent in a narrow `V' like shape. The jet bending in case of Wide Angle Tail (WAT) radio galaxies are such that, the WATs exhibit wide `C' like morphologies. The relative motion of the host galaxies through the inter-cluster medium or the strong inter-cluster wind is believed to cause the bending of the radio jets. Tailed radio galaxies are generally found in a rich cluster of galaxies. It is seen that NAT galaxies reside towards the edge whether WAT galaxies are located towards the center of a cluster. One can use NAT and WAT sources as a probe to detect nearby galaxy cluster. We have used our set of newly discovered head-tailed radio galaxies (Sasmal et al., 2018) to look for the hitherto undiscovered cluster of galaxies. Here we are presenting the discovery of three new clusters of galaxies from our study.

| EA - 52 | ASI2019_221 | Vijayakumar Doddamani | Poster |
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Vedavathi P and Vijayakumar H Doddamani

## Long term monitoring study of MRK 335 with IUE satellite

IUE satellite had made long term monitoring low-resolution spectroscopic observations of MRK335 from December 1983 to September 1993, a well-known seyfert1 galaxy for its UV variability. Variability monitoring of active galaxies with the UV and optical observations over nearly two decades have enabled us investigate the variability characteristics in greater details. The continuum and emission line lights curves obtained from such long monitoring observations have shown outbursts separated by local minima and the emission-line responses are slightly delayed in terms of several days. In this paper, we present the UV variability characteristics of MRK 335 as it was quasi-continuously monitored by IUE satellite from December 1983 to September, 1993. We have found the Fvar (NVA) to be 0.151, 0.132, 0.114 and 0.081 at UV continuum of 1325, 1475, 1655 and 2175 Å respectively. The Rmax values have been found to be 2.029, 1.576,1.491 and 1.237 similarly at 1325, 1475, 1655 and 2175 Å respectively. The decreasing trend of Fvar and Rmax variability parameters are similar in trend found in NGC 4151, NGC 7469 and may other low redshift active galaxies observed by IUE but over short-time scale intervals. The variability characteristic of MRK 335 appear to be similar in this trend at optical observations too. These observations suggest that the central accretion disk geometry/structure would be similar in radial direction. A more detailed discussion on the UV-variability of MRK 335 and in comparison with other IUE observations is presented this paper.

| EA - 53 | ASI2019_522 | VINOD KT | Poster |
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Vinod K T, S Aswathy and C D Ravikumar

## Study of Central Intensity Ratio in Seyfert galaxies

We estimated Central Intensity Ratio (CIR) of nearby Seyfert galaxies ($z < 0.0118$) using aperture photometry. The CIR is defined as I1/(I2-I1), where I1 and I2 are the intensities of the light within circular apertures of radius 1.5 arcsecs and 3 arcsecs respectively. For this study, we have taken a sample of 18 face-on galaxies with archival images from Hubble Space Telescope using Wide Field Planetary Camera 2 in the F814W filter . We find that CIR shows good correlation with nuclear star formation rate calculated at r = 300pc, star formation rate at r = 1kpc and the mass of the super massive black hole residing at the centre of the galaxy. It is also noted that there is no correlation between CIR and extended star formation rate determined at distances greater than 1kpc from the galactic centre. These correlations suggest a novel, simple, photometric way to study the central region of galaxies using CIR.

**Posters**
**General Relativity and Cosmology**

| GRC - 1 | ASI2019_64 | Kiren OV | Poster |
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Kenath Arun, C Sivaram

### Planet Nine: Testing ground for Dark Matter and Alternate Models

Recently there has been much excitement about the possibility of a remote massive planet orbiting the sun,far beyond the orbit of Neptune.The presence of such a planet was inferred from the peculiar clustering of six previously known Trans Neptunian Objects.It is postulated that a planet with the mass of Neptune has shepherded the six objects into their strange elliptical orbits. However until direct direction is achieved it remains a hypothesis.Here we propose the possibility that this recently postulated Neptune-sized planet with an orbital period of 1500 years could be a gravitationally condensed DM object.The observed mass of Planet Nine fits with the theoretical mass predicted for such DM objects formed by 60GeV DM particles,which is currently favoured DM particles.Here we look at the possible ways of formation of such DM planets and their number density in the solar neighbourhood.It is of interest to note that such DM objects with plantary mass could have formed in the early Universe well before stars and galaxies.These could be primordial planets that could make up much of DM.As Planet Nine has an expected orbit 200times the distance of Neptune,the solar gravitational acceleration would drop to MOND value of 10^-8cms^-2.So if there are objects orbiting the sun,at few thousand AU,MOND would suggest that their orbital velocity tends to a constant value given independent of their distance from the sun.In principle,MOND should apply whenever in an autonomous gravitationally bound system,the acceleration drops below the MOND acceleration,the force law should change and objects orbiting at larger distances should show an asymptotically constant velocity.Thus this object could also provide us with a testing ground for modification of Newtonian Dynamics(MOND).

| GRC - 2 | ASI2019_35 | Louise Rebecca | Poster |
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Louise Rebecca Kenath Arun C Sivaram

### Dark matter density distributions and dark energy constraints on structure formation

It was shown recently that the size of gravitationally bound large scale structures can be limited from the requirement that their gravitational binding self-energy density should at least be equal to the background repulsive dark energy density. This requirement for large scale cosmic structures implies a mass-radius relation for M/R^2, which is of the order of 1 g/cm^2, as pointed out earlier. This relation seems to hold true for primeval galaxies as well as those at the present epoch. The universality of the M/R^2 relation can be suggestive of the evolution of dark energy and can set constraints on the nature and evolution of dark energy. It appears that dark energy has remained constant from the early formation of galaxies, indicating a constant cosmological constant as the background dark energy density. Besides, we also set constraints on the size of galaxy clusters and superclusters due to the repulsive cosmological dark energy. This could indicate why large scale cosmic structures much larger than ∼200 Mpc are not seen. This model can be further extended to incorporate various dark matter density distributions in galaxies and clusters which could set constraints on their sizes which are consistent with observation. We also show that the constraints set using modified Newtonian dynamics (MOND) is again consistent with observations and same as that in the Newtonian case, hence making it impossible to distinguish the two (i.e. Newtonian case with DM and MOND) as pointed out recently. We also point out that the recent observations of baryon-dominated disk galaxies formed about ten billion years ago indicates better consistency of MOND (rather than DM) with observations.

| GRC - 3 | ASI2019_31 | Mandar Patil | Poster |
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| Mandar Patil (Faculty IIT Dharwad), D Narasimha (Formerely Faculty TIFR), Priti Mishra (Faculty Patna U.) | | | |
| Gravitational Lensing by Binary Black Holes | | | |
| Binary black holes have been in limelight off late due to the detection of gravitational waves from coalescing compact binaries in the events such as GW150914. In wake of this we study gravitational lensing by the binary black holes modeled as equal mass Majumdar-Papapetrou dihole metric and show that this system displays features that are quite unprecedented and absent in any other lensing configuration investigated so far. We unravel the existence of a new set of relativistic images and caustics. We also discuss the implication of our study for gravitational wave science. (Based on Phys. Rev. D 95, 024026 (2017)) | | | |

| GRC - 4 | ASI2019_330 | Manvendra Rajvanshi | Poster |
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| Manvendra Pratap Rajvanshi, J.S. Bagla | | | |
| Comparative study of nonlinear spherical perturbations in quintessence vs tachyon field dark energy models. | | | |
| A number of theoretical models have been proposed for Dark Energy ranging from the Cosmological constant to dynamic scalar fields. A big question is distinguishing between these models, first in theoretical terms which can lead to observational implications. It has been shown that any model of dark energy can be tuned to produce the same expansion history. In this work, we look at the question: how two different dark energy models; tachyonic field and scalar quintessence dark energy affect the dynamics of nonlinear perturbations. We first construct potentials for the two theories so as to get exactly same background evolution and then study nonlinear perturbations with the restriction of spherical symmetry. We find that the differences are weak for models which are closer to the cosmological constant. | | | |

| GRC - 5 | ASI2019_378 | noel jobu | Poster |
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| Noel Jonathan Jobu, Dr. Kazuyuki Furuuchi | | | |
| Causality constraints on effective field theories with gravitational interaction | | | |
| In 2005, Vafa proposed that not every seemingly consistent effective field theory may be embedded into a consistent UV theory. The theories that cannot be UV completed are said to lie in the swampland. Since then several criteria have been proposed to find effective theories in the swampland. We consider Adams et. al. proposal for a criterion to find effective field theories which cannot be UV completed. Adams et. al. proposed that models which have superluminal propagations of fluctuations in a background are in the swampland. This condition of causality can be used to attain a positivity constraint on the leading interaction term. Separate constraints on the leading interaction term can be imposed by requiring analyticity and unitarity. We discuss causality constraints on effective field theories and the necessity of extending the work of Allen Adam et. al. to include gravitational interactions. | | | |

| GRC - 6 | ASI2019_395 | Praveen Kumar | Poster |
|---|---|---|---|

Praveen Kumar, G S Khadekar, Saqul Islam

## Gravitational model of compact spherical Reissner-Nordström-type star under f (R, T) gravity

We present the interior solutions of distributions of charged fluid inside a sphere in f(R, T) gravity and which admits the existence of conformal Killing vectors. The charged sphere is embedded in an exterior RN metric. We assume that all physical quantities are in static equilibrium. The perfect fluid matter is studied under a particular form of the Lagrangian density f(R, T), and smooth matching conditions with the exterior RN metric are applied. The energy conditions as well as the stability of the solutions are also investigated. Emission from the surface of such a star is shown to blueshifted, rather than redshifted, and we calculate its value. Furthermore, the fluid body under f(R, T) gravity is shown to be non-geodesic in nature.

| GRC - 7 | ASI2019_204 | Safiqul Islam | Poster |
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Presented by : Safiqul Islam; Affiliation : Harish-Chandra Research Institute, HBNI, Chhatnag Road, Jhunsi, Allahabad-211019, India. Co-Authors: GS Khadekar, Praveen Kumar; Affiliation: Department of Mathematics, RTM Nagpur University, Nagpur 440033, India

## FRW bulk viscous cosmology with modified Chaplygin gas in flat space in (2+1)-dimensional space

In this paper we study the FRW bulk viscous cosmology in presence of modified Chaplygin gas in (2 + 1)-dimensional spacetime. The modified Friedmann equations due to bulk viscosity and Chaplygin gas are derived. For a particular choice of constant ζ in the energy-momentum conservation equation we find that the energy density is dependendent on the scale factor a. We obtain the time-dependent energy density for the special case of flat space using a particular ansatz. The variation of energy density with time is plotted. The Hubble expansion and deceleration parameters are studied. In this work, we consider Chaplygin gas and bulk viscous effect as a linear combination of two terms, one constant and other is a linear combination of the Hubble parameter ‘H’. In this frame work, we obtain the time-dependent energy density and also discourse the stability of the model in the (2+1)- dimension spacetime. The stability of system as well as some physical interpretations of the cosmological solutions are discussed with reference to the framework of the (2 + 1)-dimensional spacetime.

**Posters**
**Instrumentation and Techniques**

| IT - 1 | ASI2019_53 | AISHWARYA SELVARAJ | Poster |
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Aishwarya Selvaraj, Ravinder Kumar Banyal, R Sridharan

Development of camera control software for high speed acquisition.

A real-time adaptive optics(AO) system is necessary to improve the telescope resolution which otherwise is limited by the Earth's atmospheric turbulence. An AO system consists of a wavefront sensor(WFS) to measure the wave-front aberrations, a controller to analyze/reconstruct the wavefront and a deformable mirror(DM) to correct the aberrations. A WFS sensor needs to temporally sample the wavefront at high speed at which the atmospheric changes take place. This requires camera system with high frame rate. We have developed a custom software to control the ANDOR Neo 5.5 sCMOS camera for the high speed AO system which is under development. The basic functionalities of the camera are replicated using the SDK libraries provided by ANDOR. Python and its superset Cython are used as the programming platform for developing camera control and implementing various functionalities. A graphical user interface has been developed using PyQt, Qt library package. Python threading and Qt module signal and slot have been used to achieve the image acquisition and display speed comparable to the stand-alone software provided by the vendor.

| IT - 2 | ASI2019_248 | B Ananthamoorthy | Poster |
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B. Ananthamoorthy, Debbijoy Bhattacharya

UVIT and GALEX: A comparative study

AstroSat, India's first multi-wavelength satellite is designed to observe the universe in UV and broad X-ray band with its five onboard payloads. Ultraviolet Imaging Telescope (UVIT) onboard Astrosat observes the universe in FUV (130-180 nm), NUV (200-300 nm) and VIS (320-500 nm) with its best resolution of 1.5 arcsec (compared to 5 arcsec of GALEX) till date. Objective of this work is to study the variability of the UV sources and search for any possible new detection. The methodology used in this work which includes the detection of background, setting up a threshold map, detection of the sources, source flux calculation etc. are similar to that used in GALEX catalog preparation with required modification necessary for UVIT. The detection of background and Threshold map is setup using Poisson statistics. SExtractor and PSFex are used for source detection and photometry. The observation of UVIT and GALEX for few similar field of observation are analyzed for source flux variation and possible new source detection by UVIT. The challenges, method adopted and preliminary results obtained with the UVIT and GALEX data are presented here.

| IT - 3 | ASI2019_495 | Bhupesh Saxena | Poster |
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Dr.Bhupesh Saxena , Dr.Rajesh Sharma , Dr.P.S.Parihar

## A Performance Evaluation of 0.5m optical telescope of Varahmihir Astronomical Observatory, Ujjain.

M.P. Council of Science and Technology (MPCST), Bhopal has established an astronomical observatory at Dongla, Ujjain, named “Varahmihir Astronomical Observatory”. Observatory site is relatively dark, having moderate seeing and found to have a large number of clear nights during September-April months. The long spell of clear nights is best suited for continuous monitoring of variety of variable stars and the transient objects. Observatory has a medium size robotic Optical Telescope equipped with a large format advanced CCD imaging camera. In this poster, we report our efforts to characterize the site as well as evaluate the performance of the telescope-CCD system. We also report few selected scientific observations carried out using the facility. Observatory is also being used to train young college/university students to carry out astronomical research as well as for the public outreach related activities.

| IT - 4 | ASI2019_343 | Binukumar Gopalakrishnan | Poster |
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B.G. Nair1, Margarita Safonova2 , Ajin K. Prakash1 , Joice Mathew1 , Mayuresh Sarpotdar1 , Ambily Suresh1 , K. Nirmal1 , Jayant Murthy1, Dipshika Chakravortty3 , Annapurni Rangarajan4 , and Ramananda Chakrabarti5
1 Indian Institute of Astrophysics, Bangalore 560034, India, 2 M. P. Birla Institute of Fundamental Research, Bangalore, India, 3Dept. of Microbiology, IISc, Bangalore, India, 4MRDG, IISc, Bangalore, India, 5Center for Earth Sciences, IISc, Bangalore, India

## Micrometeorite collector and SAMPLE – A Method of Collection of Stratospheric Samples Using Balloon-Borne Payload

Earth’s atmosphere at stratospheric altitudes contains dust particles from soil lifted by weather, volcanic dust, man-made aerosols, IDP (Interplanetary Dust Particles) – remnants of comets and asteroids, and even interstellar dust. Satellite observations suggest that approximately 100– 300 tons of cosmic dust enter Earth’s atmosphere every day. However, very little is known about the microbial life in the upper atmosphere, where conditions are very much similar to that on Mars and possibly on some exoplanets. Stratosphere provides a good opportunity to study the existence or survival of organisms in these conditions. Despite the importance of this topic to astrobiology, stratospheric microbial diversity/survival remains largely unexplored, probably due to significant difficulties in the access and ensuring the absence of contamination of the samples. Possibility of collection of micrometeorite using balloon based stratospheric platforms is an unexplored area as well. To conduct a detailed study into this, we are developing the balloon-borne payload system SAMPLE (Stratospheric Altitude Microbiology Probe for Life Existence) to collect dust samples from stratosphere. This balloon-borne payload system will rise through the atmosphere till it reaches an altitude of about 25–30 km above sea level. The payload consists of detachable pre-sterilized sampling chambers designed to collect and contain the dust samples and get them back to the surface without contamination during the flight, a microprocessor and a controller which will determine the altitude of the payload system to actively control the opening and closing of the sample collection chambers. On retrieving the payload, the sampling chambers will be sent to a suitable laboratory where the samples will be examined for the presence of biological matter and micrometeorites.

| IT - 5 | ASI2019_412 | Biswajit Mondal | Poster |
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Biswajit Mondal, Prof.Santosh V Vadawale

Optimization and reflectivity data fitting for x-ray multilayer mirrors.

Multi-layer coatings contains alternate layers of high Z and low Z materials with typical thickness of XXX nm/Å. Coatings with equal spacing are effective for discrete energies but the thickness of the layers can be varied over different layers to obtain broader energy range. Design of such dept require optimization of coating materials, number of layers, their thicknesses, roughness etc. IMD is a standard software used for such optimization, however, being an IDL based GUI software, it has some limitations in terms of iterative scripting capabilities or complex fitting. Finally say that in this context we have developed alternate implementation of the Fresnel formalism to calculate reflectivity of multi-layer coatings which can be used with the standard spectral fitting software such as ISIS or XSPEC. Details of this implementation along with its comparison with IMD as well as experimental data will be presented.

| IT - 6 | ASI2019_151 | Deepangkar Sarkar | Poster |
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Deepangkar Sarkar, Prabhu K., Ravindra B., Dipankar Banerjee

Measurement of Meteorological Parameters for the National Large Solar Telescope at the Pongong Lake Site

Measurement of seeing is important for any astronomical site and has to be carried out before putting any large telescope. The meteorological parameters such as air temperature, humidity, wind speed and wind direction are an important parameters to study which will cause the turbulence near the ground level and affect the seeing at the site. To determine how these parameters change during the day, over the seasons and years, an automatic weather station (AWS) was installed in the incursion site of Pangong lake in Merak village. The Automatic Weather Station (AWS) is one of the site characterization instruments which collects meteorological data such as temperature, wind speed, wind direction, relative humidity and atmospheric pressure. The instrument is operational since 2009 at the incursion site. In this poster, we present the results of wind speed, direction, variations in temperature and relative humidity change over the day and seasons for the years 2009-2018. A comparison of these parameters with other best solar sites will also be presented.

| IT - 7 | ASI2019_466 | Divita Saraogi | Poster |
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Divita Saraogi and Varun Bhalerao

All sky instruments for high energy transients

The high energy sky is highly dynamic. Detailed studies over decades have yielded rich information about variable and transient objects like X-ray binaries, active galactic nuclei, gamma ray bursts, etc. However, our understanding of these objects is far from complete. GRB afterglows have been studied extensively, but our knowledge of the prompt emission is still limited by meager data. The gamma ray burst associated with the binary neutron star merger GW170817 was far fainter than expected from our understanding of the GRB population. To close these gaps in understanding, we need high energy instruments with all-sky sensitivity that can obtain lightcurves, spectra and polarimetric information of the prompt emission from bright transients. I will present plans and characteristics of such a proposed instrument, and discuss the expected scientific outcomes.

| IT - 8 | ASI2019_456 | Harsh Kumar | Poster |
|---|---|---|---|

Author :- Harsh Kumar Co-Authors: Dr. Shubham Srivastav, Dr. Varun Bhalerao , Prof. G.C.Anupama

## Growth-India: India's first robotic telescope

The GROWTH India robotic telescope is a 0.7m, wide-field, fully automated telescope set up at Hanle, Ladakh. As a part of the international GROWTH network (Global Relay of Observatories Watching Transients Happen), this telescope will address three key science goals: 1) The search and study of electromagnetic counterparts to gravitational wave sources, 2) The study of young supernovae, and 3) Follow-up of near-earth asteroids. The telescope achieved first light in June 2018, and steady progress has been made since on automation of the telescope. We present status updates and early science results from this telescope.

| IT - 9 | ASI2019_306 | Kumar TS | Poster |
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T S Kumar, Shobhit Yadava and Brijesh Kumar

## Development of a generic instrument controller for the 3.6 m DOT facility at ARIES

Although most of the instrument control systems are simpler but in an observatory it is important to standardize the hardware and interfacing software for optimizing the development time and cost and also for maintainability and upgradability. Thus, a common hardware platform is being developed for controlling the instrument rotary and linear stages. The controller also has analog and digital ports for interfacing analog sensors and other I/O devices like limit switches and relays. The instrument control system would be capable of interfacing motion stages driven by different types of motors including stepper motors, brushed DC motors and brushless motors. It supports feedback from incremental encoders and serial absolute encoders while the embedded control algorithm supports both open and closed loop control. The controller is scalable over I2C and CAN bus and is interfaced with a computer either directly or using an adapter board over a predefined protocol and command sets. The adapter board has inbuilt serial, serial to USB, I2C, CAN and SPI ports and supports plug in modules for expanding the telemetry capabilities to LAN, WiFi, Zigbee etc. Currently, the controller hardware is being tested with AC, stepper, brushed and brushless DC motors and a generic firmware is being developed.

| IT - 10 | ASI2019_516 | Mahesh Burse | Poster |
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Mahesh Burse, A.N. Ramaprakash, Sakya Sinha, Anurag Tyagi, G. Meena, Sreejith Padinhatteeri, Aafaque R. Khan, Durgesh Tripathi

## Design and architecture of the SUIT processing electronics

Solar Ultraviolet Imaging Telescope (SUIT) is one of the payload on Aditya-L1. SUIT will observe the Sun between 200-400 nm wavelength range and it will provide full disk images of different layers of the solar atmosphere by making use of 11 filters. SUIT has number of operational modes, each mode comprises of different set of filter combinations in particular sequence along with fully configurable exposure parameters like exposure time, binning size and frame size. The on chip program will allow switching between several such sequences based on internal and external triggers received from other payloads. There are also specific sequences for PI driven observation modes and for calibration purpose, which shall be uploaded / selected through ground commands. Some of these sequences and parameter values may have to be defined post launch, after receiving sufficient data. Also the images along with meta-data and health and house keeping related information will be downlinked continuously through separate channels. SUIT will have all the intelligence necessary for autonomous observations (including flare detection and sun tracking), and at same time it will also listen to ground commands and execute them at right time. ISRO certified proven, heritage, space qualified FPGA has been chosen for processing and detector electronics along with the space grade SDRAM and EPROM. Compare to the current generation of FPGAs that are available in the market, this one has limited resources and lack in feature like DSP. In this poster, we present the instruction set based design and architecture of the SUIT processing electronics and describe how in spite of various constraints, it achieves all above mentioned goals. It not only meets the current science objectives but also has provision to handle any post launch unforeseen situation(s).

| IT - 11 | ASI2019_134 | Mohan Lal | Poster |
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Mohanlal Jangra, Ankita Patel, Vaibhav Dixit, S.N. Mathur, B.S. Munjal(SAC-ISRO), Hemant Arora(SAC-ISRO), Tejas Mavani(SAC-ISRO), Vipin Kumar and Mudit K. Srivastava

## Mt Abu Faint Object Spectrograph and Camera-Pathfinder(MFOSC-P) on PRL 1.2m Telescope: Opto-Mechanical and Control System Design

Mt. Abu Faint Object Spectrograph and Camera-Pathfinder (MFOSC-P) is an upcoming instrument on PRL 1.2m telescope at Mt. Abu. MFOSC-P is designed to provide seeing limited imaging in Bessell's B,V, R and I filters over the field of view of ~6X6 arc-min^2. Slit limited resolutions of 2000, 1000 and 500 around 6500, 5200 and 6500 angstroms would be provided using three plane reflection gratings. The instrument has been designed fully in-house including its optical, mechanical, electronics motion control system and user's interface software, while commercially available off-the-shelf ANDOR 1KX1K CCD camera system is used as the detector. The main optics of the instrument is designed as three lens elements collimator and five lens elements camera sections. These lenses have been fabricated by external manufacturers and later assembled in to in-house designed and developed lens mounts, barrels, and cage-rod system as per the design requirements of optical alignment, to ensure the desired image quality. Five movable sub-systems of the instrument (gratings/imaging fold mirror, filter wheel, slits/open aperture unit, calibration fold mirror and auto-guider optics) are being driven by the stepper motors. These sub-systems are finally assembled into an instrument enclosure chassis to be fixed on the telescope with additional support structure. Various motions controls aspects of the instrument and calibration lamps operations are controlled by an in-house developed electronic control system and graphical user's interface. The control system has been developed around commercially available stepper motor controllers and drivers modules. It can facilitate the operations of up to eight stepper motors along with its encoders/limits feedbacks and four calibration lamps. The user's interface is developed using open source Python-QT software. MFOSC-P is currently being assembled is the laboratory and has been successfully verified for its image quality. We shall be reporting on the various design aspects of MFOSC-P in the meeting.

| IT - 12 | ASI2019_499 | Narasimha Jayanth | Poster |
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Narasimha Jayanth(1), Annu Jacob(2), Padmakar Parihar(2), Sriram S(2) Manoj Kumar(2) 1. Manipal Institute of Technology, Manipal. 2. Indian Institute of Astrophysics, Bangalore.

## Development of a Customized Shack-Hartman Wavefront Sensor for the relative Radius of Curvature Measurement.

Shack Hartmann Wavefront Sensor (SHWS) device is most commonly used in Adaptive Optics Systems. However, the same device can also be effectively used as an optical metrology instrument to characterize any optical system made of lenses or mirrors. To get acquainted with SMT, a prototype segment mirror telescope (PSMT) is being designed and developed at Indian Institute of Astrophysics (IIA) Bangalore. The proposed prototype telescope will use seven hexagonal mirrors, which will be supported by simple mirror support assembly and driven by indigenously developed voice coil based actuators. The PSMT mirror segments are planned to be manufactured in IIA' optics fabrication facility. One of the stringent requirement associated with the PSMT mirror segments is that they should have almost matching ROC and any relative departure in the ROC by few hundred micron will results in substantial degradation in the telescope image quality. During the optics manufacturing process, the relative ROC of mirror segments need be measured precisely and then after any departure from required ROC has to be corrected at the manufacturing stage itself. After exploring various options to measure ROC, the PSMT engineering team has come up with an approach which uses SHWS. Since SHWS needed for the optics metrology has got specific requirements and therefore any commercially available SH may not serve the purpose. Therefore, we attempted to develop a customized SHWS which can be used to test PSMT mirror segments. As a first step we design the optics of the instrument using ZEMAX, then after mechanical structure and the control. We also developed necessary software to control the instrument as well as data analysis software. At present, instrument is going through extensive calibration and testing in the laboratory. In this poster, we present the opto-mechanical design of the instrument, control and the preliminary test results.

| IT - 13 | ASI2019_285 | Rangarajan Komandur | Poster |
|---|---|---|---|

K.E.Rangarajan, B.Ravindra, P.U.Kamath, P.K.Nikhil, K.Nagaraju, D.V.S.Phanindra, K.Prabhu, M.Rajalingam, S.Sriram

## College level Solar Physics Experiments

As a part of public outreach program of Indian institute of Astrophysics (IIA), a graduate and undergraduate level experimental setup using an indigenously designed solar spectrograph along with a 2 mirror coelostat was fabricated and tested. The data acquisition, reduction and instrument control software were developed at IIA. In this document we discuss some of the experiments that can be carried out with the attainable resolution. The test results and the experiments performed are described. Realistic cost estimate of the prototype is indicated. Detailed design, expertise and the prototype instrument are available with the institute.

| IT - 14 | ASI2019_423 | Rushikesh Deogaonkar | Poster |
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Rushikesh Vinod Deogaonkar

## Automation in Telescope

Accurate pointing and precise tracking of the telescope towards the desired celestial objects is necessary when it comes to observational astronomy. This project is about automation in a telescope. The aim of this project is to build a low-cost control system which can be built by any student or professionals which is easy to implement. Also, as this project is going to be open source so it can be developed further by individuals according to their needs. The setup is expected to take the coordinates of the celestial objects from the user or some predefined objects from the database are to be selected and given as input. The control system will then move the telescope to the desired location. Also, the telescope has a facility to track the object. The current testing of the control system's hardware and software is being done on a 4-inch dobsonian mount. The rotation takes place along the altitude and azimuth axis. Arduino is used as the microcontroller which will carry out the necessary calculations and operations. Arduino was selected as the microcontroller considering robustness, low cost, ease of implementation and availability of plenty of help online. The RA-DEC values given as input will be converted to Alt-Az coordinates, and this moves the telescope to the required position. Stepper motor with torque of 19.8 KgCm and step angle of 1.8 degree is used. For the feedback, optical encoders having resolution of 1024 PPR is used. The gear reduction ratio is 60:1,so the least count of the telescope is 0.03 degrees. As the size of the telescope increases, it becomes difficult to move the telescope manually. A well sophisticated GOTO telescope is not affordable to anyone. Further this system can have a good user-friendly GUI and also can be incorporated with a virtual sky simulator (eg. Stellarium)

| IT - 15 | ASI2019_481 | Sai Prabhath Deevi | Poster |
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Sai Prabhath D, Padmakar Parihar, Tarun Kumar Sharma and P M M Kemkar

## Development of a direct drive based Alt-Azimuth Telescope for the MASS-DIMM Intruments

The plane light wavefront from distant objects gets distorted while passing through Earth's turbulent atmosphere. The image formed by such wavefront is blurred and has scintillation (twinkling) effect. The MASS-DIMM instruments uses these two observable effects of atmosphere to understand its kinematic property. MASS measures the scintillation effect in stellar light and provides a vertical structure of atmospheric turbulence. DIMM uses the fluctuation in the phase of incoming wavefront and provides seeing. This helps in selecting a new site for astronomical observations as well as for effective implementation of adaptive optics. The efficient usage of MASS-DIMM instruments over a range of wind speeds require a very sturdy telescope, since the DIMM operation is highly impacted by wind speeds. To serve this requirement, a direct drive Alt-Az mount telescope was developed with in-house design at IIA, Bangalore. The cross-section area of telescope is minimized by usage of truss structure and anti-backlash is eliminated by direct drive which also helps in adjusting telescope stiffness dynamically. Three phase AC torque motors with stall torque capability of 39Nm are used for direct drive along with a high resolution optical-rotary encoder and interpolated in in azimuth and elevation axes. A slot type opto-schmitt sensor is used for telescope homing and proximity sensors for electronic limiting. Electro-magnetic brakes are being used for both axes when the scope is not operational. The telescope control system is implemented using controller from SideReal Technologies. The control application from Sidereal Technologies is integrated with in-house developed MASS & DIMM software. Functionality of the telescope is tested in the laboratory set-up, however, sky testing is yet to be done. The all sky pointing accuracy of the telescope is expected to be better than ten arc-sec and the tracking performance is expected to match with large size research grade telescope.

| IT - 16 | ASI2019_265 | Shanti Prabha | Poster |
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Shanti Prabha, B.G. Nair, Ambily Suresh, Margarita Safanova, Jayant Murthy

## Spectroscopic Imaging of Nebular Gas: Cubesat based spectrometer to explore nebular astrophysics through imaging spectroscopy

One of the most exciting parts of the astrophysical spectrum is the far-ultraviolet (FUV: 912 – 1800 Å). Indian Institute of Astrophysics (IIA) is planning to develop an imaging spectrometer to observe and study diffuse nebulae. The spectrometer will be incorporated into a 6U size (300 x 200x 100 mm) satellite. The FUV spectrometer will be designed for operation in the spectral range of 900 and 1800 A0. The field of view is 4° x 1’ with a spatial resolution of 13” and a spectral resolution of 0.6 Å (Resolution ~2000). The spectrometer employs an off-axis parabolic (OAP) mirror with SiC coating, to maximise the collecting area we have selected a rectangular aperture for the mirror. Incident light focussed by the OAP will be allowed through the slit onto a grating, which is mounted in a Rowland circle configuration. The grating is a toroid (40 mm x 40 mm) with 1800 lines per mm to obtain the necessary resolution, the toroid disperses and focus the light on to a 2k×2k detector plane. We have chosen a toroidal grating because it is possible to achieve low astigmatism over a range of wavelengths with the toroid geometry. The detector will be a GaN coated MCP based detector developed by the Institute of Astronomy and Astrophysics at the University of Tübingen. Material selection of components for the spectrograph, geometry of the OAP, coating, type and size of the detector and the parameters of the grating will be discussed in detail. To determine the positions of the components, ray tracing(sequential) is done. Aberrations in the grating can be found by path length calculations which we have used for minimize the effect introduced by astigmatism etc. In this work we present the optical design of the spectrometer using hand calculations and computational simulations using Zemax software.

| IT - 17 | ASI2019_163 | Sireesha Chamarthi | Poster |
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Sireesha Chamarthi, Ravinder Kumar Banyal, S.Sriram

## Sensitivity analysis on VBT Echelle spectrogtaph for precision Radial velocity measurements

High-resolution Echelle spectrograph at VBT, Kavalur, India is a general purpose instrument with a compact design and movable grating to accommodate for the wavelength gaps. The instrument is utilized for various spectroscopic observations, thus movement of the grating is inevitable. With these design considerations, the zero-point of the optomechanical components (required for high precision Radial velocity measurements) is not fixed. Hence it is essential to analyze the sensitivity of individual optical components to estimate the stability tolerance from the spectrograph. From the analysis, in order to utilize the spectrograph for precision RV studies, the optomechanical locking requirement is evaluated. In this work, the stability analysis and the estimate of achievable precision in RV measurements with the spectrograph are reported.

| IT - 18 | ASI2019_448 | Sreejith Padinhatteeri | Poster |
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Sreejith Padinhatteeri, Sakya Sinha, Mahesh P. Burse, Manoj Varma, Amrita Unnikrishnan, Aafaque R. Khan, Anurag Tyagi, Nagaraju K., Durgesh Tripathi, A. N. Ramaprakash

### SUIT on-board decision making algorithms.

Solar Ultraviolet Imaging Telescope (SUIT) is one of the instrument onboard ADITYA-L1, India's upcoming space observatory. SUIT will be imaging the Sun in high-resolution using 11 filters with in near UV wavelength band ( 200-400 nm). Apart from normal operations like filter wheel rotation, CCD image capturing etc., SUIT also does some on-board decision making. This includes Solar flare trigger generation, finding the location of the flare on the solar disk, defining and tracking the ROI for correcting solar rotation etc. This decision making is not trivial due to unpredictability in flaring location, time and above all on-board computational resource limitations. This presentation explains SUIT on-board decision making algorithms and its implementation scheme.

| IT - 19 | ASI2019_49 | Sridharan Rengaswamy | Poster |
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Sridharan Rengaswamy, A. Raja Bayanna, P. Venkatakrishnan

### Diffraction limited imaging with the Multi Application Solar Telescope (MAST)

We demonstrate the diffraction limited imaging capability of the MAST by restoring high contrast images. The observing setup included a simple re-imaging system with two achromatic lenses at the back-end of the MAST. Short exposure images of the solar surface in H-alpha and near-infrared (700-1100 nm) were recorded with a fast camera. The images were processed with our speckle masking code to retrieve high-resolution images with high contrast. We emphasize the diffraction limited imaging capability of the MAST under typical seeing conditions.

| IT - 20 | ASI2019_335 | Srinath Patti | Poster |
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Srinath Patti(IIA), Sendhil Raja(RRCAT), R. Sridharan(IIA), Mayank Chaturvedi(RRCAT) and P. Sreekumar(IIA).

### Hybrid Optical Correlator for Gravitational wave signal detection

In order to enable Multi-messenger astronomy, detection of the Gravitational wave (GW) has to be processed in nearly real time i.e., rapid identification of GW candidate events to trigger immediate Electromagnetic (EM) wave observations. The detection of gravitational wave signatures in the strain data of LIGO Detectors is done using computational techniques such as matched filter using template banks. LIGO Data computing system uses several processors for parallel computing. A novel way is to use Optical correlators that provide inherent parallelism, which is suitable for above problem, and also by using volume holographic technique thousands of templates can be multiplexed in a single hologram. In this method we use optical matched filters to detect, using electro-optic techniques, the signature of gravitational wave in the interferometer strain data. The strain data is loaded into the spatial light modulator (SLM) which acts as an input to the optical correlator. The design consists of an electro-optic matched filter detector using SLMs and the templates are stored as multiplexed holograms. A matched signal leads to a peak in the corresponding output angle which is detected using a photodiode. In this poster, I will present a model of Optical Correlator.

| IT - 21 | ASI2019_486 | Tarun Bangia | Poster |
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Tarun Bangia,Brijesh Kumar

## Mechanical aspects of 3.6m Telescope at Devasthal and proposed future developments

An Alt-Azimuth mount 3.6 meter optical telescope weighing about 150 tons has been installed at Devasthal site of ARIES for astronomical observations. Since installation of telescope in 2016 several mechanical activities have been carried out for maintaining good health of the telescope systems. Disintegration and precise integration of heavy mechanical assemblies of telescope during primary mirror aluminization in 2018 has been a major mechanical task undertaken by mechanical team of ARIES. Indigenous design, in-house manufacturing and installation of cable anti-twister for instrument cables has been carried out successfully. Mechanical support has proved vital in identification and solving of various technical problems being faced with the telescope. Maintenance in telescope mechanical systems such as compressor unit, air dryer, hydraulic group and chillers has maintained operational viability of the telescope for astronomical observations with various back end instruments. Proposed future developments involve indigenisation of mechanical systems, interfacing of upcoming backend instruments with telescope, mounting of instruments on side ports and upgradation activities for telescope enclosure.

| IT - 22 | ASI2019_120 | Vaibhav Dixit | Poster |
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Vaibhav Dixit, Mudit K. Srivastava

## Development of an Adaptive Optics Test-bench: The Computational Approach

An Adaptive Optics (AO) laboratory test-bench is being developed to simulate and characterize the AO performance in the laboratory controlled conditions. The test-bench is envisioned as the prerequisite experimental facility to develop AO assisted imaging instrument for upcoming Physical Research Laboratory (PRL) 2.5m telescope at Mt. Abu. While the laboratory experimental setup is being designed using commercial off-the-shelf optical components (wavefront sensor, deformable mirror etc.), a parallel approach to develop a complete computational model of the said AO test bench (and systems in general) has been initiated as well. This computational test bench shall provide a detailed theoretical framework of said AO system including the atmospheric effects. The computational model is based on the theoretical framework of Fourier Optics/Fresnel propagation of beams to describe the properties of AO imaging systems. Several effects that are of importance to an astronomical adaptive optics systems are being modeled in the computational setup e.g. beam propagation through turbulent media, spatial and temporal variability of phase structures over the pupil, sampling and reconstruction of the pupil phase map, correction applied by deformable mirror and residual error map etc. The theoretical understandings employed in the development of this computational simulation model would be validated with the help of hardware test-bench setup for various error budgets and expected performance. The computational test-bench is being developed to provide the expected AO system outputs for its imaging as well as control requirements in variety of hardware set-up parameters as well as for various different theoretical models of the AO systems. In this poster, we shall introduce the AO test-bench project at PRL and describe early results from the computational test-bench.

| IT - 23 | ASI2019_400 | Vibhore Negi | Poster |
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Vibhore Negi Hum Chand Bikram Pradhan Jean Surdej

## Data Reduction Pipeline for 4 m ILMT

A new telescope, International Liquid Mirror Telescope (ILMT) is being installed at ARIES Devesthal observatory, Uttarakhand, India. ILMT consists of a 4-m diameter zenith mirror characterised by a f/2 focal ratio. It will perform a deep survey of a long and narrow strip of the sky by looking at space debris, asteroids, stars, supernovae and galaxies crossing its field of view. Since the sky covered by ILMT is vast (141.2 sq. degree), it will have plenty of exotic sources which will be equally focussed, with an integration time equal to the transit time of source by applying a special technique known as Time-Delay Integration (TDI) technique. In the TDI mode, images are formed by electronically stepping the relevant charges collected in the pixel of Charge Coupled Device (CCD) used as a detector in the observation. The transfer rate is kept similar to the target drifts rate across the detector . To be prepared for when the ILMT becomes functional in coming months and also as the traditional approach in data reduction of the raw CCD images is not sufficiently efficient and accurate for this mode, a data-reduction and calibration pipeline specifically dedicated for the data taken in the TDI mode has been developed by us. In this, a few innovations have been brought to properly handle such raw images. The data reduction algorithm includes dark subtraction, flat-field correction, sky subtraction, object detection, photometry and astrometry etc. This pipeline can be used to reduce and analyse CCD frames obtained in the TDI mode. So, to examine the efficiency of our pipeline, we have taken data from 1.3 m Devesthal Fast Optical telescope (DFOT) in the zenith observing mode. We will present the methodology used in the reduction pipeline and some results based on the existing 1.3m data taken in TDI mode.

| IT - 24 | ASI2019_229 | VIPIN KUMAR | Poster |
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Vipin Kumar, Mohan Lal, Ankita Patel, Vaibhav Dixit, S.N. Mathur and Mudit K. Srivastava

## Assembly-Integration-Testing (AIT) and Characterization of Mt. Abu Faint Object Spectrograph and Camera-Pathfinder (MFOSC-P)

Mount Abu Faint Object Spectrograph and Camera-Pathfinder (MFOSC-P) is an imager-spectrograph to be commissioned on PRL 1.2m telescope at Mt. Abu. The instrument has been designed and developed in-house to provide imaging as well as spectroscopy capabilities in visible wavelengths. Imaging is provided for ~6X6 arc-min^2 field of view on a 1K X 1K Andor CCD detector, with a sampling of 3 pixels/arc-second. The optics has been designed to provide ‘seeing limited imaging’ in astronomy standard Bessell’s B, V, R and I filters. Three modes of slit limited spectroscopy with gratings can achieve the resolutions of 2000,1000 and 500 around 6500, 5200 and 6500 angstroms respectively for 1 arc-second of slit width. Three plane reflection gratings are used for this purpose. MFOSC-P is conceptualized as a general user's instrument to choose any of the observing modes with sufficient ease during the operation. The instrument is currently being assembled in the laboratory with first on-telescope sky tests are scheduled in near future. Subsequent to assembly-integration-testing (AIT) of the instrument several characterization tests are planned to ensure the designed performance of the instrument. These include both the laboratory and on-sky characterization of image quality, efficiency and resolutions measurements, detector and noise characteristics measurements, performance evaluation of calibration optics, motion control and control system tests etc. We shall be presenting the AIT procedure as well as the laboratory and on-sky performance of the instrument in the meeting. At the time of writing this abstract the optical chain of the instrument has been successfully assembled and verified in the laboratory for its image quality.

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