XXXV Meeting of

Astronomical Society of India

B. M. Birla Auditorium, Jaipur

6 - 10 March 2017

ABSTRACT BOOK- ASI 2017

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Monday, March 6, 2017

ASI - 2017 Astronomy Education and Outreach

Time: 18.30 - 19.30 Venue: Hall E

ASI2017_1025	Somak Raychaudhury	Astronomy Education and Outreach
IUCAA, Pune		
IUCAA's role in Astronomy Education in India		
The Inter-University Centre for Astronomy and Astrophysics (IUCAA) in Pune was created as an autonomous institution under the UGC "to promote the nucleation and growth of active groups in astronomy and astrophysics at Indian universities". For almost three decades, it has nurtured the development of teaching, research in Astronomy and Astrophysics at institutions of higher education all over India. I will present highlights of this work, and outline future plans, along with an overview of our work on Astronomy Outreach.		

ASI2017_474	H. P. Singh	Astronomy Education and Outreach
University of Delhi, Delhi		
Astronomy and Astrophysics at Delhi University		
I shall present a review of A&A teaching being done at the University of Delhi and discuss the prototype of a Robotic Telescope for remote observing.		

ASI2017_474	Priya Hasan	Astronomy Education and Outreach
MANUU, Hyderabad		
Saath Satve Aasman: Together to the Seventh Heaven		
I shall talk about my journey as an astronomer, as a student and then as faculty. I describe Astronomy Outreach that I have been involved in, Astronomy Olympiads and the methods that can be used to make Astronomy interesting to all. I shall also discuss the shortcomings of our education system that fails to nurture interested students in Astronomy.		

Tuesday, March 7, 2017

ASI - 2017 Vainu Bappu Presentation

[Chairperson: Annapurni Subramaniam]

Time: 11.30 - 12.30 Venue: Auditorium

ASI2017_1090	Luca Cortese	Vainu Bappu Presentation

International Centre for Radio Astronomy Research

Galaxy transformation in the local Universe

One of the most outstanding challenges in extragalactic astronomy is to identify the astrophysical processes responsible for transforming simple dark matter haloes into the heterogenous population of galaxies inhabiting today's Universe. How did different morphological types form and evolve? Does the environment where a galaxy lives influence its evolution?

Inevitably, the answers to these questions entail a detailed investigation of all the components of the interstellar medium (gas, dust, metals) and their relation to stellar properties, kinematics and environment. This clearly requires multi-wavelength information for statistically significant samples of galaxies across the cosmic web, which are becoming available only now.

In this talk, I will review our current understanding of the physical processes driving galaxy transformation and illustrate the power of cold gas and dust measurements to reveal the effects of environment on the star formation cycle of galaxies. I will also highlight how upcoming integral field spectroscopic surveys will be critical for unveiling the origin of the Hubble sequence, and for making further progress in this field.

ASI - 2017 Special Lecture

Time: 12.30 - 13.30 Venue: Auditorium

ASI2017	Jonathan Tennyson	Special Lecture

University College London, London, UK

Molecular Line Lists for the Opacity of Exoplanet and other Hot Atmospheres

Fundamental molecular data play a key role for spectral characterization of astrophysical objects cool enough to form molecules in their atmospheres (cool stars, extrosolar planets and planetary discs) as well as in a broad range terrestrial applications. However, at elevated temperatures, the laboratory data for a number of key species is absent, inaccurate or incomplete. The ExoMol project provides comprehensive line lists with the aim of providing data for all molecules likely to be observable in exoplanet atmospheres in the foreseeable future [1]. This is a huge undertaking which involves providing in excess of a hundred of billion spectral lines for a large variety of molecular species [2].

The physics of molecular absorptions is complex and varies between different classes of absorbers, which are therefore divided into following topics (a) diatomic, (b) triatomics, (c) tetratomics, (d) methane and (e) larger molecules. Special techniques are being developed to treat each case. The line lists for a number of key atmospheric species currently available from ExoMol (www.exomol.com) including H2O, NH3, CaH, MgH, BeH, SiO, HCN/HNC, KCl, NaCl, CH4, PN, PH3, H2CO, AlO, NaH, ScH, HNO3, SO2, SO3, H2S and NO.

I will present examples of molecular spectra computed using the ExoMol line lists. I will also discuss the progress in and prospects of characterising exoplanets using molecular spectroscopy.

The ExoMol project was supported by the ERC under Advanced Investigator Project 267219.

References

[1] J. Tennyson and S.N. Yurchenko, Mon. Not. R. Astron. Soc., 425, 21 (2012). [2] J. Tennyson and the ExoMol Team, J. Molec. Spectrosc. 372, 73 (2016).

ASI 2017 Parallel Session - Tuesday, 7 March, 2017

Sun and the Solar System - 1 [Chairperson: K. Sankarsubramanian]

Time: 14:30 - 16.00 Venue: Hall A

ASI2017_1366	Dibyendu Nandi	Oral

Dibyendu Nandy (1), Dipankar Banerjee (1,2), S.P. Rajaguru (1,2), K. Sankarasubramanian (1,3), A.K. Srivastava (1, 4), Nandita Srivastava (1,5), Prasad Subramanian (1,6), Durgesh Tripathi (1,7) 1. Center of Excellence in Space Sciences India, IISER Kolkata, 2. Indian Institute of Astrophysics, 3. Indian Space Research Organization, 4. Indian Institute of Technology-BHU, 5. Udaipur Solar Observatory, PRL, 6. IISER Pune, 7. Inter-University Centre for Astronomy and Astrophysics

The Science Case for Solar and Space Weather Observations from Lagrange Point L5 in Space

Here we present the scientific case for comprehensive solar observations from Lagrange point L5, a location which provides uninterrupted views of the Sun-Earth system thus enabling system-wide Sun-Earth science. Given that on-disk solar magnetic features observed at L5 rotate in 4-5 days to the Sun-Earth line, solar observations from L5 could also lead to predictions of geo-effective space weather events well in advance. Possible synergy with the Aditya-L1 mission – which is currently under development – is discussed. Taken together, these vantage points in space can provide unprecedented space weather diagnostics of benefit to India and the world.

ASI2017_1317	Vipin K. Yadav	Oral

Anil Bhardwaj, Space Physics Laboratory (SPL), Vikram sarabhai Space Centre (VSSC), Thiruvananthapuram, Kerala

Solar plasma (Alfven) wave observation at L1 point with the magnetic field measurements

Plasma, also known as the fourth state of matter, is an assembly of charged particles which shows the collective behaviour. In universe, many natural plasma systems exist such as stars, galaxies, interstellar medium (ISM), black-holes, pulsars, quasars, etc. Near to Earth, Sun is the most prominent natural plasma system. The solar plasma environment and the interplanetary magnetic field (IMF) have a strong effect on the space weather around the Earth. Therefore, it is essential for us to keep a track of all those solar events which can affect the Earth in one way or the other. There are several space missions dedicated to continuously observe the space weather by measuring the energetic charge particle flux as well as the large variations in the space magnetic field. Fluxgate Magnetometers (FGM) are used to measure low magnitude steady state magnetic fields and are regularly sent onboard space missions to measure the local IMF. In the space plasma environment, one of the special features is plasma waves which have a universal presence. Plasma waves are generated in many solar system plasmas such as planetary magnetospheres and ionospheres, ionosphere of some of planetary satellites, comets, interplanetary medium (IPM), etc. From sun also, along with energetic particles and IMF, a number of plasma waves come out. These solar plasma waves can be used to infer back the solar plasma properties which are otherwise not possible due the hostile solar environment. The plasma

waves getting generated near the Sun carry the history of their generation mechanism along with them which provide information about the physical phenomena-taking place there. The first Lagrangian (L1) point can be an ideal location to carry outsolar plasma wave studies, away from the Sun as well as from the Earth's magnetosphere.There were several missions sent to study the sun such as: Helios 1 & 2, ISEE-3, Ulysses, YOHKOH, WIND, SOHO, ACE, TRACE, GENESIS, RHESSI, HINODE, STEREO, SMO, PICARD, SDO and IRIS. Some of these missions have FGMs onboard to measure the IMF magnitude and direction, which can be further analysed to decipher the solar plasma wave information. In this paper, the magnetic field data collected by the FGMs onboard ACE and WIND is used to extract the scientific information about the solar plasma waves reaching at the L-1 point.

ASI2017_1254	Mekhi Dhesi	Oral

Marcell Tessenyi1,2, Giorgio Savini1,2, Giovanna Tinetti1,2, Jonathan Tennyson1,2, Mekhi Dhesi2, Max Joshua2
AFFILIATION:
1.Physics and Astronomy, UCL, London, United Kingdom
2.Blue Skies Space Ltd., London, United Kingdom

Twinkle Space Mission

Twinkle is a space mission designed for visible and near-IR spectroscopic observations of extrasolar planets. Twinkle’s highly stable instrument will allow the photometric and spectroscopic observation of a wide range of planetary classes around different types of stars, with a focus on bright sources close to the ecliptic. The planets will be observed through transit and eclipse photometry and spectroscopy, as well as phase curves, eclipse mapping and multiple narrow-band time-series. The targets observed by Twinkle will be composed of known exoplanets mainly discovered by existing and upcoming ground surveys in our galaxy and will also feature new discoveries by space observatories (K2, GAIA, Cheops, TESS).
Twinkle is a small satellite with a payload designed to perform high-quality astrophysical observations while adapting to the design of an existing Low Earth Orbit commercial satellite platform. The SSTL-300 bus, to be launched into a low-Earth sun-synchronous polar orbit by 2019, will carry a half-meter class telescope with two instruments (visible and near-IR spectrographs - between 0.4 and 4.5μm - with resolving power R~300 at the lower end of the wavelength scale) using mostly flight proven spacecraft systems designed by Surrey Satellite Technology Ltd and a combination of high TRL instrumentation and a few lower TRL elements built by a consortium of UK institutes. The Twinkle design will enable the observation of the chemical composition and weather of at least 100 exoplanets in the Milky Way, including super-Earths (rocky planets 1-10 times the mass of Earth), Neptunes, sub-Neptunes and gas giants like Jupiter. It will also allow the follow-up photometric observations of 1000+ exoplanets in the visible and infrared, as well as observations of Solar system objects, bright stars and disks.

ASI2017_1163	Mahendra Verma	Oral

Mahendra Verma, Physics Department, IIT Kanpur

How MHD Turbulence theories can help understand solar wind and solar magnetic field.

Most astrophysical states are described by magnetohydrodynamics (MHD) turbulence. The physics of MHD turbulence is not fully understood. According to Kraichnan and Iroshinokov, the turbulence phenomenology differs significantly from hydrodynamic turbulence due to the mean magnetic field, and the spectrum is proportional to $B_0^{½} k^{-3/2}$. However, Verma [1] showed that the “effective mean magnetic field” is wavenumber dependent ($B_0 \sim k^{-⅓}$), which leads to $k^{-5/3}$ spectrum, as is observed in the solar wind. The above theory can be used used to estimate the turbulent dissipation in the solar wind and solar corona [2,3]. The turbulence however is suppressed by the mean magnetic field that should affect the dissipation rate. These aspects need further investigation. These theories also help understand the magnetic field generation or dynamo. The growth of the large-scale magnetic field occurs due to the energy supply or flux from the large-scale velocity field to large-scale magnetic field [3]. References: [1] M. K. Verma, Mean magnetic field renormalization and Kolmogorov's energy spectrum in magnetohydrodynamic turbulence, Phys. Plasmas, 6, 1455 (1999). [2] M. K. Verma, D. A. Roberts, and M. L. Goldstein, Turbulent heating and temperature evolution in the solar wind plasma, J. of Geophys.Res., 100, 19839 (1995). [3] M. K. Verma, Statistical theory of magnetohydrodynamic turbulence: recent results, Phys. Rep., 401, 229-380 (2004).

ASI2017_1255	Rengaswamy Sridharan	Oral

Vasantha Raju N

Imaging with Masked Apertures: Application to Solar Imaging

We explored the use of masked apertures with non-zero transfer functions in imaging solar surface features with ground based telescopes. We estimate the transfer functions of masked apertures numerically under different seeing conditions and show that, in general, they show smaller variation with seeing compared to those of filled apertures, and thus are less sensitive to the atmospheric seeing. We apply the bi-spectrum image reconstruction code, originally developed for filled aperture speckle imaging, to the simulated images of masked aperture telescopes and show that images can be reconstructed with high fidelity under typical seeing conditions. Also, we show that the contrast enhancement can be better that achieved with filled apertures provided the object contains small scale features close to the diffraction limit of the telescope. We discuss the relative merits of using such masked apertures for solar observations.

ASI-2017 Parallel Session - Tuesday, 7 March, 2017

Time: 14:30 - 16.00 Venue: Hall B

Stars, ISM and the Galaxy – 1 [Chairperson: Eswar Reddy]

ASI2017_1437	Sarita Vig	Invited
-		

An insight into massive star formation in dense cores of molecular clouds

The intricacies of the formation process of a star, particularly a massive one, is far from certain. A number of factors are known to affect this process and it is now being contested whether a simple theory can explain the entire process. While a number of factors are being investigated through simulations, the nature of initial conditions as well as the feedback mechanisms are believed to play a significant role in the protostellar evolution. I will give a brief introduction to the current status of our understanding of massive star formation process including observational results that help constrain the theories. I will also present a few examples of massive star formation in different evolutionary stages, from deeply embedded protostellar objects to optically obscured young clusters associated with extended HII regions.

ASI2017_1236	Blesson Mathew	Oral
P. Manoj (TIFR), B. C. Bhatt (IIA), D. K. Sahu (IIA), G. Maheswar (ARIES), S. Muneer (IIA)		

The curious case of PDS 11: a nearby, >10 Myr old, classical T Tauri binary system

We present results of our study of PDS 11 binary system, which belongs to a rare class of isolated, high galactic latitude T Tauri stars. Our spectroscopic analysis reveals that PDS 11 is a M2 - M2 binary system with both components showing similar Hα emission strength. Both the components appear to be accreting, and are classical T Tauri stars. The lithium doublet LiI 6708, a signature of youth, is present in the spectrum of PDS 11A, but not in PDS 11B. From the application of lithium depletion boundary age-dating method and a comparison with the LiI 6708 equivalent width distribution of moving groups, we estimated an age of 10 - 15 Myr for PDS 11A. Comparison with pre-main sequence evolutionary models indicates that PDS 11A is a 0.4 solar mass T Tauri star at a distance of 114 - 131 pc. PDS 11 system does not appear to be associated with any known star forming regions or moving groups. PDS 11 is a new addition, after TWA 30 and LDS 5606, to the interesting class of old, dusty, wide binary classical T Tauri systems in which both components are actively accreting.

ASI2017_1217	Mahathi Chavali	Oral

Manoj Puravankara (TIFR) Blesson Mathew (TIFR) Sudip Bhattacharya (TIFR)

Comparative analysis of X-ray emission from T Tauri stars and Herbig Ae/Be stars

Herbig Ae/Be (HAeBe) stars are thought of as evolutionary progenitors of intermediate mass main sequence stars. HAeBe stars are expected to be X-ray dark as they are fully radiative and hence incapable of driving a dynamo and are not known to possess high speed stellar winds. To address this question we investigated X-ray emission properties of HAeBe stars. We carried out a comprehensive search of the Chandra X-ray observatory archive and point source catalogue using a master list of 170 HAeBe stars in the galaxy, and found 25 HAeBe stars which show X-ray emission. Using the spectral types and distances compiled from the literature, we estimated stellar parameters such as bolometric luminosity, effective temperature, stellar radius and rotation period for these sources. We also determined the accretion disk/activity indicators such as near-infrared excess and Hα emission strength. We searched for correlations between observed X-ray properties and stellar properties and accretion/disk tracers to study the origin of X-ray emission in HAeBe stars. We further compared the X-ray properties of HAeBe stars with those displayed by their lower mass counterparts, T Tauri stars. The X-ray observations of T Tauri stars were taken from the COUP (Chandra Orion Ultradeep Project) data and the stellar and accretion/disk indicators were compiled from various catalogues. Our results show that the fractional X-ray luminosities of HAeBe stars are 2-3 orders of magnitude lower than that observed for T Tauri stars. We also find that the X-ray properties of both T Tauri stars and HAeBe stars are not correlated with accretion/disk indicators, indicating that the X-ray emission from young stars does not have circumstellar origin. We will present our results and discuss the possibility of stellar origin of X-rays in pre-main sequence stars.

ASI2017_1357	Dhrimadri Khata	Oral

Dr. Soumen Mondal, Dr. Ramkrishna Das, S.N.Bose National Centre For Basic Sciences; Salt Lake; Kolkata-700106

Understanding Physical Properties of Young M-dwarfs : Optical and Near-IR spectroscopic studies.

Large population of M-dwarfs (more than 70% of all stars) are becoming attractive targets as a representative of archaeological record of the chemical evolution, star formation history of the Milky Way and as potential exoplanet host stars. Based on the age distribution of M dwarfs, we have taken a sample of young M-dwarfs from young moving groups and old population from the galactic field for medium spectral resolution spectrophotometric studies in the optical and near-infrared region. Using optical HFOSC and Near-IR TIRSPEC instruments on 2m Himalayan Chandra Telescope (HCT) at Hanle, Ladhak, we are characterizing a sample of M dwarfs on basis of several atomic and molecular indices. The main goal is to quantify the changes in the strength of these absorption features with spectral types and to find the correlation with different fundamental parameters like effective temperature (Teff), surface gravity (logg), metallicity ([M/H]) etc. of M dwarfs. To complement with observations, the synthetic spectra from PHOENIX (BT-Settl) model grid and moderate resolution archival observed spectra (1-2.5 μm) from several library like IRTF SPEX-spectral library for different spectral types (M0V-M9V) is taken to support a qualitative validation of our approach. These will help us to find the best-fit of these parameters as well as to determine radii, ages and masses etc., which will provide a road map for future target selection of transit search around young and old population of M dwarfs.

ASI2017_905	Krishnakumar M.A	Oral

Bhal Chandra Joshi (National Centre for Radio Astrophysics) P.K. Manoharan (Radio Astronomy Centre, National Centre for Radio Astrophysics)

Towards understanding the ISM turbulence using pulsars

The turbulent ISM causes difficulties in observations of the compact astronomical objects, particularly in the radio regime. One of the best tools for studying the turbulent ISM is radio pulsars. Since the observations to understand the turbulence in different lines of sight are very less, we have started a concerted effort to improve the level of current statistics to a good level by observing the scatter broadening of pulsars. We will discuss details of our observations made with ORT and GMRT and the proposed studies at other radio telescopes around the world. We will review the current understanding of the ISM turbulence based on our observations and from such efforts available in the literature. Importance of such studies are currently understood in the fields of pulsar timing array (PTA), which search for gravitational waves from supermassive black holes, where the variation in dispersion measure due to turbulence is seen and will affect the sensitivity to gravitational wave detection. We also review the advantages of such studies from the future telescopes such as FAST, and SKA.

ASI-2017 Parallel Session - Tuesday, 7 March, 2017

Time: 14:30 - 16.00 Venue: Hall C

Extragalactic Astronomy – 1 [Chairperson: Chanda Jog]

ASI2017_1302	Sudhanshu Barway	Oral

Saha, Kanak (IUCAA); Vaghmare, Kaustubh (IUCAA); Kembhavi, A. K.(IUCAA);

Which bulges are favoured by barred S0 galaxies?

S0 galaxies are known to host classical bulges with a broad range of size and mass, while some such S0s are barred and some not. The origin of the bars has remained as a long-standing problem -- what made bar formation possible in certain S0s? By analysing a large sample of S0s with classical bulges observed by the Spitzer space telescope, we find that most of our barred S0s host comparatively low-mass classical bulges, typically with bulge-to-total ratio (B/T) less than 0.5; whereas S0s with more massive classical bulges than these do not host any bar. Furthermore, we find that amongst the barred S0s, there is a trend for the longer and massive bars to be associated with comparatively bigger and massive classical bulges -- possibly suggesting bar growth being facilitated by these classical bulges. In addition, we find that the bulge effective radius is always less than the bar effective radius --indicating an interesting synergy between the host classical bulge and bars being maintained while bar growth occurred in these S0s.

ASI2017_470	Sheelu Abraham	Oral

Sheelu Abraham, IUCAA, Pune, India-411007; Arun Kumar Aniyan, SKA South Africa, Pinelands,Cape Town 7405, South Africa; Ajit K. Kembhavi, IUCAA, Pune, India - 411007

Automated Detection of Barred Galaxies using Convolutional Neural Network

Bars are one of the prominent features in most of the disc galaxies. It is observed that a significant fraction of disc galaxies are barred in the near universe and bars play a major role in the secular evolution of disc galaxies. So it is important to detect bars and proper identification of barred galaxies enables us to understand the evolution of disc galaxies. We present a method for detecting bars in galaxies using deep learning. Deep learning methods enable automatic feature learning and extraction directly from the images rather than handcrafted features by humans thereby enabling optimised learning and high accuracy classification. Such methods have significant importance with future observatories where Petabytes of data is generated on a daily basis. We trained a deep convolutional neural network using SDSS DR12 images. Our classifier is able to distinguish barred and unbarred galaxies with ~93% accuracy. We used our classifier to detect bars from Meert et al. 2015 catalogue where they have done bulge-disc decomposition of ~7 x 10^5 galaxies from SDSS DR7.

ASI2017_687	Preetish Kumar Mishra	Oral

Yogesh Wadadekar, NCRA-TIFR. India. Sudhanshu Barway, SAAO, South Africa.

Pseudo bulges in galaxy groups: the role of environment in secular evolution

We examine the dependence of the fraction of galaxies containing pseudo bulges on environment for a flux limited sample of ~5000 SDSS galaxies. We have separated bulges into classical and pseudo bulge categories based on their position on the Kormendy diagram. Pseudo bulges are thought to be formed by internal processes and are a result of secular evolution in galaxies. We attempt to understand the dependence of secular evolution on environment and morphology. Dividing our sample of disc+bulge galaxies based on group membership into three categories: central and satellite galaxies in groups and isolated field galaxies, we find that pseudo bulge fraction is almost equal for satellite and field galaxies. Fraction of pseudo bulge hosts in central galaxies is almost half of the fraction of pseudo bulges in satellite and field galaxies. This trend is also valid when only galaxies are considered only spirals or S0. Using the projected fifth nearest neighbour density as measure of local environment, we look for the dependence of pseudo bulge fraction on environmental density. Satellite and field galaxies show very weak or no dependence of pseudo bulge fraction on environment. However, fraction of pseudo bulges hosted by central galaxies decreases with increase in local environmental density. We do not find any dependence of pseudo bulge luminosity on environment. Our results suggest that the processes that differentiate the bulge types are a function of environment while processes responsible for the formation of pseudo bulges seem to be independent of environment.

ASI2017_1129	Koshy George	Oral

Galaxies reborn: The curious case of star forming elliptical galaxies

Elliptical galaxies in the local Universe are understood to be passively evolving "red and dead" stellar systems that formed from a burst of star formation when the Universe was less than half of its current age. This classic notion got changed with the recent observations of stellar mass growth and size evolution of elliptical galaxies over the past ~ 8 billion year. We now have a class of blue star forming elliptical galaxies which on contrary to the star forming spiral galaxies retain the elliptical morphology. We report here the structural study on 55 blue star forming elliptical galaxies where we found that a majority of these systems show signature of recent interaction while retaining the elliptical morphology and follow elliptical galaxy scaling relations. The star forming population of elliptical galaxies at low redshifts could be normal ellipticals that might have undergone a recent gas rich minor merger event. The star formation in these galaxies will shut down once the recently acquired fuel is consumed following which the galaxy evolve to a normal elliptical galaxy.

ASI2017_822	Sushma Kurapati	Oral

Jayaram N. Chengalur and NCRA-TIFR

HI observations of gas-rich void galaxies

Studying the void galaxies will allow us to understand the effect of environment on galaxy evolution, as the low density environment is expected to result in low rate of interactions and mergers. Numerical simulations indicate that fainter dwarfs (Magnitudes fainter than -16) in voids are significantly bluer and have higher specific star formation rates than their higher density counterparts, while the luminous dwarfs (M~ -18) in voids are statistically indistinguishable from similar dwarfs in the field. Previous observational studies show that, for brighter dwarfs (brighter than -16.5), the properties of void galaxies are statistically identical to their counterparts in dense regions. Since the effect of environment is expected to be the largest for the galaxies of the smallest masses, it is important to study the fainter dwarfs from nearby voids. The nearest void, Lynx-Cancer sample contains a total of 104 galaxies for which optical photometry, gas metallicity and HI integrated parameters are available. Some of the faint galaxies from this sample appear to evolve in average slower than their analogs in denser environments. A relatively small fraction (~10%) of void low mass galaxies show unusual properties indicating their unevolved status. We have selected the upper quartile of gas-rich galaxies (with M(HI)/L(B) >1.9) for a statistical robust analysis of the gas distribution, kinematics and dark matter distribution. This sample allows us to not only examine the global statistical properties of void galaxies, but also to explore the details of dynamical properties (e.g. signs of mergers, etc). We present the neutral hydrogen properties, i.e content, morphology and kinematics of these 28 galaxies in detail. We also highlight the key results on individually interesting systems.

ASI2017_1405	Mousumi Das	Oral
H.Intema (Leiden University), K.S.Dwarakanath (RRI), P.Kharb (NCRA)		
A Study of the Galaxies within the Bootes Void		
We present a study of the galaxies within one of the largest known voids in our nearby universe, the Bootes void. Voids contain a sparse but significant population of galaxies that represent the remnants of the hierarchical galaxy formation process and their distribution may delineate a void substructure. A significant fraction of these galaxies show signatures of ongoing star formation and nuclear activity similar in nature to normal galaxies in denser environments. It is not clear what triggers this star formation and nuclear activity; close interactions with companion galaxies or gas accretion along filaments are possible explanations. To obtain a better understanding of these galaxies we have studied the stellar, gas and radio emission from galaxies in the Bootes void using GMRT radio observations and existing HI, optical and x-ray observations in the literature. We find that galaxies in the Bootes void are more evolved compared to those in smaller voids; we discuss the implications of our results.		

ASI-2017 Parallel Session - Tuesday, 7 March, 2017

Time: 14:30 - 16.00 Venue: Hall D

General Relativity and Cosmology – 1 [Chairperson: Biswajit Pandey]

ASI2017_1420	Supratik Pal	Invited
-		
Inflationary cosmology post-Planck 2015		
I will give a broad overview of the present status of inflationary cosmology based on the latest data from Planck 2015. With a brief discussion of CMB and major observables therefrom, I will mostly address two questions: how much do we know about inflation and what can we say about different class of inflationary models till date? I will also highlight on certain avenues to explore further, like the primordial non-Gaussianities, tensor modes, CMB spectral distortions etc.		

ASI2017_496	Abir Sarkar	Oral

1) Shiv K Sethi , Raman Research Institute 2) Subinoy Das, Indian Institute of Astrophysics

The effects of non-standard dark matter on CMB spectral distortion

Currently active research is going on worldwide to understand the nature of dark matter. Here an attempt is made to reveal the nature of it by studying its effects on the spectral distortion in the CMB, an unique probe of the thermal history of the universe. In the early universe, energy is dissipated into the photon-baryon plasma due to Silk Damping which heats up the baryons. This eventually deviates the photon spectrum from its pure blackbody nature. The amount of heat dissipated and thus the deviation is dependent on the transfer function of the dipole component of the CMB, which is sensitive to the nature of dark matter. In this work, along with the standard cold dark matter we have considered a handful of other dark matter models. For each of these models, we have studied the evolution of the heating rate of the photon-baryon plasma and calculated the Compton y-parameter. We have found that not only the y-parameter is different for different dark matter models but also, given the sensitivity, those are expected to be measured and distinguished by the forthcoming PIXIE-like experiments. We also provide a physical explanation of the nature of distortion that can be expected at different epochs of the thermal history of the universe and argue that only the intermediate scales of the transfer function contribute in the spectral distortion.

ASI2017_1256	Janakee Raste	Oral

Shiv Sethi, Raman Research Institute

Analytically Modelling Early Phase of EoR

Epoch of Reionization is one of the most important events in the history of the universe. During this time, stars and galaxies, which formed in large scale collapsed structures, ionized and heated the medium surrounding them. Ly-alpha, X-ray and ultraviolet were three of the most important components of the radiation emitted by these collapsed sources. To study the EoR, redshifted 21 cm signal, emitted or absorbed by neutral hydrogen (HI), is one of the most important probes. This signal is affected by the spectrum of the radiation and details of structure formation. Therefore, it is important to examine various models of EoR analytically, before we can detect the 21 cm signal. We analytically model the early phase of EoR, which allows us to investigate the impact of different modelling parameters on 21 cm signal and its 2-point correlation. We use excursion set formalism to generate number distribution of ionized bubbles at any redshift and generate temperature profiles around these bubbles by examining the effects of Ly-alpha and X-ray on the medium. We use geometric and probabilistic arguments to calculate 2-point correlation of the 21 cm Brightness temperature and contrast it against simplistic models where complete or no heating is assumed. We also try to examine the effect of temperature correlation on the total 21 cm correlation and the global history of reionization. This method can be applied to calculate and compare correlation for various reionization and heating histories during the early phase of reionization when ionization fraction is small and bubbles do not overlap.

ASI-2017 Parallel Session - Tuesday, 7 March, 2017

Time: 16.30 - 18.00 Venue: Hall A

Sun and the Solar System – 2 [Chairperson: K. Sankarsubramanian]

ASI2017_1276	Bidya Binay Karak	Oral

P. J. Kapyla, M. J. Kapyla (Max Plank Institute for Solar System Research, Germany) & A. Brandenburg (Colorado University, USA)

Why do stars rotate differentially?

Stars do not rotate like a solid body. For the Sun we know that the equator rotates faster than the higher latitudes. This type of rotation profile is called the solar-like differential rotation which has been observed in many stars. However, the opposite case where the equator rotates slower than the higher latitudes, referred to as the anti-solar differential rotation, is also possible. I shall discuss the origin of these types of differential rotations using global MHD simulations. Then I shall discuss how with the decrease of the Coriolis number the differentiation rotation changes from solar to anti-solar profiles. The influence of the dynamo-generated magnetic field will also be discussed.

ASI2017_1389	Anusha, L. S.	Oral

M. van noort

Non-equilibrium hydrogen ionization in the solar atmosphere

In the solar atmosphere, the assumption of local thermodynamic equilibrium is well known to be invalid. Further, the assumption of statistical equilibrium is not true in general. In such cases, energy transport calculations must include all time-dependent terms and the level-population evolution must be treated explicitly. Here we discuss this problem of non-equilibrium ionization in the solar chromosphere, for the particular case of hydrogen.

ASI2017_566	Krishnendu Mandal	Oral

Samrat Halder, Jishnu Bhattacharya, Shravan Hanasoge

Computation of 3d spherical kernel for the understanding of meridional circulation

Understanding the Meridional circulation in the Sun is utmost importance for the modelling of solar dynamo process. Though meridional circulation was detected on the solar surface, still there are following few aspects of meridional circulation that are not well understood 1) whether a single flow spans the whole depth of convection zone or there are multiple cells stacked on top of each other, 2)the depth at which equatorward flow returns i.e whether meridional cir- culation is shallow or deep, 3)uncertainty about the speed of the equatorward return flow. To understand all the above mentioned features, we need to do inversion of the solar oscillation data (a method in time distance helioseismology). Compu- tations of the kernels is important for doing the inversion. Till now, people have used ray kernels for the inversion. Results obtained by this method is doubtfull because ray approximations is not a good approximation for solar 5 min. oscilla- tion. Understanding the limitation of the ray kernel, we have computed kernels using wave theory. We have used first order Born approximation to compute the kernels and tested it with the analytical value. Our next goal is to use this kernel for the inversion of the solar oscillations data. In this meeting, I shall present about our work in which we have computed the spherical 3d kernels and how it will help to infer about the features of the meridional circulation.

ASI2017_1230	Rajashik Tarafder	Oral

Rajashik Tarafder (1,2) Dibyendu Nandy (1,2) 1.Center of Excellence in Space Sciences India 2.Department of Physical Sciences Indian Institute of Science Education and Research, Kolkata

A Mathematical Model for Solar and Anthropogenic Forcing of Global Climate

The Sun’s radiative energy output is the primary external, natural driver of the Earth’s climate. Several complicated non-linear models exist which model the physical processes leading to global climate fluctuations. Some of the more advanced models use observed data to constrain various parameters involved. However, the exact processes that affect the globally averaged temperature variations are not well understood fully physically. We develop a physically motivated reduced climate model utilizing a novel mathematical formulation involving non-linear delay differential equations to study temperature fluctuations when subjected to an imposed solar radiative forcing. This study may provide pathways for understanding the response of the global climate to a combination of relevant, external and internal factors.

ASI2017_1166	Abhishek Kumar	Oral

Abhishek Kumar and Mahendra K. Verma, Department of Physics, IIT Kanpur

Energy spectrum for buoyancy-driven turbulence

Gravity or buoyancy plays an important role in astrophysical flows. The flow is destabilized when heavier or colder fluid is on top of a lighter or hotter fluid, often seen in thermal convection. Convection plays a significant role in interiors of many planets and stars, and it is one of the mechanisms for the generation of a magnetic field. Conversely, the flow is stabilized when a lighter fluid sits on top of a heavier fluid, for example, in Earth's atmosphere. An important unsolved problem in this field is how to quantify the spectra and fluxes of kinetic energy and potential energy, respectively, of buoyancy-driven flows. According to Kolmogorov, for hydrodynamic turbulence, a constant energy flux flows across the intermediate length scales, called the inertial range, of the system. However, for stably stratified flows, Bolgiano and Obukhov conjectured that buoyancy will convert the kinetic energy (KE) to the potential energy (PE) at all scales, thus making the kinetic energy flux in the inertial range a decreasing function of wavenumber. Further, Procaccia and Zeitak and L'vov and Falkovich proposed that the Bolgiano and Obukhov scaling of stably stratified flows would also be applicable to the turbulent convection. Using high-resolution direct numerical simulations (DNS) and arguments based on the kinetic energy flux [1,2], we demonstrate that the Rayleigh-Benard convection, an idealized model of thermal convection, follows Kolmogorov's spectrum. We show that the kinetic energy flux increases briefly, and then becomes constant due to a delicate balance of dissipation and energy supply rate. Due to the constancy of energy flux, the turbulent RBC exhibits Kolmogorov's spectrum rather than Bolgiano and Obukhov's spectrum. We performed the aforementioned simulation for the extreme Rayleigh number approximately 10^{11} in a closed cubical box of 4096^3 grid [3]. We also performed DNS for the stably stratified turbulence at moderate stratification and exhibited Bolgiano-Obukhov spectrum with k^{-4/5} scaling for the KE flux. Further, we constructed a unified shell-model for buoyancy-driven turbulence, which yields similar results as obtained from DNS, albeit at extreme parameters [4]. References: [1] A. Kumar, A. G. Chatterjee, and M. K. Verma. Energy spectrum of buoyancy- driven turbulence. Phys. Rev. E, 90:023016, 2014. [2] M. K. Verma, A. Kumar, and A. G. Chatterjee. Energy spectrum and flux of buoyancy-driven turbulence. Physics Focus, AAPPS Bulletin, 25, 2015. [3] M. K. Verma, A. Kumar, and A. Pandey, Phenomenology of buoyancy-driven turbulence: recent results, Under review in New Journal of Physics, (2016). [4] A. Kumar and M. K. Verma. Shell model for buoyancy-driven turbulence. Phys. Rev. E, 91:043014, 2015.

ASI-2017 Parallel Session - Tuesday, 7 March, 2017

Time: 16.30 - 18.00 Venue: Hall B

Stars, ISM and the Galaxy– 2 [Chairperson: Eswar Reddy]

ASI2017_933	Manoj Puravankara	Oral

D. Neufeld (Johns Hopkins, USA), S. T. Megeath (Univ. of Toledo, USA) D. M. Watson (Univ. of Rochester, USA), B. Gonzalez (ESAC, Spain), R. Vavrek (ESAC, Spain) and the HOPS team

Underabunadance of water behind interstellar shocks: Implications for the oxygen budget of the ISM

We detected, for the first time, a jet in the far-IR [OI] lines from an intermediate mass protostar FIR 3 in the OMC-2 region. The jet line luminosity and implied mass loss rate are a factor of 10 higher than those found for low mass protostars, indicating that intermediate mass protostars drive more powerful jets than their low mass counterparts. We further analysed the far-IR water line emission from protostars, which is thought to arise from shock heated gas in protostellar outflows. In the postshock gas behind shocks, the water vapour abundances are expected to be considerably enhanced compared to those in cold molecular gas. Our results, however, indicate that the water abundances in shock heated gas in protostars are significantly lower (by a factor of 3) than those predicted by theoretical models. The "underabundance" of water behind protostellar outflow shocks has important implications for the total oxygen budget of the ISM.

ASI2017_708	Amit Pathak	Oral

M. Buragohain(1), P.J. Sarre(2), T. Onaka3, I. Sakon(3) 1-Department of Physics, Tezpur University, Tezpur 784 028, India 2-School of Chemistry, The University of Nottingham, University Park, Nottingham NG7 2RD, UK 3-Department of Astronomy, Graduate School of Science, The University of Tokyo, Tokyo 113-0033, Japan

The Deuterium abundance in astrophysical PAHs

The presence of polycyclic aromatic hydrocarbon (PAH) molecules in the interstellar medium (ISM) of the Milky Way and external galaxies is confirmed by the observation of emission features at 3.3, 6.2, 7.7, 8.6 and 11.2 μm popularly known as the aromatic infrared bands (AIBs) (Tielens et al. 2008). Astronomers suggest that about 10% - 15% of the interstellar carbon budget is within PAHs. Apart from the pure PAHs, substituted PAHs play an important role in interstellar chemistry. PAHs might host significant fraction of elements other than carbon and hydrogen. Deuterium is an important interstellar component that may be added to PAHs by direct association or by replacing one of the H atom. ISO observations show that C – D stretching in deuterated PAHs (PADs) gives rise to the 4.4 and 4.65 μm features (Peeters et al. 2004). Further, PADs have also been incorporated in a deuterium depletion model to account for the missing Deuterium (Draine 2006). AKARI observations do show similar features but suggest a smaller fraction of deuterium within PAHs (Onaka et al. 2014) . We present theoretical infrared spectra of deuterated and deuteronated interstellar PAHs (DPAH+) (Buragohain et al. 2015, Buragohain et al. 2016). A deuteronated PAH (DPAH+) is a PAH with one deuteron (D+) added. The site where the D+ is added becomes aliphatic in nature. We discuss the D/H ratio and

compare it to the observation estimates. A detailed analysis of the IR spectra of these molecules is presented and discussed in context of possible astrophysical implications. Possible mechanisms for the formation of deuteronated PAHs are also discussed.

ASI2017_1306	Piyali Saha	Oral

Piyali Saha (ARIES), A. Soam (KASI), Neha S. (ARIES), Maheswar G. (ARIES), Manoj P. (TIFR)

Polarimetric and Spectroscopic Study of L1616

The Lynds cloud L1616 is located at an angular distance of about 6 degree west of the Orion OB1 associations, in the galactic coordinate l = 203.5384 degree, b = - 24.6870 degree roughly in the east-west direction. This cloud, placed at a distance of ~ 450 pc, shows a clear head-tail morphology. The presence of highly massive stars in the Orion belt is supposed to be responsible for its cometary shape. We carried out optical polarimetry of the cometary globule L1616 to map the ambient magnetic field geometry. The contribution of foreground material in polarization was removed from the observed polarization results by doing polarimetry of a number of foreground stars inferred from their distances measured by the Hipparcos satellite. The plane-of-sky magnetic field lines are found to be randomly oriented. Optical and NIR broadband spectroscopy also have been done for YSOs around L1616. Based on the polarimetric results we can conclude that magnetic field strength in L1616 is very small and this cometary globule is fragmenting. We also present spectral type of YSOs from spectroscopic study.

ASI2017_1145	Swagat Ranjan Das	Oral

Anandmayee Tej, Sarita Vig (Indian Institute of Space Science and Technology, Trivandrum 695547, India)
Swarna K. Ghosh, Ishwara Chandra C. H. (National Centre For Radio Astrophysics, Pune 411007, India)

Star formation associated with infrared bubbles

Infrared (IR) bubbles are the outcome of expanding HII regions into surrounding interstellar medium (ISM) around massive stars. These are driven by thermal pressure, stellar wind, radiation pressure or a combination of these feedback mechanisms. IR bubbles bubbles show interesting morphologies and are bright in the mid-infrared (MIR) wavebands because of the excitation of the polycyclic aromatic hydrocarbon (PAH) molecules by UV photons. Apart from enabling us to probe high-mass star formation, they also help us understand triggered star formation in the swept up shells. Multiwavelength studies of these bubbles have the potential to investigate the physical characteristics of the associated gas and dust and the ongoing star formation activity. In this talk, I will present an observational study of a sample of bubbles from infrared through radio wavelengths. Observations with GMRT is complimented with archival near, mid and far infrared data for this study.

ASI2017_951	Siddhartha Gupta	Oral

Siddhartha Gupta(1,2), Biman B. Nath(1), Prateek Sharma(2) (1) Raman Research Institute, Bangalore, India (2) Indian Institute of Science, Bangalore, India

Lack of thermal energy in superbubbles : hint of cosmic rays ?

The observed X-ray temperature and the thermal pressure of the hot (>10^5 K) gas behind the shock, driven by OB associations, are found to be less than that expected from the theory. With the help of hydrodynamical simulations, we show that the expected thermal pressure is ~0.8 \rho_{amb} v_{sh}^2$ independent of the radiative energy loss and the ambient density profile where v_{sh} is the shock velocity and \rho_{amb} is the ambient density. We suggest that the absence of the hard X-ray (>1 keV) component and the shortfall of the thermal pressure both can be explained if a significant fraction (~0.5) of the thermal energy goes to the non-thermal particles such as cosmic rays.

ASI2017_715	Somnath Dutta	Oral

Soumen Mondal, S.N. Bose National Centre for Basic Sciences, Kolkata 700106, India Jessy Jose, Kavli Institute for Astronomy and Astrophysics, Peking University, Yi He Yuan Lu 5, Haidian District, Beijing 100871, China Ramkrishna Das S.N. Bose National Centre for Basic Sciences, Kolkata 700106, India

Stellar population and the star formation histories of distant Galactic HII regions NGC 2282 and Sh 2-149 Complex

In spite of profound influence on their host galaxies, the formation and evolution of massive stars are not well understood. HII regions are low-density cloud of ionized gas excited by UV radiation from massive stars (e.g. O and early B-type). Galactic HII regions containing massive stars provide the best platform to understand both high- and low-mass star formations. The massive stars within HII regions furnish its neighborhood in the form of their strong stellar winds, energetic radiation and eventually supernova explosion. Understanding the interaction between the massive stars and surrounding dense molecular gas is important for characterizing triggered star formation. We studied the stellar contents and star formation activities of a few distant Galactic HII regions (e.g. NGC 2282, Sh2-149) using deep optical, near-infrared, mid-infrared data sets and 12CO(2-1) molecular line observations. From optical spectroscopic analysis of 8 bright sources in NGC 2282, we have classified three early B-type members including a new Herbig Ae/Be star. Using IR color-color (CC) criteria and Hα-emission properties, we have identified more than 150 candidate young stellar objects (YSOs), of which, 50% are classified as Class II, 6% are Class I YSOs. From time series CCD photometry at I-band (~ 20.5 mag) on NGC 2282, a total of 65 stars were found as photometric variable, and majority of them are PMS. The morphology of the region has been studied from spatial distribution of YSOs, stellar density distribution, signature of dust in various optical-infrared images along with the K-band extinction map. From our studies on Sh2-149 complex, we have identified few optically bright ionizing sources, and their spectral types are estimated to be massive O7-B0 V using the optical spectra. We detected several infrared excess stars from NIR and IRAC CC diagrams. These YSOs are spatially distributed along the dust ridge, which indicates that the region is an active star formation site. The morphology from 12CO(1-0) map identifies various clumps including a stream line flow towards South-West. Mid-IR dust structure suggests that millimeter contours encompass two filamentary structures, one towards West and another towards East, which is an ionized boundary layer associated with Sh2-152. The core region of Sh2-149 is extended towards South-East, which is

associated to 2MASX J22555978+5814424 via an ionized layer. The morphology and spatial agreement among millimeter-IR observations, distribution of YSOs and ionizing stars indicate that the star-formation activity observed at filaments is probably a tentative example of triggered star formation. Our overall analysis suggests that the star formation occurs at the locations of the denser gas, and associate massive members particularly in Sh2-149, might be possible causes of the triggered star formation on its surrounding molecular medium.

ASI-2017 Parallel Session - Tuesday, 7 March, 2017

Time: 16.30 - 18.00 Venue: Hall C

Extragalactic Astronomy – 2 [Chairperson: Suchetana Chatterjee]

ASI2017_936	Preeti Kharb	Invited

Prajval Shastri (IIA), S7 Team

Low Frequency Radio Observations of Radio-Weak Seyfert Galaxies

I will discuss the results from our multi-(low-)frequency study of a large sample of Seyfert galaxies. These observations have been carried out with the GMRT and the VLA. They reveal kiloparsec-scale radio structures (KSRs) in a vast majority of them, in contrast to previous observations in the literature typically carried out at high frequencies. However, the contamination from the host galaxy disk emission also increases at the lower frequencies of observation, making it more difficult to disentangle the AGN and star-formation contributions to the radio. I will discuss some of the successes and shortcomings of low frequency observations of radio-weak Seyfert galaxies.

ASI2017_784	C S Stalin	Oral

S. Stalin Suvendu Rakshit Indian Institute of Astrophysics

Narrow Line Seyfert 1 galaxies

Narrow Line Seyfert 1 (NLSy1) galaxies were identified as a new class of active galactic nuclei (AGN) by Osterbrock and his collaborators in the year 1985. Since then the number of NLSy1 galaxies has gradually increased and the last homogeneous catalog of NLSy1 galaxies was from SDSS-DR3 that resulted in 2011 NLSy1 galaxies. The interest in the study of NLSy1 galaxies has increased recently due to the detection of gamma ray emission in about half a dozen sources by the Fermi gamma-ray space telescope. This detection of gamma-rays in some NLSy1 galaxies indicate that they do have relativistic jets similar to blazars. Recent multi-band SED modeling results indicate that they resemble flat spectrum radio quasars. To augment the number of NLSy1 galaxies known as of today we have carried out a systematic analysis of sources classified as QSOs in SDSS-DR12. Our systematic study has yielded a new sample of about 11,000 sources, a factor of five

increase from what is known today. Cross-correlating these new NLSy1 galaxies with the FIRST radio survey we found that only about 5% of NLSy1 galaxies are radio-loud. This is much lower than the 15% of radio-loud sources we know in quasars. Long-term optical variability study of this new sample of NLSy1 galaxies, using data that spans over 10 years, indicates that they show less variation compared to their broad line counterparts. Further details of this work will be discussed.

ASI2017_1211	Sravani Vaddi	Oral

Preeti. Kharb (NCRA-TIFR), Ruth. Daly (Penn State University), C. P. O'Dea (University of Manitoba), S. A. Baum (University of Manitoba)

Black hole spins of radio loud quasars

Black holes are defined by two simple yet important parameters - mass and spin. While BH mass has been determined effectively, determining the black hole spin has been much more difficult. Black hole spins leave important clues about the growth of black hole over time and give implications on the merger and accretion history of a galaxy. We focus on measuring the spins of black holes in 11 quasars that have classical double lobe morphology. The radio properties can be used to estimate the beam power channelled through a large scale outflow. Together with the BH mass, the beam power can be used to estimate the black hole spin. We studied 11 FRII radio loud quasars using EVLA at 1.4GHz and 5 GHz in matched array configuration. We present preliminary results from EVLA observations of this quasar sample.

ASI2017_1372	Debbijoy Bhattacharya	Oral

Krishna Mohana A, MCNS, Manipal University Sanna Gulati, MCNS, Manipal University, Subir Bhattacharyya, Astrophysical Division, BARC, Nilay Bhatt, Astrophysical Division, BARC, P. Sreekumar, IIA, C. S. Stalin, IIA

Unusual long term low activity states of EGRET Blazars in the Fermi Era

We examine the long term (nearly 10 years) gamma-ray variability of blazars observed by EGRET and Fermi and find that 10 EGRET-detected flat spectrum radio quasars (FSRQs) were not present in any of the Fermi catalogue (during the first four years of Fermi observation). A search for the Fermi counterparts of these sources was carried out using seven years of Fermi data which showed that five of these sources are at their low states during the Fermi era. This result indicates that FSRQs exhibit long term quiescent state (more than 7 years) and suggests a jet inactive state probably because of decrease in jet fuelling and/or reduction in soft photon density. Apart from limited X-ray observations for one source, other sources were not monitored at other wavelengths. These low gamma-ray states might be due to the slow variations in accretion power in the source. This change in the accretion power in these sources indicates a possible change of state in the accretion flow as observed in black hole X-ray binaries. Also, 37 new gamma-ray sources are detected during the course of this analysis. Since that most of the EGRET and Fermi sources belong to the AGN class, majority of these new sources are expected to be associated with AGN.

ASI-2017 Parallel Session - Tuesday, 7 March, 2017

Time: 16.30 - 18.00 Venue: Hall D

Instrumentation and Techniques – 1 [Chairperson: Santosh Vadawale]

ASI2017_1365	Rekhesh Mohan	Oral

Rekhesh Mohan (IIA), Prajwel Joseph (IIA), N. Sindhu (VIT University), Annapurni Subramaniam (IIA), C. Stalin (IIA)

Observing with UVIT: Software Tools to plan your observations

Ultraviolet imaging telescope (UVIT), onboard ASTROSAT, consists of two 38-cm telescopes providing three channels for imaging the sky at an angular resolution of 1 to 1.5 arc sec over a field of 28 arc minutes. The Payload Operation Centre (POC) for UVIT is operational at the Indian Institute of Astrophysics. Here we present an overview of the software tools available at the POC website. These tools have been developed to assist the scientific community in planning their observations using the UVIT.

ASI2017_444	Mithun N P S	Oral

S. V. Vadawale (PRL), T. Chattopadhyay (PRL, Penn State Univ.), A. R. Rao (TIFR), D. Bhattacharya (IUCAA), A. Vibhute (IUCAA), V. B. Bhalerao (IUCAA), S. Sreekumar (VSSC)

In-flight Spectral Calibration of AstroSat CZT Imager

Cadmium Zinc Telluride Imager (CZTI) on-board AstroSat is an imaging and spectroscopic instrument in the hard X-ray energy range of 20-200 keV. In CZTI, an array of pixellated CZT detector modules constitute the detecting element and coded aperture mask is employed for imaging as well as for simultaneous background measurement for spectroscopy. Extensive ground calibration was done to characterize the instrument response prior to the launch. Here we present the methodology employed in spectral extraction and response generation and the improvements in various aspects of the instrument spectral calibration using in-flight calibration observations. In CZTI, background subtracted source spectrum is obtained by using mask-weighting algorithm suitably adapted for peculiarities of the instrument like unequal pixel area. The mask-weighting method is very sensitive to source location relative to mask and detectors, hence we make use of this to measure the alignment of coded-mask with respect to the detector plane with multiple observations of bright sources like Crab. Background subtraction by mask-weighting is dependent on measurement of non-uniformity of background counts in the detector plane and multiple blank sky observations are used to obtain this. Detector gain is continuously monitored using on-board calibration source and these spectra are used to fine tune the pixel wise gain correction factors which were determined from ground calibration. After incorporating these improvements in response, crab spectrum was fitted with canonical power law model to verify the response matrix. Further deviations were empirically modeled to arrive at effective area correction factors for each quadrant of CZTI.

ASI2017_743	Ajay Vibhute	Oral
Ajay Vibhute, Dipankar Bhattacharya on behalf of CZTI team		
ASTROSAT CZTI IMAGE ANALYSIS		
India's first dedicated satellite Astrosat carries on board a hard X-ray payload Cadmium Zinc Telluride Imager (CZTI), which operates in the energy range 10 keV to 100 keV. The science objectives of the CZTI include hard X-ray Imaging, determination of spectral and thermal behaviour of Active Galactic Nuclei and X-ray binary systems as well as the detection of gamma ray bursts and the study of their early light curves. CZTI is also capable of measuring hard X-ray polarisation. CZTI uses an indirect imaging technique called "Coded Mask Imaging" for the imaging purpose. Detailed analysis of performance verification data has been used to quantify the relative shifts between the mask and the detector in each individual quadrant. Corrections for this have been incorporated in the data analysis software. The methods of imaging employed and the results from the PV phase data are highlighted in this poster.		

ASI2017_584	Srikanth Panini Singam	Oral
Dr.P.Sreekumar(IIA),Dr. K.C.Shyama Narendranath(ISRO), Dr.P.S.Athiray(UM), Dr.H.L.Marshall(MIT)		
Development of multilayer mirror based soft X-ray polarimeter		
X-ray polarimetry is one of the last observing windows that has been poorly explored. The difficulty is mainly due the lack of polarizing detecting elements at X-ray regime. Multilayer mirrors can operated at Brewster's angle whose reflectivity is a function of the polarization state of the incident X-ray. Polarimeter using multilayer mirrors are sensitive to very soft X-ray with lower cutoff energy as low as 0.2 keV where no other technique is efficient. Design of a soft X-ray polarimeter is made with broad band sensitivity from 0.2 keV to 0.8 keV. Modulation index of the instrument over entire range is over 0.95. Design aspects of the instrument, effective area estimation and the poarization detection sensitivity will be presented. Initial results of soft X-ray reflectivity of the multilayer mirror at Brewster's angle will also be presented.		

ASI2017_1328	Prashant Kumar	Oral

Prashant Kumar (PRL,Ahmedabad), Arpit R Patel (PRL,Ahmedabad), Hitesh L Adalja (PRL,Ahmedabad), Pranav R Adhyaru (PRL,Ahmedabad), S B Banerjee (PRL,Ahmedabad), M Shanmugam (PRL,Ahmedabad), Tinkal Ladiya (PRL,Ahmedabad), M B Dadhania (PRL,Ahmedabad), K P Subramanian (PRL,Ahmedabad), Bhas Bapat (IISER, Pune), P Janardhan (PRL,Ahmedabad), D Chakrabarty (PRL,Ahmedabad), Aveek Sarkar (PRL,Ahmedabad), Santosh V Vadawale (PRL,Ahmedabad), S K Goyal (PRL,Ahmedabad), Neeraj K Tiwari (PRL,Ahmedabad), A K Hait (SAC, Ahmedabad), R Bhavsar (SAC, Ahmedabad), M Chauhan (SAC, Ahmedabad)

Solar Wind Ion Spectrometer (SWIS) on-board Aditya-L1 Mission

ASPEX is one of the six payloads selected for the upcoming Aditya-L1 mission. The objective of this payload is to carry out systematic and continuous in-situ measurement of particle fluxes over an energy range from 100 eV to 5 MeV from the L1 point of the Sun-Earth system. SWIS is a sub-system of this payload and is primarily meant to measure ions in the energy range of 100 eV—20 keV. The main scientific objectives of SWIS are to understand the origin of supra-thermal ions, to study thermal anisotropy, to detect arrival of CME's at L1 by providing a "compositional flag" and to understand the solar wind turbulence. To accomplish the above stated objectives, observational requirement demands FOV coverage of 2π in the plane of ecliptic as well as across this plane. To suit this requirement, two top hat energy analysers (THA) will be used in SWIS. The first analyser (THA-1) will scan ions coming in the ecliptic plane and has the capability to measure angular, energy and mass distributions simultaneously in the required energy range. In this analyser, a magnetic mass separator, consisting of 16 thin permanent magnets, is used to differentiate masses of ions arriving on the detector. The second analyser (THA-2) has the acceptance plane perpendicular to the ecliptic. THA-2 only measures the energy and angular distribution of the incoming ions. The detector in both these analysers consists of chevron MCP pair followed by a position sensitive detector. The design parameters for electrostatic part (ESA) in both the analysers were optimised based on ion trajectory simulations performed in SIMION. The instrument response for both the analysers was studied and an energy resolution of 10% is obtained. An in-house developed MATLAB code was used to understand the field pattern of the magnetic mass analyser (MMA). This helped in deciding various design parameters for the MMA and also in estimating magnetic field leakages due to MMA. To verify the simulation results, experiments on a similar instrument were conducted in lab using a Nier type ion source and position sensitive anode made from PCB with metallic tracks. The analyser response and the magnetic deflection values were obtained for ions of different mass which includes H2+, He+, Ar+ and Ne+ at 2keV energy. These values show good agreement with the simulated ones. Presently, the payload is at PDR stage and an engineering model is expected by mid of 2017.

Wednesday, March 8, 2017

ASI - 2017 Plenary Session

ASTROSAT [Chairperson: S. Seetha]

Time: 9.30 - 11.00 Venue: Auditorium

ASI2017_742	Annapurni Subramaniam	Plenary

IIA, Bangalore

Early Science results from the Ultra-Violet Imaging Telescope

The UVIT started observations on 30th November 2015 and has been obtaining data since then. Several Science targets have been observed so far, including the demostrative observations carried out during the Performance verification phase. The first science paper from the UVIT presented the discovery of a possible post-AGB companion to a Blue Straggler star in the open cluster NGC 188. Several studies are starting to produce interesting results on topics ranging from Globular Clusters, Galaxy Clusters, Planetary Nebulae and AGN. I plan to present some of the science results which highlight the resolution, spectral sampling and timing capability of the UVIT.

ASI2017_853	Ranjeev Misra	Plenary

IUCAA

ASTROSAT: A New Era for Rapid X-ray Timing Studies

From 1995 till 2011, the Rossi X-ray timing experiment (RXTE) revolutionized our understanding of the rapid time variability of X-ray binaries. A host of amazing phenomena were discovered such as Quasi-Periodic Oscillations (QPOs) ranging from a few Hz to kHz, Burst Oscillations, and broad band variability. These phenomena originate close to the black hole or neutron star and hence are linked to their strong gravity described by General Relativity. With the successful launch of ASTROSAT the field has entered into a new era. ASTROSAT/LAXPC has a larger effective area at energies > 20 keV than RXTE, and unlike RXTE generates event mode data for all observations. Moreover, the multi-wavelength capability of ASTROSAT allows for the first time to obtain broad band spectrum at the time when the rapid timing phenomena are observed. The talk will discuss these capabilities and indicate how with ASTROSAT one can do sophisticated analysis such as energy dependent temporal studies and time/frequency resolved spectroscopy which will open up new ways to unravel the enigmatic nature of X-ray binaries.

ASI2017_1031	Santosh Vadawale	Plenary

Physical Research Laboratory

Hard X-ray Polarimetry with AstroSat CZTI

The Cadmium Zinc Telluride Imager (CZTI) is a wide-field coded aperture mask instrument on AstroSat, sensitive to photons from 20 keV to over 150 keV. It is primarily designed for simultaneous hard X-ray imaging and spectroscopy of a variety of celestial X-ray sources such as, black hole binaries, neutron star binaries, pulsars, AGNs and GRBs. The detector plane of CZTI consists of a large array of pixilated CZT detectors with total 16384 pixels, each having size of 2.5 × 2.5 mm2 and thickness of 5 mm. The larger thickness and the fine pixilated nature of the detector plane of CZTI is also helpful in extending useful energy range to ~250 keV as well as to measure polarization in hard X-rays, by identifying the X-ray photons interacting by means of Compton scattering. As an added advantage of the extended energy range, CZTI is also sensitive to hard X-ray transients like gamma-ray bursts. CZTI has been operating successfully since the launch of AstroSat and has detected many bright X-ray sources. Apart from the regular imaging and spectroscopic measurements, CZTI has successfully measured hard X-ray polarization in a few sources including the standard candle source, the Crab nebula; a black hole binary Cygnus X-1 and a number of gamma-ray bursts. Here I will present the early results of the hard X-ray polarization measurements with the AstroSat CZTI carried out with observations during the performance verification phase and guaranteed time observations.

ASI2017_869	Gulab Dewangan	Plenary

IUCAA, Pune

AstroSat status and science support

AstroSat, India's first multiwavelength space mission, is operating in space for more than a year now. It carries four co-aligned payloads and an X-ray sky monitor, covering optical/UV to hard X-rays. I will briefly describe the capabilities and status of the instruments, available software and tools. AstroSat is a proposal-driven observatory, and is available to the astronomy community in India. I will describe the proposal-driven operation of AstroSat, current usage statistics, and the support available from the AstroSat Science Support Cell to the user community.

ASI-2017 Parallel Session - Wednesday, 8 March, 2017

Time: 11:30 - 13:00 Venue: Hall A

Sun and the Solar System – 3 [Chairperson: Nandita Srivastava]

ASI2017_916	Bhavesh Jaiswal	Oral

V. Sheel (PRL, Ahmedabad), A. Nandi (ISAC, Bangalore), M. Sudhakar (ISAC, Bangalore), K. Sankarasubramanian (ISAC, Bangalore), P. Agrawal (ISAC, Bangalore)

Spectro-polarimetry of the limb of the Martian atmosphere: simulations based on a radiative transfer model

Vertical distribution of water vapour and aerosols (H2O ice, CO2 ice and dust) is crucial for the understanding of cloud formation processes in the atmosphere of Mars. We aim to do simultaneous measurements of water vapour and dust and cloud particles in the limb of the atmosphere of Mars. A radiative transfer model is developed to simulate the processes of absorption and Mie scattering in the Martian atmosphere. The sensitivity of the scattered polarization on the size distribution of the scatterer, namely: water ice, CO2 ice and dust is presented in this work. In this context, we have proposed a compact spectro-polarimeter in the near infrared band of 1-1.7 μm for ISRO's 2nd Mars mission.

ASI2017_1216	Naznin R Choudhury	Oral

A. K. Sen Assam University, Silchar, India and R. Botet Laboratoire de Physique des Solides UMR8502, Universit´e Paris-Sud, Universit´e Paris-Saclay, Orsay, France

Study of porous grains and related properties of cometary dust

The study of comets gives us valuable information about the least processed and pristine materials of early solar nebula from which the present day solar system has been evolved. The knowledge of the physical properties of cometary dust comes from the study of scattered light or re-emitted thermal radiation from the dust present in the coma of comet. Cometary dusts are fluffy or porous aggregates with irregular shapes. The light scattering and re-emission properties of porous (fractal) dust can be calculated by various numerical codes such as DDA, T-Matrix, etc. In the present study, the optical properties of such porous dusts, with two different models, have been discussed. One model considers a homogeneous structure made of touching dipoles. The dipoles are randomly removed one by one from a compact structure, such that the remaining structure remains connected. The other model generates dusts with porosity by randomly removing dipoles, without constraining the dipoles to remain connected. To study the effect of porosity, the polarization values at different porosities are calculated using DDSCAT light scattering code, the results obtained for both models are compared. In a separate work, the values of effective refractive indices are obtained from effective medium theory assuming the particle is homogeneous. Then, using Mie results, the differences between DDA and EMT has been discused. Also, the thermal re-emission from cometary dust in terms of composition and size distribution has been discussed.

ASI2017_592	Alok Ranjan Tiwary	Oral

Shibu K. Mathew, (Udaipur Solar Observatory) A. Raja Bayanna (Udaipur Solar Observatory) Rahul Yadav (Udaipur Solar Observatory)

Imaging Spectro-polarimeter for Multi Application Solar Telescope (MAST): Preliminary Results Obtained in the Fe I 617.3 nm and Ca II 854.2 nm.

Multi-Application Solar Telescope (MAST) is an off-axis Gregorian telescope of 50 cm clear aperture situated on an island in the Fateh Sagar lake at Udaipur Solar Observatory (USO). An Imaging Spectro-polarimeter has been developed at USO as a back-end instrument of MAST for measuring the magnetic field in the photosphere and chromospheres at two different heights. The system consists of a narrow-band imager and a polarimeter. Narrow-band imager uses two lithium niobate Fabry-Perot etalons in tandem with a blocking filter for spectral analysis. Polarimeter yields quasi simultaneously the polarization state of light in two magnetically sensitive spectral ranges at 617.3 nm and 854.2 nm. The measurement is performed with two Liquid Crystal Variable retarders (LCVRs), which modulates the incoming polarization. Then the modulated light is transformed into a varying intensity by using a Glan-Thompson polarizers. These intensities can be demodulated to obtain full Stokes vector using an efficient modulation scheme. The instruments has been calibrated for the solar spectral lines Fe I 617.3 nm and Ca II 854.2 nm. In this work, preliminary results obtained in both the above wavelengths will be presented.

ASI2017_1322	Bimal Pande	Oral

Dr. Bimal Pande Dr.Seema Pande, Dr.Neeraj Singh Bankoti, Kumaun University Nainital

Multiwavelength Analysis of a typical prominence with helical twisting associated with a CME

We present the multi wavelength observation of the eruption of a quiescent filament situated at northern hemisphere on 13 June, 2010 due to the activation of helical twist flux tube. The activation of helical flux tube could be the most likely signature of the kink instability that may cause the filament eruption. The event was observed by Mouna Loa Solar Observatory, BBSO, CAO, ARIES, Nainital in Hα, SOHO/EIT, SWAP on board PROBA2, Nobiyama Radio Observatory in 17 GHz and by STEREO A/B. The filament starts to rise slowly (~ 3.5 km/s, the speed of filament goes up to ~75km/s in the acceleration phase), rotates in anticlockwise direction and becomes kink structure which indicates the transfer of twist to writhe . The filament eruption was associated with slow CME (~ 400 km/s) observed by LASCO. There is no signature of flare/reconnection during the eruption. We conclude that the injection of the twist in the magnetic field system causes the eruption of the filament which further triggers the slow CME.

ASI-2017 Parallel Session - Wednesday, 8 March, 2017

Time: 11:30 - 13:00 Venue: Hall B

Stars, ISM and the Galaxy – 3 [Chairperson: Indulekha Kavila]

ASI2017_740	Priya Hasan	Oral

Scott Wolk, CfA, USA Hans Guther, MIT, USA

A tale of two Populations: NGC 281

NGC 281 is a complex region of star formation at 2 kpc with dual modes of star formation. This complex is situated 300 pc above the Galactic plane, and appears to be part of a 270 pc diameter ring of atomic and molecular clouds expanding at 22 km/s (Megeath et al (2003) . It appears that two modes of triggered star formation are at work here: an initial supernova to trigger the ring complex and the initial O stars and the subsequent triggering of low mass star formation by photoevaporation driven molecular core compression. To get a complete census of the Young Stellar Population, we use Chandra ACIS for 100 ksec coupled with data from 2MASS and Spitzer. The Master Xray catalog now has 446 sources, 145 soft, 213 medium, 154 hard, 303 broad. We present an X-ray spectral analysis of the Xray sorces with IR counterparts. We present the Xray luminosity function, its completeness and number of missing sources and their energy and energy distribution. We present the spatial distribution of CI v. CII v. CIII to study the progress of star formation.

ASI2017_1099	Bryan Rithesh Miranda	Oral

Annapurni Subramaniam (Indian Institute of Astrophysics, IIA), Ram Sagar (Indian Institute of Astrophysics, IIA), Vijayakumar H. Doddamani (Bangalore University)

Detecting UV bright stellar population in Open Cluster Remnants

In this paper we present the Ultra Violet (UV) Photometric Study of four candidate Open Star Cluster Remnants(OCRs) NGC 7772, NGC 7036, NGC 6994 and NGC 1252. The existing GALEX photometric data in the UV region are used in the present study. The distance of these clusters is within 1.5 kpc while their ages are of the order of a few Gyrs. They have a minimum exposure time of ∼1 hour for NGC 7772 and a maximum exposure time of ∼ 5 hours for NGC 7036. For our analysis, we have used the Flexible Stellar Population Synthesis (FSPS) models (Conroy C., Gunn J. E., White M., 2009) which have isochrones with the WD sequence and have generated the Colour Magnitude Diagrams (CMDs) for both the Optical and UV bands. The multi-wavelength study of these OCR candidates from the Optical to the UV region suggests that they may have a few young White Dwarfs (WDs), Blue Stragglers, and Main-Sequence + WD binaries . The UV bright population detected in these clusters support that these clusters are OCRs and are consistent with the expected left-over stellar population in an OCR.

ASI2017_582	Neelam Panwar	Oral
A. K. Pandey (ARIES, Nainital)		
Stellar content and mass function of the cluster Be 59 towards the low-mass end		
One of the most important problems in star formation is understanding the origin of the stellar initial mass function (IMF). However, the functional form and the universality of the IMF at a very low-mass regime are still open questions. Berkeley 59 (Be 59), a young cluster at the distance of ~1 kpc, is located at the centre of OB4 stellar association and associated with the Sh2-171 HII region. We study the young stellar content, star formation history and IMF of the cluster towards low-mass end. The deep V and I band observations of the cluster Be 59 with 3.6-m Telescopio Nazionale Galileo are complemented with infra red data from 2MASS, Spitzer/IRAC and WISE. The V/(V-I) colour magnitude diagram manifests a clear pre-main-sequence (PMS) population down to V ~24 (0.2 M⊙).		

ASI2017_1240	Sindhu N	Oral
Annapurni Subramaniam (Indian Institute of Astrophysics, Bangalore), C Anu Radha(VIT University, Vellore)		
How hot are Blue Stragglers?		
The Ultraviolet (UV) studies are crucial in understanding the hotter stellar populations in star clusters. Blue stragglers (BSS) are stars in the clusters which are not well understood since it flouts the standard evolutionary tracks. Previous studies of the BSS have shown that they emit a significant flux in the UV domain (Landsman et al .1998). We analyse the BSS in two old open clusters; M67 and NGC 188. BSS are the brightest and hotter than the main sequence stars in the UV colour-magnitude diagram (CMD). The UV CMDs of two open clusters are constructed using far-UV (FUV) and near –UV (NUV) photometry of Galaxy evolution explorer (GALEX) GR6/GR7 archival data. From the analysis of UV CMD of the clusters, it is observed that BSS dominate flux in both FUV and NUV bands. 24 BSS of NGC 188 and 17 BSS of M67 are detected in GALEX. We estimate the effective temperature of all BSS by constructing the Spectral energy distribution (SED) using VOSED tool and probe for possible binary companions of BSS.		

ASI2017_705	Snehalata Sahu	Oral
Annapurni Subramaniam Indian Institute of Astrophysics		
UVIT Imaging of the globular cluster NGC 288		

NGC 288 is a low density globular cluster located close to the Southern Galactic pole. It has a blue horizontal branch (HB) and also it is known to have the highest specific frequency of Blue Straggler Stars (BSS). Studying the HB and BSS is very useful in UV as they stand out from the cooler Main-Sequence and red giant stars. The UV properties of these populations is still not well known. We present the UVIT observations of NGC 288 in filters (F148W, F169M and N279N) with fairly large exposure times. We have performed crowded-field photometry on the UVIT images and created the UVIT Color-Magnitude Diagrams. We have fitted the CMDs with the isochrones generated for UVIT filters using the Flexible Stellar Population Synthesis (FSPS) model and derived the properties of different stellar populations in the cluster. We have identified different evolutionary sequences in the UVIT CMDs and compared it with GALEX CMDs, thus, showing the advantages of UVIT over GALEX.

ASI-2017 Parallel Session - Wednesday, 8 March, 2017

Time: 11:30 - 13:00 Venue: Hall C

Extragalactic Astronomy – 3 [Chairperson: Preeti Kharb]

ASI2017_1352	Vikram Khaire	Oral
NCRA		
Helium Reionization and Spectral Energy Distribution of Quasars		

We use recently measured He II optical depths to study their implications on the models of helium reionization and He II ionizing radiation background. The radiation with energy > 4 Ryd emitted from quasars ionize He II. The Intensity of this radiation depends on the quasar emissivity and their average spectral energy distribution (SED). Quasar emissivity is obtained through quasar luminosity functions. The average SED of quasars is usually obtained by fitting simple power laws to stacked spectrum of quasars at energy >1 Ryd. Till now, there are no observational detections of the quasar SED at energies > 4Ryd. However, it can be constrained using our cosmological radiative transfer code along with the recent measurements of He II optical depths. We find that for quasar luminosity function obtained in optical surveys, quasar SED prefers power-law index to be -1.8. We find similar conclusions for models that include faint x-ray emitting quasars which have been shown to reionize hydrogen without any contribution from galaxies. Its implications on the spectrum of ionizing background radiation will be discussed.

ASI2017_1146	Sachin P C	Oral

Anand Narayanan, Indian Institute of Space Science & Technology, Thiruvananthapuram Blair D. Savage, The University of Wisconsin-Madison, USA Vikram Khaire, National Centre for Radio Astrophysics, Pune Sowgat Muzahid, The Pennsylvania State University, United States Bart P. Wakker, The University of Wisconsin-Madison, USA

Detection of Two Intervening Ne VIII Absorbers Probing Warm-Hot Gas at z > 0

Physical conditions of IGM in the early universe is dominated by the radiations from the luminous source such as galaxies and AGN. During the formation of structures, significant changes occurred in the ionisation conditions and phase structures of CGM/IGM gas. The low redshift baryonic surveys suggest that a large fraction of these baryons are missing in their most common reservoir such as Lyman alpha forest, cold matter etc. Cosmological hydrodynamic simulations of structure formation agree with this predicts a significant fraction of baryons within temperature 10^5 - 10^6 K which produce only a broad but shallow absorption(BLA). The absorp- tions lines from the highly ionised metal lines such as Ne viii, O VI, Mg X detected in the distant QSO spectra is the proven method to study this region. In this work, we report on the detection of two intervening Ne viii absorbers at z > 0 in the HST/COS spectrum of high redshift quasars. Both the absorbers include higher ionisa- tion lines of O VI, Ne VIII, intermediate lines of C III, N IV, O IV and S IV, but only one of the system has lower ions (C II) detected. A pure photoionization modelling can explain the observed line ratios in the first absorber (with lower ions) except for Ne VIII where the Ne VIII is likely coming from a completely different warm-hot phase of the IGM. In the second absorber (without lower ions), all the lines detected and their ratios are consistent with a single phase hybrid ionisation scenario at temperature T ~ 10^5 K. From the SDSS survey, we detected several galaxies within the vicinity of these absorbers. One of the absorbers detected is within the virial radii of the nearest galaxy could be the gas in the halo of the galaxy whereas the second absorber does not show any galaxy association could be the gas in the circumgalactic region or may be associated with galaxies within the limit of SDSS detection.

ASI2017_891	Kanak Saha	Oral

Prof. Shyam N. Tandon IUCAA

ASTRoSAT/UVIT deep observation of HST/Chandra Deep Field South

We present deep imaging observations of about 615 sq arcmin area of sky in the HST/Chandra Deep Field-South using the Ultra-Violet Imaging Telescope on-board ASTROSAT. Preliminary analysis from these observations reveals better source statistics compared to the currently available UV observations performed by GALEX and Swift/UVOT, primarily due to a factor of 3 higher spatial resolution. We present preliminary results on the UV luminosity function and the most recent star-formation activities taking place in this part of the sky using the far-UV observations.

ASI2017_1391	Konstantinos Kolokythas	Oral

Dr. Ewan O' Sullivan Harvard-Smithsonian CfA, Prof. Somak Raychaudhury, IUCAA

The Complete Local-Volume Groups Sample: Radio properties and feedback implications of galaxy groups in the Local Universe

Much of the evolution of galaxies takes place in groups where feedback has the greatest impact on galaxy formation. By using an optically selected, statistically complete sample of 53 nearby groups (CLoGS), observed at both radio (GMRT) and X-ray (Chandra and XMM-Newton) frequencies, my work aims to characterize the radio-AGN population in groups and examine their impact on the intra-group gas and member galaxies. In this regard, first results from low-frequency GMRT radio images of the nearby (<80 Mpc) central brightest group elliptical from the high richness CLoGS sub-sample are presented at 235 and 610 MHz. Using the sensitivity to older electron populations at 235 MHz and the resolution of 610 MHz as a key to identify past and current AGN activity, I will discuss the properties that central group radio sources present in our sample (radio morphology, spectral index, energetics etc), along with information on the group environment that they lie into, in combination with the radio results with findings from the X-ray observations.

ASI2017_1311	Abhirup Datta	Oral

Prof. Jack Burns
Dr. Eric Hallman
Center for Astrophysics and Space Astronomy, Department of Astrophysical and Planetary Sciences, University of Colorado Boulder, Boulder, CO-80309, USA

Understanding Merger Activities in Galaxy Clusters Using High Fidelity X-ray Temperature Maps and Radio Observations

In the hierarchical structure formation framework, clusters of galaxies are the largest virialized objects in the universe and are ideal laboratories to study astrophysical plasma processes. Clusters are assembled through large and small merger activities which are among the most energetic events in the universe. During mergers cosmological shocks are driven into the intracluster medium (ICM). These shocks heat the ICM which is then detected in the soft X-ray regime through its thermal emission. In addition, these shocks accelerate non-thermal electrons and protons to relativistic speeds. The relativistic electrons have relatively short lifetimes (108 years) and emit synchrotron radiation which is then detected at the radio wavelengths. Steep spectrum radio relics and halos are now recognized as clear signposts of recent mergers. Direct evidence for cluster mergers has also been found from the disturbed X-ray surface brightness of the ICM. X-ray temperatures are very sensitive probes of recent merger or accretion events from the large-scale cosmic web. The understanding of the cluster mergers can be enhanced by combining the X-ray (high fidelity temperature maps) and radio (spectral index maps) observations. In this talk, we present our recent work on two galaxy clusters: Abell 3667 (non cool-core cluster with a cold front and hosting a double radio-relic) and Abell 85 (cool-core cluster hosting a single radio-relic). The high-fidelity X-ray temperature maps allowed us to study the X-ray shocks in the cluster using a new two-dimensional shock-finding algorithm. We will also present some new results from Abell 2744. High fidelity X-ray observations along with high dynamic range spectral index maps from upcoming telescopes like SKA (Square Kilometer Array) hold key to understand the shocks in galaxy cluster mergers.

ASI2017_540	Pooja Bhattacharjee	Oral

Sayan Biswas (Bose Institute, Kolkata, India), Pratik Majumdar (Saha Institute of Nuclear Physics,HBNI, Kolkata, India), Mousumi Das (Indian Institute of Astrophysics, Bengaluru, India), Partha S. Joarder (Bose Institute, Kolkata, India), Pijushpani Bhattacharjee (Saha Institute of Nuclear Physics,HBNI, Kolkata, India)

Searching for signatures of dark matter annihilation from Triangulum II using FERMI gamma ray data

Triangulum II (Tri II) is a recently discovered satellite of Milky Way by Pan-STARRS Survey and it appears to be a small ultra-faint and dark matter (DM) dominated dwarf spheroidal galaxy (dSphs) or globular Cluster on the edge of our galaxy. Its apparent low metallicity, high velocity dispersion and high mass to light ratio of 3600+3500 -2100 makes it a strong candidate for dark matter search. Current high precision data on cosmic microwave background (CMB) has established that non-baryonic form of matter i.e. DM, constitutes around 80% mass density of matter in the Universe. Experimental evidences and theoretical arguments favour the existence of some non-baryonic cold dark matter (CDM) to explain the formation of observed large-scale structures in the Universe. From this CDM scenario, dSphs are possibly the largest galactic substructures and they are ideal sites for indirect search of DM. Weakly interacting massive particles (WIMPs), predicted in several theories beyond the Standard Model (of particle physics), are the most probable candidates for CDM. It is assumed that pair-annihilation (or decay) would also occur in present days that would yield high energy gamma rays. Detection of such high energy gamma rays will provide indirect signature of DM. We here report on the observations of Tri-II with Fermi Gamma-Ray Space Telescope taken during its first (almost) seven years of all sky survey operation mode in the energy range 100 MeV to 50 GeV. No excess γ-ray emission has been detected above 100 MeV from Tri-II. Following this, we calculate the upper limit of gamma-ray flux due to the annihilation of WIMPs in Tri-II and put limits on the pair-annihilation cross section of WIMPs related to various theoretical models which are widely used to explain the nature of DM.

ASI-2017 Parallel Session - Wednesday, 8 March, 2017

Time: 11:30 - 13:00 Venue: Hall D

Instrumentation and Techniques – 2 [Chairperson: P. Sreekumar]

ASI2017_1243	Sagar Godambe	Oral

S. Godambe, N. Mankuzhiyil, J. Hariharan, K. Venugopal,N. Chaouhan, S.Godiyal,K.K.Yadav, S. Kotwal, A.Tolamatti, K.K. Singh, D.Sarkar,A.K. Tickoo, R.C. Rannot, S.S. Sikdar, S.K. Neema, K. Jha, Saju Joy, A. Manna, A. Behere

Performance evaluation of prototype imaging camera for the MACE telescope

21m diameter MACE (Major Atmospheric Cherenkov Experiment) is being setup at a high altitude (4270m asl) astronomical site Hanle. The telescope will deploy a Photo-Multiplier Tube (PMT) based 1088-pixel imaging camera at its focal plane. In-house developed camera has been designed as a modular structure comprising 68 Camera Integrated Modules (CIM), each of which houses 16 PMTs along with signal processing electronics. A prototype camera comprising 4 CIMs (64 pixels) has been developed to characterize the operating parameters e.g high voltage, anode current, single channel rate etc. and evaluate the performance of the imaging camera in terms of stability of these parameters with time and GHz signal digitization using Domino Ring Sampler. The prototype camera has been extensively tested at ECIL, Hyderabad, under simulated light conditions using pulsed and DC LEDs to resemble the Cherenkov pulse and night sky background. The results of the performance evaluation of the 4CIM camera will be presented in this meeting.

ASI2017_1261	Shiv Kumar Goyal	Oral

S. K. Goyal (PRL, Ahmedabad), A. R. Patel (PRL, Ahmedabad), Neeraj K. Tiwari (PRL, Ahmedabad), M. Shanmugam (PRL, Ahmedabad), T. Ladiya (PRL, Ahmedabad), Mithun N. P. S. (PRL, Ahmedabad), S. V. Vadawale (PRL, Ahmedabad), P. Janardhan (PRL, Ahmedabad), D. Chakrabarty (PRL, Ahmedabad), A. Sarkar (PRL, Ahmedabad), Hitesh L. Adalja (PRL, Ahmedabad), A. K. Hait (SAC, Ahmedabad), R. Bhavsar (SAC, Ahmedabad), M. Chauhan (SAC, Ahmedabad), S. B. Banerjee (PRL, Ahmedabad), P. Kumar (PRL, Ahmedabad), K. P. Subramanian (PRL, Ahmedabad), B. Bapat (IISER, Pune), P. R. Adhyaru (PRL, Ahmedabad), and M. B. Dadhania (PRL, Ahmedabad)

Supra Thermal & Energetic Particle Spectrometer (STEPS) - subsystem of ASPEX payload, onboard Aditya-L1 mission

Supra Thermal Energetic Particle Spectrometer (STEPS) is an independent subsystem of the ASPEX experiment. ASPEX (Aditya Solar Wind Particle EXperiment) has been selected as one of the possible experiments onboard the Aditya - L1 mission (forthcoming Indian solar mission), which is to be placed in a halo orbit around the L1 Lagrangian point, lying between the Sun and the Earth at a distance of 1.5 million km from the Earth. Primary objective of the ASPEX experiment is to make in - situ, multi - directional measurements of solar wind supra-thermal and high energy particles. The ASPEX payload has two independent subsystems: SWIS (Solar Wind Ion Spectrometer), which will measure the angular and energy

distributions of Solar wind ions in the energy range of 100 eV to 20 keV using the technique of electro-static analysis (ESA) followed by magnetic separation of particles, while STEPS - the another subsystem will measure the energy spectrum of high energetic particles from six multiple directions, in the energy range of 20 keV/n to 5 MeV/n. The STEPS instrument has been configured into three packages: viz. the STEPS - 1 detector package, the STEPS - 2 detector package and the processing electronics package. The STEPS - 1 detector package has 4 detector units, pointing in 4 different directions: SR (STEPS Radial - pointing towards Sun), SI (STEPS Intermediate - between Sun and Parker Spiral direction), SP (STEPS Parker) and SN (STEPS Northward). In this package: 2 detector units (SR & SP) will provide particle species differentiated (proton and alpha) energy spectra while other 2 detector units (SI & SN) will provide particle species integrated energy spectra. Similarly STEPS - 2 detector package has 2 detector units: SE (STEPS Earthward) and SS (STEPS Southward). SE detector unit will provide species differentiated energy spectra, while SS detector unit will provide species integrated energy spectra. The detector unit of STEPS measuring species differentiated energy spectra, will use custom designed dual window Si detector and plastic Scintillator. Dual window Si detectors are fabricated on a single m and 1.0μpackage with two different thicknesses of dead layers (0.1 m) of high Z material. The Plastic Scintillator (placed below the Siμ detector package) provides a possibility of identifying the particles up to very high energy (~40 MeV) using ΔE-E mode. The detector units of STEPS measuring species integrated spectra will use a standard Si-PIN detector. In this talk, overall configuration of the STEPS subsystem and its salient features will be discussed. Developmental status of the bread - board model with some preliminary results will also be presented.

ASI2017_694	K. Sankarasubramanian	Oral

Mohana Krishna (ISAC), Raja Bayanna (USO/PRL), and Shibu Mathew (USO/PRL)

A Novel Spectroscopic Concept for High Time Cadence Velocity Measurements

High time cadence is one of the requirement for the study of flows in the solar atmosphere e.g., Evershed flows, Inverse Evershed flows, down flows around pores and active regions etc. High cadence flow measurements is also required for local helioseismology with a large enough FOV. At present, the cadence of spectroscopic measurements are limited to the scanning capability (with a good SNR) of a spectrograph or Fabry-Perot based system and is limited to about a minute for a FOV of an arcminute. The scanning mode of operation would also introduce spurious signals in the velocity measurements especially if the observing conditions are not stable. In order to improve on the cadence and minimize the spurious signals, a novel solar spectroscopic concept is developed for the Multi Application Solar Telescope (MAST). The concept combines the advantages of a Fabry-perot system with that of the lenslet arrays to obtain single shot spectroscopy by producing images of the same FOV but with different wavelength tuning. Since it is a single shot spectroscopy, all the information required to form a 3D data cube (x,y,lambda) of a FOV of interest is obtained simultaneously minimizing spurious signals produced by other methods. An optical setup was developed, installed and demonstrated at the back end of the MAST telescope. Preliminary observations of a sunspot (NOAA 12526) at the position angle of S05W23 was observed on Mar 31st 2016. Evershed flow velocity was obtained from this instrument and compared with the regular scanned spectroscopy (using FP with MAST and spectrograph based instrument using Hinode's SOT-SP). The high degree of comparison between them provides confidence that the method works. While the other two measurements are done at a low cadence, this novel method can reach a cadence as high as one 3D data cube in few seconds. The merits and demerits of this method and its potential use for future solar telescopes will be briefed in this paper.

ASI2017_1226	Ritabrata Sarkar	Oral

Sandip K. Chakrabarti, SNBNCBS Kolkata Debashis Bhowmick, ICSP Kolkata Arnab Bhattacharyya, ICSP Kolkata

Low Cost Exploration of Space Using Weather Balloon Borne X-ray Detectors

Indian Centre for Space Physics is using low cost weather balloons for space exploration in X-ray band on a regular basis. We have experience of sending our equipments to near space (about 40 km) more than 100 times in last eight years. With the help of our futuristic technique using miniaturized technology we have been able to send payloads of up to 4 kg weight to obtain atmospheric and space data. The payload consists of various types of X-ray detectors and Geiger counters as the main component and several ancillary equipments and sensors for the mission support. We have acquired data of altitude dependent cosmic rays, solar X-rays, pulsars gamma-ray bursts etc. as well as normal weather related data such as pressure, temperature, wind velocity profiles etc. Our innovative approach makes each mission possible for less than about 30 thousand rupees. Equipments are recovered and reused as they return to earth by parachutes making the mission preparation time to a minimum and mission cost very affordable.

ASI2017_489	Varun Kumar	Oral

Padmakar Singh Parihar, Indian Institute of Astrophysics Bangalore. Athul Nakulan, Christ university Bangalore.

Analysis and design of planar flexible inductor for segment edge sensing in Segmented Mirror Telescopes

Edge sensor is a vital component of any segmented mirror telescope (SMT) and their performances highly depend on the performance of edge sensor. In order to achieve very high spatial resolution (few nanometer) and sensitivity, all mirror segments of SMT's must be precisely positioned with respect to each other to form a single primary mirror. Capacitance-based displacement sensors are widely used for this purpose, but they have inherent sensitivity towards humidity and dust which makes them unsuitable for telescopes installed at high gradient humid regions. Inductance based sensors produce promising results both the cases. Inductive edge sensors work on the principle of mutual inductance variation between two planar inductors. These planar inductors are designed in such way that, once they are mounted on the back of adjacent segment edges, their movement in tip, tilt and piston cause changes in mutual inductance. The nanometer range spatial requirement makes the design of planar inductor quite challenging. The inductive coils are first simulated and analyzed using electromagnetic FEA software for different coil parameters such as geometry of the coil, fixed and variable trace densities, different number of turns in primary and secondary coil etc. The design considerations include number of degree of freedoms to be sensed, required travel range, required spatial resolution and required sensitivity. Based upon the result of simulations, a rectangular planar inductive coil, which gives large sensing range, higher sensitivity, linearity over large range and less cross coupling between various sensing dimensions has been chosen for further evaluation. The coils of the inductive sensor are fabricated on flexible polyimide substrate using classical PCB manufacturing technology which ensures very low weight, thermal stability and it can take the shape of glass block on which it is mounted, this in turn help to improve the linearity of the sensor. The inductive sensor design and development work is being carried out at ITCC laboratory of Indian Institute of Astrophysics. Here we report the design process and current status as well as test results obtained in the laboratory.

ASI-2017 Parallel Session - Wednesday, 8 March, 2017

Time: 14:30 - 16.00 Venue: Hall A

Sun and the Solar System – 4 [Chairperson: Nandita Srivastava]

ASI2017_530	Girjesh R Gupta	Oral

Aveek Sarkar Physical Research Laboratory Ahmadabad, India

Heating and cooling of coronal loop observed during a micro-flare with IRIS, SDO, and XRT

Transient brightenings are small intense brightening found near active region. They last just for few minutes. They can be point-like, or multi-loop in nature. They can reach temperature up to 8 MK and can also have signatures in the cooler 1-2 MK lines. We found one such event from the simultaneous observations of IRIS, SDO, and XRT/Hinode. Both the loop footpoints show sudden intense brightening (active region transient brightening, ARTB, commonly called as micro-flare). After the transient event, loop gets brightened up and temperature of the loop reaches about 8 MK. Using the intensity line ratio of O IV 1399.7/1401.2 ˚A, electron density during the event was found to be around 10^11.8 /cm^3 at one of the footpoints. LOS velocity during the transient becomes 15 km/s whereas line width increases from 35 km/s to 60 km/s with respect to pre-event conditions. Micro-flaring event was recorded in almost all the passbands of AIA/SDO and SJI/IRIS whereas loop brightening was observed only in the hotter channels. Brightness (conduction) front moves from loop foot-point to towards loop-top with the speed around 200 km/s, 70 km/s, and 60 km/s as found from AIA 131 ˚A (10 MK), 94 ˚A (7 MK), and 335 ˚A (4 MK) AIA passbands. All the observables are to be compared with 1-D hydrodynamic model of coronal loops. Detailed study of these observations are under progress.

ASI2017_1409	Sanjay Kumar	Oral

1. R. Bhattacharyya, 2. Bhuwan Joshi 3. P. K. Smolarkiewicz

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On The Role Of Repetitive Magnetic Reconnections In Evolution Of Magnetic Flux Ropes In Solar Corona

Parker’s magnetostatic theorem, extended to astrophysical magnetofluids with large magnetic Reynolds number,supports ceaseless regeneration of current sheets and, hence, spontaneous magnetic reconnections recurring intime. Consequently, a scenario is possible where the repeated reconnections provide an autonomous mechanism governing emergence of coherent structures in astrophysical magnetofluids. In this work, such a scenario is explored by performing numerical computations commensurate with the magnetostatic theorem. In particular, thecomputations explore the evolution of a flux rope governed by repeated reconnections in a magnetic geometry resembling bipolar loops of solar corona. The revealed morphology of the evolution process—including onset andascent of the rope, reconnection locations, and the associated topology of the magnetic field lines—agrees with observations, and thus substantiates physical realizability of the advocated mechanism.

ASI2017_1370	Abhishek Kumar Srivastava	Oral
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Coronal EUV Waves and Their Interaction with the Localized Magnetic Structures

Global EUV Waves are large-scale wave fronts, which propagate across the magnetic field lines in the solar corona. There are several views on their nature (e.g., wave and non-wave models), however, still the exact information is lacking. I will review the various developments on understanding the nature of these waves including our recent conjecture on the formation of these waves as fast magnetoacoustic mode and slow & bright EIT-wave components. Finally, I discuss the interaction of these waves with various solar magnetic structures, and infer their role in generating localized MHD oscillations and thereby MHD seismology (e.g., inference of magnetic field in the outer corona etc).

ASI2017_599	Tomin K James	Oral
Prasad Subramanian, IISER Pune Eduard Kontar, Uni. of Glasgow		

Energetics of small electron acceleration episodes in the solar corona

We study the power and number statistics on non-thermal electrons in small episodes of electron acceleration in the solar corona. We carried out an extensive survey spanning 2004–2015 and shortlisted 5 impulsive electron events detected at 1 AU that was not associated with soft Xray flares > C1 or with coronal mass ejections. Each of these events had weak, but detectable hard Xray (HXR) emission near the west limb, and were associated with interplanetary type III bursts. The number of electrons that escaped the coronal acceleration site to reach 1 AU was found to be up to 30 % of the ones that produced thick target HXR emission. Our findings are much higher than existing reported values of 0.1% which are usually associated with big flares and in line with predictions from the simulation carried out by Wang(2016). The energy carried by the HXR producing electron population was 1e+25 ergs, while that in the corresponding population that was detected at 1 AU was 1e+23 ergs. These findings are expected to aid our understanding of nanoflare-like events that could contribute towards heating the corona.

ASI2017_425	Abhishek Johri	Oral
Prof. P.K. Manoharan, RAC, NCRA-TIFR		

Acceleration and evolution of solar energetic particle events in the Sun-Earth distance.

Solar energetic particle (SEP) refers to the high energy (keV to GeV energies) charged particles (\textit{e.g.,} electrons, protons, alpha etc.), coming from the Sun as a result of solar activity. The physics of SEP production, acceleration and propagation in the interplanetary space is rather complex and not well understood. They originate in the solar atmosphere (chromosphere or corona or both) and then are accelerated all the way from the Sun to the Earth. Near--earth spacecraft observations of these SEP events, broadly categorises them into two classes as reviewed by Reames (1999) viz; impulsive and gradual. Impulsive events are believed to be

accelerated in rapid and short--lived ($\leqslant$30 minutes) solar flares whereas gradual SEP events are found to be well correlated with coronal mass ejections (CMEs) and their charge states suggests their origin in solar corona and acceleration due to shocks driven by fast (V $\gtrsim 700$ kms^{-1}) CMEs. Here, we present the preliminary results on the spectral evolution of SEP events in the Sun--Earth distance. We have analysed the energy spectrum (assuming Flux $\propto$ Energy$^{-\gamma}$: γ being the spectral index) for 73 SEP in 10--100, 10--060, and 10--050 MeV energy ranges. Our findings are [1] SEP spectrum gets steeper from the peak of SEP event to shock arrival time near Earth space (i.e., at 1 AU), [2] It is important to mention that steepening is caused by the high energy part of the spectrum. [3] Spectral indices in the 10--060 and 10--050 MeV ranges are more correlated then 10--100 and 10--050 MeV ranges. [4] Spectral indices do not correlate with the 11--year solar cycle but maximum to minimum value of spectral index varies from one phase of solar cycle to another.

ASI-2017 Parallel Session - Wednesday, 8 March, 2017

Time: 14:30 - 16.00 Venue: Hall B

Stars, ISM and the Galaxy – 4 [Chairperson: Indulekha Kavila]

ASI2017_1045	Vishal Joshi	Invited

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Near-infrared studies of Novae: Highlights of recent results

A nova is a cataclysmic nuclear explosion occur on the surface of a white dwarf in a close binary system which causes a sudden brightening of the star. Novae are considered as nearby laboratories for the study of accretion phenomena and thermo-nuclear runaway process. Many aspects of these common stellar explosions are observationally not well constrained and remain poorly understood. Gamma-ray emission from Novae, non-spherical shape of the ejecta, formation of dust in the ejecta and physical origin of spectral classification of novae are some examples far from complete understanding. With highlights of new observational studies primarily in near-infrared, some of the above mentioned issues will be discussed in this talk. I will also discuss the puzzling case of symbiotic nova NSco2014 which does not show any evidence of emergence of shock wave despite having giant as a secondary star.

ASI2017_1371	Nirupam Roy	Oral
EVLA Nova Team		
Radio monitoring of Galactic novae: highlights of recent results		
Novae are sudden visual brightening of star triggered by runaway thermonuclear burning on the surface of an accreting white dwarf. Although they are fairly common and bright event, multiple fundamental questions about them, like the detailed pathway of developing clumps, rings, polar caps, and jets from spherical ejecta, the origin of high energy gamma ray emission, the discrepancy in observed and theoretical ejecta mass, or their possible connection with supernovae, remain unanswered. Despite their astronomical significance as nearby laboratory for the study of nuclear burning and accretion phenomena, multiple such discrepancies suggest surprising limits to our physical understanding of these events. In this talk, I will describe how radio observations with complementary multiwavelength campaigns can potentially play a crucial role in addressing some of these puzzling issues.		

ASI2017_835	Prasanta Bera	Oral
Dipankar Bhattacharya(IUCAA)		
Spectral and timing properties of the magnetic CVs		
White dwarfs in a binary system can accrete matter from the companion star which loses matter due to either Roche lobe overflow or stellar wind. In general, the accreted matter forms a disk before falling on the white dwarf surface. In case of a magnetized white dwarf in such a system, the ionized accreted matter follows the magnetic field lines when the magnetic stress dominates the flow in the accretion disk. The field strength of the white dwarf decides the region where the matter starts to follow the field lines. This accreted matter flows with a very high speed and forms a dynamical shock before coming to the rest on the white dwarf surface near the magnetic pole. The kinetic energy of the accreted matter is converted to the radiation in the shock region and emits significant amount in the soft X-ray region. Various observations suggest the presence of temporal variability of the emitted optical radiation from a few of such objects. 1-d accretion column with radiation cooling (bremsstrahlung and cyclotron) effects is modeled to study the temporal characteristics. For a stronger magnetic field, a significant amount of optical radiation is generated by the cyclotron process. The quasi-periodic oscillation behavior of the shocked structure due to the bremsstrahlung process is suppressed in the presence of this cyclotron emission.		

ASI2017_1422	N Kameswar Rao	Oral

N Kameswar Rao (IIA), Firoza Sutaria (IIA), Rekhesh Mohan (IIA), Jayant Murthy IIA), Gajendra Pandey (IIA), S Muneer (IIA)

UVIT -- A nnew Tool for the Study of Planetary Nebulae iUV

Ultraviolet imaging telescope (UVIT) is one of the main payloads on the first Indian Astronomical satellite, ASTROSAT, that has been launched on 28th September 2015. UVIT consists of two 38-cm telescopes providing three channels for imaging the sky at an angular resolution of 1 to 1.5 arc sec and a field of 28 arc minutes. One of the telescopes is optimized to FUV (1250 - 1800 Å) and the other one has a dichroic mirror that reflects NUV (2000 -3000 Å) and transmits optical (3200 -5500 Å). Each channel is provided with five filters that isolate spectral regions. The FUV has CaF_2, BaF_2, Sapphire and silica and the NUV has broad and narrower filters. The two UV channels have a grating that provides spectra of about 100 resolving power. Mapping of emission lines like C IV 1550Å can be achieved by differencing images in two filters. Imaging PNs in few emission lines is one of the main programmes to be carried out. We present the first results obtained of the planetary nebula Helix (NGC 7293) in two FUV and two NUV filters and discuss the implications.

ASI2017_735	Ananta Charan Pradhan	Oral

S. Panda (NIT Rourkela, Odisha), M. Parthasarathy (IIA Bangalore), Jayant Murthy (IIA Bangalore), D. K. Ojha (TIFR, Mumbai)

The GALEX observations of planetary nebulae.

We present the largest ultraviolet (UV) photometric surveys of planetary nebulae (PNe) using observations made by Galaxy Evolution Explorer (GALEX). We found about 108 PNe detected by GALEX in near-UV (NUV) and also in far-UV (FUV) for 28 PNe considering a 3σ surface brightness level above the background. Of the PNe, 57 are elliptical, 41 are circular and rest 10 are bipolar in NUV. The emission lines contributing to GALEX FUV flux are strong O V, C IV, and He II while the emission line contributing to the NUV flux are C III] and He II. We have determined their sizes and structures in UV and compared the same with the data available in other wavelengths.

ASI-2017 Parallel Session - Wednesday, 8 March, 2017

Time: 14:30 - 16.00 Venue: Hall C

Extragalactic Astronomy – 4 [Chairperson: Preeti Kharb]

ASI2017_867	Sumana Nandi	Oral

M. Jamrozy^{2}, R. Roy^{3}, J. Larsson^{1}, D.J. Saikia^{4,5}, M. Baes^{6} and M. Singh^{7} ^{1}KTH, Department of Physics, and the Oskar Klein Centre, AlbaNova, SE-106 91 Stockholm, Sweden ^{2}Obserwatorium Astronomiczne, Uniwersytet Jagiello\'nski, ul. Orla 171, 30-244 Krak\'ow, Poland ^{3}The Oskar Klein Centre, Department of Astronomy, Stockholm University, AlbaNova, 10691 Stockholm, Sweden ^{4}Cotton College State University, Panbazar, Guwahati 781 001, India ^{5}National Centre for Radio Astrophysics, TIFR, Pune University Campus, Post Bag 3, Pune 411 007, India ^{6}Sterrenkundig Observatorium, Universiteit Gent, Krijgslaan 281 S9, B-9000 Gent, Belgium ^{7}Aryabhatta Research Institute of Observational Sciences (ARIES), Manora Peak, Nainital, 263 129, India

A misaligned double-double radio galaxy hosted by a binary supermassive black hole system

Double-double radio galaxies (DDRGs) constitute a rare class of extragalactic radio sources that undergo multiple cycles of jet eruption. For DDRGs the out flow of new jet mostly follow the same direction of the previous jets. There are few examples of “misaligned DDRGs” which undergo different axis orientation for two epochs. The change in direction of new jet may happen due to coalescence of supermassive black holes (SMBHs). Historically radio galaxies with rapid change of jet direction in particular X-shaped galaxies are the candidates to detect the binary black hole as they are potentially dominant contributors to the gravitational wave background. Recently, the double-peaked emission lines are one of the adopted indicators to search for binary black holes. The split in emission lines are the possible out come of a bound pair of SMBHs, moving with their own characteristic velocity. In this study we report a unique restarted radio source J1328+2752, with ~30° off axis jet emission. More over this source is hosted by a giant elliptical with double-peaked emission lines. This is the first time both signatures has been detected in the same source. In fact such systems provide direct observational evidence for galaxy mergers as triggers of multiple epochs of jet activity.

ASI2017_1410	Chiranjib Konar	Oral

M.J. Hardcastle(1), J.H. Croston(2), M. Jamrozy(3), A. Hota(4), T.K. Das(5) ---------- (1) School of Physics, Astronomy and Mathematics, University of Hertfordshire, College Lane, Hatfield (2) School of Physics and Astronomy, University of Southampton, Southampton SO17 1BJ, UK (3) Obserwatorium Astronomiczne, Uniwersytet Jagiellonski, ul. Orla 171, 30244 Krak´ow, Poland (4) UM-DAE Centre for Excellence for Basic Sciences, Vidyanagari, Kalina, Mumbai, India (5) Harish-Chandra Research Institute, Chhatnag Road, Jhunsi, Allahabad-211 010, India

Episodic Radio Galaxies and Mode of Accretion in Them

XMM-Newton X-ray observations of three Double-Double Radio Galaxies (DDRGs) are presented. The X-ray emission from the lobes of the DDRGs have been succefully modelled to be the inverse-Compton scattered cosmic microwave background (CMB) photons against the electrons and positrons of the radio lobes. The outer lobes of all the DDRGs are very close to the equipartition condition. We noticed that (1) no strong [OIII] lines are observed from the host galaxies, and (2) the host galaxies are not detected in all four bands (namely 3.4, 4.6, 12, 22 μm) of Wide-Field Infrared Survey Explorer (WISE) survey. (1) and (2) together suggest that the DDRGs don't have standard accretion disk at their central engines. So, the mode of accretion of these DDRGs might be the hot mode accretion of AGNs.

ASI2017_601	Pratik Dabhade	Oral

Madhuri Gaikwad(MPIFR, Germany) Joydeep Bagchi (IUCAA, India) Huub Rottgering (Observatory of Leiden,Netherlands) Francoise Combes (Observatory of Paris, France), Shishir Sankhayayan (IISER, Pune-India)

SAGAN - Search & Analysis of GRGs with Associated Nuclei

In this talk we will present about Giant Radio Galaxies (GRGs) and highlight the importance of their studies and our efforts to solve major standing problems related to growth and evolution of GRGs and their host AGN. The GRGs represent an extreme class of active galaxies which have linear sizes in the range of ~ 0.5 Mpc to 5 Mpc which places them among the largest single astrophysical objects known to us. From the past four decades only ~ 300 GRGs are known as oppose to thousands of normal sized radio galaxies (> 450-500 Kpc). It is unsettled if the large sizes of GRGs indicate the high efficiency of radio jets ejected from the central AGN, or they grow to enormous sizes due to their location in sparser cluster environments. In spite of various studies of GRGs, there is still not a single tested unified model which might explain the immense physical scale and other extreme properties of GRGs. Moreover, till now only a small fraction of these GRGs have been studied in sufficient detail in multiple wavebands for achieving a good understanding of their unusual nature. This puts a restriction on carrying out statistical studies of their properties. We under our project SAGAN (Search & Analysis of GRGs with Associated Nuclei) aim to firstly make a complete sample of all known GRGs with same cosmological parameters for uniformity, secondly find more GRGs from existing radio and optical surveys, thirdly study the hosts of GRGs in multiwavelength to understand the nature of accretion, feedback and their excitation types. Lastly we aim to study the environments of these GRGs and explore the effects of environment on morphology and other properties. All the above listed goals are not attempted before anyone. We have already discovered nearly 200 new GRGs (Dabhade et al-2016 and Dabhade et al-in prep) from NVSS. These numerous GRGs were missed before due to their very low surface brightness features: they were just at the sensitivity limits of existing surveys like NVSS. I will describe the methods used and results of their

analysis. GMRT which provides sufficient high resolution and sensitivity at low frequencies has enabled us to decipher and study their morphologies which extend over megaparsec scales. Nearly 10 new GRGs were mapped with GMRT which has unveiled stunning new feature of these GRGs which most likely host the most massive black holes known in the Universe. Our mid-infrared studies of the hosts of GRGs too suggests this possibility. We will present our study of these AGN which emit and sustain powerful radio jets for 100s of kpc scale.

ASI2017_606	Viral Parekh	Oral

Ruta Kale, NCRA, Pune

Early results of uGMRT observations of diffuse radio sources

The Giant Metrewave Radio Telescope (GMRT) is currently undergoing a major upgrade in terms to achieve better rms sensitivity by a factor of up to three at low frequency (< GHz). This upgraded system will provide the lowest frequency broadband systems in the range 125 - 1450 MHz with instantaneous bandwidth of 400 MHz, 16384 channels and high time resolution, as well as RFI-mitigation capabilities. Wide bandwidth observations will simultaneously provide both higher angular resolution and spectral indices with unprecedented sensitivity and allows better dynamic range to detect faint radio emission. In this talk we will show our primary results of uGMRT observations of diffuse extended radio sources such as radio halos and relics. A wideband observations of a large number of extended radio sources will provide an unparalleled database of spectra. Prior to the development of the uGMRT, spectra of radio halos and relics were often not well enough sampled to discern between competing physical models. New uGMRT broadband observations of a large number of radio halos and relics will provide an unparalleled database of spectra. We will also discuss about RFI mitigation technique and other data analysis algorithms which we are testing on these new wide bandwidth data.

ASI2017_818	Ananda Hota	Oral

Ananda Hota (UM-DAE CEBS, Mumbai & RAD@home, India) C. Konar (Amity Univ. & RAD@home, India) Pratik A. Dabhade (RAD@home, India) Sravani Vaddi (NCRA-TIFR, Pune & RAD@home, India) C.S. Stalin (IIA, Bangalore) Shilpa Dubal (RAD@home, India) Megha Rajoria (RAD@home, India) Lavanya Nemani (RAD@home, India)

First results from the GMRT Observation of Objects Discovered by RAD@home Astronomy Collaboratory (GOOD-RAC).

We wish to present first results from the GMRT Observation of Objects Discovered by RAD@home Astronomy Collaboratory (GOOD-RAC).RAD@home is the first Indian citizen science initiative in astronomy involving ~70 trained citizen scientists. RAD@home has considerably grown in the past three years in terms of expertise of its members as well as in its astronomical discoveries. Since the launch of RAD@home in April 2013, oral presentations in three international conferences (MWSky@NCRA, Jets@ICTS and SPARCS@SKAscicon16) and poster presentations in previous three ASI meetings have contained preliminary reports on our discoveries from public data. For the first time, in this ASI meeting we wish to present, in front of Indian astronomy community, the results from our own GMRT observations obtained through the GMRT

Time Allocation Committee. Discoveries by citizen-scientist e-astronomers were followed up with the GMRT in 610, 325 and 235 MHz bands. Stunning new features have been revealed. These new results include discoveries of 1) a double-lobe radio galaxy surrounded by a giant relic radio cocoon similar to double-double radio galaxies, 2) a wide angle tailed radio galaxy bent by intra-filament-medium/host-galaxy motion along the filament joining two clusters of galaxies and, 3) a relic radio emission from a dead-radio galaxy revived by cosmic accretion on to the nearby cluster of galaxies (also called radio phoenix). Several more discoveries by the active e-astronomer team will also be presented. Details on this modified citizen-science research programme which is the only such project in India can be found in our paper (in press) in the Journal of Astrophysics and Astronomy available at https://arxiv.org/abs/1610.09798 . As said Any BSc/BE Can Do research joining RAD@home (#ABCDresearch #RADatHomeIndia), interested citizens may contact through: www.facebook.com/RADatHomeIndia/

ASI-2017 Parallel Session - Wednesday, 8 March, 2017

Time: 14:30 - 16.00 Venue: Hall D

General Relativity and Cosmology – 2 [Chairperson: Somak Roychowdhury]

ASI2017_668	Abhirup Ghosh	Oral

Archisman Ghosh, Nathan K. Johnson-McDaniel, Chandra Kant Mishra, Parameswaran Ajith, Walter Del Pozzo, Alex B. Nielsen, Christopher P. L. Berry, Lionel London

Testing general relativity using gravitational wave signals from the inspiral, merger and ringdown of binary black holes

We have developed a method of testing General Relativity (GR) using gravitational waves (GWs) from the coalescence of a binary black hole (BBH) system by inferring the mass and spin of the remnant black hole, using two different parts of the observed signal, the initial inspiral and the final merger-ringdown phases, and then comparing these independent estimates. The initial masses and spin obtained from the inspiral part of the GW signal, are used to obtain the final mass and spin using appropriate fitting formulae. If the two independent estimates are consistent with each other, it would mean the signal observed is consistent with the predictions of BBH coalescences in GR. This was one of the tests used to establish that GW150914 was consistent with a BBH merger in GR. We tested the robustness of the method against signals with energy and angular momentum evolution differing from that predicted by GR, and showed that the inspiral-merger-ringdown consistency test can can exclude GR with high confidence for sufficiently large departures from the theory. We now demonstrate the robustness of the test using an astrophysically motivated population of binaries as well as the sensitivity of the test to various ingredients or choices used in its construction, e.g., the GR waveform models used and the frequency used to separate inspiral from merger-ringdown. We also apply the test to a population of signals differing from GR's predictions to check the test's ability to discern smaller deviations from GR by combining together a large number of observations.

ASI2017_645	Krishnendu N V	Oral

K G Arun, Chennai Mathematical Institute, Chennai C K Mishra, ICTS-TIFR, Bangalore and IIT Madras

Testing the binary black hole nature of compact binary coalescences using gravitational wave observations

The first Advanced LIGO (Laser Interferometric Gravitational Wave Observatory) observing run (O1) detected gravitational wave (GW) signals from two binary black hole (BH) mergers. The detectors are now ready for their second observing run which is poised to detect many more of such signals (in addition to, perhaps, signals of other types). While the detected signals are completely consistent with the merger of binary BHs, alternatives which might mimic the features of a binary BH merger cannot be ruled out. We propose a new way of distinguishing a binary BH merger from mergers of binaries involving BH mimickers by measuring the quadrupole moments of the binary constituents (or their linear combination) which explicitly appear in the gravitational waveforms within the post-Newtonian (PN) approximation. Spin-induced quadrupole moment of a compact object may be defined as $Q=-\kappa/:\chi^2/:m^3$, where $\kappa=1$ for BHs by "no-hair conjuncture" where as it can vary from 4 to 8 for a Neutron Star (NS) depending up on different equation of states. For exotic compact objects like boson stars the κ value ranges roughly from 10 to 150. So the accurate measurement of the κ value can uniquely probe the BBH nature of the compact binary system. Using Fisher Information Matrix, we estimate the accuracy which κ can be measured with advanced LIGO-like detectors and show that the proposed method offers a novel way to constrain the parameter space of BH mimickers. Implications for third generation telescopes and space-based detectors are also discussed.

ASI2017_1208	Gayathri V	Oral

Eric Chassande-Mottin Archana Pai Philippe Bacon Gabriele Vedovato Francesco Salemi

Wavelet-based search of coalescing compact binaries with GW detectors

With the direct detection of gravitational waves from binary black holes, the new era of gravitational wave astronomy has begun. Besides binary black holes, compact binaries with two neutron stars as well as neutron star/black hole systems emit transient gravitational waves (frequency modulated chirp) that can be detected by the interferometric detectors. Coherent WaveBurst is a wavelet-based detection pipeline for all-sky and all-time searches for short-duration gravitational wave transients. Here, we present Wavegraph, a new time-frequency clustering scheme integrated to coherent WaveBurst that is specifically dedicated to chirp-like gravitational-wave signals such as those emitted by compact binaries. We give a description of this algorithm and its performances.

ASI2017_611	Bhal Chandra Joshi	Oral

Bhal Chandra Joshi (National Centre for Radio Astrophysics), A. Gopakumar (Tata Institute for Fundamental Research), M Bagchi (Institute for Mathematical Sciences), Dhruv Pathak (Institute for Mathematical Sciences), M A Krishnakumar (Radio Astronomy Centre, National Centre for Radio Astrophysics), Arun Kumar Naidu (National Centre for Radio Astrophysics), Mayuresh P Surnis (Radio Astronomy Centre, National Centre for Radio Astrophysics), P K Manoharan (Radio Astronomy Centre, National Centre for Radio Astrophysics), Prakash Arumugasamy (National Centre for Radio Astrophysics), Yogesh Maan (ASTRON)

Radio Pulsars, gravity and an Indian Pulsar Timing Array

Radio pulsars have traditionally played an important role in tests of gravity theories and the first indirect detection of gravitational waves. The current state of art in these two spheres is briefly reviewed, with the current level of constraints from double neutron star systems and asymetric mass systems, current and to be discovered in future using new telescopes like Square Kilometer Array. An Indian effort for constraining gravitational waves using radio millisecond pulsars from an ensemble of super massive black hole binaries, using the Ooty Radio Telescope and the Giant Meterwave Radio Telescope, called InPTA, is described alongwith new results on Dispersion Measure variations obtained from this experiment. The scope of this experiment in the context of International Pulsar Timing Array is examined alongwith possible development of dedicated pulsar timing array facilities in India.

ASI2017_544	Prerna Rana	Oral

Arun Mangalam, Indian Institute of Astrophysics

Dynamics of bound orbits in Kerr geometry and QPO frequency ratios

We discuss dynamical constraints on the emission region allowed by the stationarity and the bound orbit phase volume in Kerr geometry. We derive conditions with parameters: energy, angular momentum and spin of the black hole for the dynamics on the equatorial plane for both particles and photons. We present analytic expressions for the trajectory, radial and azimuthal frequencies that have general utility in various problems. We apply these formulae to the relativistic precession model and the non-linear resonance model to study the commensurability of the QPO frequencies in black hole binaries (BHBs). We also explain low-frequency QPOs by helical motion in Schwarzschild geometry by including various relativistic effects of gravitational Doppler shift and light bending effects on the emission.

ASI-2017 Thesis Presentations 1

Time: 16.30 - 17.30 Venue: Hall E

[Chairperson: Jayaram Chengalur]

ASI2017_1130	Avijeet Prasad	Thesis
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Magnetic helicity and force-free properties of astrophysical magnetic fields

The Thesis applies novel techniques and formulae for magnetic helicity and non-linear force-free field (NLFFF) to two different astrophysical settings: the solar corona and disc galaxies. The solutions obtained in the solar case provide alternate and verifiable means to calculate the structure and energetics of active regions (ARs). Further the topological methods provide a deeper understanding of the sources of coronal heating. In the case of the disc galaxies, our analytic treatment provided a transparent and powerful use of eigen-functions that yielded a full global solution to the galactic dynamo and its route to saturation. Complementing these solutions with future numerical models can give further insight and drive us to better models in both cases. The specific novel results are: We provided a new formulation for relative helicity in arbitrary geometries using the toroidal-poloidal representation. In the case of the solar corona, we solved linear and NLFFF equation using photospheric boundary conditions to obtain simple axisymmetric magnetic field configurations in spherical geometry and applied it to the AR 10930 and we confirmed in both models a substantial decrease in free energy and relative helicity after the flare, which is in agreement with those obtained from other numerical methods. We tested a model of self-organized criticality for the distribution of coherent braid sequences by comparing the resulting distribution of peak-flare energies with those obtained from NLFFF extrapolation. The results indicate that a significant component of the energy budget for coronal heating can potentially be supplied by nano-flares during reconnection of magnetic braids in the case of the active Sun. For the galactic dynamo, we have introduced the following novelties: building a three-dimensional model of the global field of the disc and corona using a simplified treatment of reconnecting the small-scale field to describe a large-scale force-free coronal field and balancing the global helicity by the use of gauge-free descriptions of absolute helicity and incorporated the radial dependence in the supernovae and MRI- driven turbulence parameters under a common formalism. The time-dependent solution is expressed in a separable form, with the radial part in terms of the steady-state counterparts. These global analytic solutions allowed us to calculate the field structure and evolution of relative helicity for both the disc and the corona. The resulting saturated quadrupolar magnetic field is of the order of its equipartition value (the 99% value is reached in about a Gyr, which is faster than the timescales reported in previous simulations) and proportional to the advective and diffusive fluxes.

ASI2017_1138	Atreyee Sinha	Thesis

Under Prof. V. R. Chitinis, TIFR, Mumbai

A Multiwavelength Study of TeV Blazars

Blazars constitute the most violent non-transient sources of high energy emission in the known universe and are ideal for studying the physics of poorly understood astrophysical jets. Though blazars emit copiously across the entire electromagnetic spectrum, the origin of the high energy emission is still under debate. The jet formation, collimation and acceleration are still only vaguely understood. The observed rapid variability suggests that the emission region is compact and located close to the nucleus, which lies below the resolution limit of modern facilities. Thus, even the sites of production of radiation at different energies are also not well known. The advent of the Atmospheric Cherenkov Telescopes (ACT) opened a new window into blazar research. Since the atmosphere is opaque to TeV photons, a direct detection id not possible. However, the energy and arrival direction of the primary TeV photon can be reconstructed from the Cherenkov light pool created by the Extensive Air Showers. This requires state of the art detection techniques and Monte-Carlo simulations. Moreover, studies at TeV energies are complicated due to the fact that the high energy gamma rays emitted from blazars interact with the Extragalactic Background Light (EBL) through pair production and are attenuated. Until now, several different models of the EBL have been proposed, which differ considerably. Very high energy emission seen from blazars has proven to be a very good test for these EBL models. In such a scenario, multi-wavelength temporal and spectral studies offer powerful diagnostics to study the underlying blazar environment. We analyse data from the TeV Telescope Array, HAGAR, located in the Ladakh Valley of the Himalayan Mountain Ranges, along with data from the Fermi-LAT, NuSTAR and Swift Telescopes to to understand the intrinsic particle spectrum in the jets through a thorough temporal and spatial study of HAGAR observed blazars in the ambit of leptonic models. The primary goal of this thesis has been to study the radiation mechanisms in blazar jets, with emphasis on the high energy emission. We have developed a synchrotron - Inverse Compton minimisation routine in XSPEC, and used it to study the broadband (radio - γ-ray) spectral and temporal emission from two blazars, Mkn 421 and 1ES 1011+496, and tried to understand its implications under the ambit of leptonic modelling. A model independent estimate of the EBL has been computed from a statistical study of TeV detected blazars. The results of the work will be presented and some future prospects discussed.

ASI2017_755	Krishna Kumar Singh	Thesis

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Very high energy gamma-ray observations of a few Fermi detected blazars using TACTIC telescope

Very High Energy (VHE : E > 100 GeV) gamma-ray observations provide a powerful and unique diagnostic tool for probing a wide variety of cosmic objects within and outside our galaxy. Study of this radiation can yield valuable information about the unusual astrophysical environments characterizing these sources, as well as on the intervening intergalactic space. At energies above 100 GeV, a typical gamma-ray source is generally very weak for detection using space based satellite detectors and thus ground based atmospheric Cherenkov technique is used. As an important part of the on-going global effort to observe VHE gamma-rays from astrophysical sources, scientists from Astrophysical Sciences Division, Bhabha Atomic Research Centre, Mumbai, India, have been actively involved in the observational study of potential gamma-ray sources with the TACTIC (TeV Atmospheric Cherenkov Telescope with Imaging Camera) gamma-ray telescope. With a 5σ sensitivity in 25 hours (before upgrade) for detecting the steady gamma-ray signal from the Crab Nebula above a threshold energy of 1 TeV, the telescope has detected TeV gamma-ray emission from Mrk 421 and Mrk 501 on several occasions during their strong flaring activity. The research work presented in the thesis involves VHE gamma-ray observations of two blazars Mrk 421 and 1ES 1218+304 using TACTIC along with high energy observations from Fermi-LAT (Large Area Telescope) and other instruments in X-ray, optical and radio energy bands. Blazars are the most enigmatic class of active galactic nuclei (AGN), which host a jet closely oriented to the line of sight of the observer on the Earth. The observational results of these two sources are discussed in the context of multi-wavelength emission from blazars and are used to understand the emission model involving synchrotron and synchrotron self Compton (SSC) processes. The thesis also discusses the application of VHE gamma-ray observations of distant blazars for probing the extragalactic background light (EBL), which is an important cosmological quantity for understanding star formation and evolution of galaxies in the Universe.

ASI - 2017 Plenary Session

GR and Cosmology [Chairperson: Arnab Rai Choudhuri]

Time: 9.30 - 11.00 Venue: Auditorium

ASI2017_1483	Rishi Khatri	Plenary
TIFR, Mumbai		
Information hidden in the CMB spectral distortions		

Planck is the first full sky experiment, 25 years after COBE, with sufficient frequency coverage to shed new light on the CMB spectral distortions. COBE-FIRAS estabished that the CMB spectrum is blackbody to better than 1 part in 10^4. In standard cosmological model, we expect inevitable distortions at the level of 10^-8 (accessible to the next generation of CMB experiments) which can shed new light on the early Universe. I will briefly review the processes responsible for the maintaining the blackbody spectrum of CMB in the early Universe. I then go on to describe how these processes fail one by one with time allowing the deviations from the equilibrium spectrum to be possible. I conclude by touching on what we can learn from measurement of these deviations in the future and some actual results using the Planck data.

ASI2017_1238	Biswajit Pandey	Plenary
Visva-Bharati University		
An information theory based search for homogeneity and isotropy in Galaxy Redshift Surveys		

The assumption that the Universe is statistically homogeneous and isotropic on sufficiently large scales is fundamental to modern cosmology. In this talk I will discuss about two information theory based new methods for testing the cosmic homogeneity and isotropy. We apply the proposed method on the main galaxy sample, the luminous red galaxy (LRG) sample and the quasar sample from the Sloan Digital Sky Survey (SDSS) to study the issue of cosmic homogeneity. I will present the results from our studies as well as discuss the results obtained so far from various galaxy surveys by using the traditional number count based methods and the multifractal analysis. We apply our method to test the isotropy in the galaxy distribution using the all sky 2MASS redshift survey and the 2MASS photometric redshift catalogue. I will discuss our results on these studies and finally present our conclusions on the validity of the cosmological principle.

ASI2017_1241	Kanan Kumar Datta	Plenary

Presidency University, Kolkata

Probing the universe with the HI 21cm line

A period of major changes in the Universe took place between ~0.2 and ~ 2 billion years after the big bang at the time when the first galaxies and supermassive black holes were forming. The onset of first sources of light which marked the end of the 'dark ages' and changed the IGM thermal state is often termed as 'cosmic dawn'. Subsequent period when the neutral hydrogen (HI) was ionized is popularly known as the epoch of reionization (EoR). Unfortunately, these landmark events remain largely unexplored. Radio interferometric observations of redshifted HI 21-cm radiation are considered to constitute the most promising tool to probe the reionization epoch. In my presentation, I shall start with a brief introduction about the cosmic dawn, reionization epoch and HI 21-cm radiation from these epochs. Subsequently, I shall discuss recent experimental efforts and various observational strategies being/will be adopted by ongoing or upcoming radio interferometric experiments. Next I shall focus on statistical quantities that will be measured by these experiments and present results from recent simulations. We shall then discuss about methods for detecting reionizing sources (e.g galaxies, quasars) individually. Finally, we shall discuss about the most ambitious upcoming project i.e, the SKA and some related activities being carried out in India.

Thursday, March 9, 2017

ASI 2017 Parallel Session - Tuesday, 9 March, 2017

Time: 11:30 - 13:00 Venue: Hall A

Sun and the Solar System - 5 [Chairperson: Abhishek Kumar Srivastava]

ASI2017_1293	Manjunath Hegde	Oral

SUBHAMOY CHATTERJEE (Indian Institute of Astrophysics), DIPANKAR BANERJEE (IIAP) and RAVINDRA B (IIAP)

Long term study of the sun using Kodaikanal H-alpha data archive

The filaments observed in the Hα line in the solar chromosphere are one of the basic indices of solar activity. Systematic Hα observations have been carried out since 1914 at the Kodaikanal Observatory of IIA , 1919 at the Meudon Observatory (France) (spectroscopic observations), and since 1959 at the Kislovodsk Mountain Astronomical Station of the Main (Pulkovo) Astronomical Observatory of Russian Academy of Sciences. We present Long term variations in the distribution of solar filaments observed at the Kodaikanal Solar Observatory (KSO) from 1914 -2007 which spans nearly 7 solar cycles to compare with sunspot cycle and also filament activity. Synoptic charts are produced from calibrated digitised images. Using a semi automatic technique, filaments are detected from synoptic charts. The data on each filament comprise of its centroid location, area, length and tilt angle. We study time-latitude distribution of filament centroids like butterfly diagram of sunspots. 'Rush to the pole' is clearly seen in butterfly diagram. Distribution of filament length shows log normal distribution. Such a long term digitized H-alpha data series provides us an unique opportunity to probe solar activity cycle.

ASI2017_728	Aishawnnya Sharma	Oral

1. G. R. Gupta IUCAA, Pune. 2. Durgesh Tripathi IUCAA, Pune 3. V. Kashyap Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA 4. Amit Pathak Tezpur University, Assam

Propagation of Different Sunspot Waves and Oscillations in the Magnetically Coupled Solar Atmosphere

We present an observational evidence of the coupling of solar atmosphere in terms of the propagation of different sunspot waves and oscillations using the data from Atmospheric Imaging Assembly (AIA) and Helioseismic and Magnetic Imager (HMI) on board Solar Dynamics Observatory (SDO). We find presence of different sunspot wave modes such as 5-min photospheric oscillations, 3-min umbral flash oscillations and waves, and propagating coronal waves observed at different layers of solar atmosphere where amplitudes of oscillations change in synchronization. All the sunspot waves and oscillations showed similar pattern of

increase in amplitudes of oscillations. Observed similarity and time delay in different sunspot wave modes at different layers of solar atmosphere yields an evidence of the propagation of sunspot waves from lower solar atmosphere to the higher up in to the corona. These findings further (also) suggest that all the layers of solar atmosphere are inherently connected.

ASI2017_1105	Prantika Bhowmik	Oral

Dibyendu Nandy Department of Physical Sciences, IISER Kolkata

Prediction of Solar Cycle 25 Using A Surface Flux Transport Model

In the age of increasing relevance of space weather studies, predicting the strength of future solar cycles have become an important scientific goal. Though the intrinsic stochastic nature of the Sun restricts the range of predictability, the polar flux during cycle minima has proved to be quite successful for predicting the amplitude of the succeeding solar cycle. With our newly developed Surface Flux Transport (SFT) model, we perform a continuous century scale simulation starting from the solar cycle 15 (the year 1913) to the current cycle 24 (the year 2016). We utilize our calibrated simulation to run the model forward to predict the polar flux during the cycle 24 minimum using a synthetic sunspot data profile (constructed depending on the statistical properties of sunspots) for the descending phase of the current cycle. Based on this estimated polar flux, we present a predicted amplitude of the solar cycle 25 along with the probable occurrence time of cycle 25 maximum.

ASI2017_1231	Reetika Joshi	Oral

Ramesh Chandra Kumaun University, Nainital

Multiple Solar Jets from Rotating Active Region

We present here the study of seven solar jets on 2014 April 15 - 16 from the active region NOAA 12035. These jets were well observed by AIA and HMI instruments on-board SDO satellite. We have computed the kinematics of all the observed jets at different E(UV) wavebands. We found different speeds at different wavelengths, which implies jets speed varies with the different heights of solar atmosphere. The calculated average speeds varies from 50 to 450 km/s. We have also computed the height, width and lifetimes of these jets. In order to understand the magnetic causes of these jets, we have used HMI magnetic field. The major positive polarity spots of the active region shows clockwise rotation, which evidenced the increase of shear in the active region. Further the evolution of photospheric magnetic field indicate the emergence as well cancellation at the jet's locations. We describe in detail about these emerging and cancelling magnetic features and its connection with the origin of jets.

ASI2017_422	Bhupendra Kumar Tiwari	Oral

B.K.Tiwari A.P.S.university Rewa M.P.

Dependence of Heliospheric and Cosmic Rays Modulation on Solar Activity

We sturdy the changes of Cosmic Rays (CRs) intensity for the ending period of the solar cycle 23 and the beginning of the solar cycle 24 using neutron monitors experimental data, we show that an increase of the CRs intensity in 2009 is generally related with decrease of solar wind velocity V (<450 Km/sec), strength of B of the interplanetary magnetic field, and the drift in negative (A<0) polarity epoch. Solar variability controls the structure of the heliosphere and produce changes in CRs intensity. Based on the observation from Omniweb data centre for solar- interplanetary data and yearly mean count rate of cosmic ray intensity (CRI) variation data from Oulu / Moscow neutron monitors (Rc = 0.80 GV & Rc = 2.42 GV) during 1996-2016 . It is observed that the sun is remarkably quiet and the strength of the interplanetary magnetic field has been falling off to new low levels , reduces the CR entering inner- heliosphere and it is high anti-correlation (r = -0.78) between sunspot number & CR flux. We find, during this unusual minimum, the correlation of CR intensity is poor with sunspot number(r = -0.40), better with IMF (r = -0.78) and SWV (r = -0.80) and much better with the tilt angle of the heliospheric current sheet (r = -0.90). It is also found that 10.7 cm solar radio flux, velocity of solar wind and the strength and turbulence of the interplanetary magnetic field were positive correlated with each other and inverse correlated with count rate of cosmic ray intensity. Keywords- Interplanetary Magnetic Field (IMF), Cosmic Rays (CRs), Solar Wind Velocity (SWV).

ASI2017_510	Rakesh Mazumder	Oral

Vaibhav Pant 1. Ding Yuan 3. Dipankar Banerjee 1,2. Abhishek K. Srivastava 4 · Yuandeng Shen 5. 1 Indian Institute of Astrophysics, Koramangala, Bangalore 560034. 2 Center of Excellence in Space Sciences, IISER Kolkata, Mohanpur 741246, West Bengal, India 3 Jeremiah Horrocks Institute, University of Central Lancashire, UK. 4 Indian Institute of Technology (BHU), Varanasi, India 5 Yunnan Observatories, Chinese Academy of Sciences, Kunming 650216, China

Simultaneous longitudinal and transverse oscillation in an active filament

We report on the co-existence of longitudinal and transverse oscilla- tions in an active filament. On March 15 th 2013, a M1.1 class flare was observed in the active region AR 11692. A CME was found to be associated with the flare. The CME generated a shock wave that triggered the oscillations in a nearby filament, situated at the south-west of the active region as observed from National Solar Observatory (NSO)Global Oscillation Network Group(GONG) Hα images. In this work we report the longitudinal oscillations in the two ends of the filament, co-existing with the transverse oscillations. We propose a sce- nario in which an incoming shock wave hits the filament obliquely and triggers both longitudinal and transverse oscillations. Using the observed parameters, we estimate the lower limit of the magnetic field strength. We use simple pendulum model with gravity as the restoring force to estimate the radius of curvature. We also calculate the mass accretion rate which causes the filament motions to damp quite fast.

ASI-2017 Parallel Session - Tuesday, 9 March, 2017

Time: 11:30 - 13:00 Venue: Hall B

Stars, ISM and the Galaxy – 5 [Chairperson: Sarita Vig]

ASI2017_545	Rupal Basak	Oral

Andrzej A. Zdziarski (Nicolaus Copernicus Astronomical Center, Warsaw)

Spectral study of the hard state of GX 339-4 and Cygnus X-1

The accretion disc geometry in the hard state of X-ray binaries (XRB) is a hotly debated topic with the main focus on whether the disc is truncated or not. We present a detailed analysis of all the spectral data of the black hole XRB source GX 339-4 in the hard state obtained by the XMM-Newton through 2004--2013. We model the spectrum with a thermal emission from the disc along with a Comptonization and the currently best reflection code, relxill. We modify the disc blackbody function in order to set the radius of the inner disc to that of the reflector. However, we find an unphysical behaviour of the truncation radius with the spectral hardness implying that the soft X-ray component is not simply a disc blackbody. Hence, we use this as a phenomenological model and fit the data in both full and reduced (higher energy) band. We test a large number of models e.g., that with a radial irradiation profile, adding unblurred reflection and assuming a lamppost geometry. In the coronal models, we find that the disc is highly truncated and the inner radius correlates with the spectral hardness which is fully consistent with the hard to soft transition of the truncated disc model. For the lamppost geometry as the radius could not be constrained, we fix it to the innermost stable orbit but then obtain large values of the source height. Hence, in all cases the relativistic effect is moderate. Finally, we find that in the softer states the degree of ionization is high which leads to strong spectral broadening and a broad iron line even though the relativistic effect is only moderate. Hence, the degree of ionization is a crucial parameter responsible for the broad line. A similar study is also presented for the high mass XRB source Cygnus X-1.

ASI2017_1232	Chetana Jain	Oral

Biswajit Paul (Raman Research Institute), Rahul Sharma (Delhi University), Abdul Jaleel (Delhi University), Anjan Dutta (University)

Orbital decay of the low mass X-ray binary MXB 1658-298 and indication of a massive circumbinary planet from X-ray eclipse timing

We will present an X-ray eclipse timing of the transient X-ray binary MXB 1658-298, using data obtained with the RXTE and XMM-Newton observatories. We have made 27 new mid eclipse time measurements from observations made during the two outbursts of the source. These new measurements have been combined with the previously known values to study the long term changes in the orbital period of the binary system. We have found that as compared to other eclipsing LMXBs, the mid-eclipse timing record of MXB 1658-298 is quite unusual. The long term evolution of mid-eclipse times from the three outbursts, first of which was in 1976, indicates an overall orbital period decay. But, from a large number of observations made during the second

outburst, the O-C residual curve shows a sinusoidal variation, which is indicative of the presence of a third body around the compact X-ray binary. The mass and orbital radius of the third body is estimated to be about 19 Jupiter mass and 745 lt-s respectively. If true, it is the most massive circumbinary planet and also the smallest period binary known to host a planet. The results have interesting implication for formation and migration of orbits of planets in binary stellar systems.

ASI2017_1398	Anuvab Banerjee	Oral

Ayan Bhattacharjee^{1}, Indrani Banerjee^{1}, Anuvab Banerjee^{1,*}, Dipak Debnath^{2}, Sandip Kumar Chakrabarti^{1,2} 1. S.N. Bose National Centre for Basic Sciences,JD Block, Salt Lake, Kolkata 700106. 2. Indian Centre for Space Physics, 43 Chalantika, Garia Station Road, Kolkata 700084 *-presenting author

2004 Outburst of BHC H1743-322: Analysis of spectral and timing properties using the TCAF Solution.

The black hole transient H1743-322 exhibited several outbursts with temporal and spectral variability since its discovery in 1977. These outbursts occur at a quasi-regular recurrence period of around 0.5 − 2 years, since its rediscovery in March 2003. We investigate accretion flow dynamics around the Low Mass X-ray Binary H1743-322 during its 2004 outburst using the RXTE/PCA archival data. We use Two Component Advective Flow (TCAF) solution to analyse the spectral data. From the fits with TCAF solution, we obtain day to day variation of physical accretion rates of Keplerian and sub-Keplerian components, size of the Compton cloud and its other properties. Analysis of the spectral properties of the 2004 outburst by keeping fitted normalization to be in a narrow range and its timing properties in terms of the presence and absence of QPOs, enable us to constrain the mass of the black hole in a range of 10.31Msun − 14.07Msun which is consistent with other estimates reported in the literature. *Accepted in MNRAS on 29th November 2016, doi: 10.1093/mnras/stw3117.

ASI2017_1308	Dipak Debnath	Oral

Dipak Debnath(1), Sandip K Chakrabarti(1,2), Santanu Mondal(1,3), Arghajit Jana(1), Debjit Chatterjee(1), Aslam Ali Molla(1), Shreeram Nagarkoti(1), Ayan Bhattacharjee(2), Anuvab Banerjee(2), Indrani Banerjee(2) 1. Indian Centre for Space Physics, Kolkata, India 2. SN Bose National Centre for Basic Science, Kolkata, India 3. Instituto de Fisica Y Astronomia Facultad de Ciencias, Universidad de Valparaiso, Valparaso, Chile

TCAF model in XSPEC : An efficient tool to understand accretion flow properties of black hole binaries

It has been more than two decades of the classic work by Chakrabarti and his collaborators on the two component advective flow (TCAF) model. Recently we are successfully able to include it in HEASARC's spectral analysis software package XSPEC as an additive table model to fit energy spectra from various black hole candidates (BHCs) and obtain physical accretion flow parameters, such as, two component (Keplerian disk and sub-Keplerian halo) accretion rates, shock (location, i.e., the size of the Compton cloud, and the compression ratio) parameters, etc. This has dramatically improved our understanding about the accretion flow dynamics. Evolutions of the spectral and the temporal properties are transparent from the TCAF model fitted/derived physical parameters. Reason of different spectral states and their transitions during an outburst of a transient BHC are also clear. One can also predict frequency of the dominating quasi-periodic oscillation (QPO) from TCAF model fitted shock parameters and even predict most preferable mass range of an unknown

BHC from TCAF fits. To our knowledge this gives us the most physical tool to investigate the accretion flow dynamics around black hole candidates.

ASI2017_820	Broja Gopal Dutta	Oral

Broja Gopal Dutta1,2 and Sandip K. Chakrabarti3,2 1. Rishi Bankim Chandra College, Naihati, North Twenty Four Parganas, 743165, W.B, India 2. S.N. Bose National Centre for Basic Sciences, Sector-III, Saltlake, Kolkata-700098, India 3. Indian Centre for Space Physics, 43 Chalantika, Garia Station Road, Kolkata 700084, India

Implication of disk inclination on Hard and Soft lags in binary systems

We study the lag properties from fast variability in X-ray emission high inclination (XTE J1550-564) and low inclination (GX 339-4) black hole sources during outbursts. It is clearly observed in both high and low inclination systems that the lag increases when QPO frequency goes down, i.e., when the size of the Comptonizing region goes up. In fact, exactly opposite result is found also in the declining phase. We find that (Dutta & Chakrabarti, 2016) the time lag is not only a function of the average energy of the emitted photons, it is also a function of the inclination angle of the binary system. We explain the hard and soft lags are due to the effects of (i) repeated Compton scattering which accounts higher lags (hard) for higher-energy photons and for Compton clouds of larger size before they escape, (ii) reflection, and (iii) focusing due to gravitational bending. Specifically, we showed that if we add up the qualitative variations of the lag components, then the high inclination objects could have negative time lags, i.e., soft photons appearing after hard photons due to reflection and focusing effects. We explain lag-behaviour within the framework of a single two component advective flow model. Reference; 1.Dutta, Broja. G., Chakrabarti, S. K., Astro Physical Journal (ApJ), 2016, Vol. 828: 110 (8pp), 2016

ASI2017_970	Karamveer Kaur	Oral

1). Prof. S. Sridhar from Raman Research Institute, Bangalore 2). Dr. Mher V. Kazandjian from Leiden University,the Netherlands 3) Prof. J. R. Touma from American University of Beirut, Lebanon

Non-Axisymmetric Instabilities of a Stellar Disc around a Black Hole

The centres of many galaxies harbour Massive Black Holes which are surrounded by dense star clusters, known as Nuclear Star Clusters. Observations of nearby galaxies (our Galaxy and M31) show that these systems are very different in structure from other star clusters, say, globular clusters, in their deviations from spherical symmetry. These distortions could arise from dynamical, self-gravitating instabilities: e.g. it is known that stellar discs, having the counter-rotating populations of stars, are prone to a lopsided instability. I will present new investigations of other non-axisymmetric instabilities that may afflict an axisymmetric stellar disc corresponding to a particular kind of distribution function known as waterbag.

ASI-2017 Parallel Session - Tuesday, 9 March, 2017

Time: 11:30 - 13:00 Venue: Hall C

Extragalactic Astronomy – 5 [Chairperson: Ranjiv Mishra]

ASI2017_1095	Chanda J. Jog	Oral

Chaitanya Prasad, Indian Institute of Technology Bombay

Off-centred dark matter halo leading to strong central disc lopsidedness

There is increasing evidence now from simulations and observations that the centre of dark matter halo in a Milky Way type galaxy could be off-centred by a few 100 pc w.r.t. the galactic disc. We study the effect of such an offset halo on the orbits and kinematics in the central few kpc of the disc. The equations of motion in the disc plane can be written in terms of the disc and halo potentials when these two are concentric and a perturbation term due to the offset halo. This perturbation potential shows an m=1 azimuthal variation, or is lopsided, and its magnitude increases at small radii. On solving these equations, we find that the perturbed orbit shows a large deviation ~ 40 % in radius at R=1.5 kpc, and also strong kinematical lopsidedness. Thus even a small halo offset of 350 pc can induce surprisingly strong spatial and kinematical lopsidedness in the central region within ~ 3 kpc radius. Further, the disc would remain lopsided for several Gyr, as long as the halo offset lasts. This would have important dynamical consequences, for example it can help fuel the central AGN.

ASI2017_551	Sandeep Kumar Kataria	Oral

Sandeep Kumar Kataria(JAP-IIA, Bangalore), Mousumi Das(IIA, Bangalore)

Studying the Formation and Structure of Bars in Dark Matter Dominated Spiral Galaxies with and without bulges.

We present N body simulations of bar formation in dark matter dominated disk galaxies. Bars are elongated structures found in the centers of spiral galaxies. Nearly two thirds of all observed spiral galaxies in the nearby universe have bars. Bar formation in isolated galaxies occurs due to the exchange of angular momentum between the different mass components (disk, bulge and dark matter halo). Previous studies have shown that the interaction of the dark matter halo with the disk component in spiral galaxies is very important for bar evolution. In this study we investigate the role played by classical bulges in the formation and evolution of bars. We first made various models of disk galaxies using the GalIC code (Yurin et al 2014) that had increasing bulge masses. We started with models with no bulge and increased the bulge mass to form galaxies with bulge dominated disks. We evolved these models with Gadget-2 code (Springel et al 2005) and studied the bar instabilities that formed. We calculated how the bar strength varied with time for the different bulge mass fractions. We find that for small bulges the bar forms faster than that in bulgeless galaxies. But for massive bulges the bar forms more slowly. For very high bulge to disk mass ratio the bars become weaker or does not form at all. We also explore how the bar pattern speed varies with bulge mass. Our results indicate

that early type spiral galaxies can still form strong bars in spite of having massive bulges and that bulgeless galaxies will in general have weak bars.

ASI2017_447	Aditya Chowdhury	Oral

Jayaram N. Chengalur National Centre for Radio Astrophysics, Pune.

Angular Momentum Content in Gas Rich Dwarf Galaxies

Angular momentum dictates the morphology of a galaxy - systems with high angular momentum form thin disks whereas those with low angular momentum form bulges. Angular momentum is thought to have originated from tidal torquing in the primordial universe when proto-galaxies were collapsing. Further evolution of the angular momentum depends on the merger history. In a hierarchical evolution scenario, dwarf galaxies are thought to be progenitors of larger galaxies and hence it is interesting to quantify their specific angular momentum. In this talk we present a study of the angular momentum content in a sub-class of dwarf galaxies - those with very high HI to stellar mass ratio. For these galaxies the angular momentum can be determined with relatively little uncertainty arising from the stellar mass to light ratio. We have measured the specific baryonic angular momentum for a sample of five gas rich dwarf galaxies and compare their location on the earlier established angular momentum-mass correlation for galaxies. Our sample extends the angular momentum-mass plane to two orders of magnitude in mass below what was done in previous studies. We find that these gas rich dwarf galaxies have significantly more specific angular momentum than expected from the existing correlation. We discuss possible reasons for the observed discrepancy.

ASI2017_671	Omkar Suresh Bait	Oral

Sudhanshu Barway (SAAO), Yogesh Wadadekar (NCRA-TIFR)

Star formation history of massive galaxies along the Hubble sequence

Using multiwavelength data, from UV-optical-IR, for ~7000 galaxies in the local Universe, we study the dependence of star formation history on the morphological T-types for massive galaxies (\log M_*/M_\odot \geq 10). We model the SED for each galaxy in our sample using broadband fluxes from GALEX-SDSS-2MASS-WISE and estimate the stellar mass and star formation rate of each galaxy. Since we have UV data from GALEX, we can put a better constraint on recent star formation in our sample of galaxies. As expected, we find that the late type spirals (Sc-Im morphologies) and ellipticals are mostly star forming and quenched, respectively. However, the early-type spirals (Sa-Sbc morphologies) and S0s are most interesting as they populate the green valley, which is a transition zone between the star forming and quenched region. In particular, we find that the fraction of early-type spirals decreases as we enter the green valley from the blue cloud, which coincides with the increase in the fraction of S0s. This points towards the morphological transformation of early-type spiral galaxies into S0s which can happen due to environmental effects such as ram-pressure stripping, galaxy harrasment, or tidal interactions. Interestingly, we also find a second population of S0s which are actively star-forming and are present in all environments, from low to high densities.

ASI-2017 Parallel Session - Tuesday, 9 March, 2017

Time: 11:30 - 13:00 Venue: Hall D

Instrumentation and Techniques – 3 [Chairperson: A. N. Ramprakash]

ASI2017_691	Sabyasachi Chattopadhyay	Oral

Mr. Sabyasachi Chattopadhyay Email: sabyasachi@iucaa.in Primary Author, Contact Author Primary Affiliation: Inter-University Centre for Astronomy and Astrophysics Dr. A. N. Ramaprakash Email: anr@iucaa.in Co-Author Primary Affiliation: Inter-University Centre for Astronomy and Astrophysics Dr. Vishal Joshi Email: vjoshi@prl.res.in Co- Author Primary Affiliation: Physical Research Laboratory Mr. Pravin Khodade Email: pravin_khodade@iucaa.in Co-Author Primary Affiliation: Inter-University Centre for Astronomy and Astrophysics Mr. Chaitanya V. Rajarshi Email: cvr@iucaa.in Co-Author Primary Affiliation: Inter-University Centre for Astronomy and Astrophysics Mr. Haeun Chung Email: hchung@astro.snu.ac.kr Co-Author Primary Affiliation: Seoul National University

IFU System for DOTIFS - Creation and Deployment

Devasthal Optical Telescope Integral Field Spectrograph (DOTIFS) is a new multi-object integral field spectrograph being built by the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, India for the 3.6m Devasthal Optical Telescope, (DOT). The Devasthal Observatory is being constructed by the Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital. DOTIFS is mainly designed to study the physics and kinematics of ionized gas, star formation and H II regions in the nearby galaxies. DOTIFS is a novel instrument in terms of multi-IFUs, built in deployment system, and high throughput. A magnifier at the Cassegrain side port of the telescope feeds sixteen integral field units (IFUs). Each IFU is comprised of a microlens array and optical fibers offering 144 spaxels at a sampling of 0.8” per 300μm hexagonal microlens and a total field of view of 7.2” × 8.4”. The fibres feed eight identical spectrographs that will produce 2,304 spectra at R~1800, over a wavelength range of 370-740nm in a single exposure. The sampling scale can be changed by changing the magnifier and/or by dithered observations and proper data process. The IFUs can be deployed over an 8’ diameter focal plane by x-y actuators. An intelligent deployment algorithm has been developed to allow optimized reconfiguration and to avoid any collision between IFUs. The whole deployment system has a complex 3-dimensional structure to allow maximum positioning freedom to the IFUs. It has wide deployable area relative to each IFU’s field of view, and doesn’t require any direct human interaction for the deployment. This system is one of the big technical challenges of this project. Here we present the concept of creating IFU using an indigenous method as well as how to deploy them in the field of view in accordance with astronomical target object distribution. The instrument is at the phase of fabrication and is scheduled to be commissioned in early 2017.

ASI2017_1056	Padmakar Parihar	Oral

PSMT Group

A step toward realization of a large Optical-NIR telescope in India

Recently install 3.6m DOT telescope and forthcoming TMT would not be enough to cater the need of growing Indian astronomical community. Access to 10-12m size optical-NIR telescope equipped with state of the art back-end instruments can bridge the gap between DOT and TMT. A telescope of this size is only possible when primary mirror is made of smaller mirror segments. In order to get acquainted with segmented mirror telescope technology, in IIA we have initiated a project to develop a small prototype telescope made of seven spherical mirror segments (PSMT). I will present the progress made in opto-mechanical design as well development of other sub-systems required for the PSMT. The prototyping effort is one step toward realization of a large telescope in India and it is expected to be completed in two years period.

ASI2017_1029	Arun Surya	Oral

Authors: Prof. Sivarani Thirupathi Indian Institute of Astrophysics

Title: Data Pipeline for Hanle Echelle Spectrograph

Abstract: With the growing complexity of instruments and observations, data pipelines have become invaluable to present astronomers the interface to interact with reduced data and produce timely scientific results.The development of pipelines allow users to reduce the redundant work and utilize their time for understanding scientific observations. Its also important in the context or archiving data and making data public which leads to more scientific publications and results. Also having a pipeline gives you an opportunity to utilize the instrument to its limits and making design specific routines for data reduction. This is important in highly sensitive and high resolution observations like exoplanet detections, which require the instrument to be perfectly calibrated to work at lower Signal to Noise Ratio. Hanle echelle spectrograph (HESP) is a fibre-fed, high resolution (R = 30,000 and 60,000), spectrograph for the 2m HCT telescope, developed jointly by CI(Callaghan innovation), New Zealand and IIA. The project is funded by Department of Science and Technology (DST), India. The instrument cover the entire optical wavelength in a single instrument setup, without any gap in the wavelength cover. In the case of HESP we realised that the current methods of reductions through IRAF requires improvement with better visualizations of tracing, extraction of orders and automated wavelength calibrations. The HESP pipeline was thus developed to provide a simple interface to the user of HESP data to get extracted calibrated data from the instrument. In this poster we discuss the details of routines developed as part of the pipeline, written in Python, and the initial results which shows significant improvement over classic reduction methods using IRAF.

ASI 2017 Parallel Session - Tuesday, 9 March, 2017

Time: 14:30 - 16.00 Venue: Hall A

Sun and the Solar System - 6 [Chairperson: Abhishek Kumar Srivastava]

ASI2017_1402	K. Nagaraju	Oral

K. Amareswari and K. Sankarasubramanian, Space Astronomy Group ISITE,ISAC, K. E. Rangarajan, Indian Institute of Astrophysics

Spectropolarimetric observations of a small scale reconnection event in the chromosphere simultaneously in H alpha and Ca II at 854.2 nm

Magnetic reconnection plays a central role in producing energetic events such as Ellerman bombs, small scale jets, flares and CMEs in the solar atmosphere. However direct observation of magnetic field evolution associated with these events is very challenging. It is even more challenging to simultaneously observe magnetic field simultaneously at different heights such as photosphere, chromosphere and corona. We report in this presentation about full Stokes spectropolarimetric observations simultaneously in H alpha and Ca II at 854.2 nm lines of a magnetic reconnection event in the chromosphere. The observations have been obtained using the SPINOR instrument at the Dunn Solar Telescope, NSO, NM. The magnetic field information in the chromosphere is derived using Ca II 8542 line and at the photosphere it is derived using Fe I line at 656.9 nm adjacent to H alpha. Modeling of the atmosphere before and during the reconnection event through inversion of the data will be presented. We would also present briefly about the plans for simultaneous spectropolarimetry in multiple lines at Kodaikanal tower tunnel telescope towards the goal of measuring magnetic field simultaneously in the photosphere and chromosphere.

ASI2017_757	Subhamoy Chatterjee	Oral

Dipankar Banerjee Indian Institute of Astrophysics, Koramangala, Bangalore 560034, India; Center of Excellence in Space Sciences India, IISER Kolkata, Mohanpur 741246, West Bengal, India

Extraction of Features and their Long-term Evolution from Century-long Ca II K data of Kodaikanal Observatory

Kodaikanal Solar Observatory (KSO) has archived Ca II K spectroheliograms through photographic plates for about a century (1907 - 2007). Digitization and calibration of these plates have been carried out systematically. We have used those calibrated Ca II K images to extract features of different spatial scales. Plages, the bright on-disc features with projected area ≥ 1 arcmin^2, have been segregated in an automated way and parameters like, area and centroid locations have been recorded. Using those extracted parameters, century-long evolution of plages has been studied. To confirm plages as magnetic proxy we correlated their locations with magnetic patches through construction of Carrington maps from both MDI/SoHO line-of-sight magnetograms and Ca II K spectroheliograms from KSO for overlapping rotations. Exploiting the Ca II K data we also tried to estimate the scales and other geometrical parameters of supergranules without manual intervention. We could study the correlation of solar cycle and temporal evolution of supergranule parameters for many cycles because of

availability of 100 years' data at KSO. Moreover, using plage detection we divided full solar disc into active and quite regions. For each of those regions we again recorded the temporal evolution of supergranule parameters as mentioned before. We found in phase and out of phase correspondences between sunspot number cycle and supergranule parameter cycle for aggregate and segregated regions. This study gave a hint about complex solar dynamo operating inside the sun at different spatial scales with influence of magnetic fields.

ASI2017_1283	Bhuvan Joshi	Oral

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Pre-flare activities, flux rope eruption and associated X2.7 solar flare from active region NOAA 12339

We investigate the flux rope eruption and energy release process during an X2.7 flare occurred in the active region NOAA 12339 using E(UV), HXR and metric radio observations. The RHESSI and GOES light curves along with RHESSI images reveal significant pre-flare activities in this active region prior to this large X-class flare. Although the pre-flare X-ray sources were not exactly co-spatial to the main flare but contributed toward the heating of the active region corona. During the X2.7 flare, we observe two prominent HXR bursts up to ~300 keV energies during which spectra showed strong non-thermal characteristics with power-law indices 2.9 and 2.6 respectively. The flare initiated with fast eruption of the flux rope with projected speed as ~1300 km/s. The hot flux rope along with filament material exhibited much faster radial expansion over its lateral expansion. The impetuous eruption of the flux rope occurred in conjunction with the impulsive rise of strong HXR flare emission and metric type III radio burst, implying opening of overlying closed filed lines by magnetic reconnection. The HXR source structures during the evolution of X2.7 flare shows 'standard' conjugate footpoint sources without appreciable movement of the looptop sources. The lack of upward movement of the looptop source likely indicates the absence of overlying closed filed lines in the outer envelope of the active region corona due to which magnetic reconnection could not proceeded at larger coronal heights.

ASI2017_897	Aabha Monga	Oral

Aabha Monga, ARIES, Nainital; Wahab Uddin, ARIES, Nainital; Ramesh Chandra, DSB Campus, Nainital; Arun K Awasthi, University of Worclaw, Poland.

PHOTOSPHERIC ENHANCEMENT AND Hα EVOLUTION OF THE X1.2 CLASS FLARE

The major X1.2 class flare occurred in the highly complex active region NOAA AR 11748 on May 15, 2013. Here, we reported evolution of the photospheric Doppler enhancements and the Hα evolution of the flare. Flare showed the two ribbon structure and we seems the stationary brightening propagates during the flare. The jet-like activity before the onset of the flare was the driver of instability. The flare occurred in the lower corona and the coronal loops moved upward which gives the signature of the magnetic reconnection beneath the uprising loops. On the contrary, we found two clusters(kernels) of the velocity enhancements exactly matches the Hα brightening and delayed by 4 minutes. We report on localized enhancement in line-of-sight velocities in the active region related to a flare and the sudden enhancement of this velocity seems to be caused by the Lorentz force driven by the "magnetic jerk".

ASI-2017 Parallel Session - Tuesday, 9 March, 2017

Time: 14:30 - 16.00 Venue: Hall B

Stars, ISM and the Galaxy – 6 [Chairperson: Sarita Vig]

ASI2017_1349	Susmita Chakravorty	Oral

Susmita Chakravorty (IISc, India), Pierre-Olivier Petrucci (IPAG, Grenoble, France), Jonathan Ferreira (IPAG, Grenoble, France)

MHD acceleration for accretion disk winds around black hole binaries

High resolution X-ray spectra of black hole X-ray binaries (BHBs) show blueshifted absorption lines suggesting the presence of outflowing winds. Furthermore, observations show that the disk winds are equatorial and they occur in the Softer (disk dominated) states of the outburst and are less prominent or absent in the Harder (power-law dominated) states. We are testing if self-similar magneto-hydrodynamic (MHD) accretion-ejection models can explain the observational results for accretion disk winds in BHBs. In our models, the density at the base of the outflow, from the accretion disk, is not a free parameter, but is determined by solving the full set of dynamical MHD equations without neglecting any physical term. Different MHD solutions were generated for different values of (a) the disk aspect ratio and (b) the ejection efficiency `p'. We generated two kinds of MHD solutions depending on the absence (cold solution) or presence (warm solution) of heating at the disk surface. The cold MHD solutions are found to be inadequate to account for winds due to their low ejection efficiency. The warm solutions can have sufficiently high values of p (>= 0.1) which is required to explain the observed physical quantities in the wind. The heating (required at the disk surface for the warm solutions) could come from (i) the dissipation of energy due to MHD turbulence in the disk or (ii) from the illumination of the disk surface which would be more efficient in the Soft state. We found that in the Hard state a range of ionisation parameters is thermodynamically unstable, which makes it impossible to have any wind at all, in the Hard state. Thus, using the MHD outflow models, we are able to explain the observed trends, i.e. that the winds are equatorial and that they are observable in the Soft states (and not expected in the Hard state) of the BHB outbursts. Encouraged by the success of the models we are formalising methods to predict theoretical high resolution spectra to be fitted to absorption line observations from XMM-Newton and Chandra gratings. Our models will include the key physical parameter p (the ejection efficiency) of the accretion disk. Hence we hope to directly constrain physical parameters of the disk by fitting the observed spectra.

ASI2017_1093	Bharti Arora	Oral

Jeewan C.Pandey Aryabhatta Research Institute of Observational Sciences, Nainital.

X-ray observations of a colliding wind binary WR-25.

Using the data obtained from Chandra, Suzaku, XMM-Newton, and Swift spanning over ~13 years, we present an analysis of a WN+O Wolf-Rayet binary, WR 25. The X-ray light curves folded over a period of ~208 d in 0.3-10.0 keV energy band showed phase-locked variability where the count rates are found to be maximum near the periastron passage. The X-ray spectra of WR 25 are explained by a two-temperature plasma model with temperatures of 0.644±0.007 and 2.96±0.07 keV and are consistent with previous study. The orbital phase dependent local hydrogen column density is found to be maximum after the periastron passage, when the WN star is in front of the O star. The hard (2.0-10.0 keV) X-ray luminosity is linearly dependent on the inverse of binary separation which confirms that WR 25 is a colliding wind binary.

ASI2017_727	Jayashree Roy	Oral

J.Roy, P. C. Agrawal, S.Pattnaik, M.Choudhury UM-DAE Center For Excellence in Basic Sciences, Mumbai

Temporal and Spectral study of 4U 1626-67 with LAXPC (ASTROSAT)

Large Area X-ray Proportional Counter (LAXPC) onboard ASTROSAT satellite observed ~7.67 sec accretion powered pulsar 4U 1626-67 on three occasions, 13th January, 26th January and 26th August 2016. The pulsar is known to undergo torque reversal, last detected torque reversal is centered near MJD 54500 (2008 Feb 4), since then it shows a steady spin up state. We present detailed energy dependent timing analysis of this source and observed a spin up from the source. We report a mild detection of X-ray orbital periodicity from the source at ~2500 sec for the first time in using LAXPC data for the X-ray pulsar. Detailed spectral analysis showed the detection of a cyclotron line feature centered at ~37 keV.

ASI2017_682	Nafisa Aftab	Oral

Biswajit Paul RAMAN RESEARCH INSTITUTE

X-ray reprocessing: Through eclipse spectra of High and Low Mass X-ray Binaries

A difficult aspect of studying reprocessed X-rays in X-ray binary systems is that the reprocessed emission is detected along with the primary emission, which is much brighter. During eclipse, the primary emission is blocked by the companion star and only the reprocessed emission is detected, allowing study of the reprocessing agent. We have studied 9 High Mass X-ray Binaries (Cen X-3, LMC X-4, 4U1538-522, 4U1700-377, IGR J16479-4514, SMC X-1, IGR J18027-2016, IGR J16418-4532, IGR J17252-3616) and one Low Mass X-ray Binary EXO 0748-676 during and outside eclipse with XMM-NEWTON EPIC PN. In the HMXB systems, we have generally found much stronger Fe Kα emission lines in the eclipse spectra compared to the out of eclipse spectra. However, there are some exceptions and there are significant system to system

differences. In seven long observations of the LMXB EXO 0748-676, each covering several binary orbits and the eclipses, we have not detected Fe Kα line. The eclipse spectrum in all these observations carried out over a 2 months period show the spectrum to be nearly identical and so is the out-of-eclipse spectrum above 5 keV, indicating a non-varying accretion/emission scenario. However, the out-of-eclipse spectrum below 5 keV shows significant variation. Comparing the eclipse spectra with the out-of-eclipse of these sources, we try to infer the X-ray wind and accretion disk characteristics of these systems, which are the reprocessing agents in the high and low mass X-ray binaries respectively.

ASI2017_432	Gaurava K Jaisawal	Oral

Sachindra Naik (PRL, Ahmedabad)

First detection of cyclotron resonance scattering feature in high mass X-ray binary pulsar SMC X-2 with NuSTAR

We have studied broadband spectral properties of the accretion powered X-ray pulsar SMC X-2 by using three simultaneous NuSTAR and Swift/XRT observations during its 2015 outburst. The pulsar was significantly bright (~5.5x10^38 ergs/s) during these observations, accreting above the Eddington luminosity of a canonical neutron star. Spin period of the pulsar was estimated to be 2.37 s. Pulse profiles were found to be strongly luminosity dependent. The 1-70 keV energy spectrum of the pulsar was well described with three different traditional continuum models. In addition to an iron line at ~6.4 keV, a model independent absorption like feature was detected at ~27 keV in the pulsar spectrum for the first time. We identified this feature as cyclotron absorption line of the pulsar. Corresponding magnetic field of the neutron star was estimated to be ~2.3x10^12 G. The cyclotron line energy showed a marginal negative dependence on the luminosity. The cyclotron line parameters were found to be variable with pulse phase and discussed in terms of viewing angle or the effect of the complicated structure in the magnetic field.

ASI-2017 Parallel Session - Tuesday, 9 March, 2017

Time: 14:30 - 16.00 Venue: Hall C

Extragalactic Astronomy – 6 [Chairperson: Ranjiv Mishra]

ASI2017_1185	Nayana A.J	Oral

Poonam Chandra NCRA-TIFR

LONG TERM RADIO MONITORING OF A TYPE IIP SUPERNOVA SN 2004DJ

Type IIP Supernovae (SNe) are core collapse SNe, characterised by the presence of a plateau in the optical light curve. Type IIP SNe constitute about 67% of all core collapse SNe in a volume limited sample (d<30 Mpc). Thus they are the most commonly observed variety of core-collapse events. SN 2004dj is one of the brightest and nearest Type IIP supernova discovered by Nakano et al. (2004) in July 2004. It is the closest (~ 3.06 Mpc) normal type IIP supernova to date. We present extensive radio follow up observations of SN 2004dj with GMRT and VLA from 2004 to 2016. Thus we study the 12 years of evolution of this extremely bright SN. Our well sampled spectra and light curve explain properties of progenitor star, structure of the circumstellar medium etc. The extensive radio data provide unique informations about cooling mechanisms and their dominance. We interpret our results in conjunction with the previous published results based on X-ray emission from SN 2004dj. Thus we study SN2004dj in detail as a prototype of its class.

ASI2017_1281	Aarthy E	Oral

T. Chattopadhyay (PRL, Penn State University), S. V. Vadawale (PRL), N. P. S. Mithun (PRL), A. R. Rao (TIFR), D. Bhattacharya (IUCAA), V. B. Bhalerao (IUCAA), S. Mate (IUCAA), A. M. Vibute (IUCAA), S. Sreekumar (VSSC)

GRB Polarization using AstroSat CZTI

Cadmium Zinc Telluride Imager (CZTI), one of the five instruments onboard AstroSat is primarily meant for simultaneous spectroscopy and imaging in the energy range 20 keV to 200 keV. The increasing transparency of the collimators and other supporting structures of CZTI at energies beyond 100 keV provides a unique opportunity to detect GRBs during their prompt emission. At the same energy range CZTI is shown to work as a sensitive Compton Polarimeter [Chattopadhyay et al, 2014, EXPA, Vadawale et al 2015, A&A] primarily due to the pixilation nature of the detectors and significant Compton scattering probability at energies beyond 100 keV. Given the fact that GRB prompt emission is highly polarized as corroborated by recent findings by GAP and INTEGRAL, they are one of the suitable polarimetry targets for CZTI. We have analysed all the GRBs detected by CZTI over duration of one year. Around 47 GRBs were detected by CZTI from September 2015 to September 2016 and we obtained significant detection of polarization for 11 GRBs. A detailed Geant 4 simulation of AstroSat mass model including all the instruments onboard and the satellite structure was developed for polarization analysis. We would present the preliminary polarization results of the GRBs. Statistical analysis of a large sample of GRB polarization from CZTI would lead to a better understanding of

the emission mechanism of GRBs. Some of these aspects along with the prospects of CZTI in constraining the emission mechanisms for GRB prompt emission would be briefly discussed here.

ASI2017_409	Kalyani Bagri	Oral

Ranjeev Misra (IUCAA),J.S.Yadav (TIFR),S.K.Pandey (PTRSU,Raipur)

Systematic Spectral Analysis of Low/Hard State of GX 339-4 During Four Outbursts to Investigate the Truncation of Accretion Disk

The canonical low/hard states of black hole binaries are generally explained in terms of truncation of the standard accretion disk at larger radii and the inner regions are replaced by the hot inner flow giving rise to the hard X-ray flux via Comptonization. This is empirically supported by the smaller values of photon index ~1.7 (<2) implying that the hot medium is seed photons starved. On the other hand, the presence of a broad Iron line found on several occasions during the hard state indicates that the accretion disk is not truncated but extends all the way to the inner most stable orbit. If this is the case, the hot inner flow should not be photon starved, contrary to the observational results. The broad Iron line should be accompanied by a broad smeared reflection bump at ~30 keV and it maybe that this additional component makes the spectrum hard and the intrinsic photon index is larger, i.e. > 2. This would mean that the medium is not photon deficient, reconciling the presence of a broad Iron line in the hard state. To test this hypothesis, we have analyzed the RXTE observations of GX 339-4 during its four outbursts and identify the observations when the system was in the hard state and showed a broad Iron line. We have made an attempt to fit these observations with models which include smeared reflection to understand whether the intrinsic photon index can indeed be large. We present the results of this analysis and other correlations between spectral parameters such as the flux, ionization level, Equivalent Width of the line, etc.

ASI2017_570	Abhishek Paswan	Oral

Amitesh Omar ARIES, Nainital

First observational measurement of magnetic field strengths in ISM of early- type galaxies

The magnetic field strengths are constrained observationally for the first time in the inter stellar medium (ISM) of early-type galaxies (elliptical and lenticular; ETGs) using 1.4 GHz radio continuum. A large number of blue ETGs were detected in the Sloan Digital Sky Survey (SDSS), based on their optical colors. We used the sample of blue ETGs in which the emissions are primarily due to star-forming activities without any significant contribution from active galactic nuclei. We found a remarkable correlation between the radio emission and the far-infrared emission in star-forming ETGs, similar to star-forming late-type (spiral and irregular) galaxies. The positive radio-far infrared correlation in ETGs implied that the radio emission is primarily from the synchrotron process, which allowed us to estimate magnetic field strengths assuming equipartition between cosmic rays and magnetic field energy densities. The average magnetic field strength in the ISM of ETGs is estimated as $\sim 10\mu G$, which is similar to the large-scale magnetic fields in spiral galaxies. It is proposed that magnetic fields are amplified in occasional star-bursts and subsequently regularized and sustained over long periods in ETGs in some dynamical components such as rings.

ASI2017_1266	Samyaday Choudhury	Oral

Samyaday Choudhury (1), Annapurni Subramaniam (2), Andrew A. Cole (3), Young-Jong Sohn(4) (1)Yonsei University Observatory, 120-749, Seoul, Republic of Korea (2) Indian Institute of Astrophysics, 2B Koramangala, Bangalore 560034, India (3)School of Physical Sciences, University of Tasmania, Private Bag 37, Hobart, Tasmania 7001, Australia (4) Department of Astronomy, Yonsei University, Seoul, Republic of Korea

First of its kind photometric metallicity map of the Small Magellanic Cloud

The Magellanic Clouds (MCs), comprising of the Large Magellanic Cloud (LMC) and the Small Magellanic Cloud (SMC) are two nearby (∼ 57 kpc), interacting galaxies to our Milky Way. In a previous attempt to understand the metallicity variation within the LMC, we created a first of its kind high-spatial resolution metallcity map with Red Giant Branch (RGB) stars as the tool, using the Magellanic Cloud Photometric Survey (MCPS) and Optical Gravitational Lensing Experiment (OGLE III) photometric data. The RGB is identified in the V, (V - I) colour- magnitude diagrams of small subregions of varying sizes in both data sets. The slope of the RGB is used as an indicator of the mean metallicity of a subregion, and it is calibrated to metallicity using spectroscopic data for field and cluster RGB stars in selected subregions. We now extend our technique to the SMC with similar dataset. A high spatial resolution metallicity map showing the trend across the complete SMC is still unavailable. For the SMC, we have developed a technique similar to the LMC to first estimate the RGB slope, and calibrate the same to metallicity using spectroscopic results. The map can be used to estimate the mean metallicity within different regions of the SMC, the metallcity gradient, as well as help locate outliers, which are important in the context of understanding the chemical evolution of this galaxy. The nature of any metallicity gradient in the SMC, is a matter of great current controversy and requires a study such as ours using global, homogeneous datasets to make significant advances. The LMC and the SMC map can be compared to understand the chemical evolution history and the interaction history of the Clouds. The initial results based on our study will be discussed.

ASI-2017 Parallel Session - Tuesday, 9 March, 2017

Time: 14:30 - 16.00 Venue: Hall D

Instrumentation and Techniques – 4 [Chairperson: A. N. Ramprakash]

ASI2017_845	Yashwant Gupta	Invited

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The upgraded GMRT : Current Status and Future Prospects

The Giant Metrewave Radio Telescope (GMRT) is today a major international Radio Astronomy facility working in five discrete bands in the frequency range of 150 MHz to 1500 MHz, with a maximum instantaneous bandwidth of 32 MHz. Consisting of 30 fully steerable antennas of 45 metre diameter each, it can be used as an aperture-synthesis array for imaging, as well as a phased array to study compact radio sources such as pulsars. The GMRT has produced several important results in the past 15 years of operations -- a few select ones will be highlighted. The GMRT is undergoing a major upgrade that will improve its sensitivity by a factor of upto three and make it a much more versatile instrument. The goal is to have seamless frequency coverage from about 100 to 1500 MHz, with a maximum instantaneous bandwidth of 400 MHz; improved receiver systems with higher G/Tsys; versatile digital back-end correlator and pulsar receiver using the latest FPGA and GPU technologies; revamped servo system; sophisticated monitor and control system; and matching improvements in infrastructure and computing. This upgrade will keep the GMRT at the forefront as one of the most sensitive facility in the 100 to 1500 MHz range, till the SKA phase I comes along. Most of the sub-systems of the uGMRT are nearing completion and delivery, and the upgraded observatory is being made available to users in a phased manner, from April 2016 onwards. An overview of the upgrade activities, their current status and future plans, including specific challenges faced, will be described. First science results from the uGMRT and future potential will also be presented.

ASI2017_1290	Surajit Mondal	Oral

Surajit Mondal(NCRA, TIFR), Niruj R. Mohan (NCRA, TIFR), Divya Oberoi(NCRA, TIFR), Santaji Katore (NCRA, TIFR)

Full-Stokes Holographic Measurement of GMRT Primary Beams

The primary beam of individual antennas serves as an envelope for the response of a radio interferometer. Traditionally it is assumed that all the antennas have identical and azimuthally symmetric primary beams, which allows us to apply a single multiplicative correction to the final image. In reality, the primary beam for the GMRT, like any other interferometer, has significant departures from azimuthal symmetry and also varies from antenna to antenna. In addition, the alt-az mount of the GMRT makes this beam rotate with time while tracking a source. These effects result in time and direction dependent gains for each antenna. Left uncorrected, this limits the dynamic range of the final image and this problem is exacerbated with the increased sensitivity of the GMRT. Software that is able to correct for time and antenna dependent primary beams are being

developed only now. In order to achieve the theoretical sensitivity in deep wide-field images made with the uGMRT, it is essential to account for these effects. We have therefore embarked on an exercise to measure the vector primary beams of all the GMRT antennas in all the 4 Stokes parameters at all frequency bands. Here, we discuss the methodology adopted and present initial results from this project.

ASI2017_924	Santaji N Katore	Oral

Dharam V. Lal (NCRA), Nilesh S. Raskar (NCRA) and Ishwara Chandra(NCRA).

Characterising the time-domain (250-500 MHz) band stability of the upgraded GMRT system

Giant Metrewave Radio Telescope (GMRT), located near Pune in India, is an array of radio telescopes operating at metre wavelengths. It is currently undergoing a very significant upgrade to retain its status as the most sensitive interferometer in the world at low radio frequencies. Among several ongoing upgrades to almost all aspects, in the new frond-end and the digital back-end upgraded systems, we now have 400 MHz RF receivers, and 400 MHz digital backend. We have performed the study of time-domain band stability over long time baseline for the 250-500 MHz band of the upgraded GMRT. Here, we present the improvements in the quality of the upgraded GMRT data and compare it with the legacy GMRT system.

ASI2017_771	Narendra Nath Patra	Oral

Nissim Kanekar (NCRA), Jayaram N. Chengalur (NCRA), Yashwant Gupta (NCRA)

The expanded Giant Metrewave Radio Telescope

We present some preliminary results from a study regarding possible extensions of the Giant Metrewave Radio Telescope (GMRT). We explore three possibilities for expansion, viz. (1) installing Focal Plane Array (FPA) feeds to significantly increase the field of view (2) adding antennas at short baselines (baselines <~ 5 km) to improve the surface brightness sensitivity and (3) adding antennas at long baselines (~ 50 km) to reduce the confusion level. We will present the results from studies for the optimum antenna locations for getting a desired synthesized beam. We also compare the capability of some of these expanded configurations (with and without focal plane arrays) for deep high redshift HI surveys against that of pathfinders to the SKA as well as the SKA Phase I.

ASI 2017 Parallel Session - Tuesday, 9 March, 2017

Time: 16.30 - 18.00 Venue: Hall A

Sun and the Solar System - 7 [Chairperson: Abhishek Kumar Srivastava]

ASI2017_1337	G. Sindhuja	Oral
Prof. Nandita Srivastava, Physical research laboratory, Udaipur solar observatory, udaipur		
Study of confined and eruptive solar events observed in Ca-K images		
There are two kinds of major energetic phenomena called eruptive and confined events. The former describes flares with associated coronal mass ejections (CMEs), while the latter denotes flares without associated CMEs. One of the method to understand the mechanism of the two types of events is to derive the magnetic-reconnection rates and fluxes from the flare-ribbon evolution of the active region. For this purpose we use the high cadence Ca-K time series data and low-noise 720-second HMI LOS magnetogram data were used to measure the reconnection rate, total reconnection flux. From the past studies it is understood that the surface magnetic flux swept by the flare ribbons relates to a global reconnection rate. Therefore in order to measure the abovesaid parameters, the observables like the newly brightened area and magnetic field of the area inside this, are calculated. This study is conducted both on confined and eruptive events and the difference between the two are studied. The difference is expected since in the eruptive flares, part of the energy is converted into the magnetic reconnection process into acceleration and escape of the CME, whereas in the confined flares all of the magnetic energy released is available for the flare. In this paper, we report the results of the analysis carried for different cases of confined and eruptive flares.		

ASI2017_1262	P. Vemareddy	Oral
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Recurrent eruptions by converging and shearing polarities in a solar active region		
Solar eruptions include flares and CMEs which influence the heliosphere and planetary atmosphere in a wide range of physical phenomena. Powerful, spectacular eruptions occur in active regions (ARs) with distinct evolving conditions. In the space weather perspective, they are of great scientific interest compared to non-eruptive ARs. To this end, we consider an AR producing faster CMEs recurrently in a week time of observation. Coronal observations from AIA/SDO reveal inverse S-sigmoid morphology to the magnetic structure. The HMI/SDO magnetic field observations show converging and shearing motion of opposite polarity regions co-spatial with the twisted core flux system of the sigmoid. From these observations, we propose continuous shearing and submerging motion of opposite polarity regions lead to formation of sheared arcade, which upon slow reconnection forms flux rope being erupted by tether-cutting reconnection. Various magnetic non-potential parameters support this scenario of energy build up and release by eruptions. We further analyzed modeling aspect of AR magnetic structure and feasibility conditions for eruption.		

ASI2017_1381	Amareswari K	Oral

Amareswari K. (ISRO Satellite Centre,Bangalore), Sreejith Padinhatteeri (Manipal Center for Natural Sciences, Manipal University, Manipal), Sankarasubramanian K. (ISRO Satellite Centre,Bangalore)

On the connection between Active region complexity and Solar Flare strength.

Active regions on the solar disk, with complex magnetic topology have higher probability of flaring. Modified Mount-Wilson scheme is one of the methodology to classify active regions based on their complexity (Hale e. al., 1919, Kunzel, 1965). As per this scheme, sunspots are classified as alpha, beta, gamma, and delta with the complexity of the magnetic topology increasing from alpha to delta. The delta sunspots are known to be highly flare- productive. An existing automated algorithm (SMART-DF) is modified and used to identify delta-spots for the existing full disk SOHO/MDI data. The automatically identified delta-spots is compared with the NOAA-SRS database and found to be reproducing almost all the identified delta-spots. In this study, the connection between formation of delta-spot and flares is also carried out. Preliminary results from this statistical study on solar flare-delta spots connections along with the flare strength will be presented.

ASI2017_1381	Azad Ahmad Mansoori	Oral

Azad. A. Mansoori1, Parvaiz .A. Khan2 and P. K. Purohit3
1. Department of Electronics, Barkatullah University, Bhopal – 462026, MP, India
2. Department of Electronics and Communication Engineering, Islamic University of Science and Technology, Pulwama, J & K, India
3. National Institute of Technical Teachers' Training and Research, Bhopal – 462002, MP, India

Effects of Solar Flare Radiations on the GPS Derived Total Electron Content at Low, Mid and High Latitudes

The state and dynamics of the earth's ionosphere is completely controlled by the solar radiations. The amount of solar radiation incident on the ionosphere varies considerably with the solar activity, so does the ionospheric variability. In this chapter we investigate the influences of solar flares on the ionospheric variability, since during solar flares huge amounts of radiation fluxes are released from the sun. To investigate the effect of solar flares on the ionosphere we consider the solar flares that were observed during 1998-2011. We have taken the three latitude station one each in mid, low and high latitude region. The solar X-ray flux in the 0.1 – 0.8 nm band were taken from the measurements of Geostationary Operational Environmental Satellite while as the solar EUV flux in the 24 – 34 nm band were taken from the Solar EUV monitor (SEM) onboard SOHO spacecraft. The correlative study of these fluxes was carried out with GPS derived Total Electron Content (TEC) at three latitude station viz Davis (68.570S, 77.960E), Usuda (36.130N, 138.360E) and IISC Bangalore (13.020N, 77,570E). From our study we found that peak values and peak enhancements of the radiation fluxes correlate well with the peak values and peak enhancements of TEC. However the correlation between peak enhancements of fluxes and TEC are much stronger than the correlation between peak values themselves. We then adjusted the solar radiation fluxes to the CMD, where CMD is Central Meridian Distance and takes care of flare location on the solar disc, and then investigated the correlation of CMD adjusted fluxes with the TEC. We found that the correlation between fluxes and TEC is extraordinarily improved as the fluxes are adjusted to CMD. Therefore location of flare has a considerable role in deciding how much impact it will produce on the ionosphere.
Key Words: GPS, TEC, CMD

ASI-2017 Parallel Session - Tuesday, 9 March, 2017

Time: 16.30 - 18.00 Venue: Hall B

Stars, ISM and the Galaxy – 7 [Chairperson: Sarita Vig]

ASI2017_754	Sachindra Naik	Oral

Gaurava K. Jaisawal Physical Research Laboratory, Ahmedabad

Recent Results on Cyclotron Resonance Scattering Features in Accretion Powered X-ray Pulsars

Cyclotron resonance scattering features (CRSF) are unique features detected in the broad-band X-ray spectra of accretion powered X-ray pulsars. Detection of these features provides us a direct estimation of the surface magnetic field of the neutron stars. Corresponding to magnetic field of ~10^12 G, the fundamental lines are expected in 10-100 keV energy range with harmonics expected at multiples of fundamental line energy. However, we detected first harmonics of cyclotron line at less than twice of the fundamental line energy in a few X-ray binary pulsars. With the broadband spectral capability of X-ray observatories such as Suzaku, NuSTAR etc., we have investigated the CRSF in several X-ray pulsars to understand characteristic properties of such lines. The results obtained from our studies of CRSF in X-ray pulsars will be discussed.

ASI2017_738	Varun	Oral

Varun (Raman Research Institute), Biswajit Paul (RRI),Aru Beri(University Of Southampton), Sujay Mate (IISER Pune), Pragati Pradhan (University of North Bangal), Nazma Islam (Nicolaus Copernicus Astronomical Center), Chandreyee Maitra (Max Plank Institute Of Astrophysics), Chetana Jain (Dehli University), J.S. Yadav (Tata Institute of Fundamental Institute), H.M. Antia (TIFR), P.C. Agarwal (TIFR), R.K. Manchanda (TIFR), P.Shah(TIFR), D. Dedhia (TIFR), T. Katoch (TIFR), P. Madhwani (TIFR), M. Pahari (IIUCAA), J.V. Chavan (TIFR).

Astrosat LAXPC observation of the rotation powered pulsar PSR B 1598-58

We present results from timing and spectral analysis of a LAXPC observation of the young rotation powered pulsar PSR 1509-58. This is among the sources with highest spin-down energy powering a bright Pulsar Wind Nebula. With a short observation carried out over 8 orbits of Astrosat during 01-02 March 2016, the pulsations have been detected in the entire energy band of 3-80 keV in each of the three LAXPC detectors. We have also accurately measured the spectral parameters of the pulsed emission in the 4-60 keV band. The background variation is mitigated by subtracting the off-pulse component. Prospects for further timing and spectroscopic studies of rotation powered pulsars will also be discussed.

ASI2017_1299	Prakash Arumugasamy	Oral

Prakash Arumugasamy, NCRA-TIFR

Absorption-like features in middle-aged pulsars

X-ray emission in pulsars originates from the hot stellar surface via thermal and from the magnetosphere via non-thermal processes. The spectra observed from pulsars spanning a wide range of characteristic ages are hence well-fit with a single or a combination of blackbody and/or power-law models. Middle-aged pulsars (100 - 1000 yr characteristic ages) are ideal for studying the phase-resolved variations of these emission components simultaneously, and some of them are bright enough to provide high signal-to-noise data in reasonable integration times. I will focus on two such objects where in addition to the conventional continuum emission components, we detected broad absorption-like features between 0.5 - 1 keV. I will discuss the possible origins of absorption lines in pulsar atmosphere and magnetospheres as well as the thermal or magnetic processes that mimic such features. Finally, I will motivate the work needed to devise realistic models to explain these features.

ASI2017_854	Arun Kumar Naidu	Oral

Bhal Chandra Joshi (NCRA) P.K Manoharan (NCRA) M.A KrishnaKumar (NCRA)

Simultaneous multi-frequency single pulse observations of pulsars

Aims: We report on simultaneous multi-frequency single pulse observations of a sample of pulsars with previously reported frequency dependent subpulse drift inferred from non-simultaneous and short observations. We aim to clarify if the frequency dependence is a result of multiple drift modes in these pulsars. Methods: We performed simultaneous observations at 326.5 MHz with the Ooty Radio Telescope (ORT) and at 326, 610 and 1308 MHz with the Giant Meterwave Radio Telescope (GMRT) for a sample of 12 pulsars, where frequency dependent single pulse behaviour was reported. The single pulse sequences were analysed with fluctuation analysis, sensitive to both the average fluctuation properties (using Longitude Resolved fluctuation spectrum - LRFS, and Two-Dimensional Fluctuation Spectrum - 2DFS) as well as temporal changes in these (using Sliding two-dimensional Fluctuation Spectrum -S2DFS) to establish concurrent changes in subpulse drifting over the multiple frequencies employed Results: We report subpulse drifting in PSR J0934−5249 for the first time. We also report pulse nulling measurements in PSRs J0934−5249, B1508+55, 1822−2256, B1845−19 and J1901−0906 for the first time. Our measurements of subpulse drifting and pulse nulling for the rest of the pulsars are consistent with previously reported values. Contrary to previous belief, we find no evidence for a frequency dependent drift pattern in PSR B2016+28 implied by non-simultaneous observations by Oster et al. (1977). In PSRs B1237+25, J1822−2256, J1901−0906 and B2045−16, our longer and more sensitive observations reveal multiple drift rates with distinct P3 . We increase the sample of pulsars showing concurrent nulling across multiple frequencies by more than 100 percent, adding 4 more pulsars to this sample. Our results confirm and further strengthen the understanding that the subpulse drifting and pulse nulling are broadband consistent with previous studies (Gajjar et al. 2014a; Rankin 1986, WES07) and are closely tied to physics of polar gap.

ASI2017_1200	Sanhita	Oral

Nazma Islam(1), Biswajit Paul (2). 1.Nicolaus Copernicus Astronomical Center, Poland. 2. Raman Research Institute, Bangalore-560080, India.

An intriguing partial eclipse in the high mass X-ray binary pulsar IGR J16393–4643

We will report discovery of an intriguing partial eclipse in the high mass X-ray binary pulsar IGR J16393-4643. In accreting X-ray pulsars, which are high magnetic field neutron starts, the X-rays are emitted from a small region, no larger than a few km. The eclipses in such systems are therefore expected to be complete. In most eclipsing HMXBs, the X-ray eclipses are about two orders of magnitude fainter compared to the out of eclipse emission. In contrast, we have found the hard X-ray eclipse in IGR J16393-4643 to be narrow and partial casting doubt if it is indeed an eclipse. We have carried out a further soft X-ray study of IGR J16393-4643 using a large number of observations with Swift-XRT. The soft X-ray observations also show a partial eclipse, with the intensity in the eclipse being about ~30% of the intensity outside the eclipse. In eclipsing HMXBs, the absorption column density shows increase just before and after the eclipse and the equivalent width of iron emission shows large increase during the eclipse. We have also carried out spectroscopy with the XRT data, though with limited statistics, over the entire binary orbital phase to measure the absorption column density and equivalent width of iron emission line, if any.

ASI2017_837	Avishek Kumar Basu	Oral

Avishek kumar Basu (NCRA-TIFR), Dipankar Bhattacharyaa (IUCAA), Bhal Chandra Joshi(NCRA-TIFR), Sachindra Naik(PRL), A R Rao(TIFR), Biswajit Paul(RRI), Santosh Vadawale(PRL), Vishal Gajjar (UC-Berkeley/SETI), Arun Naid(NCRA-TIFR), Brijesh Kumar(ARIES)

Simultaneous Radio and X-ray Observation of Crab Pulsar

Rotation powered isolated neutron stars are known to emit radiation in broad range of electromagnetic spectrum from radio frequencies to high energy gamma rays. These objects are known to be the efficient source of particle acceleration due to their intense magnetic field. Charge particles, mostly electrons and positrons get accelerated along the open field lines and emit non-thermal high energy gamma-ray photons that have timing characteristics of the parent neutron star. These particles generate secondary plasma higher up in the magnetosphere leading to coherent radio radiation. Crab pulsar, PSR B0531+21, is a unique neutron star, where pulsed emission has been detected over the entire range of electromagnetic spectrum. In addition, it exhibits very intense sporadic radio pulses, known as Giant pulses (GP). The mechanism for production of such pulses is not known and simultaneous multi-frequency observations can constrain theoretical attempts to explain this emission. We have carried out a campaign of simultaneous observations from radio to high energies, using three Indian facilities, namely, the Ooty Radio Telescope, the Giant Meterwave Radio Telescope and newly commissioned ASTROSAT. The results of this campaign are reported in this paper. We have calibrated the temporal offsets among the participating telescopes and examined the occurence of GP at all the wavebands observed. Implications of these results will also be discussed.

ASI-2017 Parallel Session - Thursday, 9 March, 2017

Time: 16.30 - 18.00 Venue: Hall D

General Relativity and Cosmology – 3 [Chairperson: K. S. Dwarakanath]

ASI2017_647	Prakash Gaikwad	Oral

Vikram Khaire (NCRA), Tirthankar Roy Choudhury (NCRA), Raghunathan Srianand (IUCAA)

Low-z Ly-α forest simulation and its application

The physical conditions prevailing in the intergalactic medium (IGM) provide important clues on how the cosmological large scale structure formation proceeded with time. High resolution Ly-α forest seen in the spectra of QSOs together with the cosmological high resolution hydrodynamical simulations allows one to constrain cosmological and astrophysical parameters related to the IGM physics. Simulations of high-z ($z>2$) Ly-α forest show a tight correlation between temperature and density (the effective equation of state). On the other hand at low-z ($z<0.5$) it is shown that due to different physical processes such as shock heating, various feedback processes, turbulence and radiative cooling the effective equation of state can get modified appreciably. We present a new semi-numerical method (using Gadget-2) for evolution of IGM temperature from high-z to low-z. The resultant thermal history is consistent with other low-z imulations in the past. Our method is computationally less expensive and it allows us to explore a large parameter space. The Ly-α forest spectra generated from this simulation are remarkably similar to the observed spectra. We have also developed a VoIot profile Parameter Estimation Routine (VIPER) for automatically fitting the Ly-α forest in simulations and observations. %Unlike high-z ($z > 2.0$), the simulation of low-z ($z<0.5$) Ly-α forest is non-trivial due to significant fraction of baryons in warm hot phase at low-z. We compared these simulated spectra with unprecedented quality HST-COS Ly-α forest spectra towards 82 QSOs to constrain HI photoionization rate (Γ_{HI}) in 4 redshift bins at $z < 0.5$. We used three statistics namely flux probability distribution function, flux power spectrum and column density distribution function that are sensitive to the $\Gamma_{\rm HI}$. We obtain the best fit $\Gamma_{\rm HI}$ and associated error using proper statistical analysis taking into account the appropriate co-variance matrix. We also compute systematic uncertainties arising from possible degenerate thermal histories of the universe. Our result shows that the thermal history parameters, metallicity and turbulence do not have strong influence on the derived photoionization rate. Using the cosmological radiative transfer code we find that our new constraints on $\Gamma_{\rm HI}$ can be easily achieved without any contribution to the UV background from galaxies which is contrary to the recent claims of ``photon underproduction crisis".

ASI2017_1325	Joydeep Bagchi	Oral

Shishir Sankhyayan (IISER, Pune) Prakash Sarkar (NIT, Jamshedpur) Somak Raychaudhury (IUCAA, Pune) Joe Jacob (Newman College, Thodupuzha) Pratik Dabhade (IUCAA, Pune)

Saraswati: An Extremely Massive ~200 Megaparsec Scale Supercluster

Superclusters of galaxies are believed to be the largest concentrations of matter in the Universe whose origin is still debated. I will report the discovery of an extremely massive and large-scale super cluster (called `Saraswati') found in SDSS spectroscopic survey. It shows a vast concentration of galaxies and galaxy clusters forming a wall-like structure spanning at least 200~Mpc across at the redshift z ~0.3. This enormous structure is surrounded by a network of lesser galaxy filaments, clusters and large (~20 - 150 Mpc) voids. The density contrast (delta) relative to mean matter density of the Universe of `Saraswati' is >1.62 and the densest region of this supercluster comprises at least 43 massive galaxy clusters with total mass of 2 X 10^{16} M_sun and a bound core of ~20 Mpc. This places `Saraswati' among the few largest, most massive superclusters known till date, comparable to the extremely massive `Shapley Concentration' (z = 0.046) in the local universe. The `Saraswati' supercluster and its environs reveal that some extreme large scale, prominent matter density enhancements had already formed ~4 Gy in the past eon when dark-energy had just started to dominate structure formation. I will discuss how this large galactic over density helps understand the role of dark energy and cosmological initial conditions in supercluster formation, and tests the competing cosmological models.

ASI2017_1091	Nikhel Gupta	Oral

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Observations and Simulations of Galaxy Clusters: Cluster Radio Galaxies and their Implications on SZE Signal, Simulated Pressure Profiles and SZE Mass

The discrepancy between cosmology derived from Cosmic Microwave Background (CMB) and Sunyaev-Zel’dovich Effect (SZE) selected galaxy clusters has gathered a lot of attention in recent years. The incompleteness of cluster sample and/or discrepancy in cluster masses can be the reason for this difference from two experiments. We study the overdensity of point sources in the direction of X-ray-selected galaxy clusters from the Meta-Catalog of X-ray detected Clusters of galaxies (MCXC; ⟨z⟩ = 0.14) at South Pole Telescope (SPT) and Sydney University Molonglo Sky Survey (SUMSS) frequencies. Flux densities at 95, 150

and 220 GHz are extracted from the 2500 deg^2 SPT-SZ survey maps at the locations of SUMSS sources, producing a multi-frequency catalog of radio galaxies. In the direction of massive galaxy clusters, the radio galaxy flux densities at 95 and 150 GHz are biased low by the cluster SZE signal, which is negative at these frequencies. We employ a cluster SZE model to remove the expected flux bias and then study these corrected source catalogs. We use the 150 GHz LF to estimate the impact of cluster radio galaxies on an SPT-SZ like survey. If we assume there is no redshift evolution in the radio galaxy LF then 1.8 ± 0.7 percent of the clusters with detection significance $\xi \geq 4.5$ would be lost from the sample, that doesn't explain the cosmological discrepancy. Improved constraints on the evolution of the cluster radio galaxy LF require a larger cluster sample extending to higher redshift. I will present preliminary results using redMaPPer cluster catalog observed in Dark Energy Survey (DES). In an another work, we study clusters' thermal-Sunyaev-Zel'dovich effect (SZE) from Magneticum Pathfinder hydrodynamical simulations. We examine the thermal intracluster medium (ICM) pressure profiles for galaxy clusters (M500c > 1.4 × 10^14 M⊙) out to z = 2, study the variations in shape of profiles and look for deviations from self similar evolution. We show that the thermal ICM pressure is lower than the effective pressure deduced from the approximation of hydrostatic equilibrium by 20 percent at R500c and correcting this brings cluster cosmology closer to that derived from CMB. Further, we study the Y-mass relation, confirming previous results showing that the scatter (spherical) in the relation is small ($\sigma_{\ln Y} \simeq 0.087$). In addition, we examine the impact of cluster triaxiality and large scale structure along the line of sight by measuring the cylindrical signal in redshift slices and the full light cone, respectively.

ASI2017_762	Surajit Paul	Oral

1. Prateek Gupta, Dept. of Physics, SP Pune University 2. Reju Sam John, PEC, Pondichery 3. Abhirup Datta, Centre for Astronomy, IIT Indore 4. Siddharth Malu, Centre for Astronomy, IIT Indore

Possible discovery of multiple shock structures and filamentary inroads to massive galaxy clusters by uGMRT and SKA

The structures at Large-Scales (> few tens of Mpc) in the Universe comprises of complex filamentary network of matters surrounding the large voids and they connect the massive Galaxy Clusters. Massive objects like galaxy clusters become very interesting, especially when in a merging state. Such events has been detected and studied in plenty in the last decades. But there are more interesting components that are yet to be detected in radio waves. This vital component of cosmological structures are the main channels through which dark matter and baryons drains from voids and reach the nodes where the Clusters are formed. As most of the matters are processed for the first time at the filamentary surfaces and the accretion zones of Galaxy Clusters, these are the region that contain a wealth of information about the structure formation energetics. Both the mergers shocks and baroclinic instability at the entry of filaments to the Galaxy clusters generate a significant turbulence and high degree of magnetic fields are amplified. Charged particles are accelerated in this structures through shocks and turbulence. As a result such objects then expected to produce significant amount of synchrotron radio emission due to the motion of accelerated charge particles in the enhanced magnetic field and helps in tracing back the dynamical history of these structures. In this work, we have simulated many high resolution (~15 kpc) realisations of 128^3 Mpc h^{-1} cosmological volume using ENZO hydrodynamic code. We have then formulated and implemented Diffusive Shock Acceleration and Turbulent re-acceleration models to compute the possible radio emission from the galaxy clusters and outskirts. Our modelled predictions revealed an unique structure at the filamentary entry. These filamentary inroads are expected to be observed as long trails of parallel, linear and radial radio structures in the cluster periphery. Most surprisingly these structures that are beyond the virial radius, have radio emission power only an order lower than the usual radio halos making it possible to detect with even uGMRT. Our study also reveal the possible multiple shock structures including multiple merger shocks and virial shocks. Though the virial shock is at the level of sub micro Jy in

610 GHz band, which is quite difficult to observe, an intermediate merger shocks at 2-3 Mpc away from the centre and the filamentary inroads have few 10s of μJ of radio power and very much possible that SKA will detect such structures easily. These detections not only will reveal the actual extent of the galaxy clusters, it will also give us an idea about the missing baryons and WHIMs present in the filaments.

ASI2017_794	Mamta Gulati	Oral

Dr. Jasjeet Singh Bagla, IISER Mohali.

Is Ram pressure stripping efficient in quenching star formation?

Galaxies undergo many changes during their lifetime caused by various complicated processes. For instance: star formation in galaxies depends on the amount of gas at appropriate density and temperature, this in turn is affected by various internal and external factors like galactic wind, accretion, supernova explosion and so--on. Ram Pressure Stripping (RPS) is one such process, which removes gas from the galaxy as it passes through inter galactic medium. This mechanism was proposed by Gunn and Gott more than four decades ago and is studied by various authors since then. However its efficiency is still debatable. In the present work we study analytically the efficiency of RPS as a mechanism to remove gas from galaxies and hence quenching star formation. We quantify the range of halo masses where RPS is effective in removing gas from the disc galaxies. We discuss analytical estimate of the time taken to strip off the gas from the disc as function of disc radius and mass. We further discuss how efficient RPS is as we go to higher red-shifts.

ASI2017_482	Priyanka Singh	Oral

Alexandre Refregier (ETH, Zurich), Subhabrata Majumdar (TIFR, Mumbai), Biman B. Nath (RRI, Bangalore)

Constraints on the relation between the X-ray AGNs and host dark matter halo: potential role of eROSITA

The active galactic nucleus (AGN) is a dominant contributor to the extragalactic X-ray sky. It is essential to model the X-ray emission from the AGNs carefully to extract the X-ray signal from other sources such as the diffuse, hot gas present in the form of intracluster and circumgalactic medium in the clusters and galaxies, respectively. We estimate the auto power spectrum due to the X-ray AGNs potentially resolved by eROSITA mission in the soft X-ray band. There are two main ingredients required to compute the X-ray AGN power spectrum: 1) AGN X-ray luminosity function, which describes the luminosity dependence of the AGNs and 2) the halo occupation distribution (HOD) model, which describes the halo mass dependence of the AGNs. We have verified that these two inputs are in agreement with the AGN observations as well as with each other in a wide range of redshift (especially at $z \sim 0.5 - 3.5$). We forecast the constraints on the HOD model parameters using X-ray auto and X-ray-lensing cross power spectra with eROSITA and eROSITA-LSST survey combination, respectively. We have found that the uncertainties in the HOD model parameters can be reduced by an order of magnitude by including lensing in the analysis.

ASI - 2017 Public Talk on TMT

Time: 18.30 - 19.30 Venue: Auditorium

[Chairperson: Ajit Kembhavi]

ASI2017_1022	A. N. Ramaprakash	Public Talk

IUCAA, Pune

The Thirty Metre Telescope : a leap from known unknowns to unknown unknowns

India has joined the Thirty Metre Telescope International Observatory (TIO) project which aims to build a next generation astronomy facility that will use many highly advanced technologies. When construction is completed in the mid-2020s, it will be among the world's largest telescopes and will be capable of addressing some of the most fundamental questions about the nature of the Universe which we live in. The TIO is constituted of partners from Canada, China, Japan and the USA in addition to India. The Department of Science and Technology and the Department of Atomic Energy of the Government of India is jointly supporting this project under the "Mega Facilities for Basic Research" programme. Indian participation in TIO is at about 10% level. Almost 70% of the Indian contribution is made up of high-tech hardware, software and brainware components that is developed within the country through participation from industries and academic institutes. These components include mirror segments, segment support assemblies, edge sensors, actuators, telescope control system, observatory control system, coating plants, detailed science case development etc. The talk will touch upon an overview of the project, its current status, India's contribution to it as well as the myriad challenges and opportunities which an endeavour of this scale offers.

Thursday, March 10, 2017

ASI - 2017 Plenary Session

Sun [Chairperson: Dipankar Banerjee]

Time: 9.30 - 11.00 Venue: Auditorium

ASI2017_1342	Arnab Rai Choudhuri	Plenary

Indian Institute of Science

How it begins: Magnetic field generation in the Sun's interior

The 11-year solar magnetic cycle is produced by the dynamo process taking place in the Sun's convection zone. A knowledge of the large-scale fluid flows in the interior of the Sun is needed to model this process. With helioseismology providing a lot of information about flows in the solar convection zone, it has become possible to develop a fairly sophisticated model for the generation of solar magnetic fields, known as the flux transport dynamo model. One of the current research frontiers in this field is to understand the irregularities of the solar cycle and to investigate whether such an understanding can enable us to predict future cycles.

ASI2017_565	Durgesh Tripathi	Plenary

IUCAA, Pune

It's hot, magnetic, happening and it matters: The Solar Corona

The existence of million degree hot corona and dynamics therein at a range of spatial and temporal scales has been one of the most challenging problems in Astrophysics. In addition to providing a challenging physics problem, it also has direct impact on the atmosphere of the earth, climate and space weather. On one hand the high energy explosions on the Sun can have devastating effects on society. On the other hand, the Sun's UV and X-ray radiation do impact the dynamics of the Earth's atmosphere. The active regions on the Sun provide the best target of opportunity to study the coronal heating and dynamics and they also form the source regions of high energy explosions. In this talk, I shall focus primarily on the heating and dynamics of the solar active regions and present some new results that are obtained using state-of-the-art current space missions.

ASI2017_1428	Nandita Srivastava	Plenary

Udaipur Solar Observatory, PRL

Preliminary observations with Multi-Application Solar Telescope (MAST) at Udaipur Solar Observatory

MAST is a 50 cm aperture optical solar telescope installed at the island observatory of Udaipur. It is capable of taking high resolution observations of 3 arc-minute circular field-of -view on the sun. The back-end instruments for MAST include H-alpha and G-band imager which can record simultaneous observations of solar active regions in chromospheric and photospheric layers, respectively. Further, in order to understand the evolution and dynamics of solar magnetic and velocity fields, an imaging spectropolarimeter has also been developed. An adaptive optics system is also being developed for the compensation of the atmospheric seeing. In this talk, I will present the details of back-end instruments developed at USO. I will present recent observations of sunspots and filaments recorded using the same.

ASI-2017 Thesis Presentations 2

Time: 11:30 - 13:00 Venue

[Chairperson: Jayaram Chengalur]

ASI2017_1159	Upendra Kumar Singh Kushwaha	Thesis

Dr. Bhuwan Joshi, Udaipur Solar Observatory, Physical Research Laboratory, Udaipur, 313001

Multi-wavelength Investigations of Solar Eruptive Phenomena

Solar eruptive phenomena correspond to various kind of transient activities occurring in the solar atmosphere in the form of flares, prominence eruptions and coronal mass ejections. They mostly originate from solar active regions which consist of complex magnetic structures extending from the deeper sub-photospheric layers, crossing through the photosphere to the coronal heights. An eruptive flare typically spreads across all the atmospheric layers of the Sun and involves substantial mass motions and particle acceleration. Multi-wavelength observations are thus crucial to probe the underlying physical processes occurring at different layers and regions at and above the photosphere. In my thesis, we have studied some key aspects of solar eruptive phenomena such as solar flare, prominence eruption, coronal implosion, failed eruption, and sigmoid-to-arcade evolution. These investigations have employed contemporary multi-wavelength solar observations with superior resolution. The imaging and spectroscopic capabilities of Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) have been extensively utilized to investigate the thermal and non-thermal energy release processes associated with different stages of the eruptive phenomena. Complementary to RHESSI X-ray measurements, we have combined solar observations at Extreme Ultraviolet (EUV), Ultraviolet (UV), Microwave (MW), optical, and radio wavelengths to investigate the complex physical processes occurring at different atmospheric layers of the Sun during the eruptive events. Some of the major highlights are given below: 1. We find striking evidence of ongoing magnetic reconnection in the form of an extended HXR coronal source at 50–100 keV energy band which developed during the detachment of an erupting prominence from the solar source region. This phase of intense coronal emission was associated with high plasma temperature (T~30 MK) and significant non-thermal charac- teristics. 2. We have carried out a detailed study of flux evolution through the active region in relation to triggering of an impulsive M4.0 flare. We have adopted a new approach to investigate the characteristics of magnetic transients by analyzing HMI spectral data. We find that the sudden changes in the small-scale magnetic field have likely triggered the flare by destabilizing the highly sheared pre-flare magnetic configuration. 3. We have investigated the role of pre-flare activities toward the destabilization of magnetic configuration of pre-flare corona which lead to a large-scale eruptions and associated flares. 4. We have detected a large-scale contraction of coronal loops for ~30 minutes during the pre- flare phase of an M6.2 flare in active region NOAA 10646. Such a large-scale contraction has been observed for the first time during which the loop system was subjected to an altitude decrease of ~40% of its initial height. 5. Finally, we have investigated the sigmoid-to-arcade evolution and discussed their observational disparities with the standard flare model.

ASI2017_1331	Sajal Kumar Dhara	Thesis

Study of Evolution of Magnetic Inhomogeneities on the Sun using Narrow Band Imaging

The solar atmosphere is structured by the evolving magnetic fields. On small scale - bright points with thin boundaries have been observed. On large spatial scale - plages, sunspots and filaments/prominences have been observed. One such magnetic structure is solar filament which contain dense and cool plasma embedded in the tenuous and hot corona. They appear above a boundary between the opposite polarity of magnetic fields on the Sun, normally called as polarity inversion line. They normally form in active regions, though not very uncommon in quiet regions. The quiet filament structures are highly stable and most of them will survive for weeks to months. On the other hand, the active region filaments evolve rapidly and they can survive over a period varying from few hours to days. Most often, the filament ends up with eruption associated with solar flares and CMEs. In this thesis I have studied a few selected active region filament eruptions using high resolution coronal data from AIA/SDO and ground based Hα data from BBSO and GONG to examine and understand the detailed mechanism behind these filament eruptions. The study suggests that in each filament event the onset of trigger and instability mechanism could be different. In one event, we concluded that the progress of events towards eruption, is broadly consistent with flux cancellation, that subsequently erupts due to onset of a runaway tether cutting magnetic reconnection. In other event, we found that the emerging flux, converging motion and injection of opposite magnetic helicity could be responsible for destabilizing of the filament leading towards its eruption. The observations made in multiple wavelengths around a chromospheric spectral line could provide valuable data to infer dynamical processes occur such as converging motions and rotational motions in the ends of the filaments during the eruption. We observed the rotational/vortical motion in the photosphere near the ends of the several erupting active region filaments during their initial phase of eruption, at the onset of the fast rise phase. The observed vortical motions are about supergranulation size and lasted for 4–29 minutes. Another work of this thesis is to develop a narrow band imager using Fabry-Perot interferometer, which can provide images at the chromospheric height in the solar atmosphere and also it is capable of producing dopplergrams at this height using some post-facto techniques, to study the line-of-sight motions during the filament eruptions. Here, I will present the important results obtained in this thesis work and discuss the summary and conclusion of the work along with a brief descriptions of planned future projects in which research can be carried out further.

ASI2017_1204	Nazma Islam	Thesis

NA

The many facets of variabilities in X-ray binaries

An important property of X-ray binaries is intensity variations of different magnitudes in a wide range of timescales from milliseconds (quasi-periodic oscillations, millisecond pulsations), to a few weeks (orbital and super-orbital modulations) or longer (outbursts etc). In this thesis, different types of variabilities of X-ray binaries are considered in X-ray binary population studies and to investigate certain aspects of some individual systems. 1. We report results from an investigation of energy resolved orbital intensity profiles and from exhaustive orbital phase resolved spectroscopic measurements of GX 301-2 with MAXI-GSC. A very large equivalent width of the iron line along with a small value of the column density in the orbital phase range 0.10-

0.30 after the periastron passage indicates an asymmetry in the distribution of the matter around the neutron star. 2. For the HMXB system IGR J16393–4643, we found a short eclipse in the Swift–BAT light-curve and utilised it to constrain the orbital inclination of the system. We have also studied, for the first time, broad-band pulsation and spectral characteristic of the system with a Suzaku observation, showing sub-orbital intensity variations. For the eclipsing and non-pulsing HMXB 4U 1700-37, the orbital evolution is studied using mid-eclipse times from archival as well as from long term light-curves of X-ray all sky monitors. Since no pulsations are detected in this system, it is difficult to estimate its orbital parameters, especially its eccentricity. Using mid-eclipse times from 10 years of Swift–BAT data, we have independently constrained the eccentricity of the binary system. 3. Using 16 years light-curves of X-ray binaries in 2-10 keV energy band of RXTE-ASM , multiple snapshots of X-ray binary luminosity functions of the Milky Way are constructed instead of averaging the luminosities, an improvement over previous analysis by Grimm et al. (2002). We found that the averaged luminosities of highly variable X-ray binaries do not represent their true positions in XLFs and the variability of X-ray binaries do indeed significantly affect the luminosity functions. 4. The averaged spectra of X-ray binaries using MAXI-GSC data are studied and used for constructing the composite X-ray spectrum. These composite X-ray binary spectra are useful in constraining the contribution of X-ray binaries in extra-galactic SEDs constructed from the simultaneous Chandra / XMM–Newton and NuSTAR observations of these galaxies. These SEDs will also serve as a useful input in estimating the contribution of X-ray binary heating at high redshift IGM during the Epoch of Re-ionization.

ASI2017_433	Priyanka Chaturvedi	Thesis

Priyanka Chaturvedi (PRL)

Radial Velocity studies of Eclipsing Binary Systems

A vast majority of observations of M dwarfs for varying masses have reported a higher radius by 10-20% and a temperature lower by 5-10% than those predicted by the models (Torres and Ribas 2002, Lopez-Morales et al. 2007, Torres et al. 2010). The mismatch of the radii as seen in these stars is termed as the 'M dwarf radius problem' (Triaud et al. 2013). Studying M dwarfs or very low mass stars (VLMS) in Eclipsing Binaries (EBs) in the mass range of 0.08-0.4 M_sun with an aim to alleviate the M dwarf radius problem has been the motivation for the thesis work. This research work has contributed 12% more samples to the existing 26 samples with masses and radii measurements at accuracies ~ 10%. We shortlisted a collection of 10 potential EB candidates from the photometric catalogues of Kepler, STEREO, and Super-Wasp for the PRL EB programme led by me. The aim of the study was to look for single-lined EB, where VLMS occur as companions to F, G, K type primaries. Radial velocity (RV) data of these sources were obtained using the high-resolution spectrograph, Physical Research Laboratory Advanced Radial-velocity Abu-sky Search (PARAS) coupled with the 1.2 m telescope at Gurushikhar Observatory, Mount Abu, India. Wideband differential photometry with the help of a 10 inch telescope located at PRL's Mount Abu Observatory has also been performed to complement the spectroscopy. In addition, for a few sources, the archival photometry data have been analysed and included in our study. A software code, PARAS SPEC has been developed to determine the stellar properties of the host star (T_eff, [Fe/H] and log g), essential to determine the mass and radius of its companion, based on the synthetic spectral fitting and equivalent width methods. The basic principles and methodology utilized to develop this tool and results obtained when applied to some of the programme stars are discussed in thesis. My thesis has produced the first science results with PARAS by discerning the masses, radii and orbital parameters of four VLMS in single-lined detached EBs (M3 to M7 spectral type) i.e HD 213597, HD 23765, SAO 106989 and 1SWASP J2334318+295556. Orbital parameters and system properties such as period, RV semi-amplitude, semi-major axis, masses and radii of the

components and inclination are studied as a part of this research work. We have detected three F+M EBs, wherein the M dwarfs have mass range close to the transition between radiative and convective zones (mass less than 0.3 M_sun). The fourth EB is a K+M EB, wherein the M dwarf is the second least massive star studied for its mass and radius at such high precisions.

ASI2017_1332	Subhash Bose	Thesis

Subhash Bose (ARIES), Brijesh Kumar (ARIES)

Multiwavelength investigation of Core- Collapse Supernovae

Core-Collapse supernovae (CCSNe) are the end fate of massive stars with wide range of properties and so the observable parameters of these explosions are also very diverse. Circumstellar environment and history of pre-SN evolution also plays a key role in diversifying their properties. In this thesis we characterize a number of CCSNe events which has been extensively observed in photometric, spectroscopic and polarimetric modes at optical wavelengths. This thesis utilizes data collected primarily from telescopes in India viz. 104cm ST and 130cm DFOT at ARIES, 2mIGO at IUCAA and 2mHCT at IIA. Complementary data were also collected from several international network of telescopes and Swift UVOT observations. Our primary goal was to understand various mechanisms involved in the explosion and how they govern observable parameters. We utilized the observational data to constrain progenitor properties, explosion parameters and also to probe circumstellar environment to infer their pre-SN evolution which the progenitor might have undergone. We characterize five CCSNe events (SNe 2012aw, 2013ab, 2013ej, 2013hj and 2014G) in detail. Along with the determination of various physical parameters by modeling the observables, we also probe peculiarities which they exhibit in their observed light curves and spectra. Our detailed observations and spectroscopic modelling revealed ejecta-CSM interaction in SNe 2012aw and 2013ej, and also signature of emergence of recombination phase for the first time in SNe II. Such detections are crucial to improve our understanding of these event. Another vital component of this thesis is utilizing type II SNe as a distance estimator, which has immense cosmological as well as astronomical importance. SNe due to high intrinsic brightness are always an attractive probe for extragalactic distance measurements, however SNe II require an approach which is entirely different than standard candle methods. We implement Expanding photosphere method (EPM) to estimate distances to host galaxies of eight type II SNe and also introduce some improvements in the existing methodology. Our study explored various issues and uncertainties involved in EPM and also demonstrated its potential as a reliable redshift independent technique.

ASI2017_481	Sonali Sachdeva	Thesis

Supervisor: Prof. H.P. Singh, University of Delhi, Delhi

An investigation of galaxy morphology tools and application to high redshift galaxies

More than 97% of the galaxies observed in the local Universe can be broadly classified to have an elliptical or spiral structure. However, almost all the distant galaxies, i.e, more than 8 billion light years away, are observed to have irregular and peculiar structure. Examining the development of galaxies from irregular morphologies at earlier times (~6 billion years) to the present epoch (13.7 billion years), where they have settled into few distinctly identifiable categories, is critical to understand the major physical processes involved in galaxy formation and evolution. In this thesis work, this work has been undertaken using data from latest telescopes and surveys. Presence of disc galaxies in the Universe which do not have any merger remnant (or bulge) in their centre, challenge the accepted hierarchical model of galaxy formation that is based on continuous mergers and violent interactions. The reason for their survival has been examined by studying the evolution in their various defining parameters. Additionally, efforts have been made to obtain insight into the relative role of internally and externally driven processes in the growth of bulges in disc galaxies from z~1 to the present epoch. Their role is important to be established to understand the presence of disc galaxies of varied bulge types in the local Universe. This work has been carried out in the optical as well as infrared wavelengths.

ASI-2017 Poster Presentations

Sun and the Solar System

SSS-1	ASI2017_1101	Mayank Narang	Poster

Authors: Mayank Narang (DAA, TIFR) Manoj Puravankara (DAA, TIFR)

Title: The dust composition of transitional disks

Abstract: Most young stars are surrounded by protoplanetary disks, which are thought to be the birth places of planetary systems. A small fraction (~10%) of these disks, known as transitional disks, show evidence for the presence of large inner holes or gaps within them. These large inner cavities are thought to be caused by the dynamic interactions resulting from the formation of massive, Jupiter-like planet(s) in transitional disks. We have analyzed the Spitzer Infrared Spectrograph (IRS) spectra of 161 young stars in the Taurus star forming region in order to study the silicate emission feature at 10 micron from protoplanetary disks. The 10 micron silicate emission feature is an excellent diagnostic of the degree to which dust grains are processed (grain growth and crystallization) in these disks. We find that while most disks show evidence for grain growth and crystallization, transitional disks appear to have relatively unprocessed grains in them. This is surprising at first glance because transitional disks are thought to be more evolved than other disks as planetary mass bodies have already formed in them. In this contribution, we present our analysis and discuss our results and offer possible explanations for this apparent contradiction.

SSS-2	ASI2017_1104	HITAISHI BHATT	Poster

Authors: Rupal Trivedi H. & H. B. Kotak Institute of Science, Rajkot, India. Som Kumar Sharma Physical Research Laboratory, Ahmedabad, India. Hari Om Vats Physical Research Laboratory, Ahmedabad, India.

Title: Variation in Coronal Rotation with altitude

Abstract: The coronal differential rotation is estimated by using the disk-integrated daily measurements of 11 frequencies: (275, 405, 670, 810, 925, 1080, 1215, 1350, 1620, 1755 MHz and 2800) MHz The data used from 1997 June 1–1999 July 31 and analyzed by flux modulation method. To obtain rotation period, Gaussian analysis for curve fitting of first secondary maxima of autocorrelogram is used. No results can be obtained easily from 275MHz and 405MHz due to noise in data of low frequencies. Best estimation can be achieved from curve fitting analysis. The rotation period is obtained by using earth based observations, thus the sidereal rotation period is calculated. Aschwanden & benz (1995) suggests that lower frequencies comes out from outer part of corona and higher frequencies comes out from inner part of corona. The investigations indicate that the sidereal rotation period at the highest frequency 2800 MHz is highest and lower frequencies have lower the rotation period. The difference is only ~1.4 days with increasing order. Hence, the conclusion is as altitude increases, the rotation period decreases in corona.

SSS-3	ASI2017_1136	Lekshmi B	Poster

Authors: 1.S.P Rajaguru,Indian Institute of Astrophysics, Bangalore 2.H.M Antia,Tata Institute of Fundamental Research, Mumbai 3.T. Hartlep,Bay Area Environmental Research Institute, NASA Ames Research Center, USA 4.J. Zhao,Hansen Experimental Physics Laboratory, Stanford University,CA,USA 5.Dibyendu Nandy,Center of Excellence in Space Sciences India,IISER, Kolkata

Title: Testing systematics in time-distance helioseismic measurements of meridional flows using artificial data

Abstract: Meridional circulation (MC) in the solar convection zone plays an important role in the generation and transport of solar magnetic field. The surface component of MC,which is a flow from the equator to the poles, has been well observed using various techniques. Helioseismology has provided maps of the flows in sub surface layers. The structure and strength of the flow in deep layers obtained from helioseismic measurements is under debate. A systematic center to limb variation is present in the measured helioseismic travel times of real data, which has to be removed for accurate determination of meridional flow profile.We use Artificial data (Hartlep et al, 2012), generated by numerical simulation of helioseismic wave propagation in the whole solar interior in the presence of a prescribed meridional circulation profile for our analysis. Also, we use data sets with an artificial center to limb effect added to the above global wave field simulation data. A deep focusing time distance technique is applied on these datas for calculating the wave travel times. Further, we do inversion of the measured travel times to infer the meridional flow velocity and structure in the deep interior. We validate the center to limb correction technique using these results.

SSS-4	ASI2017_1239	Sanchita Pal	Poster

Authors: Dibyendu Nandy (Center of Excellence in Space Sciences India, IISER Kolkata) Nandita Srivastava (Udaipur Solar Observatory, Physical Research Laboratory)

Title: On the relationship of the CME velocity and the magnetic parameters of its source active region

Abstract: The speed of a coronal mass ejection (CME) is one of the important measures of its geo-effectivity. Here we estimate the de-projected speed of the fastest and the slowest CMEs that an active region (AR) produces. Using the horizontal and vertical magnetic field components of the AR's vector magnetogram, we calculate seven AR integrated magnetic parameters (magnetic flux, area, and five different non-potential parameters) and examine the relationship of the CME speed with those magnetic parameters. Our analysis suggests that one of the non-potential parameters, i.e. the proxy of the AR free magnetic energy can determine the upper and the lower limits of the de-projected CME speed better than any of the other AR measures, considered here.

SSS-5	ASI2017_1246	G.S.Suryanarayana	Poster

Authors: None

Title: The question of two class of flares

Abstract: Coronal mass ejections (CMEs) are generally associated with flares of longer duration and higher peak flux. It is argued that ejection of CME affects the flare emission in such a way that energy is removed by the CME. On the other hand there are fundamental differences between the active regions that host the flares alone and the active regions that host both the flares and CMEs. Is the question of two classes of flares still alive?

SSS-6	ASI2017_1295	M. Syed Ibrahim	Poster

Authors: M. Syed Ibrahim, Bhuwan Joshi, A. Shanmugaraju

Title: Major Geo-effective Solar Eruptive Event on 2015 June 21

Abstract: We analyzed a major geo-effective Coronal Mass Ejection (CME) on 2015 June 21. The source region of this CME lies in active region NOAA 12371 where two M-class solar flares occurred between 01:00 UT and 04:00 UT. These flares and high speed CME (V = 1366 km/s) were observed by Solar Dynamics Observatory (SDO) and Large Angel Spectrometric Coronagraph/ Solar and Heliospheric observatory (LASCO/SOHO) respectively. The ICME associated with this CME caused a strong geo-magnetic storm of Dst = -204 nT. These strong flares occurred in a complex sunspot group where merging of positive and negative polarities is observed from Helioseismic and Magnetic Imager (HMI) observations. During the eruption phase, an active region filament broke out from the chromospheric heights as observed from GONG H-alpha filtergrams during the first M-class flare. Main aim of this paper is to investigate the initiation mechanism of the filament eruption, radiative signatures of corresponding solar flares along with the interplanetary propagation and geo-effectiveness of the associated CME. The interplanetary propagation of CME and its shock transit times are studied using the Drag Based Model (DBM) and the Empirical Shock Arrival model (ESA) respectively. Transit time of the CME is obtained from Advances and Composition Explorer (ACE)/Wind observations and it is compared with the estimated transit time.

SSS-7	ASI2017_1330	Ranadeep Sarkar	Poster

Authors: Sindhuja G, Sajal Kumar Dhara, Nandita Srivastava Udaipur Solar Observatory, Physical Research Laboratory

Title: On the dynamics of the largest active region of the solar cycle 24

Abstract: We have analyzed the solar active region (AR) NOAA 12192 using the full-disc intensitygrams and the vector magnetograms observed by instruments onboard the Solar Dynamic Observatory (SDO). We have also used the high cadence Ca-K time series data from the Kanzelhohe Solar Observatory (KSO). AR 12192 is the largest region since November 18, 1990, and it underwent a noticeable growth and produced 6 X-Class flares, 22 M-Class flares, and 53 C-Class flares in the course of its disc passage. But the most peculiar fact of

this AR is that it was associated with only one small CME in spite of producing several X-Class flares. This AR, after one disc passage from October 19-27, returned back to the next two-disc passages. In this work, we have calculated the area of this active region along with the individual umbra and penumbral area of the sunspots during all the three disc passages. Using the high cadence Ca-K time series data the Ca-K plage area is calculated using the histogram method as described in the Tlatov (2009) for this AR during three disc passages. In addition, we have analyzed the flux emergence, flux cancellation regions and several magnetic parameters like the shear angle, magnetic helicity of this active region for the disc passage October 19-27. From that analysis, we attempt to understand the variations in the magnetic parameters, as well as the umbral, penumbral and the plage area due to the flare activity.

SSS-8	ASI2017_1383	Jayanti Krishna Pandey	Poster

Authors: K. K. Pandey2, K. M. Hiremath3, K. Chenna Reddy4, T.K. Srivastava5 1, 5. Department of Physics, Udai Pratap Autonomous college Varanasi, U.P., 221002, India 2, 4. Department of Astronomy, Osmania university, Hyderabad, T.S., 500 007, India 3. Indian Institute of Astrophysics, Bangaluru, Karnatak, 560034, India.

Title: Low and high latitude solar activity

Abstract: Most energetic exhibition during solar activity is manifested, in general, at 0-45deg latitude (or low latitude) where as less energetic events are preferred at 46-90 deg latitude (or high latitude). Although low and high latitude activity manifestations are different in nature of occurrence but filament's occurrence is common at low and high latitude. The difference in characteristics of a common activity is more valuable study than similarity in characteristics of two different activity at two different preferred zones. Using filament data, from 1957-2008, we find that phase, periodicity and, amplitude of high latitude activity is different from low latitude activity. High latitude activity commences during solar maximum of one cycle and ends before solar maximum of next cycle at low latitude activity.

SSS-9	ASI2017_405	Pramod Kumar	Poster

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Title: Inverse gradient for conduction cooling with temperature of solar Microflares thermal X-ray plasma

Abstract: We present inverse gradient for conduction cooling time (τc(T)) of solar Microflares thermal X-ray plasma with temperature (T). The inverse dependence of cooling time with temperature is the characteristic of Newton's law of cooling which is true for the heat transfer by thermal conduction of a collisional isothermal process. For the analysis, we used X-ray spectra in ~4-10 keV of 10 solar Microflares observed by silicon detector (4-25 keV) on-board on SOXS mission using OSPEX software. From the thermal X-ray spectral modeling with the isothermal model in 4-10 keV and computation we find that the plasma temperature (T) to vary from 8.5-12.0 MK and emission measure (EM) from 0.007-0.095 x 10^49 cm-3. Employing volume (V) 4.6 x 10^26 cm3 and half loop length (L) 1.45 x 10^9 cm for the solar Microflares, we computed electron density (ne) to vary from 1.2-4:5 x 10^10cm3 and thermal energy (Eth) lies between 0.2 -0.9 x 10^29erg. The conduction cooling time (τc(T)) is found to vary between 50-562 seconds. We find that conduction cooling time (τc(T)) decreases with increase in plasma temperature (T). Present analysis is the agreement with the

Newton's law of cooling for solar Microflares thermal X-ray plasma.

SSS-10	ASI2017_416	Nishtha Sachdeva	Poster

Authors: Nishtha Sachdeva & Prasad Subramanian

Title: CME Propagation Dynamics: Relative importance of Lorentz forces and solar wind drag

Abstract: With the availability of extensive data from STEREO & LASCO observations we use Graduated Cylindrical Shell model to reconstruct 3D geometrical structure of a set of 38 Coronal Mass Ejections (CMEs). We attempt to quantify the relative contributions of the driving Lorentz forces and the solar wind aerodynamic drag acting on CMEs. In doing so we appeal to Torus Instability model and drag based model. We find that the Drag-based models typically succeed only if they are initiated at heliocentric distances as large as 15-50 Rs and that the Lorentz forces generally peak between 1.65 and 2.35 Rs for all CMEs. For fast CMEs, Lorentz forces become negligible in comparison to aerodynamic drag as early as 3-4 Rs. For slow CMEs, however, they become negligible only by 12-50 Rs. We also quantify the fall in peak Lorentz forces as the solar wind drag takes over. This work provides a framework for describing the Lorentz forces using Torus Instability model based on the drag force analysis. Combining the effects of these two forces, our results are expected to be important in building a comprehensive physical model for understanding the Sun-Earth dynamics of CMEs.

SSS-11	ASI2017_450	Atul Mohan	Poster

Authors: Divya Oberoi NCRA-TIFR

Title: A Murchison Widefield Array imaging study of a type III solar radio burst

Abstract: Type III solar radio bursts are believed to be associated with electron beams energeised during magnetic reconnection events to speeds of about c/3. In the frequency time plane the radio emission from these bursts appear as streaks of emission lasting a few seconds and showing frequency drifts of about -100 MHz/s. Due to the very dynamic nature of these bursts, their imaging radio studies have remained very challenging. New technology instruments like the Murchison Widefield Array (MWA) offer impressive spectroscopic imaging capabilities with a sufficient time resolution (spectral and temporal resolution of 40 kHz and 0.5 s, respectively). We use observations from the MWA to follow the dynamics of this emission along the time and frequency axes in the image plane. We have identified a type III solar burst which took place on November 3, 2014. Observations with bandwidth of 15 MHz each were carried out at 120 and 240 MHz. The observing bands were chosen to be a factor of two apart in frequency to enable simultaneously observations of the emission from the fundamental and the harmonic. A coronal mass ejection (CME) also took place shortly after this burst. Here we present the initial results from a detailed imaging exercise of this event and its association with solar features seen in other wavebands.

SSS-12	ASI2017_494	Akshay Suresh	Poster

Authors: Divya Oberoi (NCRA-TIFR, Pune, India)

Title: Exploring the Spatial Distribution of Weak Non-thermal Energy Release on the Solar Surface

Abstract: Low frequency solar radio observations using the new generation interferometric arrays have revealed the presence of numerous weak, short-lived (~1-2 seconds) and narrow-band (~4-5 MHz) emission features, even during quiet to moderate solar conditions. These non-thermal features are believed to arise via coherent emission processes and are considered to be observational signatures of small-scale magnetic reconnection events in the solar corona. Our previous work on statistical characterization of such features observed using the Murchison Widefield Array (MWA) has shown that they typically possess energies of about 10^{15} – 10^{18} ergs and hence, qualify as being among the weakest bursts reported in literature. Hudson (1991) has shown that for weak flares to contribute significantly to coronal and chromospheric heating, the power law (dN/dW $\propto$ W$^{\alpha}$) index of their flare energies (W) must be less than -2. We have shown that the peak flux density distribution of these features follows a power law with index -2.23, meeting Hudson's criterion. It is reasonable to expect that any mechanism contributing to coronal heating should operate roughly uniformly all over the solar surface. We have initiated an imaging study of these features with the objective of identifying the distribution of locations of these features and looking for associations with other solar features. Here we summarize the current status of this project and the results obtained thus far.

SSS-13	ASI2017_538	Vaibhav Pant	Poster

Authors: D. Banerjee, S. Willems, L. Rodrigue, M. Mierla and J. Davies

Title: Automated Detection of CMEs in Heliosphere: Comparion between manual and automated catalogs

Abstract: We have performed, for the first time, completely automated detection of CMEs in Heliospheric Imager (HI-1) on board STEREO A. We test its robustness by comparing the derived parameters of CMEs with those listed in the manual catalogs. The method of detection is outlined. Moreover, advantages, disadvantages and future improvements of the algorithm will be presented.

SSS-14	ASI2017_649	rohit	Poster

Authors: 1) Rohit Sharma, NCRA-TIFR, Pune 2) Dhrubaditya Mitra, NORDITA, Stockholm, Sweden. 3) Divya Oberoi, NCRA-TIFR, Pune

Title: On the energisation of particles by fast magnetic reconnection.

Abstract: Magnetic reconnection occurs in a wide variety of astrophysical systems. It is often invoked to explain the production of a accelerated population of charged particles. It is vital for the solar corona in context with nano-flare theory, to explain the coronal heating problem. The Sweet-Parker theory predicts the magnetic reconnection rates to be $\gamma \propto 1/\sqrt{S}$, where $S = L V_{A}/\eta$ is Lundquist number where L is the thickness of current sheet, $V_{\rm A}$ is the Alfven velocity and \$\eta$ is the magnetic diffusivity.

Within a reconnection model, if the reconnection rate goes to zero as $\S \to \infty$ then the reconnection process is defined to be {\it slow}; otherwise it is called {\it fast}. Clearly, slow reconnection is not of relevance in most astrophysical problems. From direct numerical simulations (DNS) of two-dimensional magnetohydrodynamics (MHD), Lourerio et al. (2009) have shown that at large enough turbulent intensities reconnection can be fast -- the reconnection rate becomes independent of the Lundquist number. We investigate the same question using three-dimensional DNS. We find that the reconnection rate obeys Sweet-Parker scaling for low turbulent intensity runs. Runs with large turbulent intensity develops numerous small scale magnetic features, which increases the reconnection rates making reconnection fast, v.i.z., for large enough turbulent intensity reconnection rate departs significantly from Sweet-Parker behaviour, becomes almost a constant as a function of the Lundquist number. The extent of this departure is more in 3D as compared to 2D runs. Another consequence of the magnetic reconnection is that the magnetic energy is dissipated to energise the particles in the process of reconnection. Various solar observations suggests the presence of non-thermal population of particles. For example, the coherent emission mechanisms requires a supra-thermal population of particles in velocity space in order to produce the radio bursts. We further study the energisation of test-particles in the same setup. We find that the speed of the energised particles obeys a Maxwellian distribution, whose variance also obeys Sweet-Parker scaling for small turbulent intensity but depends weakly on the Lundquist number for large turbulent intensity. Furthermore, the variance increases with the strength of the reconnecting magnetic field.

SSS-15	ASI2017_651	Tanmoy Samanta	Poster

Authors: Hui Tian: School of Earth and Space Sciences, Peking University, China; Dipankar Banerjee: Indian Institute of Astrophysics, India; Nicole Schanche: Harvard-Smithsonian Center for Astrophysics, Cambridge, USA

Title: Fine-structure dynamics in the sunspot penumbra and their coupling through the different solar atmospheric layers

Abstract: Sunspots are regions of concentrated strong magnetic fields and appear dark in the central region known as the umbra. Umbra is generally surrounded by a less darker region called the penumbra. Though the sunspots have been observed over centuries, their fine structures and their counterparts in the higher solar atmosphere have been revealed in recent decades with the advancement of high-resolution and multi-wavelength observations. With the advancement of high-resolution instruments, fine structures and their dynamics are being studied. Penumbral microjets (PMJs) are one of the prominent fine-structure dynamical features observed in the sunspot at the chromospheric height. Furthermore, recent high-resolution observations reveal that subarcsecond bright dots (BDs) with sub-minute lifetimes appears ubiquitously in the transition region (TR) above sunspot penumbra. It was proposed that both the PMJs and BDs are formed due to magnetic reconnection process and may play an important role in heating of the penumbra. It was also proposed that PMJs which originate as a result of magnetic reconnection at lower height may progressively heat up to TR temperature and may appears as BDs. Using simultaneous observation of the chromosphere from the Solar Optical Telescope (SOT) aboard Hinode and the TR from the Interface Region Imaging Spectrograph (IRIS), we study the dynamics of BDs and their relation with PMJs. We find two types of BDs, one which is related to PMJs and the others which do not show any visible dynamics in the SOT Ca II H images. From a statistical analysis we show that these two types have different properties. The BDs which are related to PMJs always appear at the top of the PMJs, show inward motion and originate before the generation of the PMJs. These behavior is puzzling and can not be explain by earlier reconnection model. Our results may indicate that the reconnection occurs at the lower coronal/TR height and initiates PMJs at the chromosphere.

SSS-16	ASI2017_785	Dr. K. CHENNA REDDY	Poster

Authors: B Prem Kumar, Department of Astronomy, Osmania University, Hyderabad, India -500007 & K Kishore Kumar Space Physics Laboratory, Vikram Sarabhai Space Center, Thiruvananthapuram, India.

Title: Meteor observations with the all-sky SKiYMET radar at Thumba

Abstract: For dedicated long term observation of meteors, a commercial version of all-sky interferometric meteor (SKiYMET) radar has been developed and installed at Thumba (8.50 N, 770 E). This radar system uses an antenna configuration designed to yield unambiguous meteor angle of arrival while minimizing mutual antenna coupling. Using a careful selection criterion to exclusively record only underdense meteor echoes, the radar allows detection of a wide range of meteor parameters. In this study, we present and discuss the distribution of some selected parameters obtained during the 2013-2015 Geminid meteor shower period. We report here the flux profile of the shower, depending on season and shower activity, typically the daily count rates varies between 6, 500 and 13,000 meteors per day. Further, the radar data used to measure the radiant and pre-atmospheric speed of the meteors form which an orbits has been calculated. With long term data set, some of the possible future potential studies to be carried with the system are discussed.

SSS-17	ASI2017_842	Sreejith Padinhatteeri	Poster

Authors: Sankarasubramanian K., ISRO Satellite Centre.

Title: Birth of a Sunspot : What condition trigger formation of a penumbra?

Abstract: Formation of penumbra, seen as fibril like structures around a dark magnetic concentration (known as umbra) in the optical band, defines the birth of a sunspot on the solar disk. The exact nature of penumbra formation (like the time and position around the umbra), leading to the birth of a sunspot, is not yet fully understood. Studies of many individual cases of penumbral formation in the past have suggested different critical values for certain parameters (like the total magnetic flux) and conditions as the trigger for penumbral formation. Launch of SDO/HMI has given us opportunity to observe a large number of penumbral forming cases to estimate statistically significant value of these critical parameters and also look into other important parameters for its absence in a statistically significant manner. Results from our study of penumbral formation using last five years of HMI data will be presented. It is clear from this preliminary analysis that parameters like critical flux, area, etc are quite different from earlier far and few estimations.

SSS-18	ASI2017_931	Krishna Kumar Pandey	Poster

Authors: K. M. Hiremath2, G. Yellaiah3 3. Department of Astronomy, Osmania University, Hyderabad, A.P, 500007, India. 2. Indian Institute of Astrophysics, Bangaluru, India.

Title: Asymmetry breaks during solar activity

Abstract: Symmetry is foundation of an established dynamic system like Sun and asymmetry evolves during process leaving an imprint of sun's activity and processes involved therein. Reduction in strength of asymmetry could be the sign of rise in symmetry at specific time/interval. Asymmetry and symmetry, both are inertial effect of some cause, hidden in the solar layers. Asymmetry is being localized within short time scale, it also persists at different time scales. In the present study we examine the character and nature of asymmetry at various time scales by optimizing sunspot area and soft X-ray flare index data set, in units of Carrington rotations (CRs). We found that asymmetry strength appears to be lowered at certain periods ~06, ~12, ~18 CRs (164, 327 and, 492 days i.e., harmonics of ~1.3 years. Number of significant asymmetry points depends upon the solar heights.

SSS-19	ASI2017_945	Dr. Ramesh Chandra	Poster

Authors: Bhuwan Joshi Udaipur Solar Observatory, Physical Research Laboratory, Udaipur 313 004

Title: Recurrent solar eruptive flares on 2016 July 23

Abstract: We present a multi-wavelength study of three M-class solar flares from NOAA AR 12565 on 2016 July 23. These flares were well observed by Solar Dynamic Observatory (SDO) and Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) in (E)UV and X-ray wavelengths. All three flares are associated with CMEs. The first flare was associated with very faint and narrow CME. The second flare is accompanied with broad CME. In the case of third flare, the associated CME was started as very bright blob like ejection. The blob like plasma structure appears up to 3 Rsun distance. The third flare was associated with type II radio burst. However, in case of first and second flare there was no type II radio burst. RHESSI observations reveal intense HXR bursts associated with these flares. The HXR sources comprise of distinct emission centroids corresponding to coronal loop-top and foot-point emissions. The non-thermal HXR spectrum extends up to ~100 keV for the first event. The second and third events are associated with very strong HXR bursts up to ~300 keV. Using the magnetic field data, we have explored the possibility that within a same active region why the first CME was very poor and the second and third flares were associated with stronger CMEs.

SSS-20	ASI2017_973	PRITHVI RAJ SINGH	Poster

Authors: Prithvi Raj Singh,A.C. Pandey, C. M. Tiwari,A.K. Saxena Department of Physics A.P.S. University, Rewa, M.P. – 486003

Title: Solar Activity in association with Geomagnetic Activity during Solar Cycles 22-24

Abstract: The 11-year cycle of solar activity is characterized by the rise and fall in the surface area of sunspots. A solar activity in association with the sunspots including; geomagnetic activity; individual solar cycles are characterized by their maxima and minima, as well as hemispheric asymmetries. Comparing the corrected whole sunspot areas to the sunspot number the two quantities are indeed highly correlated as well as geomagnetic activity with sunspot number. The smoothed monthly geomagnetic index (aa) tends to remain high during the declining phase of each solar cycles. The high levels of geomagnetic activity are found even when the sunspot number is quite low for the period (1986-2015). Taking the ratio of the hemispheric differences to the square root of the sums provides a measure of asymmetry that does not tend to favour either maximum or minimum phases. The normalized asymmetry usually switches from north-dominant to south-dominant on time scales shorter than an 11-year sunspot cycle as well as geomagnetic activity. As smoothed, normalized north-south asymmetry in sunspot area and geomagnetic activity, the northern hemisphere activity leads to the fact that in the southern hemisphere, the north will dominate early in the cycle while the south will dominate in the declining phase of solar cycles. We have made an investigation of the patterns of periodicities and their evolution for sunspot number and geomagnetic activity by Fast Fourier Transform (FFT) and Wavelet Transformation, and found that they have almost similar periodicities of ~3.25 and 2.25 years during the period (1986-2015).

SSS-21	ASI2017_979	shalini sarkar	Poster

Authors: Author: Shalini Sarkar

Title: Statistical analysis of solar radio bursts in connection to sunspot numbers for the solar cycle 23 and 24

Abstract: Statistical analysis of solar radio bursts in connection to sunspot numbers for the solar cycle 23 and 24 Shalini Sarkar The paper analyses different types of solar radio bursts statistically to look for the typical burst of maximum rate of occurrences during the time period of 1996-2016 covering solar cycle 23 and 24. Variation of sunspot numbers during these two cycles is also observed to find out its connection with the occurrences of radio bursts. The study shows interesting co-relation between the two as the occurrence rate of XRA along with sweep and fixed frequency radio bursts are observed to have maxima and minima following the maximum and minimum number of sunspots during this time span. Observations for two consecutive solar cycles also showed similarity in the relationships between the two observable stating the dependence of the solar radio energy emission on the sunspot number.

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ASI-2017 Poster Presentations

Stars, ISM and the Galaxy

SG-1	ASI2017_1041	Tejpreet Kaur	Poster

Authors: Sandeep Sahijpal, Department of Physics, Panjab University, Chandigarh 160014

Title: THE CHEMICAL EVOLUTION OF THE MILKY WAY GALAXY

Abstract: The galactic chemical evolution (GCE) deals with the origin and gradual growth of the isotopic abundance of the stable nuclides over the galactic time-scales of ~13 billion years from the stellar nucleosynthetic contributions of successive generations of stars. The nucleosynthetic inventories of the various elements increase the metallicity of the interstellar medium (ISM) in such a manner that it acquires a value of 0.014 at the time of formation of the solar system around ~4.56 Ga ago from an initial null value at the time of formation of Milky Way galaxy. The elemental as well as isotopic abundances evolution has been simulated for the galaxy. In order to develop the GCE models for galaxy, we incorporated the deduced accretion history of galaxy, the star formation rate (SFR), the stellar initial mass function (IMF), the supernovae rates, the stellar nucleosynthetic yields and the stellar evolutionary theories for different stellar masses and metallicities.

SG-2	ASI2017_1107	Rahul Sharma	Poster

Authors: Rahul Sharma (Department of Physics & Astrophysics, University of Delhi, Delhi), Abdul Jaleel (Department of Physics & Astrophysics, University of Delhi, Delhi), Chetana Jain (Hans Raj College, University of Delhi, Delhi), Biswajit Paul (Raman Research Institute, Bangalore) and Anjan Dutta (Department of Physics & Astrophysics, University of Delhi, Delhi)

Title: Spectroscopic study of the dipping behaviour of MXB 1658-298 with XMM-Newton

Abstract: MXB 1658-298 is a transient low mass X-ray binary (LMXB), which has recently undergone a phase of enhanced X-ray emission after a long period of quiescence. It has an orbital period of ~ 7.1 hours, which includes an X-ray eclipse of duration ~ 15 minutes. The source also shows dipping and burst behaviour. Study of eclipsing and dipping LMXBs is useful to probe the structures in the accretion disk. The X-ray intensity dips observed in MXB 1658-298 are indicative of obscuration by a thickened accretion disk at the outer regions. We have carried out a detailed study of this dipping source using XMM-Newton archival data for two outbursts during 2001 and 2015. During the 2001 observation, when the source was relatively brighter, dipping region lied between ~ 0.7-0.96 orbital phase; while for 2015 observation, dipping region is narrower and it lied between ~ 0.7-0.86 orbital phase. It is observed that the dipping during 2015 observation is shallower than 2001 observation. In this work, we will discuss the results of spectral analysis of dipping as well as the persistent phase of the source.

SG-3	ASI2017_1108	Geeta Rangwal	Poster

Authors: R K S Yadav (ARIES Nainital), Alok Durgapal (Kumaun University Nainital)

Title: Interstellar extinction study in the direction of five young open clusters

Abstract: The study of interstellar matter is important for many investigations related to galactic and extragalactic objects. The attenuation of star light due to interstellar matter is known as interstellar extinction. Interstellar extinction law is the best tool to study the interstellar matter. In the present study we have investigated the interstellar extinction law in the direction of five young open star clusters namely NGC 6823, NGC 7160, NGC 2401, Haffner 18 and Haffner 19. The optical and near-IR data for these clusters have been taken from WEBDA and 2MASS database respectively. All these objects are younger than 50 Myr. The derived colour excess ratios indicate that interstellar extinction law is normal in the direction of these clusters. This also indicates that the properties of interstellar matter is normal.

SG-4	ASI2017_1121	Vineet Kumar Mannaday	Poster

Authors: Parijat Thakur (Department of Pure and Applied Physics, Guru Ghasidas Central University, Bilaspur (C.G.), India), Ing-Guey Jiang (Dept. of Physics and Institute of Astronomy, National Tsing-Hua University, Hsinchu, Taiwan), D. K. Sahu (Indian Institute of Astrophysics, Bangalore, India), Y. C. Joshi (Aryabhatta Research Institute of observational sciences, Nainital, India), Swadesh Chand (Department of Pure and Applied Physics, Guru Ghasidas Central University, Bilaspur (C.G.), India)

Title: Comparative Study of JKTEBOP and TAP codes for Estimating Physical and Orbital Parameters of Extra-solar Planetary Systems

Abstract: The physical and orbital parameters of the extra-solar planetary systems can be estimated using the two publicly available codes: JKTEBOP (Southworth et al. 2004a,b) and TAP (Gazak et al. .2012). We present the comparative study of the physical and orbital parameters derived for the extra-solar planetary systems using these two codes. For our analysis, we have taken the two transit data of the different extra-solar planetary systems observed by us, as well as a few available in the literature. To estimates the above said parameters, we modeled each light curve by applying the same process using these two codes. We found that the estimated parameters obtained from these codes shows good agreement. However, the errors estimated by JKTEBOP code are smaller than those reported by TAP, which justifies the result of Hoyer et al. (2012) and Turner et al. (2013) that JKTEBOP underestimated the errors.

SG-5	ASI2017_1128	SUBHRATA DEY	Poster

Authors: Aruna Goswami Indian Institute of Astrophysics, Bangalore

Title: Study of Nitrogen abundance in carbon stars

Abstract: Carbon stars provides a valuable information on the role of low- to intermediate-mass stars of the halo on the early Galactic chemical evolution. Thus a knowledge of the Carbon stellar population in our Galaxy is a critical requirement to build up scenarios of early Galactic chemical evolution.We present a quantitative assessment newly identified carbon star catalogued by Ji et al from Lamost DR2 catalogue. The carbon abundance is well studied but the nitrogen abundance in certain carbon stars are not well known. We study the nitrogen abundances of the carbon star by analysing the CN bands in the stellar spectra at different wavelength regions. We also investigate the reason behind nitrogen abundance of these star based on our analysis and its contribution to the understanding of evolution of our galaxy.

SG-6	ASI2017_1142	Indrani Banerjee	Poster

Authors: Indrani Banerjee^1,*,Ayan Bhattacharjee^1 , Anuvab Banerjee^1,, Dipak Debnath^2, Sandip K. Chakrabarti^{1,2} 1. S.N. Bose National Centre for Basic Sciences, JD Block, Salt Lake, Kolkata 700106 2. Indian Centre for Space Physics, 43 Chalantika, Garia Station Road, Kolkata 700084 * Presenting author

Title: Analysis of spectral characteristics of the persistent source Cygnus X-1 using the TCAF Solution

Abstract: We investigate spectral behaviour of the persistent black hole source Cygnus X-1 from December 10, 1997 to June 27, 1998. We use RXTE/PCA data and apply the Two-Component Advective Flow (TCAF) solution for studying its spectral properties. This gives us an idea of the underlying accretion flow dynamics around the object in terms of the disk and halo rates and the location and size of the Compton cloud. This is the first time such details of the flow is reported. Moreover, in the TCAF model the mass of the black hole is also a spectral fit parameter and hence purely from the spectral fits we can obtain a constraint on the mass of the black hole. The mass of the black hole candidate is estimated to be M_avg = 14.430 ± 0.494 M_sun . This is consistent with previous estimates by others.

SG-7	ASI2017_1144	AYAN BHATTACHARJEE	Poster

Authors: Ayan Bhattacharjee^{1,*}, Sandip K. Chakrabarti^{1,2} 1. S. N. Bose National Centre for Basic Sciences, Block -JD, Sector -3, Salt Lake, Kolkata 700106, India 2. Indian Center for Space Physics, 43 Chalantika, Garia St. Road, Kolkata 700084, India *Presenting author

Title: Monte-Carlo Simulations of Thermal Comptonization Process in a Two Component Advective Flow around a Neutron Star

Abstract: We study spectral properties of Two-Component Advective Flow (TCAF) around a neutron star. We compute the effects of thermal Comptonization of soft photons emitted from a Keplerian disc and the boundary layer of the neutron star by the post-shock region of a sub-Keplerian flow, formed due to strong centrifugal barrier around the star. The shock location X_s is the inner edge of the Keplerian disc. We compute a series of realistic spectra assuming a set of temperature of the post-shock region T_{CE} , the temperature of

the boundary layer T_{NS} and the shock location X_s . These parameters depend on the disc and halo accretion rates (ṁ_d and ṁ_h, respectively) which modulate the resultant spectra. We find that the resultant spectrum becomes harder when ṁ_h is increased. We also study the variation of hard photons flux with the angle of observation.

SG-8	ASI2017_1147	Debashish Jena	Poster

Authors: Dr. Manjari Bagchi, The Institute of Mathematical Sciences (IMSc), Chennai.

Title: Probing the zoo of isolated neutron stars in the Galaxy with statistical techniques

Abstract: We present a statistical study of different properties of four classes of isolated neutron stars, namely Isolated Radio Pulsars (IRaPs), which emit regular radio pulse that are detectable in periodicity searches, Rotating Radio Transients (RRATs), which emit sporadic radio pulses that are detectable in single pulse searches, X-ray Dim Isolated Neutron stars (XDINs), which are seen only in thermal X-rays and Magnetars, which are seen in more luminous quiescence X-rays accompanied by strong outbursts. The parameters explored are measurable parameters like the spin period and the rate of change of the spin period, as well as derived parameters like the characteristic age, the spin-down power, the surface dipolar magnetic field, and the dipolar magnetic field at the light-cylinder. We employ both one-dimensional and two-dimensional Kolmogorov-Smirnov tests. We report that distributions of various parameters of these classes are statistically distinct.

SG-9	ASI2017_1153	Debjit Chatterjee	Poster

Authors: Debjit Chatterjee (1) Dipak Debnath (1) Sandip K. Chakrabarti (1,2) Arghajit Jana (1) Santanu Mondal (3) 1. Indian Centre for Space Physics, 43 Chalantika, Garia Station Rd., Kolkata 700084, India 2. S. N. Bose Centre for Basic Sciences, Salt Lake, Kolkata 700098, India 3. Instituto de F´sica y Astronom´a, Facultad de Ciencias, Universidad de Valpara´so, Gran Bretana N 1111, Playa Ancha, Valparaso, Chile

Title: Spectral and Temporal properties of MAXI J1543-564 during initial phase of its 2011 outburst

Abstract: We study the initial phase of the 2011 outburst of black hole candidate (BHC) MAXI J1543-564. We analyze 2.5-25 keV RXTE/PCA archival data to infer the spectral and temporal properties for this transient source. Two Component Advective Flow (TCAF) solution was used to fit spectral data, to study the accretion dynamics for this phase of the outburst. During this phase of the outburst, frequencies of the observed low frequency quasi-periodic oscillations (QPOs) are found to increase monotonically with time (day). We find that this evolution of the QPO frequencies fits well with Chakrabarti and his collaborators' propagating oscillatory shock (POS) model. We find the extracted shock parameters from POS model (such as shock location, compression ratio) roughly matched with the TCAF model fitted spetcral parameters. We notice that the normalization remains almost constant during this spectral fitting, which helped us to predict the most possible range of the mass of the black hole candidate. Our predicted mass range of the source using combined analysis with the TCAF solution and the POS model is 12.6-14.0 Solar mass.

SG-10	ASI2017_1160	Amith Govind	Poster

Authors: Amith Govind (Christ University, Bengaluru), Devarshi Choudhury (Christ University, Bengaluru), Shruthi S Bhat (Christ University, Bengaluru), Paul K T (Christ University, Bengaluru), Annapurni Subramaniam (Indian Institute of Astrophysics, Bengaluru)

Title: Classical Be Stars and their Different Hα Profiles

Abstract: We present the preliminary results of the spectroscopic study of a few Classical Be Stars. A Classical Be star is defined as a non-supergiant B-type star whose spectrum has, or had at sometime, one or more Balmer lines in emission. The emission lines originate from a circumstellar disk which is formed by the material ejected from the star and the actual mechanism for this ejection is still unknown. The properties of the disk are studied spectroscopically to understand the kinematics as well as the distribution of material in the circumstellar disk. Medium resolution spectra of these Be stars were obtained using the Universal Astronomical Grating Spectrograph (UAGS) at the Cassegrain focus of the 1 metre reflector of Vainu Bappu Observatory, Kavalur, India. Their time series spectra were obtained between the period February-May 2016 in the wavelength range 6100-6800Å. The spectra were reduced and calibrated using the routines in IRAF. From the spectra, different emission line parameters have been deduced. We also discuss different Hα profile types observed within the data set.

SG-11	ASI2017_1169	Vatsal Panwar	Poster

Authors: W.-H. Ip (Institute of Astronomy, NCU, Taiwan), H.-Y. Chang(Institute of Astronomy, NCU, Taiwan), L.-C. Huang (Institute of Astronomy, NCU, Taiwan)

Title: A study of stellar magnetic activity of M dwarfs from Kepler-2 photometry

Abstract: Magnetically active low-mass M dwarfs have recently been the subject of great interest, in context of characterization of the nature and evolution of their magnetic activity and its impact on detection and habitability of extrasolar planets orbiting them. Using photometric diagnostics of magnetic activity, we present a study of magnetic activity of a sample of bright and nearby M dwarfs observed during campaigns C0 to C7 of the Kepler Two-Wheel (Kepler-2 or K2) mission. The high-precision light curves from K2 provide a unique opportunity to study flare-statistics of M dwarfs across a range of stellar masses, spectral-types (and hence fully-convective to semi-convective interiors) and periods of rotation. We detrend the long cadence K2 light curves from the MAST archive, using a recently proposed Gaussian Processes regression based approach. By employing a classical stellar-flare identification criterion and flare energy calculation method on the detrended photometry, we calculate basic flare properties (flare energy, peak flare amplitude and flare duration) and obtain the cumulative flare-frequency distributions for the targets. We fit the energy distribution of flares with a power law and present the corresponding power law indices. For frequently flaring stars, the power law noticeably flattens towards lower energies due to incomplete detection of low energy flares. From the photometrically derived rotation periods, we also present the relation between stellar rotation and magnetic activity which shows a transition between the activity levels of slow and fast rotators.

SG-12	ASI2017_1170	Souradeep Bhattacharya	Poster

Authors: Ishan Mishra (Indian Institute of Technology, Guwahati, India), Kaushar Vaidya (Birla Institute of Technology and Science, Pilani, India), Wen-Ping Chen (Graduate Institute of Astronomy, National Central University, Taoyuan, Taiwan)

Title: Stellar Mass Segregation of the aged Galactic Open Cluster Berkeley 17

Abstract: We present an analysis of the morphology of Berkeley 17, the oldest known open cluster (~10 Gyr), using a probabilistic star counting of Pan-STARRS point sources, and confirm its core-tail shape, plus an antitail, previously detected with 2MASS data. The stellar population, as diagnosed by the color-magnitude diagram and theoretical isochrones, shows more massive than lower-mass members in the cluster core, whereas there is a paucity of massive members in both tails. This manifests mass segregation in this aged star cluster with the low-mass members being stripped away from the system. It has been claimed that Berkeley 17 is associated with an excessive number of blue stragglers. Our analysis in comparison of the cluster with nearby reference fields indicates that about half of the blue stragglers may be field contaminations, and some may be confused with the rare blue horizontal-branch stars in this cluster.

SG-13	ASI2017_1178	Abdul Jaleel PP	Poster

Authors: Abdul Jaleel (Department of Physics & Astrophysics, University of Delhi, Delhi), Rahul Sharma (Department of Physics & Astrophysics, University of Delhi, Delhi), Chetana Jain (Hans Raj College, University of Delhi, Delhi), Biswajit Paul (Raman Research Institute, Bangalore), Anjan Dutta (Department of Physics & Astrophysics, University of Delhi, Delhi)

Title: Spectroscopic study of faint X-ray Pulsators

Abstract: During the last few years, a large number of faint X-ray pulsators have been discovered having periodicity ranging from a few seconds to over a thousand seconds. This class of objects includes HMXBs, CVs and few pulsators with unknown nature. In this work, we present the spectroscopic study of 5 faint X-ray pulsators (CXOU J005758.4-722229, CXOU J163855.1-470145, CXO J184441.7-030549, CXOU J111133.7-603723 and CXOU J112347.4-591834), for which large number of Chandra and XMM-Newton observations were available. Spectra of all the sources have been extracted in 0.5-10.0 keV energy band. The best fit spectral model consists of absorbed power-law model. Iron emission line was detected in spectrum of CXOU J111133.7-603723. We also discuss the pulse profiles analysis of some of the sources.

SG-14	ASI2017_1179	GAURAV SINGH	Poster

Authors: R K S Yadav & Aryabhatta Research Institute of Observational Sciences (ARIES)

Title: Proper motion study of star clusters

Abstract: Proper motion study in star clusters probably has a more immediate impact than any other area of astronomy. Star clusters provide us with laboratories to study the formation and evolution of stars. Proper motion, cluster membership, internal dynamics as well as absolute proper motion leading to space velocities

makes a very significant contribution to the broader subject of star clusters. So, for this purpose, I am using two epoch images with a time baseline of about 10-15 years taken from ESO 2.2m telescope and applying high-precision astrometry technique to derive membership information and produce color-magnitude diagrams with reduced field star contamination.

SG-15	ASI2017_1183	Tirthendu Sinha	Poster

Authors: Saurabh Sharma*, A K Pandey*, Rakesh Pandey* *ARIES,Manora Peak, Nainital, India

Title: Optical variability of stellar sources in star forming regions

Abstract: Stellar rotation is one of the basic properties to understand the stellar evolution. The stellar rotation undergoes several changes during the whole stellar life. Such changes depend e.g., on the evolution of the internal structure, angular momentum, magnetic field etc. Our knowledge on the rotation properties at different stellar ages is increasing, however, much still to be done as the number of variables discovered in star clusters are not sufficiently large enough to constrain the various models proposed to describe the mechanisms that drive the angular momentum evolution, disk evolution etc. Specifically, the variables are not well distributed over age sequence and there are vital gaps in the age sequence of the sample of available periodic cluster members. The relationship between age, rotation, and activity has been a crucial topic of stellar evolution over the last several years. The determination of stellar rotational periods in large samples of stars of different ages and mass is also crucial for understanding the relationships with stellar properties and their close surrounding. We are studying variability in stellar objects in young star forming regions to understand those different physical processes.

SG-16	ASI2017_1188	PRANJUPRIYA GOSWAMI	Poster

Authors: Pranjupriya Goswami (Tezpur University, Tezpur), Gautam Saikia (Tezpur University, Tezpur), P. Shalima (Regional Institute of Education, Mysore), Rupjyoti Gogoi (Tezpur University, Tezpur) and Amit Pathak (Tezpur University, Tezpur)

Title: Dust modelling in the Large Magellanic Cloud

Abstract: The diffuse dust emission in the Large Magellanic Cloud (LMC) has been observed at different wavelengths ranging from the ultraviolet to infrared by space-based telescopes such as the Far Ultraviolet Spectroscopic Explorer (FUSE), the Spitzer Space Telescope and the AKARI satellites. The dust emission intensities have been studied at these wavelengths for various HII regions within the LMC. Previously, we have probed the dust species in two regions of the LMC, namely the N11 and 30 Doradus with the help of correlation studies among the far-ultraviolet (FUV) and mid-infrared (MIR) as well as far-infrared (FIR) wavelength intensities. This work presents the initial results that we have obtained while trying to model these two regions by using suitable dust mixtures.

SG-17	ASI2017_1207	Nilam Raghunath Navale	Poster

Authors: Nilam R. Navale1, Anjali Rao2, A. R. Rao3, Yash Bhargava2, M. B. Pandge1 1Dayanand Science College, Barshi Road, Latur, Maharashtra 413512, India 2Inter-University Centre for Astronomy and Astrophysics, Post Bag 4, Ganeshkhind, Pune 411007, India 3Tata Institute of Fundamental Research, Homi Bhabha Road, Mumbai 400 005, India

Title: Long Term X-ray Variability Characteristics of Black Hole Binary GRS 1915+105

Abstract: The enigmatic Galactic black hole binary GRS 1915+105 shows a bewildering variety of variability classes and occasionally it exhibits powerful jets moving at superluminal speeds. The relationship between the occurrence of variability classes with the jet emission and the high frequency quasi periodic oscillations (HFQPO) is poorly understood due to the lack of continuous pointed observations. We make use of the data from all sky monitors (RXTE/ASM, SWIFT/BAT and MAXI) to predict the variability class of GRS 1915+105 and test them with the help of existing pointed observations of RXTE/PCA. We assign variability classes to all PCA observations spanning 16 years using standard one light curves and color-color diagrams generated with standard two light curves. We study the distribution of variability classes in different bins of count rates in different energy bands of the detectors. We find that some of the count rate bins for a certain energy band includes only few of the variability classes excluding others. Such count rate bins for a given energy range can be used to predict the variability class. The detailed results of the study and the probability distribution of variability classes and their relation to superluminal jet emissions and HFQPO emission will be discussed in the paper. This can be used to predict and plan detailed pointed observations using the AstroSat satellite to make an in depth study of the disk-jet connection in this exciting black hole source.

SG-18	ASI2017_1213	Rahul Bandyopadhyay	Poster

Authors: Ramkrishna Das, S N Bose National Centre for Basic Sciences; Soumen Mondal, S N Bose National Centre for Basic Sciences

Title: Morpho-Kinematical Study of Nova V477 Scuti

Abstract: In this work we perform morpho-kinematical study of novae V477 Scuti in order to obtain a 3D model and some important physical parameters. Nova V477 Scuti (Nova Scuti 2005 N.2) made its outburst in October, 2005. The near-IR JHK-spectroscopy (1.08-2.35 μm) of V477 Scuti are found to be typical of a classical nova and show prominent H I emission lines of the Paschen and Brackett series. We extracted the near-IR K-band data of 19th October, 05, obtained during the outburst by Das et. al. (IAU Circ. 8617, 2005) at 1.2m Mt. Abu Telescope. We have primarily modeled the ejecta of Nova V477 Scuti using the 19th October Br-γ (2.1655 μm) line profile as reference with the morpho-kinematic modeling software SHAPE. The full width at zero intensity of the line calculated from the Doppler shift is found to be about 3500 km/sec. The line profile has a prominent triple-peak feature along with two smaller peaks in both red and blue sides of the central peak. In SHAPE we construct the possible 3D model and the code generates a synthetic line profile, which is directly compared with the observational line profile for a satisfactory match. The basic modeling reveals a bipolar structure, with an equatorial ring, which enhances the central peak, and the polar over-density blobs, which are considered to account the red and blue shifted peaks. The relative dimensions of the components, the axial ratio of the bipolar structure, the relative density and maximum expansion velocity of the individual components and inclination of the polar (major) axis with the line of sight is varied and several synthetic spectra are generated. The best fit parameters are obtained through optimization technique. The

estimation of the parameters are as follows: Axial ratio of the bipolar structure is 1.5, the inclination of the system is ~20° and the maximum expansion velocity of the bipolar structure, polar blobs and the equatorial ring are ~1200 km/sec, ~1400 km/sec and ~400 km/sec respectively. As the components move with different velocities, we expect that their relative density shall change with the time.

SG-19	ASI2017_1228	Dr. Sabyasachi Pal	Poster

Authors: Sabyasachi Pal (ICSP), Dusmanta Patra (ICSP), Monique Hollick (University of Western Australia), Sandip K. Chakrabarti (SNBNCBS, ICSP)

Title: Galactic and extra-galactic transient radio sources

Abstract: Dynamic radio sky is not properly studied due to various reasons. There are different kind of compact sources which show highly variable radio emission from nano second to month time scale for different kind of physical reasons. We are systematically searching transient sources in Galactic plane. We have already discovered few transient sources, most of which have high spectral index and presence of circular polarization. We are also looking for transient sources in some well observed extra-galactic field. In this paper we will summarize different methods to search transient radio sources and will summarize our effort to search Galactic and extra-galactic transient sources. We will also summary different properties of newly discovered transient sources.

SG-20	ASI2017_1252	Mohana Thara C	Poster

Authors: Mohana Thara C (Christ University, Bengaluru), Dr.Paul K T (Christ University, Bangalore), Dr.Blesson Mathew (Tata Institute of Fundamental Research, Mumbai), Dr.Annapurni Subramaniam (Indian Institute of Astrophysics).

Title: STUDY OF THE TRANSIENT NATURE OF Be STARS

Abstract: We carried out a program to study the transient nature of circumstellar disc in classical Be stars using spectra collected over a period of three years with the Himalaya Faint Object Spectrograph Camera (HFOSC) mounted on the 2-m Himalayan Chandra Telescope (HCT). This is supplemented with the archival spectroscopic data from Be star spectra (BeSS) database. The formation of disc in classical Be stars, known as `Be phenomenon', is one of the unsolved problems in stellar research. By now it is clear how the material gets redistributed in the disc once it is launched from the star. However, the central problem of how material is launched from the star remains open. A way to tackle this problem is to estimate the disc formation and dissipation time scales in Be stars, particularly from the studies of a statistically large sample. A clever way to address this problem is through spectroscopy, wherein the profile changes of H-alpha give indication of the presence or absence of disc. In certain cases, Be stars were found to show H-alpha in absorption which is suggestive of a disc-loss episode. This is often followed by disc rebuilding phase, whose time scale is assessed from the recovery period of H-alpha to emission. We have identified a sample of ~20 Be stars going through Be -> B -> Be phase, from the cyclic variation of H-alpha from emission to absorption and back to emission. Never before disc-loss episodes were reported for such a large sample of Be stars. The implications of this result in understanding `Be phenomenon' will be discussed.

SG-21	ASI2017_1268	SATADAL DATTA	Poster

Authors: none

Title: Bondi flow revisited

Abstract: Newtonian spherically symmetric transonic ac- cretion is studied by including the mass of the accreting matter, while considering the growth of the accretor itself to be negligibly small. A novel iterative method is intro- duced to accomplish that task. It is demonstrated that the inclusion of the mass of the fluid changes the critical prop- erties of the flow as well as the topological phase portraits of the stationary integral solution. The changes are small in the framework of this methodology. It is shown that to get large changes one has to develop a new method.

SG-22	ASI2017_1271	Devendra Bisht	Poster

Authors: Archita Rai (rai.archita@gmail.com), S. Ganesh (shashi@prl.res.in) and K. S. Baliyan (baliyanprl@gmail.com) Physical Research Laboratory

Title: Astrophysical parameters of poorly studied open cluster NGC 5617

Abstract: Open clusters (OCLs) are located in the Galactic disc. It is important to determine their properties and spatial distribution to understand the structure and evolution of the Milky Way. Therefore, investigation of the OCLs and, in particular, the estimation of their physical parameters like age, distance, reddening, size and metallicity are very valuable. The main aim of this paper is to study the astrophysical behaviour of poorly studied open star cluster NGC 5617 towards, longitude (l)=-45 deg in the Galactic plane. For this purpose we have used the PPMXL, 2MASS, VVV survey, ISOGAL and GLIMPSE data. The stellar density distribution and color-magnitude diagrams are used to estimate the geometrical structural parameters (cluster center, cluster radius, core and tidal radii, the distance from the Sun, Galactocenteric distance and the distance from the Galactic plane). Also, the main astrophysical parameters i.e. age, color excesses, total mass, relaxation time, dynamical evolution parameter, luminosity function, mass function and mass-segregation are also derived for this cluster. Results will be discussed in poster/oral.

SG-23	ASI2017_1279	Abinaya Swaruba R	Poster

Authors: Pandey Gajendra, IIA; Paul KT,Christ University

Title: Spectroscopic study of blue stragglers in opencluster M67

Abstract: We attempt to study the enigmatic, bluer stellar systems that lie along the apparent extension of main sequence of the cluster M67. These non-standard stellar systems are known as blue-stragglers. Many theories were proposed to explain the position of these stragglers in CMD , i.e., the increase in temperature of these systems. We have obtained the high-resolution spectra of blue stragglers in the open cluster M67. The aim is to verify the binary nature of the stragglers: 0131 and 0081, by measuring the radial velocities of these stragglers at different epochs.

SG-24	ASI2017_1294	Pratheeksha Nayak	Poster

Authors: Pratheeksha Nayak (Indian Institute of Space Science and Technology), Blesson Mathew (Tata Institute of Fundamental Research), Manoj Puravankara (Tata Institute of Fundamental Research)

Title: OI Lines in Herbig Ae/Be Stars

Abstract: Herbig Ae/Be (HAeBe) stars are intermediate mass (2M⊙< M < 8M⊙) pre-main sequence stars surrounded by accretion disks. The inner most region of the accretion disks is a reservoir for the production of several emission lines seen in the optical and near-IR spectra. We investigated the dominant excitation mechanism for the most prominent OI line at λ8446 Å observed in the spectra of HAeBe stars . Several different mechanisms have been proposed for the OI line formation, which include Lyman beta fluorescence, collisional excitation, recombination and continuum fluorescence. In Classical Be stars, the main sequence analogs of HAeBe stars and which possess ionised decretion disks, Lyβ fluorescence has been identified as the primary excitation mechanism for OI λ8446 Å line (Mathew et al . 2012b). In HAeBe stars with accretion disks, the situation is less clear . We analysed optical (5500-9000 Å) and near-IR (Y & J band) spectra of a large sample of HAeBe stars to study the excitation conditions of the OI λ8446 Å line. Excess OI emission above photospheric absorption is observed in 23 optical and 3 near-IR spectra. We measured emission strengths of Hα, OI λ7774 and OI λ8446 in these. The observed line flux values were compared with theoretical estimates to identify the dominant excitation mechanism . Our analysis indicate that Ly β fluorescence is likely the dominant mechanism for OI λ8446 Å excitation in HAeBe stars, if the line originates in the hot (> 5000 K) and dense (ne > 10^12 cm^-3) magnetospheric accretion columns. Interestingly, we find a strong correlation between OI λ8446 line flux and the accretion rates estimated from Hα. This opens up the possibility of using OI λ8446 as an accretion indicator, which, unlike Hα, is less affected by contributions from jets/outflows.

SG-25	ASI2017_1297	K. Sriram	Poster

Authors: Malu S Department of Astronomy Osmania University Hyderabad A. R. Rao DAA TIFR Mumbai

Title: Anti-correlated lags in a Z-source GX 17+2

Abstract: We performed the X-Ray temporal and spectral study of the neutron star source GX 17+2 using RXTE data. Cross-correlation analysis was implemented in various energy bands in order to detect lags. In a few observations we found that the soft (2-5 keV) and hard (16-30 keV) energy light curves show anti-correlated lags of the order of a few tens of seconds. During these observations we found that the power density spectra have also changed. The spectral analysis shows that the spectra pivots in the energy range 5-10 keV suggesting that the accretion disk geometry varied during the detected lag. Overall results are discussed in the framework of the truncated accretion disk model.

SG-26	ASI2017_1318	Anjali Rao	Poster

Authors: Ranjeev Misra, IUCAA,Pune

Title: AstroSat/LAXPC results on timing properties of black hole binaries

Abstract: Large Area X-ray Proportional Counter (LAXPC) is an important scientific payload onboard AstroSat which is capable of providing unprecedented timing information of X-ray binaries. RXTE/PCA has revolutionized our understanding of timing behavior of X-ray binaries, however, LAXPC has several advantages over RXTE/PCA, therefore, new important results are expected from the instrument. We present our results on timing studies of the persistent black hole binaries Cyg X-1 and LMC X-1. The results show the presence of Quasi Periodic Oscillation (QPO) during hard states of Cyg X-1. The properties of the QPO have been studied in detail and the results on the variation of QPO power with energy, variation of time lag with frequency and energy will be presented. We also present our results on flux-resolved spectroscopy which is now possible owing to large collection area and event mode data of AstroSat/LAXPC.

SG-27	ASI2017_1320	ALIK PANJA	Poster

Authors: Soumen Mondal, Somnath Dutta, S. N. Bose National Centre for Basic Sciences

Title: Ongoing star-formation and stellar evolution in the active H II region Sh2-242

Abstract: Galactic H II regions concerns the formation and early evolution of stars of various masses over a time-scale of few million years. To understand the star formation activity in galactic H II regions, studies of the properties of various star-forming regions (SFRs) at different environments are essential. Sh2-242 is a faint and red nebulous region located at a distance of 2.1 kpc and excited by a known B0 V star, BD+26 980. An optically visible IRAS source, IRAS 05490+2658 lies at $\sim 5'$ east of the H II region Sh2-242 and at a similar distance of 2.1 kpc. We aim to explore the young stellar population as well as to understand the structure and star formation history for the SFR Sh2-242 using optical, near-infrared (NIR) and mid-infrared (MIR) wavelengths. Using (J − H/H − K) NIR color excess diagram, we have identified more than 100 candidate members in the region Sh2-242. We estimated an average extinction Av ~ 3.8 mag towards Sh2-242 from field star decontamination method. From J vs (J − H) color-magnitude diagram, we have estimated the mass range of young stellar objects as 0.1-3.0 $M\odot$ having an average age of 2-3 Myr. From the different color composite images in NIR and MIR, it is apparent that the SFR Sh2-242 is not isolated, another two H II regions, LBN 182.30+00.07 and G182.4+00.2, may be associated with it. Further spectrophotometric analysis of few bright members are on-going for complete understanding of the region. We present here results from our preliminary analysis.

SG-28	ASI2017_1321	Surabhi Yadav	Poster

Authors: 1.Surabhi Yadav,Christ University. 2.KT Paul Christ University,Bengaluru

Title: Spatial and Dynamical properties of open star cluster:DOLIDZE 46

Abstract: The basic parameters of an unstudied open cluster DOLIDZE 46 estimated in the present study using archival PPMXL, 2MASS and WISE catalogues. The radius of the cluster is estimated by fitting the modified king's empirical model on its stellar density profile. The radial distribution of the system gives a core and cluster radii of 0.813298 arc minute and 6.030906 arc minute. The mean- proper motion of the cluster is estimated through the individual proper motion of probable members identified through dynamical methods. Most probable members are identified by estimating kinematic probability of stars within the clusters.

SG-29	ASI2017_1326	DHRUV PATHAK	Poster

Authors: Dr. Manjari Bagchi IMSc-HBNI

Title: Probing Orbital Properties of Wide Binary Pulsars

Abstract: When rotationally powered, neutron stars emit electromagnetic beams mostly in the radio wavelengths, they are known as radio pulsars. The rotation periods of radio pulsars have been found to be in the range of 1.4 milliseconds to 8.5 seconds. Radio pulsars with rotation period less than 30 milliseconds are known as millisecond pulsars (MSPs). It is believed that MSPs got spun-up during there past when they accreted matter from their companion's giant stage. Most of the millisecond pulsars are thus in binaries (usually with white dwarfs as the companion but sometimes another neutron star or an evaporated sub-stellar object can also be the companion). But there are about 60 MSPs in the Galactic field are isolated. It is thought that their progenitors were like progenitors of double neutron star systems, but the binaries got disrupted during the second supernovae. PSR J1024−0719 is a millisecond pulsar that was long thought to be isolated. However, puzzling results concerning its velocity, distance, and low rotational period derivative have led to reexamination of its properties. This is now thought to be a part of a binary with a very wide orbit having orbital period between 2-20 kyears. I explore different classical and general relativistic aspects of pulsar properties of such wide binary pulsars, especially the orbital properties. I also investigate the possibilities of other known isolated MSPs to be actually members of such very wide binaries.

SG-30	ASI2017_1327	Madhulita Das	Poster

Authors: Department of Physics and Astronomy, National Institute of Technology, Rourkela, Odisha, India

Title: Plasma-screening effects in the astrophysically relevant He-like and Li-like ions

Abstract: The spectroscopy of plasma embedded atomic and ionic systems are remarkably different from their corresponding isolated candidates. Accurate estimation of the atomic structures and their properties are of immense interest in recent years for their wide range of astrophysical applications. The Relativistic Coupled-Cluster (RCC) method has been employed to study the spectoscopy of atoms and ions in weak and strong

plasma environment by using Debye and Ion Sphere model, respectively. By using this techniques, the energy levels and transition properties of He-like and Li-like ions have been calculated in hot and dense plasma environments. Due to the plasma environment, the ionization and excitation energies as well as the oscillator strengths change considerably in comparision to plasma free systems. It is also predicted that, there is blue and red shifts in the spectral lines of the embedded plasma ions as the strength of the plasma increases. It is also found that, the quasi-degeneracy among the energy states having same principal quantum number (n) but different angular momentum (l) is slacken as plasma strength increases. These findings would be very useful in the interpretation of spectral properties of atoms and ions embedded in various astrophysical plasmas. These knowledge are very useful in estimating radiative opacity, photoionization cross sections, line intensities, etc of the aforementioned astrophysical plasmas.

SG-31	ASI2017_1338	Ranjani Lakshminarayan	Poster

Authors: Ranjani L Kandi1, K T Paul1, Annapurni Subhramaniam2 1 Department of Physics, Christ University, Hosur Road, Bengaluru-560029, Karnataka 2 Indian Institute of Astrophysics, II Block, Kormangala, Bengaluru-560034, Karnataka

Title: Emission line variabilities of Classical Be-Stars

Abstract: We present the emission line variabilities of 25 Classical Be-Stars which show long term variations of about 10-15 years. All the spectra are assembled from an archival database called BeSS. It is a complete catalog for Classical Be-Stars and Herbig Ae/Be-stars. Double-peaked Hα emission line is the most common profile which displays violet and red peaks due to the doppler effect. In about two thirds of the Be stars, the V/R ratio is equal to unity. In others, the two peaks are of asymmetric intensities and cyclically variable with a period ranging from few days to years to few decades. We have used IRAF for the spectral analysis and the long term variability is studied using a time series graph for each of the stars. The period of variability for few of the stars along with the disk radii in terms of stellar radii are calculated for all the 25 stars

SG-32	ASI2017_1340	Parijat Thakur	Poster

Authors: Vineet Kumar Mannaday (Guru Ghasidas Central University, Bilaspur (C.G.), India), Ing-Guey Jiang (National Tsing-Hua University, Hsinchu, Taiwan), D.K. Sahu (3Indian Institute of Astrophysics, Bangalore, India), Swadesh Chand (Guru Ghasidas Central University, Bilaspur (C.G.), India)

Title: Transit Timing Variation Analysis of Extra-solar Planet Qatar-1b with Three New Transits

Abstract: We report the results of the transit timing variation analysis of the extra-solar planet Qatar-1b using thirty eight light curves. Our analysis combines thirty five previously available transit light curves with three new transits observed by us between June 2016 and September 2016 using the 2-m Himalayan Chandra Telescope at the Indian Astronomical Observatory, Hanle, India. From these transit data, the physical and orbital parameters of the Qatar-1 system are determined. In addition to this, the ephemeris for the orbital period and mid-transit time are refined to investigate the possible transit timing variation (TTV). We find that null-TTV model provides the better fit to the observed mid-transit time minus calculated mid-transit time data i.e., (O-C), data. This indicates that there is no evidence of TTVs to confirm the presence of additional planet in the extra-solar planetary system Qatar-1.

SG-33	ASI2017_1356	Samrat Ghosh	Poster

Authors: Dr. Soumen Mondal, S N Bose National Centre for Basic Sciences, JD Block, Salt Lake, Kolkata 700106

Title: A Search for Photometric Variability in Young/old Brown Dwarfs

Abstract: Photometric variability studies of very low-mass (VLM) stars and brown dwarfs (BDs) are an important tool to probe the physical nature of their atmospheres. Photometric variability in these dwarfs is generally attributed to the presence of surface features like magnetic spots or dust clouds, which may cause optical modulation as the object rotates, and possible to measure the period of rotation of a dwarf. Brown dwarfs being rapid rotators having period of few hours, and the variability is observed within few nights of photometric monitoring using moderate-sized telescopes. We present here our preliminary results of optical I-band photometric variability of few selected young VLM stars and BDs in IC 348 having age of few million years and also few old field brown dwarfs having age of few Gyrs. IC 348 is a nearby (~310 pc) star forming region in Perseus Molecular Cloud.

SG-34	ASI2017_1380	Sharada Keshav Jogdand	Poster

Authors: Ranjeev Misra, Inter-University Center for Astronomy and Astrophysics, Pune 411007, India; Anjali Rao, Inter-University Center for Astronomy and Astrophysics, Pune 411007, India; Madhav K. Patil, School of Physical Sciences, S.R.T.M. University, Nanded 431606, India and LAXPC Science Team

Title: X-ray Spectral Analysis of Cyg X-1 source using LAXPC AstroSat Observations

Abstract: We present the first quick look X-ray spectral analysis of 12 Cygnus X-1 data sets acquired using the ASTROSAT's LAXPC proportional counters LAXPC 10, LAXPC 20 and LAXPC 30 during January 2016. A simple disk blackbody emission model, where Diskbb component was taken to be the seed photon source for the Comptonization, and a Reflionx components was found to constrain the time averaged 3.0-80.0 keV spectrum for the Aug16 responses with a systematic uncertainty of 1.5% and a background flux uncertainty of 4%. The individual spectral fitting of data sets finds slight variations in the estimated spectral parameters. The variations in absorbed flux were observed for LAXPC 10 in range the of -7.813 to -7.757 (+/- 0.0024 to +/- 0.0026), LAXPC 20 in the range of -7.760 to -7.708 (+/- 0.0026 to +/-0.0027) and for LAXPC 30 in the range of -7.771 to -7.555 (+/- 0.0024 to +/-0.0027). However, the power law index of the well fitted model was found to rise for LAXPC10 in the range of 1.64 to 1.73 (+/- 0.04 to +/- 0.09), for LAXPC20 in the range of 1.75 to 1.84 (+/- 0.02 to +/-0.02) and for LAXPC30 in the range of 1.67 to 1.77 (+/-0.02 to 0.06) during the 12 orbits from 1521 to 1533. Here, We didn't find any correlations between flux and photon index. These results matches the performance of LAXPC in higher energy range and hence confirms that the datasets acquired using these detectors can be suitably used for the scientific studies.

SG-35	ASI2017_431	Shruthi S Bhat	Poster

Authors: Shruthi S Bhat (Christ University, Bangalore), Paul K T (Christ University, Bangalore), Annapurni Subramaniam (Indian Institute of Astrophysics, Bangalore), Blesson Mathew (Tata Institute of Fundamental Research, Mumbai)

Title: Near-Infrared Spectroscopic Study of Classical Be Stars

Abstract: We present the preliminary results from the Near-Infrared (NIR) spectroscopic study of a sample of 23 Classical Be stars observed using TIFR Near Infrared Spectrometer and Imager (TIRSPEC) mounted on 2m Himalayan Chandra Telescope (HCT), Hanle. The observations were conducted during the period 2015 - 2016. All the stars were observed in 1 - 2.3 micron spectral region, which includes Y, J, H and K bands, at R ~ 1200. NIR spectroscopy provides a powerful tool to understand the changes in the inner circumstellar disk of Be stars since HI emission lines in this spectral window originates in a region close to the star; whereas those in optical, like Hα, are formed at a distance of 4 - 10 stellar radii. The most intense emission lines in the NIR wavelength region are due to HI lines belonging to Paschen and Brackett series, with the prominent ones being Paβ, Paγ and Brγ. Due to the location of the telescope (HCT), most of the Be stars included in the study belong to northern sky, which complements well with the previous studies of southern Be stars. An important issue which is not addressed often is the role of opacity effects in the emission strength of NIR HI lines. This is particularly interesting since mass-loss from the central star gets accumulated in the inner orbit, from where it is spread out uniformly through viscous decretion mechanism. From the analysis of flux ratio of emission lines we calculate the opacity effects of prominent HI emission lines. By means of free-free emission model, which accounts for infrared excess in Be stars, we estimate the electron density of the line forming region.

SG-36	ASI2017_436	Sujan Sengupta	Poster

Authors: Sujan Sengupta, Indian Institute of Astrophysics, Bangalore

Title: EXO-MOONS

Abstract: Formation of lExo-moons are believed to be natural consequence of planet formation as most of the outer solar-planets have a large number of natural satellites with a large variety of size. Although a large number of exoplanets are discovered, no exomoon has yet been discovered. A few methods, i.g., barycentric and photocentric Transit Timing Variation (TTV), Transit Duration Variation (xomoons around the directly imaged exoplanets.TDV), etc. have been used but owing to extremely small signa, these methods failed to detect any exomoons. We suggest that time resolved image polarimetry may serve as a potential method to detect exomoons around the directly imaged exoplanets. Adopting detailed atmospheric models for self-luminous exoplanets, we present the polarization profiles of these objects in the infrared during transit phase by an exomoon and estimate the peak amplitude of polarization that occurs during the inner contacts of the transit ingress/egress phase. According to our estimation, an image polarimeter with sensitivity ranging from 0.3 to 0.01 % may detect the presence of exomoon around the self-luminous exoplanets that are directly imaged. Future high-contrast imaging instruments on thirty-meter class telescopes may provide both the time resolution and polarimetric sensitivity to detect such moons.

SG-37	ASI2017_440	Akshaya Subbanna M S	Poster

Authors: Akshaya Subbanna M S (Christ University, Bangalore), Ravichandran S (Christ University, Bangalore), Jayant Murthy (Indian Institute of Astrophysics, Bangalore)

Title: Modelling the Diffuse Ultraviolet Radiation towards Galactic Cirrus Cloud G251.2+73.3

Abstract: The Galactic cirrus cloud G251.2+73.3 in the north galactic pole which showed excess emission in the ultraviolet (UV) region is studied in the UV and the infrared (IR) bands using data from Galaxy Evolution Explorer for the UV band (far-UV and near-UV) and Infrared Astronomy Satellite (60μm and 100μm) and Planck (350μm and 550μm) for the IR band. Good correlation was found between the UV and IR bands indicating that the emission is mainly due to the starlight scattered by interstellar dust grains. The correlation between the FUV/NUV ratio and the FUV intensity shows that there is excess emission seen in the FUV which is absent in the NUV. This excess emission was found to be due to the fluorescent molecular hydrogen emission from G251.2+73.3 and a molecular cloud GAL 249.00+73.70 present close to the cirrus cloud. We have tried to model the diffuse UV emission in this direction of the sky using the three dimensional extinction map given by Green et al. and a Monte Carlo modelling approach. The model data was found to fit well with the observed data with an offset of about 300 photons per (cm^2 s sr Å) (PU) in the FUV and about 570PU in the NUV. The best fitting albedo was 0.6 and 0.2 in the FUV and NUV respectively while the best fit for the phase function asymmetry factor was found to be 0.7 and 0.2. From the models it was also found that the scattered flux depended more on the value of phase function asymmetry factor than on the albedo of the grains in this region.

SG-38	ASI2017_455	Arghajit Jana	Poster

Authors: Arghajit Jana(1), Dipak Debnath(1), Sandip k Chakrabarti(1,2), Santanu Mondal(1,3), Debjit Chatterjee(1), Aslam Ali Molla(1) 1.Indian Centre for Space Physics, Kolkata, India 2. SN Bose National Centre for Basic Science, Kolkata, India 3.Instituto de Fisica Y Astronomia Facultad de Ciencias, Universidad de Valparaiso, Valparaso, Chile

Title: Propeties of Acctretion Flow around BHC Swift J1753.5-0127

Abstract: Galactic stellar massive black hole candidate (BHC) Swift J1753.5-0127 was discovered on June, 2005 by Swift/BAT. We analized 2.5-25 keV RXTE/PCA data of the BHC during its 2005 outburst with two component advective flow (TCAF) model as a local additive table model in XSPEC. From the spectral study, we extracted physical accretion flow parameters, such as Keplerian disk rate, sub-Keplerian halo rate, shock location and shock strength, etc. We also find mass of the BHC from our study is in the range of 4.7-5.9 solar mass. During the entire outburst, quasi periodic oscillations (QPOs) in power density spectra are observed in most of the observation in a sporadic way. From accretion rate ratio (ARR=halo rate/disk rate), QPO evolution and powe-law photon index, we classified entire 2005 outburst into two harder spectral states, such as, hard and hard-intermediate. No sign of soft spectral state is found. We also estimated the X-ray contribution from jets during the outbusrt with TCAF solution. The contribution is upto ~12.5 % of total X-ray. It is needed to mention that after the initial high X-ray flaring/outbursting signature in 2005 of roughly three months, until now the source was not went into a dormant phase and showing low X-ray activity. The reason may be that the source belongs to a short orbital period binary and companion is a mass losing star.

SG-39	ASI2017_456	Kaushal Sharma	Poster

Authors: Santosh Joshi(Aryabhatta Research Institute of Observational Sciences, Nainital, India), H. P. Singh(Department of Physics and Astrophysics, University of Delhi, Delhi, India)

Title: Low-resolution spectroscopic investigation of Am stars

Abstract: Nainital-Cape survey, an on-going ground-based asteroseismic project, was initiated in 1999 between ARIES, Nainital India and SAAO, Cape-Town South Africa aiming to search for the photometric pulsational variability in Ap and Am stars in the Northern and Southern hemisphere. In this study, we present the atmospheric parameters (Teff, log g, [Fe/H]) for six Am type stars determined from the low-resolution spectroscopic observations. Spectroscopic analysis is performed using the automatic technique of full spectrum fitting where observed spectrum is compared and minimized with respect to a set of model spectra in order to obtain the best-fitted parameters. For the sample stars, a mean Teff difference of 350+/-150 K is achieved between determined and compiled values from the high-resolution line analysis method. A similar agreement is obtained for logg and [Fe/H]. The consistency reveals that full-spectrum fitting technique might be more useful and less time-consuming in the reliable estimation of parameters of these stars, in particular, Teff, which is crucial for confirming their evolutionary status and explaining the pulsation mechanism.

SG-40	ASI2017_508	Anindita Mondal	Poster

Authors: Ramkrishna Das, S N Bose National Centre for Basic Sciences. Soumen Mondal, S N Bose National Centre for Basic Sciences

Title: Spectroscopic analysis of slow nova V5558 Sgr during its 2007 outburst using photoionization code CLOUDY

Abstract: Novae are close binary systems consisting of a white dwarf as the primary star and a red-giant or main sequence star as the secondary. They are mainly of two types, classical and recurrent. Study of novae are of utter importance as the ejecta during the outburst takes an important role in the chemical evolution of interstellar medium. We present an spectroscopic analysis of the slow nova V5558 Sgr using published optical and near-infrared(NIR) spectra its during 2007 outburst(Apr. 14.777, 2007). We use optical spectroscopic data on 7 epochs (Apr. 16 & 25, May 8, Oct. 23, Nov. 23, 2007 and Feb. 12 & 27, 2008) taken from Fujii-Bisei Observatory(FBSPEC) and NIR JHK spectroscopic data on 3 epochs (Apr. 26, May 7 & Oct. 20, 2007) taken from Mt. Abu Telescope(NICMOS). We use CLOUDY photoionization code to generate synthetic spectra by varying several parameters. The model generated spectra are then compared with observed emission line spectra obtained at seven epochs. We obtain the best fit model parameters through $\chi 2$ minimization technique. Our model results fit well with observed optical and NIR spectra with $1 < \chi 2\_red < 2$. The best-fit model parameters are compatible with a hot white dwarf source with TBB of $1.0 - 6.3 \times 10^5$ K and high luminosity of Log(L) = 37.0 − 40.0erg s^(−1). The Hydrogen density varies as the nova evolves; Log(n_H) = 12.2 − 8.5 cm^(−3) . From the analysis we find following elemental abundances (by number) with respect to solar: He/He⊙ = 0.1−2.8, N/N⊙ = 4.0 − 200, O/O⊙ = 0.2 − 1.0, Fe/Fe⊙ = 0.1 − 27, Si/Si⊙ = 1.0 − 3.5, Ar/Ar⊙ =1.2 − 1.5 and Ca/Ca⊙ = 1.2 , all other elements were set at the solar abundance. We also identify some Fe and He lines in the NIR J-band using the CLOUDY database. Using the CLOUDY generated spectra, we calculate the distance to the nova to be 1.55 kpc and using the obtained parameter values, we estimate an ejected mass in the range of $0.012 - 7.0 \times 10^{(-4)}$ M⊙, both support the previously calculated results.

SG-41	ASI2017_548	MAYUKH PAHARI	Poster

Authors: Ranjeev Misra (IUCAA, Pune), J S Yadav (TIFR, Mumbai), H M Antia (TIFR, Mumbai), Jai Verdhan Chauhan (TIFR, Mumbai)

Title: AstroSat/LAXPC hard X-ray view of Galactic micro-quasars : A new window to explore hard X-ray variability above 20 keV

Abstract: Owing to the higher efficiency than RXTE/PCA (by an order of magnitude above 10 keV) and unprecedented time resolution (~ 10 micro-seconds), Large Area X-ray Proportional Counter (LAXPC) on-board AstroSat provided a rare opportunity to study hard X-ray spectro-timing variability of Galactic micro-quasars up to 80 keV which was never satisfactorily performed by any of the contemporary or past X-ray space missions for astronomical observations. In this presentation, I shall focus on results obtained from the hard X-ray variability study of four Galactic micro-quasars: GRS 1915+105, Cyg X-1, Cyg X-3 and H 1743-322 which were extensively monitored by LAXPC during last one year. Such studies provide valuable information about the source accretion properties in the hard X-ray regime at different spectral states, namely hard/hard-intermediate and soft/soft-intermediate. Till date, many attempts have been made to connect spectral and temporal variability in these micro-quasars but unfortunately most of them are limited to 20 keV which is the upper threshold with the most reliable calibration in RXTE/PCA. With the launch of AstroSat, LAXPC reliably extends the higher energy limit to 80 keV. This allows us to test and extend our knowledge of source spectral state evolution from the soft X-ray band to the hard X-ray band. For example, spectral analysis showed existence of high energy cut-off in few source between 20-80 keV. However, spectral fitting suffers from degeneracy problem. On the other way, tracking source evolution in the hardness intensity diagram is a model-independent approach. Therefore, 'Can we use hardness intensity diagram to detect spectral cut-off/pivoting ?' Answer to this question was not possible with RXTE/PCA but it is possible with AstroSat observations. Secondly, quasi-periodic oscillation (QPO) frequency from GRS 1915+105 are reported to increase with photon energy up to 20 keV. Such observations can discard many QPO model but the confirmation on such event requires independent observation which LAXPC can provide reliably. Among many interesting aspects of high energy spectro-temporal behaviour, these are the key results which I shall discuss. I shall also discuss the importance of the hard X-ray spectro-temporal variability study in understanding the accretion and radiation mechanism in Galactic micro-quasars and how it can serve as an excellent diagnostic for the accretion around black holes.

SG-42	ASI2017_615	Richa Kundu	Poster

Authors: Shashi Kanbur,State University of New York, Oswego, NY 13126, USA. H.P.Singh,Department of Physics & Astrophysics, University of Delhi, Delhi 110007, India. Anupam Bhargwaj ,Department of Physics & Astrophysics, University of Delhi, Delhi 110007, India.

Title: Multiphase PL-PC Relations for Cepheids

Abstract: Cepheid variables are bright, population I radial pulsators that exhibit regular light curves and obey a well known Period-Luminosity relation which is an important tool in the extra-galactic distance scale measurements. In the present work light curve analysis for Cepheids is done using the technique of Fourier decomposition. Period-Luminosity, Period-Color, Period-Wesenheit and Amplitude-Color(PL, PC, WP and AC) relations for Cepheids in LMC and SMC using OGLE-IV data for various phases of pulsation are studied in V and I band. These multiphase relations can be used in light curve modeling and can provide a better insight into the physics of Cepheids. Extrema in the relations are usually observed at phase around 0.8. Breaks

in PL and PC relations at a period of 10 days for all pulsation phases are investigated using F-Test following the work of Ngeow et al. 2009. Theoretically, these breaks can be explained by the interaction of hydrogen ionization front and photosphere.

SG-43	ASI2017_634	GAUTAM SAIKIA	Poster

Authors: Gautam Saikia(Tezpur University, Tezpur), Rupjyoti Gogoi (Tezpur University, Tezpur), Ranjan Gupta (IUCAA, Pune) and D.B. Vaidya (Ex-Gujrat College, Amdavad)

Title: Infrared polarization of Circumstellar Dust

Abstract: The presence of near-infrared (NIR) emission feature at 10 micron is well known in the circumstellar dust of O and C-rich stars observed by the Infrared Astronomical Satellite (IRAS) and Spitzer satellites and has been modelled by many workers including us in the recent past. The NIR polarization observations from such objects also show similar peak features in this region. This work describes some initial attempts to model these polarization features using non-spherical dust grains with mixture of silicates and other compositions and light scattering tools.

SG-44	ASI2017_646	Neelam Dhanda Batra	Poster

Authors: Dr. Sarmistha Banik BITS-Pilani, Hyderabad Campus

Title: The strength of gravitational wave emission from the isolated neutron stars at finite entropy

Abstract: Neutron stars are superdense and are believed to contain exotic matter in their hot and dense core. As they rotate rapidly an asymmetry in the spherical mass distribution may arise which in turn creates a distortion in the gravitational field outside the star. Thus the isolated neutron stars are one of the most likely celestial objects that emit gravitational waves. We investigate the dependence of the emitted gravitational waves on the state of matter present inside these exotic stars. For this we study neutron stars with exotic matter (antikaons) at finite temperature and at constant entropy values. The equation of state for the same is developed and applied to study the static and rotating configurations of such neutron stars. Using nrotstar code of Lorene software, we then study their various global properties and finally estimate the gravitational wave signal strength that are emitted from such neutron stars.

SG-45	ASI2017_706	Supriyo Ghosh	Poster

Authors: Supriyo Ghosh*, Soumen Mondal*, Ramkrishna Das* \affil{* S. N. Bose National Centre for Basic Sciences, Salt Lake, Kolkata-700106}

Title: The Near-Infrared Spectral Calibration of Late-type Giant Stars from medium resolution HK-band Spectra

Abstract: We present here moderate resolution (λ/$\Delta\lambda$ $\approx$ 1200) spectra of K-M type giant stars including few AGB stars covering 1.50-1.84 and 1.95-2.45 μm, observed with TIFR Near Infrared Spectrometer and Imager (TIRSPEC) on 2.0-m Himalaya Chandra Telescope (HCT) at IAO, Hanle, Ladakh, India. We measured equivalent widths of some important spectral features - NaI doublet at 2.2062

μm, CaI triplet at 2.2631 μm, ^{12}CO firstovertone band-head at 2.2935 μm, and a spectral index represents the overall shape of the spectra due to H_2O opacity (the H_2O-K2 index). We have calibrated here the empirical relationship between fundamental parameters and equivalent widths of those features and H_2O-K2 index for giant stars from TIRSPEC observations and archival NIR spectral library, observed with medium-resolution (λ/$\Delta\lambda$ $\approx$ 2000) SpeX instrument at 3.0-m NASA Infrared Telescope Facility (IRTF) on Mauna Kea. The trends of observed spectral features with respect to a physical parameters are compared with BT-NextGen Phoenix Model atmosphere. We found that the H_2O-K2 index are tightly correlated with spectral type in later M class giants stars and hence it is a powerful tool for subclass greater than M5 giants stars. We also discuss the difference in behaviour between giant stars and AGB stars in our presentation. This study of K-M type stars help us to derive the fundamental parameters of these class of objects to understand their formation and evolution, and would be extremely helpful to constrain the theoretical models.

SG-46	ASI2017_707	Sumit Kumar	Poster

Authors: Arunava Mukherjee, P.Ajith, Abhiroop Ghosh (ICTS-TIFR) Arnab Dhani (IIT Roorkee) Archisman Ghosh (NIKHEF)

Title: Distinguishing population synthesis models of the evolution of binary black holes using gravitational wave observations

Abstract: Various population synthesis models (Dominik et al 2012) predict the merger rates and distribution of masses and spins for the compact binary objects such as binary black holes (BBH), neutron star-black hole (NSBH) and neutron star-neutron star (NSNS). These population synthesis models are characterized by various unknown parameters related evolution of the compact binary sources such as metalicity, binding energy, maximum mass of neutron star, etc. Advanced LIGO is expected to detect many events for merging compact binaries. In future, we can infer the mass distribution and merger rates from these observations using which we can put statistical constraints on parameter space which defines these models. We present a Bayesian inference method for distinguishing various population synthesis models based on BBH distribution. The Bayesian evidence is calculated for various models and we rank them accordingly. We tested our method on the simulated data by assuming a fiducial model and shown that we can distinguish some of these models using future detection of BBH mergers.

SG-47	ASI2017_716	Kaushar Vaidya	Poster

Authors: Souradeep Bhattacharya (BITS Pilani), Vatsal Panwar (BITS Pilani), Wen-Ping Chen (National Central University, Taiwan)

Title: IRAS 10427-6032 - An Embedded Star Cluster in the outskirts of the Carina Nebula

Abstract: The Carina Nebula is a star-forming region well-known for its extreme massive stellar content and ongoing star-formation activity. IRAS 10427-6032 is known to be a possible H II region that lies in the direction of the Carina Nebula. We study this region using various archival data including near-IR (VISTA Carina Nebula Survey), mid-IR (Spitzer, WISE), far-IR (AKARI, Herschel), radio (MGPS), and sub-mm (ATLASGAL). We discover here a young (~1-2 Myr) embedded star-cluster that constitutes a proof of ongoing star-formation in the extreme outskirts of the Nebula. In particular, we find ~40 Class II YSO candidates, and 6-7 Class I YSO candidates using the near and mid-IR data. The radio continuum image at 843 MHz (MGPS) shows the presence of a compact H II region. Lyman continuum luminosity calculation indicates

the spectral type of the ionizing source to be earlier than B0-B0.5. In addition to this compact H II region, the embedded cluster shows the presence of a cool dense clump detected by ATLASGAL that sits adjacent to it, and the YSO candidates which are found both within the core and in the peripheral regions.

SG-48	ASI2017_815	Susmita Das	Poster

Authors: Susmita Das (Department of Physics & Astrophysics, University of Delhi, Delhi 110007, India.), Harinder P. Singh (Department of Physics & Astrophysics, University of Delhi, Delhi 110007, India.), Shashi M. Kanbur (State University of New York, Oswego, NY 13126, USA.), Marcella Marconi (INAF-Osservatorio astronomico di Capodimonte, Via Moiariello 16, 80131 Napoli, Italy), Anupam Bhardwaj (Department of Physics & Astrophysics, University of Delhi, Delhi 110007, India.)

Title: A Comparative Analysis of Theoretical and Observed light curves of RR Lyrae variables

Abstract: We study the comparison of new nonlinear, time- dependent convective hydrodynamical models of RR Lyrae stars computed using a constant helium-to-metal abundance ratio (Marconi et al. 2015) and observed light curves in the optical (UBVRI) and near-infrared (JKL) bands. The models used from the theoretical data are of metal abundance Z=0.02, Z=0.008 and Z=0.004 which correspond to the chemical compositions of Galaxy, LMC and SMC, respectively. We compare the PL, PC and AC relations of LMC and SMC in V and I bands with the corresponding theoretical data. The PL slope at minimum light of observed RR Lyrae data is -2.574±0.03 and that of theoretical is -2.276±0.383, for LMC in I-band. Corresponding intercept values are 18.32±0.007 and 18.515±0.094, respectively. Similar comparative relations were found for LMC and SMC at minimum, mean and maximum lights for V- and I-bands. We use the Fourier Decomposition Technique for the quantitative analysis of the light curves. The Fourier amplitude and phase parameters are compared. The theoretical phase parameters suggest an increase with period and then a subsequent decrease, with a maximum at log P = -0.2 (P=0.63 days), which is consistent with the observed phase parameters, for both LMC and SMC in V- and I-bands. This suggests a break in PL relation at around P=0.63 days.

SG-49	ASI2017_925	Lalitha Sairam	Poster

Authors: Spandan Dash Indian Institute of Astrophysics Carolina von Essen Department of Physics and Astronomy - Stellar Astrophysics Centre, Aarhus university

Title: High-energy environment of exoplanets around low-mass stars

Abstract: Over the last 20 years, the field of exoplanetary science has rapidly evolved. Characterisation of exoplanetary atmospheres and their evolution has become a focus of this field. The observations carried out in optical and infra-red wavelengths primarily probe the lower atmospheres of the exoplanets while the observations in the X-ray and UV wavelengths reveal the uppermost layers of the planetary environment that interact with the stellar wind. The high-energy irradiation from host stars on their nearby planets can cause heating of the planetary atmosphere which can induce mass loss. Recent studies have shown that high-energy emission can have a crucial influence on the evolution of planets. I will discuss my recent findings concerning the exoplanets and the stellar environment by characterising the high-energy radiation field of close-in orbiting planet-bearing stars. I will give an outlook of how our emerging insights into the magnetic activity of the planet-hosting star, and exoplanet atmospheres will lead to a comprehensive understanding of exoplanet systems.

SG-50	ASI2017_946	Sarmistha Banik	Poster

Authors: Smruti Smita Lenka, Prasanta Char

Title: universal relations of rotating neutron stars with exotic matter

Abstract: We are yet to reach a consensus on the compact star EoS, due to our limited knowledge of the nature of matter beyond normal nuclear matter density. Hence, there have been a lot of studies in the general relativistic stellar models to find relations between observable parameters that are essentially independent of EoS. Many authors tried to highlight a relation between normalised moment of inertia(I) and stellar compactness (M/R) data for neutron stars with nucleons only core. Once we have simultaneous measurements of moment of inertia and mass(M), a universal relation will allow us to determine the radius(R) with a very high accuracy, which is otherwise difficult to measure. With the upcoming SKA telescope, measurement of I is expected to be accomplished soon. We explore if any universal relations of some of the normalised properties, such as critical mass and moment of inertia, exists that should not depend on specific EoS or as a matter of fact constituents of the dense matter. However, deviations in the universal relations for moment of inertia are observed at higher compactness.

SG-51	ASI2017_956	Indulekha Kavila	Poster

Authors: Remya T C Arundhathy V J

Title: IMF Variations and the Small Variations in Fundamental Star Formation Relations

Abstract: The Initial Mass Function of the stars is a key input into galaxy evolution models. Long lived low mass stars contribute to the mass budget while high mass stars, which are capable of injecting much energy, momentum and metals into their surroundings, are the drivers of evolution. Also, an understanding of the universality / non-universality / environment sensitive universality of the IMF is needed for constraining cosmological models through matching the observations of galaxies with cosmological simulations of structure formation. For instance, a bottom heavy IMF, as recently inferred for Early Type Galaxies in their central regions, from observations of gravity sensitive features in their spectrum, is degenerate with dark matter / non-Newtonian gravity in its impact on the mass to light ratio of the system. Though the formation of high mass stars is an ill-understood phenomenon, universality is expected for the IMF, on the grounds of the scale-free nature of both turbulence and gravity, the key factors operating in turbulent fragmentation models of star formation. However, the statistical expectation that the most massive star in a more numerous sample is more likely to be more massive than the most massive star of a less numerous sample, leads to expectations of non-universality associated with regional variations in the star formation rate / efficiency. Here, we explore the effect of such a non-universality of the IMF, on estimates of the star formation rates made from measured fluxes in various wavelength bands / spectral features. We further look into how and whether such a bias could introduce a tension between the average (over varying star forming conditions) behaviour and away from the mean behaviour, of the relation between star formation and the environment.

SG-52	ASI2017_961	Nirmal Iyer	Poster

Authors: Biswajit Paul (Raman Research Institute)

Title: Orbital intensity modulation of IGR J16318-4848 and associated spectral variations

Abstract: IGR J16318-4848, an X-ray binary in the galactic plane discovered with the INTEGRAL satellite has highest line of sight absorption column density among all known HMXBs. The material that causes complete absorption of X-rays below ~4 keV in the X-ray spectrum of this source also reprocesses the hard X-rays and produces iron and nickel emission lines with one of the highest known equivalent width among X-ray binaries. In this work, we confirm a ~ 80 day orbital period of this system with longer duration Swift BAT and INTEGRAL light curves. The orbital intensity modulation shows a main peak with an orbital phase coverage of ~ 0.4, a narrow peak with an orbital phase coverage of ~0.2 and very low intensities for the remaining period. To investigate the origin of this orbital intensity modulation pattern, we study variations of the absorption column density and emission line equivalent widths in the X-ray spectrum as a function of the orbital phase and luminosity of the source with data from ASCA, XMM-Newton, Swift, Suzaku and NuStar. We also present results about stability of the orbital intensity profile across different periods in the long term Swift BAT lightcurve of this source.

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ASI-2017 Poster Presentations

Extragalactic Astronomy

EA-1	ASI2017_1086	Arun Kumar Diwakar	Poster

Authors: D. K. Chakraborty, S.O.S. in Physics and Astrophysics, Pt. R. S. University, Raipur, C.G.

Title: Shape and orientation of elliptical galaxy by photometry

Abstract: Use of kinematical data, along with photometric data to study the shape of individual elliptical galaxy was initiated by Binney (1985) and Tenjes (1993). A rigorous method, using Bayesian statistics was taken up by Statler and his coworkers. We have followed the basic methodology developed by Statler. However, we used the photometric data alone, contrary to Statler who use kinematical data as well. Previously, Ryden used photometric data alone, and Statler (1994) re-analysed Ryden's data to obtain a different fit. Statler (1994), thus makes a point-blank remark "The distribution of intrinsic shapes can not be determined from photometry alone". We worked on constraining the shape and orientation of elliptical galaxies, using photometry alone. Strong arguments in our favour are (i) number of galaxies with good photometry is many more than those with good kinematics and (ii) alternative models and approaches are necessary to make a cross-check of the results. We found that triaxialities T0 and T∞ at small and large radii, respectively, are not constrained. It shows that almost all values of T0 and T∞ are allowed within 1σ level. However, flattening q0 and q∞ at small and large radii, respectively, are well constrained. We made several attempts to find if triaxialities T0 and T∞ can be constrained, even under some spacial conditions, e.g. assuming a spacial situation wherein galaxies may have T0 = T∞ . Such conditions can not be justified, in general, but for the sake of a problem, we just assumed it. All our attempts to constrain triaxiality through photometry failed. What we found that, at the most, the absolute value of the triaxiality difference |Td| ≡ |T∞ − T0|, along with q0 and q∞ are constrained through photometry. In the light of above results, we can very well conclude that our work is complementary, and not contradictory, to that of Statler and his coworker. We continued to apply photometry to elliptical galaxies and analysed (i) orientations of NGC 1407 (θ = 13.5, φ= 127.5), NGC 2986(θ = 31.5, φ = 118.5) and NGC 4374 (θ = 67.5, φ = 175.5) rounder galaxies (ii) shapes of 3 very flat galaxies NGC 720 (q0 , q∞ = 0.68, 0.38), NGC 2768 (q0 , q∞ = 0.68, 0.28) and NGC 3605 (q0 , q∞ = 0.68, 0.43).

EA-2	ASI2017_1157	AMIT KUMAR MANDAL	Poster

Authors: Suvendu Rakshit, Pandge M.*, C. S. Stalin and Ram Sagar Indian Institute of Astrophysics, Bangalore 560 034 *Dayanand Science College, Latur, Maharashtra

Title: Determination of the size of the dust torus in H0507+164 through Optical-IR monitoring

Abstract: Active Galactic Nuclei (AGN) are powered by accretion of matter onto super-massive black hole (SMBH) located at the centres of galaxies. According to the unified model of AGN, a dusty torus surrounds the broad line region (BLR) and the central SMBH. Torus is thus one of the most important ingredients in AGN that divides it in many categories. But, it is very difficult to resolve the central regions of AGN and find the extent of the dusty torus using conventional imaging techniques. However, recently, near-infrared (NIR)

interferometric observations have been able to measure the angular size of the dusty torus in only 23 AGN. This method of NIR interferrometry can only be used on only the nearby and bright AGN. An alternative approach to find the inner edge of the dusty torus is through the technique of reverberation mapping. This uses the response of NIR emission from the torus to variations in the UV/optical radiation from the central engine. We have carried out a systematic optical and near IR monitoring of a carefully selected low-luminous AGN, H0507+164. These observations are used to find the first measurement of the inner radius of the torus. Observations in different IR bands are also used to constrain the torus structure. Details of the results will be presented.

EA-3	ASI2017_1182	Shilpa Sarkar	Poster

Authors: Dr. Indranil Chattopadhyay, Aryabhatta Research Institute Of Observational Sciences (ARIES), Nainital

Title: Radiative processes of flows around compact objects

Abstract: We have solved two-temperature (ion and electron) equations for rotating as well as for radial flows in Newtonian as well as for pseudo-Newtonian potential. The Coulomb interactions between the protons and electrons have been considered in this study, which is mainly responsible for transfer of energy from proton to the electron and have also incorporated radiative processes such as bremsstrahlung, synchrotron and Comptonization which are mainly responsible for the cooling of electrons. We have concluded that these radiative processes lead to efficient cooling of electrons such that its temperature reduces in comparison with that of the protons and hence we obtain two-temperature profiles for the said populations. The spectral properties have also been presented here.

EA-4	ASI2017_1187	Prajwal V P	Poster

Authors: Viral Parekh (RRI, Bangalore) , Joydeep Bagchi (IUCAA, Pune), Mahadev Pandge (Dayanand Science College, Latur)

Title: Cosmic filaments around galaxy clusters

Abstract: In the large scale cosmic web, galaxies are not found sporadically but rather arranged into clusters and super-clusters which connect to form filaments. These filaments are the largest known structures in the Universe. Recent simulations and observations both predict filaments of Mpc scale. Detection of these filaments through weak lensing is poor due to their low mean density. However, region between two massive galaxy clusters would have a considerably higher density due to their interaction and these regions serve as ideal locations to detect and study these interesting filamentary structures. Galaxy clusters grow via a merger or accretion of mass. The latter process involves filaments which channel the material into the massive cluster body situated at nodes. Recent high quality X-ray observations of galaxy clusters have shown hot filaments surrounded by clusters. These hot filaments indicate either propagation of accretion shock wave or stripping of hot gas of merger cluster when passing through a massive cluster. We report a peculiar binary cluster connected with a filamentary structure and some other interesting features visible in their Chandra X-ray observation. Our study also includes GMRT radio observations at 235/610 MHz and ESO/WFI optical data. We will present our multiwavelength analysis of the filamentary structure and discuss about its cosmological implementations.

EA-5	ASI2017_1227	DUSMANTA PATRA	Poster

Authors: Dusmanta Patra (ICSP), Sabyasachi Pal (ICSP), Chiranjib Konar (Amity University) and Sandip K. Chakrabarti (SNBNCBS)

Title: Multi-frequency study of large radio galaxies

Abstract: We report multi-frequency observations of a few selected large radio galaxies. The low frequency observations were done with the Giant Metrewave Radio Telescope (GMRT) and the high frequency observations with the Jansky Very Large Array (JVLA). We have done spectral ageing analysis of these sources while possible. We use two widely used models for spectral ageing, namely, the Kardashev-Pacholczyk and Jaffe-Perola models. We also use the more realistic and complex Tribble Model. We present spectral age maps of our sources and find the best-fitting injection spectral indices. We have estimated the jet power of some of the radio galaxies from the injection index-jet power correlation published by Konar & Hardcastle (2013). We also study the behavior of the radio galaxies close to large clusters. Many times, jets of these radio galaxies bend for the movement of the jets through intra-cluster medium with sufficient velocities for the tails to bend by the action of the ram pressure into a `V', `C' or `L' shapes. Such type of bent-jet radio sources are known as Wide Angle Tailed (WAT) radio galaxies or Narrow Angle Tailed (NAT) radio galaxies depending on the bending angle of jets. We discuss continuum and spectral line radio properties of a few selected WAT and NAT radio galaxies using data from the GMRT and JVLA. We use available archival optical data to investigate the environment of the host.

EA-6	ASI2017_1307	Avni Paresh Parmar	Poster

Authors: Prof. Dwarakanath, Viral Parekh (Postdoc fellow) Raman Research Institute

Title: Exploring diffuse radio sources in low massive clusters and groups

Abstract: Radio interferometry observations have shown the existence of diffuse large scale emission from the intracluster medium (ICM), suggesting that non-thermal components, magnetic fields and relativistic particles, are mixed with the hot ICM. One class of these diffuse radio sources is known as radio halos which are detected in a fraction of galaxy clusters. Formation of radio halo is still open debate. They are useful to probe relativistic particles, magnetic field, and whole cluster formation and evolution. In this presentation we will talk about the our ongoing project of systematic search of diffuse radio sources within the GLEAM (GaLactic and Extragalactic All-sky MWA survey) survey. GLEAM is a survey of the entire radio sky south of declination +25 deg at frequencies between 72 and 231 MHz, made with the MWA (Murchison Widefield Array), the low-frequency Square Kilometre Array (SKA1 LOW) precursor located in Western Australia. We used wide-band images (170-231 MHz, central frequency 200 MHz) which have rms of ~ 7mJy/beam and resolution of ~ 2'. In order to find the position of clusters into GLEAM data, we used a catalog of clusters of galaxies identified from Sloan Digital Sky Survey III (SDSS-III). There are total 132,684 clusters in redshift range $0.05 \leq z < 0.8$ with homogenised properties such as redshift, 0.1-2.4 keV band luminosity (L500), total mass (M500), etc. available for each cluster. In this work, we have visually inspected 784 wide-band radio images for nearby ($z<0.1$) clusters with different mass ranges to find diffuse radio sources such as relics, large halo or mini halo. Along with MWA data, we also utilised other radio survey data such as NVSS, SUMSS and TGSS. We also checked corresponding X-ray images to understand dynamical states of galaxy clusters. We have derived total of ~10 clusters which shows promising diffuse radio sources in MWA data. Currently, for some of these clusters we have obtained high resolution and sensitive GMRT low frequencies observations.

We will show results of this analysis and discuss about occurrence of radio halos in nearby as well as distant clusters in frame work of low-frequency MWA observations.

EA-7	ASI2017_1312	Prolay	Poster

Authors: Annapurni Subramaniam,Prasanta Kumar Nayak, Chayan Mondal, Snehalata Sahu. (Indian Institute of Astrophysics, Bangalore)

Title: Recent star formation in the Magellanic Bridge

Abstract: The Small Magellanic Cloud (SMC) and the Large Magellanic Cloud (LMC) are two irregular galaxies orbiting around the Milky Way with distances 60 Kpc and 50 Kpc respectively. The Magellanic Bridge consisting of gas and stars connect the LMC and the SMC, which are thought to be stripped from the SMC during the last LMC-SMC interaction about 250 Myr ago. There have been suggestions of star formation in the stripped gas in the bridge. We have used the UV data from GALEX observations of the Magellanic Bridge to age date the star formation in the last 200 Myr. We generated extinction and reddening corrected UV color-magnitude diagram using FUV magnitude against (FUV-NUV) color. We have compared these with the theoretical isochrones produced using the Flexible Stellar Population Synthesis (FSPS) model by adopting the SMC metallicity. We divided the observed area into several sub-regions and created density as well as an age map of the bridge. We identify pockets of very recent star formation and we discuss the possible mechanisms for the star formation trigger.

EA-8	ASI2017_1313	Nandan Kumar	Poster

Authors: N. Kumar, P Chandra, K K Yadav, K K Singh, A K Tickoo, R C Rannot, B Ghosal, A Goyal, K K Gour, N K Agarwal , H C Goyal, N Kumar, P Marandi, M Kothari, V K Dhar, N Chouhan, C Borwankar, S Bhattacharyya, N Bhatt, S Sahayanathan, M Sharma, S Godambe, N Mankuzhiyil, K Chanchalani, K Venugopal, S Godiyal, R Koul, M K Koul, C K Bhat Bhabha Atomic Research Centre, Mumbai

Title: VHE gamma-ray observations of Active Galactic Nuclei using TACTIC gamma-ray telescope during 2015-16.

Abstract: TACTIC (TeV Atmospheric Cherenkov Telescope with Imaging Camera) gamma-ray telescope is operational at Mount Abu, Rajasthan (24.6o N, 72.7o E,1300 m asl). The telescope is being used to study mainly extra-galactic Very High Energy (VHE) gamma-ray sources. It detects VHE gamma rays from a standard candle gamma ray source Crab Nebula above ~ 850 GeV at 5 sigma level in about 12 hours of on-source observation. We have observed following Active Galactic Nuclei (AGN) by using the telescope during 2015-16. These are; 1.) Markarian 421(z ~0.031), 2.) Markarian 501 (z~0.034), 3.) IC310 (z~0.0189), 4.) 1ES1440 + 122 (z~0.163), 5.) 1ES1959 + 65 (z~0.048), 6.) B20806 + 35 (z~0.083) and 7.) PG 1553 + 113 (z~0.5) and total observation made on each source are 124.03, 23.85, 17.38, 9.38, 36.03, 93.7 and 12.7 hours respectively. The total data recorded during these observations were for 367 hours. Analysis of the recorded data to search for the presence of VHE gamma-ray signal and near contemporaneous multi-wavelength studies from radio to gamma-ray energies from the listed sources are being done. Preliminary results of data analysis on six (2 - 7 listed above) AGN will be presented in the meeting.

EA-9	ASI2017_1314	Mahendra Kothari	Poster

Authors: M.Kothari, R C Rannot, P Chandra, K K Yadav, K K Singh, A K Tickoo, A Goyal, K K Gour, N K Agarwal , H C Goyal, N Kumar, P Marandi, V K Dhar, N Chouhan, C Borwankar , B Ghosal, S Bhattacharyya, N Bhatt, S Sahayanathan, M Sharma, S Godambe, N Mankuzhiyil, K Chanchalani, K Venugopal, S Godiyal, R Koul, M K Koul, C K Bhat

Title: VHE gamma-ray observations of Markarian 421 TACTIC during 2015-16.

Abstract: We have observed extragalactic TeV gamma-ray source Mrk421 (z = 0.030) which is a blazar at Very High Energy (VHE) energies using TACTIC gamma-ray telescope at Mt. Abu, Rajasthan (24.6o N, 72.7o E, 1300 m asl) during 2015-16. The observations were made from 17th Dec 2015 to 09th May 2016 for 124.03 hours. Preliminary data analysis results indicate an excess of 374.7 ± 59.1 gamma-ray like events from the source direction with a statistically significance of 6.34 sigma corresponding to an integral flux of ~ 2 x10-12 photons cm-2 sec-1 above 850GeV. These results along with multiwavelength observations of the source from Fermi/LAT, Swift-XRT, MAXI detectors which are available publically at lower energies will be presented in the meeting.

EA-10	ASI2017_1367	Kshama Sara Kurian	Poster

Authors: C. S. Stalin, Indian Institute of Astrophysics

Title: AGN and star-burst activity in Seyfert galaxies

Abstract: Active galactic nuclei (AGN) and star-burst activity are found to co-exist in many galaxies. A variety of observations show a correlation between these two phenomena which points to a physical connection between them. It is now believed that star formation can occur in the central regions of AGN, however, it is not clear how these two phenomena are related. Imaging observations of few Seyfert 2 galaxies have shown that the UV continuum emission in them is not only dominated by the central ionizing nuclear source, but also comes from star forming areas in their circum-nuclear regions. We aim to extrapolate these findings based on limited sources (e.g. NGC 7314) using observations from UVIT as well as other X-ray payloads onboard ASTROSAT with the motivation to identify the circum-nuclear star forming regions and to study their physical nature using spectral energy distribution (SED) modeling. The mass and star formation rate will be estimated to characterize the galaxy evolution. In addition to ASTROSAT observations, data from other space missions such as Chandra (X-rays) and IR Spitzer (IR) are being used in this work. Details of this study will be presented.

EA-11	ASI2017_1373	Sanna Gulati	Poster

Authors: Debbijoy Bhattacharya Manipal Centre for Natural Sciences, Manipal University

Title: Intra-night Optical Variability of Misaligned Active Galaxies

Abstract: The Fermi Large Area Telescope has detected gamma-ray emission in 20 misaligned Active Galaxies (M-AGN) during its first four years of observation. Majority of the identified Fermi sources are blazars having jets aligned to the line of sight. Blazars show large amplitude intra-night optical flux variations (INOV). The origin of INOV is not well understood. The perturbation in accretion disk could be responsible for such variations. Alternatively, INOV can have jet origin and large Doppler beaming factor could play important role for such observed short term variability. In such a scenario, one would naturally expect these misaligned jet AGNs to either exhibit no optical variation or low amplitude intra-night optical flux variations. To test this hypothesis, we carry out short term variability study of a list of Fermi-detected M-AGNs using observations from Indian Observatories (Vainu Bappu observatory, Kavalur and Himalayan Chandra Telescope). Preliminary results of our findings will be presented here.

EA-12	ASI2017_1374	SRIYASRITI ACHARYA	Poster

Authors: Debbijoy Bhattacharya MCNS, Manipal University

Title: UV variability study of Fermi detected quasars

Abstract: Advances in space technology and multi-wavelength observations have revolutionised the field of astrophysics. One of the least studied spectral region is ultraviolet energy band. The Galaxy Evolution Explorer (GALEX) launched on 2003, carried out the first all sky imaging and spectroscopic survey in UV band. Quasars are highly luminous and exhibit variability throughout the electromagnetic waveband. A detailed study of variability across the electromagnetic waveband will be useful to better understand the emission mechanisms in active galaxies. Earlier studies indicate that radio-loud ultraviolet variable quasars (UVQs) are marginally more variable than radio-quiet UVQs. Furthermore, existence of possible correlation between radio loudness and UV-optical variability amplitude is suggested. Here, we will present the initial findings of our investigation of variability and presence of any possible correlation of a selected Fermi detected quasars in UV and gamma-ray band utilizing observations from GALEX and Fermi gamma-ray space telescope.

EA-13	ASI2017_1376	KRISHNA MOHANA A	Poster

Authors: Debbijoy Bhattacharya, Manipal Centre for Natural Sciences, Manipal University, Manipal-576104 Karnataka, India. Subir Bhattacharyya, Bhabha Atomic Research Centre, Mumbai – 400085, India. Nilay Bhatt, Bhabha Atomic Research Centre, Mumbai – 400085, India C.S. Satlin, Indian Institute of Astrophysics, Bangalore – 560034, India.

Title: Broadband Spectral Energy Distribution of PKS 0208-512

Abstract: Blazars are subclass of active galaxies, where the relativistic jet makes very small angle with line of sight of the observer. Hence these are the best sources to understand the physics of emission process in the jet. They are bright in gamma-rays and show high variability throughout the electromagnetic spectrum. Construction of Spectral Energy Distribution (SED) during both high and low activity states in different time period from the observed data and associated theoretical modeling is essential to identify jet parameters responsible for such different activity states. PKS 0208-512 is one of the Fermi detected EGRET blazars that exhibits long term low gamma-ray activity state. Here, we present the preliminary results of our detailed study of blazar PKS 0208-512 utilizing observations from FERMI-LAT, SWIFT-XRT, SMARTS and recent observations from ASTROSAT.

EA-14	ASI2017_423	YASHPAL BHULLA	Poster

Authors: Research Guide: Prof.S N A JAAFFREY Affliation : Pacific University, Udaipur

Title: ACCRETION POWER OF TRANSIENT BLACK HOLE

Abstract: The Black Hole accretion power is due to stellar mass binary system accumulate the matter onto some objects under the influence of gravity. In this work, we discuss the two transient Black Hole sources GRS 1915 + 105 and 4U 1630 - 47 with the instrument of Rossi X-ray Timing Explorer. We detect a high amplitude variability including hard flares. The sources have tremendous luminosity is equal to or more than Eddington Limit. We also present a detailed of Q.P.O., Quality Factor, Timing Properties and evolution of GRS 1915 + 105 and 4U 1630 - 47.

EA-15	ASI2017_427	Ruta Kale	Poster

Authors: Dan Wik (1), Tiziana Venturi(2), Simona Giacintucci (3), Gianfranco Brunetti (2), Rossella Cassano (2), Daniele Dallacasa (2,4) (1) INAF-IRA, Bologna (2) NASA (3) NRL (4) Department of Physics and Astronomy, University of Bologna

Title: Discovery of a radio relic in the merging galaxy cluster PLCKG200.9-28.2

Abstract: Radio relics at the peripheries of merging galaxy clusters are tracers of the elusive shocks around clusters. We report the discovery of a radio relic in the Planck satellite discovered cluster PLCKG200.9-28.2 at a redshift of 0.22 using the Giant Metrewave Radio Telescope and the Karl G. Jansky VLA. It has a largest linear extent of a Mpc and is at a distance of 0.9 Mpc from the cluster centre. The analysis of archival XMM Newton data shows that it is a merging cluster based on the disturbed X-ray morphology and a high

temperature of about 5 - 6 keV. We discuss the properties of this new relic and the host cluster and compare it with those of the other clusters with radio relics.

EA-16	ASI2017_469	Savithri H Ezhikode	Poster

Authors: Poshak Gandhi(1), Chris Done(2), Martin Ward(2), Gulab C. Dewangan(3), Ranjeev Misra(3), Ninan Sajeeth Philip(4): (1) School of Physics & Astronomy, University of Southampton, Highfield, Southampton SO17 1BJ, UK (2) Centre for Extragalactic Astronomy, Department of Physics, Durham University, South Road, Durham DH1 3LE, UK (3) Inter-University Centre for Astronomy & Astrophysics, Post Bag 4, Ganeshkhind, Pune, India (4) Department Of Physics, St. Thomas College, Kozhencherry, Kerala 689641, India

Title: Torus covering factors of type 1 AGN: A study based on a sample of 51 sources in the nearby universe

Abstract: The unification scheme of active galactic nuclei (AGN) proposes the presence of an obscuring torus around the central source, which is responsible for the observed differences in the AGN spectral energy distributions (SEDs). It is assumed that a fraction of the AGN luminosity is absorbed by the dusty torus and re-radiated in the infrared (IR) band. Then the fraction of the sky covered by the torus, known as the covering factor fc, can be indirectly obtained from the ratio of the IR to the bolometric luminosities of AGN. However, it is difficult to determine the bolometric luminosities of AGN since SEDs peak in the unobservable ultraviolet region. In this work, we estimated the bolometric luminosities of a sample of 51 type 1 AGN using a self-consistent, energy-conserving model. The IR and bolometric luminosities are computed by analyzing the broadband SEDs of the sample using multi-wavelength data from XMM-Newton, SDSS, WISE and 2MASS/UKIDSS. The obtained torus covering factor is found to be in the range of ~0.02-0.88 with a mean value of ~0.3 and a dispersion of about 0.17. We also find that fc is anti-correlated with both the bolometric luminosity and the Eddington ratio. A simulation using random samples of these parameters suggest that, rather than the bolometric luminosity, the Eddington ratio is the underlying driver of the torus covering factor. This points to a changing geometry of the accretion flow connected to Eddington ratio rather than a receding torus driven solely by illumination.

EA-17	ASI2017_499	Dr. Mahadev Baburao Pandge	Poster

Authors: S.S Sonkamble M.K.Patil S.R.T.M. University Nanded

Title: Discovery of Mpc-scale X-ray tail in MACS J0553.4-3342

Abstract: We report discovery of longest 130″(~ 1002 kpc) at (2σ) and hottest (11.86±2.3 keV) X-ray tail in northeast direction of a young merging galaxy cluster MACS J0553.4-3342, with 83 ks deep Chandra archival observation. The X-ray tail has a length-to-width ratio of ~ 3.85 (2σ). This is the longest as well as hottest X-ray tail reported to date in galaxy cluster merging environment. The X-ray tail is very luminous L[0.2−2.4,keV]~ 3.47 ± 0.02 × 10^43 erg s^1, while X-ray tail contain gas mass of M_Tail ~2.31×10^12M⊙. We interpret that the possible origin of the X-ray tail structure is either ongoing merger or stripped gas from the BCG1 (1RXS J055326.7- 334237) has been compressed and/or heated. Further deep X-ray and low frequency radio observations are needed to understand the clear nature of this X-ray tail.

EA-18	ASI2017_513	Dinesh Vasanta Hegde	Poster

Authors: 1)Dinesha Vasanta Hegde I M.Sc Department of Studies in Physics Manasagangotri Campus University of Mysore, Mysore 2)Prof.Annapurni Subramaniam Professor, Indian Institute of Astrophysics, Bangalore - 560034 3)Prof. Rama Sagar NASI Senior Scientist Indian Institute of Astrophysics, Bangalore - 560034 4)Mr.Prasanta Nayak Senior Research Fellow Indian Institute of Astrophysics, Bangalore - 560034

Title: Gaps in the Main-sequence of Star Clusters in the Large Magellanic Cloud

Abstract: The main sequence (MS) of star clusters is known to have a few gaps, which are linked to some physical properties of stars. The MS gap in open clusters of our Galaxy is well studied, but no similar study exists in the Large Magellanic Cloud (LMC). For the first time, we present the identification and analysis of MS gaps in the LMC star clusters. We have used the CMDs of 1072 LMC star clusters presented in the catalogue of Nayak et al. (2016) constructed using V and V-I data from the OGLE III survey data for the detection of prominent gaps in the main sequence. After the identification of MS gaps through the observation of Integral Distribution Diagram(IDD) of individual star clusters of LMC , we estimated gap parameters such as, luminosity at the bright and faint ends of the gap, color index at the bright and faint ends of the gap and gap width. Finally we short-listed 22 clusters out of 1072 Cluster CMDs and then subjected those for Chi-Sqare Test. MS gaps of all 22 star clusters are found to be statistical significant. All the detected main sequence gaps are vertical gaps without showing the deficiency of stars in the color in their CMDs. Observed MS gaps in the LMC are located in the relatively brighter position than that of the well studied open clusters of our Galaxy. Dependence of the location of the MS gap with the cluster age is linear, as age increases luminosity gets fainter and color gets reddened. The above mentioned relation of location of the gap and cluster age is all most same as observed in the open clusters of our Galaxy. Linear relationship between the Gap width and cluster age does not exist in the star clusters of LMC as seen in the open clusters of our Galaxy.

EA-19	ASI2017_514	Sharmila Ghosh	Poster

Authors: Dr. Mina Ray Assistant Professor

Title: A multiwavelength approach to the evolution of cold gas from quasar absorption lines

Abstract: One of the key questions in modern astrophysics is to understand how the star formation in galaxies proceeds and leads to the present-day Universe. Quasars (quasi-stellar radio sources) are the most energetic and distant members of the objects known as active galactic nuclei (AGN). As Quasars are extremely luminous and were first identified as being high redshift sources of electromagnetic energy, including radio waves and visible light, their spectra contain very broad emission lines hence they are suitable to study a multiwavelength approach to the evolution of cold gas from quasar absorption lines. In recent years, radio and optical observations of the local Universe have established a strong relationship between the star formation rate and the properties of the cold atomic and molecular gas in galaxies. Although the overall star-formation history of the Universe is known to very high redshifts, very little is known about the evolution of cold gas beyond the local Universe. An unbiased census of the cold gas in normal galaxies, irrespective of their physical properties such as morphology and mass, is required to understand the physical processes that control the evolution of the star formation history of the Universe. Even we are interested to unravel the evolution of cold gas in galaxies through the quasar absorption line technique. Specifically, at radio wavelengths for the first most sensitive search of cold gas absorption lines using South Africa's Square Kilometer Array (SKA) precursor, the MeerKAT radio telescope, starting in 2016. Mapping HI emissions with a radio telescope is a technique used

for determining the structure of spiral galaxies. HI regions effectively absorb photons that are energetic enough to ionize hydrogen, which requires energy of 13.6 electron volts. Importance and main focus of the study is to carry out the blind search of HI 21-cm and OH absorption lines through the MeerKAT Absorption Line Survey (MALS). The hydrogen line 21 cm or HI line refers to the electromagnetic radiation spectral line that is created by the transition of electron between two lower energy states of hydrogen atoms. Neutral hydrogen could produce radiation at a frequency of 1420.4 MHz due to two closely spaced energy levels in the ground state of the hydrogen atom. The electromagnetic radiation is at the precise frequency of 1420 MHZ, which is equivalent to the vacuum wavelength of 21 cm in free space. This wavelength falls within the microwave radio region of the electromagnetic spectrum, and observed frequently in radio astronomy because those radio waves can penetrate the large clouds of interstellar cosmic dust that are opaque to visible light.

EA-20	ASI2017_517	Rudrani Kar Chowdhury	Poster

Authors: Dr. Suchetana Chatterjee Presidency university

Title: X-ray properties of galaxy groups

Abstract: Galaxies that harbor active super massive black holes in their centers are called active galactic nuclei (AGN). From several observations it has been seen that AGN, residing at the centers of galaxy clusters are pouring huge amount of energy on the surrounding X-ray gas and are displacing the hot X-ray gas outward. The same phenomenon has been observed in galaxy groups too. This phenomenon is referred as AGN feedback in the literature. Feedback from AGN has a very profound effect on structure formation. By studying the X- ray surface brightness profiles of simulated galaxy groups we now theoretically evaluate the effect of AGN feedback on the gas in the intra-cluster (group) medium. In this work, we used the cosmological simulation from DiMatteo et al. 2008 to study the effect of AGN feedback on the X-Ray surface brightness profiles. Our result qualitatively matches the observational result which reveals that in the case of AGN feedback the X-ray gas is indeed underdense. Our next goal is to use a bigger cosmological data and look for the X-ray properties of galaxy groups and studying the co-evolution of the central black hole and the host galaxy. Comparing our results with observed surface brightness profiles of AGN makes the final goal of this work.

EA-21	ASI2017_547	LABANI MALLICK	Poster

Authors: Labani Mallick (IUCAA), Gulab C. Dewangan (IUCAA)

Title: Intrinsic coronal variability in the narrow-line Seyfert 1 AGN PG1404+226

Abstract: The X-ray emission from active galactic nuclei (AGN) is ubiquitous and shows strong persistent variability which is energy dependent. This strong variability implies that the X-ray emission is originated in the inner regions of the central engine. However, the anatomy of the AGN central engine is very complex in nature because of the presence of multiple emission components (accretion disc, corona and/or base of the relativistic jets) and the interplay between them. One of the major open questions is 'which component/mechanism is responsible for the observed energy dependent X-ray variability in AGN?'. To answer this question, we have observed one of the most promising, bright and potential AGN candidate, PG1404+226 with XMM-Newton for ~100 ks. PG1404+226 is a narrow-line Seyfert 1 galaxy at redshift z = 0.098 and is well-known for showing large-amplitude X-ray variability on short time scales. Here we study the

origin of a rapid X-ray flaring activity and quantify the variability of different spectral components (primary emission, soft excess) through time-resolved X-ray spectroscopy and frequency-averaged root mean square (rms) spectral modelling. We detected no significant UV variability (F_rms~1%) while the soft excess varies together with the primary continuum, although with smaller amplitude. This is in agreement with the blurred reflection scenario which is further supported by the steep emissivity profile (index q~9.5) of the accretion disc. We found very strong X-ray variability (F_rms~84%) with an increase in overall fractional rms with energy. As such, the higher-amplitude variability becomes effective when the coronal emission exhibits enhanced variability than the soft excess. However, both the soft excess and intrinsic coronal emission are varying with large changes in the coronal flux dominating the variability. We fitted the frequency-averaged ([1.4-10]×10e-5 Hz) X-ray fractional rms spectrum of PG1404+226 in the framework of 'two-component blurred reflection' model in which both blurred reflection and intrinsic continuum are variable in normalization only and are perfectly coupled with each other. The fractional variations in the normalization of the intrinsic coronal and reflected disc emissions are ~93% and ~78%, respectively. We interpret these rapid variations in the framework of light bending model, according to which the primary coronal emission is bent down onto the accretion disc due to strong gravity and forms less variable reflection component. The nature of the rapid, energy dependent X-ray variability in PG 1404+226 prefers the 'lamppost geometry' of a compact corona.

EA-22	ASI2017_552	Dipanweeta Bhattacharyya	Poster

Authors: A. Mangalam, Indian Institute of Astrophysics

Title: Evolution of the black hole nuclei in elliptical galaxies

Abstract: The $M_{\bullet} \propto \sigma^{p}$ relation is likely the result of a complicated nexus between the stellar and gas dynamics within the radius of influence, and the galaxy formation physics that determines the mass of the seed black hole. We consider the relativistic effects on the loss cone for isotropic distribution functions (DFs) and show that the stellar loss cone fueling gives a trend $M_\bullet \propto \sigma^5$ whereas the gas feed back regulation by momentum driven flow yields $M_\bullet \propto \sigma^4$. To investigate this question further, we consider realistic elliptical galaxies with spherical intensity profiles and invert it to calculate the density and the DF, $f(E)$, of the stars in presence of the supermassive black hole (SMBH) at the center. Employing the DF we compute the line of sight velocity dispersion while assuming a proportionality relation, $M_b =f M_{\bullet}$; applying this to several ellipticals we find the best fit global p and f. For the Nuker profile, we conclude that the p and f values thus derived are consistent with the observed range; this provides clues to the galaxy formation physics. We also implement the same procedure for the anisotropic case using the Osipkov-Merritt DF and show that the derived index p is lesser than the observed value. We also model a more generalized axisymmetric distribution function $f(E, L_z)$ and obtain useful physical constraints on the SMBH nuclei. Using the results of our models, we calculate the evolution of the $M_{\bullet} - \sigma$ relation over cosmic time.

EA-23	ASI2017_690	Rubinur Khatun	Poster

Authors: Mousumi Das IIA Preeti Kharb NCRA

Title: Resolving the dual AGN and tracing the helical jets in 2MASXJ12032061+1319316

Abstract: We present the 6, 8.5, 11.5, 15, 22 and 33 GHz EVLA observations of a double-peaked emission line galaxy 2MASXJ12032061+1319316 (J1203). Double-peaked emission galaxies are candidates of dual/binary active galactic nuclei (AGN). Such supermassive black hole (SMBH) or AGN pairs are expected from galaxy mergers but their detection is still rare. High-frequency radio observations are the one way to resolve dual/binary AGN at sub-arcsecond resolution. Our 6,8.5, 11.5 and 15 GHz observations reveal a core-jet structure in J1203 and jet shows a symmetric S -shaped morphology that extends over a distance of ∼ 1.5 ″ (or 1.74 kpc) on either side of a core of size ∼ 0.1 ″ (116 kpc). We have modeled the S-shaped structure as due to precessing jets that have an approximate time period of 10^5 years. This matches the source lifetime estimate via spectral aging. We thus conclude that the S-shaped radio morphology is due to precessing jet caused either by a binary/dual SMBH system, a single SMBH with a tilted accretion disk or a dual AGN system where a close pass of the secondary SMBH in the past has given rise to jet precession. We have calculated the separation of the expected binary. We also present 22 and 33 GHz EVLA observations which can confirm the dual/binary AGN picture.

EA-24	ASI2017_702	Prasanta Kumar Nayak	Poster

Authors: Annapurni Subramaniam (Indian Institute of Astrophysics,Bangalore), Samyaday Choudhury (Yonsei University Observatory, Seoul, Republic of Korea), Ram Sagar (Indian Institute of Astrophysics,Bangalore)

Title: PROPAGATION OF CLUSTER FORMATION IN THE SMC : SIGNATURES OF SMC-LMC-MILKY WAY INTERACTIONS

Abstract: The Small Magellanic Cloud (SMC) is a neighbouring galaxy (d ~ 60 kpc) to the Milky Way (MW). The recent studies have shown that the SMC had undergone tidal interactions with the MW and Large Magellanic Clouds (LMC). HI distribution (Putman et al. 2003) clearly indicates that the SMC has gone through close encounters with the LMC in the recent past. These interactions are known to disturb the gas and influence star formation events in the SMC. We have parameterised 235 star clusters in the Small Magellanic Cloud (SMC) using the Optical Gravitational Lensing Experiment (OGLE) III survey data. This study brings out 30 newly parameterised clusters. The ages of the clusters are found to be in the range, log(t)= 6.80 - 9.0 (6.6 Myr - 1 Gyr), with an uncertainty of +- 0.20, better than previous age estimations. The colour excess in (V - I) lie between 0.0 to 0.48 mag. Major cluster formation episodes are found to happen at 60 and 400 Myr. We added another 238 clusters to our catalog from previous studies and made a movie based on the propagation (in space and time) of cluster formation. Our study suggests that the southern and the western part of the SMC start forming clusters around 1 Gyr, which later propagates to eastern and northern part in the last 200-300 Myr. The central region of the SMC is found to have continuous cluster formation till date. Presently, the south and the western parts are devoid of cluster formation whereas the northern and eastern regions are actively forming clusters. The propagation of cluster formation is linked to the interaction between the SMC, the LMC and the MW in last one Gyr, and also co-related with the interaction model (Besla et al. 2010,2012). The catalog with parameters, classification, cleaned and isochrone fitted CMDs of 235 clusters, can be further used to understand the hierarchical formation of clusters in selected regions of the SMC.

EA-25	ASI2017_737	Chayan Mondal	Poster

Authors: Annapurni Subramaniam Indian Institute of Astrophysics

Title: UVIT imaging of WLM: Understanding star formation in the dwarf irregular galaxy

Abstract: WLM is a dwarf irregular galaxy, located in an isolated part of the Local group with a distance of 995 kpc. Several photometric studies have shown the presence of young population in the disk of the galaxy with an old metal poor halo. Since ultra-violet radiation can probe the recent star forming activities in a galaxy, UVIT observations in four different filters (F148W, F169M, N245M, N263M) are performed for this galaxy. We performed aperture photometry to estimate the magnitudes in each filter and created UVIT color-magnitude diagrams (CMD) with the identified sources. We have fitted isochrones, generated from Flexible Stellar Population Synthesis (FSPS) model, in the observed CMD to estimate different parameters of the identified sources. With the better spatial resolution of UVIT than that of GALEX, we have identified several star forming regions near the center of the galaxy also.

EA-26	ASI2017_748	T Swetha	Poster

Authors: S.N.Hasan Osmania University, Hyderabad

Title: Multiple minor mergers of Galaxies

Abstract: We study the simultaneous minor mergers of disk galaxies. We use cosmological merger trees (for high resolution and detailed treatment of gas) and semi-analytical models of galaxy formation (for cosmological background and low computational cost) for initial contains of hydrodynamical simulations. We use GADGET-2 code for the simulations. We carry out the simulations with and without gas particles and compare the resultant disks in the two simulations. We examine the role of gas in the thickening of the disk.

EA-27	ASI2017_764	Dr. Rulee Baruah	Poster

Authors: Dr. Kalpana Duorah, Gauhati University, Guwahati

Title: Electron capture and beta decay rates in highly explosive scenario of type II supernova

Abstract: The r-process (rapid neutron capture process) nucleosynthesis in traditionally considered to be responsible for synthesis of most of the heavy elements beyond iron. Though the site of the r-process is still not clearly known, it has been proposed that explosive and dynamic astrophysical environment of core collapse type II supernova is a viable site. Various weak interaction processes, chiefly electron capture and beta decay play a crucial role during the late stage of stellar burning and subsequent gravitational collapse for a supernova type II. After collapse the bounce pushes the material outward in form of shock wave where the energy of neutrinos eventually causes the explosion. The outward propagation of the shock depends on the rates of these processes. For most of the heavy and superheavy elements produced here, the experimental information is largely scarce. So a theoretical approach is considered a first step for gathering information on the nuclei produced in such environments. 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. Along the path , the experimental data of observed elements matches our calculated ones. Later ejecta are neutron-rich (Ye < 0.5) and leaves behind a compact neutron star or a black hole depending upon the initial contracting mass. 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. The decay rates of these elements are found to be very much higher than their electron capture rates. The electron capture precedes beta decay during collapsing stage of a massive star. But just after explosion as temperature and density decrease exponentially and r-process nucleosynthesis starts, the beta decay of the nuclei produced increases Ye, the electron fraction and compete with electron capture.

EA-28	ASI2017_768	PRATEEK GUPTA	Poster

Authors: Surajit Paul, Dept of Physics, University of Pune (SPPU), Pune Reju Sam John, P.E.C., Pondicherry University

Title: Revealing the unseen Universe by numerical modelling of radio emission

Abstract: The Universe appears as the cosmic-web structure at large-scales (>few tens of Mpc) where Galaxy clusters form the knots in the complex filamentary network (web) which drains out the matter (dark matter and baryons) from voids to feed its respective knots. As most of the matter is possibly processed first time in the filaments and the outskirts of Galaxy clusters, those region should contain a wealth of information about the energetics of the cosmic structures. Kinetic energy released during structure formation dissipates in the intra-cluster-medium (ICM) by shock thermalization and turbulence generation. This turbulence due to feeding of material can cause the local magnetic field which can be amplified by shock waves in ICM which are generated during the formation of these structures. These shock waves also accelerate the significant population of charge particles by diffusive shock acceleration (DSA) mechanism. Due to baroclinic instability at the junction of the filaments and Galaxy clusters, a significant turbulence is generated which further amplify the magnetic field by dynamo action and also re-accelerate the charge particles by turbulent re-acceleration (TRA) mechanism which in turn produce Synchrotron emission. This synchrotron radio emission could help in tracing back the dynamical history of these structures. In this work, we deployed both of our models (DSA and TRA) for computing radio emission from Large Scale Structures (LSS) using Adaptive Mesh Refinement (AMR), grid based hybrid (N-body + Hydro -dynamical) cosmological simulations. Computation is being done on grid parameters and a proper weight has been used to nullify the effect of complicated resolution pattern of an AMR simulation. Finally, we have created the synthetic radio maps, for each model and also with combined effect, and clearly predicted the possible detectable sources with the upcoming telescope (SKA). This work of ours has resolved many issues related to the observational aspect as well as yet to observe. It explained the observed radio relics found at few Mega parsec away from Galaxy cluster as well as predicted some very interesting radio structures, existence of complex filamentary network, Warm-hot intergalactic medium (WHIM) which is yet to reveal by the new generation telescopes in near future. Detection of filaments and WHIM will give us the complete structure of our universe as well as will solve the problem of missing baryons.

EA-29	ASI2017_795	Pankaj Sanwal	Poster

Authors: Dr. Brijesh Kumar , Aryabhatta Research Institute of observational sciences

Title: Optical analysis of Type IIb Supernova 2016gkg

Abstract: Supernovae caused by the core collapse of stars are called type II SNe if they show strong Balmer lines in their spectra. SNe Type II are only found in the spiral arms of galaxies with young population of stars which indicate that the progenitor stars are quiet massive. As the Type II supernovae don't form a homogeneous class of objects, there's no satisfactory explanation about the explosion mechanism, neither we've the clear answer about the progenitor properties. In this optical analysis of SNe IIb 2016gkg , we present progenitor properties i.e. the peak absolute magnitude, Ni-56 mass,ejecta mass, kinetic energy of the ejecta estimated by studying the light curve. The supernova is being monitored in the optical wavelengths using the 1.04m Sampurnanand Telescope and 1.3m Devasthal Fast Optical Telescope at ARIES, Nainital. The UBVRI broad-band photometric data were used to study the light curve evolution of the supernova. To calibrate the data one need the Landolt celestial equator standards, however in our case for the accurate calibration of our data, high quality standards set of data has been obtained at zenith using our zenith sky survey(which covers 30 arc min field of the zenith sky at the latitude 29.4deg) at Nainital.

EA-30	ASI2017_802	Bhoomika	Poster

Authors: C .S. Stalin and Indian Institute of Astrophysics

Title: The connection between optical and GeV flux variations in blazars

Abstract: The extragalactic gamma-ray sky is dominated by the blazar class of active galactic nuclei (AGN). These sources with their relativistic jets pointed close to be observer show flux variations over the entire accessible electromagnetic spectrum. By studying flux variations over multiple wavelengths one can probe the multi-wavelength emission sites in blazar jets. According to the leptonic model, the flux variations in the optical and GeV bands of blazars need to the correlated. Alternatively, in the hadronic scenario of emission from blazar jets, a correlation between flux variations in the optical and GeV bands is not expected. To probe the possible connection between optical and GeV emission mechanism in blazar jets (leptonic v/s hadronic scenario), we are carrying out a systematic study on the optical and GeV flux variations on a large sample of blazars detected by the Fermi Gamma-ray Space Telescope. Our preliminary results indicate that blazars show a wide range of variability patterns such as (a) correlated optical and GeV flux variations with/without time lag (b) optical flares with no GeV counterparts and (c) GeV flares with no optical counterparts. Details of the results will be presented.

EA-31	ASI2017_805	Abhisek Mohapatra	Poster

Authors: Ananta C. Pradhan, National Institute Of Technology, Rourkela.

Title: Ultraviolet Study of the Large Magellanic Cloud Using GALEX Observations.

Abstract: The LMC has been the center of many photometric surveys at different wavelength bands as it is characterized by a number of environmental differences relative to the Milky Way. GALEX imaged the Magellanic Clouds due to lifting of safety concerns towards end of its mission. The GALEX images contain both stars and diffuse background emission and our focus is to study the both. We have extracted diffuse UV emission by removing all the sources from the images.The estimated dust scattered diffuse emission comes out to be 1000 to 5000 photons per cm^2 s^1 sr^1 Å^1 at the GALEX bands. The FUV diffuse emission correlates well with NUV indicating that both are from dust scattered emission. Scattering in the UV is complementary to the IR emission and a correlation between the two is expected. But we found that diffuse UV emission is flat relative to the infrared emission at IR 100 μm of IRAS and at IR 160 μm of Spitzer due to the high optical depth of UV in the LMC. We have also estimated the diffuse fraction at the GALEX bands that comes out to be 73% – 80%. We cross-matched the GALEX point sources to the MCPS catalog with a matching radius of 3 arcsecond to obtain the optical counterpart of the UV sources. Then we have used the stellar atmosphere models of Castelli & Kurucz (2004) for spectral energy distribution (SED) analysis of the sources. We estimated the spectral types of the stars and extinctions using a least square technique, based on SED analysis.

EA-32	ASI2017_817	Lavanya Nemani	Poster

Authors: Lavanya Nemani (RAD@home), Megha Rajoria (RAD@home), Mitali Damle (RAD@home), Akanksha Tiwary (RAD@home), Kavil Mehta (RAD@home), Geetam Mall (RAD@home), Viswajith Govinda Rajan (RAD@home), Karuna Gamre (RAD@home), Aakash Mantri (RAD@home), Sayali Kulkarni (RAD@home) Pratik Dabhade (RAD@home), Sravani Vaddi (NCRA & RAD@home), Chiranjib Konar (Amity Univ & RAD@home), Ananda Hota (UM DAE CEBS & RAD@home)

Title: How any BSc/BE can participate in citizen science research in astronomy using GMRT

Abstract: RAD@home (#RADatHomeIndia #ABCDresearch), is the first Indian Citizen-Science research project in astronomy. It was launched in Google and Facebook in April 2013. The paradigm shift of the world towards Internet has made it possible, as students can participate in an education cum research activity from any corner of the country. The research project has been giving opportunity to students/citizens (any BSc/BE) to learn, explore and contribute to science endeavours since its inception. A group of 1800 members comprising students, working and non working class meets at this platform to share knowledge and do some scientific research. They are trained by professionals during various discovery camps, (held at various institutions all over India namely Institute of Physics (Bhubneshwar), Harischandra Research Institute (Allahabad), UM-DAE Centre for Excellence in Basic Sciences (Mumbai), Nehru Planetarium (New Delhi) and Vigyan Prasar (DST, GoI)), online e-classes (3hrs/week). Cosmic sources are discovered during these camps and on-line e-research discussion sessions by analysing data from the TIFR GMRT Sky Survey (TGSS). Members are further trained to use NASA Skyview virtual observatory, NASA Extragalactic Database (NED) which helps them further characterise the newly discovered source for advanced analysis. Thereby these discovered sources are then investigated by professional astronomers with followup observations. GMRT Time Allocation Committee has also awarded time to RAD@home for three cycles so far for these follow up

investigations. The discovered sources include several new episodic radio galaxies, Z-and X-shaped radio galaxies, bent-lobe radio galaxies sitting in new galaxy filaments, dead-lobe radio galaxies, relic/halo diffuse radio emission in clusters of galaxies etc. Due to the availability of TGSS ADR1, all sky data, the list of each type of sources has grown up significantly since the last ASI meeting held in Kashmir. There are nearly 70 camp-trained citizen-scientists or e-astronomers today, from various walks of life who work together in discovering new sources and contributing to science. The Pan India program of RAD@home has proved to be unique in its own way and its importance in the future in assisting professionals to increase research output from any telescope is documented in a recent paper. The paper is going to appear in a special issue of the Journal of Astrophysics and Astronomy titled "Science with the SKA: an Indian perspective" available freely at https://arxiv.org/abs/1610.09798 Interested citizens may connect with us at www.facebook.com/RADatHomeIndia

EA-33	ASI2017_857	Biny Sebastian	Poster

Authors: Biny Sebastian(NCRA-TIFR), Dharam V. Lal(NCRA-TIFR), A. Pramesh Rao (NCRA-TIFR), C.C. Cheung (NRL), and Sanjay Bhatnagar(NRAO)

Title: Study of candidate X-shaped radio galaxies at low radio frequencies

Abstract: The nature of X-shaped radio galaxies is a matter of considerable debate in the literature: it has even been proposed that they provide evidence for black hole mergers/spin reorientations, and therefore constrain the rate of strong gravitational wave events. Lal & Rao 2005 showed that the low-surface-brightness wings have flatter radio spectral index than the active lobes in 3C223.1, an X-shaped source, which supports above conjuncture. In order to investigate in detail the mechanism of the formation of X-shaped sources and hence the statistical understanding of nature of these sources is a must; and we undertook a study of a large sample of (candidate) X-shaped sources gleaned from the VLA FIRST survey images using GMRT. Here, we present our preliminary results.

EA-34	ASI2017_974	Aditi Vijayan	Poster

Authors: Kartick Chandra Sarkar, RRI & Joint Astronomy Programme and Department of Physics, Indian Institute of Science, Bangalore 560012 Biman B. Nath, RRI Prateek Sharma, Indian Institute of Science, Bangalore

Title: Understanding Radio Emission Using Simulations

Abstract: Diffuse radio emission is one of the signatures of star formation in spiral galaxies. While the total radio luminosity of a galaxy is related to its star formation rate, the spatial extent of the radio ‘halo’ depends on the surface density of star formation rate, its spatial distribution and disc parameters of the spiral galaxy. The extent of the synchrotron emission in our Galaxy is also crucial for the interpretation of the recently detected excess in the background radiation in radio wavelength. Observations suggest that there is a correlation between the extent of the radio halo of star forming spiral galaxies and that of the star forming region in the disc. We study the underlying processes related to the extended radio emission with the help of numerical hydrodynamical simulation. We use a 3D set-up of a disc galaxy wherein the mass and energy injection follow the density distribution in the disc. Using this, we study the correlation of the extent of the radio halo and disk parameters.

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ASI-2017 Poster Presentations

Instrumentation and Techniques

IT-1	ASI2017_1043	Sujay Mate	Poster

Authors: Tanmoy Chattopadhyay, PRL Ahmedabad; Varun Bhalerao, IUCAA Pune; Dipankar Bhattacharya, IUCAA Pune; A. R. Rao, TIFR Mumbai; H. M. Antia, TIFR Mumbai; Krishnan Kutty, TIFR Mumbai; Harshit Shah, TIFR Mumbai; Santosh Vadawale, PRL Ahmedabad; Nagabhushana. S, IIA Bangalore

Title: AstroSAT Mass Model and Transient Detection with CZTI

Abstract: We report on a detailed mass model of AstroSat created to study off-axis transients detected by CZTI. Cadmium Zinc Telluride Imager (CZTI) is a hard X-ray detector on board of AstroSAT with capability of acting as an all sky monitor at high energies (typically > 60 keV). CZTI has detected over 80 transients from all parts of the sky. Localisation as well as estimation of detector response of such detections is a challenge as both are affected by the scattering of photons caused by other instruments on satellite, satellite body and the CZTI detector elements. We have created a detailed satellite mass model in GEANT4 to calculate the CZTI-observed counts and spectra for such off-axis transients. In the mass model, the CZTI geometry is built with high accuracy while other instruments and structures are built with reasonable approximations. By using this mass model we have simulated response of GRBs in GEANT4. Same mass model is used to calculate all-sky response to localise transient sources including X-ray counterparts to gravitational wave detections.

IT-2	ASI2017_1132	Pritpal Sandhu	Poster

Authors: N. Rathnasree1, Pritpal Sandhu2, Pulkit Agarwal3, Lavanya Nemani4 and Sonia Munjal5 1. Nehru Planetarium, Nehru Memorial Museum and Library 2. Indian Institute of Technology Indore 3. National University of Singapore 4. Maitreyi College, Delhi University 5. Bonn-cologne graduate school of physics and astronomy

Title: Towards the restoration of the Jantar Mantar observatory instruments at Delhi Ia. Calibration and observations with the Jaiprakash Yantra

Abstract: A database of observations is being collected for the Jai Prakash Instrument at Jantar Mantar in New Delhi. The purpose of this database collection is to give an overall idea of the state of the instrument at present, prior to the planned restoration of the instrument surface markings by the Archaeological Survey of India. The observations and the related documentation of procedures involved is also aimed at providing templates for the planned restoration of the instrument surface markings. The restoration process can utilize the methods outlined here, for the drawing/etching of the markings for the measurement of Altitude and Azimuth on the one hand and Right Ascension and Declination on the other. The time markings along the Equator can also be undertaken. The markings related to the rising and/or culmination of the Zodiac signs, which may have been present originally on the instrument, have not been undertaken. The required markings for the same would have shifted with precession of the axis of rotation of Earth, and drawing them according to current positions would be different from the original markings. Conservation practice requires a restoration to the original design, but in this particular case, such a restoration would not make any Astronomical sense. In all the existing literature about the Jaiprakas Yantra instruments built by Jai Singh, and the one at Delhi in particular,

the current work is the only effort towards giving detailed observations using the Yantra, and arriving at an understanding of the actual condition and functioning of the instrument based on these observations.

IT-3	ASI2017_1158	Athira B S	Poster

Authors: 1.Dr.Nirmalya Ghosh, DPS, IISER Kolkata 2.Dr.Dibyendu Nandy, DPS,CESSI, IISER Kolkata

Title: Development of a novel Spectral Imaging Polarimeter for Application in Coronal Magnetometry

Abstract: Magnetic instabilities in sunspot structures and reconnection mediated restructuring of fields produce violent solar eruptions such as flares and coronal mass ejections (CMEs) which have severe space weather consequences. Measurement and analysis of the components of the vector magnetic field in the solar corona can potentially yield quantitative information on coronal magnetic structures, dynamics and heating. Among the various experimental techniques explored for coronal magnetometry, optical polarimetry (on selected spectral lines of radiation emitted by ions) has been found particularly promising. An instrument that can perform simultaneous imaging, spectroscopic diagnostics and polarimetric imaging of corona is highly desirable for astronomical observations. Such an instrument should be capable of recording full stokes vector elements over a broad wavelength region with simultaneous imaging capability. Here we describe the development of a hyper spectral imaging instrument for this purpose, which is being developed at CESSI. We demonstrate two specific experimental concepts, both of which uses a combination of birefringent medium and a polarizer in polarization analyzing unit (PSA) to determine the stokes vector. In one such system we uses a rotating waveplate with a polarizer and in the other a liquid crystal variable retarder (LCVR) in combination with a fixed polarizer. Simultaneous measurement of polarization states, spectroscopy and imaging is done by using a combination of liquid crystal tunable filter (LCTF-which selects the desired wavelength range) and the PSA unit with a CCD. The PSA unit is calibrated using the so-called eigen value calibration method which ensures high accuracy and sensitivity in measuring the full stokes vector elements. The specification of the experimental scheme, instrument development and eigen value calibration method with the system is discussed.

IT-4	ASI2017_1176	Amar Deo Chandra	Poster

Authors: Ayan Banerjee, Department of Physical Sciences, IISER Kolkata Dibyendu Nandy, Department of Physical Sciences, IISER Kolkata and Center of Excellence in Space Sciences India(CESSI)

Title: Development of a High Resolution Imaging Spectrometer for exploring the Sun's corona

Abstract: The solar corona is the outermost layer of the Sun and is very hot, having temperatures on the order of million degrees Kelvin. Coronal heating is believed to occur due to reconnection mediated nanoflares in the corona (Parker, 1983, 1988) or due to the passage of waves, which dissipate energy in this layer (Schatzman,1949). Many energetic manifestations such as flares and coronal mass ejections (CMEs) originate in the corona. Earth directed CMEs can adversely affect the conditions in our vicnity (space weather) and cause power grid failures, damage satellites and cause communication blackouts. The corona is very faint compared to the photosphere, which necessiates development of very sensitive spectrometers to resolve the feeble emission lines emanating from this tenuous layer. We will discuss the development of a novel imaging spectrometer, which is one of the modules of the Solar Hyperspectral Imaging Polarimeter (SHIP) instrument being developed at CESSI. The SHIP instrument is envisaged to work across 600-1100 nm waveband and

perform simultaneous imaging, spectroscopy and polarimetry of the solar corona. To our knowledge, no instrument is yet operational in the world which can routinely perform these observations simultaneously. We will discuss potential solar coronal diagnostics which can be performed using this high resolution imaging spectrometer.

IT-5	ASI2017_1219	Jameer Manur	Poster

Authors: Prof. Joydeep Bagchi (IUCAA) Ashish Mhaske (IUCAA) Pratik dabhade (IUCAA) Shishir Sankhyayan (IUCAA)

Title: Hands on approach to Radio astronomy

Abstract: I propose to talk about a unique facility developed at IUCAA, Pune in collaboration with NCRA called Radio Physics Lab (RPL). RPL provides a platform for the undergraduate college/University students to learn and explore Radio Astronomy along with developing aptitude for experimental astronomy. RPL has trained near 500 students, spanning all geographical regions across India over a span of eight years. RPL conducts various programs for which we get brightest students and many of them go on to join various astronomy PhD programs in India and abroad. We have designed astronomy experiments using 3-meter telescope for solar and for 21-cm neutral hydrogen (Milky way) line observations. Table-top experiment explaining the basics of different types of antennas, a Faraday Rotation experiment for teaching magneto-optics, polarized light, magnetism and communication, a Magnetic Torque experiment, a Noise Fundamentals experiment, a Magnetic Force experiment and a 4-scintillator Cosmic Ray Muon physics experiment are set up in the lab. These experiments have routinely been used for various RPL training and educational programs during the last several years. Recently we have designed and built in-house a horn antenna for detection of 21cm Hydrogen line, which is currently operational in RPL-IUCAA and being used by students. We have successfully used Software defined radio (SDR) with this telescope for the first time. These experiments are being used in our annual Radio Astronomy Winter Schools and other training programs (MSc) conducted periodically. In contrast to optical, radio astronomy is multidisciplinary and highly technical in nature, requiring good understanding of instrumentation, signal processing and electronics. This deters many potential good students to initiate research projects related to radio astronomy. Based on our past experience, hands-on approach using simple experimental setups has proved to be very useful in this respect. We have also generate and share videos and articles on experimental aspects of astronomy via various social media platforms. Overall, these objectives have made RPL a very significant and unique facility for advancing astronomy education in general and radio astronomy in particular. The general approach is to transfer knowledge of existing, well developed experiments to colleges, while developing more sophisticated experiments, thereby ensuring a gradual dissemination of information to colleges and improvement of the quality of our own programs. We conduct regularly technical as well as non-technical talks in various colleges and we plan to make network of affordable small radio telescopes in Universities across India to promote hands-on approach to experimental astronomy in particular radio astronomy. This is very crucial with respect to India’s major role in SKA (Worlds largest telescope).

IT-6	ASI2017_1251	Anilkumar Tolamatti	Poster

Authors: A. Tolamatti, S.S. Sikder, J. Hariharan, K.K. Yadav, A. Behere, K. Venugopal, S. Godambe, N. Mankuzhiyil, K K Singh, A.K. Tickoo, R.C. Rannot.

Title: Characterization of coincidence gate-width of the trigger system for MACE telescope

Abstract: The second largest gamma-ray telescope MACE (Major Atmospheric Cerenkov Experiment) is being installed at Hanle (4270m asl), to explore the gamma-ray sky in the energy region more than 20 GeV. The imaging camera of the telescope comprises 1088 pixels (Photo-Multiplier tubes) covering a total field-of-view of 4.00 x 4.30 with a trigger field-of-view of 2.60 x 3.00. The camera follows a modular design with 16 pixels forming a Camera Integrated Module (CIM). In order to achieve a low energy trigger threshold of around 30 GeV, a two level trigger system has been designed for the telescope. The first level trigger (FLT) is generated within the CIMs based on 4NN close cluster configurations while the second level trigger (SLT) is generated by combining the FLTs from the neighbouring CIMs. We have estimated the SLT coincidence gate-width of the trigger system operating a 4 CIM camera of the MACE telescope under simulated night sky background environment and monitoring the single channel rate and resulting chance coincidence rate. The estimated gate-width is found to be matching with the design specifications. The methodology and the results will be discussed in the meeting.

IT-7	ASI2017_1270	Garima Singh	Poster

Authors: Olivier Guyon (1), Eugene Serabyn (2), Nemanja Jovanovic (1) and Julien Lozi (1) (1) National Astronomical Observatory of Japan, Subaru Telescope, 650 N AOhoku Place, Hilo 96750, Hawaii. (2) Jet Propulsion Laboratory, 4800 Oak Grove Drive, MS 169-530, Pasadena-91109, California

Title: Direct imaging of Exoplanets at small inner working angle

Abstract: The direct detection of young and warm extrasolar giant planets in the habitable zone of nearby cool stars is one of the major goals of current ground-based high contrast imaging (HCI) instruments. The quest is to search for rocky exoplanets that holds the evidence for biosignatures. To characterize such exoplanets by spectroscopy of their atmospheres requires their direct imaging which is challenged by the ability to resolve planet signal above bright stellar background. Coronagraph suppresses the diffraction effects of the telescope by blocking the starlight but residual wavefront error scatters starlight over the science region of interest loosing faint planet photons in stellar noise. Therefore, the optimized coronagraphic observation at small angle require focus on three major areas: 1) optimal and predictive control of the low- and high-order aberrations, 2) speckle suppression and its interaction with the wavefront control and 3) the real-time point spread function calibration at the inner working angle using the wavefront sensor telemetry. In this talk, I will first give an overview of direct imaging techniques, current ground-based instruments and their capabilities. Then, I will introduce my PhD research, which focused on estimating low-order wave front aberrations at the inner working angle of a coronagraph and will present how my work has benefitted the HCI community. I will discuss one of the advanced HCI instrument known as the Subaru coronagraphic extreme adaptive optics (SCExAO) system at the Subaru Telescope in Hawaii where I conducted my research. As a closing remark, I will give a brief account of my experience of working at the world-class Mauna Kea Observatory to initiate and discuss direct imaging interests in the Indian scientific community.

IT-8	ASI2017_1285	Dr V K Dhar	Poster

Authors: V. K. Dhar, K.K.Singh, K. Venugopal, N. Kumar, N. Chouhan, A. K. Tickoo, R. C. Rannot, R. Koul, S. Norlah, T. Rinchen, Keshav N, R. Balasubramanium, A.K.Sinha, P.I. Hadagali, A Kumar, P. K. Biswas, S.P. Srivastava, D. Udupa, N. K. Sahoo and R. B. Tokas.

Title: Fabrication, alignment and vibration testing of diamond turned metallic mirrors for the MACE γ-ray telescope.

Abstract: A Cherenkov imaging telescope, MACE is presently being setup at Hanle(32.7°N, 79.0°E, 4270m) near Leh (J&K state), for the study of cosmos in the energy range ~20GeV-5TeV. The telescope, comprising of a parabolic 21m diameter tessellated light collector is made up of diamond turned aluminum mirrors developed for the first time in the country. The telescope, comprising of ~ 337 square meter light collector area will be the largest telescope of its kind in the Northern hemisphere. MACE telescope will deploy ~ 1 m x 1m panels, with each panel consisting of 4 diamond turned spherical mirrors of size ~0.5m x 0.5m. A total of 1564 such diamond turned metallic mirrors of varying focal lengths have been fabricated for MACE. The mean spot size of these mirrors measured using a standard 2f method is D80 ≤3.5mm (where D80 is the radius of the circle within which 80% of rays are captured). A major challenge after fabrication of these metallic mirrors is to align 4 mirrors on a single panel so as to replicate a single 1mX1m mirror with a spot size of D80 ≤6mm at the focal length, without compromising on the individual mirror facet spot size. Apart from this, the arrangement should withstand vibrations which the telescope will encounter during the actual course of observations. Again, an indigenous design based on usage of ball and socket joints has been employed to meet this requirement. To quantify the alignment design, the aligned panels have been subjected to rigorous vibration testing. Details of the manufacturing process, experimental set used for qualifying the mirrors, reflectivity measurements, panel alignment methodology and vibration testing will be presented in the paper.

IT-9	ASI2017_1286	Debangana Sarkar	Poster

Authors: D Sarkar, N Chouhan, A K Tickoo, R C Rannot Astrophysical Sciences Division Bhabha Atomic Research Centre, Mumbai 400085 debangana@barc.gov.in

Title: GPS based Event Time Stamp and Time Synchronization of various Subsystems of MACE gamma ray Telescope

Abstract: MACE (Major Atmospheric Cerenkov Experiment) will be a low threshold energy gamma-ray telescope being setup at Hanle (32.7 N, 78.9 E, 4200 m asl) in Ladakh region of North India. It is based on the most successful and widely used Imaging Atmospheric Cherenkov Technique (IACT) to detect Very High Energy (VHE) gamma-rays. When operational, it will be the largest ground based gamma ray telescope in the northern hemisphere. Aims and objectives of the telescope are to study a variety of galactic and extra galactic potential VHE gamma-ray sources in the energy range of 20 GeV – 5 TeV. We record Cherenkov event data during observation of VHE gamma-ray sources during mostly moonless and cloudless nights. The Cherenkov event data from the imaging camera of the telescope requires GPS synchronized time to attach time stamp to acquired events, with an accuracy better than ±1μs. The telescope has various subsystems like Telescope drive Control Unit (TCU), Active Mirror Alignment System, Camera Electronics and Signal Processing System, Calibration System, Operator Console, Weather Monitoring System, Sky Monitoring System etc. These subsystems must be time synchronized with each other before the start of observation run as the individual subsystem executes the respective command sequence based on system time. Further, the analysis of VHE gamma-ray data from pulsars also demands high precision in the recorded event arrival times. Accordingly, we have designed a master clock based time synchronization approach for the telescope. Wherein it will use a

Global Positioning System (GPS) based highly stable temperature controlled oscillator clock with an accuracy of ~30 nanoseconds to Universal Time Coordinated (UTC) and frequency better than 1x10-12 per seconds. TCU and Data concentrator (DC) responsible for event time stamp, the two most critical systems with respect to time synchronization receives date and time information in Inter-Range Instrumentation Group- B (IRIG-B) standard through dedicated link. IRIG-B time code decoder is implemented in onboard Field-Programmable Gate Array (FPGA) on the DC. The other subsystems present in system synchronize their system clock with the master clock using Network Time Protocol (NTP). In this paper we shall present a detailed architecture and implementation of the GPS based time synchronization system.

IT-10	ASI2017_1369	Ashish Mhaske	Poster

Authors: Ashish Mhaske, IUCAA Prof. Joydeep Bagchi, IUCAA

Title: Horn antenna and Software Defined Radio for detecting 21 cm hydrogen line

Abstract: The 21 cm hydrogen line is important in astronomy. Since radio astronomy is highly dominated by instrumrntation and signal processing a simple hydrogen line detection system is designed and built for educational purpose. A radio telescope consists of three major sections the antenna, front end and back end. A parabolic reflector antenna has been a tradition in radio astronomy. But because of the bulkyness and cost of the antenna other options were considered. A horn antanna was chosen due to its superior noise performance and low cost. It is also easier to construct and easy to replicate. The horn is a dual mode conical horn antenna. Dual mode nature of the horn reduces the sidelobes and hence improves noise performance of the antenna. Hence although it has a small aparture it is possible to detect hydrogen line with this antenna. Since hydrogen line is narrowband a 2 MHz receiver will be sufficient for studying the spectrum of the line. Keeping in mind the cost of the project software defined radio(SDR) was used. SDR is a flexible hardware which can be programmed to perform a perticular task which is controlled via software. A very good receiver that fits the description is the DVB-T dongle which has a R820T front end IC and RTL2832U signal processing IC. The dongle has variable gain up to 50 dB and a tuning range from VHF to microwave L band which covers the desired 1420 MHz frequency. The instantaneous bandwidth is 2 MHz which is sufficient to see the hydrogen line profile within the antenna beam width. The samples provided by the dongle can be converted to FFT plot on a computer. Using the described radio telescope we were able to detect the galactic hydrogen at various galactic longitudes. Multiple peaks were observed at some longitude and measurable red shifts were seen. Rotation curve of Milky Way was estimated. We plan to build multiple horn antennas for projects involving interferometry. Concepts of radio interferometry, closure phase and aparture synthesis can be explored with this setup. The estimated cost of the telescope is around 20 thousand rupees which is the cheapest telescope at L band. We plan on providing the design or low cost kits to institutes and interested individuals so that they can build and observe H1 line and get a hands-on experience in the methods and instruments involved in radio astronomy. ASI is the best platform for promoting this project as astronomers from around the country will be present.

IT-11	ASI2017_1400	Amaresh Mandal	Poster

Authors: Prasanna Deshmukh,Indian Institute of Astrophysics,Bangalore. Padmakar Parihar,Indian Institute of Astrophysics,Bangalore.

Title: A Programmable System on Chip (PSoC) based Controller for the PSMT Segment Support Actuators

Abstract: The primary mirror of any Segmented Mirror Telescope (SMT) is made of a large number of small mirror segments placed side by side to form the large monolithic surface. The most crucial task for any SMT is to maintain alignment of these mirror segments against external disturbances like wind, gravity, temperature and structural vibrations. This is achieved by using three position actuators per segment working at few-nanometer scale range. We have designed and developed a segment support actuator for the Prototype Segmented Mirror Telescope (PSMT) which is being developed at Indian Institute of Astrophysics, Bangalore. PSMT will have seven mirror segments and each segment will be supported and driven by three soft actuators. Every actuator has a dedicated local controller. The major challenges in designing actuator controller are: it should provide a few nanometer position accuracy in presence of all kind of disturbances, should facilitate servo update rate up to several KHz and should synchronously operate all 21 actuators commanded by the global controller through Ethernet or CAN network. These challenges are met by developing a mechanically robust actuator operated by a precision local controller. The electronics of local actuator controller has been developed around PSoC (Programmable System on Chip) hardware. PSoC 5LP chip is chosen because of its versatility, low cost, and ease of design. It supports the design of both analog and digital component on a single chip along with ARM Cortex M3 processor. PSoC gives design flexibility by offering Universal Digital Blocks (UDB) along with the built-in configurable ADC, DAC, filters and communication modules. The basic implementation of the local controller on PSoC has been completed and it has several modules such as Encoder interface, Position loop, Offloading loop, Signal filtering, Communication interfaces etc. In addition to the controller, separate customized driver boards which primarily provide needed power to several motors used in the actuator has also been designed and developed. The local control system of each actuator uses PID algorithm to maintain its position to the desired set point is provided by the global controller via CAN network. For the best performance, the PID gains are determined experimentally using relay tuning method. An extensive experimentation has been carried out to test the performance of actuator combined with the controller. In this paper, we present the design, implementation and some of the laboratory test results.

IT-12	ASI2017_1419	Kishore	Poster

Authors: Pritpal Sandhu, Indian Institute of Technology Indore

Title: Observations of neutral hydrogen line (HI 1420.40575 MHz) with an affordable radio receiver

Abstract: The neutral hydrogen line (1420.40575 MHz) is very abundant in our universe. The hyperfine emission of this radio line is due to the change in the energy state of neutral hydrogen. Harlod Ewen of Harvard University, under the guidance of Ed Purcell build a radio receiver which successfully detected this 21 cm line in 1951. With a motivation to replicate the same experiment with minimum expenditure, we designed a home brew radio receiver. Using this novel radio equipment: which consists of a horn aperture, inexpensive electronics, the 21 cm line can be easily detectable at the comfort of ones backyard. Here we presents the details of i) designing an inexpensive horn antenna, ii) details of the front-end & back-end receiver systems, iii) configuring the software pre-requesties to implement a radio receiver, iv) and finally the drift scan

observations of neutral hydrogen HI line (1420. 40575 MHz) in our Galactic Plane (RA: 17h 45m 10s, DEC: -29o S). This setup can be used to demonstrate, motivate and educate the young student/amateur communities. This equipment and the developed receiver has the potency to monitor and continuously observe the galactic/extragalactic radio sources such as Cygnus, Cassiopeia to name a few and HI regions in our Galactic plane respectively. We also cover the detailed analysis of observed data with the conclusions and possible plans for future improvements. References 1. Purcell, Edward Mills and Harold I. Ewen, Observations of a line in the galactic radio spectrum. Nature 168:356, 1951 2. http://www.nrao.edu/whatisra/hist_ewenpurcell.shtml

IT-13	ASI2017_1424	TARUN KUMAR SHARMA	Poster

Authors: P.S. PARIHAR P.M.M. KEMKAR RAVINDER KUMAR BANYAL INDIAN INSTITUTE OF ASTROPHYSICS, BANGALORE

Title: RESULTS FROM ONE YEAR OPERATION OF SCANNING CLOUD MONITOR AT IAO HANLE

Abstract: A CCD camera based all-sky monitor is an inexpensive tool, however, the appearance of clouds in the optical wavelength images is very deceptive due to its strong dependency on apparent sky brightness, which in turn depends on phases of the Moon, local light pollution, and other atmospheric variables. Automated software tools developed to derive a quantitative information of cloudiness from all-sky images usually fail to extract cloud information reliably, and results are often found to be inconsistent with other methods. Therefore, we have developed an instrument free from the above-mentioned shortcomings, which can provide very reliable cloud cover statistics. Our cloud monitor uses thermopile sensors which measure sky brightness temperature. Since there is a significant contrast between the temperature of clear sky and sky covered with cloud, therefore, we found this method to be more precise and reliable in detecting the cloud. The device uses an array of thermopile sensors mounted on a curved plate which is rotated in azimuth in steps. The device has gone through tedious laboratory as well as on-sky calibration, and tests and was found to meet the expected performance. Scanning cloud monitor was installed at IAO Hanle in December 2015. So far we have operated the instrument for one year and collected the cloud coverage data for more than 200 nights. In this paper, we briefly describe the operating principle, hardware and software design of the instrument. The results generated by the instrument are also presented.

IT-14	ASI2017_1426	Mahesh	Poster

Authors: Mahesh Punna1, S.Padmini1, Preetha Nair1, Shikha Srivastava1, Anushri Jain1, Behere Anita R1 R.C. Rannot2, A.K.Tickoo2, K.K.Yadav2, Nilay Bhat2, N. Chouhan2, P. Chandra2 1Electronics Division, BARC 2Astro Physical Sciences Division, BARC

Title: Automatic Generic Modern/Flat UI MACE Scheduler

Abstract: MACE Scheduler software streamlines observations of various high energy gamma-ray sources to generate observation schedule. The paper presents design of MACE Scheduler incorporating plug-in based framework to facilitate automated schedule preparation. The software also exploits advances in man-machine interfaces to provide better convenience and flexibility to the user. The software implements a filter work flow for gamma-ray sources reduction. The sources are prioritized by applying a set of customizable user defined filters like visibility filter, priority filter, priority resolution filter or any user defined criteria. This provides flexibility to apply user tailored filter criteria for reducing the source list. The scheduler automatically applies the filters over the selected date range and prepares auto-schedules based on the order of filtered sources.

Loosely coupled software design allows decoupling the astronomical timing calculation algorithms from schedule preparation workflow. Scheduler provides rich user interface by making use of WPF flat UI control templates focussing more on "Design for Content not Chrome" and user configurable filters based on XML schema.

IT-15	ASI2017_428	Prasanna Deshmukh	Poster

Authors: Padmakar Parihar, Indian Institute of Astrophysics,Bangalore. Deepta Sundar Mishra, Manipal Institute of Technology, Manipal, Karnataka. Vedashree, Christ University, Bangalore.

Title: Wind disturbance effect on PSMT Segment Support Actuator - Modeling and Control

Abstract: Upcoming Extremely large telescopes are based on segmented mirror technology. Small hexagonal segments placed side by side forms the large monolithic surface and need to be maintained against external disturbances like wind, gravity, temperature and structural vibration. This is achieved by using three position actuators per segment working at few-nanometer scale range along with a closed loop controller. Understanding the disturbances is essential for the design of different components of the SMT such as segment support actuators, segment support assembly, primary mirror control systems, etc. This paper explores the effect of wind disturbance on the position actuators of the Prototype Segmented Mirror Telescope (PSMT) under design at IIA Bangalore. The segment support actuators are primarily responsible for correcting the wind disturbances on PSMT. Initially for actuator modeling purpose, we used the first principle approach and represented it as a state space model. This enables us to develop a MIMO (multiple-input and multiple-output) model of the actuator, so as to include the wind disturbance force as one of the inputs along with the position/voltage command to the actuator. Further, in order to make the study more realistic, we obtained 1-year wind data collected at Indian Astronomical Observatory, Hanle. From this data, important wind parameters like mean speed and spectral characteristics are obtained and are used to fine-tune the analytical model of the wind flow. The drag coefficient (structure dependent parameter) due to wind flow over the telescope is estimated using wind tunnel simulation. The developed wind model is further utilized to generate time domain wind data with appropriate spectral representation at the desired height. This wind generator along with the PSMT actuator model is integrated using Matlab/Simulink to study the effect of wind disturbance on PSMT actuator. By undertaking such studies we get a step closure to predicting the worst-case wind scenario for future telescope design and simulation. In this paper, we present our simulation results and findings.

IT-16	ASI2017_533	Shrishail Raut	Poster

Authors: Pavan Kumar Gurrala, PDPU, Gandhinagar. S.Sriram, IIAP, Bangalore. P.K. Mahesh, IIAP, Bangalore

Title: Analysis of thin mirrors using integration of NX Nastran and MATLAB

Abstract: Stressed mirror polishing technique is used where we require aspherical mirrors, as they cannot be produced by traditional mirror polishing techniques. The aspherical mirrors can be used in any type of segmented mirror telescope which requires aspherical mirror system. The analysis of aspherical thin mirrors require minimum of two softwares, one has to be modeling and analysis software and other being mathematical software. The softwares we have selected are NX Nastran and MATLAB. We have to calculate a certain amount of pair of forces which has to be applied manually on the thin mirror before stressed mirror

polishing. After the forces are removed, we have to export the displacements of nodes of the surface to a program in MATLAB, which gives us the required coefficients which are to be used for further work. Application of force at the certain number of pairs ofpointson the mirror model in NX Nastran is very tediousand time consuming. Also the probability of occurrence of errors is high. For various optical terms, the values of forces to be applied will differ. Hence, to eliminate such impedances, we will attempt to automate maximum amount of steps. This includes the integration of NX Nastran and MATLAB. For better understanding, let's take an example;consider that there are 48 nodes where we need to apply 24 pair of forces respectively. For that, we can write a program in MATLAB to generate 24 pairs of forces as per the requirement of user. The NX Nastran will import this file generated by MATLAB and the 24 pairs of forces will be applied to the 48 nodes automatically. Again NX Nastran should export the surface profile to MATLAB automatically. For, few processes we can use Macros to reduce human effort. A detailed approach will be presented in the paper on how an attempt is made to integrate these two softwares. An attempt is made to reduce time for the whole process by 1/10th. This will allow us to do morework in less time with higher accuracy.

IT-17	ASI2017_554	Vineeth Valsan	Poster

Authors: S. Sriram; N. K. Mishra; A. Basheer; P. K. Mahesh; J. P. Lancelot; G. C Anupama. (Affiliation: IIA, Bangalore)

Title: Develpoment of 2D profilometer stitching algorithm

Abstract: A stiching algorithm is developed for the "D profilometer used for Stressed Mirror Polishing of TMT primary mirror segments. This profilometer consists of 61 probes which collects the surface profile data using contact method. A total of 183 data points are taken by clocking the profilometer thrice. This data is then stitched using the algorithm to reconstruct the profile which is then broken down to different Zernike terms. The algorithm is initially validated analytically as well as using finite element analysis. The actual measured data from a known surface is also used to verify the stitching accuracy of the algorithm. The output of this algorithm gives the Zernike coefficients of the surface.

IT-18	ASI2017_591	Raja Bayanna	Poster

Authors: Shibu K. Mathew, Rohan E Louis, R. Sridharan, Brajesh Kumar, B. Ramyareddy, P.Venkatakrishnan Udaipur Solar Observatory, Indian Institute of Astrophysics, Leibniz-Institut f\"ur Astrophysik Potsdam (AIP)

Title: A Low-order Adaptive Optics System for Multi-Application Solar Telescope

Abstract: Multi-Application Solar Telescope (MAST) is a 50 cm off-axis Gregorian telescope installed at the island site of Udaipur Solar Observatory (USO), India. Mean value of the Fried's parameter that characterises the atmospheric turbulence at this site is 4.5 cm. An Adaptive Optics (AO) system has been developed at USO for compensating image degradation, in order to achieve the telescope's diffraction limit. The main components of the system are (a) a stand-alone image stabilization system that compensates the global tilt of the distorted wavefront and (b) a Shack-Hartmann wavefront sensor along with a 37-Channel deformable mirror for sensing and correction of local tilts of the distorted wavefront. In this presentation, the AO system and the calibration of its various components will be described. We also present preliminary observations obtained with the MAST AO system.

IT-19	ASI2017_621	Eswar Reddy	Poster

Authors: Devika Divakar(IIA), Arun Surya(IIA), S. Sriram,(IIA) T. Sivarani (IIA),Renee Kupke(UCO), Maureen Savage(UCO), Kevin Bundy(UCO), Matt Radovan(UCO)

Title: TMT-WFOS optical design analysis and flexure compensation tool

Abstract: MT-WFOS optical design analysis and flexure compensation tool Devika Divakar, Arun Surya, S. Sriram, T. Sivarani, Renee Kupke, Maureen Savage, Kevin Bundy, Matt Radovan WFOS is one of the first-generation wide-field seeing-limited instrument for TMT. The spectrograph has two color channels simultaneously spanning 310- 550nm and 500-1100nm passbands. The instrument will be mounted at the TMT +X Nasmyth focus which is coaxial with the telescope elevation axis. The entire instrument needs to be rotated with respect to Nasmyth axis in order to correct for the field rotation during an observation. This can introduce a variable flexure during an exposure. Here, we present some of the ongoing work that was done as part of the TMT-India OMDR (Opto mechanical Design requirements) work package in collaboration with UCO (University of California Observatories, Santa cruz). The optimized optical design configuration that meets the ambitious science requirements will be presented along with various performance metrics of the design. We also present the flexible flexure compensation tool that will be used in the design of close and open loop flexure compensation design of the instrument.

IT-20	ASI2017_675	MRADUL SHARMA	Poster

Authors: Chinmay B. (APSD, BARC, Mumbai) N. G. Bhatt, (APSD, BARC, Mumbai) Subir B., (APSD, BARC, Mumbai) S. Bose, (ISI, Kolkata) R. Koul**, (APSD, BARC, Mumbai) A. K. Tickoo (APSD, BARC, Mumbai) R. C. Rannot (APSD, BARC, Mumbai) ** = Superannuated APSD, BARC= Astrophysical Sciences Division, Bhabha Atomic Research Centre ISI, Kolkata = Indian Statistical Institute

Title: Performance of the MACE gamma ray telescope in low zenith angle (5 - 25 degree) range

Abstract: The MACE (Major Atmospheric Cherenkov Experiment) is a 21 m diameter gamma-ray telescope which is at an advance stage of installation at Hanle in Ladakh, India (32^0 46^' 46^" N, 78^0 58^' 35^" E) at an altitude of 4270 m a.s.l. In this work, we present a detailed study to estimate the sensitivity of the MACE telescope by using a substantially large Monte Carlo simulation database (more than 1 billion extensive air showers) in the low zenith angle (5^0 - 25^0) range. The sensitivity is estimated by carrying out the gamma-hadron segregation using the Random Forest method. It is estimated that the MACE telescope will have an analysis energy threshold of 38 GeV for image intensities above 50 photoelectrons at 5^0 zenith angle. The integral sensitivity for point like sources with Crab Nebula-like spectrum above 38 GeV is ~2.7% of Crab Nebula flux at 5 sigma statistical significance level in 50 hrs of observation. The analysis energy threshold of MACE increases to ~44 GeV at 25^0 zenith angle and the integral sensitivity above 44 GeV is ~2.2% of Crab Nebula flux in 50 hrs of observation.

IT-21	ASI2017_797	Varun Bhalerao	Poster

Authors: A. R. Rao (TIFR) Dipankar Bhattacharya (IUCAA) Santosh Vadawale (PRL)

Title: Millisecond transients with AstroSat CZTI

Abstract: We report on the search for short duration transients with Cadmium Zinc Telluride Detector (CZTI) on AstroSat. CZTI is a high energy (20-200 keV) coded aperture mask instrument that serves as an excellent all-sky monitor at energies >60 keV. The availability of continuous time-tagged data with 20 microsecond accuray allows us to find transients at a wide range of timescales. A prime example is the regular detection of Gamma Ray Bursts, also presented at this conference. Here, we capitalize on the capabilities of CZTI to search the data for transients with millisecond to sub-secdond durations. We discuss the latest results and their astrophysical implications on rates for various sources, including proginetors of Fast Radio Bursts.

IT-22	ASI2017_801	ANNU JACOB	Poster

Authors: Annu Jacob (Indian Institute of Astrophysics, Koramangala, Bangalore-560034), Sindhu Divakaran(Manipal Institute of Technology, Manipal 576104), Padmakar Parihar(Indian Institute of Astrophysics, Koramangala, Bangalore-560034)

Title: Pyramid Sensor for Alignment and Phasing a Segmented Mirror Telescope

Abstract: For any segmented mirror telescope (SMT) , to achieve a seeing limited performance it is necessary that all mirror segments are aligned. However, for diffraction limited performance which gives highest spatial resolution as well as sensitivity, every mirror segment need to be phased. In an SMT, alignment and phasing is done with help of an active optical system which is basically some kind of wavefront sensor, having special ability to measure piston (phase discontinuty) error. One of such sensor which is being extensivly explored by various group around globe is Pyramid based Alignment and Phasing System (APS). Pyramid sensor appaers to be ideal for this purpose due to its many merits such as: it has a capability to measure piston error between two segments, measure miss-alignment of mirror segments, capable of measuring wavefront aberration caused by deformation of the mirror segment, avoid bad effects of charge diffusion in CCD detectors, ability to naturally filters out high spatial frequency information etc. Over more than an year in ITCC laboratory of of IIA, we have been exploring the possibility of using pyramid sensor for aligning and phasing proposed PSMT and NLOT telescopes. In this effort we could derive basic mathematical formulations required for the pyramid sensor as well as developed a tool using MATLAB® to simulate its operation. Pyramid sensor basically works like a modified Knife edge test. In which the PSF formed by any imaging device such as telescope is split into four parts by pyramid sensor and then subsequently made to form four pupil images using a collimating device. From these four pupil images, two images which is called signal maps are synthesized. Using these signal maps and the mathematical formula which also includes SVD based inversion matrix, we find the wavefront. The simulations have been carried out for both non-aberrated as well aberrated wavefronts and we found that in both cases we could fairly recover the injected wavefront. As a next step we designed the experimental optical setup using ZEMAX®. Finally a crude laboratory experimentation have been conducted to check over all functioning of a pyramid based wavefront sensor and its application on aligning and phasing a segmented mirror telescope. In this paper, we will present the basic theory behind pyramid sensor, some of the results of our MATLAB® simulations, optical design and preliminary experimental results.

IT-23	ASI2017_812	Saurabh Neema	Poster

Authors: S.K.Neema1, S.S.Sikder1, K.Jha1, Saju Joy1, A.Manna1, Anita B.1, J Hariharan2, Preetha M. Nair1, Shikha Srivastava1, Anushri Jain1, Padmini S.1

Title: Design and Development of Camera Electronics for MACE telescope

Abstract: The MACE (Major Atmospheric Cherenkov Experiment) telescope with a light collector diameter of 21 m, is being set up at Hanle (32.80 N, 78.90 E, 4200m asl) India, to exploring the gamma-ray sky at energies down to 20 GeV. The imaging camera of the telescope comprises 1088 pixels. The entire camera electronics is mounted on the camera with only the power and communication cables connected to ground station. Instrumentation consists of 68 Camera Integrated Modules (CIM) with 16 channels each and backend electronics consisting of Central Camera Controller (CCC), Data Concentrator (DC) and Second Level Trigger Generator (SLTG). The photomultiplier gains are matched by the programmable high voltage. Each PMT anode signal is coupled to a high bandwidth preamplifier, a dual gain amplifier, discriminator and a scalar. Individual CIM module has its signal processing electronics, first level trigger generation logic and signal digitization circuitry built into it. An analog switched capacitor array is used as a ring sampler operating at 1GSPS for continuous digitization of the photomultiplier signals. In order to ensure a wide dynamic range, each photomultiplier signal is simultaneously amplified by a low gain and a high gain amplifier. To reduce the volume of data, 1GSPS pulse profile information is stored only for those channels which have been triggered while the integrated charge content is stored for the all channels. The instrumentation has been custom designed with innovative techniques to achieve low power, small size, light weight and high performance in terms of low noise, high bandwidth and high event rates. A GPS synchronized master clock is used to generate globally synchronized time stamp for the acquired events. A two stage trigger system generates event trigger based on nearest neighbour close cluster configuration. The system health parameters such as High Voltage, Discrimination Threshold, Anode Current, Single Channel Rates, Chance Coincidence Rates, Power Supply status, Module Temperature etc are monitored at regular interval to ensure stable operating conditions. The anode current is limited in hardware as well as corrective action is taken within CIM to limit anode current to ensure safety of PMTs. The ground based control room, houses operator console and Data Archival system to provide interface to the camera and data saving respectively. The basic architecture and salient features of the camera instrumentation for the MACE telescope will be presented in this meeting.

IT-24	ASI2017_888	Ashish Mahabal	Poster

Authors:

Title: Art of Exploring and Exploiting Archives

Abstract: In the last few years astronomy has become much richer in terms of available datasets thanks to a large number of sky-surveys, and it is getting better by the day. While the teams executing the surveys do go after the obvious science, there is a lot more that is left undone for various reasons. If you can combine data from two or more surveys, even better. In general, you no longer need a large telescope to produce science that is new and of interest. If you do have access to a telescope and/or a private data-set to go with the public datasets, even better. We will describe various resources available for such explorations and exploitations (statistical, mathematical, computational), list a few large surveys (along with their properties) which have made their data available online, and mention a few ideas for such explorations.

IT-25	ASI2017_999	Vinita Navalkar	Poster

Authors: K. P. Singh, H. Shah, V. Mhatre, J. G. Koyande. Tata Institute of Fundamental Research

Title: DEVELOPMENT OF SPUTTERING SYSTEM FOR FABRICATION OF THIN FILM MULTILAYER OPTICS OF HARD X-RAY TELESCOPE.

Abstract: In the visible spectrum, most materials used for reflection have the refractive index greater than 1, while for x-rays this index is slightly less than 1, for all materials. The reflectivity for highly energetic X-ray photons is negligible at normal incidence. Therefore, the imaging optics in x-rays make use of total external reflection at grazing incidence angle. Furthermore, the critical angle for the total external reflection depends on the energy of the incident X-rays. This puts a practical limit on the design of x-ray reflective optics working at high energies (E >15 keV). Solution to this problem is the development of multilayer-coated mirror surfaces. Reflectance at angles greater than the critical grazing angle can be achieved by using depth-graded multilayer coatings on the mirror surfaces. Thin film multilayer coatings of materials having high and low atomic number Z are deposited on glass substrates. These multilayered mirrors satisfy the satisfy Bragg's equation $m\lambda=2d\sin\Theta$, thus increasing the reflectivity range and extending the imaging capabilities to a wide band of energies in the hard X-ray regime. Sputtering being an effective technique for deposition of thin films, RF Magnetron Sputtering System has been used to fabricate such multilayered mirrors. We present here the work done for developing such multilayered mirror systems and the characterizing the sputtering system using single layered structures.

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ASI-2017 Poster Presentations

General Relativity and Cosmology

GRC-1	ASI2017_1017	Pratik Tarafdar	Poster

Authors: 1. Deepika B. Ananda, Nicolaus Copernicus Astronomical Center, Polish Academy of Sciences, Warsaw, Poland. 2. Sankhashubhra Nag, Sarojini Naidu College for Women, Kolkata, India. 3. Tapas Kumar Das, Harish-Chandra Research Institute, Allahabad, India.

Title: Influence of disc geometry on shocked accretion

Abstract: This work presents a comprehensive and extensive study to illustrate how the geometrical configurations of low angular momentum, axially symmetric, general relativistic matter flow in Schwarzschild and Kerr metric may influence the formation of energy preserving shocks for polytropic accretion, as well as of temperature preserving dissipative shocks for the isothermal accretion, onto non-rotating and rotating astrophysical black holes. The dynamical and thermodynamic states of post-shock polytropic and isothermal flow have been studied extensively for three possible matter geometries, and it has been thoroughly discussed how such states depend on the flow structure, even when the self-gravity and the back-reaction on the metric are not taken into account. We have introduced an eigenvalue based analytical method to qualitatively understand how the phase orbits corresponding to transonic accretion solutions would look like, without incorporating any complicated numerical technique. We have also introduced the concept of quasi-terminal values to understand how the weakly rotating accretion flow behaves at the extreme close proximity of the event horizon and how such behaviours, for different matter geometries, are influenced by the black hole spin. Our main purpose is thus to mathematically demonstrate that for non-self gravitating accretion, various matter geometries, in addition to the corresponding space-time geometry, control the shock induced phenomena as observed within black hole accretion discs. This work is expected to reveal how the shock generated phenomena (emergence of the outflows/flare or the behaviour of QPO of the associated light curves) observed at the close proximity of the horizon depend on the physical environment of the source harbouring a supermassive black hole. It is also expected to unfold the correspondence between dependence of accretion related parameters on flow geometries and the black hole spin.

GRC-2	ASI2017_1042	MOHAMMAD SHAFI KHAN	Poster

Authors: Mohammad Shafi Khan and Manzoor Ahmad Malik 1Department of Physics, University of Kashmir,Srinagar-190006, J&K, India 2Visiting Associate, Inter-university Centre for Astronomy and Astrophysics, Pune 411007.

Title: Cosmological Evolution of the Universe from Big Bang to Structure Formation

Abstract: We study the phase transitions occurring in the gravitational clustering of galaxies on the basis of specific heat analysis and Yang-Lee theory. The investigations have been carried out in terms of time since big bang, re-placing the temperature in earlier work (paper I). It is found that a first order phase transition occurs when galaxies cluster gravitationally from an initial homogenous phase. We calculate its properties here and find that it differs from the usual laboratory phase transitions in so many ways. While the usual laboratory

phase transitions are sudden and decisive , the cosmological case is never complete since it takes longer to evolve dynamically on larger spatial scales. At a critical time tc, the system breaks the symmetry from homogeneity and there is growth of correlation functions from a linear to a non-linear regime. The application of Yang- Lee theory of phase transitions reassures the phase change significance. The results of Yang-Lee theory of phase transitions applied to the gravitational clustering of galaxies closely match with those from specific heat analysis.

GRC-3	ASI2017_1152	Arka Chatterjee	Poster

Authors: Arka Chatterjee (1), Sandip K. Chakrabarti (2,1), Himadri Ghosh (3) Affiliation: 1. Indian Centre for Space Physics 2. S. N. Bose National Centre for Basic Sciences 3. Heritage Institute of Technology

Title: Image and Time Lag properties of Photons emitted from a Two Component Advective Flow as obtained from the Monte-Carlo Simulations

Abstract: Two Component Advective Flow (TCAF) contains thermal radiation dominated Keplerian disk and Comptonization dominated CENtrifugal pressure supported BOundary Layer (CENBOL) produced by an advective halo through shock transition. We model the CENBOL as a thick disk having natural angular distribution around a black hole. CENBOL acts as the electron cloud. Gravitational bending of photons is implemented. Time evolution of photons have been calculated separately for Comptonization, disk reflection and gravitational bending. Images of TCAF is presented for various inclination angles. Cumulative time lag effects have been plotted against the inclination angle. Parameters, like, CENBOL size, accretion rate are varied. From these simulations we obtain an idea of how the time lag properties should behave as a function of energy, inclination angle, and the flow parameters.

GRC-4	ASI2017_1191	Sujata Mohanty	Poster

Authors: Dr. Ramesh Mohan Thamankar CMR University Dr. Rajesh Gopal CMRIT Bangalore

Title: Study of linear and non-linear cosmological bias of galaxies: Theory vs observations

Abstract: In this universe 90% of the matter is dark matter which is not visible and 10% ofthe matter is baryonic matter which is visible . Baryonic matter includes all the galaxies that we we see today. But the evolution of large scale structure includes the underlying dark matter . Dark matter is only affected by gravitational field whereas the baryonic matter is affected by gravitational field, as well as radiation pressure , magnetic field etc. This difference leads to the study of bias factor called as cosmological bias. The field of research is open for the study of cosmological properties which is possible by the study of cosmological bias. It is the ratio of baryonic matter density to the dark matter density. The study of cosmological bias really an interesting topic to unfold many more mystery about the evolution of large scale structures. Cosmological bias provides a wide scope to learn the properties of underlying dark matter. So cosmological bias is a significant topic for study and research. In this paper i have formulated equations containing bias coefficients and calculated the same in quasi-linear regime when there is a transition of structure formation from linear to non-linear region. The same problem is also treated in the presence of magnetic field to get bias coefficients. That means the magnetic field can be one of the bias tracer element.

GRC-5	ASI2017_1209	SAFIQUL ISLAM	Poster

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Title: Wormholes supported by two non-interacting fluids

Abstract: Title:Wormholes supported by two non-interacting fluids: In this paper, we have extended the cut-and-paste technique to two copies of a charged black hole.This has been done in generalized dilaton-axion gravity which was inspired by low energy string theory.This was done following the work of Visser (1989) who proposed a theoretical method for constructing a new class of traversable Lorentzian wormholes from black-hole spacetimes by surgical grafting of two Schwarzschild spacetimes. The main benefit in Visser's approach is that it minimizes the amount of exotic matter required. Here a new matter source that supplies fuel to construct wormhole spacetime has been provided. The exact wormhole solutions are found in the model having, besides real matter, an anisotropic dark energy. The novel point here seems to be the interpretation in terms of two fluids, which is more or less arbitrary. It has been shown that the exotic matters that are the necessary ingredients for wormhole physics violate null and weak energy conditions (NEC and WEC) but obey strong energy condition (SEC) marginally. The effective mass of the wormhole up to 4 km throat radius has been calculated as 0.561 times 1 Solar Mass (1 Solar Mass =1.475 km) . Though the wormhole comprises of exotic matters yet the effective mass remains positive. This implies that for an observer sitting at large distance could not distinguish the gravitational nature between wormhole and a compact mass M. The total gravitational energy of the wormhole is found as, Eg= 1.9397 (geometric unit of length). Since, Eg > 0, there is a repulsion around the throat which is very much expected for valid construction of a wormhole. Some physical features like visual structure, proper radial distance, energy conditions, equilibrium conditions are discussed. The equilibrium stage can be achieved due to the combined effect of pressure anisotropic, gravitational and hydrostatic forces, i.e F(g)+F(h)+F(a)=0. The three different forces acting on fluid elements in static equilibrium are plotted against the radial distance, r. The flare-out conditions have been studied and the effective gravitational mass, total gravitational energy and traversability conditions are also briefly discussed. Graphs of energy conditions and proper radial distance, l(r),are also plotted. To travel through a wormhole, the tidal gravitational forces experienced by a traveler must be reasonably small. In our model the above condition is automatically satisfied, the traveler feels a zero gravitational acceleration since $\nu = 0$.The wormhole model provided here with anisotropic dark energy and real matter is fascinating in several aspects and hence very promising one. [Published in Astrophysics and Space Science, 346, 245-252,(2013)]

GRC-6	ASI2017_1242	Arun Kenath	Poster

Authors: S B Gudennavar (Department of Physics, Christ University, Bengaluru-560029, Karnataka, India) C Sivaram (Indian Institute of Astrophysics, Bengaluru-560 034, Karnataka, India)

Title: Alternate Models to Dark Matter and Dark Energy

Abstract: The nature of dark matter and dark energy which is supposed to constitute about ninety five percent of the energy density of the universe is still a mystery. There is no shortage of ideas regarding the nature of both. And there are several experiments that are currently ongoing to detect the postulated dark matter particles. Some of these experiments have been running for many a year and has yielded no positive results so far. Only lower and lower limits for their masses are set with these experiments. But if future experiments still

do not give any clue about the existence of dark matter, one may have to consider looking for alternate theories. Keeping in mind the negative results in some of the ongoing detection experiments, here we propose the possible alternatives to both dark matter and dark energy. The alternate models include Modification of Newtonian Dynamics (MOND) and Modification of Newtonian Gravity (which has supposedly proved more successful than dark matter model, in explaining flat rotation curves of galaxies, but does not work for large galaxy clusters, where some dark matter is required anyway), Tensor–Vector–Scalar Theory (which was developed as a relativistic generalisation of MOND, and is derived from the action principle. In the weak-field approximation, static solution, this theory gives the MOND acceleration formula. This theory can account for the gravitational lensing, since it is a relativistic theory), and Modification of Einstein-Hilbert Action. The two poplar theoretical concepts to resolve the apparent inconsistency of Newtonian dynamics over galactic scales and beyond is assumption of ubiquitous presence of dark matter and secondly the assumption that Newtonian gravitational law or dynamics requires modification. Here we also look at the possibility of differentiating MOND from Newtonian dark matter theory. Theoretical problems with scenarios like fine tuning, presence of a lambda term with just the required value at present epoch etc. have also led to suggestions that general relativity be modified in such a way that leads to observed accelerated expansion. We also look at the possibility of observationally distinguishing the two alternative scenarios.

GRC-7	ASI2017_1258	Md Arif Shaikh	Poster

Authors: Satadal Datta, Tapas K. Das, Harish-Chandra Research Institute and Ivleena Firdousi, Savitribai Phule Pune University.

Title: Emergence of relativistic sonic geometry through perturbation of matter in black hole metric

Abstract: Using the linear perturbation scheme we show that the linear perturbation of not only velocity potential but also that of the mass accretion rate and the relativistic Bernoulli's constant for general relativistic accretion governed by different thermodynamic equation of state lead to the emergence of embedded curved sonic manifold. We work in both Schwarzschild metric (where we considered both the spherical flow and axisymmetric flow) as well as Kerr metric (where the flow is axisymmetric) to demonstrate the same. Except the conformal factors, the relativistic acoustic geometry remains same irrespective of the physical quantity getting perturbed. The acoustic Reimann curvature is computed obtaining the expression of the line element from the metric element. The acoustic surface gravity which is a measure of the analogue Hawking Temperature has been computed in terms of the accretion variables corresponding to the stationary integrals solutions.

GRC-8	ASI2017_1323	Ashish	Poster

Authors: Dr. Subhendra Mohanty, PRL Ahmedabad.

Title: SZ Effect in Galaxy Clusters as Probe of Dark Matter

Abstract: The abundance and structure of galaxy clusters are powerful probes of cosmology. One of the ways to study galaxy clusters is through Sunyaev-Zel'Dovich (SZ) effect which is the spectral distortion of cosmic microwave background (CMB) caused by the inverse compton scattering of the CMB photons by the high energy electrons present in the Intra-Cluster Medium (ICM). In this on-going work we describe a method to study the effect of the presence of dark matter on the cluster parameters such as temperature, cluster peculiar

velocity and cluster mass using the SZ effect combined with X-ray estimates. We also show that due to its red-shift independence, the SZ effect can be used to discover galaxy clusters. The above effect occurs in the sub-mm range of the electromagnetic spectrum and can be observed using presently available telescopes as ACT(Chile), SPT and Planck spacecraft and also using the future experiments like OLIMPO and proposed Indian Sub-mm telescope.

GRC-9	ASI2017_1343	Joseph P J	Poster

Authors: Jose Mathew, IISER Thiruvananthapuram S. Shankaranarayanan, IISER Thiruvananthapuram

Title: Inflation driven by exponential non-minimal coupling of inflaton with gravity.

Abstract: We consider a modified gravity model of the form f(R,\phi)=Re^{h(\phi)R}, where \phi is a non-interacting massive scalar field. This model leads to an exact solution, which leads to inflation with exit. We show that the exit depends on the initial velocity of the scalar field and hence leads to a viable inflationary model. We proceed to compare the power spectrum of this model with observational data to constrain the parameter space.

GRC-10	ASI2017_1348	Soumen Mondal	Poster

Authors: Prasad Basu, Cotton College State University, Guwahati, Assam. and Sandip K. Chakrabarti, S. N. Bose National Centre For Basic sciences, Kolkata.

Title: Gravitational wave emission during the coalescence of the black holes in a binary system in the presence of an accretion disc.

Abstract: Gravitational wave signal characteristics from a binary black hole system in which the companion moves through the accretion disc of the primary are studied. We chose the primary to be a super-massive (M=10^8MSun)Kerr black hole and the companion to be a massive black hole(M=10^5 MSun)to clearly demonstrate the effects. We show that the drag exerted on the companion by the disc is sufficient to reduce the coalescence time of the binary. The drag is rimarily due to the fact that the accretion disc on a black hole deviates from a Keplerian disc and becomes sub-Keplerian due to inner boundary condition on the black hole horizon. Here, we considered two types of accretion rates on to the companion- (i) Bondi accretion and (ii) Eddington accretion,when the companion is deeply immersed inside the disc. These two cases are studied and the results are compared. We arrived at a few important conclusions: (a) the coalescence takes lesser time if the central black hole is Kerr type than a Schwarzschild type. (b)When the accretion rate on to the companion is high, the effect of the drag is also high.As a consequence, the gravitational wave emission profile is modified. Our results clearly indicated that the interpretation of the data from the future gravitational wave detectors should be done more carefully.

GRC-11	ASI2017_1386	Priti Mishra	Poster

Authors: 1. Mandar Patil, Institute of Mathematics of Polish Academy of Sciences, Warsaw, Poland 2. D. Narasimha, Tata Institute of Fundamental Research, Mumbai, India

Title: Curious case of gravitational lensing by binary black holes: a tale of two photon spheres, new relativistic images and caustics

Abstract: Binary black holes have been in limelight off late due to the detection of gravitational waves from coalescing compact binaries in the events GW150914 and GW151226. In this paper we study gravitational lensing by the binary black holes modeled as an 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 in the literature. We restrict our attention to the light rays which move on the plane midway between the two identical black holes, which allows us to employ various techniques developed for the equatorial lensing in the spherically symmetric spacetimes. If distance between the two black holes is below a certain threshold value, then the system admits two photon spheres. As in the case of single black hole, infinitely many relativistic images are formed due to the light rays which turn back from the region outside the outer (unstable) photon sphere, all of which lie beyond a critical angular radius with respect to the lens. However, in the presence of the inner (stable) photon sphere, the effective potential now turns up- wards again and the light rays that enter the outer photon sphere can turn back, leading to the formation of a new set of infinitely many relativistic images, all of which lie below the critical radius from the lens mentioned above. As the distance between the two black hole is increased, two photon spheres approach one another, merge and eventually disappear. In the absence of the photon sphere, apart from the formation of a finite number of discrete relativistic images, the system remarkably admits a radial caustic, which has never been observed in the context of relativistic lensing before. Thus the system of binary black hole admits novel features both in the presence and absence of photon spheres. We discuss possible observational signatures and implications of the binary black hole lensing.

GRC-12	ASI2017_1390	Muhammed saleem	Poster

Authors: ABHIRUP GHOSH P Ajith ICTS Banglore Archana Pai IISER Trivandrum

Title: Prospects of LIGO-India in probing mass and spin parameters of compact binaries

Abstract: Observation of gravitational waves from colliding black holes by two LIGO detectors at Hanford and Livingston in United states has opened a new window to the universe. A global network of interferometers with the European detector Virgo, the Japanese detector KAGRA is likely to be operational in coming years. The fifth detector LIGO-India has got the formal approval and is expected to join the hunt for gravitational waves in next decade. Coalescences of compact object like neutron stars and/or black holes are the primary targets of this global network. In this work, we investigate the improvement in the estimation of the properties of a compact binary coalescence with inclusion of LIGO-India in the global network of detectors. We have chosen representative double neutron star, neutron star - black hole and binary black holes systems for this study.

GRC-13	ASI2017_1417	Ratna Koley	Poster

Authors: Sidhartha Samtani

Title: Magnetogenesis in Bouncing Cosmology

Abstract: Magnetic fields are ubiquitous in the universe. Starting from planets and stars, large scale magnetic fields have been detected in galaxies and galaxy clusters. Recent observational evidence suggests that even the intergalactic medium in voids could host a weak magnetic field. An intriguing possibility is that cosmic magnetic fields are a relic from the early universe. In this work we have explored the possibility to have the seed magnetic field in matter bounce cosmology followed by an Ekpyrotic phase. The model chosen here, passes through the observational constraints set by Planck 2015 data. It has been shown that in the allowed range of parameter space, one can achieve the desired amount of primordial magnetic field sufficient for seeding presently observed fields without invoking any back reaction problem.

GRC-14	ASI2017_1425	Kazuyuki Furuuchi	Poster

Authors: Nil

Title: Excursions through KK modes

Abstract: We study Kaluza-Klein (KK) dimensional reduction of massive Abelian gauge theories with charged matter fields on a circle. Since local gauge transformations change position dependence of the charged fields, the decomposition of the charged matter fields into KK modes is gauge dependent. While whole KK mass spectrum is independent of the gauge choice, the mode number depends on the gauge. The masses of the KK modes also depend on the field value of the zero-mode of the extra dimensional component of the gauge field. In particular, one of the KK modes in the KK tower of each massless 5D charged field becomes massless at particular values of the extra-dimensional component of the gauge field. When the extra-dimensional component of the gauge field is identified with the inflaton, this structure leads to recursive cosmological particle productions.

GRC-15	ASI2017_1430	Abdulla Al Mamon	Poster

Authors: Sudipta Das, Department of Physics, Visva-Bharati, India

Title: Study of parametrized dark energy models with a non-canonical scalar field

Abstract: In this work, we try to build up a cosmological model using a non-canonical scalar field within the framework of a spatially flat FRW space–time. In this context, we have considered four different parametrizations of the equation of state parameter of the non-canonical scalar field. Under this scenario, analytical solutions for various cosmological parameters have been found out. We have found that the deceleration parameter shows a smooth transition from a positive value to some negative value which indicates that the universe was undergoing an early deceleration followed by late time acceleration which is essential for the structure formation of the universe. With these four parametrizations, the future evolution of the models are

also discussed. We have found that one of the models (Generalized Chaplygin gas model) mimics the standard Lambda CDM in the near future, whereas two other models (CPL and JBP) diverge due to future singularity. Finally, we have studied these theoretical models with the latest datasets from SNIa + H (z) + BAO/CMB.

GRC-16	ASI2017_453	Chaitanya Afle	Poster

Authors: Anuradha Gupta (IUCAA), Bhooshan Gadre (IUCAA), Prayush Kumar (CITA, Toronto), Han Gil (Seoul National University, Korea), Sanjit Mitra (IUCAA)

Title: Detection and characterization of spin-orbit resonances in the advanced gravitational wave detectors era

Abstract: The spin-orbit resonances have important astrophysical implications as the evolution and subsequent coalescence of supermassive black hole binaries in this configuration leads to low recoil velocity of merger remnants. Also, it has been shown that the black hole spins in comparable mass stellar mass black hole binaries would preferentially lie in a resonant plane when their gravitational waves (GWs) enter the advanced LIGO frequency band. Therefore, it is highly desirable to investigate the possibility of detection and subsequent characterization of such GW sources in advanced detector era which can, in turn, improve our perception of their high mass counterparts. The current detection pipelines involve only non-precessing template banks (namely, IMRPhenomD and SEOBNRv2) for compact binary searches whereas parameter estimation pipelines can afford to use computationally cheaper though approximate precessing templates (e.g., IMRPhenomPv2). In this paper, we test the performance of these templates in detection and characterization of spin-orbit resonant binaries. We use fully precessing time-domain SEOBNRv3 waveforms as well as four numerical relativity (NR) waveforms to model GWs from spin-orbit resonant binaries. We find that all these approximants are performing well in recovering resonant signals (recovering ∼ 95% injections with fitting factor (FF) higher that 0.97) with IMRPhenomPv2 performing marginally better than IMRPhenomD and SEOBNRv2. Interestingly, injections with $\Delta\varphi = 180^\circ$ have higher FF as compared to their $\Delta\varphi = 0^\circ$ and generic counterparts ($\Delta\varphi$ is the angle between the components of the black hole spins in the plane orthogonal to the orbital angular momentum). This is because most of the low FFs are for binaries with high precession and negative aligned spins. Moreover, all template approximants are able to recover the NR waveforms mainly with FFs > 0.98. For all the injections including NR, the error in estimating chirp mass is < 10% with minimum error for $\Delta\Phi = 180^\circ$ resonant binaries. The symmetric mass ratio can be estimated with errors up to 10%. The aligned spin parameters have absolute error in the range [-0.1, 0.1] while the in-plane spins can be estimated with absolute error as large as -0.6.

GRC-17	ASI2017_471	Gajanan Dnyaneshwar Harale	Poster

Authors: Surajit Paul Inspire Faculty Dept Of Physics SP Pune University Reju Sam John Ph.D. student Ponducherry University

Title: Study of Particle Acceleration Mechanism during the formation of shocks in galaxy clusters formation

Abstract: Very high energy radiations that has been observed on the earth as particles showers, mainly consist of accelerated charged particles like electrons, protons and charged nuclei and non charged particles like Gamma rays, neutrinos etc. Though galactic origin of these radiations are very well studied, many of the extragalactic origin has not been explored or remained un-explained. In this context, the biggest puzzle is the observed Gamma ray and neutrino background and their acceleration mechanism. Also, we have not yet detected Gamma rays from Galaxy clusters, the most energetic object known to us. Possibly, large scale

structures emitting Gamma rays that creates this back ground, but at a particular state of its activity like mergers.During merging process the possible mechanism that can accelerate particles in Large Scale Structures and contribute to enhance the extragalactic Gamma Rays and neutrino population. We thus investigate the role of particle acceleration in the production of cosmic ray particles like gamma ray and neutrino in the structure formation shocks during formation of galaxy clusters as the mechanism for accelerating particles to such an ultra high energy. We have studied this problem with both analytical and numerical methods. So, in this work, we will try to see how we can guide the observations by predicting correct objects by using our theoretical models of particle acceleration.

GRC-18	ASI2017_503	Subhajit Saha	Poster

Authors: Subenoy Chakraborty, Jadavpur University Supriya Pan, IISER Kolkata

Title: An attempt to explain recent observations with adiabatic particle creation mechanism

Abstract: In this talk, we discuss a third alternative to explain the latest observational data concerning the accelerating Universe and its different stages. The particle creation mechanism in the framework of non-equilibrium thermodynamics is considered as a basic cosmic mechanism acting on the flat FRW geometry. By assuming that the gravitationally induced particle production occurs under "adiabatic" conditions, the deceleration parameter is expressed in terms of the particle creation rate which is chosen as a truncated power series of the Hubble parameter. The model shows the evolution of the Universe starting from inflation to the present late time acceleration and it also predicts future decelerating stage.

GRC-19	ASI2017_590	BIDISHA BANDYOPADHYAY	Poster

Authors: T. Roy Choudhury,National Centre for Radio Astrophysics, Tata Institute of Fundamental Research, Ganeshkhind, Pune 411007, India T. R. Seshadri,Department of Physics and Astrophysics, University of Delhi, Delhi-110007, India

Title: INVESTIGATING NEUTRAL HYDROGEN STRUCTURES DURING THE EPOCH OF REIONIZATION USING FRACTAL DIMENSION

Abstract: The clustering and lacunarities in density distributions can be chracterized using fractal dimensions. The generalized fractal dimensions is used to study the neutral hydrogen distribution (HI) during the epoch of reionization. The analysis is done on a simulated data of HI field which is created using a semi-numeric model of the ionized bubbles. We calculate the fractal dimensions for length scales ~ 10h ^{-1} cMpc. We find that the HI field displays significant multifractal behaviour and is not consistent with homogeneity at these scales when the mass averaged fraction of neutral hydrogen <=0.5. This multifractal nature is completely driven by the shapes and distribution of the ionized regions. The fact that the fractal dimension is sensitive to the neutral fraction implies that it can be used for constraining the reionization history. We also observe that the fractal dimension is relatively less sensitive to the value of the minimum mass of ionizing halos when it is in the range ~ 10^9 − 10^10 h^{−1} Solar Mass . Interestingly, the fractal dimension is very different when the reionization proceeds inside-out compared to when it is outside-in. Thus the multifractal nature of HI density field at high redshifts can be used to study the nature of reionization.

GRC-20	ASI2017_594	Shishir Sankhyayan	Poster

Authors: Joydeep Bagchi (IUCAA, Pune)

Title: Large Scale Structures and Clusters-Voids Cross-correlation

Abstract: We report a high concentration of 43 clusters (mass >= 10^14 M_sun each) at z ~ 0.28. We call this concentration - "Saraswati Supercluster". The comoving extent of these 43 clusters is ~ 190 Mpc. It seems, though work is still in progress, that this high concentration of clusters is unusual in LCDM model. It is observed that high concentration of clusters are surrounded by voids. Voids surround the Saraswati Supercluster as well. The dark energy density in voids is higher than the average dark energy density of the Universe. This means that void regions must expand at higher rate than the mean expansion rate and this might be helping the clustering of dark matter on the edges of voids. In order to understand the role of dark energy helping in structure formation (atleast on the edges of the voids), we calculate the clusters-voids cross-correlation and see how this changes for very high concentration of clusters, like Sararwati.

GRC-21	ASI2017_641	Ajit kumar Mehta	Poster

Authors: Ajit Kumar Mehta, Chandra Kant Mishra, Parameswaran Ajith

Title: Inspiral-merger-ringdown gravitational waveforms for binary black holes including the effect of nonquadrupole modes

Abstract: The detection and parameter estimation of gravitational waves (GWs) from binary black holes require accurate theoretical templates of the expected signals modeling the inspiral, merger and ringdown (IMR). To construct analytical templates of IMR waveforms, hybrid waveforms are constructed by matching numerical relativity simulations describing the merger and ringdown with post-Newtonian waveforms describing the early inspiral. Neglecting the subdominant modes of the radiation (beyond the leading quadrupole modes) can lead to appreciable loss of signal to noise ratio and systematic errors in the parameters. In this work we present an analytical model of IMR waveforms for non-spinning binary black holes that include the effect of nonquadrupole modes.

GRC-22	ASI2017_650	Sk Javed Rana	Poster

Authors: Sukanta Bose, IUCAA, Pune. Varun Bhalerao, IUCAA, Pune.

Title: Searching electromagnetic counterparts for gravitational wave sources

Abstract: Within the next decade, a global network of advanced gravitational wave detectors including LIGO-India are expected to detect various gravitational wave sources. These detectors can yield certain parameters of the gravitational wave source, but complementary studies in electromagnetic wavelengths are crucial for a complete astrophysical understanding. In our work, we proposed electromagnetic counterparts of these sources, and the extremely challenging problem of detecting them. We highlight why India forms a key node in this global effort, and discuss prospects of optical, IR, radio and X-ray follow-up from India. The focus of the work is ongoing efforts in India for detecting these counterparts and the open challenges in this work.

GRC-23	ASI2017_725	Akshay Rana	Poster

Authors: Akshay Rana (JRF), Dr. Deepak Jain, Prof. Shobhit Mahajan, Prof. Amitabha Mukherjee.

Title: Constrain on cosmic curvature by using statistical properties of gravitational lenses

Abstract: We use a model-independent method to constrain the curvature of the Universe. It pro- vides us an indirect method to test the curvature based on the mean image separation statistics of gravitationally lensed quasars. The basis of this methodo is that the mean image separation of gravitationally lensed quasars is completely independent of the source redshift for the all FLRW based cosmological models in a flat Universe, if the lensing galaxy is non-evolving and modeled as a Singular Isothermal Sphere (SIS). We use the final statistical sample of lensed quasars from the Sloan Digital Sky Survey (SDSS) Quasar Lens Search (SQLS) for this purpose. Further, In order to smoothen the datasets, we use a non-parametric method namely, Gaussian process (GP). Finally, we find that this method supports the spatially flat Universe within 3σ level.

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ASI-2017 Abstracts

Other

Ot-1	ASI2017_1148	Gourav Banerjee	Poster

Authors: Pratap Pal; Co-Founder, Kolkata Institute of Fundamental Science & Astronomy

Title: Developing Year-long Astronomy Activity Sessions for School Students to Promote Astronomy Education

Abstract: A new initiative to promote basic sciences (Physics, Chemistry, Mathematics and Biology) and astronomy among school students has been started recently by the Kolkata Institute of Fundamental Science and Astronomy (KIFSA). Presently the initiative is running on an experimental basis to judge the response of students, their parents and the teachers. Presently astronomy oriented workshops or camps are organized by few government or non-government organizations, amateur associations and NGOs mostly during some specific periods of the year, like the winter or summer. But rarely one can find such activities going on throughout the year. Keeping this in mind, KIFSA has started offering a unique 'Astronomy Activity' course to schools which will run throughout the year. Now they are offering this course in association with the science and astronomy clubs of few reputed private schools of Kolkata. KIFSA conducts their courses in each fortnight of every month through classes of two hours duration. The course curriculum, developed with utmost care, focuses on imparting the flavor of astronomy rather than teaching the subject in great details. The objective of designing such course is to be the engine of motivation for young minds who desire to pursue astronomy as a career. Such initiative has created much sensation in few reputed private institutions in and outside Kolkata during recent times.

Ot-2	ASI2017_1206	Ashmita Tribedi	Poster

Authors: Gourav Banerjee; Co-Founder, Kolkata Institute of Fundamental Science & Astronomy

Title: Importance of Including Astronomy in School Curriculam of India

Abstract: Astronomy has always had a great appeal among the general public historically. High school students are also among the same group.India having become a leading country in space research during recent times has created an even more appeal in present days. Leading astronomical observatories and premiere space agencies like NASA, ESA have impressive Public Outreach Programmes. India also has many truly world class observatories providing high class infrastructure for pursuing research in astronomy. But here astronomy is hardly offered by any university as a subject in the undergraduate level. It is also rarely added in few school curriculum of the nation. This lack of familiarity with astronomy acts as a vital factor for students loosing interest in the subject and opt some other field as a career. As a result, very few students opt for a career in astronomy. This work is a part of a survey project (which has been initiated recently) carried out in few schools in Kolkata to judge the interest level of secondary students in astronomy. A majority of students of Classes 8-

10 have showed their interest in learning astronomy as a course subject. The survey has also found out that many good students are having an interest to pursue astronomy as a career in future. The results of the survey have been plotted in graphs to receive an overall scenario. Positive response from a plenty of students have given us the courage to propose a suggestion of including astronomy as a part of the school curriculum in India. Data of the survey will support our proposal. The survey work will be carried out further in much broader and descriptive manner, yielding much more fruitful results in future, we believe.

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