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Abstracts

Abstracts of Talks

(A) Sun and solar system

Lunar-solar wind interaction: A new view from the SARA/ Chandrayaan-1

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Abstract. The Sub-keV Atom Reflecting Analyzer (SARA) experiment aboard the first Indian lunar mission Chandrayaan-1 consisted of two sensors mounted at 90 degree to each other on the top deck. While the Chandrayaan Energetic Neutrals Analyzer (CENA) measured energetic neutral atoms (ENAs) in the 0.1-3 keV energy range, the Solar WInd Monitor (SWIM) measured ions in the same energy range in the lunar environment. SARA observations have revealed several new and interesting aspects about the solar wind interaction with the Moon, which include: (1) substantial (∼20%) and sustained backscattering of solar wind protons incident on the lunar surface as neutral hydrogen atoms (hydrogen ENAs); (2) discovery of mini-magnetosphere on Moon using backscattered hydrogen ENAs; (3) preferential backscattering of solar wind ENAs in the sunward direction; (4) finding that the Maxwell-Boltzmann distribution fits the backscattered ENAs, thus deriving the characteristic temperature for ENAs of 60-140 eV; (5) a linear correlation between solar wind bulk velocity and the temperature of backscattered ENAs; (6) huge (∼50%) deflection of solar wind protons around strong magnetic anomalies; (7) accelerated pick-up ions in lunar environment; (8) small (∼1%) scattering of solar wind protons from lunar surface; and (9) ions in the near-lunar plasma wake (night side). These results have questioned our earlier understanding that the solar wind is completely absorbed on the lunar surface, and imply that the physics of plasma-regolith interaction is complex and needs to be tacit. They also suggest a clear linkage between magnetic anomaly and space weathering processes on the Moon. The SARA results have implications for OH-H_2O production on the Moon, the lunar plasma environment, implantation of solar wind hydrogen on lunar surface, and behaviour of small scale magnetic anomalies on planetary bodies. The SARA observations suggest that similar processes would be happening on other atmosphere-less bodies covered with regolith in the solar system as well as in extra-solar system.

Oscillations in coronal structures

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Abstract. Coronal loop structures, both open and closed, are known to support several magneto-hydrodynamic (MHD) modes. MHD oscillations are one of the important candidates that channel energy into the solar corona. Their contribution to coronal heating and/or solar-wind acceleration depends however on the nature of the oscillation and its damping mechanism. Different coronal structures supporting these oscillations were studied using imaging data from SDO/AIA in two EUV channels. In the open structures, these oscillations were found to be damped after travelling certain distance along the loop. Constructing power maps in different frequency bands, it was identified that the damping lengths are frequency dependent. Shorter periods are found to damp at comparatively shorter length scales. In an attempt to understand the nature of these oscillations and hence their significance in the coronal heating, Doppler shift information from co-temporal data obtained with coronal multi-channel polarimeter (CoMP) is also used.

The buildup to the deep solar minimum of cycle 23: Quasi-periodic changes of the solar photospheric fields

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Abstract. We have witnessed a belated cycle 24, after a long and unusual solar minimum, characterized by almost complete absence of sunspots and very weak polar fields, at the end of cycle 23. Employing a special harmonic analysis along with a wavelet method, the periodicities in the solar photospheric fields are deduced using NSO/Kitt peak ground-based synoptic magnetograms spanning over solar cycles 21, 22 and 23. We find a clear north-south asymmetry in the Fourier power distribution in the quasi-periodic changes when the data are grouped into fields prior to and after 1996. In this presentation, I will discuss that this north-south asymmetry, when coupled with both the declined solar magnetic fields and the turbulence levels in the inner heliosphere that began around the mid-nineties (~1995–1996), initiated the build-up to this deep solar minimum.

Is there heat flow outwards from the core region of the Moon?: Proposed observations of radio emission from the Moon using ground based radio telescopes and comparison with Apollo mission and radar observations

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Abstract. I will firstly summarize results from the Apollo Mission that indicated heat flow from the inner regions of the Moon but are controversial. Our objective is to map the Moon at relatively long radio wavelengths using the GMRT, but also to be able to calibrate the observed radio emission with the required accuracy of ∼ 1K as a function of wavelength of observations to test whether there is heat flow from the inner core of the Moon towards the outer surface by a liquid core and or radioactive elements. We may also use the GBT at NRAO and Arecibo telescope for finding mean temperature at various depths of the Moon's surface. The passive radio observations with the GMRT providing several km resolutions on the Moon would be compared with the radar reflection observations made at Arecibo and recent Chinese observations at cm wavelengths using a radio telescope orbiting the Moon. Objective would be to determine variation of dielectric constant and loss tangent of regolith across the Moon.

Jet associated with an impulsive flare on 23 October, 2003

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Abstract. Here, we present and discuss the jet activity from NOAA AR 10484 and associated flare on 23 October, 2003. The observations were taken from ARIES, Nainital, and various space borne satellites viz. SOHO, TRACE, RHESSI etc. On 23 October, 2003 the M2.4 class flare was initiated by the ejection of jet in the east direction. The flare was very impulsive and eruptive in nature associated with the Coronal Mass Ejection (CME). We observe a RHESSI X-ray compact source at the flare location. RHESSI 50-100 keV sources are co-aligned with the TRACE bright kernels and indicate the footprints of reconnected loops. A local linear force-free model of AR 10484 indicates that the AR magnetic field structure consists of large-scale and very extended loops and open field on the East of the active region.

On the kinematics and trigger mechanism of a twisting solar jet as observed by SDO/AIA

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Abstract. Using the SDO/AIA data of 304 Å and 211 Å we observe a twisting solar jet on 26 January 2011. This jet presents an episodic brightening at its base in the 304 Å and 211 Å lines that we interpret as a sign of localized heating. We also observe the conversion of writhe to the twisting motion during upward propagation of the jet and vice-versa. This is a rare observational evidence of the helicity conservation and its backward transfer in the polar corona. The jet rises with a speed of ∼300 km/s, while it rotates at its central part with an angular speed of ∼0.002 rad/s. The injected helical twist in the jet may subject to the kink instability that probably affects the stability and dynamics of the jet. We conjecture that the initial heating at the base of the jet may be due to the reconnection between emerging flux and the pre-existing field lines, and allowed the transfer of helicity that most likely triggered the jet motion in the corona.

Using heliospheric imaging observations to forecast the arrival time of CMEs

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Abstract. The estimation of arrival time of coronal mass ejections (CMEs) near 1 AU is a crucial problem in the development of any space weather prediction model. For more than twenty years such studies are being done mainly using coronagraphs (SOHO/LASCO) observations near the sun or using empirical, statistical or numerical arrival time models. In both the approaches, we utilize the in-situ measurements of ICMEs as a reference of the actual arrival time of CMEs. But the identification of ICMEs near the earth is based on many signatures and they usually have unclear boundaries, resulting in uncertainties in the actual arrival time too. In this way, our understanding about CME kinematics and estimation of its arrival time based on two point measurements, are not sufficient. In order to understand the CME kinematics throughout the interplanetary medium, we have analyzed the coronagraph (2.5 -15 Rs) and heliospheric imager (15-330 Rs) (SECCHI/HI) data. We applied different

methods on imaging (COR and HI) observations to estimate the true kinematics of CMEs in interplanetary medium. We used these estimates as inputs to the drag based model to predict the arrival time as well as transit velocity of CMEs at 1 AU. We also compare the accuracy of different methods implemented on imaging (COR and HI) data on our studied events. Our analysis reveals the importance of heliospheric imager observations in forecasting the CME arrival time near 1 AU.

Multi-wavelength diagnostics of thermal and non-thermal characteristics in 22 April 2011 confined flare

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Abstract. We study the spatial, spectral and temporal characteristics of thermal and non-thermal emission in an M1.8 flare, which occurred in NOAA AR 11195 (S17E31) on 22 April 2011. This study quantifies spatial and temporal correlation of thermal and non-thermal emissions in precursor, impulsive as well as gradual phase of energy release employing multi-wavelength observation from SDO, HESSI and SOXS missions. Based on spectral fitting analysis performed on the X-ray emission observed by RHESSI as well as SOXS missions in low energy and high energy respectively, we define that <20 keV emission corresponds to thermal and >20 keV emission to be non-thermal counterpart of the emission. Therefore, we construct X-ray images employing RHESSI observation in energy bands 6-20 and 20-100 keV over the time integration of 30s. We report co-spatial X-ray emission in various phases of emission. We also report absence of non-thermal counterpart in the X-ray emission in precursor phase however visible at the commencement of main phase. To characterize thermal and non-thermal signatures, we overlay the X-ray image contours on the Hα and EUV observations from GONG and SDO/AIA respectively. We report thermal emission in the precursor phase to be co-spatial to UV counterpart. In contrast, we report absence of emission in the EUV wavebands i.e. 1600 and 1700 Å which, in principle, correspond to temperature minimum zone and photosphere during the precursor phase. This confirms the absence of non-thermal emission as appeared in X-ray emission during the precursor phase. Further, during the impulsive as well as in gradual

phase, thermal and non-thermal emissions have been found to be originated from a compact source, co-spatial in nature. Analysis of Line of sight (LOS) magnetic field observations from SDO/HMI does not reveal noticeable changes in the positive and negative fluxes as well as magnetic-field gradient during this event. In contrast, Hα emission observed by GONG has revealed the filament eruption as the trigger of flare. This suggests filament eruption to be driver of this event, consistent with the CSHKP model of solar flare.

RHESSI and TRACE observations of multiple flare activity in AR 10656 and associated filament eruption

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Abstract. We present a multi-wavelength study of the activation and eruption of a filament from active region NOAA 10656 on 18 August 2004 which was accompanied with an X-class flare. EUV and X-ray observations clearly indicate two phases of the filament evolution. The activities of the first phase, or pre-eruption phase, are characterized by three impulsive sub-peaks superimposed over smoothly varying GOES SXR flux, about an hour before the main eruption, during which HXR emission was also briefly observed. The comparison between X-ray and EUV imaging observations indicates that HXR emission is associated with three localized events of energy release that took place in the vicinity of a sub-filament region. We find that the morphological evolution and the slow rise of the sub-filament during this activation phase are temporally as well as spatially associated with these pre-eruption events. The observations provide clear evidence for magnetic reconnection, non-thermal emission and particle acceleration during the activation phase in the form of plasmoid ejection, HXR emissions and soft-hard-soft evolution of HXR spectra. The sub-filament region, weakened by the multiple events of localized magnetic reconnection, rapidly evolved into a twisted structure and eventually erupted producing a large CME associated X-class flare. During this second or eruption phase of the filament, multiple HXR bursts are observed during which X-ray spectra follow hard power laws. From these multi-wavelength observations, we conclude that the HXR emission during the first or activation phase of the filament evolution represents localized events of magnetic reconnection that may play a crucial role in destabilizing the active region filaments and provide a trigger for the large-scale eruption and associated two-ribbon flare.

Formation and evolution of penumbra

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Abstract. Penumbra is the hairy like magnetic structure that develop around a pore to become a sunspot. Though recent advances in MHD simulations have successfully demonstrated the filamentary nature and some other observations of a fully developed penumbra, its formation and evolution is not yet understood. There are very few observations of penumbral formations in high resolution due to unpredictability on the time and location of sunspot formation. One case of high resolution observation and 16 cases of low resolution observations of penumbral formation were studied, and results reported. It is found that the penumbra start to appear when, the magnetic flux of the umbra is in the range of 1-12$\times 10^{20}$ Mx, magnetic field strength is in the range of 1-1.2 kG and the umbral area is in the range of 10-200 arcsec^{-2}. The wide range observed for the umbral magnetic flux and area in this study is against the earlier speculation of a particular cut-off value.

(B) Stars and Galaxy

Search for millisecond pulsars at the GMRT and the exotic discoveries

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Abstract. There are, arguably, no other astronomical object whose discovery and subsequent studies provides more insight in such a rich variety of physics and astrophysics than the millisecond pulsars (MSPs). MSPs are a small sub-class of pulsars, rotating with periods of only a few milliseconds and due to their extraordinary rotational stability, MSPs can be considered as astrophysical clocks. The search for such exotic objects will not only enhance the MSP population, but will also allow much wider probe to explore their evolutionary history. We have discovered six MSPs with much diverse characteristics at the positions of Fermi LAT unassociated sources using the GMRT. Being the first galactic disk millisecond pulsars discovered at the GMRT, these discoveries are very important scientific achievement from India and illustrate the importance of low-frequency search for nearby millisecond pulsars. The discovery of these precise astrophysical clocks demands much finer grid in search phase space, which is completely driven by the number crunching capability of the High Performance Compute engine. The discoveries of binary MSPs in exotic evolutionary phases demands complete 3-D search. For example, 7.5 Tflops of compute power is

used for the discovery of a very compact binary MSP, a Black Widow pulsar. This pulsar eclipses for about 13% of its orbit by a very low-mass companion (0.017 $M_\odot$). Such Black Widow pulsars are missing link between the isolated and fully recycled pulsars, where the pulsar is ablating its companion creating significant amount of intra-binary material to obscure the pulsar emission. Radio timing ephemeris allowed us to detect the gamma-ray pulsations from this millisecond pulsar. The details of the GMRT discoveries, the interesting results from our observations and the possible scientific impact of the discoveries of such exotic systems will be illustrated in this presentation.

Binary systems: implications for outflows and periodicities relevant to masers

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Abstract. Bipolar molecular outflows have been observed and studied extensively in the past, but some recent observations of periodic variations in maser intensity pose new challenges. Even quasi-periodic maser flares have been observed and reported in the literature. Motivated by these data, we have tried to study situations in binary systems with specific attention to the two observed features, i.e., the bipolar flows and the variabilities in the maser intensity. We have studied the evolution of spherically symmetric wind from one of the bodies in the binary system, in the plane of the binary. Our approach includes the analytical study of rotating flows with numerical computation of streamlines of fluid particles using PLUTO code. We present the results of our findings assuming simple configurations, and discuss the implications.

Star formation in the inner galaxy and associated filamentary structures

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Abstract. Young Stellar Object(YSO)s in the inner galactic region $10^o < l < 15^o$ and $-1^o < b < 1^o$ are examined using GLIMPSE images and GLIMPSE data catalogue. A total number of 1107 Class I and 1566 Class II sources are identified in this galactic region. Using GLIMPSE 5.8 μm and 8 μm images, we have shown the presence of 10 early star formation sites of which 8 of them are filamentary while 2 are clusterings of Class I/II sources. Occurrence of Hub-Filamentary System (HFS) is seen in some cases. Most of the Class I sources are found to be aligned as string

along the length of these filamentary structures, while Class II sources are located randomly. Circumstellar disk characteristics of YSOs are studied through their SED analysis. We found that most of the Class I sources detected are of mass >8 $M_{\odot}$, while Class II sources are of relatively lower mass. We find this region of inner galaxy to be profound with early star formation sites. The GLIMPSE images/catalogs are found capable of detecting filamentary structures and YSOs, where such studies are usually done with sub-millimeter studies. Detailed study of these identified regions is important to understand the process of star formation in the inner galactic regions.

Superbubbles in disk galaxies and galactic winds

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Abstract. We study the evolution of superbubbles driven by large star clusters in disk galaxies using Kompaneets approximation and numerical simulation. We investigate the effect of radiative loss on the dynamics of the superbubbles, in particular the conditions required for superbubbles to break through the disk material and throw the inner hot gas into the halo with sufficient speed so as to create a galactic outflow. We find that our calculations and simulations can explain the observed threshold star formation surface density required to create superwinds from disk galaxies.

Moving groups in the Galactic thin disk

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Abstract. Apart from the large scale structures named as thick disk and thin disk, many small scale structures or overdensities are observed in the velocity fields of disk stars in the solar neighborhood. Such structures include open clusters, OB associations, stellar streams etc. Stellar streams or moving groups are kinematically coherent groups of stars which are gravitationally unbound and are seen scattered all over the sky. Although they have been known and studied for long, their origin is not well understood. The most popular scenarios explaining the origin of moving groups are cluster disruption, dynamical perturbations within the Galaxy and the tidal disruption of satellite galaxies by the Galaxy. Arcturus stream is a well known example of streams in the thick disk, while Hercules stream, Sirius stream, Hyades stream etc, are the popular ones in the thin disk of the Galaxy. Here, we present the results of our analysis of three streams -Sirius, Hercules and Hyades. Candidate members for each of the streams were chosen based on the kinematic classification provided in the lit-

erature. The kinematic motion (U, V, W) of the sample stars, and the probability with which stars belong to the Galactic thin disk are calculated. Main focus of our study is to understand the chemistry of the stream members. The detailed chemical composition is obtained through high resolution spectroscopy and the results are compared with the abundance patterns of different Galactic components. We do not find chemical homogeneity among the stream members. It appears that the member stars are of different origin. Although, the abundance patterns in these streams favour dynamical perturbations within the Galaxy, the association of Hyades stream with Hyades cluster has been discussed.

Detection of linear polarization from SNR Cassiopeia A at low radio frequencies

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Abstract. We report detection of the weak but significant linear polarization from the Supernova Remnant Cas A at low radio frequencies (327 MHz) using the GMRT. The spectro-polarimetric data was analyzed using the new technique of Faraday Tomography (RM-synthesis). The problems of disentangling weak sky polarization from any residual instrumental polarization is discussed. A novel technique to establish association of the apparent polarization to the source, even in the presence of instrumental leakage is demonstrated. The anti-correlation of the polarized emission with soft X-ray counts seen at various Faraday-depths provides direct evidence of the co-existence of thermal and non-thermal plasmas within the source.

Study of time lag variability associated with C-type quasi periodic oscillations in GX 339-4 during outbursts

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Abstract. The transient black hole binary GX 339–4 is one of the best studied transient Galactic black hole candidates over a wide range of wavelengths. GX 339-4 has exhibited four outbursts phases at a 2-3 years of interval. The complex outburst phase begins and ends in the low/hard state. We have analyzed RXTE/PCA data of this black hole source for the 2002/2003, 2004, 2007 and 2010 outbursts. The power density spectrum exhibit quasi-periodic oscillations (QPO) whose frequency varies from 0.2 Hz to 8.1 Hz and C-type QPOs exhibit evolution in QPO frequency during

2002/2003, 2007 and 2010 outbursts. We measure the time/phase lags between soft (2-5 keV) and hard (5-13 keV) photons only on the C-type QPO centroid frequency with a width equal to the FWHM of the QPO peak. We find positive time lags which indicate that the hard curve lags soft one. The evolution of time lag is correlated with the QPO frequency for all the outbursts and suggests towards a common evolution scenario of black hole transients through their outbursts.

Abundance analysis of an extended sample of open clusters: A search for chemical inhomogeneities

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Abstract. We have initiated a program to explore the presence of chemical inhomogeneities in the Galactic disk using the open clusters as ideal probes. We have analyzed high-dispersion echelle spectra (R $\geq$ 55,000) of red giant members for eleven open clusters to derive abundances for many elements. The membership to the cluster has been confirmed through their radial velocities and proper motions. The spread in temperatures and gravities being very small among the red giants, nearly the same stellar lines were employed thereby reducing the random errors. The errors of average abundance for the cluster were generally in 0.02 to 0.07 dex range. Our present sample covers galactocentric distances of 8.3 to 11.3 kpc and an age range of 0.2 to 4.3 Gyrs. Our earlier analysis of four open clusters (Reddy A.B.S. et al., 2012, MNRAS, 419,1350) indicate that abundances relative to Fe for elements from Na to Eu are equal within measurement uncertainties to published abundances for thin disk giants in the field. This supports the view that field stars come from disrupted open clusters. In the enlarged sample of eleven open clusters we find cluster to cluster abundance variations for some s- and r- process elements, with certain elements such as Zr and Ba showing large variation. These differences mark the signatures that these clusters had formed under different environmental conditions (Type II SN, Type Ia SN, AGB stars or a mixture of any of these) unique to the time and site of formation. These eleven clusters support the widely held impression that there is an abundance gradient such that the metallicity [Fe/H] at the solar galactocentric distance decreases outwards at about -0.1 dex per kpc.

Constraining models of accretion outbursts in low-mass YSOs

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Abstract. Young low-mass stars, which are still undergoing accretion, have been found to undergo sudden outbursts in short period of time. They are believed to be due to sudden increase of typically ∼2 orders of magnitude in mass infall rate. Classically these objects are classified as FUors and EXors. FUors undergo long duration outbursts for several decades of typical magnitude $\delta m \sim 4 - 5$, while EXors undergo short duration outbursts for few months to years of typical magnitude $\delta m \sim 2 - 3$ and they might occur repeatedly. From the number count of FUors, it is estimated that every low-mass stars, on a minimum, undergo FUors kind of outburst in its early life. We present our study on three such rare outbursts in optical and near-infrared wavebands using long-term observations with 2-m Himalayan Chandra Telescope and 2-m IUCAA Girawali Observatory telescope. Using the current available models and the constrains on it, we can deduce to understand the physical process driving the outburst.

Transit timing variation analysis of exoplanet TrES-3b with five new transits

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Abstract. We report the results of the transit timing variation analysis of the exoplanet TrES-3b, using thirty seven light curves which cover more than thousand epochs. Our analysis combines thirty two previously available transit light curves with five new transits, which were observed between May 2010 and June 2010 with the 0.81-m telescope at Tenagra Observatory, Arizona, US. From these observational data, the orbital parameters of the TrES-3 system are determined and the possible transit timing variations are investigated. Our results suggest that the assumption with no transit timing variations provides poor fit to the observations minus calculations, i.e., (O-C), data. To explain the observational results, we find that the possible dynamical

models are those with one additional planet with order of hundred Earth-Mass located near but not exactly at 1:2 exterior resonance to TrES-3b.

State-of-art pulsar studies using interferometric arrays

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Abstract. The new flexible and powerful software back-end (GSB) opens up the possibility of new regimes of pulsar studies with interferometric arrays like the GMRT, as exemplified by two unique techniques - a gating correlator for millisecond pulsars (MSPs) and a multi-pixel beamformer. We have developed a coherently dedispersed MSP gating correlator at the GMRT motivated by the requirement of localising the newly discovered faint Fermi MSPs. This imaging technique uses the dedispersed visibility data folded with period, acceleration and jerk. We could localise the tighter and fainter binary MSPs in the ON-OFF image plane, even outside the HPBW of GMRT. This tool enables study of unique aspects of MSP population (also pulsars in general) using present and up-coming interferometric arrays (LEAP, ASKAP, MeerKAT, SKA etc). Study the off-pulse emission from the gamma-ray selected MSPs using the MSP gating imaging technique can provide additional constrain on the emission region in pulsar magnetosphere. Moreover, proper motion study of the fainter pulsars is highly benefited from the sensitivity enhancement on the gated image plane. We have also developed a multi-pixel beamformer technique, which is able to look for pulsations much more efficiently over a larger solid angle. This efficient technique combines the enhanced sensitivity of a coherent array beamformer with the wide field-of-view seen by an incoherent array beamformer. I will present a special application of this technique, where we use continuum imaging followed by the multi-pixel beamformer to obtain the precise locations of newly discovered MSPs with the GMRT. Accurate positions measured with single observations enable highly sensitive follow-up studies using coherent array beamformer and rapid follow up at higher radio frequencies and other wavelengths. Normally, such accurate positions can only be obtained from a long-term pulsar timing program. The multi-pixel beamformer technique can also be used for highly sensitive targeted pulsar searches in extended supernova remnants. In addition this method can provide optimal performance for the large scale pulsar surveys using multi-element arrays. These new designs widened scope of pulsar studies with the multi-element radio telescope arrays of the future and act as SKA technology demonstrator.

Near-infrared photometric study of intermediate polar YY Draconis

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Abstract. We present near-infrared J and H band extensive photometric study of the intermediate polar YY Dra. J and H band light curves are modulated by the first harmonic of orbital period which is explained as the aspect variation of the distorted secondary during its orbit motion. The observed J and H band light curve minima show a systematic phase shift and this change in phase arises due to a likely small error in the previously known value of the orbital period. The phase shifts are precisely measured at different epochs and analysed to derive a more accurate value of the orbital period as 0.16537424(2) day. J and H band orbital phase curves are modelled using Wilson-Devinney binary light curve synthesis code to obtain the inclination angle of the system as 41 ± 3 degree. In addition, we have detected kilo-second quasi-periodic oscillations (QPO) in several lightcurves observed on individual nights. The period of QPO varies from 1600 to 2600 second. The possible source of the QPO is likely to be a high density blob orbiting in the partial disc around the spinning white dwarf primary. The blob may be illuminated from the radiation coming from white dwarf, and reprocess it to emit in near-infrared spectral bands. We have also compiled all the observed outburst timings of YY Dra using V band observations from AAVSO, VSOLJ and AFOEV database to determine the outburst recurrence time. More frequent observed outbursts of YY Dra in last decade suggest that the earlier estimated value of 868 days is likely to be an integer multiple of the probable outburst recurrence time. Present analysis shows that the value of recurrence time is 364 ± 70 days.

Modelling UV sky for future UV missions

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Abstract. Software simulators are now widely used in all areas of science, especially in application to astronomical missions: from instrument design to mission planning, and to data interpretation. We present a simulator to model the diffuse ultraviolet sky, where the different contributors are separately calculated and added together to produce a sky image of the size specified by the instrument requirements. Each of the contributors to the background, instrumental dark current, airglow, zodiacal light and diffuse galactic light, is dependent on various factors. Airglow is dependent on the time of day, zodiacal light on the time of year, angle from the Sun and from the ecliptic, and diffuse UV emission depends on the look direction. To provide a full description of any line of sight, we have also added stars. The diffuse UV background

light can dominate in many areas of the sky and severely impact space telescopes viewing directions due to over brightness. The simulator, available as a downloadable package and as a simple web-based tool, can be applied to separate missions and instruments. For demonstration, we present the example used for two UV missions: the UVIT instrument on the Indian ASTROSAT mission to be launched in the next year and a prospective wide-field mission to search for transients in the UV.

Sub-beam patterns associated with the two conal rings of B1237+25

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Abstract. Multi-components observed in average profiles of many pulsars are generally understood to be consisting of emission from two conal zones (outer and inner) and a core beam. In spite of observed differences in the spectral properties of the core & the conal components (corresponding to the two presumed cones), a possible relationship between their emission processes can not be ruled out. The well-known bright pulsar B1237+25, with its multi-component profile resulting from a special viewing geometry, represents an interesting case to probe such a relationship. We present our study of a number of pulse sequences consisting of rich variety in pulse-to-pulse fluctuations from this star, exploring the underlying emission patterns corresponding to the two conal rings and any possible relationship between them.

Pulse phase resolved spectroscopy of Cyclotron Resonance Scattering Features in accretion powered X-ray pulsars

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Abstract. We have performed Pulse Phase Resolved Spectroscopy of the Cyclotron Resonance Scattering Features (CRSF) of some bright accretion powered X-ray pulsars using Suzaku observations. CRSFs which are found in 19 accretion powered pulsars till date provide us one of the surest estimates of the magnetic field strength of the neutron star. Pulse phase resolved spectroscopy of these CRSFs can in addition provide us with a wealth of information on the emission geometry and can be used to map the magnetic field structure of the neutron star as we probe it at different viewing angles. Estimation of the viewing angle parameters and the inclination between the magnetic and rotation axis of the neutron star from these studies can also provide us more robust estimates of the X-ray polarization expected from these sources.

Recovery from pile-up: Application to X-ray photon energy spectra

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Abstract. Mutually correlated random events are routinely monitored to estimate event spectra of various natural phenomenon. Such measurements count the events occurring within finite resolution in the detector used for the observation. Within the resolution, however fine, there is always a non-zero probability of occurrence of multiple events. Such multiple unresolved events are counted as one event and the corresponding event strengths get added up. Such "pile-up" of events due to finite resolution of the detector can result in significant distortion of the intrinsic event spectra. We present a solution to recover the intrinsic spectrum. The method is successfully applied to piled-up X-ray photon energy spectrum observed using the Suzaku X-ray CCD detectors.

The dynamic pulsar emission over multiple frequencies

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Abstract. In this presentation, a review of single pulse emission from radio pulsars, with particular emphasis on recent simultaneous multi-frequency studies with the GMRT on PSRs B0031-07, B0809+74 and B2319+60, is carried out. After a brief description of single pulse phenomena in radio pulsar, the relationship between subpulse drifting, nulling and profile mode-changes is explored. Recent results, obtained with the GMRT, the WSRT and Effelsberg telescope, which show that all these phenomena are correlated from 325 MHz to 4.8 GHz are discussed alongwith results on other pulsars with the GMRT and the ORT. These results suggest that these phenomena are manifestations of global changes in magnetosphere. Implications for recent models, invoking such changes, are discussed after a brief description of these models, which were proposed to explain changes in spin-down of pulsars observed during the ON and OFF states of intermittent pulsars. The presentation ends with discussion of future observations and theoretical challenges in this field.

Multi-wavelength study of Galactic HII region W40

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Abstract. Study of Galactic HII regions is one of the vital tools in understanding the effect of high-mass star(s). Copious amount of UV photons from high-mass stars can ionise the neighbouring ISM, injecting energy and momentum, which leads to a host of interesting features. Such regions can be used as test-beds for triggered star formation theories such as radiation driven implosion and collect-and-collapse model. Tangentially, it can also be tested if such processes can lead to the formation of second generation high-mass stars. The sheer complexity of an HII region makes multi-wavelength study an imperative. In this respect, we have carried out infrared, sub-millimeter, and radio continuum analysis of the W40 Galactic HII region to decipher the global star formation scenario. We discuss the preliminary results in this talk.

Nine years X-ray observations of WR 25 from XMM-Newton: Evidence of colliding wind shock

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Abstract. We present X-ray analyses of a massive binary WR 25 using the data from XMM-Newton. An orbital period of $\sim$ 208 days for WR 25 have been derived. Further, the X-ray light curves of WR 25 show the phase-locked variability, where the flux increased by a factor of $\sim$ 2 from minimum to maximum. The X-ray spectra of these stars confirmed large extinction and revealed hot plasma with prominent emission-line features of highly ionized Ne, Mg, Si, S, Ar, Ca and Fe; these are found to be consistent with a two-temperature plasma model. At a temperature of $\sim$ 0.6 keV, the cooler plasma was found to be constant at all phases for both binaries, which could be the result of a distribution of small-scale shocks in radiation-driven outflows. However, the hot plasma at $\sim$ 2.75 keV could be due to a colliding wind shock between the binary components.

Detection of possible cyclotron resonance scattering feature in the accretion powered X-ray pulsar 4U 1909+07

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Abstract. We present the timing and spectral analysis of high mass X-ray binary pulsar 4U 1909+07 using data from the Suzaku observation on 2 November 2010. The pulse period of pulsar is estimated to be 604.058(1) s. Pulsations are seen in the X-ray light curves up to ∼40 keV. The energy resolved pulse profiles are found to be strongly energy dependent. Presence of several absorption features at various pulse phases, below 10 keV make the soft X-ray pulse profiles complex. At high energies, however, the pulse profiles are found to be single peaked. We tried to fit the 1-100 keV phase averaged spectrum of the pulsar with various continuum models such as partial covering high energy cut-off power-law, cut-off power-law, negative and positive power-law times exponential cutoff (NPEX) etc. However, we found that the partial covering power-law with black-body component at soft X-rays fitted the data better. A weak iron fluorescence emission line is detected in the spectrum. The presence of an absorption like feature at ∼43 keV in the residue of the spectral fitting allowed us to add a cyclotron scattering resonance feature (CSRF) at above energy that improved the spectral fitting further. To check the presence of CSRF in the spectrum, we normalized the pulsar spectrum with respect to that of the Crab Nebula. The Crab spectrum is a featureless power-law with a photon index of ∼2.1. The resulting "Crab ratio" showed a clear dip like feature centered at ∼43 keV which we identified as CRSF in the pulsar. We estimated the surface magnetic field of the pulsar to be 3.7×10^{12} Gauss.

Transient Be/X-ray binary pulsar EXO 2030+375 at the peak of a normal type I outburst

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Abstract. We present the timing and broad-band spectral properties of the Be transient high mass X-ray binary pulsar EXO 2030+375 using a Suzaku observation during the peak of the 2007 May-June outburst. Pulsations with a period of 41.41 s were clearly detected in the light curves of the pulsar up to energy ∼100 keV. The pulse profile was found to be strongly energy dependent. Narrow dips which are generally seen in the pulse profiles up to ∼10 keV, are found to be present in the profiles up to as high as ∼70 keV. At high energies, these dips gradually disappeared and the pulse pro-

file appeared as single-peaked. The broad-band spectrum of the pulsar in 1.0-200.0 keV energy range is found to be well described by a partial covering power-law with high energy cut-off continuum model. Several emission lines such as Si, S, Fe are also detected in the pulsar spectrum. We attempted to fit the spectrum using neutral as well as partially ionized absorbers along with the above continuum models yielding similar results. The spectral fitting, however, did not require any Cyclotron Resonance Scattering Feature (CRSF) in the best fit model. To understand the changes in model parameters during the dips in the pulse profile, we carried out pulse phase resolved spectroscopy using data from XIS and PIN. During the dips in the pulse profiles, the value of additional column density was estimated to be high compared to that during the other pulse phases. While using partially ionized absorber, the value of ionization parameter is also higher at the dips in the pulse profiles. This may be the possible reason for the presence of dips up to higher energies.

Discovery of an intermittent pulsar: PSR J1839+15

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Abstract. We report the discovery of a new pulsar PSR J1839+15 in the GMRT Galactic Plane Pulsar and Transient Survey (GMGPPTS) carried out with the Giant Metre-wave Radio Telescope (GMRT). The pulsar J1839+15 has a spin period (P) of 549 ms and a dispersion measure (DM) of 68 pc-cm^{-3}. We would also like to report intermittent behaviour of the radio emission from this pulsar.

(C) Extragalactic Astronomy and Cosmology

Cold gas at high redshifts

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Abstract. I will discuss the use of semi analytic models of galaxy formation for calculating the cold gas fraction in galaxies. I will apply this to compute the large scale distribution of cold gas at high redshifts and comment on observability of the signal using upgraded and upcoming radio telescopes.

Polarization alignment in JVAS/CLASS flat spectrum radio surveys

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Abstract. We present our results on large scale alignment of radio polarizations at high redshift. We use the JVAS/CLASS 8.4-GHz data with different cuts. We report the polarization alignment on the scale of 150 Mpc for the data with polarization flux greater than 1mJy. The alignment significance decreases as we go to the larger scale. In contrast the data with polarization flux less than 1 mJy does not show significant alignment at short distances. We also study the signal by imposing a cut on the error in polarization. We find that the significance of alignment increases with decrease in the error in polarization. We are unable to attribute our results to known sources of bias. We discuss a possible physical explanation of our results.

Early time optical observations of GRB afterglows and their implications

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Abstract. Early time optical observations of GRBs are very important towards revealing the prompt emission and afterglow properties of these energetic explosions. The observations of the well-studied GRBs by Swift indicate that early time properties of the optical light-curves share diverse set of features broadly consistent with the predictions made by various afterglow models though outliers exists. The comparison of a subset of well-monitored GRBs and their early time properties at optical are compared with that seen at XRT and BAT wavelengths. In most of the cases, the very early optical observations of GRBs do not trace the canonical decay nature seen at XRT wavelengths, suggesting different origins for the observed early emissions in the two bands. In some of the early optical light-curves, the smooth rise and decay features are consistent with the onset of the afterglow although such features are also expected if the emission is seen off-axis and/or the outflow is structured.

Photometric and spectroscopic follow-up of Type IIn SN 2010jl

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Abstract. We present the results from the long term optical photometric and low reso-

lution spectroscopic observations of the core-collapse Type II supernova 2010jl which was one of the bright events of the year 2010, with unfiltered discovery magnitude of 12.9. SN 2010jl is an energetic rare Type IIn burst which has also been detected in the X-ray and UV bands. Proximity of this event along with early discovery, allow us to conduct a detail photometric and spectroscopic study of this object from the beginning. During the observation over last two years, we found that the SN was heavily interacting with its surrounding, which made us curious to investigate the shock propagation and the process of dust formation in case of Type IIn supernovae. Here, we will also present the observationally derived parameters of this SN and compare their properties with other core-collapse events of similar kind.

COSMOGRAIL: Time delays in lensed quasars from Himalayan Chandra Telescope

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Abstract. Estimating H_0 to an accuracy of few percent is an important challenge today as it will offer key insights into various questions in cosmology. By measuring time delays between the photometric variations in lensed quasar images and subsequent modelling of the mass distribution in the lensing galaxy, it is possible to constrain H_0 in a way well complementary to traditional techniques. Time delays are difficult to measure due to the long time span needed to monitor the sources and photometry is challenging due to the small angular separation between the lensed quasar images. These issues are addressed by the COSMOGRAIL (COSmological MOnitoring of GRAvItational Lenses) collaboration, which uses several telescopes in both the hemispheres to monitor a large sample of gravitationally lensed quasars. As part of this collaboration, 6 sources are being monitored using the 2 m Himalayan Chandra Telescope (HCT) in Hanle, India. We present here the preliminary estimates of time delays in these sources.

A comparative study of late-time light curves of Type Ic Supernovae

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Abstract. We present late-time Hubble Space Telescope (HST) observations of two broad lined type Ic supernovae, SN 2003dh and SN 2006aj associated with GRB 030329 and XRF 060218 respectively. Using multi-color observations covering ~70-350 days after the burst, we constrain the late-time decay of the supernovae. The late-time decay rates for SN 2003dh and SN 2006aj are steeper than the 56Co− >56Fe decay rates indicating that there is some leakage of gamma-rays. We also compare these supernovae with other broad lined type Ic with and without associated GRBs as well as normal type Ic's. For all the supernovae in our sample, 56Ni masses have been estimated based on the early time (near peak) light curves of the supernovae. We find that when we scale the late-time (nebular phase) light curves of the supernovae by the estimate of 56Ni mass, the light curves cluster together, with a particularly low dispersion in the I band. The excellent scaling between the late and peak light curves implies that inspite of their relativistic jets and high kinetic energies, the light curves of these supernovae are powered throughout by the radioactive decay of 56Ni.

Multi-wavelength variability and SED modelling of Narrow Line Seyfert 1 galaxies detected by Fermi

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Abstract. Narrow line Seyfert 1 (NLSy) galaxies having exceptional emission and continuum properties are recognized as a class of active galactic nuclei (AGN) about 25 years ago. Similar to the normal AGN population, NLSy galaxies also show the radio-loud/radio-quiet dichotomy, however, their radio-loud fraction is smaller than that of the radio-loud fraction of quasars. These radio loud NLSy galaxies show enough evidence for the presence of relativistic jets in them due to their flat radio spectra and high brightness temperatures. Recently, gamma rays were detected in four radio-loud NLSy galaxies by Fermi/LAT, namely 1H 0323+342 (z = 0.061), PMN J0948+0022 (z = 0.585), PKS 1502+036 (z = 0.409) and PKS 2004-447 (z = 0.240). This gamma-ray detection again gives strong evidence for the presence of relativistic jets in these sources, similar to blazars. To understand the nature of these gamma-ray loud NLsy galaxies, intranight optical variability observations were carried out during the beginning of 2012. Also, SED modelling of these sources were carried out using near simultaneous data in X-rays, optical and gamma rays from Swift/XRT, Swift/UVOT and Fermi. Details of these results will be presented.

Study of faint star clusters in the LMC using Washington photometry

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Abstract. We present CCD Washington CT_1 photometry of stars in the field of 50 LMC clusters which are either unstudied or very poorly studied. The data were taken using the 4.0 m Blanco telescope in Chile, operated by CTIO, and are deep enough to identify the turn-off of faint, poorly populated old clusters. Washington photometry helps us to estimate the cluster metallicities. We estimate radii, reddenings and ages for these clusters. The ages of the analysed clusters mostly fall in the range log(t)= 8-9 Gyr while few of them are younger or older than this. Some clusters in this sample may not be true clusters, but asterisms. We group this sample into three sub groups 1) true clusters 2) possible clusters and 3) asterisms.

X-ray environments of 11 clusters of galaxies with substructures

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Abstract. We have made a detailed study of the dynamics of 11 clusters of galaxies selected from the combined samples of Flin and Krywult (2008) and Ramella et al. (2007) that show presence of substructures in the optical images of the clusters. The 11 clusters were selected primarily based on the availability of the archival Chandra data. Using these Chandra observations, we have made exposure corrected and point source removed X-ray images of the clusters. Almost all the clusters in the sample are found to have anisotropic X-ray morphologies, and X-ray substructures are seen in the central parts of many of these clusters. One of the clusters A193 shows a triple nucleus at its centre. From the spectral analysis of circular annuli centered on the X-ray surface-brightness peaks, we have produced both projected and deprojected profiles of temperature, electron number density, entropy and pressure for all the clusters.

Investigating AGN-black hole masses in extreme late type spirals : Void and LSB Galaxies

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Abstract. We study the AGN emission lines in void galaxies and giant low surface brightness galaxies. Both galaxies are usually isolated, late type systems and are poorly evolved compared to regular spiral galaxies. AGN are not common in these galaxies. We study their AGN emission using SDSS optical spectra and characterise the nature of their nuclear activity. For Seyfert 1 galaxies we derive the nuclear black hole (BH) masses. We find that they lie in the 10^5 to 10^7 solar mass range but do not always lie on the M-sigma relation for bright galaxies. However, as the BH mass approaches 10^7 solar mass, the galaxies move closer to the M-sigma correlation. This suggests that the M-sigma correlation is a good approximation for BH masses greater than 10^7 solar masses but not lower in these type of slowly evolving galaxies. We discuss the implications of our results.

Three point scalar-tensor cross-correlations and tensor bi-spectrum in inflationary models with deviations from slow-roll

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Abstract. Maldacena formalism is used to study the three-point scalar-tensor cross-correlations as well as the tensor-bispectrum in single field inflationary models that permit features in the scalar power spectrum. The formalism is applied to the case of Starobinsky model to arrive at analytical expressions which are then used to validate a numerical procedure developed for the same purpose (numerics are also crosschecked against the spectral dependence in power law inflation). The code is then utilized to evaluate the three-point correlations in different classes of models which lead to features in the scalar power spectrum like the punctuated inflationary scenario, inflationary potentials with a step and the axion monodromy model. We also comment on the contributions to the above mentioned three-point functions during preheating.

Understanding the spectral break in GeV-TeV spectra of some selected blazars using Fermi-LAT and TeV observations

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Abstract. The absorption of Very High Energy (VHE: E>100 GeV) gamma-rays from distant blazars within the source and by the intervening low energy extragalactic background light (EBL) photons, introduces an ambiguity in the interpretation of intrinsic GeV-TeV spectra of blazars. With the Fermi-Large Area Telescope (LAT), the high energy observations of blazars are possible in a regime where EBL attenuation is negligible. The overlap between the operational energy range of LAT (0.1-100 GeV) and ground based TeV instruments provides a unique tool to understand the connection between GeV-TeV spectra of blazars. In the present work, we use Fermi-LAT observations of blazars from the 2nd catalog (2FGL) in MeV-GeV energy range and observations from ground based telescopes at energies above 100 GeV to study the break in the energy spectra of a few blazars at different redshifts. After accounting for EBL attenuation effects at energies above 100 GeV, we compare the Fermi-LAT spectral index with the EBL corrected TeV spectral index to study the consequence of internal or external absorption of VHE photons from blazars.

Slow unstable modes of counter-rotating nearly Keplerian stellar discs

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Abstract. The nuclei of two nearby galaxies, NGC4486B in the Virgo cluster and M31 our nearest neighbour, both show an unusual double-peak distribution of stellar light. The stars appear to be distributed in a highly anisotropic, lopsided manner about a massive black hole, whose mass could be hundred million solar masses. These nearly Keplerian stellar discs have been explored by many authors since the eccentric disk model proposed by Tremaine (1995). One of the most interesting questions concerns the origins of the high eccentricities and lopsided distribution of stellar orbits about the central black hole. A possible origin of lopsidedness, suggested by Touma (2002), is through an instability off counter-rotating streams of stars. This could occur were a globular cluster to be tidally disrupted and added to the stellar system. This work is an exploration of modes in these nearly Keplerian systems, in particular the nature of the instabilities due to counter-rotation streams of stars.

Inflation using scalar fields with non-canonical kinetic terms

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Abstract. We discuss inflation driven by non-canonical scalar fields. Our results emphasize the fact that non-canonical scalars can significantly improve the viability of inflationary models. They accomplish this by decreasing the tensor-to-scalar ratio while simultaneously increasing the value of the scalar spectral index, thereby redeeming models which are incompatible with the cosmic microwave background (CMB) in their canonical version. For instance, the non-canonical version of the chaotic inflationary model with a quartic potential is found to agree with observations for values of the coupling constant as large as unity!

Search for star formation trigger in Wolf-Rayet galaxies

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Abstract. Wolf-Rayet (WR) galaxies are characterized by presence of broad emission lines of He, C, N, and O, which originate in the stellar winds of hot WR stars. The WR stars are the most massive evolved O/B type stars with masses ($M > 20M_{\odot}$) and therefore have very short life ($\sim$ a few Myr). Due to this short WR phase in galaxies, the onset/triggering mechanisms of massive star formation can be best studied through WR galaxies. The tidal interactions between galaxies are believed to be the main mechanism responsible for Wolf-Rayet (WR) phases in galaxies. We are studying a large sample of WR galaxies including compact dwarf, spiral and other types to trace tidal features in these galaxies, using the HI 21cm-line observations from GMRT and H-alpha line observations from the Devasthal fast optical telescope. Many of these WR galaxies do not have detectable tidal interaction features or presence of nearby companion galaxy in their optical images. The results on two galaxies Mrk 996 and Mrk 005 (both dwarf system) indicate presence of low mass companion galaxies previously not known. In Mrk 996, HI bridge and a low mass companion galaxy in the line of sight have been detected. Additionally, the H-alpha disk is found to be highly misaligned with the old stellar disk. No radio continuum is detected implying that either there is a lack of magnetic field or supernova explosions from the current phase of star-burst has not taken place in the galaxy. Similarly, In Mrk 5, HI bridge with a nearby HI cloud has been detected. These results provided first direct evidence of tidal

interaction in Mrk 996 and Mrk 5. This survey will provide a conclusive statement on triggering mechanisms of star formation in WR galaxies. The survey plans and main results will be presented.

Double-double radio galaxies from the FIRST survey

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Abstract. The radio structures and optical identifications of a sample of 242 sources classified as double-double radio sources (DDRSs) by Proctor (2011) from a morphological study of sources in the FIRST (Faint Images of the Radio Sky at Twenty centimeters) survey (2003 April release, 811,117 entries) have been examined. We have been able to confirm only 23 of these as likely to be DDRSs, whose structures could be attributed to episodic nuclear activity in their host galaxies. A further 63 require either higher-resolution radio observations or optical identifications to determine whether these are DDRSs. The remaining sources are unlikely to be DDRSs. We have examined the luminosities, sizes and symmetry parameters of the DDRSs and the constraints these place on our understanding of these sources.

Extragalactic UV background

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Abstract. We have developed a numerical code to generate extragalactic UV background spectrum. For that we have solved the radiative transfer equation in expanding universe for given quasar and galaxy emissivity taking into account the effective optical depth encountered by radiation due to the presence of diffused inter-galactic clouds. We use the results of this code to probe the physics of He II re-ionization.

The uncorrelated long term gamma-ray and X-ray variability of blazars

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Abstract. We examine the long term (∼10 years) gamma-ray variability of blazars observed by EGRET and Fermi and find that for six flat spectrum radio quasars (FSRQs) the average flux varied by more than an order of magnitude. Two of these sources (PKS 0208-512 and PKS 0528+134) were extensively observed and detected at various viewing periods by EGRET and hence these dramatic variations reflect long term changes in the average flux. Over the last twenty years, these two sources were observed by several X-ray observatories (e.g. ROSAT, ASCA, RXTE, BeppoSAX, Chandra, Suzaku, XMM-Newton and Swift). While the ratios of the average gamma-ray fluxes between EGRET and Fermi observations are ∼23 and ∼13, their estimated 2-10 keV X-ray flux do not show such dramatic variations. The X-ray emission from such flat spectrum radio quasars (FSRQs) are believed to be due to synchrotron self Compton, while the gamma-rays originate from the inverse Comptonization of the external soft photons from an accretion disk and/or broad line region. In this scenario, the only explanation for this uncorrelated variability is that there was an order of magnitude decrease in the external soft photons, while the jet parameters remained more or less constant which indicates that perhaps the accretion and jet processes are not tightly coupled in these sources.

Probing the Active Galactic Nuclei using optical spectroscopy

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Abstract. Variability studies offer one of the best tools for understanding the physical conditions present in regions close to the central engine in an AGN. We probed the various properties of AGN through time variability studies of spectral lines in the optical wavelengths using the 2m telescope in IUCAA Girawali observatory. The absorption line variability studies are mainly concentrated in understanding the nature of outflows in quasars. Quasar outflows have a huge impact on the evolution of central supermassive blackholes, their host galaxies and the surrounding intergalactic medium. Studying the variability in these Broad Absorption Lines (BALs) can help us understand the structure, evolution, and basic physical properties of these outflows.

We conducted a repeated Low ionization BAL monitoring program with 27 LoBALs (Low Ionization BALs) at z 0.3-2.1 covering timescales from 3.22 to 7.69 years in the quasar rest frame. We see a variety of phenomena, including some BALs that either appeared or disappeared completely and some BALs which do not vary over the observation period. In one case, the excited fine structure lines have changed dramatically. One source shows signatures of radiative acceleration. Here, we present the results from this program. Emission line studies are concentrated in understanding the peculiar characteristics of a dual-AGN source SDSS J092712.64+294344.0.

High energy mechanism from the knot of OJ 287

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Abstract. The detection of gamma-ray flare from the BL Lac object, OJ 287 during October 2009 is associated with the ejection of a superluminal radio knot as suggested by discrete cross-correlation analysis of gamma-ray and 1 mm radio light curve. We study plausible mechanisms responsible for the high energy emission from this knot. We reproduce the quasi-simultaneous broadband spectral energy distribution from the knot considering synchrotron and inverse Compton emission from a broken power-law particle distribution. Explanation of X-ray and gamma-ray by either synchrotron-self Compton (SSC) or external Compton (EC) alone cannot reproduce the broadband spectrum and/or require unphysical set of parameters. Hence we model the high energy emission as an outcome of both SSC and EC models. The temperature of external photon field inferred from this model suggests that the gamma-ray emission must be resulting from the inverse Compton scattering of infra-red photon from the warm region surrounding the super massive black hole in OJ 287.

Galactic outflows and their cosmological implications

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Abstract. We study the galactic outflows driven by SNe energy injection and the momentum injection from AGN. Using the results from our analytical calculation, we derive the stellar to halo mass ratio of galaxies. We find that our results explain the observations of outflow properties and stellar content in galaxies. We have also studied the motion of cold phase of the winds driven by the radiation pressure from galaxy and/or ram pressure of the hot wind. We find that the ram pressure is mainly important in low mass galaxies while in high mass galaxies both radiation and ram pressure are required to explain the observations of cold outflows.

(D) Instrumentation

Concept for a near-term low-energy X-ray Spectroscopy and timing mission (XSPECT)

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Abstract. In the aftermath of India's first multiwavelength astronomy mission, a small payload (XSPECT) is proposed to address complementary timing and spectroscopy at low-energy X-rays. The proposed detector achieves modest effective area without the use of focusing optics using the new large area Swept Charge Devices (SCDs; CCD-236) which are a variant of X-ray CCDs. SCDs permit fast readouts (10-100 kHz) and moderately good spectral resolution at the cost of a position sensitivity. These devices are unique in requiring very benign cooling requirement (uses only passive cooling) unlike traditional X-ray CCDs. XSPECT with a passive collimator of 1 deg $\times$ 1 deg field-of-view, is ideally suited to pursue soft x-ray timing studies, complementary to what LAXPC does at high energies on ASTROSAT while simultaneously providing good resolution spectrum in the 1-20 keV band. Key science objectives include understanding long-term behaviour of x-ray sources through correlation of timing characteristics with spectral state changes and emission line variations. Alongside an x-ray polarimeter, this can provide a near-complete system to address photon energy, timing and polarization simultaneously. The details of realization of such a payload for launch within a two-year period will be discussed.

Construction of 3.6m ARIES telescope enclosure with eccentric pier at Devasthal, Nainital

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Abstract. Space optimized enclosure with eccentric pier for 3.6m ARIES telescope presents construction challenges at the unique observing site of Devasthal, Nainital, India. Enclosure comprises of about 16.5m diameter and 14m high insulated steel framed cylindrical dome rotating on a 14m high stationery dome supporting structure and a 24m $\times$ 12m extension structure building for accommodating aluminizing plant and ventilation system etc. Great deal of manual and mechanical excavation was carried out at the rocky site using rock breaking and JCB machines. Foundation bolts for columns of dome supporting structure and extension structure building were grouted after alignment with total station. A 7m diameter hollow cylindrical pier isolated from other structures and 1.85m eccentric with dome center designed due to space limitation at site is being casted for mounting 150 MT mass of the largest 3.6m telescope in the country. A 7m diameter template was fabricated for 3.6m pier top. Most of en-

closure components are manufactured and tested in works before assembly/erection at site. Dome drive was tested with dummy loads using VVVF drive with 6 drive and 12 idler wheel assemblies at works to simulate dome weight and smooth operation before erection at site. A 4.2m wide motorized windscreen is being manufactured with a special grade synthetic fabric to withstand wind speed up to 15m/s.

Spectral response of scanning sky monitor flight module

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Abstract. Scanning Sky Monitor (SSM) is one among the five payloads onboard the upcoming space observatory ASTROSAT meant for dedicated multiwavelength study of celestial objects. The primary objective of SSM is to scan the sky in the energy range of 2 - 10 keV, for X-ray transient sources. A position sensitive gas proportional counter acts as the main detector for this purpose. Above the detector is a collimated imaging system based on the principle of Coded Aperture Imaging. In order to have a precise estimation of the location and emitted energy of the X-ray transient source, it is necessary to calibrate the detector. We have carried out the spectral and position calibration of the SSM flight module. In order to have an account of the photon intensity in the different spectral bands of SSM and also to estimate the hardness ratio of the source being observed, it is necessary to have a spectral response of the detector which correlates the detector channels and the energy range. We generate a spectral response for SSM which maps the detector channel range of 100 - 500 with the 2 - 10 keV spectral band. A response matrix is created from the calibration results. We estimate the detection efficiency of SSM Flight module in the energy band of 2 - 10 keV, by cross - calibration with a Si - PIN detector. The details of calibration results, generation of spectral response and experimental derivation of detection efficiency will be presented.

Evaluation of photoelectron emission direction reconstruction algorithm for a soft x-ray polarimeter

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Abstract. X-ray polarimetry has been an unexplored field of X-ray astronomy. The GEM (Gas electron multiplier) based X-ray polarimeter brings high sensitivity measurement of x-ray polarization from most popular classes of celestial X-ray sources.

It derives the polarization information from the track of the photoelectron imaged by finely subdivided gas pixel detector. Either pixel or TPC based readout is used in polarimeter. TPC based soft X-ray polarimeter was planned for the NASA's GEMS Mission. Garfield simulations have been carried out for both pixel readout geometry and TPC readout geometry. The images of primary electron cloud obtained in simulation have been used for photoelectron emission direction reconstruction. We discuss the reconstruction algorithm, which has been developed and this algorithm is evaluated with the known inputs for simulation. Effect of operating parameters on the performance of both TPC readout method and pixel readout method will be compared.

Prospects of hard X-ray polarimetry with pixillated CZT detectors

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Abstract. X-ray polarimetry has not witnessed much progress in last four decades mainly due to the fact that dedicated X-ray polarimeters have very low sensitivity compared to a dedicate spectroscopy or imaging instrument. In absence of a dedicated X-ray polarimeter, there have been many attempts to salvage some polarimetric information from the existing X-ray instruments with varying degrees of success. However, such post-facto analysis is typically very complex as the instrument is not designed to provide the polarimetric information. On the other hand, if due consideration is given to the possible polarimetric capabilities during design phase of a new instrument, it might provide a reasonable sensitivity. In this context here we investigate the feasibility of measuring hard X-ray polarization using pixillated CZT detectors with detailed Geant4 simulation.

Factory verification results and status of 3.6 m Devasthal Optical Telescope

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Abstract. Considering the need and potential of establishing a moderate size optical telescope with spectroscopic capability at the geographical longitude of India, a 3.6m optical telescope with active optics technology is being installed at Devasthal, Nainital. This telescope will have instruments providing high resolution spectral and seeing-limited imaging capabilities at visible and near-infrared bands. The 3.6m DOT can be used to optical studies of a wide variety of astronomical topics including follow-up studies of sources identified in the radio region by GMRT and UV/X-ray by ASTROSAT. In this contribution, we present telescope performance verification results obtained from the sky tests which were carried out at the Factory in May 2012. The status of telescope will also be presented.

Faint Object Spectrograph for 3.6 m Devasthal Optical telescope

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Abstract. A Faint Object Spectrograph and Camera (FOSC) is designed for the upcoming 360-cm optical telescope at Devasthal. The design is based on other available similar instruments, having a collimator and camera unit. The instrument converts F/9 beam from the telescope to a nearly F/4.3 beam. The collimator and camera optics have 7 and 5 elements respectively with one aspheric component. The low dispersion glasses such as CaF2 and PBM/PBL/FSL are used in order to minimize the chromatic aberrations. These glasses also have very good transmission near blue wavelengths. The imaging is possible both in narrow and broad band filters up to the field of view of $\sim 14' \times 14'$ or $19'$ along the diagonal. The spectroscopy can be performed in the wavelength range 350-900 nm with several choices of grisms and slits with resolution in the range of 250-2000. The theoretical spot sizes in the imaging mode are expected in the range $0.04''$-$0.11''$. The overall transmission of the camera and collimator optics is expected as ~75% at 350 nm and >90% at wavelengths above 400 nm. The total weight of the instrument as designed is around 350 kg. The instrument is currently planned to be assembled in the Institute laboratory and to be commissioned on the 360-cm telescope in October 2013. The design methodology, techniques, and expected performance of the optics are presented here.

Automated telescope for variability studies

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Abstract. PRL has installed a 50 cm telescope at Mt Abu, Gurushikhar. The back-end instrument consists of a 1K $\times$ 1K EMCCD camera with standard UBVRI filters and also has polarization measurement capability using a second filter wheel with polaroid sheets oriented at different position angles. This 50 cm telescope observatory is operated in a robotic mode with different methods of scheduling of the objects being observed. This includes batch mode, fully manual as well as fully autonomous mode of operation. Linux based command line as well as GUI software are used entirely in this observatory. This talk will present the details of the telescope and associated instruments and auxiliary facilities for weather monitoring that were developed in house to ensure the safe and reliable operation of the telescope. The facility has been in use for a couple of years now and various objects have been observed. Some of the interesting results will also be presented.

High Resolution SPectrometer for HCT, Hanle: an update

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Abstract. A high resolution spectrometer for the 2m Himalayan Chandra Telescope (HCT) at Indian Astronomical Observatory (IAO) Hanle, is being built to meet the observational requirement of many advanced areas in astronomy requiring high spectral resolution. This instrument is based upon a modern design using a white pupil concept which has been adopted in several contemporary high resolution spectrometers. This design is known to reduce light losses due to vignetting and also provides the full spectral coverage (350nm-1000nm) in a single CCD frame. This design also incorporates additional features like image-slicer which would result in very high light efficiency. A peak throughput of 20% in visual range and throughput of 8% is expected at extreme blue and red wavelengths. The spectrometer would give resolutions of 60,000 and 30,000 in two resolution modes. In this contribution we describe the instrument and its environment and give an update on its development and science programs we propose to undertake.

Performance evaluation of trigger algorithm for the MACE telescope

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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 explore the gamma-ray sky in the tens of GeV energy range. The imaging camera of the telescope comprises 1088 pixels covering a total field-of-view of 4.30 $\times$ 4.00 with trigger field-of-view of 2.60 $\times$ 3.00 and an uniform pixel resolution of 0.120. In order to achieve low energy trigger threshold of less than 30 GeV, a two level trigger scheme is being designed for the telescope. The first level trigger is generated within 16 pixels of the Camera Integrated Module (CIM) based on 4 nearest neighbour (4NN) close cluster configuration within a coincidence gate window of 5 ns while the second level trigger is generated by combining the first level triggers from neighbouring CIMs. Each pixel of the telescope is expected to operate at a single pixel threshold between 8-10 photo-electrons where the single channel rate dominated by

the after- pulsing is expected to be ~500 kHz. The hardware implementation of the trigger logic is based on complex programmable logic devices (CPLD). The basic design concept, hardware implementation and performance evaluation of the trigger system in terms of threshold energy and trigger rate estimates based on Monte Carlo data for the MACE telescope will be presented in this meeting.

An AOTF-based IR spectrometer for space explorations - A concept design

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Abstract. An AOTF-based Near-Infrared Spectrometer is under development at ISRO Satellite Centre (ISAC) in collaboration with the Laboratory for Electro-Optics System (LEOS), with a focus on space explorations, especially for studies of planetary atmospheres and astronomical sources. The instrument consists of a telescope, an Acousto-Optic Tunable Filter (AOTF), an Indium-Gallium-Arsenide (InGaAs) detector, and a RF synthesizer unit. The AOTF device is a solid-state optical filter that operates on the principle of acousto-optic diffraction in an anisotropic medium. An external radio frequency signal from the RF synthesizer is applied to a transducer bonded to the crystal in order to tune the wavelength. The telescope will collect the radiation, define the FOV and maintain the quasi-parallel nature of the beam as an input to the AOTF, while the AOTF output is focused onto the InGaAs detector. The spectrometer will cover the 1-1.7 micron band, with a spectral resolution of ~ 1000 @ 1.5 micron. In this presentation, we discuss the various aspects of the instrument - the science goals, instrument design and optimization, estimation of sensitivity, and the criticalities of ground calibration.

Design and performance of axes controller for the 50/80 cm ARIES Schmidt telescope

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Abstract. We describe here the details of R.A. and Dec axes controller for the 50/80 cm Schmidt telescope at Aryabhatta Research Institute of observational sciencES (ARIES). Each axis is driven by a set of two motors for backlash-free motion and is coupled to on-shaft encoder for absolute position measurements. Additional incremental encoders are provided though a backlash-free reduction for velocity feedback. A pulse width modulation (PWM) based proportional and integral (PI) controller is designed to drive the twin-motor drive of each axis. The overall telescope control architecture features a distributed network of simple low cost PIC microcontrollers interfaced via CAN bus and RS232 ports. Using this controller it has been observed that the rms velocity errors at slew, set, guide, fine and tracking speeds are negligible. Excessive preload on the gearbox bearings results in a highly nonlinear behavior at fine speeds owing to dynamics of friction. We found that the peak errors in the tracking performance and fine speeds can be improved by properly adjusting the preloads on the gearbox bearings.