Program Schedule

PDF DAY

(July 24, 2024; Venue: ARIES Auditorium)

Time	Speaker	Title
09:45 AM – 09:50 AM	Director's Remark	
Galactic & Extragalactic Astronomy Session - 1 Chair: Neelam Panwar		
09:50 AM – 10:15 AM	Harmeen Kaur	Star formation studies in young star clusters
10:15 AM – 10:40 AM	Gulafsha B. Choudhury	Variation in the orientation of local magnetic field of dark clouds with respect to their galactic position
10:40 AM – 11:05 PM	Neha Sharma	Triggered star formation within Bright-Rimmed Clouds: The case of BRC18
Tea Break		
Session - 2 Chair: Ramakant S. Yadav		
11:25 PM – 11:50 PM	Divya Pandey	Star formation exists in all early-type galaxies -- evidence from ubiquitous structure in UV images
11:50 PM – 12:15 PM	Sharmila Rani	UVIT/AstroSat detection of white dwarf companions to blue stragglers in NGC188
12:15 AM – 12:40 AM	Samrat Ghosh	Photometric variability to study the brown dwarfs and very low mass stars using ground-based telescopes and satellite data: A statistical approach to estimate the significance of ground-based faint object data

12:40 PM – 01:05 PM	Amar Deo Chandra	Multiwavelength studies of the 2024 outburst of the transient X-ray pulsar IGR J06074+2205
Lunch Break		
Session-3 Chair: Jagdish C. Joshi		
02:00 PM – 02:25 PM	Arpan Krishna Mitra	Barrow holographic dark energy in Brane World Cosmology
02:25 PM – 02:50 PM	Abhijit Roy	Diffuse emission from molecular clouds: a probe of cosmic ray origin and propagation
02:50 PM – 03:15 PM	Krishna Mohana	Probing emission processes of "Blazars" using multiwavelength observations
Tea Break		
Atmospheric Science Session-4 Chair : Narendra Singh		
03:35 PM – 04:00 PM	Bharti Paul	Aerosol and forest fires studies by integrating multi-satellite and reanalysis data: a case on Brahmaputra valley and Uttarakhand
04:00 PM – 04:25 PM	Shishir Kumar	Assessing the vertical distribution of aerosol and cloud optical properties over Central Himalayan region using remote sensing techniques
04:25 PM – 04:50 PM	Subhajeet Debnath	Long-term and short-term tidal variabilities in the middle atmosphere

List of Abstracts

1. Title: Star formation studies in young star clusters

Speaker: Harmeen Kaur

Abstract

Young open clusters are distinctive subjects of astrophysical investigation. The majority of stars within these clusters form nearly simultaneously from the same Giant Molecular Cloud (GMC), encompassing a broad range of stellar masses within a relatively confined spatial volume. A defining characteristic of embedded clusters is their close physical association with interstellar gas and dust, whether cold or warm. The extent of their embedding in molecular gas is indicative of their evolutionary stage, thereby imprinting the fractal structure of the GMCs from which they originate. The dynamics of stars within these clusters, along with the structural evolution of embedded clusters over time, provide valuable insights into the processes of star formation and stellar evolution. Particularly, the structure observed in young embedded clusters mirrors the underlying structure present in the dense molecular gas from which they emerge. Given the significant role of young star clusters in the study of star formation and Galactic evolution, this thesis consists of "Star Formation Studies in Young Star Clusters". It aims to address existing inquiries through the exploration of four Young star clusters and H II regions

2. Title : Variation in the orientation of local magnetic field of dark clouds with respect to their galactic position

Speaker : Gulafsha B. Choudhury

Abstract

In this work, we study the magnetic field morphology of selected Bok globules and Lynd's clouds situated at low latitude within the galactic latitude (b) range of −10 degrees to 10 degrees. The polarimetric observation of four clouds, CB17, CB24, CB27, and CB188, were conducted using the 104-cm Sampurnanand Telescope (ST) located at ARIES, Manora Peak, Nainital, India, during 22-23 Dec. 2017 and 8th May 2019. The results obtained from the observed data are combined with 13 more low latitude clouds (viz., CB3, CB4, CB25, CB26, CB34, CB39, CB56, CB60, CB69, CB130, CB246, L1014, and L1415) available in literature. From the polarimetric analysis of 17 clouds, we obtained a correlation between the orientation of the local magnetic field with respect to the galactic plane and their galactic longitude (θoff = (0.0020 ± 0.0006)l 2 − (0.8380 ± 0.1841)l + (90.5358 ± 14.09), where θoff is the offset between the orientation of local magnetic field of the cloud and the galactic plane) which signifies that that the local magnetic field of clouds are oriented along the galactic plane for the clouds that are situated towards the galactic anti-center region and huge offsets are obtained in the clouds that are situated towards the galactic center region. Later, we performed optical polarimetric analysis of two more low latitude dark clouds L1495 and L1498 and found that the results fit well with our correlation. We also measured the dust column densities of L1495 and L1498 in both high density as well the low density regions of the clouds.

3. Title: "Triggered star formation within Bright-Rimmed Clouds: The case of BRC18"

Speaker : Neha Sharma

Abstract

Bright-rimmed clouds (BRCs) are interstellar clouds located at the periphery of evolved HII regions and illuminated by the light of nearby stars. The high-energy radiation from the ionizing sources

compresses and ionizes these clouds, potentially triggering star formation or destroying them. To examine the impact of the radiation-driven implosion (RDI) process on cloud formation, we mapped the magnetic field geometry and conducted millimeter observations of 12CO (J=1−0), C18O (J=1−0), N2H+ (J=1−0), and HCN (J=1−0) lines in the nearby cloud BRC 18, which is believed to be forming stars either independently or with external triggers, possibly due to RDI. Under local thermodynamic equilibrium (LTE) conditions, we estimated the physical properties of BRC 18 and analyzed the kinematic motions and structure of its molecular gas. Our analysis revealed infall signatures toward BRC 18 using HCN, C18O, and N2H+ lines, suggesting ongoing star formation. Furthermore, by integrating archival NVSS radio data with our millimeter observations, we found evidence for radiation-driven triggered star formation within the BRC 18. These findings enhance our understanding of the role of RDI in star formation processes in bright-rimmed clouds.

4. **Title: Star formation exists in all early-type galaxies -- evidence from ubiquitous structure in UV images**
   Speaker : Divya Pandey

Abstract

We compare the UV and optical morphologies of 32 ETGs (93 per cent of which are at z<0.03) using quantitative parameters (concentration, asymmetry, clumpiness and the Sérsic index), calculated via deep UV and optical images with similar resolution. Regardless of stellar mass, UV-optical colour or the presence of interactions, the asymmetry and clumpiness of ETGs is significantly larger (often by several orders of magnitudes) in the UV than in the optical, while the UV Sérsic indices are typically lower than their optical counterparts. The ubiquitous presence of structure demonstrates that the UV flux across our entire ETG sample is dominated by young stars and indicates that star formation exists in all ETGs in the nearby Universe.

5. **Title: Photometric variability to study the brown dwarfs and very low mass stars using ground-based telescopes and satellite data: A statistical approach to estimate the significance of ground-based faint object data**
   Speaker: Samrat Ghosh

Abstract

I will present photometric studies of a few flaring and non-flaring brown dwarfs using ground-based facilities like 1.3-m DFOT, 2-m HCT and TESS archival data. Due to the faintness of these low-mass objects, the ground-based data sometimes may not reflect the exact periodic signals present in high-precision data like TESS and K2. I will present a statistical approach to estimate the significance of the peaks found in the power density spectrum/periodograms in the ground-based data.

6. **Title: UVIT/AstroSat detection of white dwarf companions to blue stragglers in NGC188**
   Speaker : Sharmila Rani

Abstract

Blue straggler stars (BSSs) in one of the old open cluster NGC188 in the Milky Way have attracted attention from observations and theory to unravel their formation mechanisms. Here, we report the detection of hot companions to BSSs using UV photometry obtained from UVIT along with HST. Apart from that, we also present, for the first time, the results obtained from the FUV spectra taken with FUV grating of UVIT for one previously characterised BSS (WOCS5885) and hot subdwarf (sdB, WOCS4918) star. We characterise the hot companions to be high to extremely low mass (HM/ELM) white dwarfs (WDs) with Teff $\sim$ 9750-18250 K, R/R$\odot$ 0.02-0.08, M/M$\odot$ 0.18-0.8 using WD models.

UVIT detected 15 BSSs out of the total 22 present in NGC188. The hot companions with estimated temperatures are WDs of extremely low mass (ELM, $\sim$ 0.20 M$\odot$), low mass (LM, $\sim$ 0.20–0.40 M$\odot$), normal mass ($\sim$ 0.40–0.60 M$\odot$), and high mass ($\sim$ 0.8 M$\odot$). Besides, the physical parameters of a BSS and an sdB estimated using the spectral fitting of FUV spectra are consistent with previous estimations. BSSs found to have LM/ELM WD companions, suggesting Case-B mass transfers (MT) to be prevalent in NGC188, along with other mechanisms, and BSSs with WDs masses of $\sim$ 0.5-0.6M$\odot$ are likely to be formed via case-C mass transfer. Ten BS+WD systems have orbital parameters outside the limit for stable MT as per the models. We speculate the following three possibilities - their orbits are altered due to cluster dynamics, some may be in triple systems with LM/ELM WDs in an unknown closer orbit, or a modified MT mechanism may be required to explain their formation.

7. Title: Multiwavelength studies of the 2024 outburst of the transient X-ray pulsar IGR J06074+2205

Speaker: Amar Deo Chandra

Abstract

We carry out near-simultaneous X-ray and optical studies of the transient X-ray binary pulsar IGR J06074+2205 which was dormant for nearly two decades since its discovery in 2004 before it became active last year for short durations before fading into quiescence. The X-ray pulsations are detected over a wide energy band covering 0.5-80 keV from the compact object using observations from the SXT and the LAXPC instrument on the AstroSat satellite. Energy-resolved pulse profiles generated in several bands in 0.5-80 keV show that the pulse shape varies with the energy. The H-alpha line is detected in emission in the optical spectrum of the companion star from HCT/HFOSC observation, which suggests a decretion disc around the companion star that fuelled the 2024 outburst. Optical spectroscopic observations of the source in quiescence are required to ascertain the current state of the decretion disc around the companion star and set possible timescales on the formation/dissipation of the disc.

8. Title : Barrow holographic dark energy in Brane World Cosmology

Speaker : Arpan Krishna Mitra

Abstract

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

9. Title: Diffuse emission from molecular clouds: a probe of cosmic ray origin and propagation

Speaker : Abhijit Roy

Abstract

In the vast expanse of the Interstellar Medium (ISM), Giant Molecular Clouds (GMCs) stand out as dense, massive concentrations of gas and dust, primarily composed of molecular hydrogen. These

GMCs are important as they provide a substantial gas target for Cosmic Rays (CR) to interact with, resulting in the production of gamma rays and neutrinos. Due to their neutral nature, these particles are not influenced by Galactic magnetic fields, making them useful for probing the origins and properties of CR particles.

In our recent study, we calculated the diffuse emission of gamma-ray and neutrino from the Galactic plane, taking into account a large number of GMC populations in the Milky Way (MW). Our calculations were based on two scenarios of CR distribution: (I) the locally observed CR flux interacting with all GMCs and (II) a CR flux that varies radially.

We compared the calculated gamma-ray and neutrino fluxes from each GMC with the sensitivity of current and upcoming detectors to identify potential source candidates. We then combined the flux from all GMCs and compared it with the corresponding gamma-ray and neutrino flux observed by the Fermi-LAT, Tibet-ASγ, ARGO-YBJ, CASA-MIA, LHAASO and IceCube detectors, which showed consistent results. In the end, the spatial correlation between TeV Galactic point sources with the observed neutrino significance map of the IceCube is also explored.

10. Title: Probing emission processes of "Blazars" using multiwavelength observations

Speaker: Krishna Mohana

Abstract

Blazars are a class of active galaxies whose multi-band emission is dominated by non-thermal radiation originating from their relativistic jet pointing towards Earth. They exhibit extreme variations ranging from all the time-scale from minutes to years across the electromagnetic band. Considering the time-scale of the observed flux variation, the variability can be classified as short-term (time-scale of minutes to hours to days to weeks) and long-term variability (variations with months to years time-scale). My primary research interests lie in understanding the blazar emission processes responsible for such observed variabilities using multi-band spectral and timing studies. In this talk, I will present the results of our recent published work on radio variability of the blazar 3C 279. More than a decade of radio data were collected at seven different frequencies ranging from 2 GHz to 230 GHz. The multi-band radio light curves show variations in flux, with the prominent flare features appearing first at higher-frequency and later in lower-frequency bands. This behavior is quantified by cross-correlation analysis, which finds that the emission at lower-frequency bands lags that at higher-frequency bands. We discuss these flux variations in conjunction with the evolution of bright moving knots seen in multi-epoch VLBA maps to suggest possible physical changes in the jet that can explain the observational results. Some of the variations are consistent with the predictions of shock models, while others are better explained by a changing Doppler beaming factor as the knot trajectory bends slightly, given a small viewing angle to the jet. I will also discuss the results of our ongoing and future works to understand the blazar variability via multi-band spectral study.

11. Title: Aerosol and forest fires studies by integrating multi-satellite and reanalysis data: a case on Brahmaputra valley and Uttarakhand

Speaker: Bharti Paul

12. Title: Assessing the vertical distribution of aerosol and cloud optical properties over Central Himalayan region using remote sensing techniques

Speaker: Shishir Kumar

13. Title: Long-term and short-term tidal variabilities in the middle atmosphere

Speaker: Subhajeet Debnath

Abstract

Tidal variability in temperature and wind fields helps to understand the dynamics including long-term and short-term variability in the atmosphere. Migrating tides are investigated in the wind field from Canadian Middle Atmosphere Model (CMAM30) in the current study for both long-term and short-term variabilities. It is found that the 120-day oscillation is not influenced by solar activity but is a manifestation of the latitudinal variation of the long-term variabilities. The short-term variability of non-migrating tides is investigated from satellite (Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC)), model (CMAM30) and reanalysis (European Centre for Medium-Range Weather Forecasts Re-Analysis Interim (ERA-Interim)) data in the middle atmosphere in the temperature field and from model data in horizontal wind fields. In the current investigation, it is shown that non-linear interactions are not the only source of the non-migrating tides in the tropical MLT region and could also be the result of global oscillations as proposed by the classical tidal theory due to latent heat release in the tropical troposphere.