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Modelling observational signatures of jetted AGN feedback: ionization, emission and gas kinematics

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The AGNs are known to affect the dynamics and evolution of their host's ISM. In our study, we aim to draw a link between the simulations and the observable signatures of several different aspects of AGN feedback on the central few kpcs of their host galaxy, namely the extent of ionization, shocked emission and shocked gas kinematics. From the analysis of ionization, we find that the shocks from the jets (with kinetic power (10ˆ{45} erg/s) can ionize a significant fraction (up to 33%) of dense gas (n > 100/cmˆ3) in the disc, and that the jets clear out the central regions of gas for AGN radiation to penetrate to larger distances in the disc. However, the radiation from an AGN of similar luminosity as the jet's power, is quickly absorbed by the outer layers of dense clouds in the disc, and is not able to substantially ionize the disc on a global scale. Thus, compared to jet-ISM interactions, we expect that photo-ionization by the AGN radiation only weakly affects the star-formation activity in the central regions of the galactic disc (> 1 kpc), although the jet-induced shocks can spread farther out.
We find that the relativistic jets produce large-scale outflows, and create high-velocity dispersion in the whole nuclear regions (_˜2 kpcs) of their host. Unlike galaxies without jets, the jetted systems exhibit larger velocity widths (> 800 km/s), broader Position-Velocity maps, and disrupted symmetry in their projected velocity field. However, after the jets escape out from their host, the jet-disc coupling is weakened, resulting in decreased observable emission, and the reduced velocity dispersion in the central disc regions. We also show that the observable morphologies of

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kinematics and emission vary at different inclinations of the disc, and the observer sees different features of jet-ISM interaction at play.

Estimating binary parameters of black hole transient Swift J1658.2-4242 using Astrosat data

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Matter supplied by the companion star is captured by the immense gravity of black holes forming a disk-like
structure. The inflowing matter can be heated to an extremely high temperature as it approaches closer to the BH, resulting in
powerful X-ray emission. Therefore, both BH and companion star are equally worth studying in binary systems.
Here, we report the spectral and timing analyses of the newly discovered BH transient Swift J1658.2-4242 observed by {*AstroSat*}.
Three epochs of data have been analyzed using JeTCAF model to determine the spectral states, mass accretion rates, and the geometry of the flow.
*The model fitted disc mass accretion rate varies between 0.8 to $0.95* _{Edd}$ while the halo mass accretion rate varies
between 0.14 to 0.16_{Edd}. Therefore, the $_d$ was always higher than the halo rate, which can be an indication of intermediate or trending to soft spectral state,
in agreement with previous studies. The size of the dynamic corona varies substantially from $\sim 70$to$30r_g$.*We have also estimated the*
quasi−periodic oscillation (QPO) frequencies from the model fitted parameters, consistent with the observed QP
not well resolved in optical due to lack of instrument resolution. However, having little information from the litera
have predicted the binary parameters for this system, which can be verified in the future using the upcoming Thirty

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Discovery opportunities with upcoming radio surveys - a few case studies

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The high-sensitivity radio images generated from the international SKA and LOFAR surveys are providing excellent opportunities for researchers to discover new astronomical objects and phenomena. A number of international groups are utilizing the data. In this talk, I will present a few examples using the LOFAR and SKA images. The talk will include recently published works - search for radio emission in galaxies hosting tidal disruption events, newly discovered radio sources with circular morphology termed as the Odd Radio Circles, and some faint diffuse sources with complex and unexplained morphologies. There is an urgent need for improving automated search algorithms for detecting sources with complex morphologies and AI/ML techniques.

*Speaker

Discovery of large diffuse star forming galaxy using UVIT-ASTROSAT and MUSE

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A low-surface-brightness galaxy, or LSB galaxy, is a diffuse galaxy with a surface brightness that is at least one magnitude fainter than the ambient night sky. The LSB galaxies may account for up to 15 % of the mass of the universe. However, they are difficult to study due to the observational challenges in detecting them because of their inherent faintness. In this study, we present serendipitous discovery of a nearby diffuse galaxy that shows intense star formation in its inner disk using Ultraviolet Imaging Telescope (UVIT) and Multi-Unit Spectroscopic Explorer (MUSE) data. The galaxy was not detected earlier due to its superposition with the background galaxy NGC 6902A. They were together mistakenly classified as an interacting system. While studying a known interacting galaxy NGC6902A we noticed that south-west outer region of galaxy NGC 6902A shows diffuse blue emission. This south-western region shows prominent star forming regions in the FUV image. Further investigations revealed that these star forming regions are at a distance of around 136 million light-years, whereas the distance of NGC 6902A is around 825 million light-years. This means that the diffuse blue emission was from a foreground galaxy, which we discovered using FUV and MUSE data. We named it UVIT J202258.73-441623.8 based on the UVIT telescope that helped us to discover the galaxy. Our study suggests that powerfulful instruments such as UVIT and MUSE thus opens a gateway to searching for similar cases, where blue diffuse tidal features in interacting galaxies may not be the remnant of a merger but instead a separate foreground and/or background galaxy.

*Speaker

Hunting Habitable Worlds using K2 and SDSS Data

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In this project, I have tried to reproduce the properties of some of the known exoplanets and Circumbinary Planets like their radius, orbital period and orbital distance from the star using their Light Curves (LC) plotted by using data from K2 and TESS telescopes (Interestingly, some of them matched approximately with already found values). I have also found the stellar photosphere temperature (using Wein's Displacement law), the radial velocity of some other stars, and their distance from us by using the z value from their spectrum (from SDSS). I have also analyzed and classified some stars based on their spectral type (MK System) using their spectrum from SDSS. Further, the radial velocity and the distance of the spectral sources from us in two colliding galaxies are found using the redshift in their spectrum (from SDSS). The spectrum of these colliding galaxies has prominent HII lines, indicating more active star formation in the spectral source regions due to collision.

*Speaker

Are High-mass Planetary Systems Young? Evidences from the galactic chemical evolution

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Different stellar populations retain the traces of stellar nucleosynthesis and the chemical evolution of the galaxy, with older generations of stars exhibiting higher alpha-element abundances and later generations becoming enriched with iron-peak elements.By examining the interdependence between planetary and host star parameters, one can infer the evolutionary links and chemical characteristics of circumstellar discs, stars, and their planetary companions. Numerous past investigations have confirmed that high-mass giant planets are typically found near metal-rich stars, whereas the metallicity of the stars that host low-mass planets varies widely. In that talk I will discuss my recent work in which we analyzed the detailed chemical abundances for a sample of > 900 exoplanet hosting stars drawn from different radial velocity and transit surveys. This is further validated by the age of the host stars obtained from isochrone fitting and also from kinematic studies from GAIA DR3. The later enrichment of protoplanetary material with iron and iron-peak elements is also consistent with the core accretion process that led to the formation of the giant planets. A greater proportion of metals in the protoplanetary disc is favourable to rapid core growth, making the formation of massive planets feasible. This study suggests that the observed patterns in stellar abundances and planet masses are a natural consequence of the chemical evolution of the galaxy.

*Speaker

Probing the habitability conditions for the known terrestrial exoplanets by calculating their reflectivity.

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It is high time to characterize the Earth-like exoplanets in order to detect biosignatures beyond the Earth because such exoplanets will be the prime targets of big-budget missions like JWST, Roman Space Telescope, HabEx, LUVOIR, TMT, ELT, etc. To recognize a habitable exoplanet, we present new model reflected spectra, geometric albedo and transmission spectra (in the optical) for modern and prebiotic (3.9 Ga) Earth-like exoplanets orbiting within the habitable zone of stars of spectral types F, G, K and M. We also calculate this for potential habitable planets such as Proxima Centauri b, Trappist-1d, Kepler-1649c, Teegarden's star-b, etc.

We compute this for various atmospheric and surface compositions of the planets. Molecules that are potential biosignatures and act as greenhouse agents are incorporated in our model atmosphere. Various combinations of solid and liquid materials such as ocean, coast, land consisting of trees, grass, sand, rocks etc. are considered that determine the surface albedo of the planet.

We employ the opacity data derived by using the open-source package (Exo-Transmit) and adopt different temperature-pressure profiles depending on the properties of the terrestrial exoplanets. The model reflected spectra are constructed by numerically solving the multiple scattering radiative transfer equations.

We conclude that by knowing their reflectivity, Bond albedo and the transmission spectra, we would be able to know about the planet's surface composition, atmospheric composition, atmospheric pressure-temperature profile, presence of clouds, greenhouse gases, etc. Thus, our models will play an important role in driving future observations for the habitable planets.

*Speaker

Thermal Emission Effect on Chandrasekhar's Diffuse Reflection problem in Exoplanetary Atmosphere

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The analytical results of Chandrasekhar's semi-infinite and finite atmosphere diffuse reflection problems are crucial in the context of modeling the stellar and/or planetary atmosphere, but the atmospheric emission effect was not taken into account in this model. So the solutions are applicable only for a diffusely scattering atmosphere without atmospheric emission. But in the case of hotter exoplanets, the atmospheric emission is so high that we can not neglect it in respect of scattering. Hence we generalize Chandrasekhar's model to provide a complete picture of this problem. While including atmospheric emission, the diffusely reflected spectra of exoplanets will be enriched and carry the temperature information of all the atmospheric layers. We show that the emission effects are additive in nature, and thus our model reduces to the subcase of Chandrasekhar's scattering model in the case of B(T) = 0. Hence, we conclude that our generalized model provides more accurate results due to including the thermal emission effect in Chandrasekhar's diffuse reflection problem. The predictions of our model can be verified by high-resolution observations promised by present (JWST) and upcoming (ARIEL) telescopes.

*Speaker

Multiband study of Shell region in the North-Eastern Small Magellanic Cloud using UVIT/AstroSat and Gaia

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The Small Magellanic Cloud (SMC) is one of the nearest, gas-rich interacting dwarf satellites of the Milky Way and the companion of the Large Magellanic Cloud (LMC). The interactions with the LMC and/or with the Milky Way play a significant role in the evolution of the SMC. With its widespread star formation and low metallicity, the SMC is one of the best test beds to study star formation and evolution in a tidally driven environment. The shell region located in the North-East outskirt of SMC is a tidally affected region where there has been recent star formation. Our aim is to understand the spatial distribution, age dating, and kinematics of the young population in this part of the tidally affected SMC disk.
We obtained far-UV (FUV) images of eleven fields in the North-East SMC Shell region using the UltraViolet Imaging Telescope (UVIT) on AstroSat. We created science-ready images and performed PSF photometry. We cross-matched the detected FUV stars with the Gaia EDR3 data and eliminated foreground stars to create an FUV catalog of a few thousand stars. We created FUV-optical color-magnitude diagrams and estimated the ages of the stellar population using isochrones to map the morphology, density, and tidal features of stars younger than ~ 600 Myr. The identified episodes of star formation are used to constrain the details of the recent interaction of the SMC with the LMC. We

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also estimated the dispersion in the proper motion of the young and old stars to explore the kinematics
of the North-East part of the outer SMC disk.

Assessing the commonality of progenitor sites among r-process-rich stars

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Detection of lanthanides from the red kilonova spectra of GW170817 has shown clear evidence of r-process production during neutron star (NS) merger events. However, the detection of r-process-rich stars in the very early Galaxy, as well as in some of the primordial Milky Way satellites, pose a challenge to r-process production due to NS mergers at earlier times. Here, we present detailed chemical abundances of four r-I stars using the 10-m Gran Telescopio Canarias GTC, including thorium abundances for two stars using R=25000 high signal-to-noise spectra. We discuss r-process-rich stars across various metallicities in the Galaxy as well as possible connections between different types of r-process-rich stars, e.g., r-I, r-II stars, and its progenitor sites. We also show the kinematic analysis of the sample to assess their assembly history in the Galaxy. To understand the progenitor sites, we use differential analysis to derive precise abundances between r-II and r-I stars.

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Are giant planet hosts carbon poor?

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Planet occurrence rate and host star metallicity is a well-established relation by several studies. However, it is not clear how the abundances of individual elements play a role in this correlation. We present the carbon abundance of the main sequence dwarf stars in the LAMOST-Kepler field. And derive planet occurrence rate with respect to carbon abundance. We find (C/Fe) could be poor among stars that host hot Jupiters. We also perform differential abundances among stellar twins among visual binary systems to differentiate the effects of planet pollution versus the primordial abundance of the natal cloud in the observed correlations.

*Speaker

Spirals as the driver of wave-like breathing motion of stars in the Milky Way

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Recent studies of Milky Way kinematics in the Solar neighbourhood based on the enormous data from SEGUE, RAVE, LAMOST, and GAIA have revealed the wave-like patterns in the motion of stars. Stars coherently move away or toward the mid-plane of the Galaxy resulting in expanding or contracting breathing motion, respectively. In this meeting, we will present our recent work on the origin of this wave-like breathing motion in the Milky Way. We simulated the flyby interactions of two disk galaxies with a mass ratio of 5:1 and varied the orientation of flyby orbits. We found that the flyby interaction induces a two-armed spiral pattern in the host galaxy and the strength of this spiral pattern depends on the angle of inclination during flyby interaction. The prograde-prograde configuration of galaxy flyby induces the most strong spiral pattern. The flyby-induced spiral arms are transient density waves in nature. They form just after the pericenter passes and decay slowly after reaching maximum strength. We found that the contracting breathing motion in the disk is associated with the spiral arms, whereas the expanding breathing motion is associated with the inter-arm region. We confirmed that the breathing motion is not the direct consequence of the tidal interactions of galaxies. It is the spiral arms which originate the breathing motion in the disk of the galaxies.

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A comparative UV study of Star Forming Dwarf Galaxy types using UVIT

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Dwarf galaxies are by far the most abundant systems in the universe. They are characterized by smaller sizes and shallower gravitational potentials compared to massive galaxies. These properties make it difficult for them to retain dense gas and form stars. Our study aims to characterize and compare the star formation in different types of star-forming dwarf galaxies (SFDG), comprising dwarf spirals, dwarf irregulars, and blue compact dwarfs (BCDs), using ultraviolet (UV) observations carried out with the UVIT. As the UVIT has a high spatial resolution (_˜1.2"), it is possible to do a detailed study of the star-forming complexes (SFCs) in nearby dwarf galaxies. In this project, we have extracted the SFCs and derived their sizes and FUV star formation rates using UVIT images for 16 SFDGs. The corresponding MIPS 24-micron images are used to correct for host galaxy extinction. Using Spitzer IRAC 3.6-micron images, we derived the mean stellar disk mass associated with each complex. We show how these properties vary with the galaxy radius for each type of SFDG. We also show that the SFCs follow a star forming main sequence, which is similar to that followed by galaxies when their total star formation rates are considered.

*Speaker

DETECTION AND CHARACTERIZATION OF HABITABLE EXOMOONS IN THE JWST ERA

Suman Saha * [1]

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Rocky exomoons in the habitable zones of the exoplanetary systems hold special significance as they can host life. Although the detection of exomoons has yet remained elusive, mainly due to their smaller expected size, the next generation space missions such as JWST can provide unique opportunity for their detection and characterization. In this talk, I will present a comprehensive analytical formalism in order to model the lightcurves of transiting exoplanets hosting exomoons. In order to achieve an analytical formalism, we have considered circular orbit for the exomoon around the host planet, which is indeed the case for tidally locked moons. The formalism takes care of the co-alignement or non-coalignment of the orbits of the planet and the moon using a two angular parameter approach, and can be used to model and characterize all the possible orbital alignments for a star-planet-moon system. Using this formulation, we have studied the detectability of rocky exomoons in the habitable zones using next generation telescopes, such as JWST. I will also present our study on the detectability of the atmospheric features for such exomoons to study their habitability, using transmission spectroscopic observations from JWST.

*Speaker

Spectroscopic study of Planetary Nebula IC 2003

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Planetary nebulae (PNe) represent a transition phase of low-to-intermediate mass stars occurring after the AGB phase before they attain white dwarf configuration. A considerable fraction(15%) of the central stars of PNe show (WR) phenomena and show different evolutionary mechanism from normal PNe. To understand their characteristics, we took the observational data for IC2003 using medium resolution spectrograph attached with 2.3m Vainu Bappu Telescope. The optical spectra was reduced and analysed. After CCD corrections and wavelength calibration, flux calibration is done using the standard star hd19445. Emission line fluxes were measured and were subjected to estimate the nebular diagnostics using NEAT and get the logarithmic interstellar extinction value(c_Hβ) = 0.4. The elemental abundances and electron temperature and densities of IC 2003 were derived. These values are used as the initial values to make a complete physical model for the PN using 1D dusty-photoionization code CLOUDY. In addition to optical data, archival data in UV and IR will be used to further constrain the models.

*Speaker

Merger signatures in thee core of the Coma Cluster

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We use HCT-ACS data of the core of Coma Cluster to study the merger history of the cluster. Coma cluster is a virialised cluster, with a clear absence of interacting galaxies and visual merger signatures. With GALFIT, we make a deep study of the morphology of galaxies and study the bulge types of galaxies. We classify the bulges as classical and psuedo using Sersic index as well as Kormendy Diagram and study various parameters of the galaxies
Possible merger signatures of the bulges of non-dwarf galaxies in the core of the Coma Cluster, November 202, New Astronomy 99(3):101963

The galaxy population of the core of the Coma cluster

Nagamani Poloji, Priya Hasan, S N Hasan

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"Winged" Radio Sources from the LOFAR Two-meter Sky Survey First Data Release (LoTSS DR1)

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A small number of extragalactic radio sources disclose a pair of low-surface-brightness radio lobes, known as
"wings," aligned at a certain angle to the primary jets. Such exotic sources are known as "winged" radio sources.
Here we report the new identification of a total of 26 "winged" radio sources from the LOFAR Two-meter Sky
Survey First Data Release (LoTSS DR1). Out of the 26 "winged" sources, 14 are identified as X-shaped radio
galaxies and the remaining 12 as Z-shaped radio galaxies. The available optical counterpart of each radio galaxy is
cataloged along with its estimated redshift. Among the 26 sources, 15 candidates are classified as FR-II radio
galaxies, and two are classified as FR-I type. For nine candidates, no conclusions are drawn due to their complex
morphology. We also calculate the physical parameters such as spectral index, radio luminosity, and power of the
sources. We have made a statistical study of the spectral index by combining our estimated value with the spectral
index collected from previous works. A mean value of spectral index of 0.71 is obtained.

*Speaker

Miscellaneous radio galaxies from LOFAR survey

Tapan Sasmal *† [1], Soumen Bera [1], Soumen Mondal *

1

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Our work aims to identify the miscellaneous radio galaxies (MRGs) using the LOFAR Two-meter Sky Survey First Data Release (LoTSS DR1) at 144 MHz. The miscellaneous radio sources are very rare because of their peculiar morphological radio structure, which does not match with the known classes of radio sources. We find only four such MRGs by manually examining 18,500 samples. The peculiar morphology is not found in other radio frequencies 1400, 150, and 325 MHz. We estimate different physical parameters like spectral index, radio luminosity, and radio power of these sources. Among the four MRGs, J1428+4556 has the highest linear size of 3.972 Mpc and can be considered a giant radio galaxy. We also try to present the known galaxy cluster association with these MRGs. We find that the MRGs are associated with at least one galaxy cluster within a 1 Mpc radius. The basic parameters such as mass, radius, and richness of the clusters are also noted.

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Extra-Galactic Planetary Nebulae Studies

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Planetary Nebulae (PNe) play an important role in extra-galactic astronomy. They are the candles used to determine the distances to the galaxies accurately through the PNe luminosity function. PNe are important in the study of stellar population of low and intermediate mass stars, fractions of H-rich and H-poor CSPNe and their mass distribution in a galaxy. The mass returned to the ISM, dust properties and the chemical enrichment of galaxies can be understood from the PNe they host. An inportant factor to address in galactic evolution is that how these parameters are connected with the metallicity, which, so far was possible to address with some details for only SMC and LMC. A considerable fraction (25%) of the central stars of PNe in our Galaxy show WR phenomena ((WR)PNe) of H poor, carbon rich nature with broad emission lines. To constrain their evolutionary status and the origin of WR nature it is important to study (WR)PNe in other galaxies. This will be discussed in the light of upcoming facilities like MSE.

*Speaker

HI in nearby galaxies

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One of the most significant Byronic elements of galaxies, which is typically spread throughout the galactic disc, is atomic hydrogen (HI). Its largest radial extent and low dispersion velocity compared to other components make it a crucial tracer to preciously probe various characteristics, e.g., mass distribution, phases of ISM, kinematics and dynamics, up to very large radii. The HI-21 cm observation of galaxies, either using single-dish or interferometers, plays a pivotal role in studying different properties of galaxies. Although single-dish observations for their large beam sizes yield only the unresolved maps and the global properties of the galaxies (e.g., morphology, HI mass, velocity widths, diameter etc.), its contribution remains important, especially for survey-oriented projects that require high-sensitivity observations and study of the different scaling relations that depend on the global properties (e.g., HI mass-size relation, Baryonic Tully-Fisher relation etc.). However, through HI interferometric spectral line observation, we can study the distribution of the HI gas with unprecedented resolution, its detailed kinematics and dynamics, and a plethora of science cases, including galaxy formation and evolution, phases and stability of the ISM and its interaction with the surrounding medium. Here in this talk, I will be reviewing some of the important studies done using HI interferometric observation. This includes the 3D kinematic modeling of galaxies with the recently developed pipelines (FAT and Barolo) for fitting the tilted ring model; the mass models, i.e., the distribution of different baryonic components and halo mass by using the rotation curve obtained in 3D kinematic modelling and observations from optical or infrared bands; identification of different phases of ISM and revision of the KS law by relating the gas volume density instead of gas surface density with the star formation rate, a crucial process to understand galaxy evolution. Additionally, I will also explore the idea of using different parameters from interferometric observations instead of single-dish observation in establishing different scaling relations, e.g., the Baryonic Tully-Fisher relation. In conclusion, I will talk about the fact that all these important studies have been performed with a different and limited number of sources. However, using the existing archival data, we can verify these studies for a large number of galaxies with different properties, morphology and in different environments. In this regard, I will talk about the GMRT archive atomic gas survey (GARCIA), the potential, utility and novelty of uniformly analyzing a sample of 500+ galaxies using GMRT archives.

*Speaker

Observational study of low-frequency radio continuum and HI properties for a sample of nearby galaxies using GMRT and other archival data.

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The Spitzer IR Spectrograph observations of FR-I & FR-II radio galaxies at redshift < 0.22 have detected pure rotational emission lines from warm (100–1500 K) molecular H2 gas. It results in a new class of radio galaxies having large H2 luminosities of the order of 10ˆ40-10ˆ42 erg/s and large L(H2) to L(PAH) ratios; of 0.03–4 or greater. These galaxies are called radio molecular hydrogen emission galaxies (radio MOHEGs). Despite having a significant amount of molecular hydrogen gas, these galaxies show insufficiency in star formation, with an inadequate amount of star formation rates. It is suggested that galaxy collisions or cooling flows drive the molecular gas in MOHEGs, further heated by radio-jet feedback via shocks or cosmic rays. Furthermore, most of these galaxies appear to have stellar disks, dust disks, or dust lanes. We have detailed studies in optical and IR regions on MOHEGs. In this talk, I will describe how the low-frequency radio continuum, redshifted HI studies, and higher spatial resolution of the H2 emission region and its kinematics can provide further valuable insights regarding the possible radio-jet feedback mechanism.

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Morphology of Ultra Faint Dwarf Galaxies with Gaia-DR3

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The standard Lambda Cold Dark Matter model is considered as a theoretical astrophysics breakthrough, however observations of the Milky Way and its ultra-faint dwarf (UFD) satellite galaxies show indisputably that theory is incomplete on galactic and sub-galactic scales. We use proper motions, color magnitude distribution and metallicity to characterize morphology of Milky Way satellite galaxies using GAIA DR3 survey. We also determine the bright spectroscopic candidates using the LAMOST survey, which are suitable for high resolution spectroscopic follow-up to investigate their detailed chemical abundance patterns.

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Shock-driven synchrotron emission from the 2021 outburst of RS Ophiuchi

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We present low-frequency radio observations of the 2021 outburst of a recurrent nova - RS Ophiuchi.
Our observations span t _˜ 25-287 days post outburst at frequencies 0.15 to 1.4 GHz. The near-simultaneous spectral
indices are alpha _˜ -0.8 (F_nu $\propto$ $nû alpha$), $indicating an on-thermal origin of radio emission. Radio light curve$

*Speaker

The optical design of atmospheric dispersion corrector for individual objects on the TMT focal plane

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One of the significant factors affecting the accuracy of ground-based measurements is the earth's atmosphere. Its dispersion phenomenon causes larger images on the focal plane when a ground-based telescope observes an object at off-zenith. Hence atmospheric dispersion correction is required to achieve the best throughput for fiber-fed spectrographs. However, the larger plate scale of the thirty-meter telescope makes it challenging to correct the atmospheric dispersion across the 20-arc-min field of view (2.6m focal plane). Therefore, we designed an atmospheric dispersion corrector for individual objects that fit inside a fiber positioner. Here, we will present the optical design and preliminary simulated results of the atmospheric dispersion corrector.

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Low-radio frequency studies of a sample of nearby galaxies with GMRT

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We have observed seven nearby large-angular-sized galaxies at 0.33 GHz using Giant Metrewave Radio Telescope with an angular resolution of _˜10 arcsec and sub-mJy sensitivity. Using archival higher frequency data at 1.4 or _˜6 GHz, we have then determined their spatially resolved non-thermal spectrum. As a general trend, we find that the spectral indices are comparatively flat at the galaxy centres and gradually steepen with increasing galactocentric distances. Using archival far-infrared (FIR) MIPS 70-um data, we estimate the exponent of radio-FIR correlation. One of the galaxies (NGC 4826) was found to have an exponent of the correlation of _˜1.4. Average exponent from 0.33-GHz data for the rest of the galaxies was 0.63 +/- 0.06 and is significantly flatter than the exponent 0.78 +/- 0.04 obtained using 1.4-GHz data. This indicates cosmic-ray electron (CRe) propagation to have reduced the correlation between FIR and 0.33-GHz radio. Spatially resolved star formation rates (SFR) were estimated for the above galaxies along with 5 galaxies studied previously. For the combined sample of 12 galaxies, the equipartition magnetic fields are correlated with the SFR surface densities at sub-kpc scales and are consistent with model predictions. We have also estimated gas densities for a sub-sample of seven galaxies using archival observations of the carbon monoxide (CO) rotational transitions and the atomic hydrogen (HI) 21 cm line and studied the spatially-resolved correlation between the magnetic fields and gas density. Magnetic fields and gas densities are found to be correlated at sub-kpc scale.

*Speaker

Jet – ISM interaction in the hosts of AGN

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AGN play an important role in the evolution of their host galaxies by injecting energy into the gas in galaxies. In the case of massive galaxies hosting AGN, there are evidences to inidcate AGN playing an important role in regulating star formation in their hosts via the jets, injecting energy into the gaseous halos and regulating the cooling of gas onto the galaxy. In this work, I aim to address the interplay between AGN and the inter stellar medium (ISM) of their host galaxies on physical scales of few parsec. For this, I have taken as a test case a nearby AGN and have used data acquired in different wavelengths such as the sub-mm, radio, infrared, optical and X-rays. Using high resolution data from the Hubble Space Telescope in conjunction with 15 GHz data in the radio from the Very large array, I found the radio emission to spatially coincide wih the ionised outflow. I also found the deficiency of cold molecular gas in the AGN surrounding region which tend to indicate a scenario of AGN inhibiting star formation.

*Speaker

uMUSEing Cartwheel – Star formation history of the post-collisional ring galaxy

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I present the results of an analysis of high-resolution images obtained by the Astrosat/UVIT mission in the collisional-ring galaxy Cartwheel's far ultraviolet (FUV) band. UVIT images were combined with MUSE IFS spectra and infrared bands from publicly available data archives to investigate the Cartwheel galaxy's star formation history over the entire epoch following the galaxy suffered the ring-making collision. The Cartwheel's FUV emission is primarily concentrated in the star-forming outer ring, with no emission from the nucleus or inner ring. All UV-selected regions of the ring have more than one population of stars, with non-ionizing stars producing the majority of the FUV emission over the last 20 to 150 Myr. On the other hand, regions belonging to the spoke have negligible current star formation, with the age of the dominant older population systematically increasing as the distance from the outer ring increases. The presence of populations of various ages in the ring suggests that stars formed in the wave in the past were dragged along it to the ring's current location.

*Speaker

Stellar archaeology in the era of MSE

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The latest DR3 release of Gaia and the major spectroscopic surveys have revolutionized the field of stellar archaeology. The unavailability of the radial velocity of the fainter stars and the accurate ages of stars are some areas for improvement to take advantage of the full potential of Gaia. With MSE, chemical abundances of more than 30 elements are possible, along with accurate radial velocities of faint Gaia stars, which will be a key to understanding the formation epochs and chemical evolutionary timescale and ages of stars. In the era of MSE, facilities such as Vero Rubin Observatory and ELTs will be operational. It is a golden era for stellar physics and stellar archaeology. In this talk, we will highlight the unique capability of MSE compared to the other spectroscopic surveys in the studies of metal-poor stars in Milky Way subsystems and satellite galaxies.

*Speaker

Discoveries from the first phase of uGMRT Low-mass Galaxy Cluster Survey (GLOMACS-I)

Surajit Paul *† [1], Sameer Salunkhe , Swarna Chatterjee , Ruta Kale , Abhirup Datta

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Galaxy clusters are the massive (as high as _~10^15 M_sun) gravitationally bound objects in the Universe. Most of the massive clusters (> 5x10^14 M_sun) have been studied in radio bands which have provided ample evidence for the presence of relativistic electrons and magnetic fields (non-thermal components) in their intra-cluster medium. However, poor clusters (< 5x10^14 M_sun) have not been studied much in radio bands and the status of the non-thermal content in such systems remains largely unknown. They largely remained undetected mainly due to limitations in the sensitivity of telescopes at low radio frequencies. The absence of a theoretical estimate for favourable detection of diffuse radio emission from these objects has also discouraged systematic studies of these objects. Fortunately, the commissioning of the uGMRT and the LoFAR telescopes with unprecedented sensitivity in recent times have opened up the possibilities of their detection. In this changed scenario, we thus aim to search for the diffuse radio emission from the systematically chosen poor clusters starting with the objects in the transitional mass range (10^14 _~ M < 5x10^14). For this survey project, we select a sample of 36 galaxy clusters from low-redshift (z_~0.1) in this mass (M) range from the largest available Planck Sunyaev-Zeldovich cluster list roughly in the GMRT exclusive declination range, adhering to the maximum possible mass completeness and are unbiased towards cluster mergers. In the first phase of this uGMRT Low MAss Cluster Survey (GLOMACS-I), we observed 13 low-mass clusters with the uGMRT at band 3. Interestingly, we detect diffuse radio emissions from most of them. In this talk, I will present all new interesting detections from the first phase GLOMAC survey which includes spectacular discoveries of diffuse emission connected to cluster halo, many steep and ultra-steep spectrum sources, new radio relics and most intriguingly a relic in the core region of a cluster and many more.

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Extragalactic Surveys with the Square Kilometre Array

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SKA project will open up a golden age for radio astronomy, from the mm-to-m wavelength range. Thanks to the wide frequency coverage and high sensitivity provided by the two SKA1 telescopes i.e. SKA1-LOW in Western Australia (50 and 350 MHz), and SKA1-MID in the Karoo of South Africa ($>$ 350 MHz), the users will have access to the long-wavelength radio continuum imaging of diffuse extended large scale structures of the Universe as well as HI and extragalactic spectroscopy on nearby galaxies, AGNs and distant star-forming galaxies that will complement with the multi-wavelength surveys such as MSE, 4MOST, LSST, EUCLID, ATHENA, CTA, etc. In this talk, I will provide a summary of the SKA1 phase observation capabilities, and highlight the synergies with the forthcoming facilities, where both France and India are key collaborators.

*Speaker

IAU WiA WG activities and survey results

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The gender and diversity dimension of science and technology has become one of the most important and debated issues worldwide, impacting society at every level. The International Astronomical Union, through its Executive Committee Working Group on Women in Astronomy, has been a strong advocate for discussing these themes openly and for supporting initiatives that can improve a more balanced representation of diversity in our community. The IAU Women in Astronomy (WiA) Working Group (WG)'s mandate is to collect information, propose measures, and initiate actions in support of, or to advance equality of opportunity for achievement between women and men in astronomy, in the IAU, and the world at large. It has 198 members as of now from all continents and we look forward to welcoming many more members from all over the world. In this talk, I will provide an overview of IAU WiA WG activities as well as results of the recent survey on 'Working Conditions of Women in Astronomy' and the efforts being carried out by the WiA WG Organizing committee and regular members to improve the working conditions of women in Astronomy.

*Speaker

Deep Low Frequency Radio Sky with the uGMRT - Implications for Precision Cosmological Experiments

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In this talk, we present results from some recent observations with the uGMRT (SKA Pathfinder for India) at 300-500 MHz (Band 3) and 120 -240 MHz (Band 2). The target fields those were observed are of ELAIS-N1 (European Large-Area ISO Survey-North 1) and Bootes Field. For Band 3, the best RMS noise obtained is that of 12 uJy/beam (off-source). It should be noted that this is one of the best obtained with the uGMRT so far. We have used most of the state-of-the-art wide-field, wide-band direction-dependent calibration/imaging algorithms in CASA/SPAM for data analysis. The final results are used to characterize the nature of foregrounds both in the spectral domain as well as spatial domain. The obtained dN/dS is then compared with the previous observations of the same field at these frequencies. These foregrounds pose a major challenge in the detection of the cosmological HI signal from the Pre-EoR ($<$ 150 MHz) and post-EoR ($>$ 300 MHz) era. We present here our best estimate of the upper limit on the Post-EoR 21cm power spectrum. We will also present the initial results from the 21cm power spectrum estimation from Post-EoR epochs using ML techniques as well as the ongoing work on an end-to-end pipeline for precision observations with the uGMRT and the SKA in future.

*Speaker

An update on the MACE Telescope

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Very High Energy (VHE) gamma-rays are an excellent tool to explore extremely energetic non-thermal processes in the Universe. Even though ground-based Cherenkov telescopes have discovered large number of galactic (Pulsars, SNRs, X-ray binaries, etc.) and extra-galactic (AGNs, GRBs) sources in VHE band, this number is at least two order of magnitude less than that of high energy band. Considering the VHE attenuation due to Extragalactic Background Light (EBL), lowering the energy threshold of Imaging Atmospheric Cherenkov Telescope (IACT) is essential to detect extragalatic sources at high redshifts (z $>$ 1). A large area imaging Cherenkov telescope MACE has been recently commissioned by HiGRO (Himalayan Gamma-Ray Observatory) collaboration at Hanle, Ladakh, a high-altitude astronomical site in North India. The main objective of the MACE telescope is to study gamma-ray sources in the unexplored energy region _˜ 30 GeV. To achieve this goal, MACE is installed at an altitude of 4270 meters, which makes MACE the highest altitude Imaging Atmospheric Cherenkov Telescope (IACT) in the world. Development of various subsystems of this telescope includes a 21 meter diameter optical collector consisting of indigenously developed 1424 square-shaped diamond turned spherical aluminum mirror facets, imaging camera consisting of 1088 photo-multipliers tubes with uniform pixel resolution and drive system. In this talk we will discuss the key design features, and current status of MACE telescope.

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The Detection of a Large Sample of Dual AGN using GOTHIC and its Implications for Galaxy Evolution

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As galaxies merge their nuclei come closer and eventually become bound in a common envelope. In the process the nuclei may start accreting gas and become starburst nuclei or active galactic nuclei (AGN). So there can be pairs of AGN (also called dual AGN), starburst-AGN pairs and starforming nuclei pairs. The detection of dual AGN is important because they help us understand the formation of super massive black hole (SMBH) binaries, SMBH growth and AGN feedback effects in multiple nuclei systems. In this talk we present an algorithm called GOTHIC that makes a systematic survey of existing imagng data for the discovery of dual nuclei in closely merging galaxies. We have tested GOTHIC on a known sample of merging galaxies and subsequently applied it to a sample of a million SDSS DR16 galaxies lying in the redshift range of z=0 to 0.75 approximately. All of our sample galaxies have available spectroscopic data. We have detected 159 dual AGN in this sample, of which 2 are triple AGN systems. Our results show that dual AGN are not common, and triple AGN even rarer. The color (u-r) magnitude plots of the closely merging galaxies indicates that star formation is quenched as the nuclei come closer and as the AGN fraction increases. The quenching is especially prominent for dual AGN galaxies that lie in the extreme end of the red sequence.

*Speaker