'Early Career Researchers in Radio Astronomy and the SKAO (SKAO)' Abstracts

Talks

Half-century monitoring of SNRs in M82 e-MERLIN and the EVN

Authors

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Abstract

Centimetric-wavelength observations open a uniquely unobscured window onto compact radio sources such as supernova remnants (SNRs), bypassing the severe dust extinction that limits optical and infrared studies. Radio observations enable long-term monitoring of SNRs as their expanding shells interact with the interstellar medium (ISM). Individually, the evolving morphologies of these sources provide insight into local ISM conditions. Collectively, the detection and classification of compact radio sources are essential for constraining wider supernova and star-formation rates, which provide values for a galaxy's initial mass function (IMF), a key ingredient in understanding galaxy evolution. SNe and SNRs that reside in one galaxy can be approximated to be at the same distance, inferring a constant linear resolution and surface luminosity limit, enabling robust population-based studies.

Notably the nearest starburst galaxy in the northern hemipshere, M82 (SN rate 10 times that of the Milky Way) provides the ideal landscape (dist=3.6 Mpc, linear scale=0.017 pc/mas) to study a large population of radio SNRs.

M82 has been extensively monitored across almost 5 decades with high-resolution radio interferometers including SKA pathfinder instrument e-MERLIN and the EVN (Muxlow et al., 1994, 2010; Beswick et al., 2006; Fenech et al., 2008, 2010; Joseph et al., 2011; Gendre et al., 2013; Kimani et al., 2016; Williams-Baldwin et al., 2025), which has identified multiple unusual and notable sources, such as young radio supernova SN2008iz, a potential radio counterpart to intermediate black hole candidate (IMBH) and ultra-luminous X-ray source M82 X-1 (41.37+60.2), exotic radio variable source 41.95+57.5, and a vast collection of SNRs, HII regions and transient sources. This long-baseline dataset with continued

monitoring provides a rare opportunity to probe the life cycles, environments, and demographics of radio SNRs within an extreme star-forming galaxy.

In this work, I present new high-resolution (~50 mas) e-MERLIN imaging of the central nuclear region of M82, obtained in 2015 and 2016 at 5 and 6 GHz respectively, with an improved sensitivity of ~6 μJy/beam. Combining these observations with a comprehensive archival flux catalogue of known SNRs and compact radio sources in M82, I discuss both short- and long-term variability trends in M82's supernova remnant population over five decades of monitoring.

HI mass function from the largest sample of direct HI detections at z>0.2

Authors

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Abstract

In order to understand the build-up of stellar mass and the diversity of galaxies through cosmic times, we need to observe the neutral hydrogen (HI) - the reservoir of raw material that supplies the molecular hydrogen, from which stars directly form. Neutral hydrogen can be detected through the observations of 21cm-line, however due to its relative intrinsic faintness, such observations were mostly constrained to the local Universe ($z<0.1$). Next-generation facilities such as MeerKAT, allow us to push this threshold to higher redshifts. During the talk, I would like to present a sample of 60 galaxies with direct HI detections at redshift range of $0.22<z<0.38$, observed using the MeerKAT radio telescope. To date, only 22 HI galaxies at $z>0.2$ have been published by three different surveys, not allowing for detailed statistical analysis. Our detections greatly enrich the number of the high-redshift sample, allowing us to determine, for the first time, the HI mass function from direct HI observations for redshifts higher than 0.2. We compare our derived HIMF to the one measured for the local Universe and the one predicted by Simba-c simulations and HI spectral stacking for higher redshifts, drawing conclusions about the baryon cycle through cosmic times.

Radio Emissions from Ultra-compact White Dwarfs

Authors

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Abstract

Recent discoveries of long-period radio transients (LPTs) confirmed to host white dwarfs have increased the number of classes of radio-emitting white dwarf binaries, including cataclysmic variables (CVs), white dwarf pulsars, and AM CVn systems. However, key questions remain about accretion and outflow processes in these, particularly in AM CVns, where a white dwarf accretes from a white dwarf or evolved helium star. To date, only one radio detection of an AM CVn exists, and both its validity and emission mechanism remain uncertain. Using observations from the Karl G. Jansky Very Large Array (VLA) and MeerKAT, this study presents the deepest radio luminosity constraints for three AM CVns: AM CVn, HP Lib, and ASASSN-14mv. These data are combined with large survey catalogues, including LOFAR, RACS, and VLASS, to constrain the AM CVn population for the first time. By comparing radio and optical luminosities alongside orbital periods, we explore potential emission mechanisms. Statistical analysis of detected systems allows us to investigate how binary configuration influences radio luminosity. In this talk, I will discuss how this work contributes to our understanding of radio emission processes in compact binaries, and how the SKA will be a powerful means for this in the near future.

The PATCHwork survey: Mining MeerKAT datasets for hundreds of new discoveries

Authors

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Abstract

The MeerKAT radio telescope in South Africa is a relatively new pathfinder of the Square Kilometre Array and is currently the most sensitive radio interferometer for neutral hydrogen (HI) studies with the 21-cm line. It is so sensitive that new HI absorption and emission systems are serendipitously detected. In this talk I present a new survey: PATCHwork, Providing Ancillary science Through Catalogues of HI. By mining Open Time datasets over 250 new HI-rich galaxies have already been detected, a comparable sample size to the LADUMA and MIGHTEE-HI surveys to date. Discoveries include new galaxy groups, a 'dark' cloud lacking any stellar counterpart, and a detection of a high-velocity cloud candidate not detected in previous studies of the Magellanic Stream and surrounding sky. PATCHwork has proved to be a powerful teaching tool for Early Career Researchers - not only is it led by a postdoctoral researcher in myself, but thus far has enabled two summer studentships, an Honours project, and a PhD project, with a Masters project to begin later this year.

Spectropolarimetric analysis of a sample of powerful jets in nearby galaxy groups with MeerKAT

Authors

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Abstract

Determining the properties of the galaxy groups at high redshift can provide important constraints for the formation path of low-redshift galaxy clusters. However, measurements of the hot intra-group medium (IGrM) and the magnetic field strength in groups at z>1 are challenging with current instrumentation. One solution is to constrain them with the Faraday rotation measures (RM) of the extended radio emission from their central active galactic nuclei (AGN). In this work, we select seven nearby powerful radio sources (PKS 0038-09, PKS 0213-13, PKS 0349-27, PKS 0945+07, PKS 1559+02, PKS 2356-61, and 3C 98), forming a representative sample of galaxy groups as analogues to high-redshift objects. Utilizing the spectropolarimetric capabilities of the MeerKAT radio telescope, we investigate the correlation between their RM properties and the existing X-ray measurements of IGrM density and magnetic field strength. We calibrated the deep MeerKAT L-band data and obtained the Faraday rotation measures of the sample using the RM synthesis technique. We analyze the morphologies, spectral indices, depolarizations, magnetic field structures, and RM structures (scatter and structure function) of the sources. All our sources show typical FRII morphology. Low-brightness extensions of the wing-shaped structures are newly detected in several sources owing to the improved sensitivity. L-band spectral index maps suggest that the wings in most objects are likely a part of the backflow, while the north-south wings of PKS 0349-27 are possibly from a previous episode of AGN activity. We find significant differences in and depolarization in the 2 lobes of PKS 0038+09, PKS 0945+07, and PKS 2356-61, likely a signature of the Laing-Garrington effect. Large depolarization is detected at smaller radii from the center of the groups, although its origin is likely complicated. The magnetic field is aligned with the boundary of the lobes and wings, and perpendicular to the radio jet, as found by existing studies. The RM structure functions are computed in the well-resolved objects. We also studied the correlation between the RM scatter of the whole source with $\langle n_e\rangle$ and B in the cocoon. This work tests the concept of constraining n_e and B properties in galaxy groups with RM measurements of a single extended source. More simulation and modeling work is needed for a better interpretation of the results.

Modelling the Effects of Primary Beam Heterogeneity in SKA-Mid for 21cm Cosmology

Authors

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Abstract

21cm Intensity mapping observes the emission from neutral hydrogen (HI) tracing the Universe's large-scale structure, by quickly mapping out large volumes of the sky. As a precursor to the SKA, the MeerKAT telescope is conducting a single dish intensity mapping survey in the MeerKLASS project, which employs each antenna in the array individually, scanning at constant elevation back and forth in the azimuth. So far, MeerKLASS has detected the cross-correlation power spectrum at redshifts z=0.39-0.46 using the L-band and is currently conducting a large survey up to z=1. 45 in the UHF band. The full SKA-Mid AA* will incorporate the MeerKAT array alongside its new larger SKA dishes. However, one challenge in this set-up for HI intensity mapping science is the coherent incorporation of the beam effects in all stages of the analysis. The beam profile injects structure into the foregrounds, which are 3 – 5 orders of magnitude larger than the HI signal, affecting their smoothness across frequency and making their removal via techniques such as principal component analysis more difficult. In this work I present simulation-based results that demonstrate the complications dish mixing can cause for SKA-Mid intensity mapping clustering statistics. SKA-Mid intensity mapping will need to combine data from dishes of two different sizes and designs, introducing challenges due to the beam's dependence on these factors. Detailed modelling of combined primary beam effects in foreground-cleaned data for a mixed dish scenario will allow for the correction of beam structure contaminating clustering statistics, and is key to successfully combining these dishes in the SKA-Mid.

A MeerKAT Search for Narrowband Off-Pulse Radio Emission in Canonical Pulsars

Authors

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Abstract

Despite over six decades of research, the physics governing the radio emission of pulsars is still an open question. The population of canonical radio pulsars are characterised by well constrained pulse profiles with a main pulse and, in some cases, an interpulse separated by ~180° in phase. Off-pulse phases are often assumed to be emission free with no significant phase-aligned emission being present in the average profile. The presence of narrowband off-pulse emission would point to distinct, coherent plasma processes operating in regions of the magnetosphere not associated with the classical polar cap emission. Such emission could arise from the outer magnetosphere, particularly in the current sheet, as has been shown for Millisecond Pulsars (MSPs). This provides a potential low-frequency counterpart to emission sites responsible for high-energy γ-ray emission. Finding a similar result in young, γ-ray pulsars would provide a connection between emission processes in canonical pulsars and MSPs, allowing the development of a unified emission framework.

Here, I present a search for off-pulse emission in the Thousand Pulsar Array (TPA) population of pulsars. This is the most complete search of this kind, covering every single pulse rotation available from 2019 to 2025 on full-resolution MeerKAT data in the UHF and L bands. We analyse ~1500 pulsars using a novel machine learning approach by applying a Faster R-CNN algorithm to dynamic spectrum images of each single pulse in the population. We identify a population of candidate sources exhibiting statistically significant emission outside the main pulse window. Notably, many of these sources are associated with young γ-ray emitting pulsars, with the radio emission in several cases showing phase alignment with the γ-ray profile. This supports a connection between current sheet γ-ray emission and a possible radio counterpart arising from the same region, implying the need for new or modified emission mechanisms to account for radio emission at these locations. These results place constraints on the location and origin of pulsar radio emission, and demonstrate that off-pulse searches provide a complementary probe of the regions responsible for γ-ray production.

Galaxy bias of radio AGN and star-forming galaxies from MIGHTEE and CMB lensing

Authors

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Abstract

Radio galaxies play a significant role in galaxy evolution through feedback mechanisms, making it important to characterise the environments in which they reside. To investigate this, we measure the correlation between the positions of radio sources in the MIGHTEE survey and cosmic microwave background lensing measurements (which trace the underlying matter distribution) from the Atacama Cosmology Telescope over 20 deg^2, detecting the signal at $\sim 4\sigma$ significance. Combining this with measurements of how low- and high-redshift radio samples cluster, we measure how radio galaxies trace the underlying matter distribution across cosmic time. Fitting different environmental evolution models to the data, we find that a model in which radio galaxies evolve in step with the hierarchical growth of large-scale structure is favoured. Using a radio luminosity function, we estimate the fraction of sources that are active galactic nuclei (AGNs) or star-forming galaxies (SFGs) as a function of redshift, and model the individual contributions of AGNs and SFGs to the total clustering signal. This allows us, for the first time, to investigate the connection of radio AGNs and SFGs to their underlying halo environments without individual source classifications. We find that AGNs reside in significantly more clustered environments than SFGs, and that the halo masses of these populations evolve only weakly out to $z \sim 1.5$. Looking ahead, the SKAO surveys will reach similar depths to MIGHTEE but over thousands of square degrees. Combined with photometric redshifts from LSST and Euclid, this increase in volume will provide much tighter constraints on the environments of radio galaxies across cosmic time.

The Astrophysics Centre for Multi-messenger studies in Europe (ACME): paving the way for multi-messenger synergies in the era of the SKAO

Authors

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Abstract

The next decade will be transformative for radio and time-domain astronomy, with the Square Kilometre Array Observatory (SKAO) set to operate alongside major facilities such as LSST and LISA. Maximising the scientific return from these facilities will require a co-ordinated multi-messenger approach to develop concerted observing efforts across electromagnetic (EM) and gravitational wave (GW) facilities.

The Astrophysics Centre for Multi-messenger studies in Europe (ACME) is a new, EU-funded initiative designed to address this by improving accessibility to multi-messenger facilities and expertise across Europe. Currently, ACME offers direct access to leading expertise across 41 infrastructures, spanning radio, optical/IR, X-ray, high-energy, neutrino, and gravitational-wave facilities. ACME provides in-person and virtual support for users pursuing multi-messenger science programs.

In this session, I will present an overview of the ACME initiative and how it can be utilised by early career researchers. I will highlight how coordinated support across radio facilities such as MeerKAT, LOFAR, and e-MERLIN is critical for building future multi-messenger synergies and how the ACME initiative will improve collaboration between radio infrastructures across the UK and internationally. Finally, I will discuss the long-term legacy of ACME and outline practical pathways for the radio community to expand such multi-messenger synergies over the next decade.

From star formation to AGN jets: a probabilistic approach to the MIGHTEE radio sky

Authors

Charlotte Jackson (1)

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Abstract

Next-generation radio surveys with SKA pathfinders such as MeerKAT are transforming our view of star-forming and active galaxy populations. However, in the increasingly accessible lower luminosity regime, disentangling their contributions to the radio continuum has become a more challenging- and more important- task than ever. I will present a new, self-consistent Bayesian methodology for defining the star formation-radio continuum correlation, based on 1.4GHz MIGHTEE observations of 13,000 sources in the COSMOS field, combined with detailed FUV-FIR spectral energy distribution modelling. The framework enables a flexible, data-driven measurement of the relationship, inference of any potential evolution with redshift and stellar mass, and probabilistic identification of a population of radio AGN while fully accounting for observational and modelling uncertainties.

Using these results, I will then show that the fraction of inferred jetted AGN varies systematically with host-galaxy and AGN properties, such as accretion rate and stellar mass, providing insights into the conditions required for jet production. I will then compare these findings to results from a study of SDSS quasars observed with LOFAR, testing whether a common ground can be found between jet launching across AGN mass scales.

Wide-field on-the-fly imaging with MeerKLASS interferometric data : Exploring self-supervised classification and the effects of bright sources.

Authors

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Abstract

The MeerKLASS survey takes advantage of the speed and sensitivity of the MeerKAT telescope. The speed of the MeerKLASS scans is due to the On-The-Fly (OTF) scanning mode. However, this currently introduces smearing in the interferometric images that must be corrected. Although this will be corrected in future with a fix to the correlator, for the moment this makes deconvolution and imaging more complex.

The observations can be used to produce wide-field images with good signal-to-noise ratio. Such wide-field images would allow for large numbers of sources to be detected and classified.

Improving the quality of these images is important to allow for clear detections by automated systems. Currently, bright sources produce large artefacts, and introduce noise even at radial distances.

This project aims to contribute to improving the current imaging pipeline for the OTF data, as well as training a vision transformer on the MeerKLASS OTF images, with the aim of classifying sources.

In this presentation I will discuss the effects of bright sources on the OTF images, as well as the tests performed on the pipeline in order to isolate effects of parameters such as cell size. I will also present preliminary explorations of the use of vision transformers trained using the Image Joint Embedding Predictive Architecture (IJEPA) applied to radio images.

MeerKAT is a key stepping stone in developing the techniques and tools such as these, which are necessary to handle and exploit the large volumes of data expected from the SKA. Testing and validating pipelines such as these is a key link in shaping the science of the SKA.

From atoms to voids: constraining cosmology with voids found by MeerKAT

Authors

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Abstract

The 21-cm signal produced by neutral hydrogen (HI) is a unique tracer of the structure in the universe throughout cosmic history. Since cosmological information is found at the largest scales of the universe, low-resolution maps of the sky are suitable for constraining cosmology. To build these maps, we can use a technique called HI intensity mapping, where we integrate the entire redshifted HI emission in each pixel of observation across many galaxies, instead of resolving them individually. This enables deeper surveys to be carried out beyond the local universe. MeerKLASS, the MeerKAT Large Area Synoptic Survey, is set to provide the largest single-dish HI intensity maps to date, expecting to reach 2500 cumulative hours of observation across 10000 deg^2 by 2028.

Voids are generally defined as low matter density regions on intergalactic scales (e.g. Cai and Neyrinck 2025), making them sufficiently large that they can be consistently found with HI intensity mapping experiments, assuming foreground cleaning is effective (e.g. White and Padmanabhan 2017). Owing to their lack of matter, individual voids act as unique laboratories for studying cosmic expansion and dark energy, and the statistical properties of the void population provide competitive constraints on the validity of our current cosmological model.

We propose the use of HI intensity mapping single-dish data from the wide-area survey MeerKLASS for building void catalogs up to $z\approx1$, which in turn may be used in probing cosmological parameters through their population statistics, alongside the Alcock-Paczynski test.

We present preliminary findings on the detectability of voids with MeerKLASS, based on simulation results, and the expected constraining power of this population on the validity of our current cosmological model.

Constraining ΛCDM with 21cm-Weak Lensing Cross-Correlations: A Density-Split Analysis from SLICS to SKAO

Authors

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Abstract

Weak gravitational lensing is a powerful probe of the evolution of cosmic large-scale structure; when combined with 21cm intensity mapping, it provides a robust multi-tracer framework capable of overcoming the systematic limitations of individual surveys. We utilised the Scinet Light Cone Simulations (SLICS), which mimic the 1,000 deg^2 footprint of the KiDS survey, to generate 21cm brightness temperature maps from simulated matter density distributions. 2 point correlation statistics are measured using TreeCorr module allowing us to visualise the environmental dependence of the correlation signal from under-dense regions such as voids, to high-density regions such as clusters; the intuition of the approach is to probe how neutral hydrogen traces dark matter.
We apply a density-split framework to these maps to calculate the cross-correlation between fluctuations in the 21cm signal and galaxy shear in the lensing maps. To account for instrumental signal degradation, we implement Gaussian beam smoothing at scales of $\theta = [0, 5, 10, 20]$ arcminutes, representing the transition from an idealised scenario to the expected SKAO beam resolution. Extending this analysis to the Cosmo-SLICS suite allows us to investigate the sensitivity of this cross-correlation to variations in the Hubble constant (h), the matter density (Ω_m), and the amplitude of late-time fluctuations (σ_8). Finally, we provide forecasts for the Square Kilometre Array Observatory (SKAO) by scaling our methodology to a 20,000 deg^2 survey area. Preliminary results identify the specific angular scales at which the density-split signal provides $>1\sigma$ discrimination between models, defining the regime in which the SKAO can effectively break parameter degeneracies, offering a high-precision path toward constraining the fundamental properties of our universe in the coming decade.

The UK SKA Regional Centre: Opening Doors for the SKA Era

Authors

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Abstract

The UK SKA Regional Centre (UKSRC) has entered an exciting new phase, welcoming its first external users in early 2026. In this talk, I will present an overview of the current state of the UKSRC — from the computing infrastructure and data services it provides, to the tools and workflows being developed to support users from data access through to scientific analysis.

The UKSRC forms part of the global network of SKA Regional Centres being established ahead of SKA operations, playing a central role in ensuring UK astronomers are well-positioned to exploit SKA-scale data. I will discuss how the centre is evolving in response to the real demands of its first user cohort, and what it looks like in practice to support researchers through the full data lifecycle on UK SRC infrastructure.

I will also outline the opportunities available for the wider community to get involved. The UKSRC is designed to be an open and inclusive facility, and this talk aims to give a clear picture of where we are today and how the community can engage as we look ahead to SKA operations.

Posters

Studying the nearby Universe with e-MERLIN: an update to the LeMMINGs survey at 5 GHz and 50 mas resolution

Authors

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Abstract

In this poster, I will highlight e-MERLIN's unique ability to probe sub-arcsecond structures of nearby galaxies using the LeMMINGs survey: a statistically complete investigation of low-luminosity AGN (LLAGN), which has uncovered weak jets, nuclear activity, and multi-wavelength correlations across different AGN types. I will provide an update to the LeMMINGs survey through recently published 5 GHz 50 mas resolution radio images which detect compact radio emission co-incident with the optical nucleus in 69/280 (24%) sources. The number of detections in the 5 GHz sample have fallen dramatically, revealing contamination from jets, star formation and/or mis-identification of LLAGN in the previous 1.5 GHz sample, providing a relatively clean sample of nuclear radio emission in nearby galaxies. I will also present ongoing work showing how this affects the fundamental plane of black hole activity, paying careful attention to systematic problems with fitting the correlation.

Halfway to cosmic noon: New HI windows on environmentally driven galaxy evolution with MeerKAT

Authors

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Abstract

In the hierarchical structure formation picture, galaxies, groups and clusters grow over cosmic time through the gravitational clustering, accretion and merging of smaller structures. As galaxies evolve and migrate through the cosmic web from the lower-density field into denser environments, various astrophysical processes influence their stellar populations, morphology, interstellar medium and star-formation activity, eventually resulting in the overall quenching of star-formation. These processes range from tidal interactions and mergers between galaxies to hydrodynamical events such as ram-pressure stripping. Which of the various processes dominate at which stellar masses and in which local (galaxy-galaxy) and global (cosmic web) environments, however, is not yet clear.

To observe the effects of the environment, we turn to neutral atomic hydrogen (HI). As a gas tracer, HI extends far beyond the optical disk of most field galaxies; therefore, is the first frontier of the ISM to be affected by the environment. This makes it our premier tracer for the evolution of galaxies, especially with regards to the environment.

Previous works have demonstrated that galaxies closer to filaments are more HI gas-poor than galaxies located further from the filament. While others have focused on the effect of denser environments of galaxy clusters.

However, these studies have been limited to the local Universe ($z < 0.1$). This is due to the intrinsic faintness of the HI 21cm line. This faintness is not a problem in the local universe, as HI is incredibly abundant. At $z > 0.1$, detections become increasingly difficult as a result of this faintness. This gives rise to a cosmological desert where many of our scaling relations (used to track this evolution over cosmic time) become unreliable and our general understanding of HI at this epoch is poor.

The SKA-mid precursor MeerKAT is of such sensitivty that we are able to begin to push further into these uncharted epochs, especially when we are able to deploy statistical techniques such as spectral line stacking. We have obtained MeerKAT 32k L-Band observations covering a cosmological volume of 52 x 52 Mpc^2 (at z~0.43), enabling the exploration of these new HI windows in an effort to push to higher redshifts and begin to answer questions such as "nature" vs "nurture" for galaxies halfway to cosmic noon.

In this talk, I will present preliminary results from the observations MeerKAT of the cluster A2626. I will explore the large scale structure and galaxies identified at higher redshift behind this cluster, at z~0.43, where we believe there to be a filament-like overdensity. I will show a first-pass characterisation of the environment, looking at finding techniques and a first-pass HI data cube from these observations as we push to higher redshifts.

Surrogate modelling of the REACH beam pattern for robust 21-cm signal extraction

Authors

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Abstract

The Radio Experiment for the Analysis of Cosmic Hydrogen (REACH) aims to observe the sky-averaged redshifted 21-cm signal from neutral hydrogen between 50 - 200 MHz which will help researchers understand the nature of the first luminous sources to form in the universe, the first X-ray binaries and black holes and the transition from neutral to ionized universe. However, the signal is buried beneath instrumental systematics that are 2 orders of magnitude brighter and foreground emission from our own and other galaxies which is around 5 orders of magnitude brighter. In order to confidently extract the 21-cm signal from our data the REACH collaboration has developed a detailed Bayesian forward model of our observations. In this talk I will discuss how we are building surrogate models for the beam pattern of the REACH dipole antenna. The beam pattern shapes how the typically smooth synchrotron emission from our own and other galaxies appears in our data and it is impacted by the physical dimensions of the antenna and the surrounding environment. Modelling this effect is crucial for a confident detection of the signal as it can mimic or hide the 21-cm signal. Currently the REACH inference pipeline assumes absolute knowledge of the instrument, however Cumner et al. (2024) demonstrated that inaccurate modelling of the physical dimensions of the antenna at the level of millimeters can prevent a detection of the 21-cm signal. Surrogate modelling of the beam pattern alongside the 21-cm signal and foregrounds offers a way to capture variations in the beam pattern over time due to changes in the environment and account for construction errors. However, simulating and emulating the beam pattern is non-trivial and the parameter space is high dimensional with thousands of pixels on the sky at each MHz between 50 and 200 MHz and up to 10 free parameters describing the geometry and environment. I will demonstrate how we can emulate the REACH beam pattern at the accuracy required to capture millimeter changes in the antenna's geometry and outline a path to pipeline integration.

The MeerKAT Radio View of Star Formation in The Galactic Plane

Authors

Laurinda Macaringue (1), Dr. Jan Forbrich (1)

(1) University of Hertfordshire

Abstract

The MeerKAT radio interferometer, as an SKA precursor, is bringing a new radio perspective of the southern sky, providing opportunities to find radio counterparts to well characterized Young Stellar Object (YSO) in the Galactic Plane. We cross-matched the SARAO MeerKAT radio compact sources catalogue with the SPICY catalogue to identify YSOs candidates associated with radio emission using a 1.5 arcsecond search radius, with a chance alignment experiment confirming a false-match rate of aproximately 2.5%. We identify 1106 radio-detected YSO candidates spanning Class I, II, III, and Flat SED types. A clear correlation between radio detection fraction and YSO evolutionary class is our primary result, with detection rates rising steeply towards earlier classes, pointing to a direct link between radio activity and evolutionary stage. Among the 563 sources with well-constrained radio spectral indices (uncertainty ≤ 0.4), both thermal and non-thermal emission mechanisms are present: Class II and Flat SED sources tend towards non-thermal emission, while Class I sources show a mixture of both. Planetary Nebulae are identified as the most common, though still rare contaminant (a few percent match with known PNe). A cross-correlation with VLASS at higher radio frequencies is ongoing and will be presented at the meeting. This work produces the largest catalogue of Spitzer-identified YSOs with radio counterparts to date, and demonstrates the potencial of MeerKAT as a percursor of YSO science with SKA.

Probing the Orion Nebula Cluster: A Radio Perspective on Photoionised Discs (Online)

Authors

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Abstract

The influence of external ultraviolet radiation from OBA-stars centrally shapes disc evolution, with important implications for disc survival and planet formation. Far-ultraviolet (FUV) radiation ($6\,\mathrm{eV} < E < 13.6\,\mathrm{eV}$) drives photoevaporative flows from the disc surface, which are subsequently ionised by extreme-ultraviolet (EUV) radiation (\(13.6\,\mathrm{eV} < E < 0.1\,\mathrm{keV}\)), producing free–free emission. This emission traces the ionised component of the flow and enables estimates of electron densities, from which mass-loss rates are derived. While earlier investigations at other wavelengths explored these processes in the Orion Nebula Cluster (ONC), significant obstacles remain, particularly due to the high brightness contrast near $\mathrm{\theta^1 \, Ori \,C}$ and dust extinction. Centimetre-wavelength observations, unaffected by dust absorption and scattering, offer a way to overcome these challenges. Here, we present a radio census of photoionised protoplanetary discs in the ONC, based on 30 hours of single-pointing C-band (4–8 GHz). The synthesised beam is $ \SI{0.28}{\arcsecond}\times \SI{0.23}{\arcsecond}$, corresponding to a physical resolution of $\approx112\times 92$ AU at ≈ 400 pc.

We analysed radio images to identify photoionised protoplanetary discs (proplyds), using the HST/ACS atlas of protoplanetary discs in the Orion Nebula (Ricci et al., 2008) as the reference sample. In total, we detect 132 known proplyds, along with three additional proplyds previously catalogued outside the main atlas, yielding 135 known proplyds overall. We recover 75$\%$ of the atlas' photoionised discs, achieving a 100$\%$ detection rate within $\SI{1.26}{\arcminute}$ ($\approx 0.15 \, \mathrm{pc}$) of θ^1 Ori C. Beyond this radius, non-detections become common and begin to overlap with detections,despite high sensitivity in the inner region. This indicates that factors other than proximity and observational sensitivity may significantly influence detectability.

We estimated mass-loss rates by two independent methods—assuming ionisation equilibrium and using the observed free–free emission—finding values on the order of $10^{-7}M_\odot\,\mathrm{yr^{-1}}$, consistent with previous studies and confirming that significant mass loss is ongoing.

We investigated the influence of FUV radiation on the radio detectability of proplyds using the likely FUV irradiation values from Anania et al. (2025). Our results indicate that at high FUV flux values, the radio detectability of proplyds increases significantly. This finding suggests a strong relationship between FUV flux and the radio detectability of proplyds. Collectively, these results set the stage for what will be possible with large-scale surveys using the Square Kilometre Array.

Insights into Intermittent Pulsars Ahead of the SKA

Authors
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Abstract
Pulsars are the rapidly rotating, highly magnetised remnants of supernova explosions. Charged particles accelerated from the neutron star surface along open magnetic field lines near the poles cause coherent beams of electromagnetic radiation, sweeping through space like a lighthouse; these are detected at Earth as pulsating radio signals. Since their discovery, notable characteristic variations have been observed, allowing their categorisation into distinct populations. Intermittent pulsars are so named for their abrupt switching between detectable radio emission and apparent radio silence (turning ON and OFF) for timescales of days to months.

We present a comprehensive timing analysis of two long-term intermittent pulsars, PSR J1929+1357 and PSR J1910+0517, originally discovered with the now-decommissioned Arecibo Observatory. Our study utilises observations obtained with the Lovell Telescope at Jodrell Bank Observatory between November 2011 and October 2024. The derived timing solutions reveal different intermittency behaviours for the two pulsars: while PSR J1910+0517 maintains a steady duty cycle (fraction of ON time), we find that PSR J1929+1357 displays two statistically distinct activity cycles, reflected as well in varying spin-down rate measurements. This may provide valuable insight into the pulsar emission mechanism and its link to magnetosphere dynamics and rotational evolution.

The continued observation of these objects also has significant implications for pulsar population studies. Following its initial follow-up detection, more than 90 subsequent observations of PSR J1929+1357 over three months resulted in no detections, implying that the probability of confirming its discovery was less than 1 in 3000. This suggests that a substantial population of similar, intrinsically bright but highly intermittent pulsars may remain undetected, potentially increasing the known pulsar population by several thousand.

These results demonstrate the importance of long-term monitoring of these pulsars and highlight the transformative potential of the SKAO. The enhanced sensitivity and survey capabilities of SKA-Low and SKA-Mid will enable the discovery and systematic study of many more intermittent pulsars, providing new constraints on neutron star magnetospheres and the evolution of some members of the pulsar population.

Exploring Low-Frequency Radio Emission from Massive Young Stellar Objects (Invited)

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Abstract

Massive stars form in deeply embedded environments where accretion, outflows, and ionization overlap, making it difficult to disentangle the origin of radio continuum emission. While centimetre-wavelength observations are often dominated by thermal free–free emission from H II regions, an increasing number of massive young stellar objects (MYSOs) show evidence of collimated jets and non-thermal synchrotron emission from shocks. Low-frequency observations provide a powerful diagnostic, as free–free absorption suppresses thermal emission, while non-thermal jet emission can remain detectable. We investigate low-frequency radio counterparts to infrared-selected massive star-forming regions by cross-matching the RMS catalogue with LOFAR LoTSS DR3 (120–168 MHz). We analyse 62 LOFAR detections associated with 42 RMS sources using radio–infrared overlays and spectral indices. Several sources exhibit negative spectral indices and asymmetric morphologies consistent with synchrotron-emitting jets. The detection of low-frequency emission and potential spectral turnovers provides constraints on jet–ISM interactions, demonstrating the capability of LOFAR to identify and characterise non-thermal jets in massive star formation.