
Ailing Wang
Shanghai Astronomical Observatory, Chinese Academy of Sciences
Title: VLBI Observations of a sample of Palomar-Green quasars
Abstract: This study utilises multi-frequency Very Long Baseline Interferometry (VLBI) to examine the radio emission from 10 radio-quiet quasars (RQQs) and four radio-loud quasars (RLQs). The diverse morphologies, radio spectra, and brightness temperatures observed in the VLBI images of these RQQs, along with the variability in their GHz spectra and VLBI flux densities, shed light on the origins of their nuclear radio emissions. The total radio emission of RQQs appears to stem from non-thermal synchrotron radiation due to a combination of active galactic nuclei and star formation activities. However, our data suggest that the VLBI-detected radio emission from RQQs is primarily associated with compact jets or corona, with extended emissions like star formation and large-scale jets resolved by the high resolution of the VLBI images. Wind emission models do not fully align with the VLBI observations. Unlike RLQs, where parsec-scale radio emission is dominated by a relativistically boosted core, the radio cores of RQQs are either not dominant or mixed with significant jet emission. RQQs with compact cores or core-jet structures typically have more significant variability, with flat or inverted spectra, whereas jet-dominated RQQs have steep spectra and unremarkable variability. Future high-resolution observations of more RQQs could help determine the fraction of different emission sources and their associated physical mechanisms.

Aleksandra Krauze
Nicolaus Copernicus University (NCU)
Title: Compact AGNs at low frequencies
Abstract: Compact Active Galactic Nuclei, such as Gigahertz Peaked Spectrum (GPS) and Compact Steep Spectrum (CSS) radio sources are (a) young, and evolving into classical double radio galaxies however, in some cases their evolution may be (b) temporarily frustrated by their host environments or (c) transient on short timescales <104–105 yr. Regardless of these hypotheses, however, GPS and CSS sources are the important signposts of relativistic jet feedback in evolving galaxies. The low frequency radio observations allow us to observe the oldest plasma in such sources and thus the reconstruction of the source's history and understanding of the dynamics of radio galaxies and their interaction with their environment from the very beginning. Here, we present the preliminary results of the LOFAR study of a sample o 90 CSS sources. We looked for halos around GPS/CSS sources as a probe of past cycles of radio activity and for the peak location and slope in the optically thick part of their synchrotron spectra using LoTSS and LoLSS measurements. In addition, we also performed an analysis of infrared observations from the WISE satellite for the entire sample, and an analysis of the evolutionary status of these sources based on the relationship of the spectral turnover frequency to the linear size. The analysis of the radio properties and evolutionary status of these objects will be updated as the LoLSS observations proceed and supplemented with the high-resolution radio maps of some sources in near future.

Alex Andersson
University of Oxford
Title: Discovering radio transients with machine learning and citizen science
Abstract: Current and upcoming interferometers can now sample wide swathes of the radio sky with unprecedented sensitivity and cadence. As a result, we can now discover radio transients across an immense range of astrophysical regimes - from flare stars to FRBs. I will discuss recent, serendipitous discoveries being made with the MeerKAT radio telescope and how we can make the most of new

facilities coming online. This includes how citizen scientists have scoured our data and uncovered 100s of new variable sources. This is the first ever crowdsourcing project dedicated to radio transients in this manner and has uncovered variable sources as different as nearby flare stars, pulsars and AGN. I will also discuss novel machine learning techniques being developed to speed up the search for interesting and anomalous sources, methods that will prove invaluable as we look towards observatories such as the SKA.

Ann Njeri
Newcastle University
Title: The Quasar Feedback Survey: zooming into the core of radio emission with eMERLIN and VLA.
Abstract: Understanding how quasars ``feedback'' on their host galaxies remains a significant challenge of galaxy formation theory. Observations have connected the prevalence of galaxy-wide ionised outflows to the level of radio emission and, consequently, show that understanding the origin of radio emission in typical quasar host galaxies is a key piece of the ``feedback'' puzzle. Towards addressing this, we are performing a systematic study of a representative sample of 71 quasars at z < 0.2 (LAGN ≳10^45 erg/s). Whilst VLA data have revealed that two thirds of the sample show jet/lobe structures on > ~kpc scales, the data are not sensitive to morphologies on smaller scales and show that majority of the radio emission is located in featureless/unresolved nuclear regions. Therefore, the origin of the significant radio emission remains unknown, resulting in missing critical insight into the quasar-host galaxy connection. Using e-MERLIN imaging at C-band, I will show how we are disentangling the different radio production mechanisms at sub-kpc scales. Combining e-MERLIN data with VLA data, we have determined the primary outflow driving mechanisms, and assessed the dominant source of radio emission, across physical scales of ~100pc to ~10kpc.

Arpita Misra
Astronomical Observatory of Jagiellonian University
Title: Multifrequency analysis of a post-merger X-shaped radio galaxy
Abstract: Radio loud active galaxies mostly produce jets that are highly collimated and inversion symmetric about their host galaxies. Such galaxies sometimes display large-scale extended radio emissions that also comprise X-shaped galaxies. The morphological evolution of X-shaped radio galaxies is explained using several theoretical models, including galaxy mergers. However, a direct link between a perturbed radio morphology and a galaxy merger remains observationally sparse. Here we investigate a unique X-shaped radio galaxy J1159+5820 that has a restarting pair of inner lobes, and whose host displays the optical signature of a post-merger system. Multifrequency radio observations of the source were conducted, various particle injection models were fitted to its radio spectra, and modelling of the core spectrum was done using particle absorption models. Spectral ageing analysis performed on the wings and lobes of the radio source favours a jet reorientation model. Here I will present my results and will discuss the possible mechanisms behind the formation of the radio structure.

Athanaseus Johannes Tishetso Ramaila
SARAO / Rhodes University
Title: A high-dynamic range calibration of MeerKAT L-band observation of Pictor A
Abstract: Pictor A, located 480 million light-years away, is a significant radio source in the southern sky, offering a unique chance to comprehend radio galaxy jets, the magnetic field structures, and the termination shock environment of the radio lobes. Our primary objective was to extensively and meticulously investigate the Pictor A radio galaxy in full polarization. We used the MeerKAT telescope at L-Band to acquire high-resolution and high-dynamic range interferometric radio images

of the Pictor A radio galaxy. Our observations indicate the existence of a western jet, connecting the radio nucleus to a hotspot with no precise detection of the corresponding counter-jet. The overall lobe structures agree with previous studies conducted at similar frequencies, except for identifying significant diffuse emission between the lobes close to the active galactic core. This study comprehensively describes the steps involved in the processing pipeline, including the data reduction, calibration, and imaging processes. Moreover, we highlight the challenges and limitations encountered during the data processing stage and the techniques to overcome them.

Clara Blanchard
Université d'Orléans
Title: Spiders pulsar binaries with the Nançay Radio Telescope
Abstract: The timing of spider pulsars is known to be affected by instabilities caused by rapid variations of their orbital periods. Those pulsars are also subject to eclipsing events, when the pulsar beam is totally or partially masked by the companion cloud. I will present an overview of the spiders observed by the Nançay Radio Telescope with a focus on their orbital stability properties. I will also present preliminary results from an ongoing investigation of companion star characteristics, through an analysis of DM variations around eclipses and eclipse properties.

Davide Pelliciari
Istituto di Radio Astronomia (IRA-INAF)
Title: Investigating the FRB-magnetar connection in nearby galaxies
Abstract: Fast radio bursts (FRBs) are intense, millisecond-long radio signals of unknown extragalactic origin. The detection of the very first galactic FRB-like signal from the magnetar SGR J1935+2154 has strengthened the connection between FRBs and magnetars. Using the Northern Cross radio telescope, we conducted a targeted search for FRBs in a sample of seven nearby galaxies, with a total observation time of $\sim$ 700 hours. Our observational campaign yielded one FRB detection in the direction of the galaxy M101, observed with a DM = 302.9 pc cm−3, which supports the idea that it originated from a much distant source. From our non- detections on the galaxies we observed we can place an upper limit of 0.4 yr−1 on the rate of FRBs from magnetars like SGR J1935+2154, which disfavors them as the sole progenitors of cosmological FRBs, supporting the evidence for at least another, more exotic population of magnetars, not born via core-collapsed supernovae.

Eoin O'Kelly
University of Hertfordshire
Title: Nonthermal Radio Flaring from Young Stellar Objects in the Orion Nebula Cluster
Abstract: We present our preliminary results of an extreme radio flare source within the Orion Nebula Cluster (ONC) and the spectral index evolution associated with the flare event. The ONC is one of the most studied astronomical objects and is an active star forming region. Radio observations allow further studies of the high energy processes occurring that result in radio flares and variability. The goal is to observe radio flares and variability associated with Young Stellar Objects (YSOs), in this context radio emission is either thermal free-free or non-thermal gyroschynrotron emission. There are limited examples of radio flares from YSOs on shorter timescales and therefore are not well understood. The VLA data has enabled imaging and measurements of the radio flux density and spectral indices of a few variable radio sources, although currently only one extreme flare source provides a high enough signal-to-noise to allow reliable spectral index time series analysis. This flare is thought to be the result of magnetic reconnection events that leads to non-thermal emission. The spectral index evolution associated with radio flares within YSOs is a poorly understood area and currently there are no other spectral index time series

of such high-energy flaring events. The VLBA is offering a complementary perspective of YSO radio emission at very high angular resolution, which is uniquely enabling a census of the nonthermal radio emission. The high resolution of the VLBA also allows precision astrometry and proper motion measurements of embedded YSOs. The upgrades to the VLBA correlator allow observations of hundreds of objects simultaneously whereas previously this was limited to only a few objects. Overall, the VLA and VLBA will allow a deeper understanding of the physical processes and radio emission associated with YSOs occurring within the ONC.

Ezequiel Albentosa-Ruiz
Universitat de València
Title: Astronomical Analysis of Next-Generation Global Geodetic Observations
Abstract: The VLBI Global Observing System (VGOS) is a next generation VLBI system developed by the International VLBI Service for Geodesy and Astrometry (IVS) to achieve geodetic observations with ultra-wideband receivers, observing from 2 to 11 GHz. These receivers observe in linear polarization to achieve optimal polarization purity. This talk delves into the intricacies of VGOS data calibration, including the conversion from linear to circular polarization using PolConvert and the implementation of the Wideband Global Fringe-Fitting algorithm. Distancing ourselves from the conventional geodetic approach of fringe-fitting separately for each baseline, we present the first results obtained by performing a Global Fringe-Fitting across a global IVS array, comprising 8 antennas with intercontinental baselines, for the complete VGOS bandwidth.

Francesco Azzollini
University of Glasgow
Title: Type III Solar Radio Bursts From the Sun to the Earth
Abstract: When solar flares occur, they trigger a process where electrons gain acceleration. Subsequently, these accelerated electrons are able to escape along open magnetic field lines and are detected through direct measurements near Earth.
During their propagation through the surrounding plasma, these electrons stimulate the formation of electrostatic waves known as Langmuir waves, a phenomenon caused by Landau instability. These Langmuir waves, in turn, generate radio emissions recognized as type III solar radio bursts.
Previous works (Krupar et al 2014, Weber 1978) looked at the power density of these bursts as a function of frequency and agree on a maximum power density around 1 MHz.
Similarly, here we focus on reproducing earlier results starting from the analysis of 24 type III radio bursts. This result, along with the previous ones is compared to the prediction of the analytical model for non-linear diffusion and advection of an electron cloud traveling through the heliosphere. Moreover, we analyse how the peak emission frequency changes over time, in order to deduce the speed of the exciter responsible for the generation of these bursts.

Geferson Lucatelli
Jodrell Bank Centre for Astrophysics
Title: A multi-resolution study of the star-formation of local Ultra/Luminous Infrared Galaxies
Abstract: Local Luminous and Ultra-Luminous Infrared Galaxies (U/LIRGS) exhibit fascinating optical and radio morphologies, having high radio and infrared luminosities. This is due to their environment having extreme conditions, caused by massive merger interactions and/or AGN (Active Galactic Nuclei) activity. The two mechanisms, alongside feedback, allow high Star Formation (SF) activity to take place, from dozens up to hundreds of solar masses per year. These regions of star formation span a wide range of spatial scales, from pc scales at the nuclear region of these galaxies to large-

scale structures above 1 kpc. To understand better the role that star formation has on these systems, we require a multiscale and multi-frequency study of the properties of SF at all possible physical scales. We use e-MERLIN and JVLA radio observations to disentangle the total emission from SF in relation to AGN activity and nuclear starburst and characterize its morphology across multiple linear scales.

Inkeri Syrjärinne
Aalto University Metsähovi Radio Observatory
Title: Properties of Narrow-line Seyfert 1 galaxies
Abstract: Narrow-line Seyfert 1 galaxies (NLS1) are believed to be young and disk-like active galactic nuclei (AGN) with relatively small supermassive black holes. Yet many of these galaxies host relativistic jets that have been observed at high radio- and gamma frequencies. This is against the outdated jet paradigm which states that only massive and old elliptical AGN can host such powerful jets. However, the majority of NLS1-galaxies do not seem to have any significant activity at radio frequencies, and it remains unknown why only some of them are able to launch jets. Metsähovi Radio Observatory has monitored NLS1-galaxies for ten years with their 14-meter radio telescope at 37 GHz frequency. This had led to a unique high radio frequency data sample of approximately 200 NLS1s, of which 100 sources are observed actively. Metsähovi has observed powerful radio flares in several of the monitored NLS1-galaxies. At such a high frequency, the detections most likely originate from the synchrotron radiation of a relativistic jet. The nature of NLS1-galaxies is still not understood: there is a lot of variation between them and many of them are misclassified. Hence it is important to find out more about the host galaxies of NLS1s. In this talk I will present my analysis of typical features of jetted NLS1-galaxies that have been observed at radio frequencies. For this I used radio data from Metsähovi and other radio telescopes, such as VLA. I will also discuss determining the stellar masses of approximately 150 NLS1-sources that had enough data to do so. The stellar masses were calculated with the CIGALE code which uses multi-frequency data to create SEDs of the galaxies. They can provide us with insight into whether there are significant differences between the stellar masses of different types of NLS1s, for example jetted and non-jetted.

Isaac Radley
University of Leeds
Title: A Multi-wavelength Survey of the Ophiuchus Star Forming Region: A Precursor Study for SKA-MID
Abstract: Planet formation in protoplanetary disks requires the successive agglomeration of ISM-like dust particles spanning 12 orders of magnitude from micrometre to kilometre sizes. Understanding the intricacies of this oligarchical dust growth model requires observations which can trace dust growth across the millimetre and centimetre regime. Therefore, we require observations that enable us to constrain the distribution of large grains both spatially and temporally across planet-forming disks. Using the JVLA's X, K and Q bands, we present a multi-epoch, multi-wavelength study of the nearest and most populated star-forming region Ophiuchus A from 10-50 GHz. Our observations attain an angular resolution of 10 au and detect dust and ionised gas emission for 18 YSOs across evolutionary classes 0-III. Through the combination of JVLA and archival ALMA data at high angular resolution, we can disentangle the observed emission into dust-thermal and contaminating emission from free-free processes. Additionally, we can constrain the variable nature of YSOs and gain insight into jets, winds, and outflows. Our preliminary results indicate the majority of our YSOs exhibit variable behaviour in both K and Q bands over a timescale of 1 to 37 days which has significant implications for multi-epoch centimetre observations of YSOs. Together, our results provide an essential precursor study for SKA-MID. These critical constraints on the nature of the mm and cm

emission in Oph A will build the foundation for future interferometric observations of YSOs at centimetre wavelengths.

Jacob Brooks
University of Central Lancashire
Title: Exploring the use of generative adversarial networks for post-correlation identification of radio frequency interference detected by e-MERLIN
Abstract: Contamination of the radio spectrum is increasing, and already severely impacts the ability of radio observatories to produce high quality observations of radio phenomena. The identification and removal of this Radio Frequency Interference (RFI) is, therefore, a critical area of research. Machine learning methods potentially offer the ability to generalise across observatories and their observations, without needlessly sacrificing valuable observing time. I will describe my work in using the Generative Adversarial Network (GAN) architecture as a method of automatically flagging RFI, using manually flagged e-MERLIN visibilities as training data.

Jacob Burba
University of Manchester
Title: Bayesian 21 cm Power Spectrum Estimation With Gaussian Constrained Realizations and Gibbs Sampling
Abstract: The highly redshifted 21 cm signal from neutral hydrogen is a promising probe of the period in the universe's history known as the Epoch of Reionization (EoR), where the first luminous sources ionized the surrounding intergalactic medium. Current interferometric experiments targeting this signal from the EoR are seeking a first detection in the form of the 21 cm power spectrum. Observation of this distant cosmological signal has proven difficult, however, due to the presence of artificial radio frequency interference (RFI) and bright astrophysical foregrounds (FGs). Excising RFI from our observations results in missing gaps in the data which must be filled in with a model of the data to avoid spurious contamination of EoR dominated modes. Because of the large dynamic range between the EoR and FG signals, small modeling errors can lead to significant EoR power spectrum contamination. We are developing a Bayesian 21 cm power spectrum pipeline which utilizes the combination of Gaussian constrained realizations and Gibbs sampling to address these issues. This combination of techniques allows us to draw samples from the joint posterior of the EoR modes and their power spectrum in the presence of data with gaps due to RFI and an uncertain foreground model. In this talk, I will review our Bayesian approach to 21 cm power spectrum estimation and provide a demonstration of its performance using simulated data and a suite of RFI flagging patterns and FG models.

Joe Bright
University of Oxford
Title: GRB Radio Astronomy in the SKA Era: The Importance of Dedicated Transient Interferometers
Abstract: Modern gamma-ray burst astronomy has been revolutionised by our ability to rapidly respond to high energy triggers from spacecraft such as Swift. These capabilities have drastically increased the number of GRBs with high quality early time optical and X-ray data. The results of this followup are often released rapidly, and becomes available to the entire astronomy community as a public resource, resulting in further observations across the electromagnetic spectrum. Followup radio observations are essential, as they are uniquely capable of probing the jets produced in GRBs, and are important to understand GRB progenitors, outflow formation, and the structure of environments within which GRBs occur. By comparison with optical facilities, time on appropriately sensitive radio interferometers (often preferable over single dishes due to resolution requirements)

is precious, making rapid followup and regular monitoring of transient astrophysical sources hard to achieve. This issue becomes increasingly problematic as (necessarily) larger interferometers are built, and community interest is focussed onto a smaller pool of facilities. In this talk I will discuss the importance of `agile' interferometers, which are able to dedicate a significant percentage of their observing time to transient discovery and monitoring, while taking observing pressure away from more sensitive instruments. Particularly, I will highlight the successes of the Arcminute Microkelvin Imager Large Array and the Allen Telescope Array in enriching our understand of GRBs (and particularly the Brightest of All Time GRB 221009A), with these comparatively modest arrays often able to compete with or surpass international facilities in their scientific impact.

Jompoj Wongphechauxsorn
MPIfR
Title: The reprocessing of the HTRU-S Low Lat survey around the Galactic centre using a Fast Folding Algorithm pipeline for accelerated pulsars
Abstract: Pulsars, which are rotating neutron stars whose radio emissions is seen are observed as a series of pulses, offer valuable insights into various scientific studies, including general relativity and the interstellar medium. Therefore, the discovery of a pulsar near the Galactic centre (GC) and its black hole, Sgr A*, is particularly interesting due to its uniquely dense magneto-ionic environment. Despite expectations of up to 1000 pulsars within 100 pc around the GC, only six, including a radio magnetar—a rare type of pulsar with an exceptionally high magnetic field—have been discovered. This discrepancy is likely due to the intense interstellar scattering in the GC, reducing the efficacy of pulsar surveys. Previous surveys have used the Fast Fourier Transform (FFT) based pulsar search pipeline, which is less effective for detecting long-period pulsars, leading to a potential undiscovered population in this region . In my talk, I will present results from using the Fast Folding Algorithm (FFA) applied to the High Time Resolution Universe Pulsar Survey - South Low Latitude, within one degree of the GC. The FFA has greater advantages in searching for slow pulsars, which are less affected by the interstellar medium. This approach led to the discovery of a new slow pulsar, PSR J1746$-$2829, near the GC. Intriguingly, this pulsar exhibits characteristics typical of radio magnetars, suggesting an anomalously high ratio of magnetars to non-recycled pulsars in the GC.

Jumei Yao
Xinjiang Astronomical Observatory, CAS
Title: Interstellar scintillation and polarization of PSR J0538+2817 and PSR B0659+1414 from FAST
Abstract: SNR shells have long been suspected as the culprits for dominating pulsar scattering. The interstellar scintillation observation of pulsars associated with SNRs provide us with great opportunity to find evidence for this and reveal the properties of the compact ionized structures. Using FAST, we did high sensitivity interstellar scintillation and polarization observations of PSR J0538+2817 and PSR J0659+1414. For PSR J0538+2817, we found that the shell of SNR S147 dominates its scattering and detected the first evidence for pulsar three-dimensional spin-velocity alignment. The scattering of PSR J0659+1414 is dominated by two different compact regions, the shell of the Monogem ring and the Local Bubble. And the polarization analysis shows that the spin and velocity vectors of PSR J0659+1414 are significantly misaligned.

Katie Savard
University of Oxford
Title: Studying discrete jet ejecta in X-ray binaries with hydrodynamic simulations and simulated radio images

Abstract: In recent years, observations with the MeerKAT radio telescope have demonstrated that we can routinely track relativistic ejections from stellar-mass black holes from their launch, usually associated with an X-ray state transition, to their deceleration and termination in the ISM. These data provide us novel observations of the entire life cycle of a jet, and offer the best chance to date to determine the energy, and possibly composition, of the jet. In order to understand these ejecta, we are running the first relativistic hydrodynamic (RHD) simulations directly informed by the MeerKAT observations, and realising them as realistic simulated radio images which can be directly compared to the data. In particular, I will present work that uses the inferred properties of the ejected 'blob' from MAXI J1820+070 observed with MeerKAT to inform 2D RHD simulations in the PLUTO code of the propagation of the jet ejecta through the ISM, which present a compelling qualitative match to the observed deceleration curve. These simulations reveal small-scale instability physics that are necessary to understand cloud-crushing dynamics, and also shed light on how shocks passing through the ejecta could be responsible for in situ particle acceleration, and re-brightening of the ejecta with deceleration. I will also present a pipeline developed to transform RHD simulations into pseudo-radio images, which has allowed us to predict how various telescopes may detect these phenomena. In addition, these pseudo-radio images can be directly compared with data to extract new physics understanding from our observations.

Kelvin Wandia
Jodrell Bank Centre for Astrophysics, University of Manchester
Title: SETI as an Ancillary Science to Wide-field VLBI Observations
Abstract: In recent years, private funding e.g. Breakthrough Listen (BL) has rejuvenated the search for extra-terrestrial intelligence(SETI) in the radio regime. Most of the efforts toward this search have utilised large single dishes e.g. the Green Bank Telescope (GBT). Beam-formed arrays e.g. the Allen Telescope Array (ATA) and the MeerKAT have also come into play. On the contrary, long baseline interferometers are yet to be fully employed in this search. The advent of software correlated e.g. the Distributed FX (DiFX) and Super FX Correlator (SFXC) have enabled the correlation of data at high temporal and spectral resolutions – which is necessary for imaging over wide fields of view to mitigate the effects of bandwidth and time average smearing. Telescopes e.g. Gaia and Kepler spacecraft have also furnished SETI with good candidates. Armed with wide-field data correlated with sufficient resolution and a selection of good candidates, I will describe how any such observation can be turned into a search for technosignatures.

Lennart Heino
University of Cape Town / IDIA
Title: The Nature of Polarised Sources in MIGHTEE's Deep Fields
Abstract: This study explores the polarised emission of the faint extragalactic radio sources in the MIGHTEE (MeerKAT International Giga-Hertz Tiered Extragalactic Exploration, Jarvis et al., 2016) survey in order to systematically study the nature, origin and evolution of cosmic magnetic fields. Reaching a sensitivity of 2 μJy/beam at a resolution of 6 arcseconds, MIGHTEE is providing an opportunity to chart the evolution of polarised emission from distant galaxies over cosmic time. The MIGHTEE survey detects polarised emission for a large number of radio sources down to total intensity flux densities of the order of 100 μJy. At these flux densities the source population is increasingly dominated by star-forming galaxies (SFGs) as opposed to active galactic nuclei (AGNs) which are dominant at high flux densities. While the radiation from SFGs originates mostly from forming and exploding stars, the emission from AGNs comes from a central supermassive black hole engine and enormously large relativistic jets that are driven by the gravitational force of the central black hole. Observations of the local universe show that both, AGN and SFG phenomena, are permeated by magnetic fields and polarised emission of AGN can be traced to very distant galaxies.

However, polarised emission of SFGs at moderate distances (redshifts between 1 and 2) has not yet been detected. In order to understand the nature of galaxies we need to understand the contribution of magnetic fields through the galaxies' evolutionary stages. We use multi-wavelength criteria to classify MIGHTEE radio objects as either SFG or AGN. We perform Rotation Measure Synthesis (RMSY) on the spectro-polarimetric data cubes and use the polarisation and RMSY spectra to search for polarised emission. A comparative analysis of the polarisation properties of SFGs and AGNs is performed. The analysis is extended to the lowest possible flux densities using stacking techniques. We will show preliminary results of the MeerKAT polarisation studies of radio sources down to a sensitivity at the micro-Jansky level. From a population of 21479 radio sources down to a total intensity of 150 μJy/beam we detect polarised emission in 408 (1.9%) objects. Of these 349 (85.5%) also show evidence of AGN activity in multi-wavelength data. The remaining 59 objects (14.4%) show no evidence of AGN, and are potentially star-forming galaxies at high redshift. Further investigation is required to confirm the nature of these objects.

Louise Marinho
Laboratoire d'Astrophysique de Bordeaux
Title: A magnetic field study in the envelope of cool evolved stars
Abstract: Evolved cool stars, exhibit a massive mass loss rate, which contributes to enriching the interstellar medium and, therefore, to the recycling of the matter in the Universe. The mechanisms (e.g. the stellar magnetic field) behind these mass loss phenomena are not yet fully understood, but can be constrained thanks to observations of various molecule transition in the circumstellar envelope (CSE) of the star. In this talk, we will focus on the SiO maser line emission from a sample of recently observed evolved stars, to probe the presence of a magnetic field in the inner gas region of the envelope, up to 2-4 stellar radii from the photosphere. It is emitted by small gas cells in the CSE and is strongly polarized. From mm-wave radio observations, we can derive the Stokes parameters I, Q, U and V, and after careful calibration of these 4 quantities determine the angle of polarization, the linear and circular polarizations, which according to theoretical predictions can lead to a characterization of the environment of the emitting cells, like an estimate of the sightline-projected magnetic field strength. If there is a magnetic field and if the maser line is saturated, we should observe an « S » shape Zeeman signature in Stokes V. Using the rvm code, we search for this specific pattern in our data. We work with two theories, one for the saturated and one for the strongly saturated maser. In both cases, we can relate the observed Stokes V line profiles to the magnetic field strength. In our source sample, the magnetic field strength is hence estimated between 0.5 and 3 G. There are still open questions about the origin of the magnetic field (e.g. a solar-type dynamo, a turbulent dynamo, …) and its evolution that I will also address in this talk.

Marina Ruiz García
Observatorio Astronómico Nacional (OAN)
Title: Revealing dynamical resonances of bars in PHANGS galaxies
Abstract: Bars are remarkable stellar structures, which play an essential role in driving the secular evolution of galaxies, as they are expected to transport the gas towards the centre. In this study NIR images and ALMA CO(2-1) maps from the PHANGS survey are used to trace the stellar potential and the molecular gas distribution to determine the position of the main dynamical resonances of the bars in our targets. In this work, the gravitational torque method from García-Burillo et al. (2005) is used to locate the position of the corotation (CR), where stars and gas rotate at the same angular velocity as the bar. We have established the position of corotation for the 43 barred galaxies of the sample, which is composed of a total of 74 galaxies. Furthermore, a distinction has been made between fast and slow bars, by measuring R_CR/R_bar for every galaxy. We found that this variable has a mean value of 1.19 and standard deviation of 0.32, which is consistent with the value expected

from theory R_CR/R_bar=1.2. Finally, we have also estimated other relevant resonances such as the Inner Lindblad Resonance (ILR) and the Outer Lindblad Resonance (OLR), where rings are expected to be formed. This work provides a useful catalogue of resonances for nearby galaxies and emphasises the connection between bar dynamics and morphology, as the existence of fast and slow bars has cosmological implications for a scenario where bars may brake over time.

Mattias Lazda
University of Toronto
Title: VLBI Calibration Strategies for Localising Fast Radio Bursts with the CHIME/FRB Outriggers
Abstract: Fast radio bursts (FRBs) are short, energetic bursts of radio emission occurring throughout the Universe, and whose origins remain largely unknown. The Canadian Hydrogen Intensity Mapping Experiment (CHIME) is a non-steerable phased array telescope located in British Columbia, Canada and has become the leading telescope at detecting FRBs. To improve our understanding of their origins, three additional radio telescopes – the Outriggers – located across North America are currently being commissioned. Forming a VLBI network with CHIME, they will work together to localise one-off and repeating FRBs to ~50 milliarcseconds upon detection. However, the unpredictability of FRBs and the inability to steer CHIME and its Outriggers towards traditional VLBI calibrators makes calibrating the array a uniquely challenging task. To overcome these obstacles, the CHIME/FRB Outriggers will utilise pulsars for calibration, which have guaranteed compactness and abundant sky coverage, incorporating in-beam traditional continuum source calibrators on its shorter baselines. I will provide a general overview of the calibration strategies employed by the CHIME/FRB Outriggers, highlight the main challenges that the Outriggers face towards achieving the goal of 50 milliarcsecond localisation precision, and discuss my work in calibrating the baseline vector between CHIME and the first Outrigger.

Maxime Valeille-Manet
Laboratoire d'Astrophysique de Bordeaux
Title: Discovery and study of the physical properties of massive stars precursors
Abstract: The study of the early phases of high-mass star formation is a major topic in astrophysics that is still poorly understood. Several formation scenarios are still in competition. To elucidate which precise processes of formation are in action, it is necessary to identify the youngest precursors of massive stars (M > 8 M_⊙), even before collapse (so-called pre-stellar cores), within high-mass star-forming regions. Here we survey for massive pre-stellar core candidates (MPSC) in the data cubes of massive proto-clusters mapped in the ALMA-IMF program (ALMA Large Program; Motte et al. 2022). This survey, which images the 15 most massive proto-clusters of the Galaxy located within 6kpc of the Sun, at a resolution of 2700 au, has allowed the identification of 700 compact cores among which we aim at identifying pre-stellar cores. For this purpose, an automatized method for systematically detecting outflows from proto-stellar cores is developed. Cores without significant outflows are considered as excellent candidates to be pre-stellar cores. For this we compare the spectrum of each source (on source) with the spectrum of its surrounding environment (off source). We use both the CO(2-1) and SiO(5-4) spectral lines to identify outflowing gas. In addition to the spectra, we use outflows maps in order to confirm signs for bipolar outflow around each. First results show that 38 cores with a mass greater than 8 M_⊙ are such good pre-stellar candidates in the ALMA-IMF survey (Valeille-Manet et al. in prep). They cover a mass range from 8 to 170 M_⊙, and for a total amount of around 73 high-mass proto-stellar cores in the survey. Among those 38 cores, 13 have a mass greater than 16 M_⊙ and are more likely to form high mass stars in the future. This first sample of several MPSC will allow to constrain massive star formation scenarios. In a future work, a complete line analysis of the pre-stellar candidates will be done to study the kinematics and the chemistry undergoing in those early stages of high mass star formation.

Michael Joseph Wilensky
University of Manchester
Title: Chiborg: a Bayesian jackknife framework for testing consistency of multiple measurements
Abstract: Internal consistency is crucial when combining data to form a precision measurement. If we can identify subsets of the data that lack consistency with others, we can improve the quality of the measurement by excluding that data or reanalysing it to remove the source of the inconsistency. In this talk, we present a Bayesian formulation for testing internal consistency that evaluates how likely each subset of the data is to be systematically biased relative to some null hypothesis. We implement this in an open-source python package called Chiborg. This formulation is advantageous to other consistency checks in that it points directly to the data that are most likely to be contentious and ranks various alternative scenarios in an easily interpreted way. We also incorporate a decision theoretic framework that allows the analyst to tune the results to a particular objective. In particular, these qualities make it an effective tool in a blind analysis pipeline, where direct examination of the data to answer the same question may spoil the blinding procedure. We discuss two examples; one where we use it to statistically justify combining several subsets of data into a leading upper limit on the 21-cm power spectrum placed by HERA, and an extension of the basic formalism to investigate the potential presence of calibration errors in measurements of galactic synchrotron radiation from multiple telescopes. Given the versatility and success of Chiborg, we suggest different ways it can be used in other radio experiments, as well as in reconciling tensions in measurements of cosmological quantities such as the Hubble parameter.

Miguel Gómez Garrido
National Astronomical Observatory - IGN
Title: Continuum and line emission of the symbiotic binary R Aqr
Abstract: Symbiotic stellar systems (SSs) are interacting binaries consisting of two close components: an asymptotic giant branch (AGB) star and a white dwarf (WD). As a result of the mass loss of the AGB star, SSs are surrounded by a circumstellar environment whose shape and dynamics are affected by the presence of the hot companion. The study of SSs is key to understanding different phenomena, such as jets, non-spherical planetary nebulae, and Type Ia supernovae. R Aqr is one of the best-studied SSs. The orbit shows a period of $\sim$ 42 years with a stellar separation between 10 and 60 mas. Although R Aqr shows molecular emission in some species, due to the photodissociation by the WD, this is rarely detected in SSs. High- and medium-resolution ALMA observations of the continuum and line emission are presented exploring both extended and inner regions of this SS system for a total of three ALMA bands (6, 7, and 9). Continuum emission helps to locate the position of the AGB in the system. In addition, the jets and the mass transfer from the AGB to the WD are mapped by the continuum. Some of the studied lines are CO, SiO, SO, and H30α. A new scenario for the molecular emission in R Aqr explaining the brightness distributions shown by the different lines is explained.

Nadine Hank
Kapteyn Astronomical Institute - University of Groningen
Title: Exploring HI asymmetries in spatially resolved SIMBA galaxies
Abstract: Observations have revealed that many galaxies exhibit distorted and asymmetric morphologies in their stellar and/or gaseous components. Various astrophysical processes, such as galaxy-galaxy interactions and mergers, ram-pressure stripping, and gas accretion, have been proposed as possible origins. As such, studying galaxy asymmetries in large samples and relating these asymmetries to the processes that caused them has become a key research topic to aid in our

understanding of the relative importance of these processes and how they govern galaxy evolution. Until recently, research on asymmetries in the neutral atomic hydrogen (HI) content of galaxies has been largely limited to targeted galaxy samples in the local Universe. However, the latest generation of untargeted HI surveys on the SKA pathfinder telescopes will enable detailed studies exploring the HI in galaxies using much larger samples than previously available. In the lead-up to these new datasets, we utilise the SIMBA hydrodynamical simulations to investigate HI asymmetries in ~1200 spatially resolved, low redshift galaxies in order to understand and contextualise the state of disturbances in the HI reservoirs of galaxies. We generate synthetic HI datacubes designed to match observations from the Apertif Medium-deep Survey and assess SIMBA's ability to match the observed HI mass-size relation. We then measure various quantitative asymmetry parameters and investigate correlations between HI asymmetry and HI mass.

Santiago del Palacio
Chalmers University of Technology
Title: Radio observations and modelling of non-thermal sources
Abstract: Relativistic particles are ubiquitous in the Universe. They are present in different astrophysical sources such as the ejecta of supernova explosions, winds from massive stars, jets from young stellar objects, and relativistic jets from microquasars and active galactic nuclei. These particles can emit broadband non-thermal radiation from low radio frequencies (synchrotron) up to very high energy gamma rays. I will focus on how radio-continuum observations together with theoretical modelling can help us to unveil the physical processes operating in these sources and to infer properties such as density, magnetic field strength, and particle acceleration efficiency. Investigations of the sky at low radio frequencies are particularly promising and timely with the advent of the SKA.

Sofia Suutarinen
Metsähovi Radio Observatory
Title: Timescales of AGN radio variability
Abstract: Active Galactic Nuclei (AGNs) are extremely luminous compact sources at the centers of active galaxies. They are powered by a central supermassive black hole, which drives the variability seen in the observed light curves of the sources in varying frequency domains. This observed variability is of great interest as it can help us understand the physical conditions in AGNs. AGN variability in radio frequencies is difficult to characterise because the variability is slower than in other frequency domains. Commonly used methods, such as the periodogram, should reveal changes from correlated to uncorrelated behavior in the form of power spectral breaks. Unfortunately, limited monitoring-period lengths constrain which time scales can be identified. Metsähovi Radio Observatory has observed AGNs for over 40 years and as such its data is unique in its length. This data observed with a 14-meter telescope was used to analyze AGNs in the 37 GHz frequency in order to reveal their timescales and to link them with the physical conditions in the AGNs. The most commonly used variability study methods were also scrutinised to reveal issues that might bias the results in any way. Preliminary results indicate that even 40 years of monitoring may not always be enough to characterise the timescales of AGN variability in the radio regime. Due to the nature of the periodogram, a power spectrum may appear featureless for a surprisingly long monitoring period even if a timescale is technically already present. Several issues with the methods were also identified and considered in the analyses.

Stefano Giarratana
IRA - INAF

Title: Studying the afterglow phase of Gamma-Ray Bursts with the VLBI
Abstract: Some massive stars end their lives with a catastrophic explosion which leaves behind a spinning, stellar mass black hole or a highly magnetised neutron star. Regardless of the nature of the remnant, this central engine launches two jets of ionised matter which eventually interact with the circum-burst medium through external shocks, producing the so-called Gamma-Ray Burst (GRB) afterglow, which can be detected from the very-high energy throughout the whole electromagnetic spectrum. Radio observations, and in particular VLBI, are fundamental to measure the apparent superluminal expansion (on-axis GRB) and proper motion (off-axis GRB) of the GRB outflow, to constrain its structure and to characterise the circum-burst medium. In this talk I will present two representative cases for radio studies of GRBs: GRB 201015A and GRB 221009A. For the former, interferometric observations were crucial to characterise the density profile of the circum-burst medium; on the other hand, VLBI observations of the brightest GRB of all time, GRB 221009A, allow us to constrain the expansion and the proper motion of the centroid.

Subhrata Dey
Astronomical Observatory of the Jagiellonian University
Title: Panchromatic SED modeling of Infrared Bright Galaxies
Abstract: Luminous and ultraluminous infrared galaxies (U)LIRGs offer unique laboratories to understand various physical processes which drive the evolution of galaxies across cosmic times as they form a bridge between the normal star-forming galaxies and active galactic nuclei (AGN). The fact that these galaxies exhibit high infrared luminosity (LIR>1011 L_sun) and the ratio of infrared to radio luminosities remains constant over 5 decades of infrared luminosities suggests an interplay between stellar activity, AGN feedback, cosmic ray propagation, and gas and magnetic field coupling. Comparing the spectral energy distribution (SED) at different emission wavebands provide key insight into the origin and nature of emission and the factors setting their energy balance. Using robust state-of-the-art statistical modeling tools and Bayesian analysis, I performed the SED modeling of a sample of LIRGs in UV to radio and radio-only domains with physically motivated scenarios and constrain the physical parameters of these galaxies. For radio SED modeling, we have obtained radio continuum data covering the frequency range from 150 MHz to 10 GHz. We use our own measurements at 350 MHz and 610 MHz as well as the archival data from the VLA. Integrated radio SEDs are modeled with physically motivated scenarios in which the radio continuum originates from either single or two emission regions characterized by the same or different populations of cosmic-ray electrons and optical depths. Hence, radio-only SED modeling shows complex shapes with multiple turnovers for some galaxies, instead of the simple power-law, expected from the synchrotron emission. Further, The star formation rate estimated from UV-IR and radio SED modeling enabled us to calibrate SFR over different timescales. A striking result is that we obtain a much better correspondence of radio emission (total and synchrotron) with the young stellar population of about 10 Myr than with the older population. This is probably due to the relatively short lifetime of the synchrotron cosmic-ray electrons at the 1.4 GHz frequency. At this frequency, in a magnetic field of about 50 μG, the synchrotron lifetime is ~3.3x105 years. Therefore, synchrotron emission is an effective indicator of recent star formation rates in galaxies. Our analysis strengthens that 1.4 GHz radio SFR measurements can be used as a diagnostic tool for high-z galaxies.

Tadeus Carl
Chalmers University of Technology
Title: Deep Search for Glycine Conformers in Barnard 5
Abstract: One of the most fundamental hypotheses in astrochemistry and astrobiology states that crucial biotic molecules like glycine (NH2CH2COOH) found in meteorites and comets are inherited from early phases of star-formation. Most observational searches for glycine in the interstellar

medium have focused on warm, high-mass molecular cloud sources. However, recent studies suggest that it might be appropriate to shift the observational focus to cold, low-mass sources. We aim to detect glycine towards the so-called methanol hotspot in the Barnard (B)5 dark cloud. The hotspot is a cold source (Tgas ≈ 7.5 K) with yet high abundances of complex organic molecules (COMs) and water in the gas phase. We carried out deep, pointed observations with the Onsala 20m telescope, targeting several transitions of glycine conformers I and II (Gly-I and Gly-II) in the frequency range 70.2 - 77.9 GHz. No glycine is detected at the targeted position, but we use a line-stacking procedure to derive sensitive upper limit abundances w.r.t. H2 for Gly-I and Gly-II, i.e. < (2-5) x 10-10 and < (0.7-3) x 10-11, respectively. The obtained Gly-II upper limits are the most stringent for a cold source, while the Gly-I upper limits are mostly on the same order than previously measured limits. The measured abundances w.r.t. H2 of other COMs at the B5 methanol hotspot range from 2 x 10-10 (acetaldehyde) to 2 x 10-8 (methanol). Hence, based on a total glycine upper limit of (2-5) x 10-10, we cannot rule out that glycine is present but undetected.

Víctor Pérez-Díez
Observatorio Astronómico Nacional (IGN)
Title: Full-Polarization Images from the VLBI Global Observing System (VGOS)
Abstract: We introduce a new imaging method for wide bandwidth VLBI data, specifically from VGOS. By including genetic algorithms in traditional RML imaging methods, we optimize imaging results for our study cases, enabling multi-frequency images to extract extensive information from celestial sources. Starting from the calibrated data with a new pipeline based on the PolConvert software, we can obtain full-polarization images, unlocking valuable insights into AGN characteristics like shape, black hole morphology, magnetic fields, core shift, and Faraday rotation. VGOS's ability to observe numerous sources simultaneously facilitates comprehensive multi-source studies, promising transformative advancements in AGN research and improving geodetic observables by including the polarized structure of the source.

Viviana Piga
Università di Cagliari / INAF - Osservatorio Astronomico di Cagliari
Title: Advanced algorithms for binary pulsar searching and their applications
Abstract: Pulsars are fast-rotating neutron stars that emit an extremely regular, periodic train of pulses, mostly visible in the radio portion of the electromagnetic spectrum. This makes pulsars behave like very precise cosmic clocks that can be exploited for a number of astrophysical experiments. The most interesting pulsars are those found in binary systems, where the observed periodicity is modulated by the Doppler effect due to the orbital motion. In order to discover binary pulsars, we typically use advanced search techniques that combine Fourier analyses with algorithms capable of accounting for the orbital modulation. The most common technique is the so-called “acceleration search”, which is fast but only sensitive to relatively wide systems. On the other hand, the “sideband search” algorithm can overcome these limitations, but at the cost of much longer computational times. In this talk I will discuss how the “sideband search” can be used to discover ultra-compact binary pulsars and how the algorithm can be made more computationally efficient so as to be effectively applicable to large datasets. In this context, I will present some results obtained by applying the acceleration and sideband search methods to globular cluster observations taken with the Parkes and MeerKAT radio telescopes.

Yi (Linn) He
Kapteyn Institute
Title: Gas Dynamics and Radial Flows in Galaxies

Abstract: Numerous theoretical studies within the modern cosmological framework suggest that gas accretion from the intergalactic medium is essential to feed star formation in galaxies throughout cosmic time. However, the way gas accretion takes place is still poorly understand as a direct evidence of it is still lacking. In some models, gas accretion is expected to take place in the outer discs of galaxies, from where it should be transferred to the inner star-forming discs through radial flows. Finding such flows and quantify them opens, therefore, the exciting possibility to infer the detailed properties of the accreting gas. Unfortunately the detection of radial flows presents a significant challenge due to the magnitude disparity between the radial flow and rotational velocity. Additionally, the distortions in velocity fields produced by these flows bear similarities to the effects of warped structures, further complicating their quantification. To address this, we have developed a new methodology to measure radial velocities and quantify mass flow rates in disc galaxies. This method employs the 3D kinematic software, 3D-Barolo, and incorporates a bootstrapping approach to estimate errors. We have validated our approach using mock data from hydrodynamic simulations and subsequently applied it to HI observations local galaxies. Additionally, we have made a comparative study of galaxies in observations and simulations, focusing specifically on those with similar stellar mass and star formation rates.