MWA Project Meeting

Book of Abstracts

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MWA Project Meeting

Tuesday, July 25

Welcome

Steven Tingay | **Director's Overview**

In this talk, I will update on the status of the MWA and what the next ~five years will bring, in terms of Phase III plans and the trajectory toward the SKA. I'll also look back on the last ten years of operations and reflect on the successes of the MWA and the people who have worked so hard to support it.

MWA's Past and Future

Mark Gray, Ugo Varetto | **MWA and Pawsey: together for 47 petabytes and counting**

Sarah Pearce | **MWA importance as an SKA precursor**

Randall Wayth, Chris Riseley | **MWA Phase III Science and Engineering**

GEG Science

Chenoa Tremblay | **10 Years of Galactic and Extra-Galactic (GEG) Astronomy**

In the last 10 years, the flexibility of the MWA telescope allowed for a wide range of GEG science that was not originally conceived and made a number of amazing discoveries. In this talk I will cover some of the amazing highlights from the 6 science teams; Polarization, GEG Spectroscopy, Galactic Continuum, Cosmic Web & Galaxy Clusters, Nearby Galaxies, and radio galaxies.

Stefan Duchesne | **Abell 194 and getting the most out of archival datasets**

The MWA is a low-frequency radio telescope that can probe the intra-cluster medium via non-thermal, diffuse synchrotron emission. One such nearby cluster, Abell 194, has recently seen some renewed interest with filamentary features being revealed in deep MeerKAT observations. With the surface-brightness sensitivity of the MWA, we find other large-scale features in the low-redshift cluster. While the emission is more likely related to bright radio galaxies in the cluster, the project has evolved to attempt to make use of the myriad archival MWA datasets available, and in this brief talk I will highlight some of the work being done with joint-deconvolution of MWA phase I and 'extended' phase II data and additional imaging at 300 MHz.

Sean Paterson | A Deep Imaging Pipeline to Simplify Processing and Mosaicking of Survey Data

The Murchison Widefield Array (MWA) enables observation over a significant area of sky at low radio frequencies, which enables the ability to conduct large radio surveys. Several surveys have been conducted with the MWA like the MWA Interestingly Deep Astrophysical Survey (MIDAS) which produced thousands of observations of six extra-galactic fields. The problem however is that processing the large number of observations produced by these surveys can be tedious, unreliable, and time consuming.

Here, we present the Deep Imaging Pipeline (DIP) adapted from the pipeline used in the GaLactic and Extragalactic All-sky MWA X (GLEAM-X) survey. Initially being tested on observations from the MIDAS data, DIP is designed to provide researchers with an easy and reliable method to generate deep field images. With improvements in the cleaning methods through the use of wgridding, implementing a Tukey filter, and optimizing the cleaning parameters; computational time is reduced, allowing additional resources to be utilized to further reduce the root mean square (RMS) error present in the observational data. These improvements are expected to result in deeper images with less background noise than currently achieved. Additionally, DIP attempts to address problems found when producing deep-field images that are at declinations far from zenith, such as GAMA9, by processing the linear poles separately and then combining to create the Stokes I image. DIP utilizes the Nextflow framework with a Python back-end to provide portability and to simplify the image processing, this enables the ability to process thousands of observational images and mosaic them together with only a few commands.

Linhui Wu | Diffuse Radio Emission in the Radio Lobes of M87

This paper will present a multi-wavelength study on diffuse radio emission in the radio lobes of M87. Previous study was focused on the bright structures in the radio lobes of M87, and concluded that its energy likely injected through the jet. While new evidence showed that disk wind also plays an important role in active galactic nuclei (AGN) outflow, and galactic wind definitely can give energy for the large-scale radio emission. By utilizing the low-frequency telescope MWA observations along with VLA radio data, we measure the morphologies and flux density of radio structures from ~170 to 2500 MHz. We both use the continuous injection and impulsive injection of relativistic electron models to fit the spectrum of the diffuse radio emission regions. We further perform equipartition analysis for the radio lobes. From the X-ray observation, we can get the electron density and temperature profile in the intracluster medium (ICM) of the Virgo cluster to estimate the thermal power and the sound speed. From these results, we prefer the continuous injection model and place constraints on source age (i.e., synchrotron age and dynamic age), equipartition magnetic field strength and energetics (i.e., kinetic power and thermal power). Based on these constraints, we discuss the possible mechanism (e.g., galactic wind, jet, disk wind) to produce diffuse radio emission in the radio lobes of M87.

Kathryn Ross | GLEAM-X IDRII: What's available and what's next!

The GaLactic and Extragalactic All-sky MWA eXtended (GLEAM-X) survey boasts twice the resolution and up to an order of magnitude higher sensitivity to its predecessor the GLEAM survey. In 2020, observations for GLEAM-X were completed and the first data release was published earlier this year covering 2,000 square degrees down to an RMS noise level of <1.5 mJy/beam. In this talk, we will present the second data release covering an RA range from ~20h to 6h and all Declinations South of +30. This talk will shocase the value of DRII and present some early science results.

Christopher Riseley | A decade of MWA magnetism: where did we come from and where are we going?

Magnetic fields are everywhere in the Universe, from tiny scales on our fridges to the most massive scales of the Cosmic Web. They play a critical role in almost everything from sustaining life on Earth, to governing cosmic ray transport in galaxies, influencing the chemical enrichment of the Universe, and mediating the plethora of rich physical processes in clusters of galaxies. However, despite the ubiquitous and important nature of magnetic fields, much is yet unknown about them in many environments. Their topography and the processes that influence their evolution remain poorly explored.

Nevertheless, magnetism has been a key science driver since the conception of the SKA, and in the era of the Pathfinders and Precursors, we have been able to begin to lay the groundwork for precision magnetism science on unprecedented scales. These new instruments, plus advances in supercomputing and data processing techniques, have enabled a renaissance in this field.

Thus, the magnetoionic properties of the Universe are now being studied in unprecedented detail at low frequencies. Large-area surveys are yielding new insights into the intrinsic physics of AGN and clusters as well as their external environments, and in turn these surveys are allowing us to reconstruct magnetic fields in the foreground spaces as well as in our own Galaxy. However, extracting science from these large datasets is a non-trivial process: data volumes, imaging challenges and various systematic effects must all be overcome first.

In this talk, I will guide the audience on our journey of precision magnetism science with the Murchison Widefield Array across the decade of science operations. I will present highlights and key developments in magnetism science from our local stellar neighbourhood through to extragalactic scales, discuss the critical contributions the MWA has enabled — both the expected and unexpected — and conclude with a look forward to what we can expect in the SKA era.

PFT Science

Ramesh Bhat | 10 years of Pulsars and Fast Transients with the MWA

From the first high-quality detections of Crab giant pulses at low frequencies using the early prototype system that was comprised of merely three tiles, to the recent successful launch of an ambitious, all-southern-sky pulsar survey using the Phase II compact array, the pulsar and fast transient science with the MWA has been through a long and exciting journey. Considering the highly non-traditional path for high-time-resolution science dictated by the voltage capture system (VCS), and the enormous data management, processing and software development tasks inherent in facilitating and extracting science, this is a significant step forward. In this historical meeting, I will present an overview of some of the key milestones, highlighting examples of new science they have enabled, and commenting on the enormous science potential that can now be realised through ongoing large projects such as the SMART survey. I will also briefly remark on the yet-untapped potential of the MWA to become a powerful low-frequency monitoring machine for pulsars and fast transient science, once it is geared up with a real-time processing and beam-forming capability to support high time resolution science.

Mengyao Xue | Probing the ISM towards the Gum Nebula using Pulsar Measurements

The radio emission of pulsars undergoes multiple different kinds of frequency-dependent ISM propagation effects before they reach us. As a low-frequency radio telescope, the MWA provides us with an excellent opportunity to probe the ISM properties using pulsars as tracers. We did a detailed polarimetric study of six pulsars (PSRs J0630-2834, J0737-3039A, J0742-2822, J0835-4510, J0837-4135, J0959-4809) located in the general direction of the Gum Nebula. We precisely measured their DM, RM, and polarimetric pulse profiles. For four of these pulsars, whose degree of linear polarisation were measurable at multiple different frequency bands, their linear polarisation degree showed a steady (and rapid) decline at the lower frequencies of the MWA, which stands in contrast with the generally expected trend for pulsar emission, and can be attributed to depolarisation caused by stochastic Faraday rotation from turbulent ISM in the Gum Nebula. Specifically, the Vela pulsar was studied in great detail, since its propagation effects vary significantly as a function of the observing epoch. The depolarisation at low radio frequencies and the RM variation (with a reversing changing trend around every 15 years) of the Vela pulsar are compared with similar behaviours in the Fast Radio Burst (FRB). The results are also discussed in a more general (and wider) context of the three-dimensional model of the Gum Nebula, which is an important component of the electron density model of the Galaxy.

Bradley Meyers | The SMART pulsar survey: past, present, and future

The Southern-sky MWA Rapid Two-metre (SMART) pulsar survey is a large on-going project led by the Pulsars and Fast Transients science working group. With prospects of discovering hundreds of new pulsars, and already having discovered a handful of objects, SMART will be a valuable prototype for future SKA-Low pulsar surveys. The "first pass" (shallow search) processing of SMART data is at an end (as of January 2023), but we are currently in the midst of finalising and testing plans for the full survey processing ("second pass") workflow. This enormous task is due to start in the latter half of 2023 as data acquisition also concludes. I will run through the history of SMART, highlighting the milestones achieved, challenges we are facing, and opportunities provided by this unique pulsar survey and fantastic MWA legacy.

Garvit Grover | Discovery and follow-up of a new long-period, nulling pulsar from the SMART survey

The Southern-sky MWA Rapid Two-metre (SMART) survey utilizes the large field-of-view of the MWA to survey the southern sky in about 100 hours. In the ongoing first pass processing of the SMART survey, we have discovered a new pulsar which has a longer than average (>1 s) rotation period, and it exhibits both sub-pulse drifting and nulling phenomena. This makes it the second pulsar, out of the 5 discoveries to date by SMART, to have all three of these features. Using the unique abilities of voltage captured data, we were able to time the pulsar using past and adjacent observations, as well as triangulate it to a sky position with reasonable uncertainty. Follow up from GMRT and Parkes (Murriyang) suggests this pulsar may also be intermittent (an extremely nulling pulsar), nulling on timescales from minutes to hours at a time. The second pass of the SMART survey will process 4800-second long observations and therefore is expected to be sensitive to such long periods and nulling pulsars. To fully exploit this capability, we are integrating software such as the fast-folding algorithm and single pulse search which are expected to be more sensitive to these objects. Future SKA surveys will extend on our work, using similar algorithms and approaches to target a larger population of such intermittent and long-period pulsars.

MWA Project Meeting

Wednesday, July 26

Connection and Community

Roni Kerley, Mark Smith | **The MWA's connections to the Indigenous community**

Emma Tolley | **Switzerland's motivation to join the MWA**

Switzerland is on the path to joining the MWA. We will present the Swiss consortium, an overview of our scientific and technical interest in MWA, and Switzerland's involvement in the SKAO and other SKA precursors and pathfinders.

EoR Science

Cathryn Trott | **The MWA Epoch of Reionisation Project: the 10-year search for the 13 billion-year old signal**

I will review the journey of the international MWA EoR collaboration over the past ten years to search for the weak signal from neutral hydrogen gas in the first billion years of the Universe. The project team is closer than ever to the pristine signal, but it is the large leaps forward in understanding of our instrument, sky and analysis methodologies that have been the real advances of the team. I will place the project within the broader context of observational 21cm cosmology, and other current experiments, and describe the evolution that the past ten years has seen in our understanding of how we undertake this difficult experiment.

Stuart Wyithe | **Constraining Reionization with MWA and beyond**

Our knowledge of the galaxies responsible for reionizing the Universe is constantly improving through near-IR observations. At the same time, constraints on the 21cm power spectrum from reionization are falling, with a measurement from SKA likely. I will discuss results from Greig et al. (2021) showing how the multi redshift (z = 6.5-8.7) upper limits on the 21-cm signal from the MWA have shown some astrophysical models which are inconsistent with the data. While these excluded astrophysical models are also inconsistent with existing observations the 21cm only constraints illustrate the future utility of the 21cm power spectrum for probing astrophysics and galaxy formation during reionization. I will then describe how simulations on a scale that exceeds the primary field of view are needed to validate that analysis does not erroneously add/remove features mimicking the signal. For the MWA this require simulations spanning several Gpcs. I will show results from a simplified version of 21CMFAST of a 7.5 Gpc comoving volume (Greig et al 2022) specifically tailored to the binned spectral resolution of the MWA. In the future, maximizing what we can learn from 21cm observations will require that galaxy formation and reionization to be jointly modelled. Using the Fisher matrix formalism we explored the high-dimensional parameter space describing the DRAGONS semi-analytic galaxy formation model and forecast quantitative constraints from SKA (Balu et al. 2023). I will discuss how the model allows us to forecast constraints on the X-ray luminosity, ionising UV photon escape fraction, star formation and supernova feedback in the first galaxies.

Michael Wilensky | **Evidence of Ultra-faint RFI in Deep 21~cm EoR Power Spectra with the MWA**

We present deep upper limits on the 21-cm power spectrum (PS) from the 2014 Murchison Widefield Array (MWA) Phase I observing season, with a particular emphasis on identifying the spectral fingerprints of extremely faint radio frequency interference (RFI) contamination in the PS. By leveraging our understanding of how faint RFI is likely to contaminate the EoR PS, we are able to identify ultra-faint RFI signals in the cylindrical power spectrum. Surprisingly this signature is most obvious in PS formed with less than an hour of data, but is potentially subdominant to other systematics in multiple-hour integrations. We will show a host of PS jackknife tests that allowed us to identify the highest quality observation sets for the power spectrum upper limit as well as the shape of observed RFI contamination in 21-cm PS. We will then highlight the differences in this PS upper limit compared to previous ones, which we believe result from improved RFI mitigation. Since the total RFI budget in a PS detection is quite strict and it is possible that there is RFI at deeper levels than this data set can probe, we suggest a need to more realistically model coherently integrated ultra-faint RFI in PS measurements so that its potential contribution to a future detection can be diagnosed.

Nichole Barry | **Towards a New Upper Limit on the EoR 21-cm Measurement using FHD -- A Celebration and a Lament**

Searching the early Universe for the 21-cm signal of primordial hydrogen requires a delicate intersection of precision, sensitivity, and advanced mathematical techniques. Through a combination of the intellectual prowess of the EoR team, we are making strides towards the measurement. Using broadband RFI mitigation, van Vleck corrections, direct foreground modelling using GPUs, state-of-the-art beam calculations, Galactic plane maps, deep extragalactic catalogues, and countless other improvements, we show an updated upper limit using the Fast Holographic Deconvolution (FHD) framework. In particular, we highlight how the bright Galactic plane interacts with the horizon to create aliasing throughout the entirety of the MWA image, and how we mitigate it using power simulators. We also unveil a 3-yr ADACS project to translate and professionally package FHD into pyFHD, showcasing the future of our EoR analysis.

Takumi Ito | **Foreground Removal with Gaussian Process Regression**

Observing the Epoch of Reionization(EoR) through the redshifted 21-cm line of HI will revolutionize the study of the first stars, galaxies, and intergalactic medium in the early Universe. This signal carries information on the fraction of neutral hydrogen, spin temperature, CMB temperature, and cosmological parameters. The redshifted 21-cm line is, however, buried under foregrounds that are many orders of magnitude brighter. We must eliminate the foreground signals accurately. One of the methods to remove foregrounds is Gaussian Process Regression(GPR). This method will statistically separate the 21cm line from most foregrounds and other contaminants. Mertens et al. 2020 show that GPR is capable of removing foregrounds on Low-Frequency Array (LOFAR).

In this talk, we present the results of foreground removal using GPR to Murchison Widefield Array (MWA) observation data.

Katherine Elder | **Effect of radiative mutual coupling on beam pattern**

Systematics and foregrounds are the primary obstacle to measuring the Epoch of Reionization (EoR) measurement, and therefore the EoR team is focused on understanding and mitigating these effects. Kolopanis (2023) identified systematic in the Phase II data set which manifests as phase offset. It primarily appears on shorter baselines but isn't limited to them This systematic introduces an overall negative bias that can make foreground contaminated measurements appear as noise-limited constraints on the EoR signal amplitude.

One potential physical mechanism is radiative mutual coupling between tiles. To investigate, we have modeled the antenna beam using FEKO. The FEKO model is based on the model used in Sokolowski (2017). We have modeled three tiles with sixteen dipoles each. We present preliminary results of how radiative mutual coupling affects the beam pattern.

SHI Science

Divya Oberoi | Ten years of solar, heliospheric and ionospheric science with the MWA

The Sun turns out to be a surprisingly challenging source to image in the low radio frequencies. In the era of conventional interferometers, designed for synthesis imaging, progress in this area had been stymied by instrumental as well as algorithmic challenges.

The Murchison Widefield Array was perhaps the first large-N instrument to come online which was designed to provide a good snapshot imaging capability, a crucial requirement for the Sun. The primary science potential for solar science with the MWA arises exactly from this ability to gather data intrinsically capable of producing high dynamic range and high fidelity solar radio images over short spectral and temporal spans.

Over the past decade the MWA Solar Heliospheric and Ionospheric (SHI) collaboration has worked to realize this potential. This has been done, on the one hand by putting in a long term systematic and sustained effort towards developing the algorithms and pipelines needed and, on the other, by focusing on science problems well matched to the strength of the MWA.

The images from the MWA pipelines represent the global state-of-the-art. They have enabled exploration of previously inaccessible phase space, leading to multiple new discoveries and realizations spanning diverse areas spanning a diverse range. Examples include finding exciting evidence for nanoflare based coronal heating; realizing the potential of radio observations for coronal magnetography both for coronal mass ejections and the quiet Sun; discovering previously unknown characteristics of the usual radio bursts first observed more than 70 years ago; and surprising but robust detection of linear polarization in active solar emissions. The very wide field of view of the MWA also offered exciting opportunities for novel approaches to harness the low radio frequency sky for both heliospheric and ionospheric physics.

This talk will give an overview of the journey of the MWA solar science thus far and the road ahead. It will also touch upon the heliospheric and ionospheric science from the MWA.

John Morgan | Probing the high-resolution sky with Interplanetary Scintillation

Interplanetary scintillation (IPS) is phenomenon that causes sufficiently compact radio sources to vary in brightness on 1s timescales when close to the Sun. Remarkably, this allows the MWA, with an interferometric resolution of 1 arcminute, to determine which sources are compact on sub-arcsecond scales. This has enabled a wide range of science including identication of compact calibrators, HI absorption candidates, and high-z source candidates; and high resolution measurements of Galactic Scattering; as well as Solar wind mapping with an unprecedented density of pierce points.

I will give an overview of this work, from our earliest pilot studies in 2015, through to the publication of the MWA Phase II IPS survey. I will provide a full taxonomy of the compact sources that we detect with IPS. Finally I will discuss future plans, including multi-frequency IPS, coordination with other instruments, and contributing to the worldwide Space Weather monitoring effort.

Rohit Sharma | Detection and simulation of the weak radio bursts

Constant fluctuations of energetically weak flares permeate the quiet corona. Radio observations are suitable for such studies, especially in meterwaves. As coherent emission is involved, even the weaker solar flares can produce disproportionately strong signatures at metre waves. Despite this advantage, the amplitude of these signatures is only a few per cent of the background. The propagation effects of the radio waves through the inhomogeneous turbulent coronal plasma further complicate the scenario.

Images from the Murchison Widefield Array (MWA) now represent state-of-the-art solar radio imaging at meterwaves. They have been used to probe the low-level variability in the background solar emission. Differential radio imaging using visibility subtraction has been used successfully by other instruments. Here we present the first application of this technique to the MWA solar data. We find many interesting results, including numerous weak compact sources. Most of these are associated with regions bright in EUV and are about two orders of magnitude fainter than the million K background. As MWA is a low-frequency precursor of the Square Kilometre Array, I will also discuss challenges and demonstrate simulations of milli-SFU flux density features using SKA-low configuration.

MWA Project Meeting

Thursday, July 27

Building the MWA

Robert Goeke | **Building the MWA**

Murray Hadley | **MWA connections to industry: Science meets construction**

GCo Australia is an electrical contractor specializing in infrastructure and industrial scopes. We are based in the Midwest however we have completed projects in the delivery of electrical infrastructure Australia wide and as such have extensive technical and delivery experience. GCo Australia has had a mutually beneficial collaboration with ICRAR/Curtin for more than 14 years.

This presentation will share our experience in engagement, planning and construction of the MWA. This was made possible through collaborations. Understanding the far-reaching benefit of such collaboration and partnering, past present and future for all stake holders. The experience we gleaned through the original MWA construction saw us take an expanded role in the MWA Phase II expansion, where we completed both the infrastructure and telescope installation works and we were commissioned to develop and cost a deployment plan for the antenna stations of SKA-Low. Most importantly this collaboration has created local community engagement in the Midwest.

Operations and Engineering

Andrew Williams | **How to submit an MWA observing proposal**

I'll be demonstrating the new MWA proposal submission form for 2023B observations, and talking about how to get the best data out of the telescope, by making sure that I have the data that I need to work out what you want.

Greg Sleap | **MWA Archive Update and Retrospective**

In this talk, I will be presenting an update on the MWA Archive, MWA ASVO and all things MWA data related! I will also give a brief history of the archive, it's growth, composition, and future.

Dev Null | **Showcasing a Decade of Advancements in MWA Calibration Techniques**

Calibration, though an integral part of scientific discovery with the Murchison Widefield Array, has historically posed significant challenges in data reduction. Thanks to recent advances in our understanding of the instrument response, monumental efforts in refining our sky models and great strides in the efficiency of our calibration algorithms, calibration is no longer the beast it once was.

So how did the MWA's pioneers navigate this complex calibration landscape, to build the foundation upon which we were able to make these advances?

As we commemorate the tenth anniversary of the project, it is a good opportunity to reflect on the strides we've taken in calibration methodologies over the past decade, and how these advancements will empower future radio astronomy.

MWA Project Meeting

Friday, July 28

Discovery

Ron Ekers | Lessons in discovery

Lessons from the history of discoveries made (and missed) using radio frequency interferometers and arrays on our path to the MWA.

Danny Price | Overview of SETI and the MWA: Technosignature and FRB searches with the MWA

The MWA is an attractive instrument for fast radio burst (FRB) and technosignature (SETI) searches as it offers a wide field of view, pristine radio interference environment, and good sensitivity. For both cases, the search space is underexplored at low frequencies, meaning there is significant untapped science potential. Here, we detail the commensal MWA pipeline that produces FRB and technosignature search products and runs in parallel to the MWAX correlator. Future opportunities for FRB and technosignature searches with MWA data (e.g. SMART) will also be discussed.

Transient Science

Gemma Anderson | Celebrating 10 years of transient science with the MWA

What transients did we expect to see in 2013 and what have we detected 10 years later? I will take you on a whirl-wind tour of how MWA has become a world leader in transient science at low radio frequencies. For most of our transient science experiments, we push MWA to the very limits of its technological capabilities. I will discuss our ongoing efforts at exploring the deep, low frequency end of FRB science and show how close we are to our first MWA FRB detection. I will demonstrate our ground-breaking work using the rapid-response system for transient follow-up, which makes MWA the fastest pointed transient follow-up telescope in the world, and therefore the only instrument capable of targeting FRB emission models from gamma-ray bursts and gravitational wave events. I will discuss exciting results from targeted transient follow-up, which has resulted in some of the lowest frequency detections of flare stars and black hole binary jets. I will then conclude with the narrative around blind transient searches with MWA and how it has led to revealing a new discovery space of unexpected populations of coherent radio transients in the Galactic Plane.

Clancy James | Plans for the MWA Particle Detector Array

The MWA particle Detector Array is an array of eight detectors to be deployed to the Murchison site in Q3 2023. Funded by Australian Research Council grants, the detectors are being built in Manchester, using material/expertise provided by Karlsruhe Institute of Technology, and the invaluable assistance of the MWA ops team. The array is finally nearing completion after several COVID-induced setbacks. This talk will present the deployment plans for the array, the planned analysis chain, and its scientific goals.

Jun Tian | MWA rapid follow-up of gravitational wave transients: prospects for detecting prompt radio counterparts

We present and evaluate the prospects for detecting coherent radio counterparts to gravitational wave (GW) events using Murchison Widefield Array (MWA) triggered observations. The MWA rapid-response system, combined with its buffering mode (~ 2 minutes negative latency), enables us to catch any radio signals produced from seconds prior to hours after a binary neutron star (BNS) merger. The large field of view of the MWA (~ 1000 deg2 at 120 MHz) and its location under the high sensitivity sky region of the LIGO-Virgo-KAGRA (LVK) detector network, forecast a high chance of being on-target for a GW event.

We consider three observing configurations for the MWA to follow up GW BNS merger events, including a single dipole per tile, the full array, and four sub-arrays. We then perform a population synthesis of BNS systems to predict the radio detectable fraction of GW events using these configurations.

We find that the configuration with four sub-arrays is the best compromise between sky coverage and sensitivity as it is capable of placing meaningful constraints on the radio emission from 12.6% of GW BNS detections. Based on the timescales of four BNS merger coherent radio emission models, we propose an observing strategy that involves triggering the buffering mode to target coherent signals emitted prior to, during or shortly following the merger, which is then followed by continued recording for up to six hours to target later time post-merger emission.

We expect MWA to successfully trigger on up to two BNS merger events detetcted during the LVK O4 observing run, which could potentially result in the detection of the predicted coherent emission or place significant constraints on the emission models.

Marcin Sokolowski | All-sky high-time resolution monitoring of transient sky with SKA-Low stations

There are indications that there is a population of Fast Radio Bursts (FRBs) at frequencies below 350 MHz which has, so far, been mostly evading detection. This is supported by hundreds of CHIME detections down to 400 MHz, and several FRBs detections by LOFAR (even down to even 110 MHz) and other instruments in the northern hemisphere. Given the expected FRB rates at these frequencies, even an individual station of the low-frequency Square Kilometre Array (SKA-Low) is sufficiently sensitive to detect up to hundreds of FRBs per year in images of the entire visible hemisphere, i.e. all-sky images. Hence, an all-sky monitoring system implemented on SKA-Low stations will open a new parameter space for FRBs and other astrophysical transients searches in terms of frequency, southern sky coverage and enormous instantaneous field of view.

I will present our hardware and software efforts to develop an all-sky system for FRB and transient searches currently tested on the Engineering Development Array 2 station.

Natasha Hurley-Walker | Long-period radio transients

SKA pathfinder instruments are probing the radio sky in new ways, searching timescales hitherto poorly-explored. Sensitive image-plane surveys are discovering new kinds of radio transients, with unusual temporal, spectral, and polarisation properties. Two intriguing periodic transients were published last year: a pulsar-like object repeating every 76s that is growing fainter with time (Caleb et al. 2022), and a short-lived radio transient repeating every 18 minutes (Hurley-Walker et al. 2022a). Both are potential examples of "ultra-long period" (ULP) magnetars, and their radio emission might be explained by a temporary twisting and/or reorganisation of their intense magnetic fields.

These discoveries are spurring new searches for similar long-period sources. Last year we conducted a transient imaging survey of the Galactic plane with the MWA at 200 MHz. We were successful in detecting a further long-period transient, which compared to previous examples shows different pulse morphologies, polarisation behaviour, and a staggeringly different activity window. Timing estimates place the source below the conventional "death lines" of emission mechanisms that explain radio emission in neutron stars. These sources are just the tip of the iceberg of a new population, the exploration of which will illuminate the behaviour of neutron stars and therefore physics in extreme environments. I will conclude the talk with future survey plans across a range of telescopes.