4TH ANNUAL RETREAT
ABSTRACT BOOKLET

Caitlin Adams
University of Queensland
Dark

Theoretical Modelling of the WiggleZ Galaxy Power Spectrum

Large-scale structure data collected by galaxy surveys has a wide variety of applications in cosmological analysis. However, our theoretical understanding is lacking in comparison to the quality and quantity of data we can collect, meaning this data cannot be used to it's full potential. In this project, we focus on improving the theoretical determination of the WiggleZ Dark Energy Survey galaxy power spectrum. To do this, we use N-body simulations to form the basis for a power spectrum emulator, which has been shown to be an effective method for theoretical power spectrum estimation in the past. Our attempt differs from previous work by introducing a neutrino mass parameter, allowing our emulator to be used to constrain this value.
Anthea

Jack Line
University of Melbourne
Evolving

Creating a Radio Source Catalogue for Calibration and Peeling

Probing the physics of the epoch of re-ionisation (EoR) is possible investigating the 21cm hydrogen line using low radio frequency interferometers, such as the Murchinson Widefield Array. However, the signal is buried under foreground radios sources, which must be removed. The approach being using by the EoR team at the University of Melbourne is to fully calibrate and peel the brightest sources, and ionospherically fit and subtract orders of ~100s more. This approach requires a positionally accurate and complete source catalogue. An algorithm has been developed to combine existing catalogues, to generate reliable source positions and spectral indexes, as well as identify potentially complex sources. In this talk the algorithm will be described and some early results discussed.

Bonnie Zhang
Australian National University
Dark, Dynamic

Photometric calibration in supernova surveys

The next generation of supernova cosmology surveys (SkyMapper, DES, Pan-STARRS, LSST) will yield unprecedented numbers of Type Ia supernovae with quality light curves, which will be placed on a Hubble diagram. As statistical uncertainties decrease, the contribution of systematics to the uncertainties in cosmological parameters becomes more significant; these are currently dominated by uncertainties in the photometric calibration. I will motivate and describe efforts to ensure the consistency of the photometric calibration across wide-field surveys such as SkyMapper, and to cross-validate the calibrations between SkyMapper and higher-redshift surveys such as DES and SNLS.

Paul Hancock
Curtin University
Evolving, Dynamic

Background And Noise Estimation for more complete and reliable source finding

I use the Aegean source finder to extract source catalogues from a test image, using various background and noise models. I will show that source finding performance can be significantly increased by using a more accurate background and noise model. In this talk I compare the zones algorithm, which is the default implemented by Aegean, to a gridding algorithm which is implemented by the Background and Noise Estimation algorithm (BANE). The two approaches differ the greatest at the lowest flux densities, where the significance of a detection is most difficult to measure. A more accurate determination of a source's significance will allow for the extraction of sources at a lower flux density, effectively increasing the sensitivity of a survey or observation.

Katherine Mack
University of Melbourne
Dark

Dark Matter in the Cosmic Context

Dark matter forms the foundation for all cosmic structure, and its annihilation, decay, or other particle interactions have the potential to affect early structure formation by injecting energy into local gas. I will discuss the status of the quest to identify dark matter, major unsolved problems relevant to the abundance and structure of dark matter halos, and how these uncertainties affect predictions of dark matter's influence over cosmic time. [Paper: arXiv: 1309.7783]

Bryan Gaenlser
University of Sydney
Evolving, Dynamic

Hydrodynamical simulations of galaxy formation

We predict the dispersion measure (DM) distribution of fast radio bursts (FRBs) using the largest currently available cosmological hydrodynamic simulation. We find that the predicted shape of the DM distribution differs significantly depending on whether FRBs are randomly distributed in the Universe or trace mass and star-formation. We consider the possibility that FRBs are standard candles, and show that the observed fluences are consistent with a population of 10^41 erg bursts at a redshift around one. Finally, we show that the foreground contribution to FRB DMs has been substantially underestimated in previous studies.

Volker Springel
Heidelberg University, Zentrum furer Astronomie and HITS

The Demography of Fast Radio Bursts from Cosmological Simulations

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Christopher Springob
UWA/ICRAR
Dark

Comparing the 2MTF and 6dFGS Peculiar Velocity Surveys to models from redshift surveys

The 6dF Galaxy Survey (6dFGS) and 2MASS Tully-Fisher Survey (2MTF) are large galaxy peculiar velocity surveys of the local universe, providing distances and peculiar velocities for thousands of galaxies, derived via the Fundamental Plane and Tully-Fisher relations respectively. We compare these observed velocity fields to reconstructed peculiar velocity field models derived from redshift surveys such as the 2MASS Redshift Survey (2MRS) and the IRAS Point Source Redshift Survey (PSCz), addressing the question of whether the galaxy distribution traces the matter distribution, and whether the observed velocity fields include a "residual bulk flow" not predicted by the models.

Fang Yuan
Australian National University
Dark

OzDES: early results and progress

OzDES is a five year, 100 night, multiplex observing program at the AAT. It uses the 2dF multi-fibre system and the AAOmega spectrograph to provide spectroscopic observations for a variety of targets in the Dark Energy Survey Supernova Survey fields. The dataset will facilitate a number of

science goals, including supernova cosmology and AGN reverberation mapping. I will present a summary of the completed first year operation, during which over ten thousand objects have been targeted and more than 6000 redshifts measured. Implications for the main science goals will be discussed. I will also provide an update on the ongoing second observing season, which has already seen improved target selection and data reduction.

David Parkinson
University of Queensland
Dark

Lessons from BICEP2

The recent announcement of detection of large-angle primordial B-mode polarization by the BICEP2 experiment earlier this year caused considerable stir in the cosmology community, due to the possibility of the signal being generated by gravitational waves. Despite the fact that the significance of these results may have been overstated, especially in light of more realistic estimation of foreground contamination, the existence for the first time of a B-mode signal raises important questions about the correct way that a joint Temperature-Polarisation analysis should be conducted. In particular the tension between Planck and BICEP2 seems to drive a very blue-tilted tensor spectrum, which would be contrary to the inflation prediction. In my talk I discuss the role correct parameterisation, prior range and pivot scale play when consider a spectrum of primordial tensors, and the effect increasing dust amplitude will have on the results.

Richard Scalzo
Australian National University
Dark

The Range of Ejected Masses in Type Ia Supernovae

Type Ia supernovae, the thermonuclear explosions of carbon-oxygen white dwarfs, have been used for over a decade as precision tools for studying the expansion history of the universe. However, the evolutionary pathways to supernova explosion and the physics of the explosion remain uncertain, representing a major unsolved problem in stellar evolution and a potential source of systematic error for next-generation cosmological surveys. The total mass ejected in the explosion is a powerful discriminant between different theoretical explosion scenarios. I will discuss my recent work on inferring type Ia supernova ejected masses from their bolometric light curves, validated using contemporary numerical simulations of supernovae. My results provide strong evidence for several striking conclusions: (i) the traditional explosion scenario involving a Chandrasekhar-mass accreting white dwarf can account for at most half of all type Ia supernovae; (ii) the range of masses most likely includes sub-Chandrasekhar-mass explosions; and (iii) the ejected mass correlates strongly with the light curve width, suggesting that the progenitor mass plays an important role in producing the width-luminosity relation used to standardize type Ia supernova luminosity distances.

Anthea King
University of Queensland/University of Copenhagen
Dark

Active galactic nuclei as powerful cosmic probes and the role of OzDES.

Our team has shown that active galactic nuclei (AGN) are a potential candidate for high-redshift standard candles (Watson et al. 2011). The technique of reverberation mapping allows one to infer the intrinsic luminosity of the AGN by measuring the time delay between continuum variations from the nuclear region and spectral line strength variations in the surrounding gas clouds. The more highly luminous, the larger the ionised region, and the longer the time delay. Since AGN are so luminous they can be used to probe much earlier epochs of the expansion history of the universe than supernovae. Information from these high-redshift regions can help constrain the properties of dark energy, in particular whether it varies over time. Reverberation mapping also provides reliable black-hole mass estimates, allowing us to investigate the co-evolution of the central black-hole with their host galaxies.

OzDES is a 5-year spectroscopic survey currently underway at the AAT working in conjunction with the Dark Energy Survey (DES). As part of this survey, OzDES is monitoring on the order of 500 AGN. This is a 10-fold increase in number over the current sample of AGN, and will extend the redshift range from its current limit of $z<\sim0.3$ to $z\sim4$. As a consequence, OzDES will provide a useful sample for testing the reliability of this method for cosmological measurements and will provide a baseline calibration sample for future work. I will describe how AGN are expected to be reliable cosmic probes and discuss the predicted capabilities of OzDES.

James Allison
CSIRO Astronomy and Space Science
Evolving

Exploring 7.7 billion years of HI with ASKAP

Neutral atomic hydrogen (HI) is thought to be the ultimate ingredient in the formation of stars and the triggering of active galactic nuclei (AGN). However, until now, epochs between $0.5 < z < 2$ (equating to more than 5 billion years of galaxy evolution) have remained largely unexplored. The few existing HI surveys at these redshifts require either space-borne ultra-violet telescopes to search for the Lyman-alpha line (e.g. Rao et al. 2006) or 21cm absorption surveys, which rely on a select sample of radio sources that have known optical spectroscopic redshifts (e.g. Kanekar et al. 2009; Curran et al. 2011). The advent of the Square Kilometre Array (SKA) pathfinder telescopes will make it possible to conduct blind 21cm absorption surveys during this period of cosmic history.

During the early science demonstration phase of the Australian SKA Pathfinder (ASKAP) we are using the six-antenna Boolardy Engineering Test Array (BETA) to carry out a search for 21cm absorption towards a sample of the brightest and most compact radio sources in the southern sky. We have recently made our first discovery of HI gas towards a newly triggered radio AGN at $z = 0.44$, with follow-up optical spectroscopic observations (using Gemini South) confirming that the absorption arises in the host galaxy. I will discuss the significance of this result in the context of blind surveys, the excellent radio frequency environment of the ASKAP site, and the use of new wide-field Phased

Array Feed technology to constrain the HI column frequency distribution towards multiple sight-lines.

Stephen Curran
Victoria University of Wellington
Evolving

Complete Ionisation of the Neutral Gas in the Hosts of High Redshift AGN as Traced Through HI and MgII Absorption

Cold neutral gas in galaxies acts as a reservoir for all star formation in the Universe. Traced by the 21-cm hyperfine transition of atomic hydrogen (HI), it can be detected through absorption by quiescent galaxies, that intervene the line-of-sight to a background active galactic nucleus, or within the host galaxy of the AGN itself. While HI absorption has been detected in over 12000 intervening galaxies, through the Lyman-alpha transition, detections in the host galaxies of AGN are extremely rare: There are only 40 detections of associated 21-cm absorption at redshifts of $z > 0.1$ and all but four of these are at $z > 1$ (look-back times in excess of half the age of the Universe). Previously, we attributed this dearth of detection of associated HI at high redshift to the traditional optical selection of targets biasing observations towards the most ultra-violet luminous AGN, in which the gas in the host is ionised. This, however, is based upon 21-cm observations and so cannot rule out that the gas may be only partially ionised to column densities below the detection thresholds of current radio telescopes and/or that the gas has a high spin temperature. We have now extended this to singly ionised magnesium (MgII), one of the strongest absorption lines in the optical band, and find this to have a similar critical luminosity. Given that MgII has a similar ionisation potential to neutral hydrogen, this indicates that all of the gas in the host galaxy is indeed ionised.

Attila Popping
ICRAR / UWA
Evolving

The neutral hydrogen content of galaxies in the GAMA survey; an HI stacking experiment.

The evolution of neutral hydrogen gas with redshift is crucial in understanding galaxy formation and how star-formation is fuelled. The direct detectability of neutral hydrogen gas has been limited to the local Universe by the sensitivity and bandwidth limits of radio telescopes. The upgraded Jansky Very Large Array (VLA) allows for the first time to observe a redshift range that has not been explored before with other telescopes. With the upgraded VLA we have performed HI observations in the redshift range between $z=0$ and $z=0.45$ in regions of the Galaxy and Mass Assembly (GAMA) Survey. Positions, redshifts and optical properties of almost 3000 galaxies have been extracted from the GAMA catalogue. Although most galaxies are not bright enough to be detected in HI directly, we can determine a signal by stacking the signal of a large number of galaxies. By co-adding galaxy spectra, effective rms noises in the microJansky regime are achieved. In this talk I will present our recent VLA observations and measurements of the cosmic HI gas density in different redshift bins. The results cover a very extended range in Cosmic time and help to bridge the gap between damped Ly-alpha observations at high redshift and blind HI observations at low redshift.

Jonghwan Rhee
UWA/ICRAR
Evolving

Parkes HI intensity mapping experiment

I will introduce an HI intensity experiment, a newly initiated CAASTRO project, using Parkes radio telescope. This will allow us to make a 3D HI intensity map of WiggleZ redshift survey fields, thereby studying large-scale structure and HI evolution in the redshift range ($0.5 < z < 2$) less explored for HI science. A large amount of data has been already taken through 200h Parkes observation of WiggleZ fields with 50-cm receiver in the frequency of 700 - 764 MHz, corresponding to $0.86 < z < 1.03$. The most challenging part of this project is to mitigate RFI contamination and to remove foreground emission by galactic and extragalactic sources which is several orders of magnitude larger than the expected HI signals. Currently data reduction and analysis pipelines are under development. In this talk, I will show preliminary results that have been obtained through data reduction process.

Weiguang Cui
ICRAR, UWA
Evolving

The galaxy clusters from hydro-dynamical simulations

I will present the mass-complete (M>10^14.3 [M_{sun}/h]) cluster sample from cosmological simulations within a volume-limited box of 410 Mpc/h in each side. These simulations were run from the same initial condition and with the same parameters, but under three different baryon models. The first run only included simple collision-less dark matter particles, hereafter DM. The second run included complex baryon models with gas cooling, star forming and SN feedback, here after CSF. The last one also included AGN feedback besides the CSF baryon models, hereafter AGN. In this talk, I will present the first work of a series of investigations on this cluster sample: the statistics on the cluster centre off-sets between different identification methods, i.e. gravitational potential peak, density peak, X-ray luminosity peak, optical luminosity peak, etc. I will also show how will the included baryon models effect these statistics, how can we understand these results and how could these results be applied to observations.

Tara Murphy
University of Sydney
Dynamic

Exploring the Dynamic Universe with the SKA and its pathfinders

I will present the latest results from the Dynamic Universe Slow Transients projects. These include:

- a survey of exoplanets with the MWA
- a survey of ultra-cool dwarf stars with the MWA
- automatic classification of variable sources in the 3XMM catalogue
- latest results from the MWA Transients Survey

- predictions for the SKA detections of GRBs, GRB orphan afterglows and radio supernovae

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Marcin Sokolowski
Curtin University
Evolving

BIGHORNS: Broadband Instrument for the Global Hydrogen Reionization Signal

The redshifted 21cm line of neutral hydrogen (HI), which can potentially be observed at low radio frequencies (~ 50-200 MHz), is a powerful probe of the physical conditions of the inter-galactic medium during Cosmic Dawn and the Epoch of Reionisation (EoR). The sky-averaged HI signal is expected to be extremely weak (of the order of 100 mK) in comparison to the foreground of up to 10000 K at the lowest frequencies. The BIGHORNS is a mobile total power radiometer, which can be deployed in any remote location in order to collect radio-interference (RFI) free data. The system was deployed in remote, radio quiet locations in Western Australia and good quality data have been collected. I will present status of the experiment and analysis of the data collected to date.

Steven Murray
University of Western Australia
Evolving, Dark

Cosmological Covariance with the Halo Model

The Halo Model is an integrated framework for the description of spatial halo and galaxy statistics with several numerically calibrated components. It has been extremely successful in analyses of the galaxy-galaxy two-point correlation function, for which a simple two-parameter fit can accurately trace an observed departure from power-law behaviour. However, typically such analyses are carried out under the assumption of a static fiducial cosmology, and only the parameters of the Halo Occupation Distribution (HOD) are allowed to vary. I will present my current research which relaxes this condition, allowing cosmological parameters to be fit simultaneously with the standard HOD parameters. This work shows several interesting covariances between the cosmological and HOD schemes, indicating that a poor choice of cosmology will adversely affect the typical analysis results, and in any case, the typical results have systematic errors in the uncertainty estimates. Extensions to this work include an attempt to constrain the mass of the dark matter particle using the same fitting techniques.

Huib Intema
NRAO

SPAM - Scripted data reduction for high-resolution, low-frequency radio-interferometric observations

Processing of high resolution radio-interferometric observations below 1 GHz is complicated by time- and direction-dependent ionospheric distortions, wide-field imaging effects and radio-frequency interference. In this talk I discuss SPAM, a semi-automated data reduction approach that efficiently produces high-quality images from sub-GHz GMRT and VLA observations.

Evan Keane
Swinburne University of Technology
Dynamic

SUPERB

In this talk I will discuss the 1000-hour SUrvey for Pulsars and Extragalactic Radio Bursts (SUPERB) currently underway at Parkes. I will describe the survey strategy, the realtime processing pipelines and the neural networks being used to make live discoveries. SUPERB is also shadowed by other telescopes and an array of others are on hand to be triggered in the event of FRB discoveries. Here I will summarise the initial discoveries and scientific results.

Emily Petroff
Swinburne University of Technology
Dynamic

The first real-time fast radio burst detection: polarization and multi-wavelength follow-up of a radio transient

The origin of fast radio bursts (FRBs) is one of the most tantalizing mysteries of the radio astronomy sky. New instrumentation has decreased the time between observation and discovery from years to seconds. We report on the real-time discovery of FRB 140514 and a rapid multi-wavelength campaign to search for counterparts. FRB 140514 exhibits significant circular polarization on its leading edge, but unlike many coherent sources, no significant linear polarization. Follow-up observations from radio to X-ray wavelengths allow us to rule out models in which FRBs originate from nearby ($z < 0.3$) supernovae and long gamma-ray bursts. We will discuss what this discovery means for the future of FRB follow-up, commensal observations, and upcoming FRB surveys.

Chris Flynn
Swinburne University
Dynamic

Taking the pulse of the cosmos with Molonglo

The Molonglo radio telescope is currently being upgraded to a system with increased bandwidth and a state-of-the-art, GPU based digitial correlator. Molonglo's huge collecting area and wide field-of-view will make it a premier instrument for pulsar timing and searching for Fast Radio Bursts. I describe the project rollout over the last 18 months in a Swinburne/Sydney collaboration, and our goal to record the radio sky at 1000 frames per second.

Fabian Jankowski
Swinburne university
Dynamic

The Molonglo pulsar timing programme

We are in the process of refurbishing the Molonglo Observatory Synthesis radio Telescope (MOST) which is located about 50 kilometres South-East of Canberra. It combines a huge collecting area (18200 m2) with a large field-of-view (2x4 deg2) and is ideally suited for massive scale observations of radio pulsars. In this talk I will report on the Molonglo pulsar timing programme which I have designed and for which data has been taken nearly every night in an automated fashion since April 2014. At the moment the Molonglo timing programme consists of 16 pulsars. Most of them have a RMS timing precision of better than one milliperiod, with a mean of 0.48 milliperiods (= 135 us) for all 16 pulsars. The main goal here is to find pulsar glitches down to micro-glitch level in order to study the properties of ultra-dense matter and the structure of the neutron star interior. I will present the expected glitch frequency for the timing programme as it is now. In parallel I conduct a study at the Parkes radio telescope to provide flux density measurements at two frequencies (732 and 3100 MHz) for the majority ofthe bright Southern pulsars with the aim to provide the most systematic and uniform sample of pulsar flux densities and spectral indices to date. This will help us optimise the Molonglo timing programme and is essential for pulsar population syntheses, making accurate predictions for pulsar surveys and observations at SKA and SKA path-finders and to study the pulsar emission mechanism, which is still poorly understood in detail.

Manisha Caleb
Australian National University
Dynamic

Population studies of FRBs using Monte Carlo simulations

The High Time Resolution Universe (HTRU) is a survey of the transient radio sky at 1400 MHz with 64’s resolution. It contains three sub-surveys at low, intermediate and high Galactic latitudes. Fast Radio Bursts (FRBs) are bright (few Jy), coherent, single radio pulses on time-scales of order milliseconds. Fourteen FRBs have been detected to date of which 9 have been discovered in the high

latitude region of the HTRU survey. In my talk I will present the results of a population study of the FRBs using Monte Carlo simulations under assumptions about their luminosity distribution, their space density as a function of redshift and the properties of the Interstellar Medium (ISM) and Intergalactic Medium (IGM). The Molongo Radio Telescope, a mile long interferometer near Canberra, is currently being refitted with increased sensitivity and bandwidth. The talk will contain estimates of the FRB rates we can expect with this instrument, showing that as it is an array, will permit parallax measurements to FRBs, so that their extragalactic origin can be tested.

James Allen
University of Sydney
Evolving

The true nature of offset AGN

When two galaxies merge, their central supermassive black holes (SMBHs) are expected to spiral in and coalesce. Observing the later stages of this process are challenging due to the small spatial scales involved, but candidates can be selected based on the kinematic properties of active galactic nuclei (AGN). If the observed emission is from gas gravitationally bound to the SMBH, it will be kinematically offset from the host galaxy as the SMBH spirals inwards. Candidate objects with such kinematic offsets are rare but can be selected from large multi-object spectroscopic surveys. Confirmation requires the more detailed kinematic information provided by integral field spectroscopy (IFS). The Sydney-AAO Multi-object Integral field spectrograph (SAMI) Galaxy Survey is the largest existing survey providing such data and, with a current sample size of ~1000, contains candidate offset AGN and a representative parent population to compare them to. I will present observations of two kinematically offset AGN from the SAMI Galaxy Survey, and show how we have used the detailed IFS data to determine their true nature and the histories of their host galaxies. The results demonstrate the power of IFS observations for obtaining a far more detailed and precise understanding of individual galaxies than is possible from single-fibre spectra.

Nicholas Scott
The University of Sydney
Evolving

Better galaxy scaling relations with SAMI

Galaxy scaling relations describe how different global properties of galaxies vary relative to one another. They are valuable tools in both studies of galaxy evolution and cosmology. The Tully-Fisher relation and the Fundamental Plane provide redshift-independent distance estimates to measure the local Hubble constant. The deviation of the observed Fundamental Plane from the theoretical prediction of the Virial theorem provides valuable insight on the systematic variation of galaxy structure and stellar populations.

We demonstrate that both these scaling relations can be improved through the use of spatially resolved integral field spectroscopy. Using data from the SAMI Galaxy Survey, we show that the scatter about the Fundamental Plane can be reduced significantly, as well as eliminating several

observational biases in its determination. In addition, we show that a single, tight, Tully-Fisher-like scaling relation can fit the properties galaxies spanning a broad range in morphology and mass. We discuss some of the future applications of these results in the context of the SAMI Galaxy Survey.

Jessica Bloom
University of Sydney
Evolving

The SAMI Galaxy Survey: finding and classifying kinematically perturbed galaxies

Asymmetry in gas kinematics is often used as a tracer of dynamical disturbance in high redshift galaxies (Yang et al., 2007; F'rster-Schreiber et al., 2009.) Using the large amount of data provided by the SAMI Galaxy Survey, we are able to make statistically robust statements about the proportion and nature of kinematically disturbed galaxies within the sample. These measurements can be compared with high redshift results, in order to increase understanding of the changing proportion of disturbed and merging galaxies over time. We fit the emission line kinematics of SAMI Survey galaxies, and measure deviations from a simple rotating disk model using the quantitative technique of kinemetry (Krajnovic et al., 2007). Comparison with morphologically based classification methods, using complimentary SDSS imaging, allows us to confirm the validity of our technique. We here present a proof of concept of this combined technique, as well as preliminary science results, including evidence of relations between perturbation and star formation rate.

Iraklis Konstantopoulos
Australian Astronomical Observatory
Evolving

A Novel Data Archive for SAMI

The SAMI Galaxy Survey will collect spatially resolved spectroscopy of â‰ˆ3400 galaxies over the coming few AAT semesters. While managing the volume of data is not in itself a tall order, the nature of the information stored presents an opportunity for astronomers to get creative information access. The primary product being a datacube, that is, a matrix of spectra, one should be free to slice and dice at will, and do so directly on the data archive, rather than being restricted by having to download thousands of individual data files. This is what we have set up for SAMI. A data archive, query engine, and database, all rolled into one, using the HDF5 filesystem through a set of Python codes. I will be presenting an overview of this open source software, which we hope will be of use to other scientists who seek a simple and versatile data access mechanism.

Bart Pindor
University of Melbourne
Evolving

OzPipe: The Australian MWA EOR Power Spectrum Pipeline

Detection of the statistical fluctuations in the neutral hydrogen density field during the Epoch Of Reionization is one of the primary science goals of the Murchison Widefield Array. I will talk about the effort coordinated across multiple CAASTRO nodes to produce a data analysis pipeline which goes from raw MWA visibilities through to two-dimensional 21cm power spectra.

Cleo Loi
University of Sydney
Evolving

Waves in the sky: Probing the ionosphere with the Murchison Widefield Array

Variations in electron density of the ionosphere affect the propagation of radio waves through refraction and diffraction, causing the apparent positions and flux densities of celestial sources to fluctuate. These effects are most pronounced at low radio frequencies (< 1 GHz). For next-generation, wide field-of-view, low-frequency radio telescopes such as the Murchison Widefield Array (MWA), Low Frequency Array (LOFAR) and future Square Kilometre Array (SKA), a thorough understanding of ionospheric behaviour is needed to assess the viability of various science goals. The wide-field nature and excellent snapshot capabilities of these instruments make them valuable tools for ionospheric science, since they can probe the ionosphere on regional (1-100 km) scales.

I present the results of an analysis of ionospheric fluctuations observed by the MWA. The data reveal spectacular wave-like structures changing on timescales of minutes, many of which have characteristics of travelling ionospheric disturbances (TIDs). While the observed position offsets are largely ionospheric, flux densities appear to be relatively unaffected. This is the first time a radio telescope has been used to probe the ionosphere with such high spatiotemporal resolution over such a wide field of view.