CAASTRO

6th ANNUAL RETREAT AGENDA

Monday 28 November 2016

Day 1 Session 2

James Allison
CSIRO Astronomy and Space Science

Illuminating the Past 8 Billion Years of Neutral Interstellar Medium with ASKAP

Neutral gas in the interstellar medium (ISM) plays a crucial role in fuelling both efficient accretion onto super massive black holes and star formation. However, the neutral atomic (HI) gas in galaxies over the past 10 billion years exhibits little evolution when compared with the rapid decline in both star formation and radiatively-efficient AGN over the same period. Does this mean that the HI represents a quasi-steady intermediate state between the ionised and star-fuelling molecular gas? When examined in detail, does the cold fraction of atomic gas evolve with redshift? Unfortunately the past 10 billion years of galaxy evolution (between z ~ 0.1 and 1.7) is observationally challenging for detecting HI in individual galaxies. The brightness of the 21-cm line declines beyond the capability of existing radio telescopes and the Lyman-alpha line can only be surveyed in the UV using space-borne telescopes. However, when detected in absorption against a suitably bright and compact background source, the 21-cm line can be used to probe this largely unexplored epoch. With a wide field of view, relatively clean radio frequency environment and large fractional bandwidth, the Australian SKA Pathfinder (ASKAP) is particularly well suited to carry out such a survey for HI 21-cm absorption. I will present results from commissioning observations, focussing on an almost complete z = 0 - 1 search for HI and OH absorption towards two distant gravitationally lensed quasars, PKSB1830-211 and MGJ0414+0534. Given the sensitivity of our data, we find that for sensible choices of spin temperature our detection yield is consistent with the expected frequency intervening systems predicted by previous 21-cm and Lyman-alpha surveys. The unique nature of the alignment between the radio source and foreground companions means that in both cases the background quasar is strongly lensed by at least one foreground galaxy into several compact image components, thereby providing multiple sight-lines through each intervening system. Multi-epoch observations of our strongest detection towards PKSB1830-211 reveal variability on approximately yearly-timescales in the HI equivalent width which is correlated with the background continuum. The implication is that this spectral variability is observationally coupled to the brightening and fading of the quasar core through preferential HI coverage of these compact components of the image. We do not see the drastic variability previously detected in the molecular absorption, consistent with a physical scale for the HI absorption that is much larger than that of the parsec-scale associated with the former.

Vanessa Moss
University of Sydney

Connecting Radio and X-Ray Absorption in Galaxies with ASKAP

Recent studies of young radio galaxies have discovered the presence of dense gas near the cores traced by both 21cm HI absorption and soft X-ray absorption, offering new insight into the physical nature of the ISM in these distant galaxies. Using ASKAP-BETA during its commissioning phase, we conducted pilot observations of radio galaxies selected on the basis of their archival XMM-Newton X-ray data in order to investigate the correlation between HI absorption and X-ray absorption. Of 5 galaxies observed so far, we obtained a new associated HI detection towards PKS 1657-298. I will describe the properties of this galaxy and the scientific significance of our result, as well as future work to be conducted as part of ASKAP Early Science and beyond. I will also highlight how these pilot observations reflect on the future prospects of all-sky radio/X-ray complementarity, particularly in the context of the upcoming X-ray missions.

Elizabeth Mahony
University of Sydney

Searching For HI Absorption in the Brightest Southern Radio Galaxies

Detections of HI absorption in distant radio galaxies can provide a powerful tool in understanding the role that cold gas plays in the formation and evolution of radio-loud AGN. Using the ASKAP-BETA telescope we have searched for HI absorption against 10 sources selected from the 2-Jansky sample; a well-studied sample of southern radio galaxies with flux densities above 2 Jy at 2.7 GHz and redshifts less than 0.7. Using the lowest frequency band of ASKAP we have searched for HI absorption in the frequency range 700 MHz - 1.0 GHz corresponding to the redshift range of 0.4-1.0. In this talk I will present early results from this survey including a new detection of HI absorption towards a powerful FRII radio galaxy at z=0.67. Results obtained from this pilot study will provide valuable insight into what we can expect to detect in the First Large Absorption-line Survey for HI (FLASH), but also highlights the need for complementary, multi-wavelength data to maximise the scientific return.

Anna Kapinska
University of Western Australia

The Brilliance of Gleam: Ngc253 Starburst Galaxy at Low Radio Frequencies

The Sculptor galaxy (NGC 253), an archetypal starburst galaxy with a prominent synchrotron radio halo, is one of the brightest southern galaxies in the low frequency radio sky. In this talk, I will present our detailed radio analysis of the galaxy, and specifically its spectral energy distribution, based on the MWA GLEAM and EoR data. With the wealth of new low radio frequency data we discovered a large scale (i.e. outside central nucleus) synchrotron flattening of the energy distribution, and confirmed a spectral turnover of the free-free absorbed starburst nucleus. We contrast our low radio frequency results with recent diffuse X-ray and anomalous HI extraplanar emission of the galaxy.

Jack Line
University of Melbourne

MAJICK - Developing Interferometric Imaging Techniques for EoR Experiments

Accurately imaging the sky using an interferometer is as much a computational problem as it is a instrumental one. As only a select set of information is gathered by any interferometer, the algorithms and techniques used to construct images from this information heavily influence the kind of science that can be extracted from them. With the impending construction of SKA_LOW, and the extreme amounts of data this instrument promises to deliver, it is important to explore ways of averaging this data to reduce the computational costs, without losing any information in the process. In this talk, I will investigate two effects known as time and frequency decorrelation, and demonstrate their effects. I will go on to introduce the developmental software MAJICK, designed to mitigate these effects.

Paul Geil
University of Melbourne

Bubbles at Dawn

Motivated by the discovery of GN-z11, the surprisingly bright and massive highest-known redshift galaxy identified earlier this year, we searched for analogues of this object in our semi-analytical model-based simulations. We found that not only are they more common than previously expected, the regions of intergalactic hydrogen ionised by many of these sources during the cosmic dawn appear as well-defined spherical ‘bubbles’ in our reionisation simulations. Integrating multi-wavelength observations of these first galaxies and the ionised regions surrounding them could unlock a wealth of information about their formation, environment and role in the reionisation of the Universe. In this talk I present the concept and preliminary results of one such strategy: utilising the planned deep and wide IR survey by WFIRST (and JWST) in combination with redshifted 21-cm observations by SKA. We find that a spectral stacking approach is required in order to achieve sufficient signal-to-noise and combat cosmic variance in the interferometric data. Our initial results suggest that this strategy may provide a promising avenue toward detecting the early stages of cosmic reionisation and a better understanding of galaxy-formation physics.

Emma Chapman
Imperial College London

Foreground Removal: The LOFAR Perspective

The Epoch of Reionization signals the end of the Dark Ages of the Universe and the birth of the first stars. The race is on to make the first statistical detection of this epoch however the foregrounds swamp the cosmological data by several orders of magnitude and their removal remains a significant challenge for both current and future telescopes. I will speak broadly about the foreground mitigation techniques currently being used with EoR data and take a closer look at the efforts being made by LOFAR with blind foreground removal methods.

Tuesday 29 November 2016

Day 2 Session 3

Paul Hancock
Curtin University

Variability vs Galactic Latitude from the MWA

Scintillation induced radio variability has often been thought to vary in strength and incidence as a function of Galactic latitude, however studies at GHz frequencies have failed to provide a consensus. I will present a 1.5 year long observing campaign, carried out with the MWA that tracks the incidence and strength of variability, as a function of Galactic latitude at frequencies between 100-200 MHz.

Rodrigo Cañas
University of Western Australia

Robust Identification of Stellar Structures in Simulations: The Effect on Scaling Relations

The latest generation of galaxy formation simulations have been producing statistical samples of galaxies whose properties can be compared with galaxy survey data. However, the structures that form in these simulations are complex, and how we interpret the results of these simulations can be affected by how we identify these structures. Estimating stellar masses in galaxies and their surroundings is an important quantity but challenging to define robustly, particularly in the case of galaxy interactions. Here we present an improved version of the publicly available 6-D friends-of-friends halo finder code VELOCIraptor. Its new features include the robust identification of kinematically distinct, but very close stellar structures that reside in the same dark matter halos, and of the environment that surrounds a given system, i.e. intra-halo stellar mass (IHSM). We find that this new version of VELOCIraptor successfully separates galaxies that are as close as a few kpc. We find that the consequences of this improved algorithm on the predicted scaling relations can be important, particularly if focus is placed on interacting galaxies.

Holger Baumgardt
University of Queensland

On the Existence of Massive Black Holes in Globular Clusters and Ultra-Compact Dwarf Galaxies

We have modelled the dynamics of 50 galactic globular clusters with well observed velocity dispersion profiles to determine their total masses, mass-to-light ratios and investigate the possible presence of intermediate-mass black holes (IMBHs) in these clusters. We find that the surface density and velocity dispersion profiles of most globular clusters are incompatible with the presence of IMBHs in these clusters. The only exception is the globular cluster Omega Cen for which we find strong evidence for the presence of an IMBH with ~40,000 solar masses. We conclude that massive black holes with masses above 1000 solar masses are rare in globular clusters, but that they could be common in nucleated dwarf galaxies.

Shivani Bhandari
Swinburne University of Technology

Christmas FRBs and Their Multi-Wavelength Follow-ups

Fast Radio Bursts (FRBs), exotic millisecond duration bursts which are now established as bona fide astrophysical phenomena are currently the hottest topic in the field of transient astronomy. The discovery of FRBs has stimulated a range of theoretical investigations to understand their origin and physics as well as observational efforts around the world to search for more such bursts. New instrumentation capable of real-time detection at the Parkes radio telescope has enabled prompt multi-wavelength follow-ups upon detection. The ongoing SUPERB project at Parkes is discovering FRBs in real time and effecting rapid multi-wavelength follow-ups which are a key to determining FRB progenitors. In this talk, I will present latest SUPERB FRB discoveries and the results of their radio, optical and x-ray follow-ups. There is no more exciting time to be involved in the field!

Fiona Helen Panther
Australian National University

SN1991bg-like Supernova Host Galaxies through a New LEnsS

Thermonuclear supernovae have been used for around two decades as standard candles to measure the geometry of our universe with incredible accuracy. The proliferation of supernova surveys has lead to the discovery of numerous classes of object which, while maintaining defining features of thermonuclear supernovae, fall outside the Phillips relation, which is so useful for cosmology. SN1991bg-like thermonuclear supernovae (SNe 91bg) are one such class of peculiar SNe Ia. It has long been noted that these events tend to occur in the old stellar populations of elliptical galaxies. However, this statement does not tell us much about the immediate environment of the supernova, which may differ from global properties of a galaxy, nor does it give a quantitive estimate of the possible ages of the progenitor systems and the populations they arise from. In LEnsS (Local ENvironments of Sub-luminous Supernovae), we use integral field spectroscopy to make detailed spatially resolved, spectroscopic observations of the local environment of past SNe 91bg to better understand the metallicity, stellar population age and star formation rate in the vicinity of the supernova. This work will help us to better understand rate of SNe 91bg across cosmic time as measured in the Dark Energy Survey, and the rate of SNe 91bg in our own galaxy in light of them being a compelling source of most diffuse Galactic antimatter.

Fabian Jankowski
Swinburne University of Technology

The Largest Survey of Pulsar Spectral Properties to Date

We have conducted a large scale survey to measure the spectral properties of radio pulsars at the Parkes telescope. Together with unpublished data from a long-term pulsar timing project we have assembled the largest data set of systematically calibrated pulsar spectral data to date. It comprises data of more than 400 pulsar at up to three radio frequencies. Using techniques from robust regression and information theory we have classified the pulsar spectra into different categories. We

found that 10 percent of the population display significant deviations from a simple power law spectrum. I will show novel results we obtained for the class of gigahertz-peaked spectrum pulsars, newly identified GPS pulsars, constraints for the pulsar emission mechanism and geometry, measurements of scintillation in the interstellar medium, and finally relations between the spectral and rotational properties of pulsars studied in this work. Our work can be used to predict the best set of pulsars to observe with low to intermediate frequency instruments, such as the MWA and others.

Xiang Zhang
Curtin University

Radio Emission from Meteors

When meteoroids pass through the atmosphere, they are heated to ablation and create ionized trails. These trails have been studied for decades, and they are known to reflect radio waves. However, for a long time people didn't realize the possible existence of intrinsic radio emission from meteor trails, until a recent detection done by the Long Wavelength Array (LWA). The LWA team found that meteor trails radiate at low frequencies, but the telescope they used has some drawbacks like low time resolution and narrow bands. In our project, we will investigate the properties of radio emission from meteors with the Murchison Widefield Array radio telescope, and compare our results with data from the Desert Fireball Network (DFN).

Dougal Dobie
University of Sydney

Searching for Supermassive Black Hole Binaries and Extreme Scattering Events with the ATESE Survey

First observed in 1987, Extreme Scattering Events (ESEs) are a form of extrinsic variability caused by lensing of a source along the line of sight. The Australia Telescope Extreme Scattering Events (ATESE) Survey is an ongoing ATCA survey that aims to enhance our understanding of ESEs using high-cadence radio observations. The current dataset spans over 2 years and consists of monthly observations of approximately 2000 sources. The large sample size, longevity of the survey and wide observation bandwidth has produced an incredibly rich dataset that has thus far only been explored in the narrow scope of searching for ESEs. In this talk I will present the preliminary results of a search for general radio variability in the survey.

Wednesday 30 November 2016

Day 3 Session 6

Christopher Jordan
Curtin University

Characterisation of the Ionosphere above the MRO with EoR Datasets

The Murchison Widefield Array (MWA) is a SKA precursor, with a large field of view at low radio frequencies. The ionosphere particularly affects low frequencies, and so poses a significant problem for low-frequency astronomy. With existing EoR datasets, I will discuss our work into characterising the spatial offsets induced by the ionosphere, and present results such as the portion of time unaffected by ionospheric activity.

Steven Murray
Curtin University

An Improved Point-Source Foreground Model for the EoR

Statistical detection of the Epoch of Reionisation, the period in which the first luminous objects began to heat the surrounding neutral hydrogen, is a primary science goal of current low-frequency instruments such as the MWA. The major obstacle to this detection is the presence of systematics up to 4 orders of magnitude brighter than the expected signal, of which a major component is extra-galactic point-sources between us and the EoR. Despite their importance, current models for the statistical influence of point-source foregrounds are extremely basic -- assuming a single power-law flux density distribution, and a Poisson spatial distribution.

In this talk, I present improved models for both of these elements. I first extend the flux-density distribution to an arbitrary double power-law, and examine the induced bias on the measured signal arising from an incomplete knowledge of the source count function.

Secondly, I extend the description of the spatial arrangement of foreground sources to include the well-known cosmological clustering using a purely analytical model. In particular, I calculate the contribution of the cosmological clustering to the covariance of the interferometric visibilities, which in turn translate to the measured EoR signal.

These more sophisticated treatments will become important as we attempt to control systematics to the sub-percent level in an effort to detect one of the most exciting signals of our generation.

Marcin Glowacki
University of Sydney

HI Absorption in Compact Young Radio Galaxies

We present the results of a search for 21 cm associated HI absorption against a sample of 66 compact radio sources thought to represent a population of young, active radio galaxies, selected from the Australia Telescope 20 GHz survey. Observations were carried out with the Australia Telescope Compact Array Broadband Backend across a redshift range of $0.040 < z < 0.096$. In total we have made seven detections, five of these previously unknown. We investigate whether these HI observations show a consistent pattern with their host galaxies and their AGN feedback through a consideration of available multiwavelength data: the optical, mid-infrared and X-ray. This work also

employed and developed a Bayesian parameterisation approach to our spectral analysis (Allison et al. 2012), and serves as a low-redshift benchmark for the upcoming First Large absorption Survey in HI (FLASH) with ASKAP. FLASH will probe the relatively unexplored redshift space of $0.4 < z < 1$ across the southern sky to aid our knowledge of galaxy evolution and hydrogen distribution.

Kathryn Plant
Swinburne University of Technology

Trialling New Digital Receivers at UTMOST in the Search for FRBs

Advances in radio astronomy instrumentation are making it possible to revitalise old telescopes with new low-cost commodity off-the-shelf hardware and low-cost receivers. The Molonglo telescope has recently been upgraded into a powerful new facility (the UTMOST) by deploying a hybrid FPGA/CPU/GPU signal processing solution at the site. Although this system is discovering new Fast Radio Bursts (FRBs) and timing hundreds of radio pulsars, its localisation of FRBs is restricted in the north-south direction to ~2 degrees. In this talk I will describe how we are using radio frequency over fibre technology (RFoF) and a new inexpensive receiver board (the SNAP) to develop a new North-South extension to the UTMOST that will deliver few arc-second localisations of FRBs. Many elements of our solution could be directly applicable to other telescopes, such as the MWA and the Deep Synoptic Array at the Owens Valley Observatory.

Jean-Pierre Macquart
Curtin University

Pulsar Variability Imaging

Traditional time-domain searches for pulsars and highly temporally variable sources are computationally prohibitive with modern radio telescopes such as the Murchison Widefield Array (MWA) because of the large numbers of images and or tied-array beams that must be searched. However, several classes of compact objects can reveal their existence by the fact that their intensity fluctuations vary both in frequency and time due to scintillation, potentially obviating the need for such data-intensive searches.

We describe our efforts to detect pulsars by examining the differences between spectra of pixels in pairs of images taken days to weeks apart. The process of image subtraction removes imaging artefacts common to both datasets, while preserving evidence of any temporal and spectral variability that may be present. Pixels of non-variable sources exhibit the statistical properties of thermal noise, but the scintillations associated with pulsars skew their intensity distribution to be highly non-gaussian.

We report the results of our deep search of one of the MWA Epoch of Reionization fields. Curiously, as well as detecting several candidates, we also find some pixels whose noise temperature is lower than the sky temperature.

Laura Wolz
University of Melbourne

Going Beyond Cosmology: Hydrogen Measurements Using Intensity Mapping Cross-Correlations

Intensity mapping surveys of neutral hydrogen (HI) are a novel way to measure the large scale matter distribution of our Universe and thus constrain parameters describing the Universal expansion. The next generation of radio telescopes and interferometers are being designed and built to optimise the detection of the HI line at low spatial resolution allowing efficient mapping of large volumes. The impact of instrumental systematics of radio observations on cosmological measurements can be significantly reduced by cross-correlating the HI signal with galaxy surveys.

The cross-correlation also offers an innovative way to statistically detect the average HI content of the optically-selected galaxy sample since the noise on the cross-power spectrum measurement scales with the galaxy HI temperature. I will present an in-depth study of this new HI measurement approach using an analytical model description and as well the latest cosmological simulation suite. I will show how the SKA pathfinder experiments can detect the relevant scales which are sensitive to the cross-power spectrum noise and probe the HI content of medium redshift galaxies to faint for direct detection with radio telescopes.

Willem van Straten
Swinburne University of Technology

Studying Pulsars Using the Higher Order Moments of Electromagnetic Radiation

Radio pulsars have long been known to emit radiation in short bursts, ranging from giant pulses that remain unresolved on nanosecond timescales to sub-pulse structures with microsecond and millisecond durations. From one turn of the pulsar to the next, these impulsive radiation events switch between orthogonally polarized states. I will review various techniques that have been used to study the orthogonally polarized mode switching phenomenon and present a relatively new statistical framework based on the covariances between the Stokes parameters. In principle, this framework can be used to differentiate between physical regimes of mode combination (e.g. superposed or disjoint); it also provides the basis for improving the sensitivity of high-precision pulsar timing experiments, including Pulsar Timing Arrays. I will outline some of the recent progress on this statistical framework and highlight some of the avenues that remain to be explored.

Day 3 Session 7

Samuel Hinton
University of Queensland

Hierarchical Bayesian Methods for Supernova Cosmology

With systematic and calibration uncertainty now on equal footing with statistical uncertainty for supernova cosmology, supernova analysis methodologies need improved techniques, rather than larger data sets, to achieve most precise and robust cosmological constraints. Bayesian methods offer one solution to this problem. After giving an overview of current and in-development analysis methodologies for supernova cosmology, I will detail my current work on Hierarchical Bayesian modelling. Specifically, the big question in supernova cosmology is how to accurate model biases and selection effects, and their non-analytic nature has driven a large push towards forward

modelling. I present a new method to calculate biases that has been integrated within a Bayesian framework, without resorting to lower-dimension functional approximations.

Jacobo Asorey
University of Queensland

Measuring Large-scale structure using angular cross-correlations

One alternative to the standard 3D analysis of the galaxy distribution is study the redshift evolution of the galaxy clustering by dividing survey catalogues in tomographic bins, as a way to avoid assuming a particular cosmological model to estimate distances. We show that we can recover three dimensional clustering information by using angular cross-correlations and we also address the perspective of using multiple density tracers to measure the growth rate of structure by considering redshift space distortions with no sample variance, using the cross correlation of photometric samples. Large Scale Structure studies are usually affected by the uncertainty on the determination of photometric redshifts and in particular angular correlations are affected by selection functions. We show that if we weigh the galaxy number counts in each tomographic redshift bin by the photometric redshift probability of each galaxy to belong to the corresponding bin we can reduce the measurement biases on the parameters due to photometric uncertainties.

Claudio Llinares
Institute for Computational Cosmology, Durham University

Finding New Ways of Testing Gravity

Cosmologists have increasing interest in testing different gravitational theories in more and more accurate ways. Large effort is being devoted in doing so by increasing the precision of the measurements of very well know observables such as correlation functions, redshift space distortions, etc. While performing such experiments is indispensable, it is important to keep in mind that this might not be the only way to go, especially if modified gravity happen to be degenerate with standard gravity in this small set of observables. This talk will be about what else can we do to test gravity (i.e. what alternative observables are sensitive to the underlying gravitational theory). One example of such observables is related to the presence of waves that propage in the extra degrees of freedom usually present in modified gravity theories. I will show some properties of such waves as well as their impact in observables quantities.

Day 3 Session 8

Bonnie Zhang
Australian National University

A Blinded Determination of H_0 from Low-Redshift Type Ia Supernovae, Calibrated by Cepheid Variables

Presently a >3\sigma tension exists between values of the Hubble constant H_0 derived from Planck and type Ia supernovae (SNe Ia). The need to preclude human bias is more compelling than ever before, and we implement this by obscuring the value of H_0 throughout our analysis and the referee process. We perform a blind reanalysis of Riess et al. 2011 (R11) to measure the H_0 using

SNe Ia from CfA3 and LOSS, calibrated by Cepheid variables and the geometric distance to NGC 4258. Our analysis incorporates the covariance matrix method adopted in SNLS and JLA to quantify SN Ia systematics, and includes a simultaneous fit of all SN Ia and Cepheid data using MultiNest, thus capturing the full dependences and interactions of all parameters. The measured value of H_0 is yet to be revealed; however, we find a relative uncertainty in H_0 of 3.5%, marginally larger than the error in R11 or the Efstathiou 2014 analysis. Our error budget is dominated by statistical noise in the supernova data.

Edward Taylor
Swinburne University of Technology

The First Direct Halo Mass Measurements from Targeted Galaxy-Galaxy Weak Lensing

I will briefly outline some progress in our efforts pioneering new approaches to measuring the effect of weak gravitational lensing. The essential insight is that the information encoded in the observed velocity fields of rotating galaxies allows one to make much more precise lensing measurements. These new approaches are uniquely suited to individual galaxy-galaxy lensing systems -- and thus halo mass measurements of individual galaxies -- at low redshift. I will also discuss the prospects for using this technique to measure cosmic lensing statistics -- and so to obtain proper 3D tomographic information about the large scale distribution of dark matter in the local universe -- from a large galaxy IFU survey like Hector.

Cullan Howlett
University of Western Australia

Testing Gravity with Peculiar Velocity Surveys

One of the key predictions of Einstein's theory of General Relativity is that the rate at which the largest structures in the Universe grow depends only on the underlying matter density of the universe and does not change based on the scale at which we look. In this talk I will describe how the peculiar motions of galaxies can be used to measure this "growth rate of structure" and its potential scale dependence, using preliminary measurements from the 2-Mass Tully Fisher survey (2MTF). I will then show that the upcoming TAIPAN survey has the potential to go far beyond this and provide one of the strongest tests of General Relativity to date.

Natalia Eiré Sommer
Australian National University

Reverberation Mapping with OzDES

It has recently been shown that active galactic nuclei (AGN) potentially can be used as standard candles, as their luminosities may be inferred from properties other than the observed flux. To infer the luminosity of an AGN, it is necessary to utilise the technique of reverberation mapping, in which one measures the time lag between fluxes originating at two different locations outside a black hole. Given the persistent luminosity of AGN, as well as their presence throughout the Universe, using them as standard candles would allow to probe the Universe at much greater distances than ever before. Such a probe has the potential of teaching us more about the evolution of cosmological

parameters, the Universe, and its contents over cosmological time. The photometric Dark Energy Survey (DES), and the spectroscopic, Australian counterpart, OzDES, are involved with reverberation mapping measurements. Given their large field of view and the multi-object spectroscopy provided by OzDES, the two collaborations will significantly contribute to the global reverberation mapping catalogue. The large number of objects targeted by DES and OzDES also allows for performing reverberation mapping in bulk, something which previously has not been possible due to the low number of observed objects. In this talk I will present the promising results we expect to obtain utilising reverberation mapping in bulk with the combined DES and OzDES data.

Anais Möller
Australian National University

Update on the SkyMapper Transient Survey

The SkyMapper Transient (SMT) survey is performing a rolling search of the southern and equatorial sky utilizing the SkyMapper Telescope at Siding Spring Observatory. Its main goal is to obtain an untargeted sample of type Ia supernovae (SNe Ia) for cosmology. SkyMapper aims to have > 100, well calibrated (∼ 1%) low redshift ($z < 0.1$) type Ia supernovae. In addition, the SkyMapper Transient survey aims to discover interesting transients and counterparts for gravitational waves and fast radio burst events.

In this talk we will give an update of the SMT survey. To date SkyMapper has discovered over 20 spectroscopically confirmed supernovae including 14 Type Ia and the peculiar Type IIn SN 2015J with a triple-peaked light curve. We have participated in the search for optical counterparts of gravitational waves as well as fast radio bursts and other transients including a collaboration with the Deeper, Wider, Faster program.

The SkyMapper Transient Survey is in full operation and discovering a large number of transients. The SkyMapper supernovae data set will be valuable as a high quality, uniformly observed and reduced, and non-targeted sample of low-redshift SNe Ia.

Day 3 Session 9

Rajan Chhetri
Curtin University

Compact Populations in the Low Radio Frequency Sky

What population dominates the compact source population observable at low radio frequencies? I will present work carried out in identifying compact radio populations smaller than arcsecond angular size scales in the Murchison Widefield array, augmenting the instrument's angular resolution capability by over two orders of magnitude. I will, then, present recent results on the properties of the identified compact sources towards understanding the population that dominates the compact-extragalactic low radio frequency sky.

Pascal Elahi
University of Western Australia

nIFTy SURFS or Building Synthetic Galaxies for the Real Universe

Cosmological simulations are a vital tool in understanding the observable universe. These complex tools aim to reproduce observations and make predictions for upcoming surveys. By using both agreement and disagreement with observations, we can gain insights into the physical processes governing the formation and evolution of galaxies and cosmic structure. I will discuss recent work from the nIFTy Comparison Project comparing a vast swath of hydrodynamical codes and galaxy formation prescriptions. I will show that there remains much work to be done to improve current state-of-the-art models. I will then discuss current work being done at ICRAR to produce Synthetic UniveRses For Surveys, the next generation of mock observations and present preliminary work.

Luz Angela Garcia Peñaloza
Swinburne University of Technology

Diagnosing the EoR with Metal Absorption Lines

In this work, we study the Epoch of Reionization (EoR) with metal absorption lines in quasar spectra at high redshift, using high resolution hydrodynamical simulations. For this purpose, we set up the physical conditions of the intergalactic medium at z_{EoR}, and we post-process the simulations to implement a uniform UV ionising background for quasars and galaxies. We use Voigt profile fitting to compute the column densities of the ions from the synthetic spectra and obtain a statistical distribution of the absorbers. Our simulations produce absorbers properties that are in good agreement with observations in the literature, especially for the high ionization species. Furthermore we are able to reproduce an observed example of a Lyman-alpha emitting galaxy-CIV absorber pair at z=5.7, proving a physical insight into such systems beyond the limit of current observations. In addition, we implement a variation in the normalisation of the UV ionizing background in order to investigate a more realistic description of the metal absorbers with low ionisation states.
