3rd Australia-China Workshop on Astrophysics

ACAMAR 3

ABSTRACT BOOKLET

Session 1: Antarctic Astronomy

Session Chair:

Sun Kwok (invited talk)
The University of Hong Kong

THz Observations of Molecular Clouds from Antarctica

Many small molecules have rotational and vibrational transitions in the terahertz range which have not yet been detected astronomically. A submillimeter-wave telescope equipped with appropriate detector and spectrometer in Antarctica will be well placed to search and detect such molecular transitions in interstellar clouds. The fine-structure lines of common neutral atoms and ions are expected to be strong and can be mapped across the galactic plane by such a telescope. In this talk, we will use several examples to illustrate the scientific potential of a THz telescope in Antarctica.

Michael Ashley
University of New South Wales

Future Options for Powering Telescopes at Dome A

To cope with funded experiments at Dome A, we need to increase the available electrical power from 1kW to 5-10kW and above. UNSW is making progress on a new modular diesel engine system to allow power to be added in 5kW increments. We are also designing a high-efficiency wind turbine with a nominal 15-20m hub height and three 6m carbon fibre blades to provide renewable power during winter. Other options being considered include a 30kW microturbine, which would provide 15kW at the altitude of Dome A, although at lower efficiency than a diesel engine.

Hui Zhang (invited talk)
Nanjing University

Searching for Exoplanets from Dome A, Antarctica

Marcus Duldig
University of Tasmania

The Importance of Antarctic Cosmic Ray Observatories

The polar regions provide unique low-cutoff observations of the Cosmic Ray flux at Earth. The viewing directions of polar neutron monitors allow excellent near real time mapping of the 3-D anisotropy which is valuable for Space Weather applications.

Muon telescopes observing at higher rigidities allow deeper definition of Space Weather structures arriving at Earth and observation of the structure of the heliosphere. The Mawson surface and underground muon telescopes and the proposed additional Japanese telescopes at Syowa have and will continue to provide important input into these studies. Ice Cube, operating as a high-energy muon telescope, now opens the prospect of observing the heliosphere and local spiral arm Cosmic Ray interactions and possibly the boundary variations between these two regions as it varies throughout the solar cycle.

Polar stations also provide information on Ground Level Enhancements (GLE's) where the cosmic ray flux can increase up to more than 40 times normal background levels due to solar Cosmic Rays. During GLEs the radiation dose at aircraft altitudes is significantly increased and the Antarctic neutron monitors are a critical part of the assessment of this impact and input to warning systems used for airlines. Spectral analysis of GLEs add to our knowledge of possible particle acceleration mechanisms which is still poorly understood.

These studies rely on a global network of observatories in which the Antarctic plays a critical role.

A review of the observations, what we can learns from them and their contribution to practical applications such as Space Weather and aircraft radiation dose will be presented.

Session 2: Antarctic Astronomy

Session Chair:

Xiaoyan Li
Nanjing Institute of Astronomical Optics and Technology

AST3-2 Performance at Dome A

The 2rd Antarctic Survey Telescope (AST3-2) is a 0.5m aperture wide-field optical imaging telescope that was deployed to Dome A, Antarctic in January 2015. It has experienced 3 winters without human attended. In 2017, it has observed for more than 4 months, collecting more than 200,000 images and 23TB of data. In this presentation, I will review the performances of the telescope and significant upgrades during the 3 years (2015-2017) including the reliability, redundancy and auto-operation strategy.

Matthew Freeman
University of New South Wales

Measuring the K-Band Infrared Sky Background at the High Antarctic Plateau.

The central regions of Antarctica have very dark skies in the infrared. Measurements from the South Pole in the K-dark band (2.4 microns) show sky brightness levels as low as 100 µJy arcsec^-2, which is superior to established infrared sites such as Mauna Kea and the Atacama. The high Antarctic plateau is colder and drier than the South Pole, so is expected to have an even darker background.

We report here on the first measurements of the infrared sky background from the Antarctic high plateau, using the robotic NISM instrument near Dome A. This instrument was installed in January 2015, and operated over the winter season. NISM observes the sky in the 2.4 micron Kdark band, which lies in a gap between airglow and thermal emission, and hence has a very low atmospheric background.

A sufficiently low infrared sky background could open up the high plateau of Antarctica for ground-based infrared telescopes, allowing long duration measurements of infrared sources to be made.

Zhaohui Shang
National Astronomical Observatories, CAS

Unattended Automatic AST3 Sky Survey at Dome A, Antarctica

The optical Antarctica Survey Telescope (AST3) has been operated at Dome A for a few years with increasing reliability for time-domain astronomy. We have achieved fully automatic sky survey with a customized Control, Operation and Data (COD) system, supported by PLATO-A for power and satellite communication. We have also developed a real-time system to support the operation, monitoring the status of all instruments as well as the weather conditions. Real-time pipeline processes data onsite, detects transit candidates through image difference photometry, and posts the candidates on a website for further confirmation and follow-up observations.

Sheng-Cai Shi (invited talk)
Purple Mountain Observatory

THz/FIR Atmospheric Transmission Measured at Dome A in Antarctic

The terahertz (THz) and FIR band is a frequency regime to be fully explored in astronomy. However, water vapor renders the terrestrial atmosphere opaque to this band over nearly all of the Earth's surface. Dome A in Antarctic – the site for China's Antarctic Observatory, with an altitude of 4093 m and temperature below -80 Celsius degree in winter, may offer the best possible access for ground-based astronomical observations in the THz and FIR band. We recently carried out measurements of atmospheric radiation from Dome A spanning the entire water vapor pure rotation band from 20 μm to 350 μm wavelength (0.75~15 THz) by an unmanned Fourier transform spectrometer (FTS). Our measurements expose atmospheric windows having significant transmission throughout this band. This talk will firstly introduce our FTS measurement results from Dome A, and then the latest development of superconducting mixers and detectors for the DATE5 telescope proposed to build at China's Antarctic Observatory.

Nick Tothill
Western Sydney University

A Survey of Molecular Gas in the Southern Galactic Plane

In order to support and enable science outputs from facilities studying the interstellar medium, such as Antarctic THz telescopes and even ASKAP, a good basic knowledge of the structure of the ISM in our Galaxy is needed. The dense molecular component can be traced by CO emission, and we report on the aims and progress of a survey of the southern Galactic plane in ground transitions of CO and its isotopologues, carried out by the Mopra telescope in Australia. We also consider the possibilities of further mm-wave ISM surveys of our Galaxy.

Session 3: The Interstellar Medium

Session Chair:

Joanne Dawson
Macquarie University

Shining Light on the Dark ISM: The Role of ASKAP and FAST

It has long been recognised that "standard radio spectral line tracers of the ISM fail to account for a substantial fraction of the neutral gas in star-forming galaxies. While the warm atomic medium is readily mapped by the HI 21 line

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Di Li
National Astronomical Observatories, Chinese Academy of Sciences

Tracing the Formation of Molecules in Space

I introduce here our recent work on studying the transition between atomic and molecular ISM. We developed an observing technique, HI Narrow Self-Absorption (HINSA), which provides a rare "robust chemistry clock" (McKee & Striker 2007). Using HINSA, we measured the molecular cloud formation time scale to be ~10 Myr, thus more consistent with the canonical star formation picture than with fast star formation scenarios. We also observed and modelled C+, OH, and CH in transition zone and clouds and derived empirical formulae for OH abundance, dark gas density, etc. versus extinction. We also identified a clear example of an isolated dark clouds undergoing current H2 formation. Our studies have implications in understanding star formation law, simulating galaxy evolution, and protostellar disk formation.

Naomi McClure-Griffiths
RSAA-ANU

The FAST track to Diffuse Gas in the Milky Way Halo

The mystery of how spiral galaxies like the Milky Way receive fresh gas to maintain their star formation rates runs deep and has important implications for galaxy evolution across all of cosmic time. In the Milky Way the amount of atomic gas (HI) in the halo available to "feed" the galaxy appears to be significantly less than required to keep the Milky Way active in star formation. In a recent paper by Moss et al (2017) we showed that there may be a significant population of diffuse atomic gas that has been almost unseen by most surveys of HI. This discovery of diffuse HI, if ubiquitous throughout the halo, suggests that the diffuse HI may outweigh the usually detected dense HI by a factor of 3! With its incredible surface brightness sensitivity, FAST is the perfect telescope to measure the prevalence or lack thereof of this elusive atomic component of the Milky Way.

Katie Jameson (co-talk)
Australian National University

Gas Temperature Demography and the HI-to-H2 Transition in the Magellanic Clouds

Not only is the transition from warm to cold neutral gas a rate limiting step to the formation of molecular gas, but it appears to influence star formation efficiency globally and we still do not understand how metallicity affects this transition. Given their proximity and low metallicity, the Magellanic Clouds provide the ideal laboratory to study the evolution of gas in the interstellar medium. We present first results from a new HI and OH absorption line study using the ATCA to measure the warm-to-cold atomic fraction and the atomic-to-molecular transition in the Large and Small Magellanic Clouds (LMC and SMC, respectively). The survey targets 48 sources in the LMC and 29 sources in the SMC, which doubles the number of existing observations and with at least $3\times$ greater sensitivity and higher spectral resolution than previous absorption line measurement studies. We decompose the emission and absorption spectra using the autonomous gaussian decomposition software GaussPy (Lindner et al. 2015), which allows us to measure the spin temperature and optical depth of the HI gas. These measurements of the optical depth allow us to constrain the amount of ``CO-faint'' gas that is optically thick HI gas. Initial analysis indicates that we measure higher spin temperatures than the previous studies (Dickey et al. 1994, Marx-Zimmer et al.

2000), and cold atomic gas fractions of ~20\%. We currently have no detections of OH absorption and an upper limit on the column density of molecular gas in the targeted lines of sight of ~few x 10^22 cm^-2, which is consistent with the dust-based molecular gas estimates.

Boyang Liu (co-talk)
ICRAR

Gas Temperature Demography in the Magellanic Clouds

A galaxy's star formation rate is partially determined by how quickly gas converts from diffuse atomic (HI) state to molecular (H2). This HI-H2 conversion is affected by the amount of metals in the gas and the strength of interstellar radiation fields. We have conducted an Australia Telescope Compact Array (ATCA) observation project that uses HI absorption to probe the HI-H2 conversion within disparate environments in two local laboratories: the nearby Large and Small Magellanic Clouds. This project will complement the ASKAP survey, GASKAP and help us understand the gas processes that lead to star formation and how these impact galaxy evolution throughout the Universe.

Our project observed 48 sightlines in LMC and 31 in SMC with 6A configuration of ATCA telescope, which doubled the total number of sampling. By May 2017 we have completed all the ~800 hours observation and derived the preliminary results for the temperature distribution of atomic gas in the Magellanic Clouds. We'll show the results and its implications for our knowledge of ISM evolution and galaxy formation.

Bi-Qing For
University of Western Australia

A Radio Continuum Study of the Magellanic Clouds

The GaLactic Extragalactic All-Sky MWA (GLEAM) survey is the main MWA continuum survey that covers the sky south of declination +30 degrees and at frequencies between 72 and 231 MHz. We utilize the data from the GLEAM survey to carry out a continuum study of the Magellanic Clouds. I will present the derived global spectral indices and radio spectral index maps. In conjunction with multiwavelength data, we discuss the implication of varying spectral index across the Magellanic Clouds in relation to star formation processes.

Session 4: Optical Instrumentation and Survey Science

Session Chair:

Anais Möller (invited talk)
Australian National University

SkyMapper Transient Survey

The SkyMapper Transient (SMT) survey is exploring variability in the southern sky by performing both a rolling search and a Target of Opportunity program utilizing the wide-field SkyMapper Telescope. SMT aims to obtain an untargeted sample of >100 type Ia supernovae (SNe Ia) at low-

redshift. In addition, our strategy allows us to discover and study exotic transients. We have an automatic response program for the search of optical counterparts for gravitational waves and fast radio burst events which benefit from SkyMapper's large field of view of 5.6sqd.

In this talk we will give an update of the SMT survey, our work towards a first data release and the role of Supernova Sighting, a citizen science project where the general public can help classify possible transients discovered by SkyMapper, thus improving the processing time for the survey. To date SMT has discovered over 60 spectroscopically confirmed supernovae including several peculiar objects as a Type IIn SN 2015J with a triple-peaked light curve and a supernova in the so-called superluminous-gap. Over 40 type Ia SNe have been discovered and classified, including SNIa 2016hhd found within the first few days of explosion with possible evidence of shock interaction. The later may provide insight on different production channels for thermonuclear supernovae which may give some clues to their diversity.

Xiangyan Yuan (invited talk)

Optical System of Chinese Large Optical/IR Telescope

Elisabete da Cunha (invited talk)
The Australian National University

The Taipan Galaxy Survey

I will present the Taipan galaxy survey, a new multi-object spectroscopic survey starting in late 2017 that will cover 2pi steradians over the southern sky and will obtain optical spectra for about 2 million galaxies in the local Universe ($z < 0.4$) over 5 years. Taipan will use the refurbished 1.2m UK Schmidt Telescope at Siding Spring Observatory with the new TAIPAN instrument, which includes an innovative Starbugs optical fibre positioner and a purpose-built spectrograph. The main science goals of Taipan are: (1) to measure the present-day expansion rate of the Universe, H0, to 1% precision, and the growth rate of structure to 5%; (2) to make the most extensive map yet constructed of the mass distribution and motions in the local Universe using peculiar velocities; (3) to deliver a legacy sample of low-redshift galaxies as a unique laboratory for studying galaxy evolution as a function of mass an environment. I will describe our observing strategy, which has been optimised to achieve these scientific goals.

Jon Lawrence
Australian Astronomical Observatory

The AAO Instrumentation Program

The Australian Astronomical Observatory (AAO) has been a world leader in astronomical instrumentation for over 40 years. The AAO has designed and built a wide range of innovative optical and infrared instruments for telescopes around the world, with particular expertise in fibre positioning systems, spectrographs, and fibre cables. This talk will review the current instrument projects and capabilities at the AAO, with a view to widening the existing collaboration with Chinese institutes in instrumentation.

Shiyin Shen
Shanghai Astronomical Observatory

The Complementary Galaxies in LAMOST Spectral Survey: Galaxy Pairs and Compact Galaxy Groups

There are a small fraction of main sample galaxies($r<17.77$) in SDSS without spectroscopy because of the fiber collision, which has been designed as the input of the complementary galaxy sample in the LAMOST spectral survey. The LAMOST spectroscopy of these galaxies are essential for the studies of galaxy interaction and small-scale environmental effects, e.g. galaxy pairs and compact galaxy groups.

Session 5: Radio Astronomy and SKA

Session Chair:

Lisa Harvey-Smith (invited talk)
CSIRO

ASKAP Early Science

The Australian SKA Pathfinder is an innovative 36-dish radio interferometer located at the SKA site in Western Australia. ASKAP is fitted with phased array radio receivers, which give the telescope a wide field-of-view (30 square degrees), which makes the telescope ideal for all-sky surveys. In this talk, delegates will hear about the latest science results coming from the ASKAP-12 antenna early science array.

Bo Peng (invited talk)
National Astronomical Observatories, CAS

ACAMAR Era Ticking: Chinese Radio Astronomy

I will present recent progress on radio astronomy in China, address perspectives for ACAMAR cooperation, focusing on new facilities like FAST and representative research groups like pulsar searching and timing at Peking University.

Randall Wayth
ICRAR/Curtin University

MWA Phase II Status and Plans

I will present a brief update on the status of the MWA Phase II upgrade and the science programs being pursued with the upgraded array.

Marko Krco (invited talk)
National Astronomical Observatories, Chinese Academy of Science

FAST Commensal Survey Plan and Technical Challenges

The Five Hundred Meter Aperture Spherical Telescope (FAST) will soon begin its long-awaited commensal survey using the 19-beam receiver developed at CSIRO. Within approximately 400 days of observing time we will cover the entire FAST sky in two passes using drift scan observations. The survey will include multiple back ends accommodating four primary projects to be observed simultaneously: Galactic HI, Extragalactic HI, Pulsar Search, and FRB search. Such commensal observing is unprecedented. We will discuss our survey plan, and how it was made to accommodate all the groups' science goals. In particular we will discuss a newly developed calibration scheme that will permit for the use of a noise diode which does not interfere with Pulsar search observations.

Jimi Green
CSIRO Astronomy and Space Science

A Scientific Hat-Trick: Parkes, FAST and the SKA

The Parkes radio telescope, known affectionately as ‘The Dish’, is located ~380 km west of Sydney, Australia, and has been in operation since 1961. It is a 64-metre parabolic antenna, with receiver systems capable of observing from 700-MHz to 26 GHz with bandwidths up to a GHz, and it is part of the CSIRO Australia Telescope National Facility (ATNF). I will discuss the ongoing efforts connecting Chinese and Australian astronomers and engineers through the combined use of the Dish and the FAST radio telescope, both through radio astronomy research programmes, and through newly developing education programmes. I will also discuss Parkes' links with the SKA as a technology Pathfinder, and the potential technology opportunities this brings for other telescopes.

Session 6: Radio Astronomy and SKA

Jingbo Wang

QTT

Cathryn Trott (invited talk)
ICRAR - Curtin University

Epoch of Reionisation with the Murchison Widefield Array, and looking toward SKA

I will review the Epoch of Reionisation experiment with the Murchison Widefield Array (MWA) radio interferometer in the Western Australian desert. I will present results to date, and future work. I will then place MWA EoR in the context of SKA-Low MWA is a precursor telescope for the technology, science and site-specific details of designing and executing the SKA EoR and Cosmic Dawn program.

Attila Popping
ICRAR - UWA

Where is the Gas? Detecting Neutral Hydrogen in the IGM.

The interaction of galaxies with their direct environment is a crucial aspect of galaxy formation. How gas is distributed around galaxies, and how it is accreted onto them to support star formation, is one of the most fundamental, but unanswered questions in galaxy evolution. In this talk I will give an overview of the significant progress that has been made in this field recently. ASKAP started doing early science and can observe large areas between galaxies because of its large field of view. IMAGINE is a legacy project on ATCA which observes the extended environment of individual galaxies at unprecedented brightness sensitivity. FAST started doing commissioning observations and is an ideal instrument to bring this field to a next level.

Qingxiang Chen
ICRAR/UWA

Knowing HI Cosmic Density via Stacking

An important topic related to HI study is to measure its cosmic density at different redshifts. While the star formation rate at redshift 1 decreased by almost one magnitude, the evolution of the neutral hydrogen as the fuel of star forming is still not well understood. In the local Universe, a lot of work has been done by directly observing the 21 cm emission line from nearby galaxies. Beyond this, the hydrogen line signal becomes too weak for current facilities to detect. Thus a different idea involves observing absorption lines where light from quasars comes through the Damped Lyman alpha system. By using this strategy, the density of neutral hydrogen has been studied from redshift 1.5 to 5. However, below redshift 1.5, the Lyman alpha line sits in the ultraviolet range, which makes it very difficult to study using ground-based facilities.

But by using the 21cm stacking technique, we can still get some important information in this redshift gap. By summing up signals from thousands of objects, signal to noise can be dramatically enhanced, thus giving a detectable HI signal. This is so-called stacking method. By stacking signals from large numbers of galaxies, some valuable work has been done to get the cosmic density evolution of neutral hydrogen. My work focuses on using data from a VLA HI G09 survey, which is a DINGO pathfinder, to study the cosmic HI density using stacking technique. It will move on to use DINGO data when it is ready in the future.

Ray Norris (invited talk)
Western Sydney University

Big Data: EMU and Machine Learning

The Evolutionary Map of the Universe (EMU) project, starting shortly on the new ASKAP telescope, will detect about 70 million radio sources, compared to the total of about 2.5 currently known, and will amass several petabytes of data. To liberate the science from the data, traditional techniques of data analysis will be inadequate. We have therefore embarked on several projects to develop machine learning techniques for tasks such as source extraction, classification, cross-identification, and redshift measurement. For example, cross-identification against optical and IR surveys is harder than simple optical-optical cross-identification because the radio sources often have spatially separated components, and there may be no radio emission detected at the position of the optical host galaxy.

An even harder challenge is detecting the unexpected. History shows that the majority of major astronomical discoveries have been unexpected or accidental discoveries made while targeting an unrelated science goal. Such discoveries are often made when new technology enables a new part of observational parameter space to be observed, and this is certainly the case with EMU. But most unexpected discoveries have been made when an astute observer notices something odd in the data. How can we possibly do this in petabytes of data? Instead, we are attempting to build machine-learning techniques to search for the unexpected in EMU data.

Stas Shabala
University of Tasmania

Active Galactic Nucleus Feedback in the Era of SKA Pathfinders

Active Galactic Nuclei (AGN) play a key role in the formation and evolution of galaxies through so-called AGN feedback. Over the last half of Hubble time, the dominant mode of this feedback is through synchrotron-emitting radio jets. Quantifying the magnitude (and even the sign) of jet feedback, however, is difficult.

I will outline our group's work on modelling the jet-environment interaction, using both analytical and numerical techniques. The key innovation is in combining models describing the dynamical evolution of observable radio AGN properties with semi-analytic galaxy formation models. We find that the mapping between observables (such as radio luminosity) and physical parameters (such as AGN jet power and age) is strongly environment-dependent, and also evolves substantially over AGN lifetime. These findings have important ramifications for interpretation of data from current and future radio continuum surveys. We have used our techniques to determine the physical properties of both low and high-redshift AGN. I will discuss how a combination of models, broadband radio, and ancillary multi-wavelength data, will help us quantify the AGN-galaxy interaction.

Session 7: Time Domain Astronomy

Session Chair:

Xuefeng Wu (invited talk)
Purple Mountain Observatory, Chinese Academy of Sciences

Magnetar-Powered High Energy Transients in the Distant Universe

I will talk about the theoretical models involving magnetars for some high energy transients in the distant universe, such as gamma-ray bursts, superluminous supernovae, electromagnetic counterparts of gravitational waves and fast radio bursts.

Ryan Shannon
ICRAR-Curtin and CSIRO

The Population of Fast Radio Bursts Detected with ASKAP

Fast radio bursts (FRBs) remain one of the most exciting and confounding classes of astronomical transients. There is mounting evidence that these bright, dispersed pulses of radio emission originate at cosmological (Gigaparsec) distances. Not only do the energetics of the events point to a new radiative process, but the pulses are imprinted with propagation through the ionised intergalactic medium and cosmic web, making them invaluable probes of media invisible to most other types of observations. Despite considerable effort to detect additional bursts, the yields have been low because of relatively narrow fields of view of most searches. Here I will present the discovery this population from a wide-area survey conducted with the Australia Square Kilometre Array Pathfinder (ASKAP), which leveraged the telescope's phased-array feeds (PAFs) and utilized a fly's eye search strategy. I will highlight the discoveries to date, which have yielded four FRBs, as of the abstract submission, and likely more between then and the conference. I will additionally show how we can use the PAF detections to better localize and measure the fluences of the bursts than other larger telescopes. I conclude by presenting future plans to develop interferometric fast transient capabilities with ASKAP, necessary to harness the full value of FRBs, and the bright prospects for detecting a complementary population of fast radio bursts with FAST.

Shi Dai
CSIRO Astronomy and Space Science

Prospects for Discovering Pulsars in Future Continuum Surveys Using Variance Imaging

In Dai et al. (2016) we developed a formalism for computing variance images from standard, interferometric radio images containing time and frequency information. Variance imaging with future radio continuum surveys allows us to identify radio pulsars and serves as a complement to conventional pulsar searches which are most sensitive to strictly periodic signals. Here, we carry out simulations to predict the number of pulsars that we can uncover with variance imaging on future continuum surveys. We show that the Australian SKA Pathfinder (ASKAP) Evolutionary Map of the Universe (EMU) survey can find $\sim$ 30 normal pulsars and $\sim$ 40 millisecond pulsars (MSPs) over and above the number known today, and similarly an all-sky continuum survey with SKA-MID can discover $\sim$ 140 normal pulsars and $\sim$ 110 MSPs with this technique. Variance imaging with EMU and SKA-MID will detect pulsars with large duty cycles and is therefore a potential tool for finding MSPs

and pulsars in relativistic binary systems. Compared with current pulsar surveys at high Galactic latitudes in the southern hemisphere, variance imaging with EMU and SKA-MID will be more sensitive, and will enable detection of pulsars with dispersion measures between $\sim$ 10 and 100 cm $^{-3}$ pc.

Ramesh Bhat
ICRAR-Curtin, CAASTRO

Wide-Band Low-Frequency Observations of Millisecond Pulsars

Studying the gravitational-wave sky with pulsar timing arrays (PTAs) is a key science goal for SKA and its pathfinder telescopes. With current PTA experiments approaching sub-microsecond timing precision, making accurate measurements of interstellar propagation delays and mitigating them from timing measurements have become increasingly important. As propagation effects are much stronger at longer wavelengths, low-frequency facilities such as the Murchison Widefield Array (MWA) and Low Frequency Array (LOFAR) provide promising avenues for undertaking extensive studies aimed at characterizing the interstellar medium toward PTA pulsars and thus potentially increasing the detection sensitivity of PTAs by complementing timing data with low-frequency measurements. The development of pulsar science capabilities for the MWA and the Engineering Development Array (EDA) bring in excellent opportunities for undertaking such studies for PTA pulsars in the southern sky. The flexible design of MWA allows simultaneous multi-band observations over the 80-300 MHz frequency range, whereas the EDA design enables wide-band pulsar observations over 50-325 MHz. I will present an overview of these new capabilities and their potential to study pulsars, and science highlights from an ongoing observing campaign of millisecond pulsars. These include scintillation studies as well as the investigation of subtle effects such as chromatic dispersion measures. I will also describe the future promises now in the horizon with the design and construction work ramping up toward an expanded MWA and a much improved EDA. Successful demonstration of the use of such low-frequency facilities to support PTAs with Parkes and MeerKAT will also serve as an important preparatory work for making effective use of SKA1-low to support PTA efforts with SKA1-mid.

Jeremy Mould
Swinburne University of Technology

The OzDES Survey

The OzDES project targets the hosts of supernovae found by the Dark Energy Survey to obtain redshifts and construct a Hubble diagram. We can also co-add these spectra to study SN host properties, such as age and metallicity. The line strengths of these spectra tell us that the absorption line spectra of SN Ia hosts are consistent with their location towards the Sloan Survey's "blue cloud" of star forming galaxies and distinct from the stellar population of red sequence galaxies. Across the redshift range (0,1) of OzDES, we see that SN Ia hosts 5 Gyrs ago were on average more metal poor with a larger fraction of billion year old stars.

Session 8: Time Domain Astronomy

Session Chair:

John Morgan (invited talk)
Curtin University

Interplanetary Scintillation as an Astrophysical Tool

In this talk I will give an overview of the history of Interplanetary Scintillation Studies from its discovery in the 1960s to its current resurgence due to new generation of low-frequency radio telescopes. I will conclude by discussing recent results and their implications for astrophysics in the SKA era.

Songbo Zhang

Xiang Zhang
Curtin Institute of Radio Astronomy

Detection of Meteors and Space Debris with the MWA

Radio reflection from meteors has been known for decades, but intrinsic emission from meteors was only revealed recently by the Long Wavelength Array scientist in the US. Following up their work, we carried out observations of meteors with the Murchison Widefield Array (MWA). In this talk I'll describe the incidence and influence of meteors, and our ability to detect space debris with the MWA.

Session 9: Data Intensive Astronomy and Simulations

Session Chair:

Julie Banfield (invited talk)
Australian National University & Western Sydney University

Citizen Science in Radio Astronomy

Robert Shen
Astronomy Australia Limited

Astronomy Data and Computing Services (ADACS): AAL's Approach to Address Astronomy Community Needs

The Decadal Plan for Australian Astronomy 2016-2025 identified five top-level science infrastructure priorities, including "wold-class high performance computing (HPC) and software capability for large theoretical simulations, and resources to enable processing and delivery of large data sets from these facilities" [1]. To better address this priority, Astronomy Australia Limited (AAL) eResearch advisory committee commissioned a working group and released a final "computing infrastructure planning working group report" [2] in October 2016, which gave an in-depth review of existing astronomy related computing infrastructures and advised AAL on investments over the next 5 years in data and computing infrastructure areas. In accordance with the recommendations in this report, AAL has invested in the establishment of the Astronomy Data and Computing Services (ADACS) initiative, to provide eResearch support services for the astronomy research community. A two-stage tender process was initiated to identify appropriate eResearch subcontractors, resulting in two service providers engaged to deliver ADACS-related services: (1) Swinburne University of Technology, with four collaborators (1a) eScience Institute, University of Washington, (1b) Institute for Data Intensive Engineering and Science, Johns Hopkins University, (1c) Microsoft Azure, and (1d) NVIDIA; and (2) Curtin University and Pawsey Supercomputing Centre with two collaborators (2a) Cray Inc., and (2b) Cisco.

Specifically, ADACS was officially launched in early 2017, to provide astronomy-focused training, support and expertise to allow astronomers to maximise the scientific return from data and computing infrastructure [3]. ADACS currently focuses on delivering the following three service components:

- Provide astronomy-focused training, using workshops, hackathons, webinars and online documentation.
- Collaborate with relevant astronomy experts to create/enhance astronomy data portals to facilitate the management, sharing and reuse of data.
- Collaborate/partner with National eResearch providers to help coordinate and maximise the computing and storage resources available to astronomers.

This talk will review three ADACS service components in details and the lessons ADACS learned so far. Furthermore, this talk will also discuss the potential ADACS roles in futures to better address the Australian astronomy community needs on community support, skill uplift and industry engagements.

Andreas Wicenec
ICRAR

Regional Science Centre Prototyping Activities and how they Might Impact on your Research

There are several activities planned or already under way to get ready for the data deluge from the SKA. Initiatives like ERIDANUS and AENEAS are trying to coordinate such activities in the Asia/Pacific and the European/African region, respectively. In this presentation we will focus on the activities in the Asia/Pacific region and in particular Australia and China to prototype regional data dissemination and exploitation. Our region is in a very lucky situation with a number of new large scale radio telescopes coming on-line or being already operational. This includes MWA and ASKAP in Australia and FAST, Tianlai and MUSER in China, just to name a few. ICRAR, CSIRO, SHAO, NAOC and Kunming University together have started to coordinate a bottom-up approach using data from the above

mentioned telescopes to implement a fully functioning precursor Regional Science Centre infrastructure, which is setup to be beneficial for users trying the access and analyse data of those facilities in the region. The idea behind this is pretty much 'learning by doing' and the scale of all of the facilities together is very close to the SKA1 already. Doing this will give us the opportunity not just to learn how to handle and manage the data, but also help us to overcome technical, organisational and political issues well in advance of the actual SKA data flow. We will present the current state and the future plans of the various activities and very much encourage people to actively join and give feedback.

Minh Huynh
CSIRO, UWA/ICRAR

The CSIRO ASKAP Science Data Archive

Astronomy is moving into the era of "big data" a paradigm where data volumes will be reaching 10s PBs (ASKAP), and in the near future 100s PBs (SKA1). Science from the next generation of radio telescopes requires long term storage of the data and tools for querying and accessing the data. At CSIRO we have addressed this by building the CSIRO ASKAP Science Data Archive (CASDA) to provide long term storage for Australian SKA Pathfinder (ASKAP) data products, and the hardware and software facilities that enable astronomers to access the data. CASDA will store ~5 PB per year from ASKAP and serve that to astronomers around the world using both virtual observatory (VO) and web-based portal services. This paper will present the current status of CASDA and future development plans.

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DRAGONS: AGN Quenching of High Redshift Star Formation

Massive quiescent galaxies are thought to have formed stars rapidly at early times followed by a long period of quiescence. The recent discovery of a massive quiescent galaxy, ZF-COSMOS-20115 at $z \sim 4$, only 1.5 Gyr after the Big Bang, places new constraints on galaxy growth and the role of feedback in early star formation. Spectroscopic follow-up confirmed ZF-COSMOS-20115 as a massive quiescent galaxy at $z = 3.717$ with an estimated stellar mass of $\sim$1e11M$\odot$, showing no evidence of recent star formation. We use the Meraxes semi-analytic model to investigate how ZF-COSMOS-20115 analogues build stellar mass, and why they become quiescent. We identify three analogue galaxies with similar properties to ZF-COSMOS-20115. We find that ZF-COSMOS-20115 is likely hosted by a massive halo with virial mass of $\sim$1e13M$\odot$, having been through significant mergers at early times. These merger events drove intense growth of the nucleus, which later prevented cooling and quenched star formation. ZF-COSMOS-20115 likely remained quiescent at $z < 3.7$. We find that the analogues host the most massive black holes in our simulation and were luminous quasars at $z \sim 5$, indicating that ZF-COSMOS-20115 and other massive quiescent galaxies may be the descendants of high redshift quasars. In addition, the model suggests that ZF-COSMOS-20115 formed in a region of intergalactic medium that was reionized early.
