
# 2nd OSKA Workshop

# ABSTRACT BOOKLET

**8TH April 2016, Rendezvous Hotel, Perth, WA, Australia**

**Ramesh Bhat**
ICRAR, Curtin University

*Low-frequency pulsar astronomy in the SKA era: from the MWA to SKA-LOW*

Studying the gravitational-wave sky with pulsar timing arrays (PTAs) is a key science goal for the SKA. PTAs are most sensitive to long-wavelength (nano-Hertz) gravitational waves and will enable astrophysics that is highly complementary to ground-based LIGO-type detectors. With timing precisions approaching the sub-microsecond regime, the success of PTAs will rely on our ability to accurately measure and calibrate interstellar propagation delays. Propagation effects are stronger at the lower observing frequencies, and hence instruments such as the MWA can be fruitfully used to increase the detection sensitivity and scientific impact of PTAs by complementing timing data with low-frequency measurements. The MWA has recently attained the ability for pulsar science, through the development of a voltage-capture functionality and a processing pipeline for generating full polarimetric tied-array beam. I will review the current capabilities and recent science highlights, as well as ongoing pulsar programs, including routine observations of timing-array pulsars, in support of the Parkes PTA project. Successful demonstration of the MWA in supporting PTAs with Parkes and MeerKAT will also pave the way to using SKA1-LOW in supporting PTAs with SKA1-MID.

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**Tyler Bourke**
SKA Observatory

*The SKA - Science Drivers and Early Update*

The Square Kilometre Array (SKA) will be the world's largest radio telescope when Phase 1 is completed in the next decade. The past few years have seen great progress toward this goal, with construction to start in 2018 and science operations anticipated to begin in 2023. In this presentation I will provide a status update on SKA activities, with a focus on the science it will enable and the avenues available for astro-community involvement.

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**Kate Chow**
CSIRO Astronomy and Space Science

*The MRO, Australia's Radio-Quiet Site: Enabling World-Class Radioastronomy*

The Murchison Radio-astronomy Observatory (MRO) is located in an extremely radio-quiet region of the planet, approximately 800 kilometres north of Perth, within the boundaries of the Boolardy Station pastoral lease. This unique observatory is now the most well protected radio astronomy site in the world. The MRO is currently the site of the Australian Square Kilometre Array Pathfinder (ASKAP) and the Murchison Widefield Array (MWA); the Australian component of the international Square Kilometre Array (SKA) telescope project is to be sited in the same region. The extremely remote nature of this location makes it an ideal site for radio astronomy.

Since 2005, a number of regulatory measures have been introduced by the Commonwealth government (through the Australian Communications and Media Authority) and the Western Australian government (through the Department of Mines and Petroleum) to prevent or control radio frequency interference (RFI) to radioastronomy at the MRO. In total, these measures provide unprecedented radio quiet protection– in frequency coverage, in geographic extent, and in the range of potential interference sources. RFI can arise from both internal and external activities, including electrical equipment on the telescope site, or transport and pastoral activities external to the telescope. I will describe briefly the government measures currently in place to protect the MRO, possible future extensions, limitations of the protection regime, and the actions taken to minimize RFI from on-site equipment.

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**Peter Hall**
ICRAR/Curtin

*SKA-low development in Australia*

In this presentation I will give an overview of the substantial science and engineering trailblazing being done for SKA_LOW in Australia. In particular, I will describe the AAVS1 verification telescope, its links to the MWA and the path to significant Australian research and industry involvement in SKA construction.

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**George Heald**
CSIRO Astronomy and Space Science

*Cosmic Magnetism with the SKA*

Probing the emergence and evolution of magnetism in the Universe through a large-area polarization survey has long been a central scientific theme for the Square Kilometre Array. In this talk I will present a summary of the key science plans of the SKA Cosmic Magnetism Science Working Group, along with a progress update. I will discuss the activities that are being undertaken to enable the key discoveries anticipated with the SKA, highlighting the unique role of the Australian community in establishing the context required to make the most of SKA-era polarization surveys.

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**Minh Huynh**
*ICRAR, University of Western Australia*

*Extragalactic Continuum Science with the Square Kilometre Array*

The focus of the Extragalactic Continuum SKA Science Working Group is the study of continuum emission from galaxies, active central black-holes (or active galactic nuclei) and galaxy clusters over Cosmic time, including the evolution of the cosmic star-formation rate. I will describe the key science goals of the working group, the SKA surveys which will allow us to achieve them, and outline the role of the SKA pathfinders, such as ASKAP, in preparing for SKA continuum science.

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**Carole Jackson**
ICRAR-Curtin

*Update on ANZSCC SAC Activity*

The Science Advisory Committee (SAC) provides scientific advice to the Australia/New Zealand SKA Coordination Committee (ANZSCC). The SAC members have diverse radio astronomy science backgrounds and aims to respond to both ANZSCC and Aus/NZ community issues of a scientific nature for the SKA project.

Since its 2015 refresh, the SAC now meets three times a year. As SAC Chair I will provide an update on some of the key matters the SAC has provided advice on, along with a broader view of Australia's scientific participation in SKA project activities.

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**David Luchetti**
Department of Industry, Innovation and Science

*Have I Got A Mega-Science Project For You! An SKA Policy Update*

The SKA has commenced negotiation of an inter-governmental treaty and the Australian Government has announced $294 million to support Australia's initial involvement in the SKA. I will talk about progress with the inter-governmental process and the decision by the Australian Government to make an early commitment to the SKA. My talk will also provide an update on domestic and international policy processes which are essential to enabling the commencement of construction of the SKA in Australia.

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**Jean-Pierre Macquart**
ICRAR

*Transients in the SKA Era*

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**Martin Meyer**
UWA/ICRAR

*HI Galaxy Science with the SKA*

The SKA will be a powerful instrument for studying HI across cosmic time. Proposed surveys for phase 1 include highly detailed studies of our own Milky Way and the Magellanic System, deep integrations of nearby galaxies pushing to new limits in resolution and column density sensitivity, resolved studies of massive galaxies to z~0.8, and absorption line studies at the highest redshifts. I will give an update on the proposed work following the Stockholm KSP meeting and improved understandings of likely receiver characteristics.

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**Sarah Pearce**
CSIRO Astronomy and Space Science

*Are We Nearly There Yet? SKA Engineering and Operations Update*

The SKA is now in stage 2 of its pre-construction phase, with the baseline design well established and consortia working towards a number of critical milestones before construction can start. Plans for how the SKA will be operated in Australia are starting to take shape, so I will explore the general structure of the Observatory and steps being taken to prepare the Australian site for SKA. I will also explain the emerging consensus on how time will be allocated on the two SKA telescopes, and the latest discussions on the role of ASKAP in the SKA.

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**Bart Pindor**
University of Melbourne

*EoR/CD Science for SKA-LOW*

*D*etection of redshifted 21cm emission from neutral hydrogen in the early universe will be one of the main science goals of SKA1-LOW. I will outline the motivation of this experiment, describe some of the most serious challenges which must be overcome, and discuss the how the Australian community can contribute to the success for this pioneering effort.

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**Peter Quinn**
University of Western Australia

*Enabling Survey Science with SKA and its Precursors*

SKA is being showcased internationally as an Exa-scale project and considerable excitement and expectation is being generated in the scientific and industrial community by the associated technological and discovery opportunities. Today we know that Exa-scale enterprises require Google-like resources and we need to understand how astronomy will scale to, and afford, challenges of this magnitude. I will examine the SKA-data requirements as determined by the set of SKA Key Science Projects. The existing SKA Phase 1 baseline design coupled with HI survey requirements already implies data volumes of processed products for a single survey to be in excess of 1 ExB. I will discuss the projected costs, timelines, challenges and capabilities of various approaches to the support of SKA astronomers and the production and delivery of SKA science products. This analysis will draw upon the experience gained across a number of major research efforts (VLT, ALMA, SDSS, LHC and LSST). The analysis will show that the SKA construction budget

will not be able to deliver all of the resources and systems needed to do survey science with SKA. Australian astronomers will need to work with regional partners and the international SKA project to find significant additional resources and put in place systems that will enable us to maximize our scientific engagement and return from the SKA. I will discuss a possible regional approach to meeting this challenge.

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**Randall Wayth**
Curtin University/ICRAR

*Expanding the MWA: towards SKA_Low*

The MWA is embarking on ambitious phase of expansion to double the number of antenna tiles and double the maximum baseline length, with enhancements specifically to support more sensitive EoR science and improved imaging fidelity for survey science. Infrastructure works for phase 2 of the MWA are largely complete with commissioning of new tiles to begin in the second half of 2016. I will also describe the envisioned MWA phase 3, which will expand the MWA's signal processing capabilities & requirements to be within an order of magnitude of SKA_Low, hence the MWA phase 3 will be an extremely useful instrument in ramping up expertise and capability on the road to Low.

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**Laura Wolz**
University of Melbourne

*Intensity Mapping Cosmology and Synergies with the EoR*

Intensity mapping of the neutral hydrogen is a new observing technique designed to efficiently map the large scales of the matter distribution in our Universe since hydrogen closely traces the dark matter. The flux of the redshifted 21cm emission is measured on low resolution without identifying individual galaxies such that the clustering behaviour of the cosmic web is still preserved and cosmological analysis such as, for instance, Baryon Acoustic Oscillation measurements are feasible. Accessing information on the epoch of the cosmic acceleration is one of the primary science goals in future ground and space-based experiments while being very challenging in optical wavelengths. Intensity mapping presents a unique way to probe the large-scale structure at such timescales in the radio regime. Experiments can be conducted by the Square Kilometre Array with SKA-LOW for redshifts close to the end of the Epoch of Reionization (EoR) and with SKAMID/SUR for redshifts up to 3 either in single dish mode or as interferometric measurements. The challenges posed by continuum observations such as intensity mapping and EoR probes, are due to strong foregrounds, high dynamic range imaging, and calibration uncertainties. I will show forecasts for the scientific outcomes of the SKA with respect to cosmology and galaxy evolution measurements by intensity mapping. Furthermore, I will present novel and versatile tools for the data processing pipeline which address foregrounds and imaging in a consistent framework applicable to EoR and intensity mapping experiments

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