



**Monthly Newsletter of International URSI Commission J – Radio Astronomy**  
August 2018

**Officers**

Chair: Richard Bradley  
Vice-Chair: Douglas Bock

ECRs: Stefan Wijnholds  
Jacki Gilmore

Prepared by R. Bradley, Chair, Commission J, [rbradley@nrao.edu](mailto:rbradley@nrao.edu)

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**News Items**

Greetings Commission J Members!

The Commission J program for the upcoming Pacific Radio Science Conference (AP-RASC) has been finalized with a very nice set of interesting sessions. Please see the article below for details.

I'm continuing to solicit workshop and session ideas for the 2020 URSI General Assembly and Scientific Symposium in Rome. A working draft of the 2020 GASS Commission J program is given below – we will continue to modify it over the coming months. Your input is welcome and encouraged – consider convening a session – your help is appreciated by the organizers but the personal experience in seeing your session come together at the Symposium is quite rewarding.

Congratulations to the MeerKAT group on achieving an important milestone last month! The official inauguration was held on July 13 at the SKA site and Justin Jonas kindly captured the highlights of this event in a nice article for the Activities Spotlight this month. Some remarkable radio images from MeerKAT are included along with photos of the instrumentation and inaugural activities. Thank you, Jonas, for your contribution to the our Newsletter.

One of the two plenary speakers at the 2019 URSI-USNC meeting in Boulder, CO will be ALMA Director Sean Dougherty. The title of his presentation is “*Atacama Large Millimeter Array (ALMA) in 2030.*” See <https://nrsmboulder.org/> for more information.

I kindly request your ideas, articles, news, photos, etc. for upcoming editions of Newsletter. Let's keep it interesting and informative! I thank all of you who have already contributed.

*Submitted by R. Bradley*

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## **2019 URSI Pacific Radio Science Conference (2019 AP-RASC)**

9 -15 March 2019, New Delhi, India

**Plan to present your work at the 2019 AP-RASC in New Delhi, India!**

See <http://aprasc2019.com/> for details.

### **Commission J Program**

#### **J01: Evolution/Latest Results from uGMRT (Contributions and Felicitation of Govind Swarup)**

Prof. Govind Swarup, the father of Radio Astronomy in India, left a career in Stanford, USA and returned to India in January 1962. Over the next several decades, he and his team designed and built several Radio Observatories in India, including the 32 dish interferometer in Kalyan, in Bombay, the Ooty Radio telescope, The Ooty Synthesis Radio Telescope and the Giant Meterwave Radio Telescope. This session will present a historical introduction on Prof. Govind Swarup who will be turning 90 in 2019 and take a look at some of the significant contributions to Radio Astronomy by Prof. Swarup and his group at TIFR and how they established Radio Astronomy research on a firm foundation in India.

*Conveners: Subra Ananthkrishnan and Yashwant Gupta*

#### **J02: Updates from Existing Radio Astronomy Facilities – I**

Radio astronomy has played a predominant role for more than five decades, both in terms of outstanding scientific achievements, and cutting edge technical developments. Major landmarks have been achieved for example in the discovery of the 21cm line of neutral hydrogen and its use in the study of the structure of the Milky Way, the role in discovering radio re-combination lines from ionized hydrogen (H II) regions, the discovery of pulsars, to name a few. Several Radio Astronomy facilities are either in the process or are planning major upgrades. This session aims to provide a platform for the exchange of information regarding the progress of these plans, as well as for each facility to provide an update on their current status as well as of recent exciting new science results made using the facility.

*Conveners: Jayaram Chengalur and Douglas Bock*

#### **J03: Updates from Existing Radio Astronomy Facilities – II**

The vast range of topics encountered in the pursuit of radio astronomy throws open very diverse fields ranging from the cosmic microwave background to radio galaxies, objects in our own solar system, and gravitation. These studies require functioning telescopes and facilities, many of which have been operating for many decades now. Some of these facilities like for example the Ooty Radio Telescope, have provided valuable complimentary data to space based observatories like ASTROSAT to achieve important new insights and breakthroughs in other wavebands like hard X-rays. This session will aim to provide a platform to bring together researchers working on establishing and/or using radio astronomy facilities especially in the Asia-Pacific region and facilitate exchange of information regarding their progress and future plans. It will also enable researchers from each facility to provide an update on their current status as well as of recent exciting new science results made using the facility.

*Conveners: R Ramesh and Douglas Bock*

## AP-RASC Commission J Program

### **J04: VLBI: Current Status and Future Prospects**

With new instruments coming on line in the Asia Pacific region, there is growing scope for Very Large Baseline Interferometry (VLBI) between these facilities and the existing radio telescopes. While upgrade of GMRT provides a high sensitivity radio telescope for VLBI and geodesy, new telescopes are being commissioned in Thailand and China. Along-with the existing VLBI networks, such as the Korean and Japanese VLBI network and LBA, and antennas in China as well as the Russia-led Space VLBI mission Radio Astron, these facilities provide a platform for exciting VLBI science in studying extremely high brightness temperatures in active galactic nuclei, super-massive black hole binaries, new ways of probing radio scattering and scintillation in the interstellar medium, star formation and geodesy with both ground based interferometers as well as a space interferometer. This session aims to review recent developments in VLBI science, instrumentation and techniques with an audience of astrophysicists and instrumentation scientists in mind, while looking to future of VLBI in the SKA era. It also aims to bring together representatives of the community for discussions on collaboration for global VLBI efforts in these directions.

*Conveners: B C Joshi and Sergiy Gulyaev*

### **J05: Radio Astronomy Instrumentation & Techniques – I (Rcvr Systems: Analog/Digital/Optical Fibre)**

Increased bandwidth, sensitivity and wider field of view are some prime characteristics for new generation of receivers on radio telescopes that are being upgraded or built, such as FAST, MWA, ASKAP, Upgraded GMRT, ORT and MOST, as well as SARAS, SWAN, ELI, CSRH to name a few. In order to meet these demands, there has been plenty of research and development efforts taking place in various labs around the globe. This session aims to focus on progress and advances in receiver and radiometer technology. Suggested topics include design and construction of cryogenically cooled heterodyne and bolometers receivers, receivers with LNAs at ambient temperature for traditional multi-beams and phased array feeds (PAF), radiometers, RFI mitigation using PAFs, narrow band filters, HTS filters etc., technology development in the areas of improved dynamic range, time response, spectral bandwidth, spectral resolution, compactness in size etc. Other topics covered in this session include calibration techniques for single telescopes, interferometers and array receivers. This session will provide a forum for those engaged in these activities to share their experience and understanding, as well as to address and discuss possible solutions to meet the present and future challenges.

*Conveners: B Ramesh and S Srikant*

### **J06: Radio Astronomy Instrumentation & Techniques - II (Data Processing: Imaging, Big Data)**

Even after about 2 decades, the Giant Metrewave Radio Telescope is still advancing, thanks to the "upgraded-GMRT" project. A near seam-less frequency coverage over 125-1500 MHz with new wide-band receivers has been built with an aim to increase the sensitivity of GMRT. The "upgraded-GMRT", now an SKA pathfinder instrument, will complement several other new space and ground observatories such as ASTROSAT in India, 500 m dia. FAST in China, etc. which will all be useful for discovery in several areas of astrophysics. The future Thirty-Meter-Telescope and the Square Kilometre Array projects, along with the above instruments, will also contribute enormous amount of data that will need sophisticated processing. This session aims to focus on the current trends, key results of imaging and its challenges, and big data handling.

*Conveners: Dharam Vir Lal and Veeresh Singh*

## AP-RASC Commission J Program

### **JGH7: Recent Scientific Results on Solar, Solar Wind and Space Weather Observations**

Observations of the solar corona at radio wavelengths have witnessed somewhat of a revival of late, with interesting new results from the Low Frequency Array (LOFAR) and the Murchison Widefield Array (MWA). In recent times, the Sun has shown an increasingly peculiar behaviour, with solar photospheric fields having continuously reduced over the past two decades or more and interplanetary micro-turbulence levels also having dropped in sync with solar photospheric magnetic fields. This rather unusual situation on the Sun will possibly have significant space weather and climatic effects and which can be studied using a host of ground and space based observatories. Imaging observations at cm and decimetre wavelengths are important in understanding flare energy release and energetic particle propagation and acceleration. Instruments like the Chinese Spectral Radio Heliograph (CRSH) operating between 0.4 and 15 GHz will play an important role in understanding these phenomena. This session aims to provide a platform for solar radio astronomers, plasma physicists, planetary scientists, astrophysicists, and radio scientists to communicate and discuss a wide range of interesting and exciting topics, including the recent progress of radio observations of the Sun, solar wind, and planets, spacecraft measurements, data processing, theories, new technologies and much more.

*Conveners: P Subramanian, Yihua Yan and P Janardhan*

### **J08: Recent Scientific Results on Galactic, Extra-Galactic, Star Formation, Transients**

Recent years have seen major improvements in imaging the radio sky. In addition to the existing major radio telescopes such as ALMA, JVLA, GMRT, LOFAR and MWA, new facilities are also begun operational. In India, the existing Giant Metrewave Radio Telescope (GMRT) has just finished major upgrade with huge improvement in the sensitivity. MeerKAT in South Africa has just begun operational and in Australia ASKAP is beginning to image radio sky. In this session, updates from all major observatories and exciting science results from both existing and new facilities would be presented. This session also should enable collaboration among scientists.

*Conveners: Ishwar Chandra and Kenta Fujisawa*

### **J09: The Early Universe (EoR Experiments and Related Results)**

This session aims to provide an update on the study of early universe at radio wavelengths. Study of Cosmic Dark Ages, Cosmic Dawn and Epoch of Re-ionization with the redshifted 21cm signal (redshift  $> 8$ ) is a major probe to this last frontier of structure formation history. Several ongoing and upcoming radio telescopes are partially or fully dedicated to conduct crucial observations in this field. Major telescopes like the GMRT, LOFAR, MWA, 21CMA, PAPER have been used to observe the fluctuations of redshifted HI 21cm signal from these early epochs of formation of the Universe. Lessons learnt from these experiments forms an essential component of future observations with upcoming telescopes like the uGMRT, SKA and HERA. Similarly, all-sky averaged 21cm signal forms the major science goal another set of radio experiments like the EDGES, SWAN, BIGHORNS, etc. Moreover, the same probe is also utilised to study the evolution of the neutral hydrogen in later redshifts. Such observations about the HI intensity mapping forms major science goal of experiments like TIANLAI, CHIME and SKA.

*Conveners: Abhirup Dutta and Tirthankar Roy Choudhury*

## AP-RASC Commission J Program

### **J10: Future Radio Astronomy Facilities (including Square Kilometre Array)**

These are exciting time for the field of radio astronomy. Recent and continuing technological advances on multiple fronts have been leading to ever more ambitious and capable telescopes. These telescopes span the entire range from THz to the lowest frequencies able to penetrate the ionosphere and will enable transformative science. This session aims to provide a platform for updates from single dish and interferometric facilities across the world which are currently being designed or at various stages of development and commissioning. These facilities include, but are not limited to, the SKA and its precursors, FAST, CHIME, LOFAR2.0 and ngVLA.

*Conveners: Divya Oberoi and Ramesh Bhat*

### **EFGHJ-6: Upcoming Areas in Interference and Interference Mitigation**

The aim of this session to bring together researchers, engineers from all radio science disciplines to consider how RFI affects their respective fields, to develop mitigation strategies and to foster cooperation. Particular attention will be given to the impact of new and future sources of RFI, spectrum management challenges, and new technology developments. Recent progress towards the ultimate goal of being able to do observations with real-time mitigation of the undesired signals, while leaving the desired signals minimally affected, will be discussed. This session is also aimed to focus on: new mitigation approaches; innovative processing, smart antenna, meta-materials and new EMI issues in innovations; Connected vehicles, smart grids, smart cities, IoT, 5G etc.

*Conveners: Hanna Rothkaehl, Uttama Ghosh Dutta and Stefan Wijnholds*

### **E07: RFI Mitigation in Radio Astronomy**

The aim of this session is to focus on the following topics: radio frequency interference (RFI) issues and their mitigation that are of particular importance for observational sciences such as radio astronomy, microwave remote sensing of the Earth, and solar and ionospheric studies, where highly sensitive measurements are necessary.

*Conveners: Subra Ananthkrishnan, Kaushal Buch and Tasso Tzioumis*

### **EACFJ-8: EM Spectrum Allocation and Management**

With the proliferation of applications using wireless solutions, spectrum management and its use have become real challenges because of the limited spectrum resource. This session aims to focus on all the existing works and the emerging new technical concepts that would create a viable approach to address this important issue.

*Conveners: Anjana Jain, Tasso Tzioumis and Jean-Benoit Agnani*

### **JOS: Any Other Aspect of Radio Astronomy**

Authors who feel that their submission is outside the scope of the ten sessions J01 – J10, or are unsure about which specific session it appears to fit in, can submit here. It will be reviewed and, once accepted, will be re-allocated appropriately to a relevant session by the Session leads.

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## **2020 URSI General Assembly and Scientific Symposium (2020 URSI GASS)**

*Rome, Italy*

We are now in the early stages of planning for the next URSI General Assembly and Scientific Symposium. Volunteer to convene a session or organize a one-day topical workshop around an important area of research. Let's work together to maintain the long tradition of excellence that the GASS provides to the radio science community.

### **\*\*\* Draft Program for Commission J – GASS 2020 \*\*\***

#### **Sessions:**

New Telescopes on the Frontier

Recent and Future Space Missions

*Conveners: Joe Lazio*

Single Dish Instruments

Very Long Baseline Interferometry

Millimeter/Submillimeter Arrays

Receivers and Radiometers: Design and Calibration

Digital Signal Processing: Algorithms and Platforms

Short-Duration Transients and Pulsars: Observations, Techniques, and Instrumentation

Solar, Planetary, and Heliospheric Radio Emissions (Commissions HJ)

Ionospheric Models and their Validation (Commissions JG)

Characterization and Mitigation of Radio Frequency Interference (Commissions JEF GH)

Spectrum Management (Commissions ECJ)

Historical Radio Astronomy

*Conveners: Richard Schilizzi*

Latest News and Observatory Reports

*Conveners: Rich Bradley and Douglas Bock*

#### **Workshops:**

Space Weather (Commissions GHJ)

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## **Activities Spotlight - MeerKAT Inauguration**

The MeerKAT radio telescope was officially inaugurated on Friday 13th July 2018 by the Deputy President of South Africa, Mr David Mabuza. The event was held at the MeerKAT/SKA telescope site in the Karoo, with the formal proceedings being conducted in the huge dish fabrication shed that provided welcome shelter from the cold winter wind. Until October last year, when MeerKAT antenna #64 was completed, this shed had been the bustling production line for the MeerKAT main reflector sub-assemblies.

The Master of Ceremonies was Phil Mjwara, Director General of the South African Department of Science & Technology, and the Director General of the SKA Organization, Phil Diamond, and the

Managing Director of the South African Radio Astronomy Observatory (SARAO), Rob Adam, were among the speakers preceding the Deputy President's address.

Guests at the inauguration included senior officials in the South African government and the governments of a number of African partner countries, ambassadors from SKAO member countries, members of the Board of the SKAO (the SKAO Board meeting was held in South Africa in the two days immediately prior to the inauguration), international and local radio astronomers with close ties to the SKA and MeerKAT, contractors responsible for the delivery of major telescope subsystems, and SARAO staff members. Directors from various radio astronomy observatories were present, as were the PIs of the MeerKAT Large Survey Projects and providers of MeerKAT guest instrument back-end equipment.

Special guests with a long involvement in the SKA and MeerKAT projects included all of the past South African Ministers of Science and Technology who had overseen the initiation and execution of the MeerKAT project during their respective tenures, Prof Richard Schilizzi, the founding Director of the SKA Project Development Office and past Chair of Commission J, Dr George Nicolson, the Founding Director of HartRAO and the leading figure in the development of radio astronomy in South Africa, and Dr Khotso Mokhele who was CEO of the National Research Foundation when South Africa joined the SKA community and a key initiator of the MeerKAT project (Dr Mokhele was also a major figure in the SALT optical telescope project).

Although the actual telescope was the star of the show, the radio images that were revealed for the first time by Project Scientist Fernando Camilo also attracted huge accolades. These images are products of the very first MeerKAT observations that were conducted just days after the 64-station correlator was deployed.

An iconic image of the Galactic Centre, assembled from a mosaic of about 20 telescope pointings, was used as a backdrop to the stage. This is the most detailed and highest fidelity centimetre-wavelength radio image of the Galactic Centre ever made, showcasing the dynamic range of the MeerKAT resulting from the unblocked aperture, stable electronics, large number of baselines, and the dense central concentration of antennas (the fact that the Galactic Centre passes directly overhead MeerKAT also helped!). Single-dish L-band data from the Green Bank Telescope (provided by Bill Cotton, NRAO) was used to complement the interferometer data in order to provide zero-spacing UV coverage. According to Fernando Camilo, Chief Scientist at SARAO: "We wanted to show the science capabilities of this new instrument. The centre of the galaxy was an obvious target: unique, visually striking and full of unexplained phenomena – but also notoriously hard to image using radio telescopes. Although it's early days with MeerKAT, and a lot remains to be optimized, we decided to go for it – and were stunned by the results."

Other L-band radio images resulting from deep observations of extragalactic fields reveal thousands of new radio galaxies, highlighting MeerKAT's sensitivity and resolution. It is expected that all of the inaugural images will be the subject of journal publications in the near future.

No pulsar data was revealed at the inauguration event, but MeerKAT test observations of known millisecond pulsars have provided indications of impressive pulsar timing capability, primarily ascribed to the sensitivity, processed bandwidth and polarization purity of the telescope.

Although the MeerKAT is providing tantalizing first results, a significant programme of commissioning, debugging and extensions to functionality needs to be conducted in the coming months before the telescope will be ready for open calls for observing time and routine observations. In the interim, test and shared risk observations will continue to ensure that the MeerKAT is performing to specification, allowing the prioritized Large Survey Projects can get started.

A collection of quotes from radio astronomers who attended the event:

*“Formal openings of new astronomical facilities can be dull affairs - often the instruments are still several years away from delivering science quality data. South Africa astronomers have bucked that trend with the immediate delivery of fantastic new images of the Galactic Centre and several other distant cosmic radio sources. MeerKAT has undoubtedly hit the ground running, and expectations of major astronomical discoveries being made soon are quite literally... sky high!” – Mike Garrett*

*“I have watched the development of MeerKAT from its genesis many years ago. It has been a massive achievement by the SARAO team to develop an impressive telescope on a virgin site, starting with such a small team. It was a pleasure to share the day with my South African colleagues, to see the already impressive early images and to contemplate what the future will bring as SKA starts construction.” – Phil Diamond*

*“The MeerKAT launch was a happy affair celebrating the culmination of a visionary project for South Africa and the African continent. The quality of the Galactic Centre image was superb and promises well for exciting results in the future.” – Richard Schilizzi*

*“It was amazing to see the breath-taking image of the galactic centre produced by MeerKAT as a testament to the power of the instrument. It is rare to see such an impressive demonstration at inauguration of these world-class facilities!” – Matthew Bailes*

*“This is a fantastic achievement. Our South African colleagues did not only build a radio telescope, they build the best. Truly remarkable.” – Michael Kramer:*

*Submitted by J. Jonas*

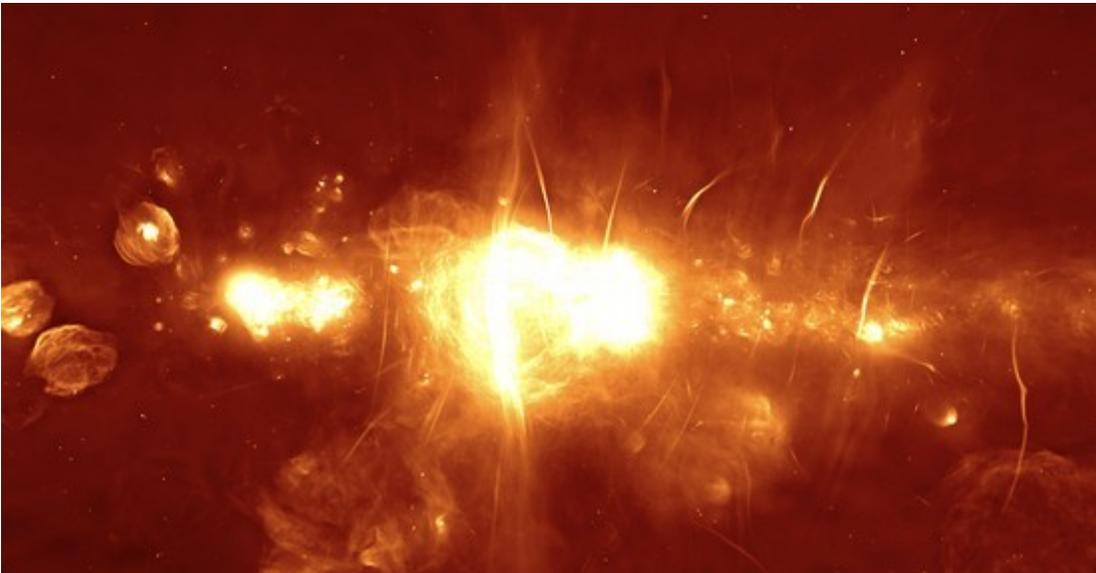
Please see the [Photos from the Field](#) section of the Newsletter for several photographs of the radio images, telescope instrumentation, and event activities.

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## Photos from the Field



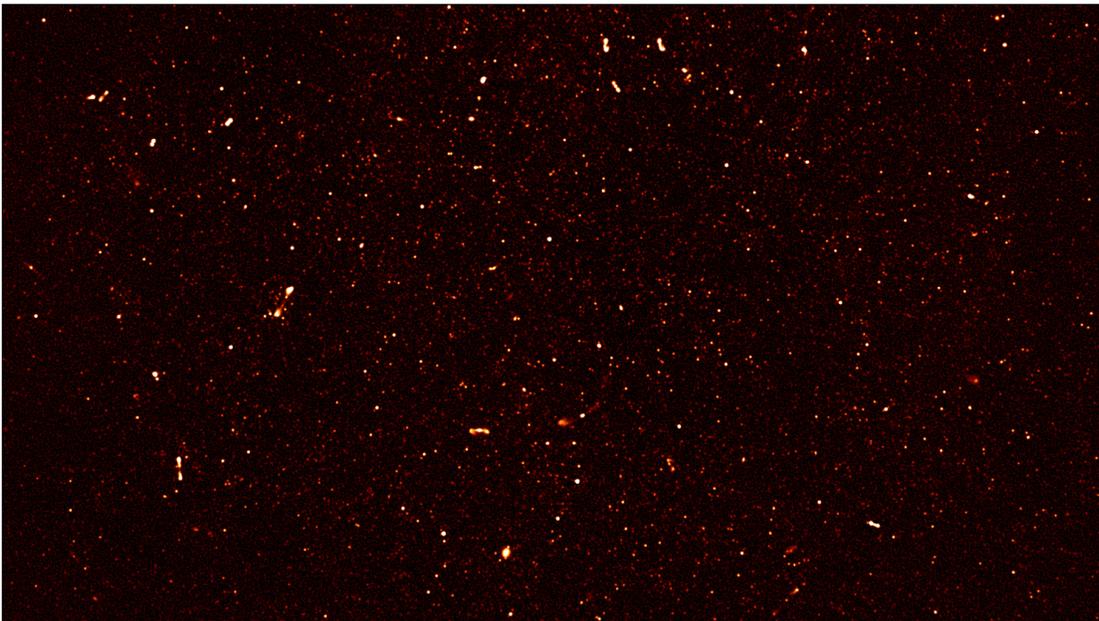
*An aerial view of the inner core of the MeerKAT telescope. About 54 of the 13.5-meter antennas lie within the 1 km diameter core.*



*The mosaic L-band radio image of the Galactic Centre region produced from observations made within the first month of MeerKAT commissioning.*



*A MeerKAT single-pointing L-band image of the radio galaxy Fornax A.*



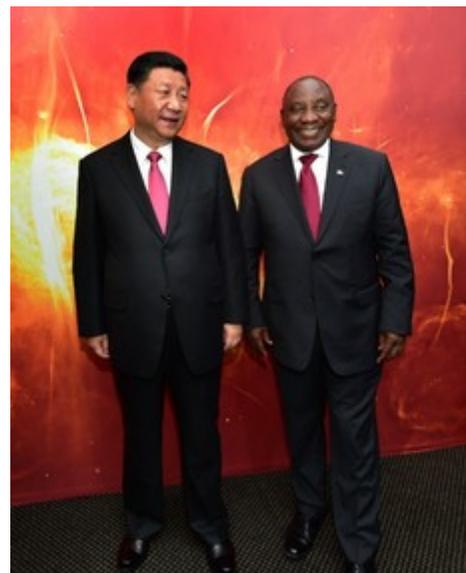
*A section of a deep L-band single-pointing observation of a field towards the South Celestial Pole, revealing thousands of new radio galaxies within the MeerKAT primary beam area.*

*The Chair of the SKAO Board, Catherine Cersarsky, flanked by SKAO Director General, Phil Diamond, and SKA stalwart and past Commission J Chair, Richard Schilizzi. The sight of the MeerKAT core dishes evoked this response from Richard: “The MeerKAT dishes look like a flotilla of sails in the desert. Reminded me of the sails you see in Friesland NL of boats gliding along the canals.”*



*A view of the stage inside the dish construction shed that was used by the speakers at the MeerKAT inauguration. The backdrop to the stage was a large print of the MeerKAT radio image of the Galactic Centre.*

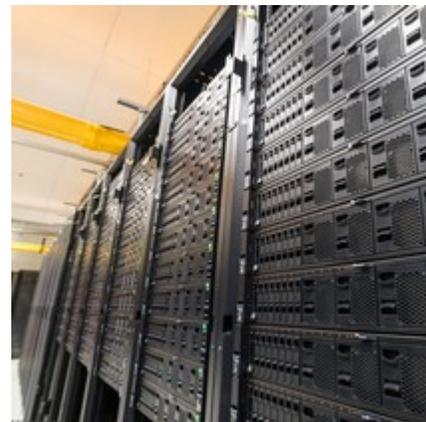
*Presidents Xi Jinping and Cyril Ramaphosa pose in front of the MeerKAT Galactic Centre image at a joint China-South Africa exhibition of science, technology and innovation in Pretoria that was held two weeks after the MeerKAT inauguration.*





*A section of the MeerKAT correlator, based on the CASPER architecture and populated with SKARAB (aka ROACH3) FPGA processing nodes.*

*The MeerTRAP back-end to MeerKAT, provided by Ben Stappers from the University of Manchester and funded by an ERC grant. MeerTRAP will undertake commensal searches for pulsars and fast transients during all of the Large Survey Projects. (Picture credit: Fabian Jankowski)*



*A small subset of the scientists, engineers and technical staff involved in the design, construction, commissioning and operation of the MeerKAT telescope.*

*Photos courtesy of J. Jonas*

If you have an interesting photograph that you wouldn't mind sharing with others in the public domain I encourage you to please send a copy to me along with a brief caption and the person's name or organization to whom I should credit.

