

CONTACT

ISSUE 01

SEPTEMBER 2019

**THE MAKINGS OF AN INTERNATIONAL
SCIENCE ORGANISATION**

SKA ON TOUR IN INDIA

DRONES IN THE OUTBACK



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Aerial view of the SKA Global Headquarters at Jodrell Bank at sunrise.
Credit: SKAO / Dragons Eye Filming



Dear colleagues,

Welcome to the first issue of the new, aptly named SKA publication, *Contact*. *Contact* is obviously a movie reference but the name also reflects our desire to connect the SKA community. As we emerge from the detailed design phase, move towards the establishment of the SKA Observatory and see construction on the near horizon, we decided to move away from our two previous newsletters (one internal to the project, the other aimed externally) to deliver a single magazine which will cover the growing range of SKA activities around the world. In this more ambitious format we will seek articles from across the community, from scientists in SKA science working groups, from engineering, design and construction teams, from precursor and pathfinder telescopes and occasionally from our government partners.

This first issue of *Contact* is published at a period of heavy activity as the design teams prepare for the System Critical Design Review, scheduled for

9-12 December. Success in this review will enable us to prepare the SKA1 Construction Proposal and Operations Plan which we intend to submit to the SKA Observatory Council, upon its establishment. When the Council approves the proposal and commits the agreed funding, SKA will move into the construction phase of the project. So, the next 15 months or so will be an exciting period and we will endeavour to share progress and milestones to make sure you keep up-to-date on the most relevant happenings within the project.

I hope you enjoy this new SKA publication. I'd like to thank all the authors who contributed to the first issue and I'm sure that our communications team will welcome feedback, suggestions for improvement and of course contributions to this publication, which is very much yours!

**Prof. Philip Diamond, SKA
Director-General**



CHINA HOSTS FIFTH SKA SUMMER SCHOOL IN SHANGHAI

BY DR TAO AN (SHANGHAI ASTRONOMICAL OBSERVATORY) & YANG JIE (SKA CHINA OFFICE)

A week-long training session involving more than 70 students and young scholars in SKA-related fields was held in Shanghai, China in August.

Using data obtained from the SKA precursor and pathfinder telescopes, the summer school focused on the search for and study of radio transients.

Leading researchers from China, SKA Organisation, and the University of Sydney were invited to give lectures and share their experience in practical data processing, offering an opportunity for the trainees to acquire a basic understanding of SKA transient sciences, and to ready themselves for the future research on transients with the flood of SKA data.

"We had lectures on hot topics like gravitational waves, gamma-ray bursts, fast radio bursts and supernovae, and SKAO Project Scientist Dr Evan Keane set the students a practical challenge to search for FRBs," explains Dr Tao An of Shanghai Astronomical Observatory, which hosted the event.

"They processed this using a prototype SKA data centre, making them some of the first users of the prototype, and giving them an insight into the future processing of SKA data.

Within the dataset, which was hundreds of gigabytes in size, the students found radio transient 'FRB010724' which has a duration of only a few tens of milliseconds."

Supported by China's Ministry of Science and Technology, the SKA China Office, and the Chinese Academy of Sciences, the summer school is part of China's consistent efforts to nurture future talents to work in SKA-related fields, and has been organised five times since 2013.

"As a long-term project, the SKA requires continuous contributions from the community, and knowledge propagation and education of young SKA scientists is a vital part of that," adds Dr Tao An.

China is also due to host the 2019 SKA Shanghai Meeting during the last week of November.

Above: The fifth Chinese SKA Summer School brought together researchers with a broad range of research interests. Credit: Shanghai Astronomical Observatory.

ASKAP COUNTS DOWN TO FULL OPERATIONS

BY DR AIDAN HOTAN (CSIRO)

Some amazing early science has already been delivered with CSIRO's Australian SKA Pathfinder (ASKAP) telescope, including the recent localisation of a one-off fast radio burst.

The paper is available in [Science](#), with a fantastic image of ASKAP on the cover. We also made a [short video](#) about the discovery.

ASKAP is now transitioning to full operations and this transition will provide the SKA community with a wealth of experience as we encounter many of the issues that will be faced by the SKA in a few years. ASKAP was designed to operate as a survey telescope, conducting large-scale projects for international science teams and providing image products as its primary output (instead of raw data). This operations model is new for many radio astronomers and we have a plan

to make the transition from construction to operations a smooth one!

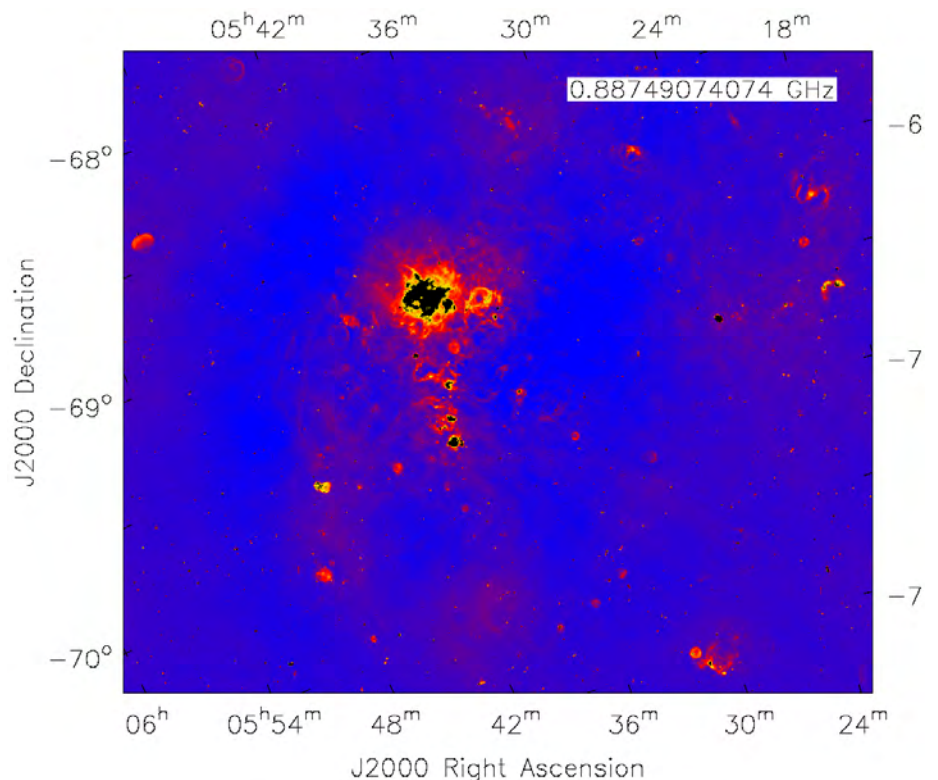
ASKAP is conducting a series of "pilot surveys" to test the instrument and our scheduling, data processing and quality control frameworks and our communication channels with the science teams. The first round of pilot surveys consists of 100 hours observing time for each of the eight teams. Each pilot will use observing modes and processing strategies devised for full-scale surveys. This means we expect to see interesting scientific outcomes, while maintaining a focus on deep analysis of data quality.

Feedback will be used to prioritise any improvements required before embarking on multi-year survey campaigns.

In preparation for the pilot surveys, our science teams have been working on individual test observations of typically 10 hours duration. These single-field tests are used to check the end-to-end operation of the telescope and develop a survey strategy, with the final stage being a public data release containing all the products that would be required for survey analysis. This staggered approach makes the transition from construction to full operations much more manageable, by providing regular checks and opportunities for feedback from the science teams.

Data from the EMU GAMA23 continuum test field are already available on the public archive, [CASDA](#). The next test field data release will be from the WALLABY science team, consisting of neutral hydrogen maps of the Eridanus cluster.

Right: Small cut-out from a recent continuum test observation covering the Large Magellanic Cloud at a frequency of 888 MHz. The star-forming region 30-Doradus is clearly visible, along with many other objects and filamentary structures. The full image is available on CASDA.





SKA HOSTS REACH OUT TO LOCAL COMMUNITIES FOR NATIONAL SCIENCE WEEK

BY VIVIENNE ROWLAND (SARAO)

The South African Radio Astronomy Observatory (SARAO) participated in the South African National Science Week 2019 launch, which was held in Kimberley in the Northern Cape province at the end of July.

The launch was graced by the Minister of Higher Education, Science and Technology, Dr Blade Nzimande, along with other government stakeholders and dignitaries.

SARAO was represented by colleagues Simphiwe Madlanga, Tshegofatso Monama, Chantel Mabeleng and Isaac Magolego educating school learners and educators on the SKA and science and technology-related career options at SARAO.

National Science Week (NSW) is an annual event to exhibit and communicate awareness of science.

This year it took place from 29 July to 3 August 2019. It is an initiative of the Department of Science and Technology (DST), a countrywide celebration of science involving various stakeholders and/or role players conducting science-based activities during the week.

NSW is run across the country simultaneously at multiple sites, with this year's theme "facing the harsh realities of climate change."

You can watch Prof. Justin Jonas, SARAO Chief Technologist, being interviewed on the morning of the launch on SABC1 [here](#).

BY ANNABELLE YOUNG (CSIRO)

Hot on the heels of the big 50th Anniversary of Apollo 11 in Australia was National Science Week, themed The Moon, of course!

At CSIRO, we teamed up with Curtin University and ICRAR to celebrate science in Geraldton, the closest town to the Murchison Radio-astronomy Observatory (MRO). Our team started with a chat to the students who attend Meekathara School of the Air (MSOTA). These students live in the outback and attend school via the airwaves, and they are plugged in and switched on to science, keeping us busy with questions about the MRO and our precursor telescopes. CSIRO's Outreach and Education Specialist, Rob Hollow has been visiting MSOTA since 2006 and has built a great relationship there.

The team visited a range of schools around Geraldton and held some fun activities – noise levels with 300 young people modelling the Solar System were substantial! Students are so curious about the Universe, one even asked whether it's possible to leave it?! They also love to hear about the SKA, it's kind of special to know it's being built in your own "backyard".

Our booked-out event at the local Museum, "From the Moon to the Murchison" took the audience on a journey from CSIRO's involvement in the Moon-landing, with our Parkes Radio Telescope, across to Western Australia's role in the space programme including new missions handled through the ESA deep space tracking facility and up to the Murchison, with it all leading towards the ultimate instrument – the SKA.

Top: Isaac Magolego, Simphiwe Madlanga, Tshegofatso Monama and Chantel Mabeleng from SARAO at the launch of National Science Week, which took place in Kimberley in the Northern Cape province, South Africa. Credit: SARAO



CSIRO Outreach & Education Specialist Rob Hollow giving a talk during National Science Week at a local school in Western Australia. Credit: CSIRO



TEAM SKA AT BLUEDOT 2019

BY JOE DIAMOND (SKAO) & DR HILARY KAY (UNIVERSITY OF MANCHESTER)

It may have been a soggy weekend of classic British summer weather, but that didn't dampen the spirits of the tens of thousands of people who flocked to the annual Bluedot Festival from 18-21 July.

Hosted at Jodrell Bank Observatory, which was recently inscribed as a UNESCO World Heritage Site, the festival offered an inspiring mix of science, music and culture.

Team SKA's stand in the Star Field, situated between SKA Global Headquarters and the iconic Lovell Telescope, provided an opportunity to engage with festival-goers young and old. In the shadow of the SKA inflatable dish, towering 8m above the stand, visitors were encouraged to create pictures of the Universe inspired by the SKA's *Shared Sky* artworks, learning techniques used by indigenous artists from the two SKA sites in Australia and South Africa.

Younger visitors tried their hand at navigating through the Universe, learning about SKA science along the way, with the aid of Bee-Bot programmable robots.

Clad in SKA's brand new "Science is for Everyone" T-shirts, staff and students from the SKA Organisation and the University of Manchester were on hand to explain the science and technology involved in building the world's largest radio telescope.

Away from the Star Field and in the midst of Bluedot's musical and cultural attractions, SKA scientists and engineers enthralled festival-goers as part of a wide-ranging talks programme, covering star formation, the science and engineering demands of the SKA, and its potential to impact society beyond science.



Flags flying at the SKA HQ

THE MAKINGS OF AN INTERNATIONAL SCIENCE ORGANISATION

BY MATHIEU ISIDRO (SKAO)

In March 2019, hundreds of guests from around the world gathered in a richly adorned ceremonial room at the Italian Ministry of Education, University & Research on a sunny Roman spring day to witness a historic moment. But to understand how they got there, we need to wind back the clock to 2013.

A month shy of six years ago, the SKA's then recently formed Strategy Committee (StratCom) presented its findings to the SKA's Board of Directors at their meeting in Doha, Qatar: the most suitable legal structure for the SKA, given its 50+ year lifetime and international nature, would be an intergovernmental organisation or IGO - an entity created by treaty, involving two or more nations, to work in good faith, on issues of common interest.

The conclusion built on years of policy work by many international partners through projects like Prep-SKA and Go-SKA, funded by the European Union's successive research programmes.

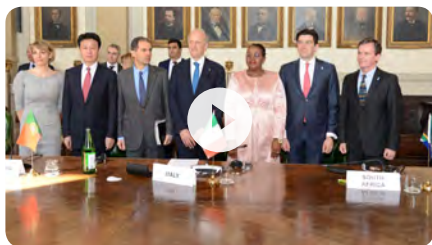
Under the leadership of then Chair of the SKA Board Prof. Giovanni Bignami, President of INAF, things accelerated and in October 2015, a first round of negotiations took place

in Rome after Italy offered to lead the negotiations. Representatives from the Australian, Chinese, Indian, Italian, the Netherlands, New Zealand, South African, Swedish

and UK governments were officially mandated to negotiate on behalf of their governments. Portugal joined them in due course, with other nations in attendance as observers.



Participants of the second meeting of the preparatory negotiations towards establishing the SKA Organisation as an IGO at the Accademia dei Lincei, in Rome, Italy, in January 2016. Credit: INAF



[Watch the SKA's new trailer celebrating the creation of the SKA Observatory](#)

Four rounds of negotiations would take place in Rome over a period of two and a half years to agree everything about the new organisation from its purpose to its scope, locations, rights, obligations, etc. The process concluded with a "legal scrub" – where lawyers from the various countries got together to scrutinise the text of the treaty.



With dictionaries at the ready, lawyers pour over the SKA treaty text at SKA HQ to make sure they have the same interpretation of words and terms.

In May 2018 the text was opened for initialing – literally, for negotiators to write down their initials on it, as one would on a contract – to indicate it had been agreed as final by all parties. The heads of each delegation took turns to initial the text to indicate their country approved the text as it stood.

Fast forward a few months and all of a sudden, a date was set and invitations were sent out for the official signing ceremony: March 12, 2019 – curiously, six years to the day after the inauguration of ALMA, the world's current largest multi-national radio telescope in Chile.

A mere six weeks before the date, the announcement kicked off frantic preparations to organise the event, from the protocol around attendance, to which room the ceremony would be hosted in at the Ministry, to the guest list, the livestreaming and yes, even the Carabinieri in full ceremonial uniform.

DID YOU KNOW?

The SKA treaty is actually called a convention. Whereas an international treaty can be bilateral and involve only two countries, a convention is a multilateral treaty signed by multiple countries.

Seven countries signed the SKA Convention that day: Australia, China, Italy, the Netherlands, Portugal, South Africa and the UK. Ministers, ambassadors and other high-level representatives from over fifteen countries interested in joining were present to witness the event signaling the creation of a global observatory to promote international collaboration in radio astronomy and to build the SKA.

The day had its share of excitement and drama that'll no doubt become part of the SKA's legend, but one thing is certain: there was an incredible sense of hope for the future in the room, and a sense that all were witnessing a historic moment for international science. Indeed the SKA Observatory has the honour of being only the second intergovernmental organisation dedicated to astronomy in the world - the other being the European Southern Observatory, ESO.

So what next? At the time of publication of this magazine, [the Netherlands has become the first country to ratify the SKA treaty](#).

Good progress is being reported in the other signatory countries, with the

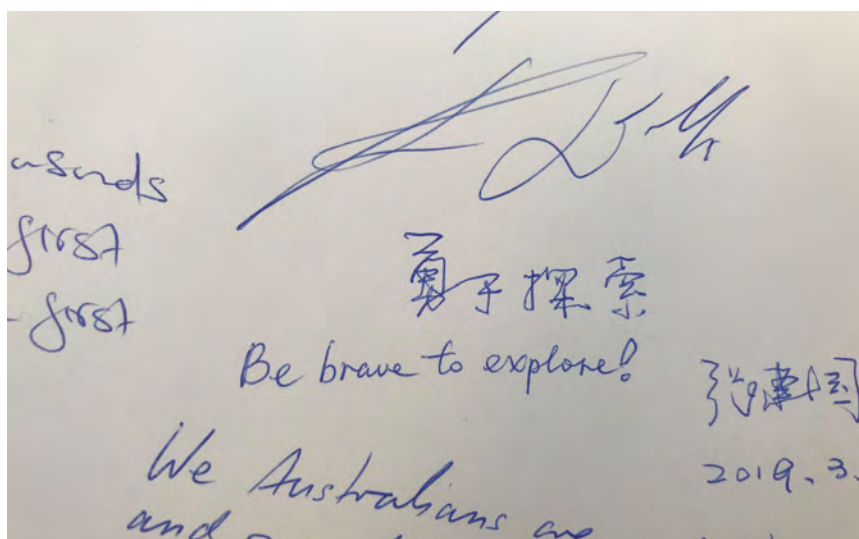
text currently sitting before Parliament in Australia, Italy, South Africa and the UK, and China indicating the text could be ratified by the end of the year.

At SKA HQ, the team in charge of the transition is aiming for a first Council meeting in June 2020. From there, the approval of construction by said Council is in sight, and construction itself.

TRANSITION?

Establishing an IGO isn't without precedent. What is, is establishing one from a company. "Traditionally IGOs are born out of nothing" said Theunis Kotze, SKAO's in-house legal expert, "but in our case we're having to transfer existing assets, staff, finances, etc. from a private company to an international organisation. There was no book to refer to on how to do that so we've had to follow our own path."

It has been many years since the first discussions around a suitable model of governance for the SKA, and the process can sometimes seem remote, disconnected from the reality of the engineering and the science needed to deliver the project. But every now and then, in moments like the treaty signing ceremony, we are reminded that both are intimately connected, and that curiosity, a sense of wonder and passion for discovery unite us all in the SKA world around our common goal.



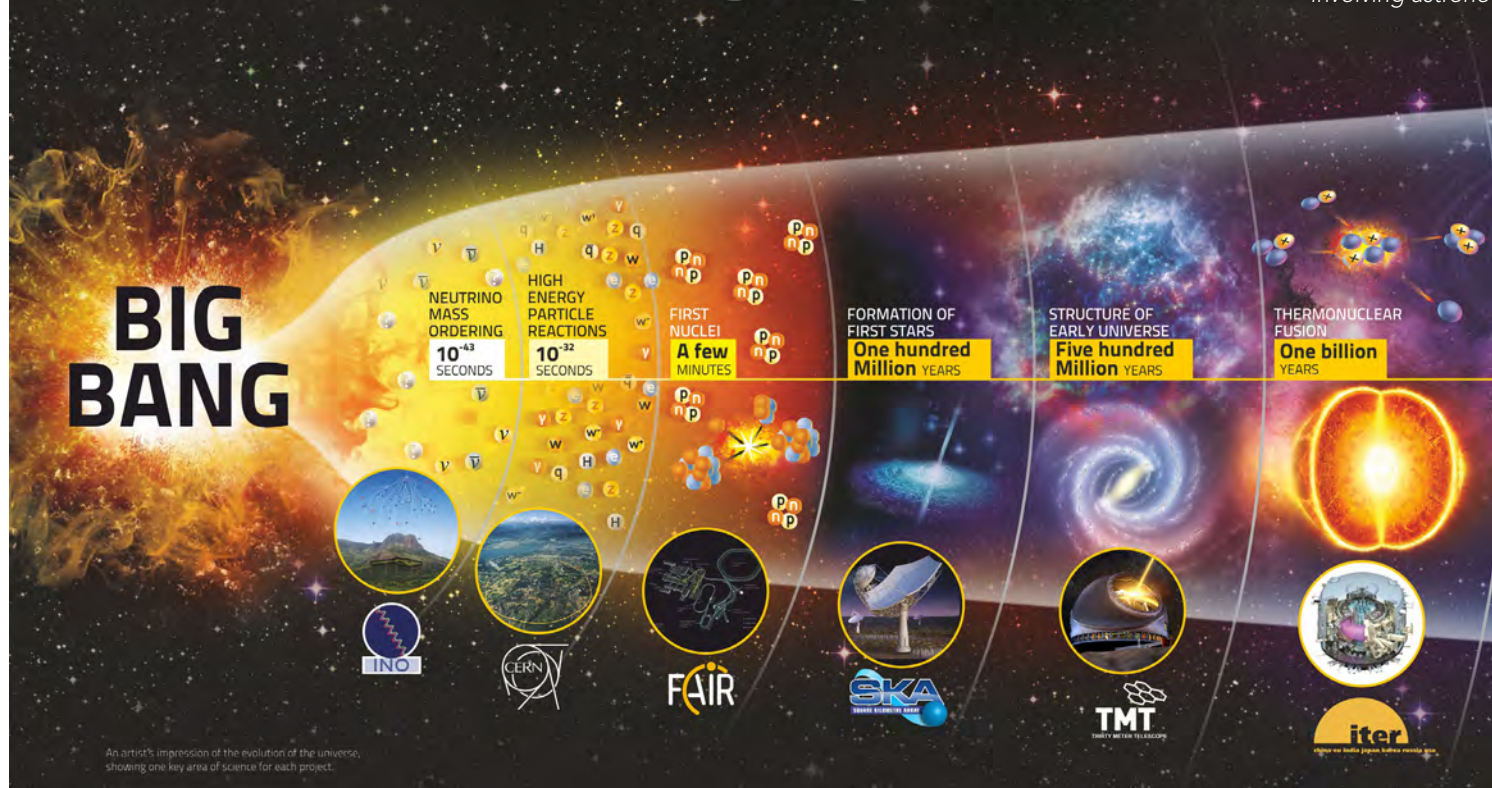
Message written by the Chinese Vice Minister of Science & Technology Jianguo Zhang in the SKA Observatory Book of Testimonies, celebrating the signing of the SKA Convention.



From micro to macro: Understanding the universe through mega science projects

Organised by

The image shows the evolution of the universe along with the science projects involved. The SKA project is a major focus, involving astronomy and physics.



VIGYAN SAMAGAM: THE FIRST EVER MEGA SCIENCE EXHIBITION IN INDIA

BY DR TIRTH CHOUDHURY (NCRA) ON BEHALF OF THE SKA-INDIA CONSORTIUM

In a first of its kind, the main funding agencies for science projects in India, namely, the Department of Atomic Energy (DAE) and the Department of Science and Technology (DST), along with the National Centre for Science Museums (NCSM) organised a major exhibition to showcase the mega-projects India is involved in.

The exhibition called "Vigyan Samagam", or "Confluence of Scientific Ideas" in Hindi covers India's participation in [CERN](#), [FAIR](#), [INO](#), [ITER](#), [LIGO](#), [SKA](#) and [TMT](#).

The exhibition is travelling to four major Indian cities, staying for about a couple of months before moving to the next one. The first leg in Mumbai is already over (May - July 2019) and saw more than 200,000 visitors go through the

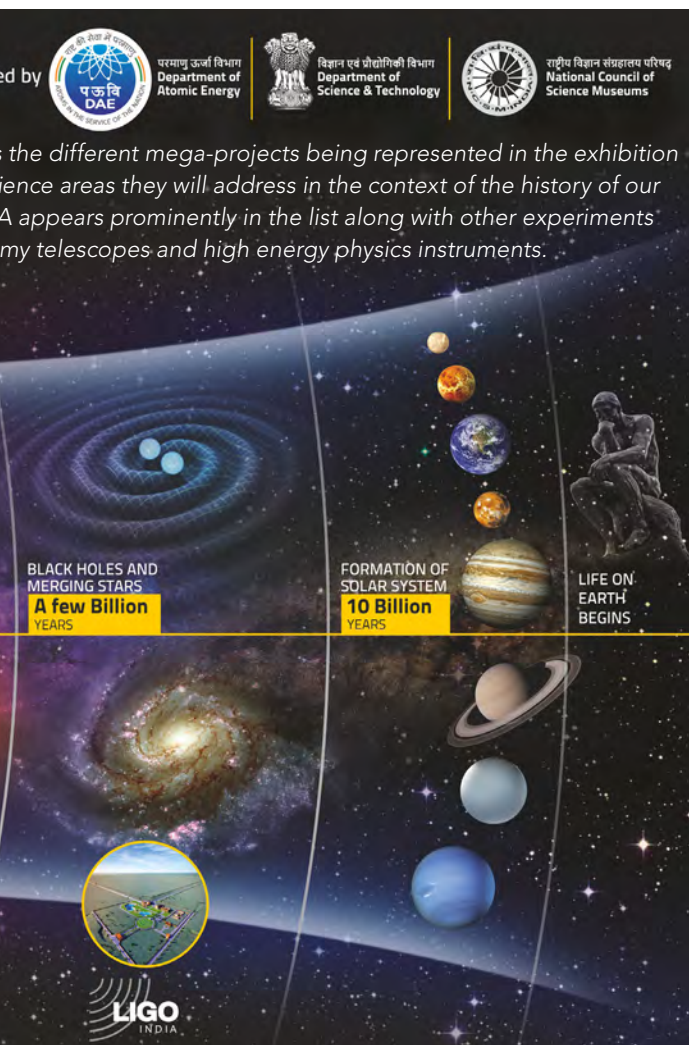
exhibition. The second leg in Bengaluru is currently on (July - September 2019). Next will be the turn of Kolkata (October - December 2019) with the final leg in Delhi (January - March 2020).

The exhibition at each venue consists of three components:

- an inaugural programme consisting of lectures and panel discussions involving all the mega-projects
- a stall for each project

consisting of posters, videos, models for demonstration and an interactive kiosk

- a week devoted to each project which can consist of lectures, live demonstrations, quizzes and any other innovative event the organisers can think of.



Below: NCRA Director Prof. Yashwant Gupta and CERN Director-General Prof. Fabiola Gianotti at the SKA booth. Students from local schools attending a talk.



Credit: Prof. Yashwant Gupta



Credit: Vigyan Samagam

The inaugural event was held in Mumbai on 8 May. Dignitaries and high-level officials from government and the various projects including Prof. K VijayRaghavan, Principal Scientific Advisor to the Government, attended the event and stressed the recent advancements in India's participation in the mega-projects. The SKA exhibit was prepared in close collaboration between the SKA-India Consortium and the SKA Office, in particular, SKAO's Communications team, and included posters, scaled models of an SKA dish and Low antenna as well as NCRA's GMRT as one of the SKA pathfinder telescopes. Volunteers from across the country were trained by NCRA to guide visitors through the stand. During the SKA week in Mumbai, there were three lectures for the general public every day. These covered the basics of radio astronomy, the importance of the SKA and its pathfinders, the interesting science questions to be addressed and the technical and engineering challenges.

The SKA week also consisted of a quiz competition. The questions were based on astronomy and the participants were from nearby schools and colleges. A very popular event during the SKA week was the telescope making workshop. The hands-on demonstration involved making a small radio telescope using a simple kit. The attendees were mostly students who enjoyed the experience immensely. Another popular event during the week was the QASTRO (Quest for Astronomical Sources Through Radio and Optical) contest which involved making UV-Optical-IR-Radio image overlays of various types of cosmic objects seen in any part of the sky.

The exhibition has been receiving significant footfall with people from the cities and nearby places coming to visit and engage. This has been nicely complemented by reports and coverage in the media, resulting in successfully popularising the SKA to members of the public in India.

Below: Science communicator Sonal Katyal interviews President of the Astronomical Society of India GC Anupama and SKA Director-General Prof. Philip Diamond.



Credit: Prof. Yashwant Gupta



Credit: Sonal Katyal

Left: SKA Board members for India Arun Srivastava (centre) and Prof. Yashwant Gupta.

Panoramic view of the SKA HQ, the future home of the SKA Observatory, at Jodrell Bank, UK.



“THIS IS OUR MISSION CONTROL” GLOBAL HQ OF SKA OPENS

BY CASSANDRA CAVALLARO (SKAO)

Deep in the Cheshire countryside, just south of the buzzing city of Manchester, lies a historical site. It's a place famed for its radio astronomy heritage, a newly designated UNESCO World Heritage site, and now home to the SKA's Global Headquarters.

On 10 July 2019, SKA HQ was officially opened and a new chapter in Jodrell Bank's long history of radio astronomy began. Around 200 guests from around the world gathered to celebrate the day, among them guest of honour Prof. Dame Jocelyn Bell Burnell, co-discoverer of the first pulsar, and many more long-time friends and early pioneers of the project.

Proceedings got under way with speeches by representatives of the HQ's three funders: Prof. Dame Nancy Rothwell, President and Vice-Chancellor of the University of Manchester, Prof. Mark Thomson, Executive Chair of the UK government's Science and Technology Facilities Council (STFC) and Cheshire East Council Leader Cllr Sam Corcoran.

Together the three organisations provided £16.5m as part of the UK's contribution to the SKA project, which saw the original SKA office transformed in less than 18 months into a building triple its initial size. Its crowning glory, the spectacular glass-walled Council Chamber, played a starring role in the inauguration and was filled to capacity for the hour-long ceremony.

Earlier the same day it was named in memory of Prof. Giovanni Fabrizio Bignami, former SKA Chair of the Board of Directors.

A common theme ran through all the speeches: Jodrell Bank being part of both the development and the exciting future of radio astronomy. Indeed, as one of the three host sites of the SKA Observatory, the HQ will play a crucial

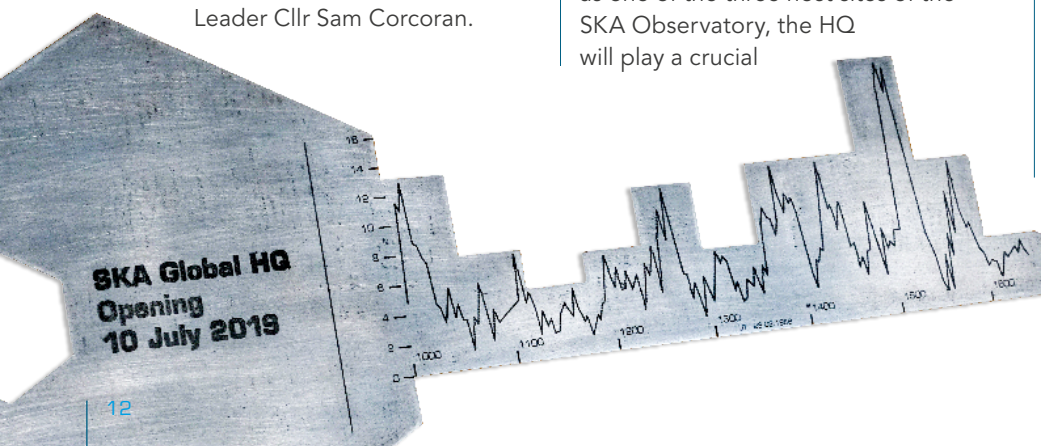
role in the delivery and operation of the telescopes alongside the Australian and South African sites.

It was only fitting that the handover of the building encapsulated that message of generational progress. As everyone scrambled to take pictures, Prof. Thomson from STFC, on behalf of the UK government, presented SKA Director-General Prof. Philip Diamond with a ceremonial key fashioned from an original panel of the Lovell Telescope.

As Dame Jocelyn remarked: “It's got good radio astronomy vintage.” She also mentioned having walked on those original panels.

FUN FACT

For the true radio astronomy buffs among our readers, at 21cm the length of the key matches the wavelength of neutral hydrogen, and it's etched with the signal of the first pulsar co-discovered by Dame Jocelyn in 1967, as observed the following year by the Lovell Telescope.





When the SKA Observatory comes into being next year, the HQ will be its home. The flags that already fly outside the entrance represent the many countries who are contributing their time, money and expertise to this ambitious project.

"This isn't just a building: it is a meeting point of nations who have decided to come together in order to advance human knowledge," Prof. Diamond told guests during his speech.

"It's always been my ambition that this place become a nexus for radio astronomy in the 21st century, and so today I'd like to tell all the engineers, scientists, software developers, policy makers and others working on the SKA around the world: this facility is now open and please, consider it as your home too. This is our Mission Control."

With the handover complete, it was

time for Dame Jocelyn to deliver her keynote, to notable excitement from more than a few fans in the room.

Highlighting the astronomical progress made in the past 100 years, she also made some (educated) guesses about where the next 100 would take us, including that we will have found evidence of life on an exoplanet – although perhaps not intelligent life.

"I'm absolutely clear in all of this, the Square Kilometre Array will be playing a very large part as one of the world's biggest, most sensitive telescopes," she said.

On that inspiring note, it was time to celebrate, local and international dignitaries mingling with SKA staff to the soundtrack of a string quartet playing hits by Manchester rock legends Oasis. Many guests took the opportunity to view the SKA's

Shared Sky indigenous astronomy/art exhibition celebrating Australian and South African ancestral knowledge of the skies, which now graces the walls of SKA HQ. The inauguration capped a momentous week on the site, which also saw Jodrell Bank Observatory designated as a UNESCO World Heritage Site, in recognition of its international, historic, and scientific significance. A significance that is set to last well into the future with the SKA HQ.

"It's like seeing a dream come true," said Prof. Yashwant Gupta of India's NCRA, a member of the SKA Board of Directors. "Not just for the people here but even for those of us who come from outside and have been working so hard over the years to make the project happen, this is a very important and significant step."

“

THIS ISN'T JUST A BUILDING: IT IS A MEETING POINT OF NATIONS WHO HAVE DECIDED TO COME TOGETHER IN ORDER TO ADVANCE HUMAN KNOWLEDGE

”

Prof. Philip Diamond, SKA Director-General



2 MINUTES WITH...

DR JOHN MORGAN

RADIO ASTRONOMER,
ICRAR-CURTIN UNIVERSITY,
AUSTRALIA

John is spending six weeks at SKA Global HQ as an Australian Fellow – we caught up with him to hear about his work.



What kind of research do you do at Curtin?

I work a lot with the Murchison Widefield Array (MWA), one of the SKA precursor telescopes, observing the Sun and doing big surveys to discover as many new radio sources as we can. We're also looking for the particularly extreme objects in the Universe, like galaxies which are extremely young and very compact with supermassive black holes.

What are you working on at SKA HQ?

I'm working mostly with the science team but also the engineers, to see how my work with MWA might be applied to the SKA. That includes learning lessons from MWA, like highlighting issues the scientists are grappling with now that it's built, so with the SKA we can try to deal with them beforehand. I'm also trying to get to know as many people as possible and understand a bit more about the project because it's the future of radio astronomy!

What will the SKA mean for your science?

At the moment we're trying to discover these extreme objects but we're just scratching the surface because we can only detect the really obvious ones which, if your eye could see in radio waves, would be the very bright things in the sky. The SKA, being so much bigger and more sensitive, will show us the millions and millions of other objects that are out there.

What's it like being at the SKA Global HQ?

It's a wonderful place to work. There's that sense of it being a growing organisation; it's always really exciting to be somewhere that has new people arriving all the time, where everyone's looking to the future.



SKA PRIDE

SKAO staff got together on a recent weekend to see the Manchester Pride Parade, one of the biggest events in the city's calendar.

Backed by SKAO's Recreational Committee and Equality, Diversity & Inclusion Working Group, the outing was an opportunity to show support for LGBT+ equality, particularly in Science, Technology, Engineering and Maths (STEM) fields where there is still a lack of awareness and inclusion towards LGBT+ colleagues ([read the report](#)).

Some 300,000 people came together to watch the parade, which this year was on the theme of Deep Space Pride: A Future World of Equality. With diversity a core value of the SKA and our eyes set on the next generation with the SKA operating for the next 50 years, this was a perfect event to attend, blessed by the hottest summer bank holiday weekend in the UK on record!

There's already talk of taking part in the parade in the future...

SKA-VLBI WORKSHOP

THE WORLD'S EYE ON THE SKY

**14 — 17
OCTOBER
2019**

SKA GLOBAL HQ, UK

[SKATELESCOPE.ORG/
SKA-VLBI-WORKSHOP](http://SKATELESCOPE.ORG/SKA-VLBI-WORKSHOP)

INVITED SPEAKERS

DANA SIMARD (U. Toronto, CA): Pulsar scattering
JACK RADCLIFFE (U. of Pretoria/SARAO): Wide-field VLBI
MARCELLO GIROLETTI (INAF, IT): GW-EM counterparts VLBI follow-up
JAN FORBRICH (U. Hertfordshire, UK): Stellar continuum, young stellar objects
YOON KYUNG CHOI (MPIfR-Bonn, D): Maser astrometry, evolved stars
MANISHA CALEB (U. Manchester, UK): Fast radio bursts
PIKKY ATRI (ICRAR, AU): Black hole X-ray binaries
LEAH MORABITO (U. Oxford, UK): Low-frequency AGN surveys
JOHN MCKEAN (ASTRON, RU Groningen, NL): Gravitational lensing, cosmology
JAMES CHIBUEZE (North West U., SA): VLBI in Africa

LOCAL ORGANISING COMMITTEE

SARAH LAMB (SKAO) | **JOSEPH DIAMOND** (SKAO) | **CLAIRE TAYLOR** (SKAO) | **ROBERT BESWICK** (JBCA-U. Manchester) | **ANTONIO CHRYSOSTOMOU** (SKAO) | **CRISTINA GARCIA-MIRO** (SKAO)

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LAURA SPITLER, MPIfR-Bonn, Germany | **KAZI RYGL**, INFN-IRA, Italy | **MICHAEL RUPEN**, HAA-NRC, Canada
MARIA RIOJA, ICRAR-UWA/CSIRO, Australia; OAN, Spain | **CHRIS PHILLIPS**, CSIRO, Australia
MAR MEZCUA, ICE/CSIC, Spain | **PREETI KHARB**, NCRA-TIFR, India | **HIROSHI IMAI**, U. Kagoshima, Japan
ROGER DEANE, U. Pretoria, South Africa | **JOHN CONWAY**, OSO-Chalmers U., Sweden
PACO COLOMER, JIVE, Netherlands | **ANNA BONALDI**, SKAO, United Kingdom | **TAO AN**, ShAO, China
ANTONIO CHRYSOSTOMOU, SKAO, United Kingdom (co-Chair) | **ZSOLT PARAGI**, JIVE, Netherlands (co-Chair)

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A MODERN TAKE ON THE **FLA**



FLAMMARION ENGRAVING



This edition's featured image comes to us from PhD student Sambit Kumar Giri at Stockholm University, Sweden, and was realised by his friend and colleague postdoctoral fellow Hannah Ross at Lawrence Berkeley National Lab, USA. This modern take on the Flammarion engraving was created for the front page of Sambit's thesis. We asked him to tell us more about his research.

"I draw my inspiration to study the origin and evolution of our Universe from the popular Flammarion engraving, which was a wood engraving that appeared in *L'atmosphère: météorologie populaire*, authored by French astronomer Camille Flammarion in 1888. I thought of creating a version featuring a present-day astronomer using the SKA and computer simulations to understand cosmology.

My thesis studies one of the least understood periods in the Universe's evolution: the Epoch of Reionization (EoR). Even though the current night sky is filled with billions of stars, this was not always the case! There were no stars until about 400 million years after the birth of the Universe, known as the Big Bang.

Energy from the first stars heated and ionized the surrounding hydrogen gas, which is the most abundant element in the Universe. This period, the EoR, saw almost all the gas in the Universe change from being cold and neutral to hot and ionized. The EoR is not well understood because our current telescopes cannot observe it. That will change with the SKA.

The SKA's low-frequency component, to be located in Australia, will be sensitive enough to detect the EoR and even produce pictures of the distribution of neutral hydrogen using its 21cm signal. This light has been stretched by the expansion of the Universe so the wavelength is now in the radio band of electromagnetic waves. Before the SKA comes online, it is vital that we understand what we will be able to learn from its observations. In my thesis, I study the evolution of the reionization process as seen with the 21-cm signal. I also develop tools to not only understand how the reionization proceeds but also find the properties of stars that drive the process."

Image credit: Sambit Giri and Hannah Ross

A snapshot from the SKA Science Data Challenge image, showing a large Active Galactic Nucleus (AGN) as if observed by SKA-Mid at 1.4 GHz.

ICRAR TOPS THE LEADERBOARD IN

SKA'S FIRST SCIENCE DATA CHALLENGE

BY PETE WHEELER (ICRAR)

An Oxford University and International Centre for Radio Astronomy Research (ICRAR) team has come out on top of an inaugural competition designed to prepare the community for dealing with SKA data sets.

Known as the [SKA Science Data Challenge 1](#), the competition saw nine teams from around the world tackle a mock data set similar to the images that will be generated by the SKA.

The data was overlaid with different levels of noise, and participants were set the task of extracting galaxies from the data.

ICRAR astrophysicist Dr Aaron Robotham worked with Oxford University PhD student Catherine Hale on the winning project.

The team optimised a piece of software originally developed for optical astronomy, called ProFound.

"It did a pretty good job on the mock SKA data," Dr Robotham said.

"Most of the sources we found blind were real sources not noise, and the properties we measured from those sources were pretty close to the known fake inputs."

ICRAR also took out second place in the competition with an artificial intelligence bot trained to recognise galaxies, called ClaRAN.

ICRAR data scientist Dr Chen Wu, who was part of the second-placing team, said the data sets were much harder than he'd expected.

"The signals were so faint," he said.

Dr Wu said the faintest galaxies couldn't be identified among the noise even by a trained human eye, and the team's initial results were very poor.

"So we decided to pre-process the data," Dr Wu said.

"We discarded all the weak signals from the catalogue and only focused on the signals where we could see something with our own eyes."

"Then we trained our algorithm, ClaRAN, on those."

Another difficulty was that some features required by the challenge were completely missing from ClaRAN.

The team overcame this by marrying ClaRAN with another piece of radio astronomy software called Miriad.

"It turns out that we can get traditional software to work with machine learning techniques," Dr Wu said.

In all, 12 institutions in eight countries took part in the SKA Data Challenge.

The teams were given nine large images, about 32,000 pixels on each side and 4GB in size.

The data was designed to simulate how the SKA's mid-frequency array, to be located in South Africa, would see the radio sky.

The mock data was from three different frequencies (560 MHz, 1.4 GHz and 9.2 GHz) and at three depths (eight hours, 100 hours and 1000 hours of observing time).

The SKA Office is now inviting teams to join forces in the collaborative phase of the SKA Science Data Challenge.

Groups will be able to share lessons learnt and further improve their results ahead of final publication.

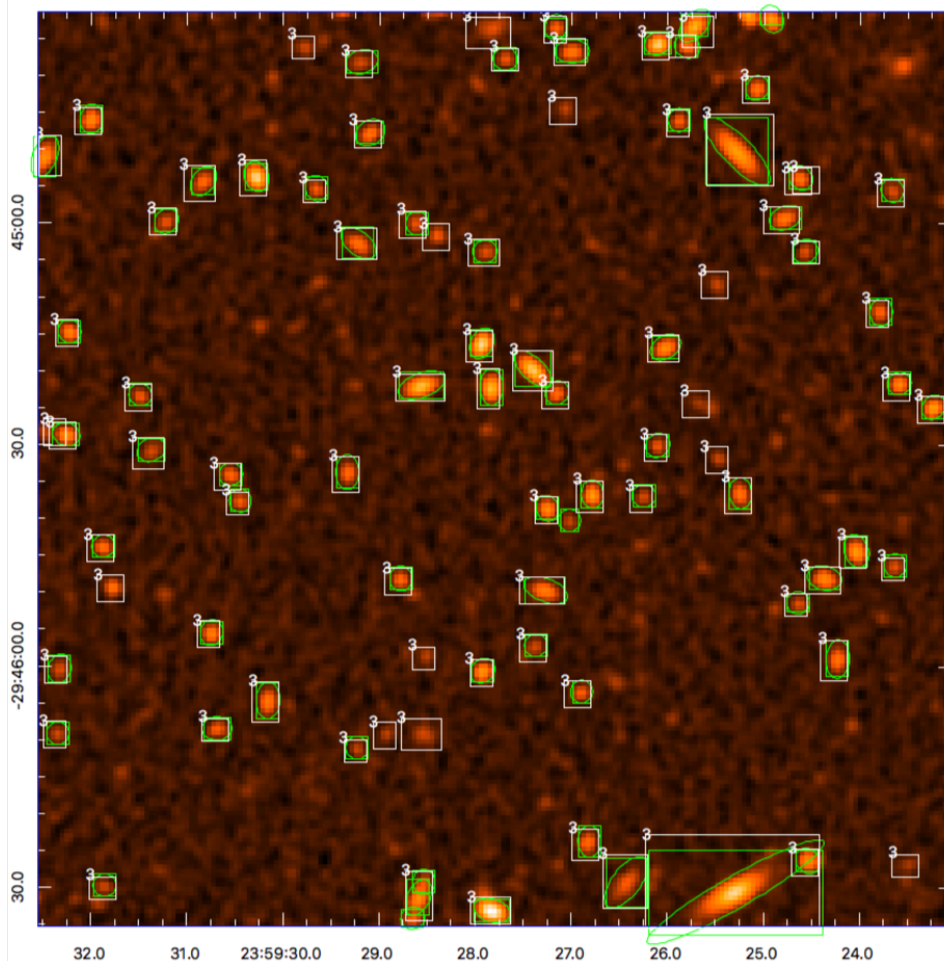
A full list of the participants, results and ranking methodology from the challenge can be found on the [SKA Science website](#).

A personal challenge

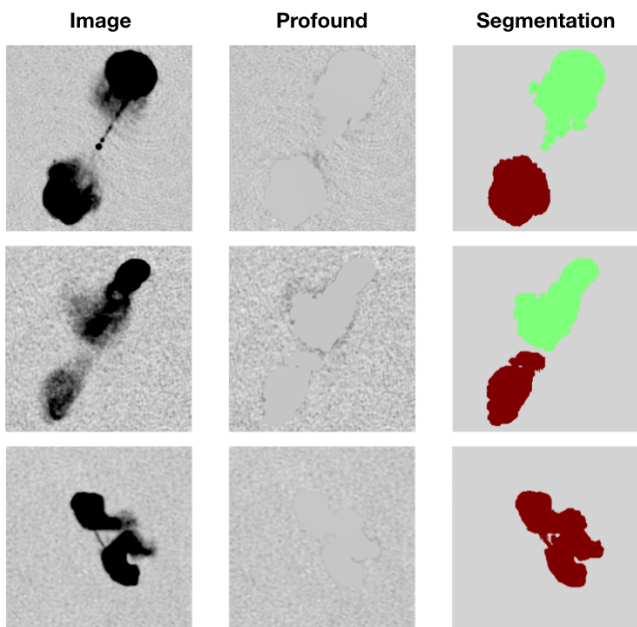
For Dr Wu, it coincided with a life-changing event.

The competition was announced in the same week his first child was born.

His daughter was seven months old at the end of the challenge.



One of the SKA Data Challenge image cutouts processed by ClaRAN, an artificially intelligent algorithm created by ICRAR researchers. The green circles and rectangles show the “true” sources simulated by SKAO for the challenge, and the white boxes show galaxies that have been recovered from the noise by the ClaRAN source finding algorithm. Credit: Original simulated data courtesy of SKAO with overlays generated by ICRAR’s ClaRAN algorithm.



An example of complex radio source extraction with ProFound. The left column shows images of real galaxies, the middle column shows the ProFound model’s subtracted images (nearly all source flux is gone in each case), and the right column shows the identified galaxy’s pixels in red. Credit: Catherine Hale, University of Oxford. ‘Radio Source Extraction with ProFound’ Hale et al, 2019, MNRAS, 487, 3971.

THE VIEW FROM SKA HQ

We are very pleased with the response we got on the first SKA Science Data Challenge. With nine teams, from eight countries and 12 institutes around the globe, delivering high-quality results, SDC1 is achieving what we set out to do: getting the community together to help solve the challenges that the SKA data will pose.

Dr Anna Bonaldi, SKAO



DRONES IN THE OUTBACK: MEASURING THE COMPLEX BEHAVIOUR OF SKA-LOW ANTENNAS ON SITE

BY DR DARIA GUIDETTI (INAF) & DR PIETRO BOLLI (INAF)

In June an International team from INAF, CNR (Italy), University of Malta and ICRAR (Australia) travelled to the Murchison Radio-astronomy Observatory (MRO) in Western Australia to conduct measurements on the SKA-Low prototype antennas. The measurements were essential to validate the electromagnetic numerical models being used to predict the antennas' behaviour in the field, and are part of bridging activities in the lead up to construction.

"One antenna on its own behaves differently to multiple antennas close together, because they interact electromagnetically with one another," says Dr Pietro Bolli from INAF. "We have models to predict that, but it's important to validate those models with real data from the field to make sure we're calibrating the antennas properly, otherwise astronomical observations would be useless."

The remote location of the site together with the broad technical expertise needed to successfully perform the measurement presented extra challenges that required significant planning and logistical support to overcome. "It took many months for our team to plan every single aspect of the campaign and minimise the risk of failures" adds Pietro.

Building on similar work at the Mullard Radio Astronomy Observatory in Cambridgeshire in the UK and at the LOFAR radio telescope in the

Netherlands, the team decided to use a drone-based system to perform the measurements. Mimicking a well-known source, they used the drone to emit a signal at different frequencies from different points around the antennas, and then measured how that signal was received by the antennas. "Using a drone was the only way to put enough distance between the antennas and the source of the signal for the data to be useful. At the same time, the artificial system assures a strong signal over an astronomical source," says Pietro.

"We flew at a height of 120 to 200 m, covering a field of view of $\pm 45^\circ$ from the zenith point, with an accuracy of about 2 cm horizontally and 7 cm in height."

Accurate positioning was extremely important, hence why the drone was equipped with a precise satellite positioning system, but weather conditions on site were challenging. "We were faced with strong winds of up to 45 km/h which makes flying a

drone and keeping to a stable position difficult, but in the end we were able to carry out the measurements, and acquired 10 GB of data in total."

Thanks to their successful campaign, the team have saved precious computing resources. "With over a million degrees of freedom, modelling a full-station of 256 SKA-Low antennas to analyse these patterns requires intense computing power," explains Pietro. "It would have taken hundreds of hours even on a powerful machine equipped with more than 1TB of RAM and over 50 cores."

The team is now busy analysing the data, which seems to confirm the measured behaviour is consistent with the models.

"This would confirm that the models we use to predict the behaviour of the antennas when put together accurately describes their real behaviour. It's a crucial step to build confidence in the performance of the antennas and meet the tough requirements of the SKA."

“

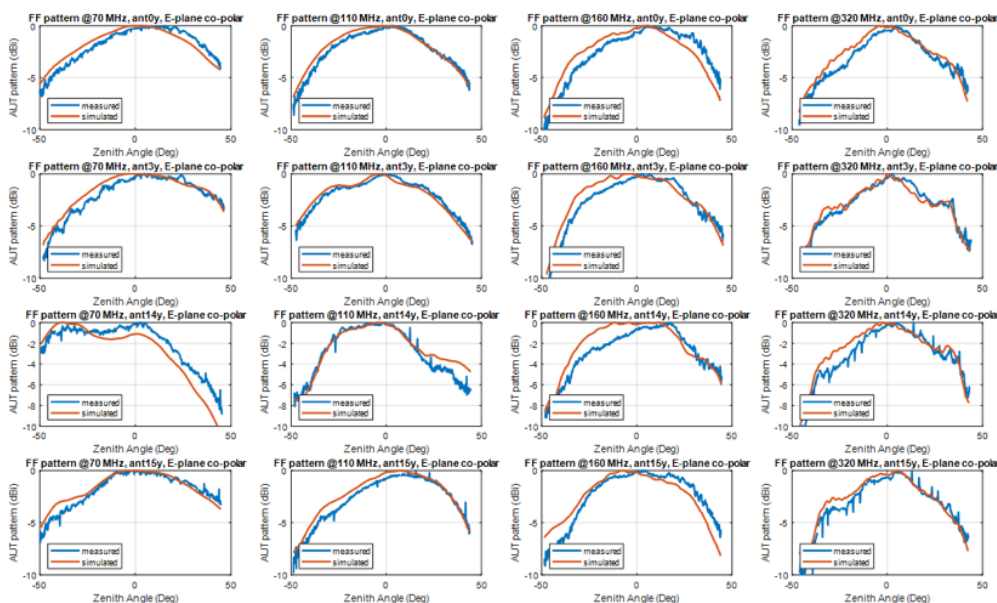
WE WERE FACED WITH STRONG WINDS OF UP TO 45KM/H WHICH MAKES FLYING A DRONE AND KEEPING TO A STABLE POSITION DIFFICULT.

”

Pietro Bolli, INAF

THE TECHNICAL BIT

The on-board dipole antenna transmits a continuous wave radio-frequency signal along a specific trajectory, and by measuring the received signal it is possible to evaluate the embedded element patterns (the single antennas' behaviour) and the digitally beam-formed patterns (the arrays' behaviour corresponding to the combination of many individual antennas) of the antennas being tested. The FPGA firmware installed in the digital acquisition system of the array where signals from the antennas converge was modified to narrow the standard frequency channel (800 KHz) by a factor of 128. The power level emitted by the transmitting antenna on the drone and the ground antennas' receiver attenuation level were selected to ensure a high signal-to-noise ratio and avoid clipping.



Above: The team used this commercial drone and customised it to carry a frequency synthesizer and dipole antenna with a satellite positioning system. Credit: INAF/CNR.

Top left: Aerial view of the three different SKA-Low prototype stations at the Murchison Radio-astronomy Observatory in outback Western Australia. Credit: ICRAR/Curtin.

Left: Measured (blue curve) and simulated (orange curve) behaviour for four SKA-Low prototype antennas (lines) at four different frequencies (columns).

The 32m VLBI dish and Northern Cross telescope at the Medicina Radio Observatory near Bologna.
Credit: Fabio Grandi



THE WOW FACTOR: EXPLAINING RADIO ASTRONOMY TO ALL AGES

BY DR DARIA GUIDETTI (INAF)

The Italian National Institute for Astrophysics recognises the importance of scientific communication to bring astronomy closer to people, but public radio astronomy communication is not straightforward: people often think astronomy is a visible science and don't know that many celestial bodies are natural radio sources.

To address this, INAF's Institute of Radio Astronomy (INAF IRA) has developed a strategy aiming at giving the public the "wow" factor – the scale and ambition – and the "how" factor – explaining how radio telescopes work – of the SKA.

INAF IRA believes both are essential to successful communication. In line with this strategy, INAF IRA recently organised a public event to showcase the breadth of science and technology and the social and human impact of the SKA as part of

Waiting for the Researchers' Night 2019 and Bologna Summer 2019. The event was held on Saturday 8 June 2019 in Medicina near Bologna.

Activities included

- Digital planetarium shows about multiwavelength astronomy.
- Video projections of facilities INAF is involved in - including the SKA - as well as interviews with INAF IRA staff and international collaborators about their experience installing the latest Italian prototypes of SKA-Low antennas on the Australian SKA site.
- Educational workshops for kids. Pegs of different sizes (left image) were used to demonstrate the concept of image resolution and its impact on the work of radio astronomers such as time for data processing and space for data archiving. Using numbered grids that can be coloured in, INAF scientists also explained that radio data are invisible and have to be converted through techniques such as false colour imaging.
- An exhibit showed a basic rendering of the Australian

site with two generations of SKA-Low antennas and two fun examples of local fauna: a snake and a very big spider.

- A guided tour of the Northern Cross and INAF's 32-metre VLBI antennas.
- A round table on the challenges and promises of the SKA project with experts from INAF*.

The public learned about the key science projects, unprecedented instrumental capabilities, as well as societal aspects, with INAF researchers talking about how construction of the SKA will also respect local traditions and the environment.

The human side was not left out. The scientists recounted their personal experiences working in such a large collaboration and in remote areas, as well as their hopes and expectations, and the meaning of bringing their professional skills and Italian spirit to the project.

**Our thanks to Grazia Umana (INAF Catania Astrophysical Observatory), Gianni Bernardi and Jader Monari (INAF IRA) as well as Stefania Varano and Daria Guidetti (INAF IRA) for their contribution.*



EWASS 2019 SHOWCASES SKA SCIENCE IN LYON

BY DR MAMTA PANDEY-POMMIER
(OBSERVATOIRE DE PARIS)

In June, the annual European Week of Astronomy and Space Science (EWASS) 2019 was held amid soaring temperatures in Lyon, France. This year's event featured a special session on the SKA, titled "The role of European-led surveys in guiding future SKA1 science", alongside a week-long project exhibition. The special session jointly convened by SKA HQ and Maison SKA-France highlighted current and imminent European-led, multi-wavelength observing programmes that could help define SKA1 large survey strategies during the next decade.

An organising committee of astronomers representing 11 of the SKA partner countries selected a wide range of science talks for the session.

"When making our selections we paid particular attention not only to the quality of the talks submitted, but also national

affiliation and gender of the presenter, reflecting the SKA's commitment to encouraging broader representation of women and under-represented groups," says SKAO Project Scientist Dr Jeff Wagg, who was on the committee. "In the end, almost three-quarters of the presenters were women."

More than 40 participants saw presentations on cosmic magnetism and EOR, synergies with on-going multiwavelength surveys, and transient and solar physics, to name just a few.

The introductory talk by SKA Organisation Project Scientist Dr Anna Bonaldi featured commissioning results from the French SKA pathfinder NenuFAR, showing the imaging capability of the array down to 50 MHz (SKA-Low frequency limit) as well as on-going science projects.

Details of the session can be found [here](#)

With thanks to Prof. Robert Braun (SKAO), Dr Jeff Wagg (SKAO), Dr Chiara Ferrari (Maison SKA-France), the SKAO Comms team and all the organisers and participants of the SKA special session for their contributions.



Left: SKAO Project Scientist Dr Evan Keane was also awarded the Merac Prize for Observational Astrophysics for his work on Fast Radio Bursts

COMING UP...

ASTRONOMICAL DATA ANALYSIS SOFTWARE AND SYSTEMS (ADASS)

<https://www.adass2019.nl>

6-10 October | Groningen, the Netherlands

SKA-VLBI KEY SCIENCE PROJECTS AND OPERATIONS WORKSHOP

<https://indico.skatelescope.org/event/539/>

14-17 October | SKA Global HQ, Jodrell Bank, UK

IAUS 358: ASTRONOMY FOR EQUITY, DIVERSITY AND INCLUSION — A ROADMAP TO ACTION WITHIN THE FRAMEWORK OF THE IAU 100TH ANNIVERSARY

<https://iau-oao.iao.ac.jp/iaus358/>

12-15 November | Tokyo, Japan

SPOTLIGHT ON

SKA SHANGHAI MEETING

<https://indico.skatelescope.org/event/551/>

25-28 November | Shanghai, China



All SKA eyes will be on Shanghai from 25-28 November for a major meeting involving engineers, data scientists, astronomers and a host of other experts from across the SKA community and beyond.

All are invited for the 2019 SKA Shanghai Meeting: *Concluding our Past, Realising our Future*, which will focus on the immediate and long-term future of the SKA, from procurement to commissioning and operations.

It will see the SKA Organisation present the full design of the two telescopes for the first time, finally unifying the years of work carried out by the SKA's design consortia. There will also be talks on key SKA science topics, presentations by colleagues at precursor, pathfinder and peer projects, and sessions on SKA Science Regional Centres, along with a site visit to the 500m FAST telescope.

[Watch SKA Director-General Prof. Philip Diamond's invitation](#)



DR ALKISTIS POURTSIDOU

Above: Alkistis took up surfing for the first time on a trip to Cape Town, at the urging of her colleagues. Now she tries to get out on the waves whenever possible, whether in South Africa or sunny Cornwall, UK. Credit: Alkistis Pourtsidou

A few months ago, Dr Alkistis Pourtsidou from Queen Mary University in London was awarded a Future Leaders Fellowship, a UK Research and Innovation (UKRI) funded scheme supporting the best researchers and innovators to develop their careers. We sat down with her to find out more about her career in cosmology, her involvement in the SKA's Science Working Groups, and how she plans to use the fellowship.

What was the path that led you to choosing radio astronomy as a career – were you interested in science from a young age?

I think I decided to become a physicist at about 16 years old, but I don't remember exactly why! I was very fortunate to grow up in a family that valued knowledge – any kind of knowledge – and my interests were very varied.

At a young age I was mostly into the classical subjects, especially literature. I was always curious about how nature works, but I was finding the maths and physics taught in school really dry and boring. However I somehow decided I wanted to study physics and really started enjoying it in my final year at University.

Initially I wanted to be a particle physicist, but during my MSc I discovered cosmology and was instantly hooked. After changing sub-fields during and after my PhD – from cosmic strings to dark energy and modified gravity – I am now spending most of my time on radio and optical survey cosmology, and I absolutely love it!

You've studied in several countries – is that quite typical? How has it benefitted your career?

It is quite typical for people of my generation, and even more so for the younger generations. Science today is definitely a global endeavour, and mobility is a way to gain different skills and perspectives, develop new collaborations, and open your mind to different cultures and ways of working. I have benefited immensely from it, for all the reasons above.

To be completely honest, like many others I never had the privilege of picking and choosing where my next job (postdoc) would be, so I really doubt I would be where I am now if I was not prepared to move around.

I should also say that mobility often comes with great personal costs and it is far from ideal for people with family responsibilities or other constraints. While that was not the case for me, I know many brilliant people – especially women – who have left research because they could not move, and this is something we need to

address. In a nutshell, I think mobility is great but it should not be what makes or breaks someone's career.

The Future Leaders Fellowship (FLF)

FLF is a UKRI scheme supporting UK-based early-career researchers and innovators with outstanding potential. Team SKA's Dr Conor Fitzpatrick of CERN and the Uni. of Manchester was also awarded a fellowship.



Tell us about how you came to be involved with the SKA and what you're working on within the project at the moment.

I started working on radio cosmology around 2011 but I became really involved with the SKA a few years later while contributing to the SKA Science Book in 2015. After that I continued being involved and I am now a core member of the Cosmology Science Working Group and co-lead the "Cosmology with SKA-Low" focus group. At the moment I am working with the first intensity mapping data from MeerKAT, which is one of the South African SKA precursors, and I am also developing simulations and data analysis pipelines for MeerKAT and SKA-Mid. A recent exciting development has been the [updated SKA cosmology forecasts](#) we presented.

Congratulations on your UK Future Leaders Fellowship! How will it benefit your work – how will you use it?

Thank you very much, I am absolutely delighted about it! Having experienced first hand the challenges of juggling research, positions of responsibility in large collaborations, teaching and admin as young faculty, the freedom, length of time, and resources offered by the UKRI Future Leaders Fellowship is fantastic. On top of that, the support of my host institution, Queen Mary University of London, has been phenomenal and I feel very fortunate to be a Future Leaders Fellow here.

I will use the Fellowship to hopefully make my research dreams come true! I am excited about cosmology with the SKA, and I also want to exploit synergies between the SKA and optical galaxy surveys I am heavily involved in, like ESA's [Euclid satellite mission](#).

My research proposal is all about using both radio and optical surveys for cosmology and finding optimal ways to combine them. It focuses on working with pathfinder data, developing numerical simulations, and preparing for analysing the wealth of high quality data expected from these surveys in the next few years. The most exciting thing about the Fellowship's support is that I will be able to form a team of researchers working closely together on this science. I can't wait!

What most excites you about being part of Team SKA?

The SKA is a cutting-edge experiment and international project, bringing together hundreds of brilliant scientists and engineers, innovation in radio technologies, and unprecedented big data challenges. Being part of this global effort is great, not least because I get to interact and work with some of the most talented people in the field.

I particularly enjoy the strong links with South Africa, where MeerKAT/SKA-Mid is based – I visit Cape Town about twice a year to collaborate with the MeerKAT and SKA cosmology teams there and discuss various projects in collaboration with Queen Mary University of London.

What advice would you give to budding scientists out there, who may want to follow in your footsteps?

I don't know if there is any advice that could work for everyone, but I can certainly tell them that choosing to be a scientist comes with a rare and invaluable privilege: the pure joy of figuring things out – so keep that curiosity alive and kicking!

Team SKA

In each issue of Contact, we'll get to know one of the many talented people contributing to the SKA, hearing about their work, how they got here and their advice for the next generation.

[Hear more from them on our website.](#)

“

SCIENCE TODAY IS DEFINITELY A GLOBAL ENDEAVOUR, AND MOBILITY IS A WAY TO GAIN DIFFERENT SKILLS AND PERSPECTIVES, DEVELOP NEW COLLABORATIONS, AND OPEN YOUR MIND TO DIFFERENT CULTURES AND WAYS OF WORKING

”





NEWS ROUNDUP

A BRIEF RECAP OF THE BIG STORIES COVERED BY THE SKA COMMS TEAM IN RECENT MONTHS.

It's been a busy time for our engineering teams at SKAO and across the partnership, with both the [Science Data Processor \(SDP\)](#) and [Assembly, Integration and Verification \(AIV\)](#) consortia wrapping up their design and planning work. SDP, led by the University of Cambridge in the UK, involved close to 40 institutions in 11 countries, all focused on designing the SKA's supercomputing "brain". For AIV, led by the South African Radio Astronomy Observatory (SARAO), the task was to detail how and when the SKA's many components from all over the world will arrive and be put together at both the sites.

SKA HQ has hosted several ministerial visits since the SKA Observatory Convention was signed in April, starting

with [South African Minister of Science and Technology Mmamoloko Kubayi-Ngubane](#). In the following weeks we also welcomed [then-UK Science Minister Chris Skidmore MP](#), and [China's Minister of Science and Technology Wang Zhigang](#). Extremely positive and fruitful discussions were held, focusing on the involvement and contribution of these countries into the project and the organisation going forward.

SKA Organisation [welcomed its newest member](#), Germany's prestigious research organisation the Max Planck Society, following a unanimous vote by the SKA Board of Directors.

Chairperson of the SKA Board of Directors Dr. Catherine Cesarsky described the decision as "a deserved recognition of the significant

contributions Germany has made to the SKA project over the years".

There was science success for [SKA precursor telescope ASKAP in Australia](#), where an Australian-led international team of astronomers used the 36-dish array to determine the precise location of a fast radio burst (FRB) for the first time. The cause of these powerful millisecond bursts of cosmic radio waves is unknown, but the ability to determine their exact location is a big leap towards solving the mystery.

And finally, hot off the press, [South Africa's MeerKAT telescope has discovered giant radio bubbles](#) at the centre of the Milky Way. We'll be covering this story in the next issue of *Contact*.

Chinese Supercomputer
Tianhe-2. Credit: Prof. Yutong Lu

NEWS FROM AROUND THE WEB

NATURE

[The quest to unlock the secrets of the baby Universe](#) – A look at the radio telescopes aiming to explore the dark ages and cosmic dawn, including SKA precursors and pathfinders like MWA, HERA & LOFAR.

NATURE INDEX

[How to run a successful citizen science project](#) – India's SKA pathfinder GMRT is playing a role in citizen science, with more than 150 volunteers trained to identify black hole galaxy systems in images taken by the telescope.

SCIENTIFIC AMERICAN

[Astronomers are closer to cracking the mystery of fast radio bursts](#) – How Canadian SKA pathfinder CHIME is revealing that repeat fast radio bursts are not as rare as once thought, more than quadrupling the number of known repeaters.

PHYS.ORG

[Solar physics with the Square Kilometre Array](#) – The unprecedented scale of the SKA will benefit our understanding of the Sun, including major new insights on the dynamics of coronal mass ejections and flares, and their impact on space weather.

XINHUA

[China readies regional data center for SKA super telescope](#) – News of China's preparations for an SKA Regional Centre, including the recent construction and testing of a prototype data centre, and how it's being used to train future astronomers.

SKA JOBS

DEVOPS ENGINEER

An ideal role for an enthusiastic DevOps advocate, who is interested in working for a groundbreaking international scientific project.

Deadline: 6/10/2019

[Apply here](#)

DIGITAL SIGNAL PROCESSING ENGINEER

This role would suit an enthusiastic and motivated digital engineer who is interested in working in radio astronomy.

Deadline: 30/9/2019

[Apply here](#)

PARTNER INSTITUTE JOBS E-MERLIN/VLBI RESEARCH SUPPORT SCIENTIST (UP TO 2 POSTS AVAILABLE) - UNIVERSITY OF MANCHESTER

Uni. of Manchester are seeking candidates with expertise in radio interferometric science and observations, observatory

operations and/or data processing techniques. These positions will provide support for scientific users of the e-MERLIN facility, and contribute to operations and the ongoing development of this world class facility.

Deadline: 7/10/2019

[Apply here](#)

INTERMEDIATE SOFTWARE ENGINEER - MDA

This is an exciting opportunity to get involved in the early stages of the MID.CBF project and then grow as the project scope and team size grows. You will work initially with a small team at MDA and NRC, as well as being part of the larger international MID.CBF team. They are looking for an engineer confident and passionate about the development of complex systems of firmware, software, and hardware.

Deadline: Open

[Apply here](#)

PARTNER PUBLICATIONS

READ THE LATEST SKA-RELATED NEWS FROM SOME OF OUR INTERNATIONAL PARTNERS



[AUSTRALIAN SKA PROJECT DIRECTOR'S UPDATE – AUGUST 2019](#)

[CSIRO MRO NEWS – JUNE-JULY 2019](#)



[SKA-FRANCE -BULLETIN – JULY 2019](#)



[ASTRON NEWS – SUMMER 2019](#)

RADIONET

[RADIONET NEWSLETTER – AUGUST 2019](#)

Contact – The SKA magazine

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We welcome your contributions to *Contact*!

Find out how to submit ideas [here](#).

All images in *Contact* are courtesy of SKAO unless otherwise indicated.

About the SKA

The Square Kilometre Array (SKA) Organisation leads an international effort to build the world's largest radio telescope. The SKA will be constructed in Australia and South Africa with a later expansion in both countries and into other African countries. Its global headquarters is located at Jodrell Bank in the UK.

The SKA will conduct transformational science and help to address fundamental gaps in our understanding of the Universe including the formation and evolution of galaxies, fundamental physics in extreme environments and the origins of life in the Universe.

Front cover: Sunset at the Aperture Array Verification System 1.5 (AAVS1.5), an evolution of the antenna design for the SKA's low-frequency telescope at the Murchison Radio-astronomy Observatory in Western Australia. AAVS1.5 uses the fourth generation of SKALA antennas. A team of international institutions has been working on the design for SKA-Low stations including ASTRON (the Netherlands), University of Oxford (UK), University of Cambridge (UK), INAF (Italy), University of Malta (Malta) and ICRAR-Curtin (Australia). (Credit: ICRAR-Curtin University)

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