

REPORT ON THE RADIONET3 NETWORKING ACTIVITY

TITLE: ADVANCING ASTROPHYSICS WITH THE SQUARE KILOMETRE ARRAY

DATE: 09 – 13 JUNE 2014, WHOLE DAY

LOCATION: GIARDINI NAXOS, ITALY

MEETING WEBPAGE: [HTTPS://INDICO.SKATESCOPE.ORG/CONFERENCEDISPLAY.PY?OVW=TRUE&CONFID=270](https://indico.skatelescope.org/conferenceDisplay.py?ovw=True&confId=270)

HOST INSTITUTE: INAF

PARTICIPANTS NO: 244

MAIN LEADER: INAF

REPORT:

1. Agenda and/or programme of the meeting

Monday June 9		
8:30-8:40	Welcome Message from SKA	Phil Diamond
8:40-8:50	Welcome Message from INAF	Grazia Umana
8:50-9:15	Introduction	Robert Braun
SESSION 1: Chair – Jonathan Pritchard		
9:15-9:45	The Cosmic Dawn and Epoch of Reionisation with SKA	Leon Koopmans
9:45-10:05	H I observables: fluctuations versus imaging	Garrett Mellema
10:05-10:17	Imaging H I Regions from galaxies and Quasars during reionisation with SKA1- LOW	Stuart Wyithe
10:17-10:29	Physics of Reionization	Benoit Semelin
10:29-10:41	EoR modeling and simulations for SKA	Ilian Iliev
10:41-10:53	Constraining cosmic dawn and epoch of reionisation astrophysics with H I data	Andrei Mesinger
10:53-11:15	Break	
SESSION 2: Chair – Garrett Mellema		
11:15-11:35	CD/EoR and Cosmology	Jonathan Pritchard
11:35-11:55	All-sky signals from recombination to reionization	Ravi Subrahmanyam
11:55-12:07	First galaxies -Ly α , X-ray, spin temperature fluctuations	Kyungjin Ahn
12:07-12:19	Bulk flows and end of dark ages	Umberto Maio
12:19-12:31	21-cm forest	Gianni Bernardi
12:31-12:43	Correlations and cross-correlations: kSZ, radio galaxies, and NIR background	Vibor Jelic
12:43-12:55	Synergy with CO/[CII]/Ly α intensity mapping during EoR	Tzu-Ching Chang
12:55-13:07	Foregrounds Removal in CD/EoR and intensity mapping	Emma Chapman
13:07-14:10	Lunch	
SESSION 3: Chair – Xuelei Chen		
14:10-14:21	Overview: Cosmology with the SKA	Roy Maartens
14:21-14:42	Cosmology with H I intensity mapping surveys	Mario Santos
14:42-15:03	Cosmology with H I galaxy surveys	Filipe Abdalla
15:03-15:24	Cosmology with radio continuum surveys	Matt Jarvis
15:24-15:40	Radio Weak Lensing with the Square Kilometre Array	Michael Brown
15:40-16:00	Break	
SESSION 4: Chair – Roy Maartens		
16:00-16:16	Measuring baryon acoustic oscillations with the SKA	Phil Bull
16:16-16:32	Measuring redshift - space distortion with the SKA	Alvise Raccanelli
16:32-16:48	Cosmology on the largest scales	Stefano Camera
16:48-17:00	Topology of H I distribution with the Square Kilometre Array	Xuelei Chen
17:00-17:12	Testing foundations of modern cosmology with the SKA	Dominik Schwarz
17:12-17:24	Cosmology with galaxy clusters in the SKA era	Jochen Weller
17:24-17:36	Weak Lensing Simulations	Prina Patel
17:36-17:48	Foregrounds for Intensity Mapping Surveys	Laura Wolz
17:48-18:00	Real time cosmology	Hans-Rainer Kloeckner
18:30-20:00	Break Out Sessions: EoR, Cosmology, Pulsars	

Tuesday June 10**SESSION 5: Chair – Ben Stappers**

8:30-8:45	Pulsar Science with the SKA - An Overview	Michael Kramer
8:45-9:05	A Cosmic Census of Radio Pulsars	Evan Keane
9:05-9:25	Understanding the Neutron Star Population	Vicki Kaspi
9:25-9:45	Gravitational Wave Astronomy with the SKA	Gemma Janssen
9:45-10:05	Tests of Gravity with Pulsars	Lijing Shao
10:05-10:15	Radio Pulsars in the Galactic Center	Ralph Eatough
10:15-10:25	Pulsars in Globular Clusters	Jason Hessels
10:25-10:55	Break	

SESSION 6: Chair – Michael Kramer

10:55-11:15	Probing the neutron star interior and the cold dense-matter equation of state with the SKA	Renxin Xu
11:15-11:35	Understanding the Pulsar Magnetosphere	Aris Karastergiou
11:35-11:55	Structure and the Magnetoionic Interstellar Medium	Jinlin Han
11:55-12:05	Pulsar Wind Nebulae	Joseph Gelfand
12:05-12:30	Discussion	
12:30-13:30	Lunch	

SESSIONS 7: Chair – Jean-Pierre Macquart

13:30-13:50	The Transient Universe with the Square Kilometre Array	Rob Fender
13:50-14:05	Exploration of the Unknown	Peter Wilkinson
14:05-14:25	The SKA View of Gamma-Ray Bursts	Davide Burton
14:25-14:45	SKA as a powerful hunter of jetted Tidal Disruption Events	Immacolata Donnarumma
14:45-15:00	Variability of Active Galactic Nuclei	Steve Croft
15:00-15:30	Break	

SESSION 8: Chair – Rob Fender

15:30-15:50	Fast Transients at Cosmological Distances	Jean-Pierre Macquart
15:50-16:10	Incoherent transient radio emission from stellar-mass compact objects	Stephane Corbel
16:10-16:25	Early Phase Coverage of X-ray Transients and Exploration of Non-stationary Accretion	Regimes Wenfei Yu
16:25-16:40	Thermal in the Time Domain: Radio Emission from Novae and Symbiotic Stars	Michael Rupen
16:40-16:55	A systematic search for CCSNe in the local Universe	Miguel Perez-Torres
16:55-17:10	Investigations of supernovae and supernova remnants in the era of SKA	Lingzhi Wang
17:10-17:30	Discussion	
18:00-19:30	Break Out Sessions: Continuum, Pulsars	
Evening	Buses to Catania. Talk by INAF President (in Italian) or free time in Catania	

Wednesday June 11

SESSION 9: Chair - Isabella Prandoni

8:20-8:40	Continuum Science: Scientific Cases, Reference Surveys, Commensalities and Synergies	Isabella Prandoni
8:40-9:00	Tracing star-formation activity over cosmic time with the SKA	Nick Seymour
9:00-9:12	SKA Observations at >10GHz: Fundamental Astrophysics of Star Formation at High-z	Mark Sargent
9:12-9:32	SKA studies of nearby galaxies: star-formation & accretion processes across all environments	Rob Beswick
9:32-9:44	The Interplay between SF and AGN Activity and its role in Galaxy Evolution	Kim McAlpine
9:44-9:56	Radio Observations of Star Forming Galaxies	Claudia Mancuso
9:56-10:16	AGN Activity over Cosmic Time	Vernes Smolcic
10:16-10:28	Unravelling the lifecycle of Radio-loud AGN	Anna Kapinska
10:28-10:50	Break	

SESSION 10: Chair - Nick Seymour

10:50-11:02	Identifying the first generation of Radio Loud AGN in the Universe	Jose Afonso
11:02-11:14	Physics of radio-loud AGN	Martin Hardcastle
11:14-11:26	The physics of the radio emission in the quiet side of the AGN population	Monica Orienti
11:26-11:38	Strong Gravitational Lensing with the SKA	John McKean
11:38-11:50	An SKA Mid-frequency All-sky Continuum Survey	Ray Norris
11:50-12:02	Cluster Radio Halos at the crossroads between astrophysics and cosmology	Rossella Cassano
12:02-12:14	Non-thermal emission from galaxy clusters: feasibility study with SKA1	Chiara Ferrari
12:14-12:26	Evolution of radio mini-halos and AGN feedback in cool-core galaxy clusters	Myriam Gitti
12:30-13:30	Lunch	
Afternoon	Mt Etna excursion or free time	
19:00-20:00	Rebaselining discussion with Phil Diamond	

Thursday June 12

SESSION 11: Chair – Federica Govoni

8:30-8:57	Using the Rotation Measure Grid to Reveal the Mysteries of the Magnetised Universe	Melanie Johnston-Hollitt
8:57-9:19	Measuring magnetism in the Milky Way with the SKA	Sui Ann Mao
9:19-9:31	Measuring Magnetic Fields Near and Far via the Zeeman Effect	Tim Robishaw
9:31-9:53	Structure, dynamical impact, and origin of magnetic fields in nearby galaxies	Rainer Beck
9:53-10:05	Magnetic field tomography in nearby galaxies	George Heald
10:05-10:17	SKA Deep Field and Cosmic Magnetism	Russ Taylor
10:17-10:29	Stacking for Cosmic Magnetism	Jeroen Stil
10:30-11:00	Break	

SESSION 12: Chair – Melanie Johnston-Hollitt

11:00-11:22	Relativistic Jets in active galactic nuclei	Ivan Agudo
11:22-11:34	Broadband Polarimetry with the SKA	Bryan Gaensler
11:34-11:46	Unravelling the origin of large-scale magnetic fields in galaxy clusters and beyond	Annalisa Bonafede
11:46-11:58	Cluster magnetic fields through the study of polarized radio halos	Federica Govoni
11:58-12:10	Filaments of the radio cosmic web: opportunities and challenges for SKA	Franco Vazza
12:10-12:22	Statistical methods for the analysis of rotation measure grids in large scale structures	Valentina Vacca
12:22-12:34	Unveiling the nature of Dark Matter with the SKA	Sergio Colafrancesco
12:35-13:30	Lunch	

SESSION 13: Chair – Grazia Umana

13:30-13:45	SKA and the Cradle of Life	Melvin Hoare
13:45-14:10	Protoplanetary disks and the dawn of planets with SKA	Leonardo Testi
14:10-14:25	Radio Jets in Young Stellar Objects	Guillem Anglada
14:25-14:50	Complex organic molecules in protostellar environments	Linda Podio
14:50-15:05	Maser astrometry with the SKA	Jimi Green
15:05-15:30	Magnetospheric Emissions from Extrasolar Planets	Philippe Zarka
15:30-16:00	Break	

SESSION 14: Chair – Melvin Hoare

16:00-16:25	Searching for Extraterrestrial Intelligence with the Square Kilometre Array	Andrew Siemion
16:25-16:50	The impact of SKA on Galactic Radioastronomy: continuum observations	Grazia Umana
16:50-17:05	OH masers in the Milky Way and Local Group galaxies	Dieter Engels
17:05-17:20	The Ionised and Radical Milky Way: line surveys with SKA	Mark Thompson
17:20-17:30	Discussion	
Evening	Conference Dinner	

Friday June 13**SESSION 15: Chair – Lister Staveley-Smith**

8:30-8:55	Neutral Hydrogen and Galaxy Evolution	Thijs van der Hulst
8:55-9:10	Connecting the Baryons: Multiwavelength Data for HI Surveys	Martin Meyer
9:10-9:35	The Intergalactic Medium	Attila Popping
9:35-10:00	Galaxy Formation Models in the SKA Era	Claudia Lagos
10:00-10:15	The SKA as a Doorway to Angular Momentum	Danail Obreschkow
10:15-10:45	Break	

SESSION 16: Chair – Tom Oosterloo

10:45-11:10	Cool Outflows and HI absorbers	Raffaella Morganti
11:10-11:25	The coevolution of supermassive black holes and galaxies	Filippo Mannucci
11:25-11:50	The Interstellar Medium in Galaxies	Erwin de Blok
11:50-12:15	The Galaxy and Magellanic System	Naomi McClure-Griffith
12:15-12:30	The Physics of the Cold Neutral Medium: Low-frequency Radio Recombination Lines with the SKA	Raymond Oonk
12:30-13:30	Lunch	

SESSION 17: Chair – Wenwu Tian

13:30-13:50	Euclid-SKA Synergies	Thomas Kitching
13:50-14:00	Multiple supermassive black holes systems: SKA's future leading role	Roger Deane
14:00-14:10	The connection between radio and high energy emission in black hole powered systems	Marcello Giroletti
14:10-14:20	SKA and the next-generation multi-wavelength observatories	Andrea Possenti
14:20-14:40	Synergy between the Large Synoptic Survey Telescope and the Square Kilometer Array	David Bacon
14:40-15:00	Delivering SKA Science - the science case for SKA-data	Peter Quinn
15:00-15:20	Break	

SESSION 18: Chair – Tyler Bourke

15:20-15:40	Very Long Baseline Interferometry with the SKA	Zsolt Paragi
15:40-15:50	The synergy between SKA and ALMA in studying the formation of stars and stellar clusters	Sergio Molinari
15:50-16:00	Synergies between SKA and ALMA: observations of Nearby Galaxies	Rosita Paladino
16:00-16:20	Lunar detection of ultra-high-energy cosmic rays and neutrinos	Justin Bray
16:20-16:30	Overview of Complementarity and Synergy with Other Wavelengths in Cosmology	Keitaro Takahashi
16:30-16:40	Enabling the next generation of cm-wavelength studies of high-redshift molecular gas with the SKA	Jeff Wagg
16:40-17:10	Closing Remarks and Future Outlook	Chris Carilli

2. Scientific Summary

The conference has brought together 244 scientists from around the world presenting results in fields as diverse as cosmology, exobiology, pulsars or cosmic magnetism, focusing on the game-changing capabilities the SKA's diverse instruments will provide to their fields of research.

There was palpable excitement and enthusiasm among the science community, following an intense week of engaging science talks showing just how the future SKA observatory, with its diverse instruments, will allow research in many different fields, including radio-astronomy but also beyond to fundamental physics.

"This week has shown a fully engaged scientific community that sees the SKA as a transformational tool that will alter our understanding in many different fields, in astronomy but also in fundamental physics and potentially beyond" declared Prof. Philip Diamond, Director-General of the SKA Organisation.

Ten years ago, in 2004, the comprehensive 'Science with the Square Kilometre Array' book was published. Since then numerous and unexpected advances have been made in the fields of astronomy and physics relevant to the capabilities of the SKA. The SKA itself has also progressed from an idea to a developing project with a baselined design, many ongoing engineering activities around the world and construction planned from 2018.

The talks that were given this week will be compiled into a comprehensive Science Case, highlighting some of the key science projects that will be done with the SKA. They are defined as projects that need to address questions in fundamental astrophysics, that need to be unique to SKA or radio astronomy with SKA playing a key complementary role to other existing observatories, and that need to excite the broader community.

Game-changing research

In particular, the talks generated a lot of excitement and expectations in the field of pulsars and gravity, where it is expected that the SKA will bring the capability necessary to detect and characterise gravitational waves, predicted by Einstein but never directly observed. With the first gravitational waves hoped to be detected in the next few years, the SKA will allow the identification and characterization of the sources of these waves, and will be used to conduct studies of extragalactic pulsars. By looking at pulsars, the SKA will also enable astronomers to conduct tests of gravity in extreme conditions, improving our understanding of how gravity works. Chris Carilli, NRAO's Chief Scientist said "the impact of such research will be dramatic".

Another field that showed great promise at the conference is the study of the Epoch of Reionization, the time, early in the history of the Universe, when the first celestial objects, proto-galaxies and stars, started to form through gravitational instabilities and their light ionized the neutral material around them. By detecting the emission from neutral hydrogen (hydrogen before it was ionised), astronomers using the SKA expect to be able to push even further back into what is known as the Dark Ages, the time prior to the first structures such as galaxies and stars, thus giving astronomers invaluable insights into the early period of the Universe. This research is critical to our understanding of the early Universe.

Fundamental radio astronomy

Other talks at this week's conference also highlighted the SKA's game-changing capabilities in a number of other fields, in particular the traditional and fundamental fields of radio astronomy, such as the study of cosmic magnetism to get a better understanding of how magnetic fields form and evolve in the Universe. The SKA is expected to be able to map the magnetic fields of thousands of galaxies up to redshifts far beyond today's capabilities, thus ultimately leading to a better understanding of star-formation. Combined with the study of magnetic fields on large-scale structures in the Universe, such as galaxy clusters – groups of hundreds or thousands of galaxies, the SKA will help map the distribution of matter and establish the global structure of the Universe – how galaxies and matter clump together and how these clumps are connected – known as the cosmic web.

Research on galaxy evolution, star formation and matter accretion is also expected to benefit significantly from the SKA's capabilities, yielding a deeper understanding of the history of the Universe and thus addressing fundamental questions in cosmology, such as dark matter and dark energy.

High-risk / high-gain fields

A number of talks also focused on other areas of research that, should astronomers use the SKA in these fields, have the potential to fundamentally change our understanding of the Universe.

In particular, these fields include exobiology, with the study of the presence and distribution of pre-biotic molecules in the Universe, the building block of Life, the study of matter accretion and the formation and evolution of proto-planetary disks as well as the search for extra-terrestrial intelligence, with the SKA being expected to detect potential signs of civilization up to dozens of light years from Earth, which represents a comprehensive study of hundreds and possibly thousands of solar systems in our neighbourhood.

Pathfinders and precursors

The talks given throughout the week highlighted the integral role pathfinder telescopes have played in the process (such as the JVLA in the US, LOFAR in the Netherlands, etc.). A number of these pathfinder telescopes were deployed from the beginning with the goal in mind to enable engineers to test technologies and allow astronomers to conduct early research and refine the key science fields leading up to the SKA. As such, they are a great success in themselves.

Precursor telescopes - pathfinder telescopes located on the SKA core sites in Western Australia and South Africa – have also seen great progress. The Murchison Widefield Array (MWA) in Western Australia, which is conducting research in the low frequencies, has been routinely operating since July

2013, the Australian SKA Pathfinder (ASKAP) also in WA is currently being commissioned with 6 of its 36 antennas already conducting science-grade observations, and MeerKAT, the South African precursor telescope under construction, with its first antenna recently inaugurated.

“We’ve had an intense week of first class science presentations from the community that truly show just how much the SKA will add to our understanding of the Universe.” Concluded Prof Robert Braun, Director of Science at the SKA Organisation. “Not only has the science case for the SKA grown even stronger, but we’re also more excited than ever about the “unknown unknowns”, the other discoveries we cannot even predict but are sure the SKA will bring”.

3. Attendance list (incl. participant names, affiliation and country) signed by the participants and confirmed by the organizer

Dr. ABDALLA, Fillipe, University College London, London, UNITED KINGDOM

Dr. AFONSO, Jose, Centre for Astronomy and Astrophysics - University of Lisbon, Lisbon, PORTUGAL

Dr. AGUDO, Ivan, Joint Institute for VLBI in Europe, Dwingeloo, NETHERLANDS

Prof. AHN, Kyungjin, Chosun University, Gwangju, REPUBLIC OF KOREA

Ms. ALDERIGHI, Monica, INAF - IASF Milano, Milan, ITALY

Dr. ANGLADA, Guillem, Instituto de Astrofisica de Andalucia (IAA- CSIC), Granada, SPAIN

Dr. ANTON, Sonia, IAA-CSIC/CICGE/FCUL, Lisbon, PORTUGAL

Dr. ARMSTRONG, Richard, University of Cape Town / SKA SA, Cape Town, SOUTH AFRICA

Dr. BACON, David, University of Portsmouth, Portsmouth, UNITED KINGDOM

Dr. BALL, Lewis, CSIRO Astronomy and Space Science, Sydney, AUSTRALIA

Dr. BARR, Ewan, Swinburne University of Technology, Melbourne, AUSTRALIA

Dr. BECK, Rainer, MPIfR, Bonn, GERMANY

Dr. BEN BEKHTI, Nadya, Argelander-Institut für Astronomie, Bonn, GERMANY

Dr. BERNARDI, Gianni, SKA SA & Rhodes University, Cape Town, SOUTH AFRICA

Dr. BESWICK, Rob, University of Manchester, Manchester, UNITED KINGDOM

Dr. BIJ DE VAATE, Jan Geralt, ASTRON, AA Dwingeloo, NETHERLANDS

Dr. BOLTON, Rosie, University of Cambridge, Cambridge, UNITED KINGDOM

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Mr. BOUFFLER, Brendan, Amazon Web Services, Newtown, AUSTRALIA

Dr. BOURKE, Tyler, SKA Organisation, Macclesfield, UNITED KINGDOM

Prof. BOYLE, Brian, Department of Industry, Canberra, AUSTRALIA

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Prof. BROWN, Michael, University of Manchester, Manchester, UNITED KINGDOM
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on behalf of LOC Dr. Grazia Umana





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5. Conference Proceedings and Web page

The conference program is presented with links to individual talks here:

<http://astronomers.skatelescope.org/documents/aaska14-presentations/>