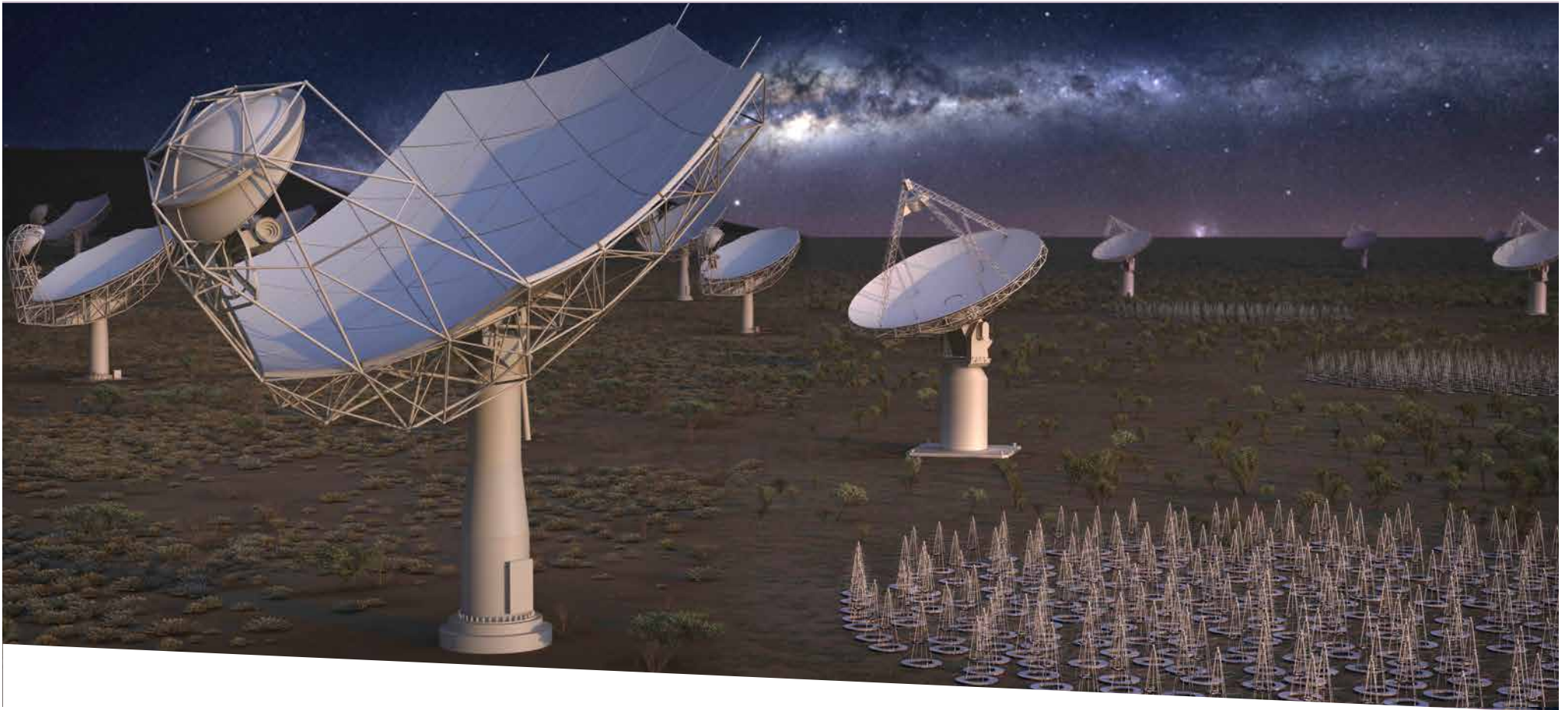


SKA SWG Update



SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

**Robert Braun, Science Director
& SWG/FG Chairs**

12 December 2017

Reports from the individual SWGs

- Extragalactic (non-HI) Spectral Line
- Our Galaxy
- Epoch of Reionization
- Cosmology
- Extragalactic Continuum
- Cradle of Life
- HI galaxy science
- Pulsars

Extragalactic spectral line (non-H1) - SWG

- **Remit: Advocate all SKA related extragalactic spectral line studies that do not fall under the remit of the HI SWG group**
- i.e. Broadly includes all areas of non-H1 & molecular line astrophysics, including non-thermal maser transitions, as well as other lines such as HCN, CI, CO, recombination lines from the local Universe through to high-z. *Covers all science objectives that use such lines. Science objectives have significant complementarities & synergies with many other SWGs.*
- Multiple on-going group activities / objectives :
 - advocacy of the science area & SKA impacts (e.g. via invited talks/reviews at national & subject-specific meetings), Building links beyond 'traditional radio specialists'
 - development of KSP related projects (expectation that KSP should science driven with molecular spectroscopy as key element alongside other parts)
- *SWG: Current membership is 38 SWG members these cover a wide range of science interests and geographical origins. – Growing 'OPEN' group*
- ***Chairs*** : Rob Beswick*(U. of Manchester, UK)/Francoise Combes (Observatoire de Paris, FR)
- * *Rotating off in early 2018 – to be replaced by Sebastien Muller (Chalmers, SE)*

Seven Sisters Milky Way dreaming
Gabriella Possum Nungurrayi

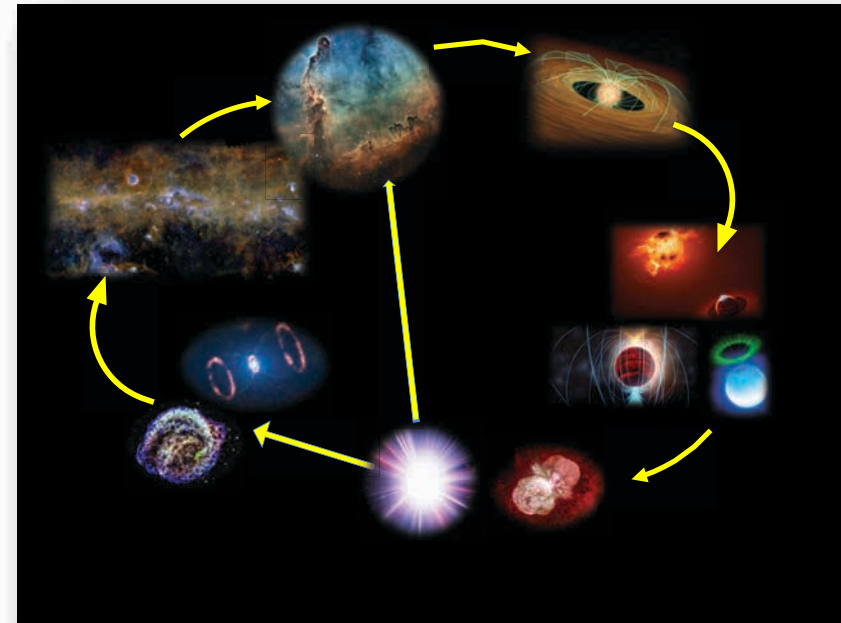
Chairs: G. Umana (INAF)- Erik Rosolowsky (Uni. of Alberta)

60 members: good coverage in expertise, as well as in Nationality
many of them involved in SKA pathfinder projects (LOFAR, ASKAP, MeerKAT)

The BIG PICTURE of Our Galaxy:

Uncovering the ecology of baryons/
understand the cycle of matter in/out and between
Components of our Galaxy:

- ***We want to understand the details of such interplaying.***
- **We want to use Our Galaxy as a resolved template to understand how Galaxies work.**



Most of the phases of the cycle of matter in Our Galaxy can be studied with different radio diagnostics:

- Molecular Clouds via molecular lines
- The ionized gas components via RRLs and continuum;
- Jets and winds in the first phases of Stellar Formation via thermal continuum
- Different phases of stellar evolution via thermal and non-thermal continuum

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Seven Sisters Milky Way dreaming
Gabriella Possum Nungurrayi

Preparatory work (Spectral and continuum surveys)

KuGARS (PI Thompson) Pilot JVLA, $4^\circ \times 2^\circ$ deg, 12-18 GHz, 110 μJy (5σ), sub-arcsec
pathfinder to **MeerGAL** (PIs- Thompson and Goedhart): **Currently in stand-by**
MeerKAT, 140 deg², GP, 14 GHz, 30 μJy (5σ), 0.8 arcsec, multi-epoch

THORS (Bihl et al., 2015)- JVLA, 100deg² GP, 1-2 GHz, 10-20", 0.3-1mJy/b (1σ)

SCORPIO (PI Umana) **ATCA**, 1.4 GHz, 30-40 μJy (1σ), 10 arcsec, 4 deg²
pathfinder to **EMU** (PI R. Norris), ASKAP, All-sky 1.4 GHz, 50 μJy (5σ), 10 arcsec
Currently in Early Science phase
Galactic EMU 2 KSP- *Galactic Plane* (PI: Kotes)- Different classes of Galactic Objects, in. SNRS
Radio Stars (PI: Umana) more focused on "normal stars"

Lessons learnt so far:

- **Pathfinder surveys essential** to design the better strategy for Galactic Plane SKA surveys;
To face *issues due to complex structures in the GP, to the variable sources and diffuse emission*
- **Need for automated source extraction (both compact and extended) and classification methods**
- **Need for baseline zero data; need for better methods to combine single-dish and interferometric data**



To reach our main goal –the BIG PICTURE-

Several KSPs and Focus follow-up cases carried out by a team (TBD) consisting of people coming from different SWGs: define clear commensal objectives
contact points” between SWG

Via:

Synergies/discussions/meeting with Cradle of Life, Magnetism, HI, (non) HI spectral line, Continuum

KSPs : some already defined, some in preparation, others just in the *"brain storming mode"*

- a) **Stars, planets and civilization:** synergy with CoL
- b) **Nearby young stellar clusters:** synergy with CoL
- c) **The Galactic Center:** synergy with Magnetism

Need to revamp Our Galaxy:

- organise the SWG in small sub-group focusing in particular topics that **could** lead to a KSP
on going, sub-groups to be finalised by the end of 2017
- organise a f2f meeting in the first half of 2018, before the Science meeting planned in

○ Manchester

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CD/EoR SWG

- Recent activities:
 - Meetings in Pisa (March 2017) and Zagreb (September 2017).
 - Collection on a web page of simulated 21-cm light cones from different simulation codes for use in data processing tests
 - Development of a blind challenge for power spectrum extraction from a 21-cm data set
 - Cosmological signal + noise
 - Cosmological signal + noise + foregrounds
 - Noise + foregrounds
 - ERC Synergy Grant application for development of full data processing / analysis pipeline (PIs Koopmans, van der Veen, Offringa, Mellema).

Cosmology SWG

- Main science goals
 - Continuum surveys, Weak Lensing, HI galaxies and intensity mapping. NB also synergies and simulation
- Meeting at QMUL 18/19 Dec and joint session with Euclid 20 Dec; Session at EWASS April 2018
- Key Goals for 2018
 - Detailed workplans for each Focus Group
 - Red book : 2 yearly summary of science status
 - Establish connections with related science areas
 - Strengthen working group

Extragalactic continuum SWG

Co-chairs: Mark Sargent, Rossella Cassano^{*}

- Our science activity can be followed at <http://skacontinuum.pbworks.com>
- **Science Focus Groups**
 - [Star Formation History of the Universe](#)
 - [Active Galactic Nuclei and Their Role in Galaxy Evolution](#)
 - [Galaxy Clusters and Large Scale Structure](#)
 - [Detailed Astrophysics of Star Formation and Accretion in Local Galaxies](#)
 - [Strong Lensing](#)

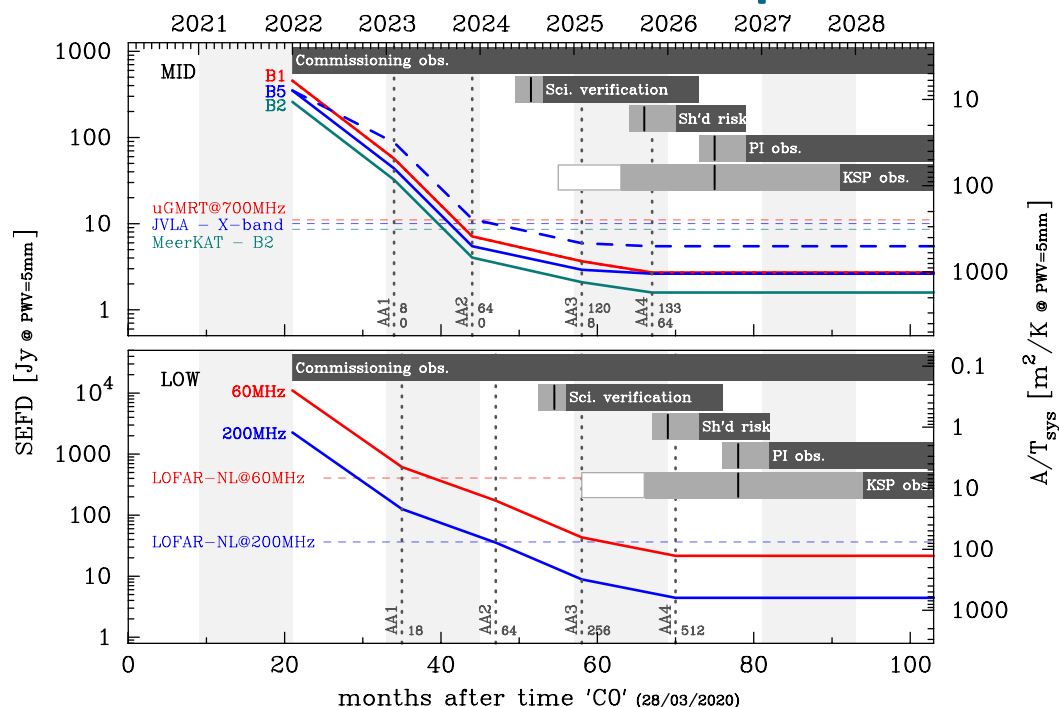
Technical Focus Groups

- [Simulations](#)
 - Source Extraction and Characterisation
 - [SKA1-LOW data analysis/calibration team](#)
-
- Last activities: assessment of SKA1 cost saving measures (spring/summer)
 SDP modelling of HPSOs/continuum reference surveys (July)

^{*} *(in place of Natasha Hurley-Walker until February 2018)*



Continuum SWG Discussion of 'Science and Operations Planning' document



- 1) Favour an earlier submission of Lols & definition of KSP programs than planned now.
 - provides clear mechanism for KSP teams to participate to commissioning/sci. verif.
 - ensure sufficient time for resourcing prior to the start of KSP
- 2) Without clear mechanism for ('proto-')KSPs to be involved in commissioning/sci. verif.:
 - too little time between 'shared risk' observing and KSP proposal deadline to enable lessons from "Pilot Surveys" to be taken on board for KSP proposals.
 - unclear in what order different observing modes will become available; does this place some KSP areas at a disadvantage if they cannot demonstrate KSP-readiness via "Pilot Surveys".
- 3) Further clarifications needed on differences between PI and KSP science.

CoL Preparatory Science

Grain Growth :

- VLA pilot survey toward Ophiucus A (Coutens, Liu, Jimenez-Serra, Testi & collaboration, in prep.).
- New simulations of PPD dust continuum emission (Hoare).

Astrochemistry/Astrobiology :

- Simulations of formamide in gravitationally unstable disks (Quenard, Ilee, Jimenez-Serra, et al. in prep.).

Planets & Exoplanets:

- Release of ExPRES code (Exoplanetary and Planetary Radio Emission Simulator).
- Observations of radio bursts from exoplanets and cool or active stars (Turner et al. 2017; Loh et al. in prep.)

SETI:

- “Custom Experiment Policy” in preparation.
- Accepted proposals with MeerKAT and MWA



CoL Science Activities

- Participation in the “Origins of Life” symposium (Netherlands, 31 Aug-1 Sep; van der Wiel & van Langevelde).
- Exoplanet search review chapter with SKA within French SKA White Book (Lamy & Zarka).
- Talk delivered at SKA workshop in Valencia (5-6 Nov; Jimenez-Serra).
- Talk delivered at SKA-related workshop in Obs. Arcetri (GENESIS project; 4-5 Dec; Jimenez-Serra).
- SS5 Special Session on COMs at EWASS 2018 (4 April 2018; Jimenez-Serra, Viti, Caselli, Testi).
- Creation of a repository with information about CoL current activities/science.
- Through discussions with community in Spain and in Italy, much more interest than what membership in the WG would suggest

HI-SWG Update

- Incoming chairs in process of setting up new communication processes for HI SWG:
 - Instigating monthly email to inform group of news from SKA office
 - Setting up Google repository for easy sharing of documents (although this could be an issue for Chinese colleagues...)
 - Planning telecon in March 2018 to discuss status of various HI surveys with SKA precursors/pathfinders
 - 2 face-to-face meetings with group members planned:
 - PHISCC workshop in China in June 2018
 - SKA KSP workshop in UK in September 2018

SCIENCE AND OPERATIONS PLANNING (some caveats)

- The 1 year gap between survey approval and starting observations would be tight to enable resourcing for projects in some cases
- Full commissioning of all modes of observation expected well beyond the KSP +PI calls. This may pose difficulties in proposing the KSP programs well before all modes of observation are commissioned (and hence actual performances known)
- KSP Lols coincides with the start of Science verification observations: too tight to have sufficient information to prepare the Lols?
- The period between PI shared risk proposals and PI proposals seems too short
- The call for KSPs will be after the PI call (even if PI observations will start before). It may complicate decisions as what should be part of a KSP or test observation for a KSP and what for a PI proposal

HI-SWG Update



Topic for SKA science meeting in Manchester

- Trigger mutual knowledge of the overlapping areas between SDP, SRC, community perspectives

- Science teams working on KSP preparation, summarizing the kind of tools they are considering
- SDP, on what pipelines are being considered and how the interaction with the scientific teams is taking place, and what will be the products that the SDP will deliver
- SRCCG, on how the requirements are being defined and how those are expected to fulfill the needs of the community
- Initiatives to prepare for the SRCs: AENEAS, ERIDANUS, IDIA, Canada, etc
- SKA data challenges, that will be of much interest also for the algorithm and pipeline development

Magnetism-SWG Questions

- *The quality* calibration of polarisation is likely to be delayed beyond that of the intensity, so there are likely to be operating science verification programmes in one category at the same time as shared-risk programmes in another category. The timeline seems over-simplistic for polarisation/magnetism related science.
- Another question that arises is how much time will be assigned to PI observations and to KSP observations, and discretionary time for the DG. Moreover, I wonder if the access policy will be managed at the level of partner countries, assigning a percentage of time to each of them, or at the central level.
- Coordination of commensal surveys : Since it is likely that we will try to propose commensal surveys, I think there needs to be some recognition in the planning about how those will be handled. It's not as simple as saying "fold it in with the primary proposal" because there may be only a little overlap between the teams, there are separate resources that will be required for polarization, etc.
- PI Science vs KSP Science : Also, it is not clear how the KSPs influence the PI science, since PI science looks like it's going to start early. There needs to be some understanding that observations under approved KSPs will generally not be approved for PI science unless there's some specific justification.
- There is some (deliberately) vague language about partnership and access, etc, etc, and that teams may need to be restricted. I don't know what that means. So, independent of whatever software partnership NRAO is currently negotiating, it's not clear what access will be given to people from US. Are they not allowed to be on the proposal or not allowed to have access to the data as part of the team?

Fundamental Physics with Pulsars SWG



Pulsar Astrophysics: The Next Fifty Years

IAU Symposium 337 - 4th-8th September 2017 - Jodrell Bank Observatory, University of Manchester

Fundamental Physics with Pulsars SWG



Meetings

- Pulsar and FRB Search Software Workshop
 - Cape Town (11 - 14 Dec - this week!)
- Pulsar SWG Strategic Planning Workshop*
 - Auckland, before NZ SKA Forum (13 – 16 Feb)

* proposed

Fundamental Physics with Pulsars SWG



Precursor / Pathfinder Progress

- MeerKAT Pulsar Timing LSP:
 - Observations will likely start in April 2018
- MeerKAT Transient and Pulsar LSP:
 - Hardware tender out (delivery before Q2 2018)
- Recent study using MWA (Xue, M. et al 2017)
 - SKA1-Low can potentially detect ~9400 pulsars
- CHIME:
 - First light achieved, first part of FRB instrument installed, and pulsar instrument 70% done



Fundamental Physics with Pulsars SWG



SKA Data Challenges

- Pulsar SWG fully supportive and engaged
- Top 2 Ideas for SKA Pulsar Data Challenges:
 - modeling newly discovered binary systems in minimal observing time
 - classification of pulsar survey candidates
- Potential to collaborate with IPTA on challenges related to gravitational wave detection



SKA Data Challenges

- Sequence of increasing size, realism, every ~12 months
- Request for SWG input:
 - What is a plausible database/data-product **size** to exercise your current (or short-term future) capabilities for data transport, processing, visualisation, etc.?
 - What aspect is of greatest interest to you:
 - Visibility-based, image-cube-based or time series processing ?
 - Calibration, imaging, source extraction, source characterisation, etc. ?
 - What data format is most desirable ?
- Please be patient if your SWG/KSP needs are not met by an early release (need to walk before we can run)

Upcoming Meetings

- EWASS-2018, Liverpool, 3 – 6 April 2018
 - “Opening new frontiers in cosmology with the Square Kilometre Array”
- SKA Key Science Project Workshop, SKA HQ,
3 – 7 September 2018
 - Some suggestions for the Science Focus of Meeting
 - New Science and new techniques in the SKA Era
 - Large Synergistic Surveys

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www.skatelescope.org