

SKAO

Science Operations at SKAO

Shari Breen - Head of Science Operations

Swiss SKA days - 3rd September

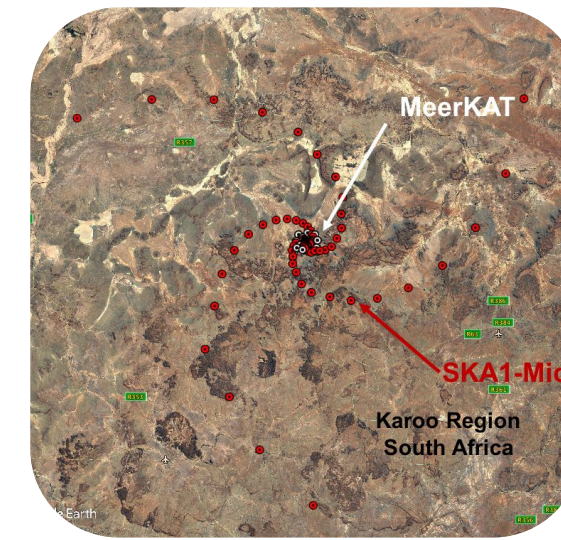


Science operations overview

- SKA is a flexible science machine!



SKA1 Band	Freq (GHz)	Band
Low	0.05 - 0.35	300 MHz
Mid Band 1	0.35 - 1.05	700 MHz
Mid Band 2	0.95 - 1.76	810 MHz
Mid Band 5a	4.6 - 8.5	3.9 GHz
Mid band 5b	8.3 - 15.4	2 x 2.5 GHz



- Each supports up to 16 subarrays (splitting the 512 stations and 197 dishes into smaller arrays)
- Low can create substations
- Templates will be offered to the community

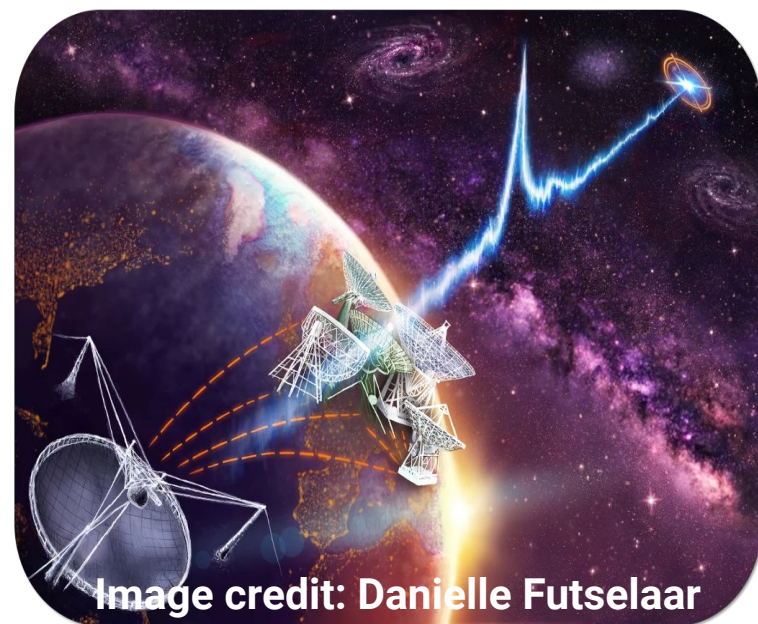
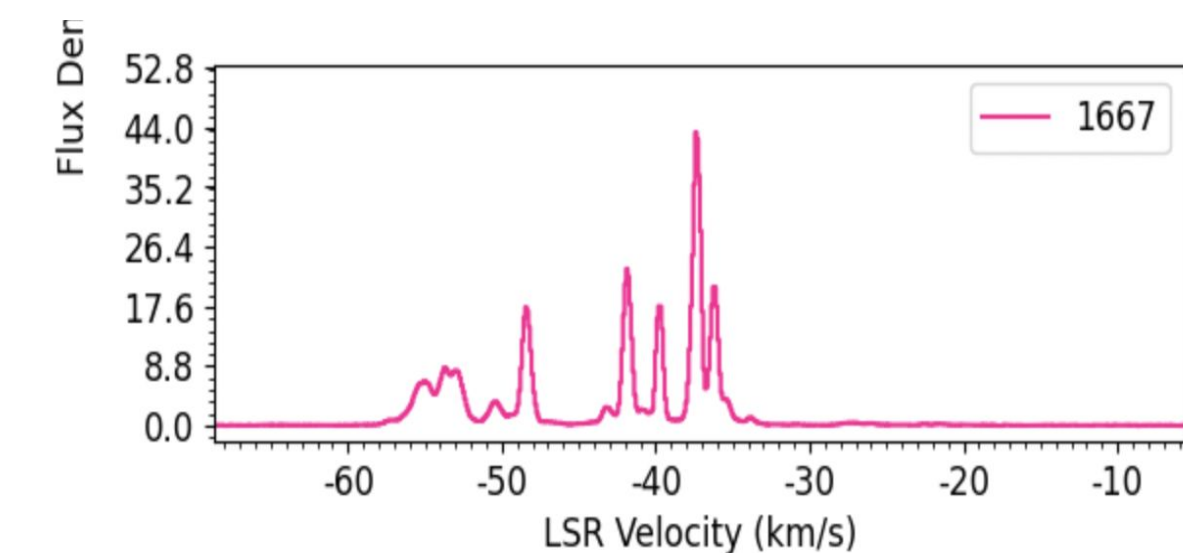
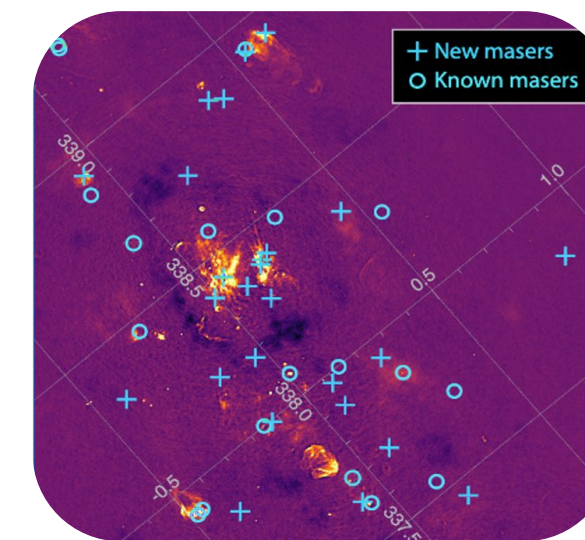


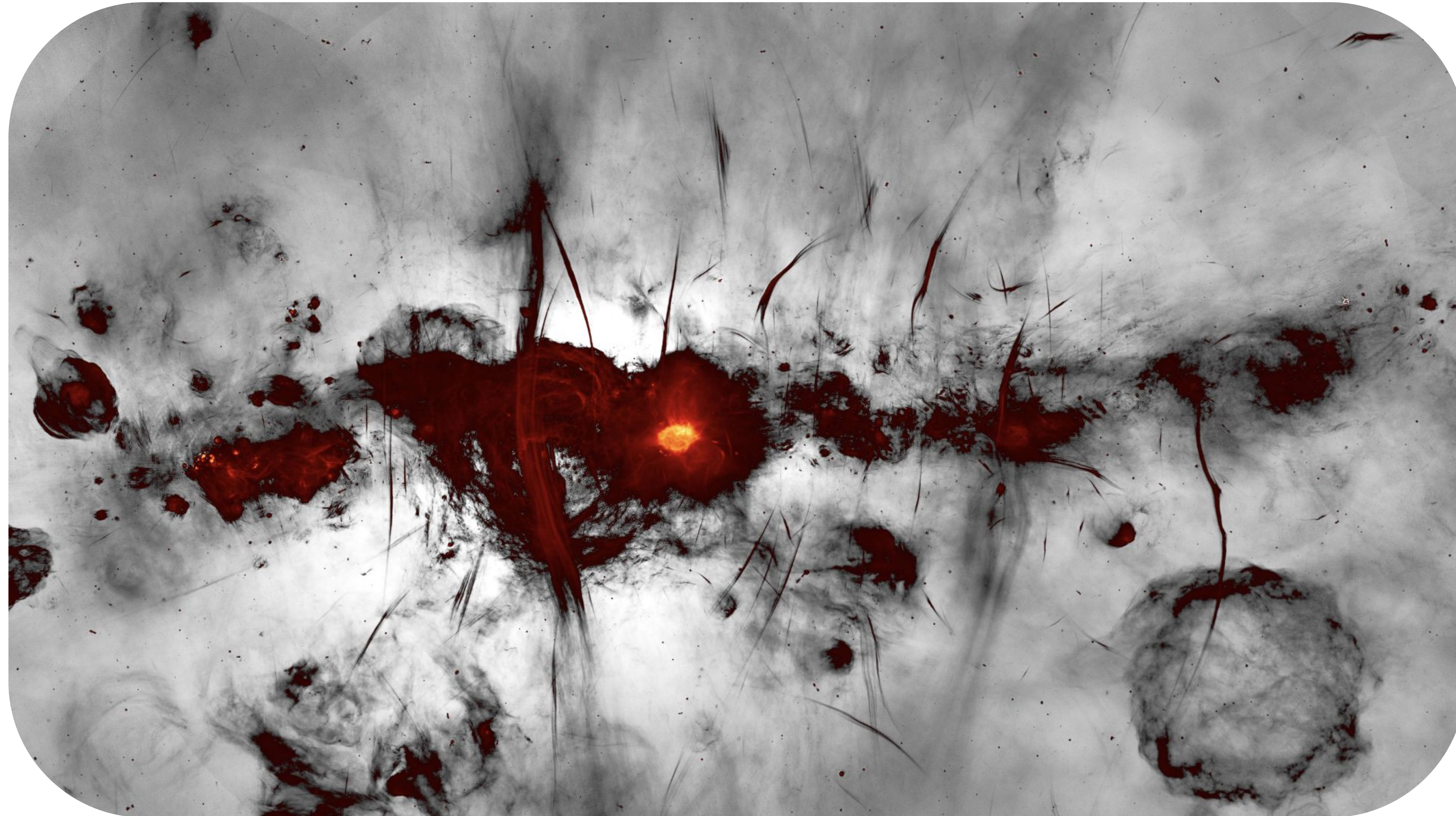
Image credit: Danielle Futselaar

- Very flexible Correlator beam formers (CBFs) but ultimately resource limited
- Imaging and non-imaging modes supported
 - Broad-band continuum, Spectral/zoom, Pulsar and transient search (PSS), pulsar timing (PST), VLBI, transient buffer



- Commensality supported (data, observing, multiplexed)

We will deliver data products!



Credit: I. Heywood, SARA0

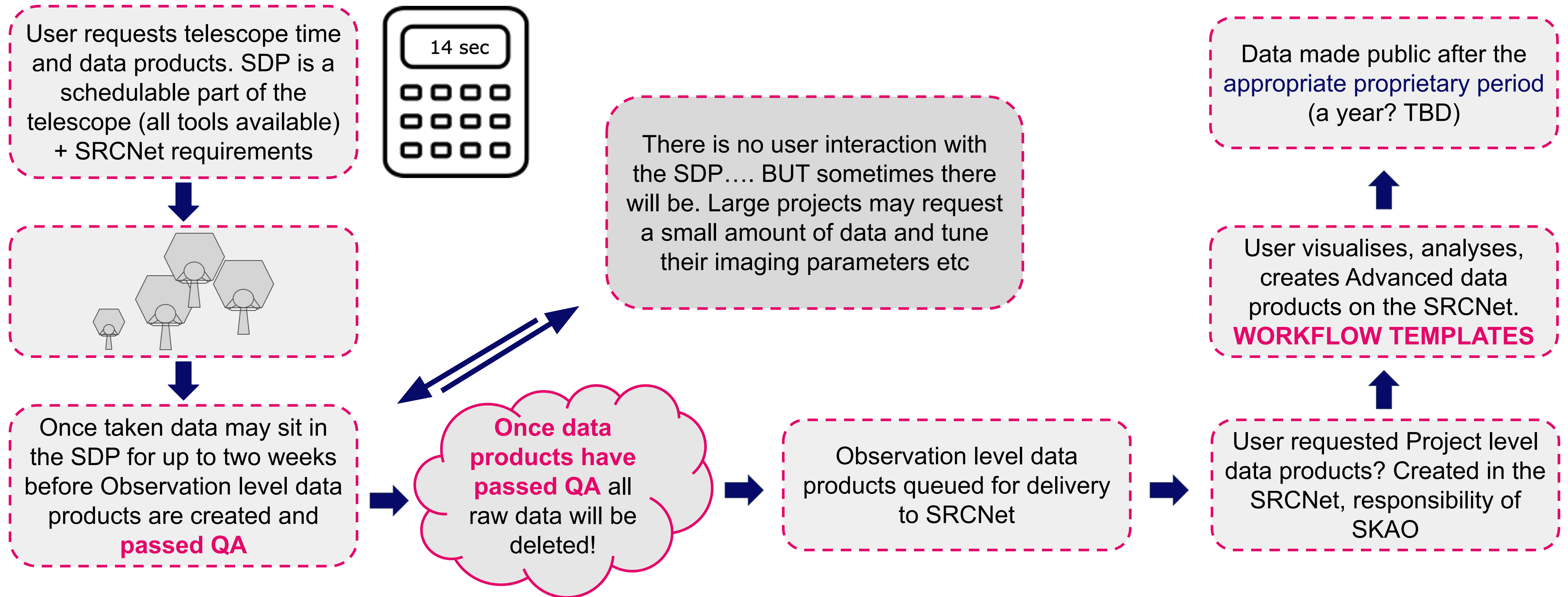
- Our data are BIG, expecting to deliver ~ 700 PB/year of *data products*
- Don't need to be a radio expert to access the SKA!
- Transformational science increasingly relies on multiwavelength data, everyone is welcome



SKAO Operational model (brief summary)

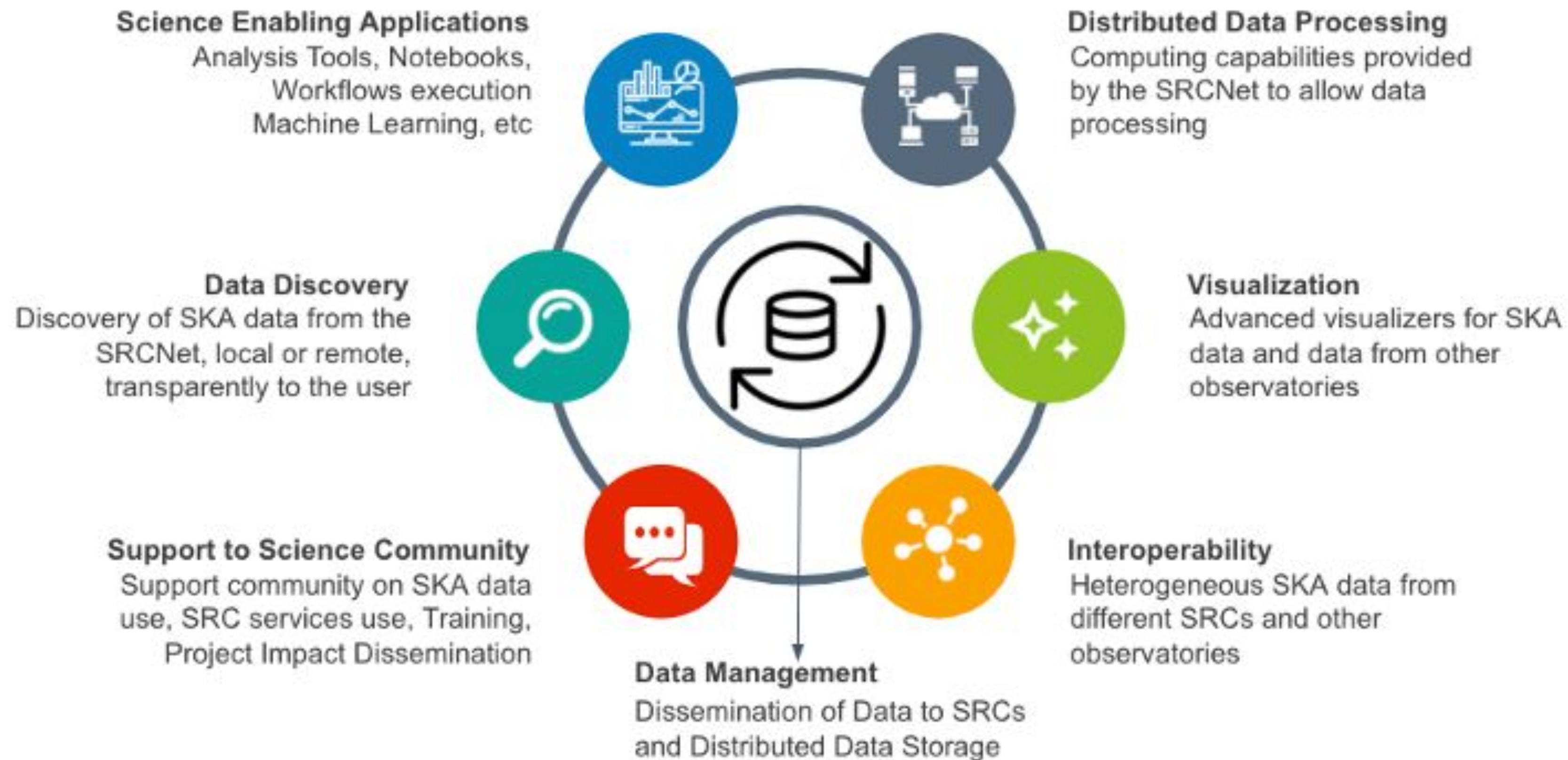
Details in the OEDP: <https://www.skao.int/en/resources/402/key-documents>

SKAO science data products: A summary document lists many of the kinds of data products we are expecting (details of data formats aren't yet available)



SRC Network is critical

Delivering SKA data products to scientists, storing SKA data for future use, computer facilities to undertake scientific analysis and local user support all fall outside of the construction budget



Complexity of the SRCNet and the responsibility boundaries with SKAO will be hidden as much as possible from the users - one Helpdesk, and a plan to lead with principles of fairness, equality and inclusion



Access to the SKA

- Observing time will be allocated on the basis of scientific merit and technical feasibility while maintaining access in proportion to member shares
- Building to a small amount of Open Time

Telescope and data processing will be awarded across three categories:

1. Key Science Projects (KSPs)

- Truly transformational and exciting science projects
- significant observing time and resources often over a period longer than one Observing cycle **>~500h?**
~50-70%
- **Leadership team restricted to member countries**, Co-Is from non-member countries is possible, but may be limited.
- SWGs are NOT KSPs - no time has been awarded yet - see Wendy's talk

2. Principle Investigator (PI) projects

- observing projects that require less time and resources than a KSP, typically over a single cycle **<~500h?**
~30-50%

3. Director-General's Discretionary Time (DDT)

- Allocated outside a proposal call

ToO, Long Term Projects, Joint SKA projects, Coordinated Projects (e.g. VLBI, [ESO](#)) available



Resources for the science community

Slides with more info at the end of the deck



Tools for the community - Available now!

SKAO OBSERVATORY

ABOUT US CAREERS SEARCH

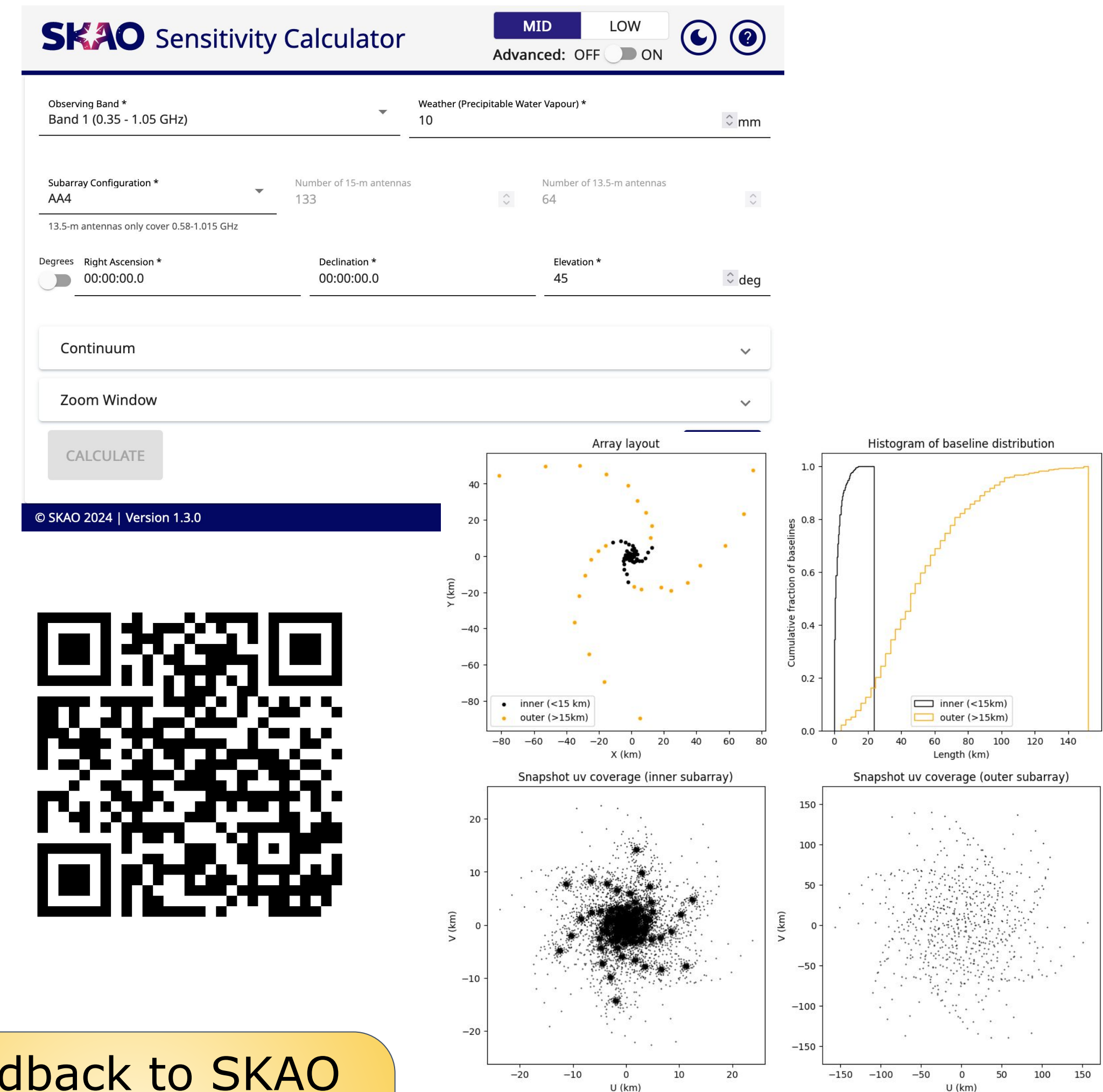
SKAO Explore Opportunities Resources Partners News & Events **Science Users**

Home > Science Users > SKA Tools

SKA Tools 8

This page provides a list of tools that SKAO has made available to the user community.

- Sensitivity calculators
- Staged delivery, array assemblies and subarrays
- SKA subarray templates library



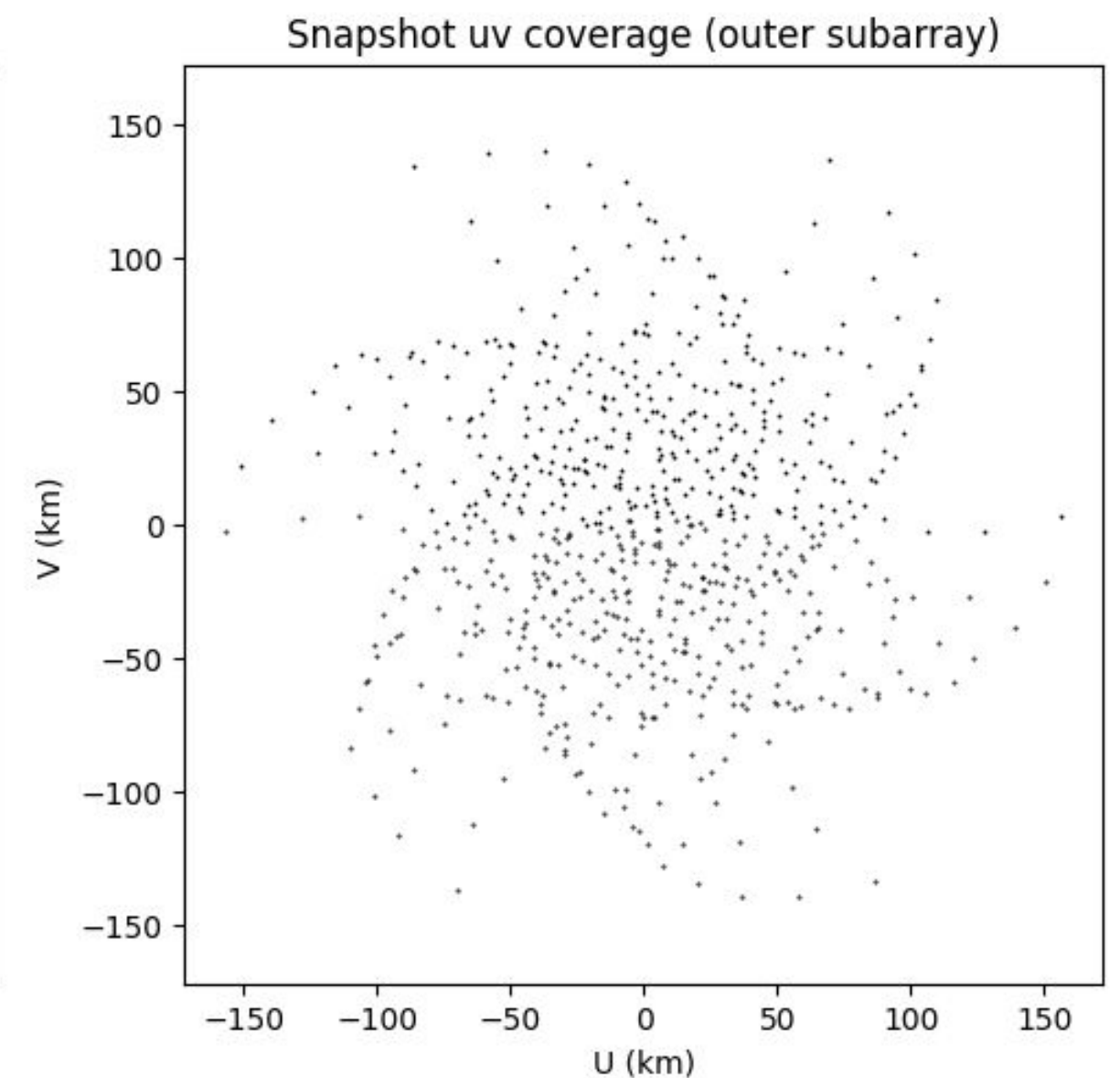
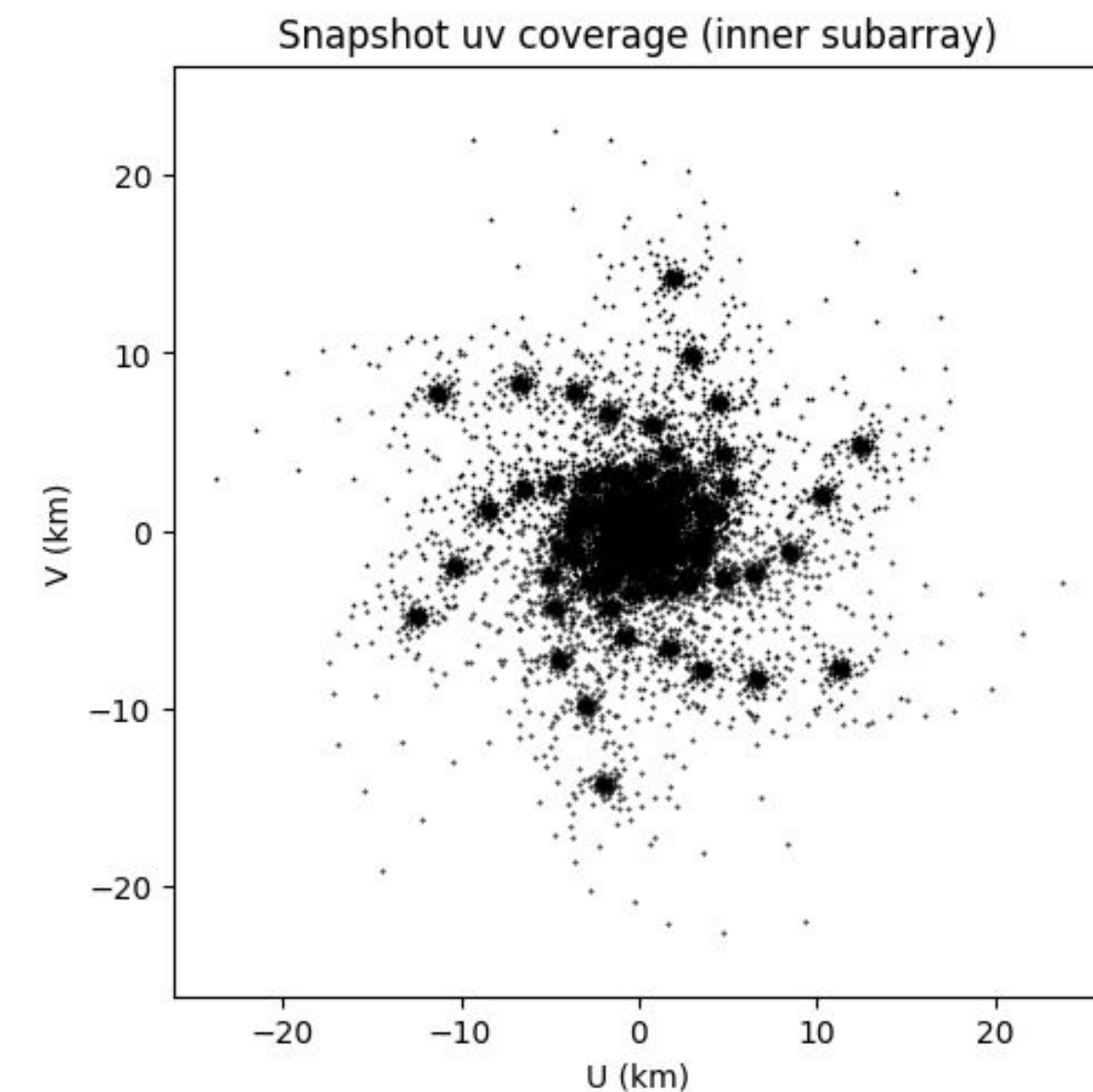
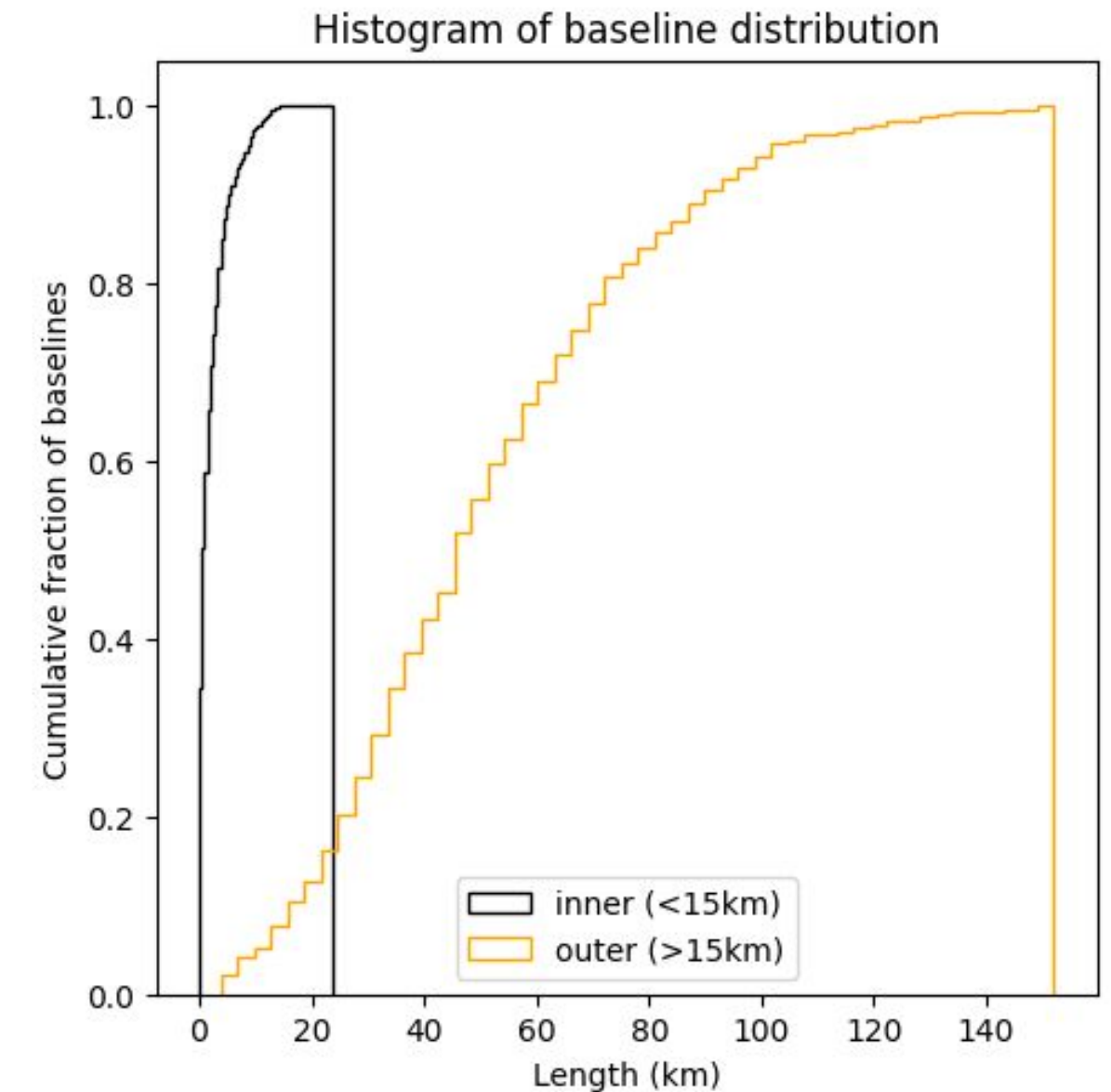
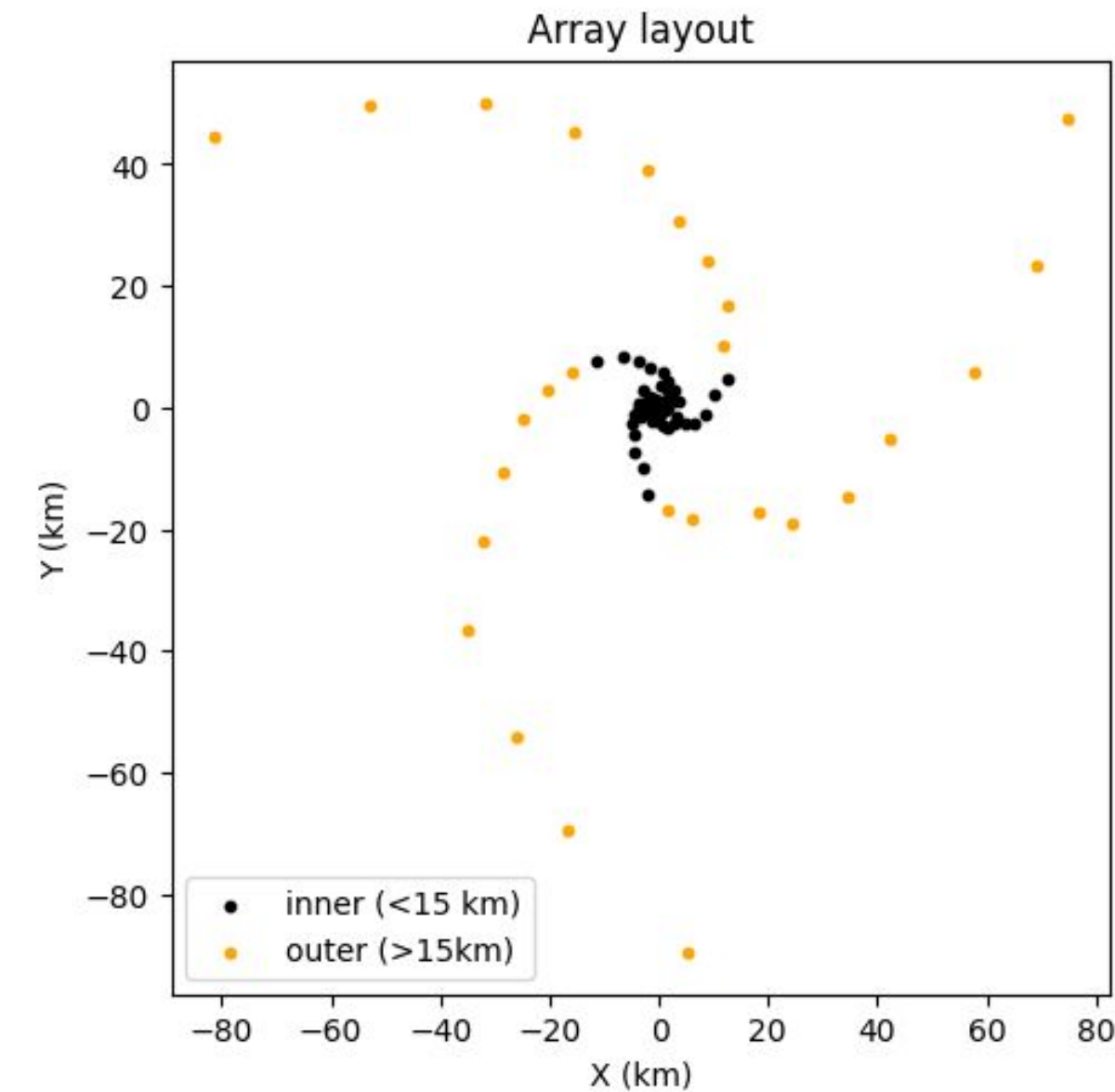
Feedback to SKAO
Science
Operations:
sciops@skao.int

<https://www.skao.int/en/ska-tools>

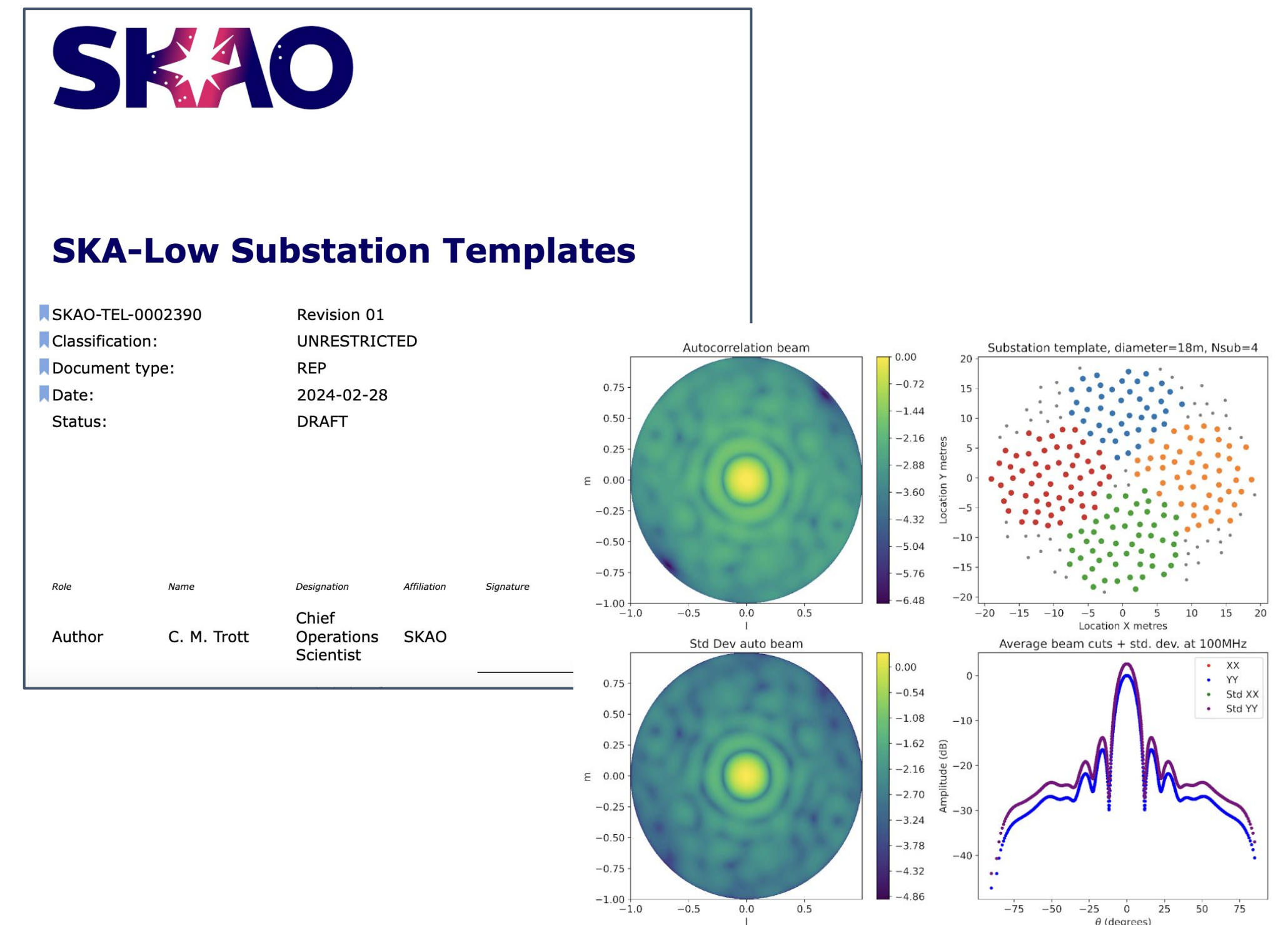
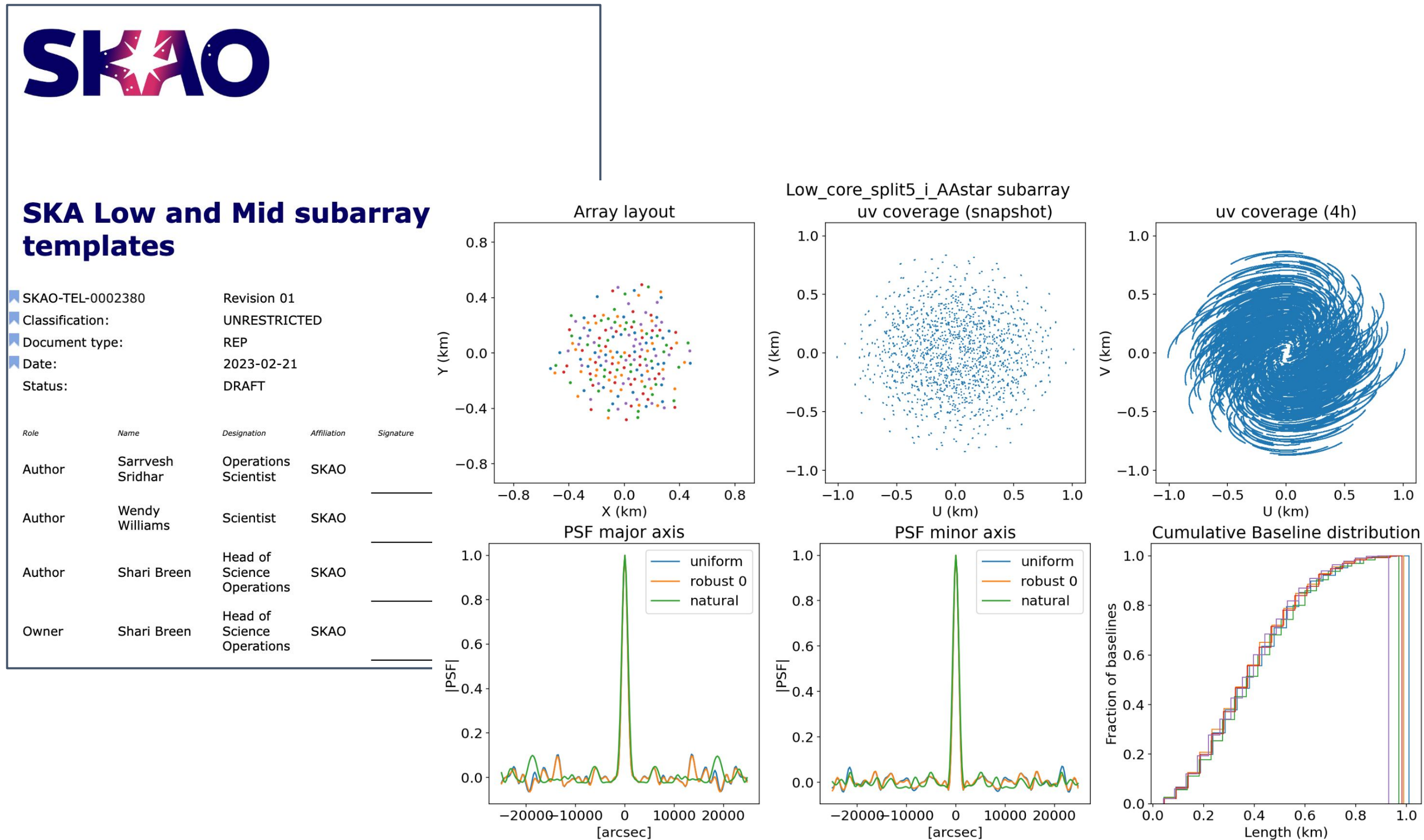


Memo and Software package

- Memo released late last year ([link](#))
- Software interface to the antenna coordinates
- SKAO repository: [ska_ost_array_config](#)
 - Detailed documentation in a [Jupyter notebook](#)
- Allows you to
 - Configure a custom subarray
 - Simulate interferometric observations
 - Plot array layout and uv coverage
 - Export the layout to CASA for more comprehensive simulations
- Figure on the right plots baseline distribution and uv coverage of two Mid subarrays



Tools for the community - Subarray (left) and substation (right) templates (coming very soon!)



- Worked with the SWGs to define this first set of templates
 - 26 Mid, 27 Low
 - Document to be released for feedback (google form with questions available) and refinement: <https://www.skao.int/en/science-users/ska-tools/543/ska-subarray-templates-library>

- Like subarrays, users will be able to select from a series of templates
- Document includes 18, 12, 9 and 6m examples, 18 and 12 for cross correlation, 9 and 6m for fly's eye mode



We want your feedback!

- We want to use this first version to drive the conversation with the community.
- Created a questionnaire with 6 open ended questions.
 - Feedback will help refine the templates (or add new ones).



Feedback on SKA subarray templates library

Links to the [SKA subarray templates memo](#) and the [simulation software](#) package.

sarrvesh.sridhar@skao.int [Switch accounts](#)



Not shared

Email ID (in case we need to contact your for further clarification)

Your answer



Do you imagine using any of the subarrays from the template list? If so, what are they and what is the science area?

Your answer

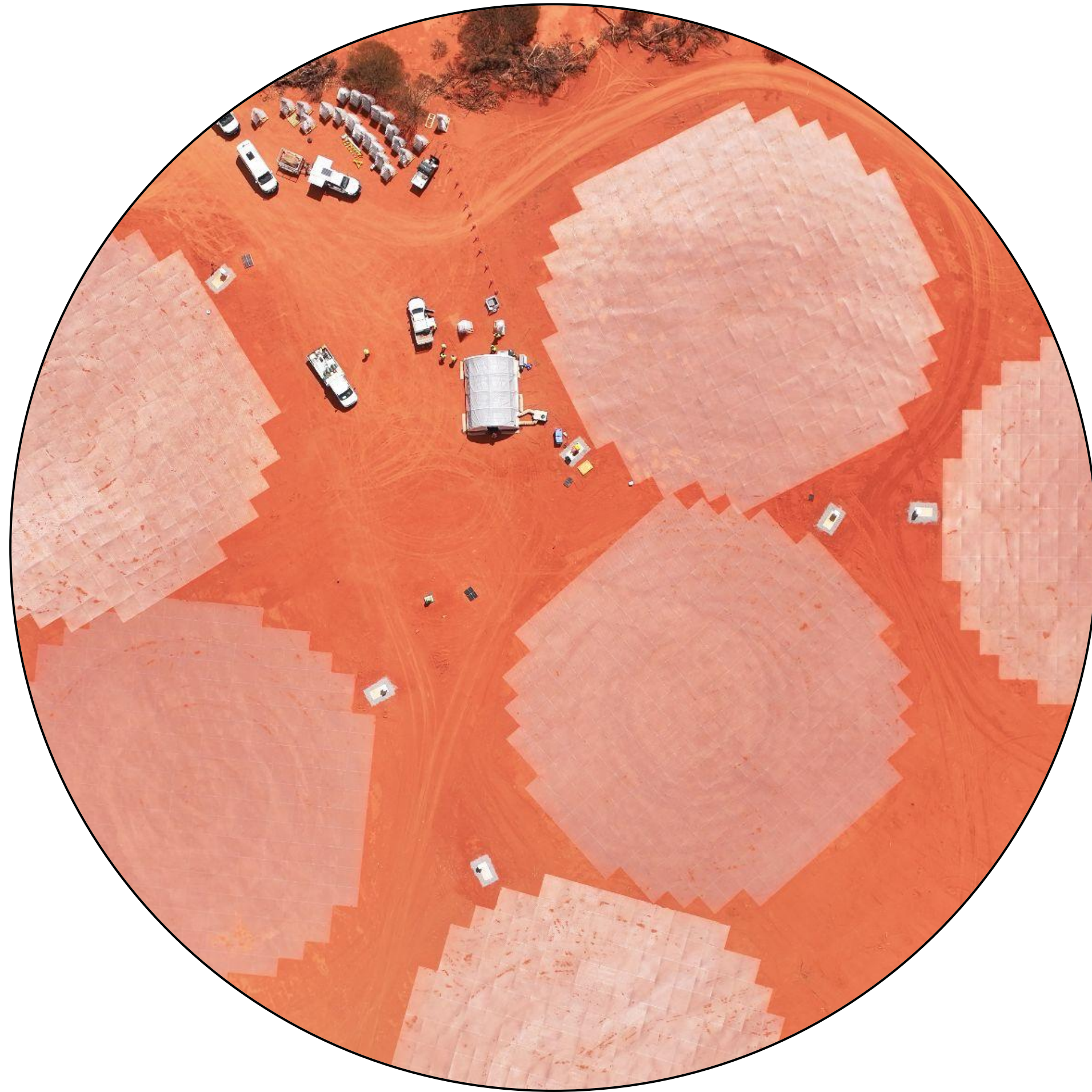
What further information might you need to better understand what subarray might fulfil your science needs?



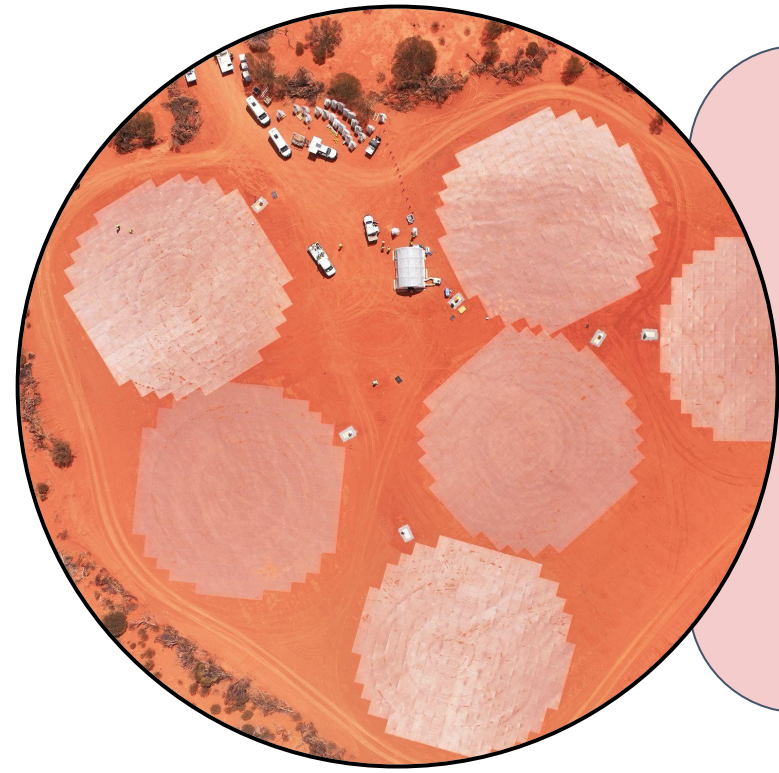
Timelines - when will you see data?



Construction is happening now!



On the road to science - major SKAO milestones

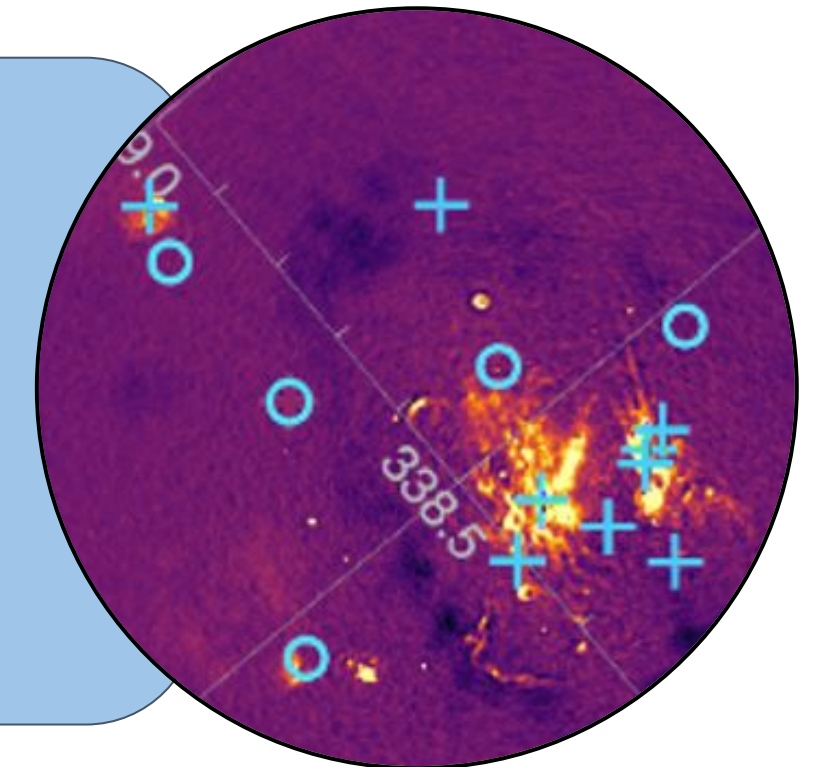


Commissioning

- Follows Assembly, Integration and Verification
- Includes commissioning (system verification end-to-end) and science commissioning (specification, execution and analysis of astronomical observations)
- SKAO activity; first members of the commissioning team in place at Low and Mid.

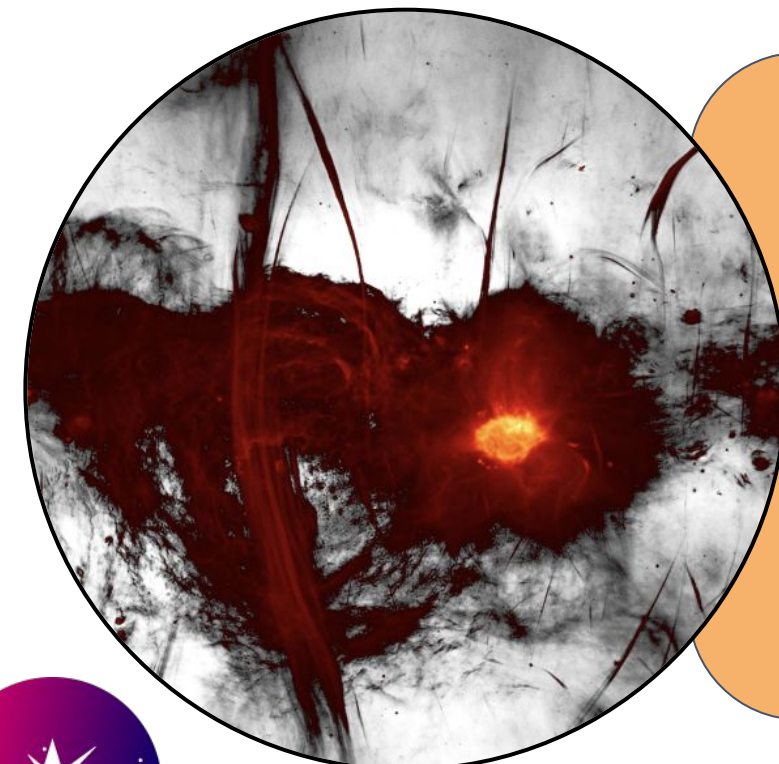
- Full dress rehearsal - does the end-to-end system meet the needs of the science and operational user?
- Community driven - you submit ideas for targets and the data will be made publicly available to the community for verification
- Mode availability follows science commissioning - once we think the telescope mode and pipelines are working we will invite you to scrutinise!

Science Verification



Cycle 0

- "Proper" shared-risk PI projects (i.e. no Key Science Projects)
- Mode availability follows successful Science Verification
- Teams, SRCNet delivery and resources for analysis, visualisation, and Advanced Data Product creation
- Data subject to proprietary periods
- modes offered based on successful SV



Commissioning Timeline to the SKA

Milestone event (earliest)		SKA-Mid (end date)	SKA-Low (end date)
AA0.5	4 dishes 4 stations	2025 Oct	2024 Dec
AA1	8 dishes 18 stations	2026 Jun	2025 Nov
AA2	64 dishes 64 stations	2027 May	2026 Oct
AA*	144 dishes 307 stations	2028 Mar	2028 Jan
Operations Readiness Review		2028 Jun	2028 Apr
Formal end of construction (including contingency)		2029 Mar	
AA4	197 dishes 512 stations	TBD	TBD

Construction happening now!



Science Verification

- Start towards the end of 2026
- Arrays are scientifically interesting (64 dishes/stations)

Science verification

Final step in the broader delivery of the system (Assembly, Integration, verification, commissioning, science commissioning, science verification \longleftrightarrow)

Full end-to-end test “dress rehearsal”, starting with a submitted idea, observation, data product creation, quality assurance and data delivery

- 1 Call(s) issued to the community for verification ideas to test specific modes and capabilities, supported by workshops
- 2 Short description of the idea submitted by astronomers
- 3 Light touch assessment; Does the idea provide the tests that we need? Do they use the correct modes? Good set? Appropriate comparison data? -> **Pool of prioritised ideas**
- 4 Observed, data products (e.g. image cubes) created using the Science Data Processor (SDP), including a QA assessment
- 5 Data products **delivered publicly** via the SRCNet following an announcement. Some SRCNet resources may be made available for analysis
- 6 Report generated to assess the status of the associated observing mode, supported by community assessment.



Expected mode availability for early SV - AA2

AA2 mode prioritisation:

1. Continuum
2. Pulsar timing (PST)
3. Pulsar and transient search

Zoom (maybe), VLBI (maybe-ish)
Transient buffer (unlikely)

Continuum: 16k channels, 800 MHz (4 x 200 MHz) BW

PST: ≥ 6 beams (steerable) with de-dispersion, 800 MHz BW

PSS: ≥ 16 beams (steerable), Not fully pipelined, non real-time operation, full BW



AA2 mode prioritisation:

1. Continuum
2. Pulsar timing (PST)
3. Zoom
4. Pulsar and transient search

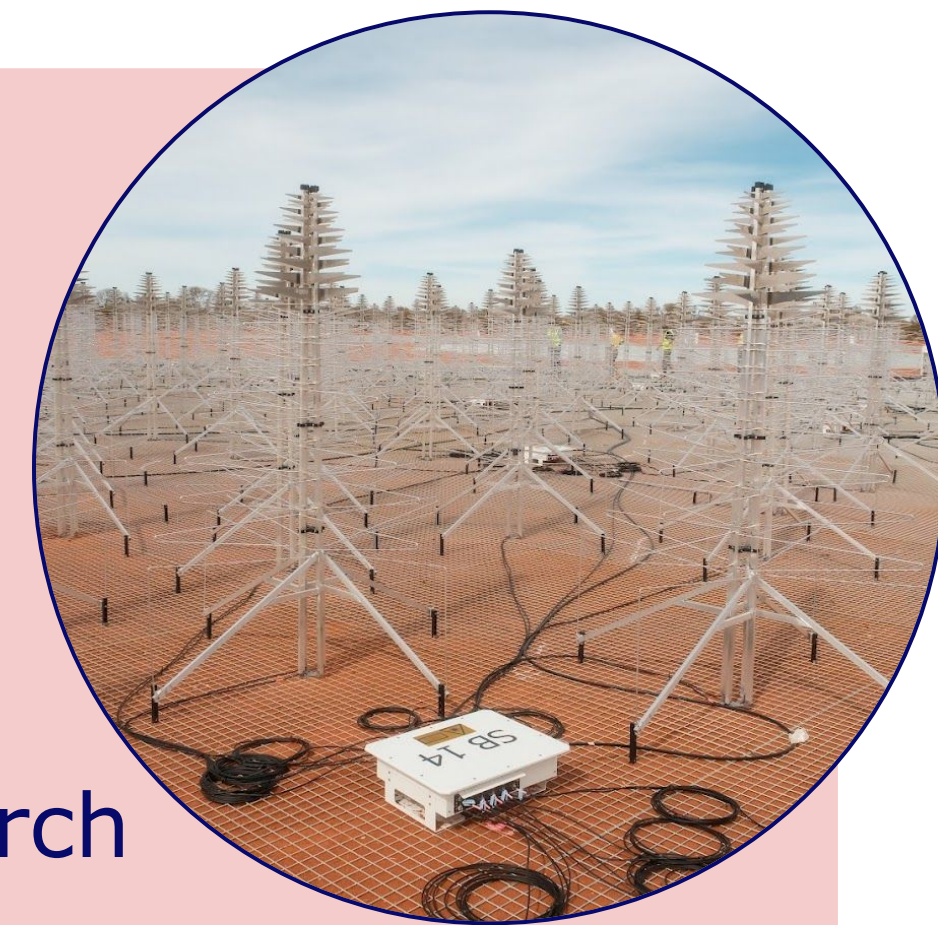
Transient buffer (unlikely), VLBI (unlikely)

Continuum: 27k channels, 150 MHz BW

Zoom: Up to 16 zoom windows (lowest resolution: 3.12 MHz BW, 1808 Hz resolution, 1728 channels)

PST: ≥ 4 beams

PSS: ≥ 30 beams



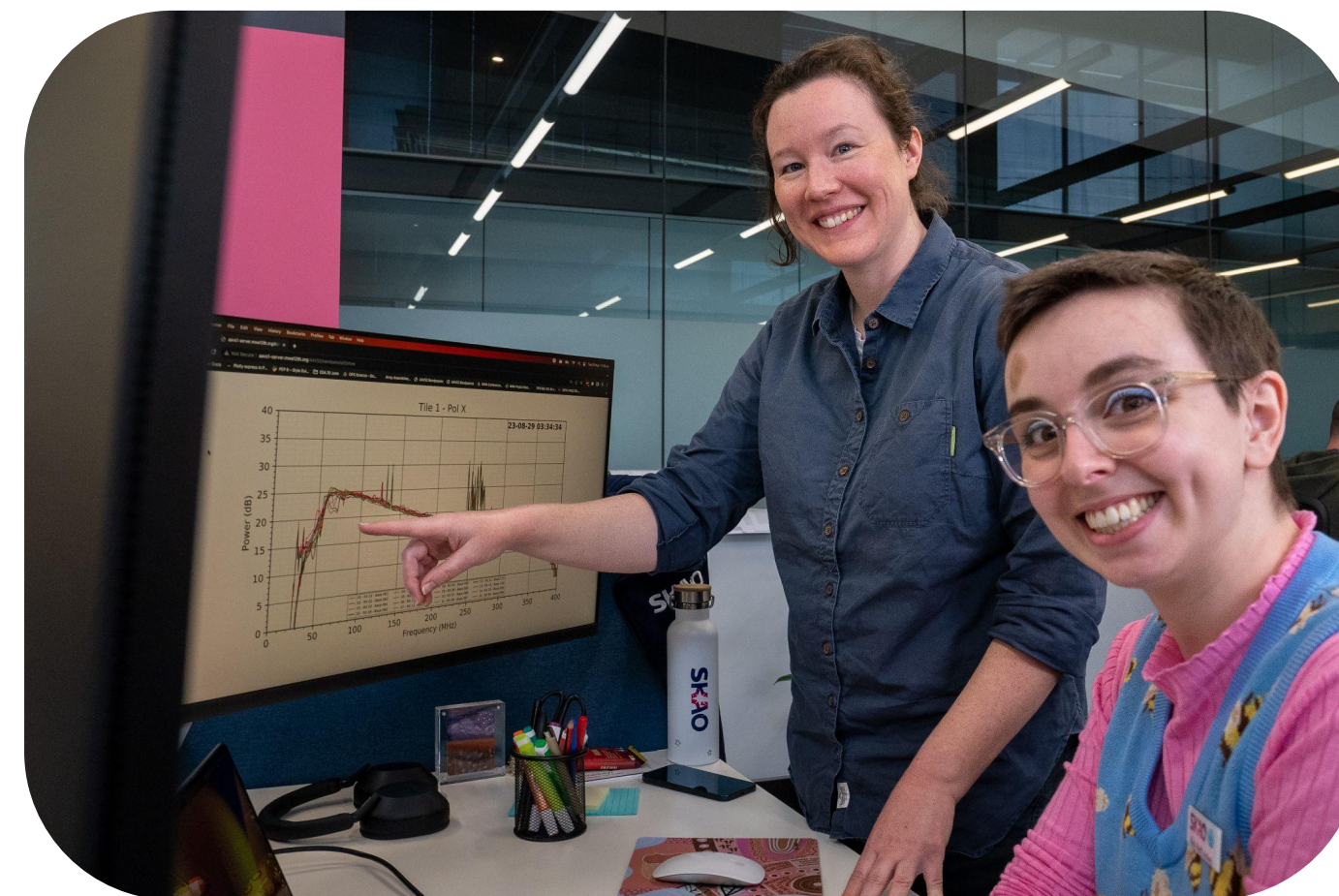
Modes only available for SV once successfully passed science commissioning - expecting continuum and PST to be the early focus (AA2), moving to other modes as we progress to AA



Preparing for Science Verification

- Building up complexity of modes/capabilities/data products as we progress from AA2 → AA*
- Expecting to deliver visibilities alongside continuum/spectral data products during SV
 - Verification of pipelines as much as the telescope
 - Important for building trust
- Verification periodically as modes/array mature/grow (even into Cycle 0)
- Released following announcements (observed in “trickle” + dedicated blocks)

- Supported by community workshops
 - Mode availability, tool usage, SKA Regional Centre Network availability and usage
- Intend to have a memo series, so that early career researchers, e.g., can receive technical credit, especially if a dataset doesn't result in publication



SKAO

Memo

Document Number SKAO-GOV-0000000
Classification: UNRESTRICTED
Document type: POL
Revision: 01
Date: 2021-05-20
Status: Released

Author	Name	Designation	Affiliation	Signature	Date
Author	Astronomer	Policy & P&I Coordinator	SKAO		



Preparing for Principal Investigator and Key Science Projects

- Full observing cycles
 - modes will be those that have successfully passed SV (i.e. unlikely to be the full mode capability)
 - Full proposals, data product delivery, proprietary periods, SRCNet resources

Cycle 0

- Shared-risk observing
- Won't have full mode capability available
- Duration ~9 months?

Cycle 1

- More likely to be the full mode capability
- Unlikely to include KSPs
- Duration 1 year (probably)

Cycle 2 - more standard (?)

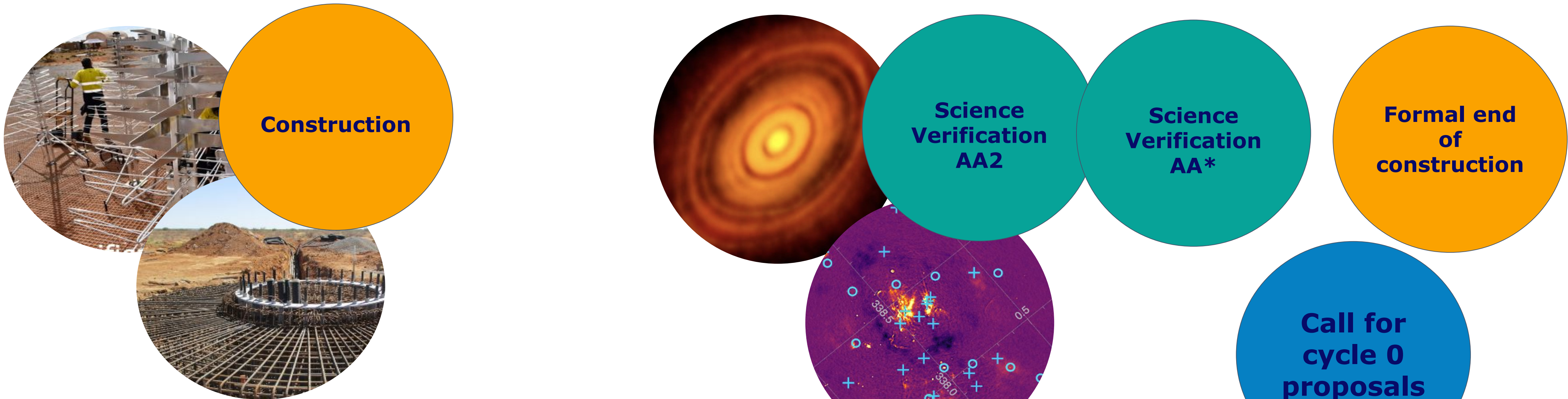
- likely to be full mode capabilities, data product and project type
- KSPs likely
- Duration 1 year

- Community training and workshops
 - Documentation, videos, drop in sessions, podcasts, community days all in the planning stages!
 - Proposal calls likely to be 4-6 months before deadlines
- 2027 - 2029 Key Science Project planning



The timeline





2024 2025 2026 2027 2028 2029

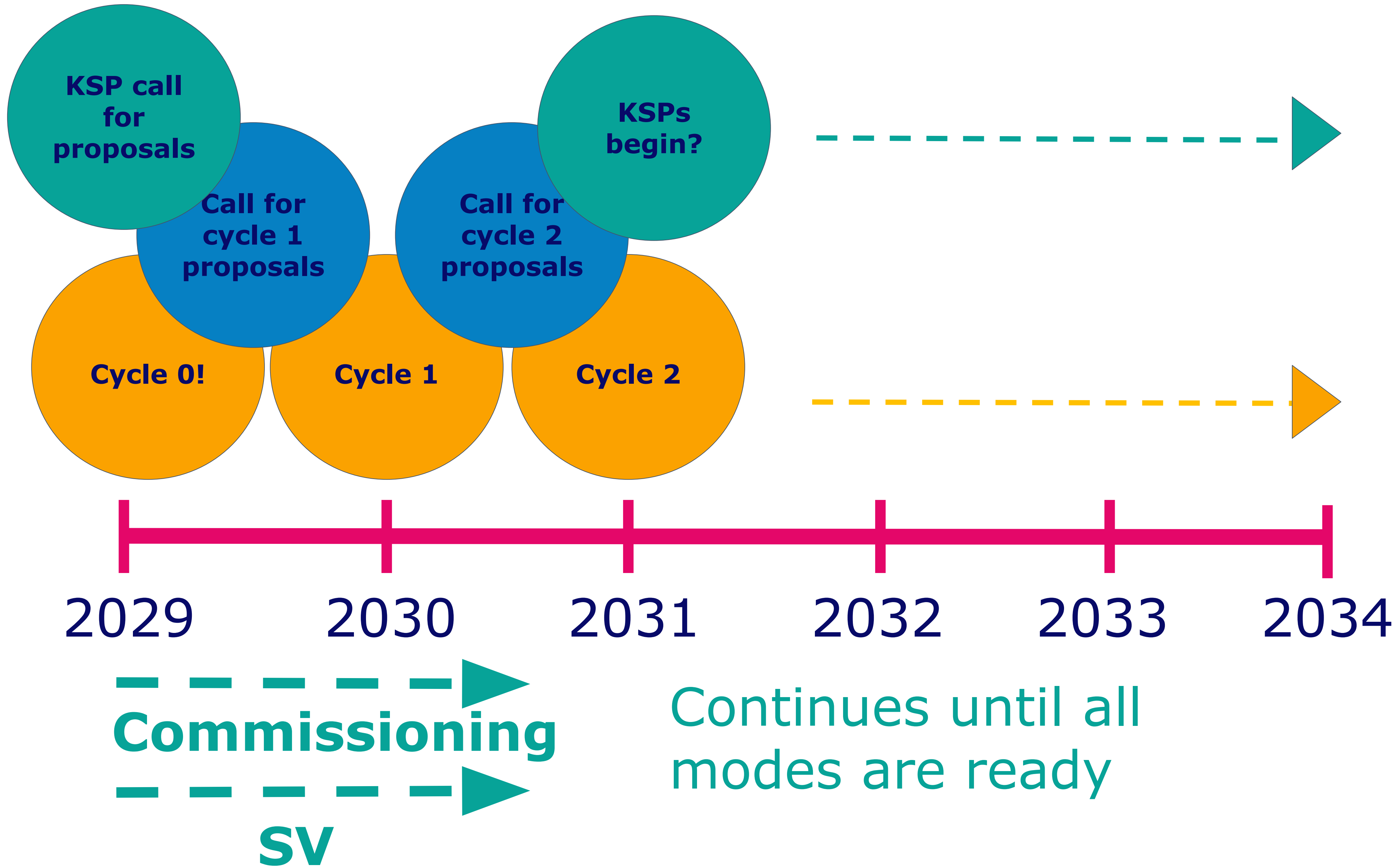


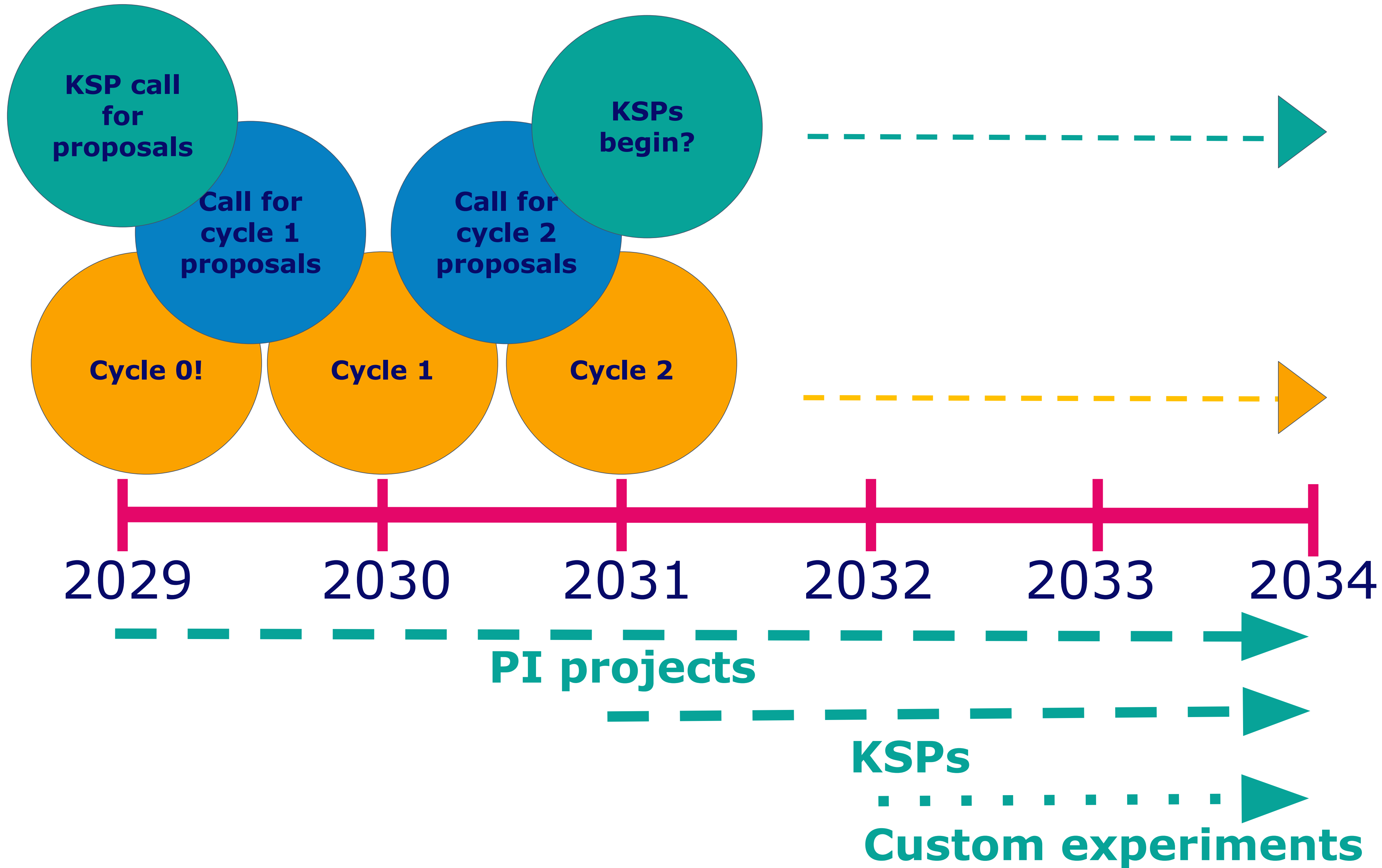
Commissioning



SV





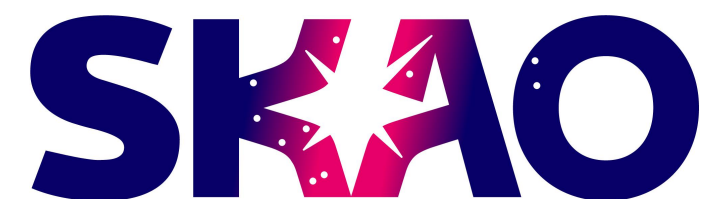


Roles within Science Operations

10 Operations Scientists

broadly responsible for astronomy support to operations → supporting the efficient delivery of the science program, facilitating interaction with the community, research

We aim to recruit a gender balanced Science Operations team, with an aim of ≥ 5 of the current round of SKAO recruitments to be women



Closing date 13th September
<https://recruitment.skao.int/vacancies.html>





- SKAO Construction activities are proceeding at pace - SKAO science is now clearly on the horizon!!!!
- Planning is progressing well - get involved, or get *really* involved and come and work for us!!
- If you want to know more, get in touch! <sciops@skao.int>



Thanks for listening!

Shari.Breen@skao.int

*We recognise and acknowledge the
Indigenous peoples and cultures that have
traditionally lived on the lands on which
our facilities are located.*

SKAO

www.skao.int