

Early SKA science and community involvement

Kristine Spekkens

Queen's / 🇨🇦 SKA Science Director



Image credit: SKAO

The telescopes being built:

Slide/image by SKAO



SKA-Low

257

Stations

Up to **48**
station beams

Up to **1440**
substations

74 km

Max Baseline

AA*

Up to **16** subarrays, **commensal** Observations
Two telescopes, frequency coverage of 50 MHz
and 15.4 GHz

Continuum

Spectral Line

Pulsar Timing

Pulsar Search

Transient Buffer

VLBI

Observing modes

SKA will be **highly flexible**, complicated and delivered on
an **enormous scale**. Plan to deliver **highly processed**
Observatory Data Products adds to this complexity → we
expect to build up to **the full set of capabilities** over
time

Delivery of capabilities



SKA-Mid

144

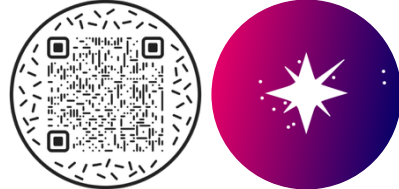
Dishes

36 km

Max Baseline

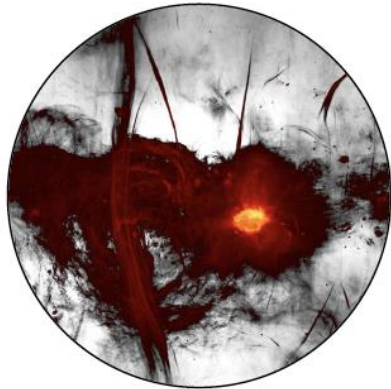
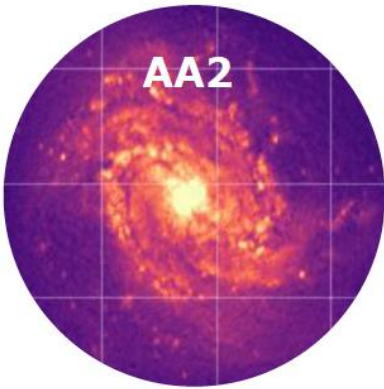
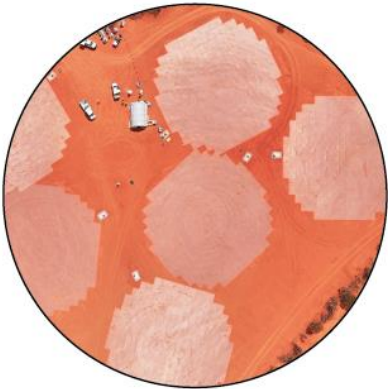
*108 km including SKA008

The SKA Timeline to Science



Community involvement

Full Science



Construction

Commissioning

Science Verification

Cycle 0



Now

Now

Mid-2027

First-half 2029

2030



Now

Now

First-half 2029

First-half 2031

2032

Credit: I. Heywood, SARAO

The SKA Timeline to Science



Community involvement

Full Science

What do the dates and stages mean?

How to get the first SKA data?

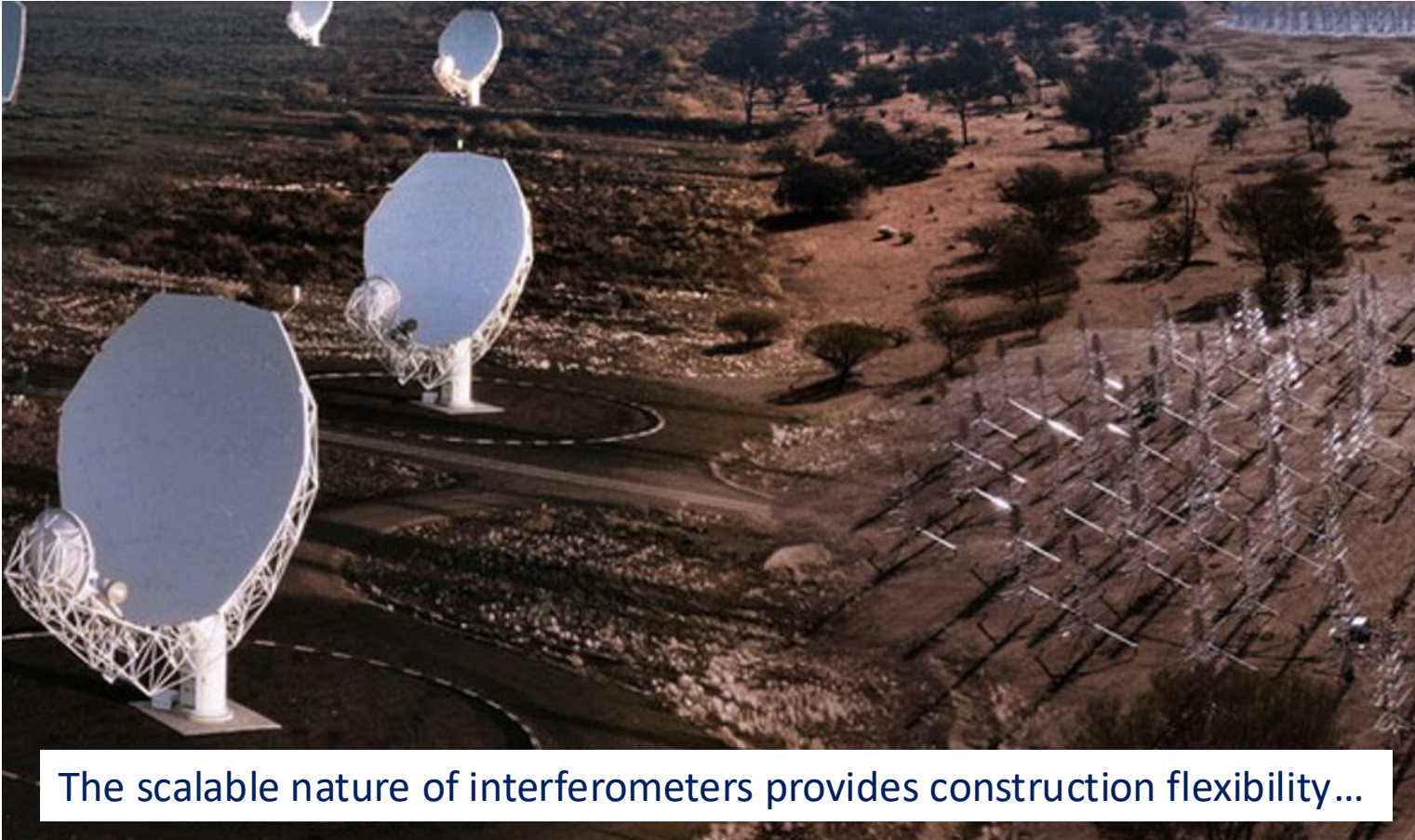
How to get the latest updates?

How to get involved?

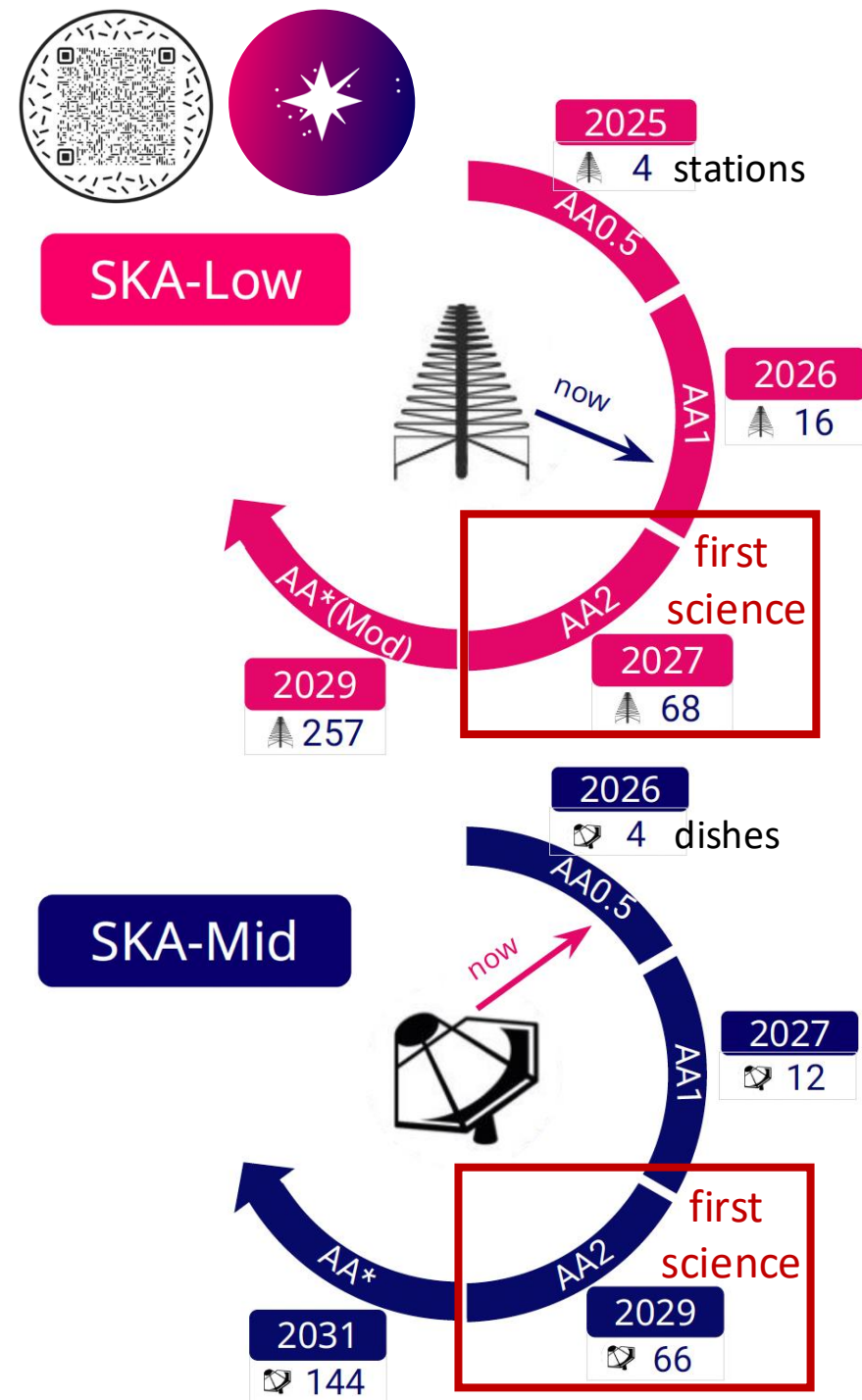


Credit: I. Heywood, SARAO

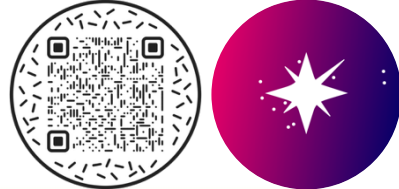
SKA science rollout: Array Assemblies



Construction/verification happens in stages called **Array Assemblies (AAs)**: parts of the telescope can be used for science while the rest is being built.

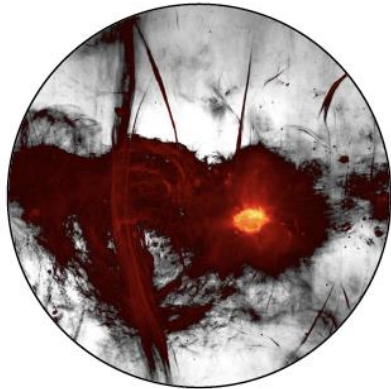
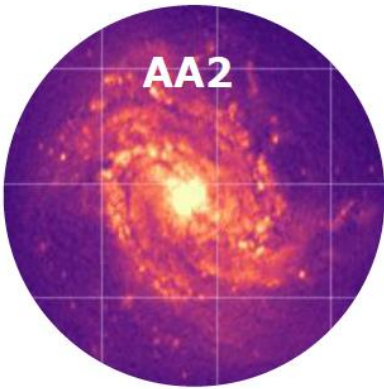
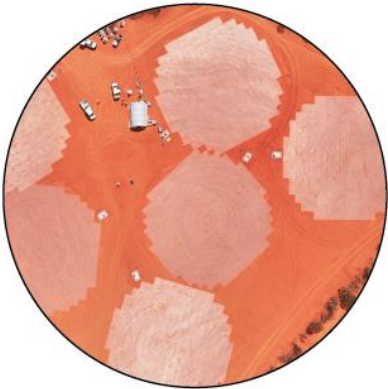


The SKA Timeline to Science



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Construction

Commissioning

Science Verification

Cycle 0



Now

Now

Mid-2027

First-half 2029

2030



Now

Now

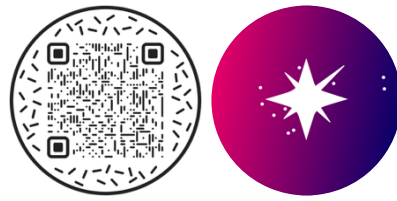
First-half 2029

First-half 2031

2032

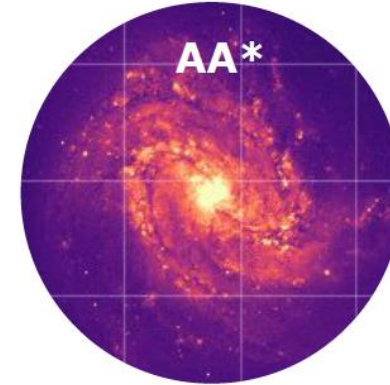
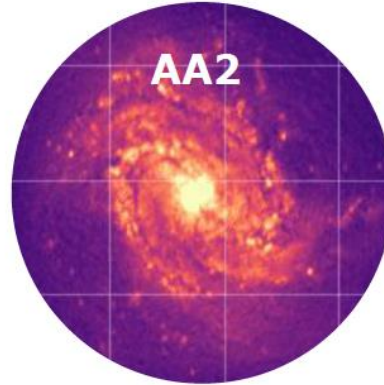
Credit: I. Heywood, SARAO

The SKA Timeline to Science



**Science
Verification
(SV) = first
release of
SKA data**

Community involvement



Science Verification

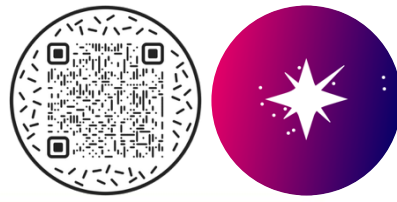
Mid-2027

First-half 2029

First-half 2029

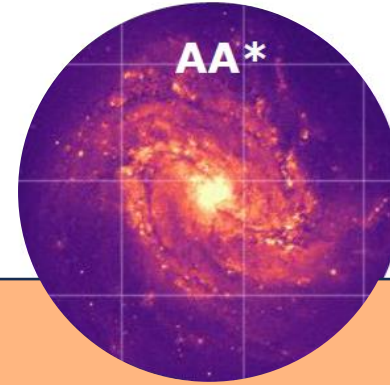
First-half 2031

The SKA Timeline to Science



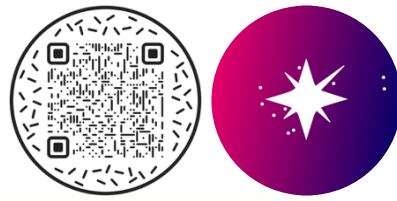
Science Verification

Community involvement



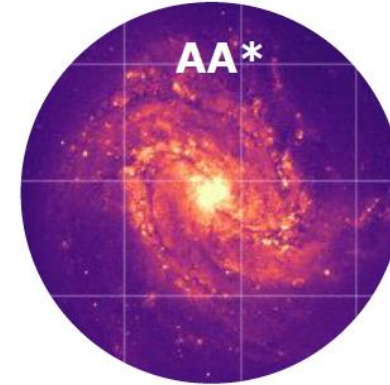
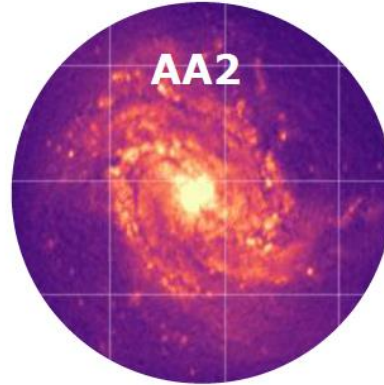
- Starts when Mid and Low are comparable to current state-of-the-art telescopes
- Primary purpose is to verify scientific capability, overall workflow and usability of the system → science is a bonus, not guaranteed.
- Provide an end-to-end test of the system for each mode/data product
- Get broad feedback on SKA data, SKAO operational model and SRCNet from a diverse user community → data will be publicly available for thorough scrutiny
- Science Verification data will not be owned by any person/group.

The SKA Timeline to Science



**Science
Verification
(SV) = first
release of
SKA data**

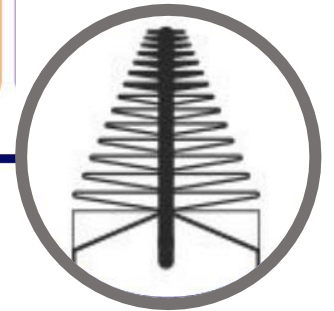
Community involvement



Science Verification

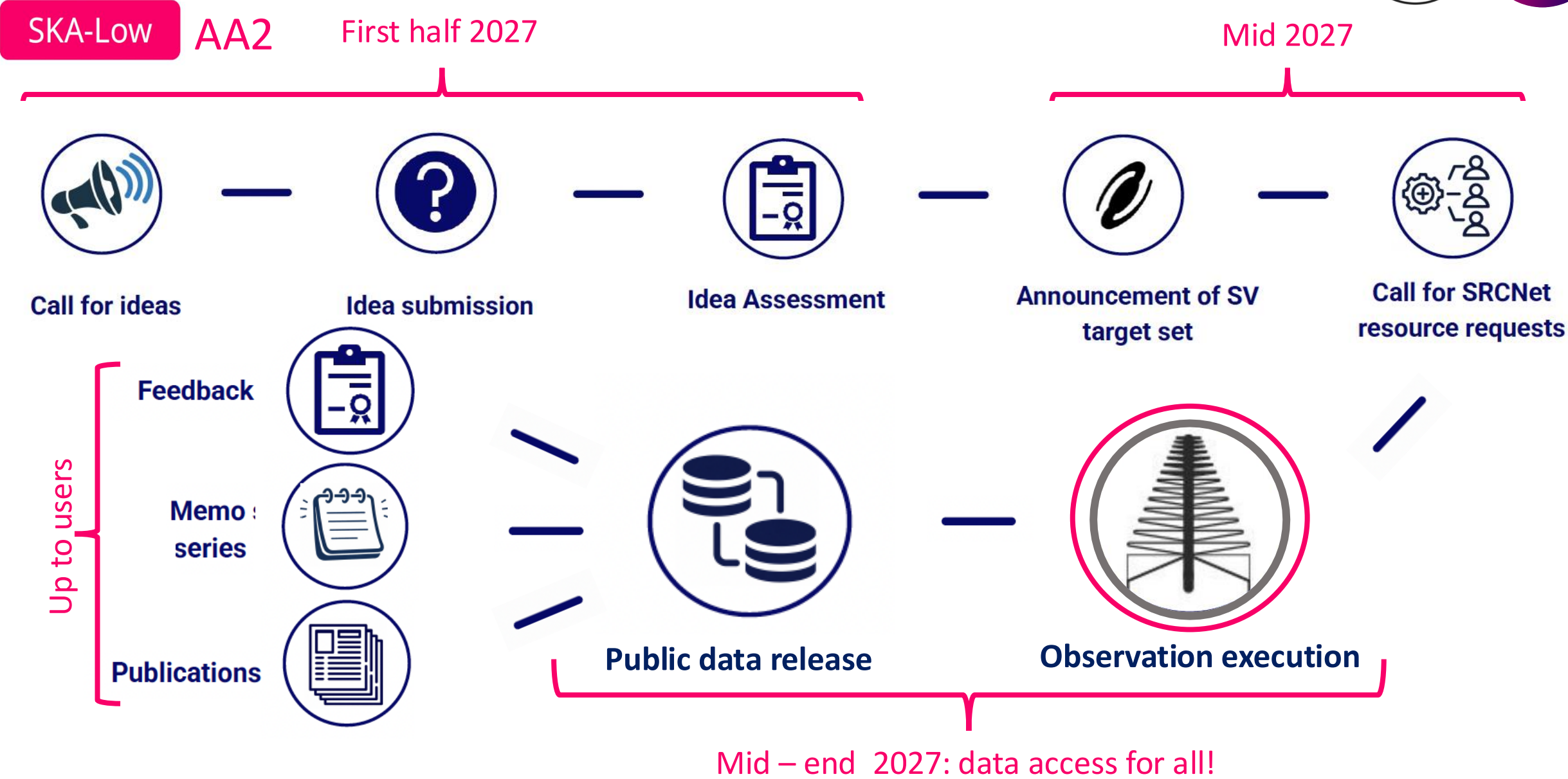
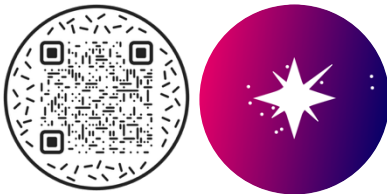
Mid-2027

First-half 2029



The first data will
come from SKA-Low.

Science Verification - How will it work?



SKA-Low AA2



1 subarray



1 pointing, **1** beam



Max **4 hrs**

Bandwidth



150 MHz

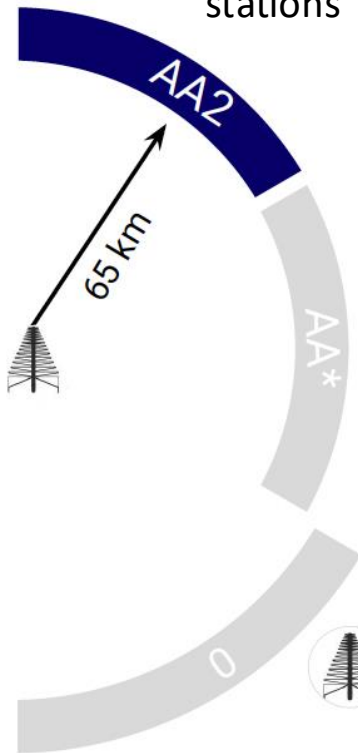
50%

2027 - 2029



68

stations



2029



257*

2030



Science Verification

Continuum

Up to **40** channels imaged

Expecting to exclude (all?)
Galactic observations at this
stage as we build the GSM

Spectral Line

Up to **4000** channels

Continuum subtraction
(early implementation)
Spectral resolution up to
226 Hz

PST (Pulsar timing)

At least **1** beam
Flow through + detected
filterbank



Both the telescope and
compute are schedulable.

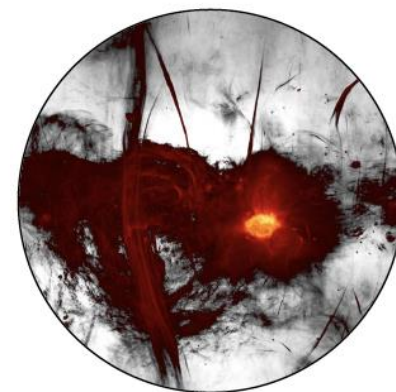


Full science operations

>2033 for Low

>2035 for Mid

Full Science



Credit: I. Heywood, SARAO

Cycle 0



2030



2032

Key Science Projects (KSPs)

- Truly transformational & exciting science
- Significant resources and observing time (>1 observing cycle)
- Leadership team restricted to people from member countries
- Co-Is from non-member countries are possible

Full science operations

>2033 for Low
>2035 for Mid

50-70%

Access to 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**

+ Proposal attributes

- 🕒 Long Term Projects
- 🎯 Target of Opportunity
- 👥 Joint SKA projects
- 🔗 Coordinated Projects

Principal Investigator (PI) Projects

- Observing projects that require less time and resources than a KSP
- Typically allocated over a single cycle

30-50%

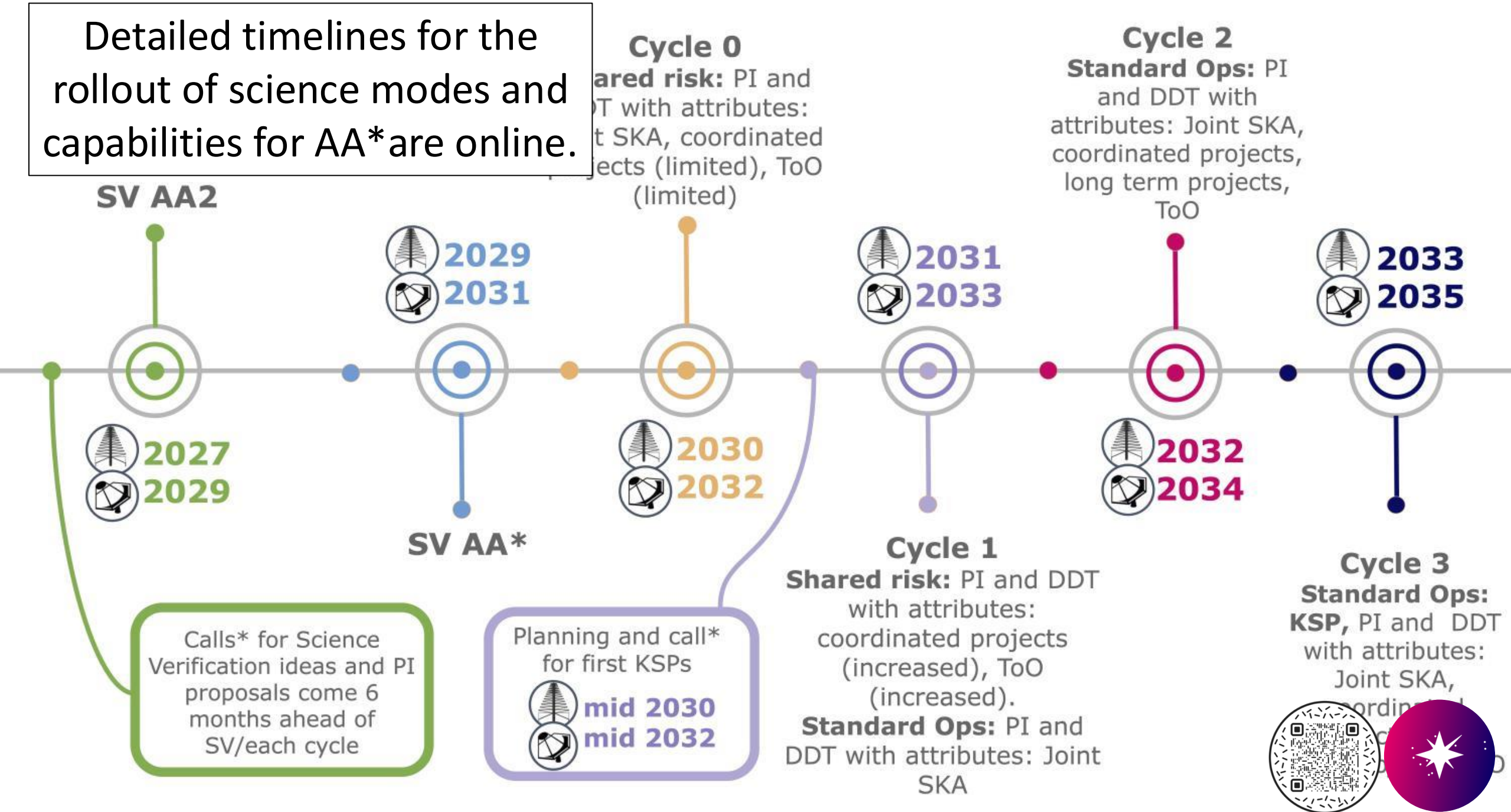
Director-General's Discretionary Time (DDT)

- Timely projects that could not have been submitted in a standard cycle

+ Archival projects that require compute resources



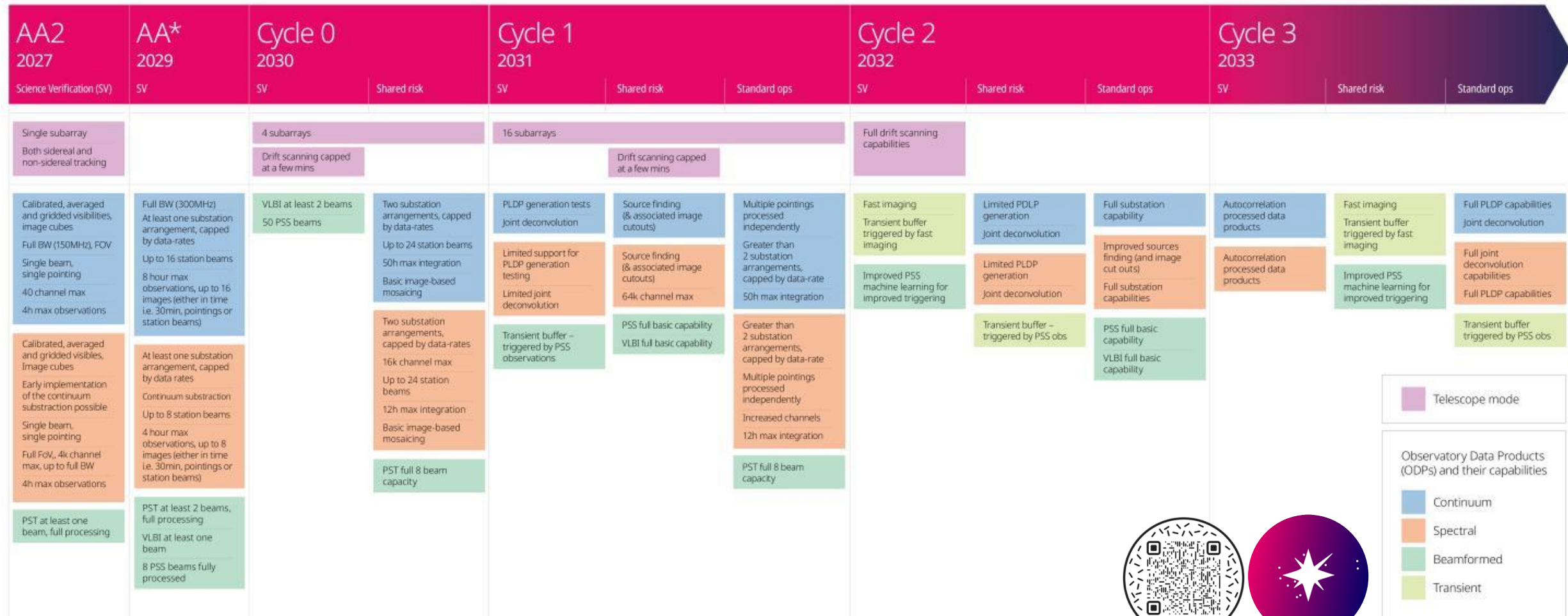
Detailed timelines for the rollout of science modes and capabilities for AA* are online.





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SKA-Low: Delivery of observing modes and data to the astronomy community





Detailed timelines for the rollout of science modes and capabilities for AA* are online.

SKA-Mid: Delivery of observing modes and data to the astronomy community

AA2 2029	AA* 2031	Cycle 0 2032		Cycle 1 2033			Cycle 2 2034			Cycle 3 2035		
Science Verification (SV)	SV	SV	Shared risk	SV	Shared risk	Standard ops	SV	Shared risk	Standard ops	SV	Shared risk	Standard ops
Single subarray Both sidereal and non-sidereal tracking		4 subarrays Drift scanning capped at a few mins		16 subarrays	Drift scanning capped at a few mins		Full drift scanning capabilities Wide area scanning					
Calibrated, averaged and gridded visibilities, image cubes (excluding SKA008) Full BW (800 MHz), FoV Single pointing 40 channel max 4h max observations	Full BW (up to 5 GHz) 8 hour max observations, up to 16 images (either in time i.e. 30min, or pointings) Zoom resolution (up to 0.21 kHz) Continuum subtraction 4 hour max observations, up to 8 images (either in time i.e. 30min, or pointings) PSS 200 beams fully processed VLBI 4 beams PST 8 beams, full processing	Limited support for PLDP generation tests Limited joint deconvolution Limited support for PLDP generation tests Limited joint deconvolution Transient buffer - triggered by PSS observations	Multiple pointings processed independently (i.e no joint deconvolution) Use of SKA008 possible for appropriate projects 50h max integration 16k channel max Multiple pointings processed independently (i.e no joint deconvolution) Use of SKA008 possible for appropriate projects 12h max integration PSS full basic capability VLBI full basic capability PST full 16 beam capability	Fast imaging Transient buffer triggered by fast imaging (limited by buffer latency, perhaps less than 10 seconds) Improved PSS machine learning for improved triggering	Source finding (& associated image cutouts) Limited PLDP generation Joint deconvolution Source finding (& associated image cutouts) 64k channel max Joint deconvolution Limited PLDP generation Transient buffer - triggered by PSS observations	Multiple pointings processed independently (i.e no joint deconvolution) Use of SKA008 possible for appropriate projects 50h max integration 16k channel max Multiple pointings processed independently Use of SKA008 possible for appropriate projects 12h max integration PSS full basic capability VLBI full basic capability PST full 16 beam capability	Autocorrelation processed data products Autocorrelation processed data products	Fast imaging Transient buffer triggered by fast imaging (limited by buffer latency, perhaps less than 10 seconds) Improved PSS machine learning for improved triggering	Improved source finding (& associated image cutouts) Full PLDP generation Joint deconvolution Improved source finding (& associated image cutouts) 64k channel max Joint deconvolution Full PLDP generation Transient buffer triggered by PSS observations	Autocorrelation processed data products Autocorrelation processed data products	Improved PSS machine learning for improved triggering Fast imaging Transient buffer triggered by fast imaging (limited by buffer latency, perhaps less than 10 seconds)	
Raw, calibrated, averaged and gridded visibilities, image cubes (excluding SKA008) Single pointing Full FoV, 4k channel max output, up to full BW Early continuum subtraction implementation 4h max observations												
PST at least one beam, full processing 8 PSS beams, fully processed 1 VLBI beam												

Telescope mode

Observatory Data Products (ODPs) and their capabilities

Continuum

Spectral

Beamformed

Transient





Explore

Opportunities

Resources

Partners

News & Events

Science Users



SKAO Science Users

These webpages are intended for the use of professional astronomers. The main information can be accessed through the various cards below.



Lots of information available on the SKAO Science Users site.

Science
Community

Advancing
Astrophysics

SKA
Telescope

Timeline
to



Explore

Opportunities

Resources

Partners

News & Events

Science Users



SKAO Science Users

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Newsletters
&
Webinars

Advancing
Astrophysics
II

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Specifications

Timeline
to
Science

Science
Working
Groups

Science
Meetings

SKA Tools

Data
Challenges

Relevant
Documents

SKA
Regional
Centres

SKAO
Science
Contacts

Science
User
Q&As

SKA
Simulated
Data
Products

Community
updates
and
feedback

A Year in
the Life
of the
SKA

SKAO
Science
Data
Products

- SKA data are coming soon! Anyone can access the very first SKA data (ie. Science Verification from “AA2”) as soon as they are released!
- Science Verification (“SV”) will involve both observatory-curated data and community-requested data: the first call for ideas for SKA-Low AA2 SV is expected in early 2027. SKA-Mid AA2 SV is anticipated in 2029.
- In Science Verification, both advanced data products and the datasets that produced them will be publicly available. There are many tools on the SKAO website to help the community prepare.
- Plans for the rollout of modes and capabilities through SKA Early Science are available on the SKAO Science Users pages. Information about how to engage in large Key Science Projects (“KSPs”; >2033) should be shared by SKAO near the end of this year.

Ways to get involved:

1

Sign up for SKAO
webinars and
newsletters!



SKAO webinars page

2

Join an SKAO Science
Working Group!



SKAO SWG page

3

Follow Canadian
community
activities!



CASCA ACACS page

Next up:
CASCA@
Montreal!