



SKA SWG Update

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Head of Scientific Services

21 April 2026



SKA Science Update

- Outcome of surveys on the next science meetings (Tyler)
- SKA-Low station beam response simulator (Sarrvesh)
- SKA-Low AA*(Mod) configuration (Maciej)
- Q&A on Science Verification (Shari)



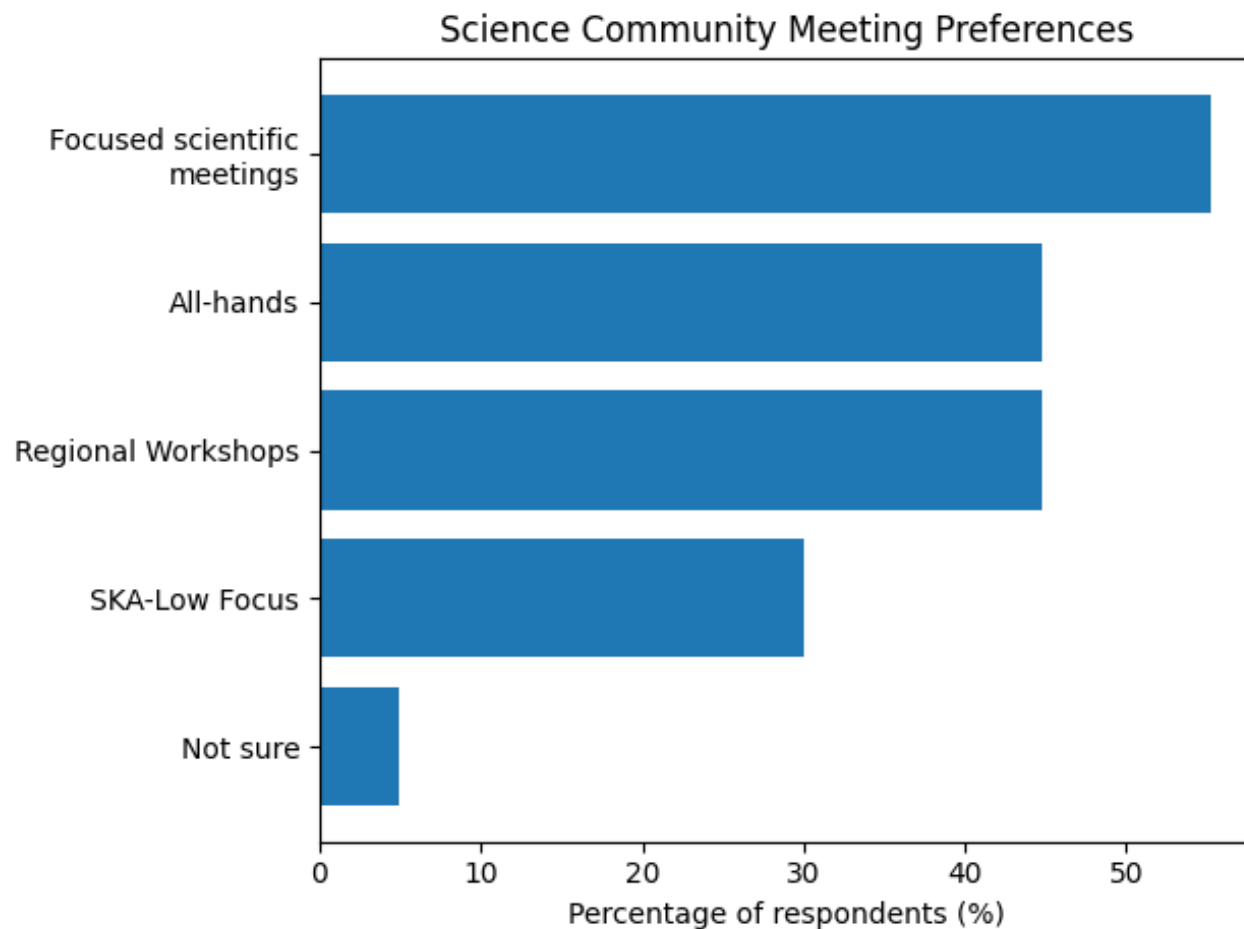
The next SKAO Science Meeting(s) - your input

Community poll on the format of future SKAO "science" meetings. Options:

1. **[All-hands]** An "all-hands" SKA science meeting covering all science topics and operational planning for both telescopes, with SKAO updates, similar to Gorlitz (early/mid 2028)
2. **[Focused]** A series of smaller meetings focused specific science areas starting from 2027
3. **[SKA-Low]** A meeting one year focused on SKA-Low and its science and one the next year focused on SKA-Mid and its science
4. **[Workshops]** A series of national/regional workshops on Science Verification and KSP planning
5. Not sure



The next SKAO Science Meeting(s) - your input



The next SKAO Science Meeting(s) - your input

Results:

1. **[Focused > 50%]** A series of smaller meetings focused specific science areas starting from 2027
2. **[All-hands ~ 45%]** An "all-hands" SKA science meeting covering all science topics and operational planning for both telescopes, with SKAO updates, similar to Gorlitz (early/mid 2028)
3. **[Workshops~ 45%]** A series of national/regional workshops on Science Verification and KSP planning

DISCUSS



The SKAO logo is rendered in a bold, white, sans-serif font. The letter 'A' is stylized with a starburst pattern inside it. The background of the entire slide is a composite image showing a night sky with the Milky Way galaxy, a modern building with a curved roof, and several radio telescope dishes in a desert landscape.

SKAO

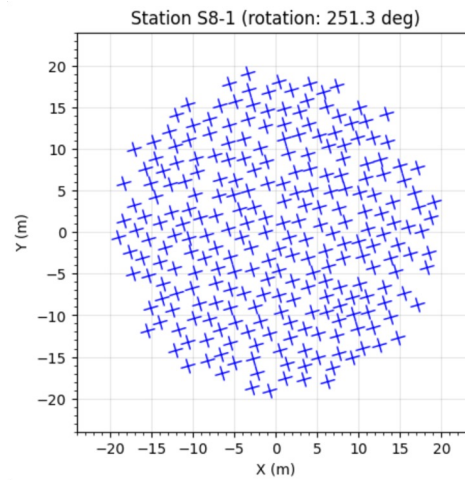
SKA-Low station beam response simulator

Sarrvesh Sridhar & Maciej Serylak

SKA SWG chairs meeting (21/04/2026)

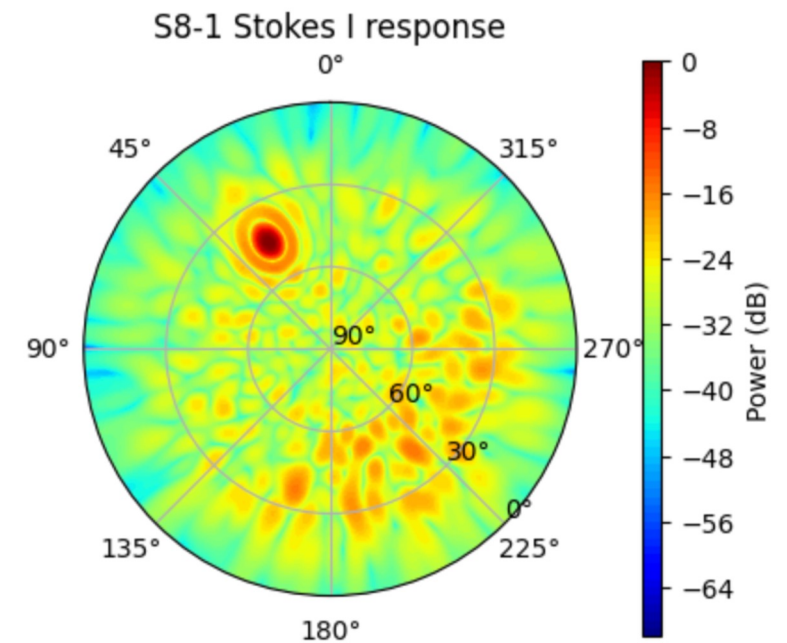
Aim

- Simulate SKA-Low station beam response given a (sub)station layout, station beam pointing direction, and frequency.
- Simulation tool will be useful to inform various operational aspects:
 - Substation templates
 - Beam apodisation schemes



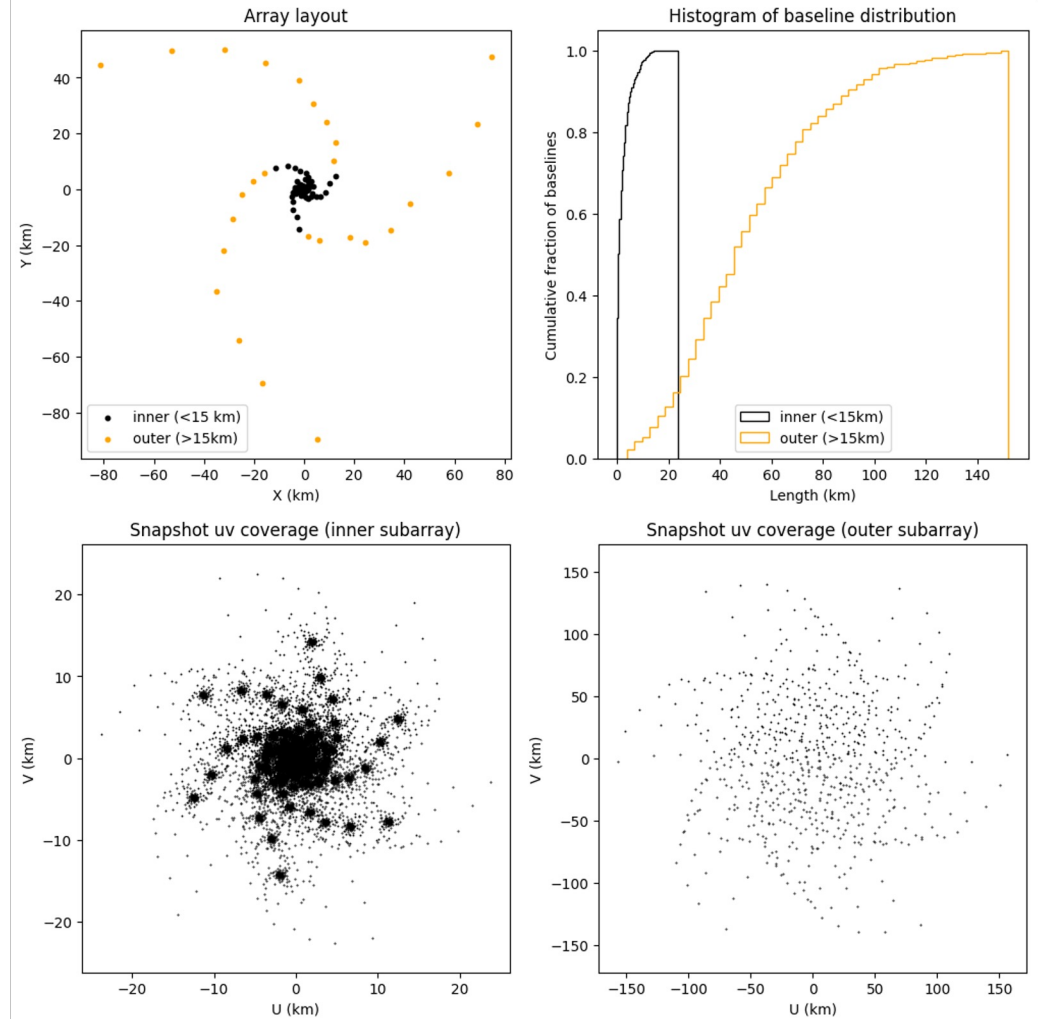
Pointing direction

Observing frequency



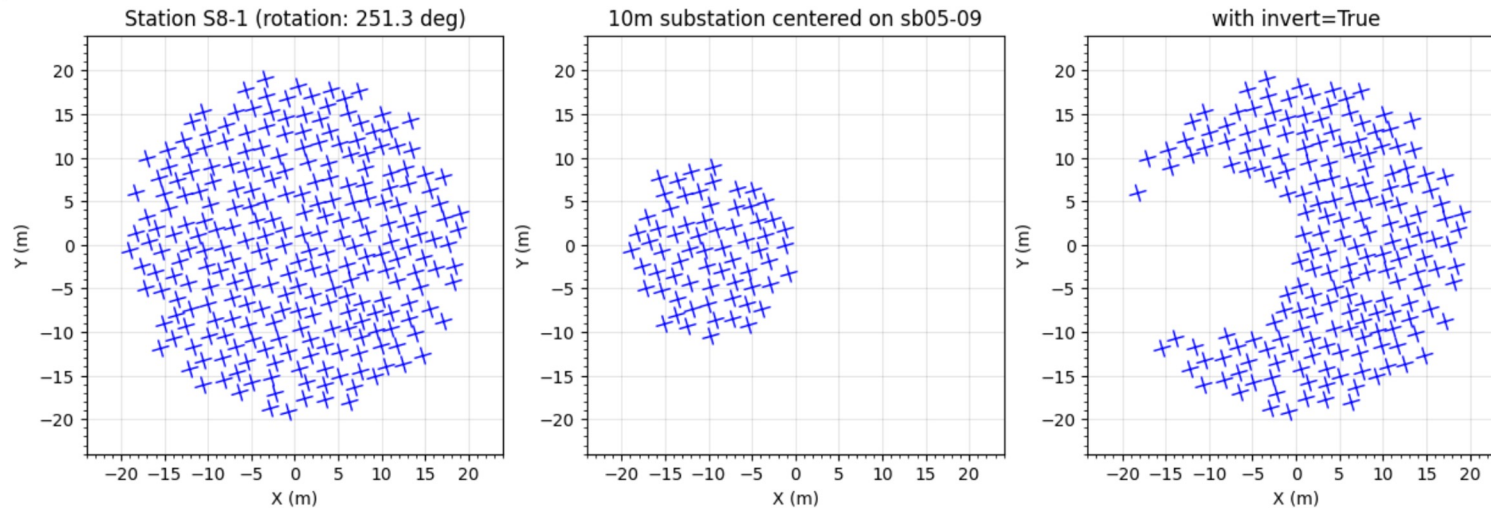
ska_ost_array_config

- 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



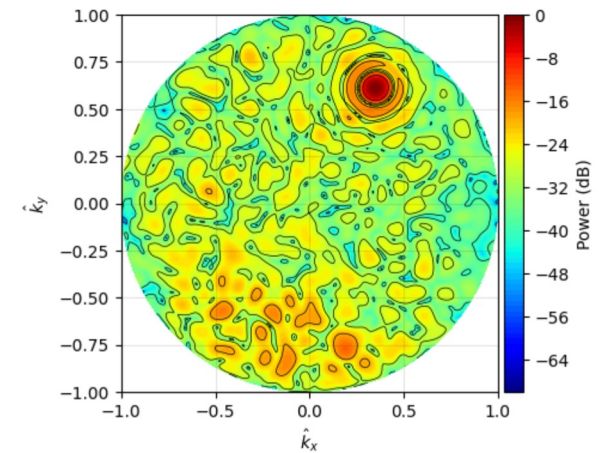
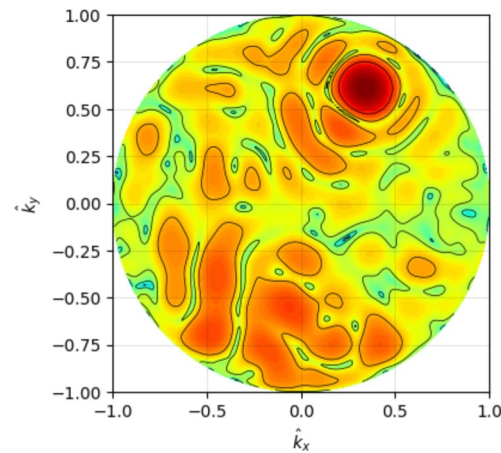
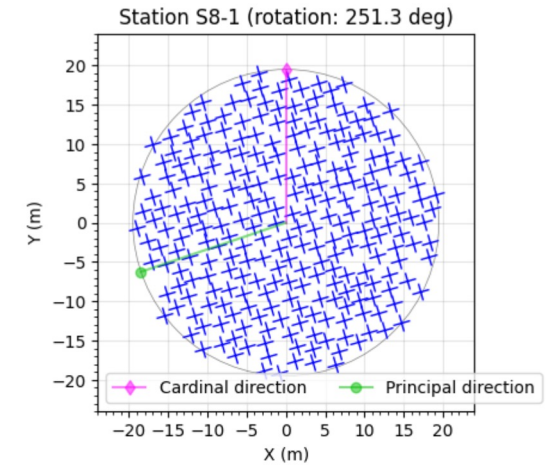
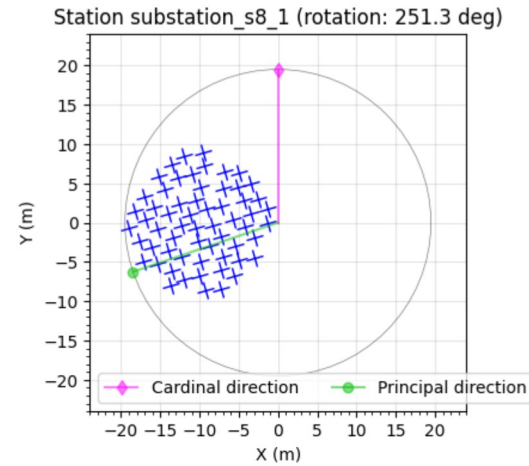
ska_ost_array_config: a new LowStation class

- SKAO repository: [ska_ost_array_config](#)
 - Detailed documentation in a [Jupyter notebook](#)
- As of version 4.2, a new **LowStation** class provides a programmatic interface to the Low antennas
 - Detailed documentation in the [LowStation Jupyter notebook](#)
- Current version includes “as-built coordinates” of all antennas in AA1 stations.
 - More stations will be added as their “as-built” coordinates become available.



ska_ost_sim_low_station_beam - the SKA-Low station beam response simulator

- Repository: [ska_ost_sim_low_station_beam](#)
 - Detailed documentation: [Jupyter notebook](#)
- Currently, station beam response can be estimated at specific frequencies (100, 200, and 300 MHz)
 - Straightforward to extend to other frequencies
 - Want to first implement the main functionalities before extending the frequency choice.
- Beam response can be estimated in either HH, HV, VH, VV or I, Q, U, V.

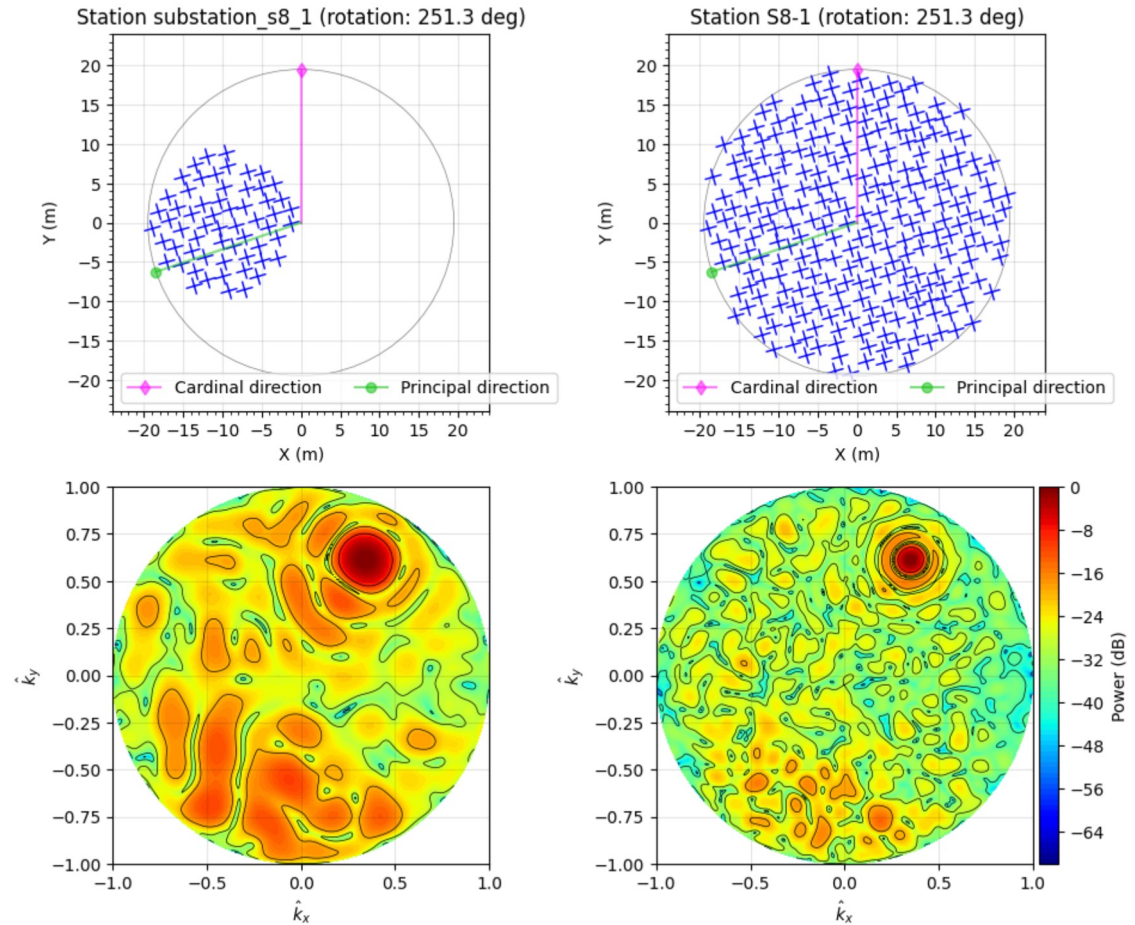


ska_ost_sim_low_station_beam - the SKA-Low station beam response simulator

```
# Define a LowStation
station = LowStation("S8-1")

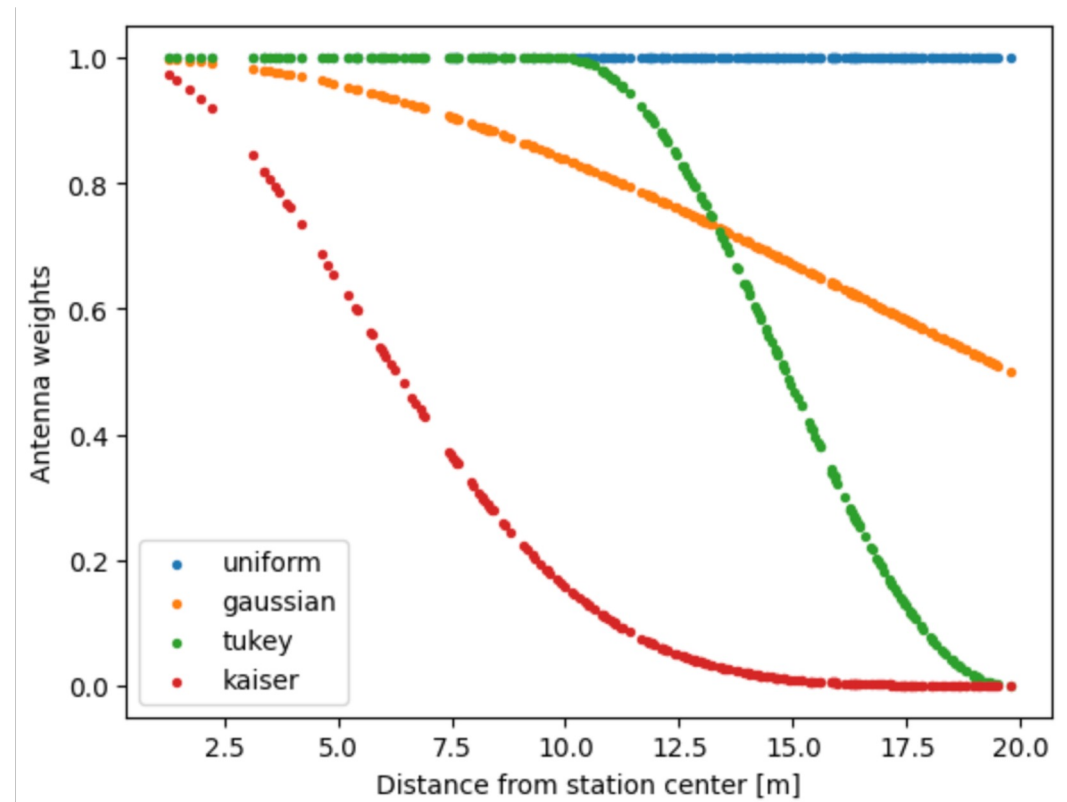
# Generate the beam response
beam_response = generate_low_station_beam(
    station=station,
    frequency=100*u.MHz,
    pointing_direction=(30,45),
)

# Plot the beam response
fig, axes = plt.subplots(1, 2, figsize=(11, 4))
beam_response.plot_beam_response(
    pol="HH",
    axes=axes[1]
)
```



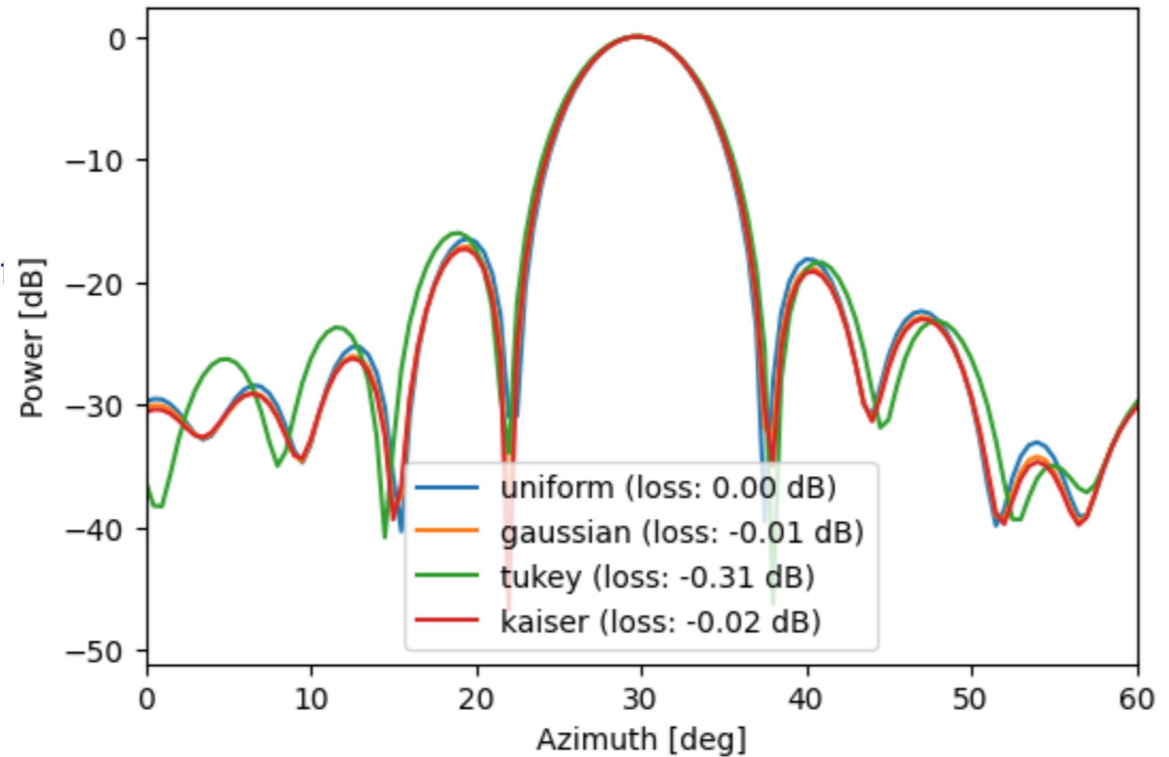
Beam apodisation

- Apply complex multiplicative weights to each antenna before station beamforming
- Trade-off sensitivity vs sidelobe levels
- `ska_ost_sim_low_station_beam` currently supports four one-sided radial weighting functions:
 - Uniform
 - Gaussian
 - Tukey
 - Kaiser-Bessel
 - Custom (pass a weighting function)
- Shape of the weighting functions can be modified using a `scale_factor`.
- The weighting function returns **tapering loss** associated with each weightin scheme



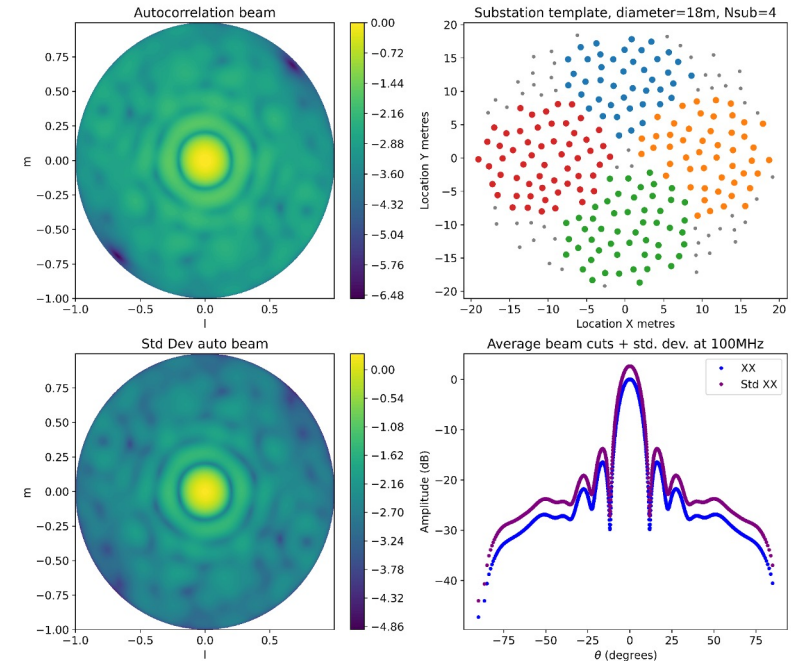
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Defining substation templates for the community

- Working on a version 2 of the "SKA-Low substation templates" document by Cath Trott ([SKAO-TEL-0002390](https://www.skao.org/portal/portal/0002390))
 - In SKAO-TEL-0002390, station beams were calculated using Average Element Patterns (AEPs) - recalculate station beams using individual EEPs
 - The document presents 4 example substation configurations (4, 9, 16 and 38 substations/station), all with uniform weighting
- In the subarray templates document ([SKAO-TEL-0002380](https://www.skao.org/portal/portal/0002380)), only one Low subarray template (Low_inner_r350m) makes use of substations



Low_Substation_18m template
(4 substations/station) from
SKAO-TEL-0002390



Web application - <https://ska-low-station-beam-simulator.skao.int/>

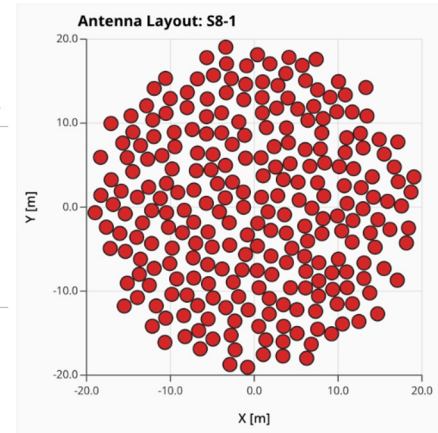
SKAO SKA-Low station beam response viewer

Welcome to the SKA-Low station beam response viewer. This tool allows you to visualize the beam response of an SKA-Low station for a given frequency, pointing direction, and polarization. You can generate station beam response for both full station and substation modes. Use the plot on the right and/or the antenna list input field to define the substation layout. Please send feedback to sciops@skao.int.

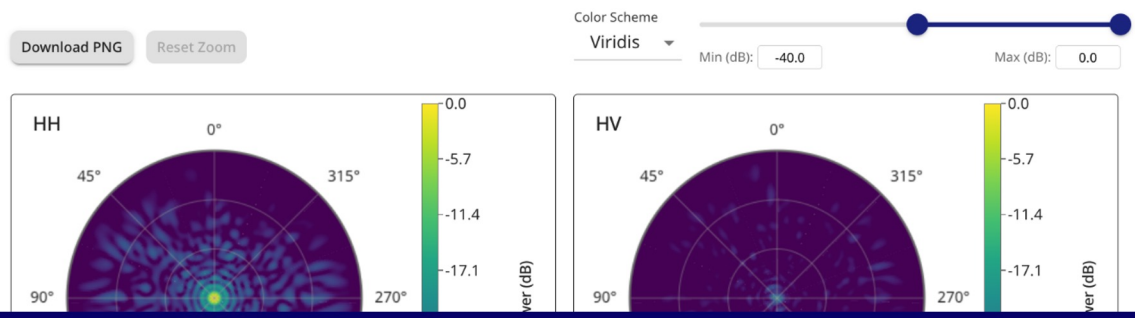
Station: S8-1 | Pointing direction: (0, 90) | Observing frequency (MHz): 100 | Polarizations: HH,HV,VH,VV

Antenna list: sb01-01, sb01-02, sb01-03, sb01-04, sb01-05, sb01-06, sb01-07, sb01-08, sb01-09, sb01-10, sb02-01, sb02-02, sb02-03, sb02-04, sb02-05, sb02-06, sb02-07, sb02-08, sb02-09, sb02-10, sb02-11, sb03-01, sb03-02, sb03-03, sb03-04, sb03-05, sb03-06, sb03-07, sb03-08, sb03-09, sb03-10, sb03-11, sb04-01, sb04-02, sb04-03, sb04-04, sb04-05, sb04-06, sb04-07, sb04-08, sb04-09, sb04-10, sb04-11, sb05-01, sb05-02, sb05-03, sb05-04, sb05-05, sb05-06, sb05-

Select all antennas | Invert selection | Drag mode: Lasso | Clear selection | Undo selection



Generate beam response



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SKAO

SKA-Low AA*(Mod) configuration

Maciej Serylak (on behalf of the PSRR Science Tiger Team)

SKA SWG chairs meeting (21/04/2026)

Deferred capabilities

To help resolve the budget, we will defer until post-2030 the delivery of 4 capabilities:

- 1) 50 stations in the core of SKA-Low. The initial delivery will now be 257 stations, of which 149 are in the core.
- 2) PSS on SKA-Mid will be limited to 200 beams until *at least* Cycle 0 as advertised
- 3) PSS on SKA-Low will be limited to 50 beams in the first observing cycles
- 4) The SKA-Low CBF will match AA* (it was previously over-scoped to match AA4)

It is our clear intent to reinstate the capabilities as soon as financially viable starting from 2031, or sooner, to minimise the impact on science.



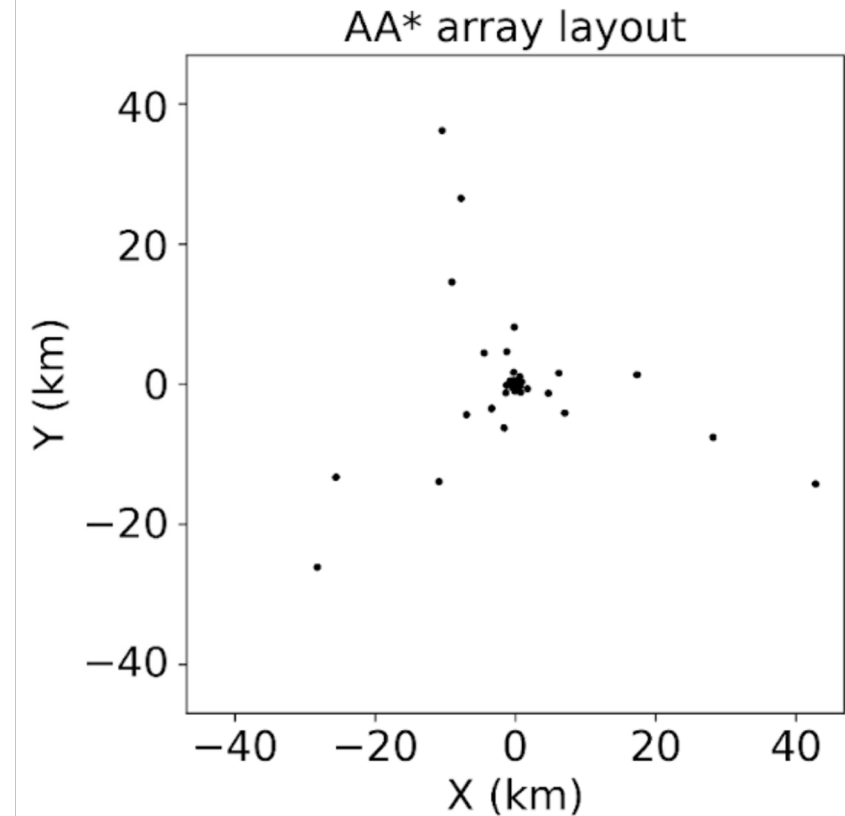
Which 50 SKA-Low stations to defer?

- A Program Schedule Risk Review (PSRR) Science Tiger Team was set up in Nov 2025.
- Interface with the community and identify which 50 core stations can be deferred.
- Minimise science impact.
- Identify a solution that minimises the Construction and Operational cost.



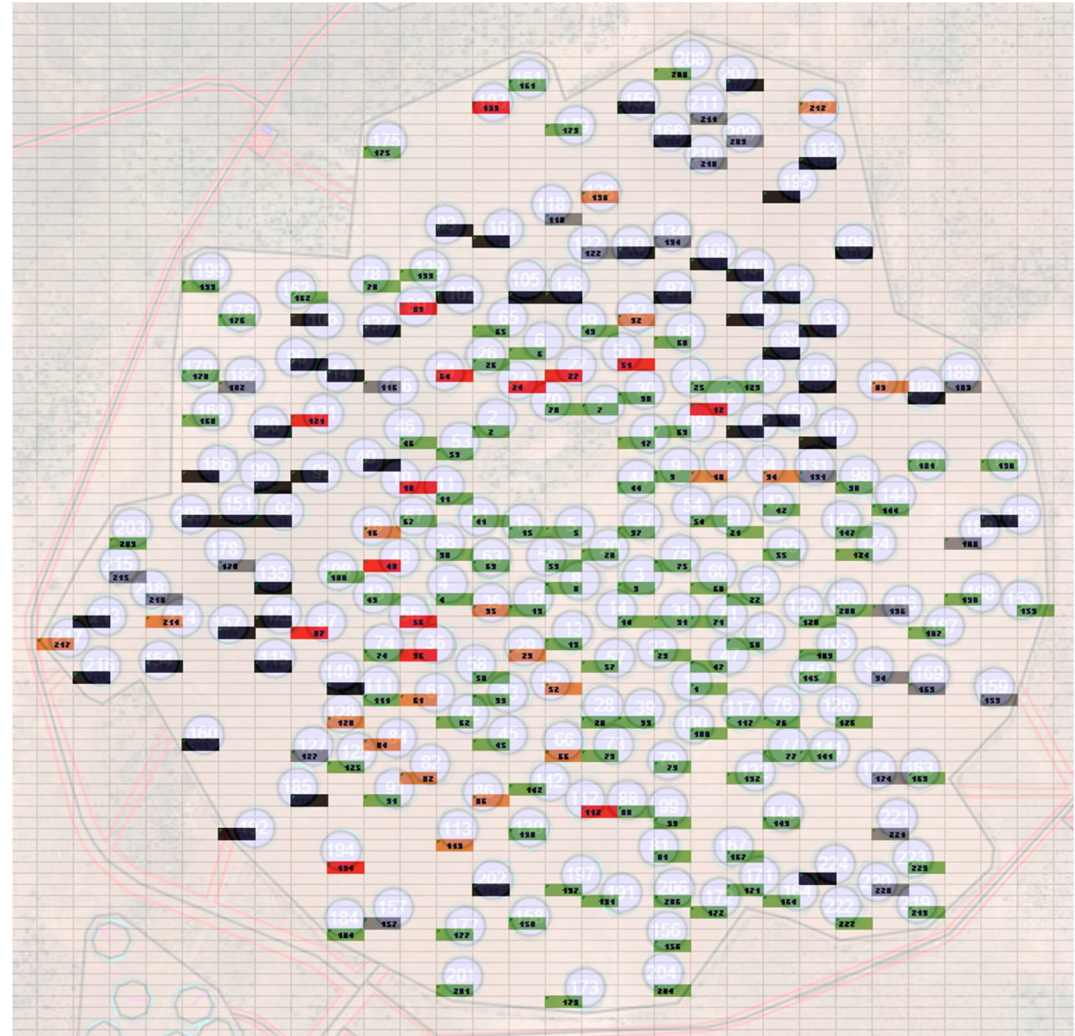
SKA-Low AA* array

- AA* has 307 SKA-Low stations:
 - 231 stations connected to the CPF.
 - 199 core stations + 32 stations in the inner spirals (E1-4, N1-4, S1-4).
- The goal of this work was to identify which 50 of the 199 stations to select for deferral.
- Number of deferred TA beams was decided earlier as part of PSRR process.



Engineering constraints - 1. Mesh condition

- All the meshes in the core have been laid.
- Some meshes have degraded:
 - Vegetation.
 - Soil erosion caused by water.
 - Sand accumulation caused by wind.
- Deferring a **green** mesh is more costly than deferring a **red** mesh.



Black mesh - deferred station.

Gray mesh - AA4 station.



Engineering constraints - 2. AARNet Fibre Occupancy

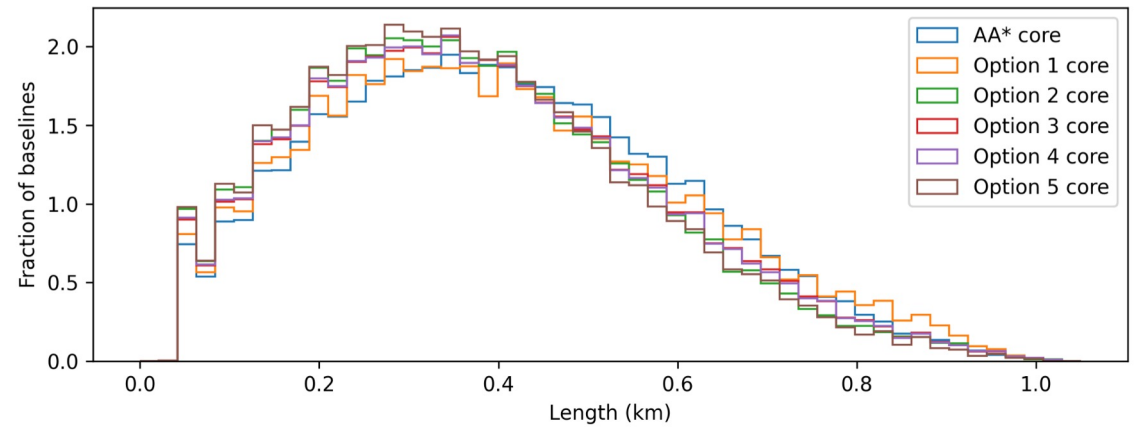
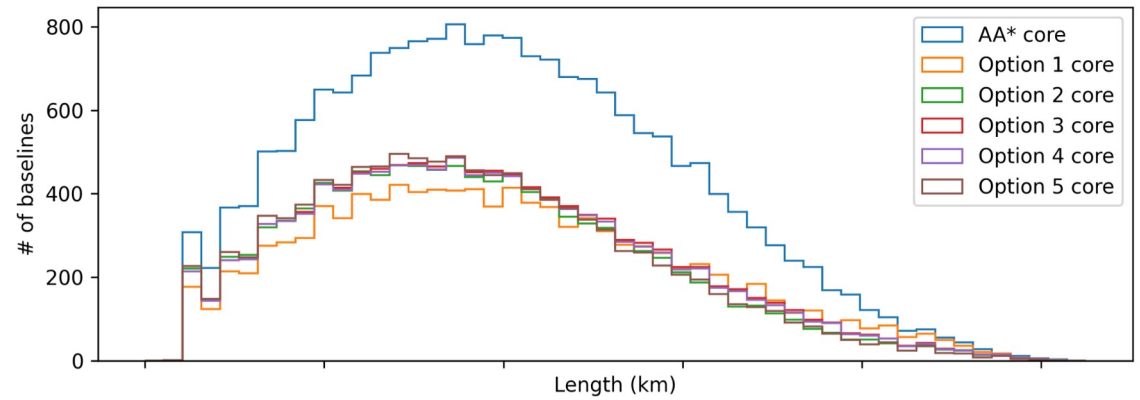
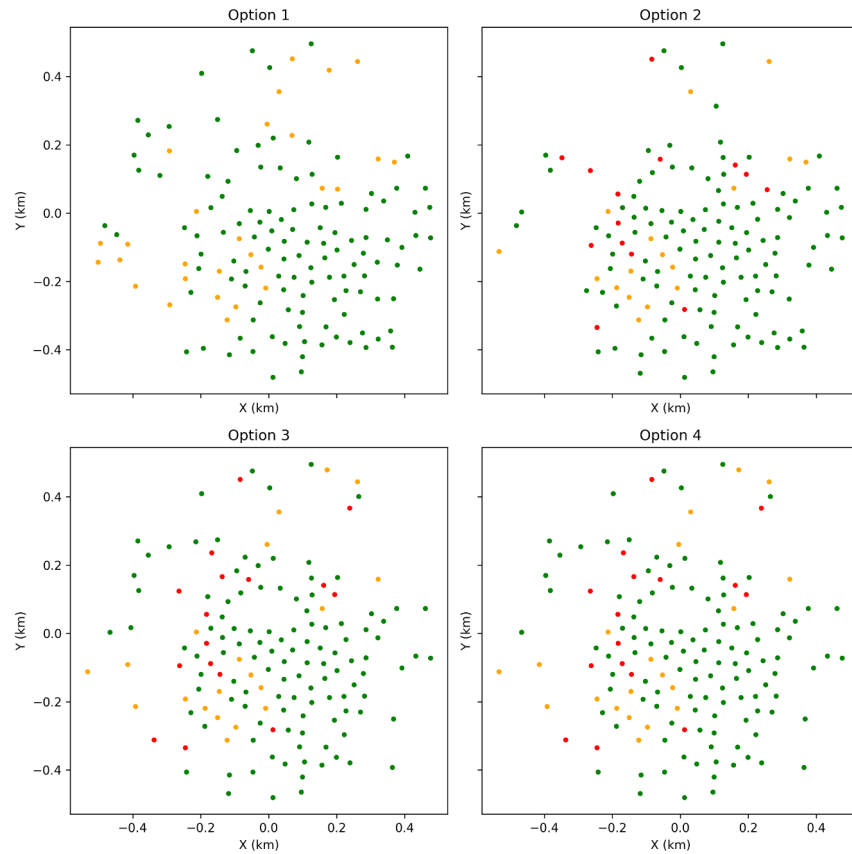
- Each AARNet fibre transfers data from 6 stations in a CPF cabinet to Perth.
- To reduce operational costs, we aimed to minimise the number of active AARNet fibres.
- Main constraint was that the station-to-fibre mapping is fixed since that's how the fibres in the CPF have been routed.

	B	
L	FS46	FS49
F1	FS64	FS65
F2	FS78	FS89
L	FS90	FS92
F1	FS93	FS95
F2	FS102	FS137
L	FS139	FS162
F1	FS175	FS176
F2	FS199	FS214
L	FS152	FS196
F1	FS225	FS226
F2	FS229	FS230



Four initial options

- Mimic the baseline distribution of SKA-Low AA*.



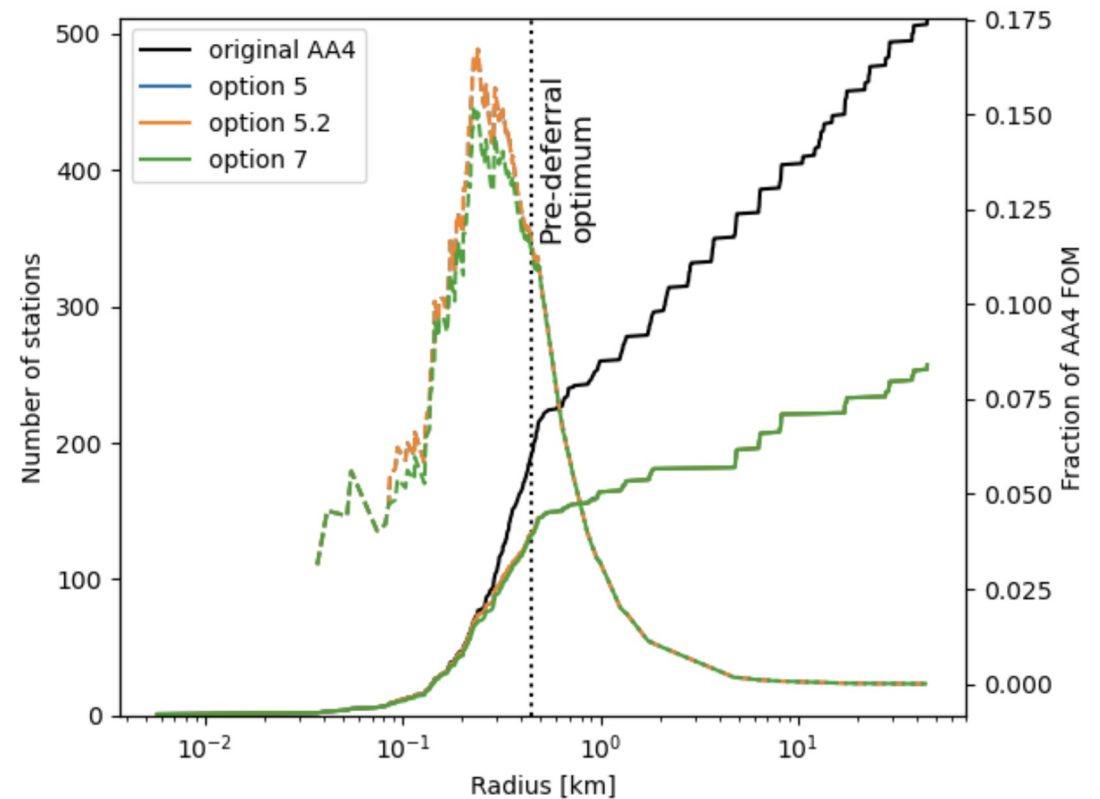
Analysis by EoR SWG

- Performance of different configurations was studied for:
 - power spectrum estimation,
 - 21cm tomography,
 - sampling statistics (uv coverage of a 4-hour track + PSF behaviour).
- All analyses provided consistent results showing degraded performance compared to SKA-Low AA*, with at least 20% increase of observing time required.
- Option 1 rejected as the worst with two new configurations proposed.
- Option 5 best in terms of engineering compliance, and delivers better performance than SKAO's Options (1 – 4).
- Option P1 being the best could not be selected due to engineering constraints.



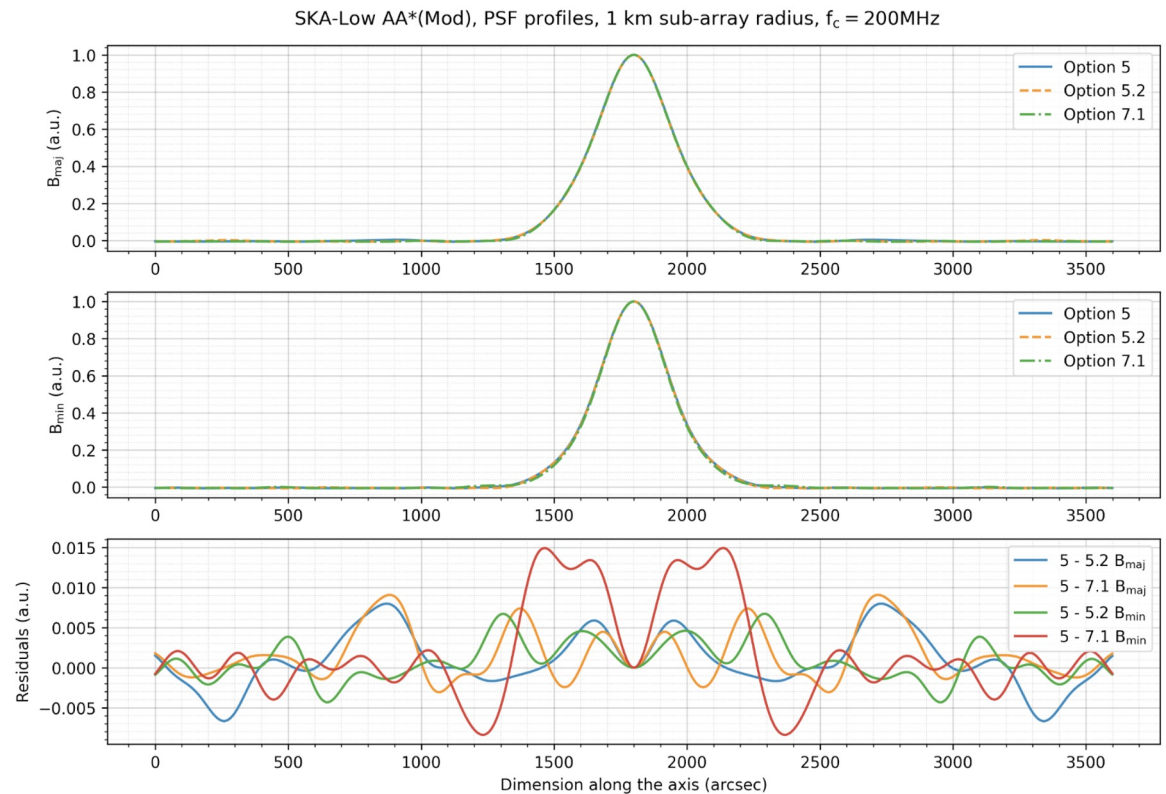
Analysis by Transients SWG

- The effect of the deferred capabilities will be a reduction in the FRB science potential to 12% (SKA-Low) and 18% (SKA-Mid) of its original capabilities.
- By trading sensitivity for the FOV of TABs, 17% (SKA-Low) and 33% (SKA-Mid) of capabilities can be recovered.
- Preference of Option 5.2.
- SWG reinstatement priorities are:
 - 1125 PSS beams on Mid.
 - 250 PSS beams on Low.
 - 50 Low core stations.
- Various mitigation strategies offered in order to recover FoM.



Analysis by Pulsars SWG

- Collecting area most important factor in pulsar observations.
- 24% loss of sensitivity with loss of 50 stations in the Core resulting in decreased timing precision and pulsar discovery rate (irrespective of options/layouts).
- Preference to remove stations from the arms instead of the Core.
- The PSF shape of all the options is quite similar, the SWG does not have strong preference for any of the layouts proposed.
- Reinstating number of beams signalled as next in priority after stations.



Option 5.2.3

- With some more iterations between Telescope Delivery Team, we have selected option that:
 - given the budget constraints, works from science and engineering perspectives,
 - minimises number of AARNet links required,
 - minimal amount of ground work (mesh) required.
- **Next steps:**
 - It was already mentioned at the last webinar that we are going ahead with this option.
 - Two stations have been swapped compared with Option 5.2.
 - Make a new release of the Staged Delivery memo (and everything else downstream).



<p>Core</p>	<p>C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C59, C60, C61, C62, C63 , C64, C65, C66, C67, C68, C69, C70, C71, C73, C74, C75, C76, C77, C78, C79, C81, C82, C83, C84, C86, C87, C88, C89, C91, C98, C99, C100, C103, C108, C111, C112, C113, C117, C120, C121, C123, C124, C125, C126, C128, C130, C132, C138, C139, C141, C142, C143, C144, C145, C147, C153, C156, C158 , C161, C162, C163, C164, C167, C168, C170, C171, C172, C173, C175, C176, C177, C179, C181, C184, C187, C190, C191, C193, C194, C197, C198, C199 , C200, C201, C203, C204, C206, C208, C212, C214, C217, C219,</p>	<p>149 stations</p>
<p>East</p>	<p>E1-3, E1-4, E2-1, E2-2, E2-3, E3-1, E3-3, E3-4, E4-1, E4-2, E4-3, E8-1, E8-2, E8-3, E8-4, E9-1, E9-2, E9-3, E9-4, E10-1, E10-2, E10-3, E10-4, E13-1, E13-2, E13-3, E13-4, E15-1, E15-2, E15-3, E15-4, E16-1, E16-2, E16-3, E16-4,</p>	<p>35 stations</p>
<p>North</p>	<p>N1-1, N1-6, N2-1, N2-2, N2-3, N3-1, N3-2, N3-3, N4-1, N4-2, N4-3, N8-1, N8-2, N8-3, N8-4, N9-1, N9-2, N9-3, N9-4, N10-1, N10-2, N10-3, N10-4, N13-1, N13-2, N13-3, N13-5, N15-2, N15-3, N15-4, N15-6, N16-1, N16-2, N16-3, N16-4,</p>	<p>35 stations</p>
<p>South</p>	<p>S1-1, S1-2, S2-4, S2-5, S2-6, S3-1, S3-4, S4-2, S4-3, S4-6, S8-1, S8-2, S8-3, S8-4, S8-5, S8-6, S9-2, S9-3, S9-4, S9-5, S10-1, S10-2, S10-3, S10-4, S10-5, S10-6, S13-1, S13-2, S13-3, S13-4, S15-2, S15-3, S15-5, S15-6, S16-1, S16-2, S16-3, S16-4,</p>	<p>38 stations</p>

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Any Other Business

*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
www.skao.int/en/science-users