SWG Update

Tyler Bourke
Senior Scientist

22 April 2025

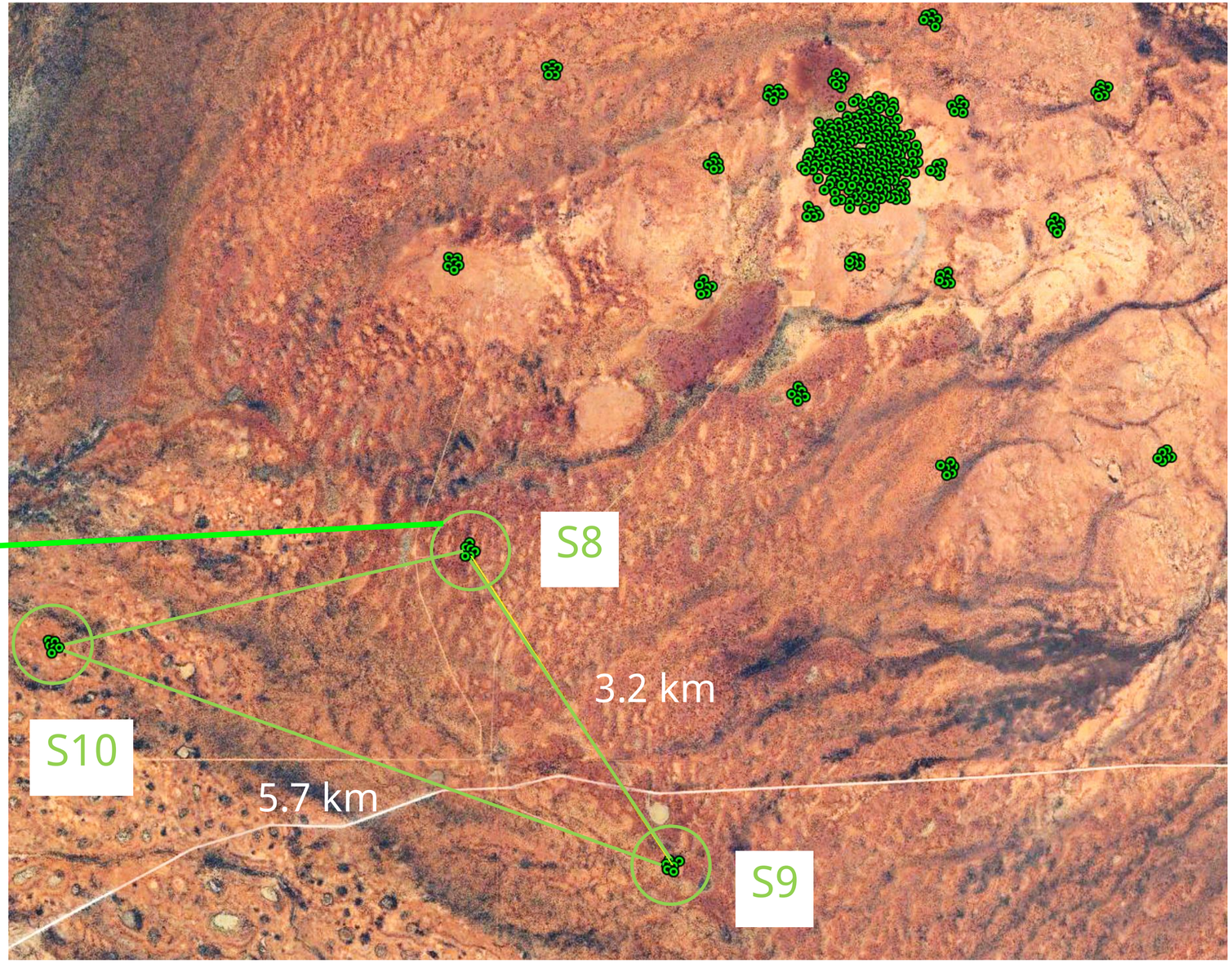
SKA Science Update

- Construction Update
- SKA Science Meeting
- Advancing Astrophysics II
- Science Data Challenges
- Satellite Constellations
- Other science meetings
- Reminders
- AOB

Construction Update – SKA-Low

SKA-Low AA0.5

4 Stations
2 x S8
1 x S9, S10



Construction Update – SKA-Low

SKA-Low AA2

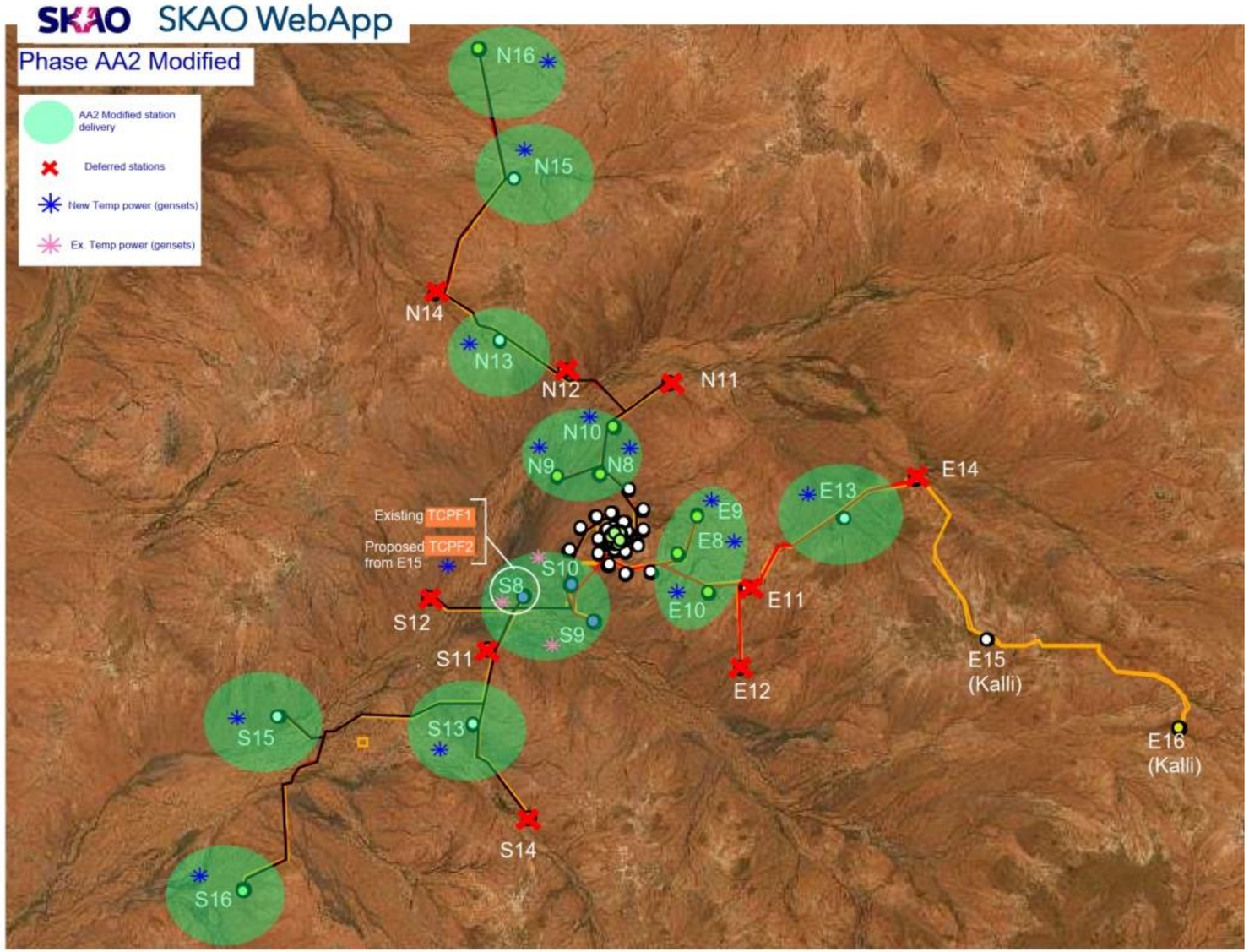
68 Stations

Modified layout due to delay in construction of Central Processing Facility (CPF)

No stations integrated in the core until CPF available (~~AA2~~)

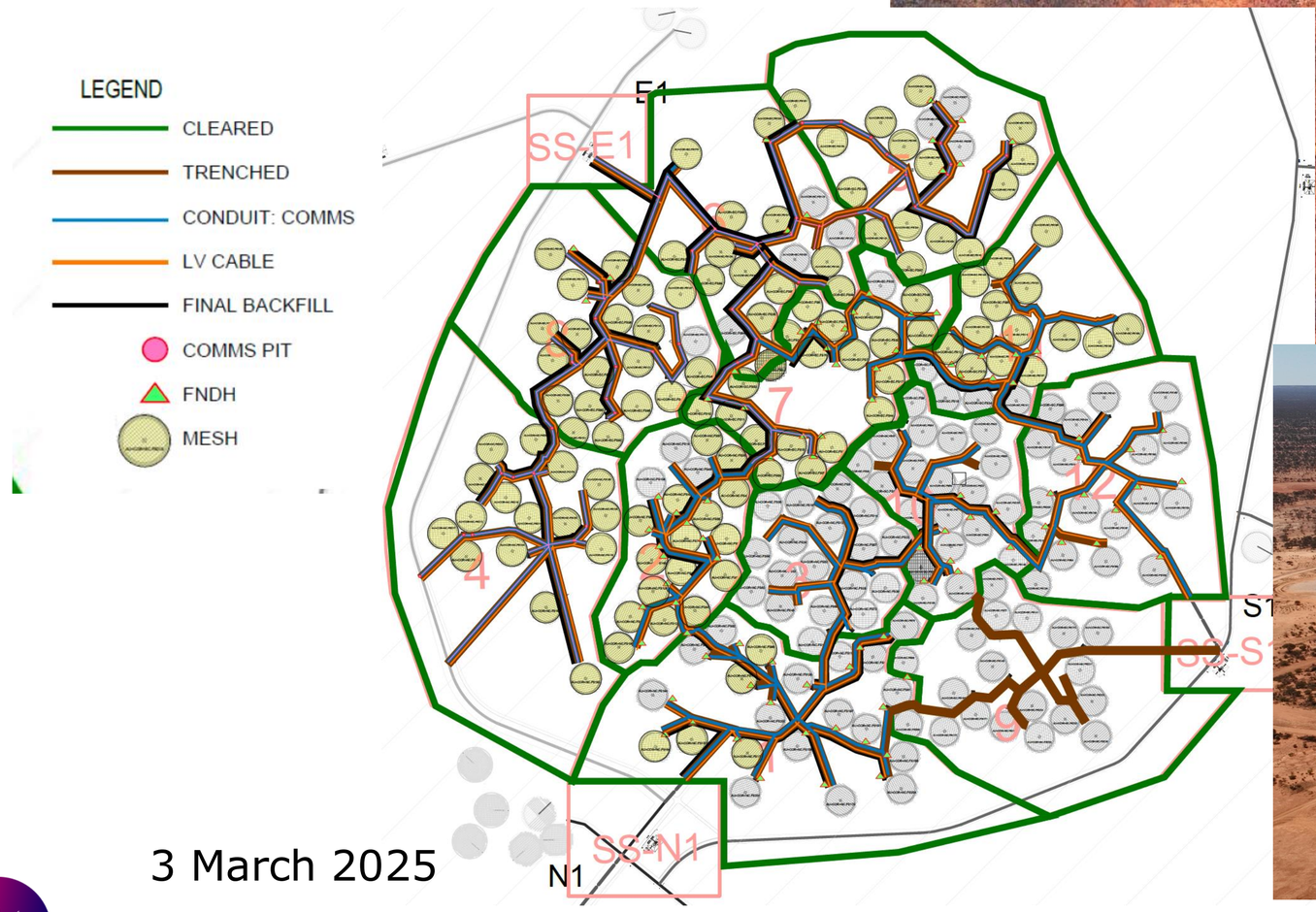
Science – pro: longer baselines earlier – con: no core tied-array beams (impacts pulsars/EoR)

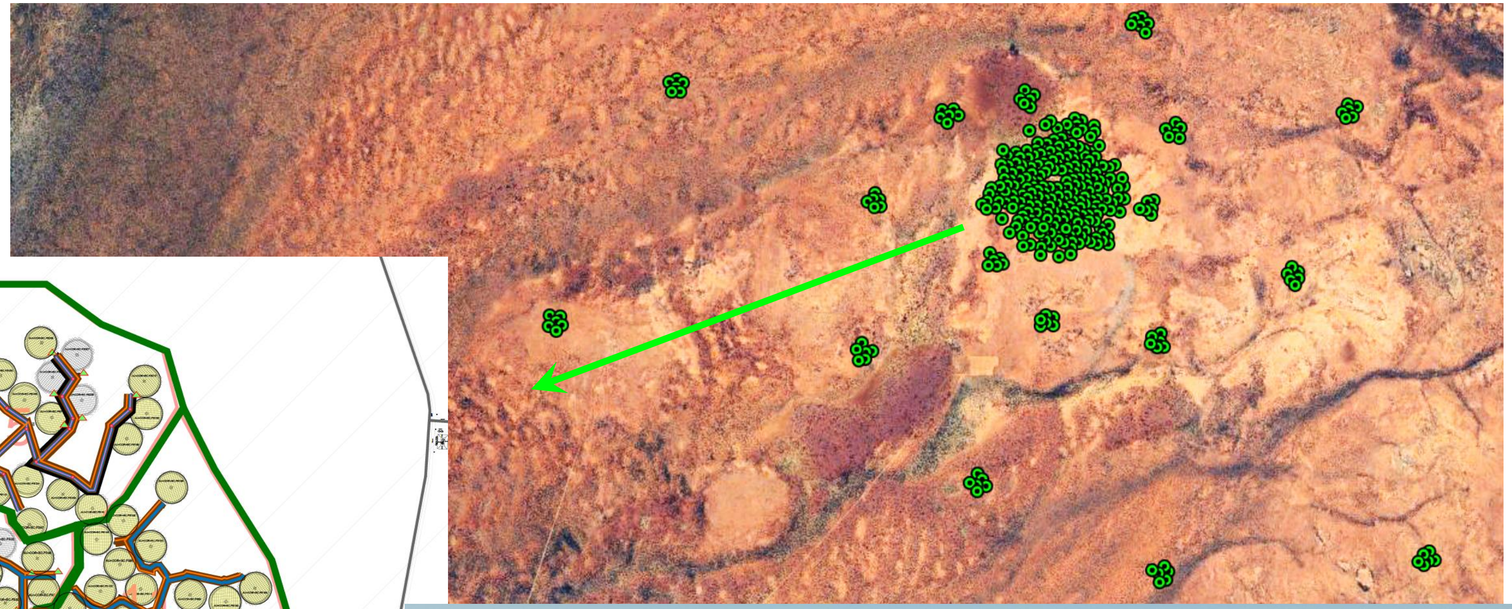
Science Verification still on track starting early 2027



Construction Update – SKA-Low – progress toward AA*

12 of 16 AA1 stations deployed





3 March 2025

Construction Update – SKA-Mid

SKA-Mid AA0.5

SKA063 – erected, can move with MeerKAT, photogrammetry underway

SKA001 – dish surface lifted (next slide)

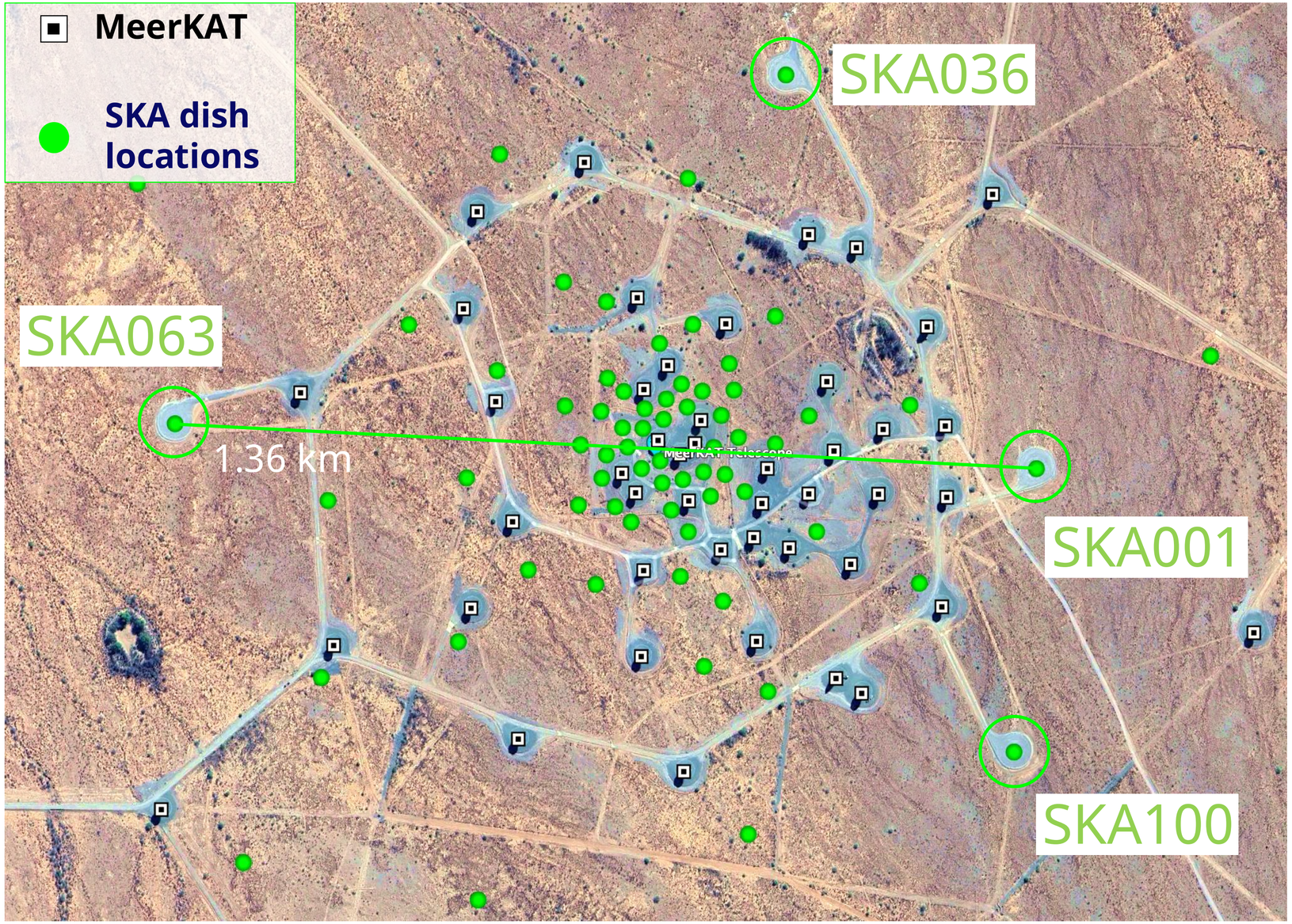
SKA100 – dish surface lifted

SKA036 – pedestal up

7 dishes on site, more on the way

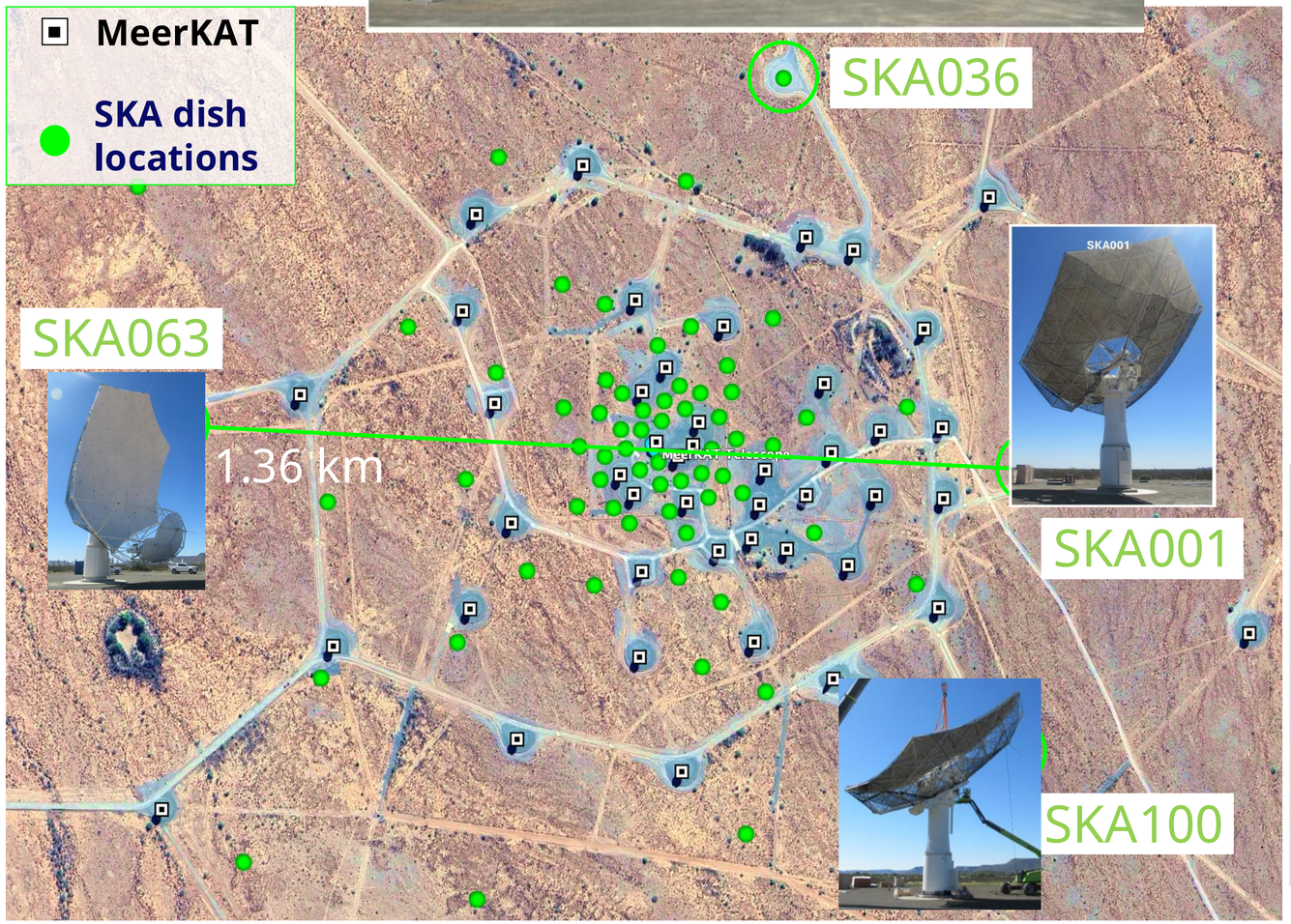
2025 goal:

fringes with AA0.5



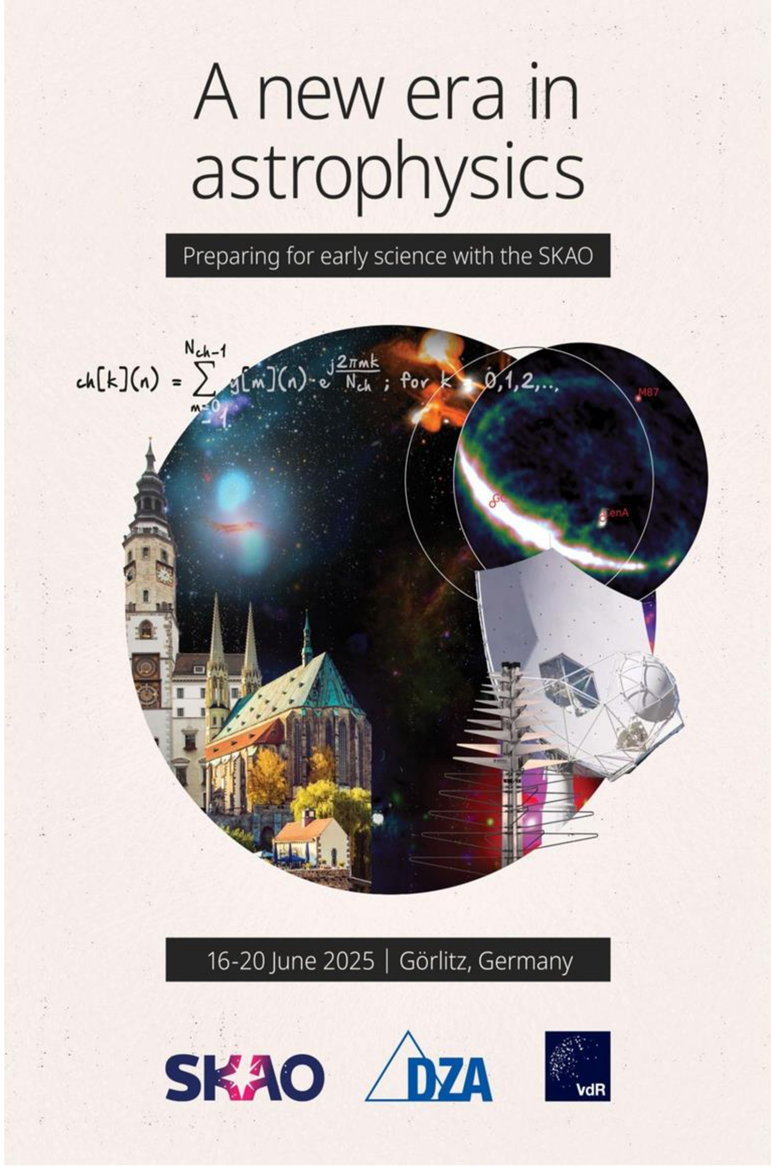
Construction Update – SKA-Mid

SKA-Mid AA0.5



A new era in Astrophysics:
Preparing for Early Science with the SKAO

- **Dates and location:**
  - 16th-20th June 2025, Görlitz, Germany
- **Theme:**
  - Preparing for the exciting science to come from early SKA observing cycles
- **Aims:**
  - A talk programme that will generate excitement for the early science opportunities using the *deployment baseline (AA*) telescopes*
  - Support and encourage SWG discussion and collaboration via parallel session programme
  - Preparing future observers: information sessions led by SKAO Science Operations team, who will share detailed telescope capabilities, operational policies and observer tools during both plenary sessions and bespoke SWG-based discussion opportunities



https://www.skao.int/en/science-users/skao-science-meeting-2025

A new era in Astrophysics:
Preparing for Early Science with the SKAO

- **Programme overview:**
  - 212 science talks in total, selected from 619 abstracts following anonymised review process
  - 32 plenary session science talks
  - “Observing with SKAO” special plenary session
  - 8 x 1.5 day parallel sessions
  - 180 parallel session science talks in total
  - SWG discussion sessions
  - ‘Lightning talks’ from poster presenters, in addition to poster viewing sessions
  - Tailored Q&A sessions with operations team

https://www.skao.int/en/science-users/skao-science-meeting-2025

A new era in Astrophysics:
Preparing for Early Science with the SKAO

- **Registrations**
  - Venue capacity now 500 (up from 370)
  - Additional places secured after a second site visit. Places offered to those on waiting list, with poster presenters prioritised.
- **Attendee accommodation**
  - **Attendees urged to book accommodation ASAP** as rooms likely to go quickly now that block reservations have expired (please see related emails)
- **Programme**
  - Small updates will be finalised in the next week and abstract book added to website.
  - Now also have list of confirmed poster presenters.
- **Next steps:**
  - Speaker and poster presentation guidelines to be issued soon

https://www.skao.int/en/science-users/skao-science-meeting-2025

A new era in Astrophysics:
Preparing for Early Science with the SKAO

- **Dates and location:**
  - 16th-20th June 2025, Görlitz, Germany

- **Key Dates:**
  - *Abstract submission opened: 13 December 2024*
  - *Registration opened: 13 January 2025*
  - *Abstract submission closes: 7 February 2025*
  - *Speaker notification: 14 March 2025*
  - *Programme published: 21 March 2025*
  - *In-person registration (reduced rate) closes: 31 March 2025*
  - Virtual registration (reduced rate) closes: 31 May 2025
  - In-person registration closes: 1 June 2025
  - Virtual registration closes: 15 June 2025

https://www.skao.int/en/science-users/skao-science-meeting-2025

AASKAII: Updated SKAO Science Book

- Communication to be sent to lead authors soon, confirming submission date and process.
- Introductions for Authors and LaTeX template.
  - (Can also be found on SKAO website).

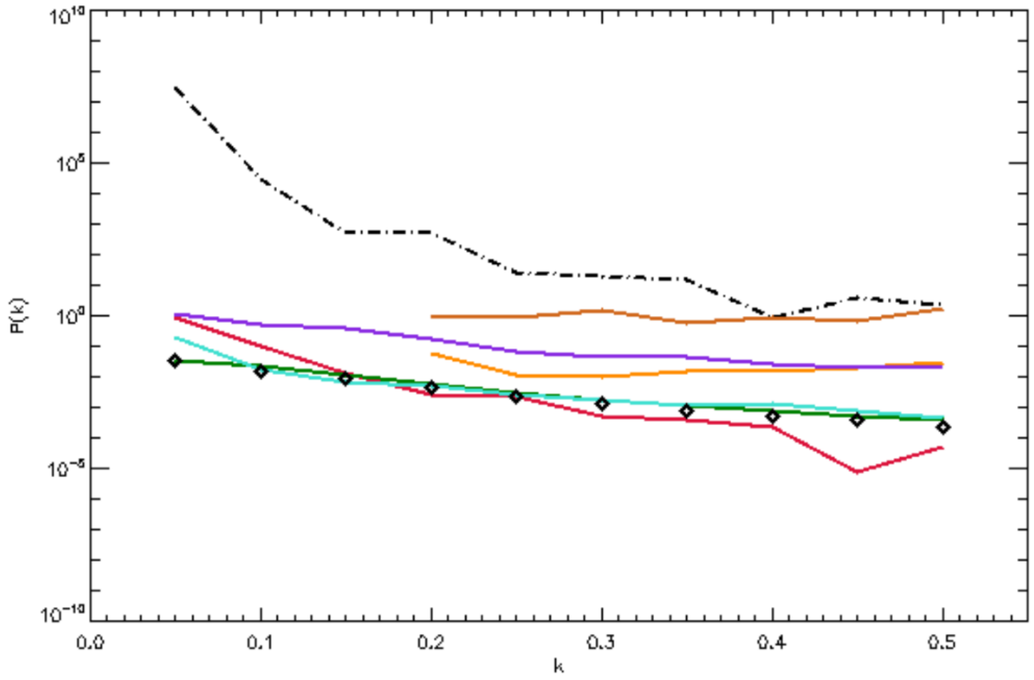
Science Data Challenge 3a: EoR Foregrounds

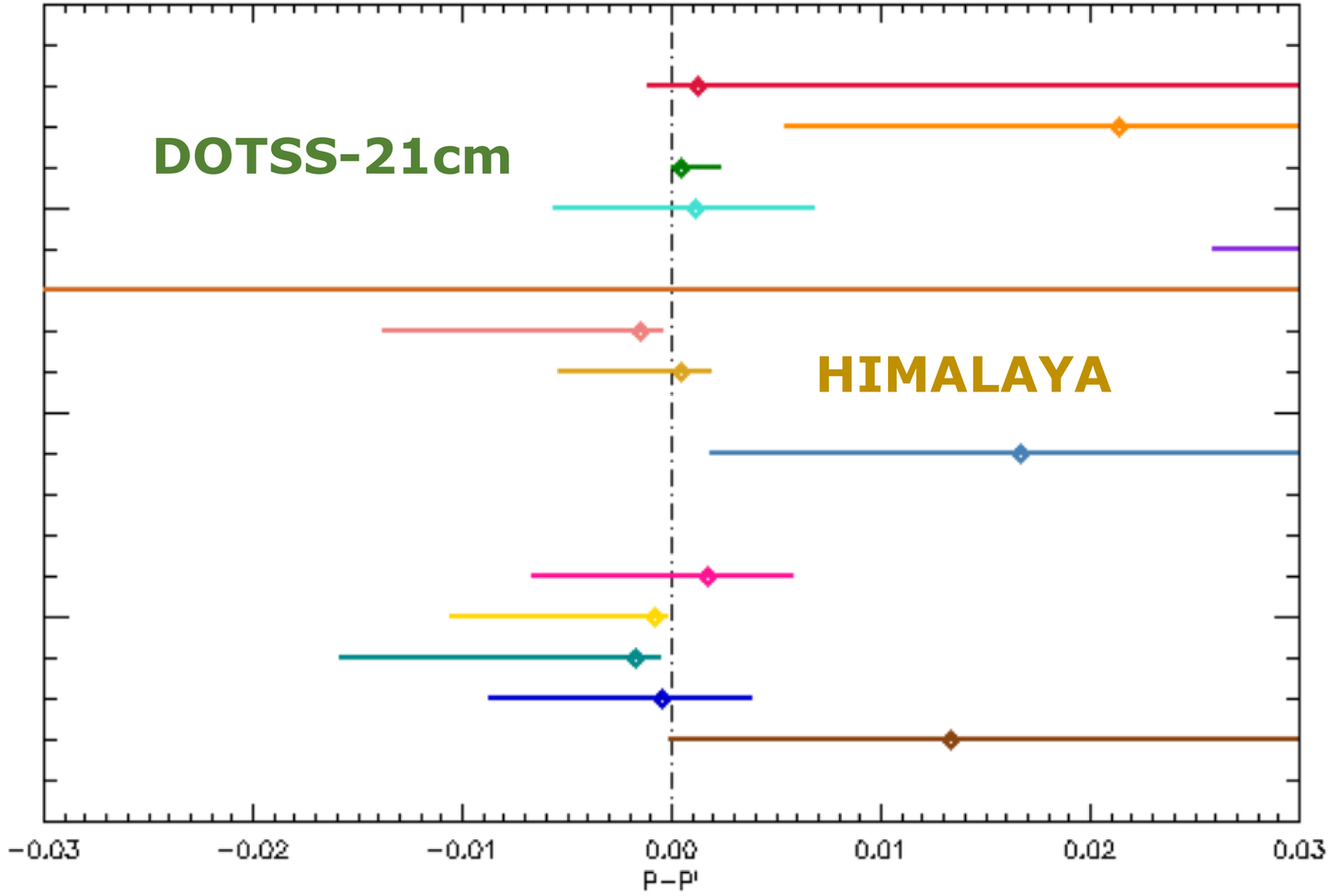
Square Kilometre Array Science Data Challenge 3a: foreground removal for an EoR experiment

Paper submitted!!

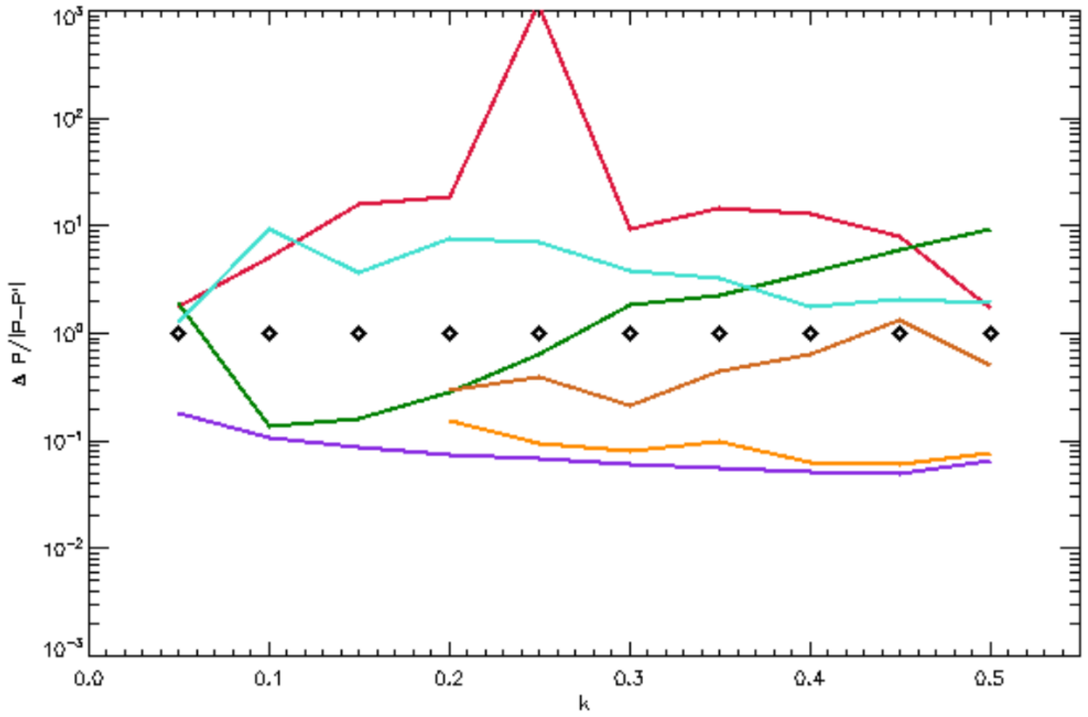
A. Bonaldi[1], P. Hartley[1], R. Braun[1], S. Purser[1], A. Acharya[2], K. Ahn[3], M. Aparicio Resco[4], O. Bait[1], M. Bianco[5], A. Chakraborty[6], E. Chapman[7], S. Chatterjee[8], K. Chege[9], H. Chen[10], X. Chen[11], Z. Chen[12], L. Conaboy[7], M. Cruz[13], L. Darriba[14], M. De Santis[15], P. Denzel[16], K. Diao[17], J. Feron[7], C. Finlay[18], B. Gehlot[9], S. Ghosh[9], S. K. Giri[19], R. Grumitt[17], S. E. Hong[20], T. Ito[21], M. Jiang[22,23], C. Jordan[24,25], S. Kim[26], M. Kim[27], J. Kim[28], S. P. Krishna[5], A. Kulkarni[29], M. López-Caniego[4,30,31], I. Labadie-García[14], H. Lee[32], D. Lee[3], N. Lee[32], J. Line[24,25], Y. Liu[33,34], Y. Mao[17], A. Mazumder[35], F. G. Mertens[36,9], S. Munshi[9], A. Nasirudin[37], S. Ni[10], V. Nistane[18], C. Norregaard[38], D. Null[24,25,39], A. Offringa[40], M. Oh[3], S.-H. Oh[27], D. Parkinson[20], J. Pritchard[38], M. Ruiz-Granda[13,41], V. Salvador López[4], H. Shan[42,43,44], R. Sharma[45], C. Trott[24,25], S. Yoshiura[46], L. Zhang[47], X. Zhang[48], Q. Zheng[42,44], Z. Zhu[42], S. Zuo[11], T. Akahori[46], P. Alberto[49], E. Allys[50], T. An[42], D. Anstey[33,34], J. Baek[20], Basavraj[51], S. Brackenhoff[9], P. Browne[52], E. Ceccotti[9,53], H. Chen[10], T. Chen[5], S. Choudhuri[54], M. Choudhury[55], J. Coles[33], J. Cook[24,25], D. Cornu[36], S. Cunnington[35], S. Das[54], E. de Lera Acedo[33,34], J.-M. Delouis[56], F. Deng[11], J. Ding[57], K. M. A. Elahi[54], P. Fernandez[58], C. Fernández[59], A. Fernández Alcázar[4], V. Galluzzi[53,60], L.-Y. Gao[48], U. Garain[61], J. Garrido[14], M.-L. Gendron-Marsolais[14,62], T. Gessey-Jones[33,34], H. Ghorbel[15], Y. Gong[11], S. Guo[42], K. Hasegawa[63], T. Hayashi[64,65], D. Herranz[13], V. Holanda[58], A. J. Holloway[35], I. Hothi[50], C. Höfer[9], V. Jelić[66], Y. Jiang[11], X. Jiang[10],

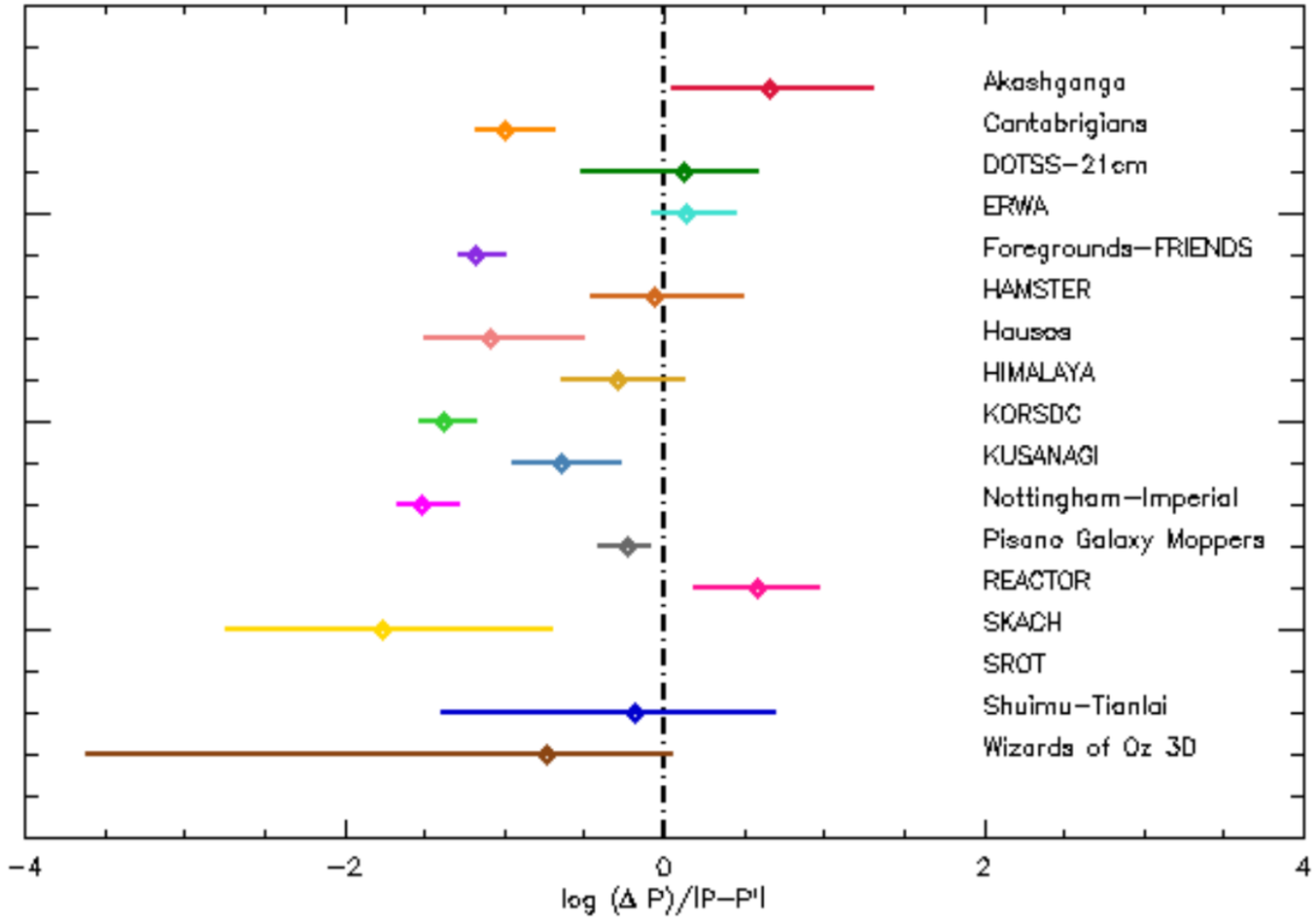
Science Data Challenge 3a: EoR Foregrounds





Science Data Challenge 3a: EoR Foregrounds





Science Data Challenge 3a: EoR Foregrounds

SKA-Low simulations for a cosmic dawn/epoch of reionisation deep field

TBC

7 February 2025

ABSTRACT

We present a realistic simulation of an SKA-Low cosmic dawn/epoch of reionisation (CD/EoR) observation, which can be used to further the development of foreground-mitigation approaches. The simulation corresponds to a deep (1000 h) integration pointing over the 106 MHz–196 MHz frequency range. The sky components include the CD/EoR signal, extragalactic foreground emission featuring strong out-of-field sources and in-field sources down to 1 μJy at 150 MHz, and Galactic emission from the GSM2016 model complemented with small-scales structure beyond the native $\sim$ 1 deg resolution of that model from a magneto-hydro-dynamic simulation of the interstellar medium. Modeled errors include a partial de-mixing of the out-of-field sources, direction-dependent calibration errors leading to residual ionospheric effects, and direction-independent gain calibration errors, on top of thermal noise. Simulated observations are delivered as visibilities as well as imaging products both with natural and uniform weighting. The true, uncorrupted, CD/EoR signal is also delivered, to allow an assessment of the efficacy of foreground-mitigation approaches. The codes used to generate these simulations are also delivered, so that new simulated datasets can be produced. This simulation has been the basis for the SKA Science Data Challenge 3a (SDC3a), which addressed foreground removal.

Key words:

Companion paper on the simulation in preparation

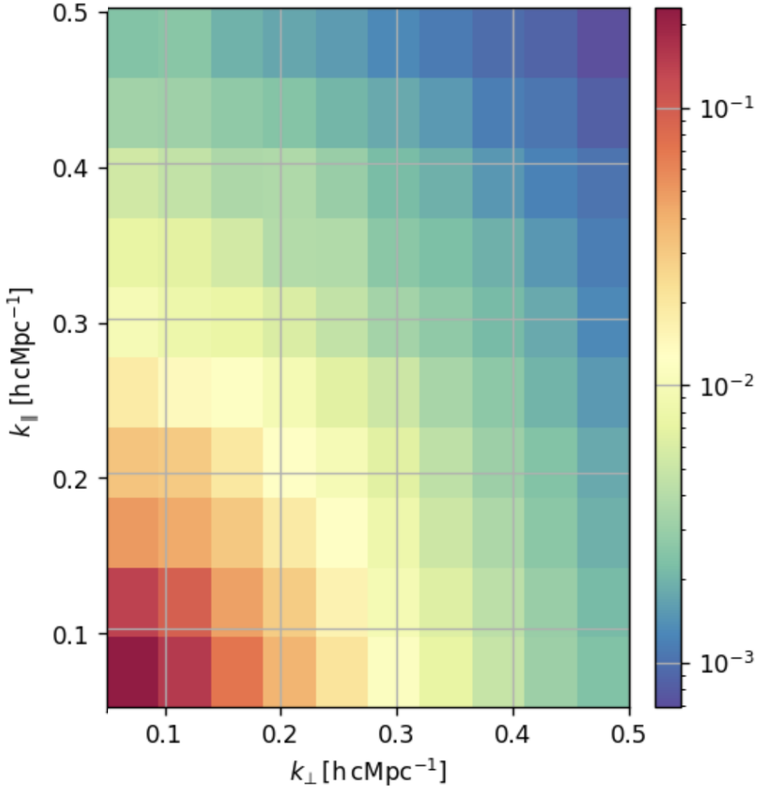
All codes to be released as well!

Science Data Challenge 3b: EoR Inference

- The datasets:
  - PS1: Power spectra of EoR1 + noise + SKA-Low telescope simulation for one simulation code
  - PS2: Power spectra of EoR1 + noise + SKA-Low telescope simulation for another simulation code
  - PS3: Power spectra of EoR1 + noise + foreground residual + SKA-Low telescope simulation
  - IM1: imaging product corresponding to PS3 (includes foreground residual)

- Status: ongoing. Deadline for results: 30th April 2025

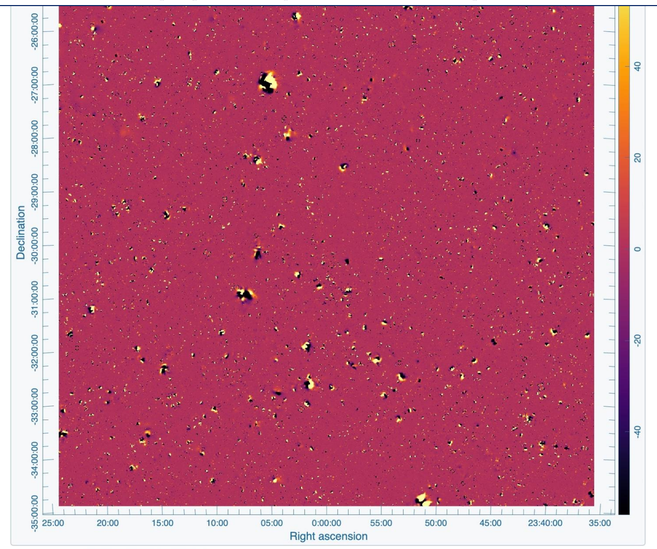
Example 2D power spectrum



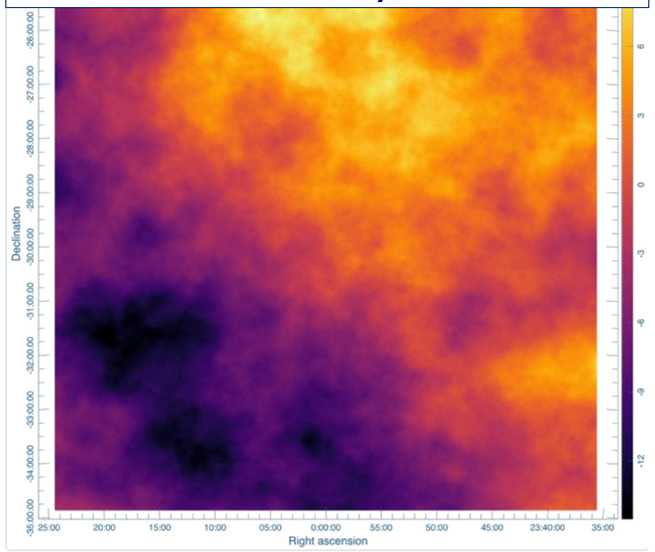
SDC4 Magnetism: Data Products, Goals, Timeline

- IQUV images at sequence of centre frequencies ($\Delta\nu \sim \nu^3$) matched to RM_{Max} = 500 or 5000 with depolarisation (due to $\Delta\nu$) of < 5%
- Ancillary Products:
  - Dirty PSF, Mosaiced I and I^2, Mosaiced instrumental QUV
  - (Propagated complete IQU sky model, and RM(z) not public during challenge)
- Total size:
  - **9 deg²**: 650x10x324 MB = 2.1 TB, **100 deg²**: 6650x10x324 MB = 21.5 TB

Projected RM(z) Sky Model (z = 0.01–3.2)



ISM RM Sky Model



SDC4 – Open questions

- Missing data products ?
- Additional challenge goals (beyond recovery of intrinsic IQU plus RM source catalogue)
  - IQU from diffuse IGM is extremely faint (10s of nJy/beam) so not really viable in this depth of obs
  - Some instances of magnetised Large-Scale Structure aligned with (extended) background sources
- HPC resourcing needed per team: storage, memory, CPU-h/GPU-h

➢ Consult with magnetism SWG members, enlist a few of them to inspect the data products.

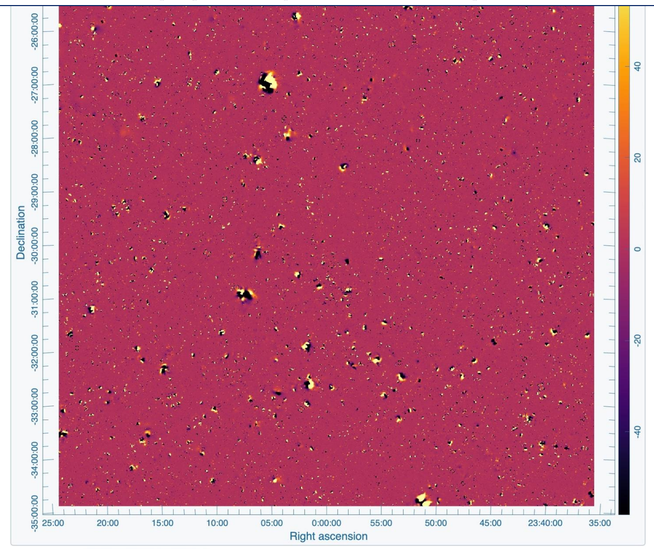
SDC4: Status and Timeline

2025 Q2 Q3 Q4 2026

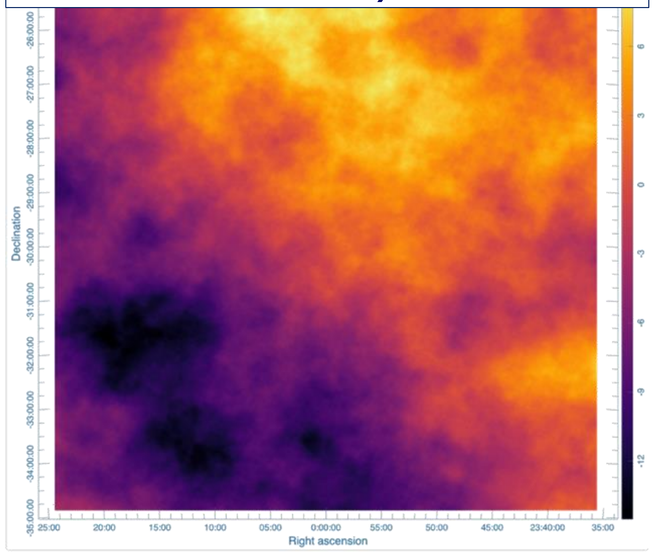
Complete and test

Run challenge

Projected RM(z) Sky Model (z = 0.01–3.2)



ISM RM Sky Model



Impact of Satellite Constellations on Mid B5b

- Starlink (at least) downlink transmissions occur in Ku band, specifically10.7-12.7 GHz.
- High risk of major impact on Band 5b observations
- We continue to investigate the impact on this window, and the possible usability when the constellations are heavily populated (e.g., boresight avoidance measures). More details at Görlitz
- One aspect is whether to build this part of B5b at all, or to instead cover higher frequencies (B5b 8.3-10.7?, B6 12.7-?)
- Qs to SWGs:
  - What science is lost if 10.7-12.7 GHz is not covered, and how critical is that?
- Please begin discussions with your core group before Gorlitz. We may seek detailed feedback post-Görlitz

Science Meetings – SKAO sessions

- European Astronomical Society EAS-2025 23–27 June 2025
  University College Cork, Ireland
  - Lunch session The SKA Observatory: preparing the community for SKA science
  - Evening event for Ireland-based astronomers (Ireland have expressed interest in joining)

Presentations from most past SKAO-(co)led science meetings are available online

Science Meetings related to SKA

- PHISCC (Pathfinder HI Survey Co-ordination Committee) Workshop 2025
  2025 Sept 22-26, Cagliari, Italy
  https://sites.google.com/inaf.it/phiscc2025

- Pulsar 2025 (A conference in memory of Nichi D'Amico)
  2025 Sept 21-26, Sardinia, Italy
  https://sites.google.com/inaf.it/pulsar2025/

- SPARCS XII (SKA Pathfinder Radio Continuum Surveys)
  2025 Nov 3-7, Cairns, Australia

- SALF (Science at Low Frequencies)
  2025 Dec 8-12, Orléans, France

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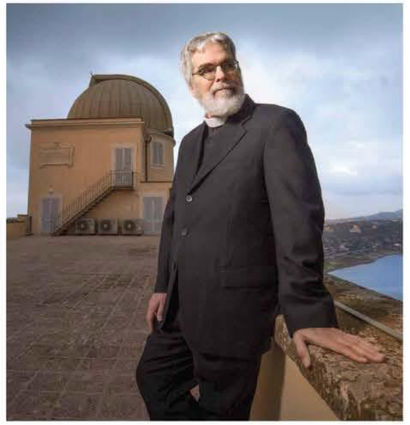
SKAO

Speaker series

Discarded Worlds:

Astronomical ideas that were almost correct...



Br. Guy Consolmagno

Director
Vatican Observatory

TUESDAY 6 May 2025

11am UTC, 12 noon BST, 1pm SAST, 7pm AWST, 9pm AEST

Astronomy is more than just observing; it's making sense of those observations. A good theorist needs to blend a knowledge of what's been observed, with a good imagination... and no fear of being wrong. Ptolemy in ancient Rome, the medieval bishops Oresme and Cusa, the 19th century astronomers Schiaparelli and Pickering, all rose to the challenge; and they were almost correct. Which is to say, they were wrong... sometimes hilariously, sometimes heartbreakingly so. What lessons can 21st century astronomers take from these discarded images of the universe?

A native of Detroit, Michigan, Brother Guy Consolmagno SJ earned undergraduate and masters' degrees from MIT, and a Ph. D. in Planetary Science from the University of Arizona, was a postdoctoral fellow at Harvard and MIT, served in the US Peace Corps (Kenya), and taught university physics before entering the Jesuits in 1989. At the Vatican Observatory since 1993, in 2015 Pope Francis appointed Dr. Consolmagno director of the Vatican Observatory.

Br. Guy's research explores the physical structure of meteorites and asteroids using both laboratory and telescopic observations. Along with nearly 300 scientific publications, he is the author of a number of popular books.

In 2014 he received the Carl Sagan Medal from the American Astronomical Society Division for Planetary Sciences for excellence in public communication in planetary sciences. He currently serves as president of the Meteoritical Society, and chair of the IAU Mars Nomenclature Task Group.

Click here to access the speaker series talk

Reminders

SKA Speaker Series

- SKA Speaker Series
  - series of interesting talks, accessible to all within the broader SKA community, covering a wide range of topics, from astronomy to physics, engineering, big data and computing, EDI, and more.
  - Encourage your SWG members to sign up to give a talk (and consider giving a talk yourself).
  - Talks recorded – all available for reviewing via the Speaker Series page (2020+) https://confluence.skatelescope.org/display/SKAQA/SKAO+Speaker+Series

Outreach & Engagement

- **CONTACT** is the SKAO magazine aimed at the entire SKA community
- Ideas for articles for CONTACT are always welcome (email Tyler). These include:
  - Let's Talk About (Feature length … science focussed)
  - Pathfinders & precursors. Short pieces on recent results
  - SKA-related events (e.g. SPARCS, etc)
  - any other news of SKA relevance (award/honours, job openings, …)
- Encourage your SWG members to sign up

SKA Positions

- SKAO positions (HQ Manchester UK, Australia-Low, South Africa-Mid)
  https://www.skao.int/en/opportunities/careers-opportunities
  SKA-Low Operations Scientist (Perth) (30/04/2025)
- SARAO employee SKA positions (Cape Town, Canarvon)
  https://www.sarao.ac.za/vacancies/
- CSIRO employee SKA positions (Perth, Geraldton)
  https://jobs.csiro.au/search/?q=astronomy&locationsearch

Construction Strategy

- **Target**: build the SKA Baseline Design (197 Mid dishes; 512 Low stations: AA4)
- Not all funding yet secured, therefore following **Staged Delivery Plan** (AA*)
- Develop the earliest possible working demonstration of the architecture and supply chain (AA0.5).
- Then maintain a continuously working and expanding facility that demonstrates the full performance capabilities of the SKA Design.

Milestone Event (earliest)		SKA-Mid	SKA-Low
AA0.5	4 dishes 4 stations	2026 Q2	2025 Q3
AA1	8 dishes 16 stations	2027 Q1	2026 Q1
AA2	64 dishes 68 stations	2027 Q4	2026 Q4
Science Verification begins		**2028+**	**2027+**
AA*	144 dishes 307 stations	2028 Q3	2028 Q2
Operations Readiness Review		2029 Q1	2028 Q3
End of Staged Delivery Programme		2029 Mar	2029 Mar
Early Operations (Shared Risk)		**2029+**	**2029+**
AA4 (Design Baseline)	197 dishes 512 stations	TBD	TBD

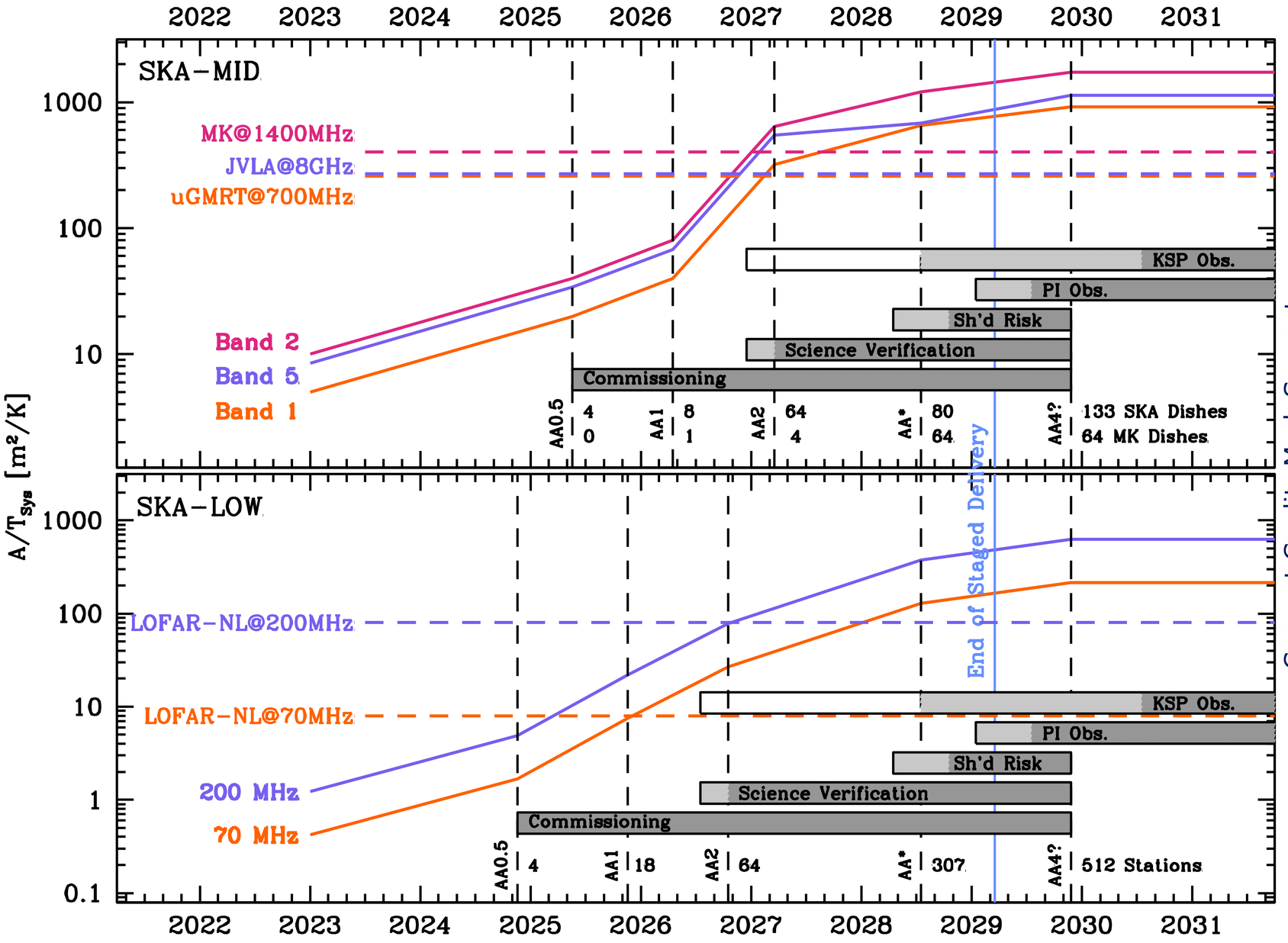
AA = Array Assembly

Updated February 2025 (Construction Report)

First Science Verification data release to the community expected in ~2027

SKAO Commissioning Timeline

- AA0.5
  - Basic imaging and Tied-Array Beams
  - Off-line reduction
  - Limited BW/N_{Chan}
- AA1
  - Plus multiple beams/sub-stations
- AA2
  - Plus pipeline reduction, more BW/ N_{Chan}
  - Science verification!
- AA*
  - Full BW, N_{CHan}, zooms
  - Shared Risk Cycle 0
  - PI and KSP Proposals!



Any Other Business

- News from SWG Chairs?
- Updates from Precursors or pathfinders?

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
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