# SWG Update





### Tyler Bourke Senior Scientist

18 March 2025

## **SKA Science Update**

- Construction Update
- Commissioning Update
  - Low (George Heald)
  - Mid (Robert Laing)
- SKA Science Meeting
- Science Data Challenges
- 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-Mid**

SKA-Mid AA0.5

SKA063 – erected, can move with MeerKAT, photogrammetry underway **SKA001** – dish surface lifted (next slide) **SKA100** – dish surface lifted yesterday

> 7 dishes on site, more on the way 2025 goal: fringes with AA0.5







## **Construction Update – SKA-Mid**











## **Construction Update – SKA-Mid**









## **Commissioning Updates**

### SKA-Low

(George Heald, SKA-Low Lead Commissioning Scientist)

# SKA-Mid

(Robert Laing, Head of System Science)

The updates are in separate slide sets



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

AA = Array Assembly

Updated February 2025 (Construction Report)





## 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 SWGbased 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**

#### • 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 March 2025
- In-person registration closes: 1 June 2025
- Virtual registration closes: 15 June 2025





# Registration now open

A new era in astrophysics

Preparing for early science with the SKAO



#### 16-20 June 2025 | Görlitz, Germany



skao.int/en/science-users/skao-science-meeting-2025

#### 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
  - Look out for full programme on Friday (March 21)!





# Registration now open

A new era in astrophysics

Preparing for early science with the SKAO



#### 16-20 June 2025 | Görlitz, Germany



skao.int/en/science-users/skao-science-meeting-2025

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





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

#### **Paper submitted!!**

A. Bonaldi <sup>1</sup>, P. Hartley<sup>1</sup>, R. Braun<sup>1</sup>, S. Purser <sup>1</sup>, A. Acharya <sup>2</sup>, K. Ahn <sup>3</sup>, M. Aparicio Resco <sup>4</sup>, O. Bait<sup>1</sup>, M. Bianco <sup>65</sup>, A. Chakraborty <sup>66</sup>, E. Chapman <sup>67</sup>, S. Chatterjee <sup>8</sup>, K. Chege <sup>9</sup>, H. Chen <sup>10</sup>, X. Chen 6<sup>11</sup>, Z. Chen<sup>12</sup>, L. Conaboy 6<sup>7</sup>, M. Cruz 6<sup>13</sup>, L. Darriba 6<sup>14</sup>, M. De Santis<sup>15</sup>, P. Denzel<sup>16</sup>, K. Diao <sup>017</sup>, J. Feron <sup>07</sup>, C. Finlay<sup>18</sup>, B. Gehlot <sup>09</sup>, S. Ghosh <sup>09</sup>, S. K. Giri <sup>019</sup>, R. Grumitt <sup>017</sup>, S. E. Hong <sup>020</sup>, T. Ito<sup>21</sup>, M. Jiang <sup>022,23</sup>, C. Jordan<sup>24,25</sup>, S. Kim <sup>026</sup>, M. Kim<sup>27</sup>, J. Kim<sup>28</sup>, S. P. Krishna <sup>05</sup>, A. Kulkarni <sup>029</sup>, M. López-Caniego <sup>4,30,31</sup>, I. Labadie-García <sup>14</sup>, H. Lee <sup>32</sup>, D. Lee <sup>3</sup>, N. Lee<sup>32</sup>, J. Line<sup>24,25</sup>, Y. Liu<sup>33,34</sup>, Y. Mao <sup>17</sup>, A. Mazumder<sup>35</sup>, F. G. Mertens <sup>36,9</sup>, S. Munshi <sup>9</sup>, A. Nasirudin <sup>37</sup>, S. Ni <sup>10</sup>, V. Nistane<sup>18</sup>, C. Norregaard<sup>38</sup>, D. Null <sup>024,25,39</sup>, A. Offringa <sup>040</sup>, M. Oh <sup>03</sup>, S.-H. Oh <sup>027</sup>, D. Parkinson <sup>020</sup>, J. Pritchard <sup>38</sup>, M. Ruiz-Granda <sup>13,41</sup>, V. Salvador López <sup>4</sup>, H. Shan <sup>42,43,44</sup>, R. Sharma<sup>45</sup>, C. Trott <sup>16</sup>/<sub>6</sub><sup>24,25</sup>, S. Yoshiura <sup>646</sup>, L. Zhang<sup>47</sup>, X. Zhang <sup>48</sup>, Q. Zheng<sup>42,44</sup>, Z. Zhu <sup>42</sup>, S. Zuo <sup>11</sup>, T. Akahori <sup>46</sup>, P. Alberto<sup>49</sup>, E. Allys <sup>650</sup>, T. An <sup>42</sup>, D. Anstey<sup>33,34</sup>, J. Baek <sup>20</sup>, Basavraj <sup>51</sup>, S. Brackenhoff <sup>9</sup>, P. Browne <sup>52</sup>, E. Ceccotti <sup>9,53</sup>, H. Chen <sup>10</sup>, T. Chen <sup>5</sup>, S. Choudhuri <sup>54</sup>, M. Choudhury <sup>55</sup>, J. Coles<sup>33</sup>, J. Cook<sup>24,25</sup>, D. Cornu <sup>36</sup>, S. Cunnington<sup>35</sup>, S. Das<sup>54</sup>, E. de Lera Acedo<sup>33,34</sup>, J.-M. Delouis <sup>56</sup>, F. Deng<sup>11</sup>, J. Ding<sup>57</sup>, K. M. A. Elahi <sup>54</sup>, P. Fernandez <sup>58</sup>, C. Fernández <sup>59</sup>, A. Fernández Alcázar <sup>4</sup>, V. Galluzzi <sup>53,60</sup>, L.-Y. Gao <sup>48</sup>, U. Garain <sup>61</sup>, J. Garrido <sup>14</sup>, M.-L. Gendron-Marsolais <sup>14,62</sup>, T. Gessey-Jones<sup>33,34</sup>, H. Ghorbel<sup>15</sup>, Y. Gong <sup>11</sup>, S. Guo <sup>42</sup>, K. Hasegawa<sup>63</sup>, T. Hayashi <sup>64,65</sup>, D. Herranz <sup>13</sup>, V. Holanda <sup>58</sup>, A. J. Holloway <sup>35</sup>, I. Hothi <sup>50</sup>, C. Höfer <sup>9</sup>, V. Jelić <sup>66</sup>, Y. Jiang<sup>11</sup>, X. Jiang <sup>10</sup>,















#### **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  $1 \mu Jy$  at 150 MHz, and Galactic emission from the GSM2016 model complemented with small-scales structure beyond the native  $\sim 1 \text{ deg}$  resolution of that model from a magnetohydro-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 foregroundmitigation 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: 30<sup>th</sup> April 2025







# **SDC4 Magnetism: Data Products, Goals, Timeline**

- 5000 with depolarisation (due to  $\Delta v$ ) of < 5%
- Ancillary Products:
  - Dirty PSF, Mosaiced I and I<sup>2</sup>, Mosaiced instrumental QUV
  - (Propagated complete IQU sky model, and RM(z) not public during challenge)
- Total size:
  - 9 deg<sup>2</sup>: 650x10x324 MB = 2.1 TB, 100 deg<sup>2</sup>: 6650x10x324 MB = 21.5 TB

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





• IQUV images at sequence of centre frequencies ( $\Delta v \sim v^3$ ) matched to RM<sub>Max</sub> = 500 or





## **SDC4 – Open questions**

- Missing data products ?
- catalogue)
- 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.



#### Additional challenge goals (beyond recovery of intrinsic IQU plus RM source)

• 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



Slide / 18

## **SDC4: Status and Timeline**











#### 2026

#### Run challenge







# Science Meetings – SKAO sessions

- African Astronomical Society AfAS-2025 23-28 March 2025 University of South Africa (UNISA), Pretoria
  - The SKA Observatory: status update and opportunities Tue 25/03 at 16.30-18.30 local time (14.30-16.30 UK).

- <u>European Astronomical Society EAS-2025 23–27 June 2025</u> University College Cork, Ireland
  - Lunch session The SKA Observatory: preparing the community for SKA science



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 2005 Sept 22-26, Cagliari, Italy https://sites.google.com/inaf.it/phiscc2025
- SALF (Science at Low Frequencies) 2025 Dec 8-12, Orléans, France
- ??



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### **Robert Braun retirement SKAO Science Director 2013-2025**

Robert retires on March 31

### • As the SKAO Science Director (a few key activities):

- led teams in defining the high level science requirements, and the science priorities for the SKA
- face of monetary/design constraints
- engineering/cost and science (e.g. SKA-Low vogel layouts)
- planning of their science programmes

#### • Previously

- One of the originators of the idea of a 1 km<sup>2</sup> radio telescope circa 1990
- Coined the term "Square Kilometre Array" (1994)
- co-edited (with Russ Taylor) the first SKA Science Book in 1999 Science with The Square Kilometer Array, A Next Generation World Radio Observatory (note the use of the term Next Generation ... seen a complementary to the NGST aka JWST)
- Long involvement in SKA activities







championed tirelessly for the science priorities and the need to put the science capabilities of the arrays front and centre even in the

worked hard to ensure the designs of the telescopes, in particular Low, would meet the requirements, campaigning against accepting solutions that would significantly compromise the science while proposing solutions that provide a good trade-off between

provided a detailed view of the anticipated science performance of the telescopes, essential for the science community in early

led the work in setting forth the first timelines for science and operations from the earliest AAs to steady-state operations



### Thank You





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# Reminders



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## **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/displa y/SKAQA/SKAO+Speaker+Series



### **SKAO** SKAO Speaker Series

#### My personal journey as a female astronomer of colour

#### **Cherry Ng**

Permanent Astronomer Centre National de la Recherche Scientifique (CNRS) *Laboratoire de Physique et Chimie de l'Environnement et de l'Espace (LPC2E)* Orléans, France



This talk is a collection of reflections on my career: from X-ray binaries to exoplanets, from pulsars to Fast Radio Bursts and SETI; on the challenges of motherhood and how it shapes my personality, and on the search for my cultural identity moving through six countries.

Wednesday 13 March 2024

10.00am UTC

Click to access the Speaker Series talk here

#### SKAO **SKAO Speaker Series**

#### Establishing an Evolutionary Picture of Fast Radio Bursts



Chief Scientist - FAST

With FAST, the largest single-dish telescope ever built, we have designed the Commensal Radio Astronomy FAST Survey (CRAFTS), which realizes, for the first time at any major facility, simultaneous data recording of pulsar search, HI imaging HI galaxies, and transients (FRB and SETI). CRAFTS has discovered ~200 pulsars, ~10 FRBs including the only persistently active repeater FRB 20190520B, and ~5000 d^2 HI images with 1% calibration consistency, 5-10 times better than what is vailable from Arecibo

RAFTS, we derived a FRB event rate ~ 120K per day per 4pi. We find universal frequency-depender larization among repeating FRBs, which can be well fitted by multi-path scattering and a single free parameter sigma\_RM that described the complexity of the magnetized environments of FRBs. We have published in 2021 the first complete energy distribution toward any FRB, which is clearly bimodal between 10^37 and 10^40 erg. Such bimodality iut in the subsequent monitoring of active repeaters.Recently, 10% drop of FRB 121102's DM on a decade time scale, is being robustly detected. I am proposing an evolutionary picture of FRBs, which aims to unify not only repeating FRBs, but most if not all non-repeaters.

Tuesday 23 April 2024 11.00am UTC (12noon BST) Click to access the Speaker Series talk here







# **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/
- SARAO employee SKA positions (Cape Town, Canarvon) https://www.sarao.ac.za/vacancies/
- CSIRO employee SKA positions (Perth, Geraldton) <u>https://jobs.csiro.au/search/?q=astronomy&locationsearch</u>









## **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  $\sim 2027$ 



# **SKAO Commissioning Timeline**

#### 2022 • AA0.5 SKA-MID Basic imaging and Tied-1000 |= MK@1400MHz Array Beams uGMRT@700MHz Off-line reduction 100 • Limited BW/N<sub>Chan</sub> • AA1 Band 2 10 Plus multiple beams/sub-Band 5 Band 1 stations • AA2 SKA-LOW ب<sup>©</sup> 1000 • Plus pipeline reduction, more BW/ N<sub>Chan</sub> 100 ELOFAR-NL@200MHz Science verification! • AA\* 10 LOFAR-NL@70MHz • Full BW, N<sub>CHan</sub>, zooms 200 MHz • Shared Risk Cycle 0 70 MHz • PI and KSP Proposals!

2022

0.1





## **Any Other Business**

## News from SWG Chairs?

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





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

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