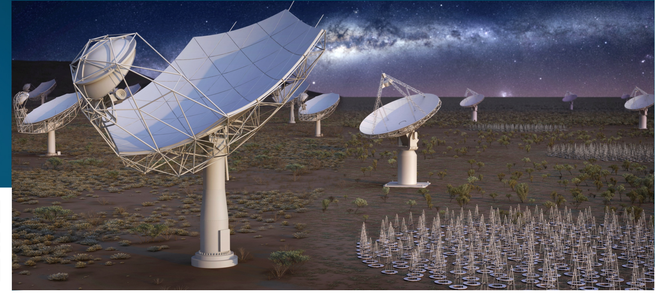
Expected Science Performance of the SQUARE KILOMETRE ARRAY

astronomers.skatelescope.org



Poster available via this QR under "Presentations"

Tyler Bourke, SKA Project Scientist, on behalf of the SKA Science Team

WHAT IS THE SKA?

- The SKA is an ambitious project to build radio telescopes that will enable breakthrough science and discoveries not possible with current facilities
- The telescopes will be located in Australia and South Africa
- When completed it will provide over one million square metres of collecting area
- SKA is being built in two phases. **Phase 1 (SKA1)** is currently nearing the end of its design phase, with construction to start before the end of this decade

SKA ORGANISATION → SKA OBSERVATORY

- The SKA Organisation consists of **10 Member countries** (Australia, Canada, China, India, Italy, Netherlands, New Zealand, South Africa, Sweden, UK), with headquarters on site at Jodrell Bank Observatory.
- Over **600 engineers and scientists** are undertaking detailed design work in the member countries and beyond (incl. Germany, Spain, France, Portugal, Switzerland, Malta, ...) at a cost of over €200M.
- Critical Design Reviews at element and system level in 2018.
- Construction approval expected at end of 2019

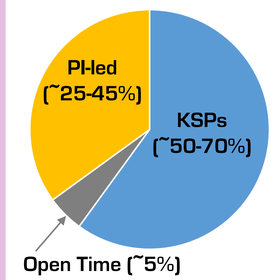
SKA OBSERVATORY

- Member countries currently negotiating an Inter-Governmental Organisation (IGO) structure for SKAO (analogous to ESO, ESA, ...)
- Headquarters in the UK, with scientists, engineers, project managers, operations staff.
- Data processed and archived in host countries at Perth and Cape Town

OBSERVING ACCESS PRINCIPLES

KEY SCIENCE PROJECTS (KSPs)

- Large programs (>1000 h) performed over multiple semesters (nominally 1 year)
- PI & management team from SKA-member countries; co-Is from any country
- Expected to provide added-value data products and tools back to SKAO



PRINCIPAL INVESTIGATOR (PI) PROJECTS

- Small programs (<1000 h) performed within a single semester
- PI and majority of co-Is from SKA-member countries

OPEN TIME (~5% of available time)

- Small programs led by PI from any country, performed with a single semester

TIMELINE – KEY DATES

2019	End of Design Phase, start of Construction Activities
2022	Science Commissioning begins
2026	Shared Risk Science begins
2027/28	Large Projects (Key Science Projects - KSPs) begin

THE MID FREQUENCY TELESCOPE

SKA1-Mid

Off-axis dishes:	133 x 15-m + 64 x 13.5-m (MeerKAT)
Frequency range:	0.35 – 15 GHz (expandable to 24 GHz)
Maximum Baseline:	120 km
Angular Resolution:	0.22" @ 1.7 GHz; 34 mas @ 15 GHz)
Location:	Karoo, South Africa

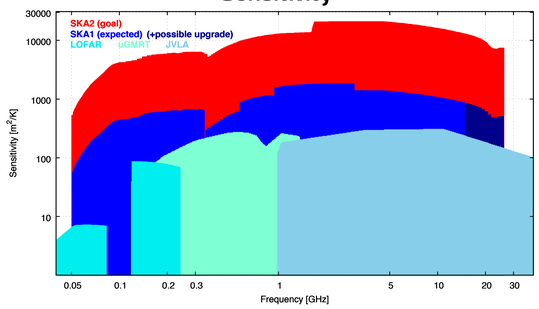
THE LOW FREQUENCY TELESCOPE

SKA1-Low

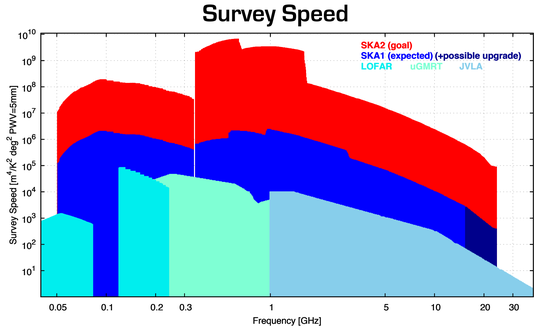
Antennae:	~131,000 log-periodic dipoles
Frequency range:	50 – 350 MHz
Maximum Baseline:	65 km
Angular Resolution:	11" @ 110 MHz; 3.5" @ 350 MHz
Location:	Murchison, Western Australia

EXPECTED IMAGING PERFORMANCE

Sensitivity



Survey Speed



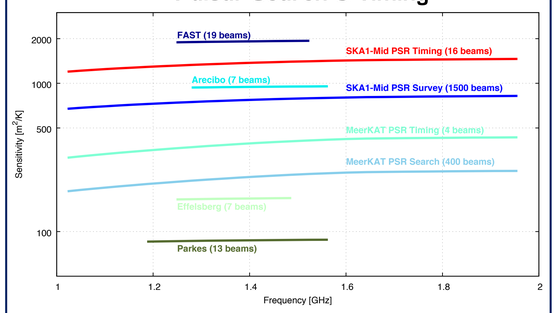
Comparisons of the **expected SKA imaging performance and survey speed** against the current best facilities. Note the angular resolution of SKA1 at > 350 MHz is significantly greater than the other facilities.

For details and more information on imaging and non-imaging performance see the document **"Anticipated SKA1 Science Performance"** using the **QR code** at left

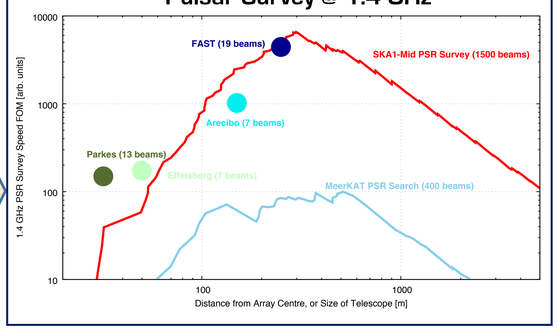
Comparisons of the **expected SKA performance for Pulsar surveys and timing** against the current best facilities. Note the number of beams available for SKA1 pulsar search and timing.

EXPECTED PULSAR PERFORMANCE

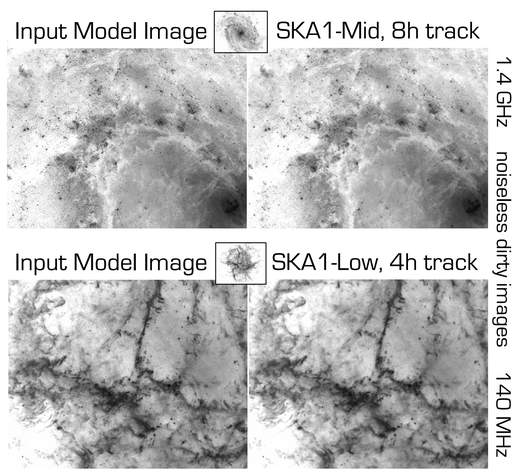
Pulsar Search & Timing



Pulsar Survey @ 1.4 GHz



IMAGING SIMULATIONS

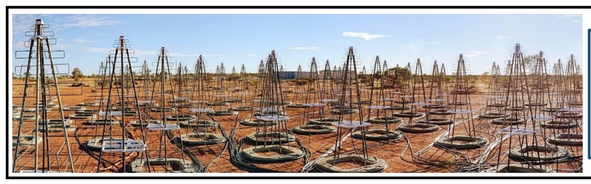


IMAGING SENSITIVITIES IN ONE-HOUR INTEGRATIONS

Frequency [GHz]	Line Sensitivity[a] [μJy per beam]	Continuum Sensitivity[b] [μJy per beam]	Min. Beam Size[c] [arcsec]	Max. Beam Size[c] [arcsec]
0.11	1850	26.0	12.00	600
0.30	800	14.0	6.00	300
0.77	300	4.4	1.00	145
1.40	140	2.0	0.60	78
6.70	90	1.3	0.13	17
12.50	85	1.2	0.07	9

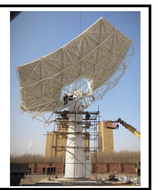
Table Notes:
[a] Line sensitivity assumes fractional bandwidth per channel of $\Delta\nu/\nu = 10^{-4}$ ($>10^{-6}$ will be possible)
[b] Continuum sensitivity assumes fractional bandwidth per channel of $\Delta\nu/\nu = 0.3$
[c] The sensitivity numbers apply to the range of beam sizes given by Min. and Max. beam sizes

The updated SKA Science Case: **Advancing Astrophysics with the SKA** Individual chapters can be found via the **QR code (left)**



SKA1-Low Antenna Array Verification System (AAVS) on site in Australia

SKA1-Mid prototype dish production in China



SKAO HQ expansion at Jodrell Bank Observatory, UK