SKA Prototype Comparison

AAVS2 and EDA2 Installation

AKA “We know you really like that antenna design, but it’s super problematic”

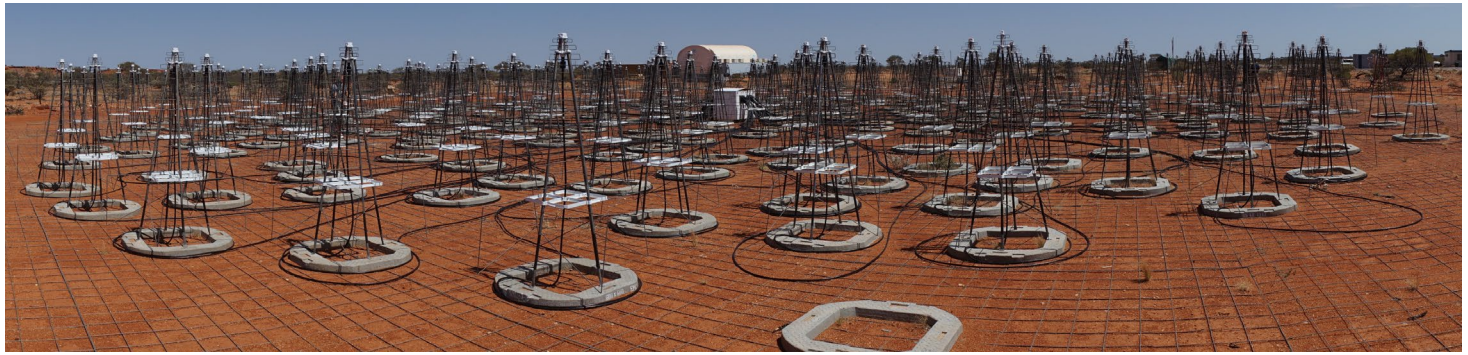
Mia Walker
Project Officer and Electronics Engineer
Curtin University / Murchison Widefield Array

A brief history of SKA prototype stations

- AAVS0.5 (2012)

- EDA1 (2016)

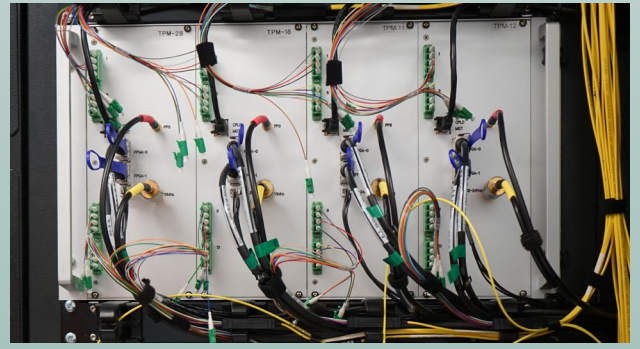
- AAVS1 (2017)



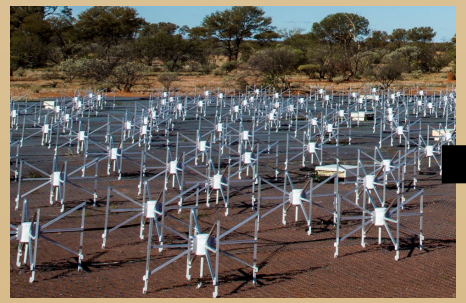
Signal chain, AAVS1 vs EDA1

Antenna, LNA, ADC

APIU



TPM



Antenna, LNA

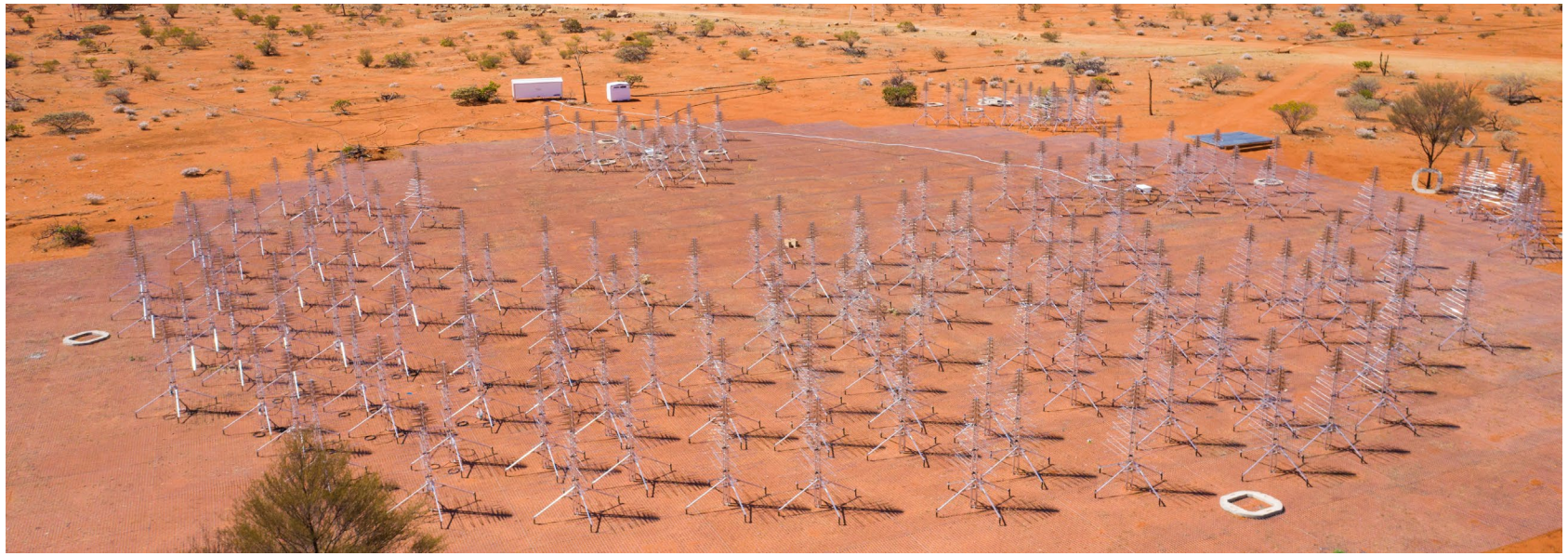
MWA Beamformer

Kaelus Beamformer, ADC

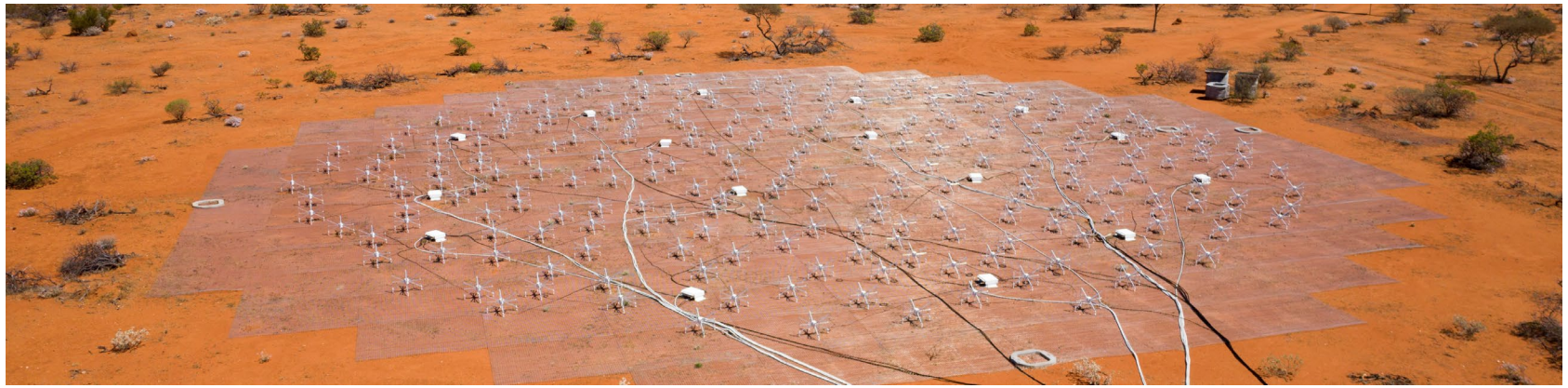
MWA Correlator

Current prototype stations

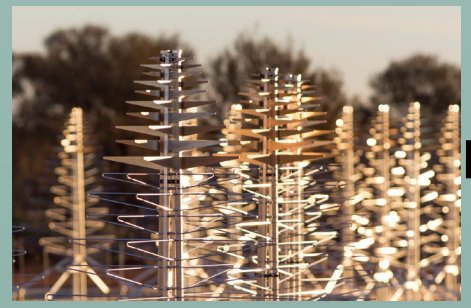
- AAVS2.0 (2019)

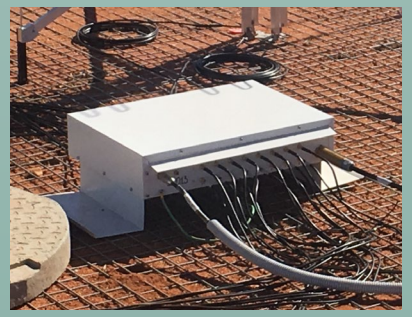


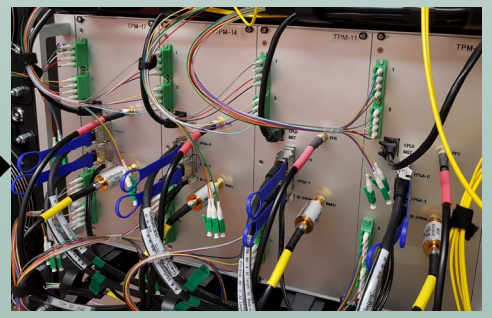
- EDA2.0 (2019)



Signal chain, AAVS2 vs EDA2





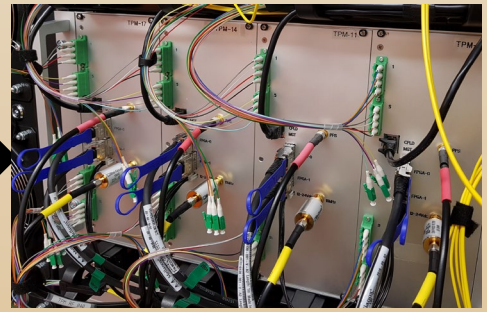


Antenna, amplifier

SMARTbox (RF over fibre)

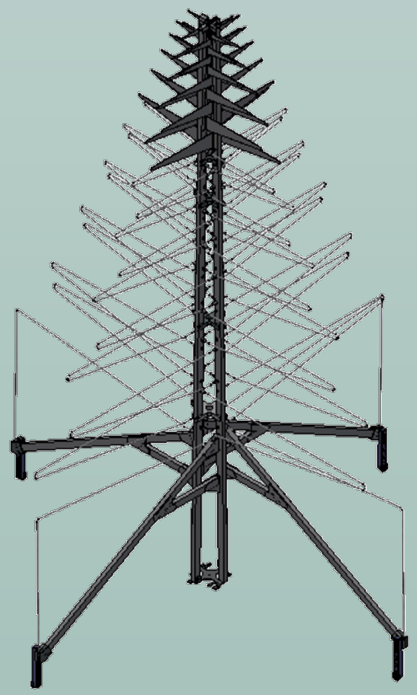
FNDH (Power, signal aggregation)

TPM (ADC, Channelisation, Beamforming)



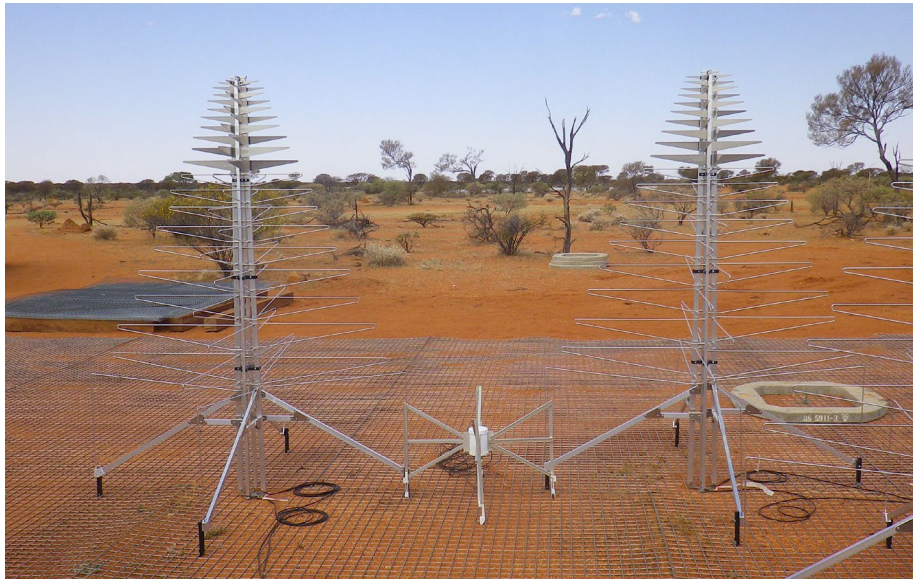
Antennas - Similarities

SKALA4.1 Antenna

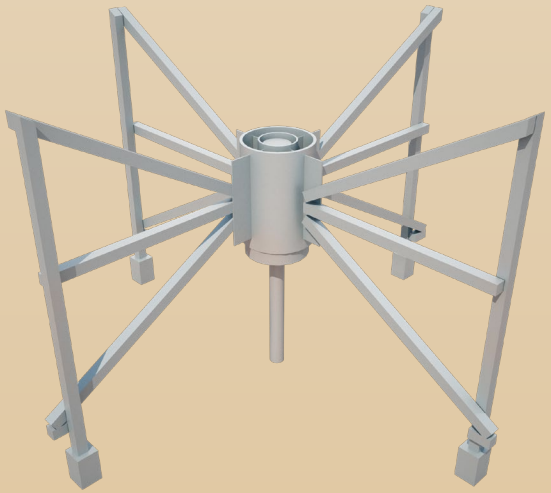


AAVS2

- Frequency: 50-350MHz
- LNAs installed inside antenna
- X&Y copper cables
- Clip-on legs

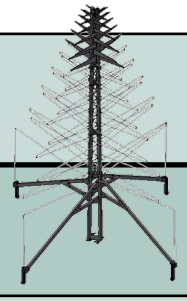
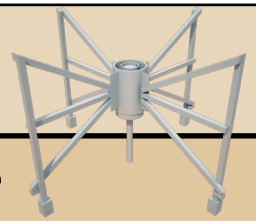


Modified MWA Antenna



EDA1, EDA2

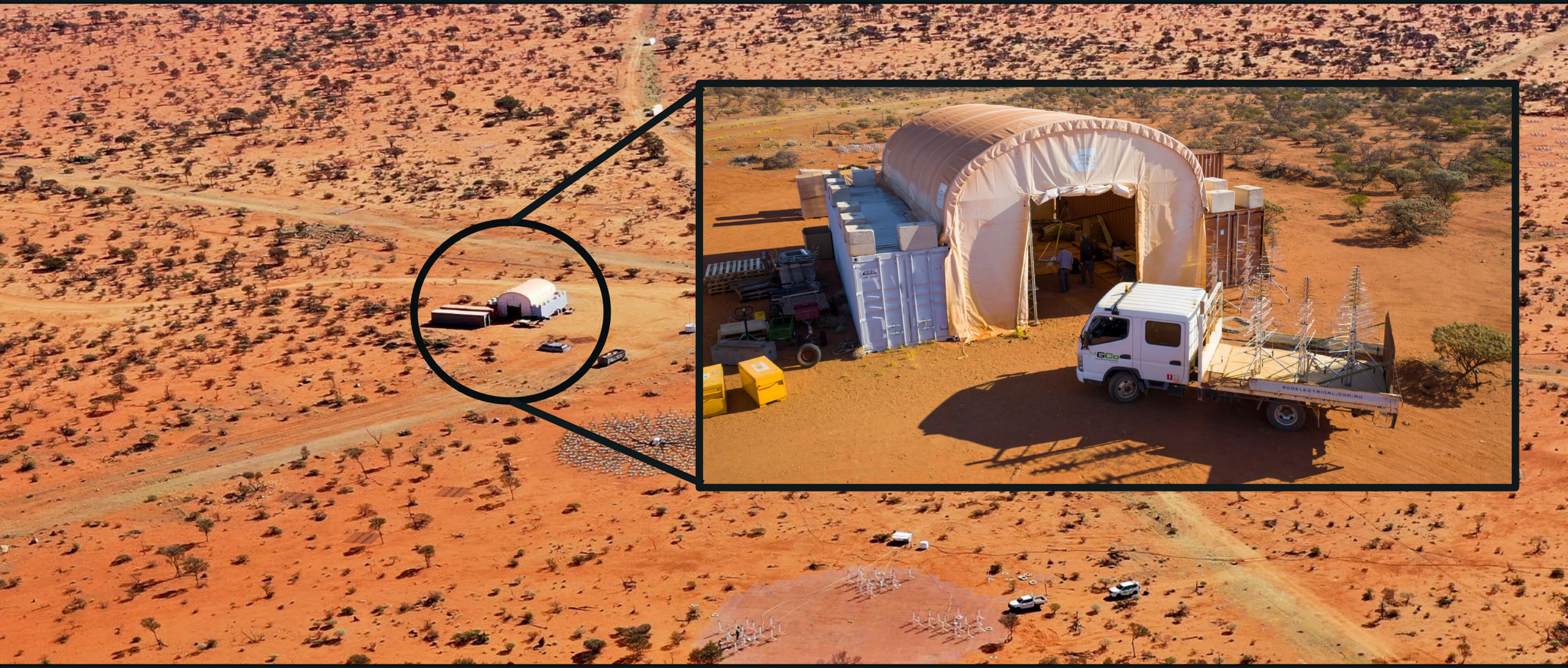
Antennas - Differences

Parameter	SKALA4.1 (AAVS2) 	M-MWA (EDA2) 
Size	2.1m tall x 1.7m wide	0.5m tall x 0.7m wide
Shape	20 dipoles (10 solid, 10 wires)	2 open Aluminium dipoles
RF Power output	40dB	19dB
Build time (1 person from scratch with LNA, not including station install)	51 minutes	5 minutes
Antenna performance	6 months of engineering observations	6 years of experience and science observations
Cost (AUD)	$645	$225

Transport

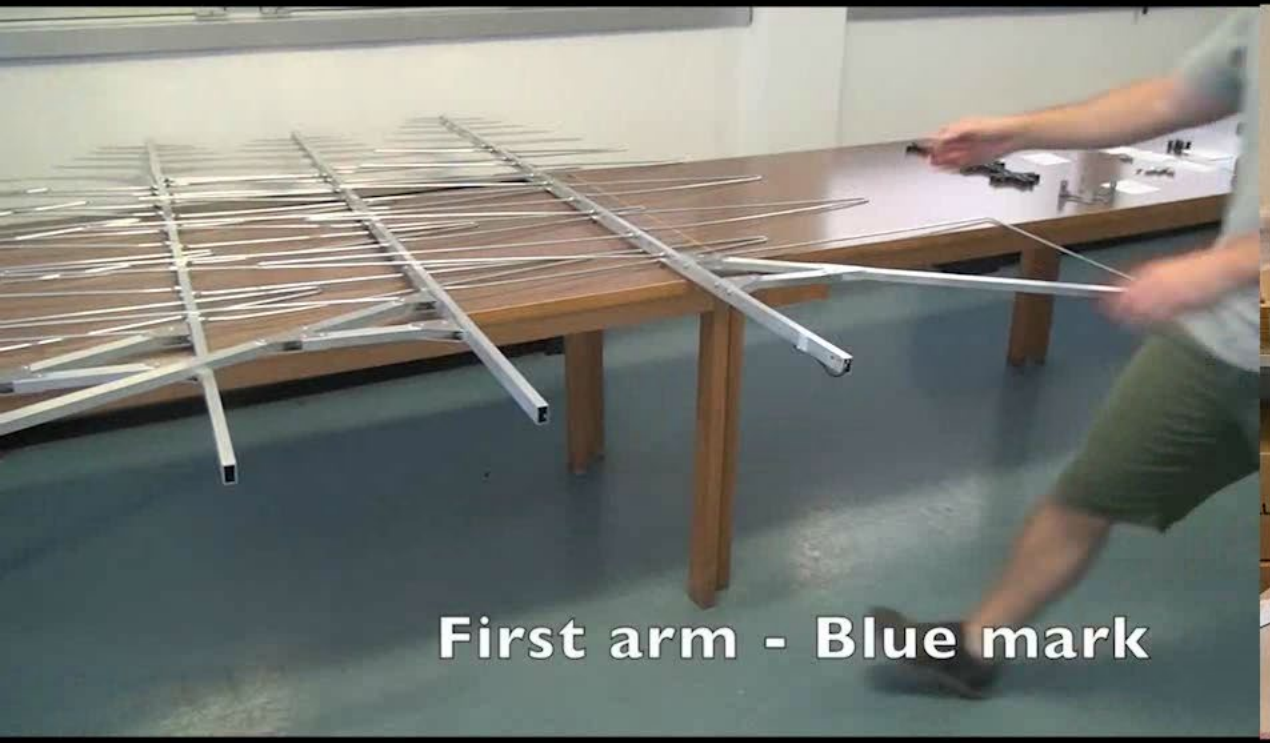
- AAVS2:
  - 31 pallets, 91m³
- EDA2:
  - 5 pallets, 11m³
- All-terrain forklift
- Area for cost reduction
- Packaging needs to be optimised
- Equipment safety

Location

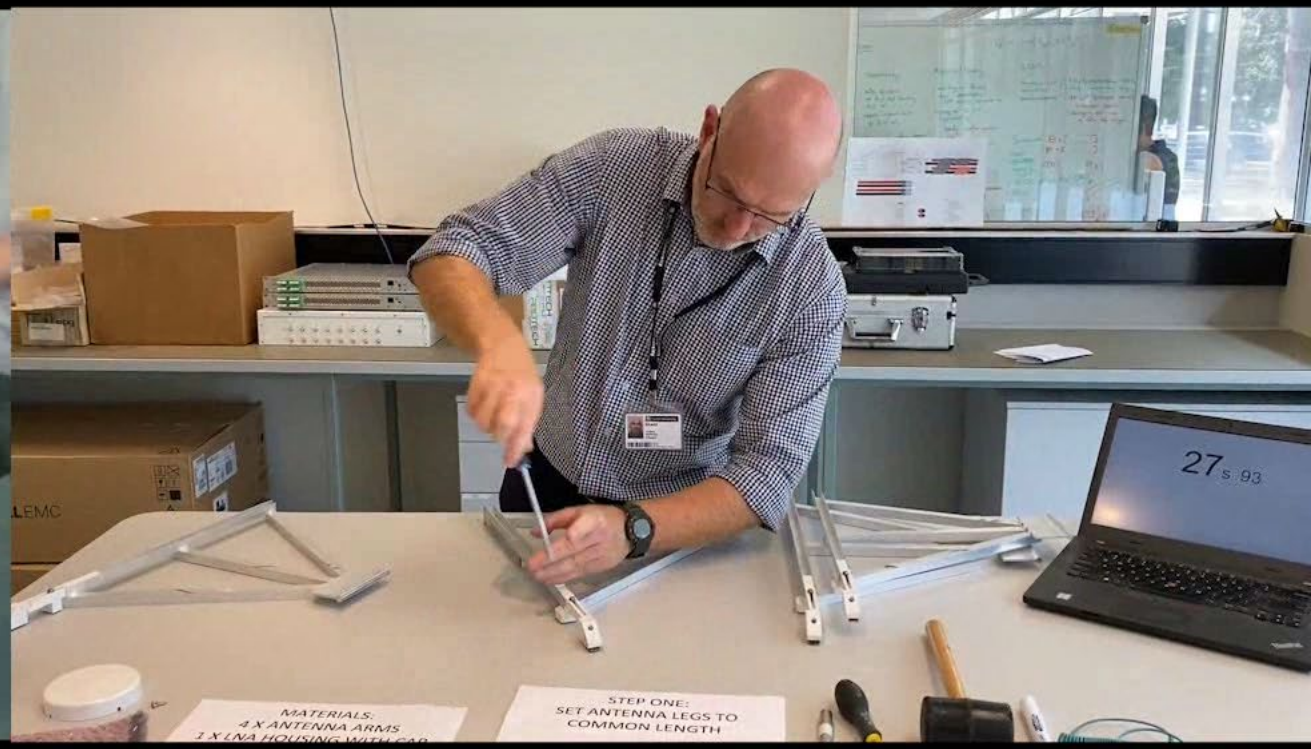


Antenna Assembly

SKALA4.1, AAVS



M-MWA, EDA



Antenna Assembly

EDA2

M-MWA

AAVS1.5

SKALA4.1

AAVS2 Antenna Assembly

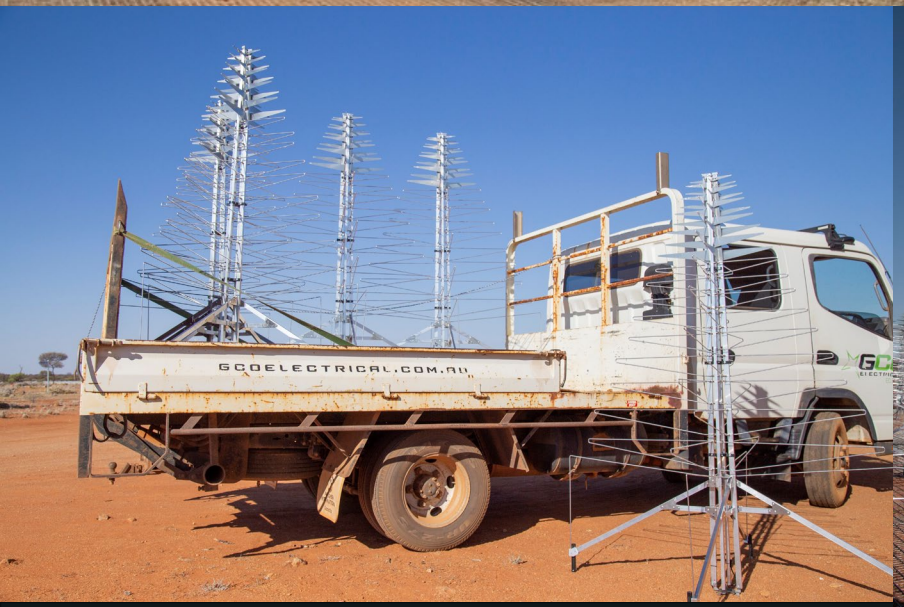
AAVS2 Antenna Assembly

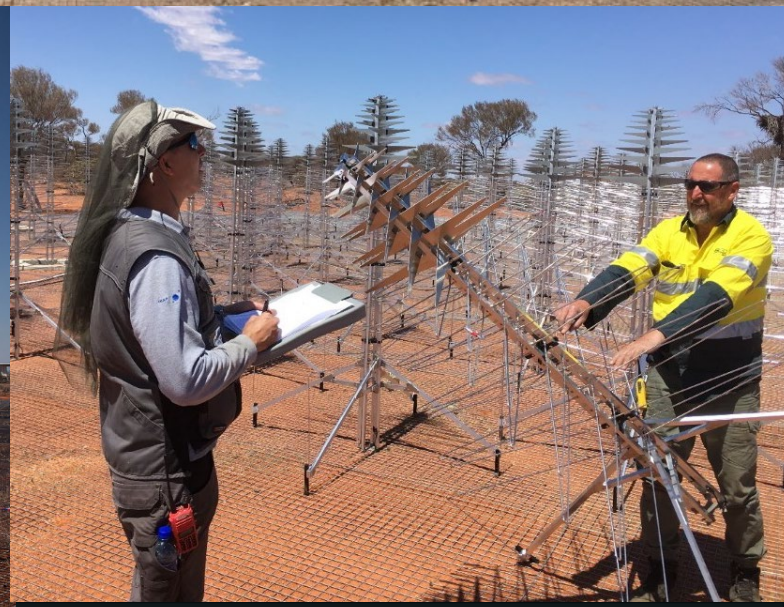
AAVS2 Antenna Assembly

EDA2 Installation

Surveying antenna locations

AAVS2 Installation





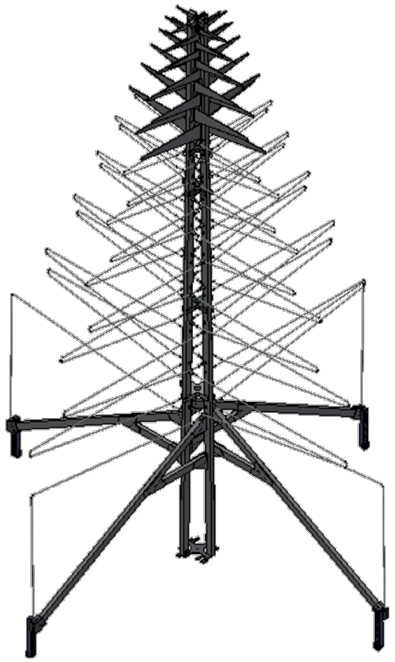
Waste

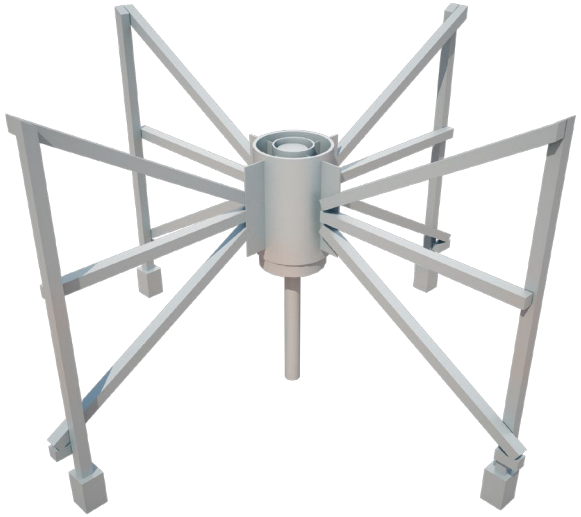
- AAVS2: 20m³
- EDA2: 3m³
- No waste disposal on site
- Reduce single use items
- Environmental concerns

Install Conclusions

Parameter	SKALA4.1 (AAVS1.5)	SKALA4.1 (AAVS2) 	M-MWA (EDA2) 	SKALA:MWA
Packaging scaled for one full station (256 antennas)	6 pallets, each approximately 1.55x1.4x0.86m	2 Standard 40 ft Shipping Containers with 25 pallets	5 pallets, 1.2mx1.2x.15m	5:1
Volumetric density – total packaged volume for 256 antennas, including LNAs and cables	11.88 m^3/station	91.26 m^3/station	10.8 m^3/station	9:1
Unpacking (Hrs)	2.5 Hrs	N/A	N/A	-
On Site Line Assembly – unpacking to LNA install (min/antenna/per)	51 mins/ant/pers	19 mins/ant/pers	4 mins/ant/pers	5:1
Installation Time onto mesh without cabling	1.5 mins/antenna	1.5 mins/antenna	0.5 min/antenna	3:1
Waste generated from packaging	~4 m^3/station	~20 m^3/station	~3 m^3/station	7:1
Cost per station (AUD, excluding freight)	N/A	**~$198,600**	**~$39,300**	**5:1**

Install Cost (exc freight) for SKA-Low, in AUD

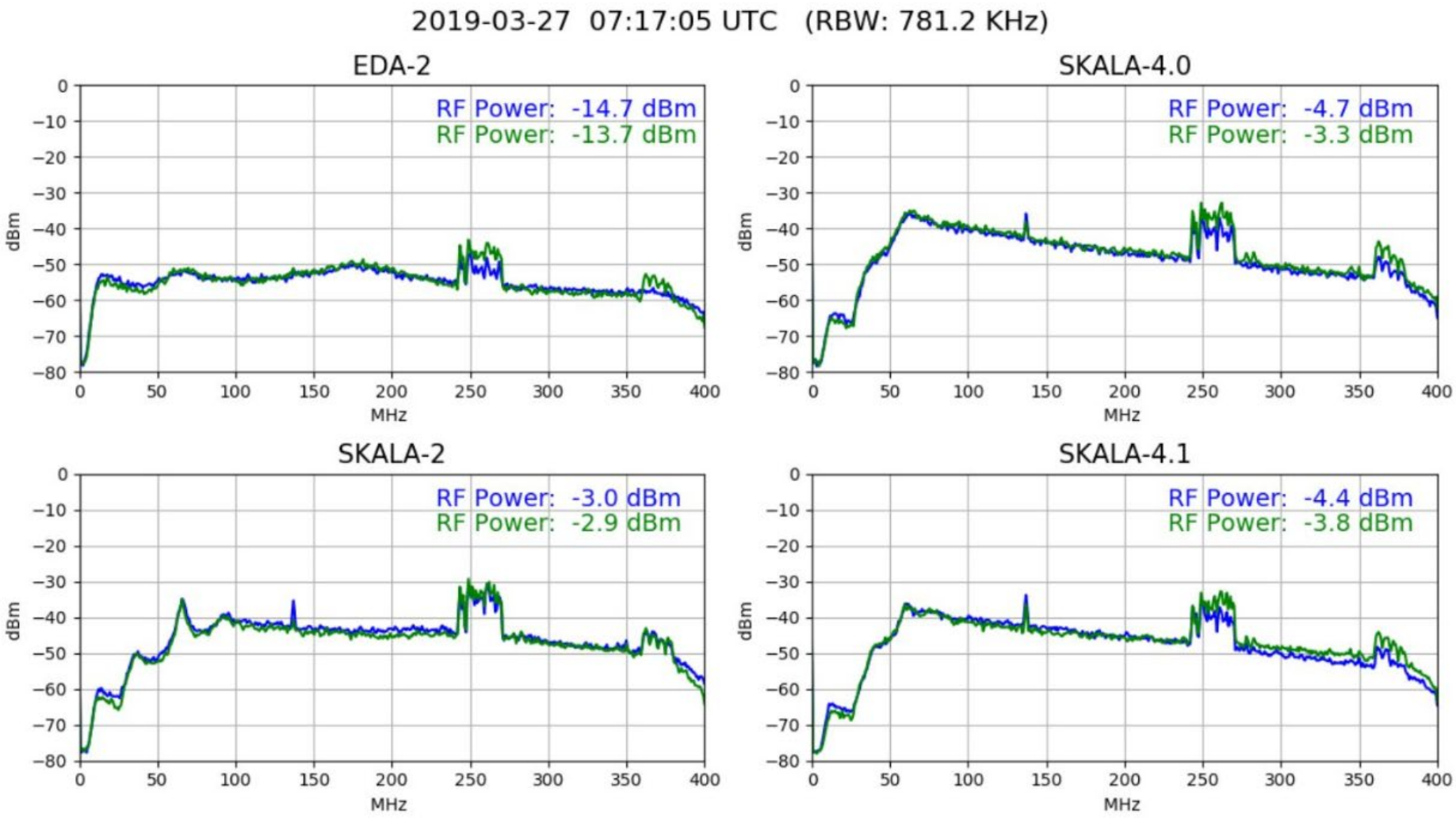




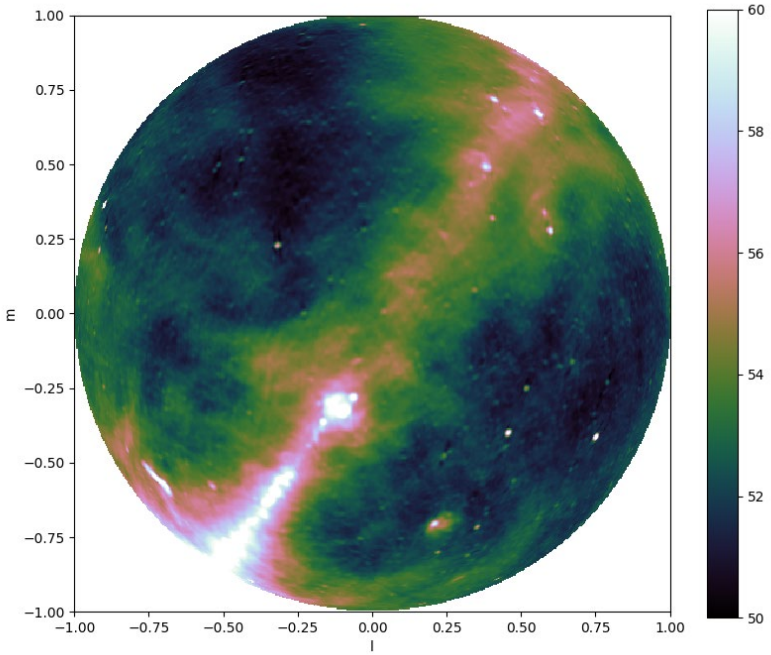
~$101.6M

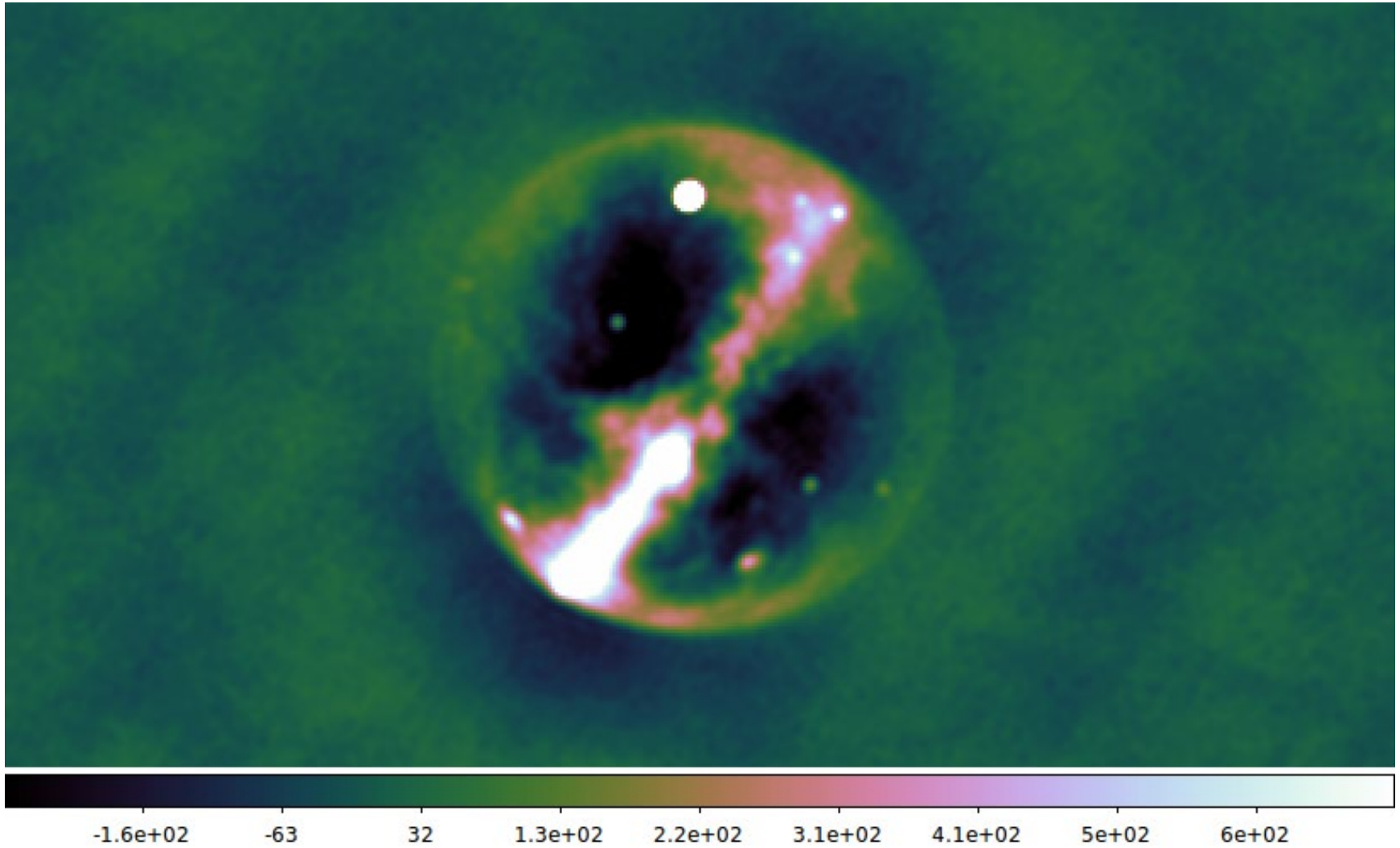
~$20.1M

Results on the way!



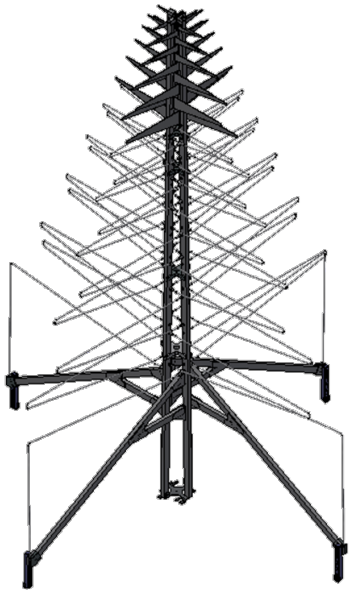
EDA2 First Light (Left: Simulated sky)

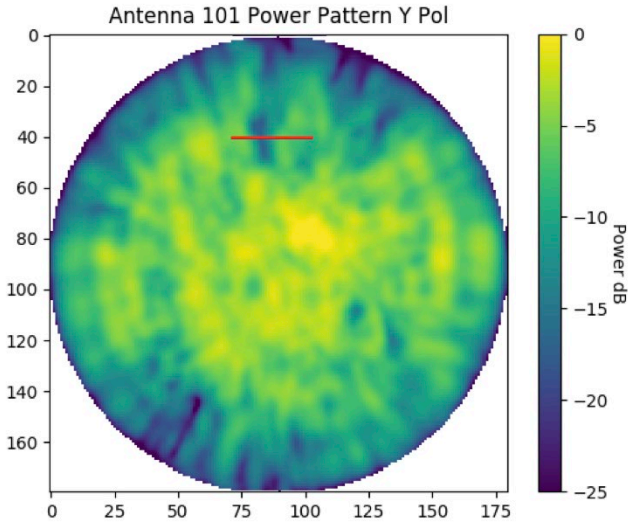


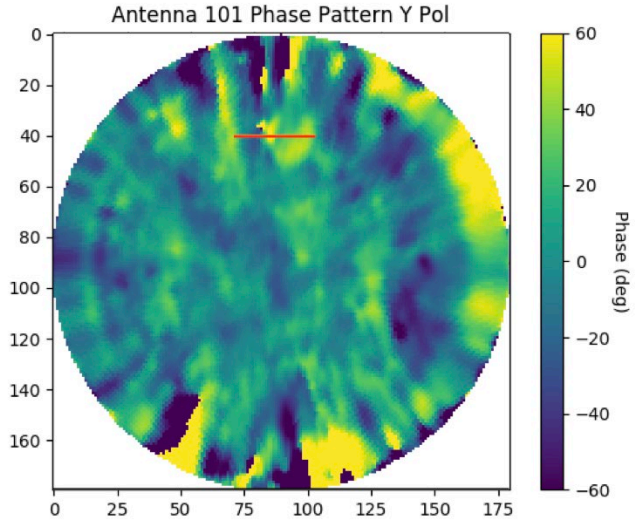


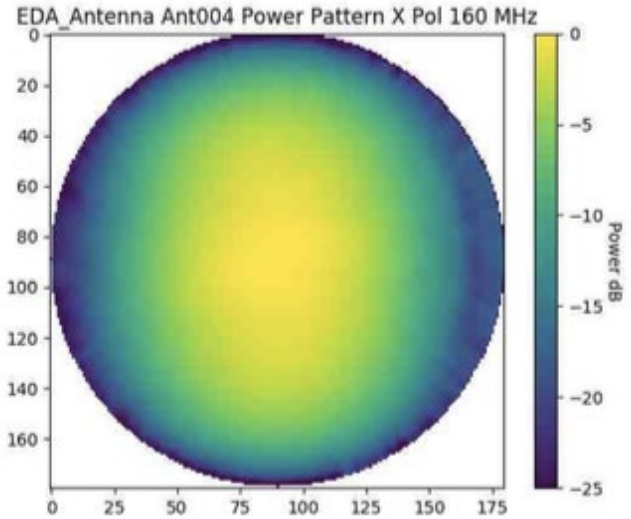
Close coupling effects

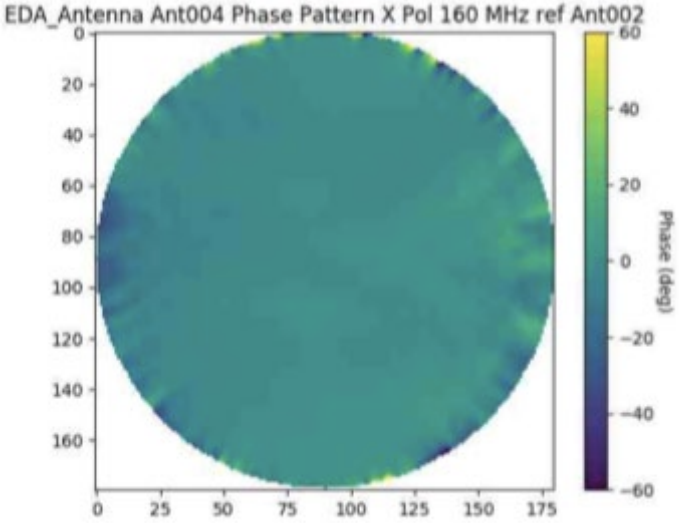
SKALA4.1 Antenna



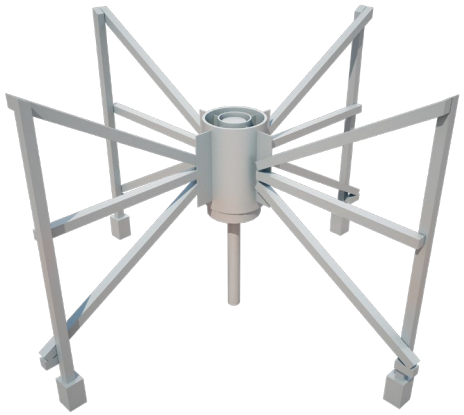






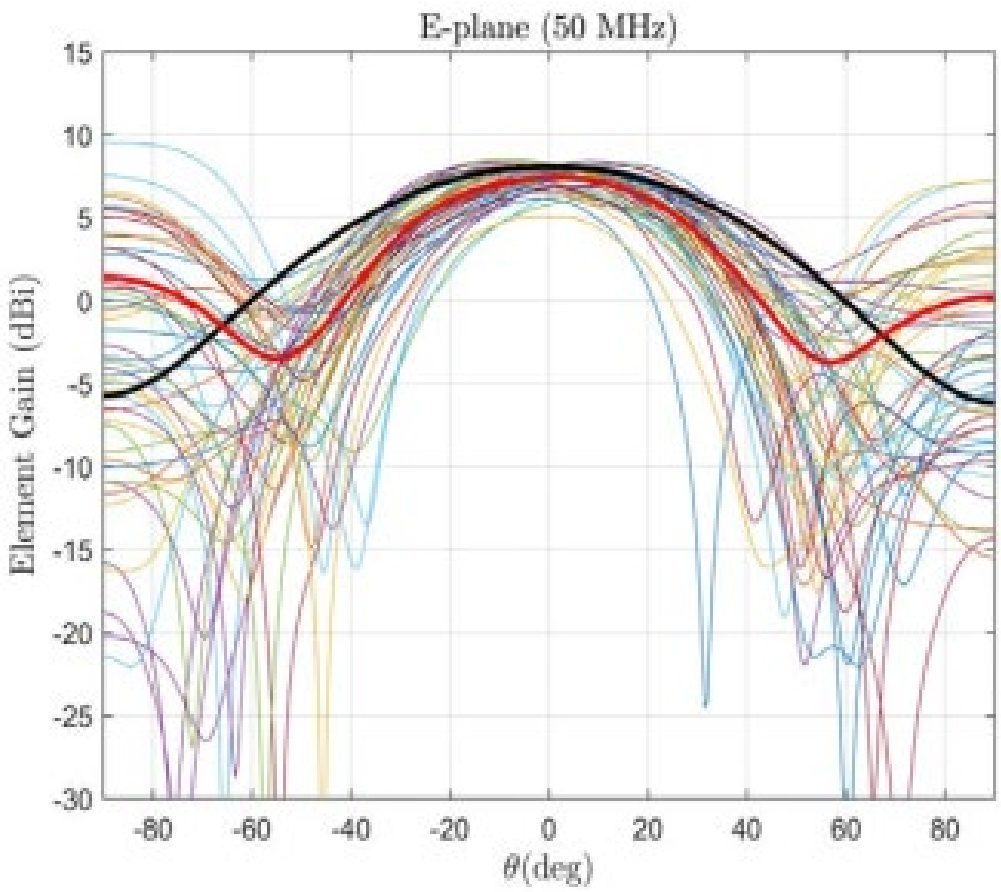


M-MWA Antenna



Embedded element patterns

SKALA4.1 Antenna, AAVS2



M-MWA Antenna, EDA2