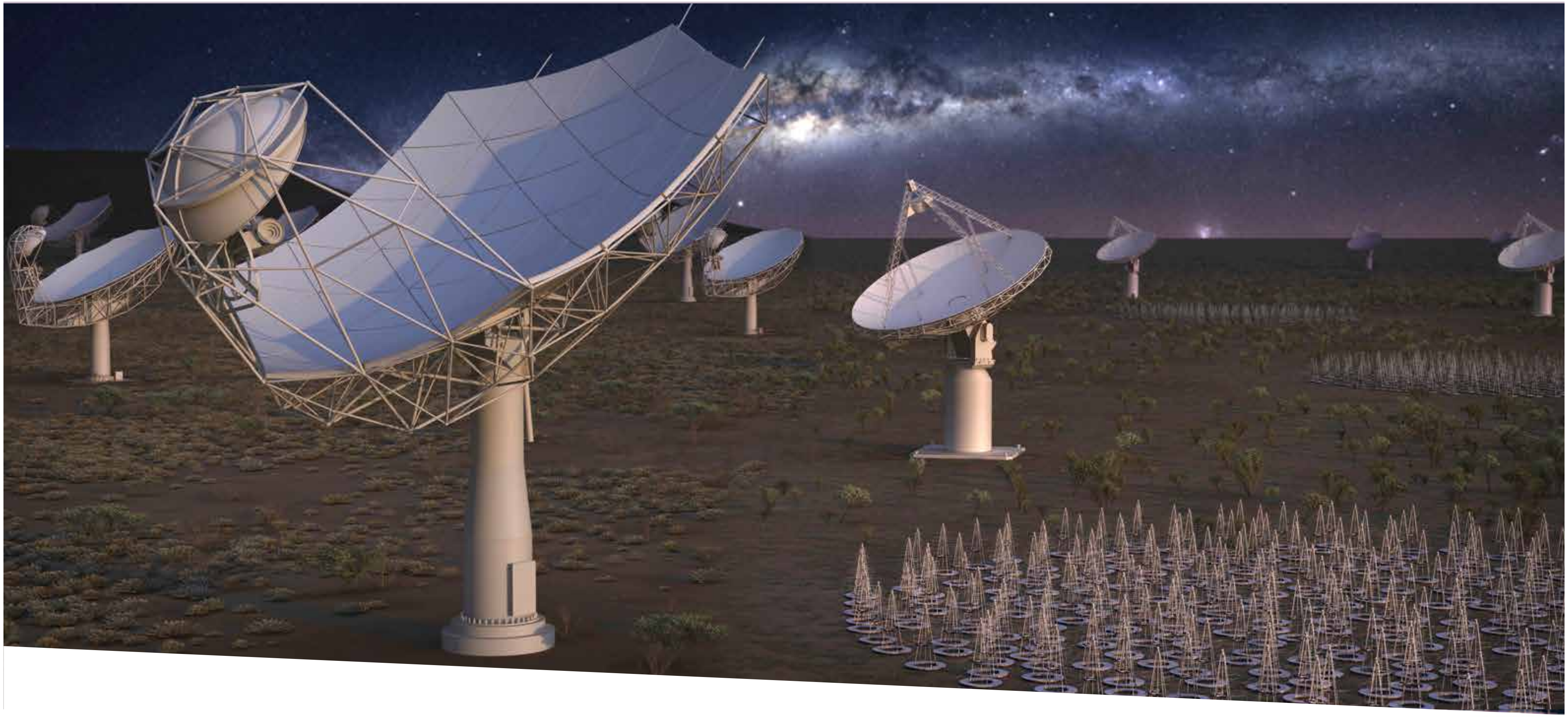
SKA SWG Update



SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

Robert Braun, Science Director

11 April 2017

Cost Control Process

- Board decision March 29/30 was as follows:
  - Further investigation of Design Space that incorporates components of "Scenario 3" (sequential minimisation of Science Impact) and "Scenario 8" (re-use of precursor technologies)

Cost Control Process

- Specific items for detailed technical study
  - SKA1-Low Beamforming
    - early digitisation versus analogue
  - SKA1-Mid Correlator
    - CSP Frequency Slice versus MeerKAT-based designs
  - SKA1-Low Antenna
    - Fresh look at optimised antenna design, LPD versus dipole
  - SKA1-Mid Freq and Time reference
  - SKA1-Mid MeerKAT-based "data capture engine"
  - SDP Execution Framework

Cost Control Process

- Science Assessment Team 1/3
  - Impact on EoR/CD of changes to SKA1-Low maximum baseline length
    - Emma Chapman (ICL, Chair), Sarod Yatawatta (ASTRON), Gianni Bernardi (SKA-SA), George Heald (CSIRO)
    - Establish the range in baseline lengths that are required for accurate EoR/CD foreground modelling and subtraction

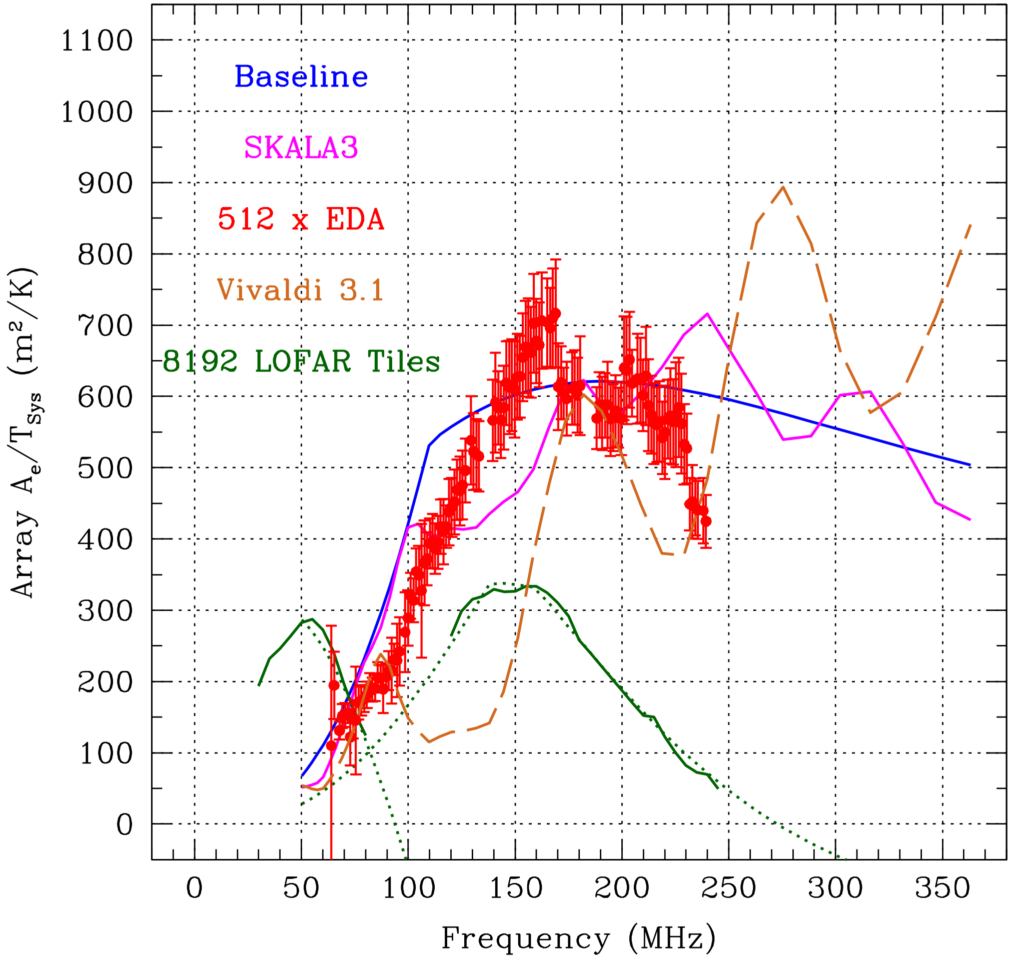
Cost Control Process

- Science Assessment Team 2/3
  - Required timing accuracy to enable successful precision pulsar timing science
    - Andrea Possenti (INAF, Chair), Ingrid Stairs (UBC), Ben Stappers (UMan), Scott Ransom (NRAO)
    - Confirming, or not, the science requirements for precision pulsar timing capabilities with SKA1

Cost Control Process

- Science Assessment Team 3/3
  - Impact of SKA-Low antenna frequency coverage
    - Leon Koopmans (UGroningen), James Aguirre (UPenn), Annalisa Bonafede (INAF), Jason Hessels (UAmsterdam), Chiara Ferrari (ObsCoAz), Divya Oberoi (NCRA), Philippe Zarka (ObsPM)
    - Assess and document the scientific implications of a reduction of the optimised(/total) frequency coverage of the SKA1-Low antenna system from its current 100–300(/50–350) MHz range to the more restricted optimised range of 100–200(/50–350) MHz

SKA1-Low Alternate Antennas



- Science impact of changes to frequency optimisation range of the SKA1-Low antenna
- EDA data (170 – 200 MHz impacted by RFI) from Wayth et al 2017, in prep.

Draft Plan

- Sequence of reinstatable (via extra funding) measures to achieve construction Cost Cap
- Ordering of measures (top to bottom) is attempt to reflect science impact – needs SWG review / update
- Some line items represent “competing” options for which a future down-select would occur

WS	Description	Alternate Design Description	LOW MID COMM	Comment	Science Impact
5.39	**INFRA_SA Renewable energy to outer dishes**		MID	Applied to 9 outer dishes	1
5.34	**Maximise use of code produced during Pre-Construction**		COMM	GMRT, ASKAP, MeerKAT – further investigation (€12M claimed)	1
5.38	**Simplify DDBH LOW**		LOW		1
5.38	**Simplify DDBH MID**		MID		1
5.25.2	**Reduce PSS-MID: A, 750 nodes to 500 nodes**		MID	From 2 to 3 Beam/node	1
5.25.2	**Reduce PSS-LOW: A, 250 nodes to 167 nodes**		LOW	From 2 to 3 Beam/node	1
5.35	Reduce CBF-MID: Frequency Slice variant of CSP design	Reduce CBF-MID: MeerKAT-based design	MID	It is still possible to have the 5GHz full bandwidth at the cost of the other parametres. Therefore DSH is delivering the full bandwidth.	1
5.19	MID Frequency and Timing Standard (SaDT solution)	MID Frequency and Timing Standard (MeerKAT-based solution)	MID		1
5.19	MID SPF Digitisers (DSH solution)	MID SPF Digitisers (MeerKAT-based solution)	MID		1
5.26/5.29	LOW RPF: Early Digital Beam Formation	LOW RPF: Analogue Beam Formation	LOW		1
2	LOW: Log Periodic Antenna Design	LOW: Dipole Antenna Design	LOW	None of the current designs meet the L1 requirements	3
8	**SDP- HPC: Deploy 200 Pflops (rather than 260 Pflops)**		COMM	Science Risk to HPC-intensive objectives (lower allowed duty cycle)	2
5.24.3	**Reduce Bmax MID to 120 km: A, remove 3 dishes, but keep infra to 150km**		MID	Reduced number of dishes, prepare for dishes	2
5.24.2	**Reduce Bmax MID to 120 km: B, remove infra, but add dishes to core**		MID	(1.5 in renewable power savings not realised for outer 3 dishes)	2
5.24.1	**Reduce Bmax MID to 120 km: C, remove infra, remove dishes**		MID	(1.5 in renewable power savings not realised for outer 3 dishes)	2
5.13.2	**Reduce Bandwidth output of band 5 to 2.5GHz**		MID	Longer SPF5 observing times (2x)	2
5.13.2.1	**Reduce MID Band 5 feeds: A, from 130 to 67**		MID	Deploy in arms, but not core. High res HPSOs OK, low res	2
5.25.2	**Reduce PSS-LOW: B, 167 nodes to 125 nodes**		LOW	Reduction in PSS parameter space (1.3x)	2
5.25.2	**Reduce PSS-MID: B, 500 nodes to 375 nodes**		MID	Reduction in PSS parameter space (1.3x)	2
5.35	**Reduce MID CBF BW: 5 to 1.4 GHz (1.4 GHz imaging all bands, 1500 beams Pulsar 300MHz, 16 beams PST 1.4 GHz, zoom windows)**		MID	Included the 2.3 from DSH	2
5.31	**Reduce CBF-LOW BW: A, 300 to 200 MHz**		LOW	Longer observing times (1.5x)	2
8	**SDP- HPC: Deploy 150 Pflops (from 200 Pflops)**		COMM	Science Risk to HPC-intensive objectives (lower allowed duty	3

WS	Description	Alternate Design Description	LOW MID COMM	Comment	Science Impact
5.30.0	Reduce Bmax LOW to 50km: A, remove infra, add 18 stations to core		LOW	High Science Risk to EoR: Bmax. With Deployment in the inner core.	3
5.30.0	Reduce Bmax LOW to 50km: B, remove 18 stations		LOW	High Science Risk to EoR: Bmax	3
5.25.2	Reduce PSS-LOW: B, 125 nodes to 83 nodes		LOW	Reduction in PSS parameter space (2x)	3
5.25.2	Reduce PSS-MID: B, 375 nodes to 250 nodes		MID	Reduction in PSS parameter space (2x)	3
5.30a	Reduce Bmax LOW to 40km: B, remove next 18 stations		LOW	High Science Risk to EoR: Bmax	3
8	SDP- HPC: Deploy 100 Pflops (from 150 Pflops)		COMM	Science Risk to HPC-intensive objectives (lower allowed duty cycle)	4
8	SDP- HPC: Deploy 50 Pflops (from 100 Pflops)		COMM	Science Risk to HPC-intensive objectives (lower allowed duty cycle)	4
5.24	Remove 11 MID Dishes from core		MID	10% Sensitivity loss in core	4
5.30	Remove 54 LOW stations from core		LOW	10% Sensitivity loss in core	4
5.24	Remove additional 11 MID Dishes from core		MID	20% Sensitivity loss in core	4
5.30	Remove additional 54 LOW stations from core		LOW	20% Sensitivity loss in core	4
5.24.a	Reduce Bmax MID to 100 km: D, remove infra, remove next 3 dishes		MID	Lose Science (Planetary disks, High res Star Formation)	4
5.5.1	Remove MID Band 1 feeds: 108 to 0		MID	Lose Science (Cosmology, Galaxy Evolution) Excluded the already counted 6 Band1 because shorter baseline	4
5.5.2	Reduce MID Band 5 feeds: B, from 67 to 0		MID	Lose Science (Plantary disks, Star Formation) Excluded the already counted 6 Band5 because shorter baseline	4

- Cost Cap is reached at the heavy line
- Measures below the line represent further, less desirable, measures
- Extensive Workstream documentation on each measure available in Confluence – request access if you want it

SKA Science Town Hall Meeting

- May 18+19 near JBO (Cottons Hotel, Knutsford)
  - Lists of nominees from each SWG/FG
  - Seek broad representation of science areas and member community
- Preliminary reports from the three Science Assessment Teams (Pulsar timing reqs., Low B_{Max}, Low Freq. Opt.)
- Preliminary Science Assessments from each SWG / FG which:
  - Endorse or suggest reordering of items in the cost savings measures list (document available shortly with more explanation)
  - Affirm or not the transformational science capability of the cost-capped observatory
- Final written reports from both SATs and SWG/FGs needed by 1 July for July Board Meeting

Any Other Business

- ???

SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

www.skatelescope.org