The Australian Square Kilometre Array Pathfinder (ASKAP): an SKA pre-cursor

Robert Braun

www.csiro.au

CSIRO

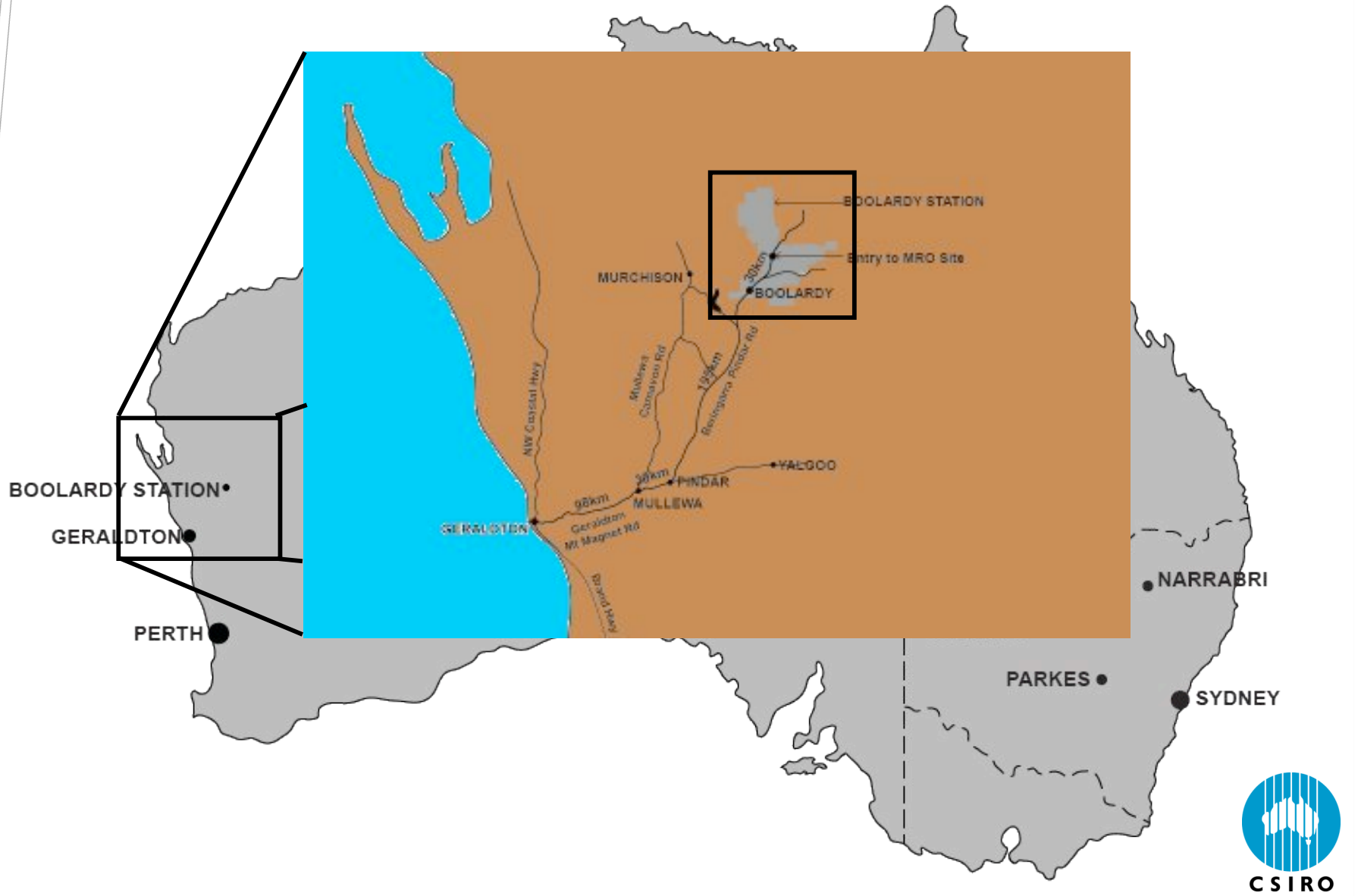
ASKAP Design Goals

High-dynamic range, wide field-of-view imaging

Number of dishes	36
Dish diameter	12 m
Max baseline	6 km (30 dishes inside 2 km)
Resolution	8 - 180″
Sensitivity	65 m^2/K
Speed	1.3×10^5 $m^4/K^2 \cdot deg^2$
Observing frequency	700 – 1800 MHz
Field of View	30 deg^2
Processed Bandwidth	300 MHz
Channels	16384
Integration time	5 seconds
Focal Plane Phased Array	192 elements

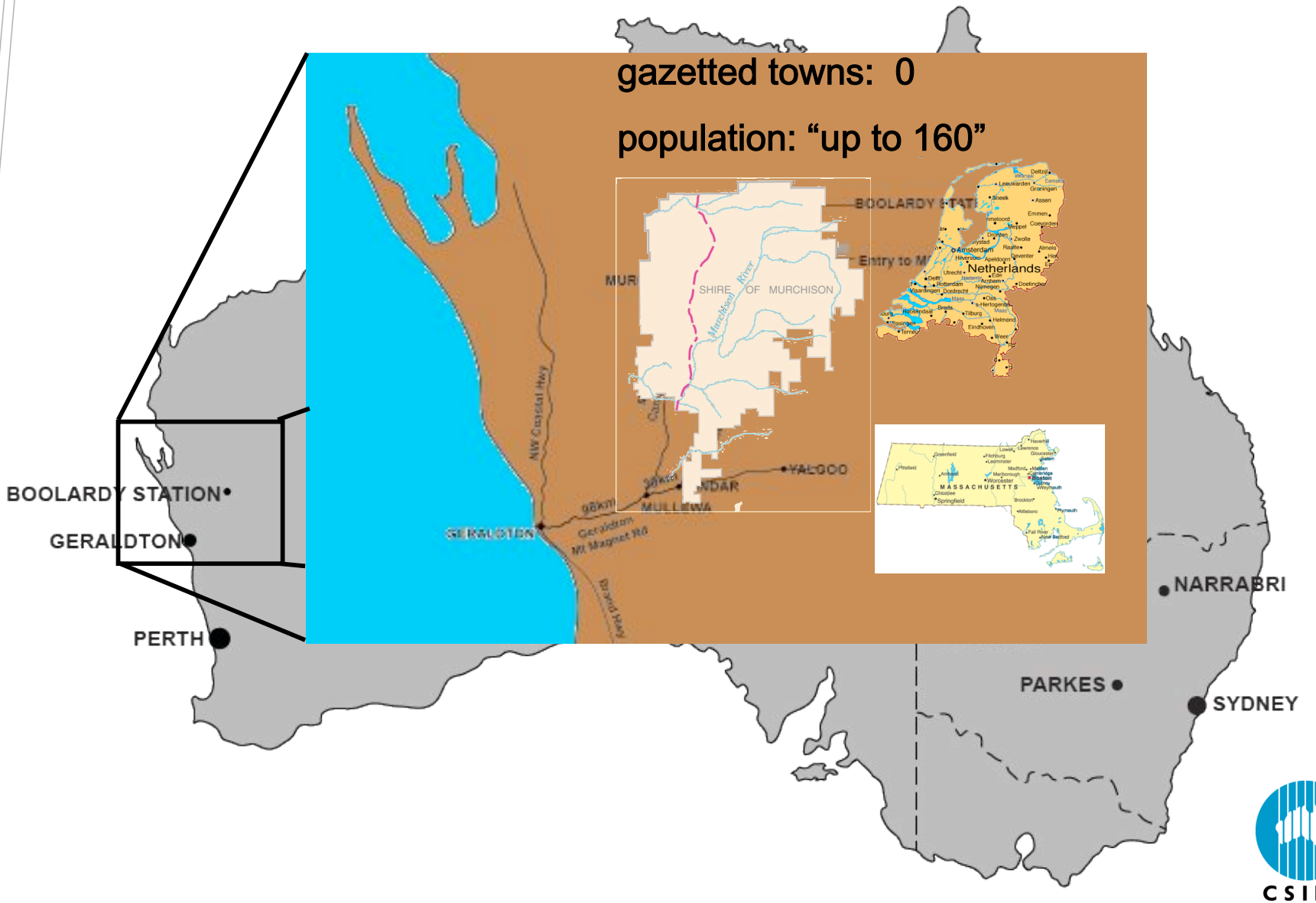
+ Infrastructure for new SKA-ready observatory
  Murchison Radio Observatory (MRO)

Murchison Radio Observatory



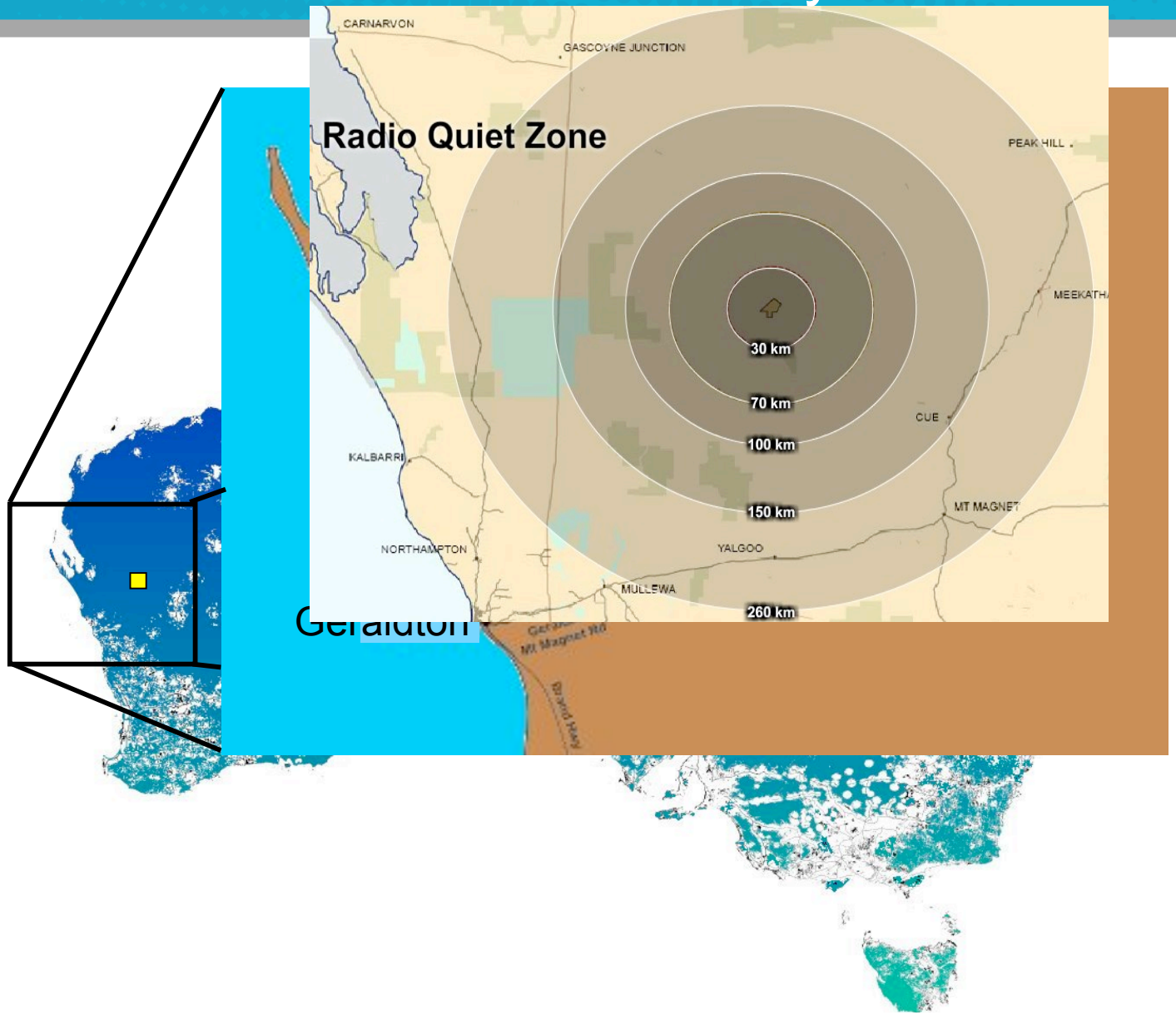
CSIRO

Murchison Radio Observatory

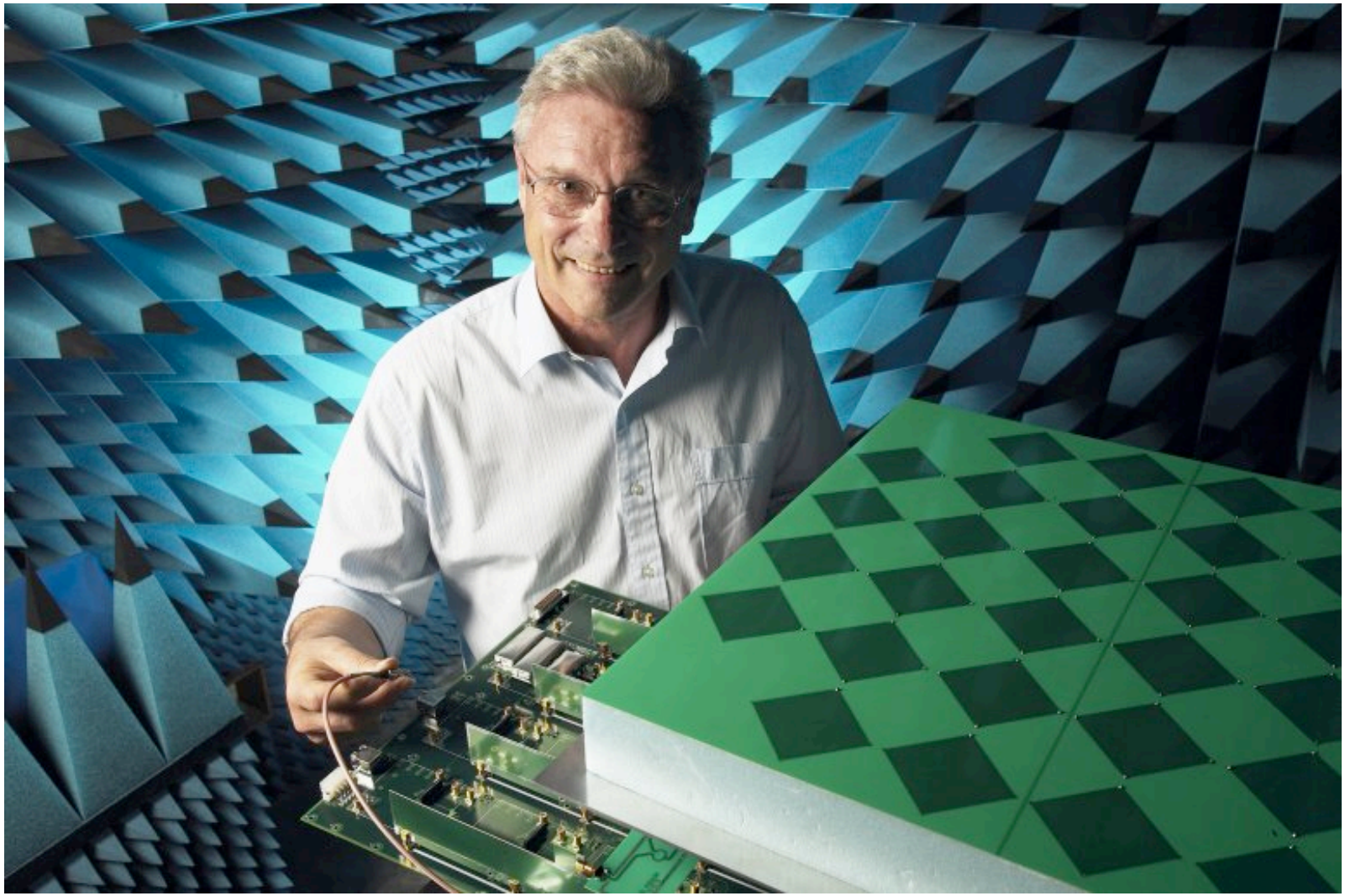


CSIRO

Murchison Radio Observatory

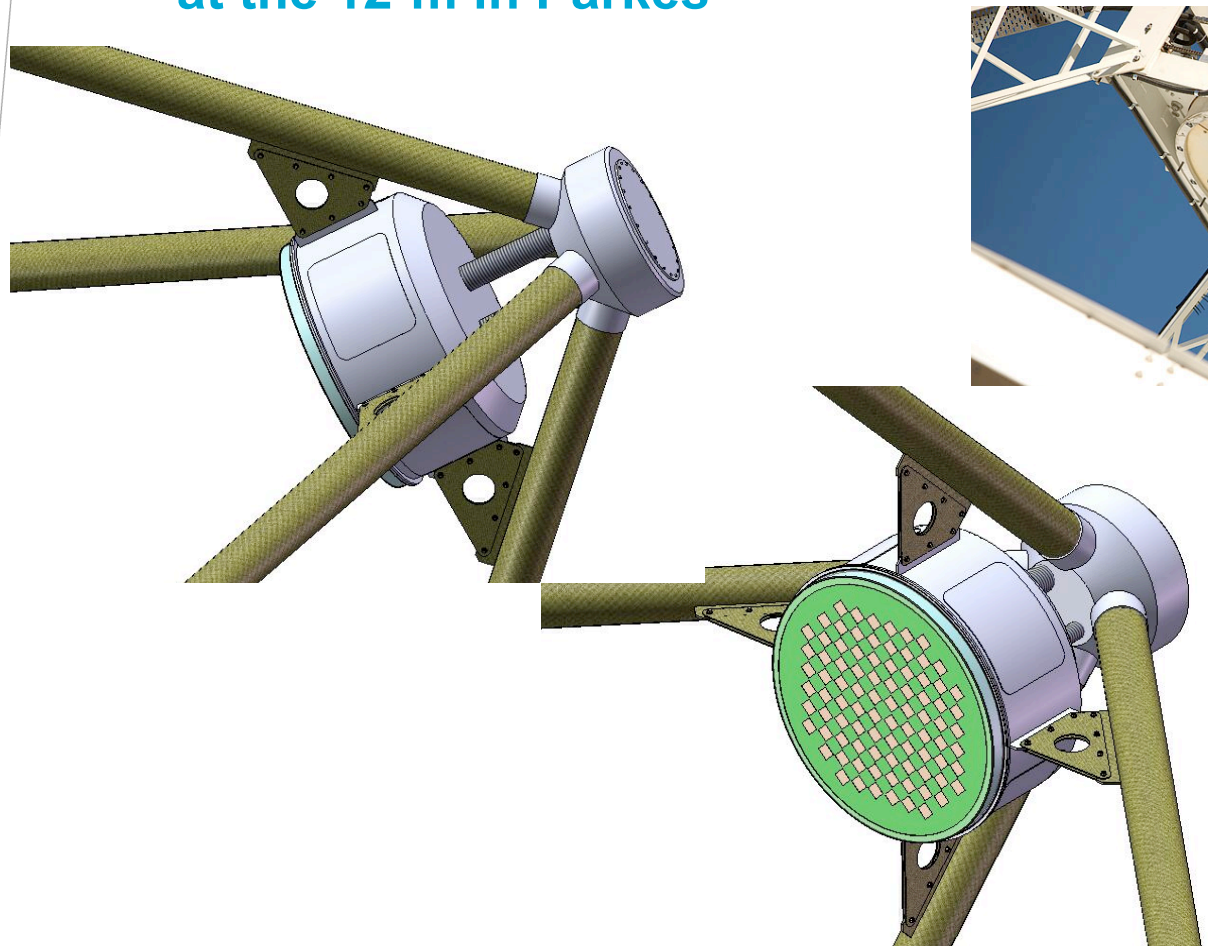


Phased Array Feed



Phased Array Feed

- **Focal Plane Array research and development continues at the 12-m in Parkes**



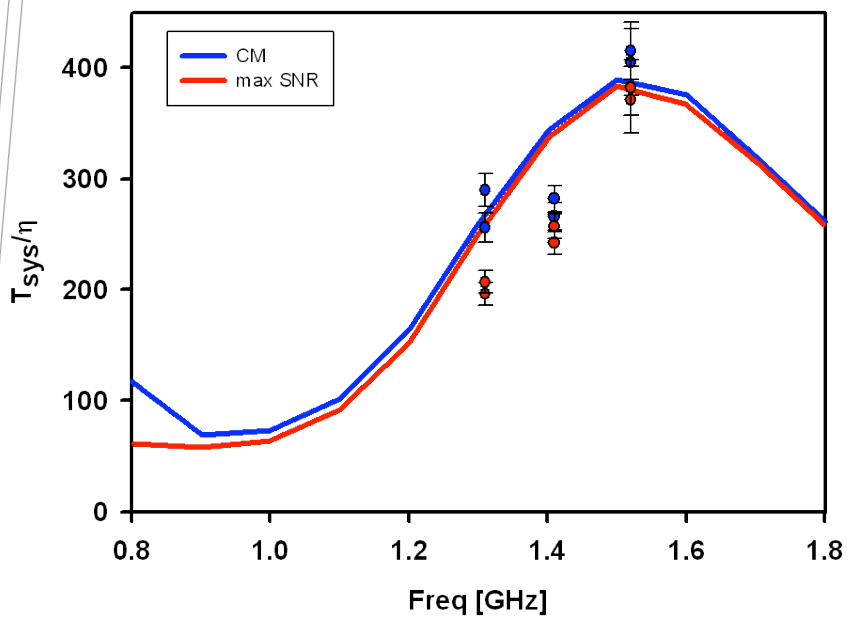
Parkes Testbed Antenna

CSIRO

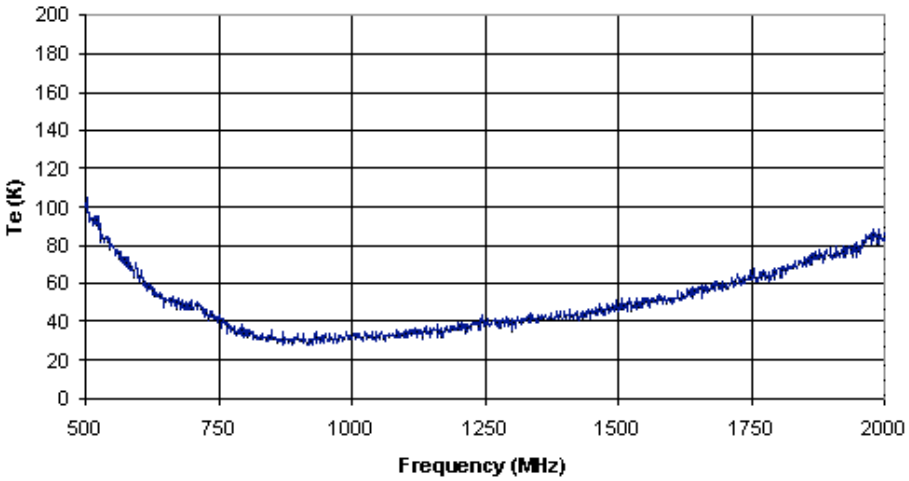
Phased Array Feed

- **Current performance**

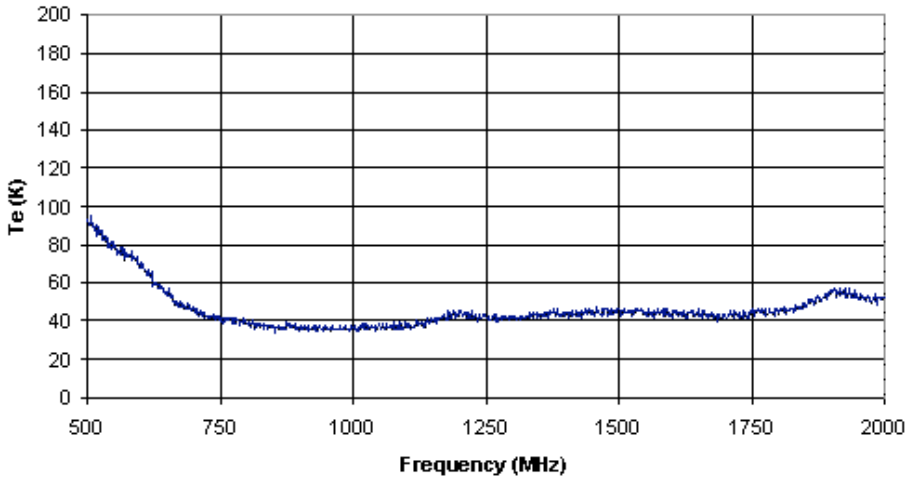
Version 1: T_{sys}/η



Version 1: T_{Rcv}

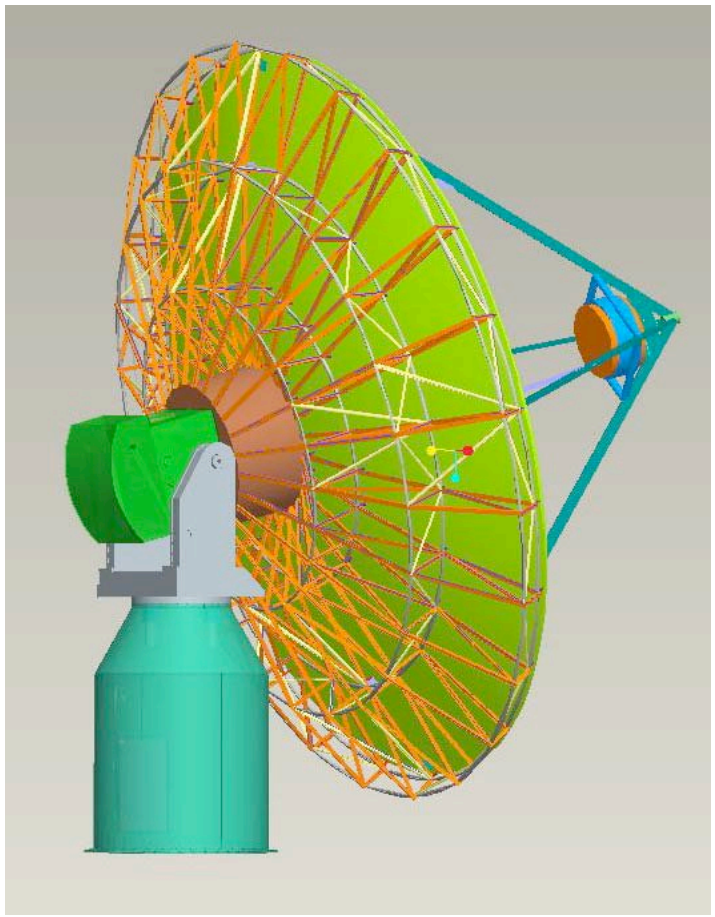


Version 2: T_{Rcv}



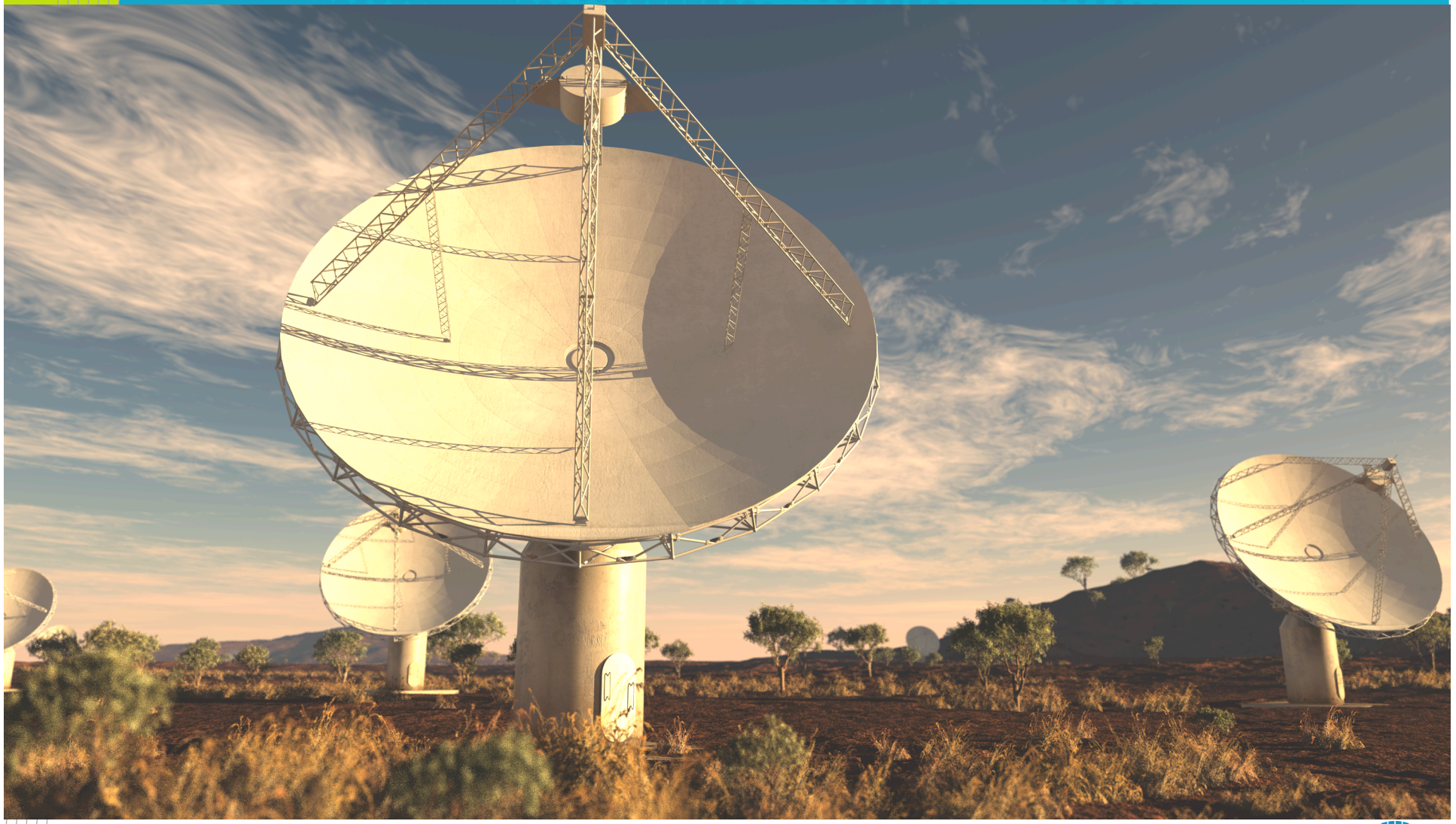
Antenna Contract

- **Awarded to 54th Research Institute of China Electronics Technology Group Corporation (known as CETC54)**
- **36 12-meter antennas design-delivery AU$9.9M**
- **3-axis “sky mount” design**
- **Prime focus, f/D=0.5**
- **1mm rms**
- **30″ pointing**
- **Antenna #1 Dec 2009**
- **Antenna #36 Dec 2011**



CSIRO

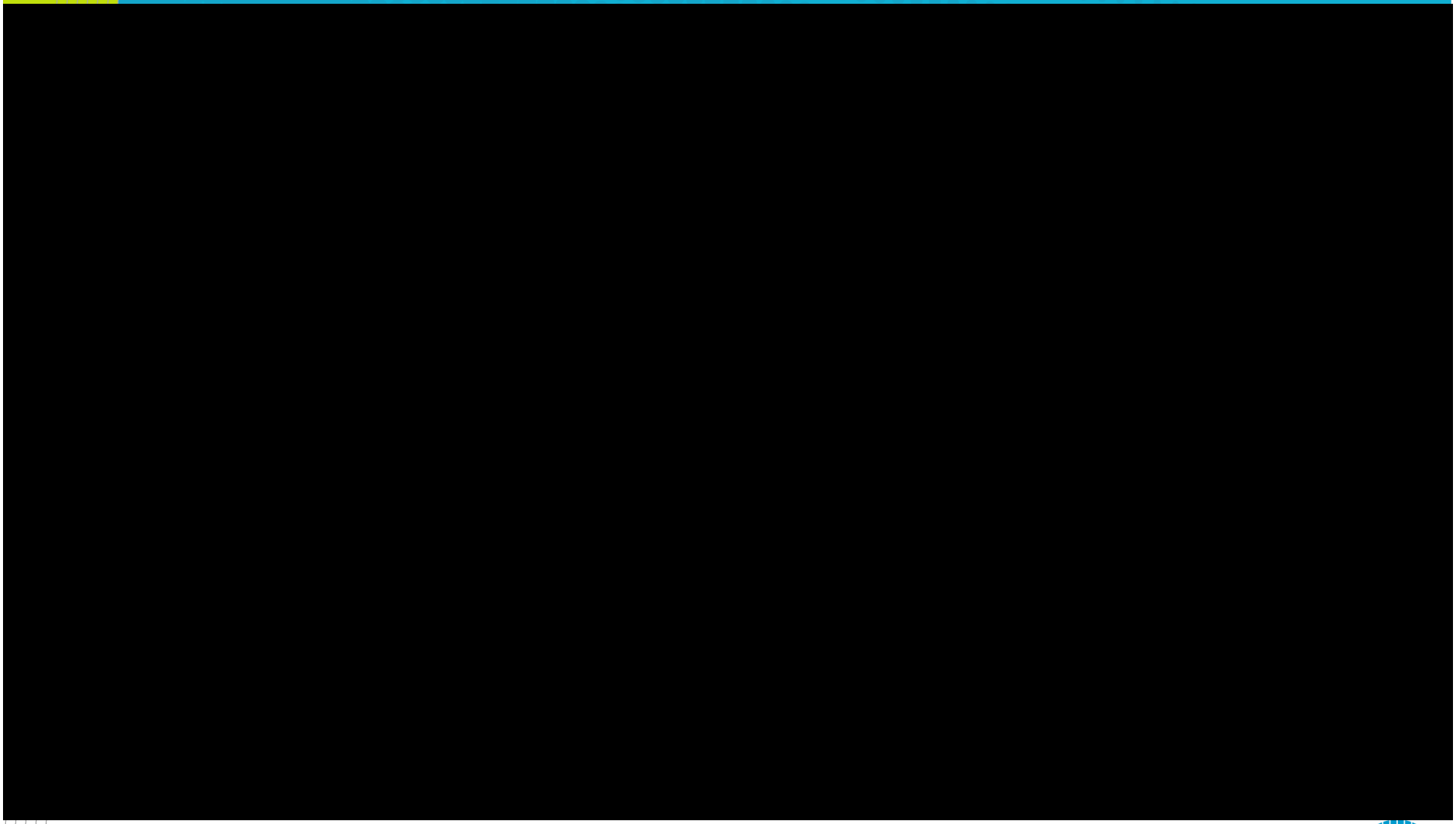
Antennas



Animation credit: Swinburne Astronomy Productions

CSIRO

Antennas



Animation credit: Swinburne Astronomy Productions

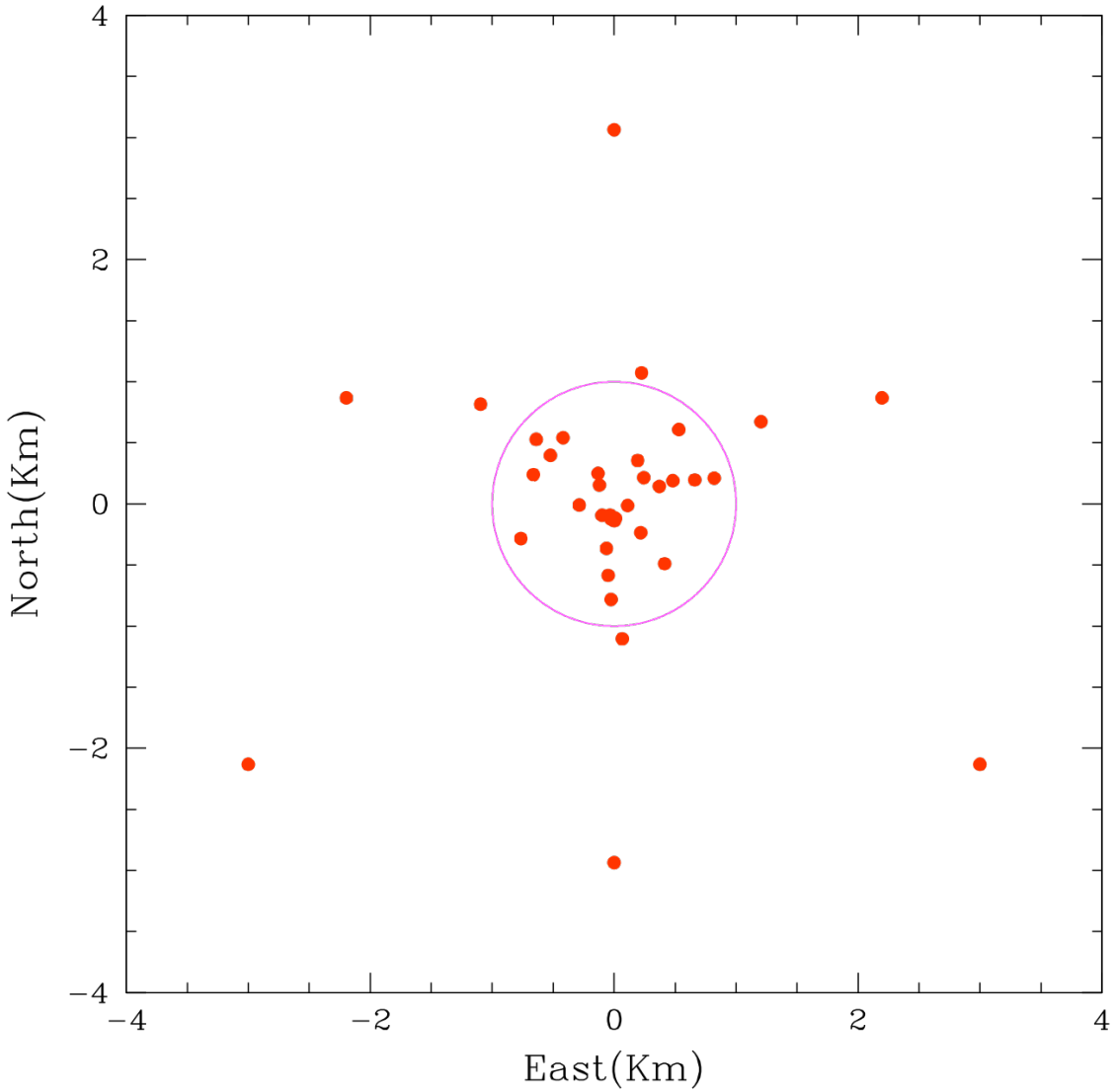
CSIRO

Antennas

Animation credit: Swinburne Astronomy Productions

CSIRO

36 Antenna Array Configuration

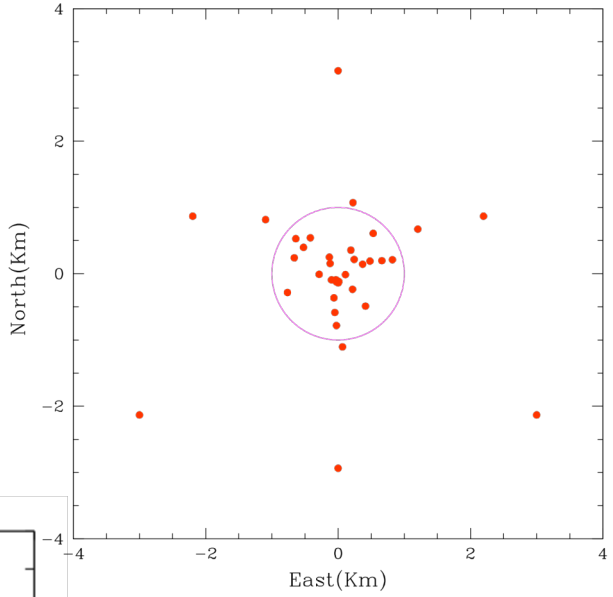


Gupta et al. 2008, ATNF ASKAP Memo 21

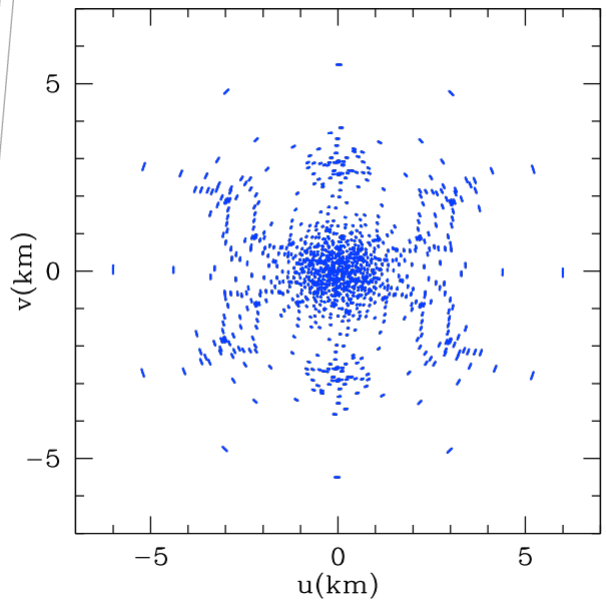
CSIRO

UV coverage & natural beam size

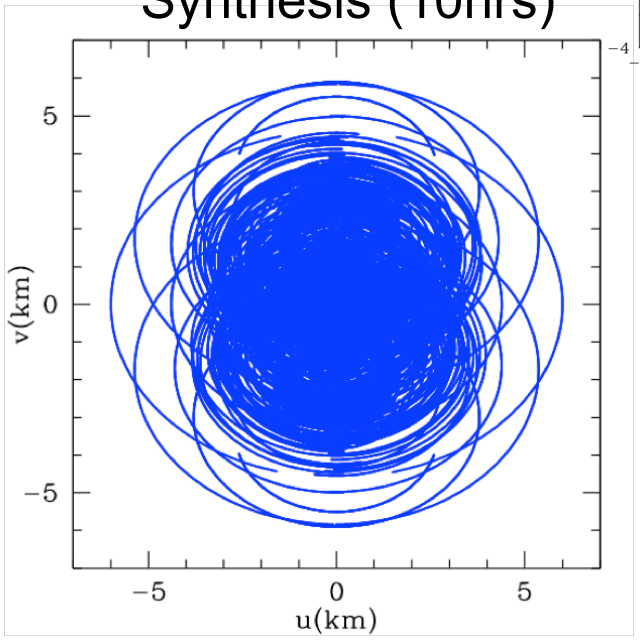
Declination (deg)	Snapshot beam (arcsec x arcsec)	10 hr beam (arcsec x arcsec)
−50	19.1 x 15.4	19.4 x 15.9
−30	17.6 x 15.2	18.9 x 17.5
−10	17.9 x 15.3	19.6 x 18.2
0	18.4 x 15.3	19.5 x 19.3
+10	21.5 x 15.1	20.1 x 19.2



Snapshot (12mins)



Synthesis (10hrs)



Gupta et al. 2008, ATNF ASKAP Memo 21

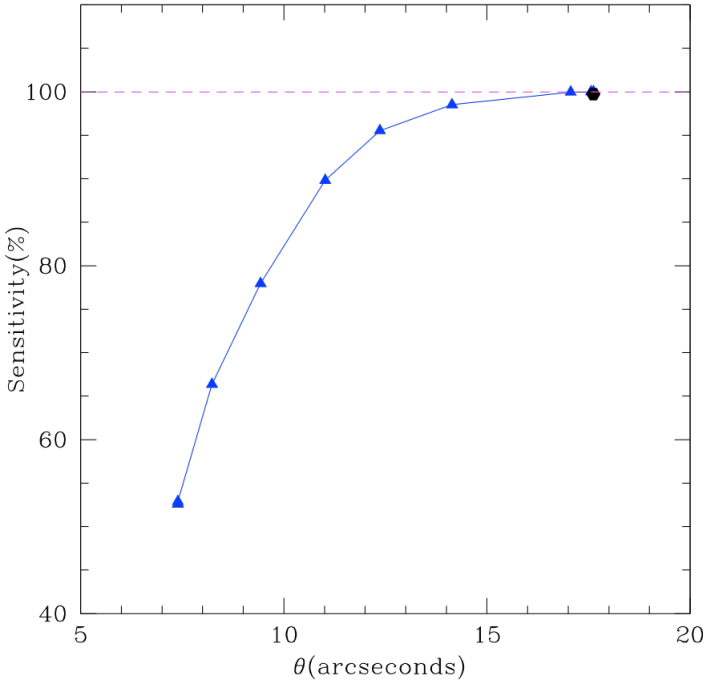
CSIRO

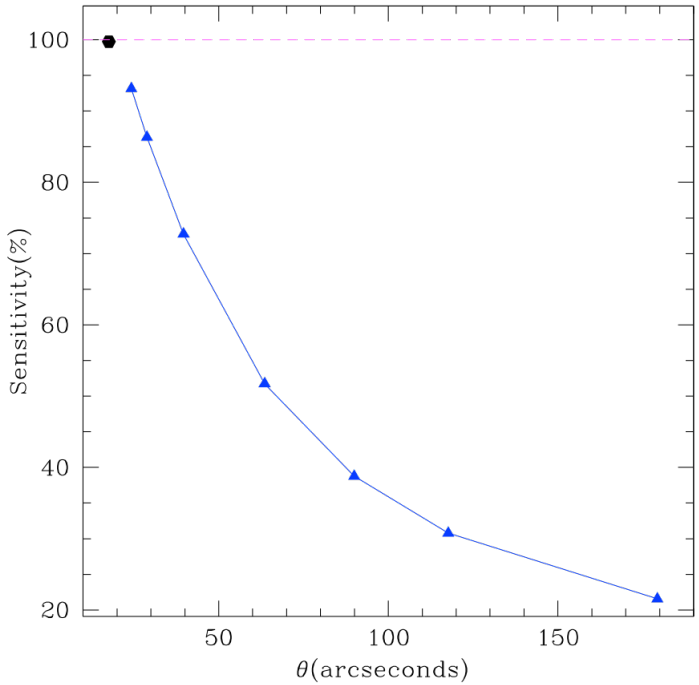
Sensitivity & Survey Speed

Parameter	10”	18”	30”	90”	180”	
Continuum sensitivity (300 MHz)	37	29	34	74	132	μJy/bm
Line sensitivity (100 kHz)	2.1	1.6	1.9	4.1	7.3	mJy/bm
Surface brightness sensitivity (5 kHz)	-	-	5.2	1.3	0.56	K

In 1 hour

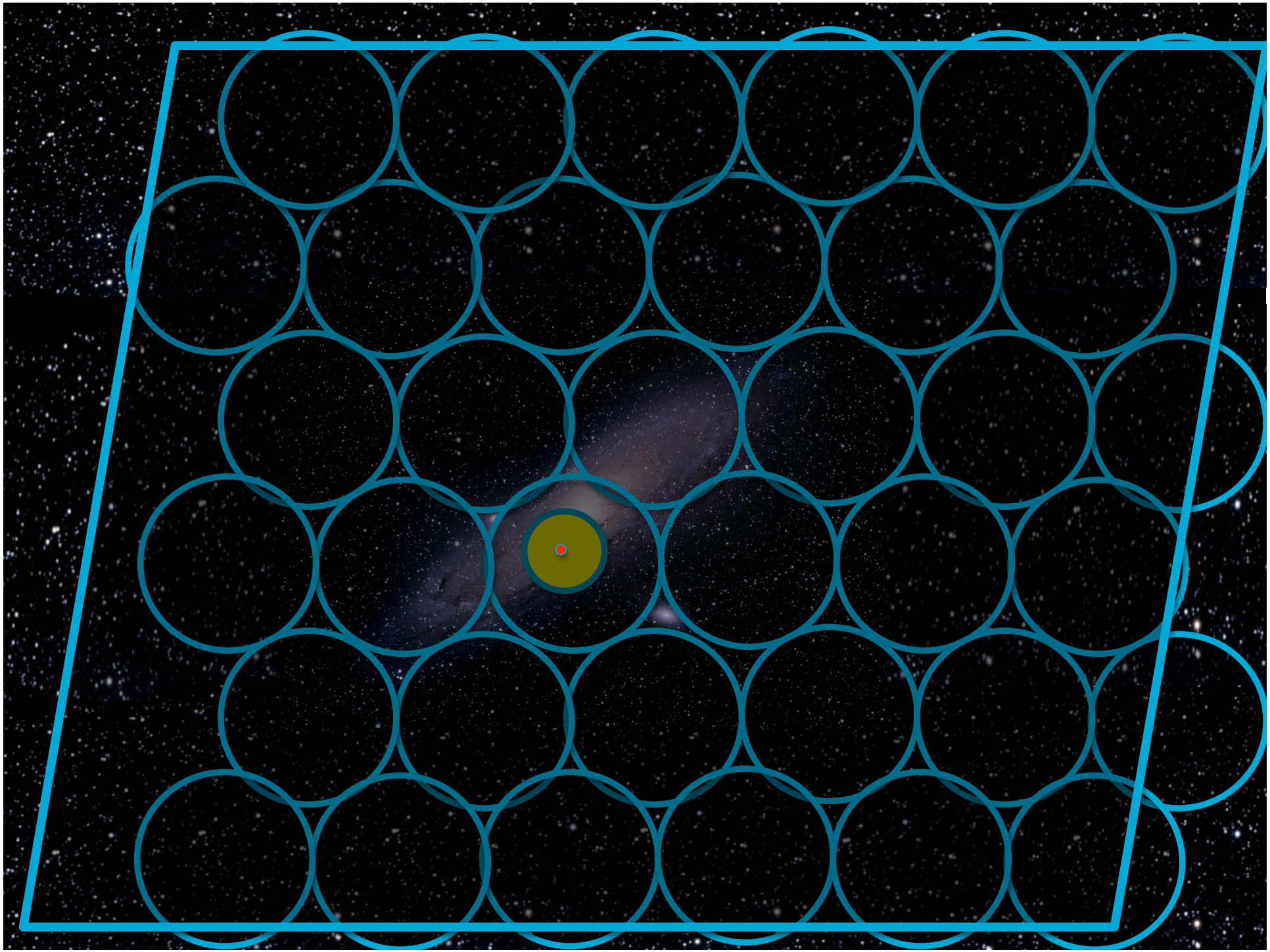
Parameter	10”	18”	30”	90”	180”	
Continuum survey speed (300 MHz, 100 μJy)	220	361	267	54	17	deg^2/hr
Line survey speed (100 kHz, 5 mJy)	184	301	223	45	14	deg^2/hr
Surface brightness survey speed (5 kHz, 1 K)	-	-	1.1	18	94	deg^2/hr





Gupta et al. 2008, ATNF ASKAP Memo 21

CSIRO



Comparative Speeds

	N	D	ε	Tsys	FoV	Survey Speed
ASKAP	36	12	0.8?	50	30	13
PKS-MB	1	64	0.6	22	0.6	1
VLA	27	25	0.5	33	0.3	0.6
ATA	350	6.1	0.7?	50	5	9
Apertif	14	25	0.8?	50	8	11
Meerkat	80	12	0.6	30?	1	3

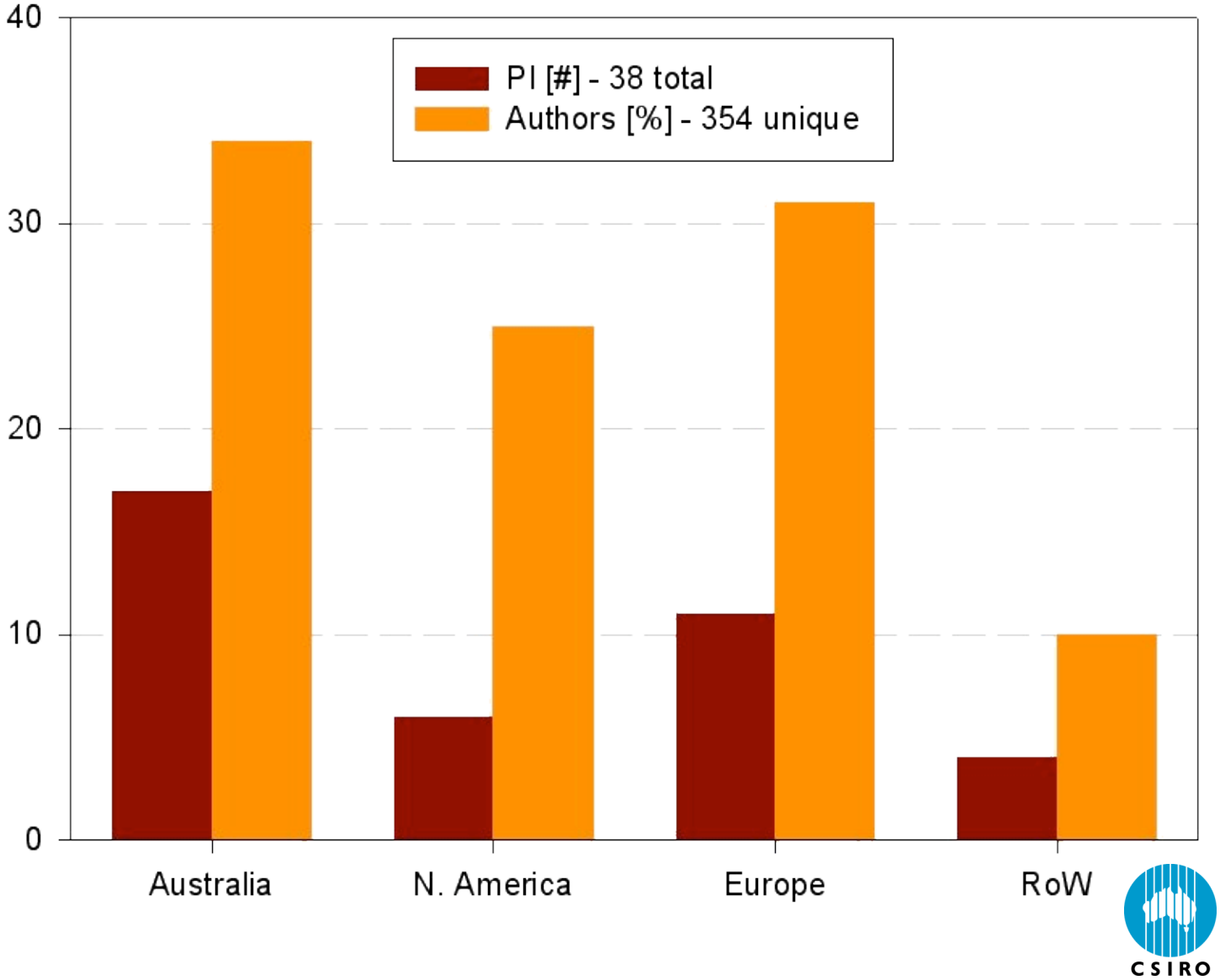
CSIRO

ASKAP Current Status

- **Expression of Interest for large survey science projects**
  - Open access, international call, closed Dec 15, 2008
  - 38 received, 354 authors, 25 years telescope time
- **27 invites to submit Survey Science Proposals**
  - Due date June 15, 2009
- **Successful proposals move to design study**
  - Aug 2009 – End 2011
- **First antenna November 2009**
- **6 element test array operational mid 2010**
  - Data for teams to play with
- **ASKAP operational early 2013**
  - First 5 years scheduled

Expressions of Interest

Science areas:
1.Extragalactic spectral line
2.Continuum
3.Polarization
4.Galactic spectral line
5.Slow transients
6.Fast transients
7.Pulsars
8.VLBI



CSIRO

Summary - I

- **ASKAP has four main aims**
  - To establish an SKA-ready observatory site on the most radio-quiet location on the planet
  - To develop & deploy focal plane array technologies crucial to obtain the survey speeds necessary for SKA science
  - To produce a world class scientific instrument that carries out precursor SKA science in the mid frequency band
  - To build up a user community in readiness for the SKA
- **ASKAP has an aggressive time frame**
  - Operations to start less than 4 years from now!

CSIRO

Summary - II

- **ASKAP is a fast survey precursor to SKA science and technology**
- **It is an open access radio telescope with time allocated based on scientific merit**
- **Participate in Survey Science Teams !!**
  - Contact Ilana Feain & Simon Johnston (ASKAP Project Scientists) via atnf-askap-ps@atnf.csiro.au
- **More information**
  - http://wwwatnf.atnf.csiro.au/projects/askap/

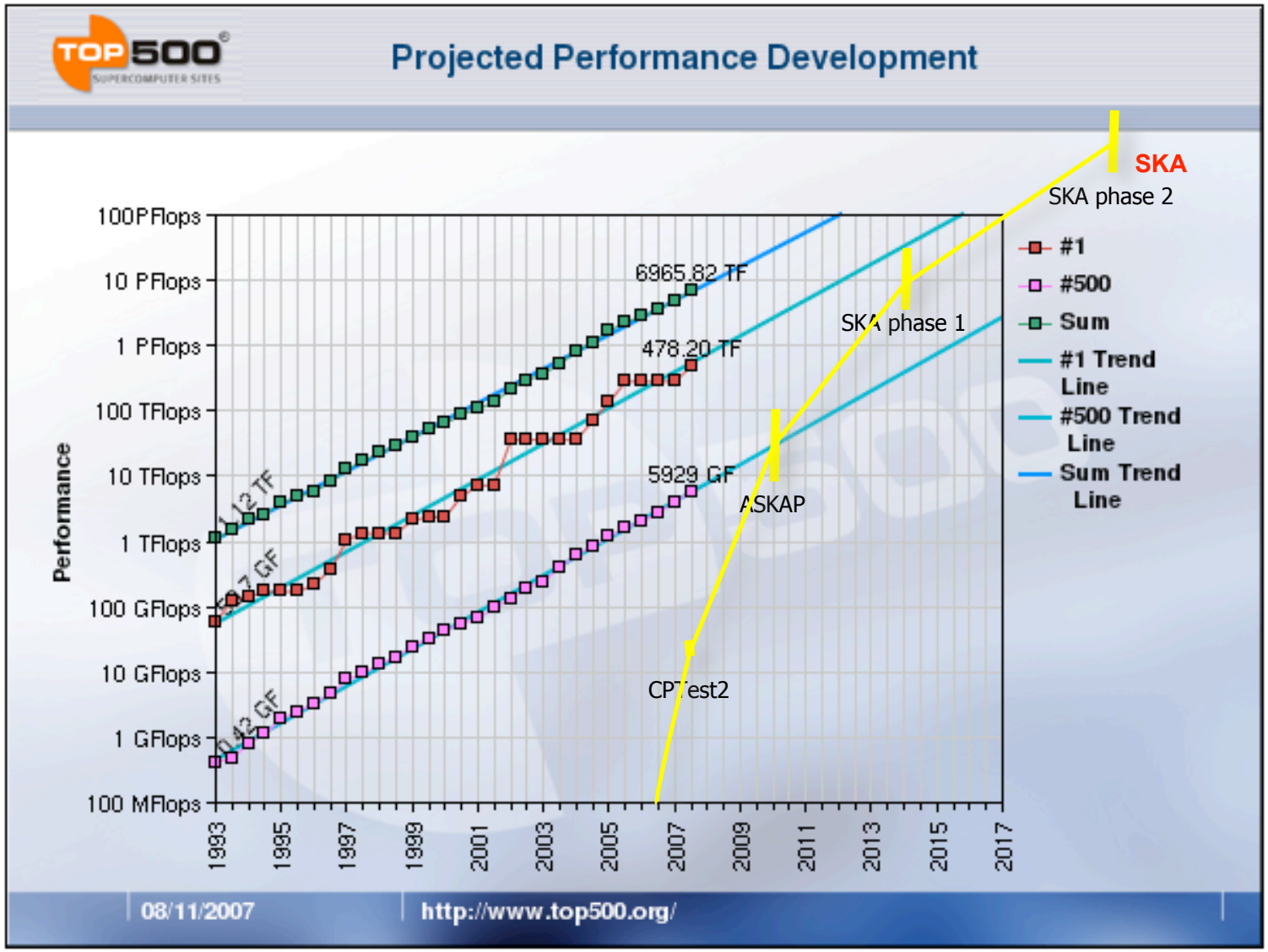
CSIRO

From ASKAP to SKA….

	ASKAP – 1% Precursor	SKA P1 – 10% Phase I	SKA
Number 12 m dishes	36	500	5000
Frequency Range	0.7 – 1.8 GHz	0.3 – 10 GHz	0.3 – 22 GHz
Number of receivers	8,000	200,000	1,000,000
Bandwidth	0.3 GHz	2 GHz	4 GHz
DSP Processing	30 Teraflop	6,000 Teraflop	200,000 Teraflop
Computer Processing	2 Teraflop	1,200 Teraflop	24,000 Teraflop

CSIRO

Climbing Mount Exaflop



CSIRO

Australia Telescope National Facility
Robert Braun
Assistant Director
Astrophysics Theme & Program Leader

Phone: +61 (0)2 9372 4271
Email: Robert.Braun@csiro.au
Web: www.csiro.au/atnf/

www.csiro.au

Thank you

Contact Us
Phone: 1300 363 400 or +61 3 9545 2176
Email: enquiries@csiro.au Web: www.csiro.au

CSIRO