

Deep Extragalactic Surveys with MeerKAT

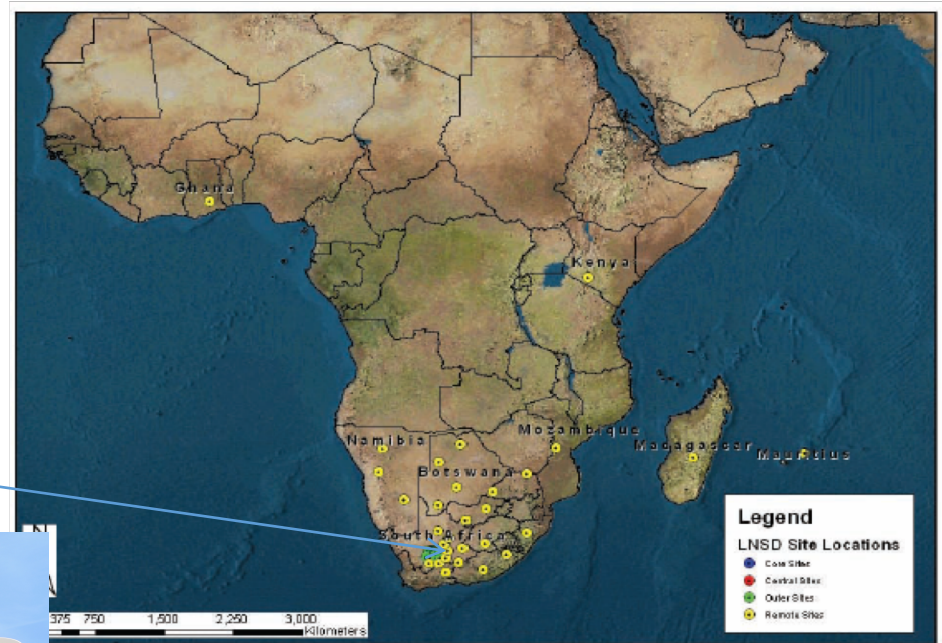


Russ Taylor

Inter-University Institute for Data Intensive Astronomy
and

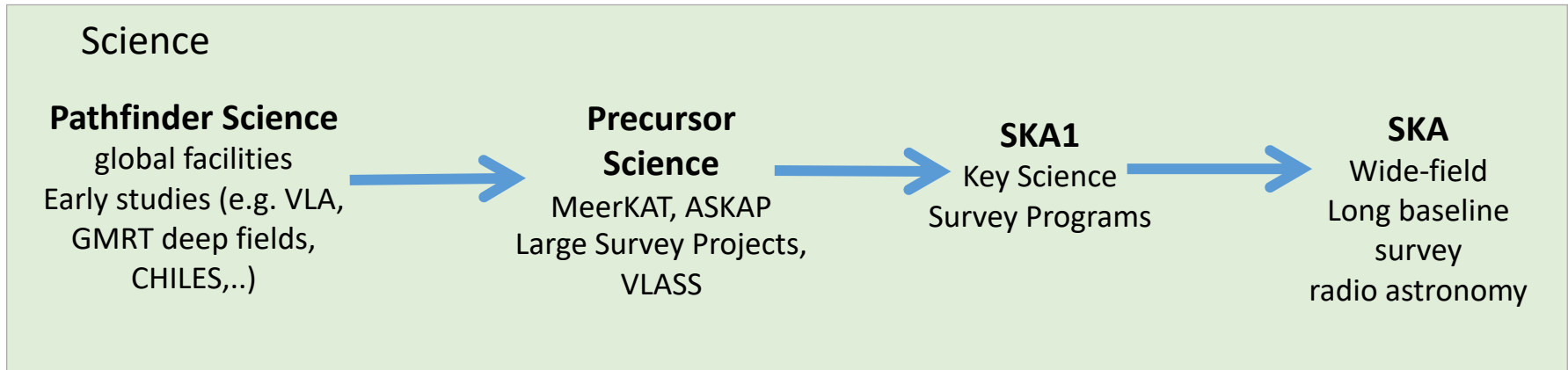
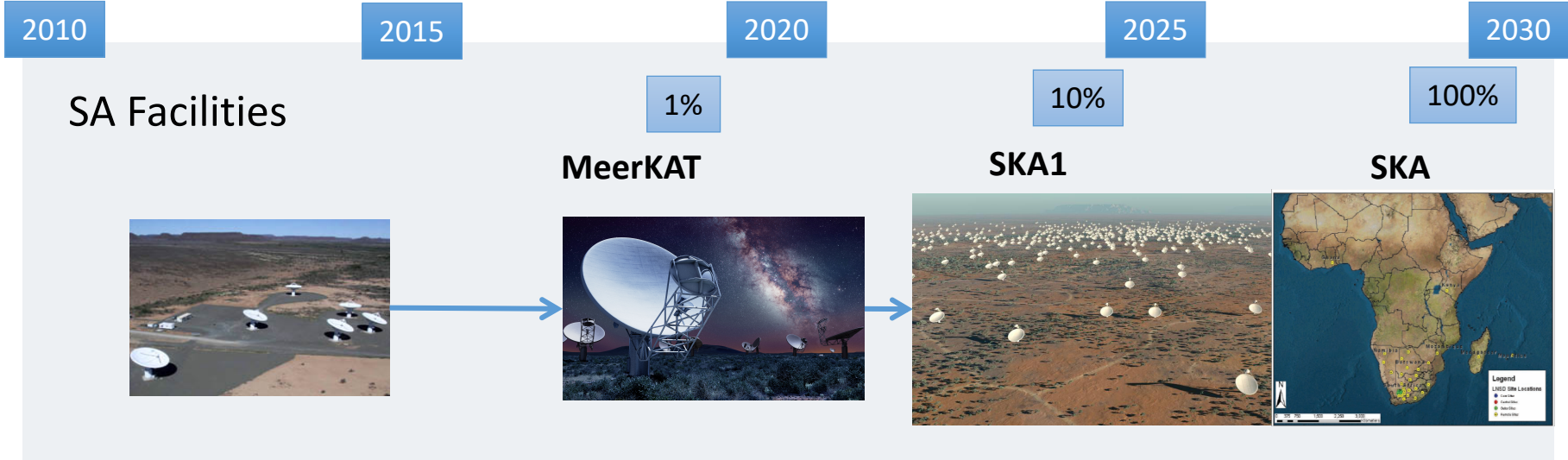
University of Cape Town, University of the Western Cape

SKA-mid: 2500 fibre-connected dish antennas



Rob Millenaar

SKA Timeline(s)



SKA0: MeerKAT completed at the SA SKA Site

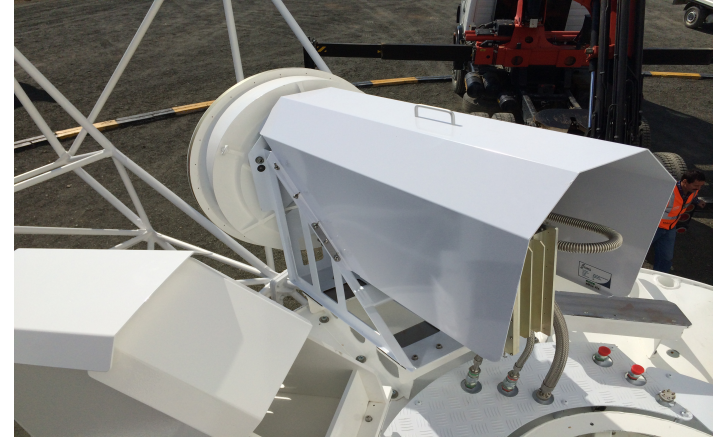
13 July 2018



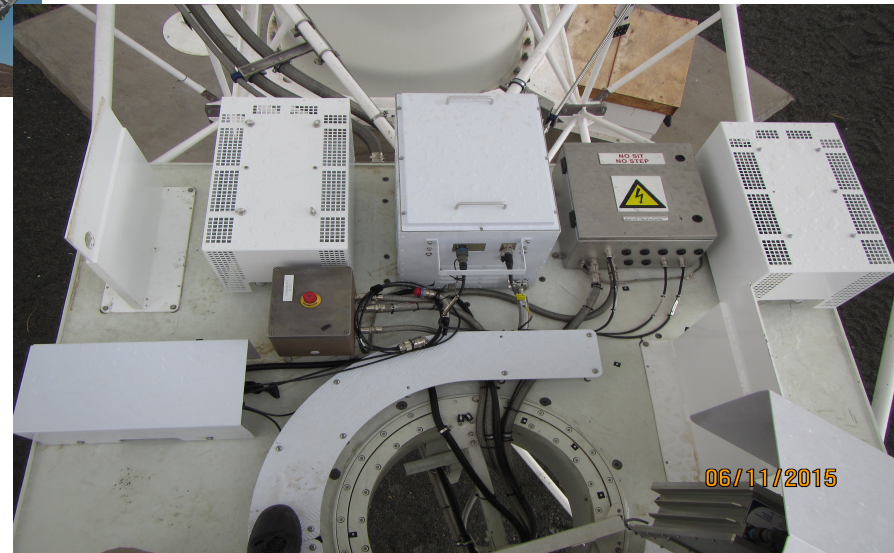
SKA0: MeerKAT completed at the SA SKA Site



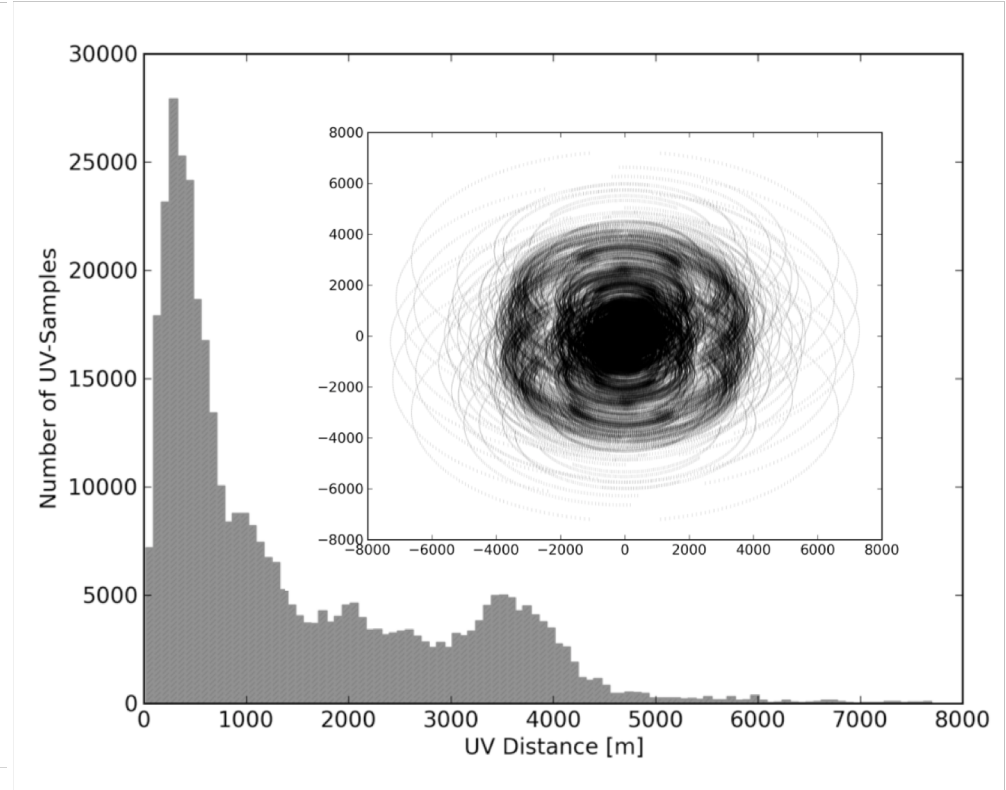
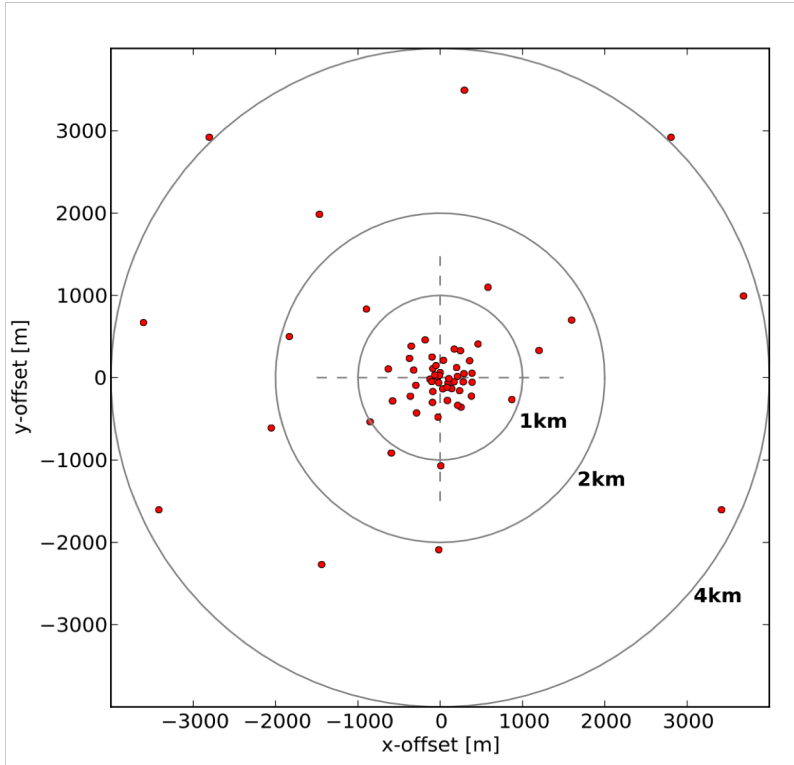
MeerKAT Receivers



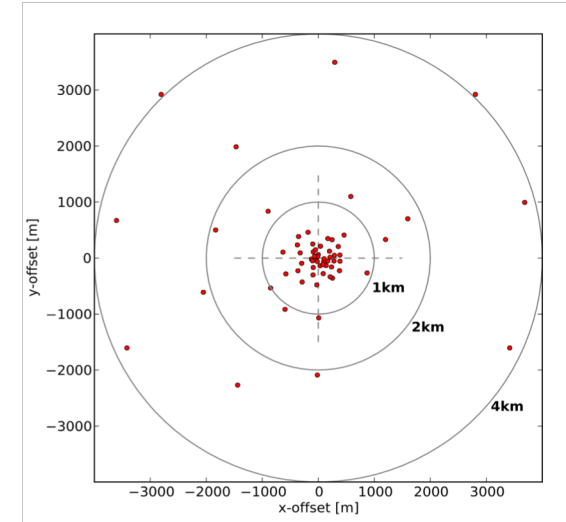
- 0.58-1.015 GHz (UHF-band)
- 0.9 – 1.67 GHz (L-band)
- 1.75 - 3.75 GHz (S-band)



MeerKAT Configuration



MeerKAT Array: A powerful imaging telescope



VLA 'E'+D+C+B configuration all at once, with 4 times the FoV.

MeerKAT Large Survey Projects

imaging

- LADUMA (Deep atomic hydrogen)
- **MIGHTEE (Deep continuum imaging for galaxy evolution)**
- Fornax (Deep HI Survey of the Fornax cluster)
- MHONGOOSE (targeted nearby galaxies HI)
- MeerKAT Absorption Line Survey (extragalactic HI absorption)

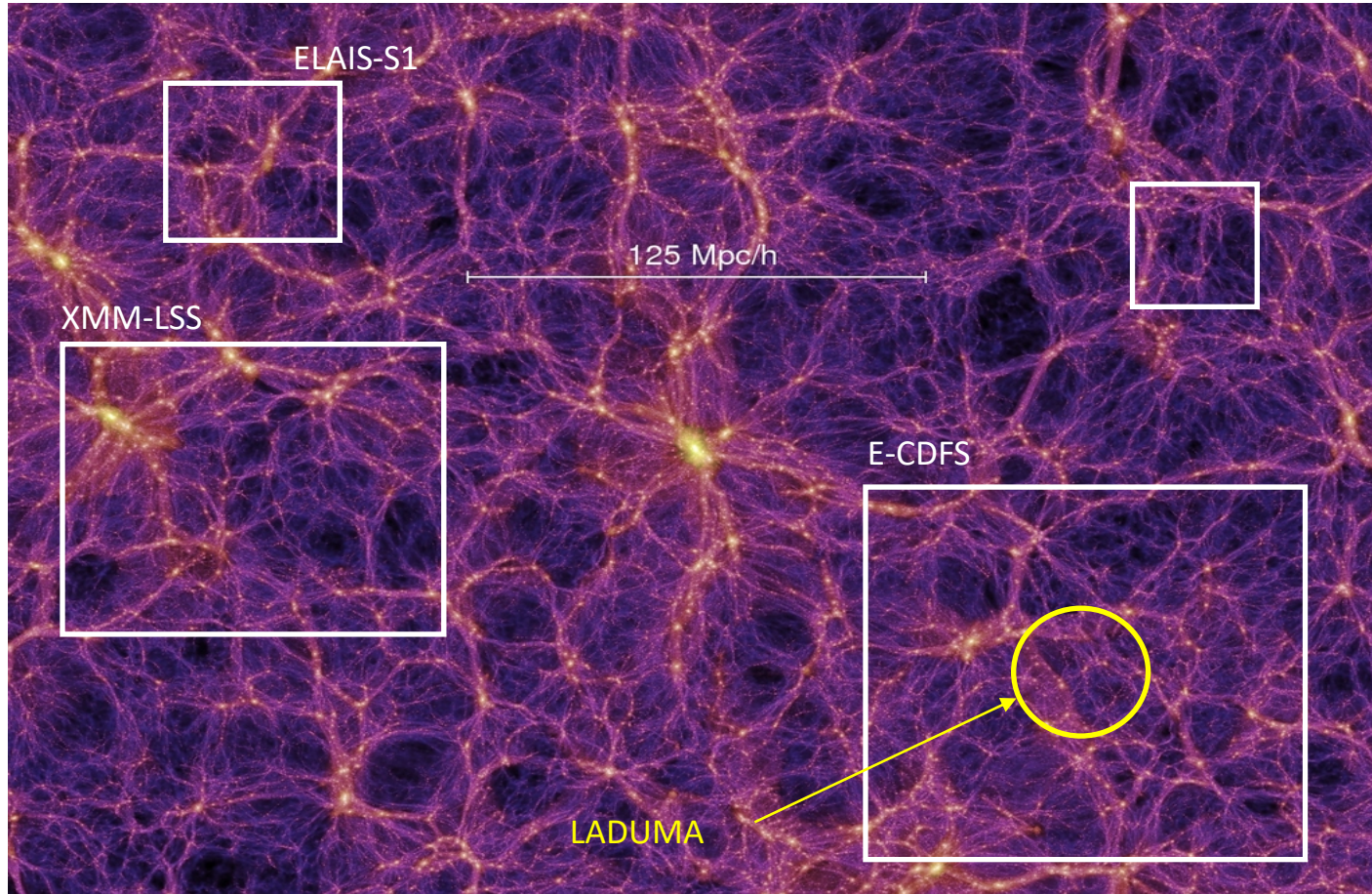
Time domain

- ThunderKAT (exotic phenomena, variables and transients)
- TRAPUM (pulsar search)
- MeerTime (pulsar timing)
- MESMER (High-z CO)
- MeerGAL (Galactic Plane Survey)



The MeerKAT International GHz Tiered Extragalactic Exploration

MIGHTEE co-principal Investigators: Matt Jarvis (Oxford), Russ Taylor (UCT, UWC)



MIGHTEE: Observing Plan (4 years)

1960 hours

5000 hours

MIGHTEE MID L-band: 2 μJy rms

- XMSS – 6.7 deg²
- CDFS – 8.3 deg²
- ELAIS S1 – 1.6 deg²
- COSMOS – 1 deg²

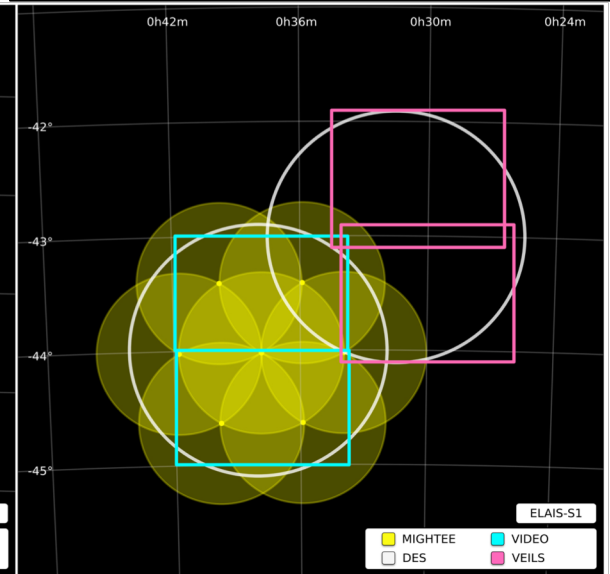
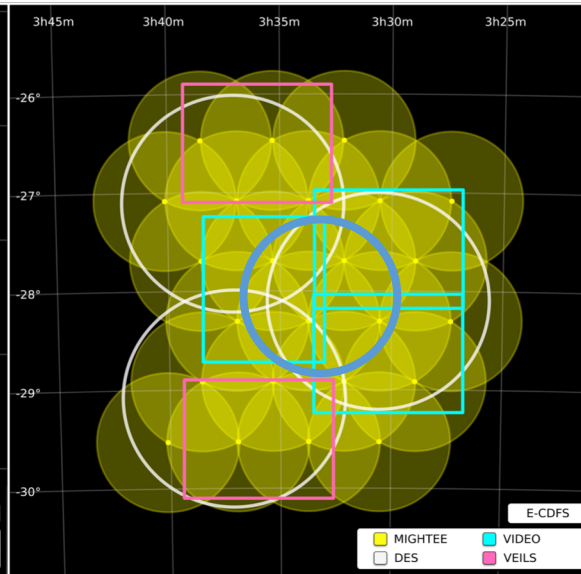
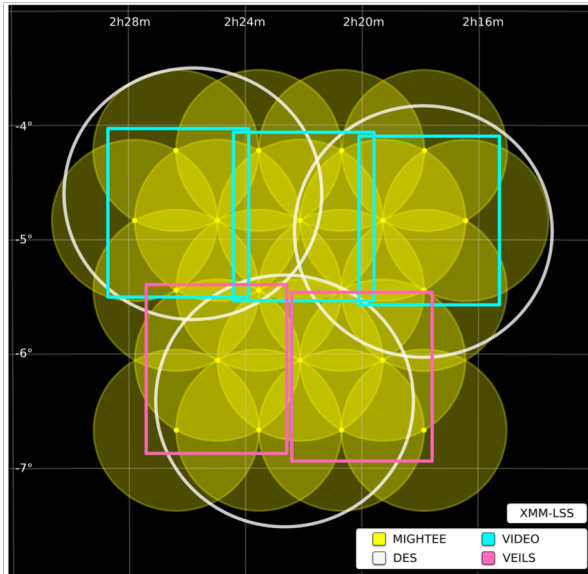
MIGHTEE MID S-band: 1 μJy rms

- CDFS – 4 deg²
- COSMOS – 1 deg²

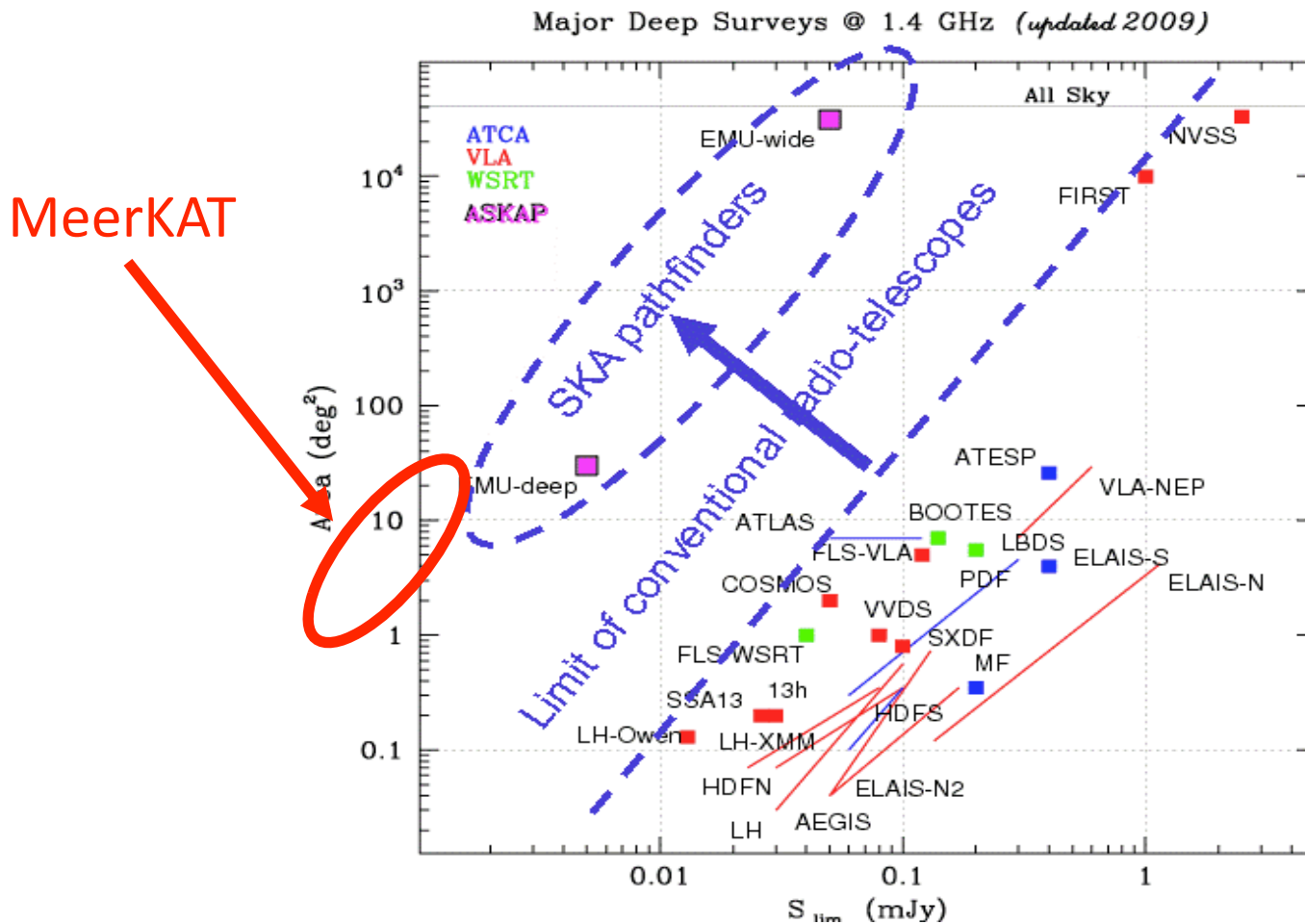
MIGHTEE DEEP L-band: 0.1 μJy rms UHF: 0.1 μJy rms

- CDFS – 1 deg²

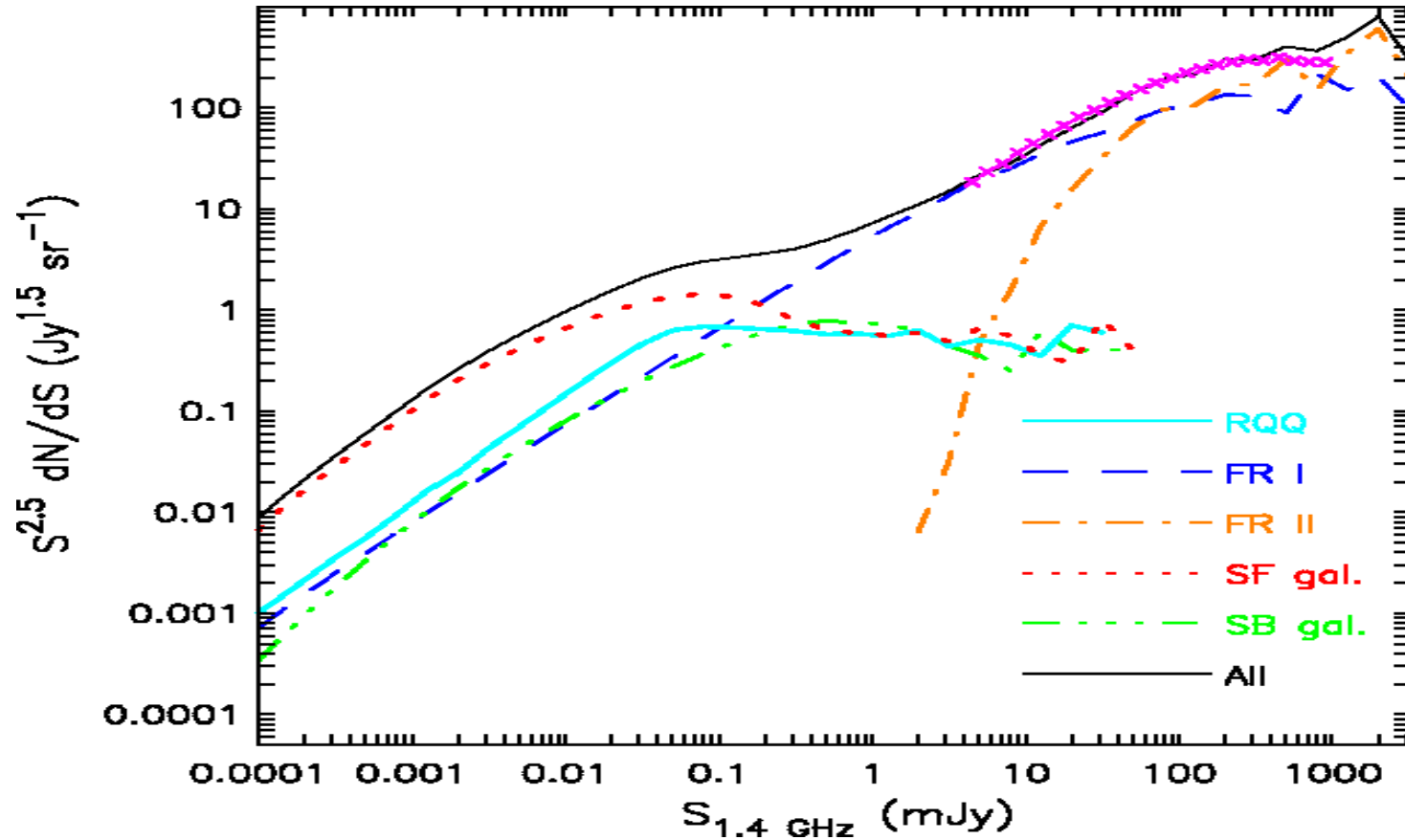
LADUMA COMMENSAL



MIGHTEE: Deep “Continuum” Survey

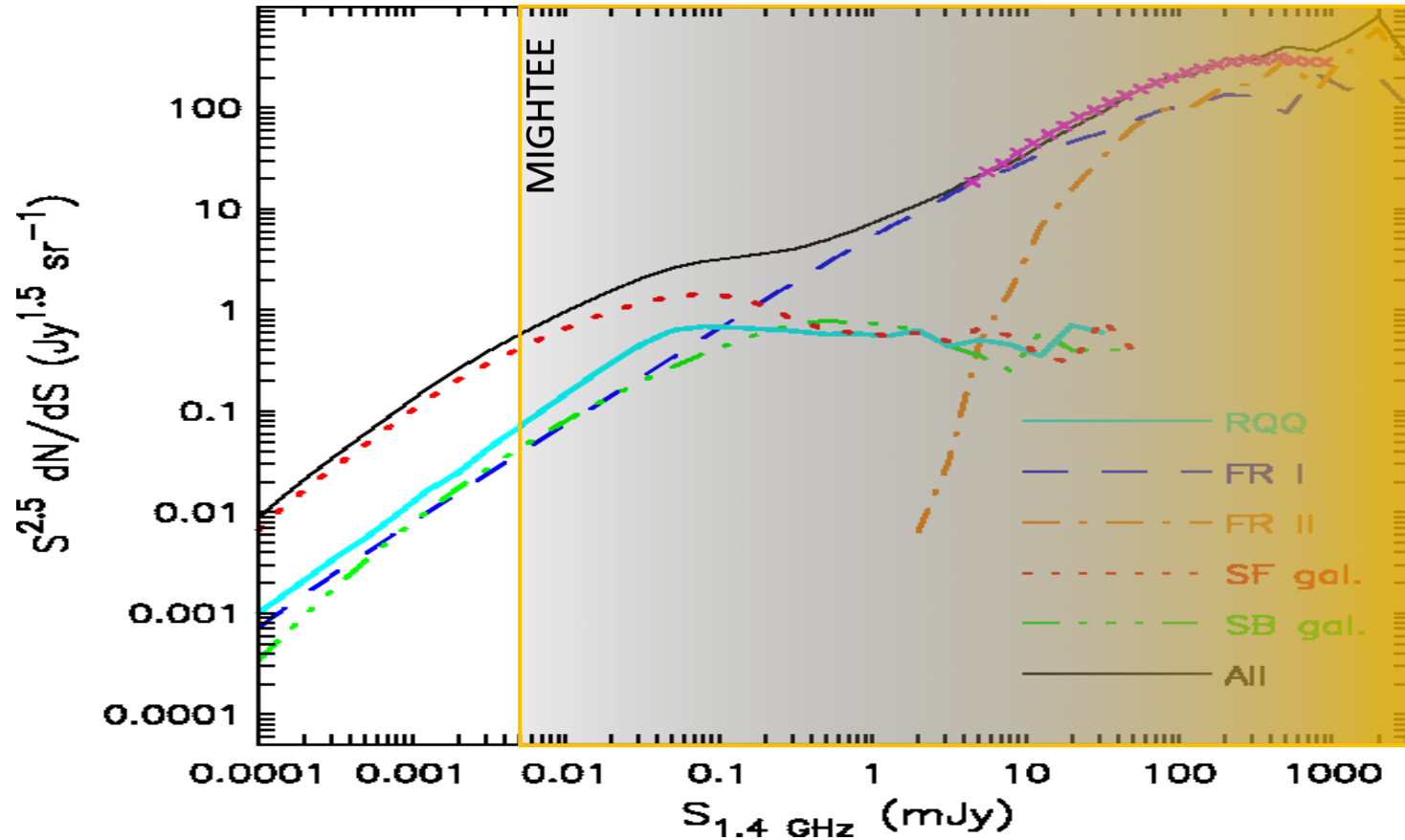


Radio Source Populations



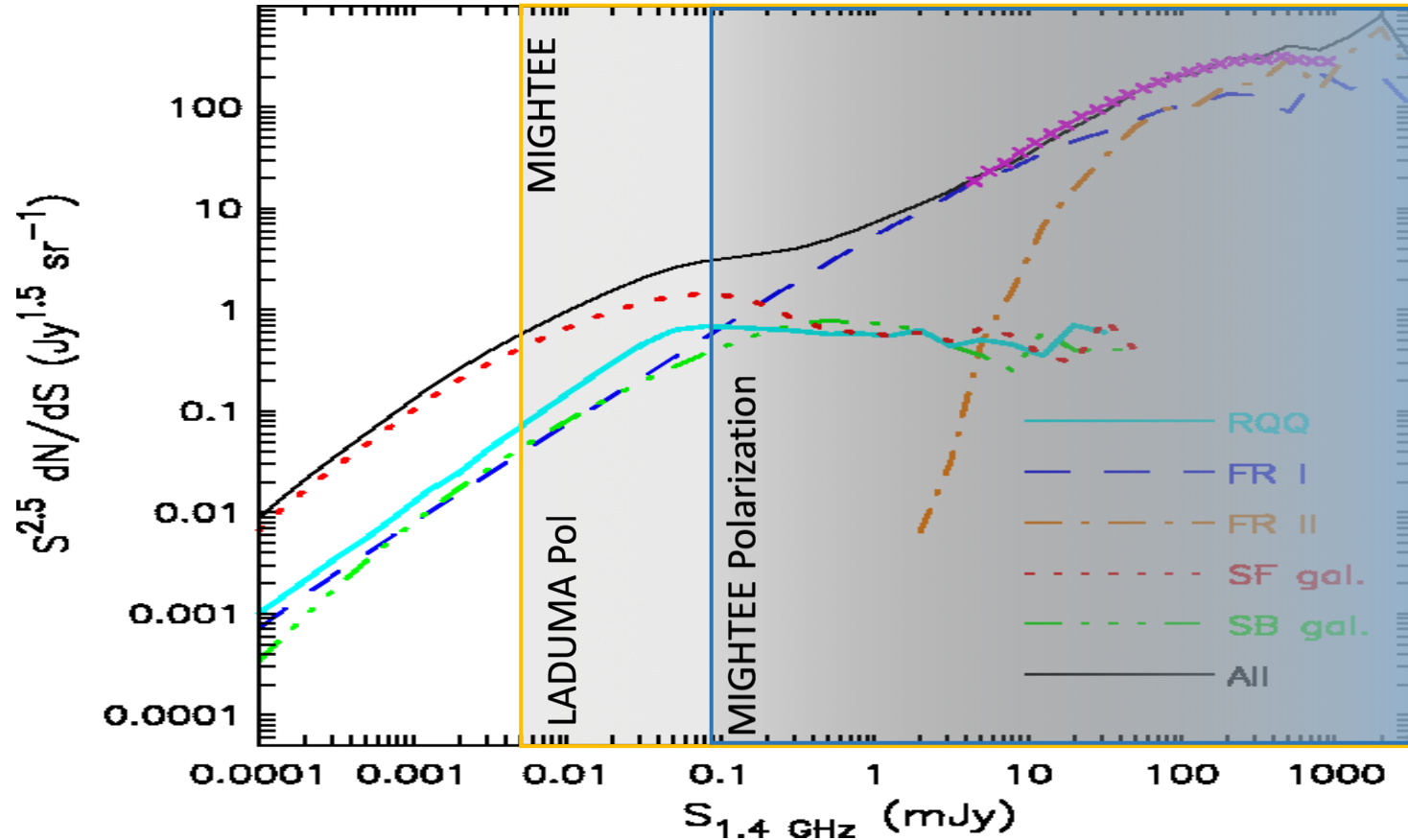
Total intensity source populations counts: SKADS Simulation (Wilman et al. 2008)

Radio Source Populations – MIGHTEE



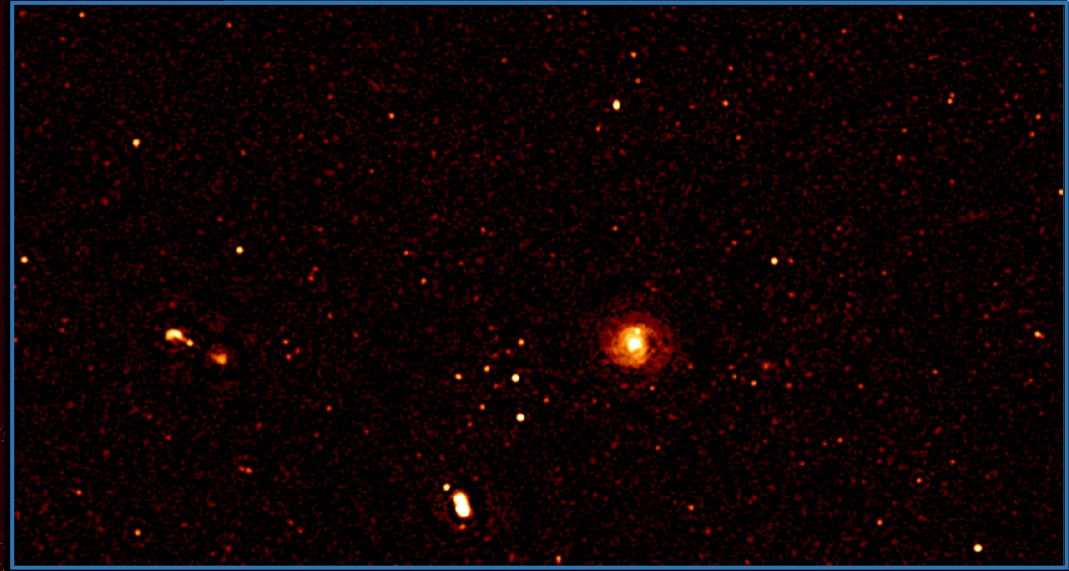
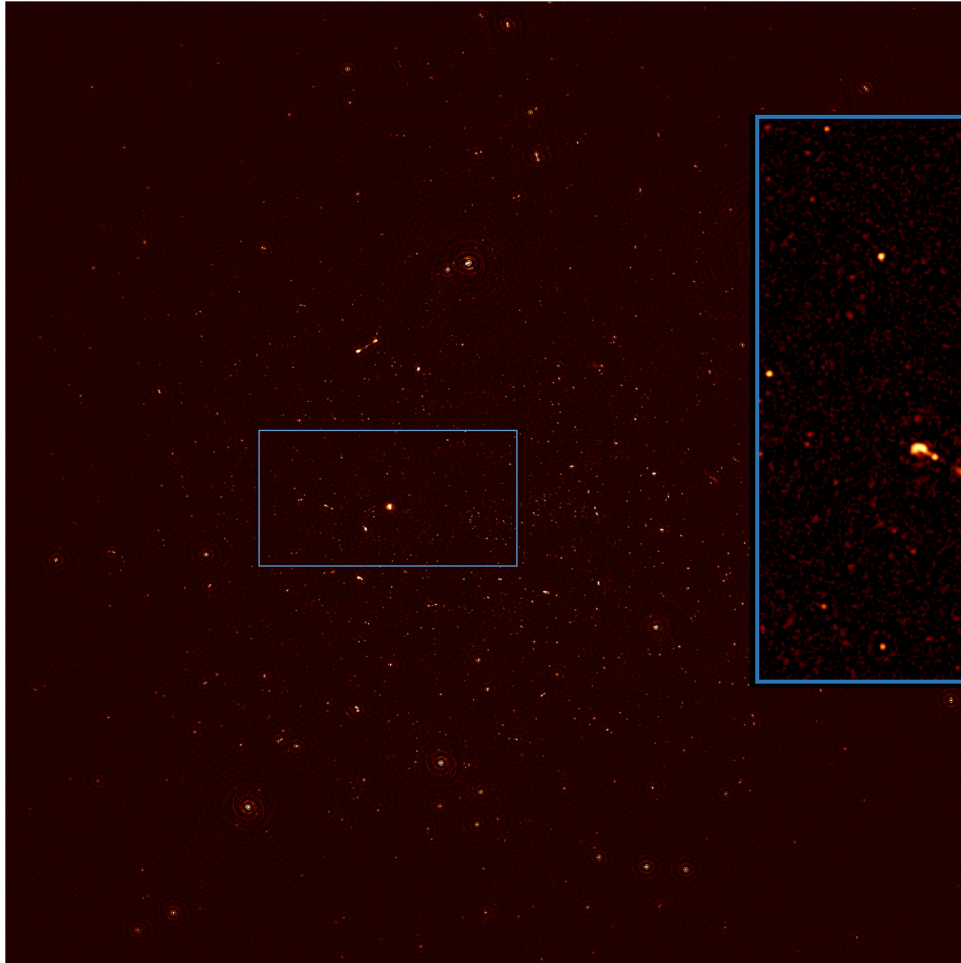
Total intensity source populations counts: SKADS Simulation (Wilman et al. 2008)

Radio Source Populations – MIGHTEE Pol



Total intensity source populations counts: SKADS Simulation (Wilman et al. 2008)

MeerKAT-16 DEEP8 Commissioning Observations



April 2017

14 hours, 14 antennas, rms = $10 \mu\text{Jy}$

MIGHTEE Early Shared Risk Observations

CYBERSKA

A Cyberinfrastructure platform to meet the needs of data intensive radio astronomy on route to the SKA

Home Profile Settings myDashboard myGroups Tools Help About

Admin Search Go Log out

Pages > MIGHTEE > MIGHTEE MeerKAT Observation Summary

Create a sub-page



MIGHTEE
MeerKAT International GigaHertz
Tiered Extragalactic Exploration
survey

Closed group

Subgroups:

- MIGHTEE-GMRT
- MIGHTEE-Continuum
- MIGHTEE-Noise
- MIGHTEE-HI-absorption
- MIGHTEE-HI-emission
- MIGHTEE-XID
- MIGHTEE-POL
- MIGHTEE-Data
- MIGHTEE Management Team

Group Applications

Group activity

Group blog

Group bookmarks

Group calendar

Group discussion

Group file folders

Group files

Group pages

Group tasks

Related groups

Edit group settings

Edit widget layout

Invite to group

MIGHTEE MeerKAT Observation Summary

Last updated just now by Russ Taylor Comments (1)

mightee, observations

Group: MIGHTEE Edit

This page contains a summary listing of MIGHTEE MeerKAT observations. The pointing coordinate for all of MIGHTEE target fields are [listed here](#).

Summary of MIGHTEE MeerKAT observations

DATE	ID	POINTING	TARGET	PRIMARY	SECONDARY	POL	T_int [s]	N_chan	Track [h]	N_ant
2018-04-11	1523464709	COSMOS	COSMOS	J0408-6545	3C237	J1331+3030	8	4096	6.74	54
2018-04-12	1523518570	CDFS_16	CDFS16	J1939-6342	J0240-2309	J0521+1638	4	4096	4.26	55
2018-04-12	1523541036	CDFS_16	CDFS16	J1939-6342	J0240-2309	J0521+1638	4	4096	4.33	55
2018-04-19	1524147354	COSMOS	COSMOS	J0408-6545	3C237	J1331+3030	4	4096	8.65	64
2018-05-06	1525613583	COSMOS	COSMOS	J0408-6545	3C237	J1331+3030	4	4096	8.39	62
2018-10-06	1538856059	XMMLSS_12	J0217-0449	J1939-6342	J0201-1132	J0521+1638	8	4096	8.02	59
2018-10-07	1538942495	XMMLSS_13	J0220-0449	J1939-6342	J0201-1132	J0521+1638	8	4096	8.07	59
2018-10-08	1539028868	XMMLSS_14	J0223-0449	J1939-6342	J0201-1132	J0521+1638	8	4096	8.03	60
2018-10-09	1539109858	ELAIS-S1_4	J0037-4359	J1939-6342	J0224-4202	J0521+1638	8	4096	8.02	62
2018-10-11	1539286252	XMMLSS_12	J0217-0449	J1939-6342	J0201-1132	J0521+1638	8	4096	8.05	63
2018-10-12	1539372679	XMMLSS_13	J0220-0449	J1939-6342	J0201-1132	J0521+1638	8	4096	8.03	62
2018-10-13	1539460932	XMMLSS_14	J0223-0449	J1939-6342	J0201-1132	J0521+1638	8	4096	8	62
2018-10-14	1539540056	ELAIS-S1_4	J0037-4359	J1939-6342	J0224-4202	J0521+1638	8	4096	8.03	62

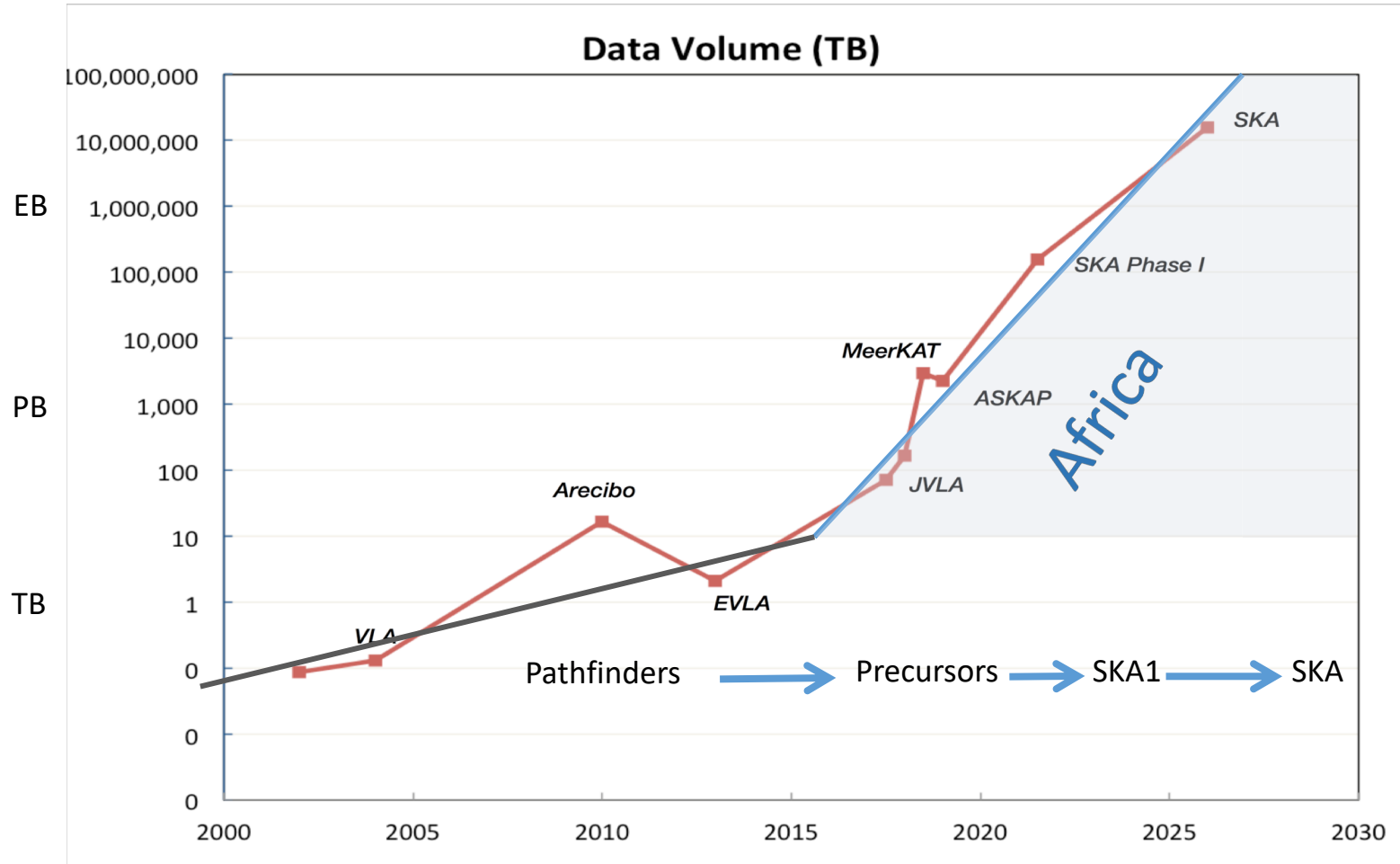
Comments

 Ian Heywood 28 days ago

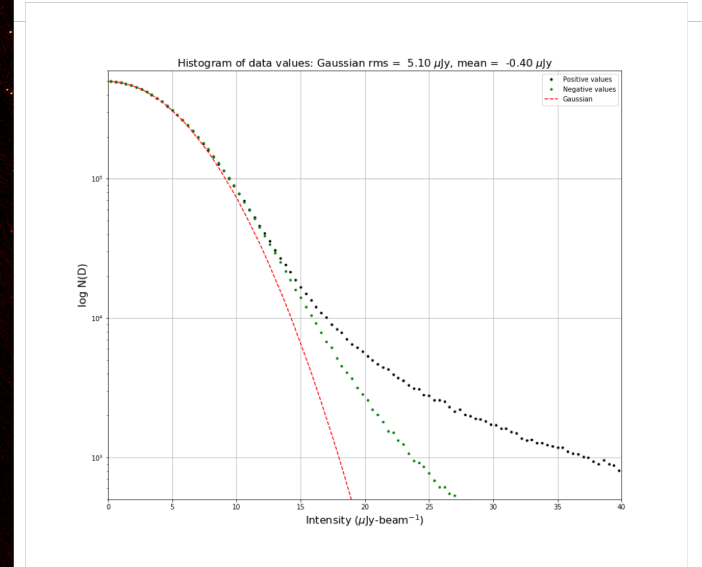
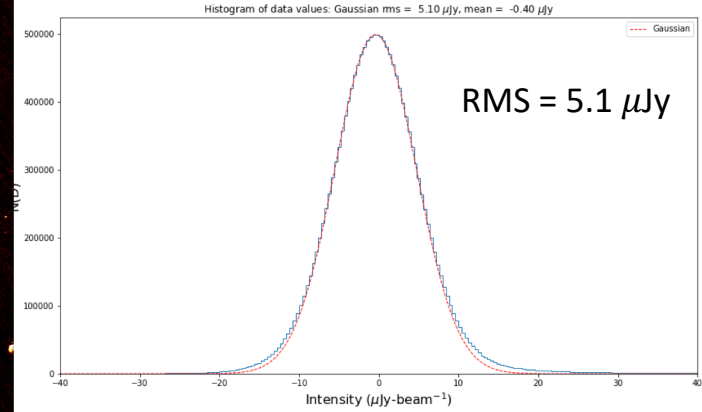
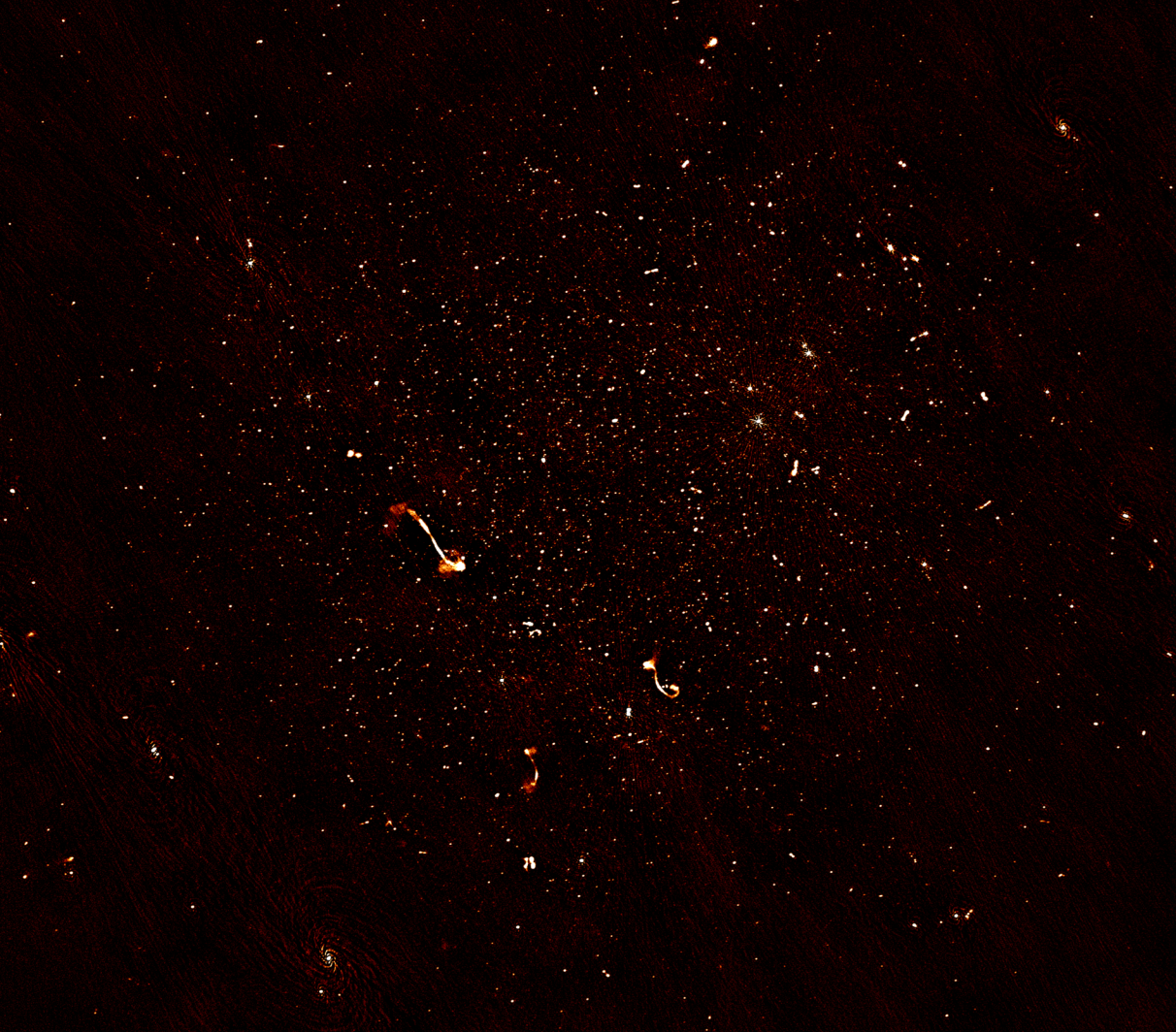
Here is a spreadsheet with details of the most recent observations in.

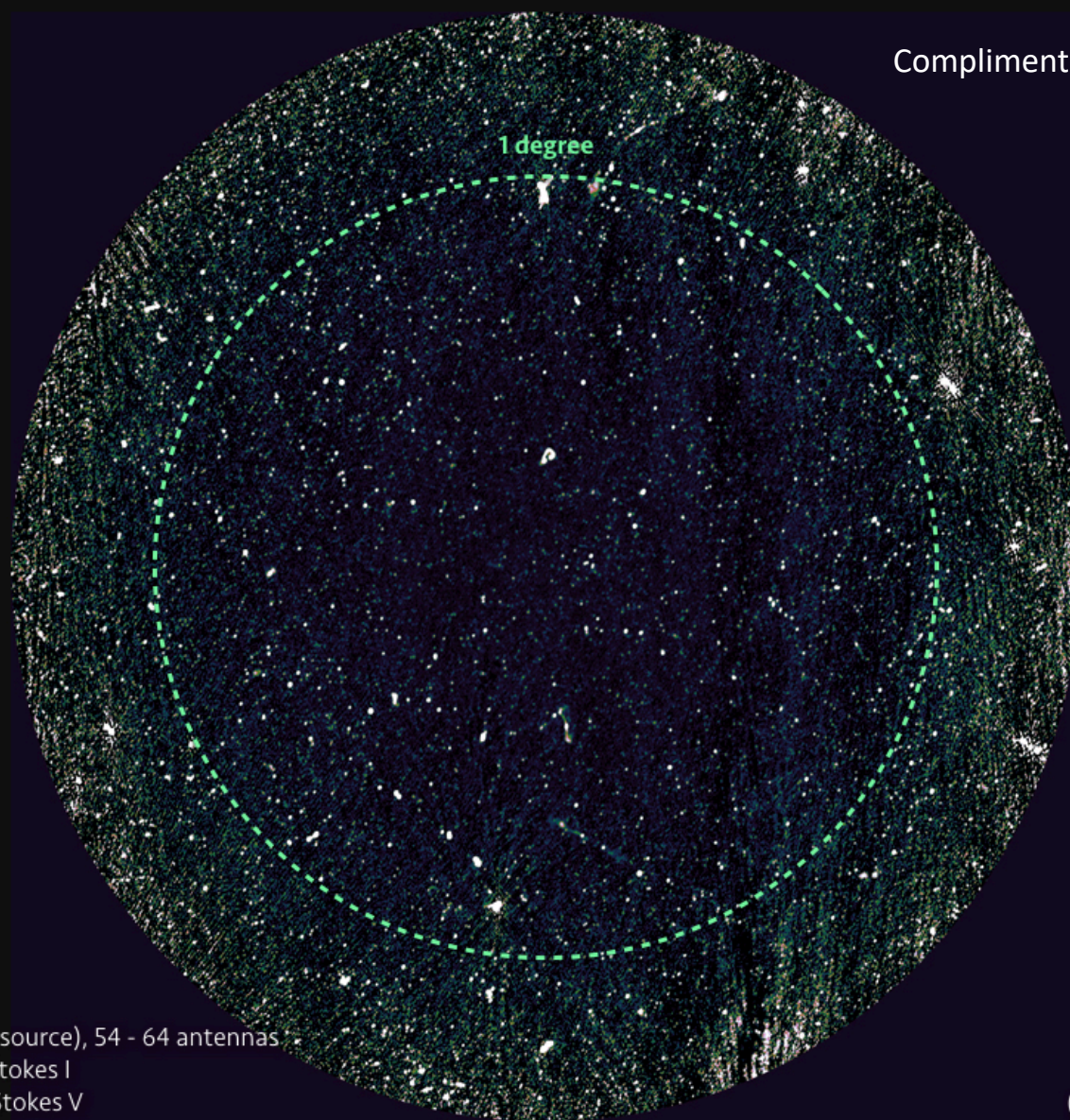
[Edit comment](#)

Growth of Data Volumes to Radio Astronomers



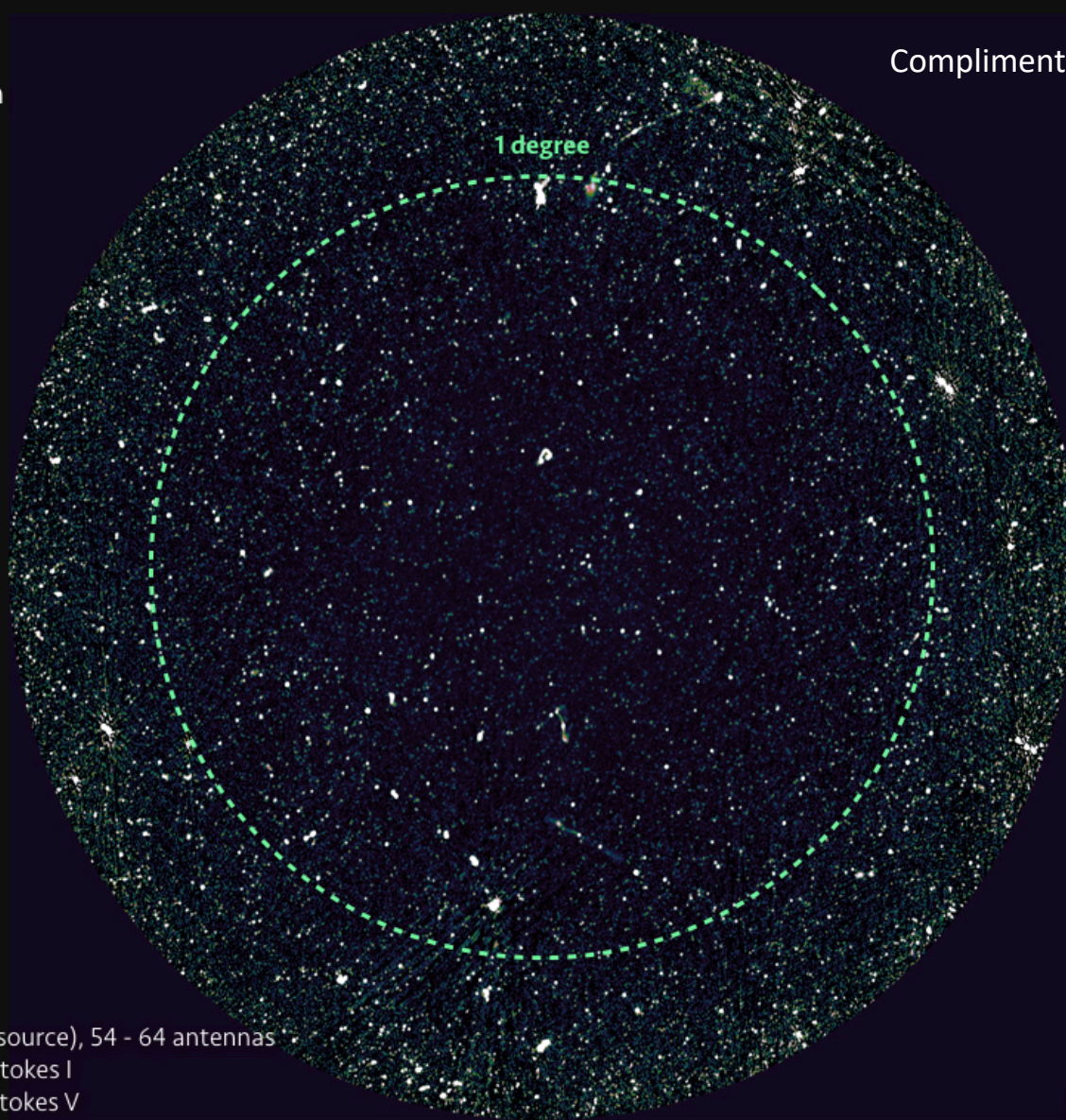
CDFS - IDIA CASA pipeline - up to Direction Independent self-calibration
55 antennas, 8 hours
Compliments: Krishna Sekhar





24 hours (~19 on source), 54 - 64 antennas
5.1 $\mu\text{Jy}/\text{beam}$ in Stokes I
2.5 $\mu\text{Jy}/\text{beam}$ in Stokes V

(wsclean + cubical)



24 hours (~19 on source), 54 - 64 antennas
2.8 μ Jy/beam in Stokes I
2.5 μ Jy/beam in Stokes V

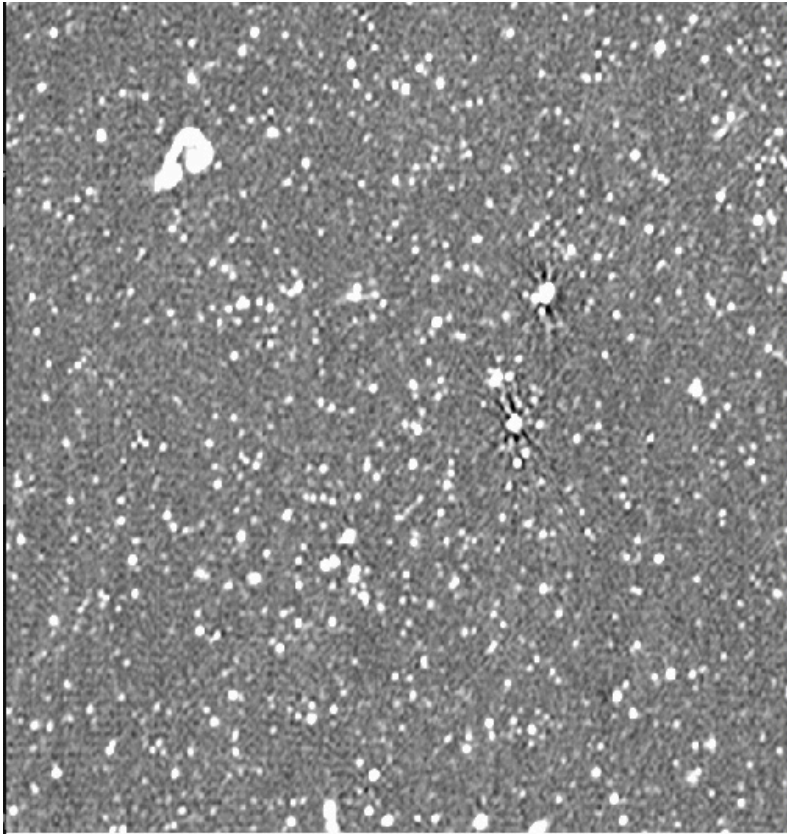
(DDFacet + killMS)

MIGHTEE-COSMOS vs VLA-COSMOS

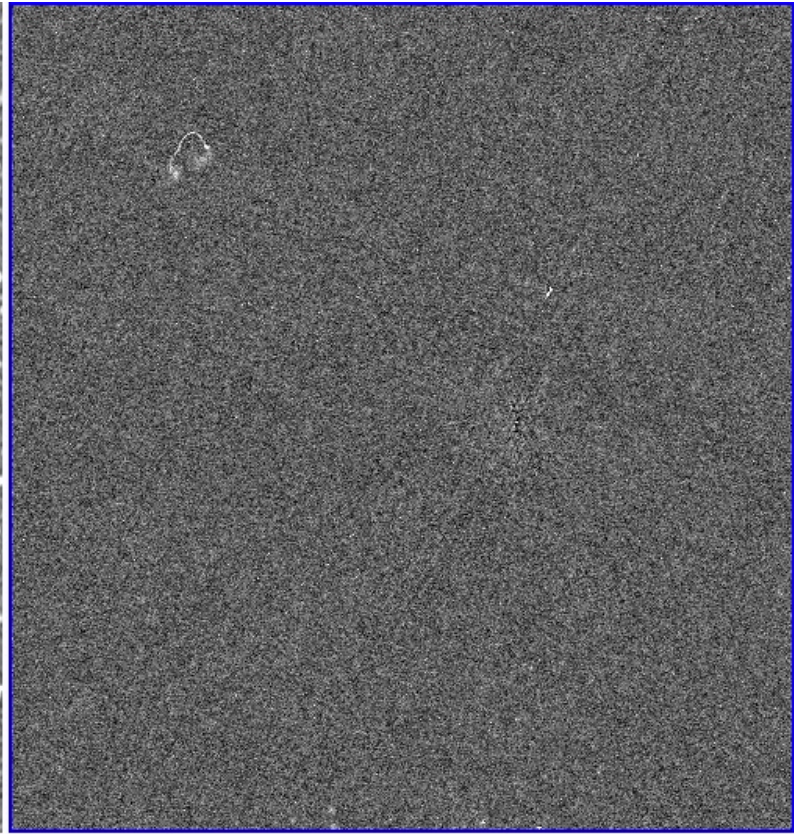
	VLA (Smolcic et al 2017a)	MIGHTEE (early)
Field size	~2deg ²	~1.5deg ²
Central frequency	3GHz	1.2GHz
Bandwidth	2GHz	800MHz
Integration time	384 h	19 h
rms	2.3 μ Jy	2.8 μ Jy
Angular resolution	~0.75''	~7''

MIGHTEE vs VLA COSMOS

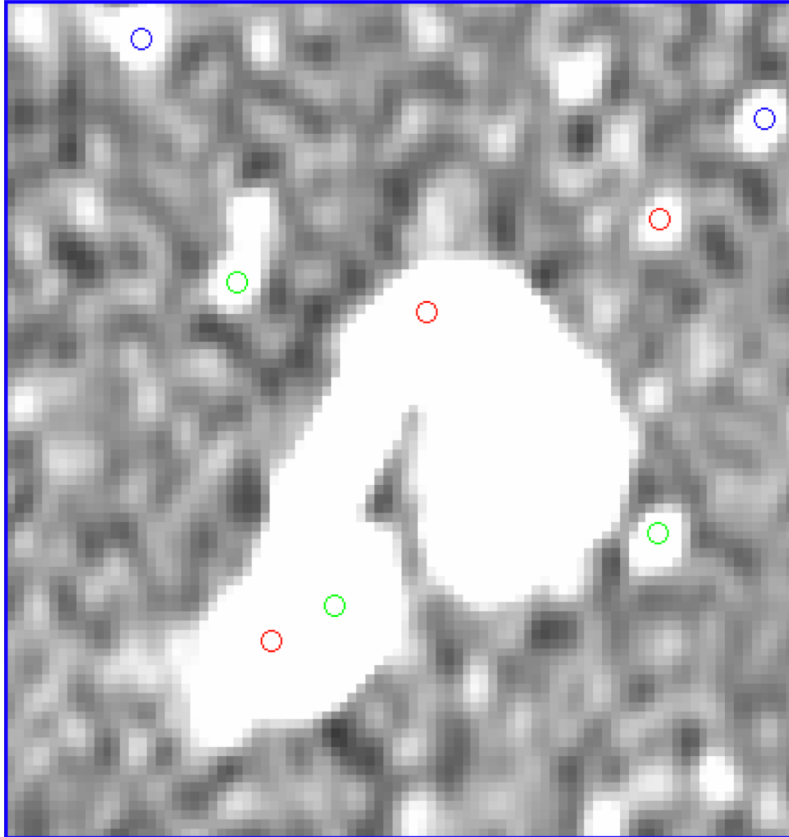
MIGHTEE



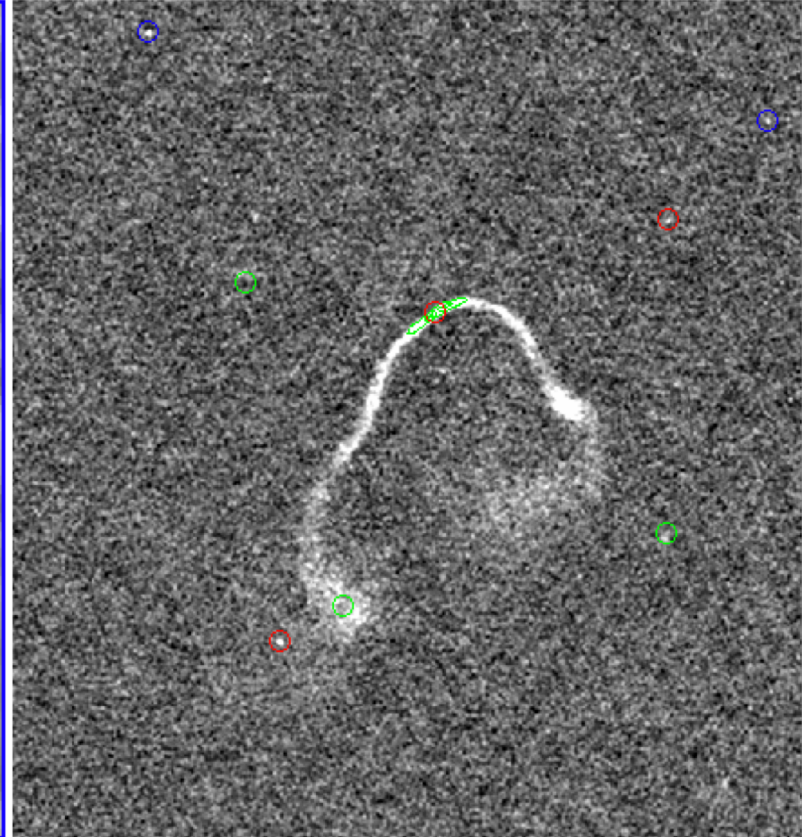
VLA



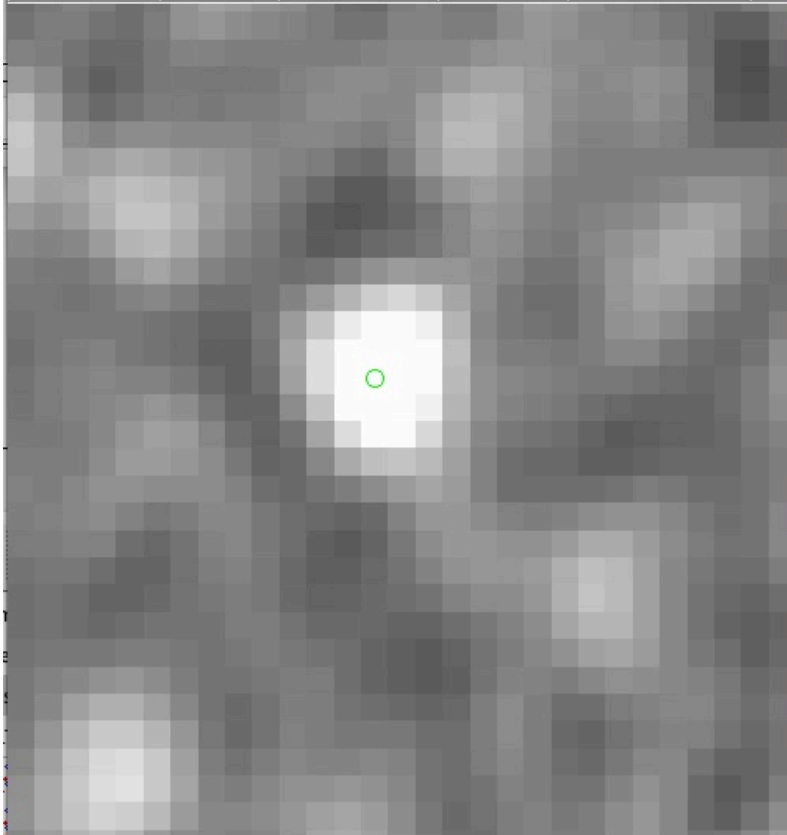
MIGHTEE



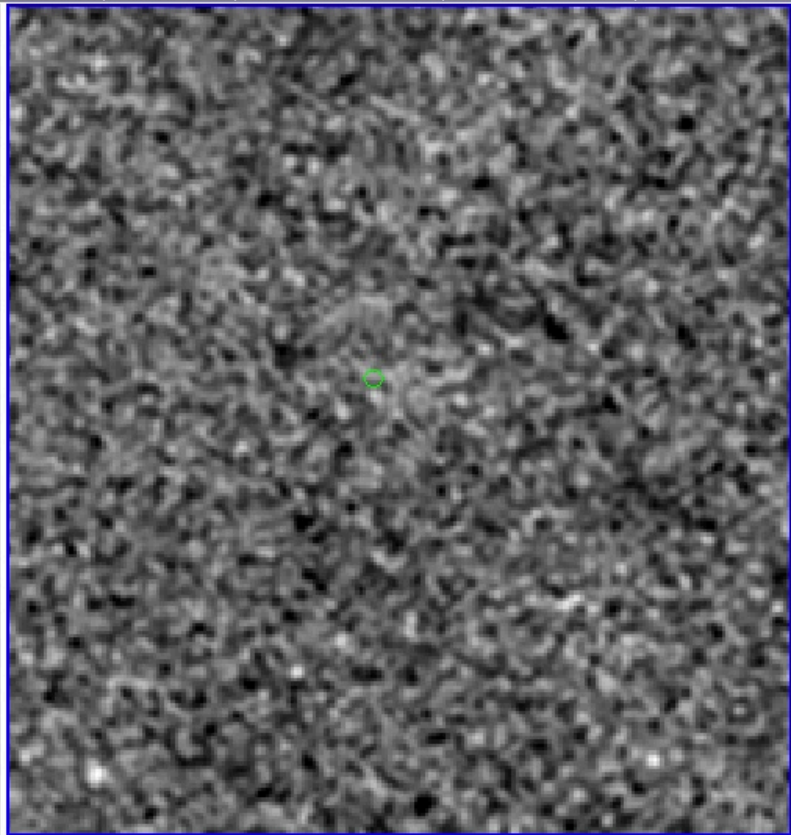
VLA

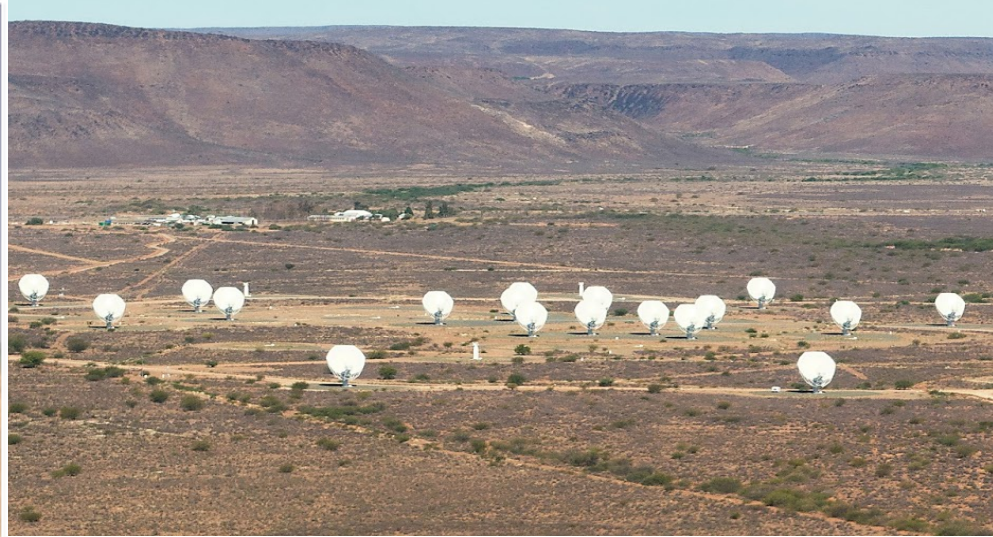


MIGHTEE



VLA





Indo-SA Flagship Programme in Astronomy

Joint Exploration of the Deep Radio Sky with
MeerKAT and the GMRT:

The Pathway to the SKA



Department of Science and Technology
Government of India



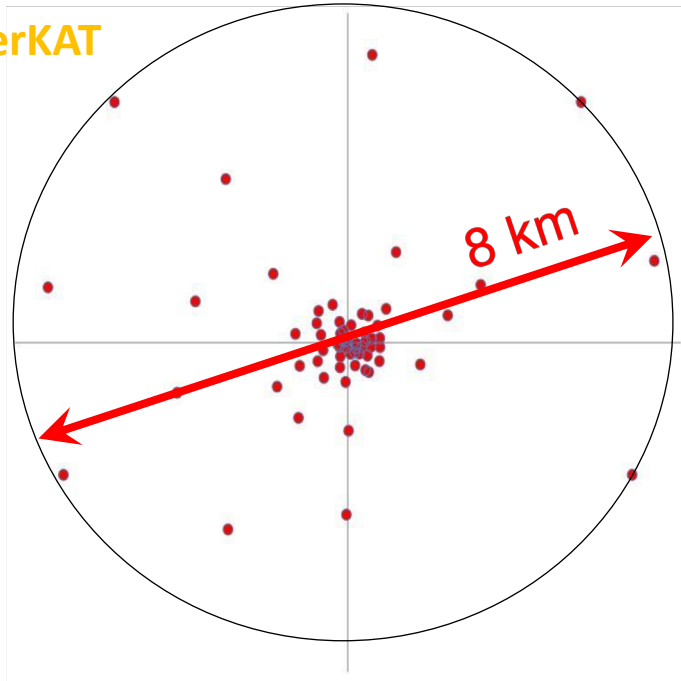
Astronomy
sub-Agency

Angular Resolution Complementarity

$$\theta_{1.8 \text{ GHz}} = 5''$$

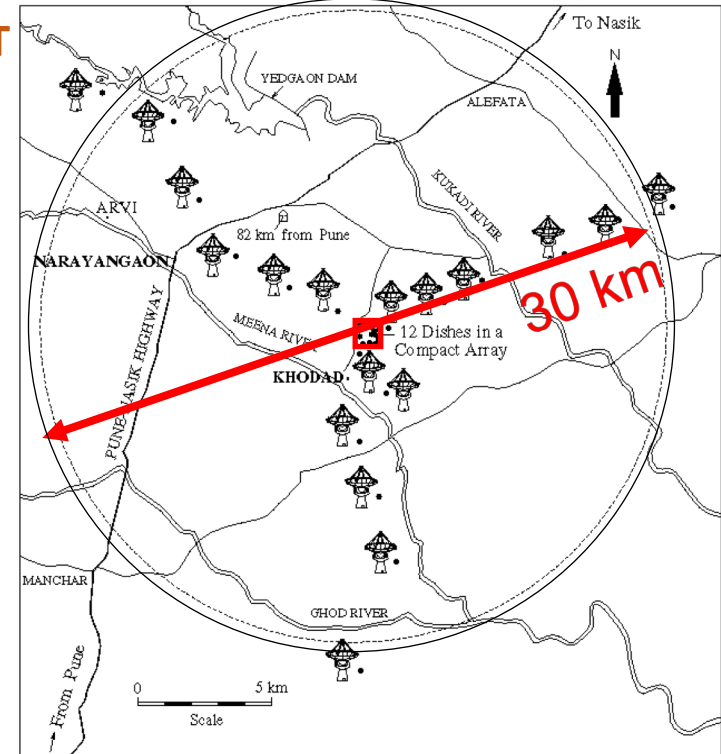
$$\theta_{0.6 \text{ GHz}} = 5''$$

MeerKAT

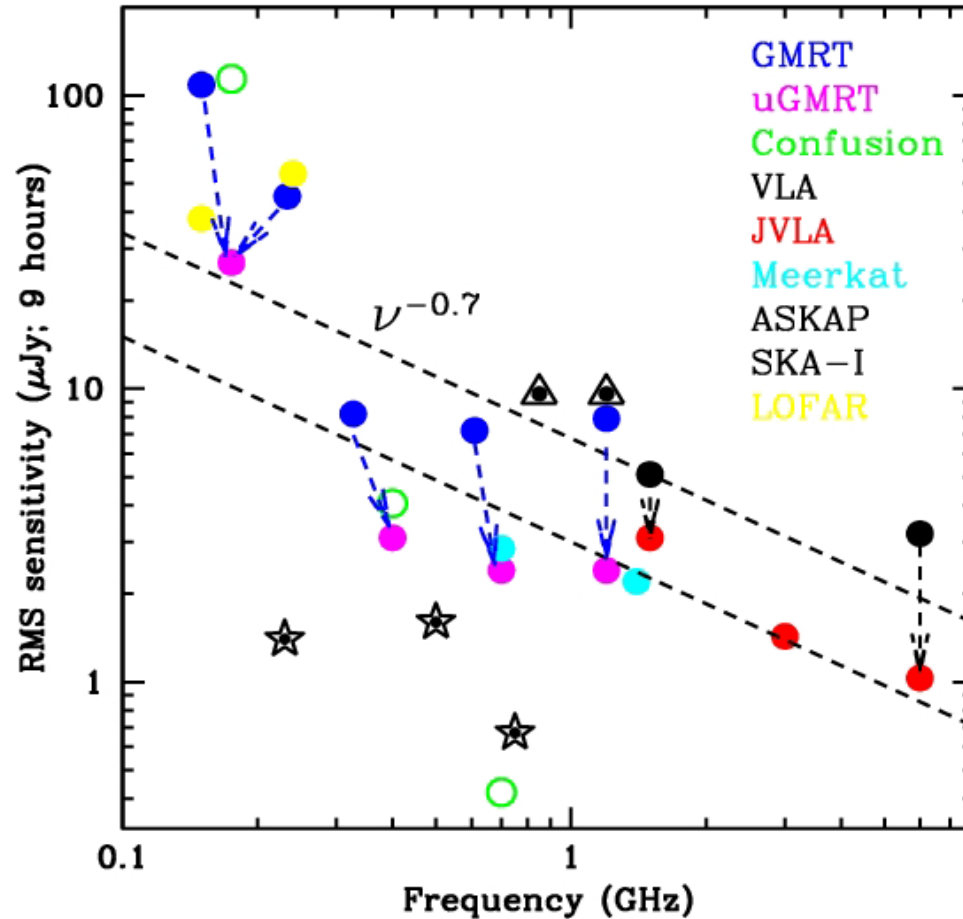


GMRT

LOCATIONS OF GMRT ANTENNAS (30 dishes)



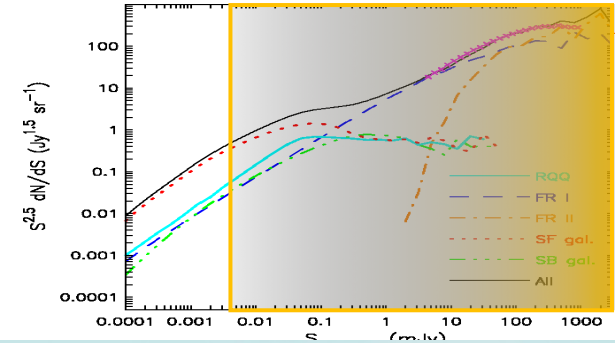
Sensitivity and Frequency Complementarity



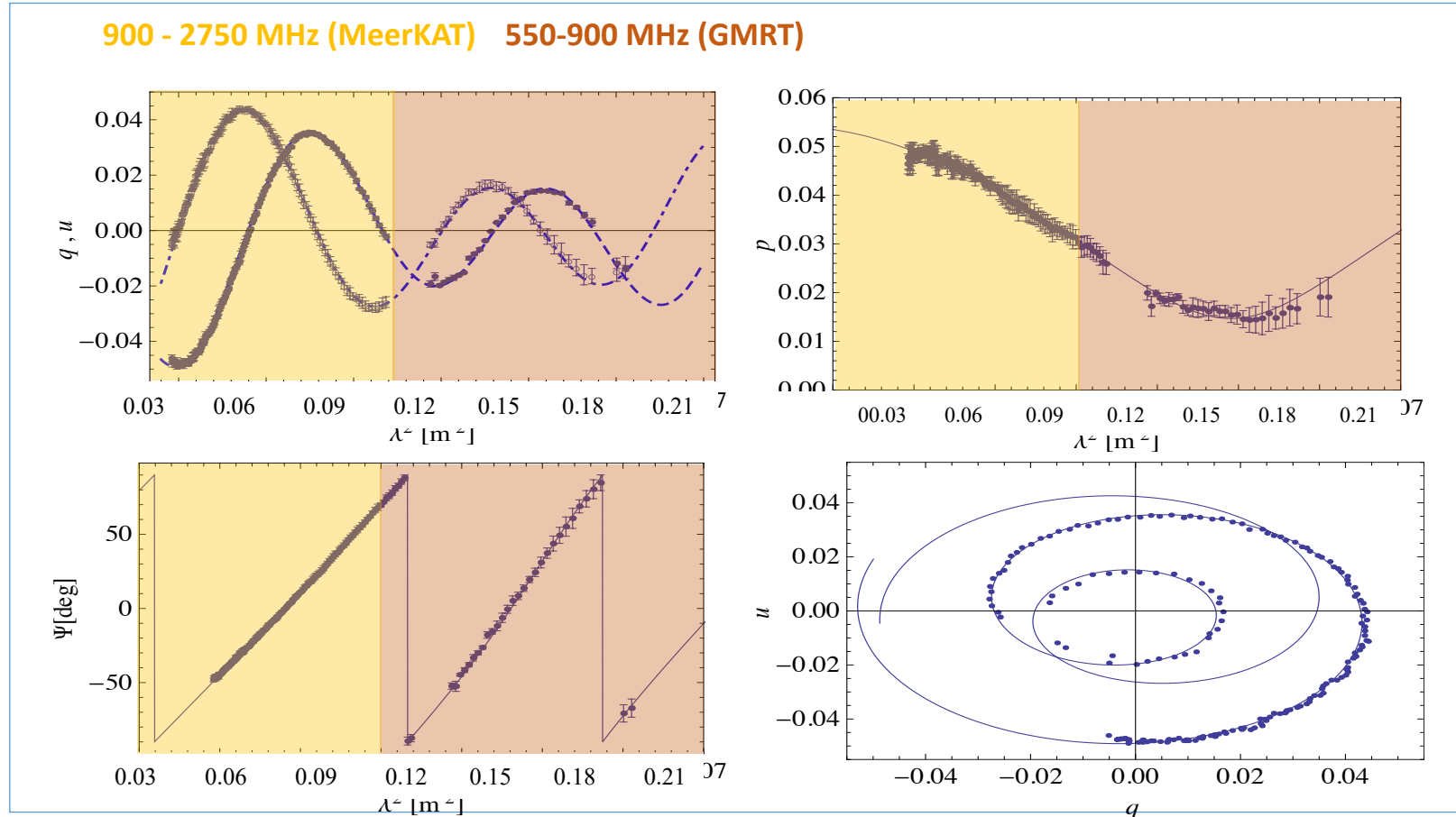
SuperMIGHTEE

An uGMRT-MIGHTEE ultra-broad band Deep full Stokes Survey

- 0.3 – 1.7 GHz (14 deg²), 0.3 – 2.7 GHz (6 deg²)
- rms 2 μ Jy per band
- 5" resolution



Polarimetry: Bandwidth is key



Polarimetry of PKS B1610-771 (O'Sullivan et al. 2012)

Slide modified from Bryan Gaensler



The Square Kilometre Array

Celebration of Jasper at 80

