

SKADS Simulated Skies (S-cubed) http://s-cubed.physics.ox.ac.uk/index.php Google

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UNIVERSITY OF OXFORD S<sup>3</sup> - The SKADS Simulated Skies

Oxford Physics oerc SKADS

e-mail webmaster

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**Introduction**

July 8, 2008 : The S<sup>3</sup> map-making utility now includes an option to add total intensity Galactic foregrounds from the Global Sky Model. [More...]

The SKADS Simulated Skies (S<sup>3</sup>) are a set of simulations of the radio sky performed at the University of Oxford, suitable for planning science with the Square Kilometer Array (SKA) radio telescope.

Three simulations can be accessed through this portal:

- [S<sup>3</sup>-SEX \(Semi-Empirical extragalactic database\)](#) [Access]  
The simulation of the extragalactic radio continuum sky puts an emphasis on modelling the large-scale cosmological distribution of radio sources, rather than the internal structure of individual galaxies. The simulation covers a sky area of 20 by 20 degrees, out to a cosmological redshift of  $z=20$ , and down to flux density limits of 10 mJy at 151 MHz, 610 MHz, 1.4 GHz, 4.88 GHz and 18 GHz.  
**Status : Total intensity simulation complete. Linear polarization information available.**
- [S<sup>3</sup>-SAX \(Semi-Analytical extragalactic database\)](#) [Access]  
This simulation of the extragalactic radio sky puts an emphasis on modelling the small-scale HI emission at smaller scales, and covers a sky area of 5.2 by 5.2 degrees, out to a redshift of  $z=4$ . Continuum emission information at 151 MHz, 610 MHz, 1.4 GHz, 4.88 GHz and 18 GHz is yet to be added.  
**Status : Total intensity simulation complete. Database in progress.**
- [S<sup>3</sup>-PUL \(PULser database\)](#) [Access]  
This simulation of the Galactic population of pulsars is performed in collaboration with R. Smits (Jodrell Bank Centre for Astrophysics) using the PSRPOP package developed at Parkes Observatory, and an algorithm to generate synthetic high-temporal resolution profiles.  
**Status : Simulation design in progress.**

Regarding the extragalactic simulations, query results may be subjected to post-processing algorithms described in the relevant sections, and used to build maps or data cubes.

A set of standalone python tools may be used to build and query local databases, apply post-processing to query results and build maps and cubes on a local system. These SKADS Simulated Skies Interactive Tools are described here and may be downloaded here. They use the same routines that are implemented on the server, so that users may for instance query the online databases, download results, and use local post-processing and map-making tools.

# Mosaic imaging with the GMRT

## a users approach



Hans-Rainer Klöckner

Algorithms Oxford 2008

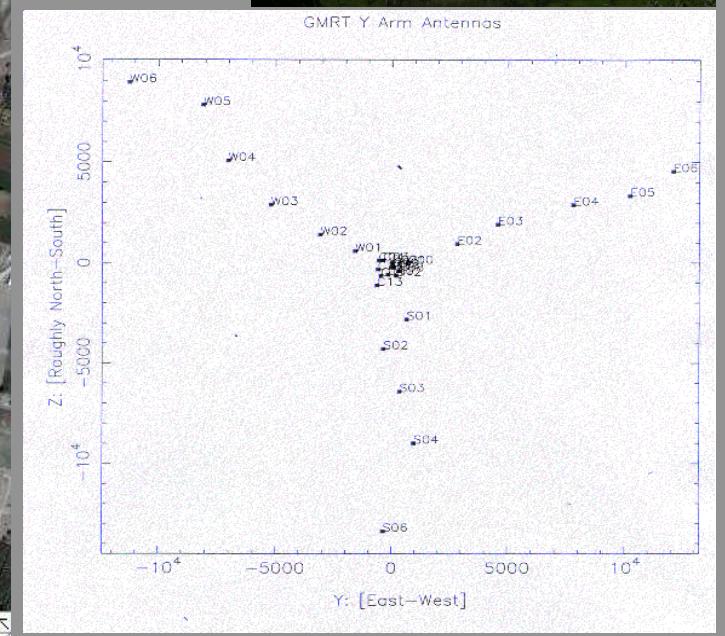
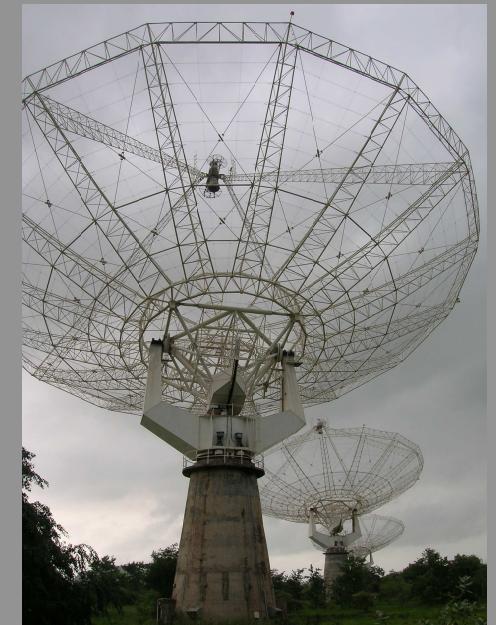


D. Obreschkow

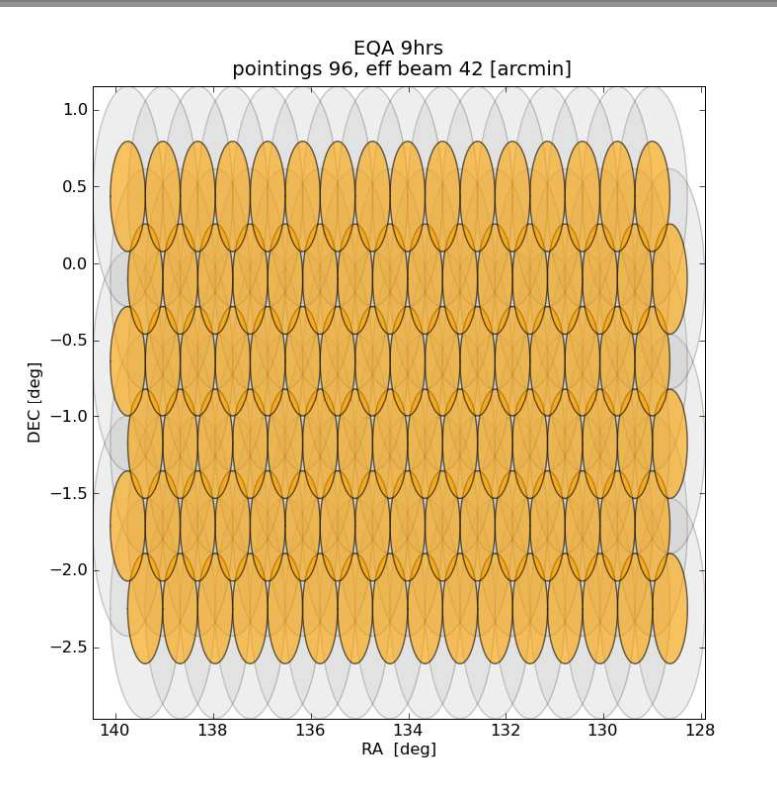
# GMRT

## Giant Metrewave Radio Telescope (GMRT) Khodad located near (2-3 hrs by car) Pune in India:

- 30 x 45m antennas in a Y-shape = 4% SKA
- baselines ~25.5 km



# Surveying

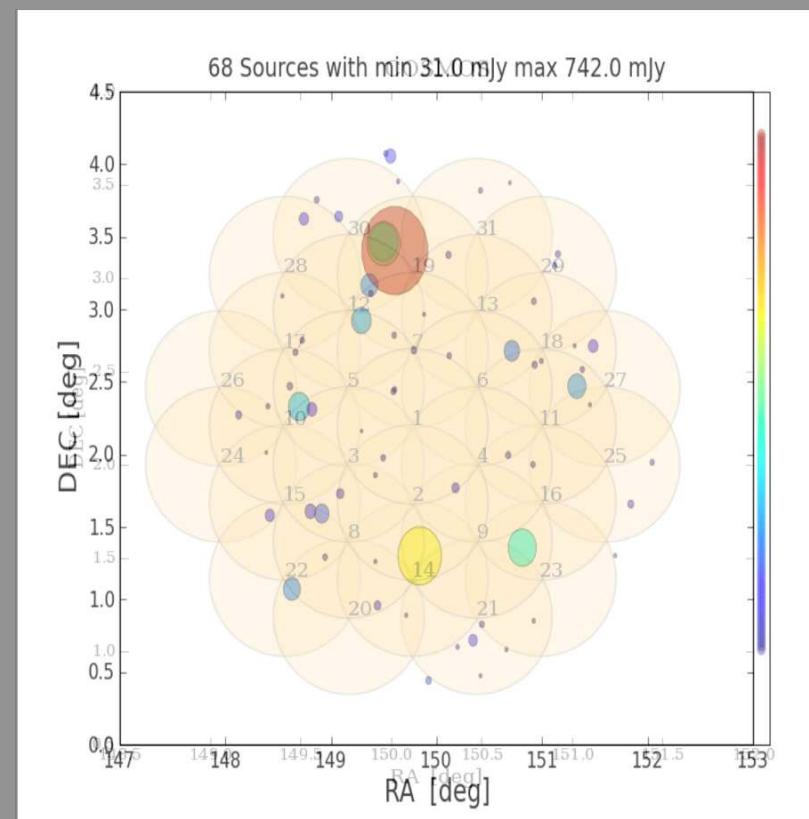


**HPBW**

119' [ $\sim$ 230 MHz]  
85' [ $\sim$ 330 MHz]  
44' [ $\sim$ 600 MHz]  
26' [ $\sim$ 1400 MHz]

## Baseline sensitivity [360 MHz, avg]

- 60 minutes 1.419570e-03 Jy
- 30 minutes 2.007576e-03 Jy
- 15 minutes 2.839141e-03 Jy
- 7 minutes 4.156077e-03 Jy
- 3 minutes 6.348512e-03 Jy
- 1 minutes 1.099595e-02 Jy



# GMRT - pipeline

AIPS



(Eric Greisen et al.)

**ParseiTongue** (Mark Kettenis)

EVALUATE - DATA  
CALIBRATE  
EVALUATE - DATA  
SELF- CALIBRATE

**GMRTcalinit.py**

**GMRT\_CALIB.py**  
**HAND\_FLAG.py**  
**GMRT\_IMAGER.py**

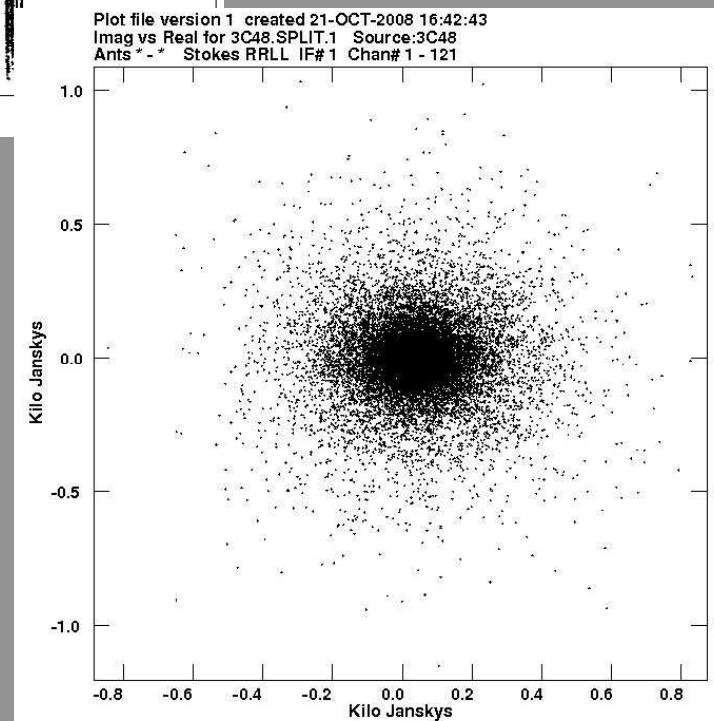
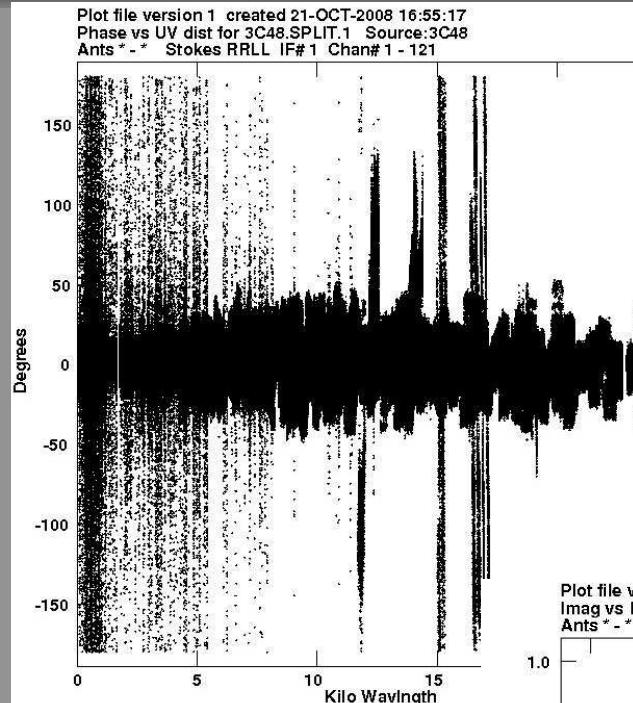
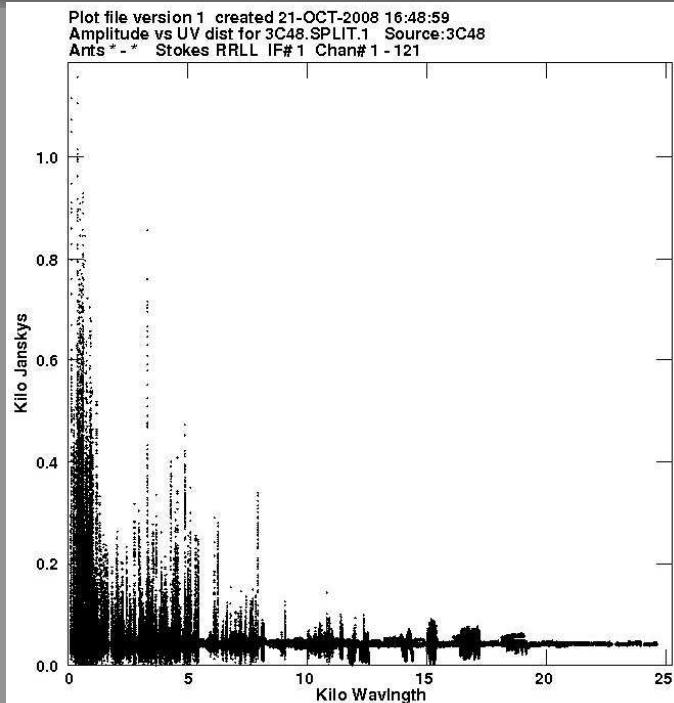
**GMRT\_FLAGER.py**  
**GMRTdisk.py**  
**GMRTTools.py**  
**HAIPStask.py**

**GMRT\_MERGER.py**  
**SPECTRA\_EXTRACT.py**  
**GMRT\_PRTOUTPUT.py**

**make\_run\_files.py**  
**makepublic.py**  
**readdata.py**

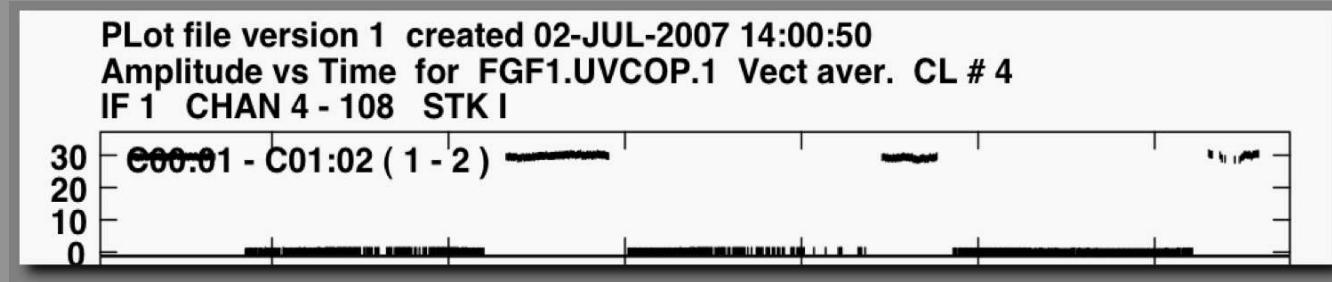
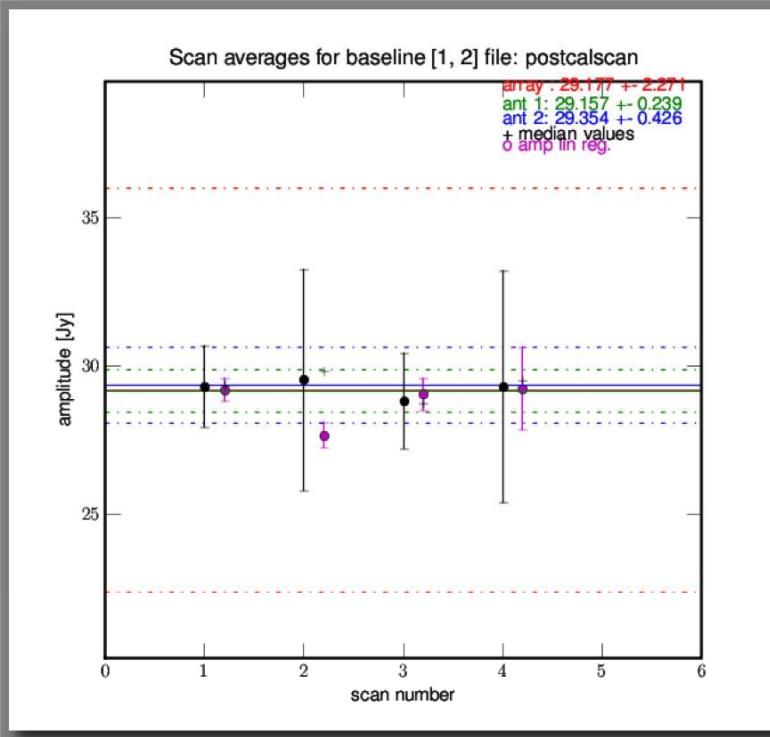
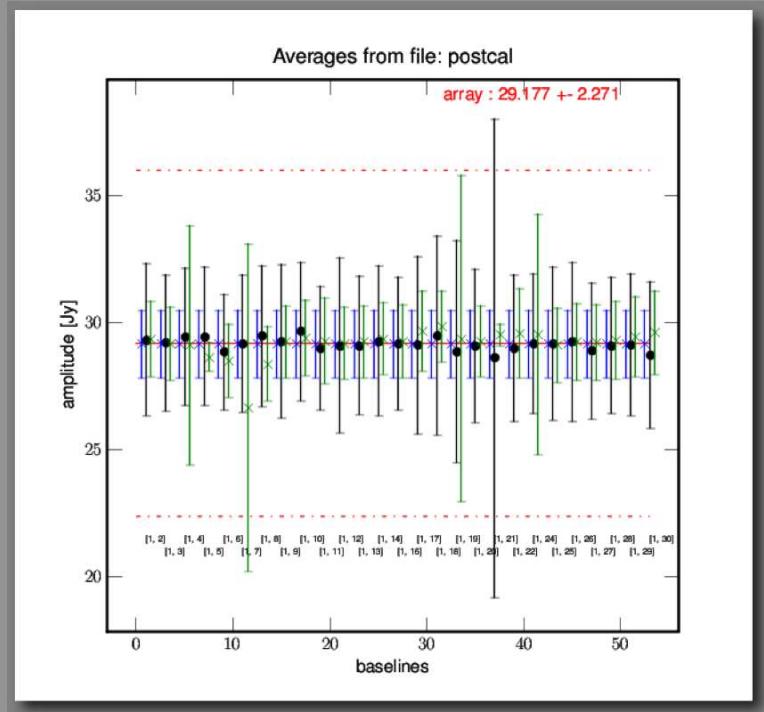
# Evaluate data Phase - calibrator

360 MHz



# Flagging - on continuum [phase-calibrator]

Telescope  
Baseline  
Scan



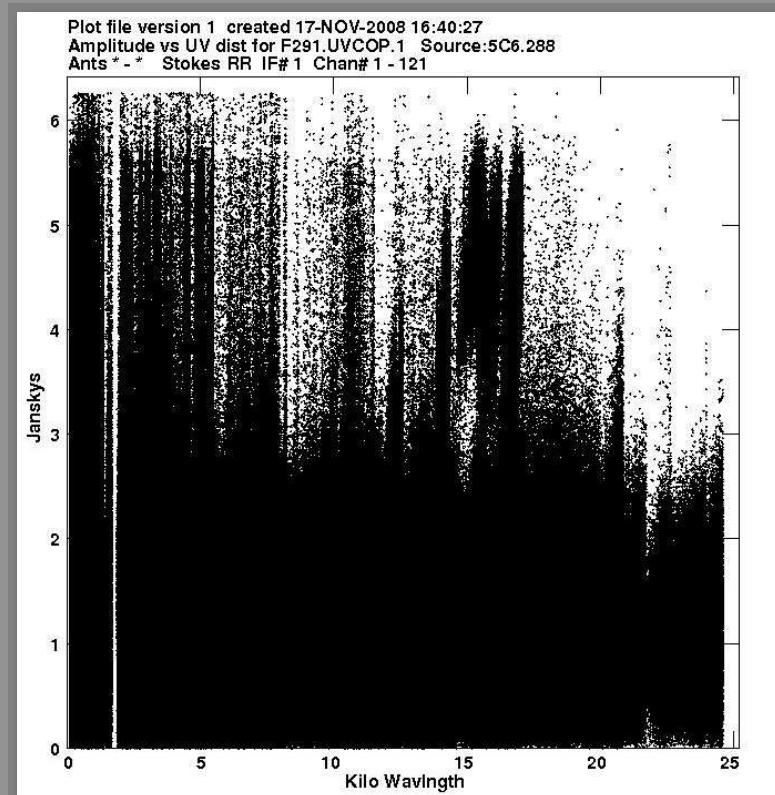
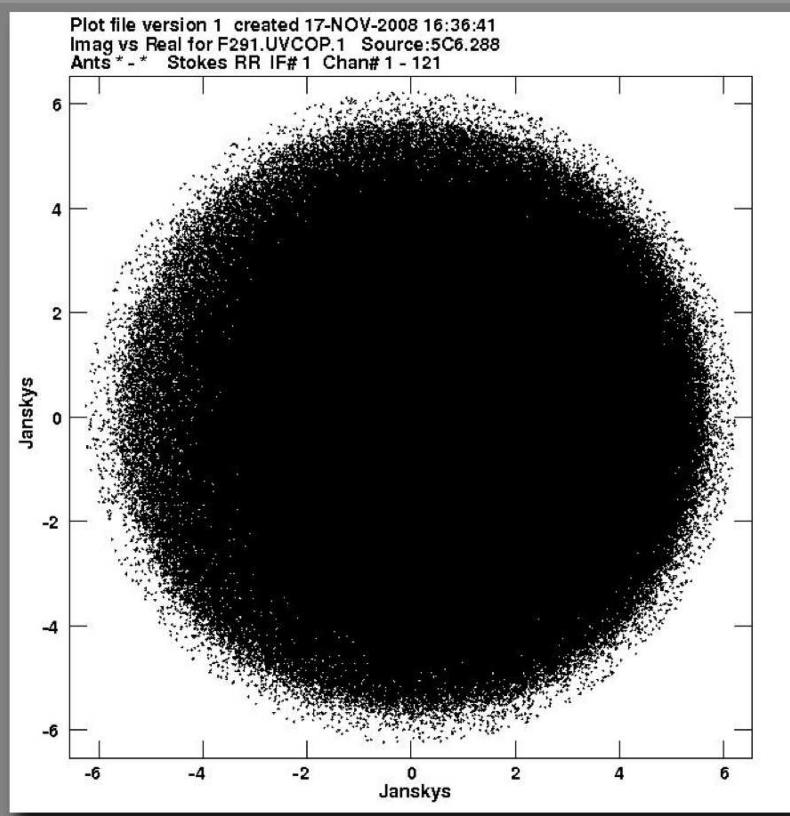
# Flagging - on channels [target]

360 MHz

Stokes RR

183592 flags; 145739 vis \* 121 chan -> 4%

LL is 20 %



# Evaluate data on target

360 MHz

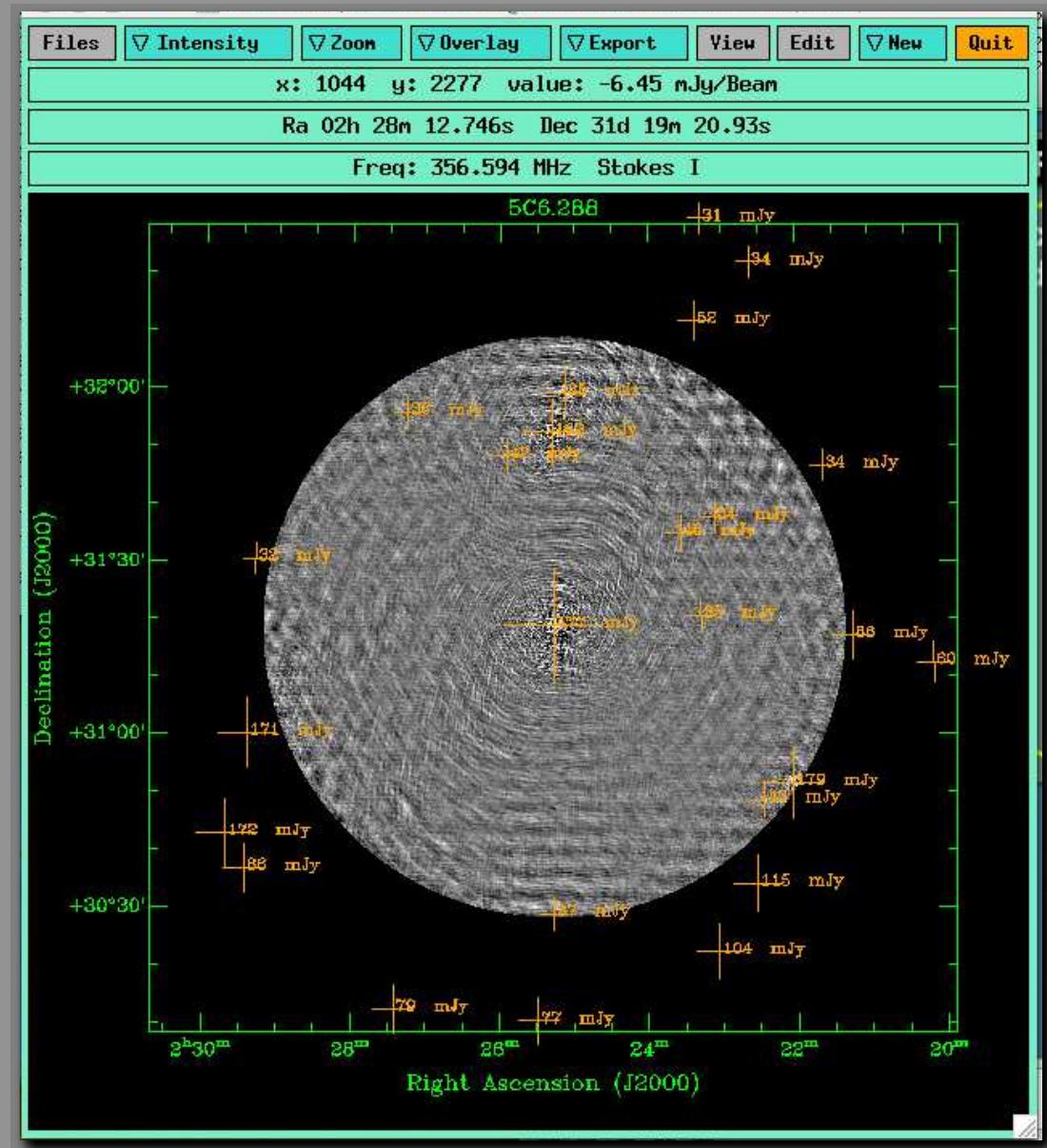
dirty image

multifacet

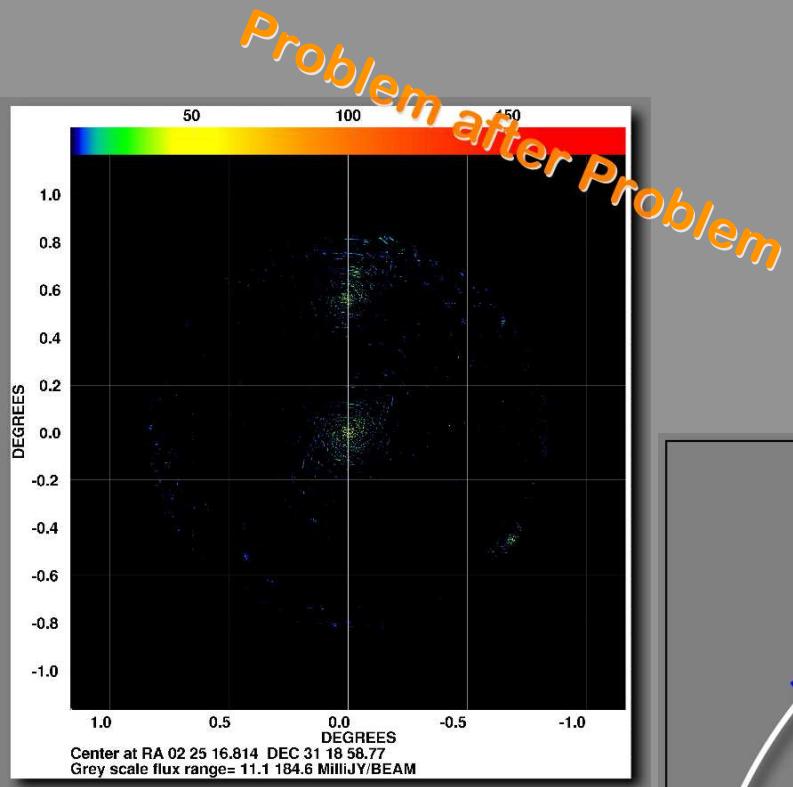
760 mJy

250 d.-rang

careful  
baseline sensitivity



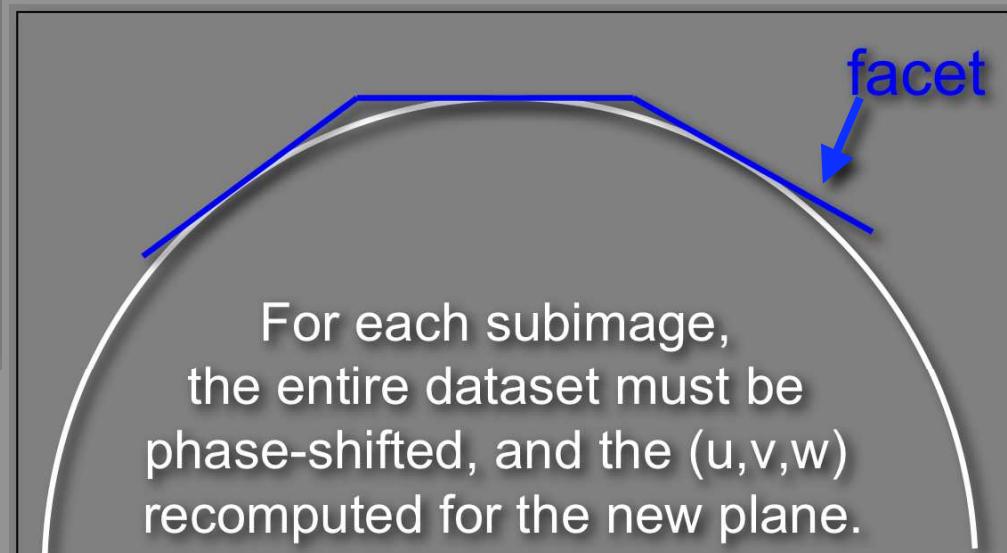
# Multifacet selfcalibration



FoV  $\sim 1.3$  deg

Iteratively build up a model sky

Faceting with 37 sub images  
(e.g. 244 MHz  $\sim 200$  sub-images)



[see Eric's talk]

Self-calibration finds antenna gains  $g_i$   
which minimize the measured visibilities  $V_{ij}$  and model visibilities  $V^*_{ij}$

# Multifacet selfcalibration

Selfcalibration:

Decrease the number of CC

Decrease the integration time

**Caution Baseline sensitivity**

Building up a model sky:

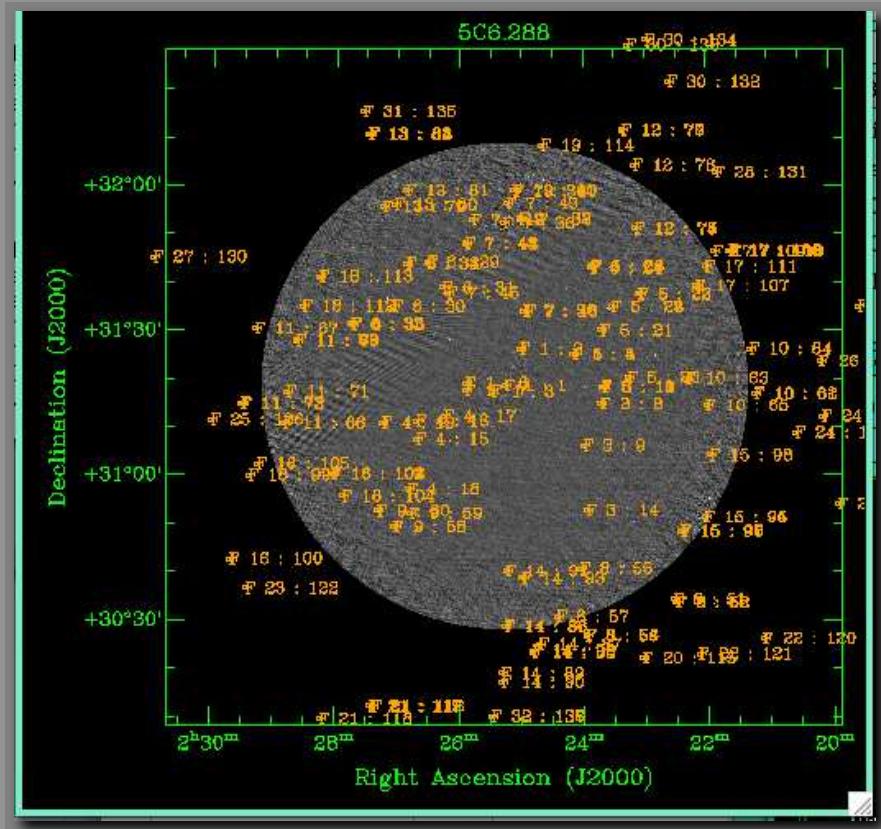
Faceting with 37 sub images  
global rms

local rms

Final sky

147 CC components

137 CC sources

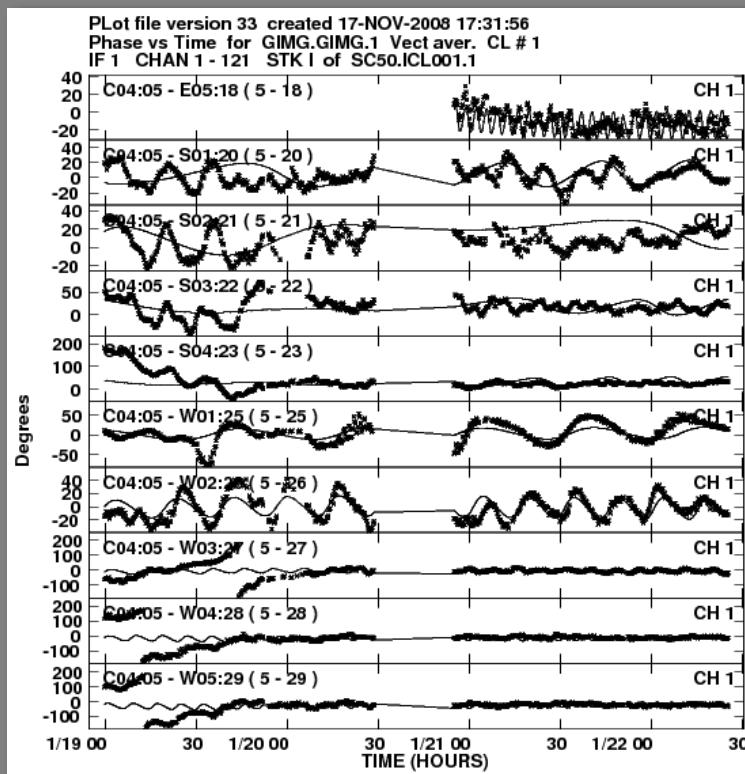


# some output

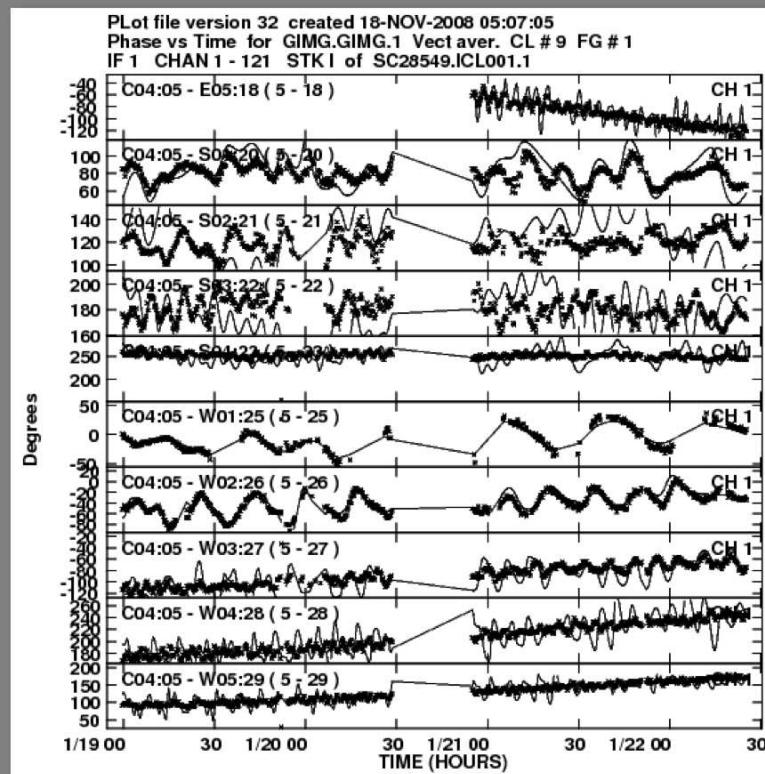
Iteratively build up a model sky

Image - select good cc components - **phase** calibration

1st scal step



final scal step

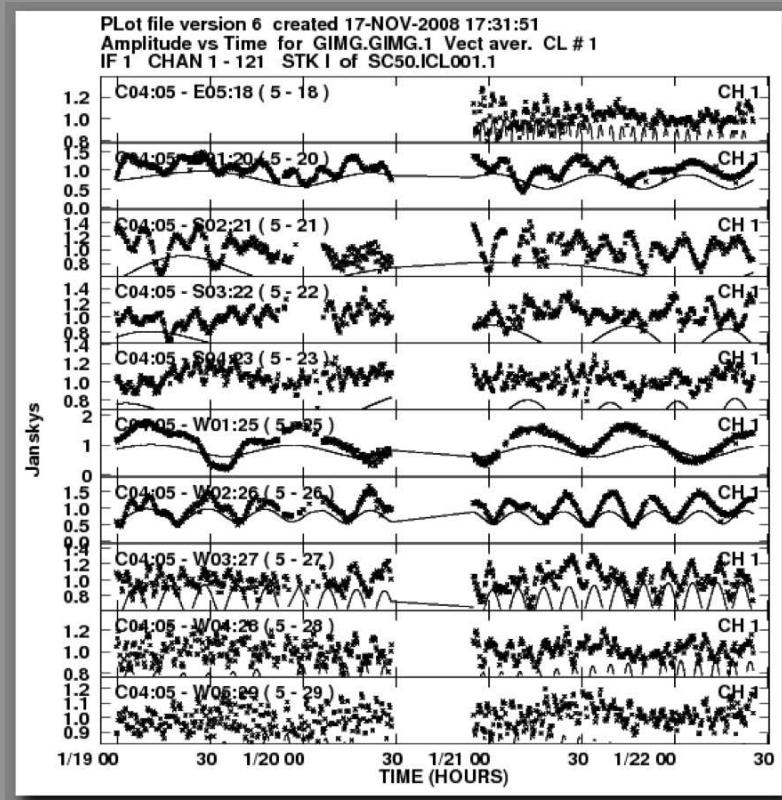


# some output

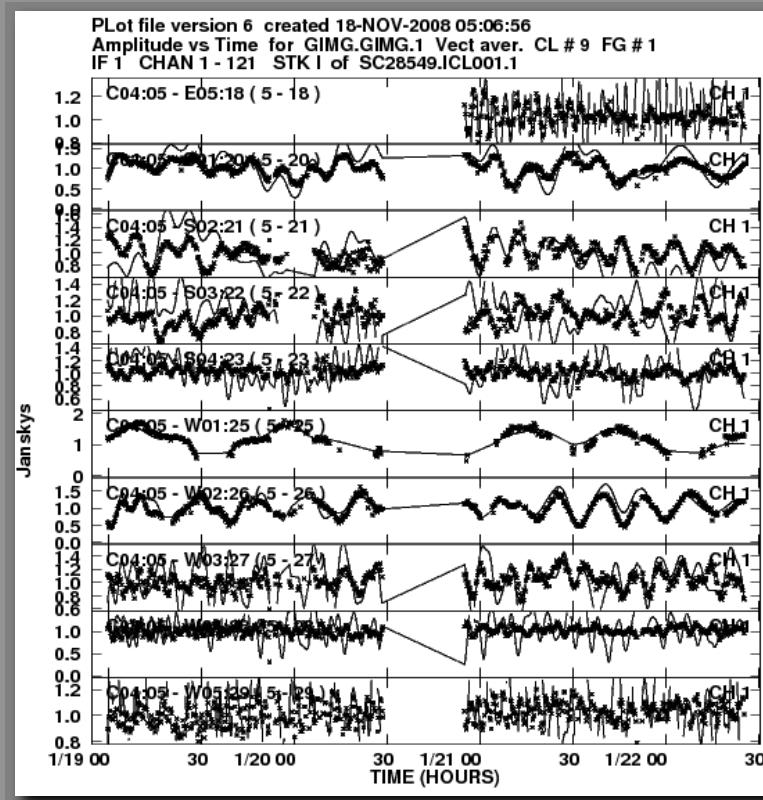
Iteratively build up a model sky

Image - select good cc components - **amplitude calibration**

1st scal step



final scal step



**5C6.288**

$z = 2.982$

5C6.288

**37 facets**

FoV 1.3 deg

107 sources

357 MHz

76 min

noise 0.2 mJy

Theo noise 0.05 mJy

Declination (J2000)

+31°45'

+31°30'

+31°15'

+31°00'

+30°45'

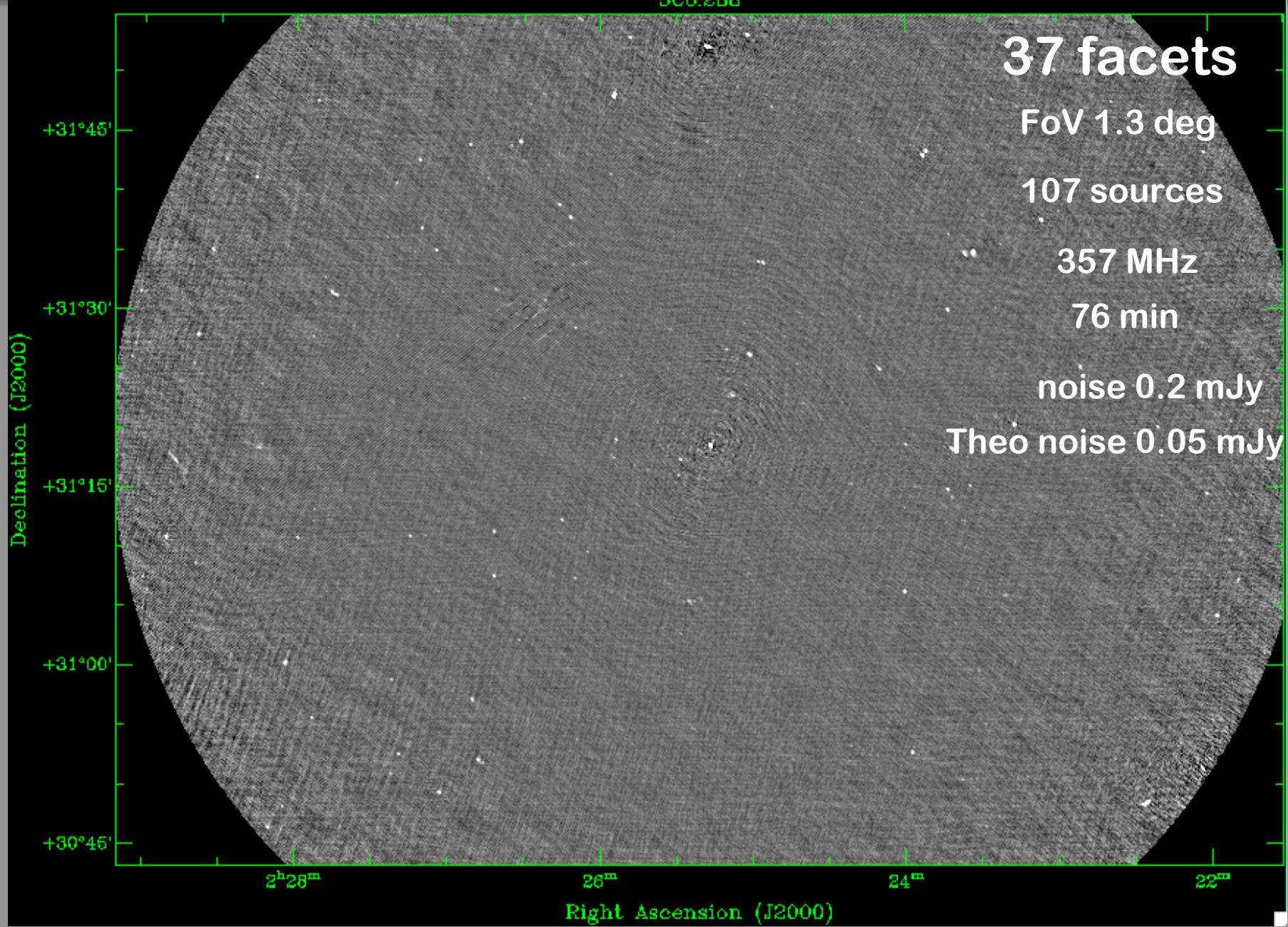
2<sup>h</sup>28<sup>m</sup>

26<sup>m</sup>

24<sup>m</sup>

22<sup>m</sup>

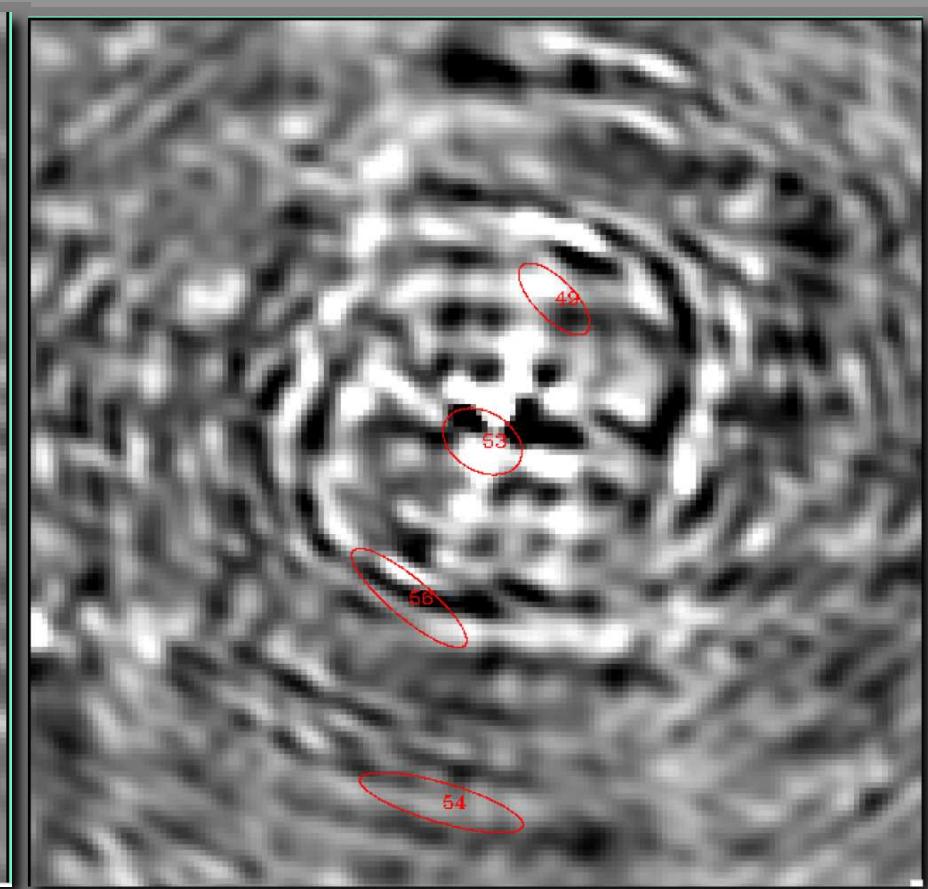
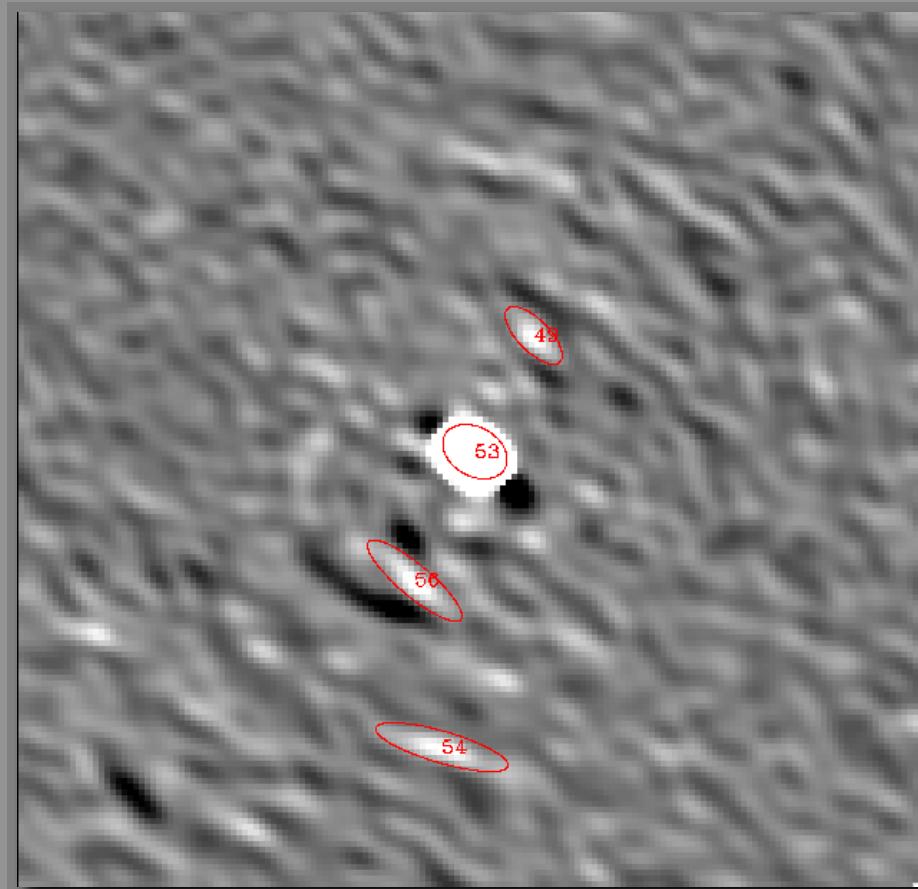
Right Ascension (J2000)



5C6.288

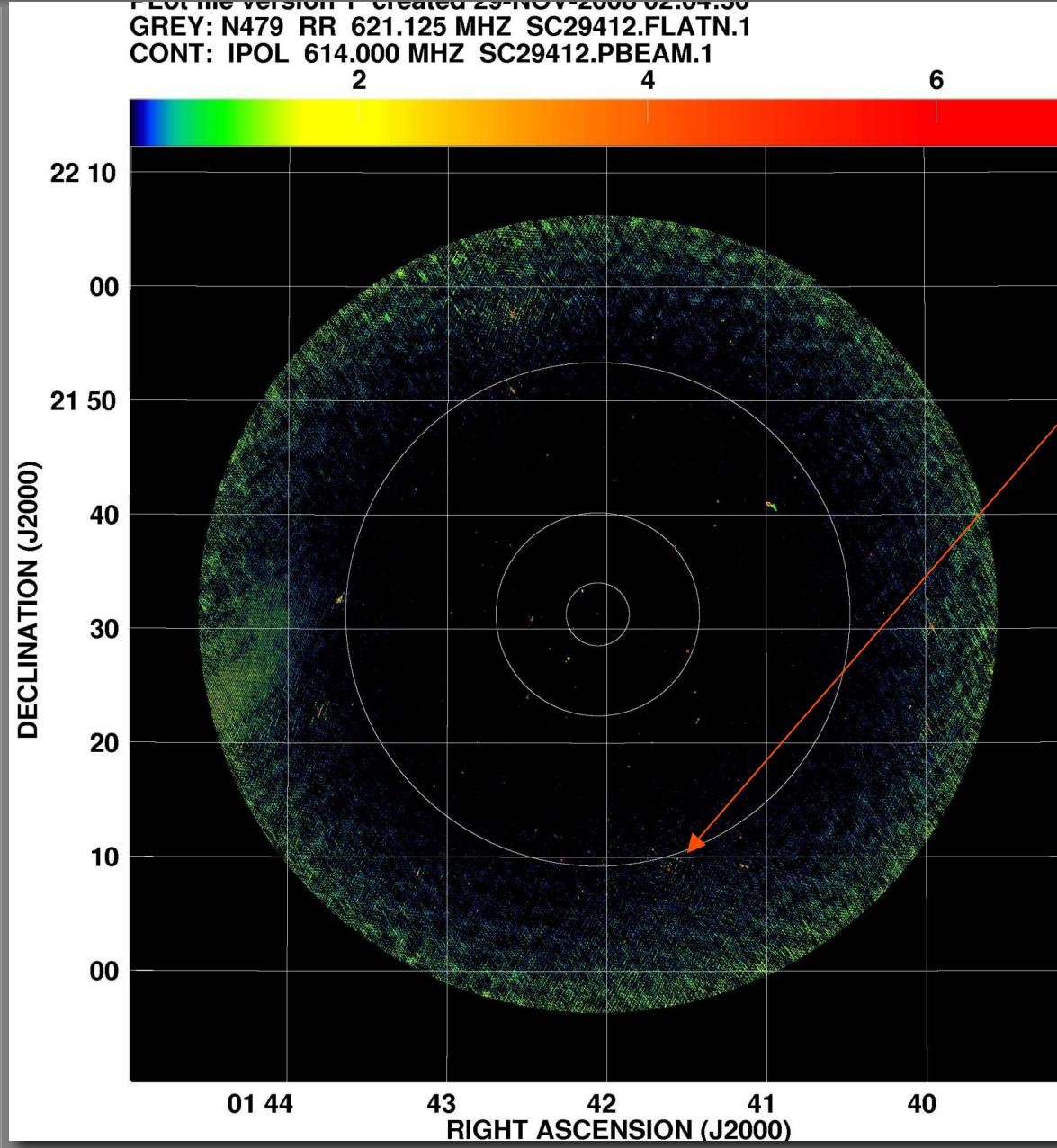
3 TTU

subtract 5 strongest sources



# NGC 479 - a not so easy task

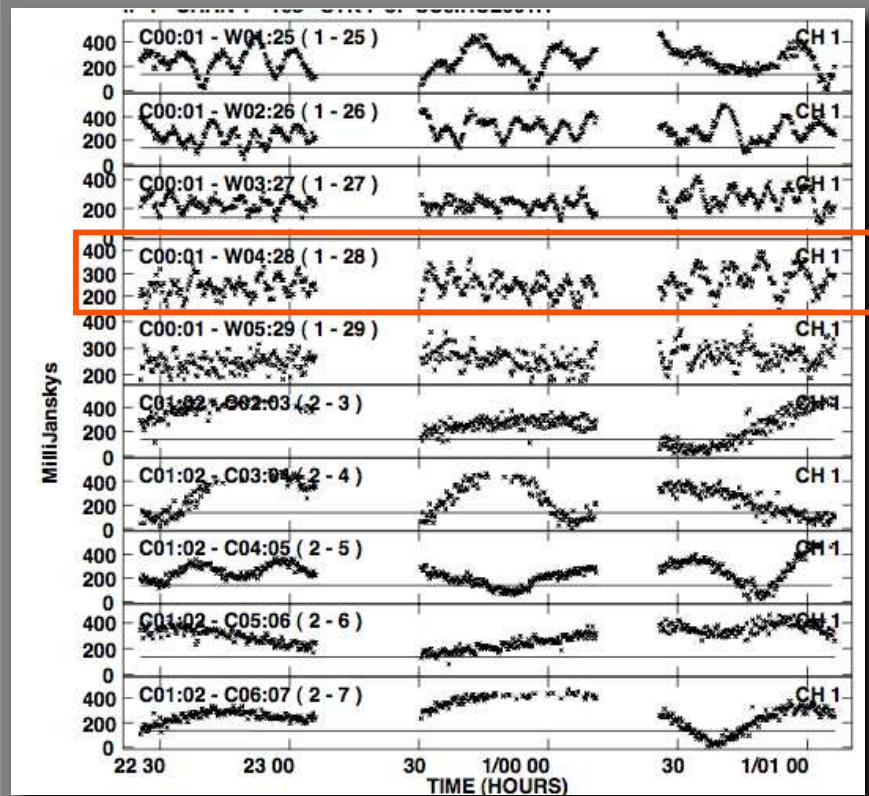
610 MHz



strongest source at  
50% of primary beam

# amplitude versus time

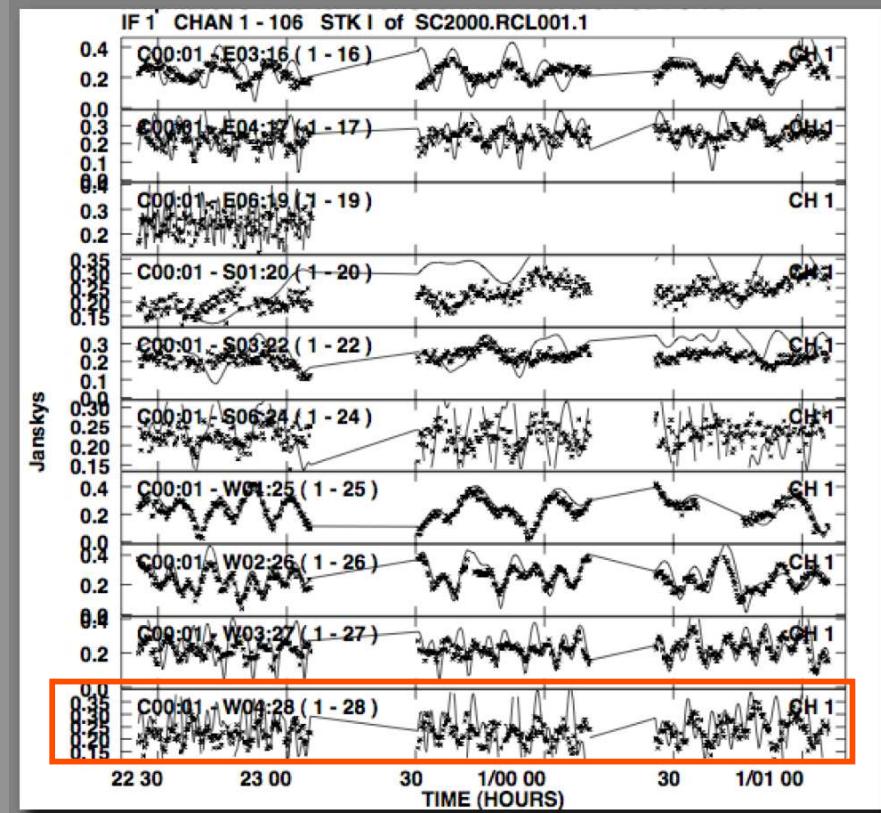
final scal step



shift the phase centre

Not shift the phase centre  
long baselines  
can not be calibrated !!!

final scal step



## conclusion

- phase variations [ $\sim 20$  deg]
  - local to global dynamic range [ $\sim 200:10000$ ]
  - factor of a few of thermal noise (only if !)
  - can get away with standard calibration  
if no strong source is in the field
- 
- better analysis tools [closure phase & amplitude, etc.]
  - an improved data-base structure