

# REPORT FROM IMAGING BUSY WEEK

## 13

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Meudon Observatory, 30 January – 3 February 2012

# PARTICIPANTS

- 22 participants
- Participation from various KSP's: Surveys, Transients, EoR, Solar
- Participation of the developers

Roberto Pizzo  
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Michael Hogan  
Alexander van der Hosts  
Jess Broderick  
Frank Breitling  
Julien Jirard  
Bas van der Tol  
Sarod Yatawatta  
Ger van Diepen  
Joris van Zwieten

# WHAT NEEDED TO BE TESTED?

## I. AWImager:

- Test on simulated data and on real data;
- test the time-computing performance.

## II. Sagecal:

- Performance w.r.t. demixing
- start providing some documentation for the Lofar Imaging Cookbook

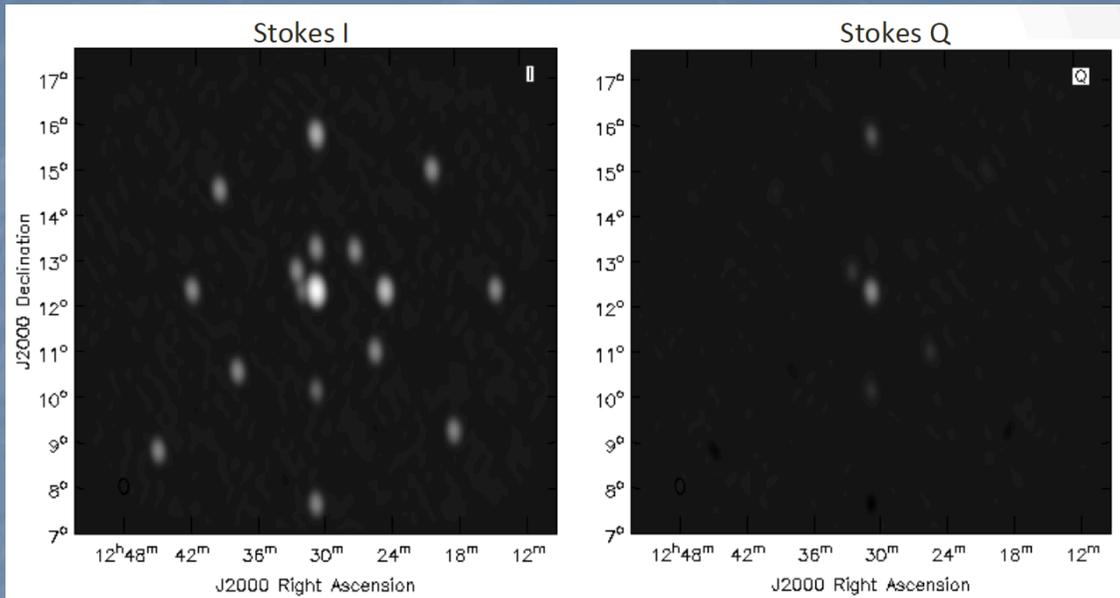
## AVAILABLE DATA

Source	Observation ID	Band	$\Delta\nu$ (MHz)	$\Delta t$ (h)	Beams	Status - processed with:
3C65 3C66	L43788	LBA	~58	6	4	NDP3+DEMIXING +BBS
A2256	L29689	LBA	12-67	10	1	NDP3+BBS

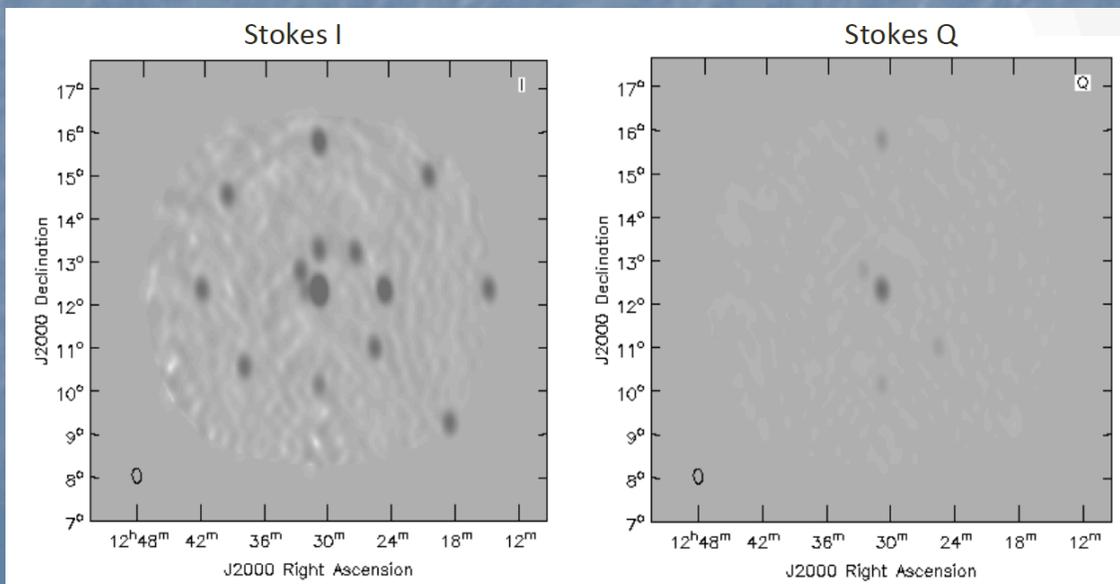
+ simulated dataset within an 8h LBA observation of Virgo A – central source + 16 other sources along a spiral up to 5 degrees from the field center.

Fluxes to be recovered by the commissioners

# AWIMAGER PERFORMANCE ON SIMULATED DATA



no element beam applied



element beam applied

✓ Images become smaller (padding=1 → padding=1.2)

# RECOVERED FLUXES

Source	True Flux	BBS Beam correction Flux	Error	+StepElement=1 Flux	Error
0	10	9.97	-0.3%	9.99	0.0%
1	0.5	Too low res.		Too low res.	
2	1	1.00	0.0%	0.96	-4.0%
3	1	1.02	2.0%	1.00	0.0%
4	1	1.02	2.0%	1.01	1.0%
5	3	2.97	-1.0%	3.01	0.3%
6	1	0.94	-6.0%	0.98	-2.0%
7	0.5	0.45	-10.0%	0.46	-8.0%
8	1	0.93	-7.0%	0.94	-6.0%
9	1	1.00	0.0%	0.96	-4.0%
10	1	1.05	5.0%	0.98	-2.0%
11	2	2.19	9.5%	2.00	0.0%
12	1	1.07	7.0%	1.02	2.0%
13	1	0.98	-2.0%	0.99	-1.0%
14	1	0.88	-12.0%	0.94	-6.0%
15	1	0.87	-13.0%	Outside image	
16	1	0.88	-12.0%	Outside image	

Courtesy of F. Batejat,  
E. Varenus & F. de  
Gasparin

# AWIMAGER: SELFCAL LOOP

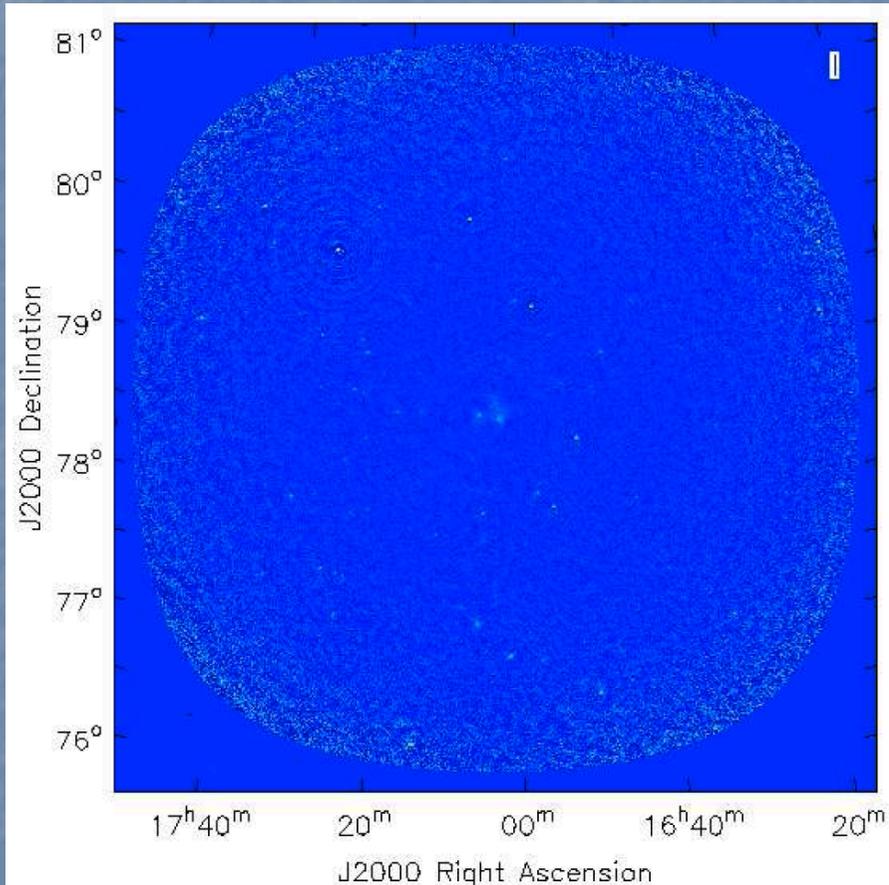
Source	True Flux	1 cycle of selfcal		2 cycles of selfcal		3 cycles of selfcal	
		Flux	Error	Flux	Error	Flux	Error
0	10.00	10.12	1.2%	9.92	-0.8%	9.84	-1.6%
1	0.5	Too low res.		Too low res.		Too low res.	
2	1	0.81	-19%	0.92	-8%	0.94	-6.0%
3	1	0.92	-8%	0.97	-3%	0.97	-3.0%
4	1	0.92	-8%	0.97	-3%	0.98	-2.0%
5	3	2.91	-3%	2.97	-1%	2.96	-1.3%
6	1	0.91	-9%	0.97	-3%	0.96	-4.0%
7	0.5	0.43	-14%	0.42	-16%	0.43	-14.0%
8	1	0.87	-13%	0.92	-8%	0.92	-8.0%
9	1	0.87	-13%	0.94	-6%	0.95	-5.0%
10	1	0.90	-10%	0.94	-6%	0.94	-6.0%
11	2	1.91	-4.5%	1.94	-3%	1.95	-2.5%
12	1	0.92	-8%	0.99	-1%	1.01	1.0%
13	1	0.88	-12%	0.95	-5%	0.95	-5.0%
14	1	0.86	-14%				
15	1						
16	1						

✓ When starting from a skymodel with only the central source, all source fluxes are recovered in 2-3 cycles

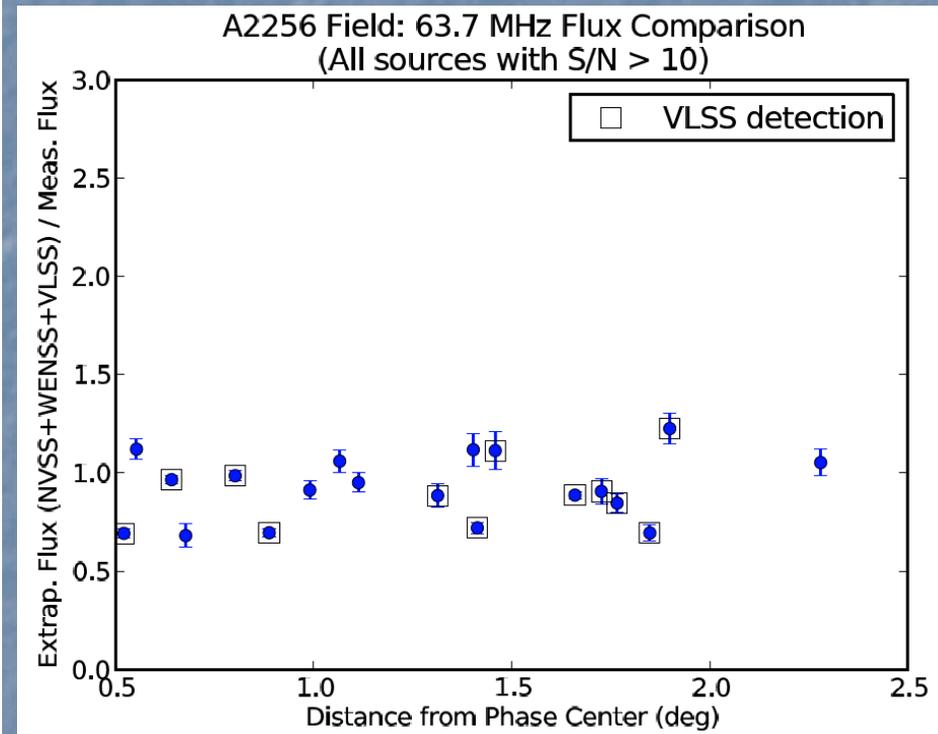
Courtesy of F. Batejat,  
E. Varenus & F. de  
Gasparin

# AWIMAGER PERFORMANCE ON REAL DATA

## A2256



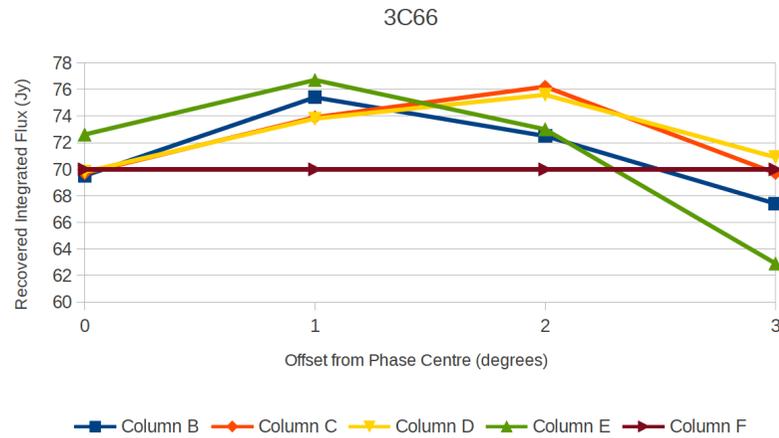
Courtesy of A. Shulevski



Beam correction good within 10-20%

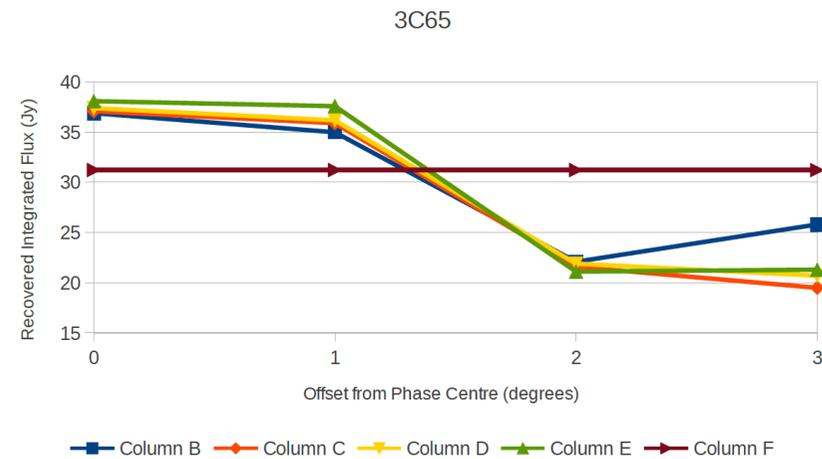
# AWIMAGER PERFORMANCE ON REAL DATA

## 3C66 - 3C65



Recovered integrated fluxes for 3C66 as found by PyBDSM. (note: Source is extended, peak fluxes in agreement with those found by Alexander van der Horst.) Labels Column B, C and D refer to the images of pointings concatenated with `frequol='2MHz'` and with `SAE = 5,0` and `1` respectively. Column E is with `SAE = 1` for pointings concatenated with `frequol` left unset. Column F is the expected flux (70.0Jy)

Courtesy of M. Hogan and A. Mueller



As above but for 3C65. Expected extrapolated flux of 31.1Jy. Note that the SED on NED suggests that index may be  $>0.8$  at low frequencies.

The recovered flux for 3C66 is consistent within 10% up to  $3^\circ$  from phase center showing that the beam correction is successful. However, recovered fluxes for 3C65 deteriorate significantly when this weaker source is  $>1^\circ$  from phase center. Varying the `StepApplyElement` parameter is found to not significantly affect the recovered fluxes.

Maybe due to the data reduction (demixing+BBS)? Further tests will assess this.  
To check also if selfcalibration improves the situation.

# AWIMAGER: TIME PERFORMANCE

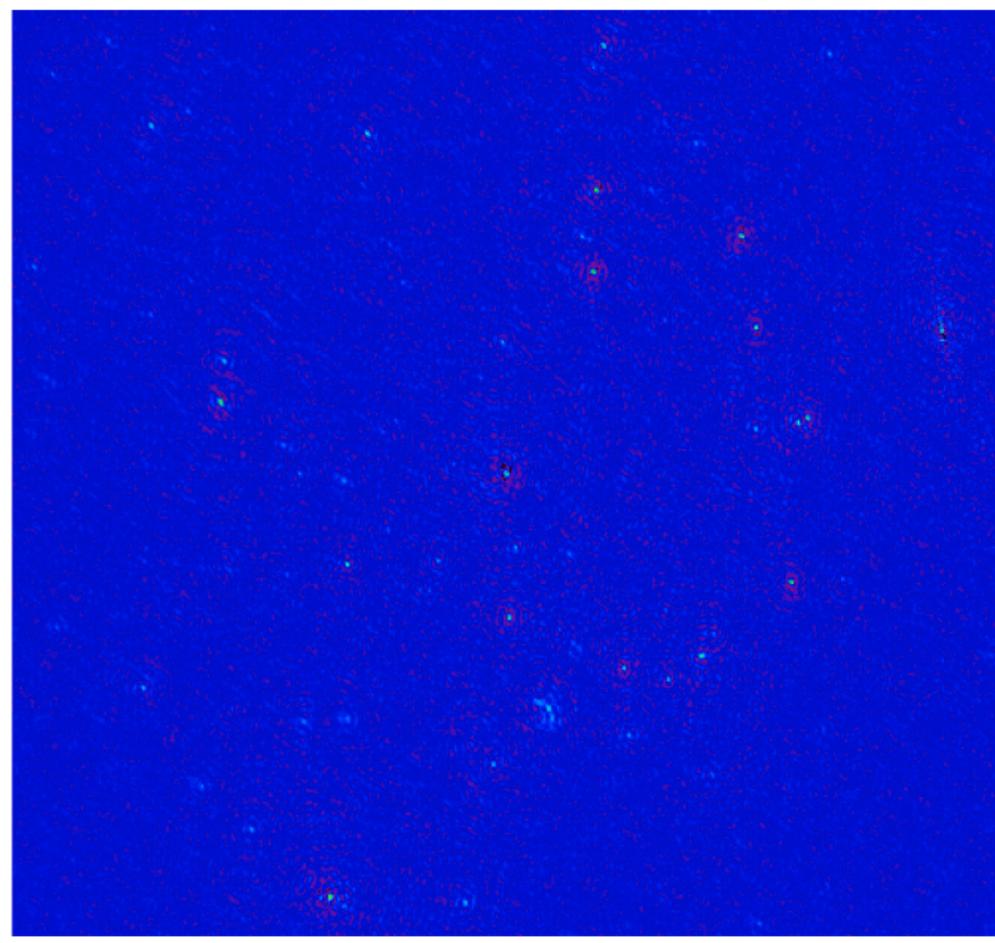
Beam nr	SB nr	Hour nr	Time hr:min:sec	3C66 Peak Jy/beam	3C66 Rms Jy/beam	3C65 Peak Jy/beam	3C65 Rms Jy/beam
0	0	1-6	1:45:40	38.09	0.29	...	...
0	0	1	0:12:53	38.11	0.45	...	...
0	0	2	0:14:44	37.07	0.43	...	...
0	0	3	0:18:10	37.96	0.48	...	...
0	0	4	0:17:11	36.47	0.41	...	...
0	0	5	0:13:33	38.27	0.43	...	...
0	0	6	0:12:17	38.77	0.47	...	...
1	4	1-6	2:01:30	40.62	0.37	21.18	0.32
1	4	1	0:14:39	40.34	0.65	24.18	0.73
1	4	2	0:17:55	38.19	0.66	22.54	0.99
1	4	3	0:20:34	39.59	0.72	22.56	0.44
1	4	4	0:20:08	38.58	0.64	17.78	0.64
1	4	5	0:15:48	42.53	0.80	14.46	0.55
1	4	6	0:13:23	44.27	0.81	13.44	0.72
2	8	1-6	2:21:43	36.81	0.46	33.92	0.22
2	8	1	0:16:39	40.66	1.10	32.41	0.54
2	8	2	0:22:26	39.94	0.93	29.77	0.49
2	8	3	0:25:32	36.26	0.88	31.21	0.42
2	8	4	0:27:17	33.42	1.16	32.10	0.57
2	8	5	0:21:12	30.34	1.09	34.89	0.52
2	8	6	0:15:43	29.21	1.96	34.64	0.63
3	12	1-6	2:48:46	...	...	34.49	0.24
3	12	1	0:18:32	...	...	31.91	0.41
3	12	2	0:23:43	...	...	31.10	0.38
3	12	3	0:28:09	...	...	33.32	0.41
3	12	4	0:26:18	...	...	33.71	0.51
3	12	5	0:22:54	...	...	36.99	0.39
3	12	6	0:18:56	...	...	35.61	0.55

Courtesy of A. van der Horsts

See also tests from Jess Broderick

- ✓ On average, for the full 6 hour observations the imaging time is 2 hours and 14 minutes, for  $\sim 1.070.000$  visibilities; for the 1 hour observations the average was 19 minutes, for  $\sim 178.000$  visibilities.
- ✓ Improvement by a factor of 10-16 w.r.t. the old imager version; it runs in real time
- ✓ Still differences w.r.t. CASA gridder, likely assessed in the near future

# SAGECAL MACS0717+35



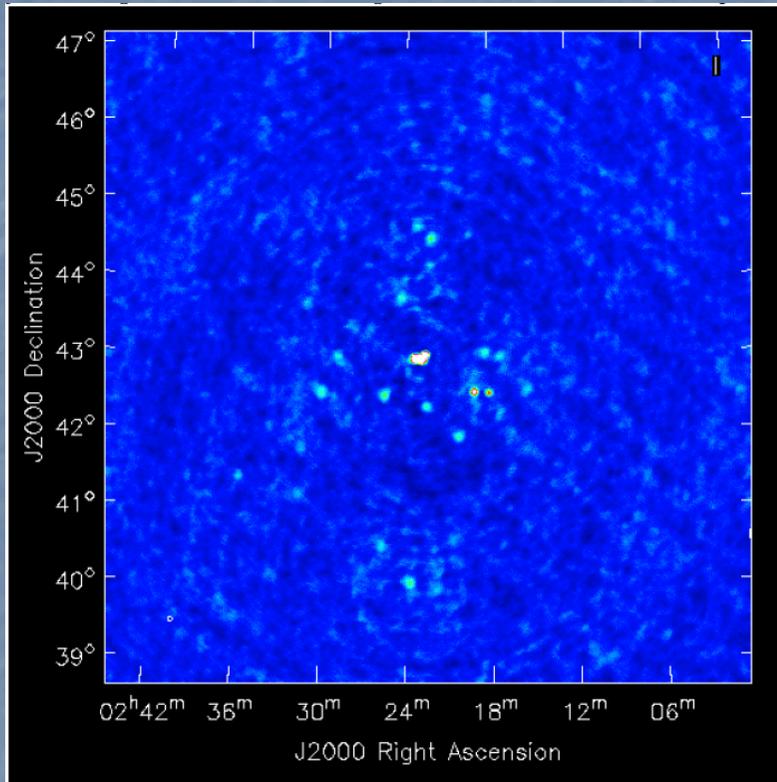
Courtesy of A. Bonafede

- ✓ Cas A at 70 deg, Tau A at 27 deg
- ✓ Cas A demixed; demixing of Tau A did not succeed
- ✓ Directional gains in BBS did not improve the situation (took 24 h)
- ✓ Sagecal used to calibrate in 21 directions (including TauA): took 4 h
- ✓ Sagecal improves the noise from 35 mJy/beam to 25 mJy/beam

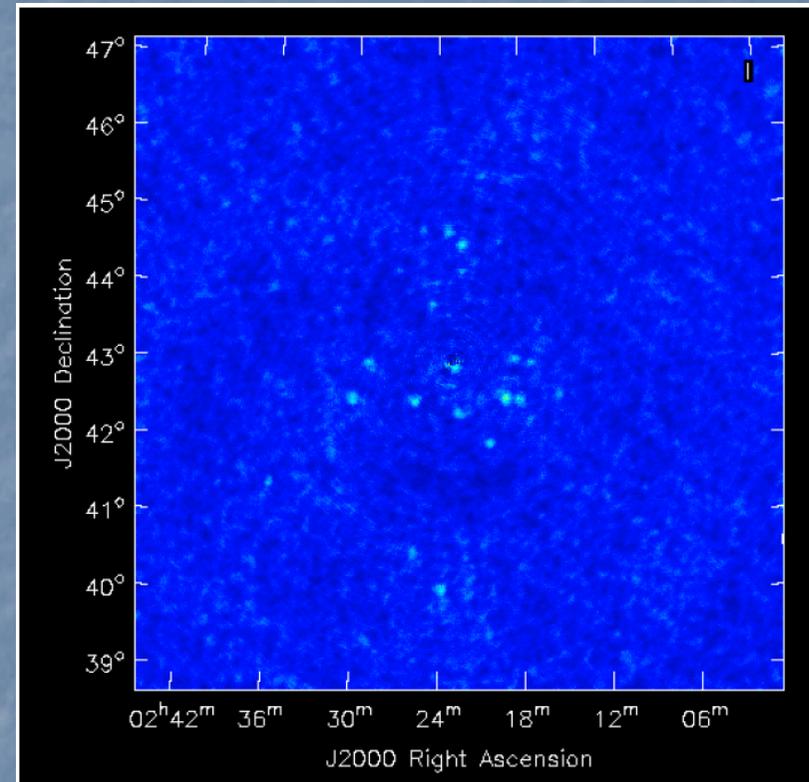
Similar results on the Bootes field (L. Ker) and on the Sun (F. Breitling)

# SAGECAL

## 3C65, 3C66



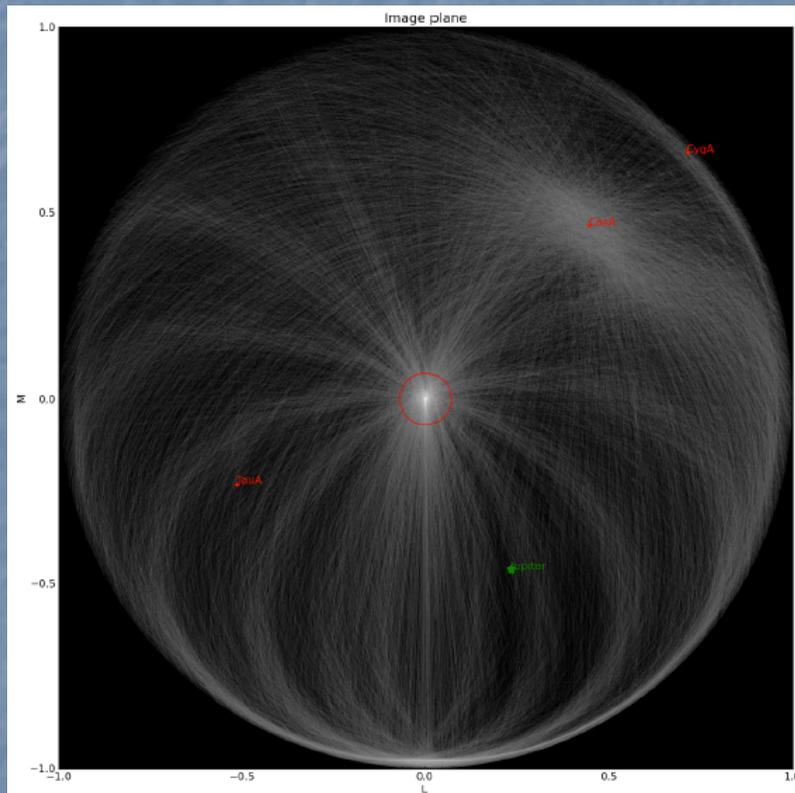
Courtesy of N. Jackson



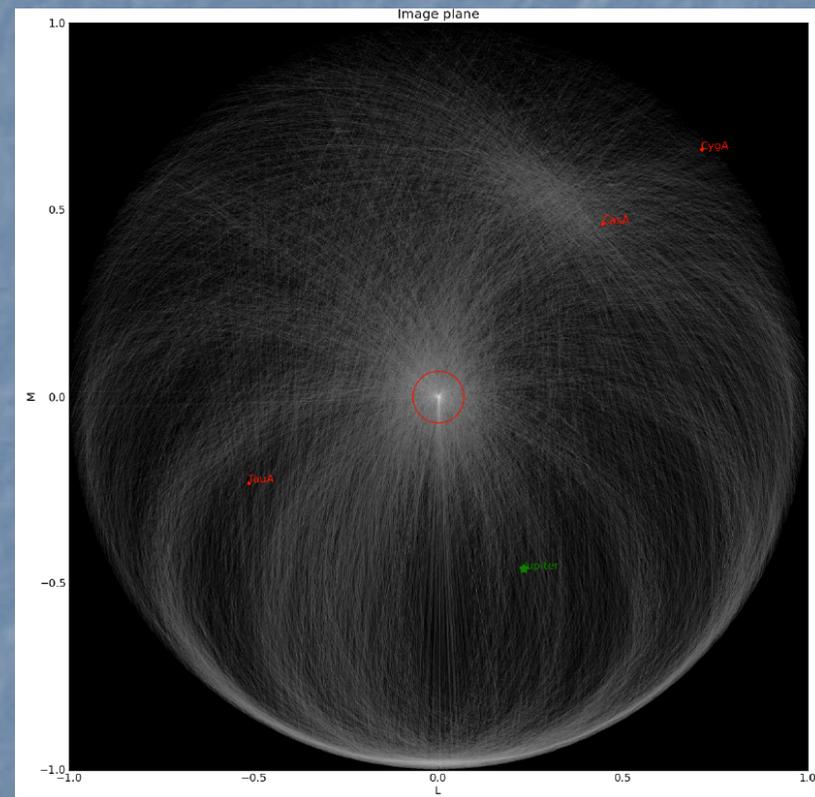
- ✓ To first order, sources are removed, but some residual remain
- ✓ Some antennas show large excursions in gain solutions at particular times
  - ✓ The initial calibration in BBS may be a problem

# SAGECAL: PERSEUS

- ✓ Demixing and Sagecal used to take care of CasA, CygA, and TauA
- ✓ Sagecal successful in the subtraction of TauA



Courtesy of E. Orru'



✓ Demix = 10 h; Sagecal=20 min

✓ Sagecal provides a good and fast alternative to the demix and multi directional self-calibration.

# REPORTS



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## LOFAR Commissioning Section

This section will contain information on the commissioning of LOFAR, including meetings, busy weeks, etc.

### MSSS

MSSS observing status can be found: [here for LBA](#) [or here for HBA](#).

- Logistics
- Duty Roster
- Documentation
- Available data and its location
- Cluster computing info
- Overview of useful scripts and tools
- Tasks
- Progress reports

### Busy Weeks

#### Upcoming busy weeks

#### Past busy weeks

In development...

#### Imaging busy weeks

- Imaging Busy Week 1
- Imaging Busy Week 2
- Imaging Busy Week 3
- Imaging Busy Week 4
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# CONCLUSIONS

- ✓ The AWImager works properly on simulated data; on real data, the performance is sometimes unclear, but this could be possibly due to the calibration strategy
- ✓ The beam model needs to be studied on its own (disentangled from imaging/calibration issues)
  - ✓ A to Do list for the AWIMager has been compiled
  - ✓ Sagecal seems to be a good and fast alternative to the demixing