ASTRON

Netherlands Institute for Radio Astronomy

LOFAR Status & MSSS Update

George Heald

MKSP Meeting, Bologna
24 November 2011

LOFAR Status: Stations

- Verified:
  - 8 international
  - 9 remote
  - 24 core
- In progress:
  - 2 remote (RS408,409)
  - Note that these ones enhance the east-west resolution

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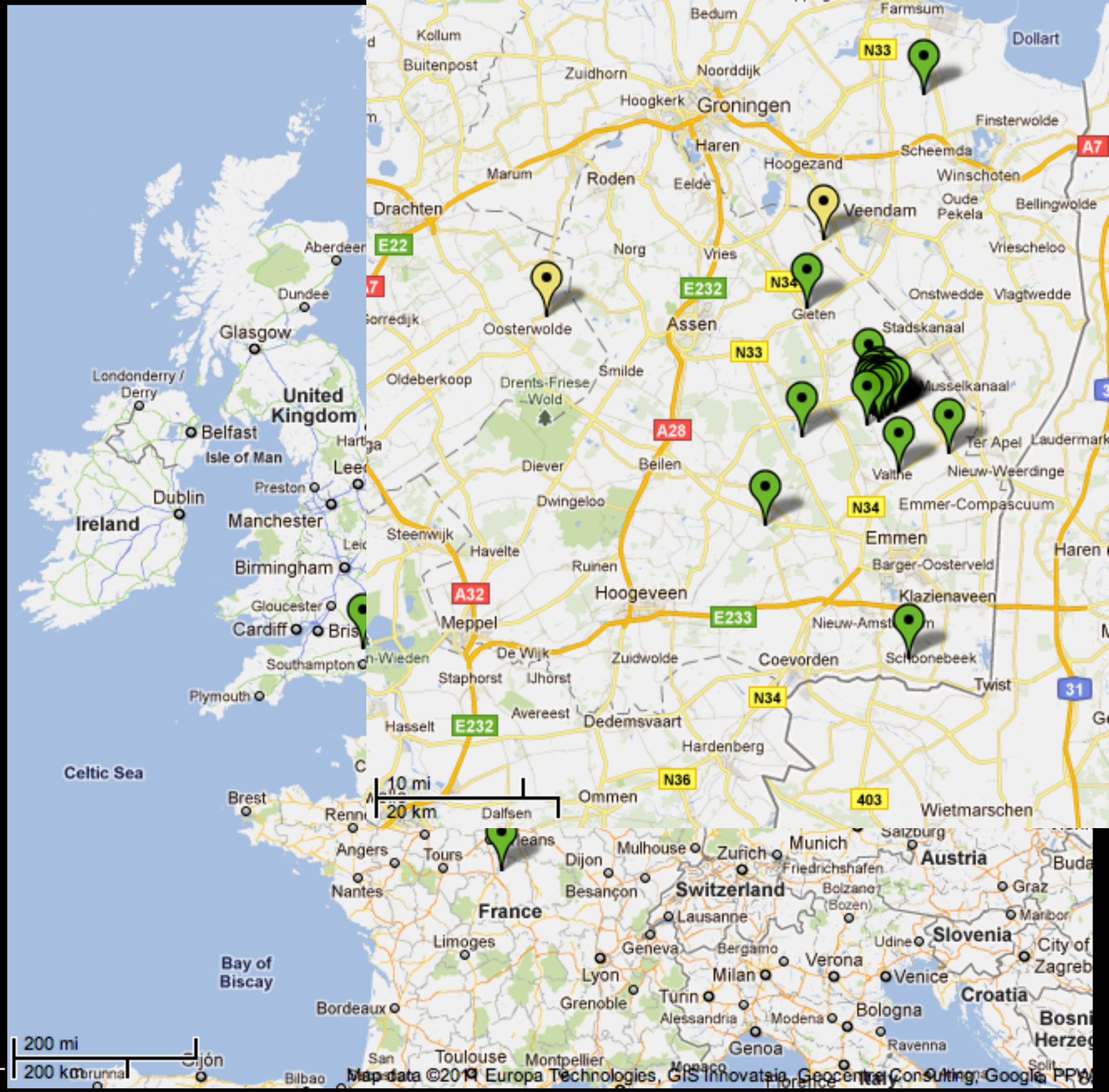

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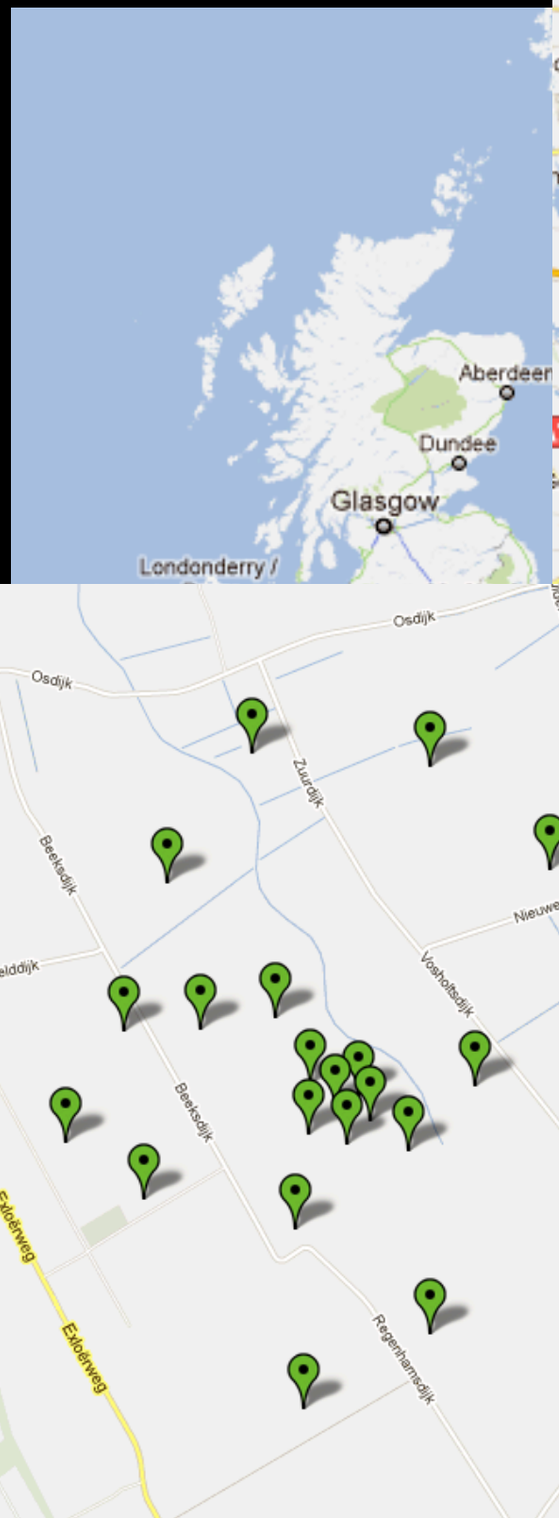
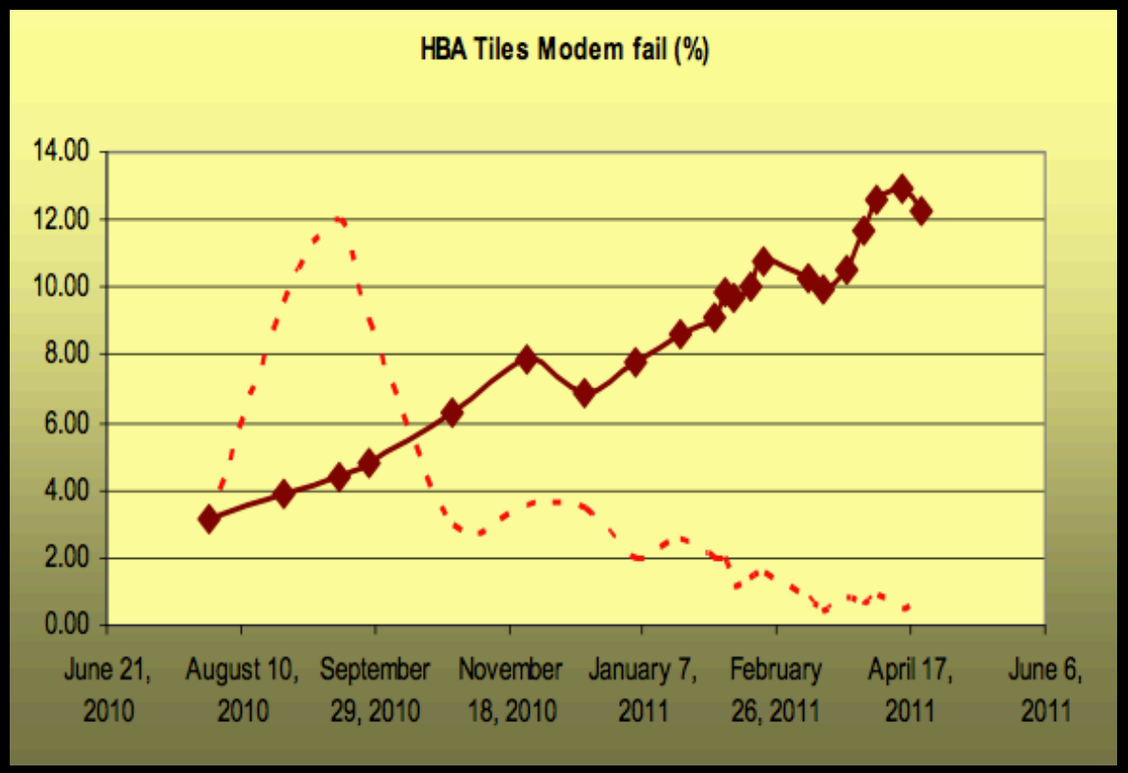
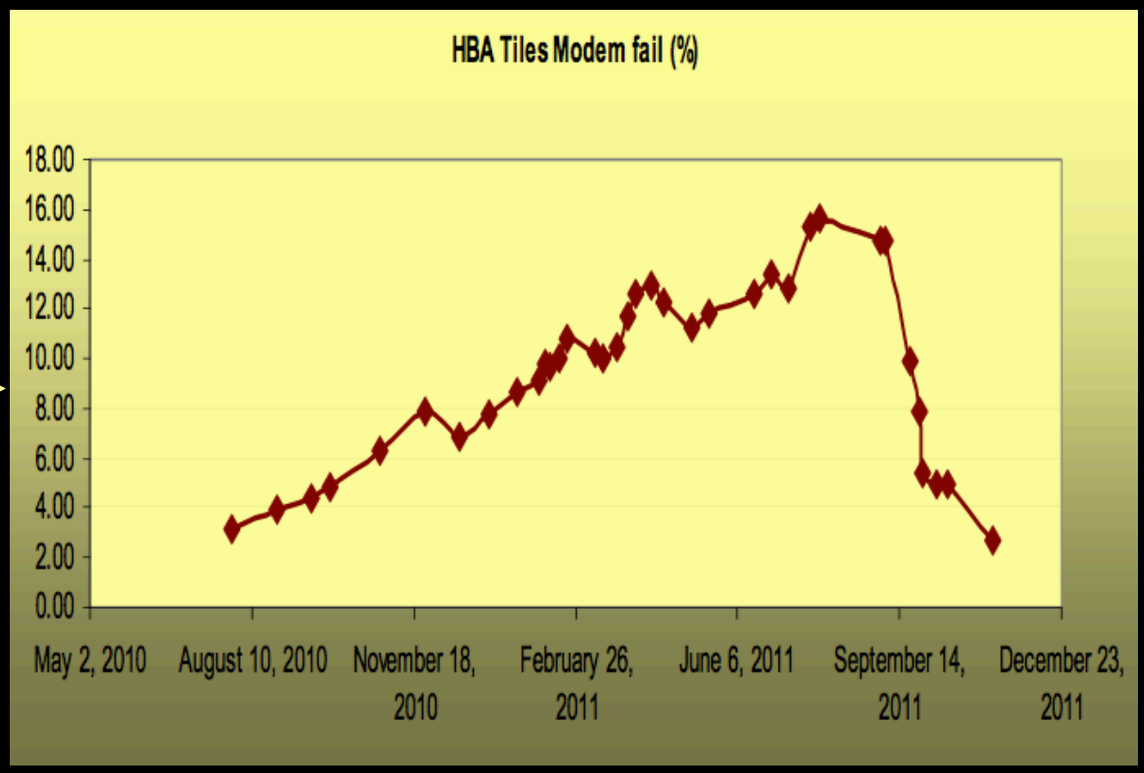


LOFAR Status: HBA Repair

- HBA repair (see LSM 16-Nov-2011 by N. Ebbendorf)
  - all HBA-0 completed, HBA-1 completed for 7 stations
  - new electronic components being produced
  - firmware update almost done; drainage fix almost done
- LBA repair also in progress, but less of an issue than for HBA





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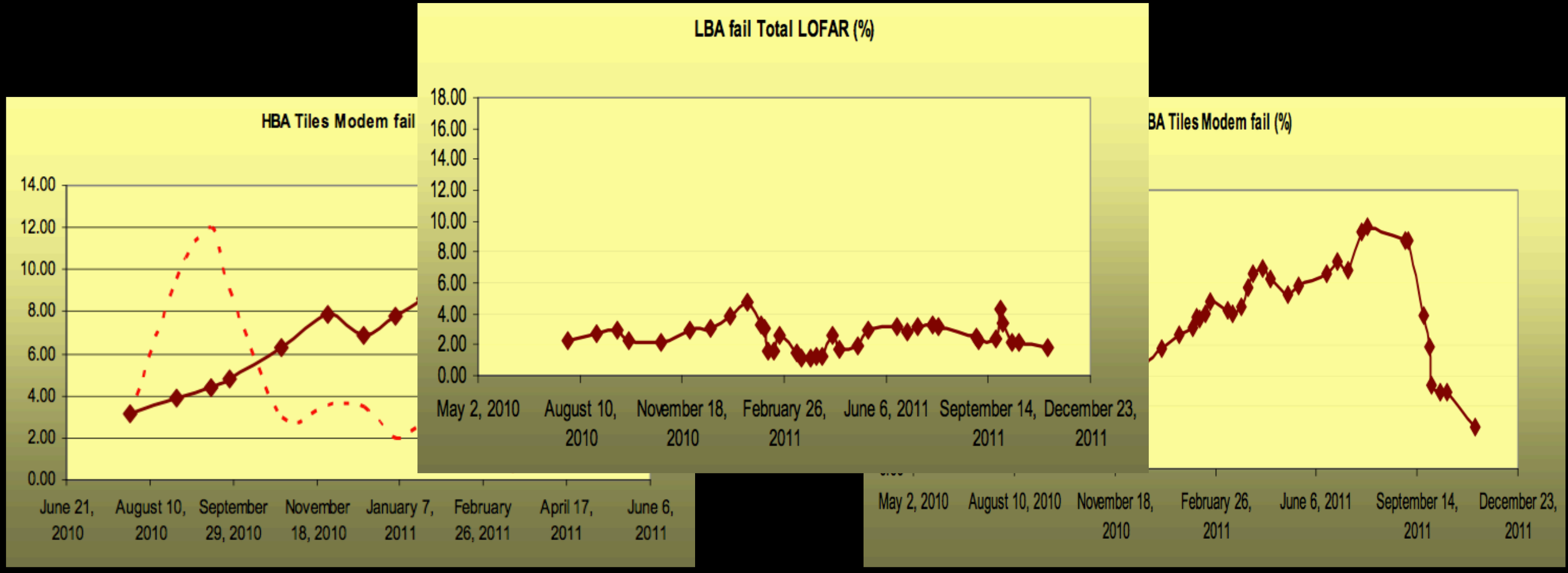


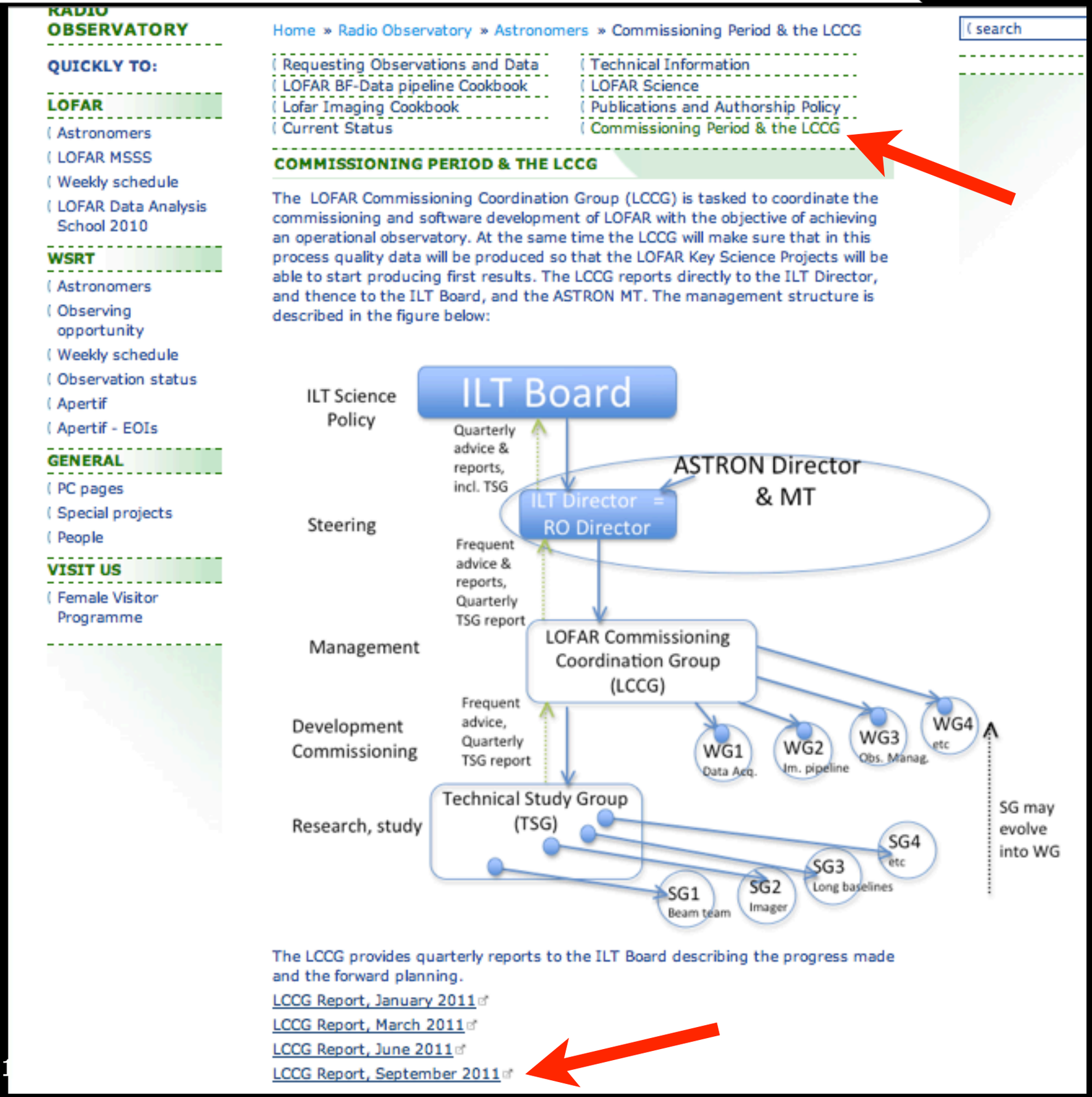
LOFAR Status: Station calibration

	Calibration Tables					HBA repairs		
Station Name	LBA_OUTER Mode ½	LBA_INNER Mode ¾	HBA Low Mode 5	HBA Mid Mode 6	HBA High Mode 7	RCU firmware V12	Last HBA repair	Remark
CS 001						13-09-11	20-09-11	HBA repair 50%
CS 002	28-Sep-11	28-Sep-11	28-Sep-11			12-09-11	12-09-11	HBA repair 100%
CS 003	28-Sep-11	28-Sep-11	28-Sep-11			13-09-11	16-09-11	HBA repair 100%
CS 004	28-Sep-11	28-Sep-11	28-Sep-11			12-09-11	15-09-11	HBA repair 100%
CS 005	28-Sep-11	28-Sep-11	28-Sep-11			12-09-11	15-09-11	HBA repair 100%
CS 006	28-Sep-11	28-Sep-11	28-Sep-11			13-09-11	19-09-11	HBA repair 100%
CS 007	28-Sep-11	28-Sep-11	28-Sep-11			12-09-11	13-09-11	HBA repair 100%
CS 011	NEW STATIONS					15-09-11	03-10-11	HBA repair100%
CS 013						14-09-11		HBA not complet
CS 017	14-Oct-11	4-Nov-11	14-Oct-11			04-10-11	27-09-11	HBA repair 100%
CS 021	14-Oct-11	4-Nov-11	14-Oct-11			13-09-11	31-10-11	HBA repair 100%
CS 024	14-Oct-11	4-Nov-11	14-Oct-11			14-09-11	22-09-11	HBA repair 100%
CS 026			14-Oct-11			04-10-11	22-09-11	HBA repair 100%
CS 028	NEW STATIONS					05-10-11	04-10-11	HBA repair 100%
CS 030		4-Nov-11	14-Oct-11			04-10-11	29-09-11	HBA repair 50%
CS 031	NEW STATIONS					14-09-11	11-02-11	HBA repair 100%
CS 032		4-Nov-11	14-Oct-11			15-09-11	29-09-11	HBA repair 100%
CS 101	4-Nov-11	4-Nov-11	14-Oct-11			04-10-11	20-09-11	HBA repair 100%
CS 103	4-Nov-11		14-Oct-11			05-10-11	21-09-11	HBA repair 100%
CS 201	4-Nov-11	4-Nov-11	14-Oct-11			05-10-11	21-09-11	HBA repair 100%
CS 301	14-Oct-11		14-Oct-11			13-10-11	27-09-11	HBA repair 50%
CS 302		14-Oct-11	14-Oct-11			14-10-11	26-09-11	HBA repair 100%
CS 401	4-Nov-11		14-Oct-11			18-08-11	03-10-11	HBA repair 50%
CS 501	4-Nov-11	4-Nov-11	4-Nov-11			13-10-11	27-10-11	HBA repair 100%
RS 106		14-Oct-11	14-Oct-11			17-10-11	16-09-11	HBA repair 100%
RS 205		14-Oct-11	14-Oct-11			15-11-11	16-09-11	HBA repair 100%
RS 208	14-Oct-11		14-Oct-11			24-10-11	22-09-11	HBA repair 100%
RS 306	14-Oct-11		14-Oct-11			17-10-11	20-09-11	HBA repair 100%
RS 307	14-Oct-11	14-Oct-11	14-Oct-11			15-11-11	16-09-11	HBA repair 100%
RS 406	14-Oct-11	14-Oct-11					09-09-11	HBA repair 100%
RS 503	14-Oct-11	14-Oct-11	14-Oct-11			26-10-11	19-09-11	HBA repair 100%
RS 508	14-Oct-11	14-Oct-11	14-Oct-11				28-09-11	HBA repair 100%
RS 509	14-Oct-11	14-Oct-11	4-Nov-11				12-04-11	HBA repair 100%
DE 601								
DE 602		14-Oct-11	14-Oct-11					
DE 603		INTERFE-	14-Oct-11					
DE 604		-RENCE	14-Oct-11					
DE 605		14-Oct-11	14-Oct-11					
FR 606		14-Oct-11	14-Oct-11					
SE 607		14-Oct-11	14-Oct-11					
UK 608		14-Oct-11	14-Oct-11					

GREEN = table applied
YELLOW = obs but not reduced
RED = no obs, or must be repeated

LOFAR Status: More information

- Check the LOFAR "Commissioning Period & the LCCG" section on the main ASTRON website for more (and updated) information about progress
- In this stage, leading up to "LOFAR V1.0", the main driver is MSSS



MSSS compared to other surveys

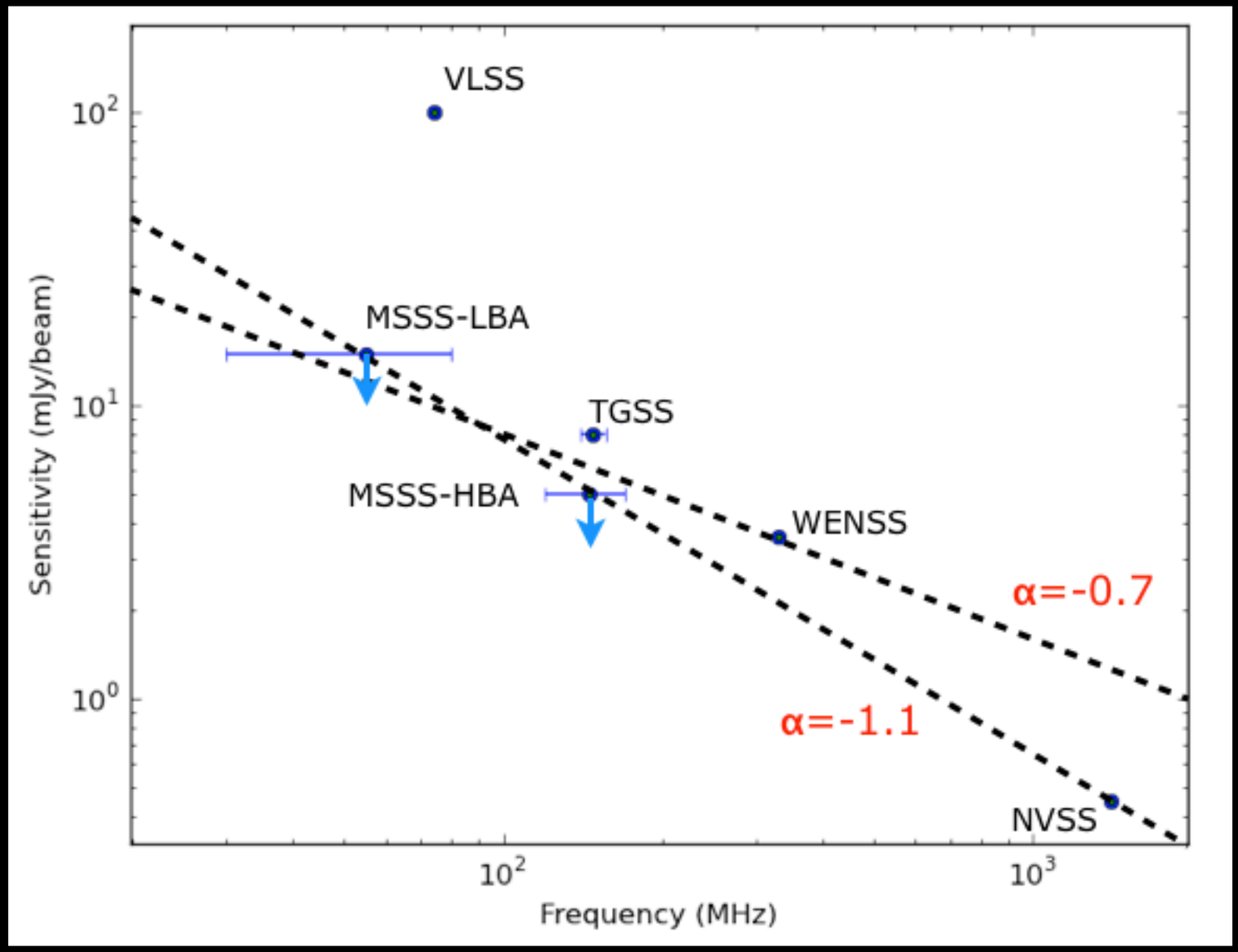
Table 2: Parameters of default MSSS and comparison with other surveys

Survey	Frequency	Sensitivity	Resolution	Area
MSSS-LBA	30 – 78 MHz	$\lesssim$ 15 mJy beam^{-1}	$\lesssim$ 100″	20,000 □° ($\delta > 0°$)
VLSS	74 MHz	100 mJy beam^{-1}	80″	30,000 □° ($\delta > -30°$)
MSSS-HBA	120 – 170 MHz	$\lesssim$ 5 mJy beam^{-1}	$\lesssim$ 120″	20,000 □° ($\delta > 0°$)
TGSS	140 – 156 MHz	7 – 9 mJy beam^{-1}	20″	32,000 □° ($\delta > -30°$)
WENSS	330 MHz	3.6 mJy beam^{-1}	54″	10,000 □° ($\delta > +30°$)
NVSS	1400 MHz	0.45 mJy beam^{-1}	45″	35,000 □° ($\delta > -40°$)

Note. Sensitivity and resolution values for the MSSS surveys are upper limits corresponding to core-only (HBA) and 10-km (LBA) surveys. Full array observations will be taken; final sensitivity and resolution values are likely to improve (provided that the new imager is fully functional, and that sufficient compute resources are available).

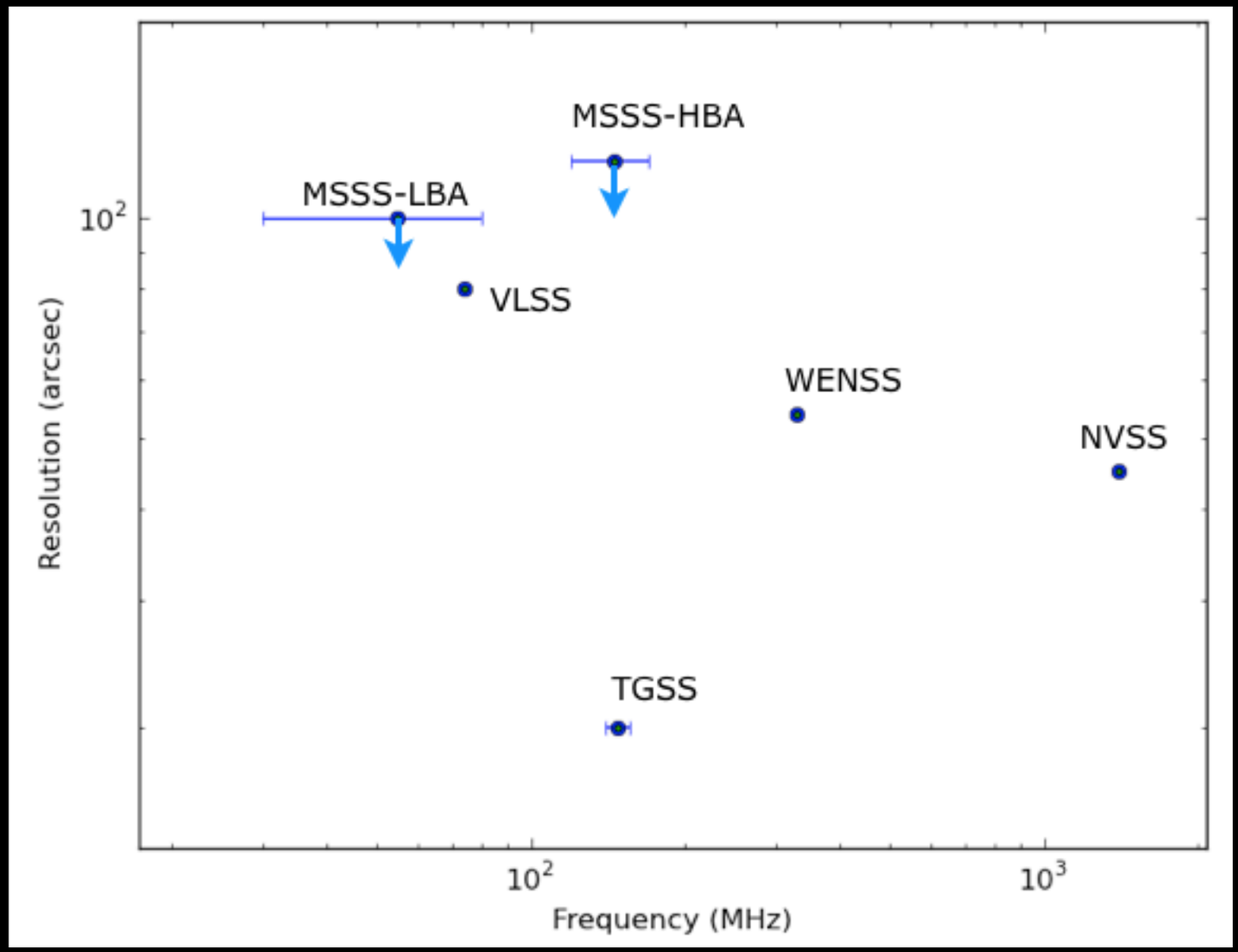
MSSS compared to other surveys

- In terms of (expected) sensitivity, MSSS is interesting
  - Typical spectral index sources detected in both WENSS, MSSS
  - Steep spectral index sources detected in both NVSS, MSSS



MSSS compared to other surveys

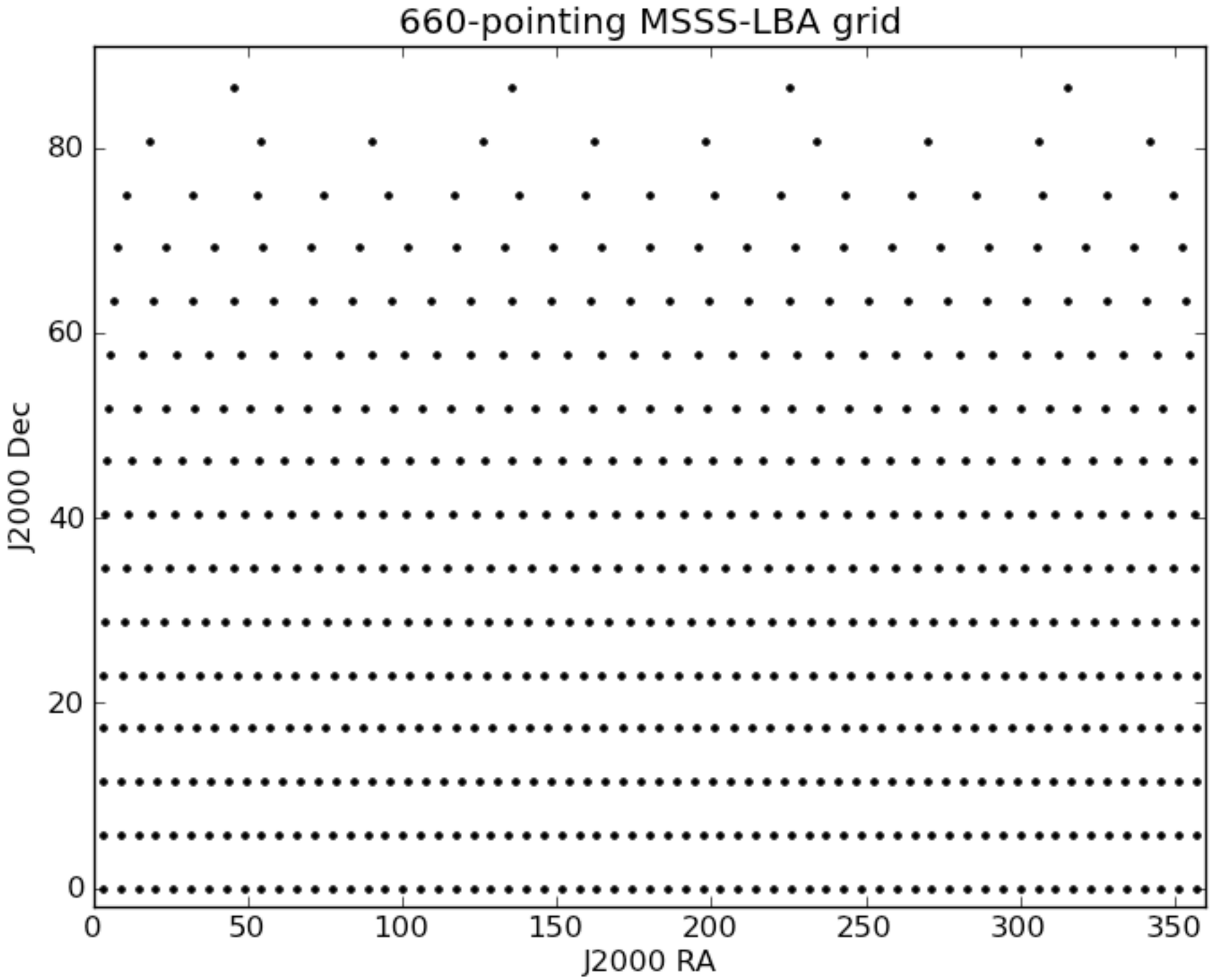
- For resolution, a substantial improvement can be made
  - Re-processing for improved resolution will be planned for
  - Note that *uv* coverage is not optimal in HBA



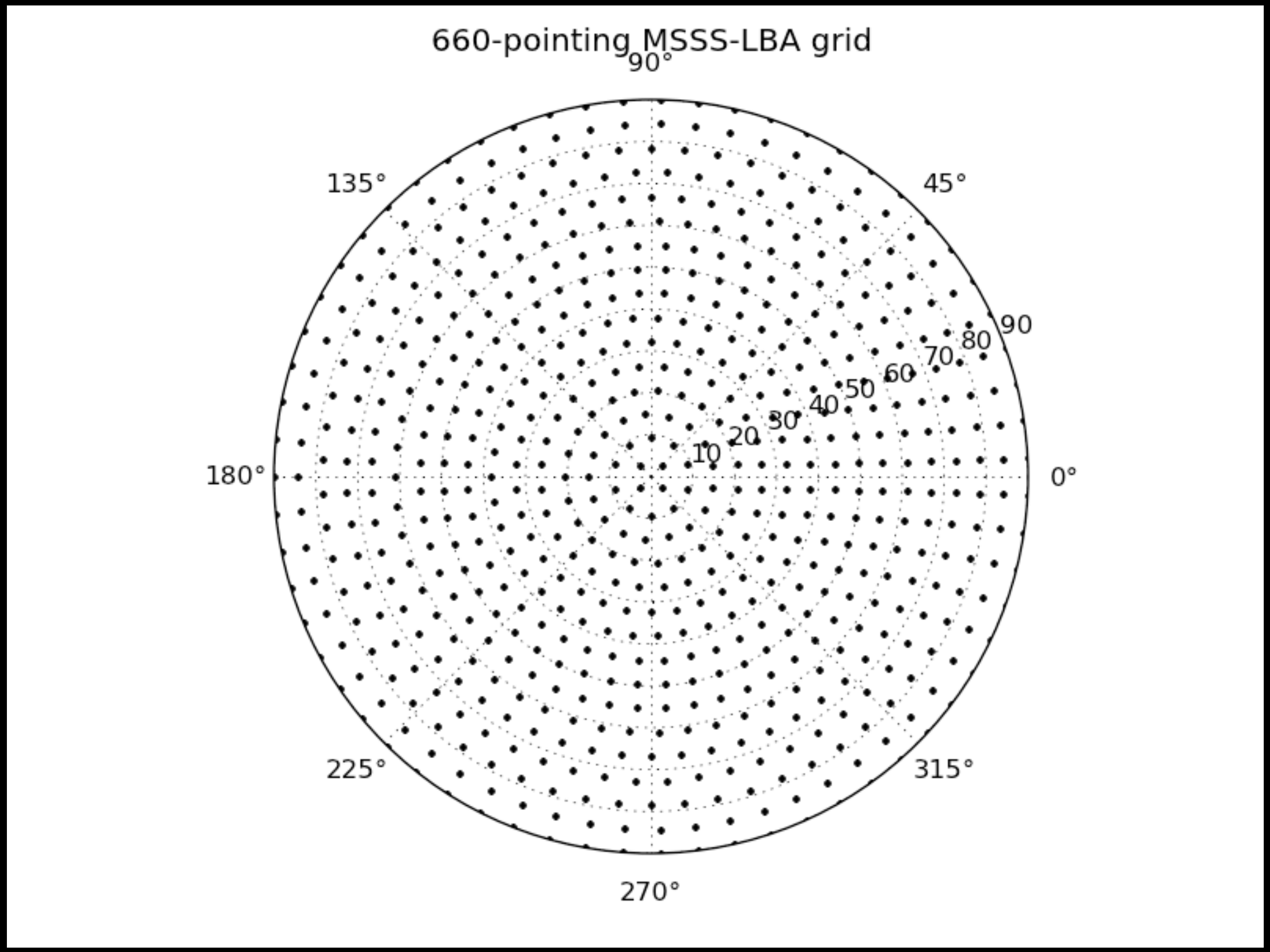
MSSS Survey grid

- Nominal field spacing is 2.42, 5.77 degrees (HBA, LBA)
  - optimized for 150, 60 MHz respectively
- Fields are evenly distributed on declination strips
  - declination strips spaced by nominal field spacing
  - RA spacing is determined such that the lowest integer number of fields fit in the strip, with an upper limit for the spacing given by the nominal spacing value
  - this leads to 660 LBA fields and 3616 HBA fields
- Default planning is for declination ≥0 degrees only
  - Extension to lower declination may be possible, if observing time permits .... and:
  - *Tests of low-dec performance need to be analyzed*

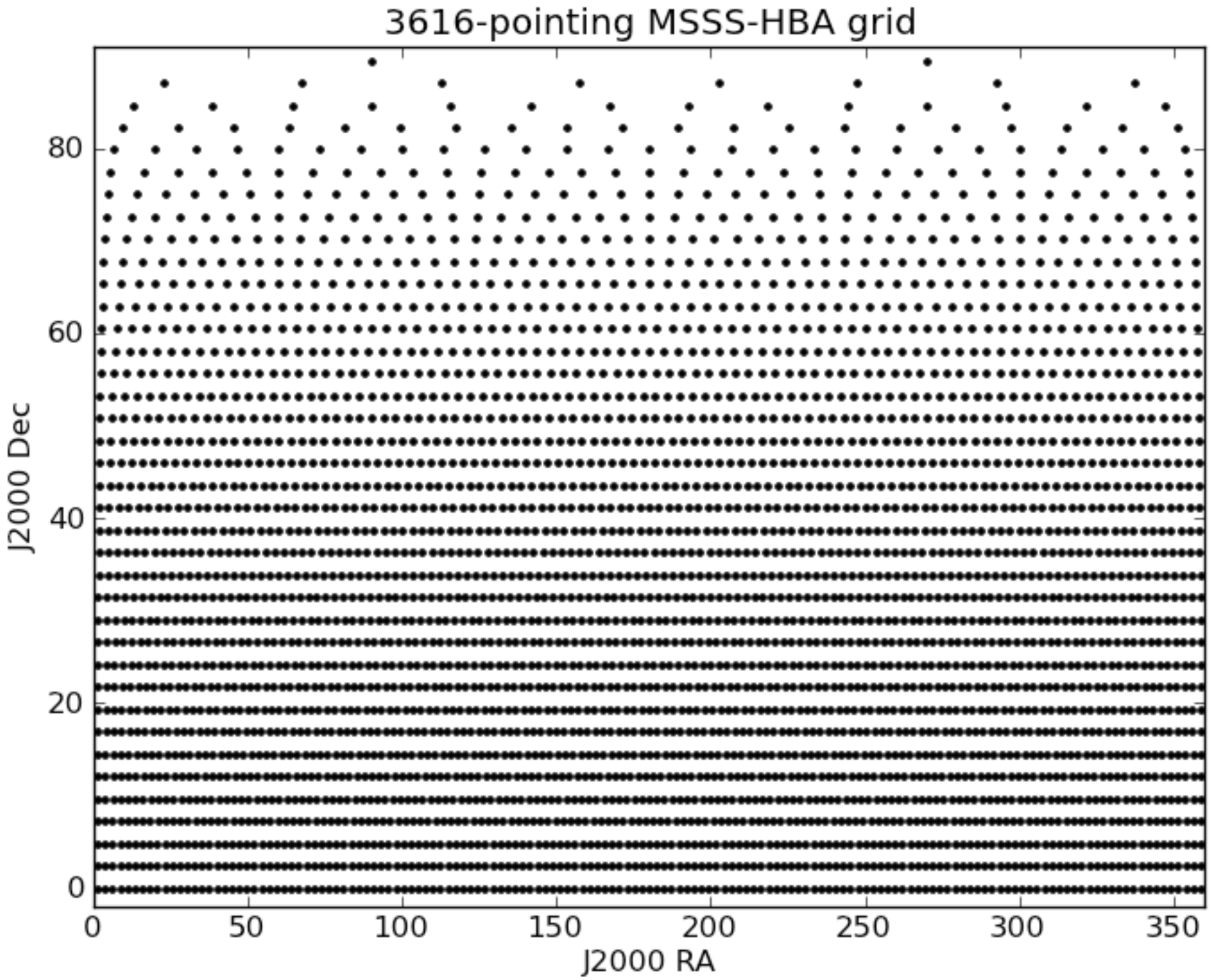
MSSS Survey grid - LBA



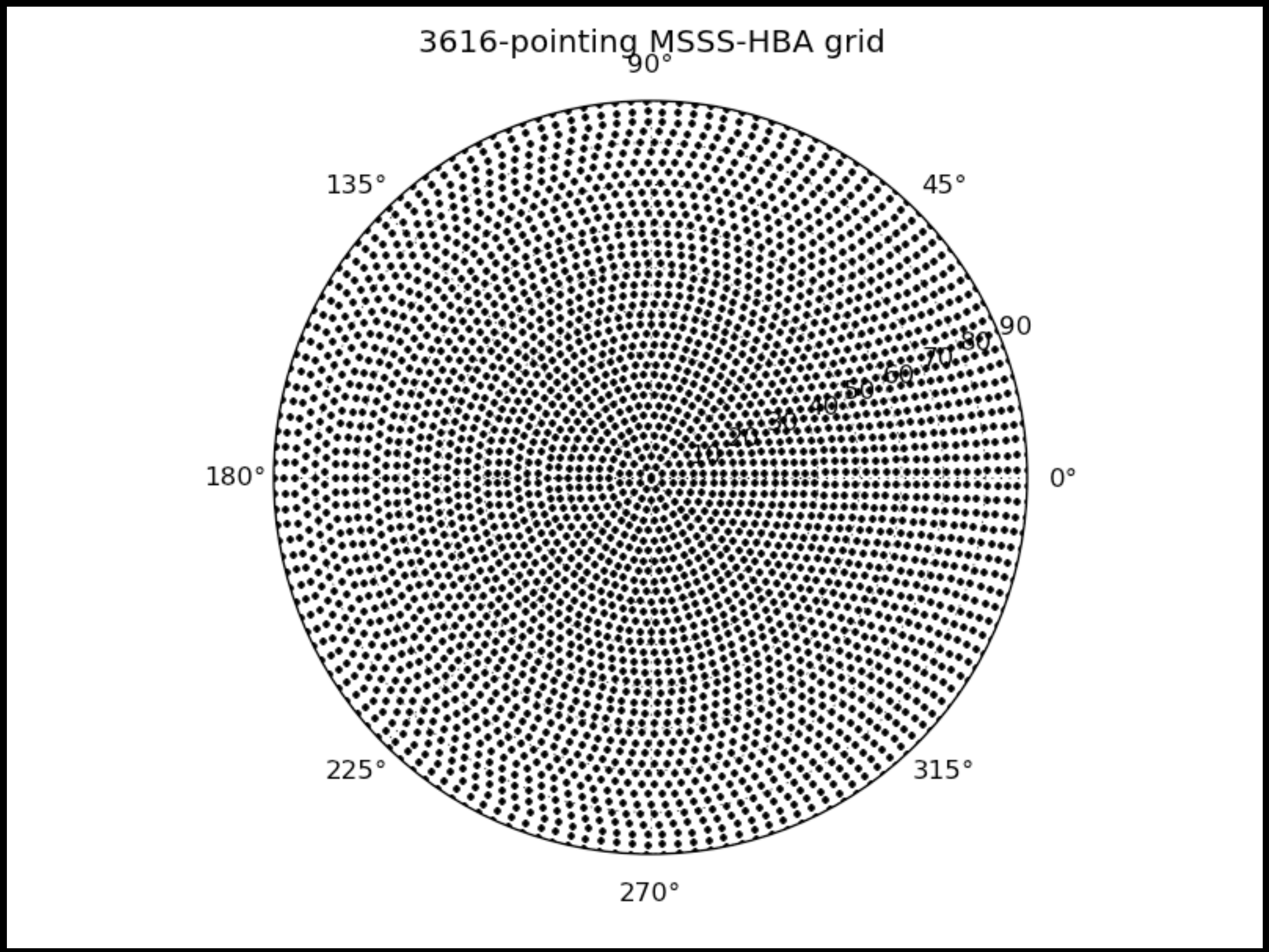
MSSS Survey grid - LBA



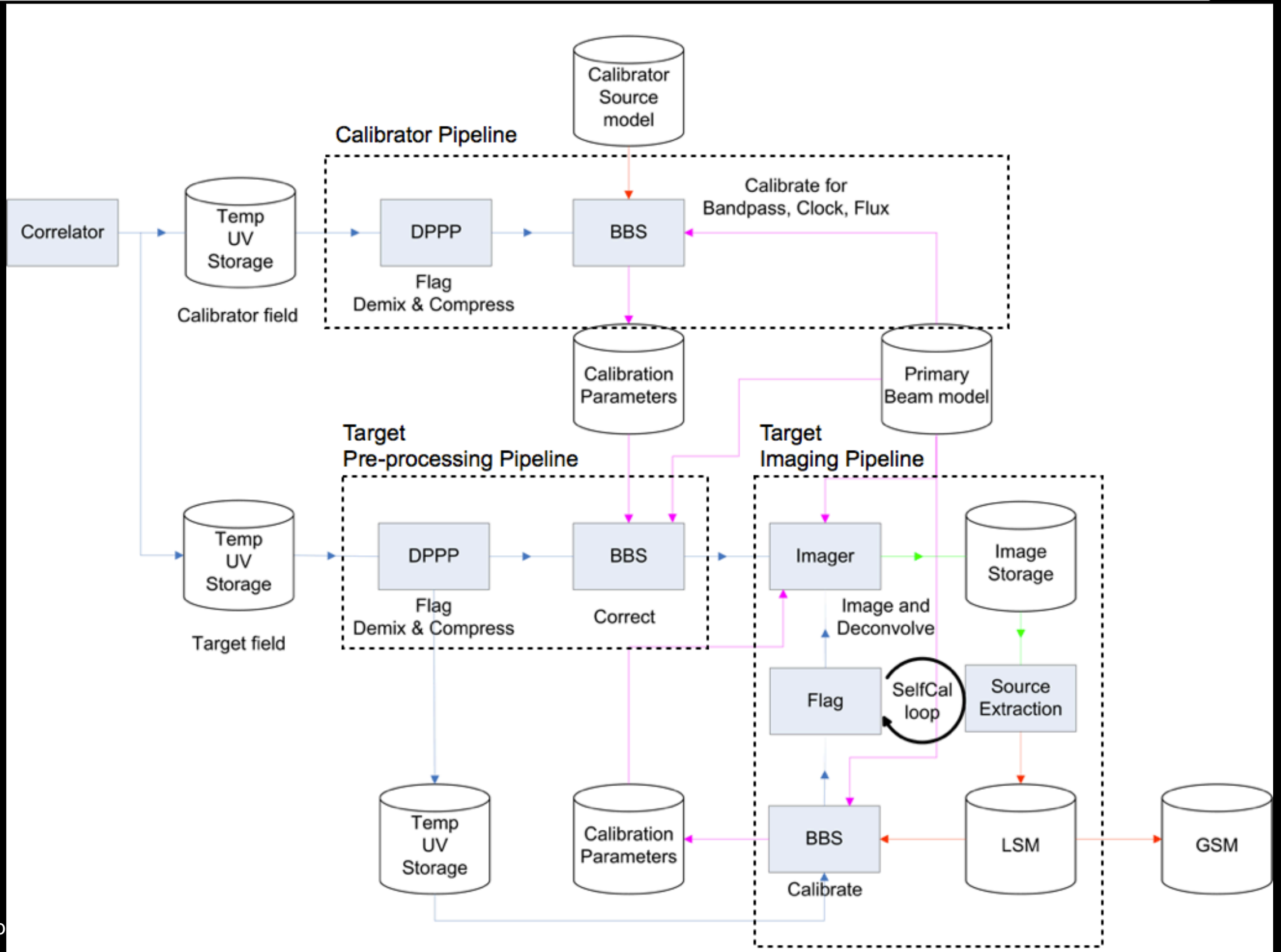
MSSS Survey grid - HBA



MSSS Survey grid - HBA



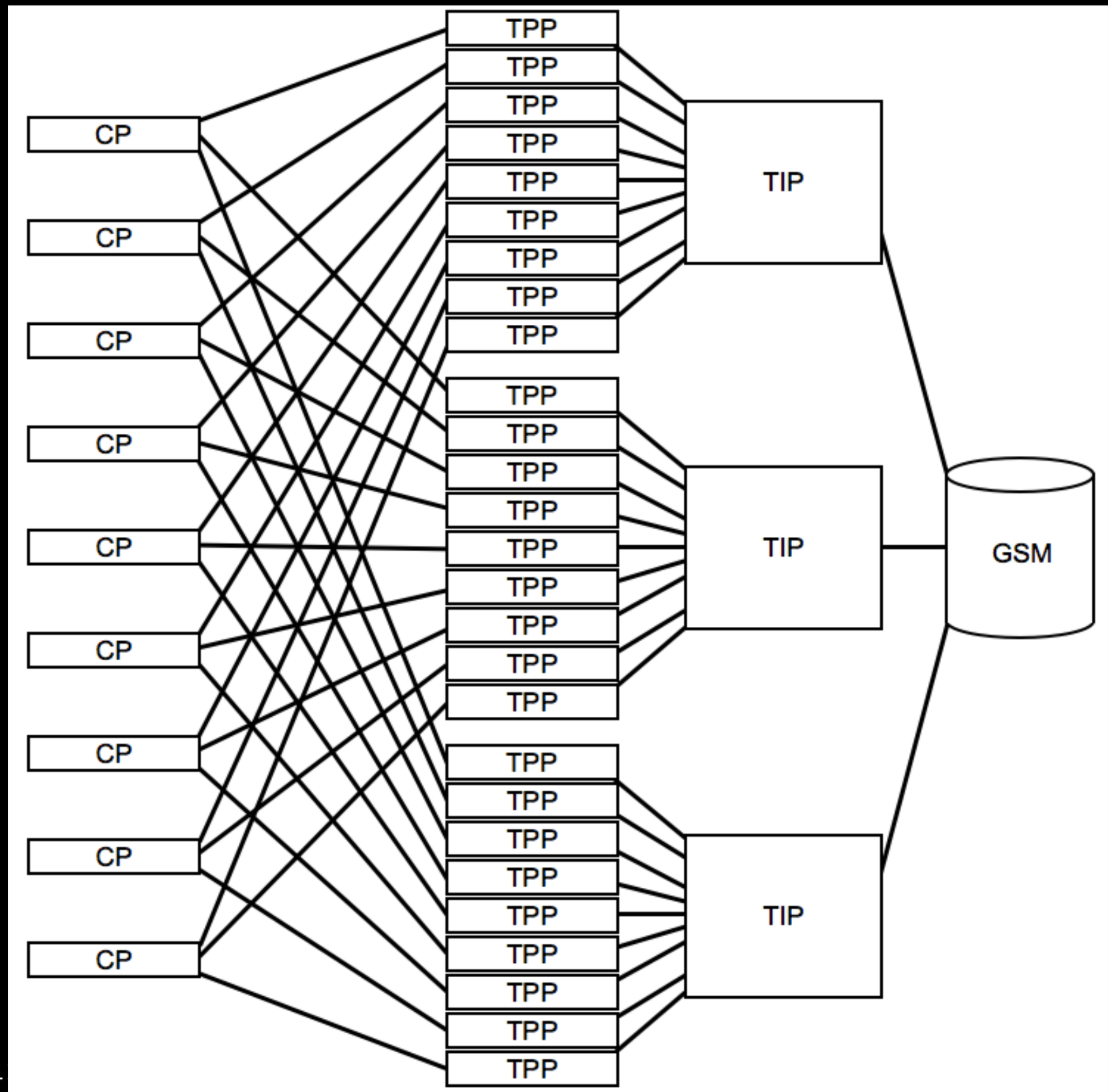
Recap of processing chain



Recap of (LBA) processing chain

- For each beam triplet, the pipeline steps fit together as shown (for LBA):

- Note that TIP can be decoupled from the observational schedule (essential for moving forward)



MSSS observing status

- Observing status: test observations were delayed
  - 1-minute gap had been enabled for earlier MSSS test this summer, and then disabled
  - System stability was poor during October
  - Priority was to fix stability, then restore 1-minute gap
  - Both done now, but international links having trouble ... ?

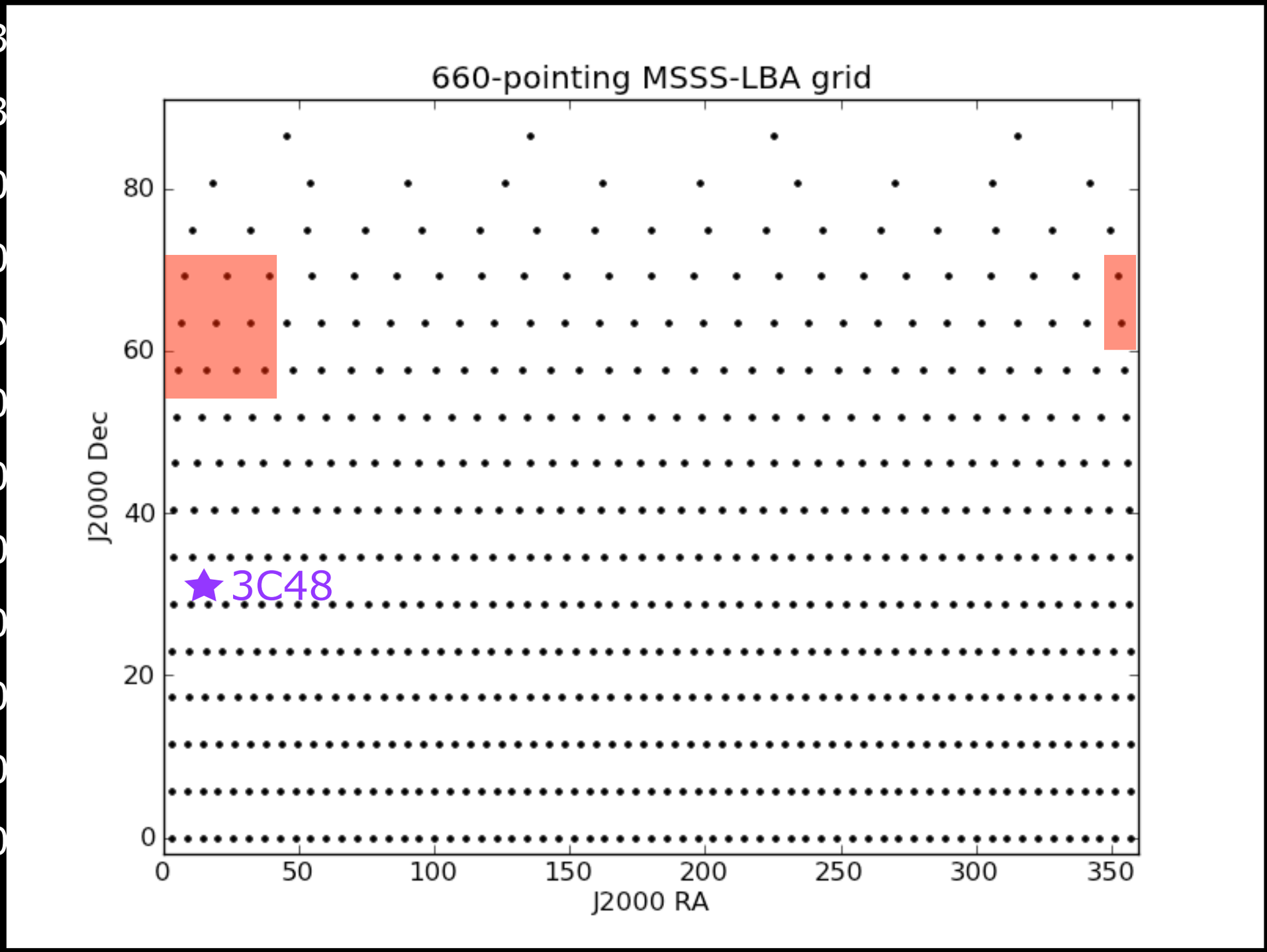
- New tests done three weeks ago and also last two weekends
  - 100% success rate, 24 fields/24 hr, all SB written to disk
  - DE602 and DE604 were 100% flagged three weeks ago and may have caused more severe failures two weeks ago (that test was repeated the weekend before last)
  - Pre-processing pipeline being run on all data

MSSS observing status

- LBA test field: ~400 square degrees north of primary calibrator
  - L352+69 23:28:41.7391 +69:14:24.000
  - L354+63 23:34:17.1429 +63:28:12.000
  - L005+58 00:21:10.5882 +57:41:60.000
  - L008+69 00:31:18.2609 +69:14:24.000
  - L006+63 00:25:42.8571 +63:28:12.000
  - L016+58 01:03:31.7647 +57:41:60.000
  - L023+69 01:33:54.7826 +69:14:24.000
  - L019+63 01:17:08.5714 +63:28:12.000
  - L026+58 01:45:52.9412 +57:41:60.000
  - L039+69 02:36:31.3043 +69:14:24.000
  - L032+63 02:08:34.2857 +63:28:12.000
  - L037+58 02:28:14.1176 +57:41:60.000

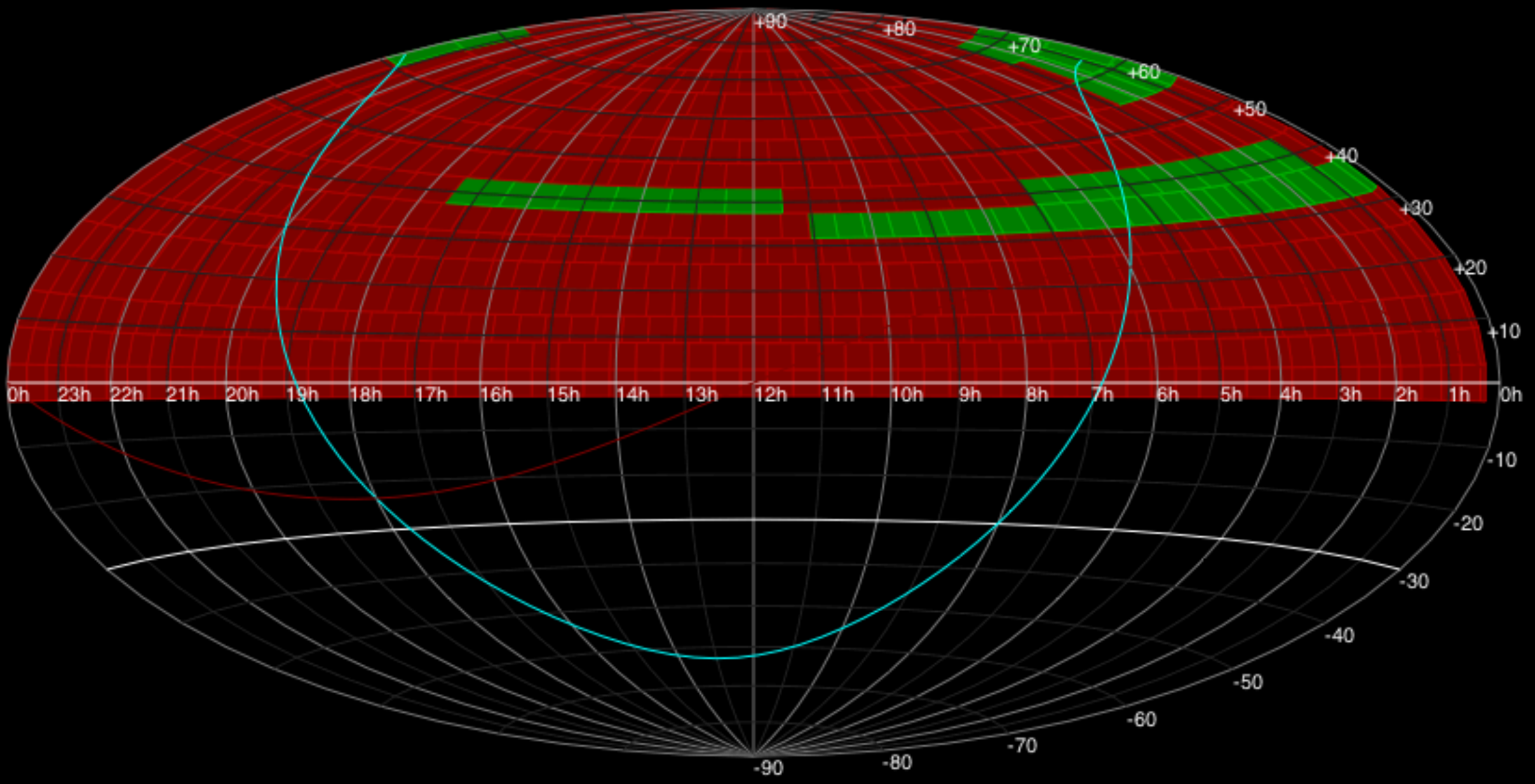
MSSS observing status

- LBA test field: ~400 square degrees north of primary calibrator
  - L3
  - L3
  - L0
  - L0
  - L0
  - L0
  - L0
  - L0
  - L0
  - L0



To-date MSSS tests (LBA)

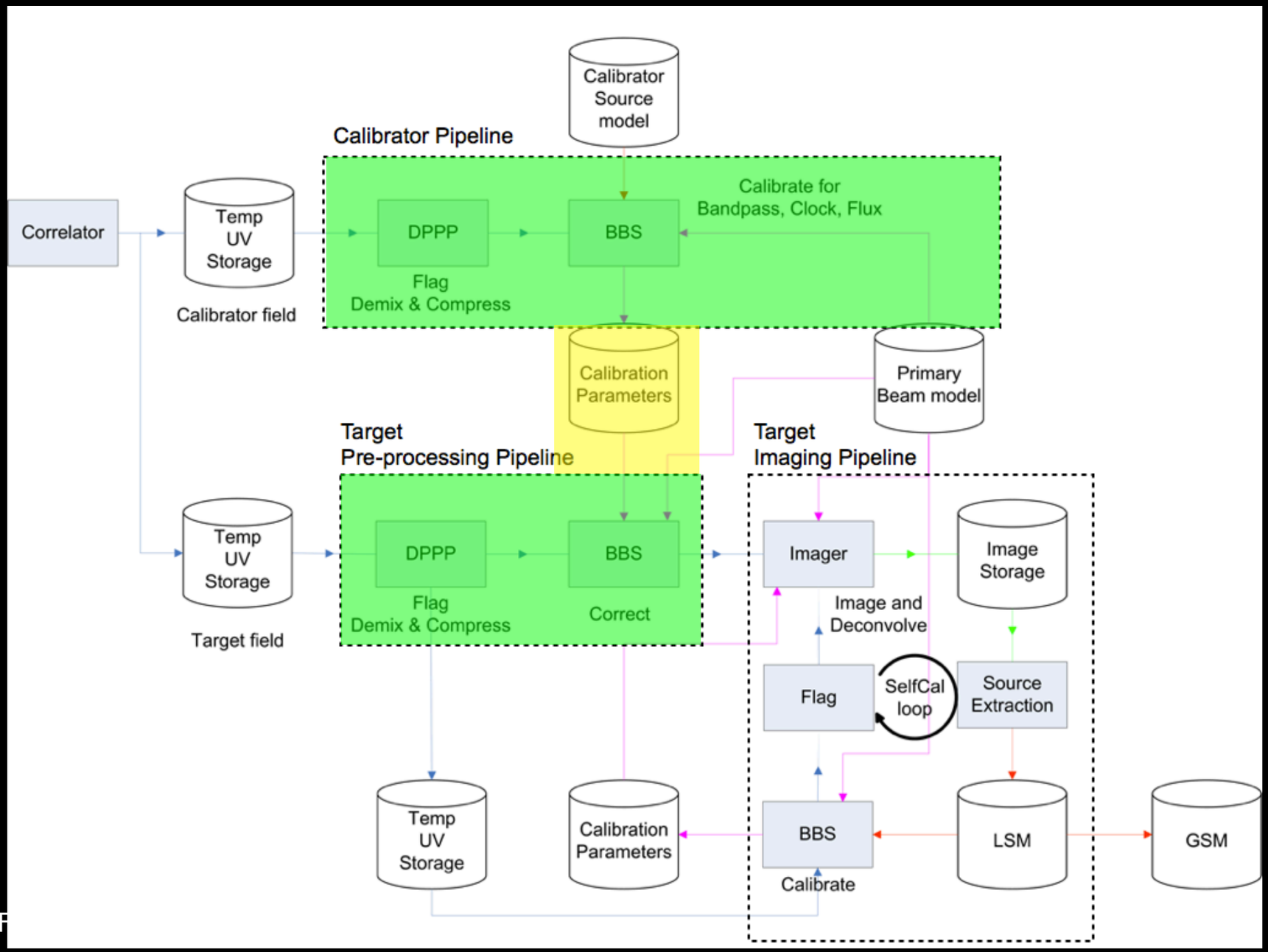
- See http://www.astron.nl/~heald/msss/msssmap_lba_obs.html



Map maker developed as part of PanSTARRS

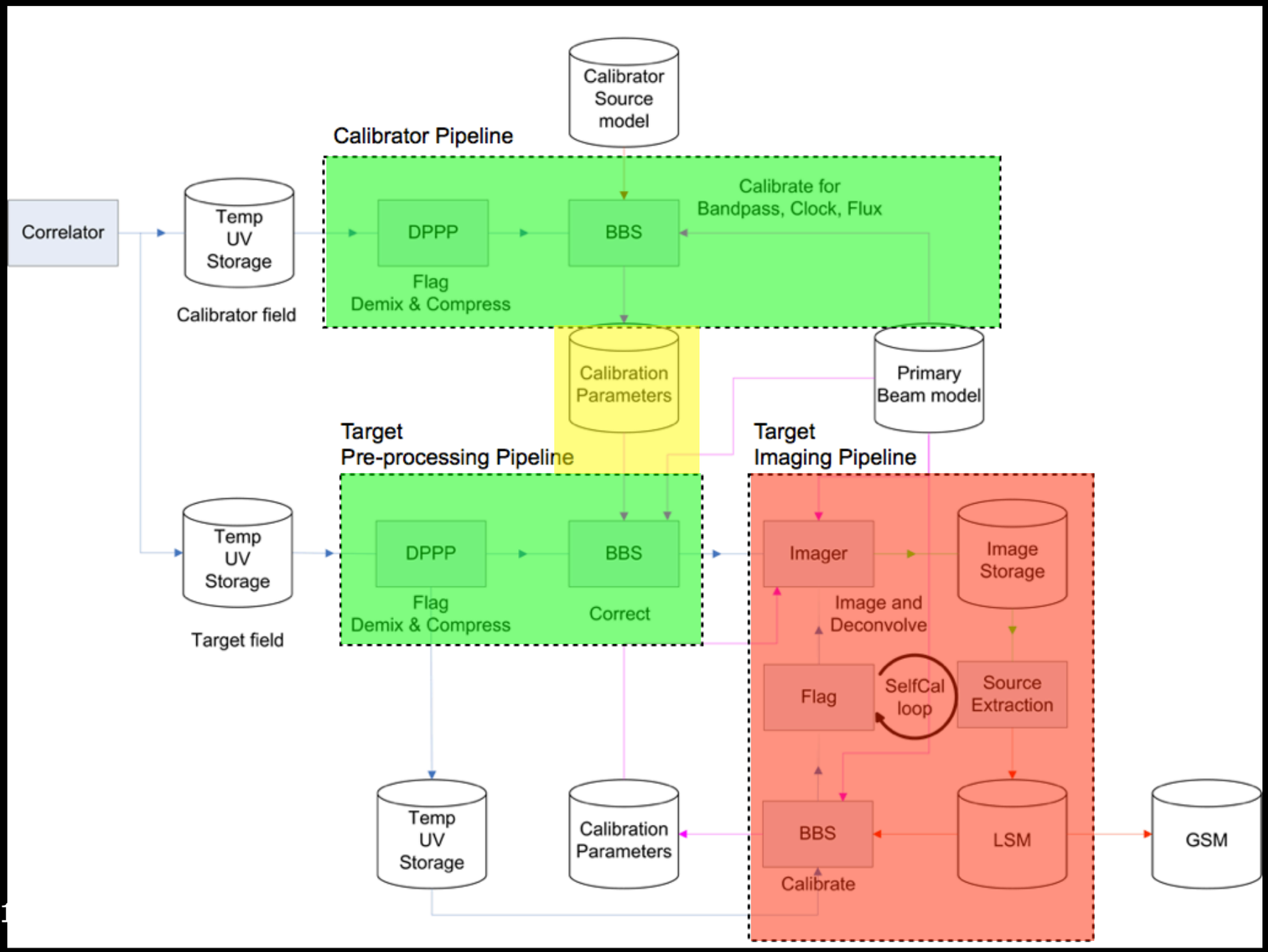
MSSS processing status

- "Front end" of the processing chain (the CP and TPP) were successfully run on existing MSSS test data
- Change to calibration strategy identified and implemented



MSSS processing plans

- Verify CP - TPP transfer strategy works successfully
- Pre-processed target field data used for major cycle tests
  - Need for additional manpower
  - note that this is a highly specialized activity but *very urgent*



Manpower for MSSS work

- Preliminary list of names compiled:

Name	Institute	Level	KSP(s)	Dates available	Notes
Adebahr, Bjoern	Bochum	PhD	MKSP	now	
Bonafede, Annalisa	Bremen	Postdoc	SKSP	now	solver statistics
Broderick, Jess	Southampton	Postdoc	TKP	after Feb 1	
Carbone, Dario	Amsterdam	PhD	TKP	now	
Cendes, Yvette	Amsterdam	PhD	TKP	now	
Daiboo, Soobash	Groningen	Postdoc	EoR	now	
Fallows, Richard	Aberystwyth	Postdoc	Solar	3wk November	
Hassall, Tom	Southampton	Postdoc	TKP	after Feb 1	
Iacobelli, Marco	Leiden	PhD	MKSP	now	
Jelic, Vibor	ASTRON	Postdoc	EoR	now	
Jurusik, Wojciech	Krakow	PhD	MKSP	1 week in Dec	visiting ASTRON; MSSS support dates flexible during visit
Martinez, Oscar	Groningen	PhD	EoR	now	
Mulcahy, David	Bonn	PhD	MKSP	now	
Nikiel-Wroczynski, Blazej	Krakow	PhD	MKSP	Jan onward for 2x2wk	has travel funding but needs accommodation support
Orru, Emanuela	Nijmegen	Postdoc	MKSP,SKSP,CR	now	
Pandey, V.N.	ASTRON	Postdoc	EoR	now	statistics & benchmarking
Pietka, Gosia	Southampton	PhD	TKP	after Feb 1	
Prasad, Peeyush	Amsterdam	Postdoc	TKP	now	
Rolinson, Antonia	Amsterdam	Postdoc	TKP	now	
Scheers, Bart	Amsterdam	Postdoc	TKP	now	GSM
Sobey, Charlotte	Bonn	PhD	MKSP	now	
Sotomayor, Carlos	Bochum	PhD	MKSP	now	
Stewart, Adam	Southampton	PhD	TKP	after Feb 1	
Swinbank, John	Amsterdam	Postdoc	TKP	now	
ter Veen, Sander	Nijmegen	PhD	CR	?	piggybacking support
van der Horst, Alexander	Amsterdam	Postdoc	TKP	now	
van Weeren, Reinout	Leiden/ASTRON	Postdoc	SKSP	now	

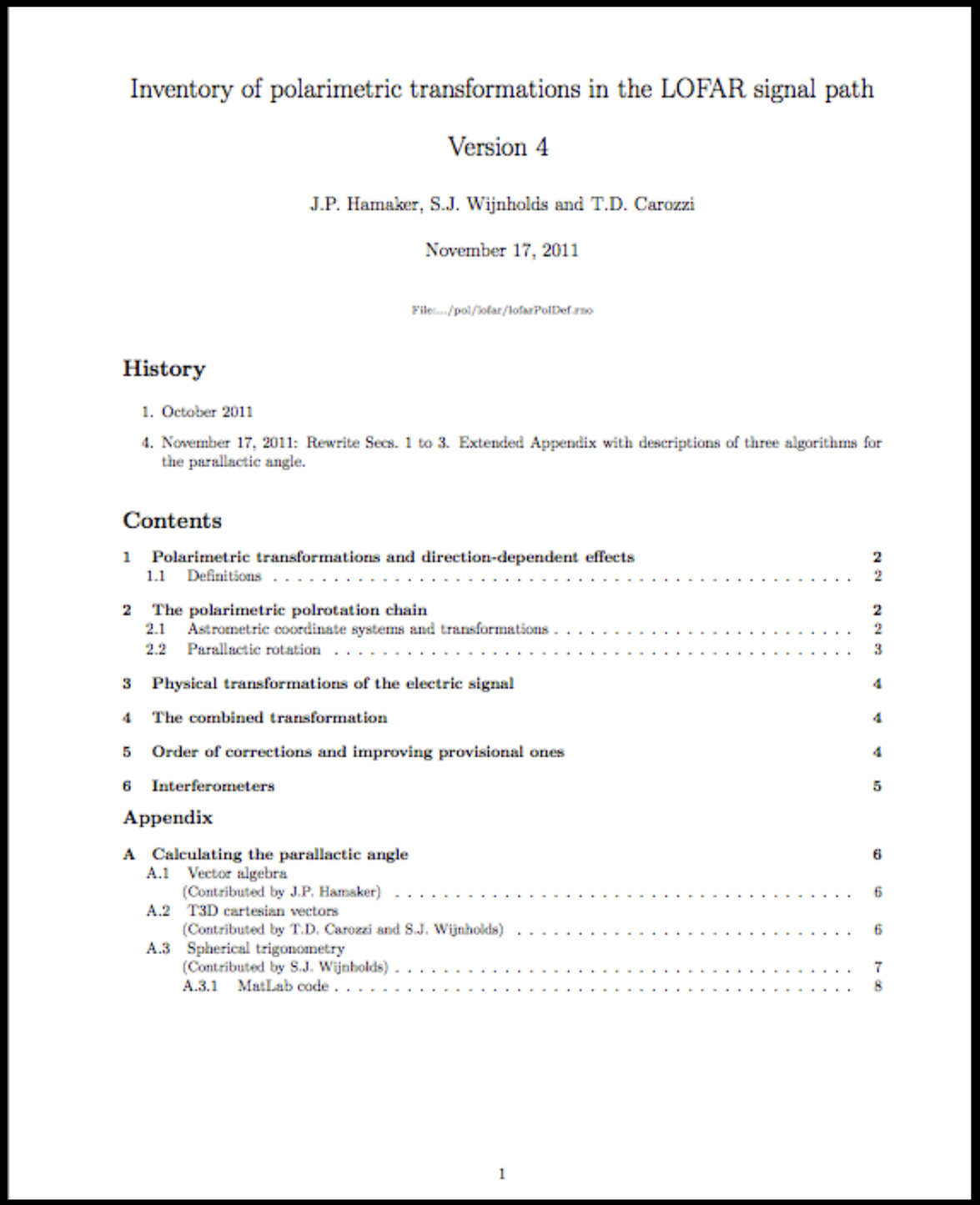
- MSSS task list under development
- **Coming this week**: developing a visit calendar ... stay tuned ...

Pressing issues

- Observatory
  - Scheduler system (and pipeline interaction / kickoff)
  - Support during MSSS observations
  - Storage space [temporary full-res; long-term compressed]
- Pipeline development
  - Definition of major cycle - *Highest priority in short term*
  - Imager and beam issues
    - Required for successful major cycle
    - Both are being actively pushed forward
- Getting underway
  - Moving from test programs to full observing schedule
  - Requires completed justification of pre-processing chain

Beam & imager developments

- Full description of LOFAR beam is in progress (Hamaker et al.)
- Intention is to fully describe end-to-end sequence of projections and rotations needed to transform from antenna coordinates to polarization frame on the sky
- Goal is transferring this into the beam model that is used in BBS and the awimager



Inventory of polarimetric transformations in the LOFAR signal path

Version 4

J.P. Hamaker, S.J. Wijnholds and T.D. Carozzi

November 17, 2011

File:.../pol/lofar/lofarPolDef.tex

History

1. October 2011
4. November 17, 2011: Rewrite Secs. 1 to 3. Extended Appendix with descriptions of three algorithms for the parallactic angle.

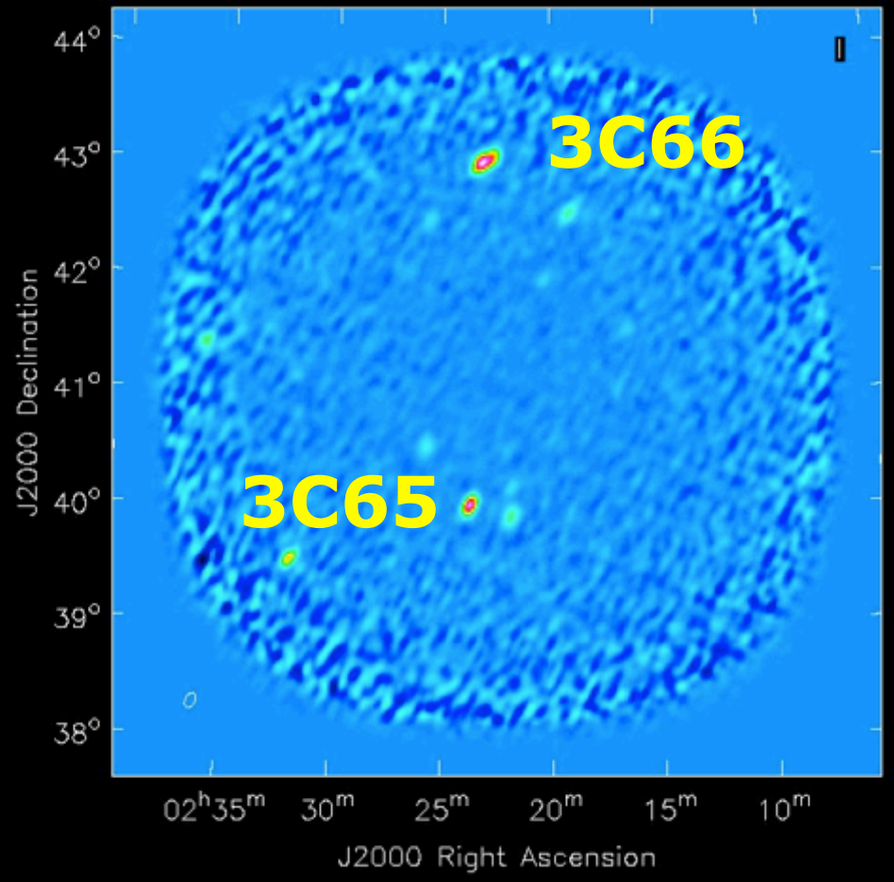
Contents

Appendix

1

Beam & imager developments

- "awimager" is working but is not fast ....
- deconvolution is in place
- Recent speed increase from treating two beam parts separately
  - dipole part: common to all antennas and full-pol
  - station part: unique to each antenna, but scalar



Pointing	Distance from Phase center, approximate (degrees)	Uncorrected		Corrected		Difference of corrected fluxes of 3C66 relative to pointing 1. (%)
		3C66 (Jy)	Map maximum (Jy/beam)	3C66 (Jy)	Map maximum (Jy/beam)	
1	0	58	35.5	58.10	35.62	N/A
2	1	49.6	31.1	60.8	37.92	4.64
3	2	22.97	13.01	55.5	31.18	4.47

Comparison of a sequence of pointings between 3C65 and 3C66 (Aleksandar Shulevski)

MSSS: getting more information

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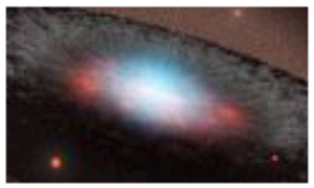

Water vapour reveals how stars

An international team led by astro
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LOFAR MSSS

Introduction to MSSS

The Multifrequency Snapshot Sky Survey (MSSS) is the first major observing program to be carried out with LOFAR during its ongoing commissioning phase. The primary goal of MSSS is to produce an accurate and detailed low frequency sky model, which will be used as the basis of calibrating images produced in the future by LOFAR. Along the way, the process of making MSSS possible is an efficient way of shaking down telescope operations!

This page provides an overview of the MSSS survey design, progress, processing flow, and expected output. Updates will be posted as the survey progresses. More detail about MSSS will be provided in a refereed journal article which is now in preparation.

Survey Design

MSSS will cover two main frequency windows: within the LBA range (covering a frequency span from 30 to 74 MHz) and the HBA range (spanning 120 to 170 MHz). Each window will be simultaneously observed in 8 bands of 2 MHz each. LOFAR's multi-pointing capability will be utilized to observe three fields at the same time, in every MSSS observation.