MSSS and LOFAR Commissioning

LOFAR Surveys Meeting
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(Ger de Bruyn and R. Nijboer)

Commissioning phases

We can distinguish 3 different phases for commissioning activities:

- Before MSSS: Jun-Oct 2009 from 1 ⇒ 20 stations

- During MSSS: Nov-Jan 2010 20 stations (+ 3-5 European)

- After MSSS: Jan-Aug 2010 30 ⇒ 40 stations

Assuming start of regular LOFAR observing in mid to late 2010 (?)

Why do a MS^3 ?

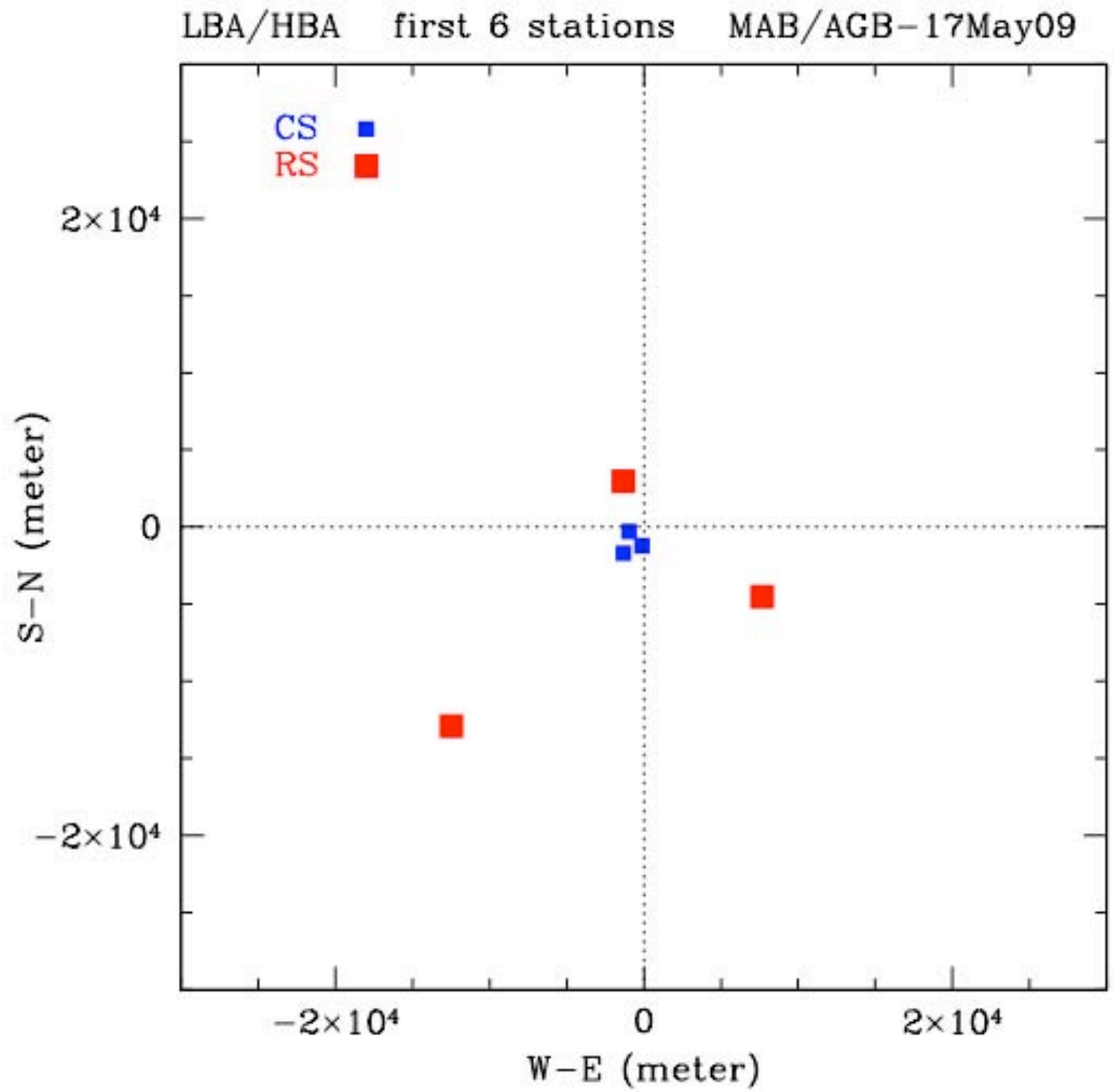
LOFAR needs a *Global Sky Model (GSM)* for the northern sky which

- has a proper flux scale
- has validated (initial) source parameters (spectrum, structure, ..)
- is astrometrically correct to better than 0.5”
- interfaces efficiently to calibration & imaging pipeline (through LSM)

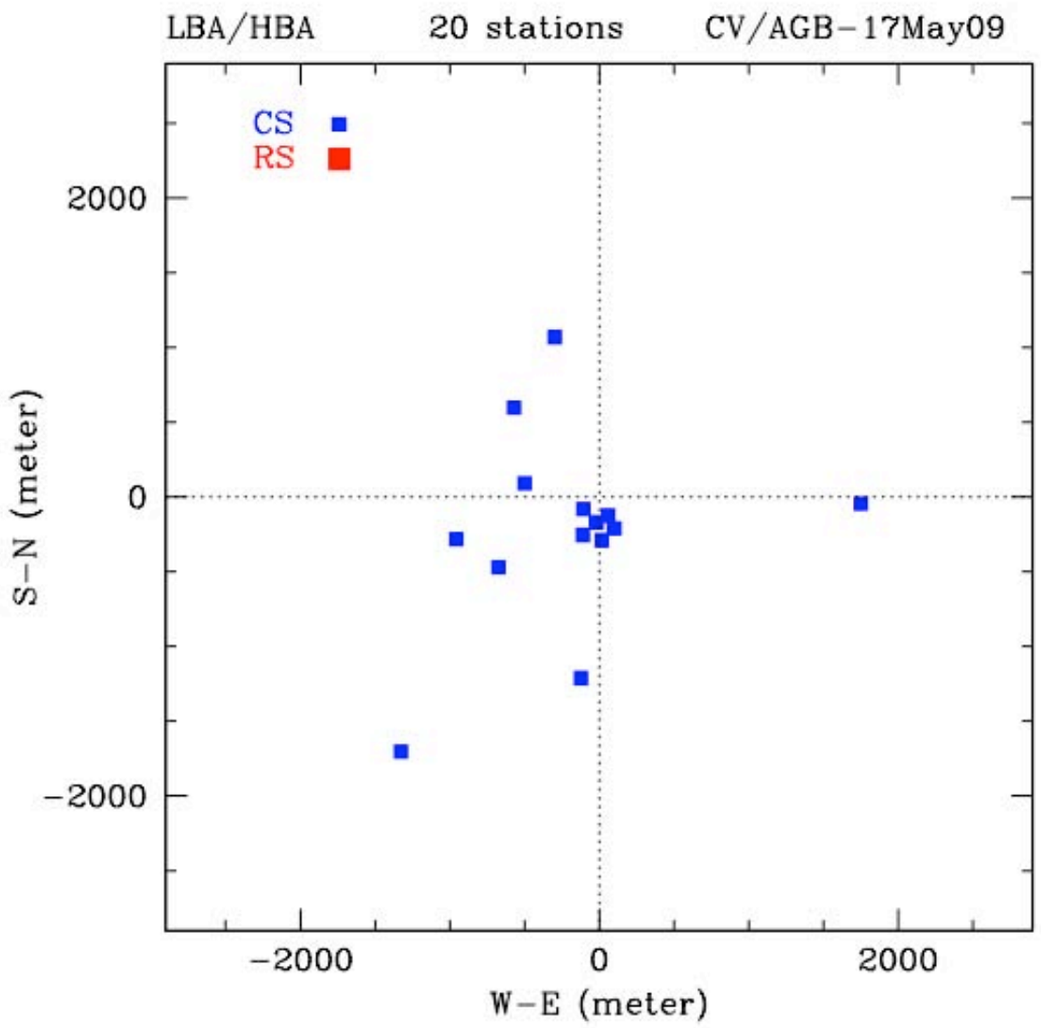
Moreover, carrying out MS^3 will

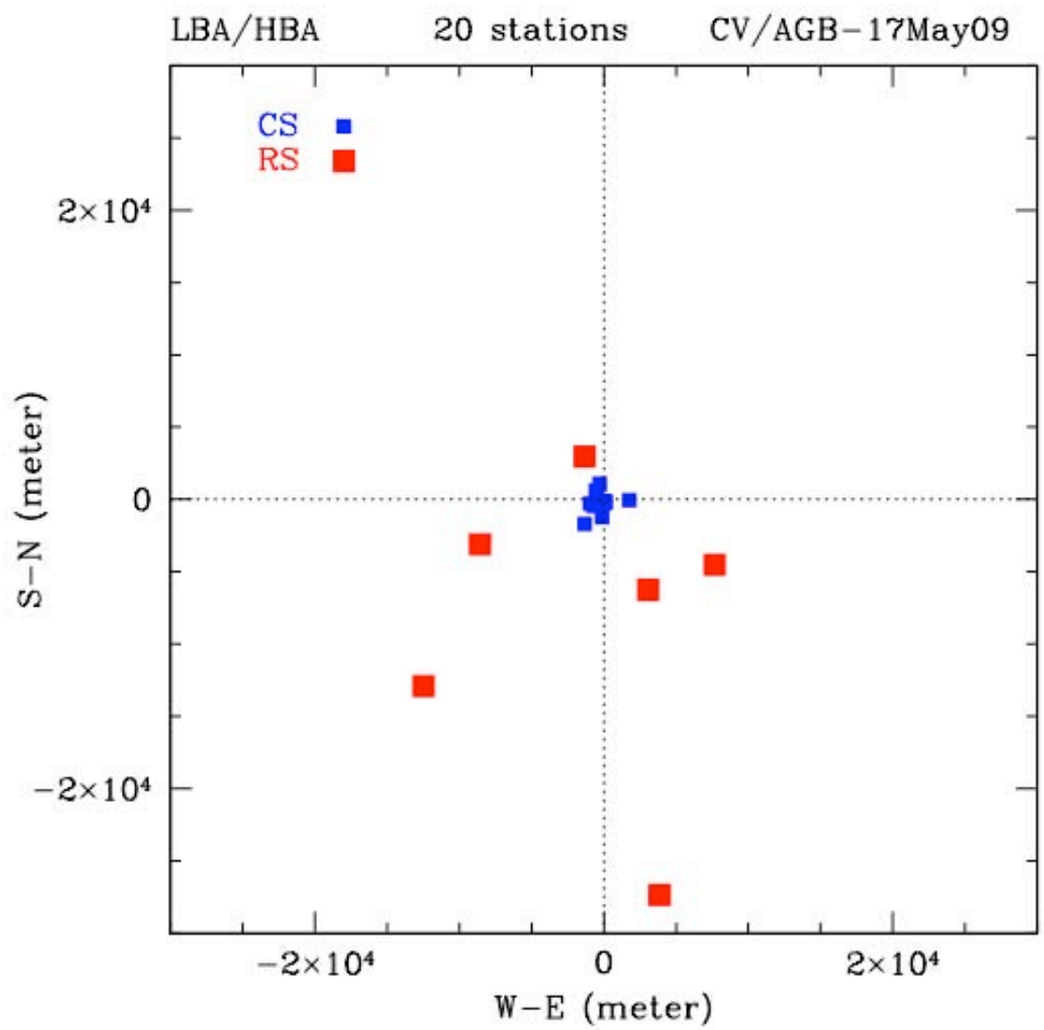
- create a ***joint focus for activities***
- integrates scheduling, monitoring, processing, calibration & imaging
- test all KSP-pipelines
- provides a field-test for storage and processing resource needs
- provide the conditions for a rehearsal of full LOFAR operations

Early array configuration: 6 stations, late Jul09



MSSS configuration: 20 stations, Oct09





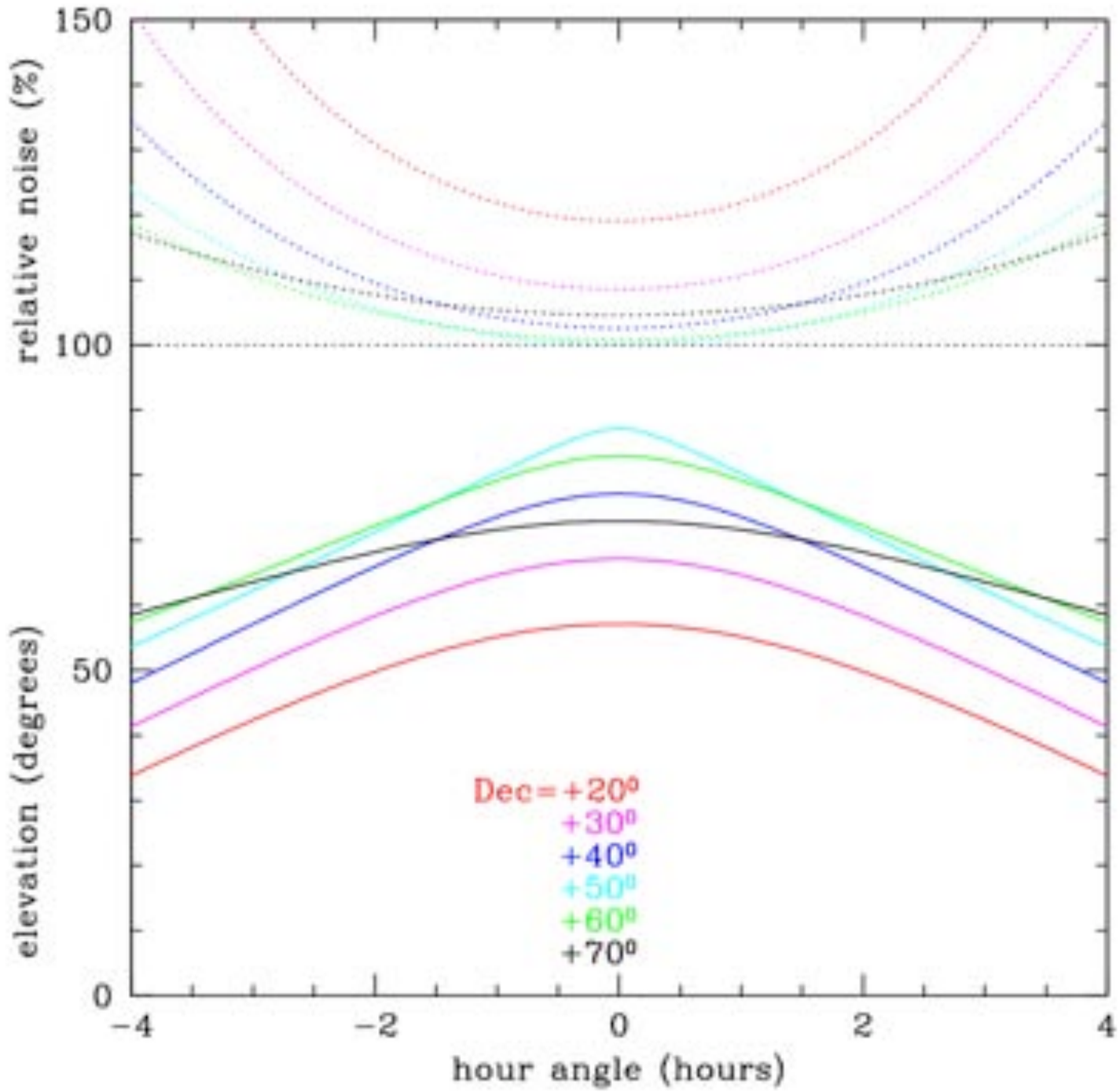
HA-range : uv-coverage vs projection

Ideally many snapshots at wide range of hour angles, say -4h to 4h

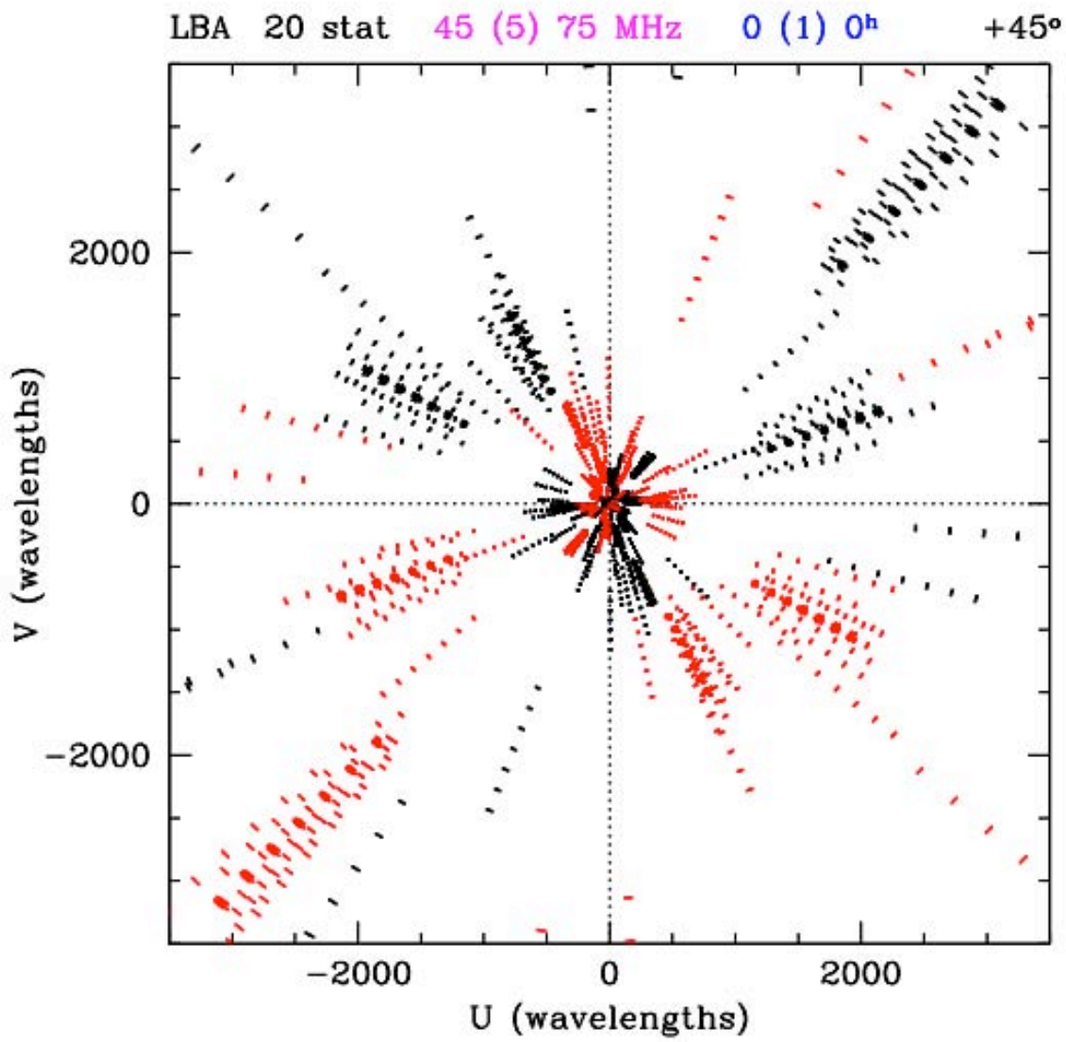
BUT

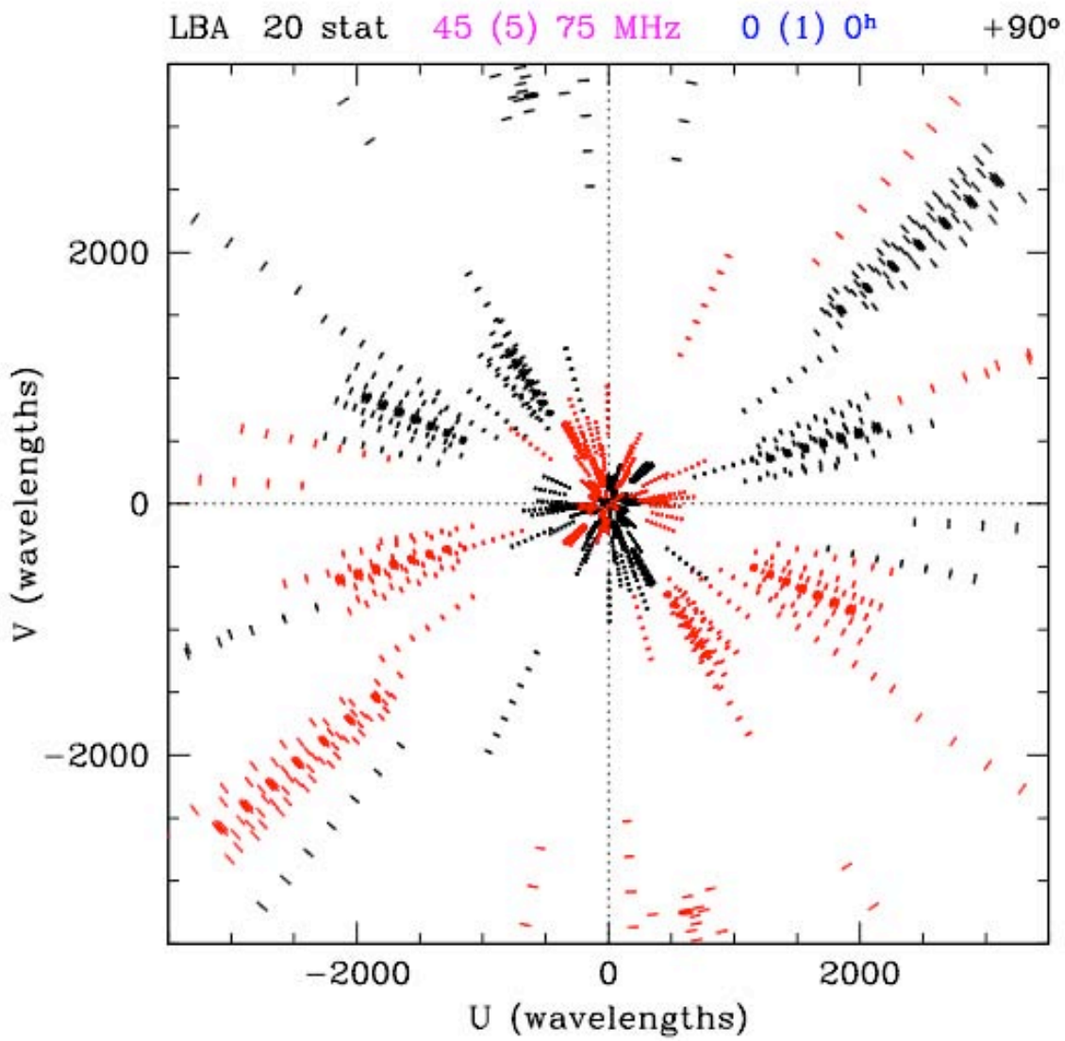
for Dec < +20^{o} severe sensitivity penalty !

⇒ for low Dec probably aim for snapshots within -2h, +2h HA-range



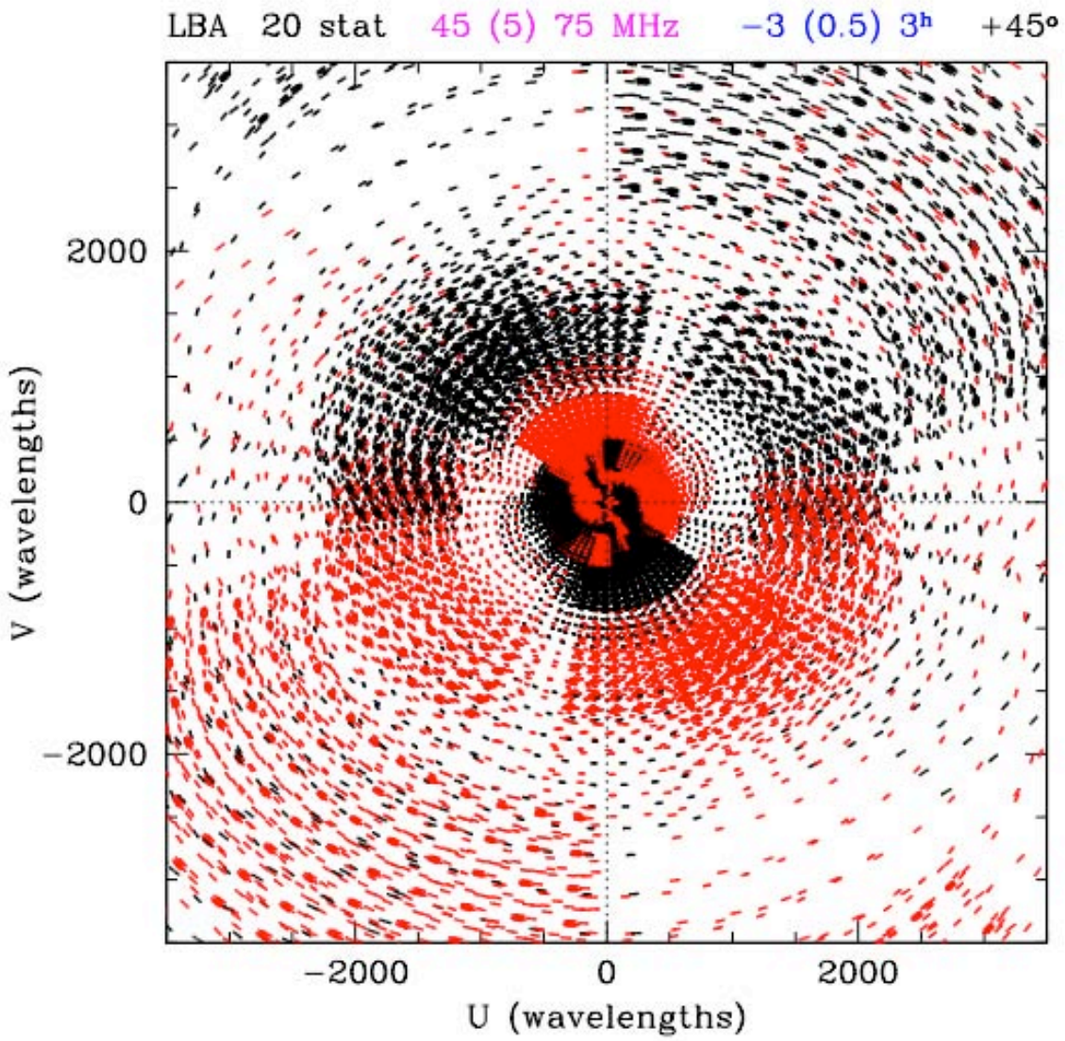
LOFAR20 uv-coverages for LBA-band

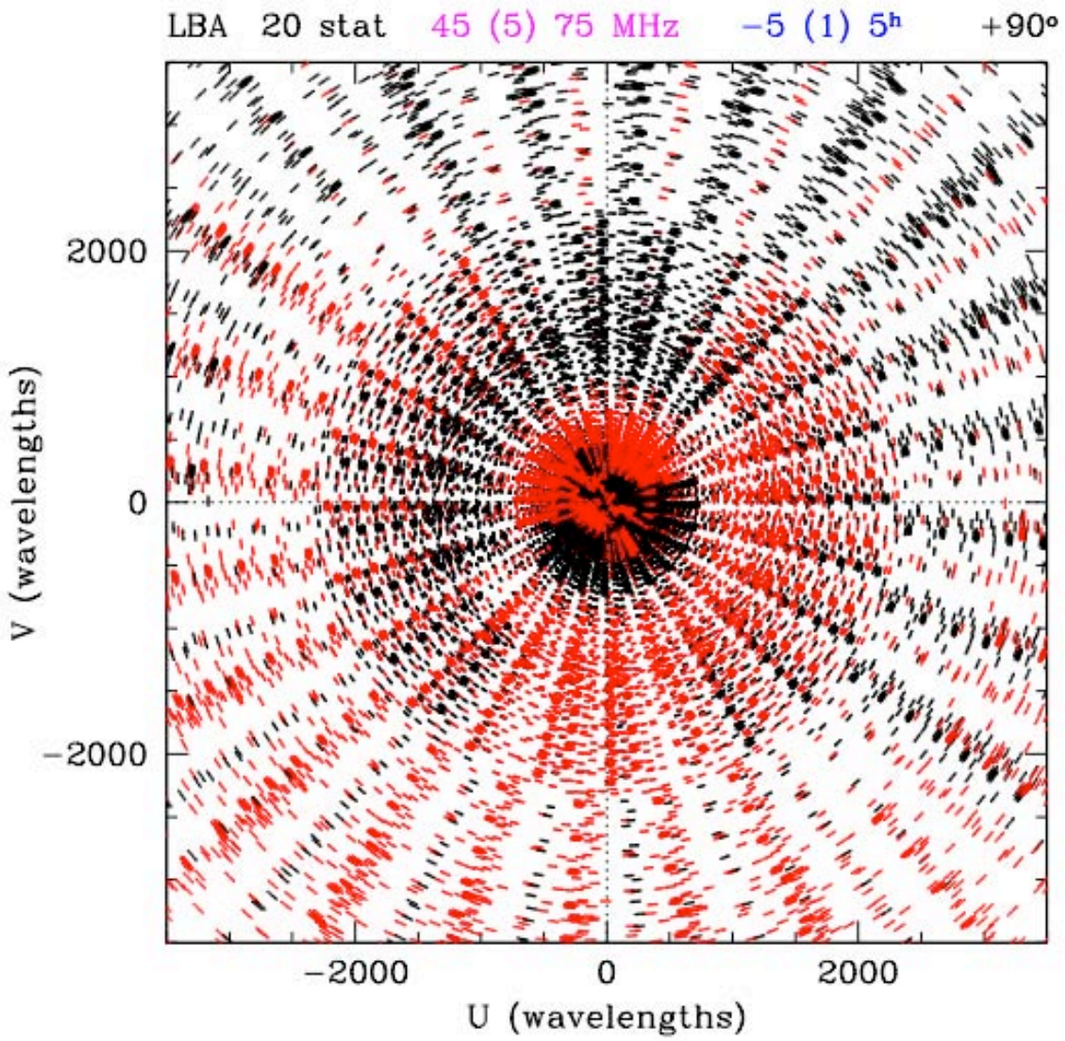




snapshot (1 cut, 5m) + very broadband (30 MHz)

LOFAR20 uv-coverages for LBA-band





multiple cuts of 5m + very broadband (30 MHz)

How to do MS^3 : an initial proposal

Observations:

- 20 NL stations (13+7) => multiple snapshots for decent uv-coverage
- limit to two (broad?) frequency ranges: 60 MHz & 150 MHz
- complete in < 3 months (30% efficiency) & ‘real-time’ processing
- 4 beams of ~10 MHz (+ CasA beam, ~1 MHz)

Products:

- 1 million sources, of which ~ 100,000 will be high S/N (i.e. ~ 5 / □^{o})
- spectral indices for the ~ 100,000 sources seen in both bands
- structural information: ~20 - 60” PSF (~VLSS/WENSS/NVSS)
- fully tested pipelines
- arcsecond images of ~ 4,000 (?) European-LOFAR calibrator sources
- lists of polarized calibration sources for ionospheric RM-monitoring

MSSS - some basic numbers (Nijboer, March09)

	60 MHz	150 MHz
Bandwidth	8 MHz	8 MHz
Observing time per FoV	36 times 5 minutes	12 times 5 minutes
FoV	106 deg^2	19.4 deg^2
FWHM	11.6 deg	4.97 deg
PSF resolution (10 km)	82.5 arcsec	33.0 arcsec
Correlator time resolution	1 s	1 s
Correlator freq resolution	0.76 kHz	0.76 kHz
Uv data size	762 Gbyte	678 Gbyte
Post DP^3 time res.	5 s	5 s
Post DP^3 freq res.	21.3 kHz	42.6 kHz
Post DP^3 uv data size	~ 4.76 Gbyte	~ 2.12 Gbyte
# channels per image cube	Tbd	Tbd
# pixels per image plane	2048 x 2048 ?	2048 x 2048 ?
Total image size	Tbd	Tbd

Table 1: Specifications per pointing / FoV

- 2048 squared plane ~ 16.8 MByte

MSSS - some basic numbers (Nijboer, March09)

Frequency (MHz)	Area (sq. deg.)	Rms (mJy)	BW (MHz)	Sources / FoV	Int. time (hrs)	# pointings	Tot. obs. (days)	Tot. sources
60	20262	5.37	8	6062	3	609.1	19.0	1.18e+6
150	20262	0.499	8	5768	1	3346	34.9	6.14e+6

- # sources @ 5 σ thermal noise
  - Multiple freq. planes & 30 σ: few times1e+5
- Total obs. Time (100% eff.): 53.9 days or 7.7 weeks
- At 50% eff.: 15.4 weeks or 3.4 months

- Not taken into account:
  - Nyquist sampling yields another factor 1.5 in sensitivity
    - (or 2.25 in observing time)
  - Tapering of HBA stations for near sidelobe reduction

MSSS - some basic numbers (Nijboer, March09)

	60 MHz	150 MHz
Total # fields (2 pi steradian)	609	3346
Total observing time (100% eff., using 4 beams)	456.75 hr	836.5 hr
Total # sources	Tbd	Tbd
Total uv data size	466 Tbyte	2.27 Pbyte
Total post DP^3 uv data size	~ 2.9 Tbyte	~ 7.1 Tbyte
Total image data size	Tbd	Tbd

Table 2: "All sky" specifications

- 1 freq. plane: 16.8 MByte x 3955 = 66.4 GByte

Preparation Tasks

- Absolute flux scale
- Ionospheric issues
  - *GPS – MIDAS 4D?*
  - *Refraction – TEC relation*
- Polarization issues
  - *WSRT polarized beam*
  - *Polarized source models*
  - *Polarization issues for EU baselines*
- GSM issues
  - *Initial GSM*
  - *GSM for EU baselines*
- Determination of uv-taper for imaging
- Determination of station taper (HBA)
- RFI statistics
- Preparation for MSSS
  - *Target field, pointing schemes, frequency span, sub-band selection, etc.*
  - *Data quality checks, dry runs, etc.*

Working Groups

Beam Modeling — **Johan Hamaker**, Sarod Yatawatta, Stefan Wijnholds, Michiel Brentjens, Ronald Nijboer

Ionosphere — **Jan Noordam,** Ger de Bruyn, Bas van der Tol, Huib Intema, James Anderson, Anna Scaife, Joris van Zwieten, Mamta Panday, (Maaijke Mevius),..

Polarization — **Marijke Haverkorn,** Ger de Bruyn, George Heald,James Anderson, Aris Noutsos, Anna Scaife, Enno Middelberg,..

GSM/LSM — **John Swinbank**, Bart Scheers, Niruj Mohan, Sarod Yatawatta, Ger van Diepen, Michael Wise

Data Quality & Monitoring — **V. N. Pandey**, Jason Hessels, Evert Rol, Fabien Batejat, Jan Noordam, Michael Wise

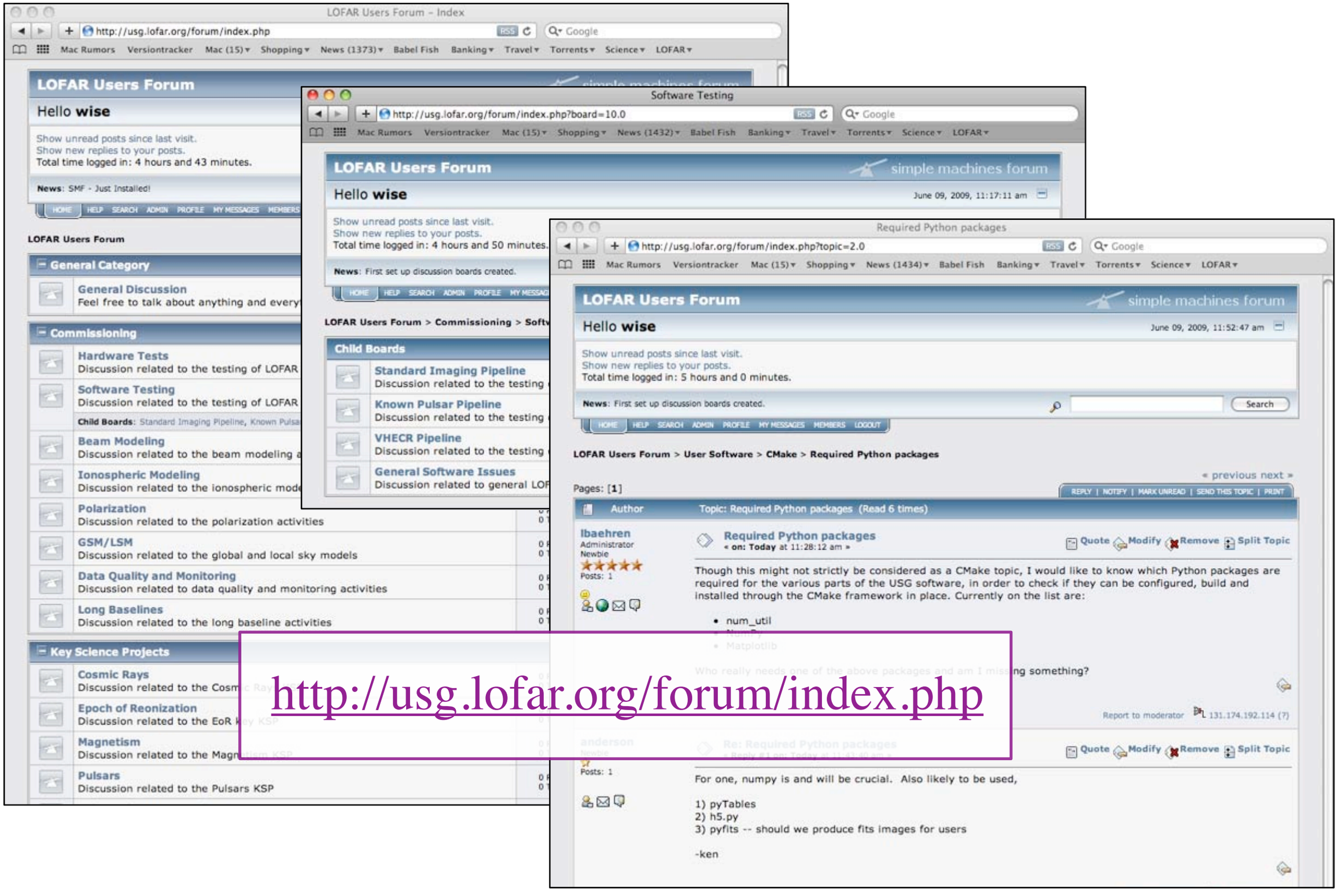
Long Baselines — **John Conway**, **James Anderson**, Jean-Mathias Grießmeier, Hans-Rainer Kloeckner, Philippe Zarka, Annette Haas, Jan Noordam, Ger de Bruyn

Busy Weeks®

- Pulsar I: Nov. 17-21, 2008 (HBA tracking)
- Pulsar II: Mar 2-6, 2009 (Initial TAB tests)
- TBB I: Mar 30- Apr 3 (Basic data-taking, LCU trigger)
- Pulsar III: Jun 2-6, 2009 (BF data writer, TAB tests)
- TBB II: June 22-26, 2009 (Basic data-taking, metadata)
- Polarization I: July 6-10 (TBD)
- *Imaging I: late July 2009* (End-to-end pipeline tests)
- *Ionosphere I: August 2009* (TBD)
- *Imaging II: August 2009* (MSSS dry runs)
- *Transients I: late August 2009* (Transient detection pipeline)

*Registered trademark, Ben Stappers (2008)

LOFAR Users Forum



http://usg.lofar.org/forum/index.php

The End