LOFAR Calibration Scheme and Planning

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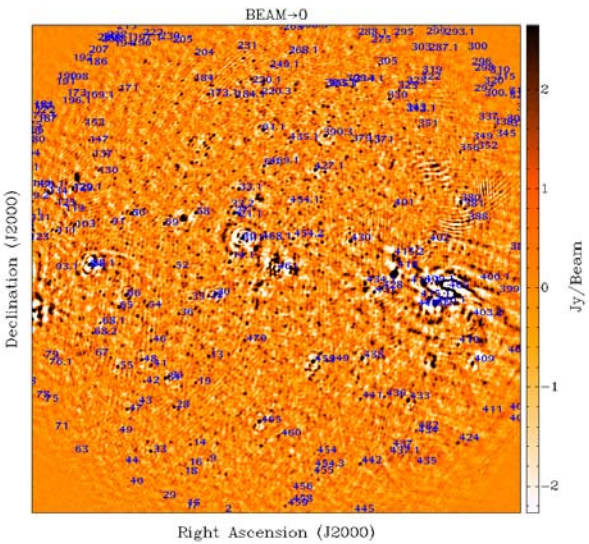
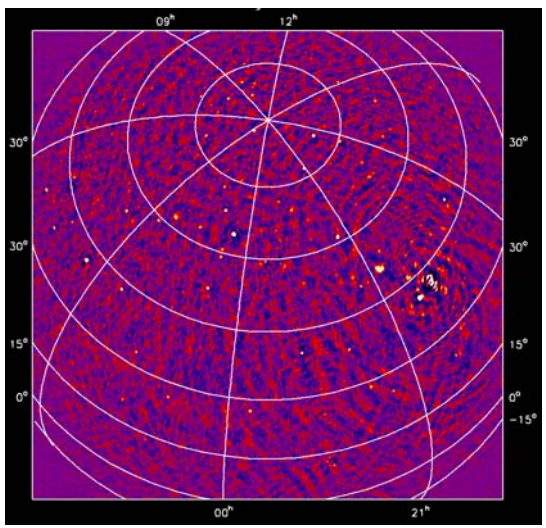
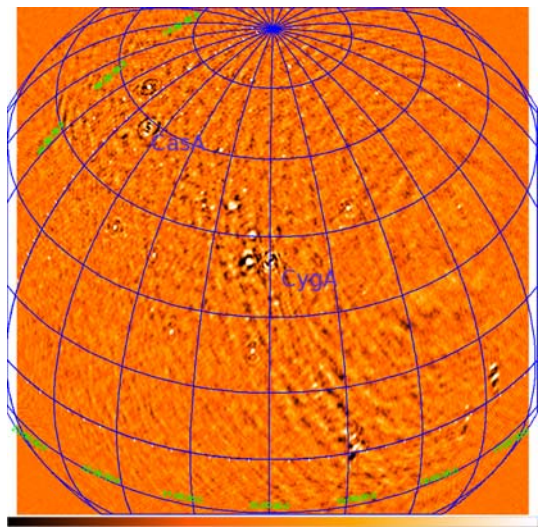
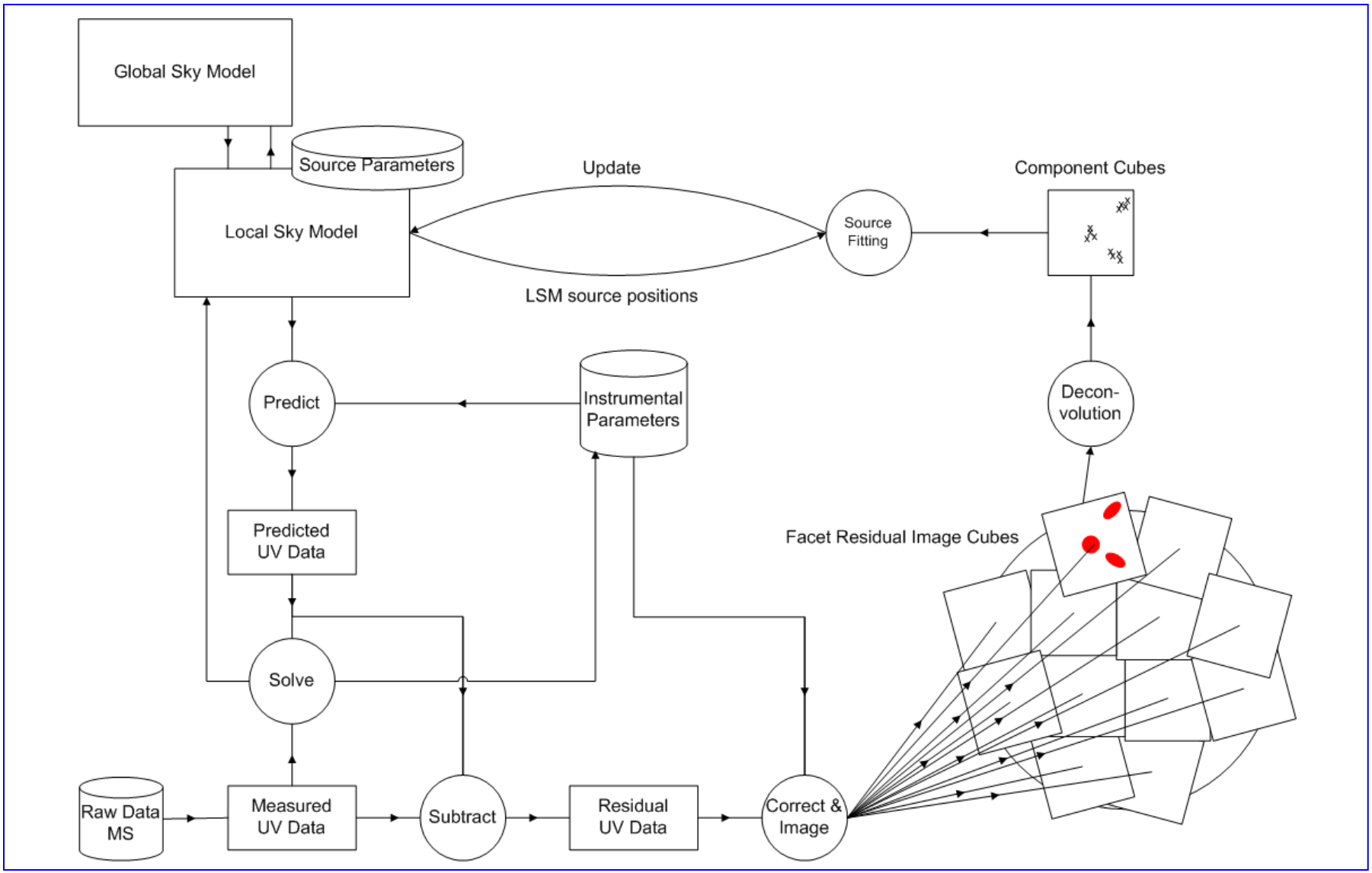
ASTRON







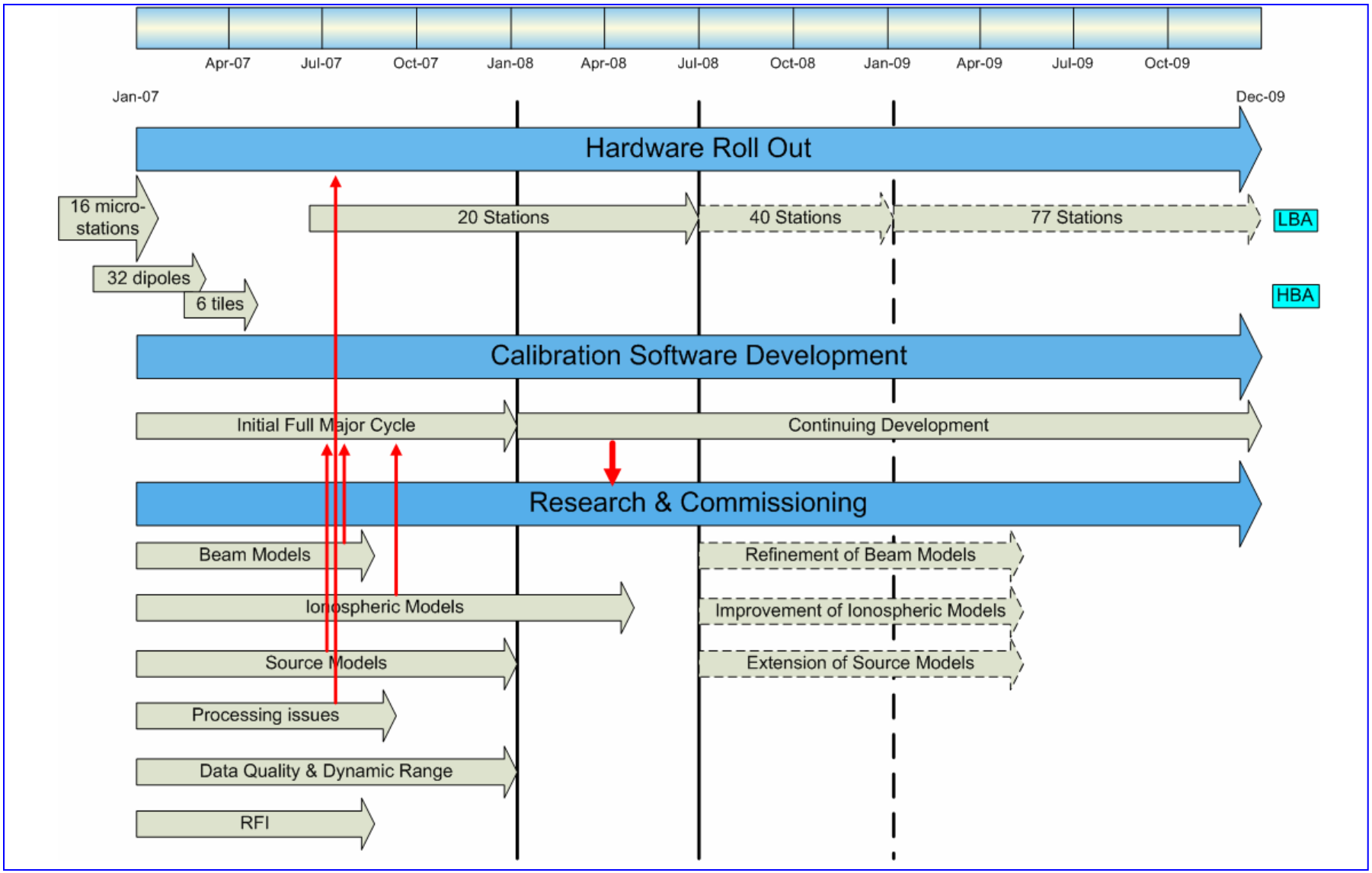
The Major Cycle



Calibration steps

- On-line calibration …
- Pre-processing steps
  - Flagging
  - Taking out the bandpass
  - Integration of data
- Calibration of uv-plane effects & fitting of ionosphere
  - Station gains (& clocks)
- Calibration of Image Plane effects
  - Cat. I Peeling (fit instrumental model)
  - Subtract Cat. I & II sources
  - Hierarchical Flagging
- Facet Imaging, deconvolution, source extraction, …

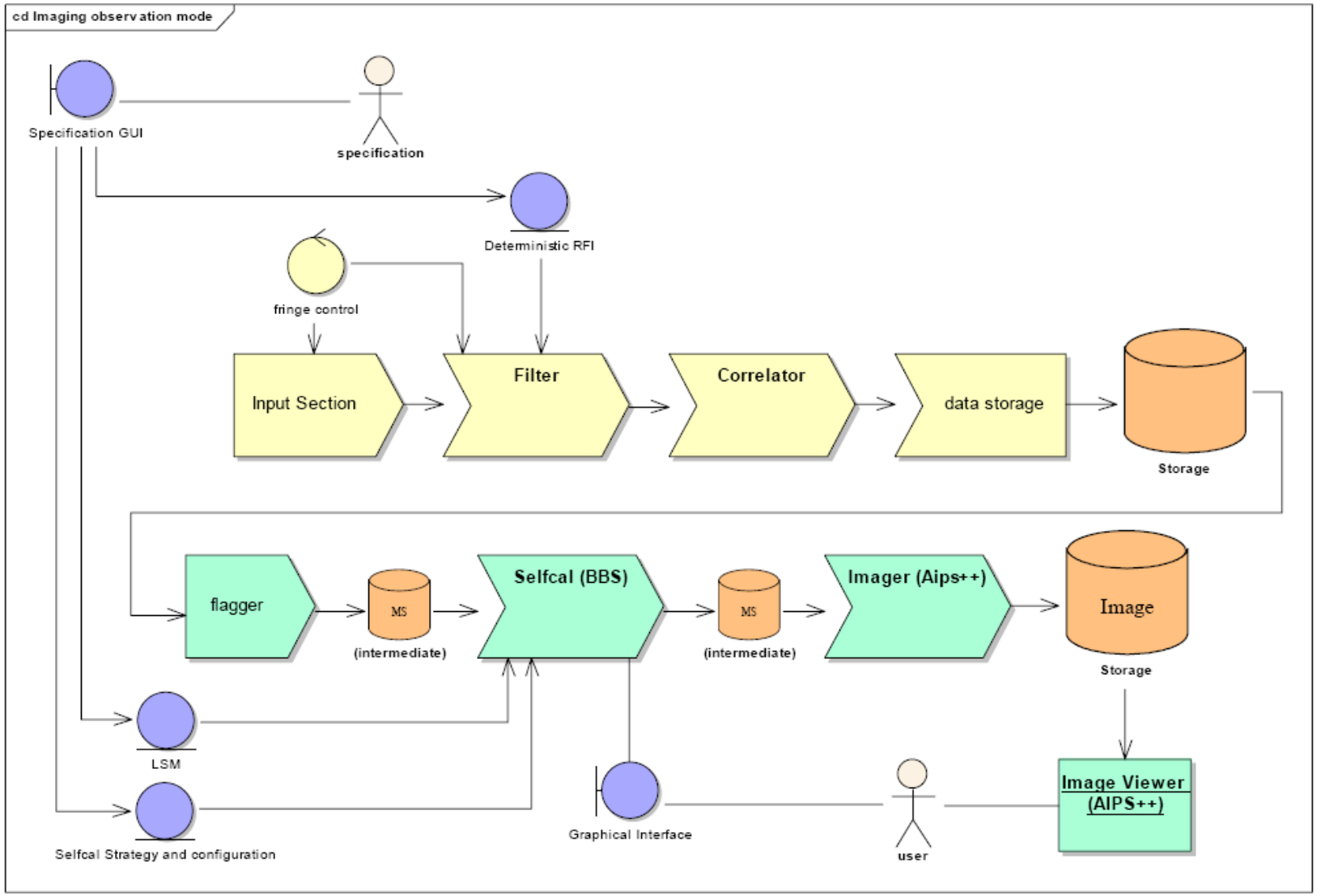
Timelines


Apr-07
Jul-07
Oct-07
Jan-08
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-07
Dec-09
Hardware Roll Out
16 micro-stations
20 Stations
40 Stations
77 Stations
LBA
32 dipoles
6 tiles
HBA
Calibration Software Development
Initial Full Major Cycle
Continuing Development
Research & Commissioning
Beam Models
Refinement of Beam Models
Ionospheric Models
Improvement of Ionospheric Models
Source Models
Extension of Source Models
Processing issues
Data Quality & Dynamic Range
RFI

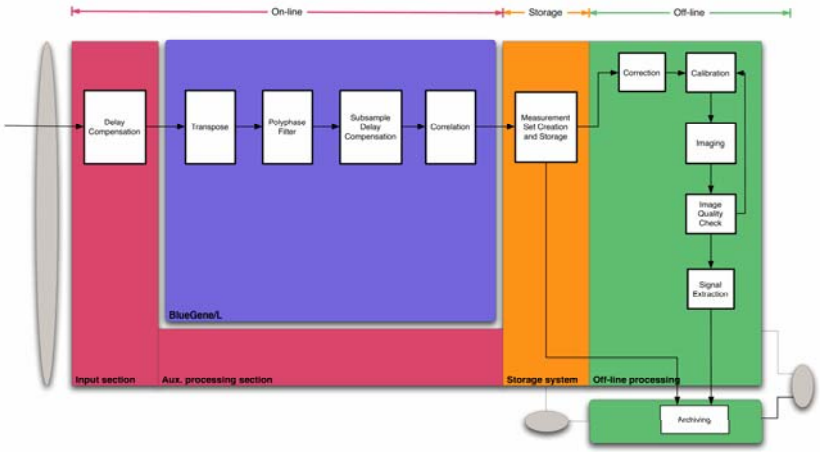
Software Development

- Pipeline software
  - Pre-processing, Calibration, Imaging (Yatawatta)
  - Data compression (Renting, Yatawatta)
- BBS
  - BBS kernel still being tested (Pandey, van Zwieten)
  - BBS control ready for distribution (Loose, van Zwieten)
- Imager
  - Currently AIPS++
  - Distributed Imager under development
  - Distributed Deconvolution under development

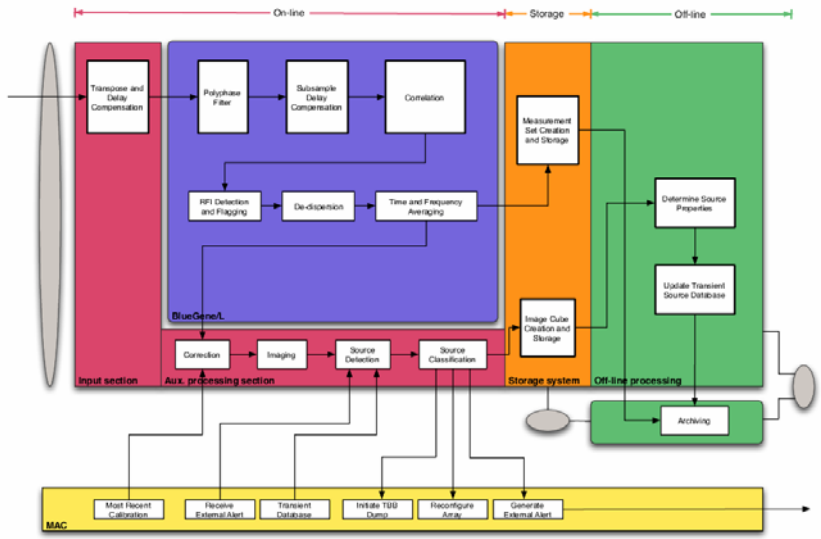
CS1 Imaging Pipeline



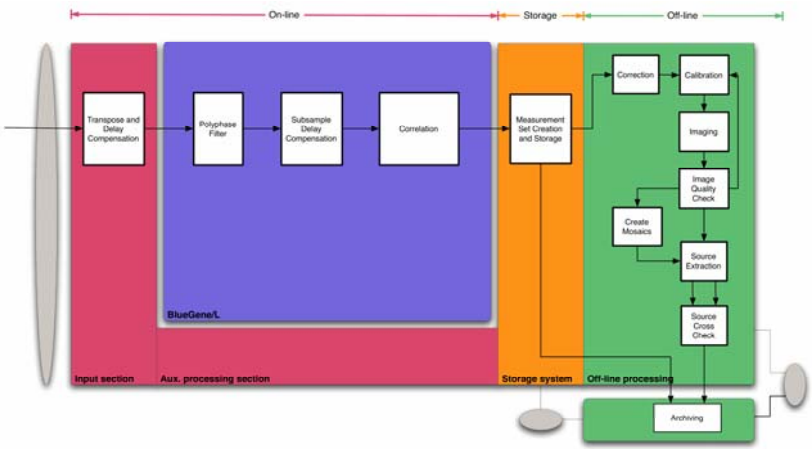
Pipelines



EoR



Transients



Surveys

Beam models

- LBA dipole and station beam model (Yatawatta)
  - Validation using solar flare observation
- Expansion model (Hamaker)
  - HBA configuration studies
- HBA test program (Brentjens)

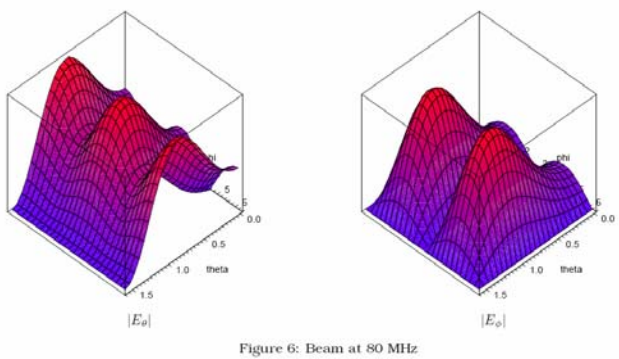
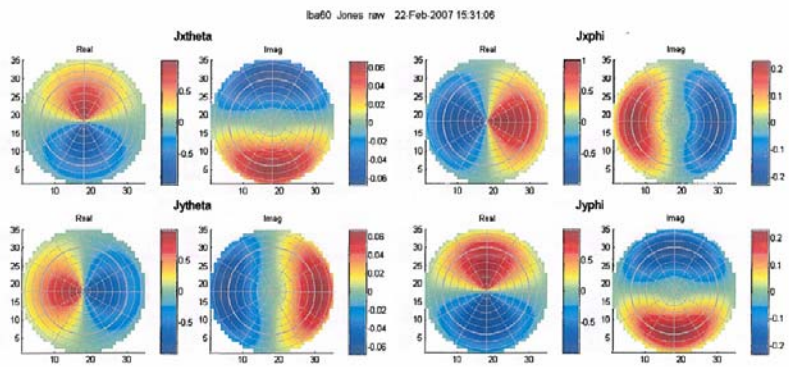


Figure 6: Beam at 80 MHz

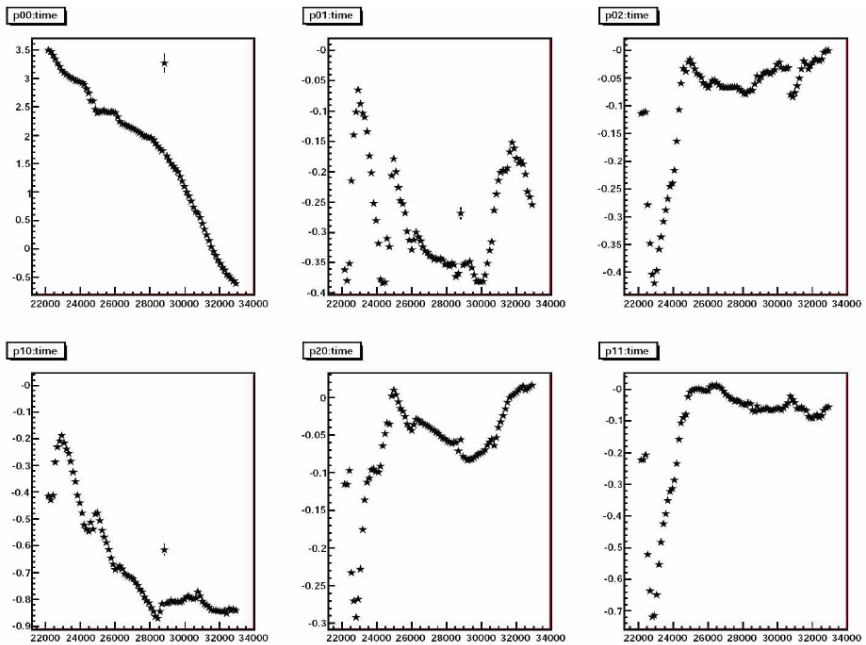
Dipole beam by Sarod Yatawatta



Dipole Jones matrix components by Johan Hamaker

Ionosphere

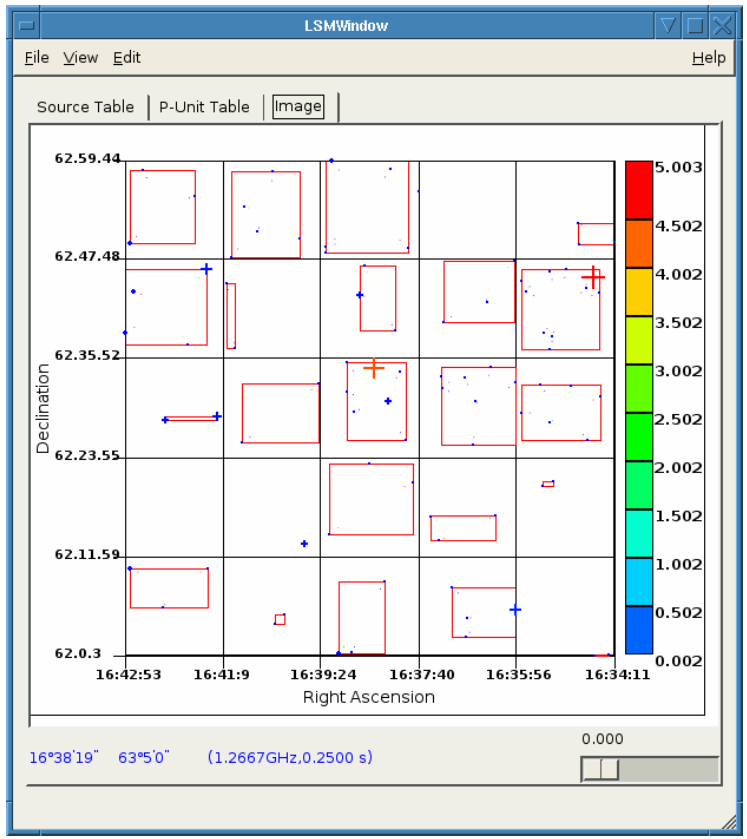
- GPS data (Mevius, Anderson, Noordam)
- Ionospheric modelling with MeqTrees (Van Bemmel)
- Estimation theory (Van der Tol)
- GMRT / VLA / CS1 (Omar)



MIM solution by Maaijke Mevius et al.

Source models

- VLSS based GSM for CS1 (Mohan, van Weeren)
- LSM prototype (Yatawatta)
- Source extraction prototype BDSM (Mohan)
- Absolute flux scale



LSM prototype by Sarod Yatawatta

Processing issues

- Off-line cluster (Nijboer, Romein)
- Selfcal flops (Brentjens)
- Selfcal scaling (Bregman)
- Scale towards 20 stations (LOFAR20):
  - What kind of operation is foreseen?
  - What kind of data product / resolution is foreseen?
  - What kind of Calibration approach is foreseen?

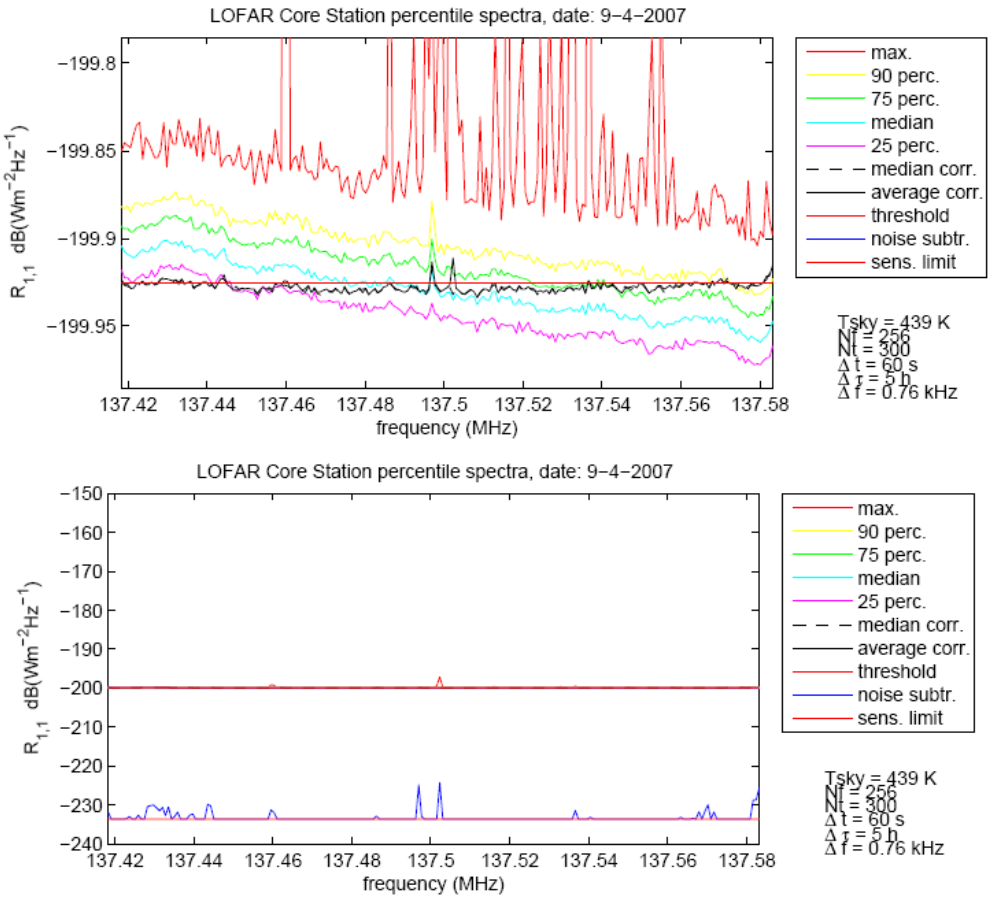
- Pipeline steps (Yatawatta, Renting)

- Simulation of Peeling (Intema)
- Peeling from estimation theory perspective (Van der Tol, Jeffs)

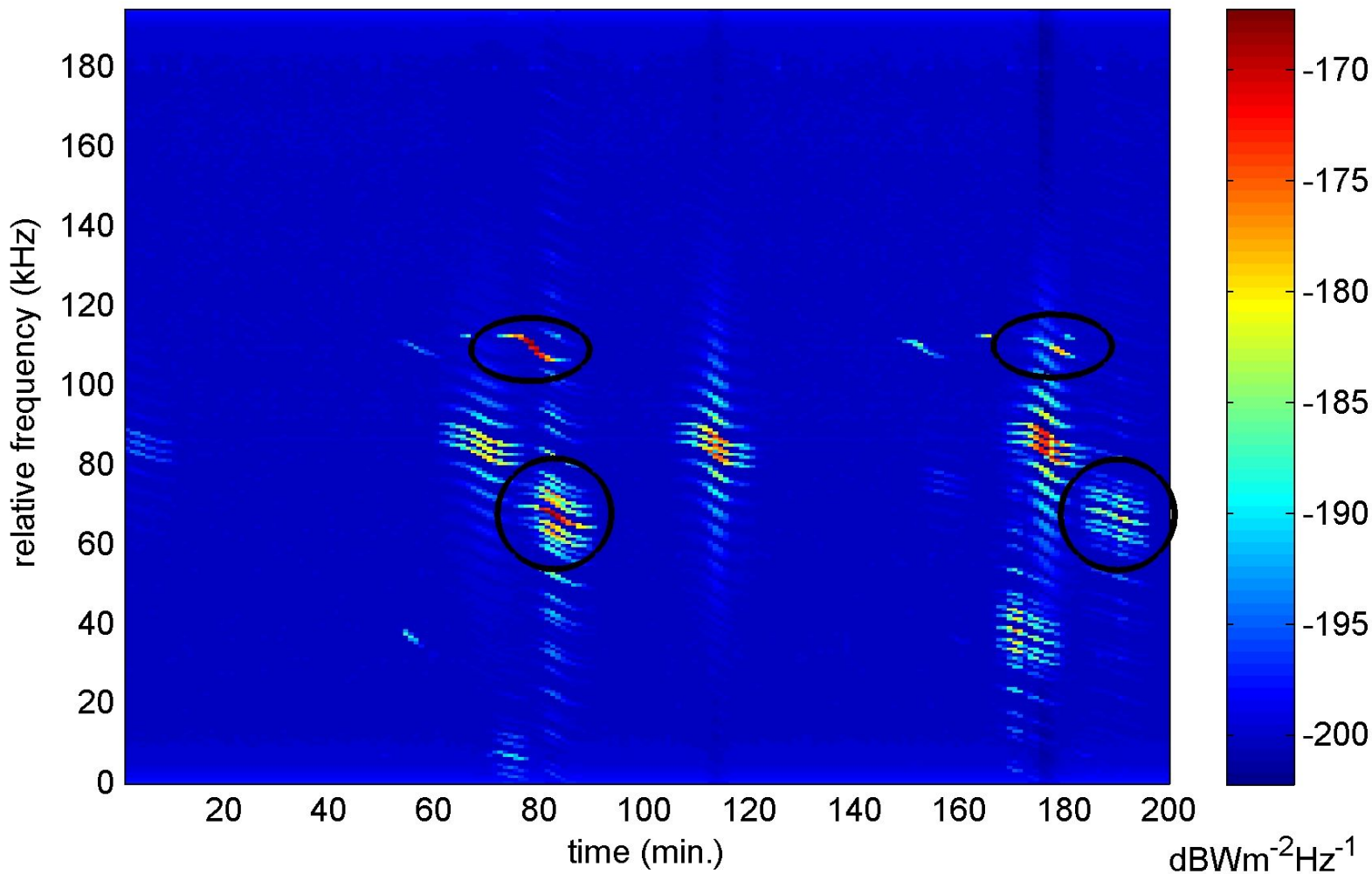
Data Quality & Dynamic Range

- LBA & HBA system validation (Wijnholds)
- DR of CS1 images (Yatawatta, Noordam, de Bruyn)
- MeqTree simulator: Siamese (Smirnov)
- Simulations plan (Noordam)

- MS to MATLAB converter (Harmen Jeuring)
- High Band spectrum environment (Boonstra)
  - Taking out analogue and digital passbands
  - Correcting for linear gradient
- High Band cleaner than expected (Low Band even cleaner)



Satellites over CS1



Near future work

- Software development
  - Incorporate additional functionality
  - Cope with more data
  - Make it run under SAS / MAC
- Better understanding of the Calibration
  - By looking at CS1 data
  - By comparing with simulations
  - FT images back to uv-domain
- How do we get deeper in the map (without extra data)?
  - Use larger domains / funklets

Near future work

- Development of pipelines
  - First uv-plane correction (clocks), then Peeling
  - Correcting for directions we don't solve for
  - Intrinsic sky map?
  - Compare XX and YY images?
  - KSP specific
- Simulation plan
  - What is the effect of the PSF in the map?
  - What is the effect of w-projection in the map?
  - Simulated VLSS sky vs. CS1 measured sky
  - Ionosphere
- Input for off-line cluster design
  - Pulsars
  - Cosmic Rays