LOFAR Calibration and Imaging

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and

ASTRON

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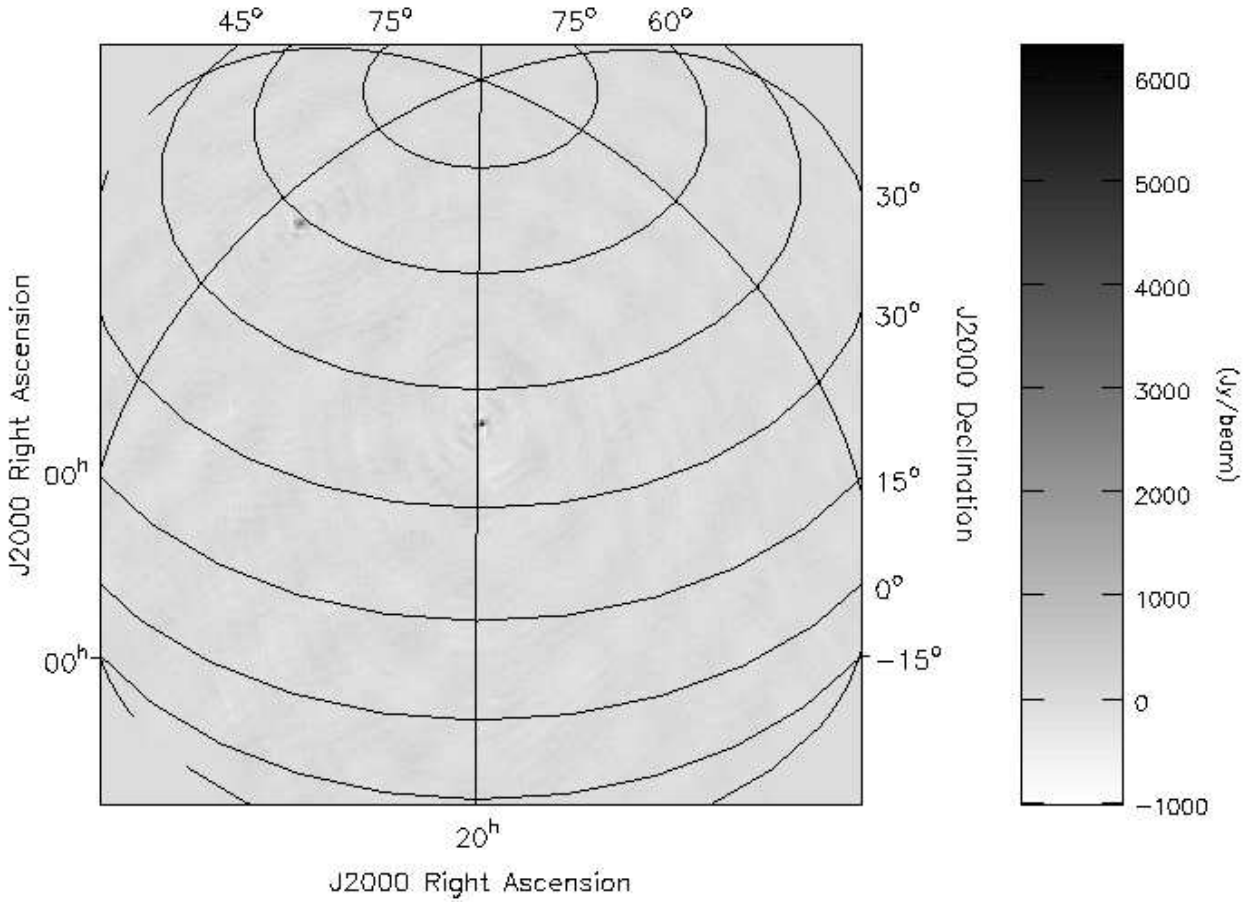
First calibrated LOFAR image



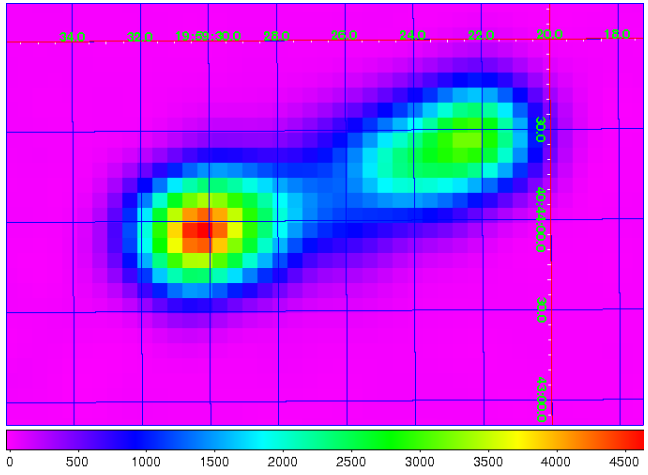
Calibrated, Full sky, CygA (center) CasA (top), Jan 2007

Issues with LOFAR

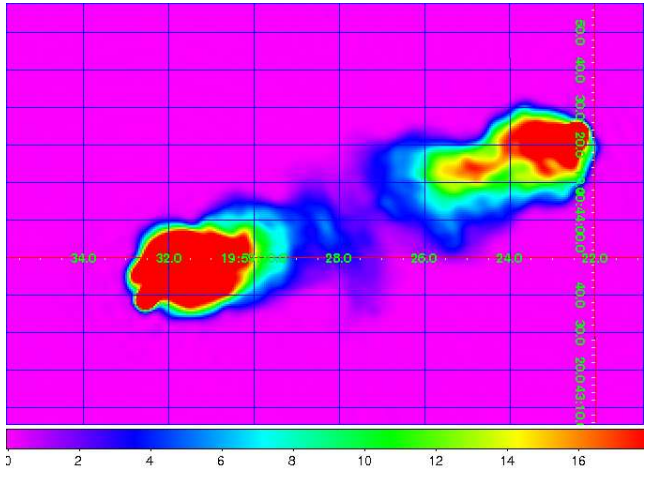
- Sky: bright, extended sources, many more
- Ionosphere: turbulence, TIDs, Faraday rotation
- Beams: time/freq varying, beam polarization, mutual coupling
- Receivers: clock variation, gain drifts,
- RFI
- Too eager astronomers

The Sky

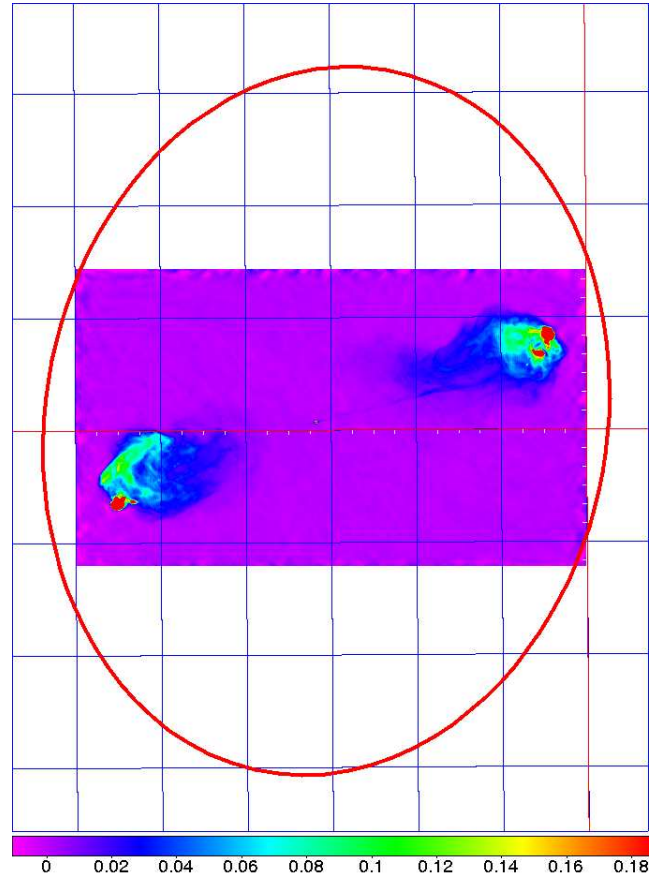
There are NO point sources



VLA 74 MHz



VLA 327 MHz



VLA 4.5 GHz, WSRT PSF at 140 MHz

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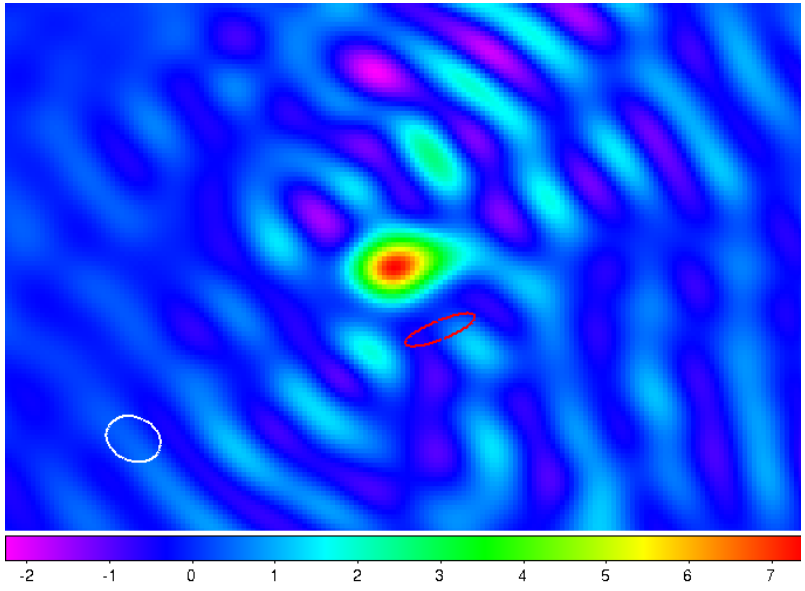
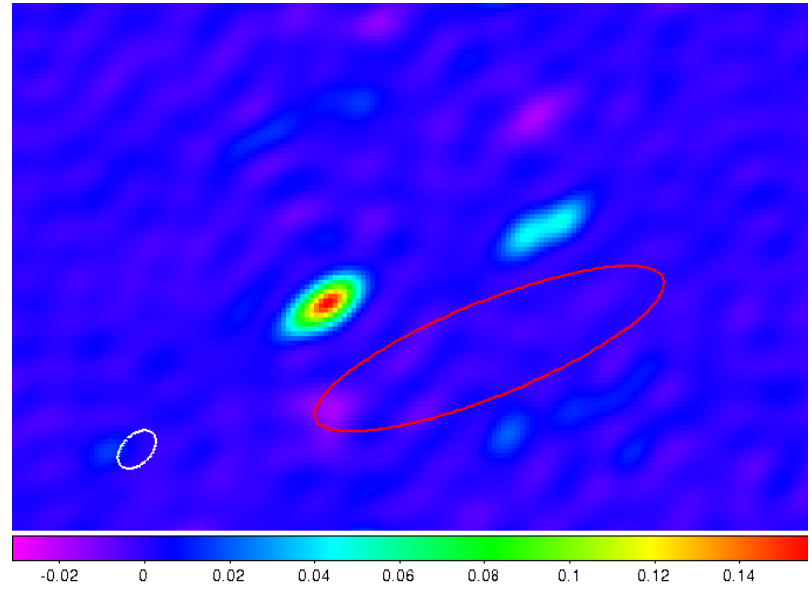
The Sky

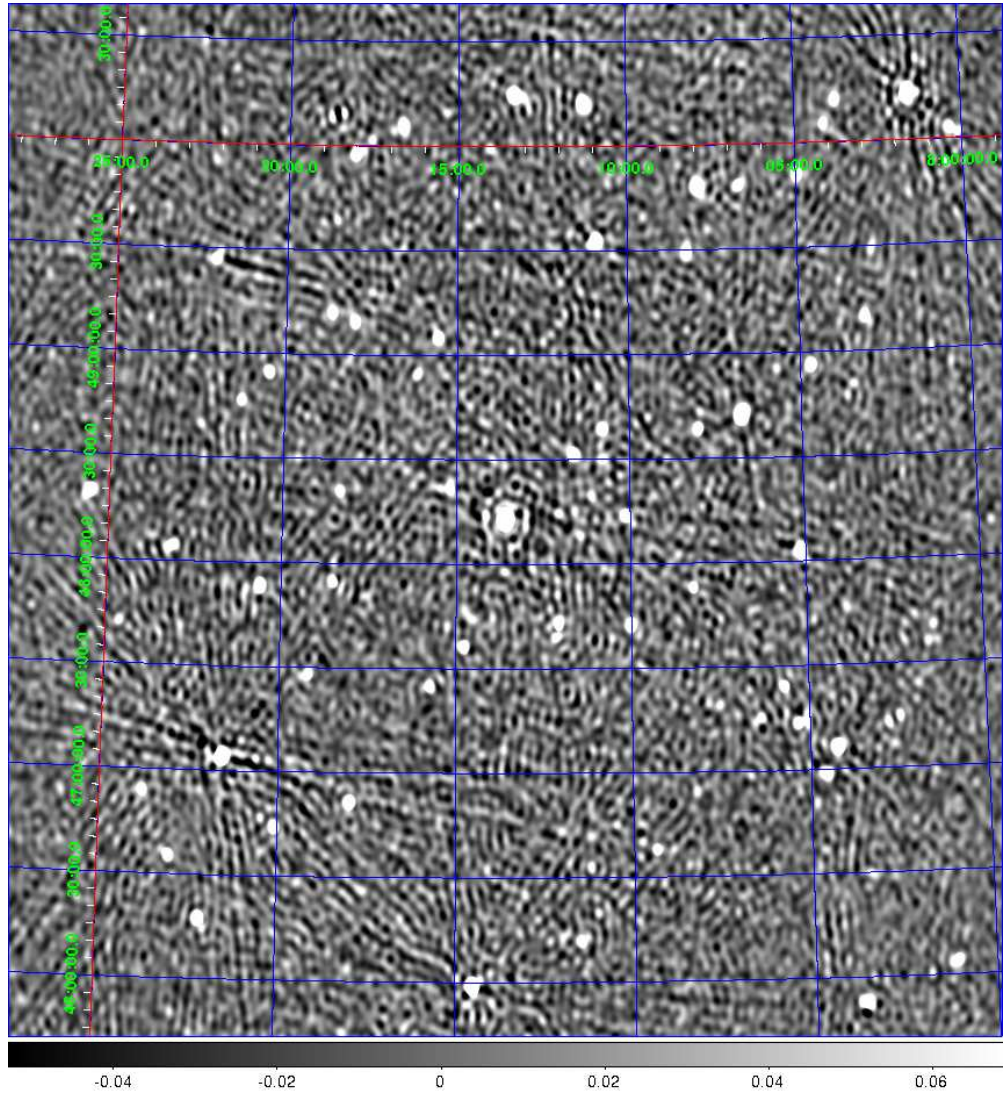


LOFAR CygA at 15 MHz



LOFAR CygA at 170 MHz

The Ionosphere



3C196, WSRT at 140 MHz

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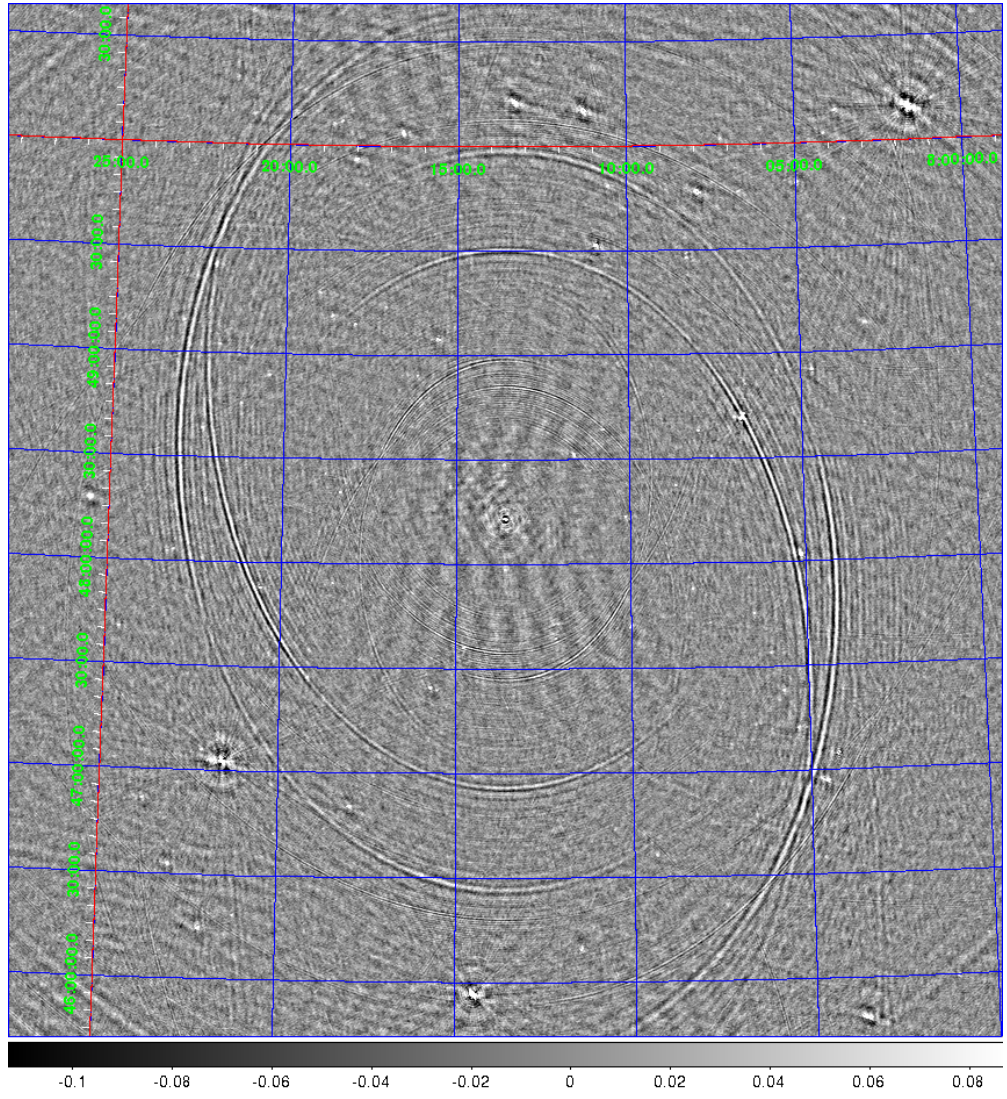
The Ionosphere



3C196, LOFAR at 40 MHz

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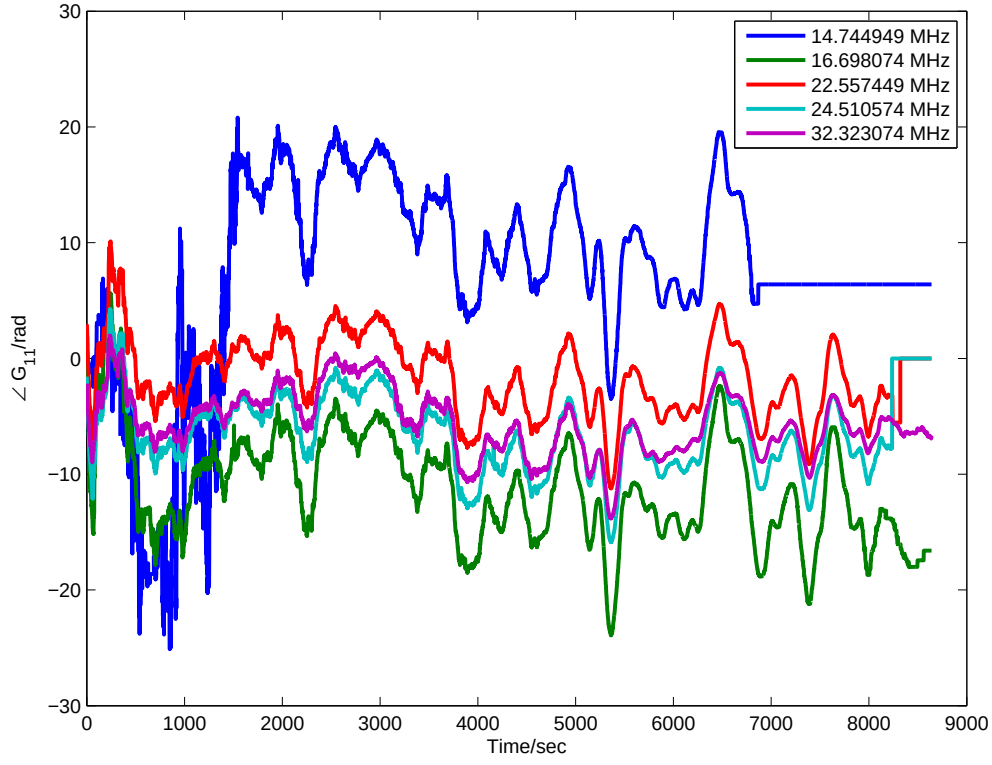
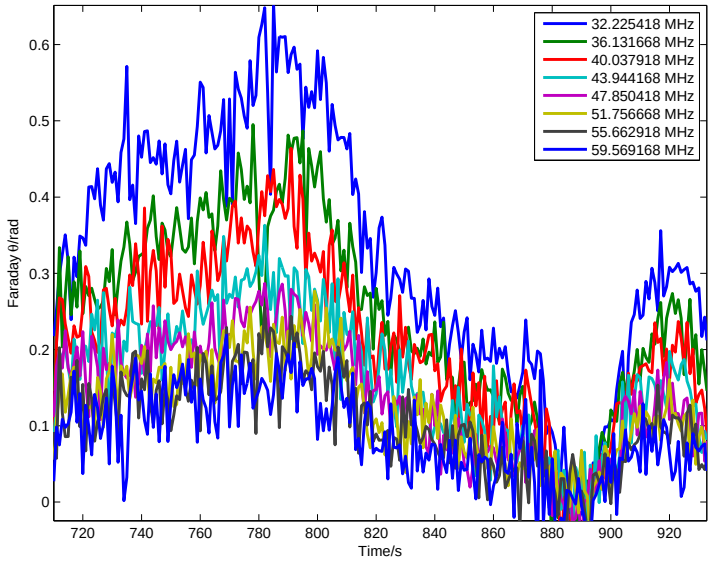
The Ionosphere - Phase variation

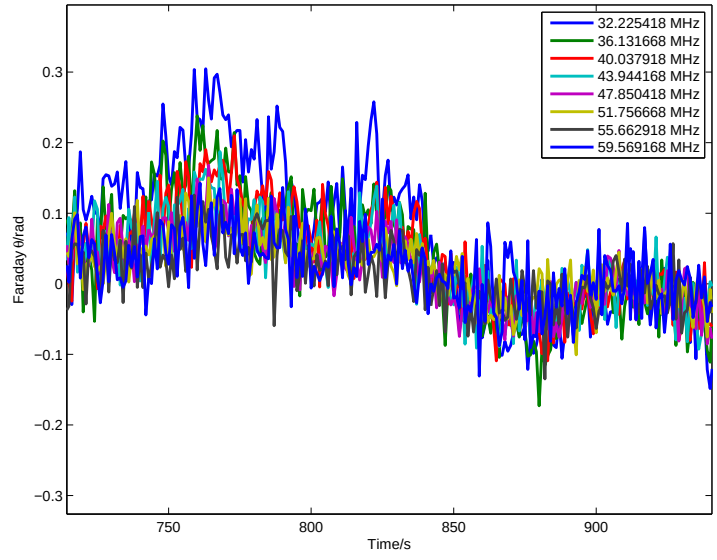


Phase variation in the LBA for 3C196

The Ionosphere - Faraday rotation



20 km baseline differential FR



2 km baseline differential FR

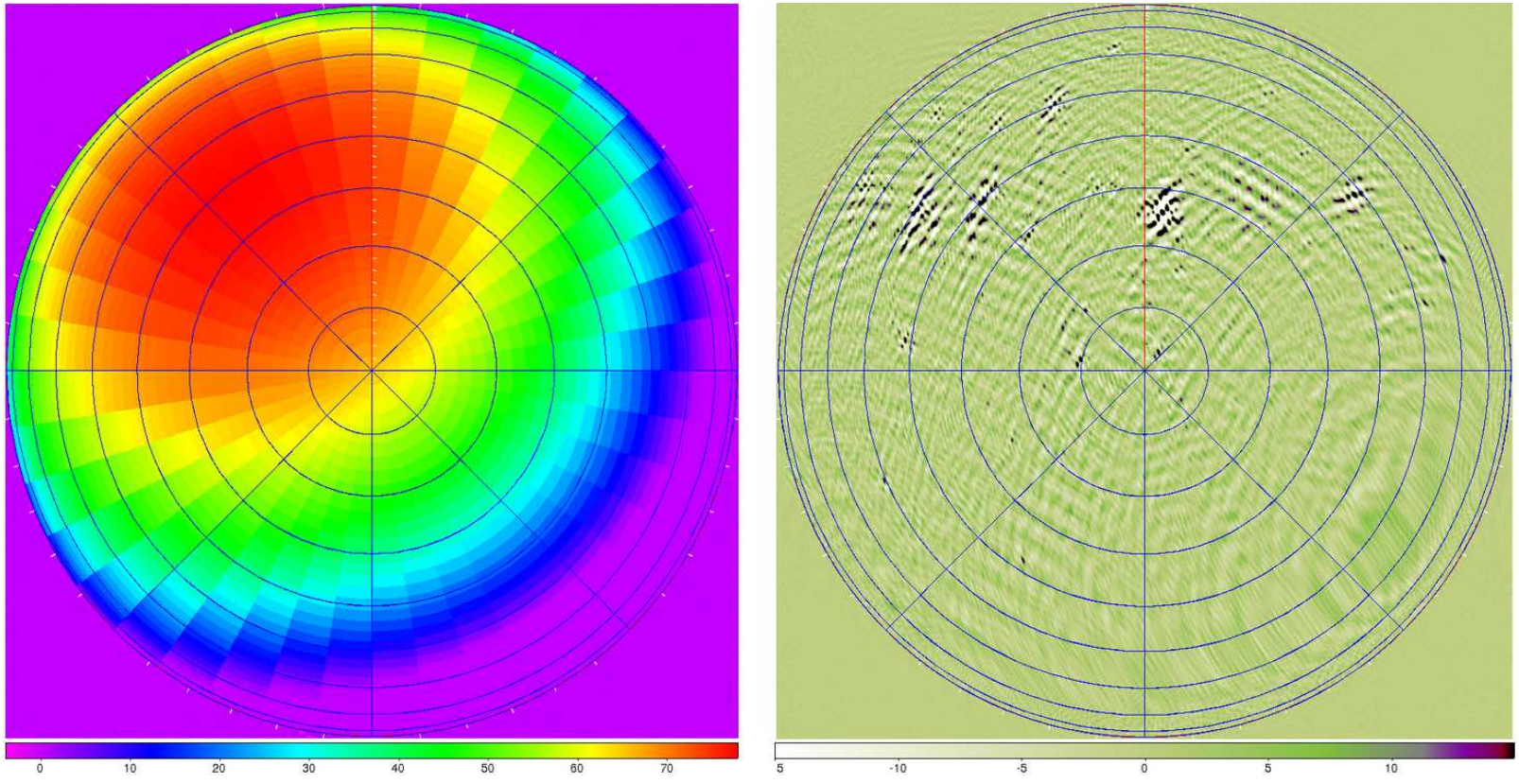
The beam

LBA element

HBA element

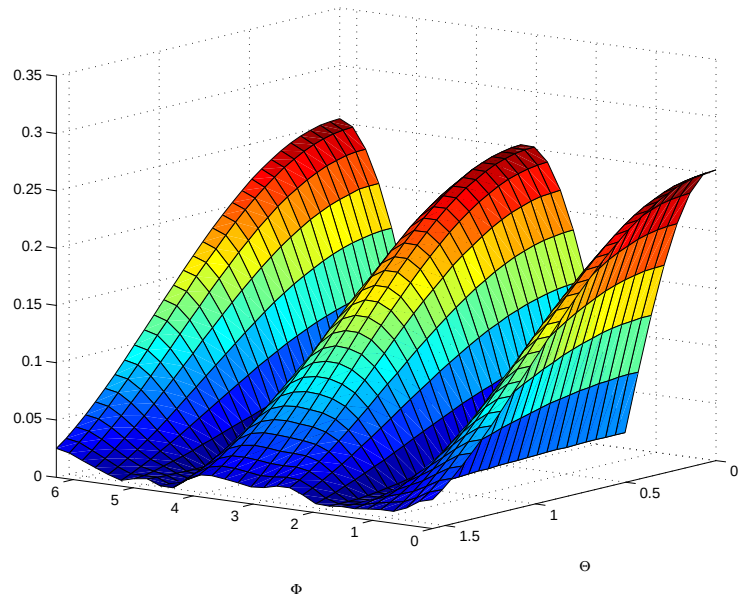
LBA: low band (10-80 MHz), HBA: high band (100-240 MHz)

Beam/Sky movie

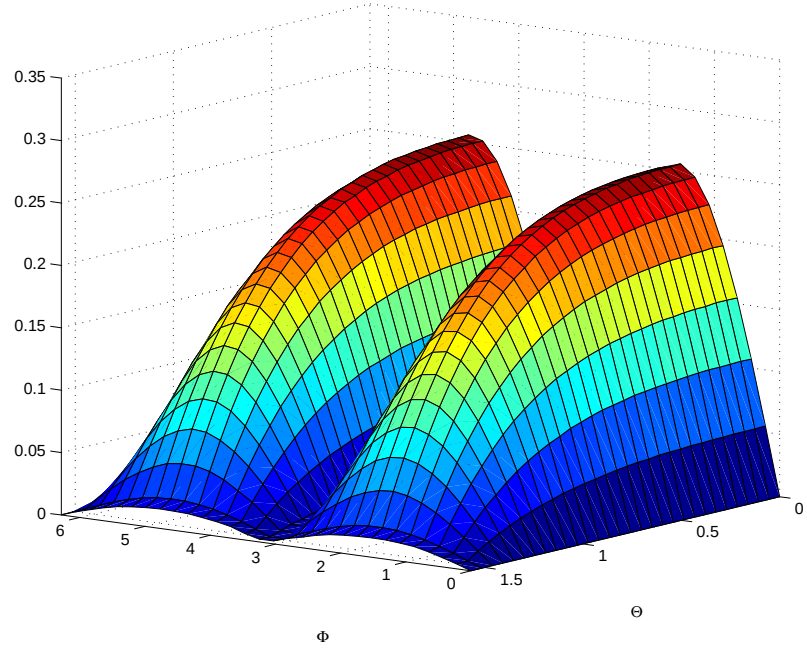


beam (left), sky (right), 1 hour snapshots

Solving for Beams



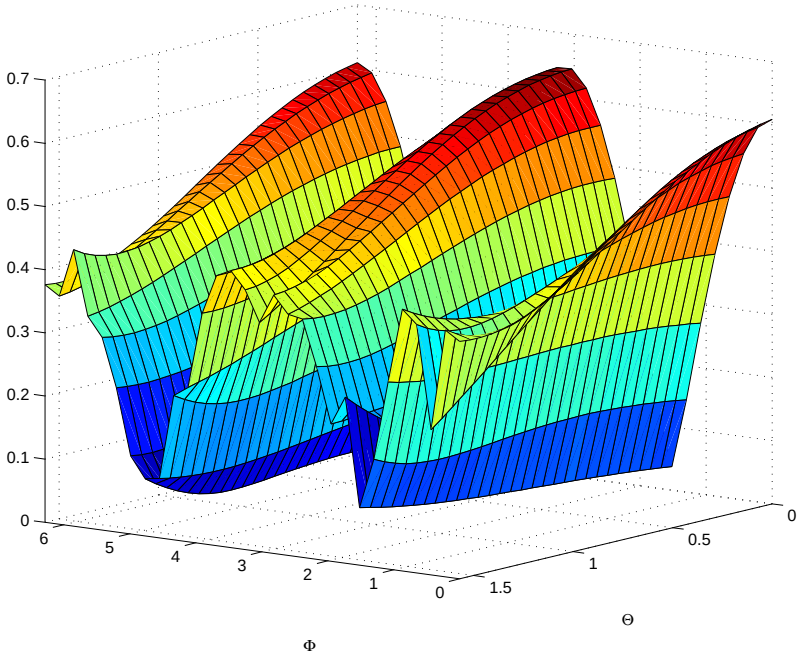
$|\mathbf{E}_\theta(\boldsymbol{\theta})|$



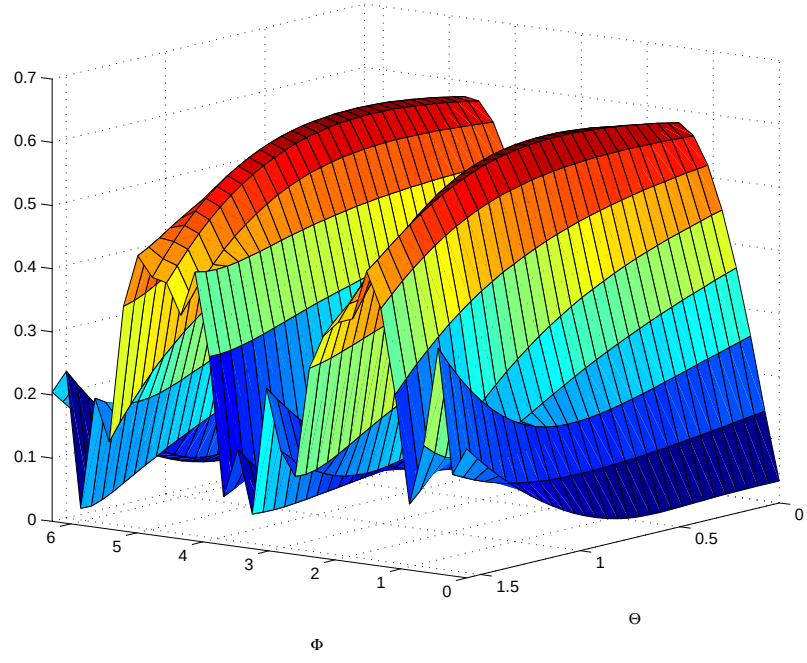
$|\mathbf{E}_\phi(\boldsymbol{\theta})|$

- Strategy: Use orthonormal basis for beamshapes
- Solve for source fluxes and beam.. iterate

Solved Beam



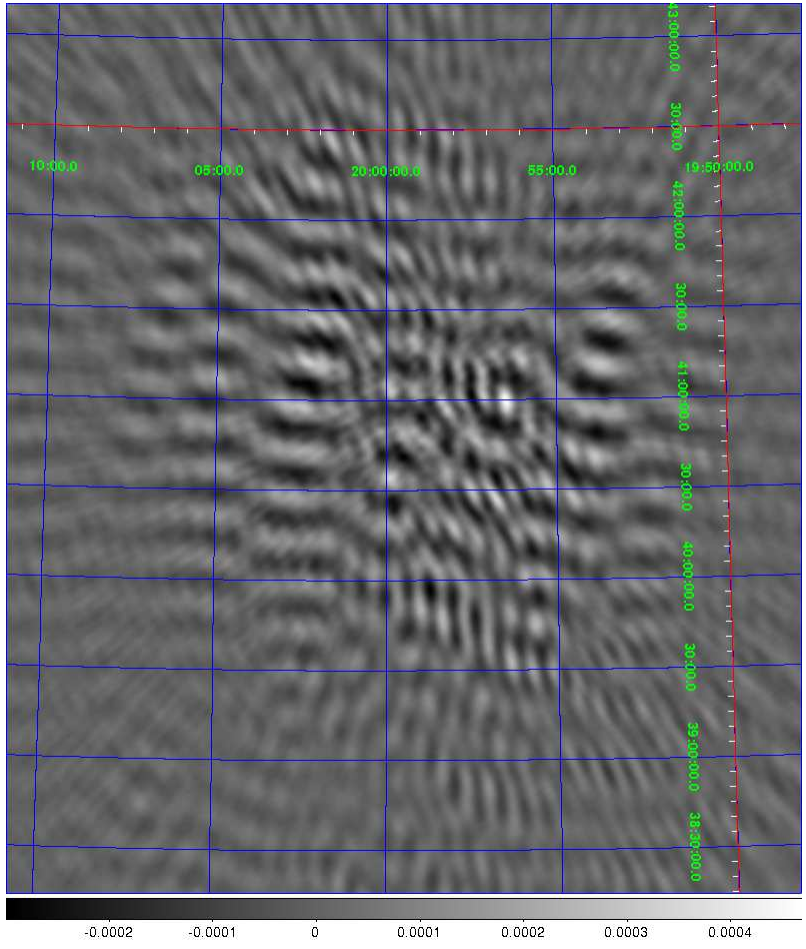
$|\mathbf{E}_\theta(\boldsymbol{\theta})|$



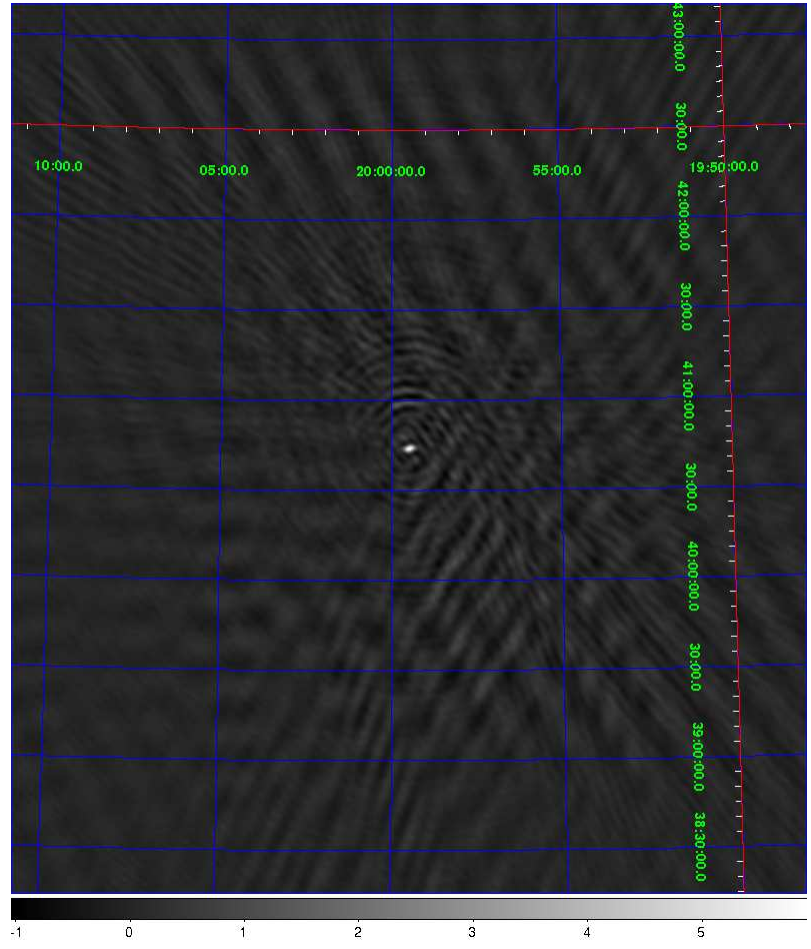
$|\mathbf{E}_\phi(\boldsymbol{\theta})|$

- Beam Team: Brentjens, Hamaker, Wineholds, Yatawatta
- All issues with LOFAR beams: Side/grating lobes, Mutual coupling, Rain,

The Clock



Raw image, CygA, 14 MHz



Calibrated image, CygA, 14 MHz

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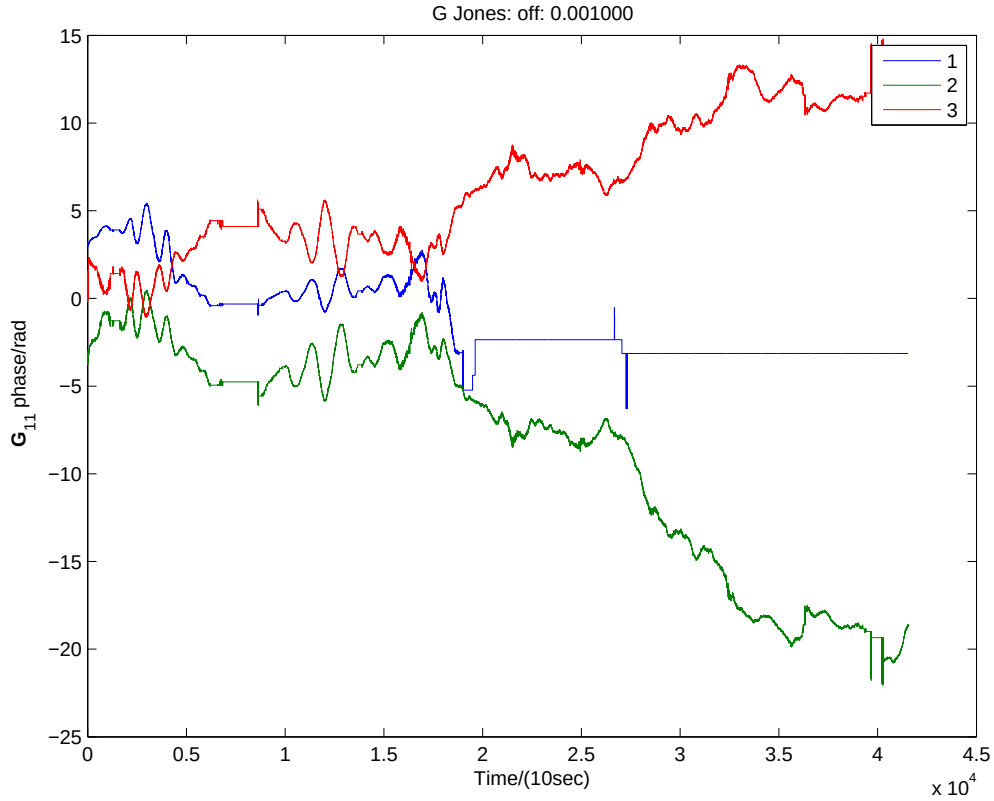
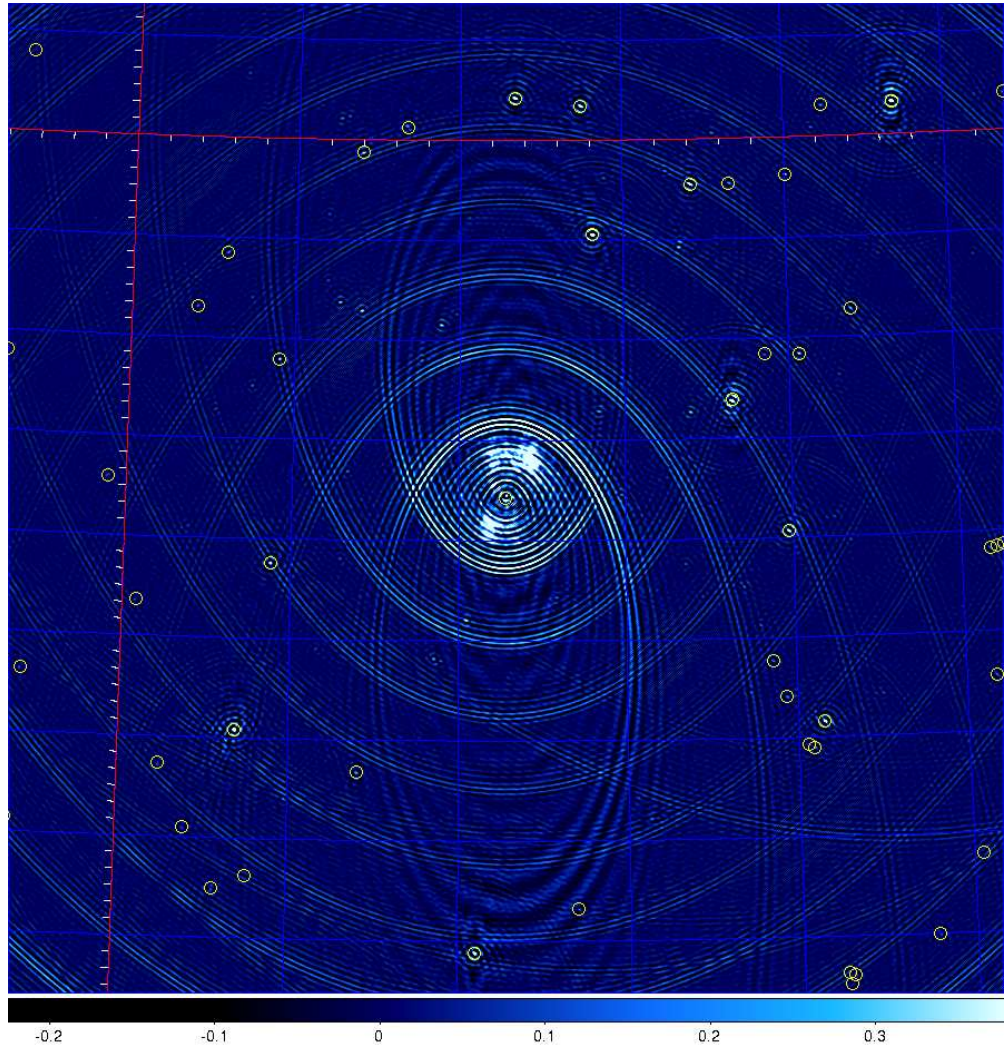
The Clock



Clock/Ionospheric phase at 170 MHz

Finally - Three baseline imaging



3C196, 150 MHz, 3 baselines

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