Max-Planck-Institut
für
Radioastronomie

LOFAR
Polarization Commissioning

Andreas Horneffer

for the LOFAR Magnetism KSP

LOFAR

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LOFAR

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- 41 Station operational
  - 24 core, 9 remote, 8 international
- 3 remote stations nearly done
  - 4 more remote stations planned
- more international stations planned

MSSS

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- Multifrequency Snapshot Sky Survey
- Goals:
  - Develop and test automated pipeline processing of images.
  - Generate a global sky model for LOFAR that can be used to start calibration of observations.
  - First LOFAR all sky survey
- LBA and HBA survey
  - a few short snapshots of each field
- MSSS “army”
  - 44 commissioners from all KSPs
  - MKSP well represented

MSSS Sensitivity

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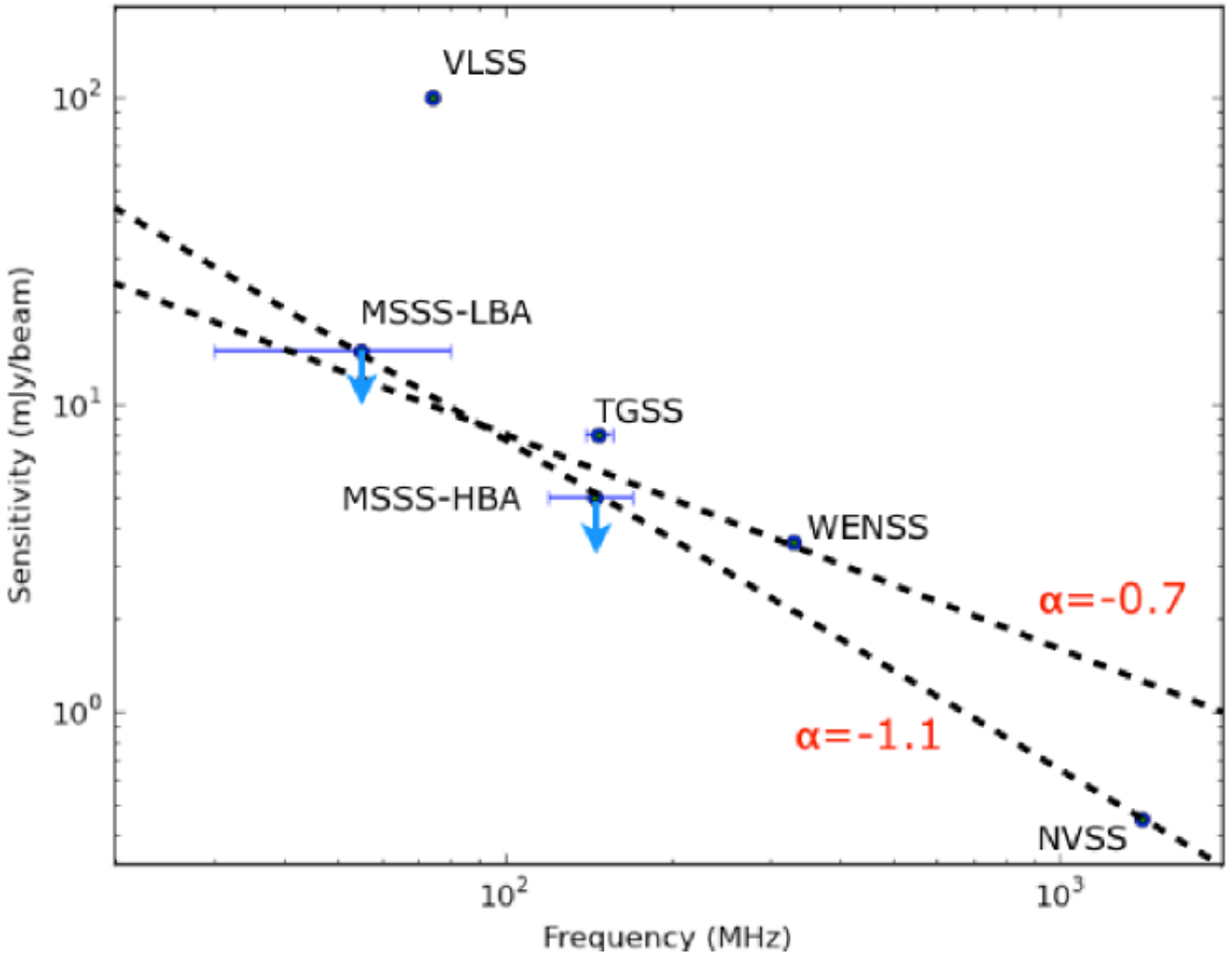

MSSS LBA

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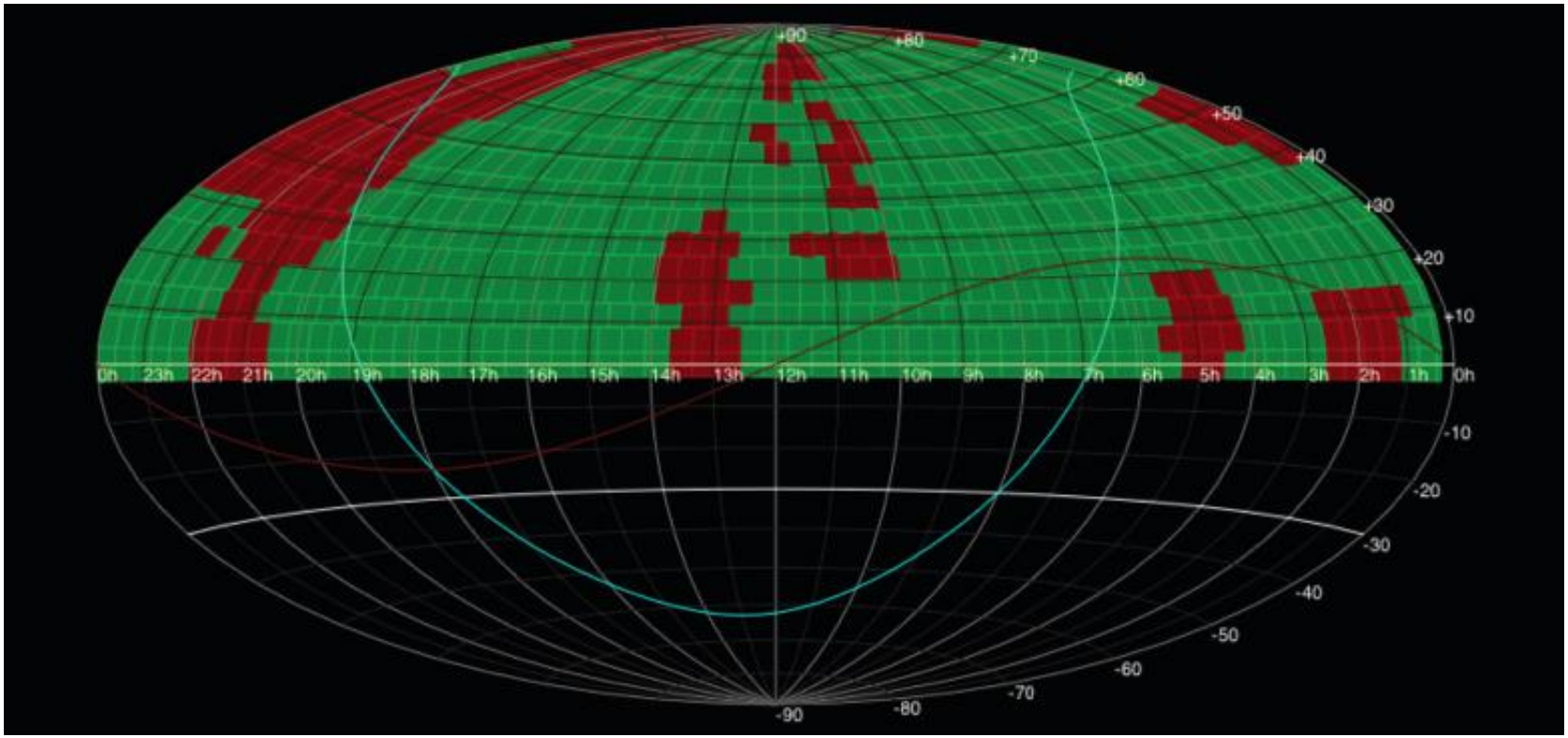

- 78% of LBA survey observed
  - currently stalled due to storage and processing backlog

MSSS Image

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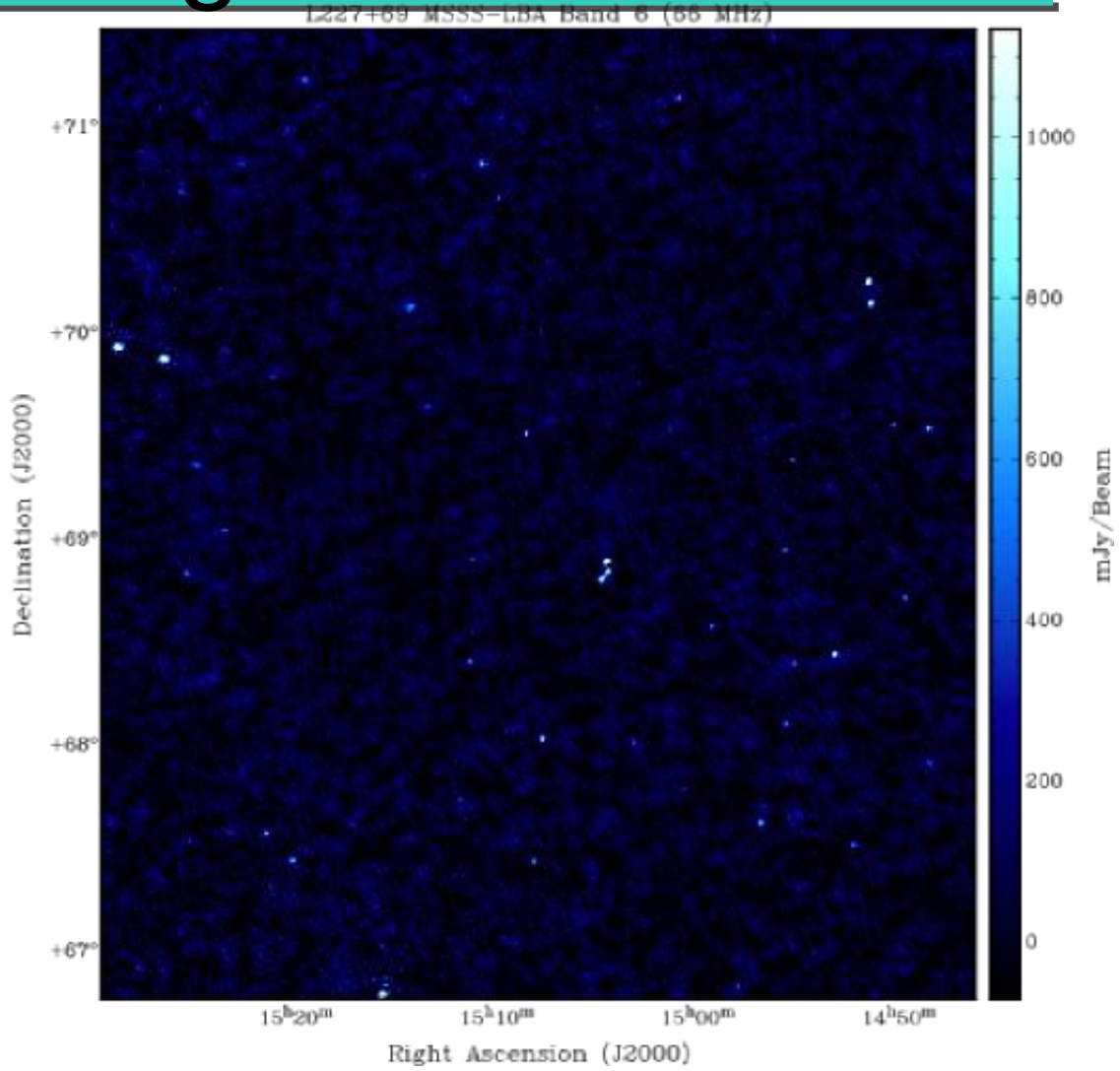
- L227+69 field
- 2 MHz Bandwidth
- 85 mJy/beam noise
- 70” resolution



Polarization and MKSP Results

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- Pulsar in imaging
- Pulsars
- Fan region
- Double Double B1835+620
- Galaxies

PSR J0218+42
Detected in Polarization

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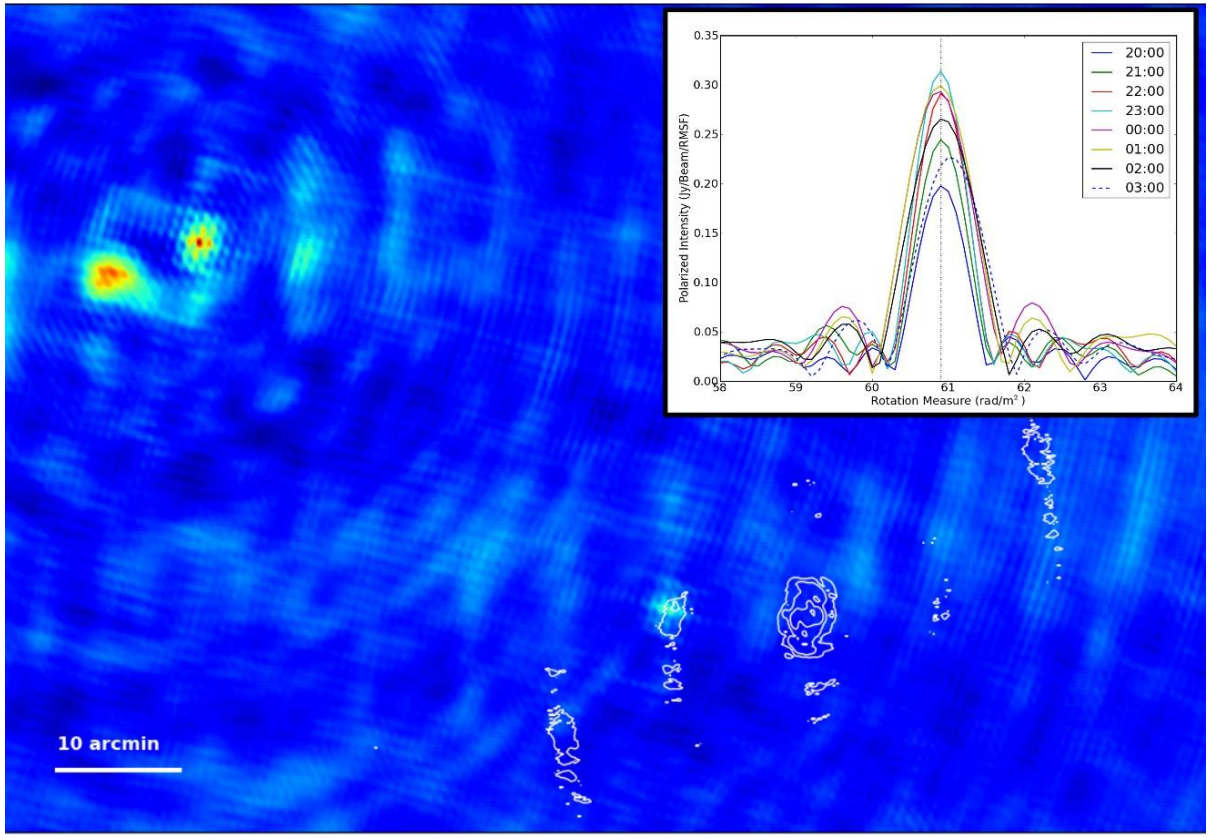

M.Bell

- Astron daily image 16. March 2011

Results: PSR B1929+10

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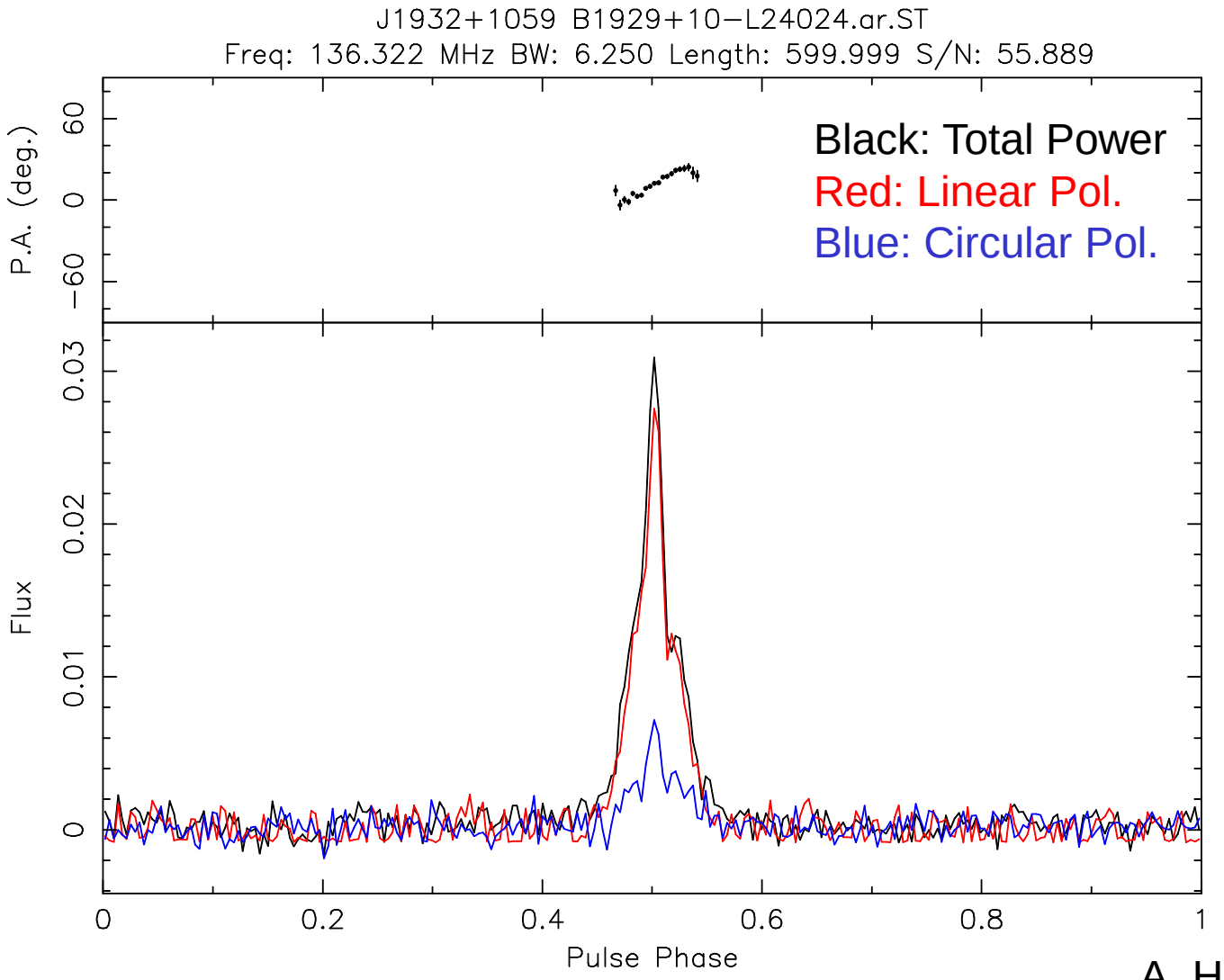

Fan Region

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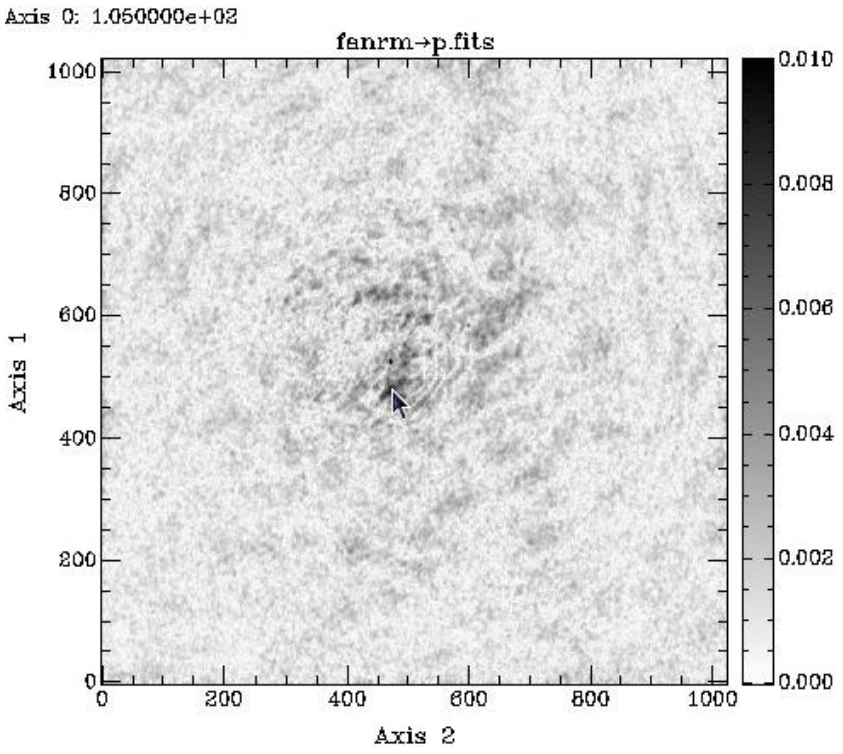
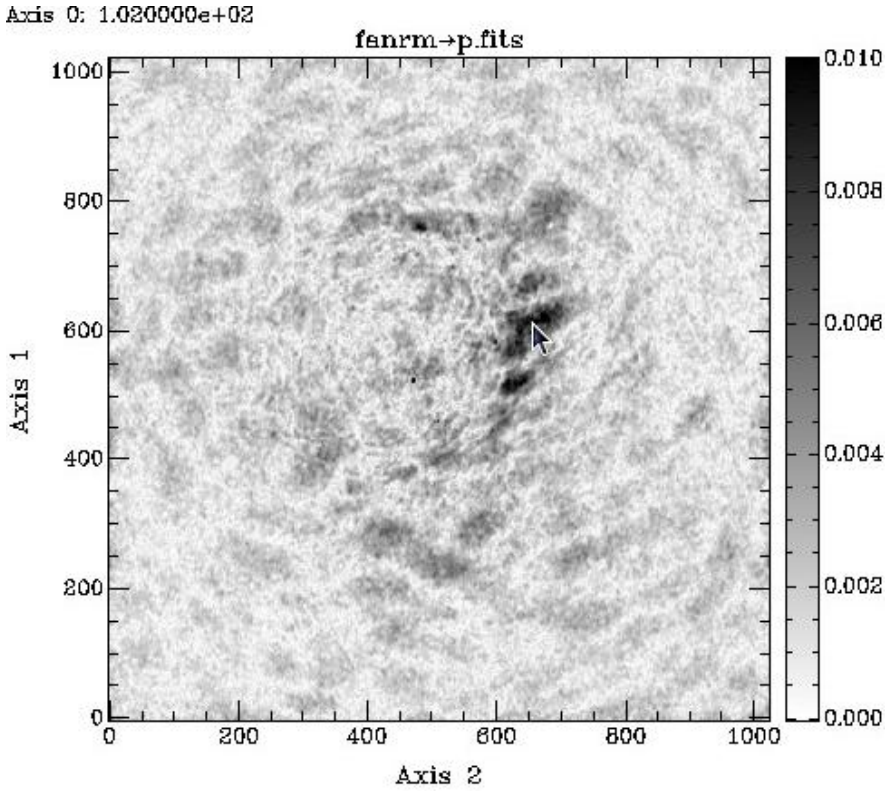
FD = -5 rad/m/m



FD = -2 rad/m/m



Fan Region: WSRT Results

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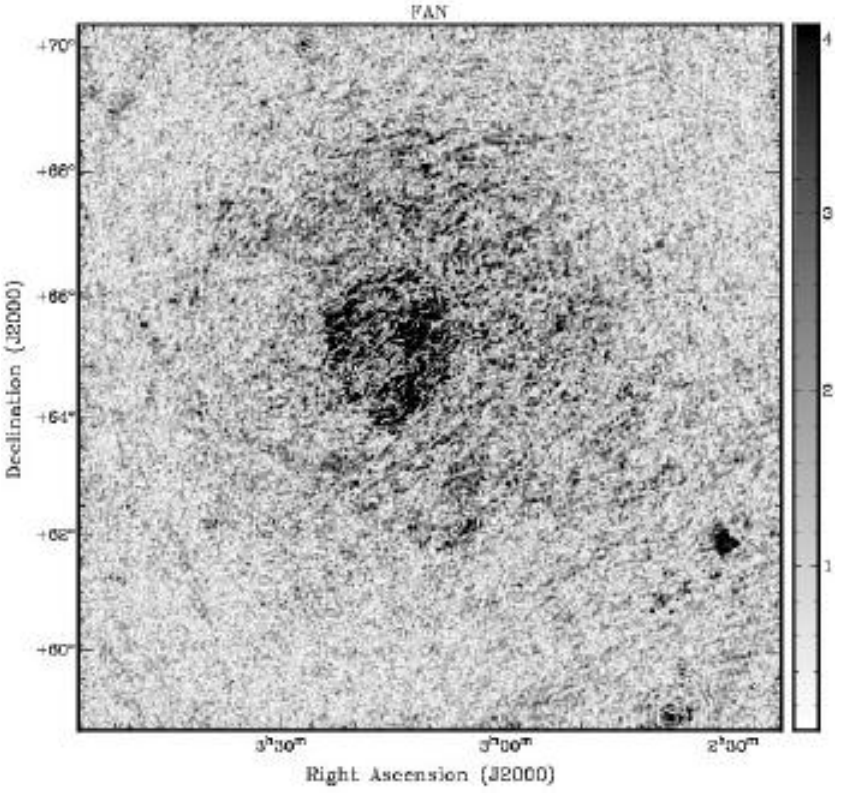
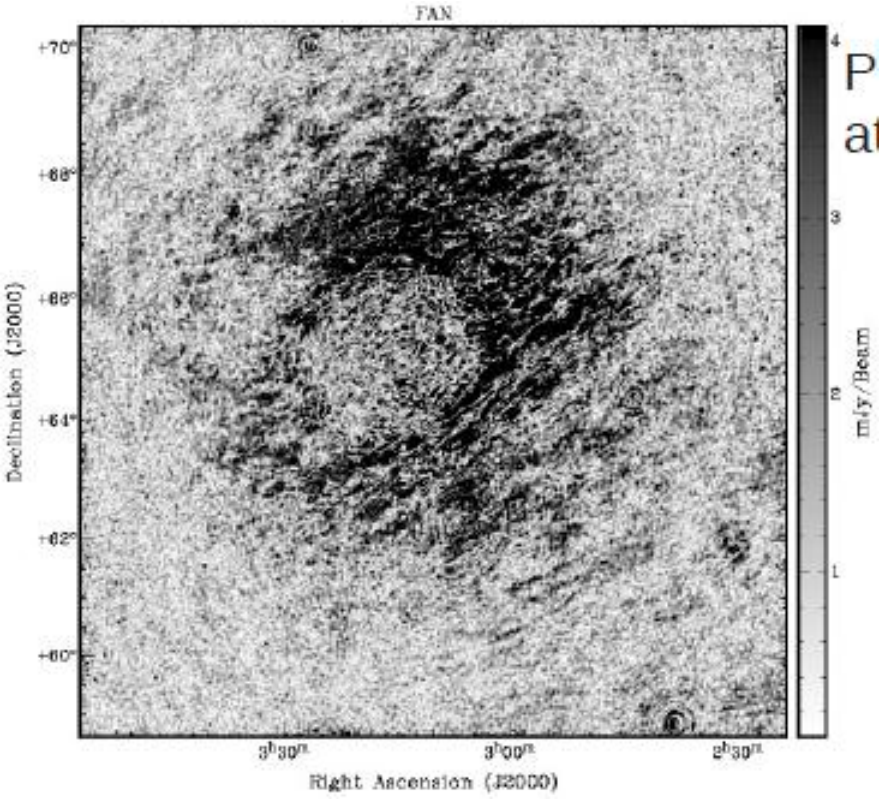
FD = -6 rad/m/m



FD = -2 rad/m/m



Double Double B1835+620

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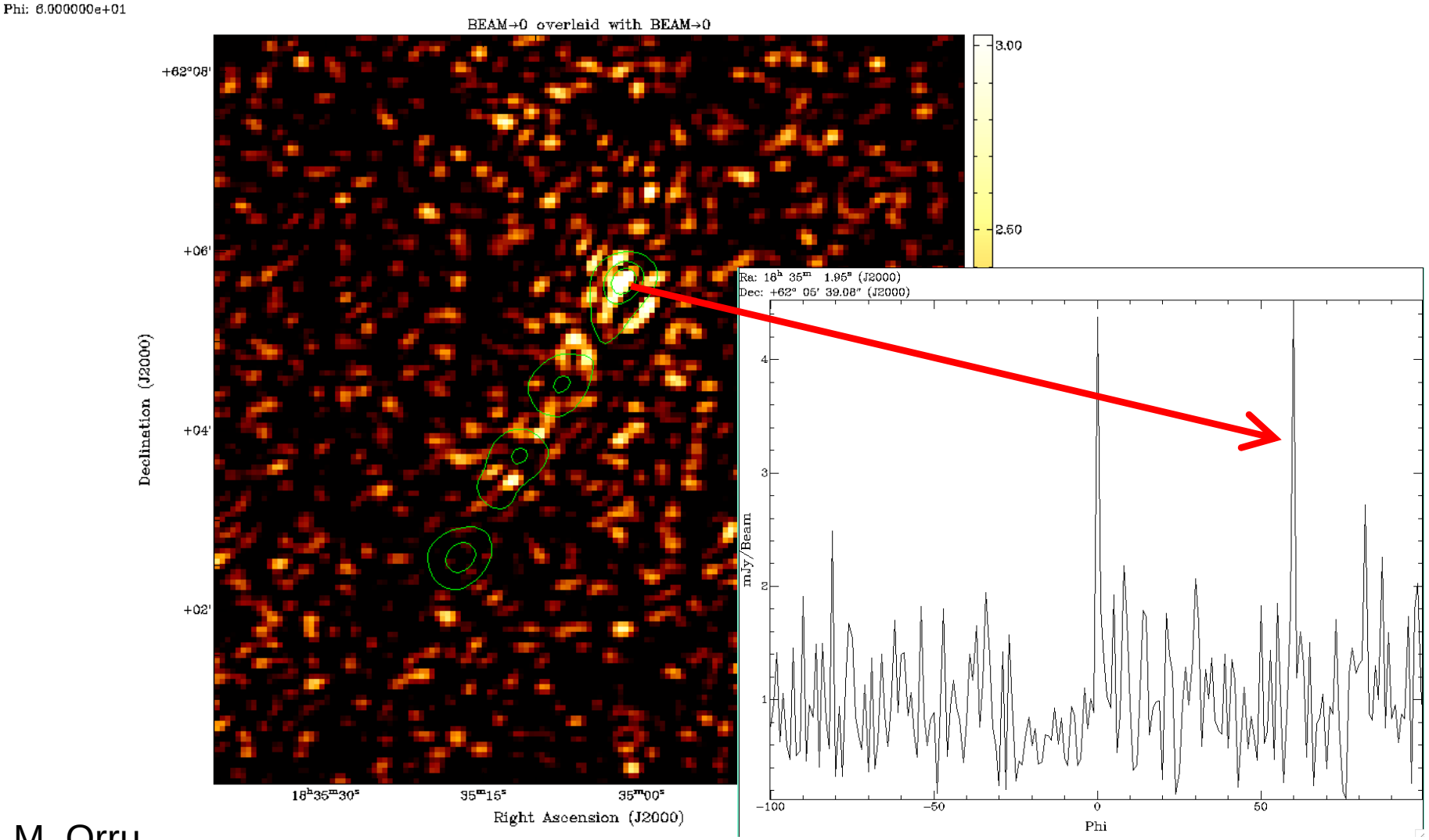

NGC 4631
Map from 77 SBs

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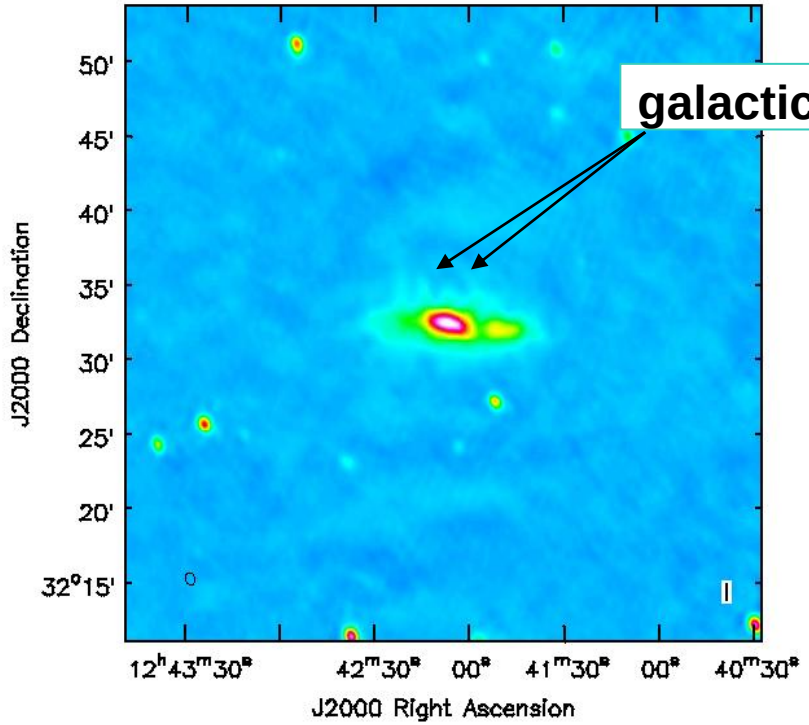

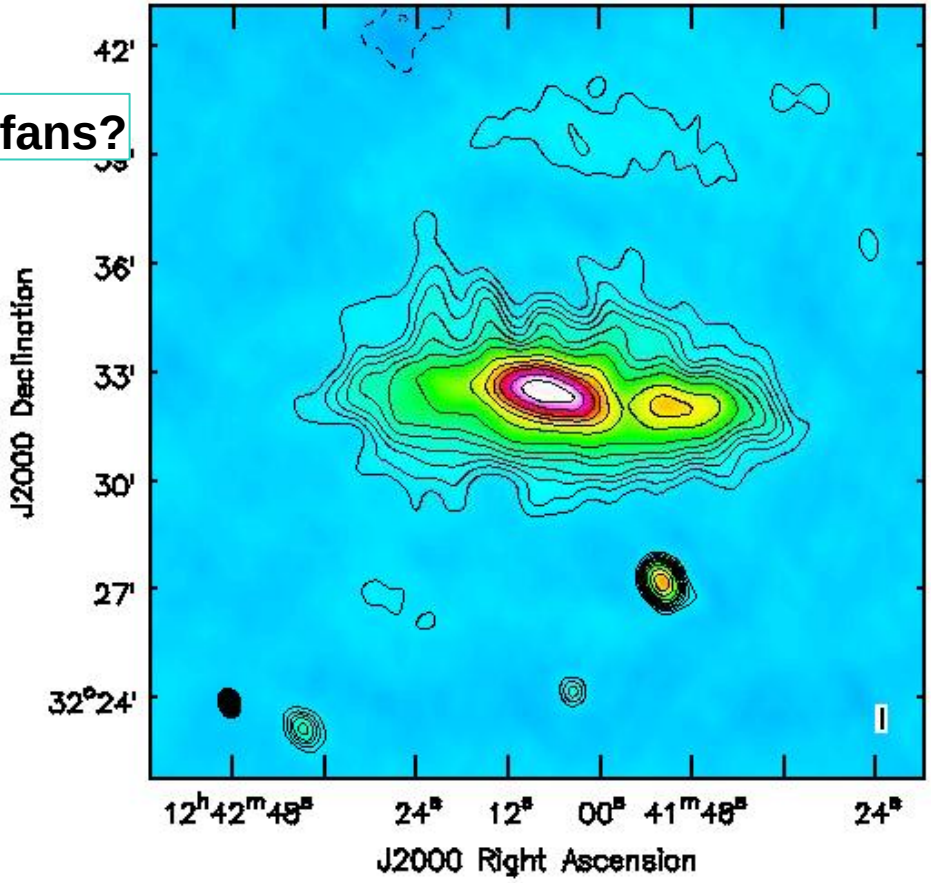

Beam = 51x37''
Weighting:
Briggs robust 0,
uvtaper 20 ''

Lev: 2 x(-3, 3, 5 ,7, 9, 13, 15 ,20, 30, 40, 50, 60, 80, 100) mJy/beam

M51
New Observation

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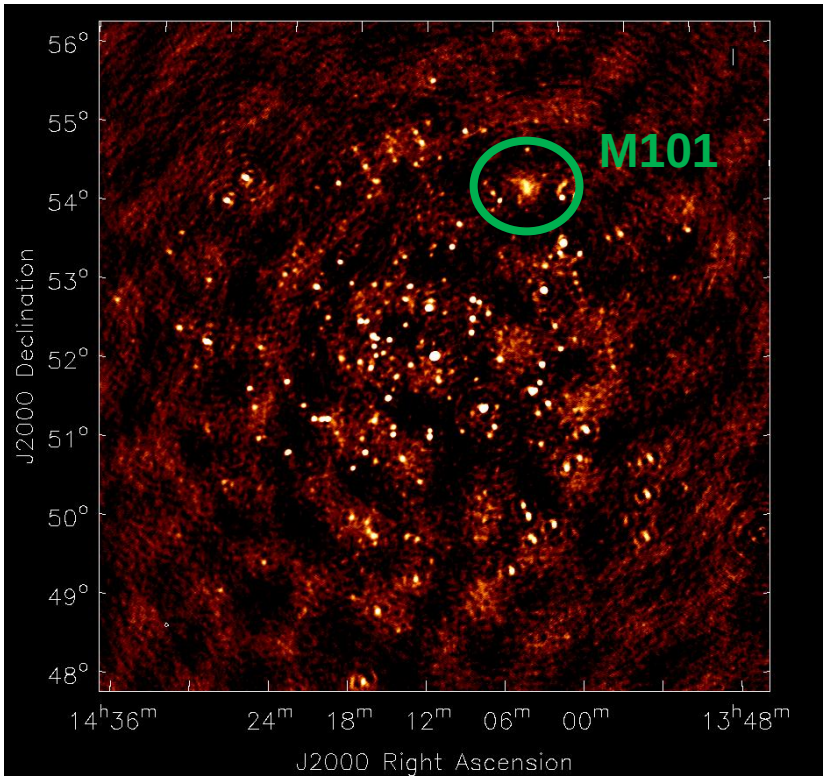
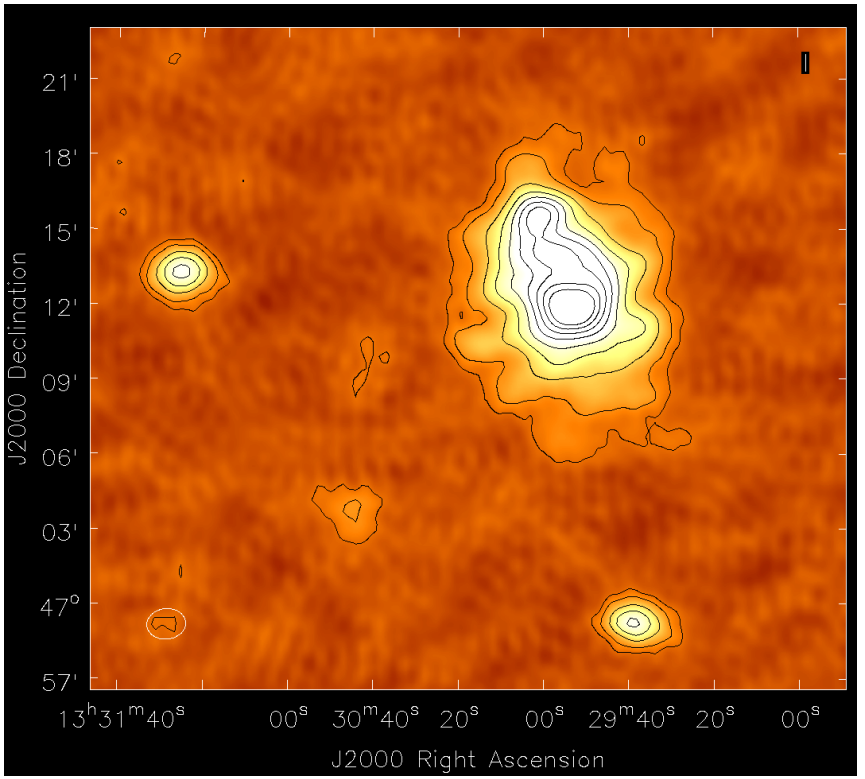
3C295 field



M51 closeup



- New observation: M51 with 3C295 as calibrator
- Test calibration interpolation and study M51

Open Issues

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List of Milestones:

1. Good total power images
2. Long integrations of polarization
   - Multi-hour observations
3. RM Cubes with absolute FD
   - Multi-Epoch observations
4. High Resolution in FD
5. Low instrumental Polarization
6. High angular resolution

Milestone 0: Normal Imaging

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- Need to calibrate data:
  - Station clocks
  - Ionospheric delay
  - Station gains (incl. dipole gains)
- Selfcal needs good model of the sky to work
  - Have a good sky model from e.g. MSSS
  - Transfer solutions from a second beam on a calibrator.
- Demixing, sagecal, BBS **must not** corrupt polarization information.

5 ns Problem

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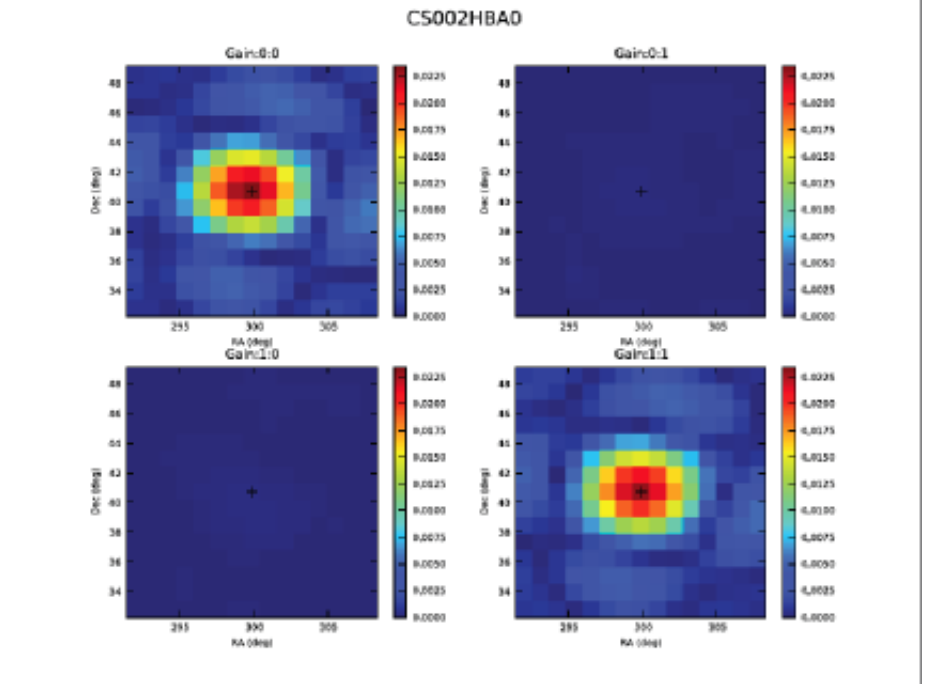

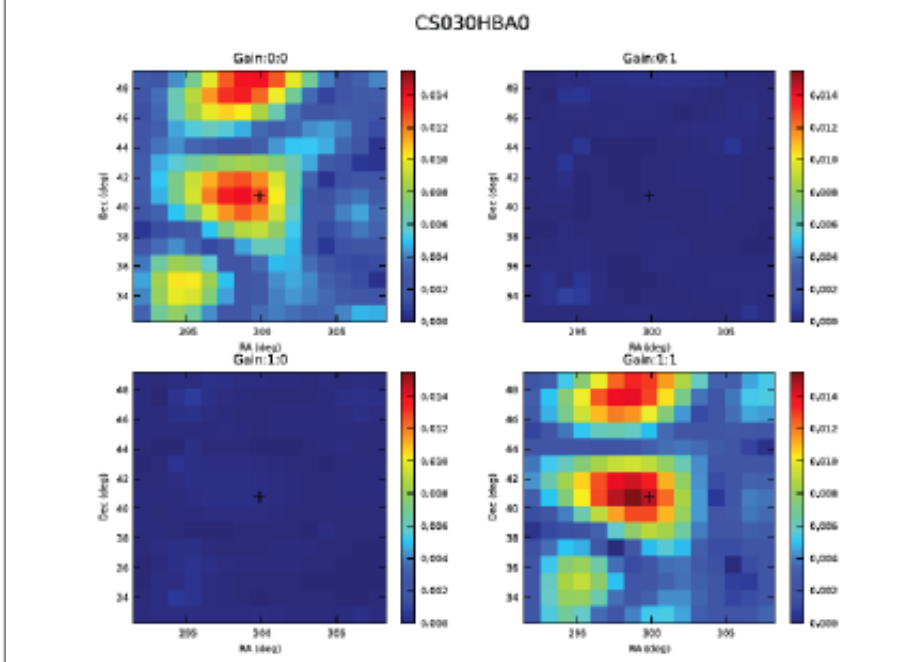

- A problem in the station electronics can lead to parts of the station being 5ns off.
- This changes the station beam
- New module to fix this is in production

Gain Interpolation
Interpolation Methods

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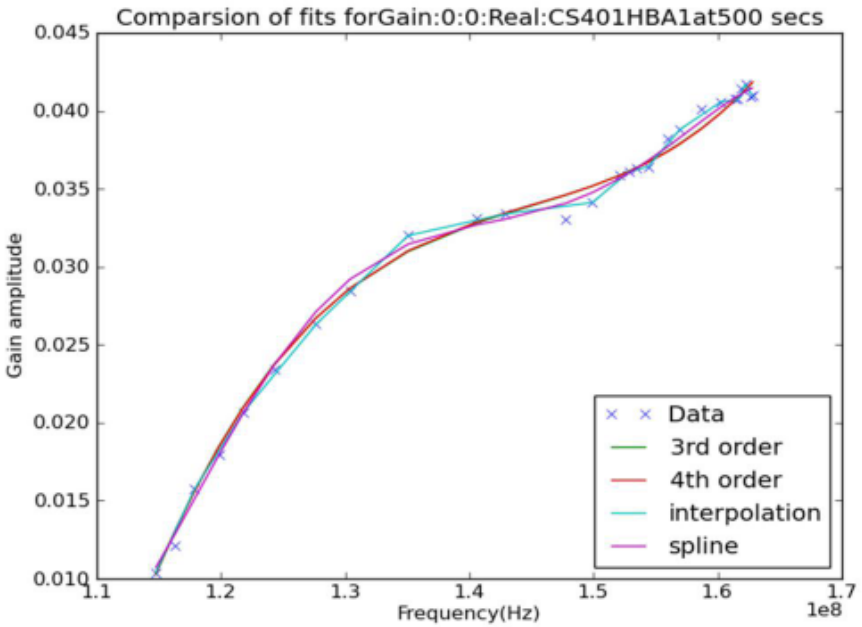

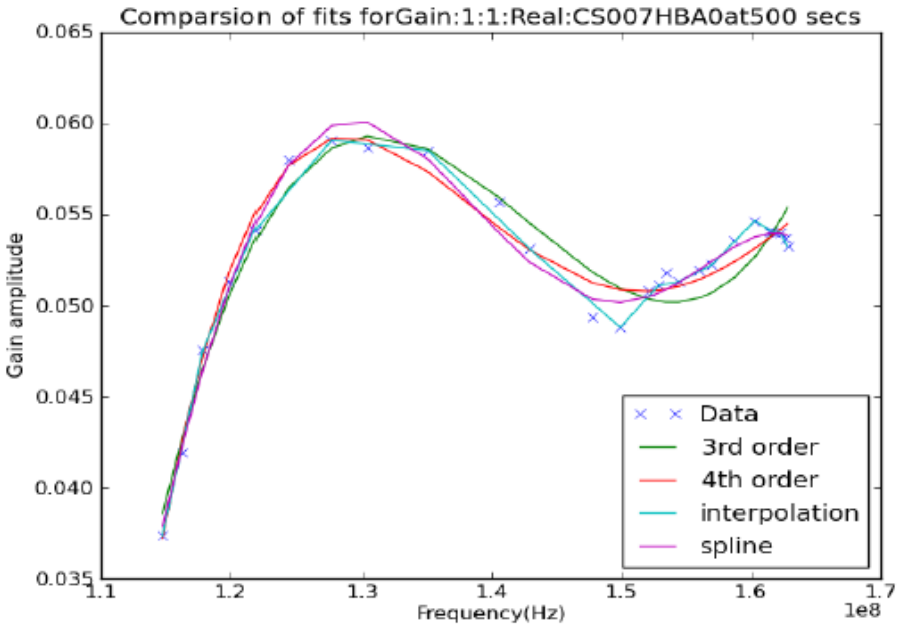

Milestone 1: Long Integrations

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- Needs Conversion between visibilities and Stokes parameters done correctly
  - correct beam model
- Needs the ability to correct for **changes** in the ionospheric RM
  - calibrate on pulsars or with GPS based corrections
- Need list of calibrators

Beam Model Test
3C295 Data

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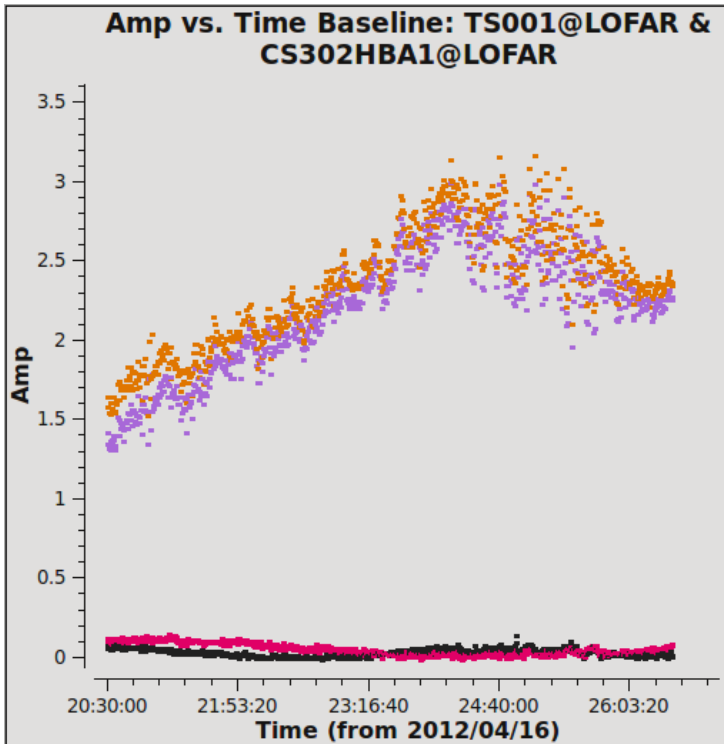
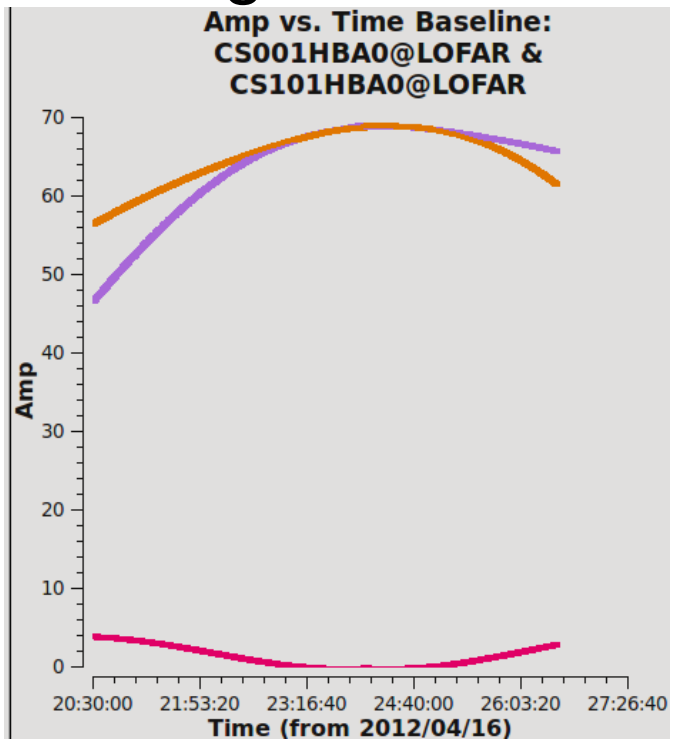
Left: data



Right: simulation



- The LOFAR beam model is needed for two steps:
  - to compute the station beam, e.g. for calibration transfer or source subtraction
  - to convert from Stokes parameters to visibilities or vice versa

Pulsars and Ionospheric RM from GPS data

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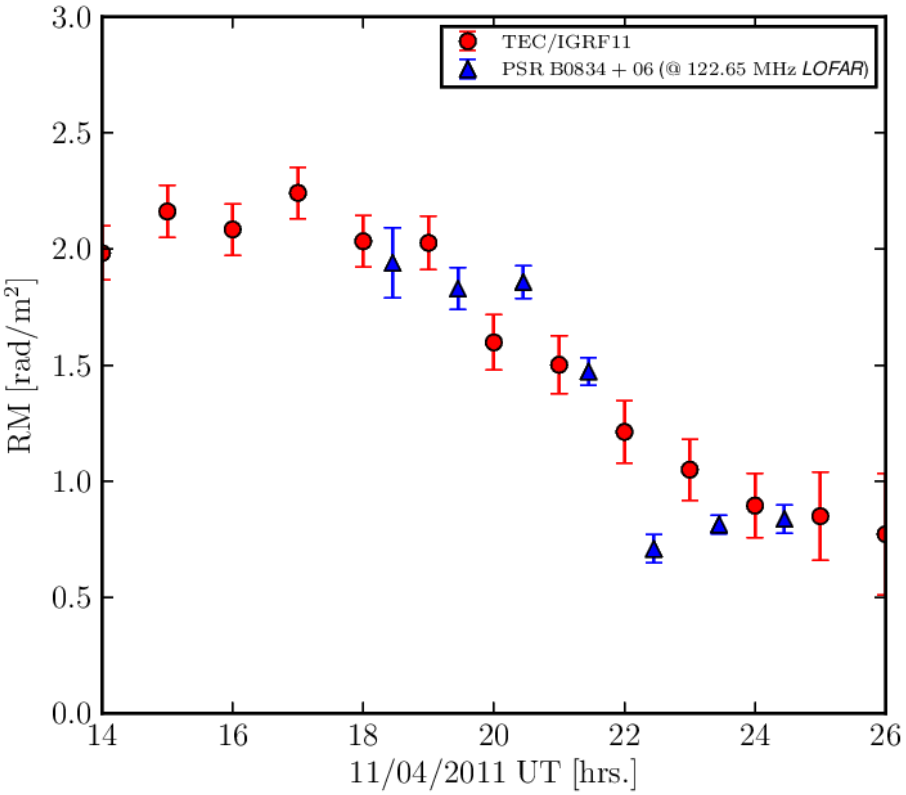

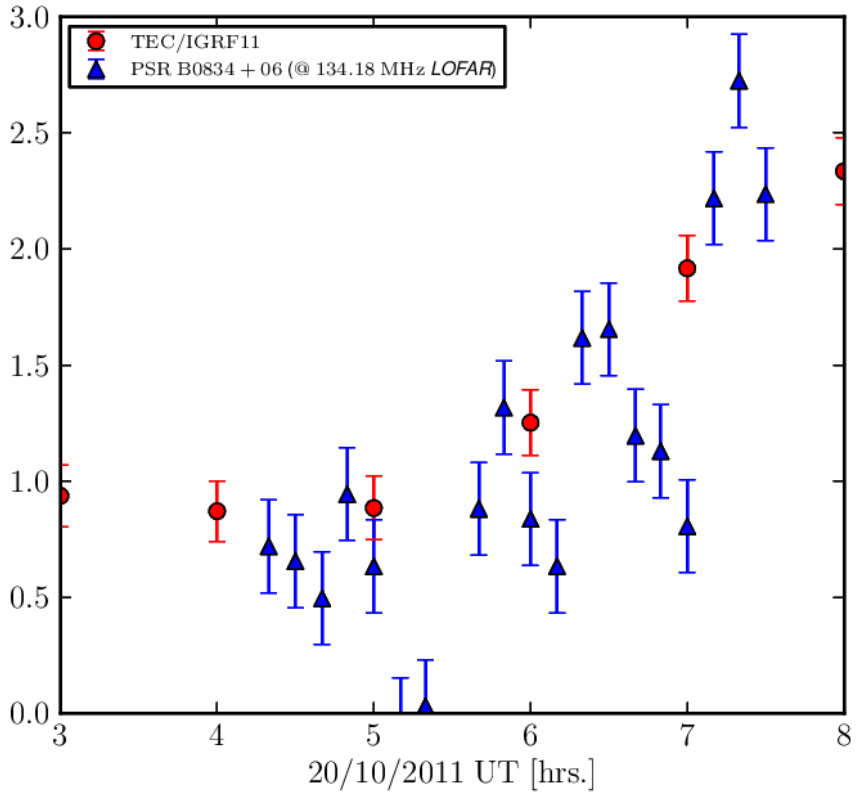

- Comparison of Ionospheric RM prediction (red) and pulsar data (blue).
- Still needs to be included into calibration.

Milestone 2:
RM Cubes with absolute FD

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- Needed for multi-epoch observations
- Needs at least one calibrator with known absolute RM
  - Get it from studies of measured RM and e.g. ionospheric RM from GPS
  - Connect the position angle of a source (a blazar?) to higher frequencies.
  - “Assign” a RM to a calibrator and use it as reference
- Propagate absolute RM to all calibrators

Milestone 3: High Resolution in FD

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- Needs wide frequency coverage
  - 8-bite mode?
  - multi-epoch observations
- Use the low-band?

Milestone 4:
Low Instrumental Polarization

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- Good understanding of the instrument

Milestone 5: High Angular Resolution

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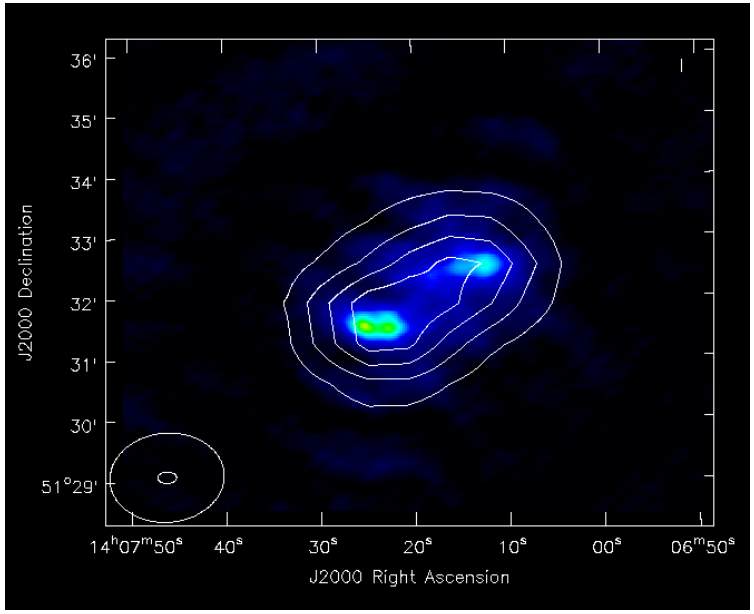
- Needs us able to deal with long baselines.
- Made a start at the long-baseline BW



Random source in 3C295 field.

Contours: baselines < 6km, Colors: all Dutch baselines

The End!

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