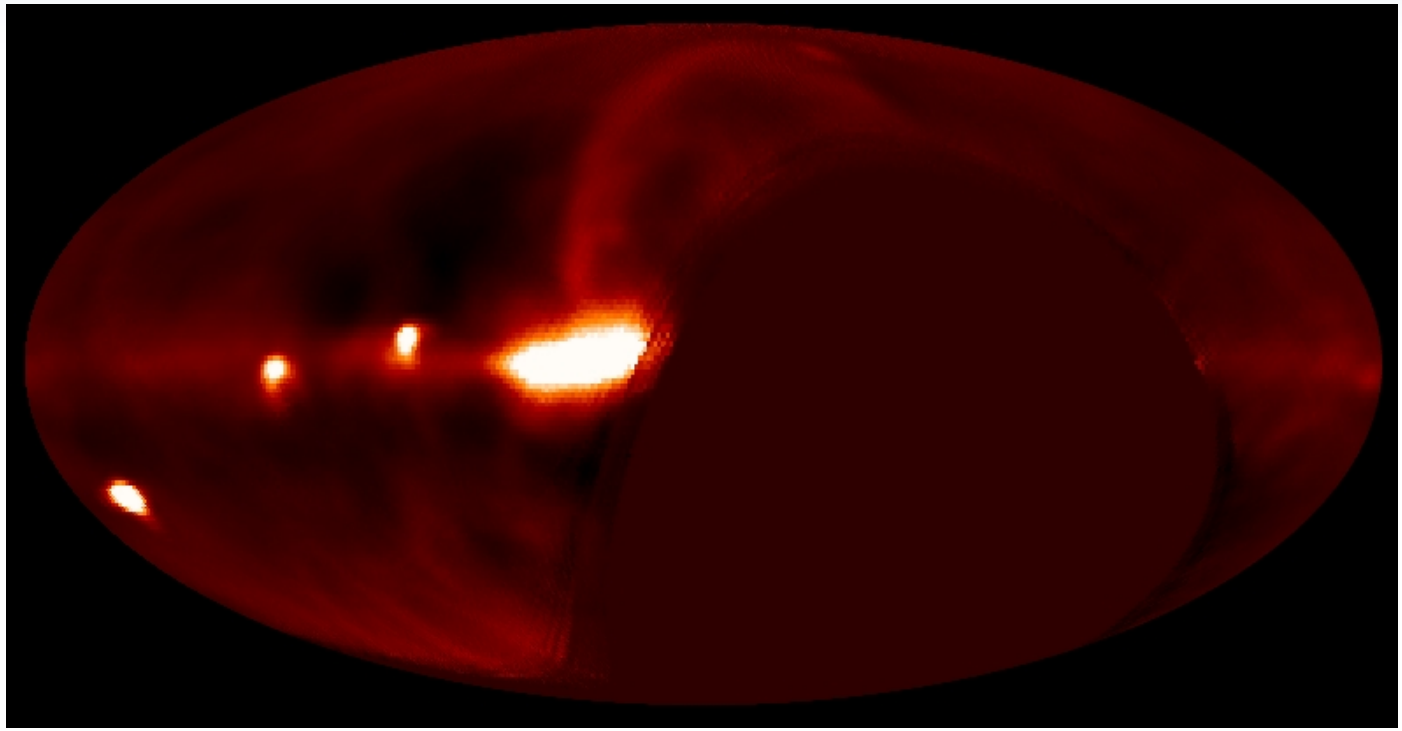
All-sky Polarization Imaging using TBB-Data (LC0_044; ELG2013_000)

Jana Köhler (MPIfR)



Max-Planck-Institut für Radioastronomie

IMPRS astronomy & astrophysics Bonn and Cologne

Main Aim of the Project

- map of the large scale total and polarized intensity of the entire Northern Sky at low frequencies
- using RM Synthesis for measuring the polarized emission
- having a closer look at the polarization properties of the Milky Way

→ especially polarization properties of the cosmic rays in the disk and halo

→ studying the structure of Milky Way ISM and turbulences

Reaching the goal

for RM Synthesis small channels are needed to avoid bandwidth depolarization

→ using LOFAR TBB data (raw voltages)

strong RFI

→ using own code with self-calibration

Calibration of the Ionosphere

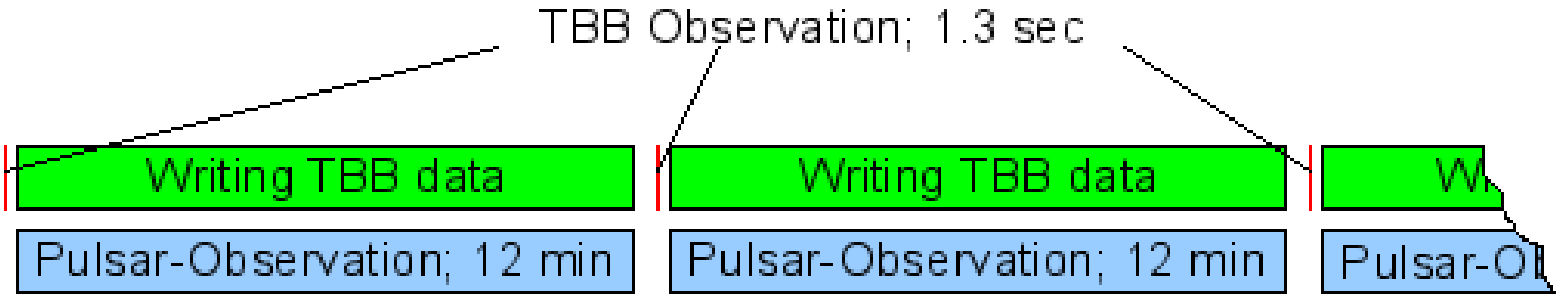
→ using simultaneous pulsar observations + code from Sotomayor et al.

Instrumental Polarization

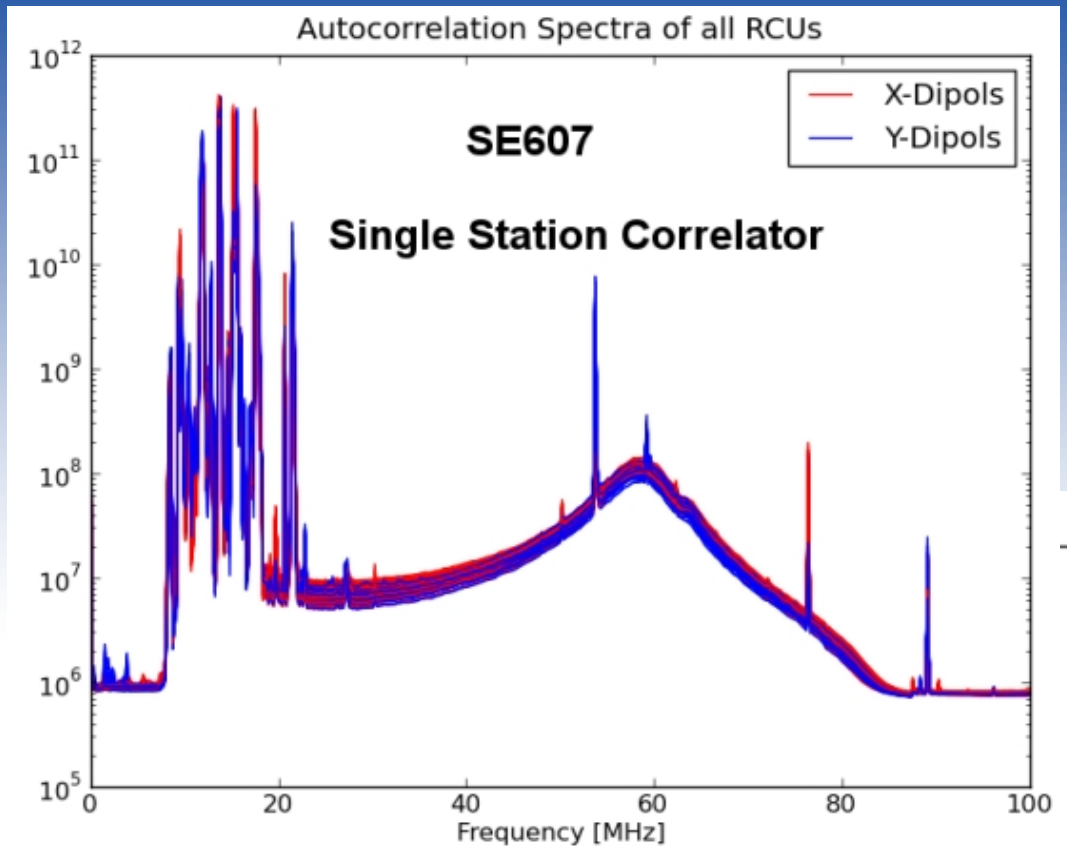
→ using 24 hour observation to create a dipole beam model

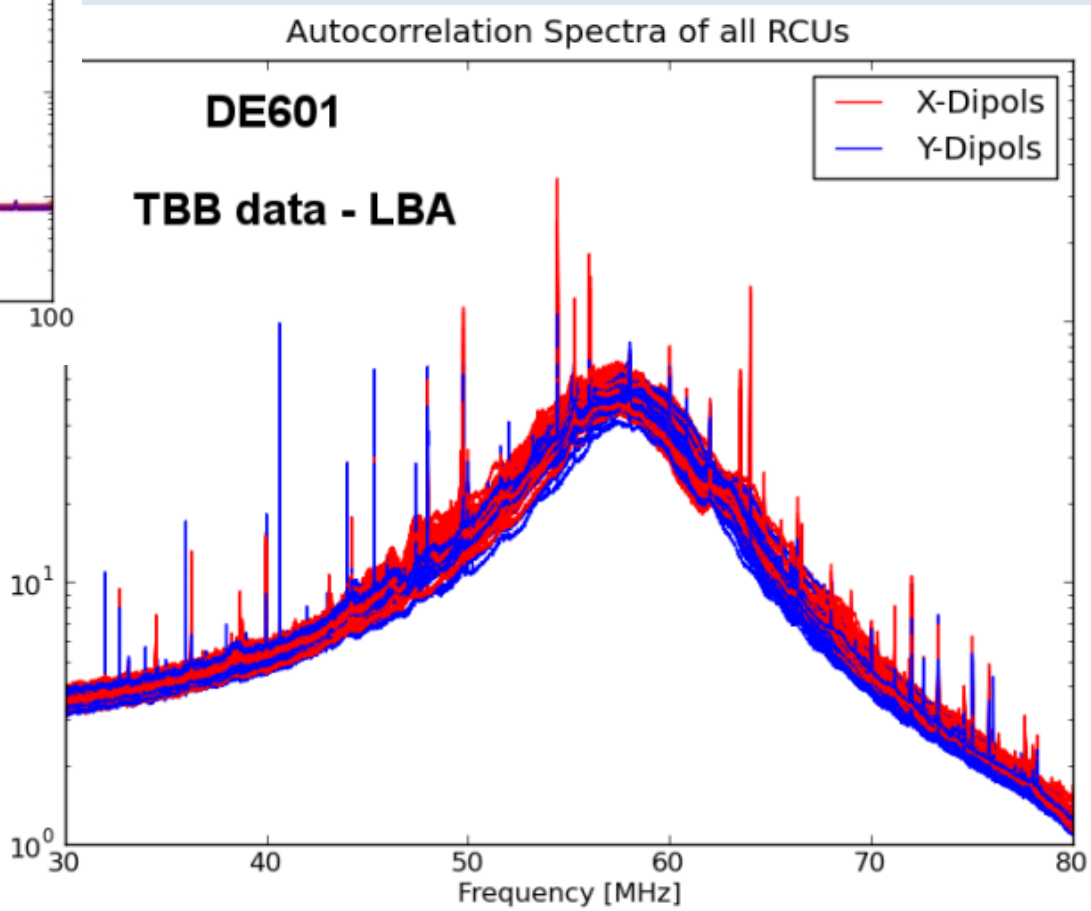
Cycle 0 Observations - LC0_044

- received 288 hours Single Station time with Effelsberg (12 x 24 hours)
- observations are performed every second week
- measurements are done every 15 min
- observations are be done in all RCU modes
- already 6 observations runs done



RFI in LBA

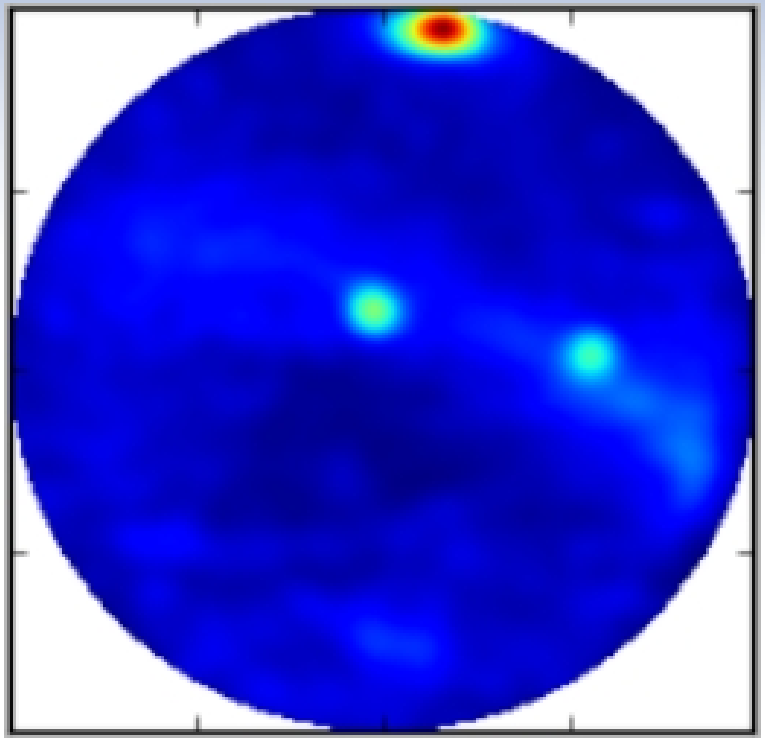




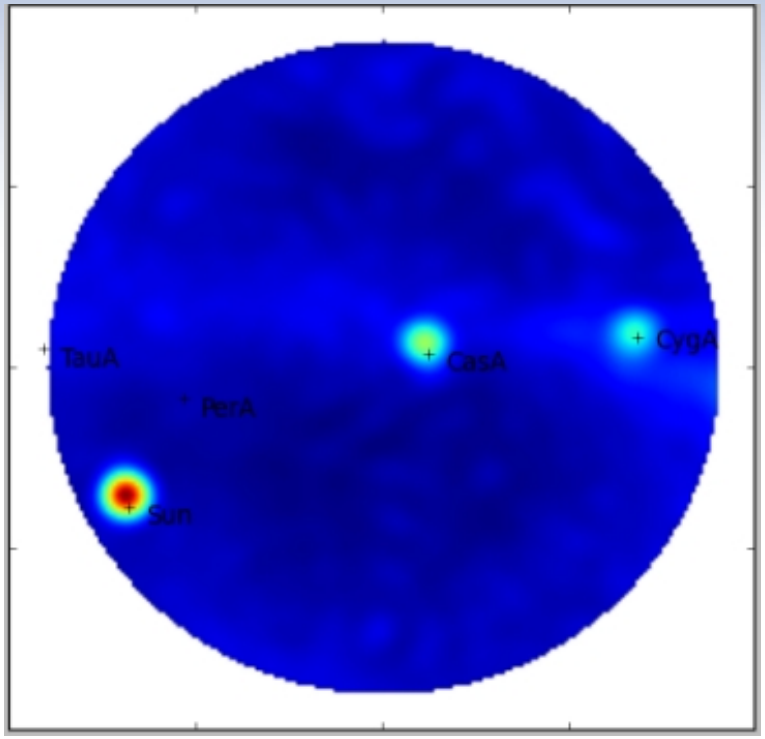
RFI situation in Effelsberg is worse than (most of) the other stations

Need for Selfcal !

for the calibration good models are needed!
→ not possible for RFI, active Sun or Jupiter ...

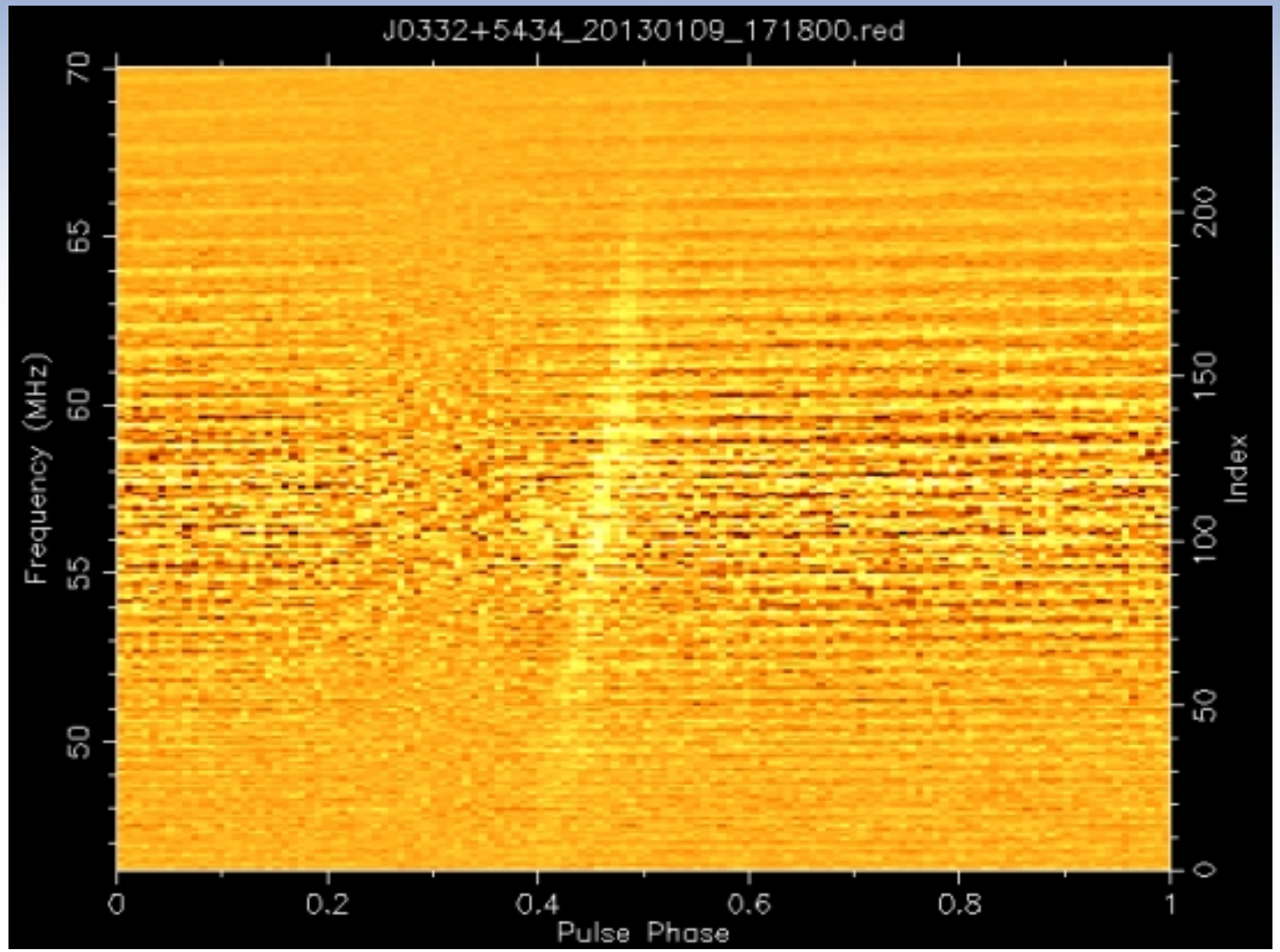


strong RFI from the direction of the 100m telescope (Effelsberg)



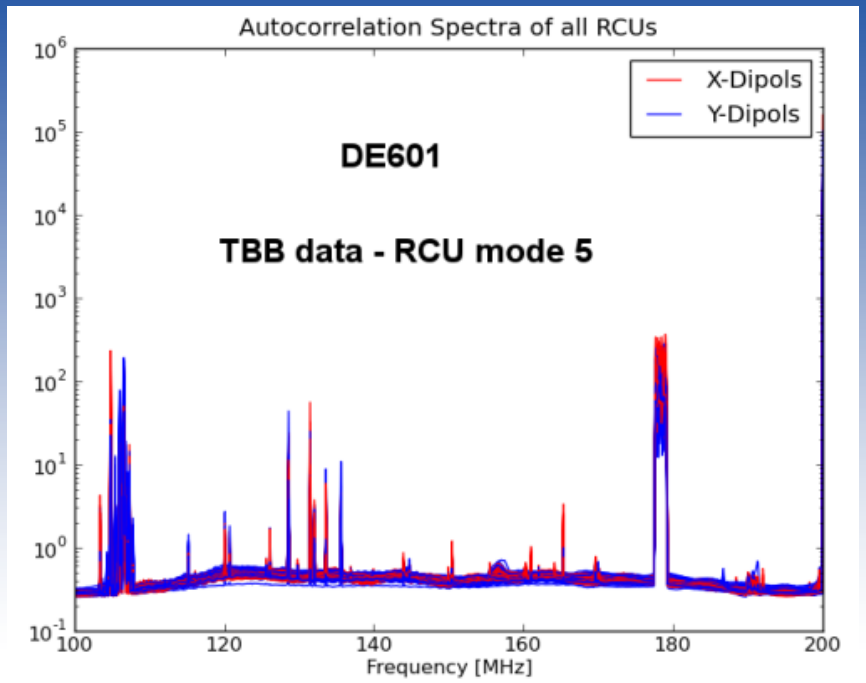
active sun at 51 MHz

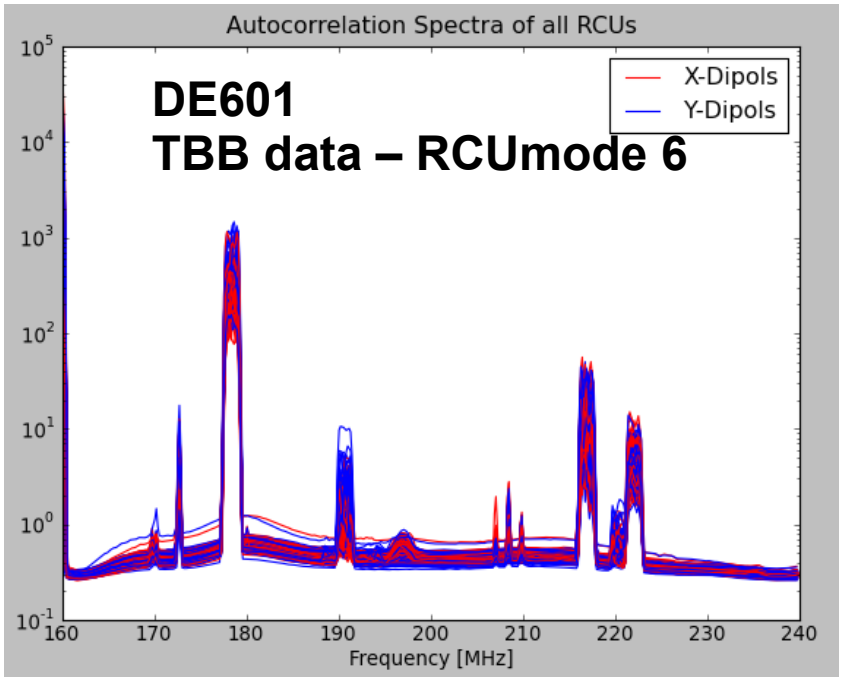
RFI in LBA – pulsar data

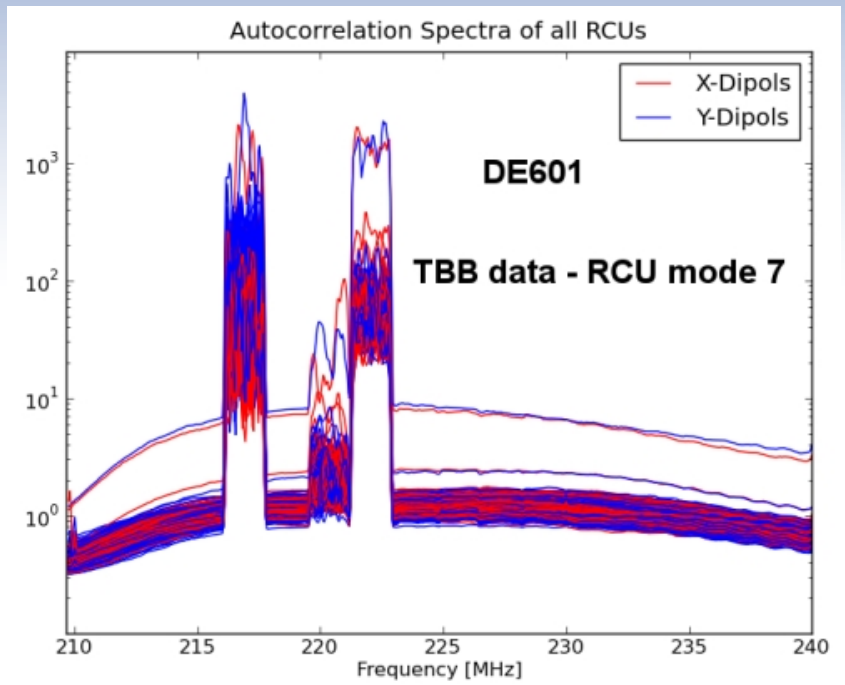


too much RFI in LBA (Effelsberg) to reduce pulsar data in a good way
→ all pulsar observations will be done in HBA

HBA spectra

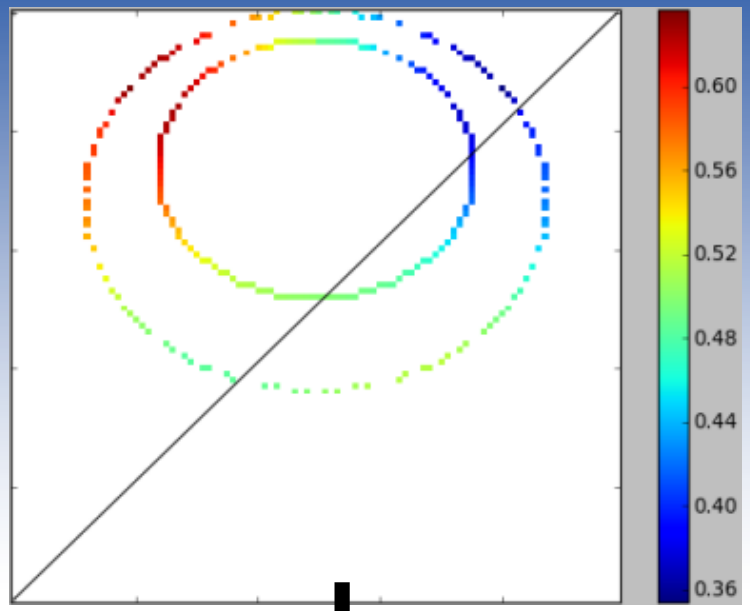






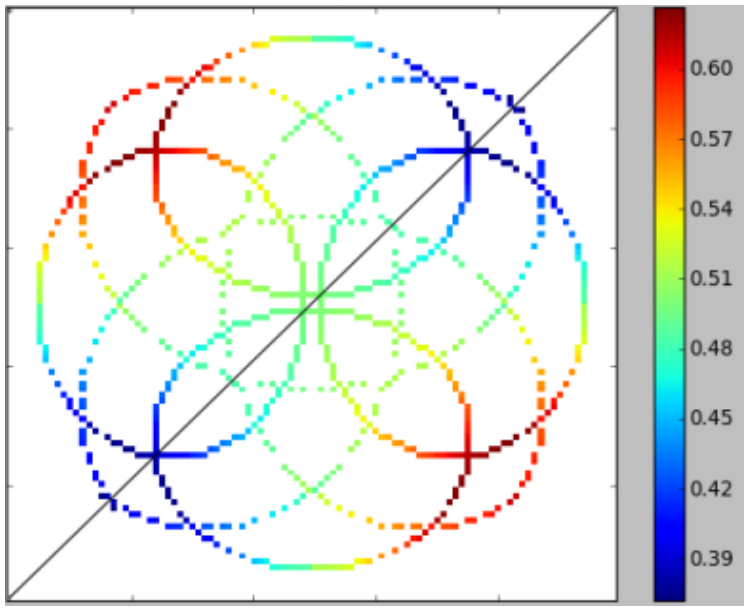
TBB Correlation code works for all RCU modes

Creating a beam model

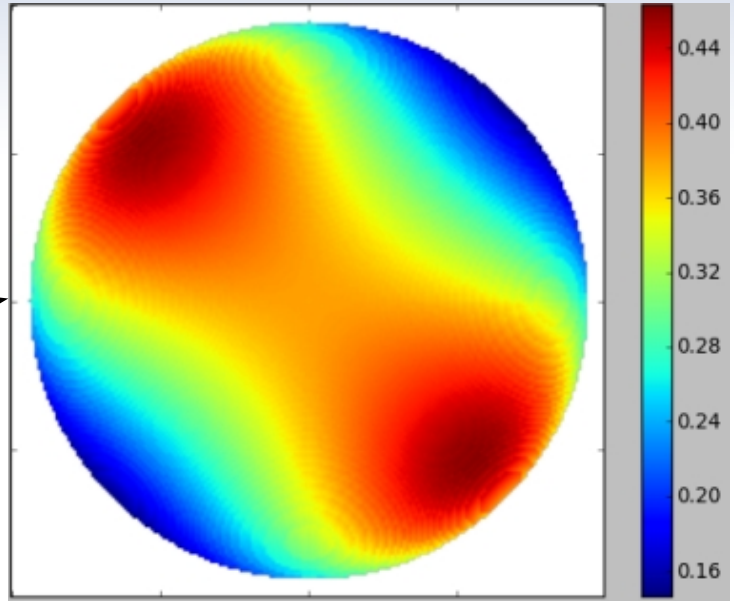


24 h observation
of CasA & CygA

@ 50 MHz



?

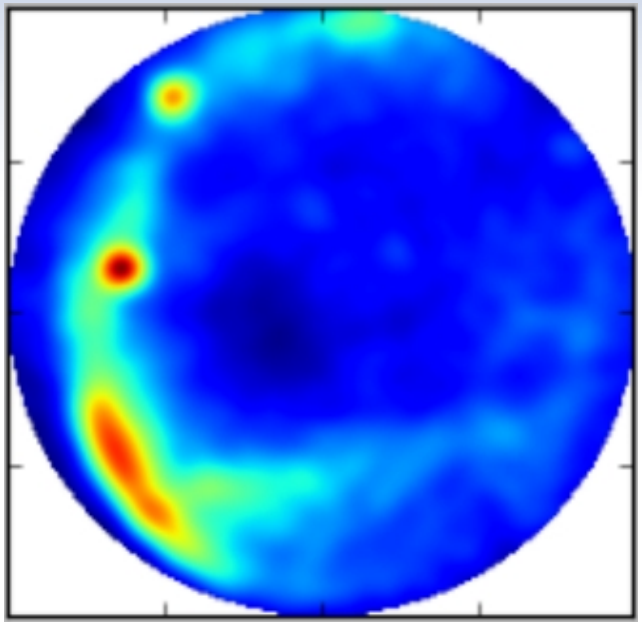


using
symmetry
to fill the map

code from Tobia Carrozi
(EM-Simulations)

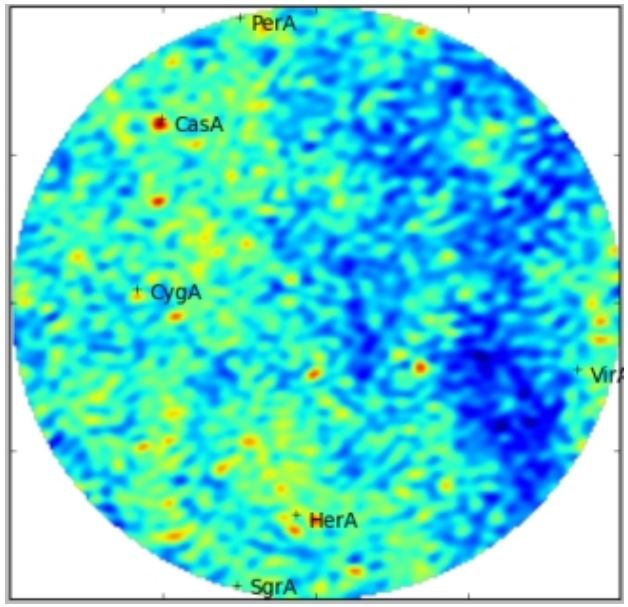
First results – Stokes I
LBA & HBA

TBB data – 1.3 sec
44 MHz - 5 kHz channel

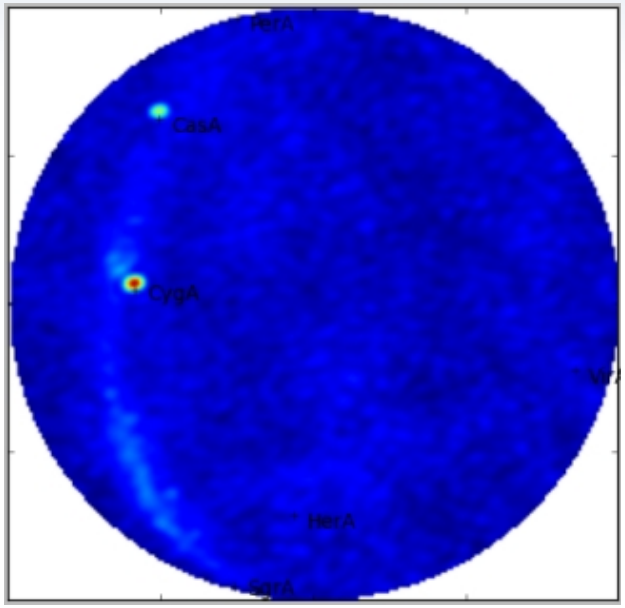


calibrated

TBB - 1.3 sec
120 MHz – 50 kHz channel



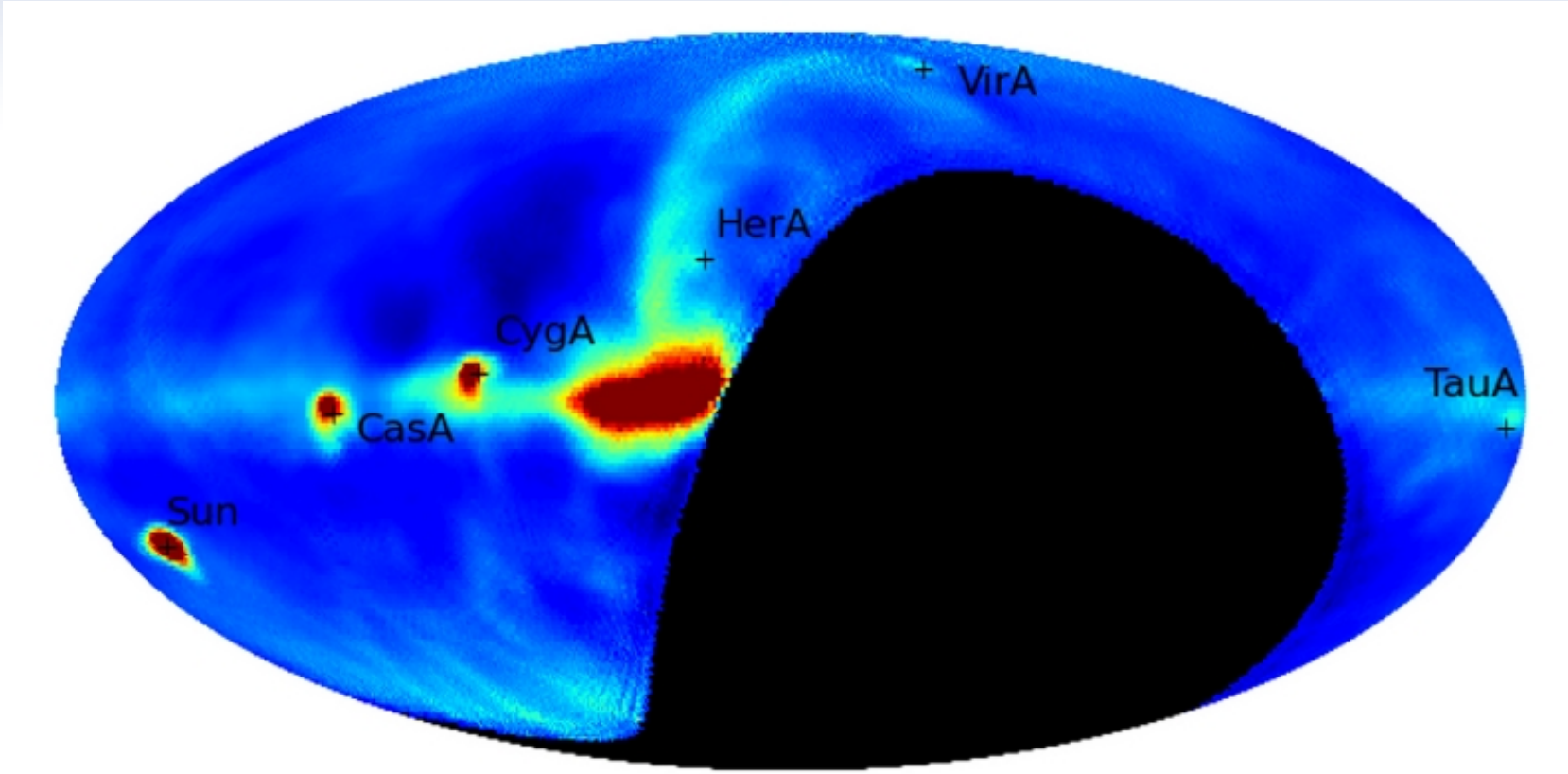
uncalibrated



calibrated

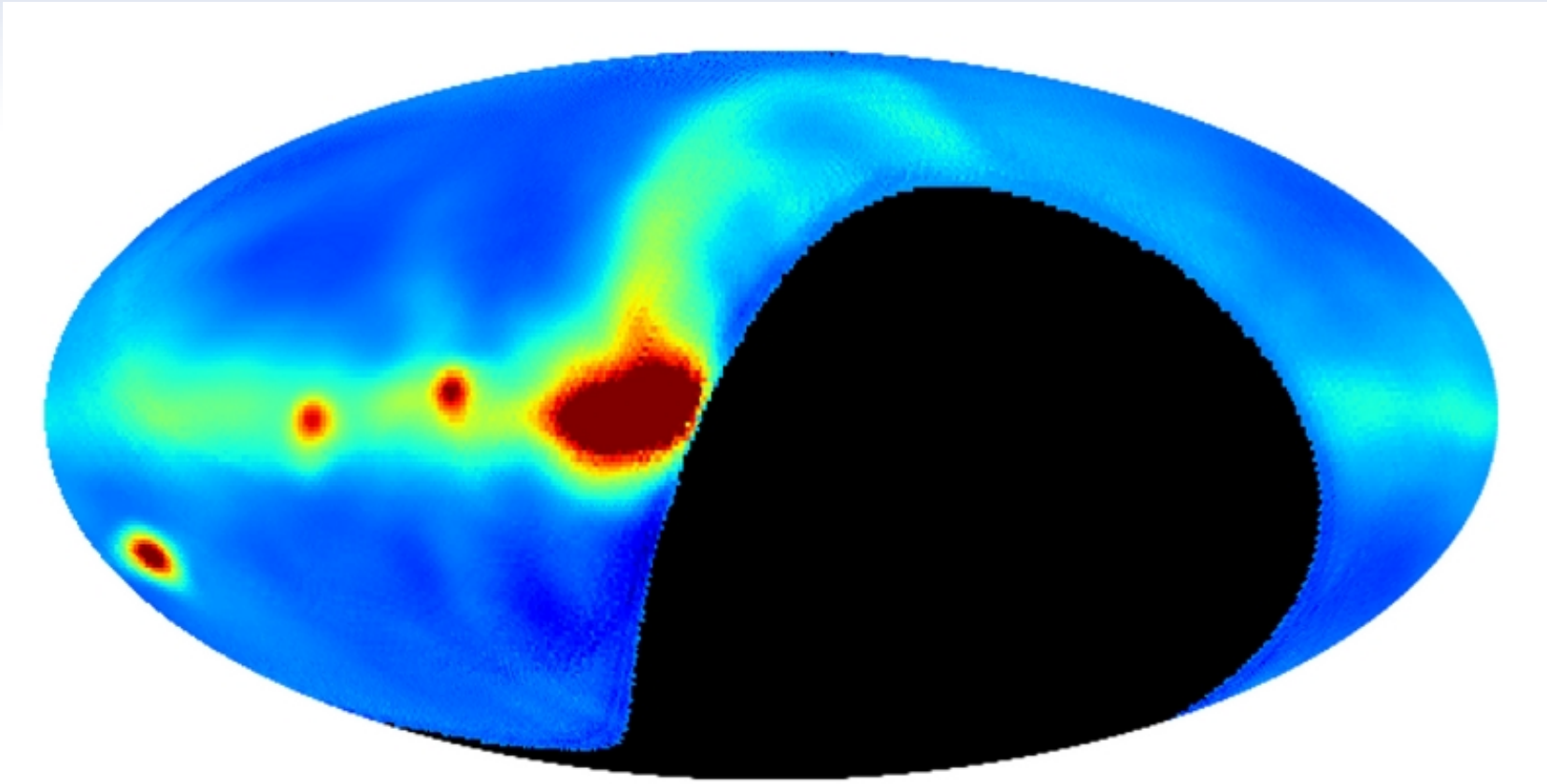
First results – Stokes I galactic @ 71 MHz

24 hours observation with SE607
180 measurements with 1 sec integration time (station correlator)
200 kHz bandwidth

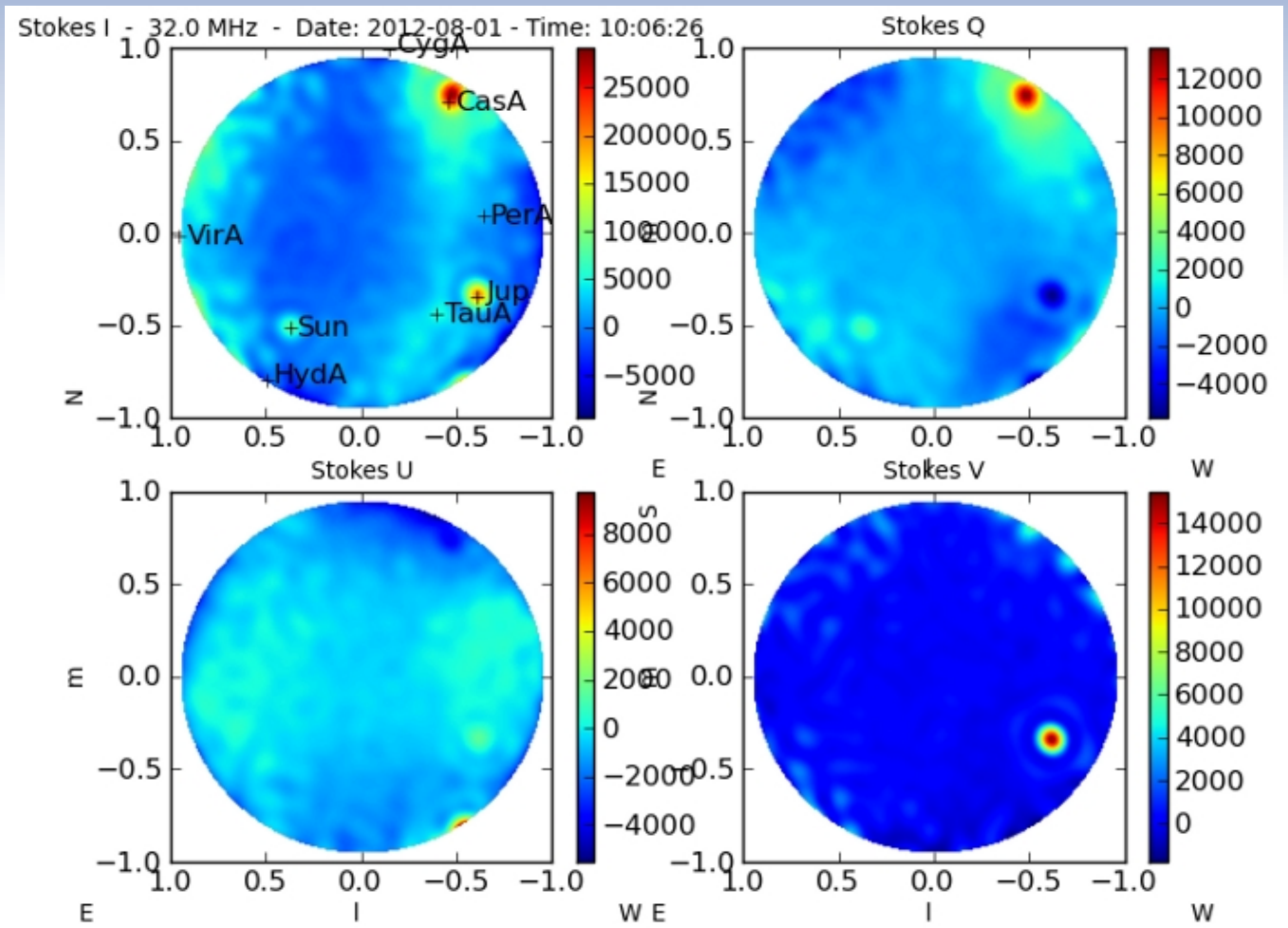


First results – Stokes I galactic @ 54 MHz

24 hours observation with SE607
180 measurements with 1 sec integration time (station correlator)
200 kHz bandwidth



First results – Polarization of Jupiter



- TBB data; 1.3 sec
- CS002
- LBA_outer
- circular polarization of 60 – 80 %

Summary

- Correlation and Calibration code is exists and working
  →works for all RCU modes
  → it can deal with (most of) the RFI
  → calibration is working for polarization as well
- Cycle 0 observations are running
  → simultaneous observations of TBB data and pulsars are working
  → even RCU mode 6 seems to work
- Future work:
  - continuing with observations
  - improvement of the antenna model
  - later combining all observations in full polarization
    → running RM synthesis on the data