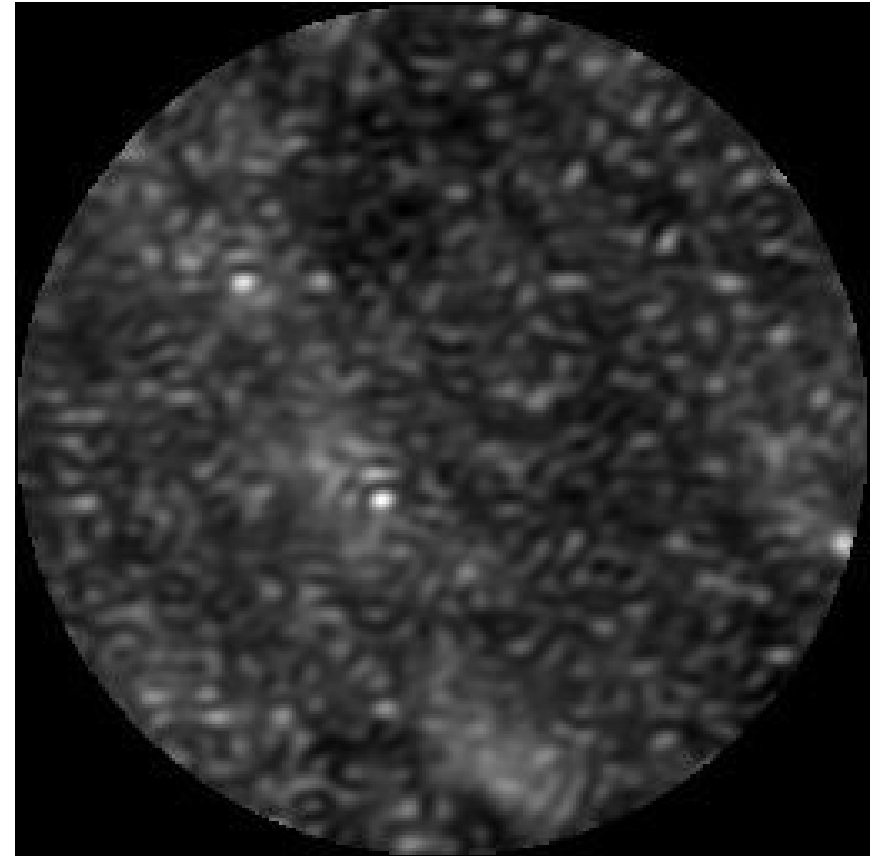


Effelsberg HBA All-Sky Images

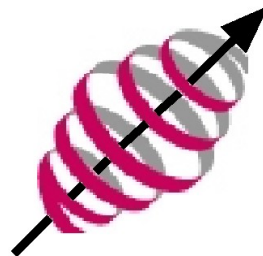
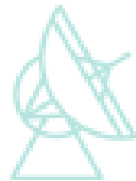
James M Anderson

anderson@mpifr-bonn.mpg.de

On behalf of the LOFAR collaboration



Max-Planck-Institut
für Radioastronomie



LOFAR



MAX-PLANCK-GESellschaft



Finding Time to Work on Simple Problems

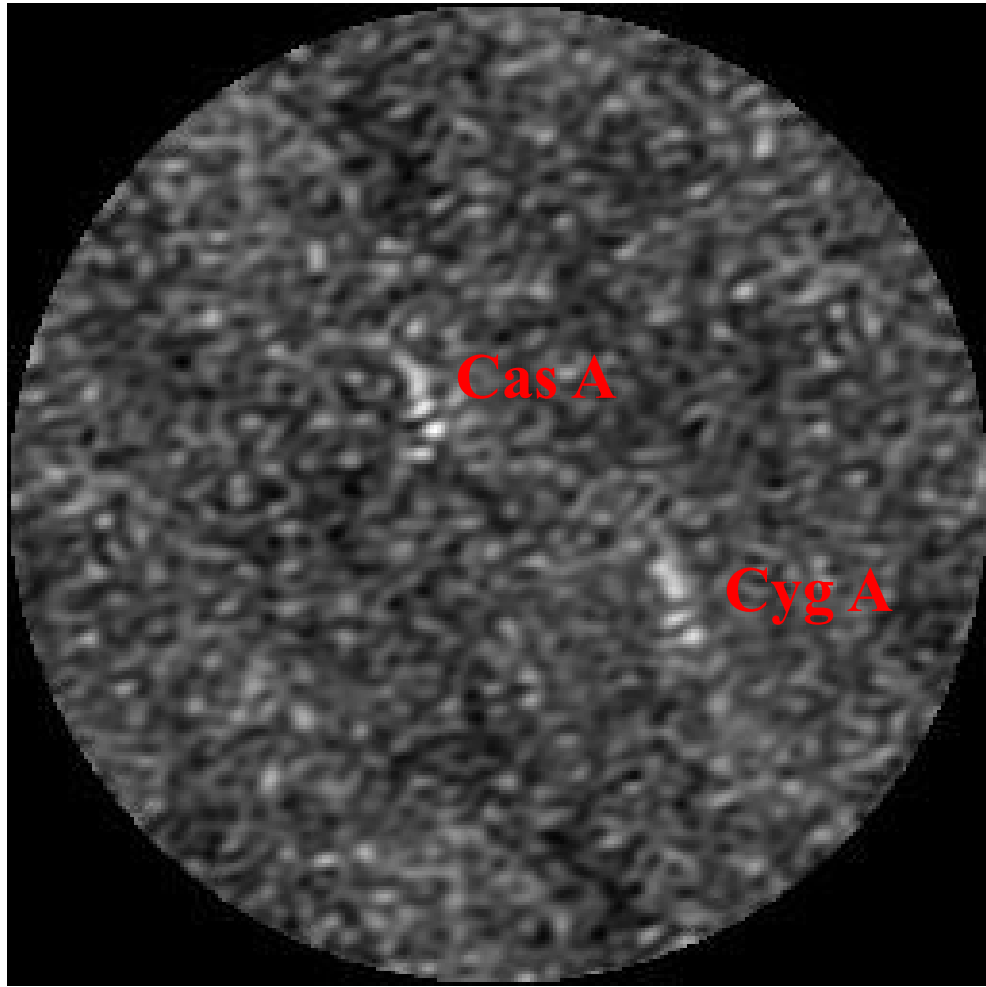
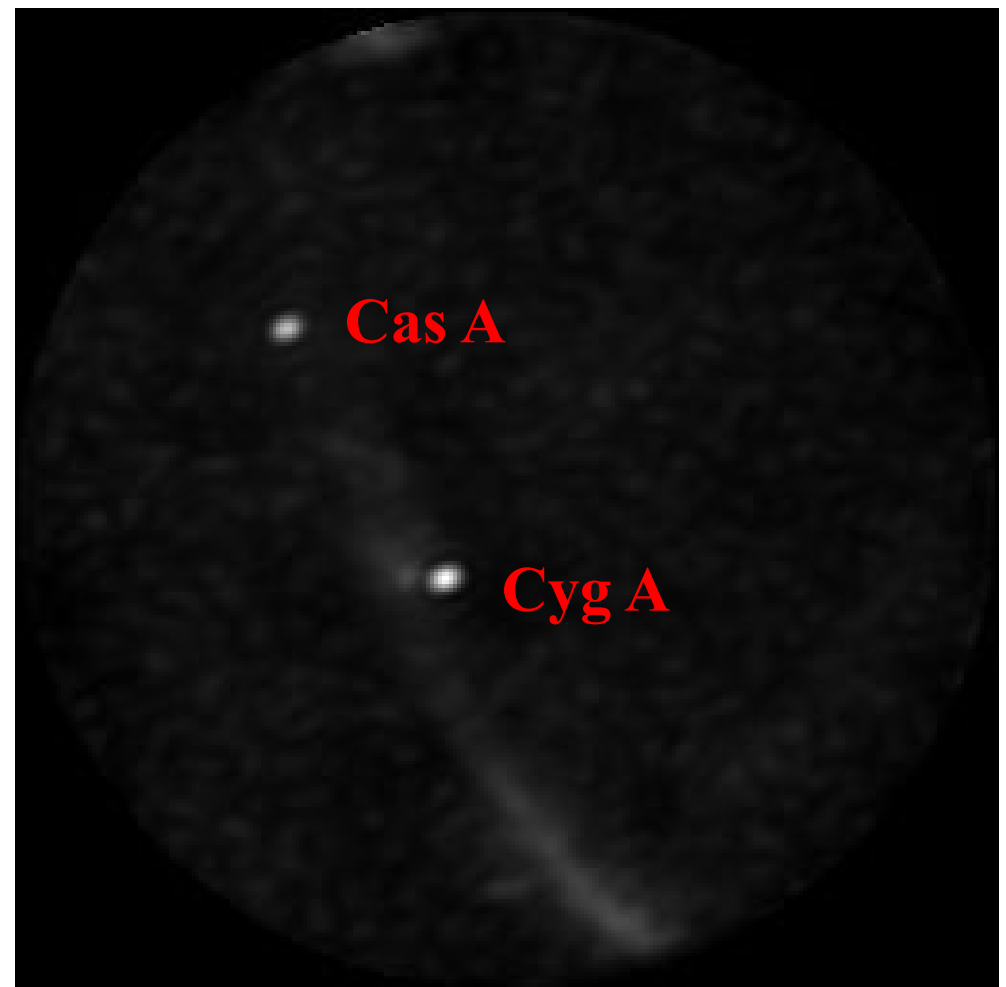


Image from last week
Obvious problems

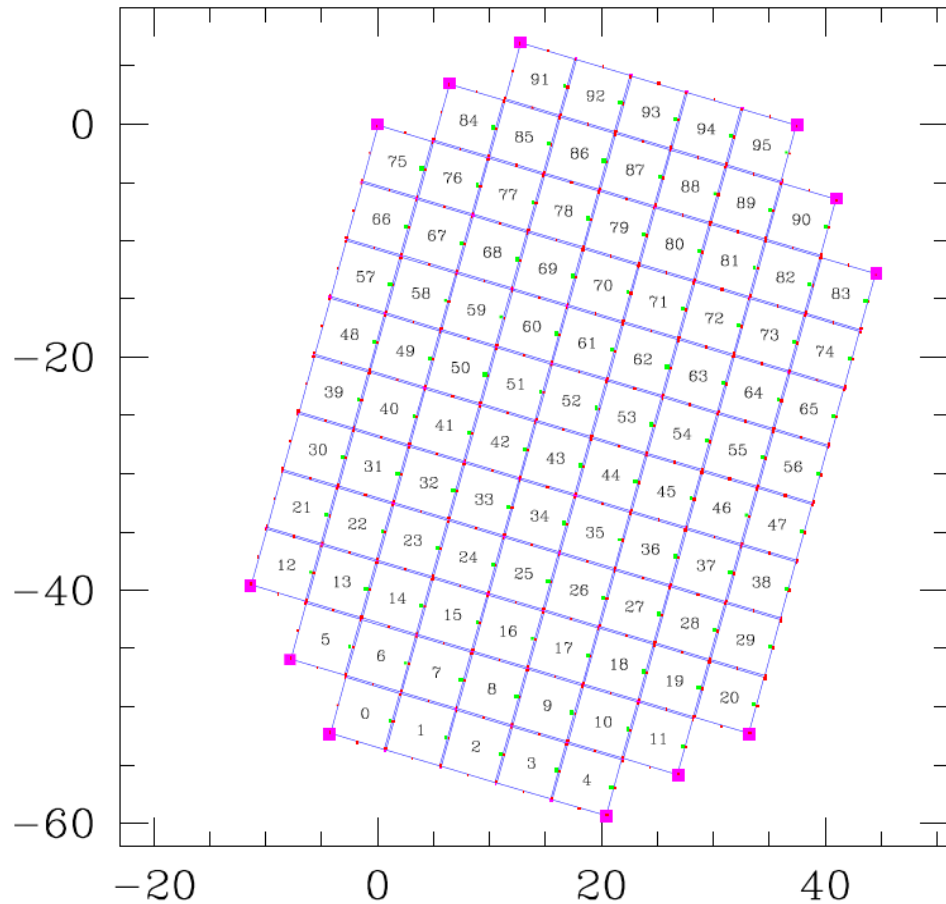


New dataset and imaging Tuesday
afternoon

Isn't selfcal great!



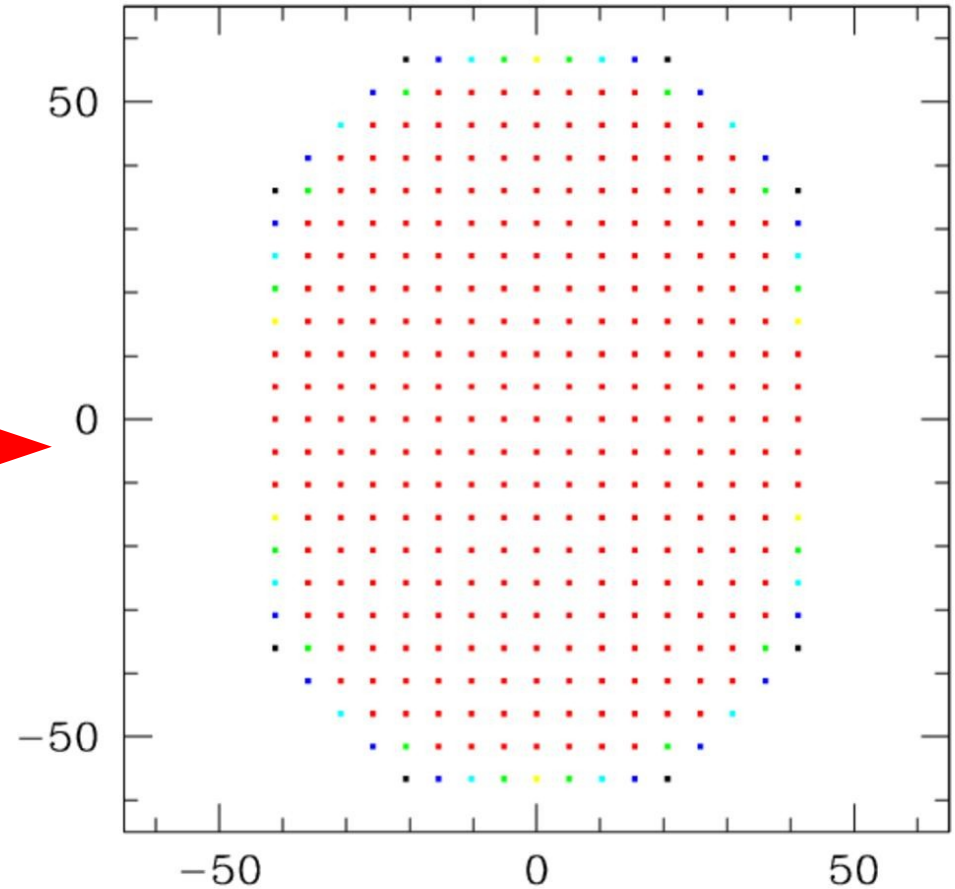
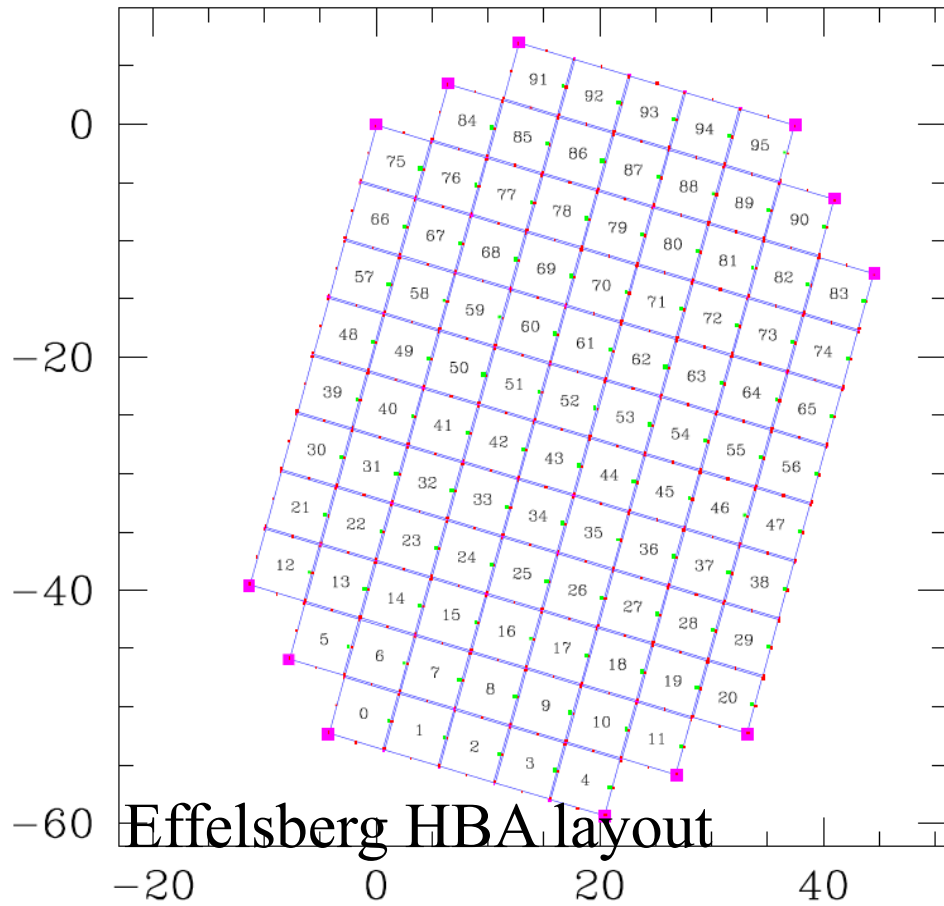
How to Make All-Sky HBA Images



Effelsberg HBA layout

- HBA tile beams select only a small area on the sky (the tile beam), thus preventing all-sky images
- So, manually shut off all but one antenna per tile
- Each single antenna can see the entire sky
- But since it is only a single antenna, it is much less sensitive

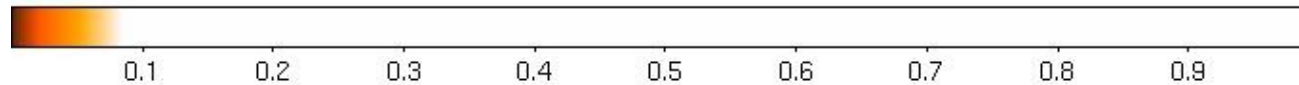
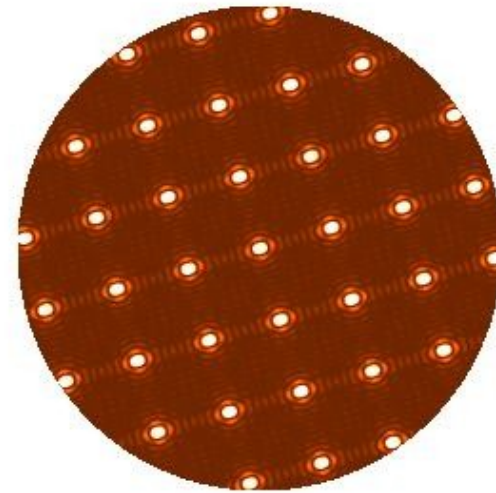
(u,v) Coverage



- Choosing the same antenna for each tile gives grating lobes
- And there are no short spacings

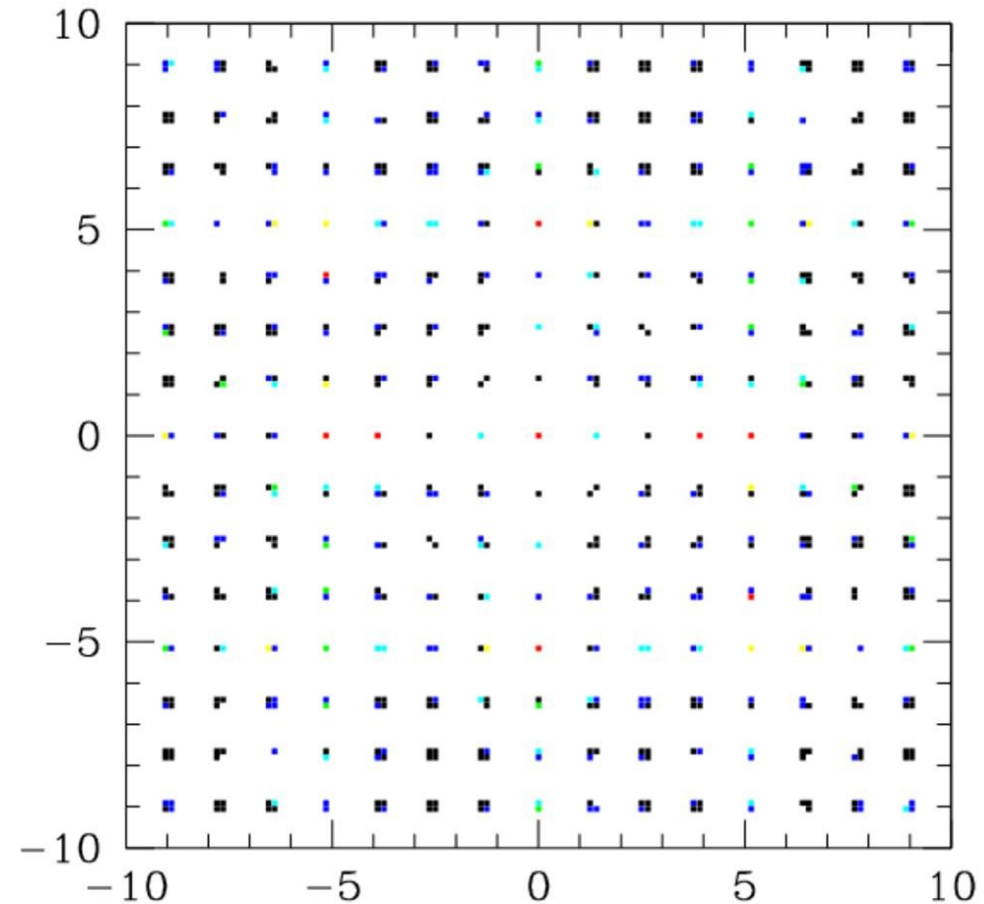
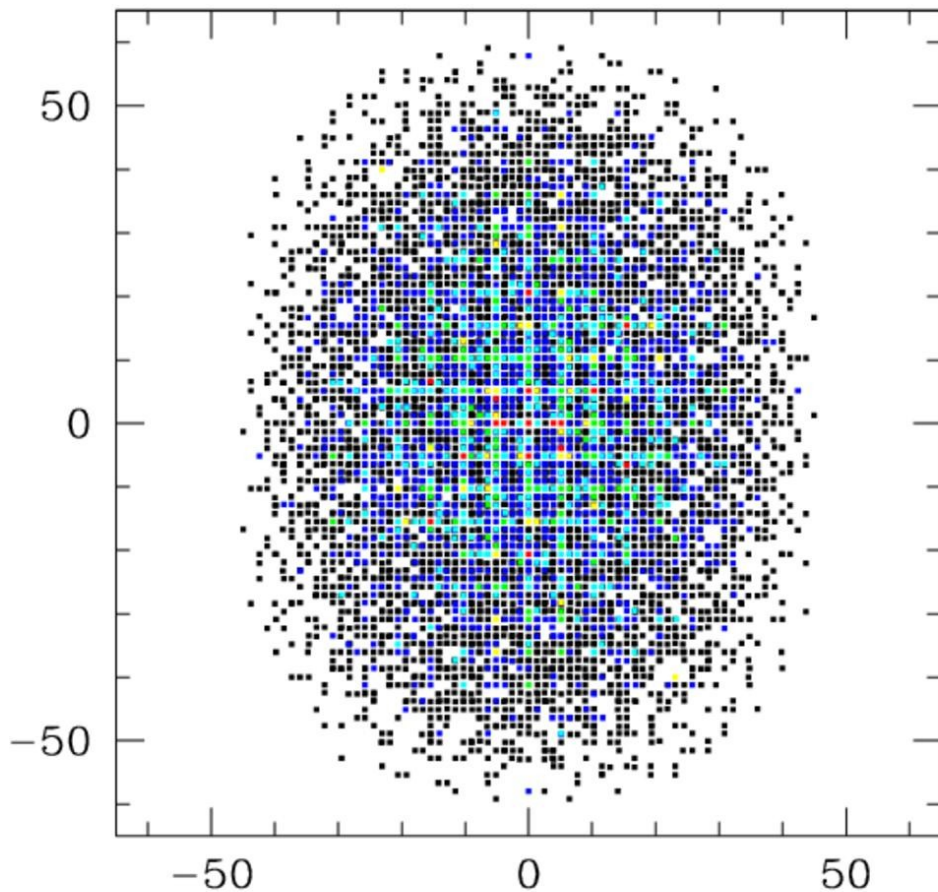


Grating Lobes



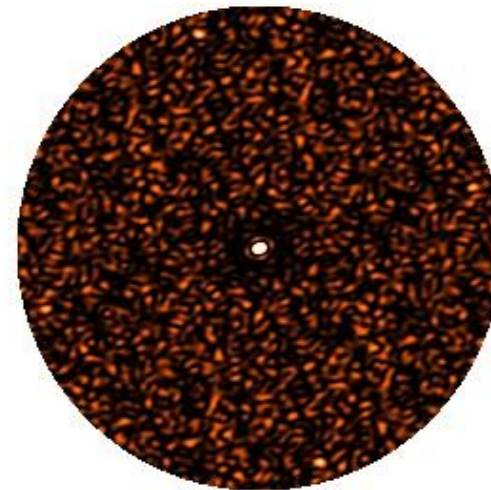
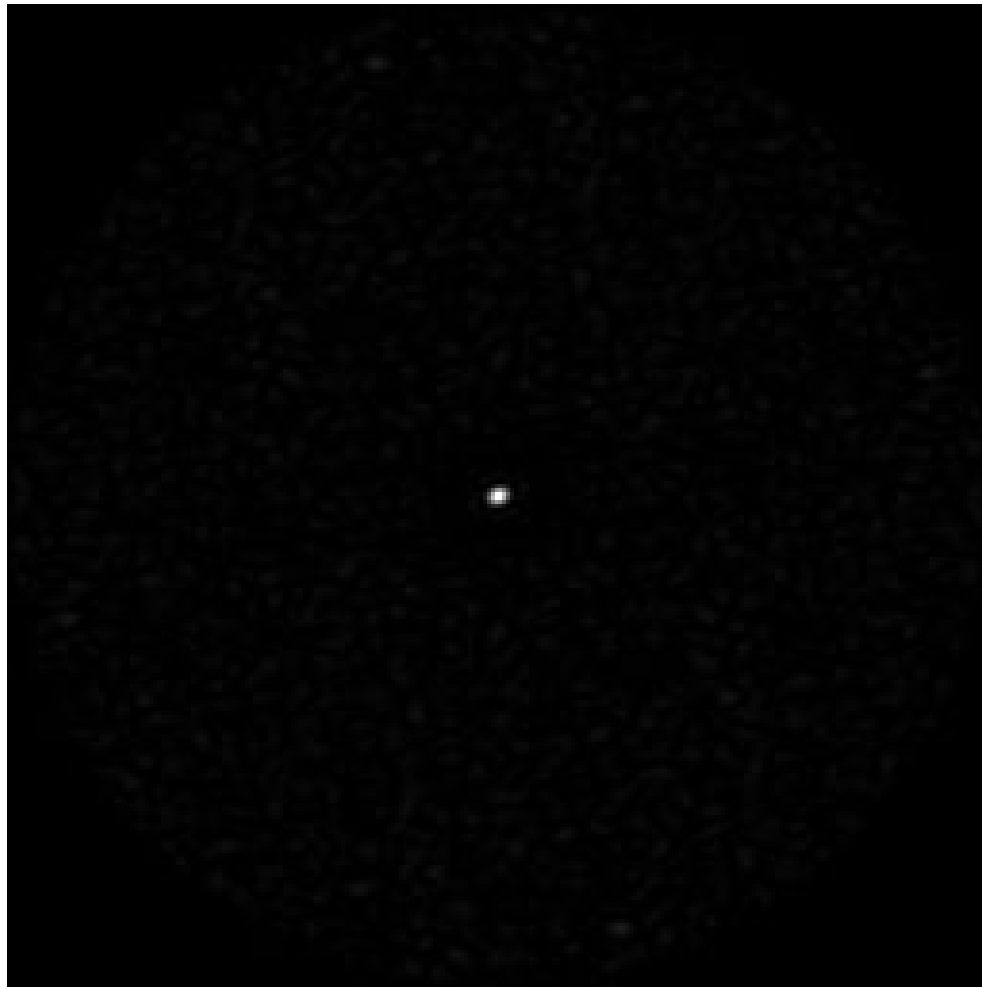
- Dirty beam for snapshot image
- Left: full linear scale Right: zoom in on low-level

Optimize Tile Antenna Selection



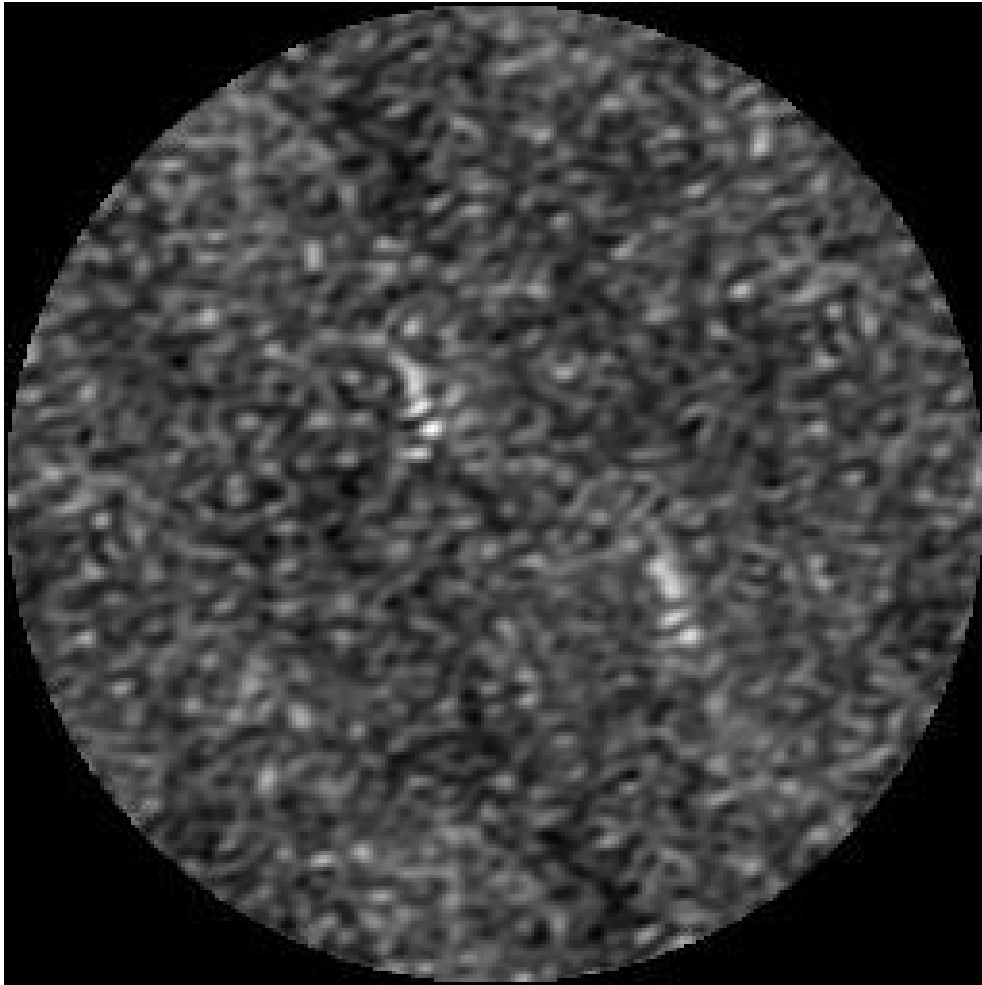
- Start with random antenna selection, then use genetic fitting algorithm to find best (u,v) coverage
- Left: complete (u,v) snapshot coverage, in units of meters
- Right: closeup of the short spacings
- Color indicates overlap: black means 1 hit, red means many hits

Optimized Dirty Beam



- Dirty beam for snapshot image
- Left: full linear scale Right: zoom in on low-level

Progress Through Last Week

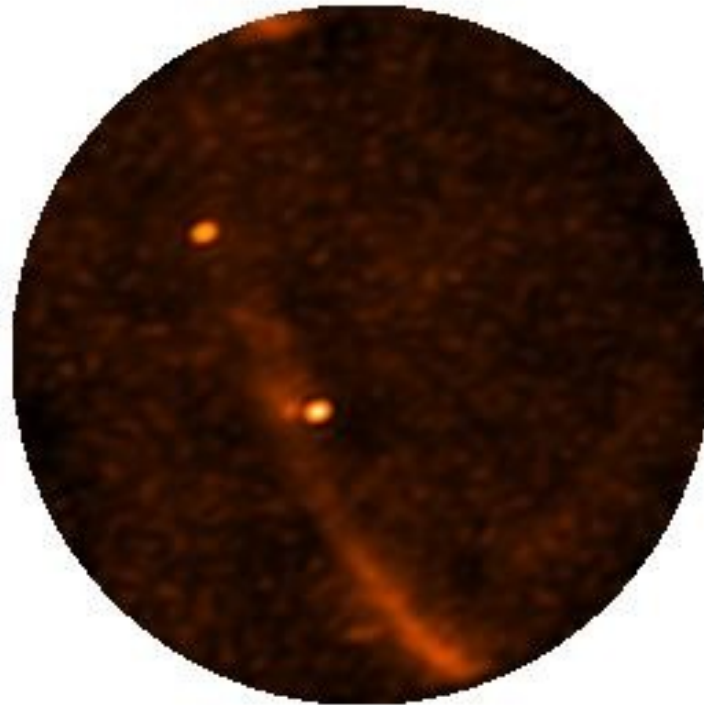


- MatLab code from S Wijnholds doesn't work in Bonn (not enough RAM on computer with license)
- No converter available in Bonn to generate MeasurementSet from raw data
- So, write own imager from scratch in C/C++
 - Faster than me trying to develop in MatLab
 - About 4 days of work so far
- Try to understand how to run the station, and deal with all of the station issues...
- LBA images look ok, HBA images look bad, but at least they are not pure noise!

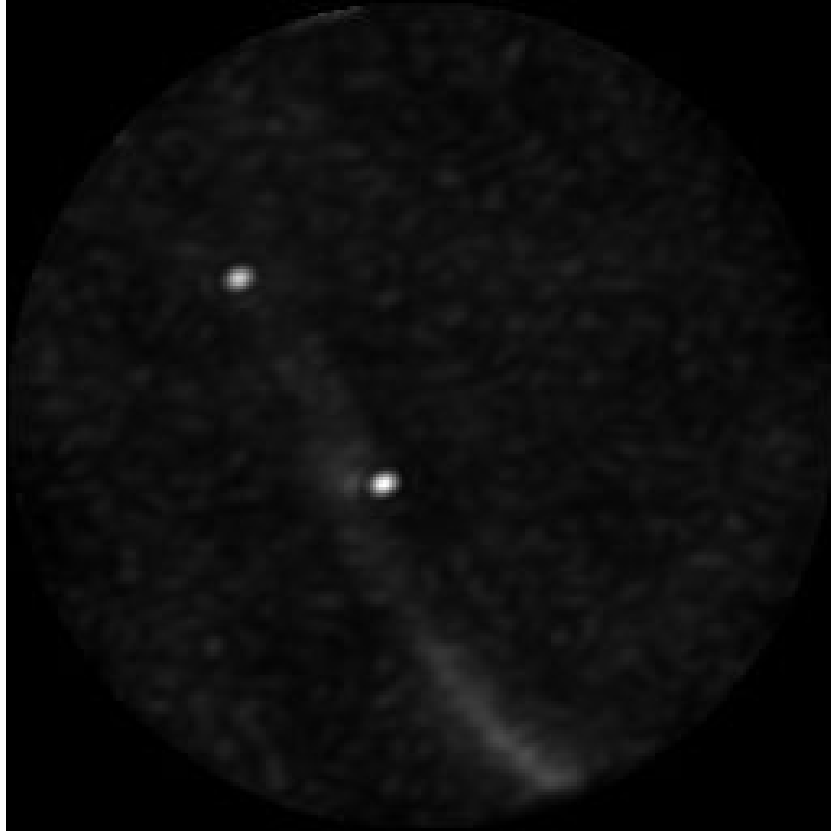


Progress Through Tuesday Afternoon

- 120 MHz image from Effelsberg
- 16:34 local time
- Cyg A, Cas A, and the Galaxy too



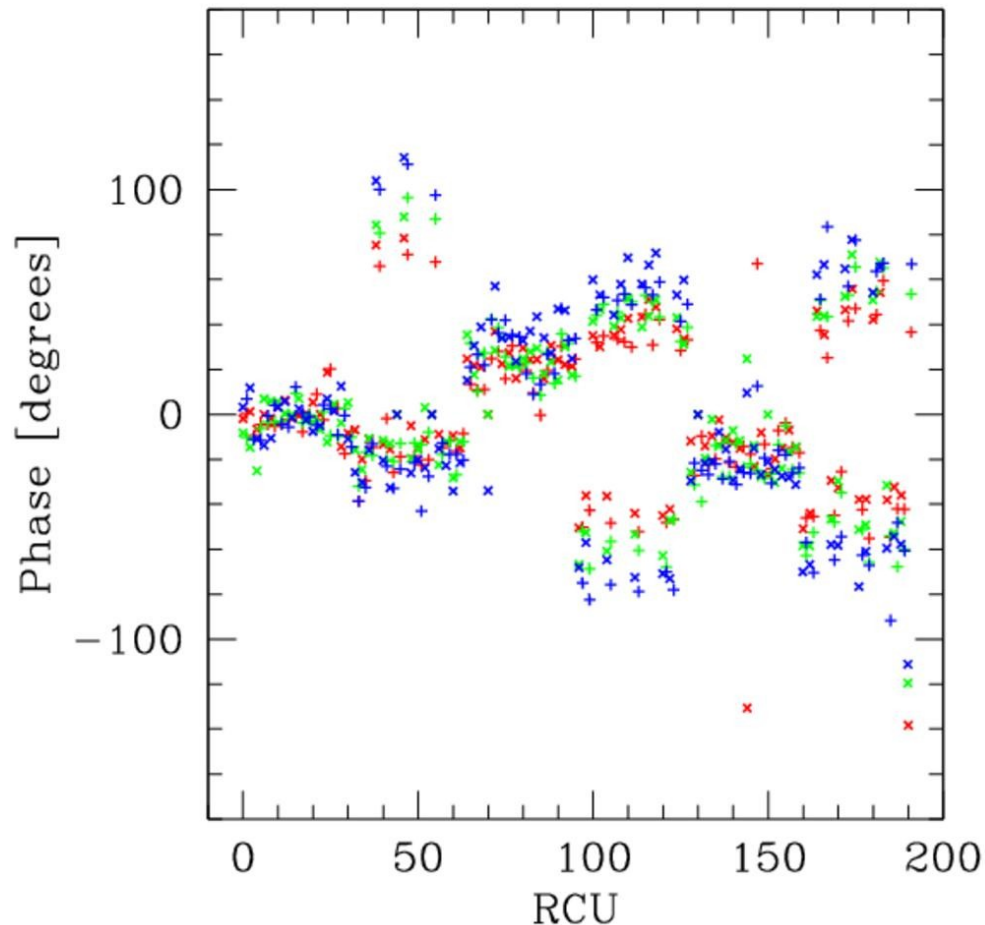
Current Software Status



- Automatic flagging of bad RCUs
 - 3 or 4 RCUs not working at Effelsberg for LBA
- (u,v) restrictions possible
- SelfCal (phase-only or amplitude and phase)
 - Aims to find Cyg A and Cas A
 - Should be straightforward to add the Sun too (important for highest frequencies and/or flare observations)
- Generates dirty image
 - No deconvolution

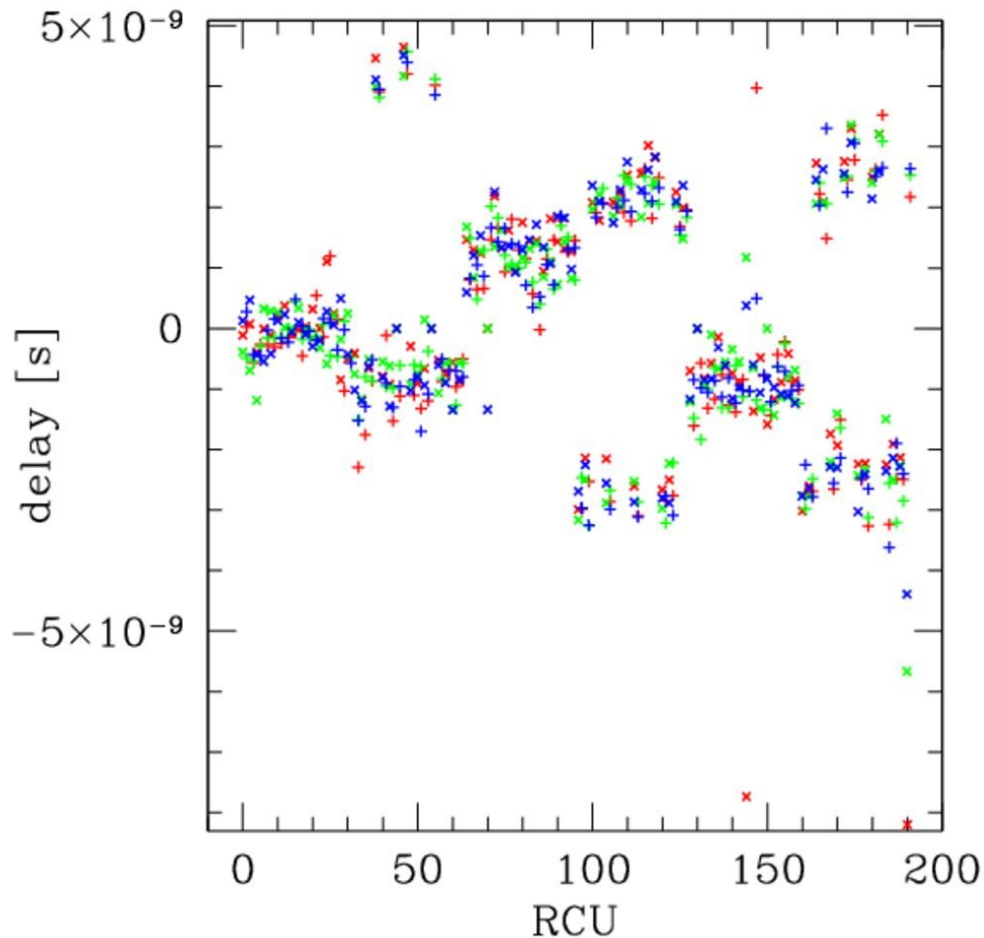


Effelsberg LBA RCU Offsets



- SelCal gain(phase) solutions
- Blue: high frequency
- Green: middle frequency
- Red: low frequency
- Clear trend with phase offsets higher at higher frequencies
- Also clear trend for individual subbracks

LBA Delay

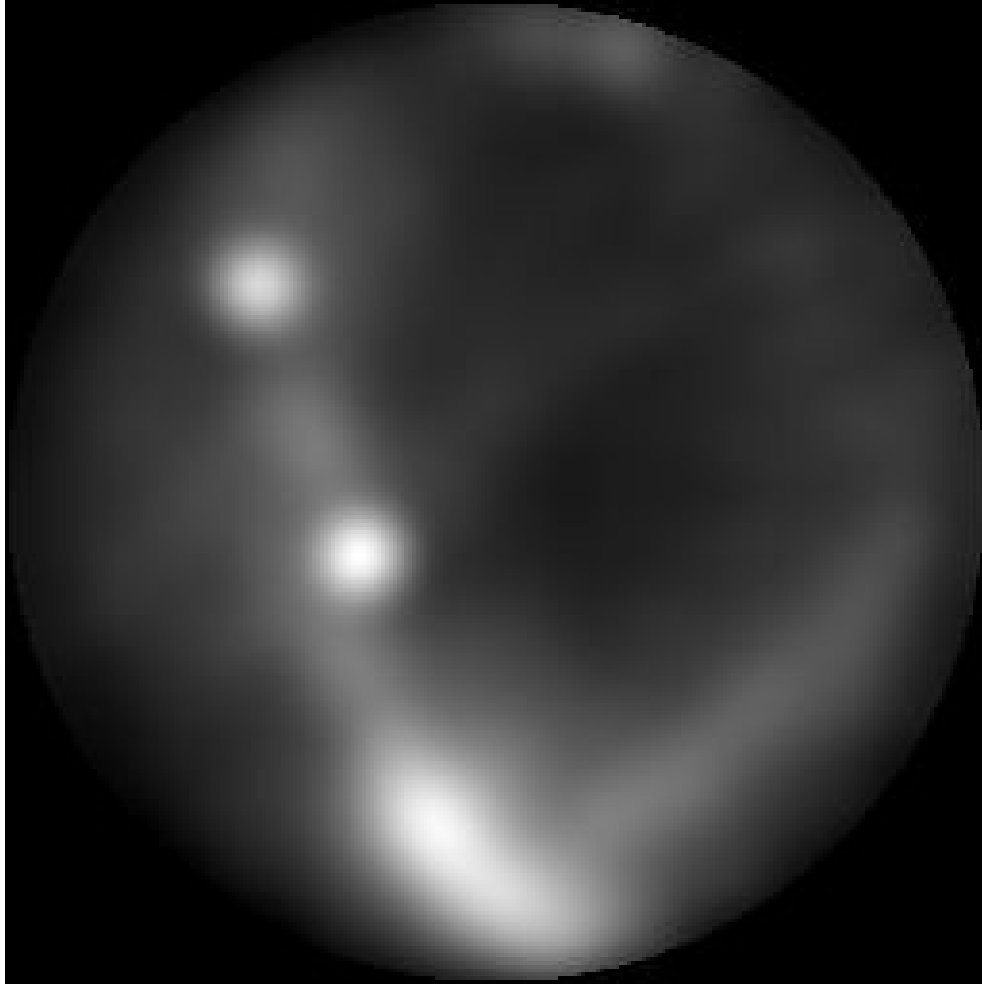


- Expressed as a delay the gain (phase) solutions are all in agreement within the noise level
- Delays for the HBA are about the same, but since the HBA frequencies are much higher, the delay is nearly the size of a whole turn of phase, and the raw images look horrible
- **Need station calibration running at Effelsberg to correct this for beamforming**

Future Work

- Clean up code and make available to other stations/LOFAR svn
- Bonn working on MeasurementSet converter for station correlator raw data
- Move to standard analysis software
- Better calibration options
- Deconvolution
- Science
 - Large scale emission
 - Transient searches
 - And so on

The End



- Movie from Effelsberg observations on the afternoon of 2009 Nov 10
- Starts at 35 MHz and goes up in ~ 4 MHz chunks, ignoring the FM band (100 MHz) gap