

LOFAR observations of the Leo Triplet



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- **Scientific contest**
- **The Leo Triplet**
and NGC3627
- **Recent studies**
and possibly new low frequency results
- **LOFAR observations**
- **Very first images**
- **Data issues**
to be further discussed at the Busy Days
- **Conclusions**

- The observations are part of the **LOFAR Survey of Nearby Galaxies**

- **Science goals**

Thermal absorption

Cosmic rays

Outflows

The FIR-RC correlation

Magnetic fields

- The observations are part of the **LOFAR Survey of Nearby Galaxies**

Science goals

- **Thermal absorption**

Renewed interest on the low frequency radio spectra of galaxies (see Lacki 2013) ---- Observations are needed to constrain models

Cosmic rays

Outflows

The FIR-RC correlation

Magnetic fields

- The observations are part of the **LOFAR Survey of Nearby Galaxies**

Science goals

Thermal absorption

- **Cosmic rays**

At low frequencies we can study low energy CR and the energy losses of these particles. ---- Edge-on galaxies are the most suitable target for these studies.

Outflows

The FIR-RC correlation

Magnetic fields

- The observations are part of the **LOFAR Survey of Nearby Galaxies**

Science goals

Thermal absorption

Cosmic rays

- **Outflows**

Galactic outflows produced by episodes of enhanced star formation in galaxies (Heesen et al. 2011) ---- Edge-on galaxies are the most suitable target for these studies.

The FIR-RC correlation

Magnetic fields

- The observations are part of the **LOFAR Survey of Nearby Galaxies**

Science goals

Thermal absorption

Cosmic rays

Outflows

- **The FIR-RC correlation**

High resolution studies at LOFAR frequencies of the FIR-RC correlation (so far analyzed at frequencies >327 MHz) ---- Variation of CRE diffusion in arm and interarm regions in nearby galaxies.

Magnetic fields

- The observations are part of the **LOFAR Survey of Nearby Galaxies**

Science goals

Thermal absorption

Cosmic rays

Outflows

The FIR-RC correlation

- **Magnetic fields**

Magnetic field is a very sensitive tracer for interaction in the interstellar medium ---- Polarized intensity outside the optical extend of Antenna galaxies (Chyzy & Beck 2004), or in Virgo cluster galaxies (Vollmer et al. 2007) are good examples.

- Ideal target for these studies



It is nearby (~ 10 Mpc): it allows studies of low surface brightness regions of the galaxies.
NGC3627 a barred spiral
NGC3628 an edge-on
NGC3623 highly inclined spiral

● Interesting HI tails detected

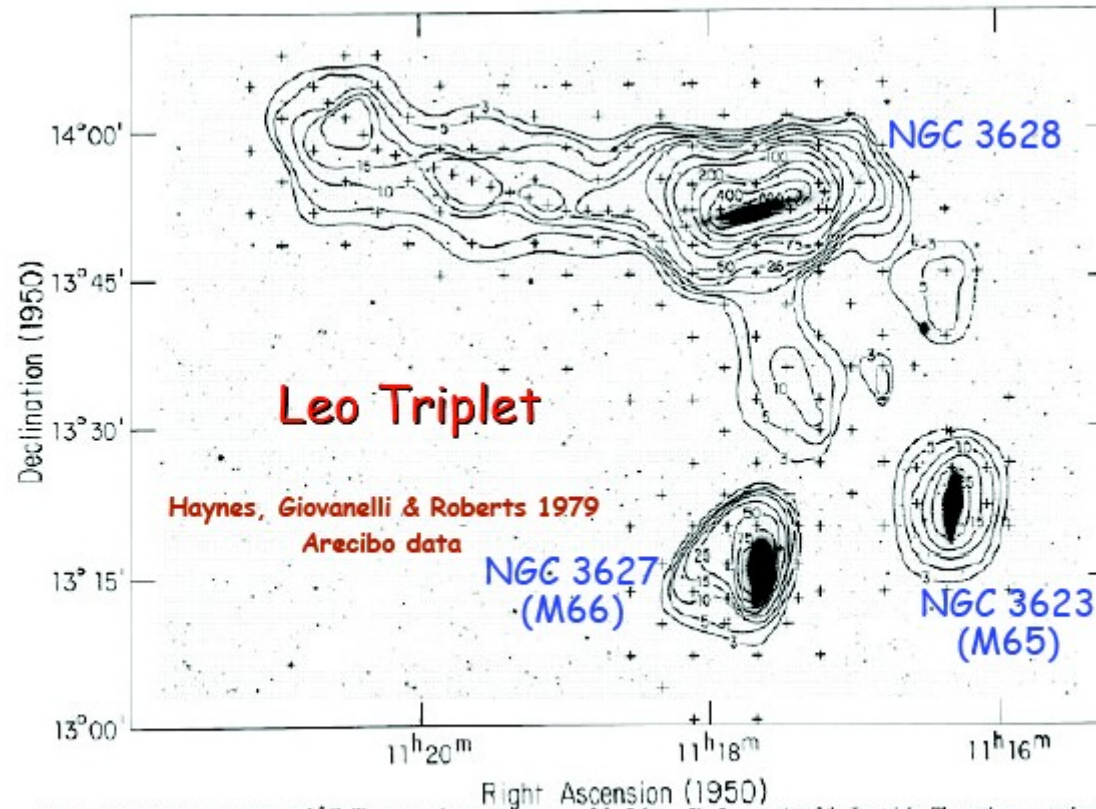
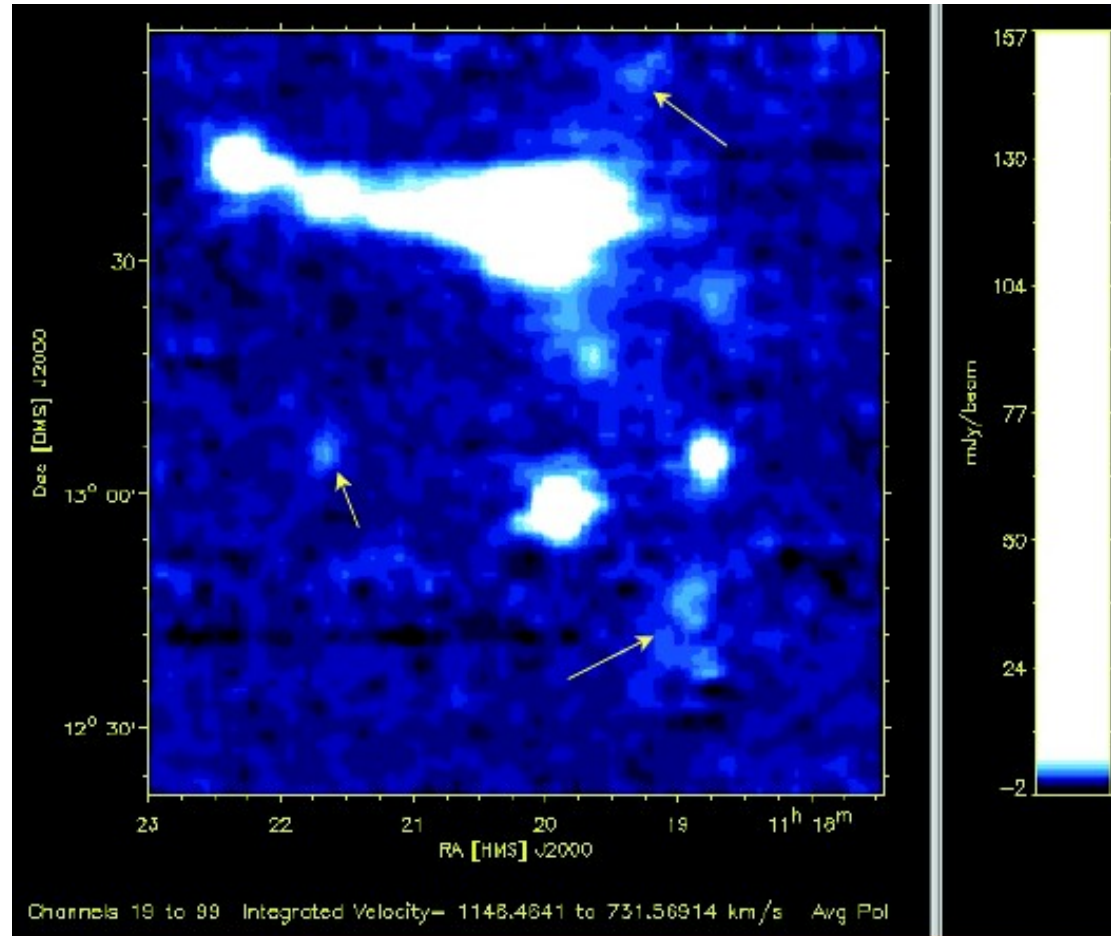


FIG. 1.—Neutral hydrogen contours of $\int T_{\text{mb}} dv$ superposed on an enlargement of the Palomar Sky Survey print of the Leo triplet. The northernmost galaxy is NGC 3628; the southernmost is NGC 3627; the westernmost is NGC 3623. Crosses mark the sampling points of the Arecibo observations. The long appendage extending eastward from NGC 3628 is referred to as the plume; the extension in the region between the three galaxies is the bridge.
 HAYNES *et al.* (see page 84)

- More recent HI image: ALFALFA survey



Stierwalt et al. 2006

- NGC3627 well observed at different frequencies



Optical

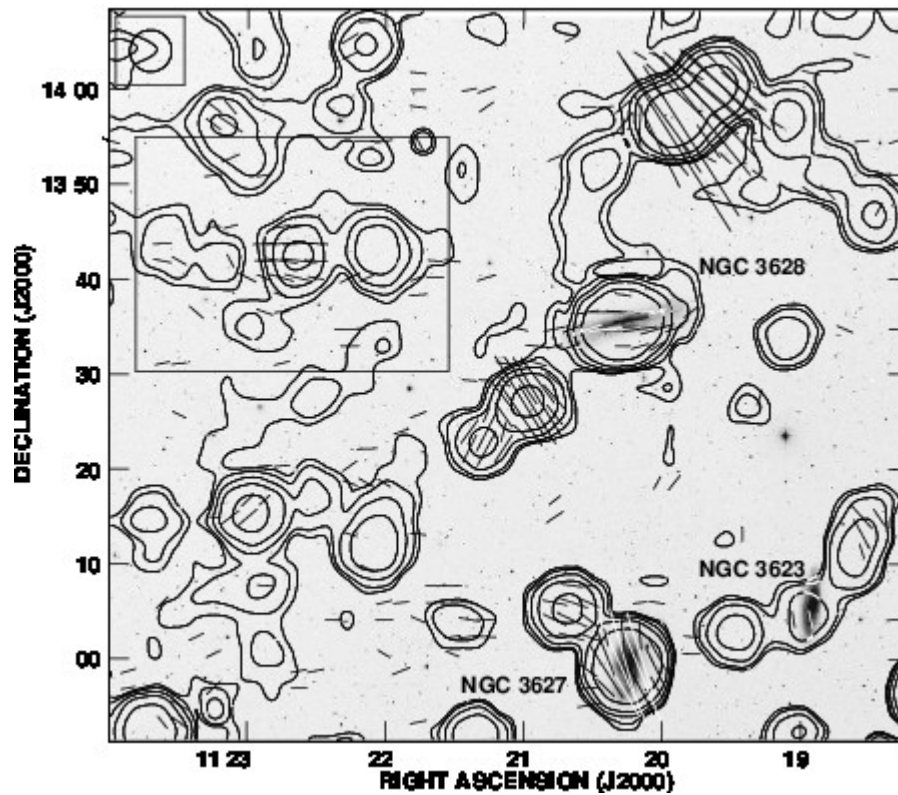


IR

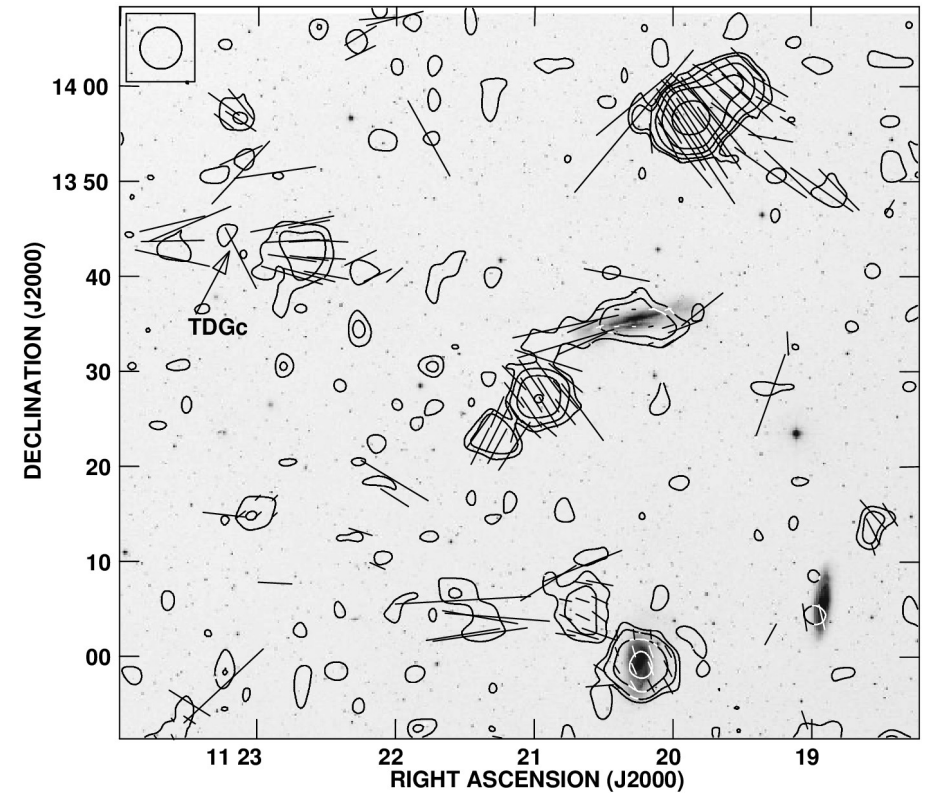


X-ray

● Leo Triplet at 2.64 GHz



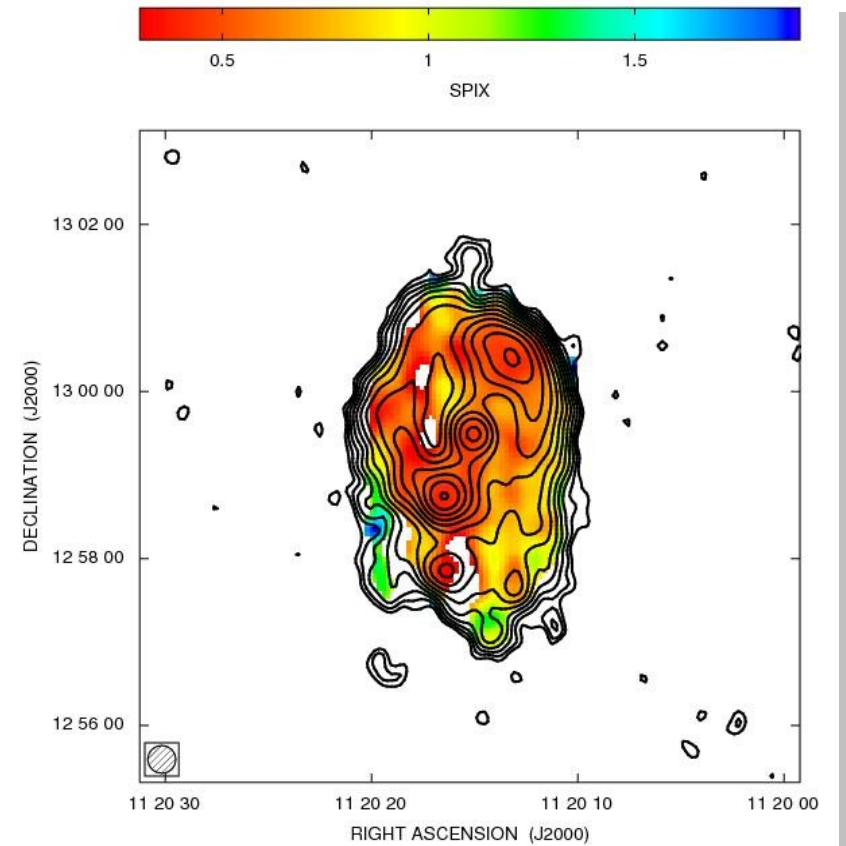
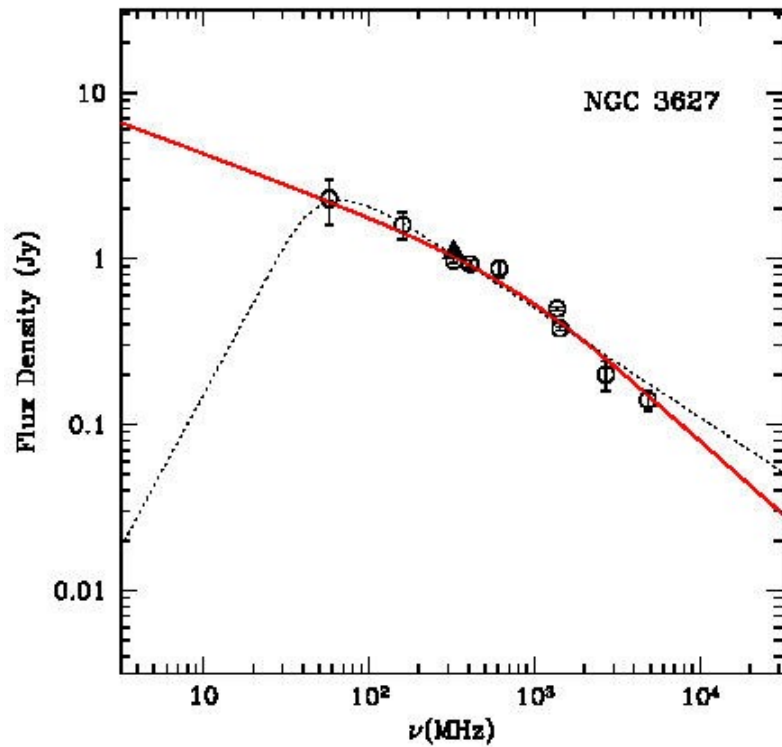
total power contour



polarized intensity contour

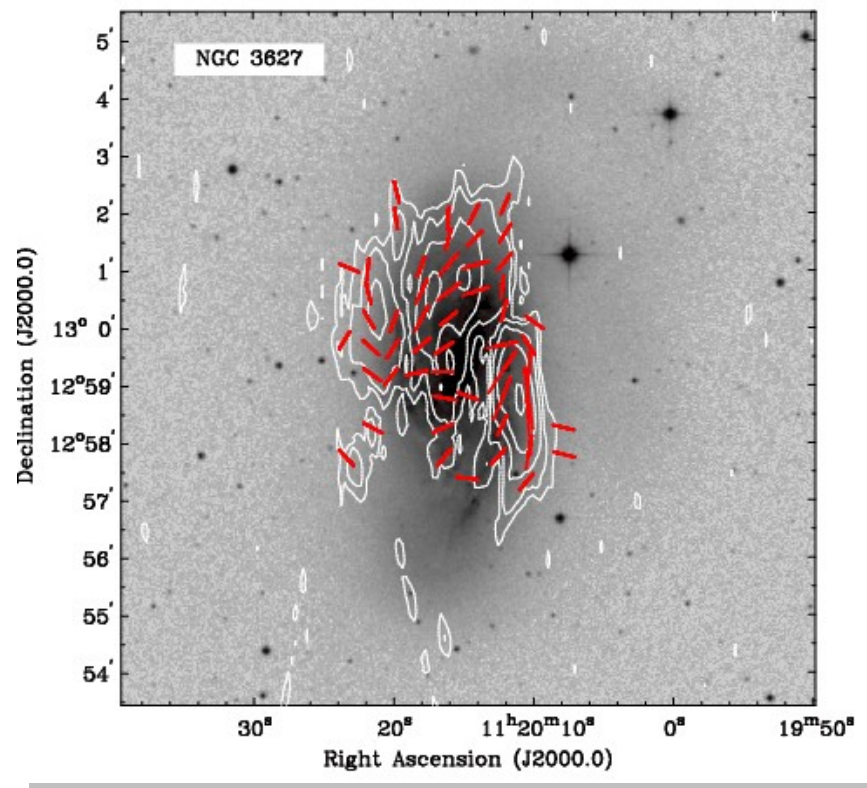
Wroczynski et al, 2013

● NGC3627 spectral index and SED



Paladino, Murgia & Orru', 2009

● NGC3627 magnetic field



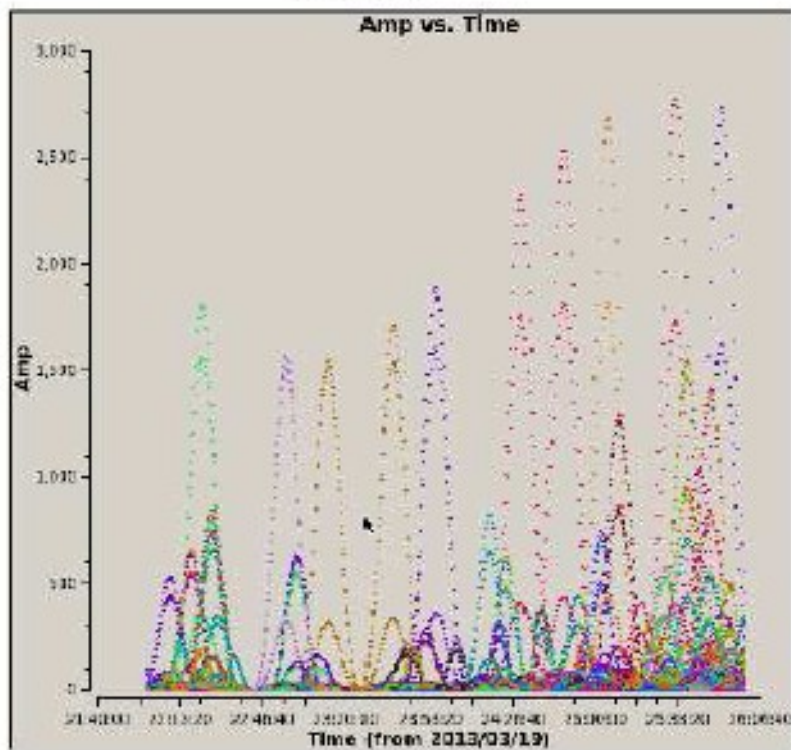
Contours: polarized intensity
Red vectors: magnetic field orientation

Heald et al, 2009

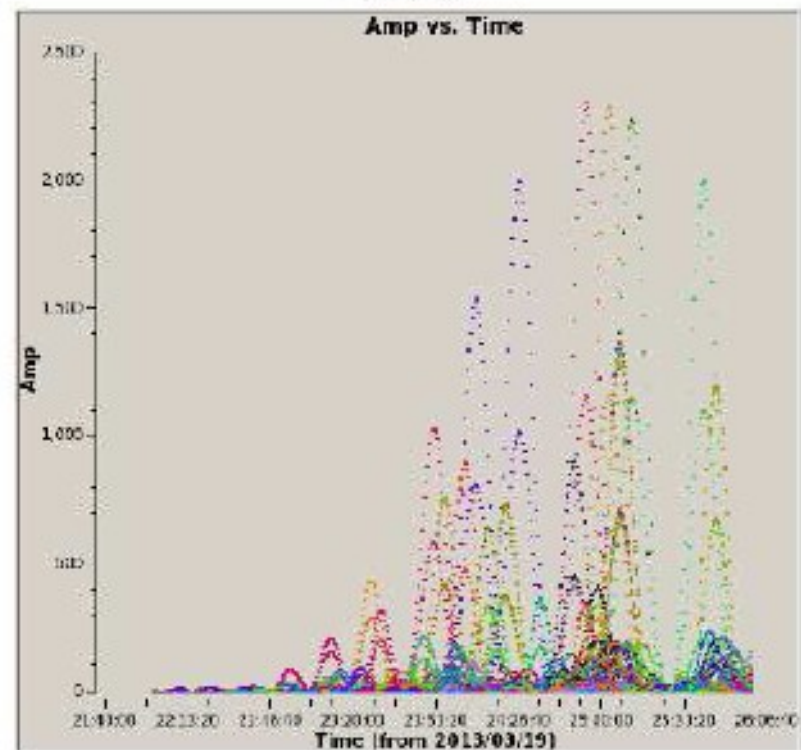
- Before Observations: Demixing strategy

Simulations of A-team contributions during observing time

CasA



CygA



● **LOFAR Cycle 0 Observations**

2013-03-19 22:03:00 – 06:32:00

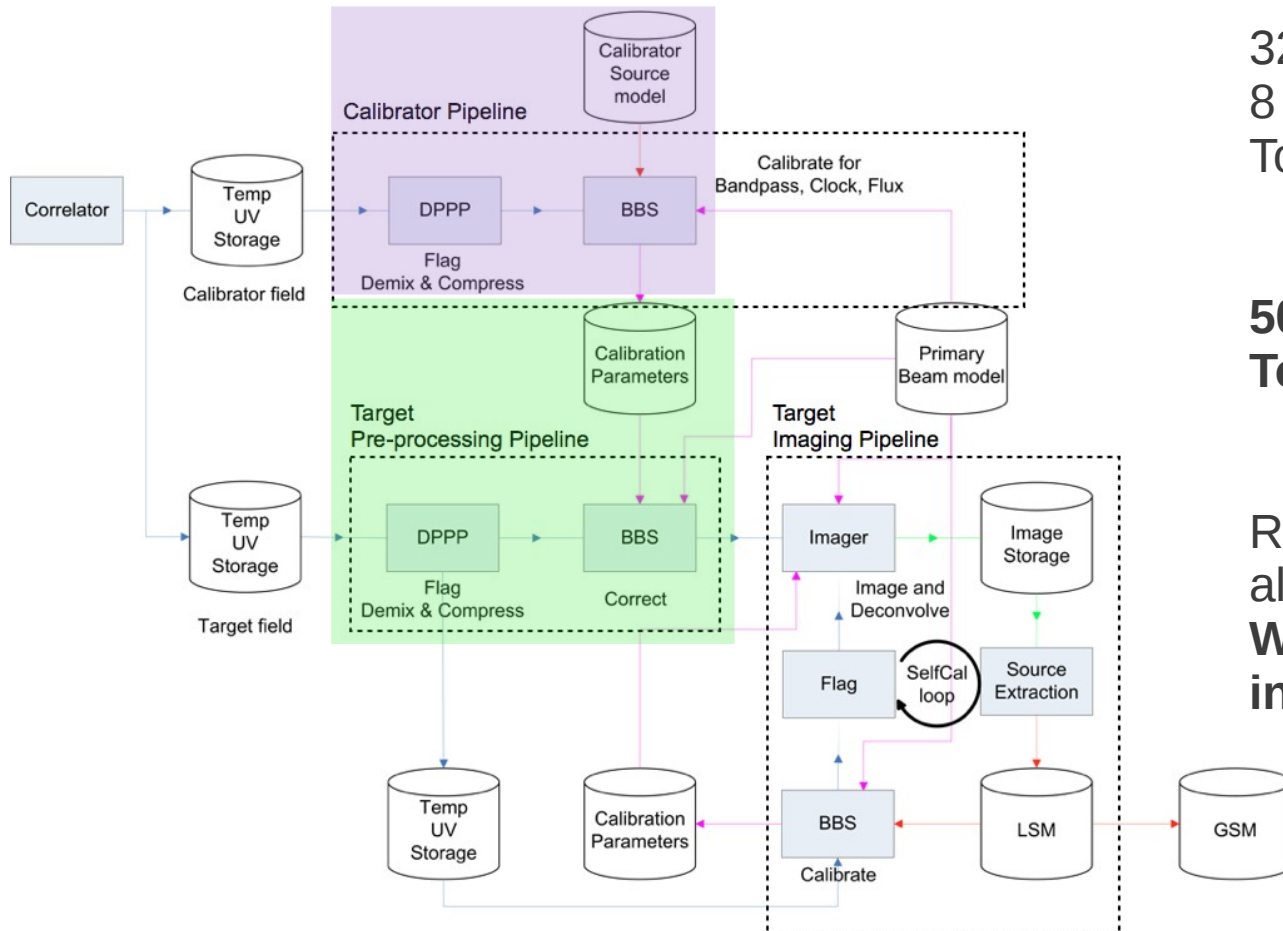
2013-04-02 21:00:00 – 06:30:00

Each observation: 17 scans on source 12 min
Total time on source = 6h 48m on source

Target observations separated by 3C286 observations

HBA observations: total frequency range covered 63 MHz

Pipeline products



For each scan:

323 SB

8 chans 24.41 kHz wide

TotBW=195.312 kHz

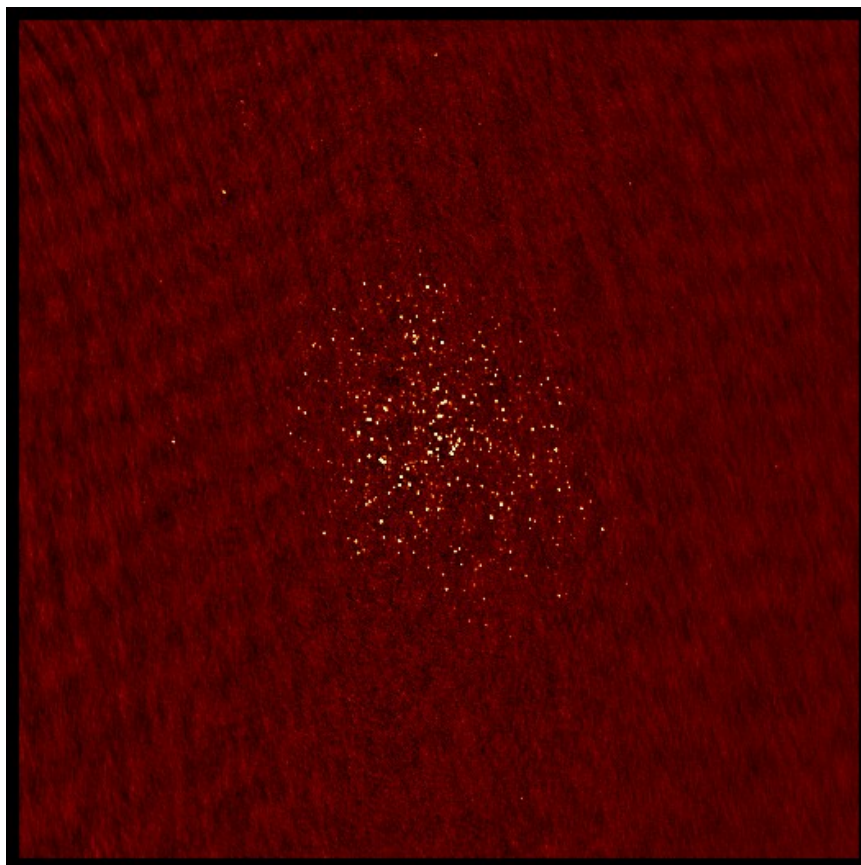
500 MB 1SB in 1 scan

Total amount : ~ 6TB

Raw data and calibrated target
already archived in Juelich

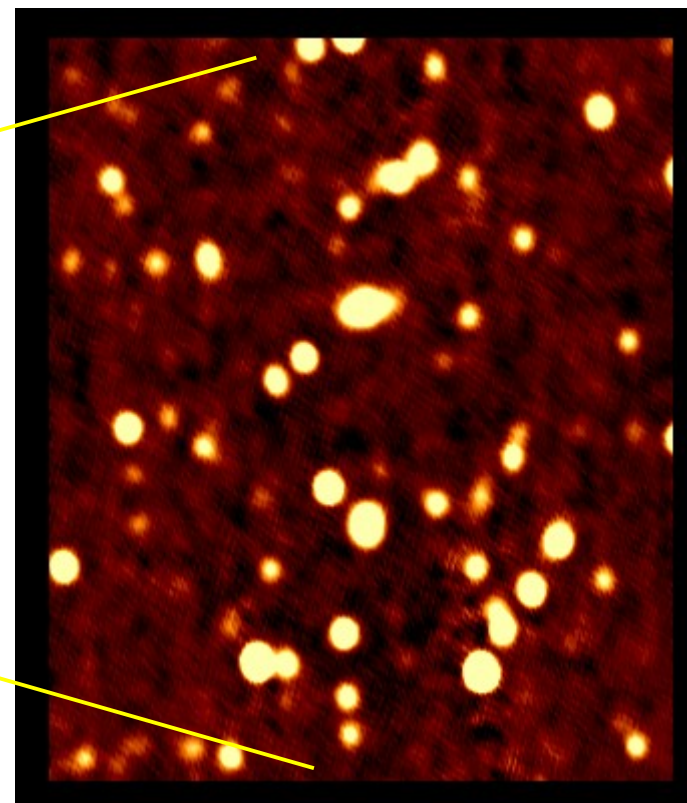
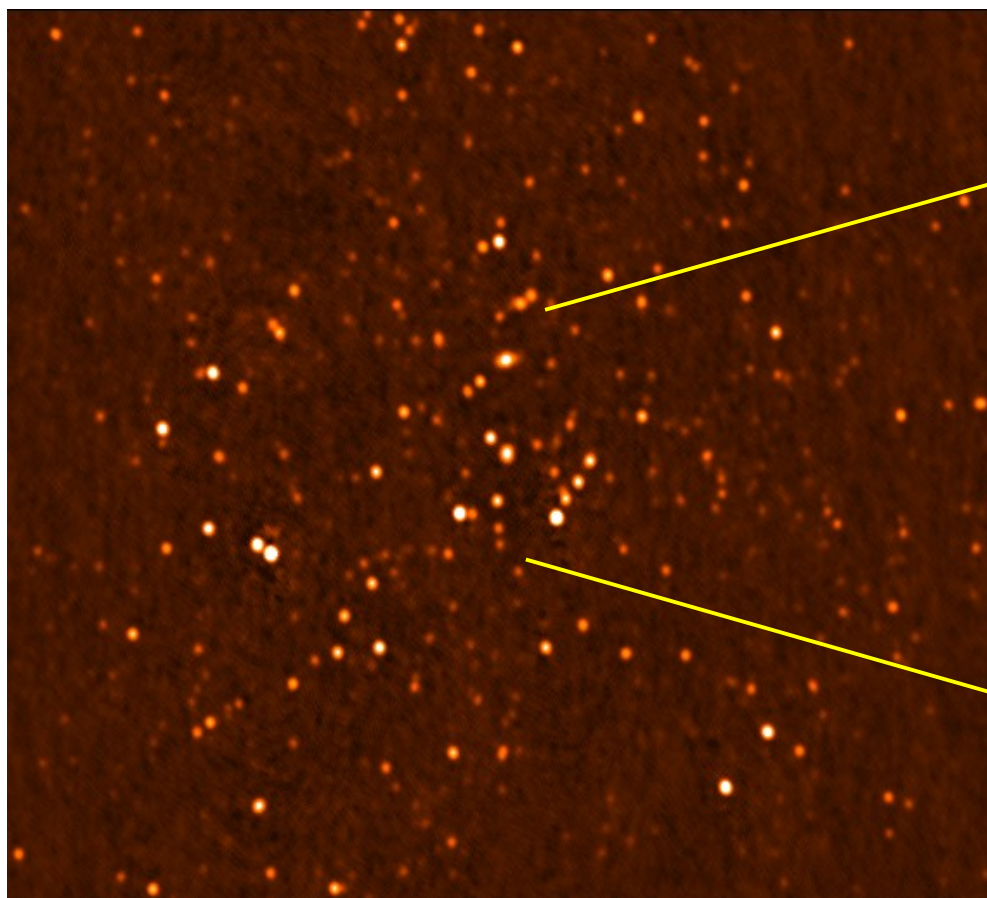
**Where to store the
intermediate products?**

- Total intensity image only core stations
1SB=137 MHz



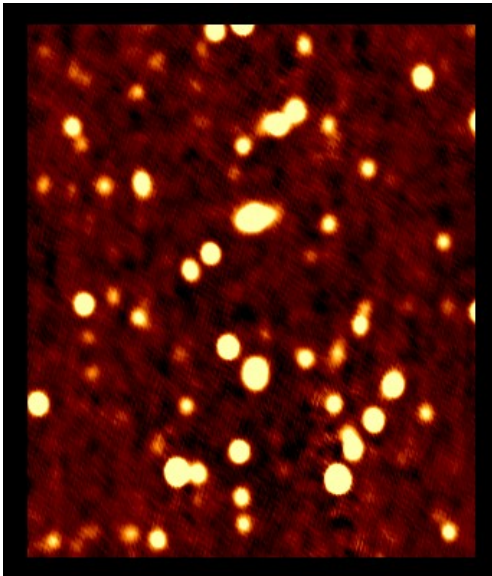
**Just pipeline calibrated data.
Some problems to be investigated**

- Total intensity image only core stations
1SB=137 MHz



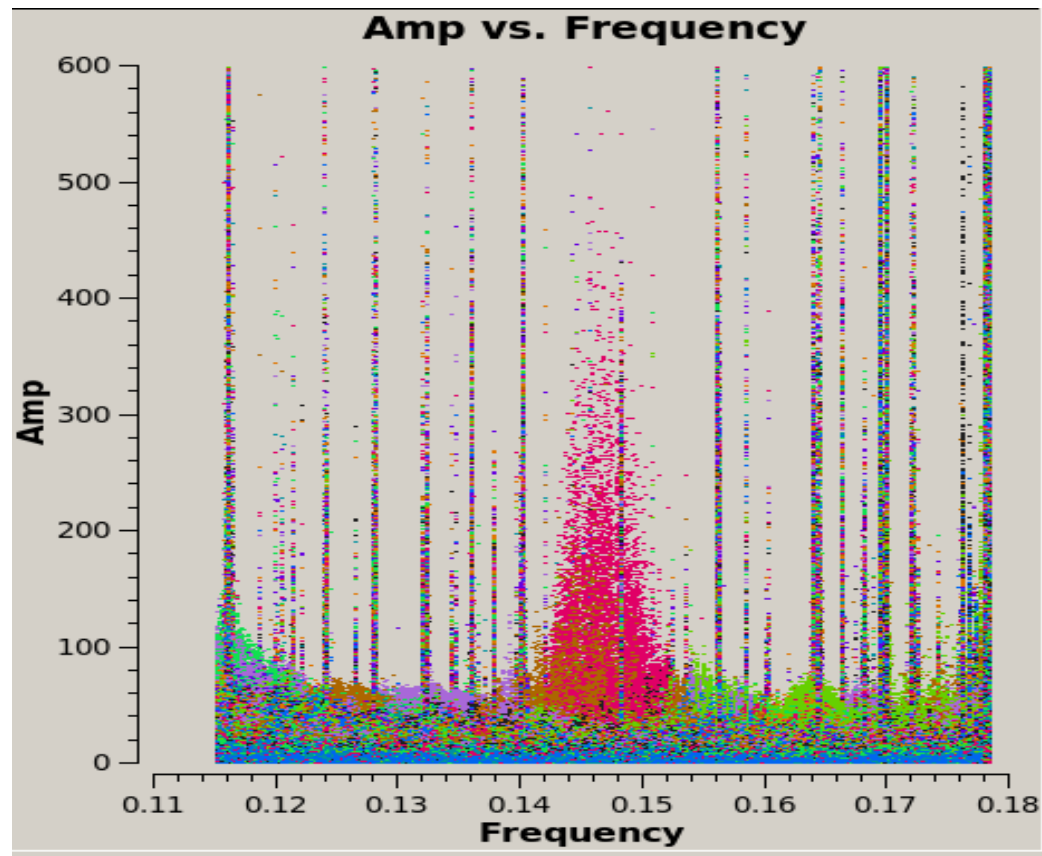
Just pipeline calibrated data.

● Plans

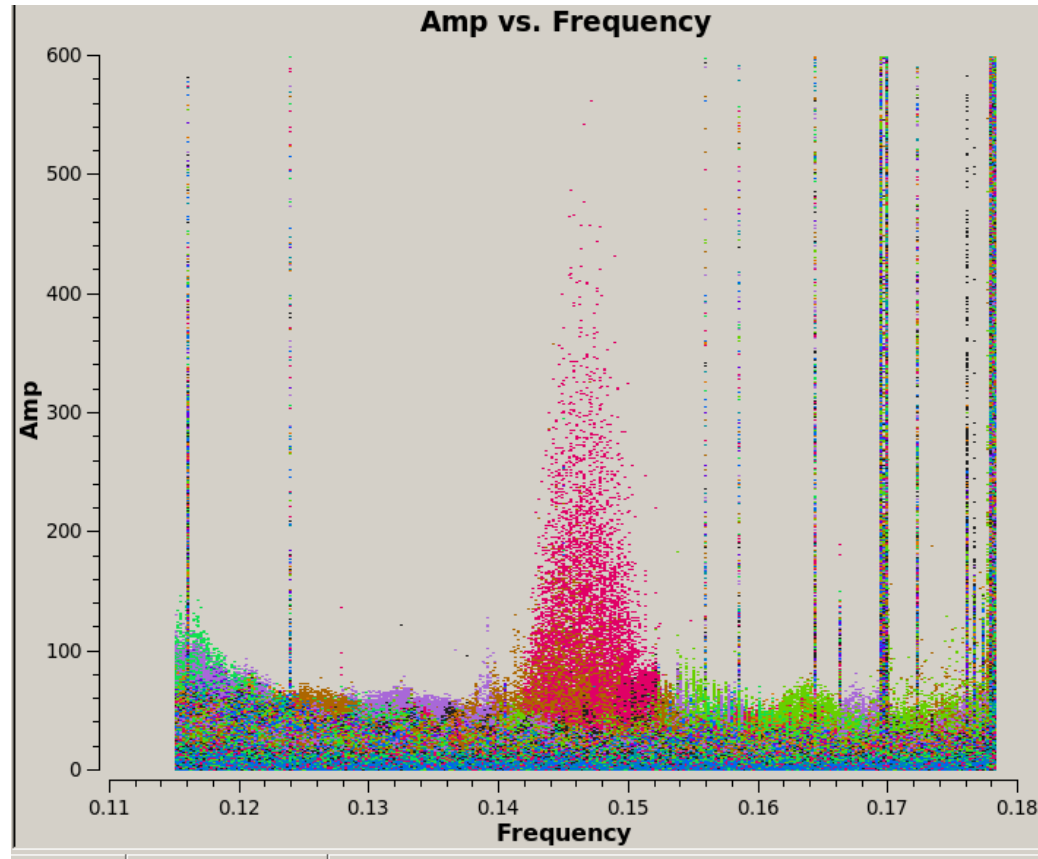


- Some problems with the pipeline in the observation on april 02. Some data need to be calibrated again.
- Find a good high resolution model to calibrate remote stations in total intensity, averaging the channels to one channel per SBproblems with awimager
- Raw data have been archived so they will be available to use for IQUV imaging in the (hopefully near) future.

- 1 scan on target (12 min), entire band each SB averaged to one channel



● Removing antenna CS028HBA0



**Still a baseline to remove and some interferences.
Need to check if it is the same for all the scans....**

- The Leo Triplet is a promising target for low frequencies studies
- LOFAR dataset seems to be promising after some problem solving
- Need to discuss about issues and strategies during the Busy Days

Thank you