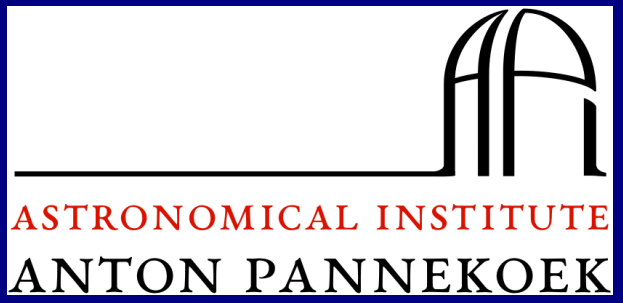
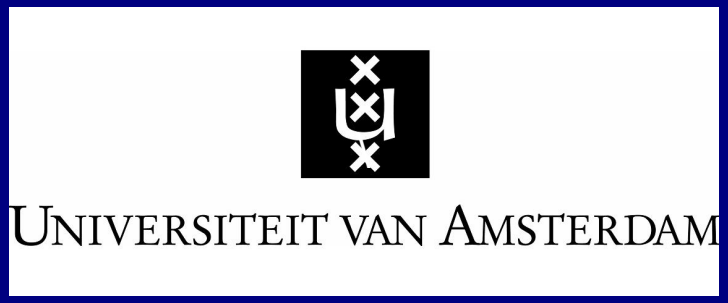




LOFAR & PanSTARRS: Transient Searches in Different Frequency Domains

Dario Carbone

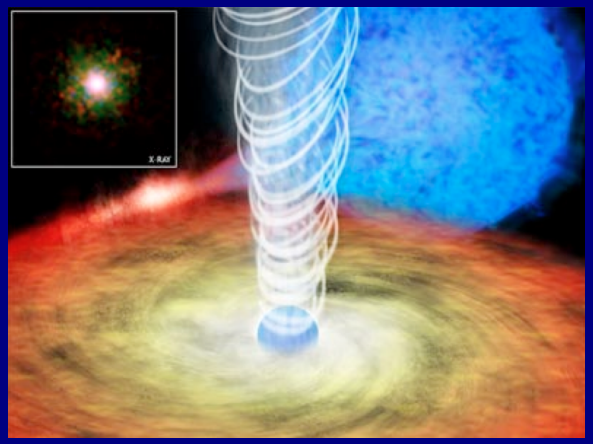
LOFAR: A. van der Horst, A. Stewart, R. Wijers, R. Fender
PanSTARRS: J. Tonry, S. Smartt

Outline

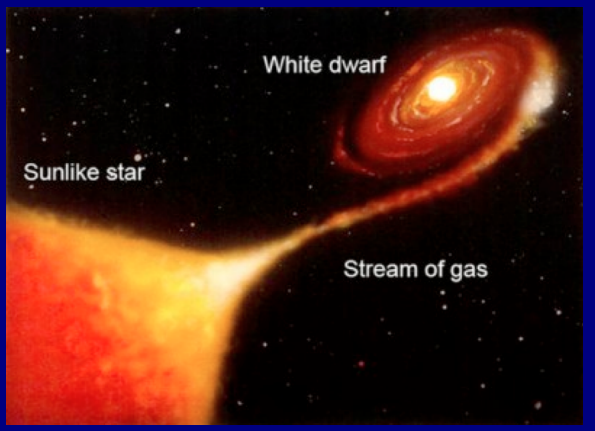
- Science case for transient searches
- Introduction to LOFAR
- Observations
- Analysis techniques
- Future developments

What transients can we expect?

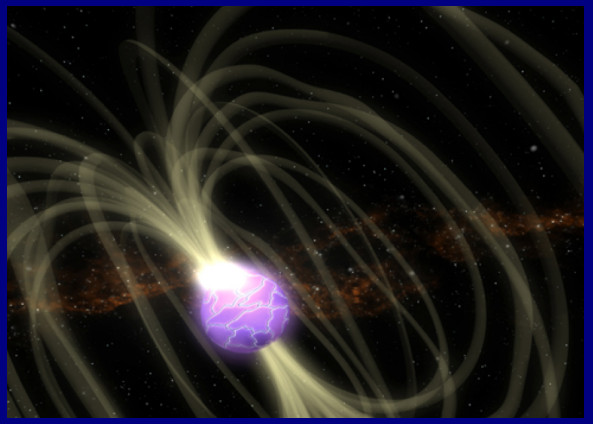
AGN (Zauderer et al. 2011)



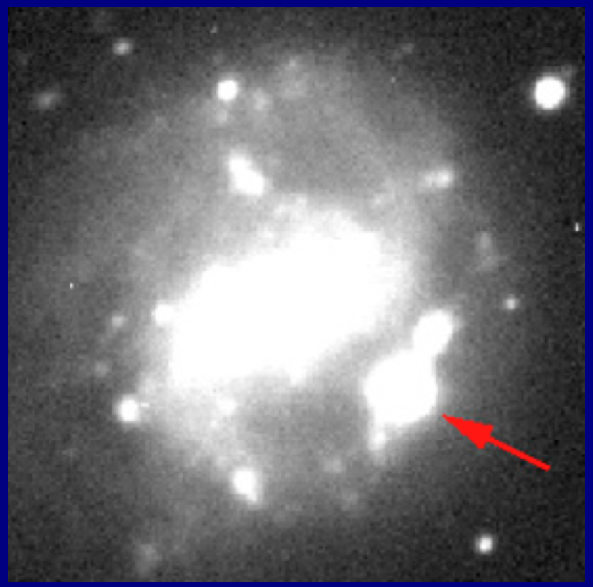
NS & BH (Fender et al. 2004)



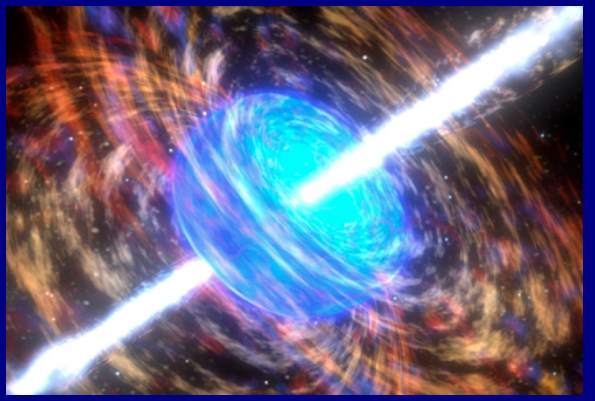
Novae (Kording et al. 2008)



Magnetar (Gaensler et al. 2005)



SNe (Galama et al. 1998)



GRB (Kulkarni et al. 1998)

What transients can we expect?

AGN

2008)

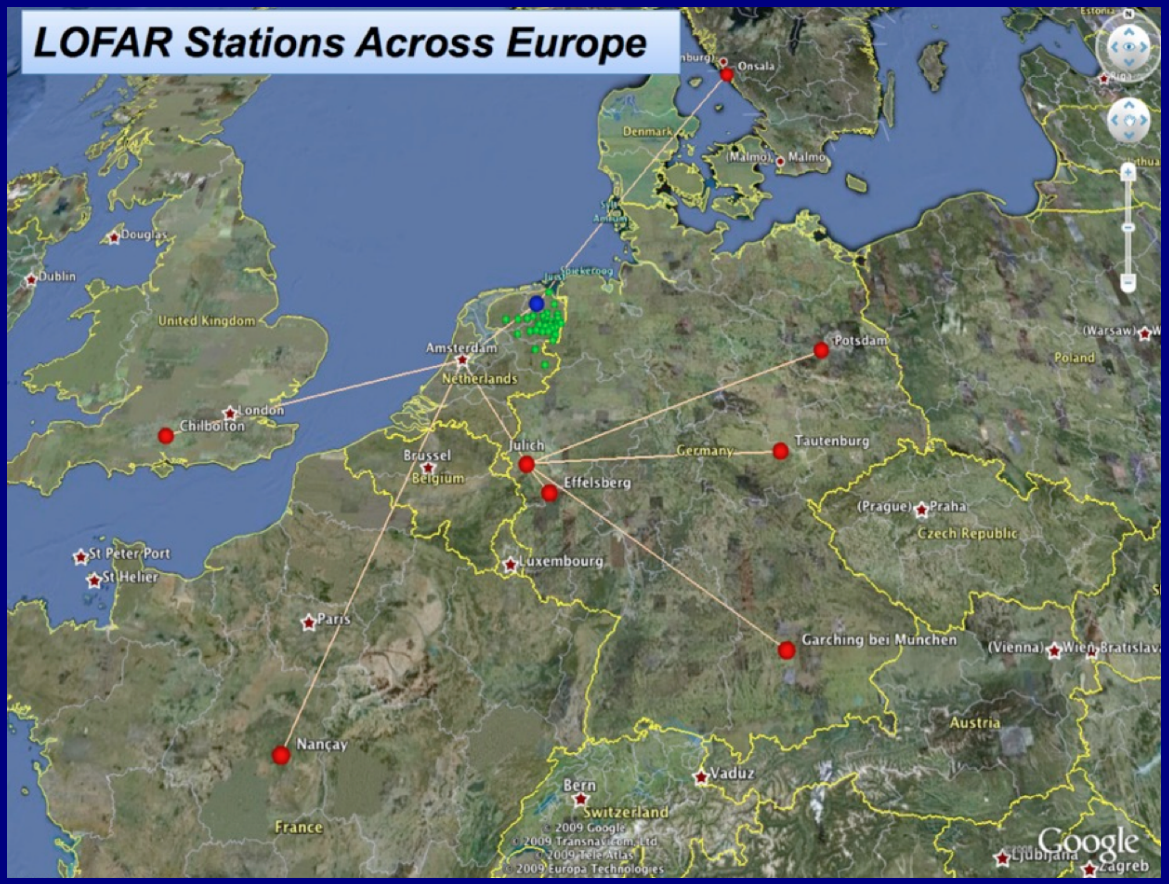
Magnetar (Gaensler et al. 2005)

SNe (Galama et al. 1998)

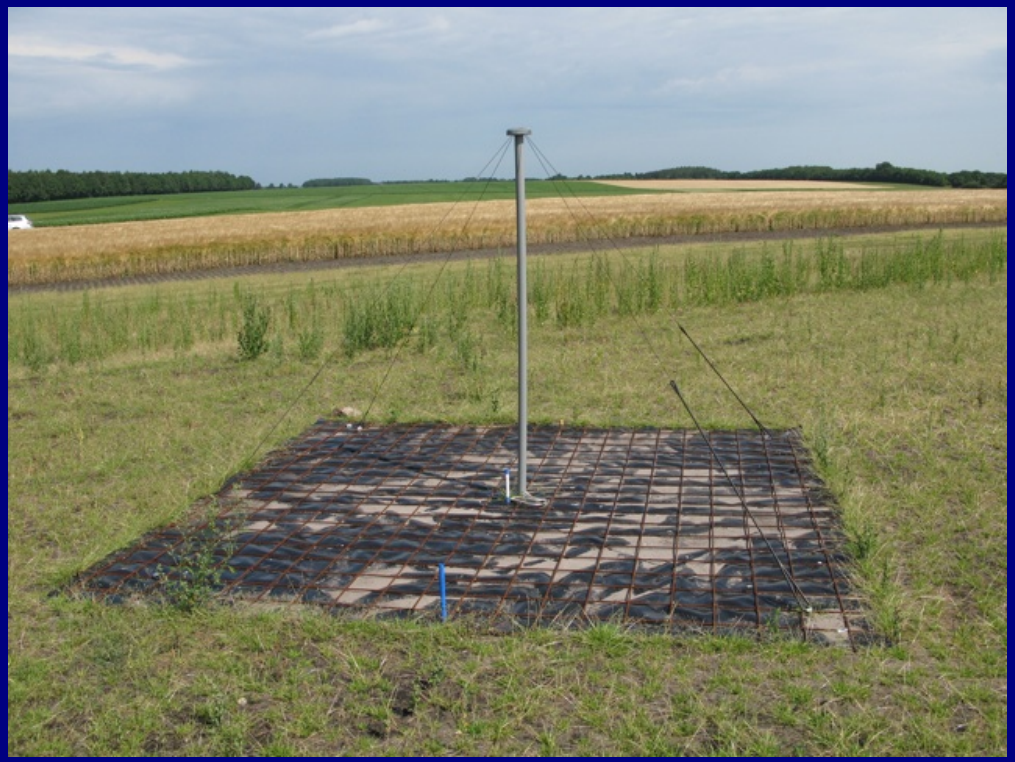
GRB (Kulkarni et al. 1998)

Low Frequency Array

- International collaboration, lead by the Netherlands
- Baselines up to 2000 km (sub arcsec resolution)
- Dutch baselines: ~ 10 arcsec resolution



LOFAR

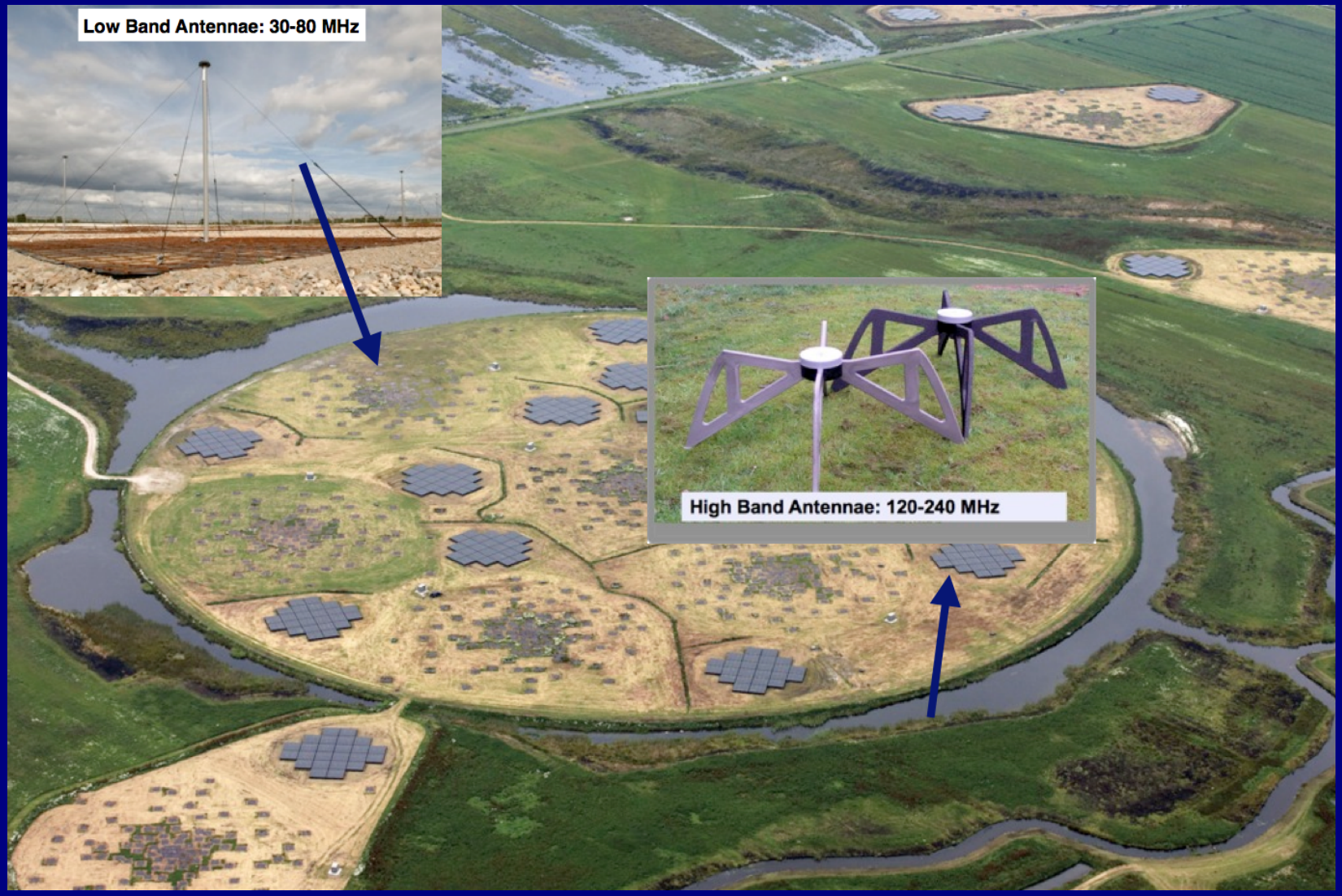


Low Band Antenna
30-80 MHz

High Band Antenna
120-240 MHz

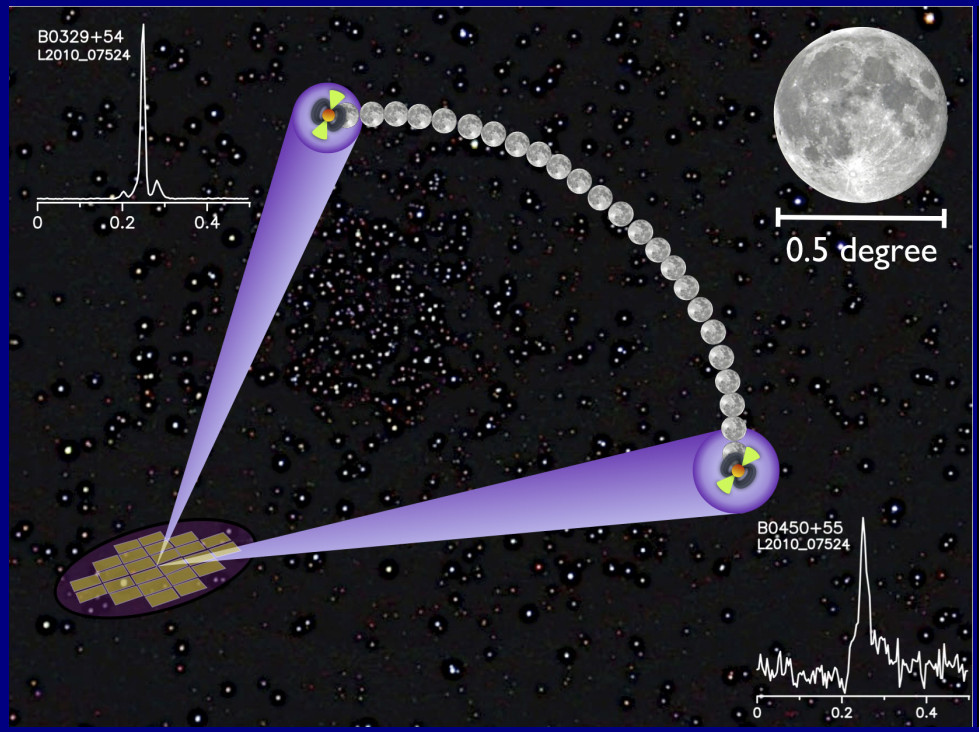
48 stations of dipoles in the Netherlands & in Europe
(one station = hundreds of dipoles)

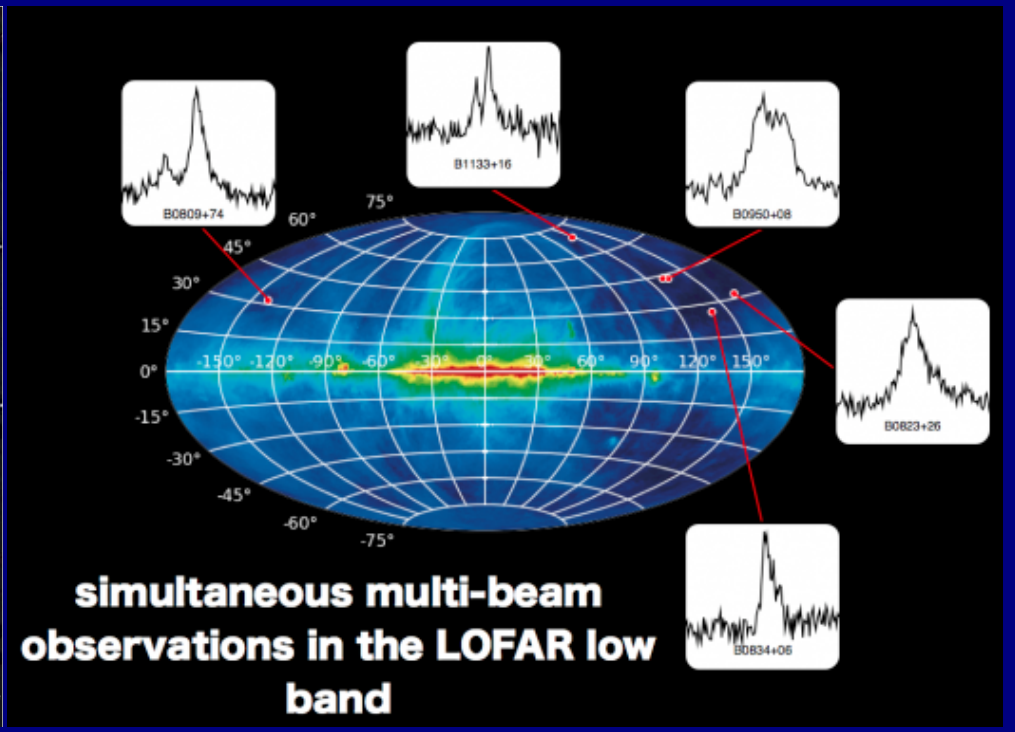
LOFAR Superterp



Sensitivity of 40 mJy/beam in 11 minutes (HBA)

Multiple LOFAR beams





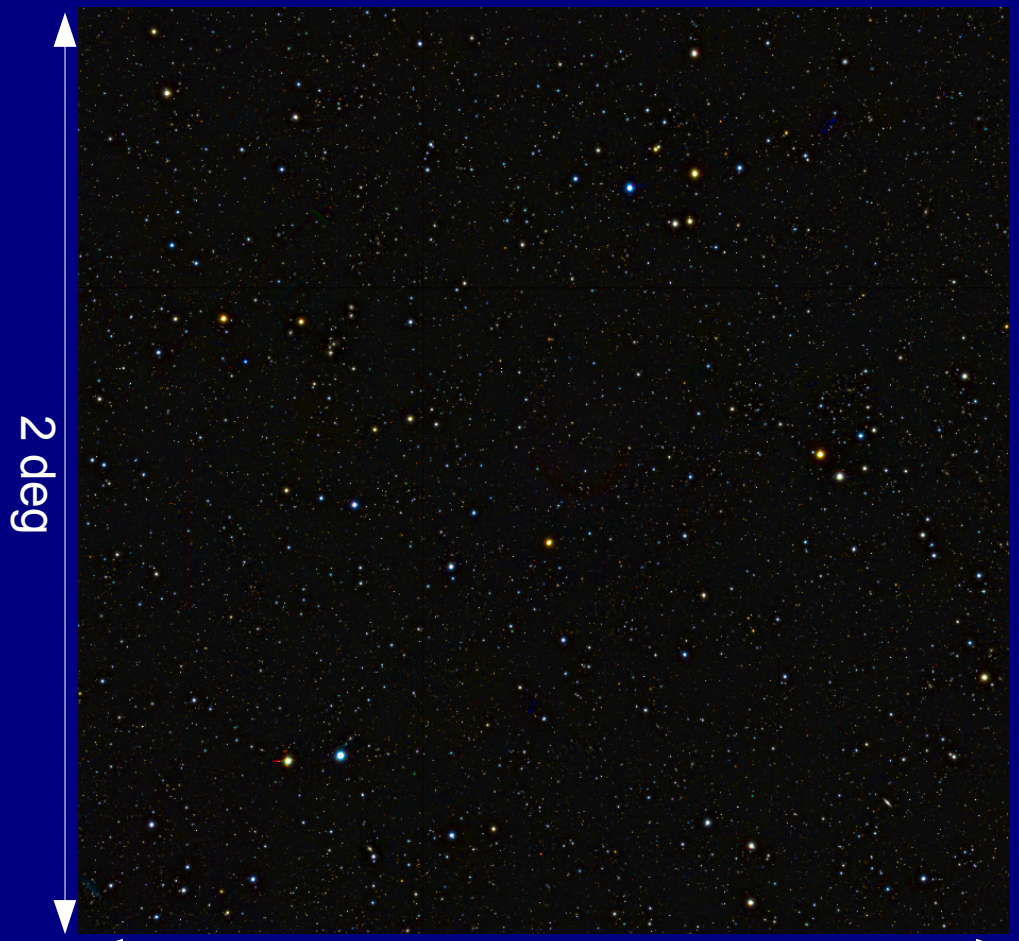
- Aperture array
- Wide field of view
- Digital beamforming → multiple beams (up to 130)

PanSTARRS

- The Panoramic Survey Telescope And Rapid Response System
- 1.8 m telescope on Hawaii
- Survey the entire visible sky in five filters (g, r, i, z, y)
- FOV ~ 9 deg^2

Optical Images

Credits: J. Tonry & S. Smartt



MD03 IFA/Lynx

MD05 Lockman-DXS

LOFAR Observations

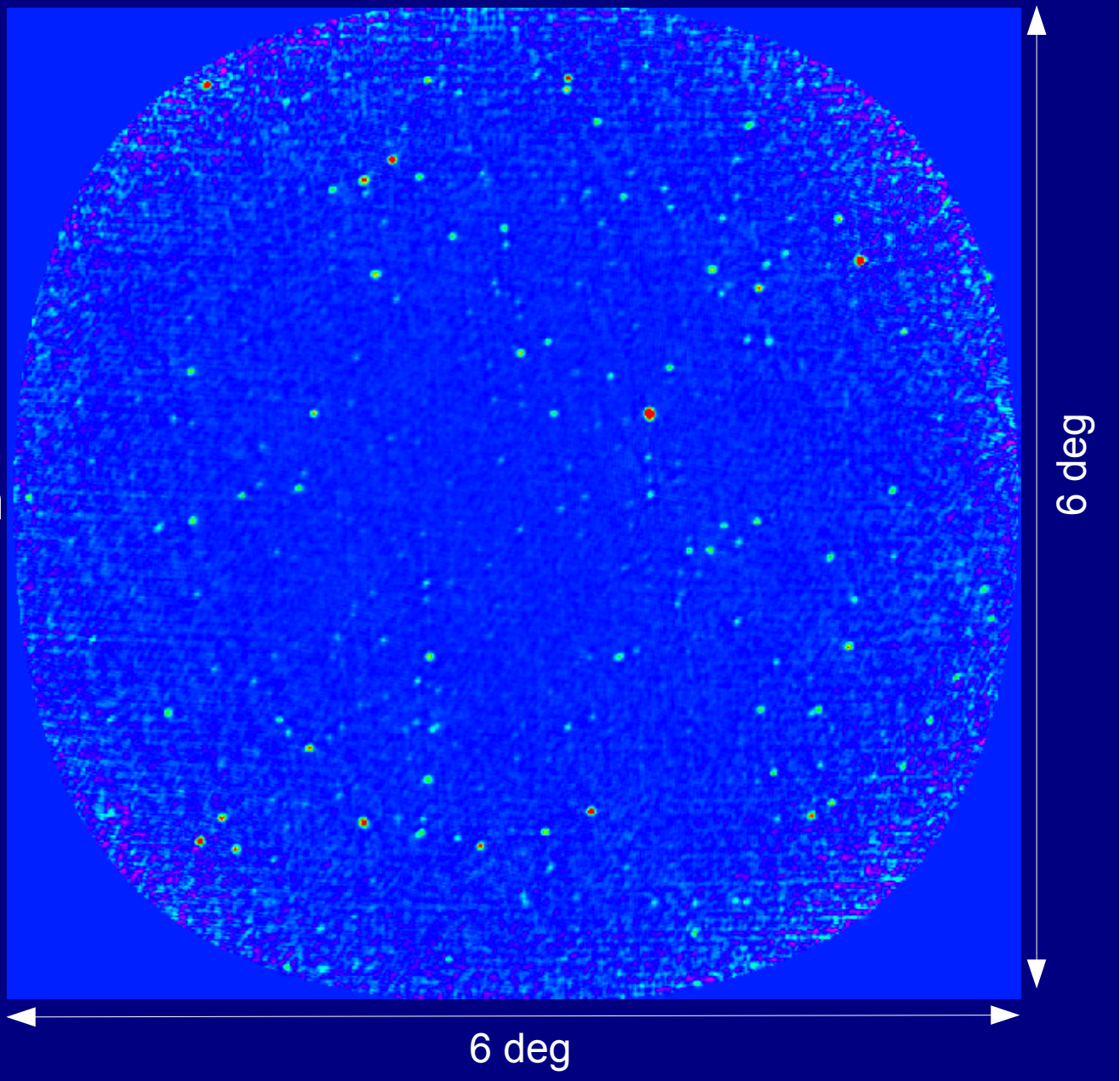
- Observing MD03 and MD05 once every 2 weeks since March 2nd (except March 17th)
- 2 hours – 8 snapshots of 11 minutes
- 6 HBA bands (117 – 156 MHz)
- 2 beams (1 for each field)
- 3C196 as calibrator

Snapshot image of MD03

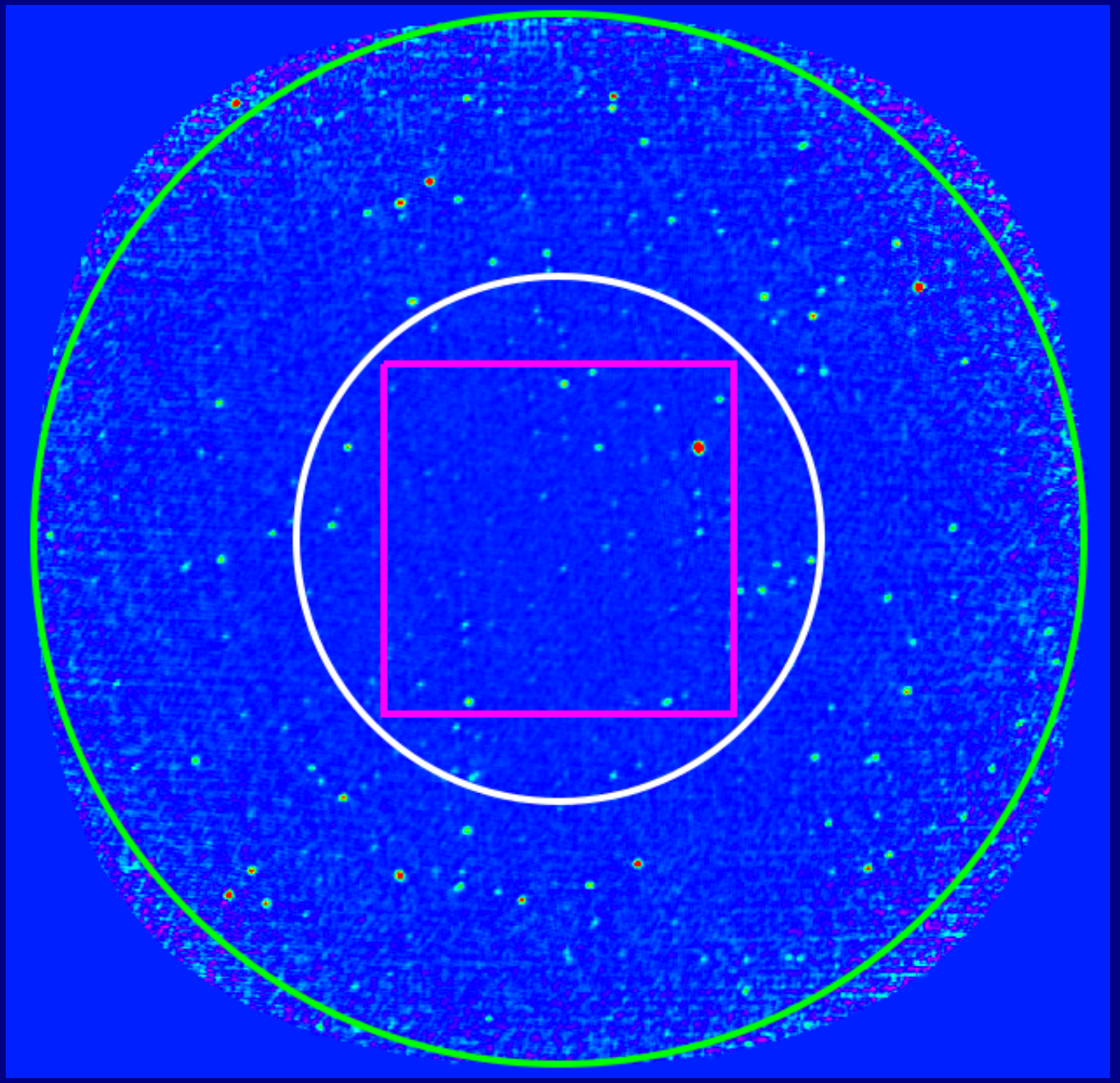
- 11 minute observation
- Full bandwidth
- Inner 6 km of array

- rms noise = 13 mJy/beam

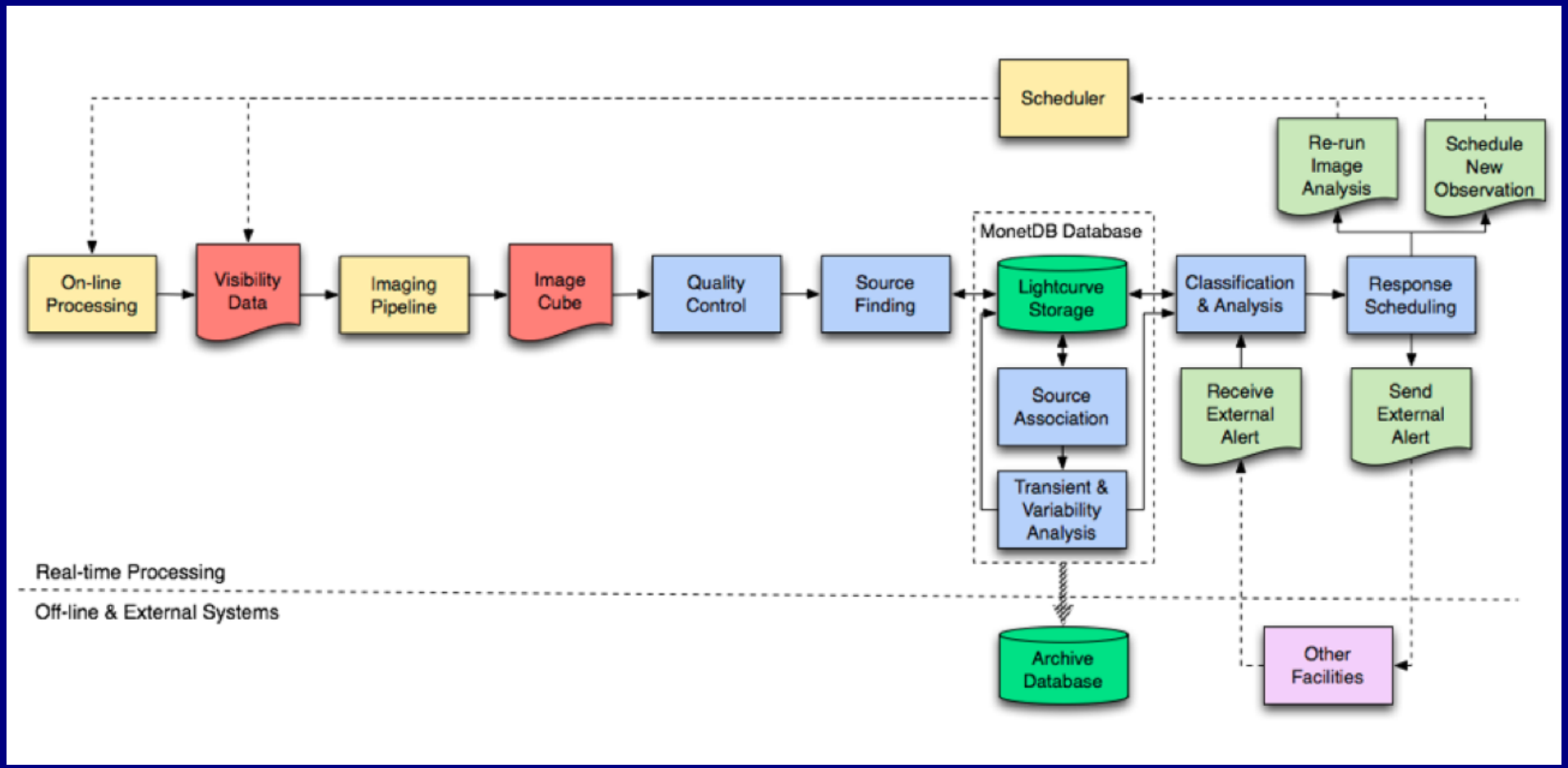
- ~ 250 sources detected



Comparing FOVs

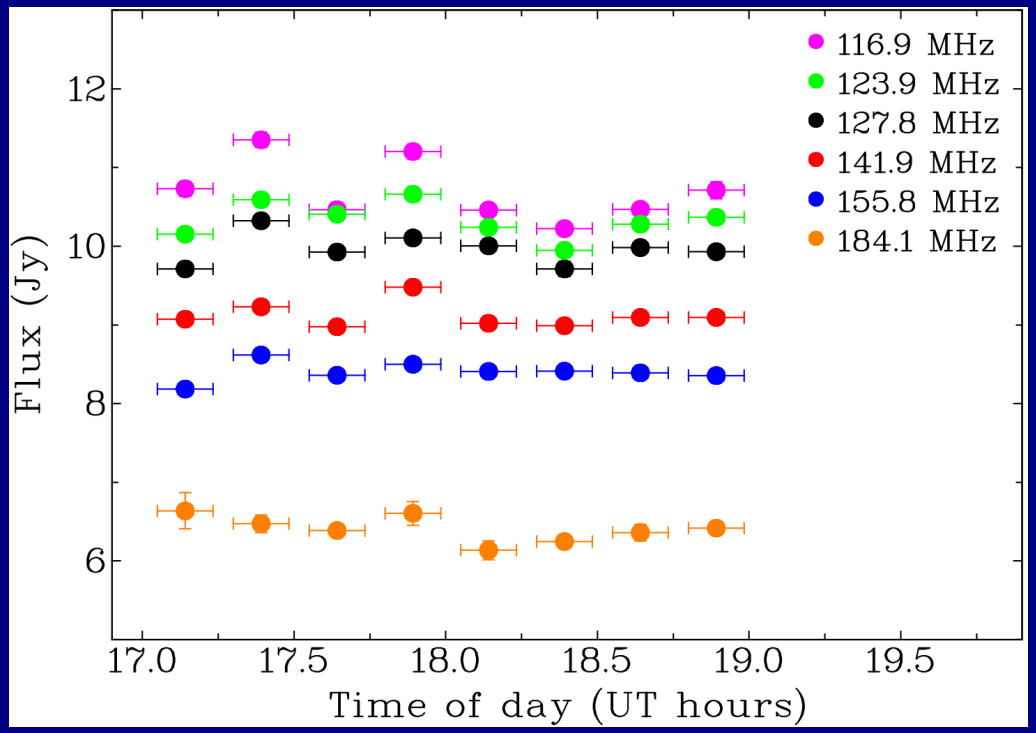


TraP

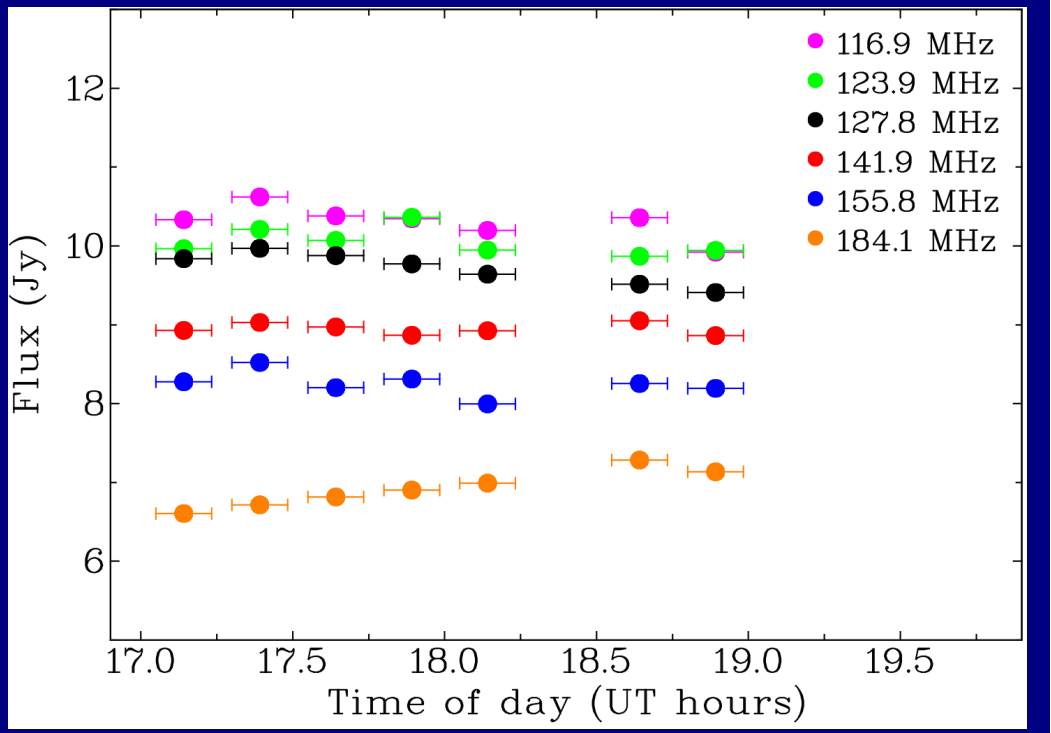


Credits: J. Swinbank

Light Curves



Light curve for March 30th observation

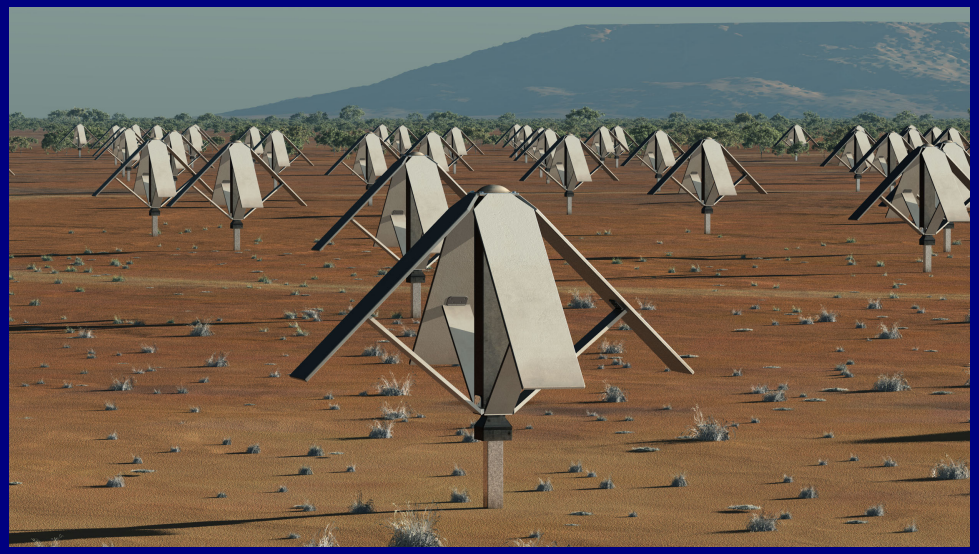


Light curve for April 13th observation

2 weeks

LOFAR: a Pathfinder for SKA

- Split between South Africa and Australia
- Sensitivity 1 μJy (5σ) in 10 hours
- Spatial Resolution < 1 mas



Low Band Antenna:
70 - 300 MHz

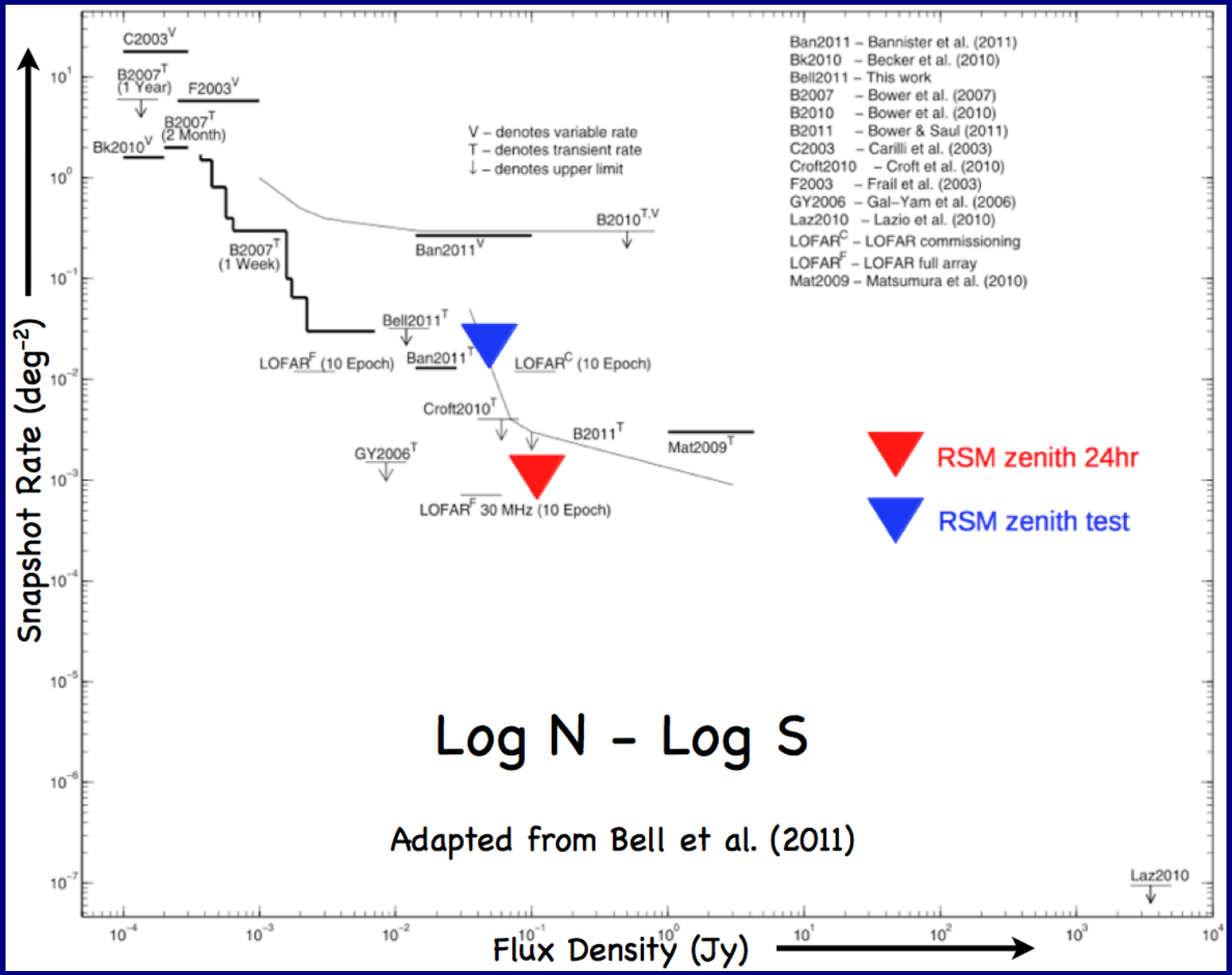
High Band Dishes:
300 MHz - 10 GHz

Conclusions

- LOFAR is starting to collect a lot of data for transient searches at low radio frequency.

- LOFAR – PanSTARRS project:
  - searching for transients in optical and radio
  - LOFAR observations of Medium Deep Fields
  - transient searches on different timescales, from tens of minutes to weeks

Transients rate



Credits: J. Broderick