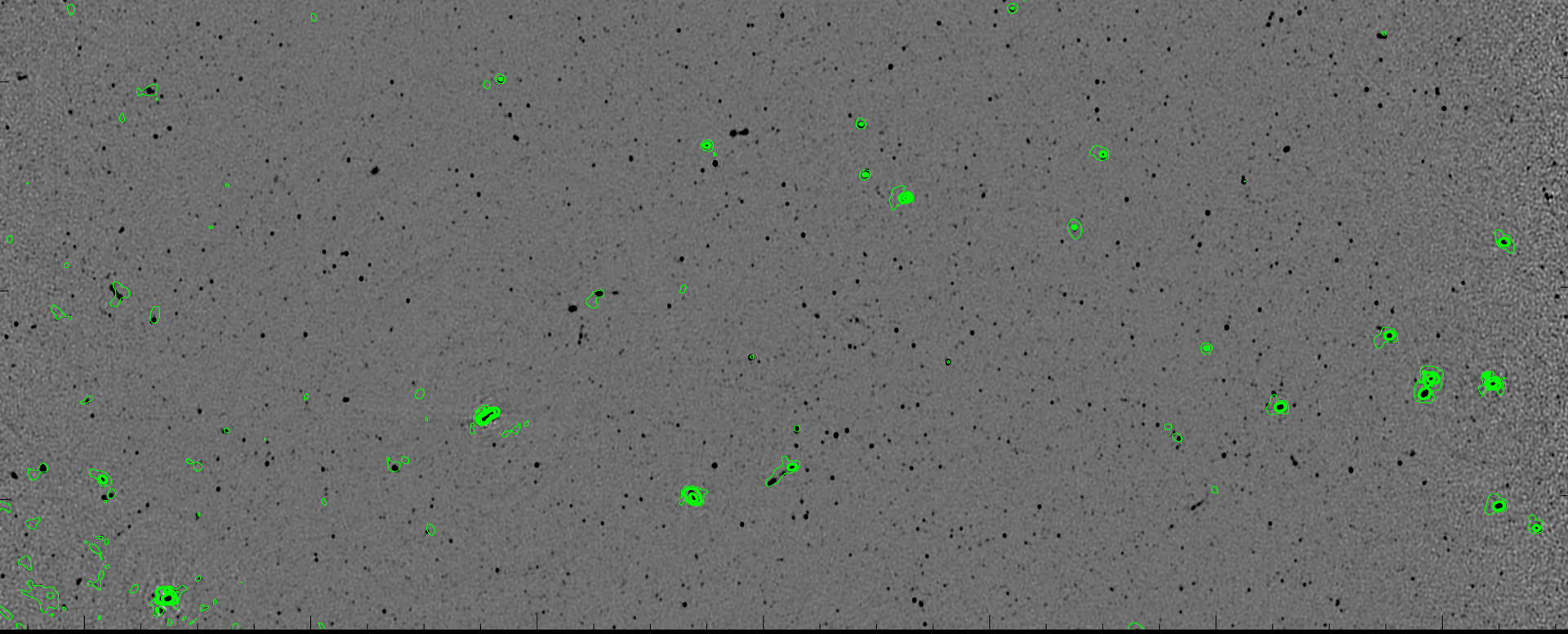


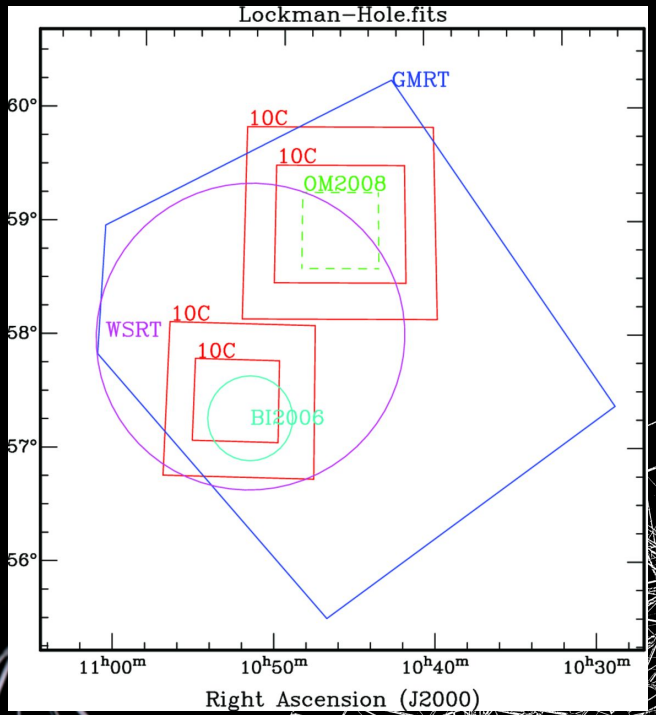
The Lockman Hole with LOFAR

Elizabeth Mahony, Ilse van Bemmel, Raffaella Morganti, Isabella Prandoni and many others in the Surveys KSP.

ASTRON
Netherlands Institute for Radio Astronomy

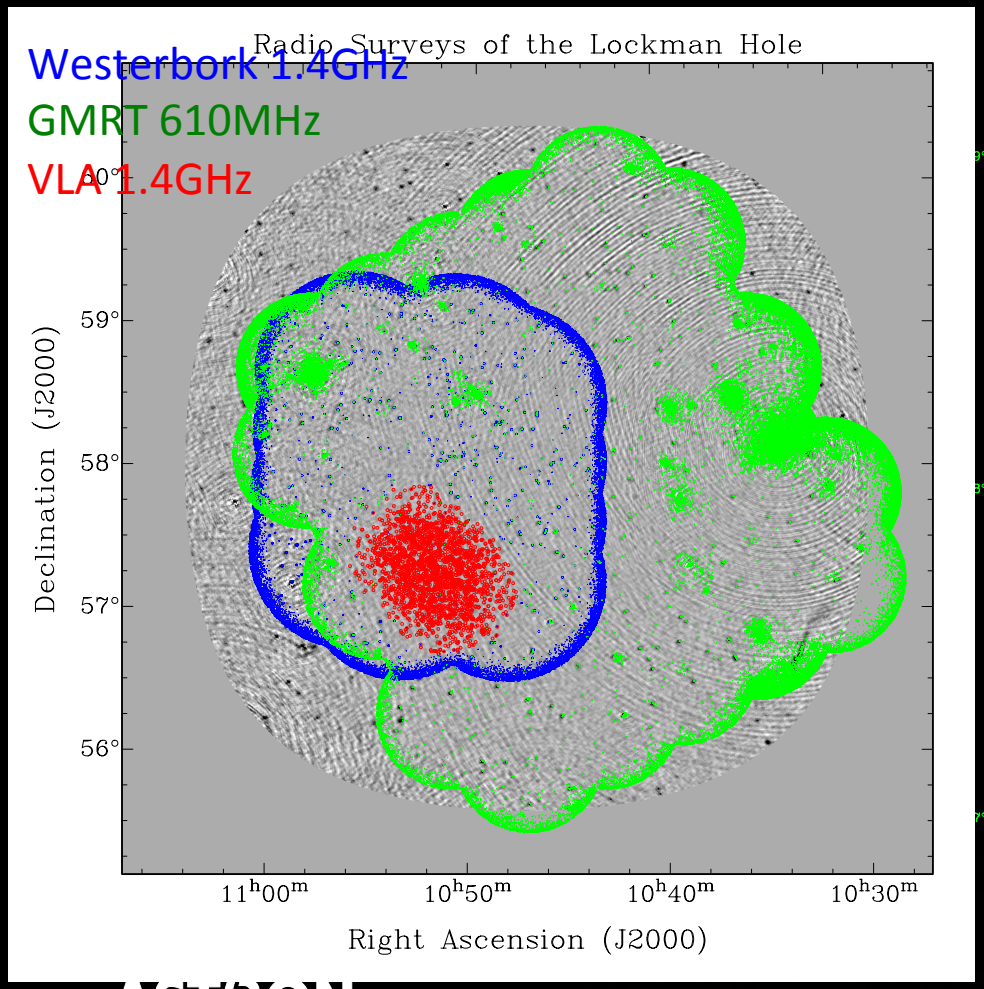
The Lockman Hole

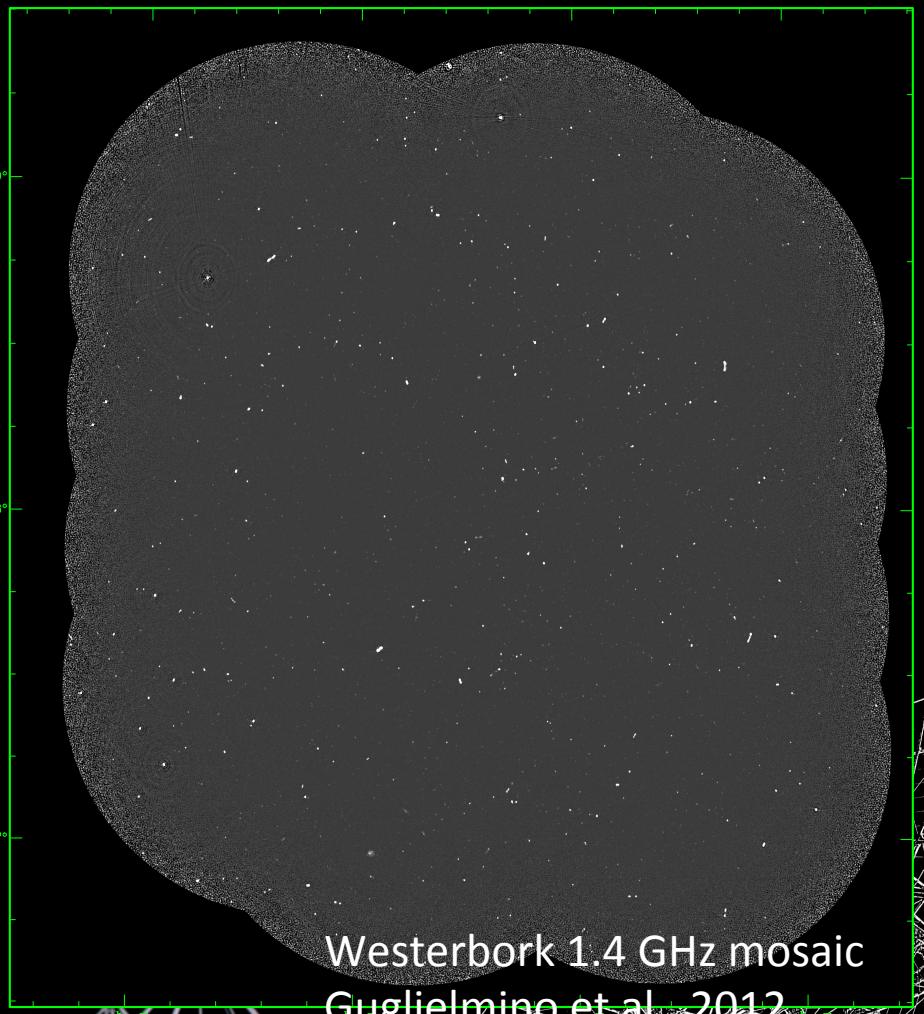
- Observed as part of the “Blank Fields” working group in the Surveys KSP (PI: Philip Best)
- Extensive multiwavelength data:
  - PanSTARRS, UKIDSS, SERVS, SWIRE, HerMES, VLA, GMRT, WSRT, Chandra, SCUBA, SCUBA-2, Galex
- Multiwavelength radio data covering a wide range in frequency:
  - WSRT: 1.4 GHz, 7 deg^2, 11 uJy
  - WSRT: 350 MHz, 0.7 mJy
  - GMRT: 610 MHz, 5 deg^2, 60 uJy
  - VLA: 1.4 GHz, 1 deg^2, 6 uJy
  - 10C: 15 GHz, 4.5 deg^2, 0.1 mJy



Whittam et al., 2013

The Lockman Hole





Westerbork 1.4 GHz mosaic
Guglielmino et al., 2012

Observations + data reduction

- HBA observations
  - 10 hr observations, 366 subbands (70 MHz bandwidth)
  - 3C196 + 3C295 observed for 10 mins at beginning and end

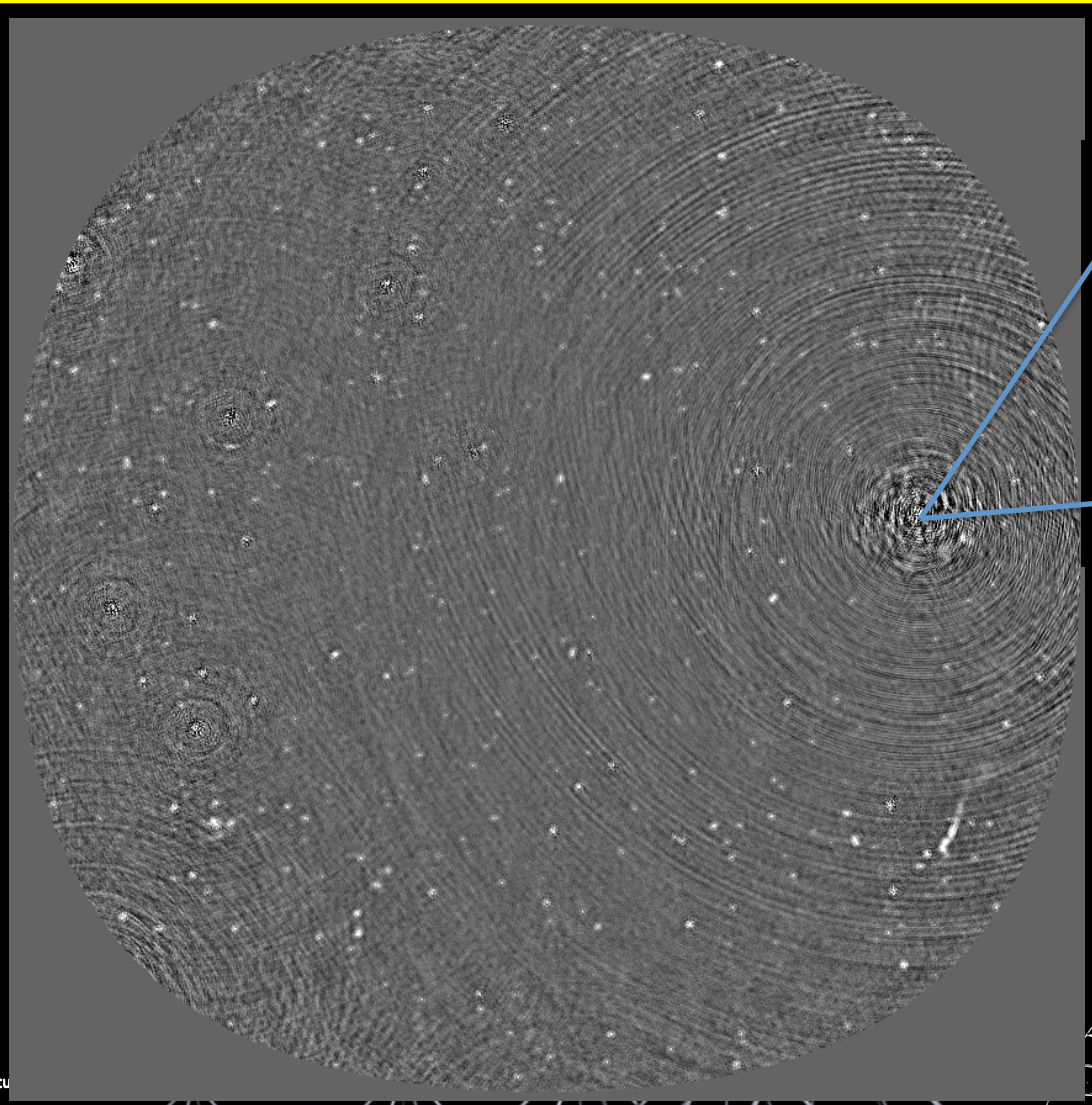
- Data reduction:
  - Preprocessing (RFI flagging/averaging – 5sec, 4 channel per SB)
  - Solve for amplitude solns on primary calibrator (3C295)
  - Transfer solutions (both amp and phase) to Lockman Hole
  - Combine SBs into groups of 10 (2 MHz bandwidth)
  - Solve for phase-only solutions on Lockman Hole field
  - Peel 3C244.1 (~30 Jy source in the field)
  - Phase cal again
  - Image

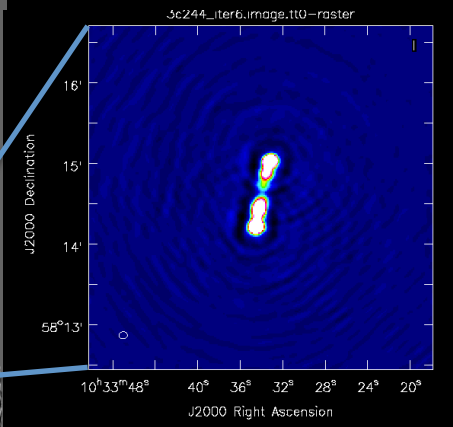
Peeling 3C244.1

Image quality before subtracting 3C244.1

– 30 Jy source ~2 degrees from phase centre

This image is 10sb, ~30arcsec resolution

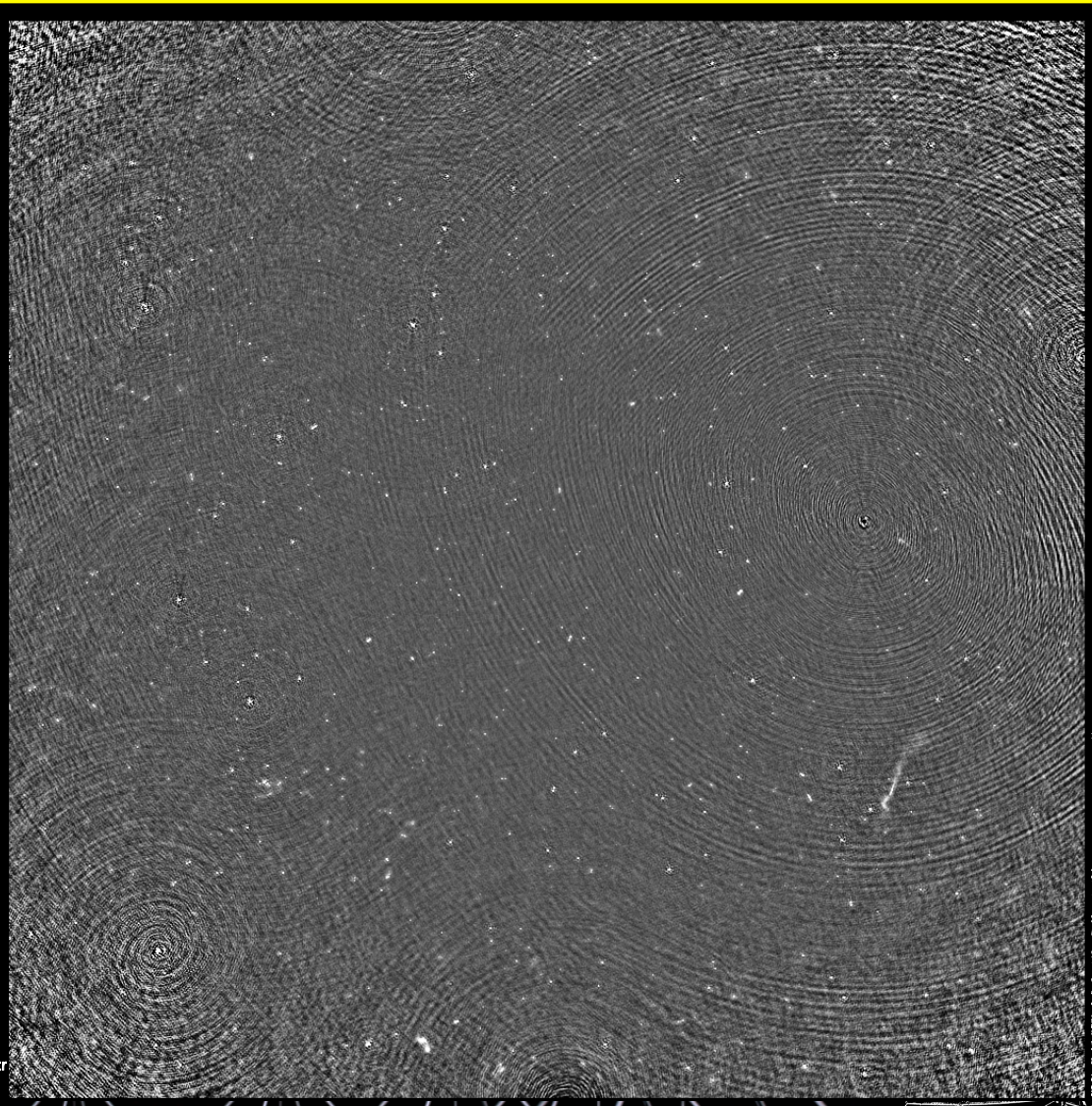




ASTRON
Netherlands Institu

Peeling 3C244.1

Despite improving the skymodel of 3C244.1, residuals <1% still clear throughout the image.



ASTRON

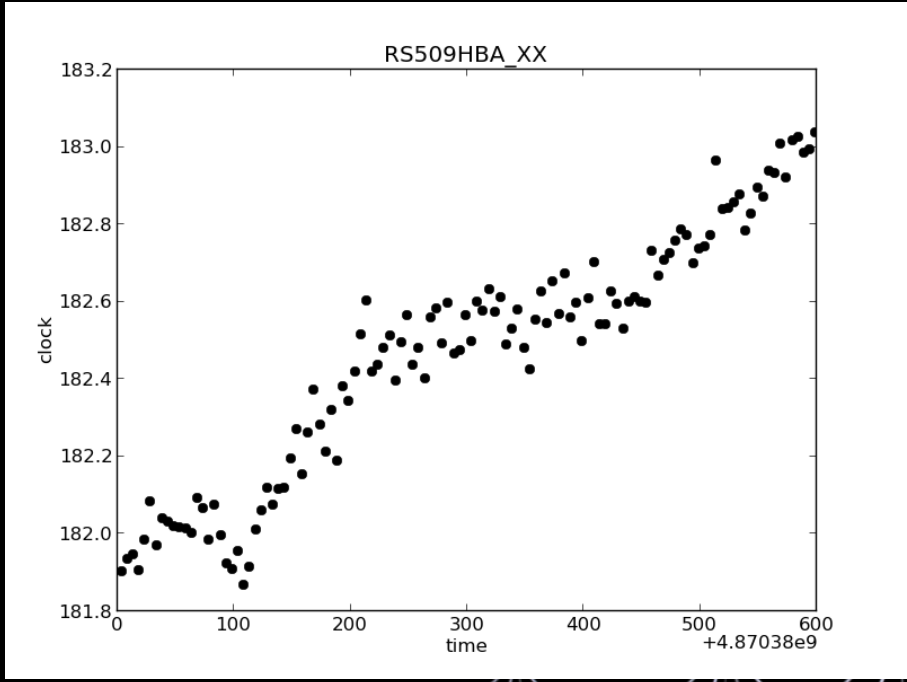
Netherlands Institute for Radio Astr

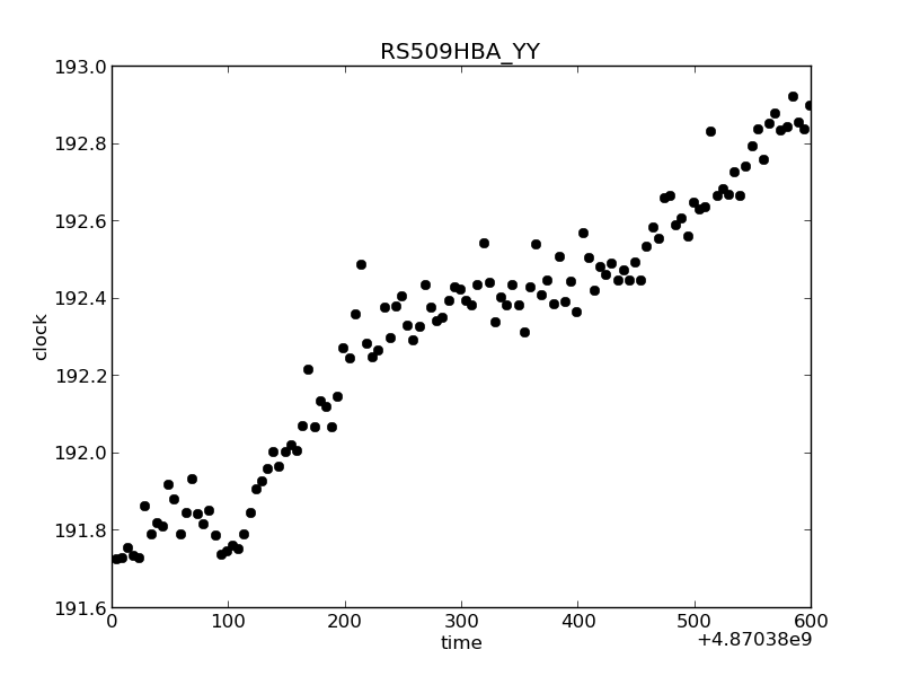
Peeling 3C244.1

The problem: clock errors.

The longest baselines have clock errors >180ns. When combining 10SB this leads to phase decorrelation within the band and therefore can't be calibrated properly.

Solution: Instead of just transferring the amplitude solutions from the calibrator, transfer amp + phase (where the clock solutions will be accounted for in the phase solns)



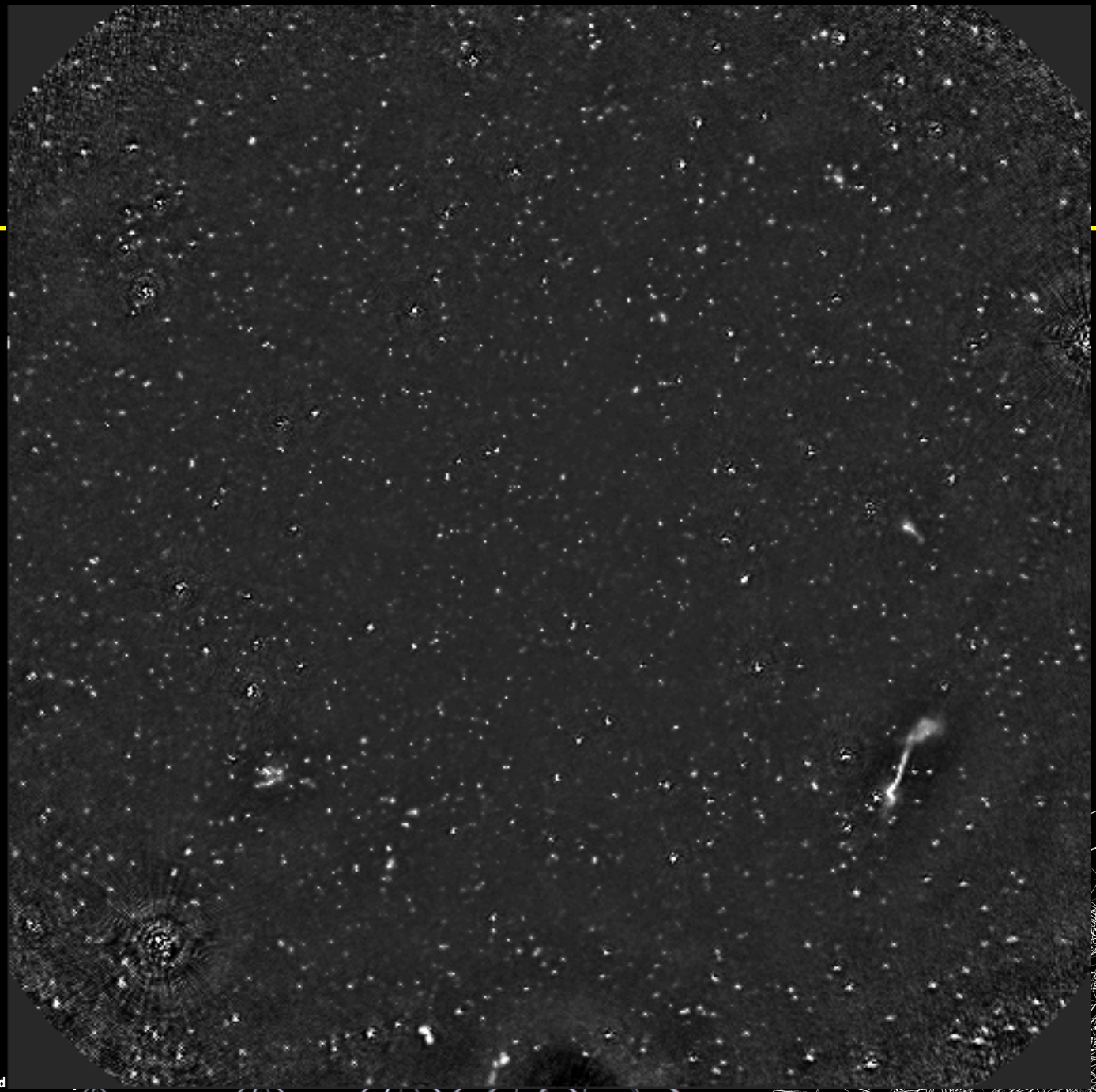


300 subbands

res. 28”

rms ~0.6 mJy/bm

~3000 sources



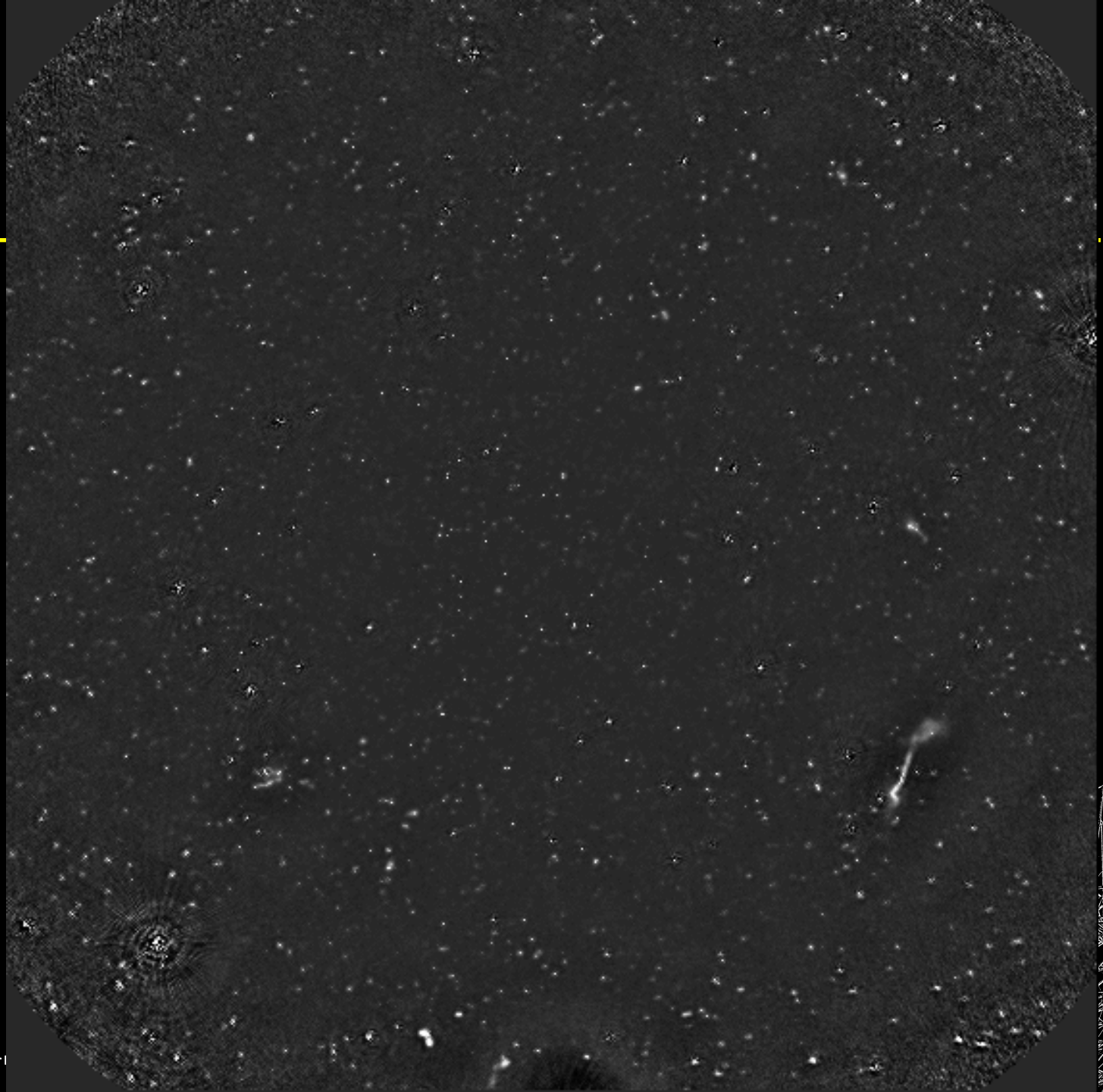
ASTRON

Netherlands Institute for Rad

300 subbands

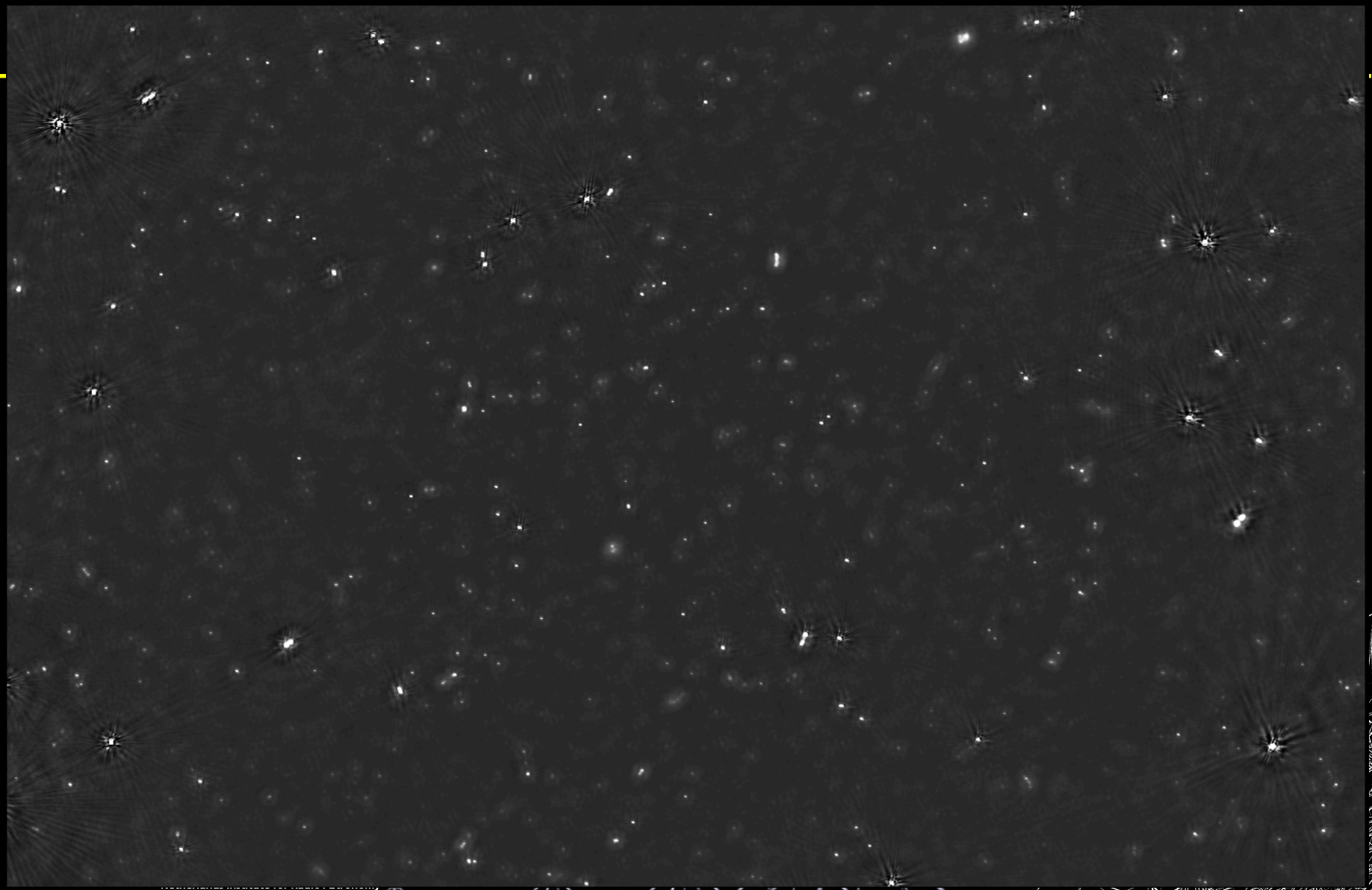
res. 14”

rms ~0.4 mJy/bm

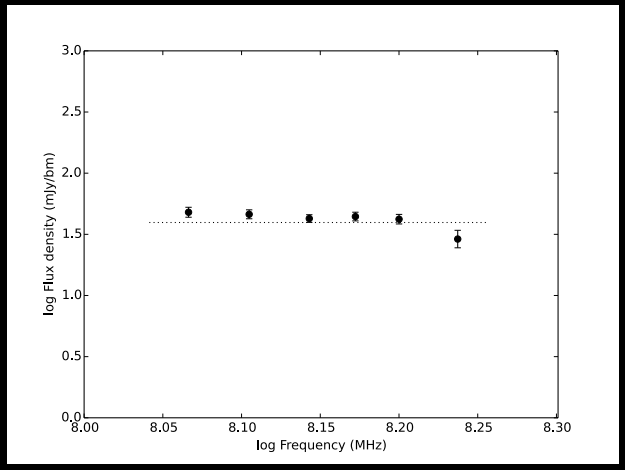


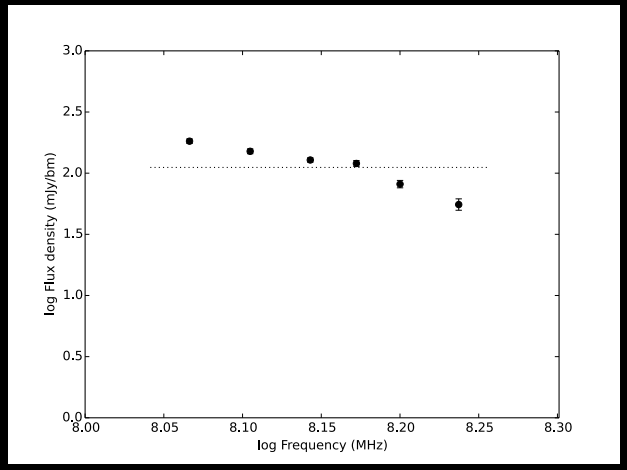
ASTRON

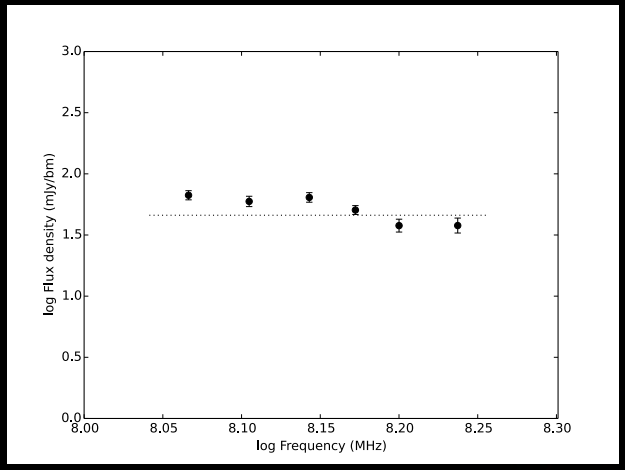
Netherlands Institute for

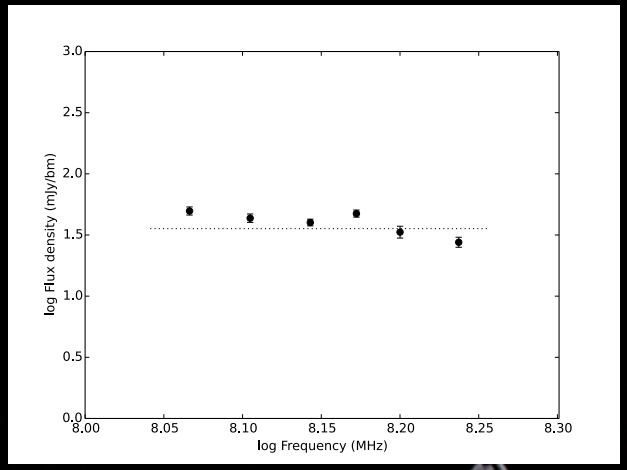


SEDs









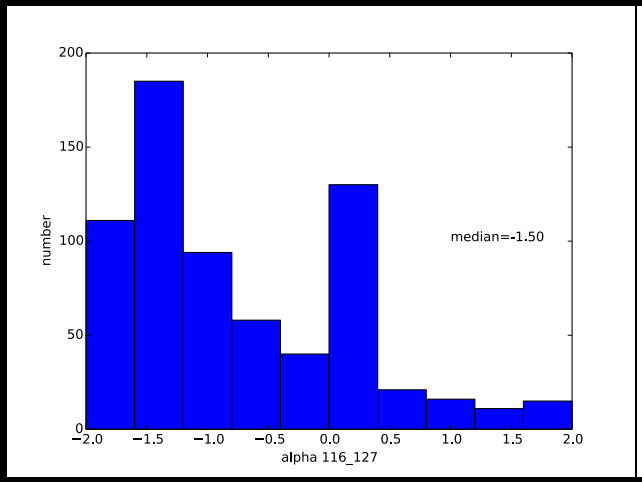
Badness ☹

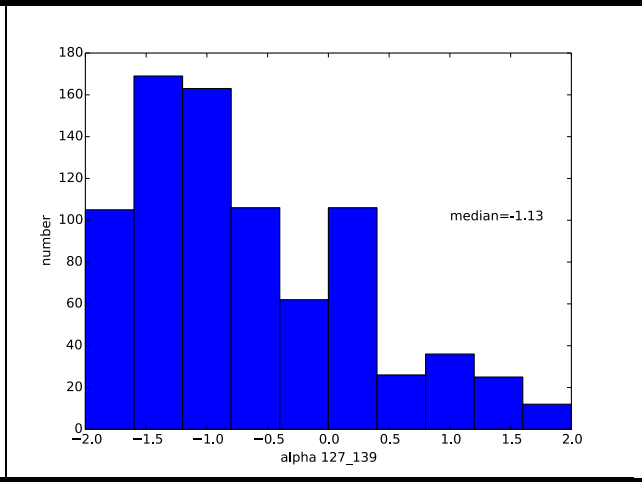
Sources in general too steep

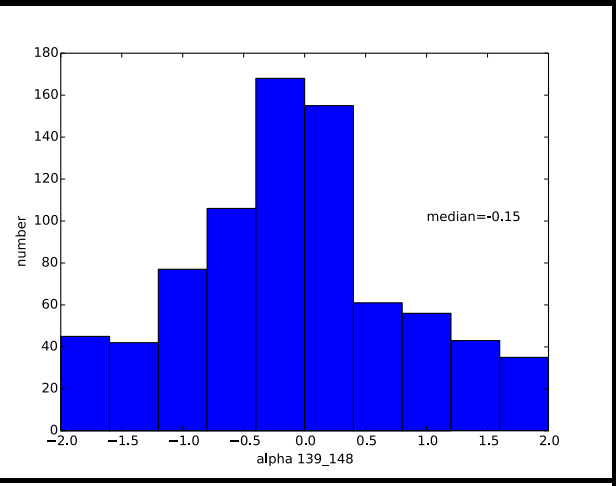
-> probably due to incorrect beam model

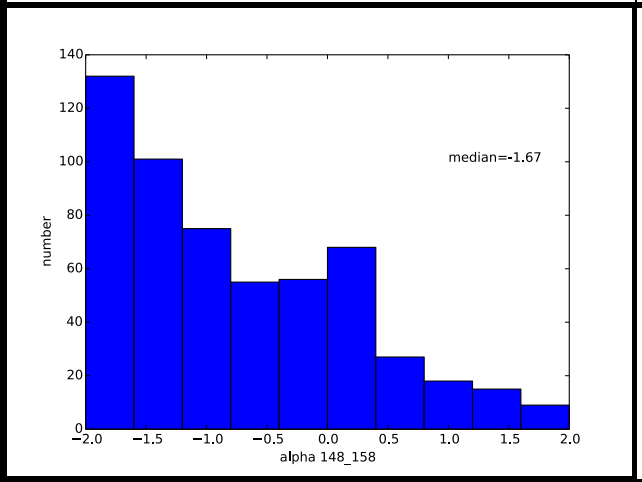
(See George's talk from previous LSMs)

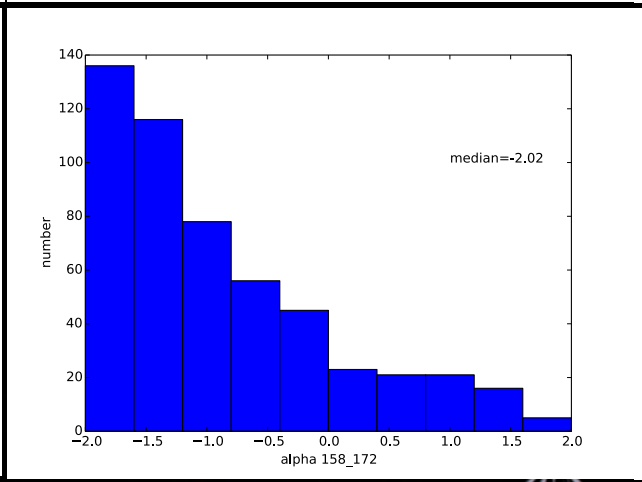
Spectral index distributions

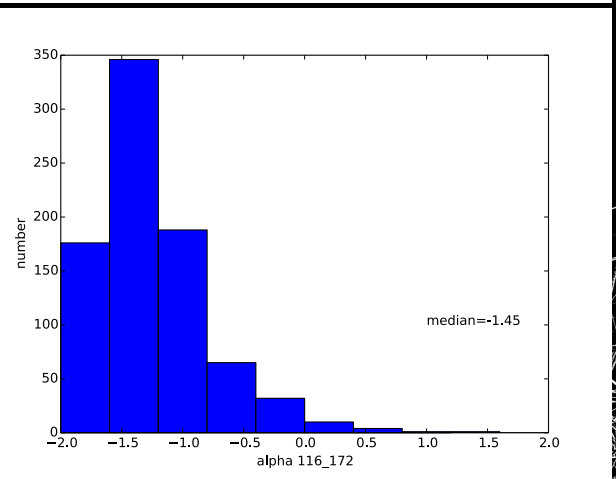






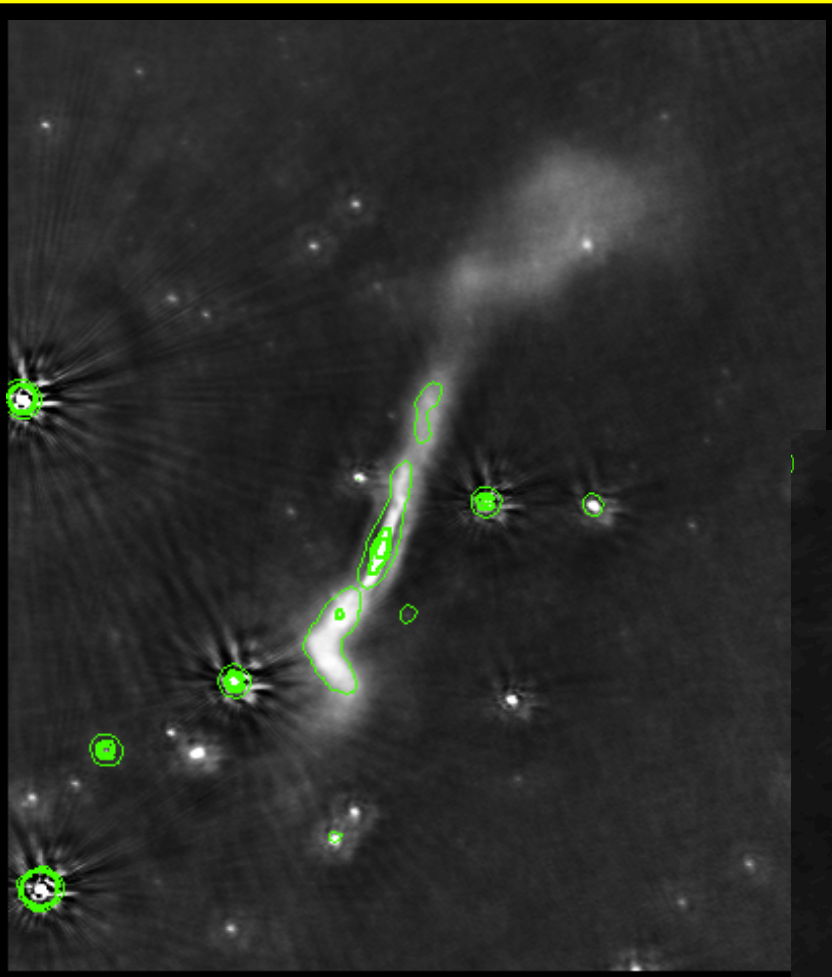






ASTRON
Netherlands Institute for Radio Astronomy

Interesting sources in the field



1029+5702

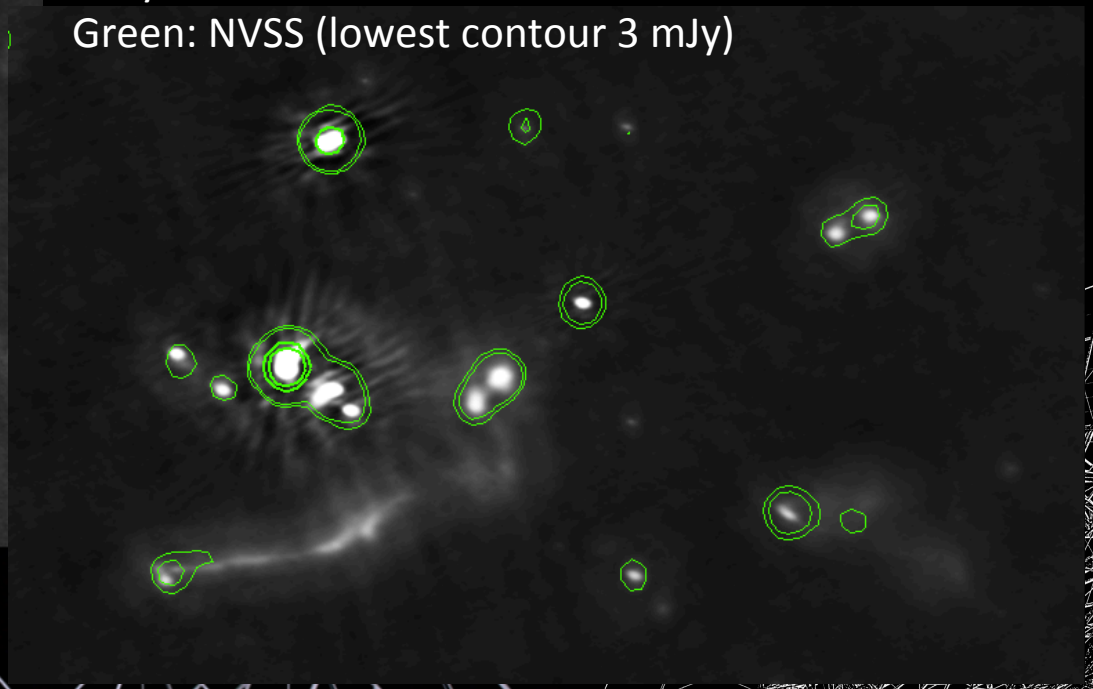
Greyscale: LOFAR

Green: NVSS (lowest contour 5 mJy)

Abell 1132 + WAT nearby?

Greyscale: LOFAR

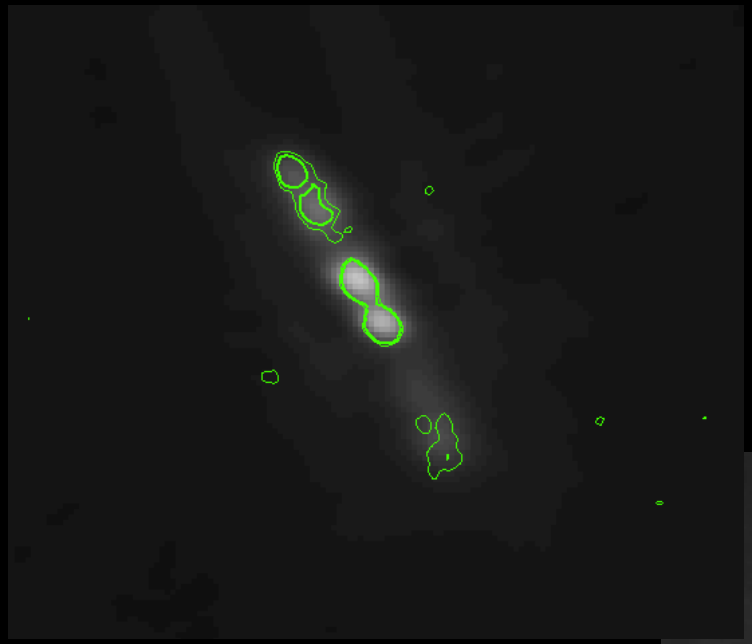
Green: NVSS (lowest contour 3 mJy)

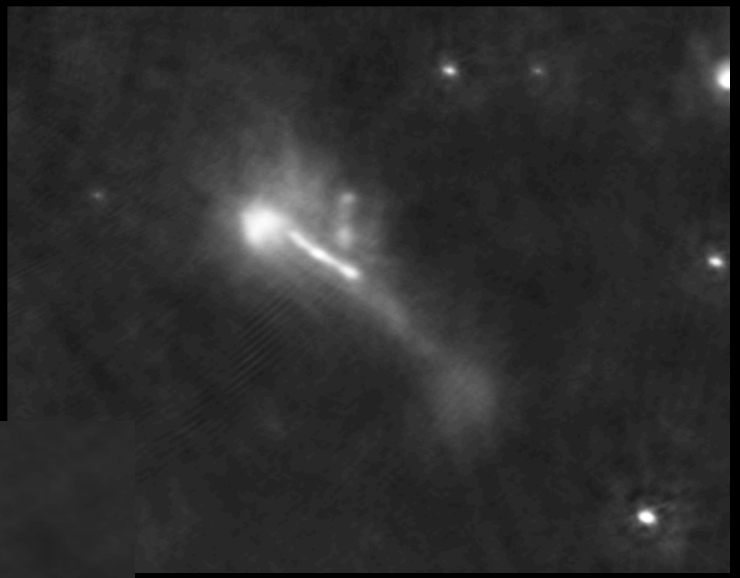


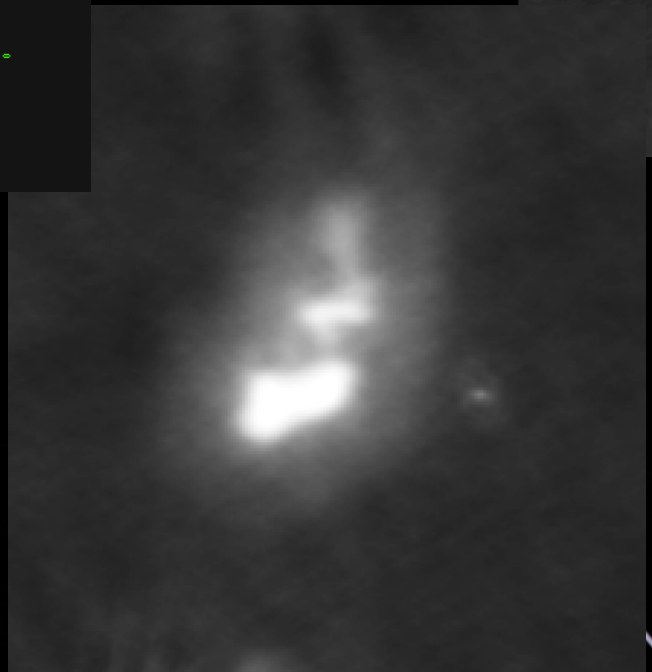
ASTRON

Netherlands Institute for Radio Astronomy

Interesting sources in the field







Greyscale: LOFAR

Green: GMRT 610 MHz

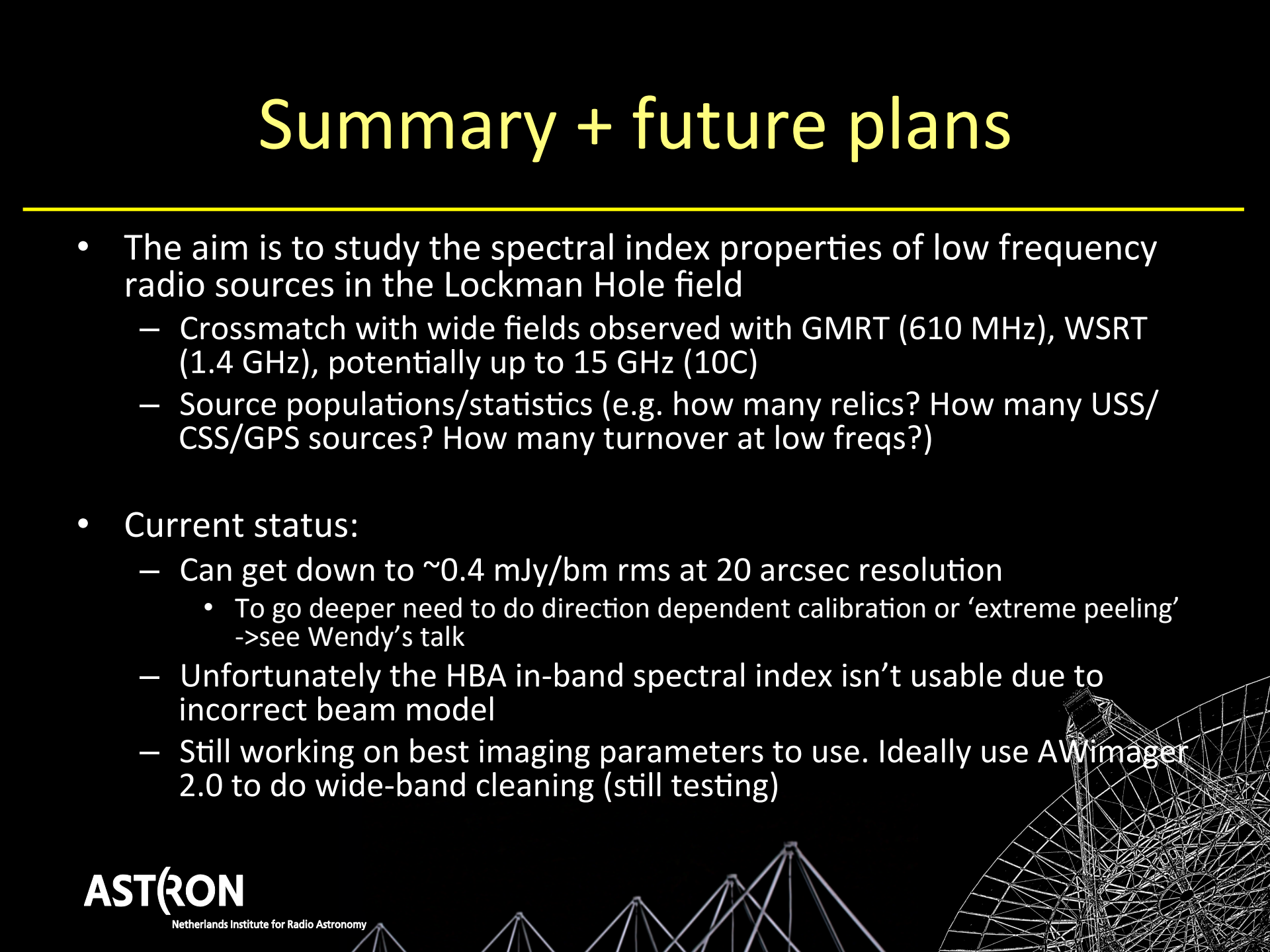
ASTRON

Netherlands Institute for Radio Astronomy

Summary + future plans

- The aim is to study the spectral index properties of low frequency radio sources in the Lockman Hole field
  - Crossmatch with wide fields observed with GMRT (610 MHz), WSRT (1.4 GHz), potentially up to 15 GHz (10C)
  - Source populations/statistics (e.g. how many relics? How many USS/ CSS/GPS sources? How many turnover at low freqs?)

- Current status:
  - Can get down to ~0.4 mJy/bm rms at 20 arcsec resolution
    - To go deeper need to do direction dependent calibration or 'extreme peeling' ->see Wendy's talk
  - Unfortunately the HBA in-band spectral index isn't usable due to incorrect beam model
  - Still working on best imaging parameters to use. Ideally use AWimager 2.0 to do wide-band cleaning (still testing)



ASTRON
Netherlands Institute for Radio Astronomy

ASTRON

Netherlands Institute for Radio Astronomy