

15/9/2011

Giant elliptical galaxy

Virgo A with LOFAR

Or:

“how to reduce 28 k seconds of data in 5 M seconds of work to obtain one million of pixels”

Virgo cluster:

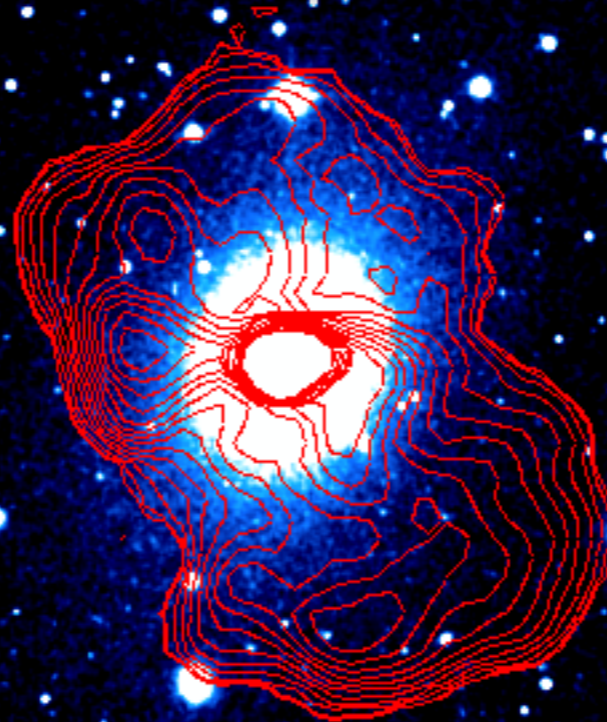
Distance: 16 Mpc

Closest cluster

Gas stripping

Mergers

AGN activity...



Virgo A:

Size (core): 5 kpc

Size (halo): 80 kpc (16')

BH mass: $10^9 M_{\odot}$

Amorphous source

Francesco de Gasperin

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The Observations

LBA (low):

15 - 30 MHz

16 Jul 2011

28805 s (~8 h)

25 antennas

LBA (high):

30 - 77 MHz

14/15 Apr 2011

28810 s (~8 h)

24 antennas

HBA (dual):

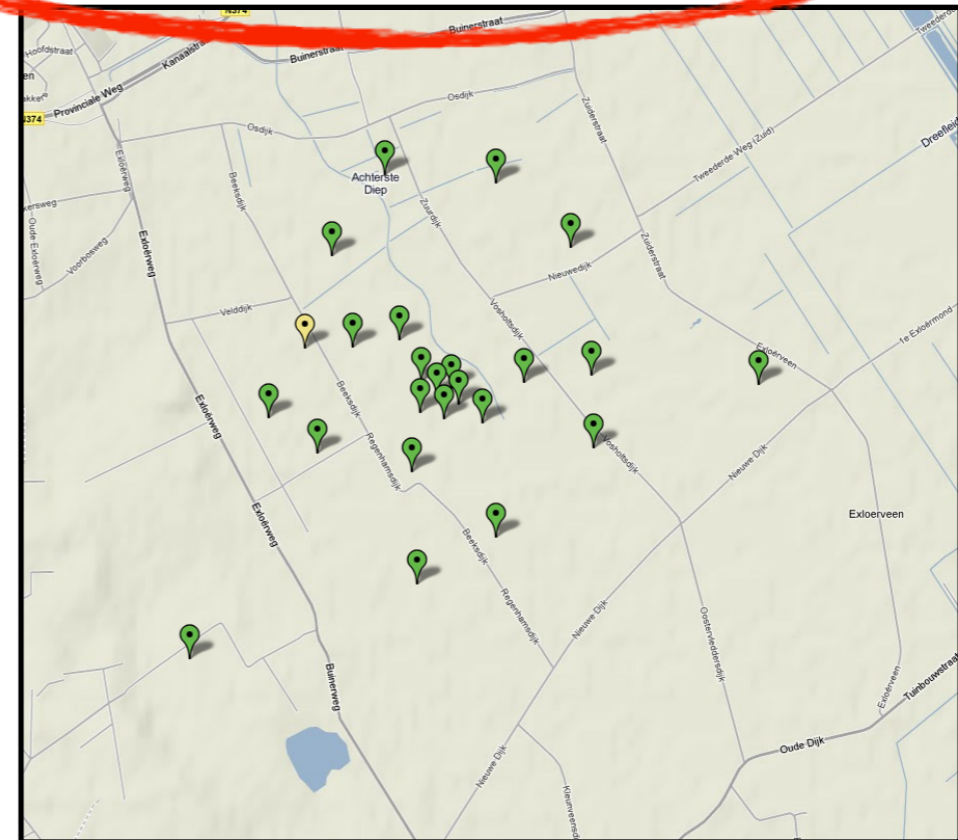
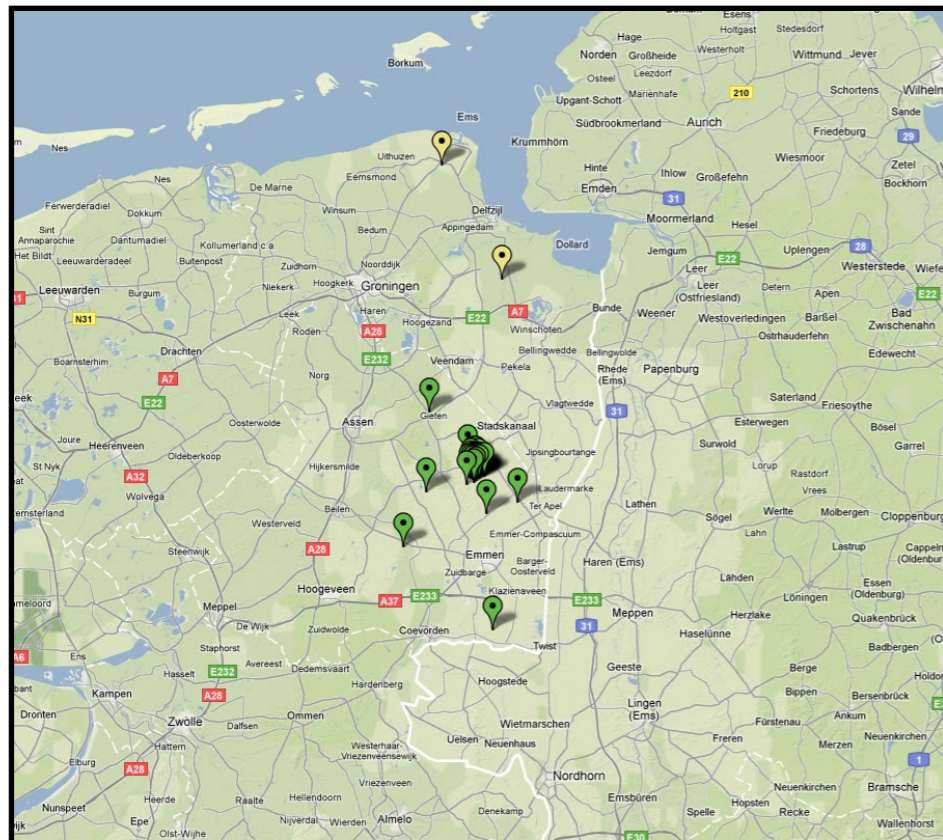
115 - 162 MHz

2/3 Apr 2011

28810 s (~8 h)

45 antennas

ear-ear BL flagged



The Calibration

LBA (low):

15 - 30 MHz
16 Jul 2011
28805 s (~8 h)
25 antennas

LBA (high):

30 - 77 MHz
14/15 Apr 2011
28810 s (~8 h)
24 antennas
demixed

HBA (dual):

115 - 162 MHz
2/3 Apr 2011
28810 s (~8 h)
45 antennas
ear-ear BL flagged

AOFlagger (flag)

~~Demixing~~

NDPPP (compress)

BBS (calibrate)

CASA (imaging)  10x

Good model for this frequencies.

Long BL: OK

Short BL: residual from A-team

The Calibration

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15 - 30 MHz
16 Jul 2011
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25 antennas

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24 antennas
demixed

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115 - 162 MHz
2/3 Apr 2011
28810 s (~8 h)
45 antennas
ear-ear BL flagged

AOFlagger (flag)

Demixing (compress)

NDPPP (flag)

BBS (calibrate)

CASA (imaging)



Good model for this frequencies.

Long BL: OK

Short BL: *residual from A-team?*

The Calibration

LBA (low):

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30 - 77 MHz
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28810 s (~8 h)
24 antennas
demixed

HBA (dual):

115 - 162 MHz
2/3 Apr 2011
28810 s (~8 h)
45 antennas
ear-ear BL flagged

AOFlagger (flag)

NDPPP (compress)

CASA (calibrate)

CASA (imaging)

30x

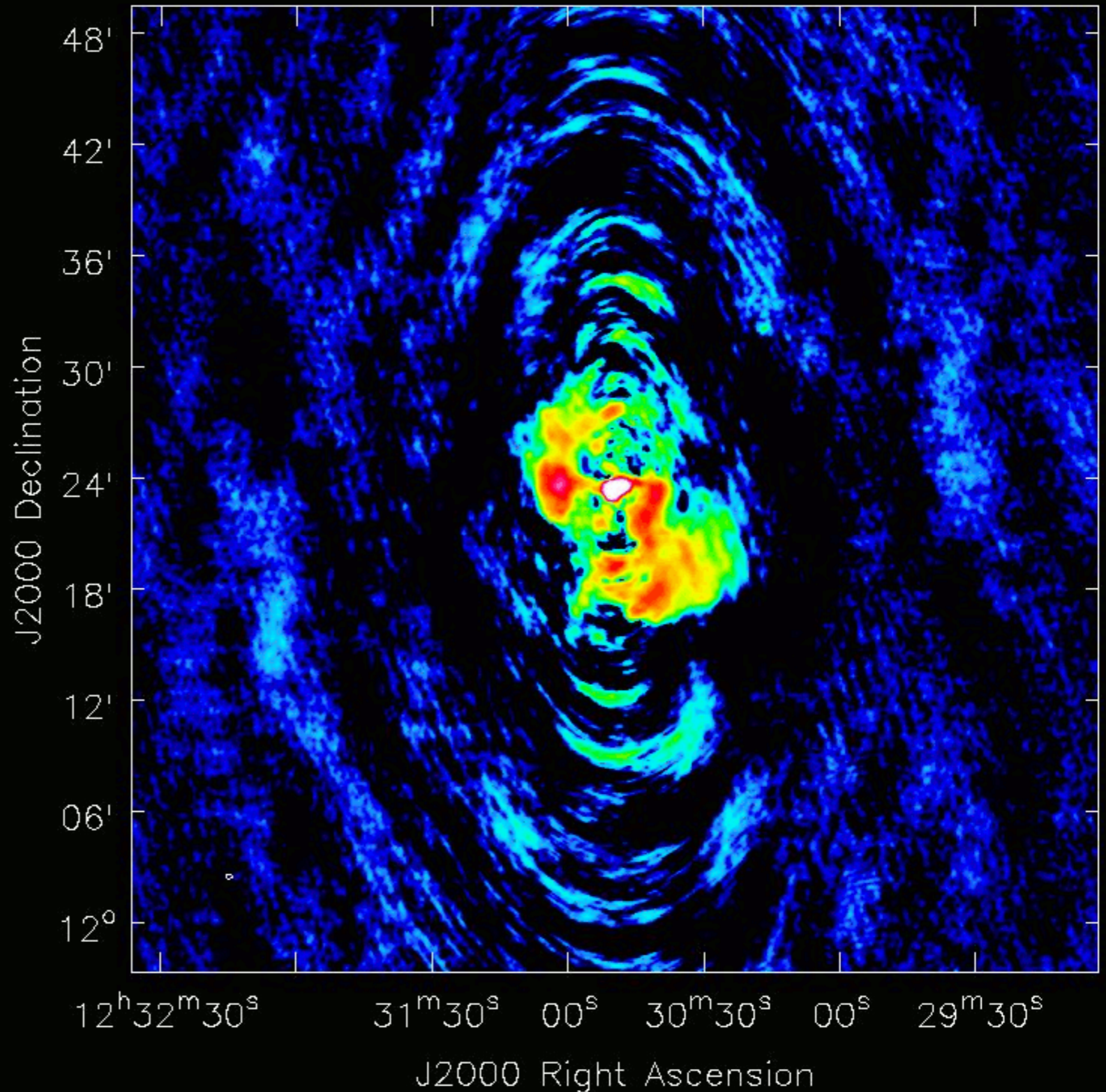
Bad model for this frequencies.

Long BL: *poorly calibrated*

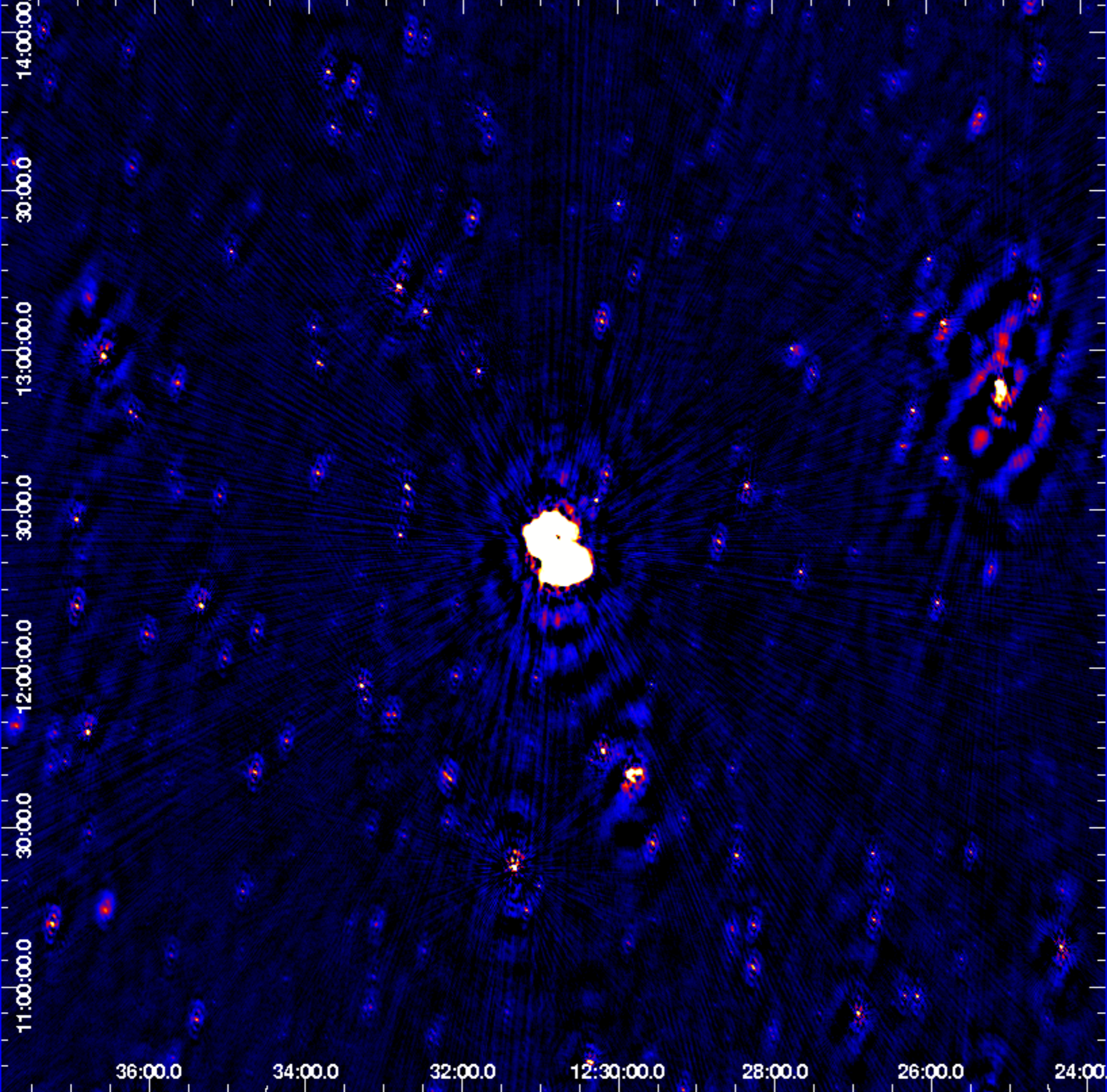
Short BL: OK

The Calibration

HBA
selfcal



Imaging: mix of clean (core) +
MEM (extended) +
DD calib & subtract

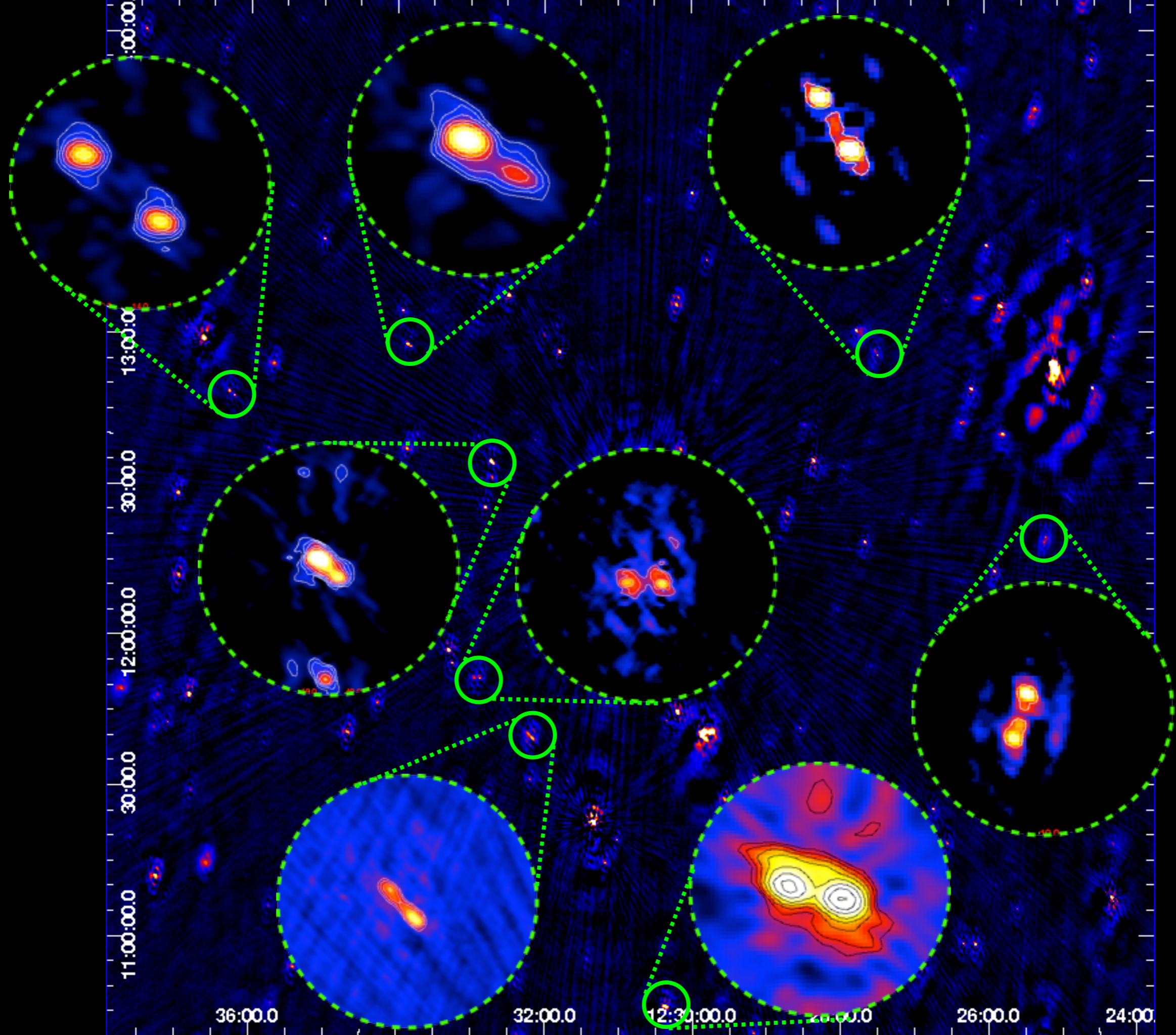


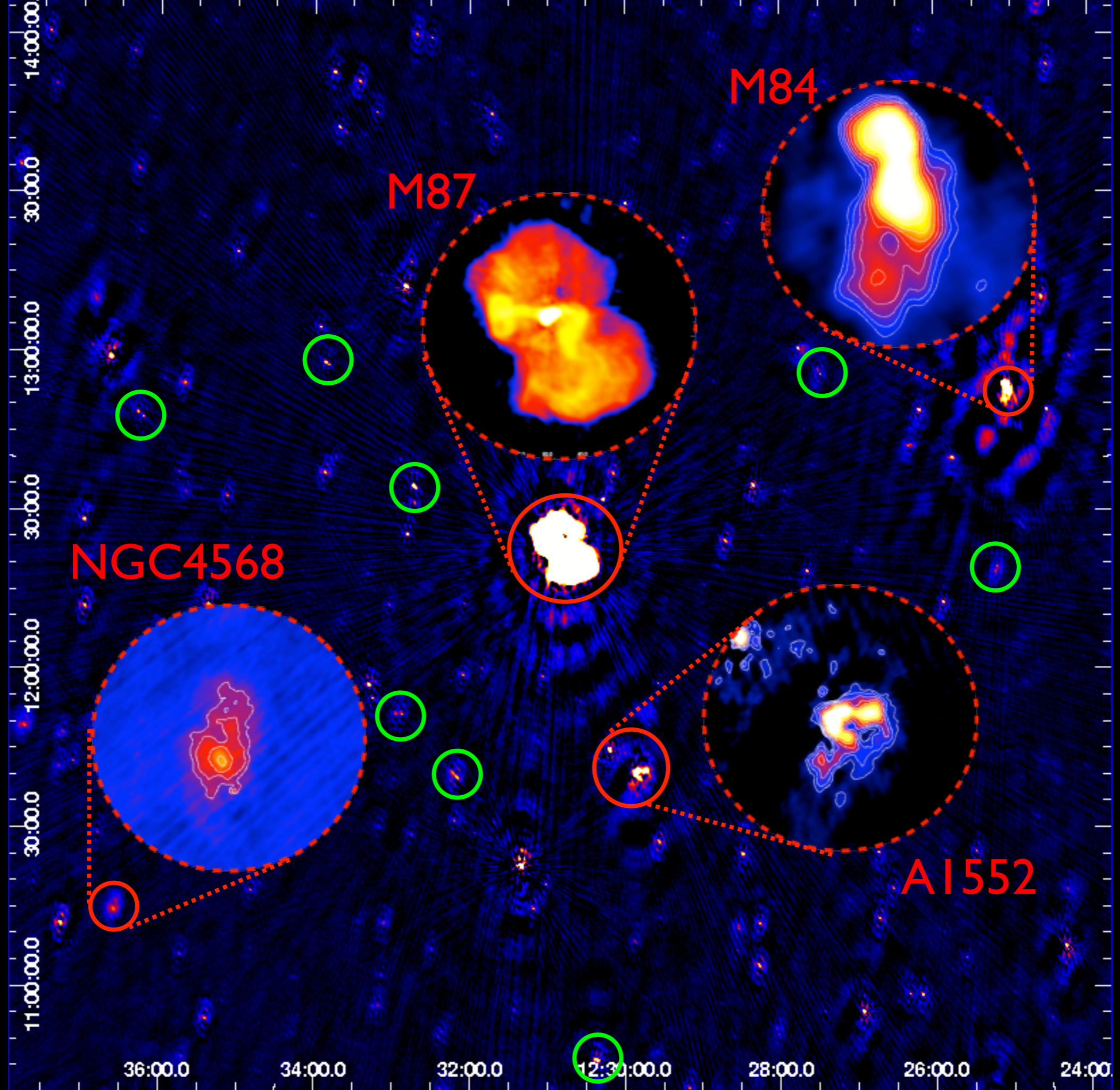
HBA map:

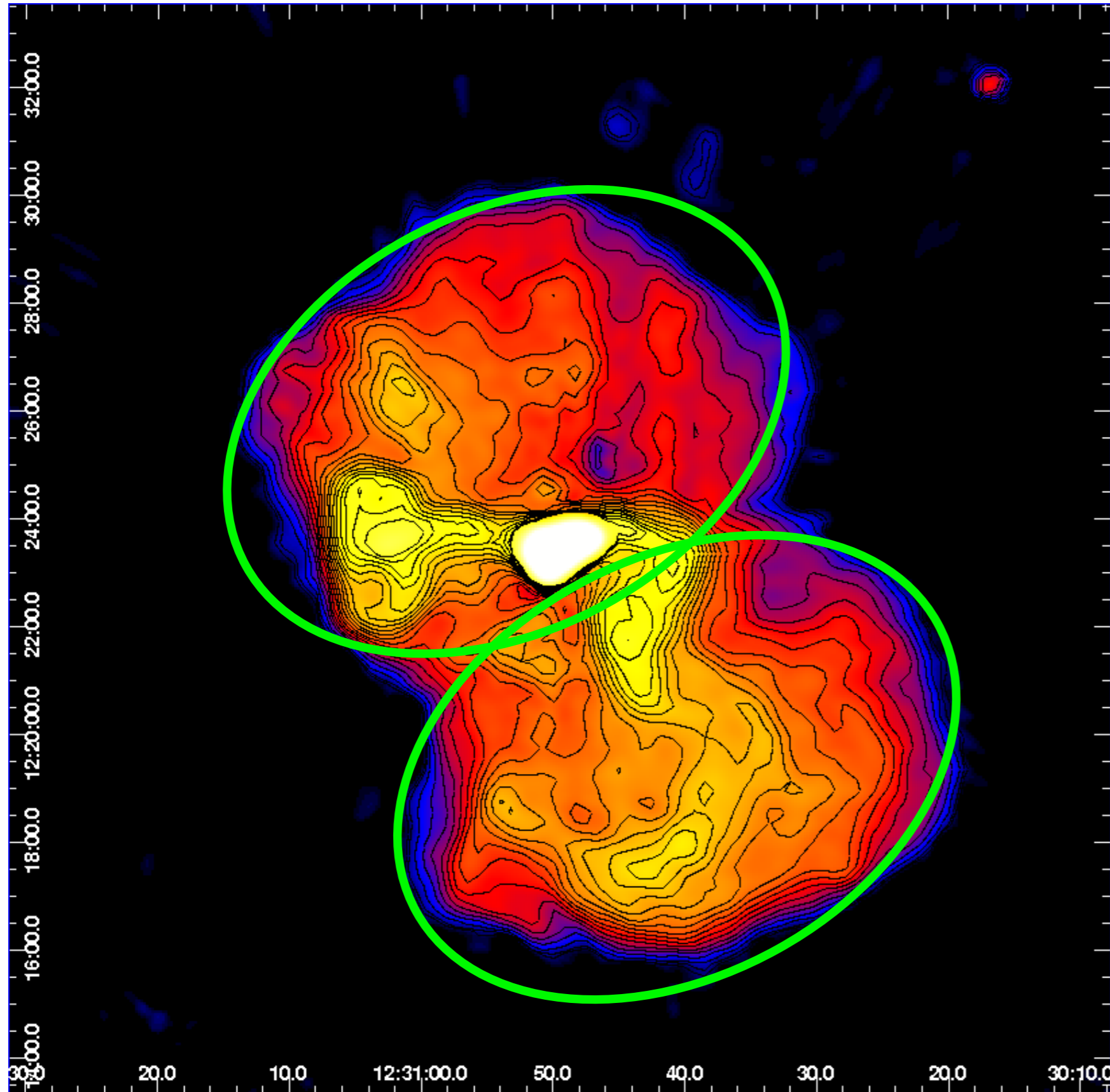
RMS: 2.8×10^{-3} Jy/beam

Beam: $23'' \times 19''$

Dyn Range: ~ 31000







HBA map:

RMS: 2.4×10^{-3} Jy/beam

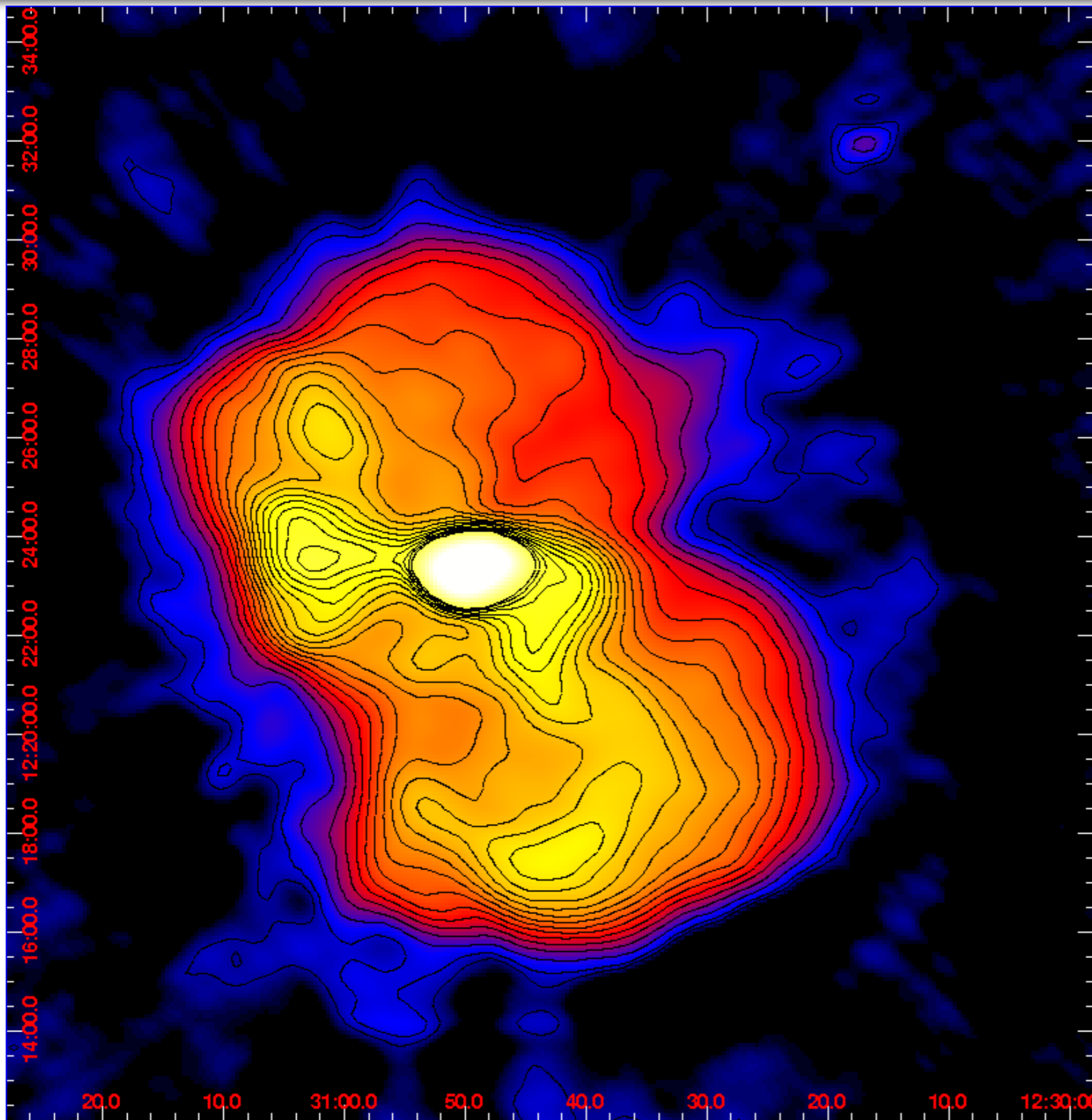
Beam: $22'' \times 18''$

Dyn Range: ~ 35000

Freq: 115 - 162 MHz

NOTE:

- Other strong sources uv-subtracted
- Imaging of the core with clean algorithm
- Imaging of the extended emission with MEM algorithm



LBA map:

RMS: 2.26×10^{-2} Jy/beam

Beam: $70'' \times 50''$

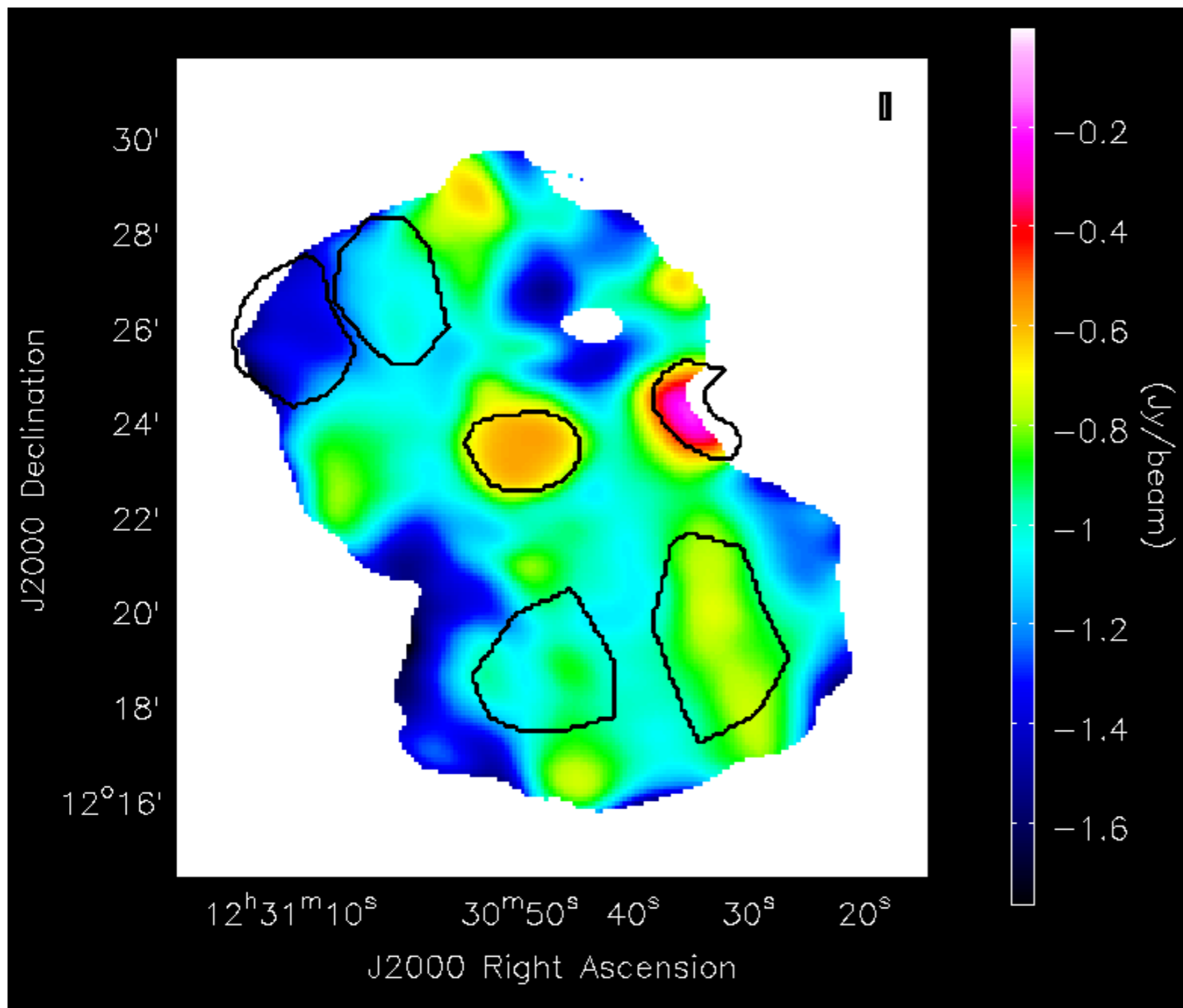
Dyn Range: ~ 13800

Freq: 30 - 77 MHz

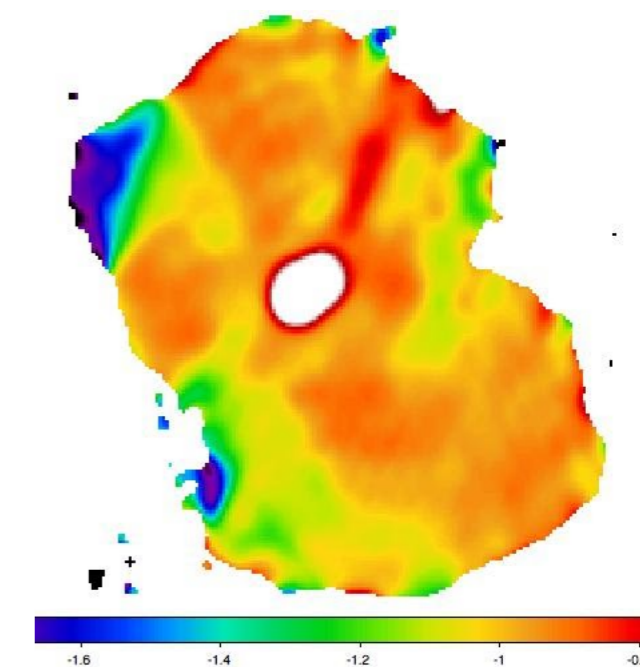
NOTE:

- Imaging of the core with clean algorithm
- Imaging of the extended emission with MEM algorithm

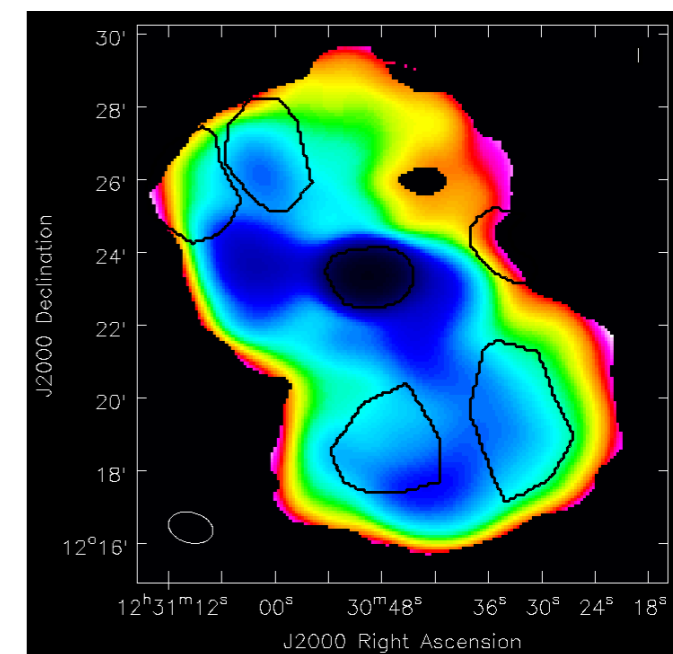
LBA spectral index map



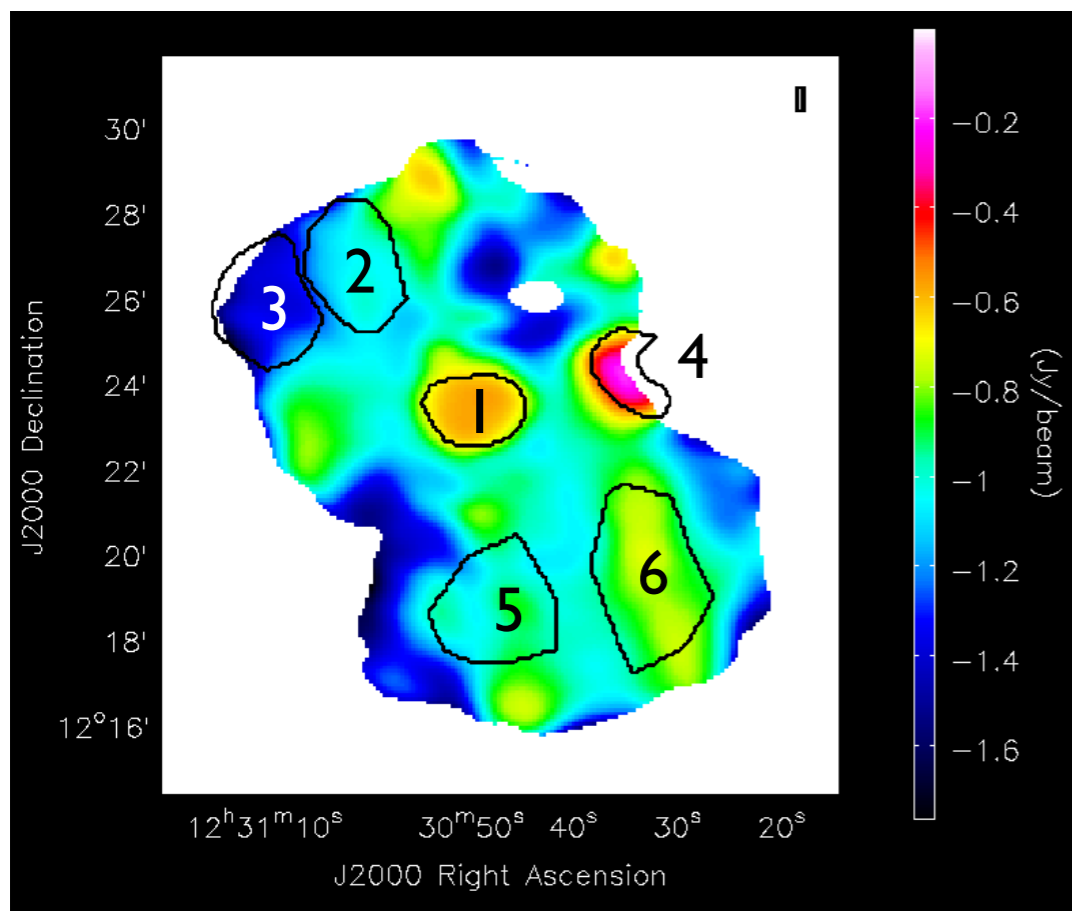
.....
VLA spectral index map (74-333 MHz)



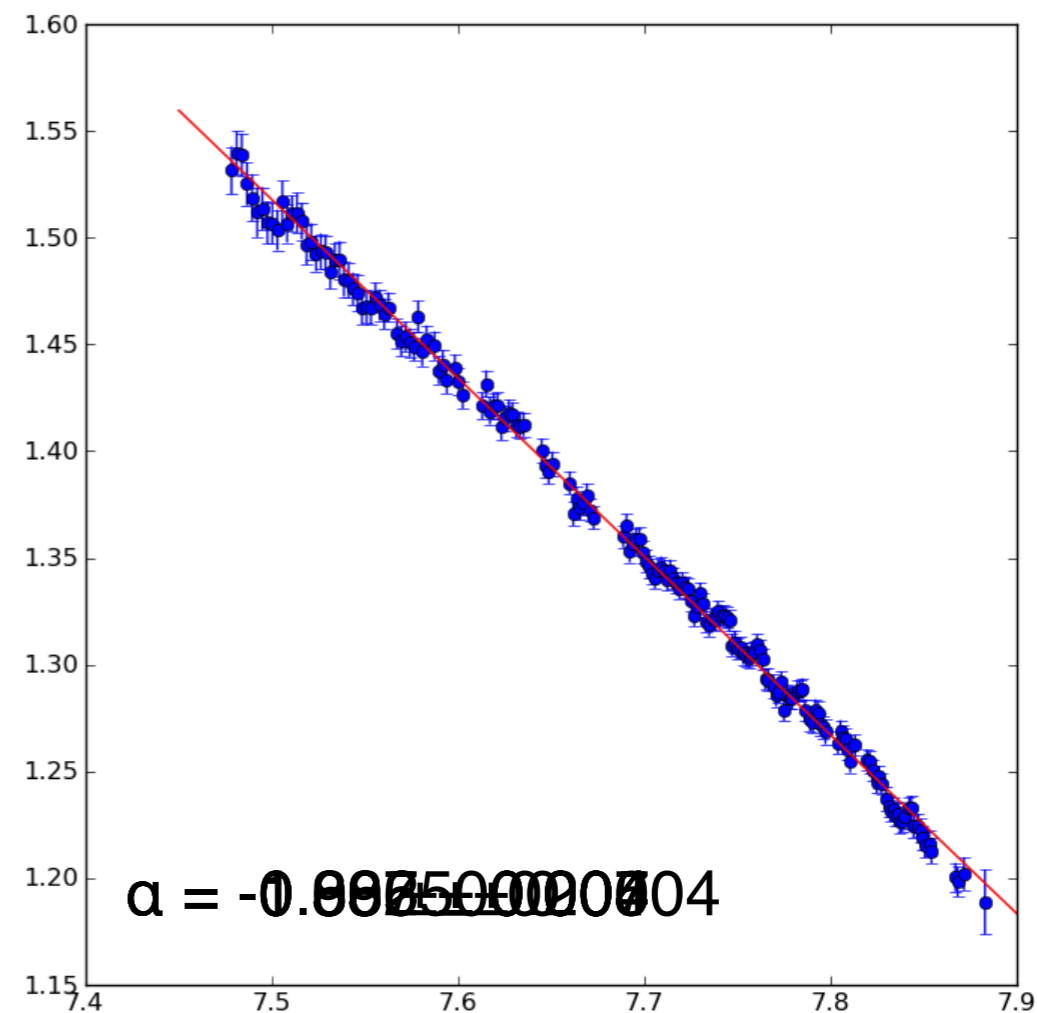
.....
RMS map

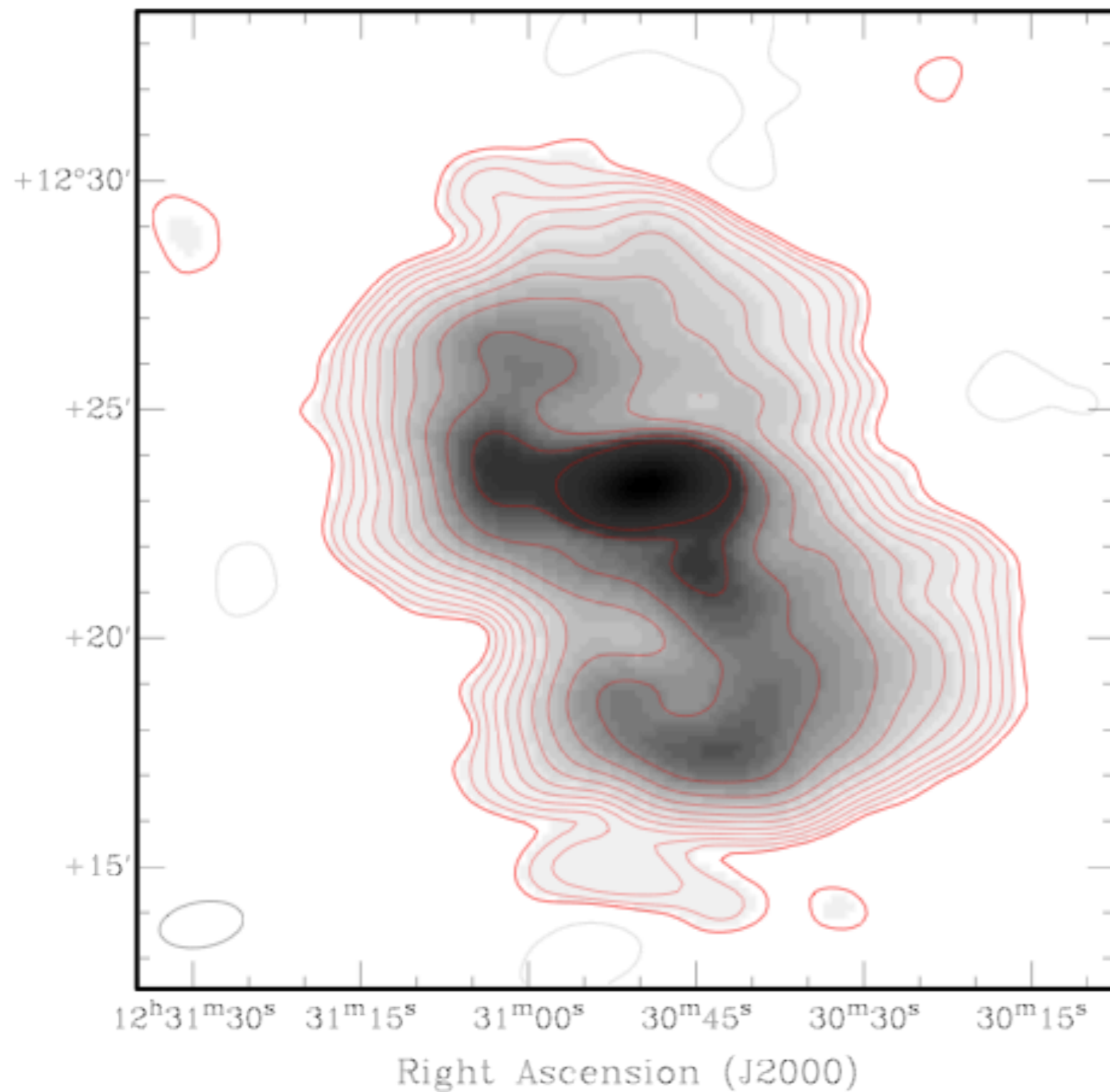


LBA spectral index map



Log frequency (Hz) Vs Log Flux (Jy/beam)





LBA map:

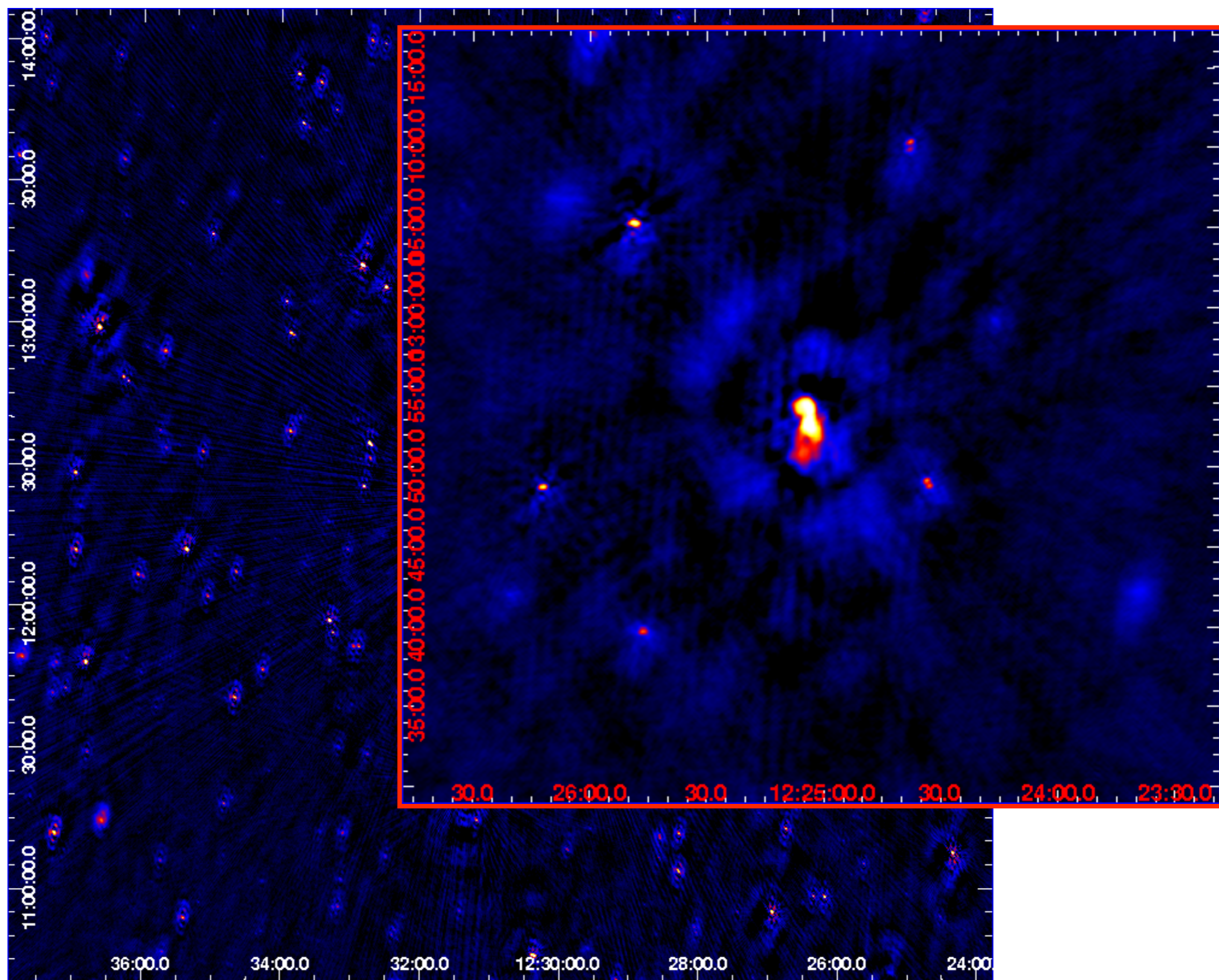
RMS: 4.9×10^{-1} Jy/beam

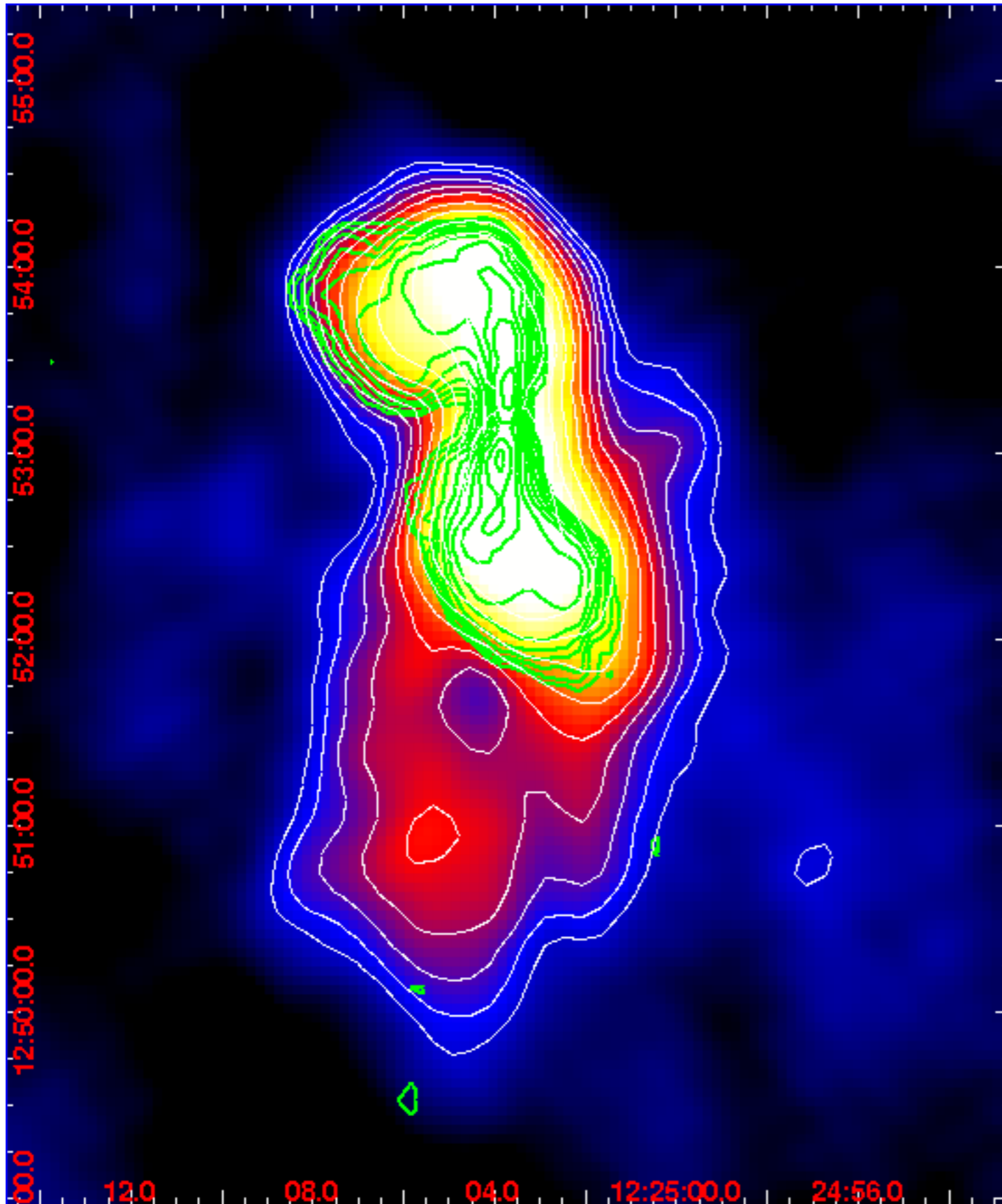
Beam: $110'' \times 60''$

Dyn Range: ~ 2500

Freq: **20 MHz**

M84





HBA map:

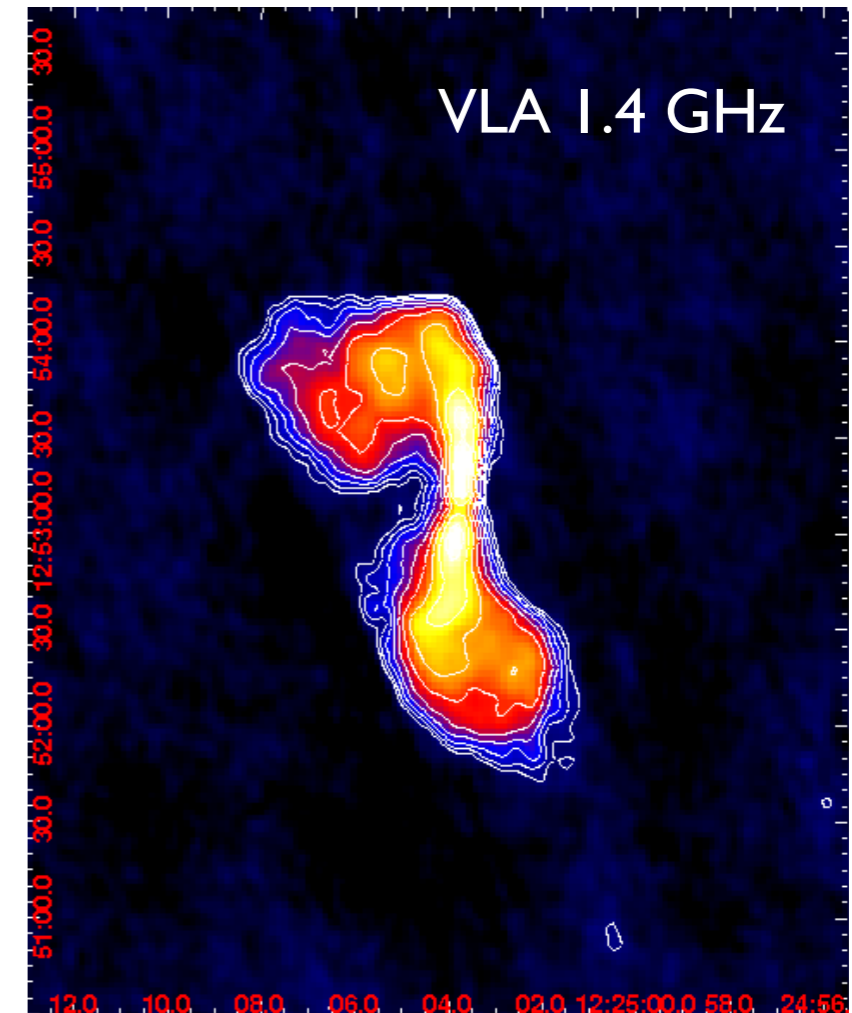
RMS: 1.5×10^{-3} Jy/beam

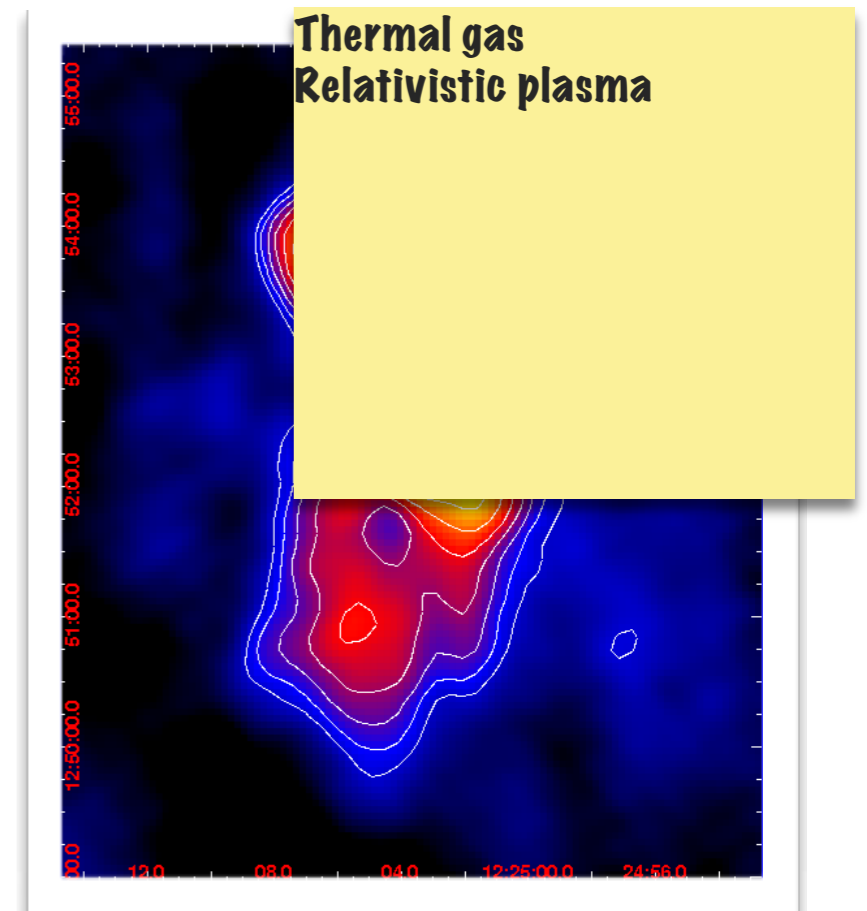
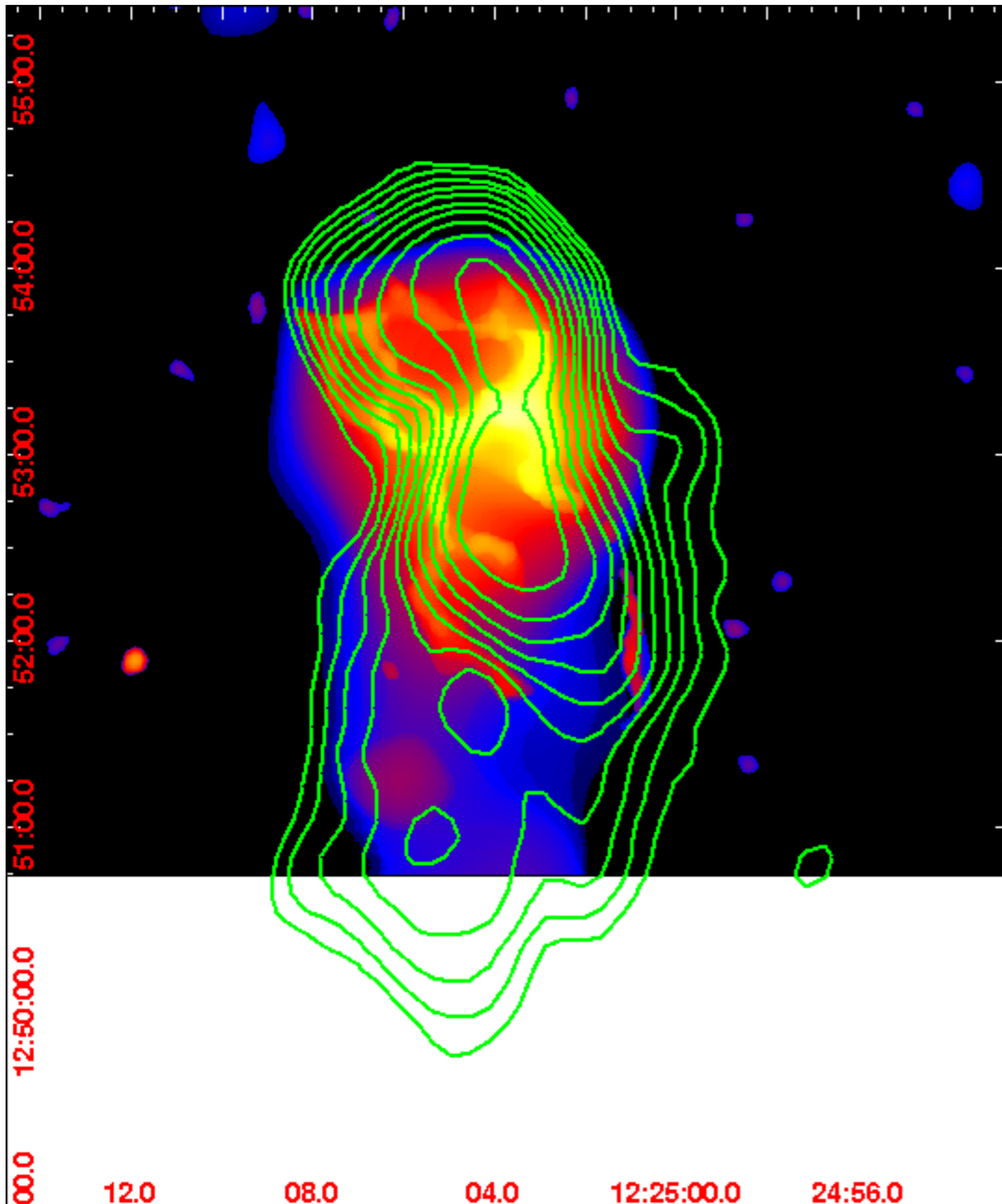
Beam: $23'' \times 14''$

Dyn Range: ~ 600

NOTE:

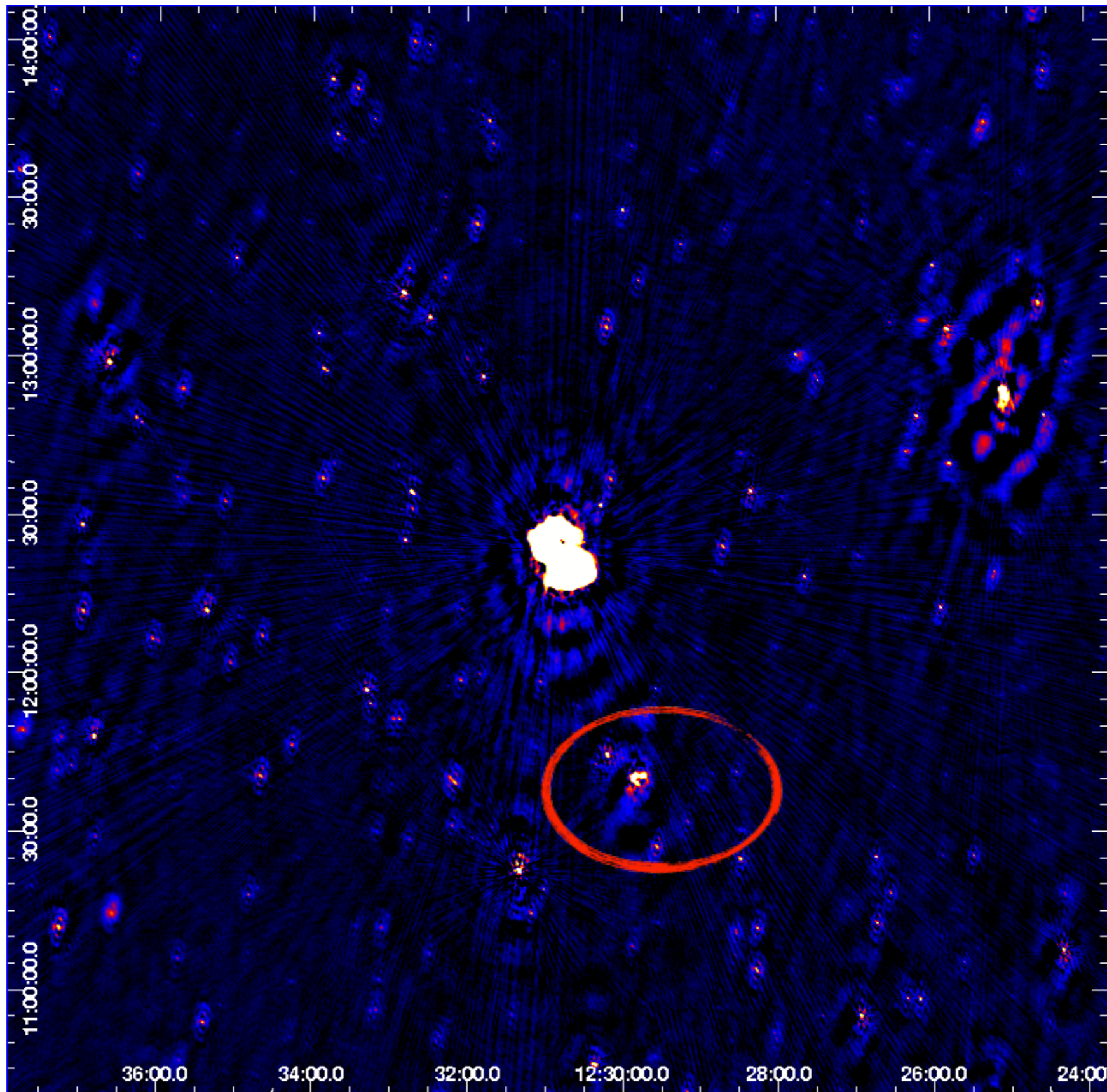
- Virgo A calibrated and uv-subtracted
- Other strong sources uv-subtracted
- Data recalibrated in the direction of M84
- Beam correction **not** included!



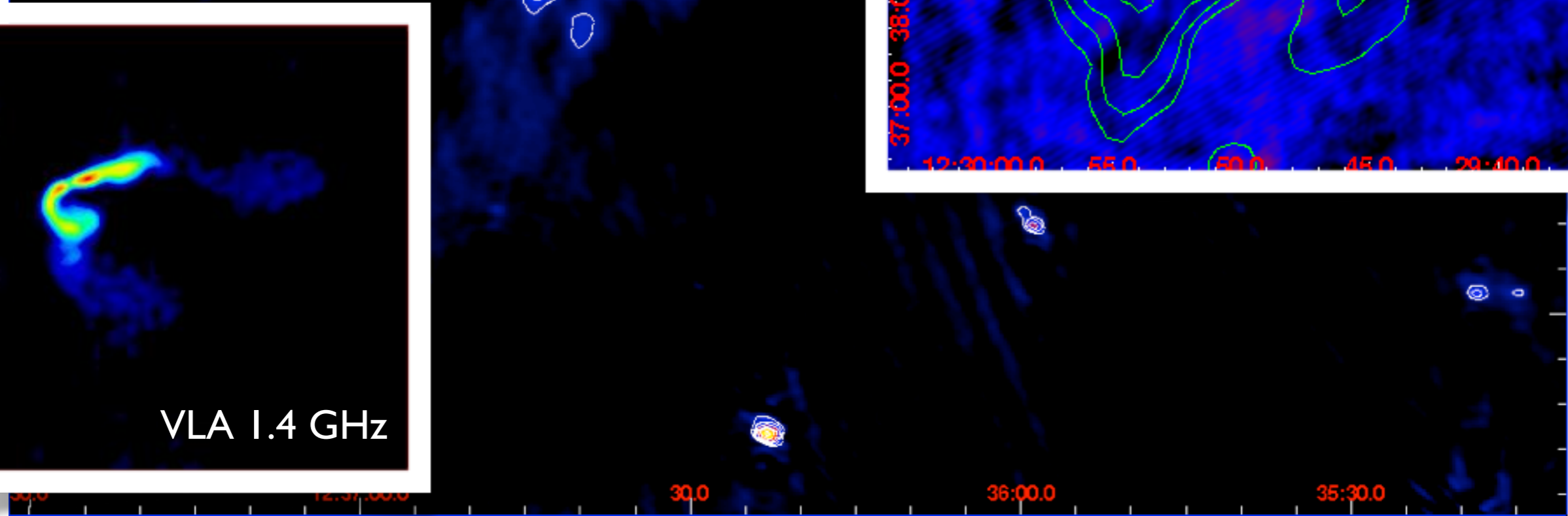
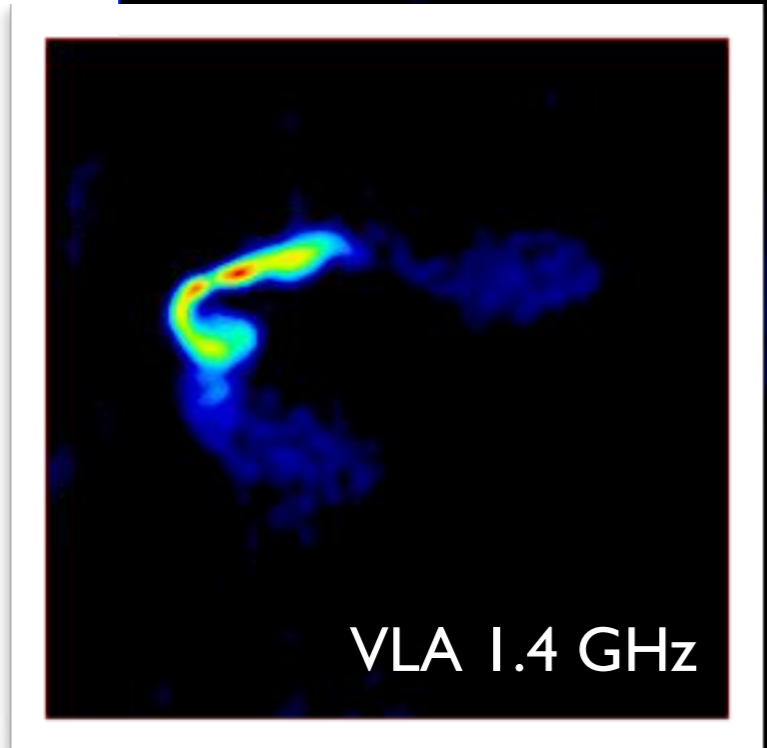
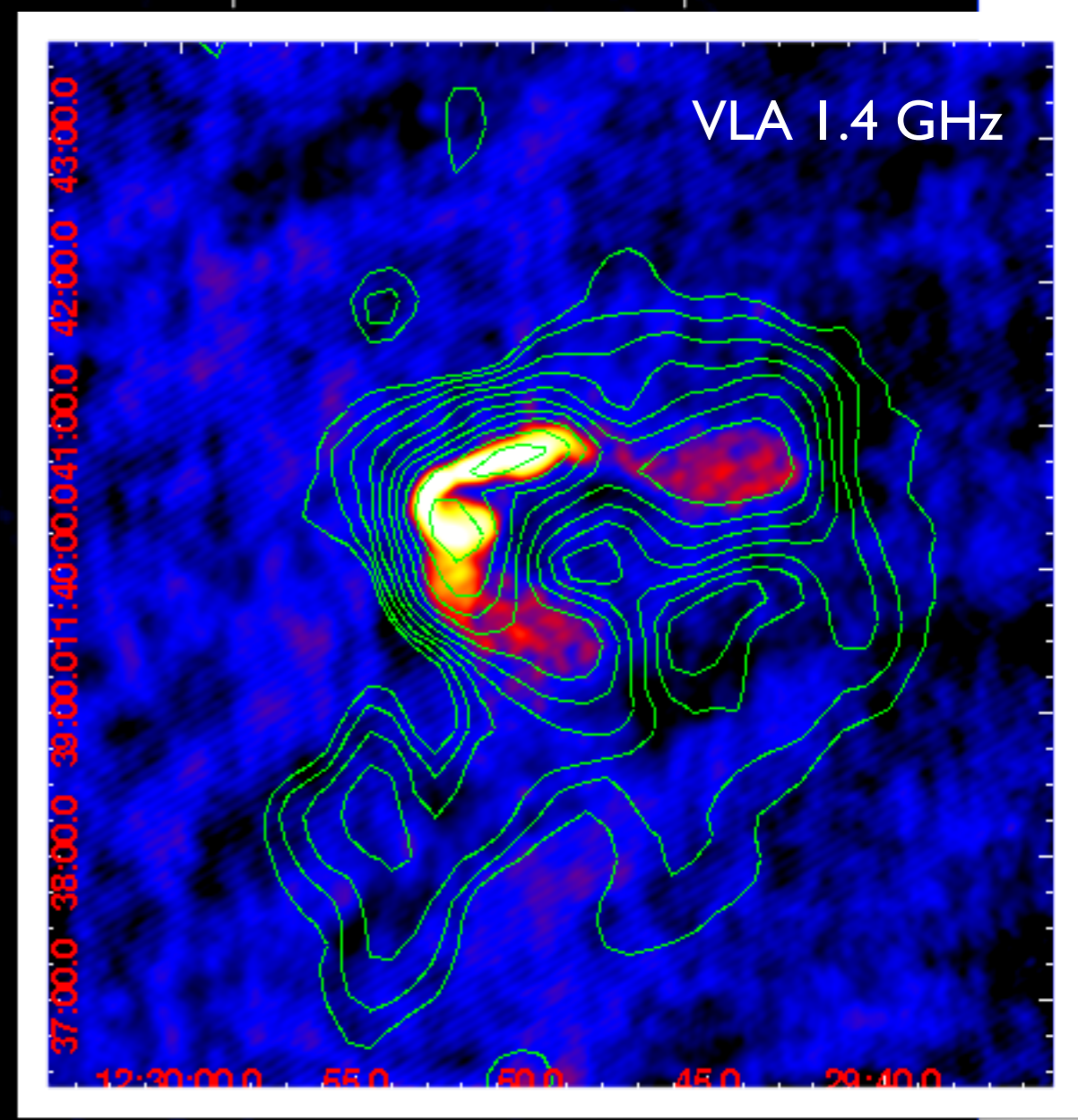
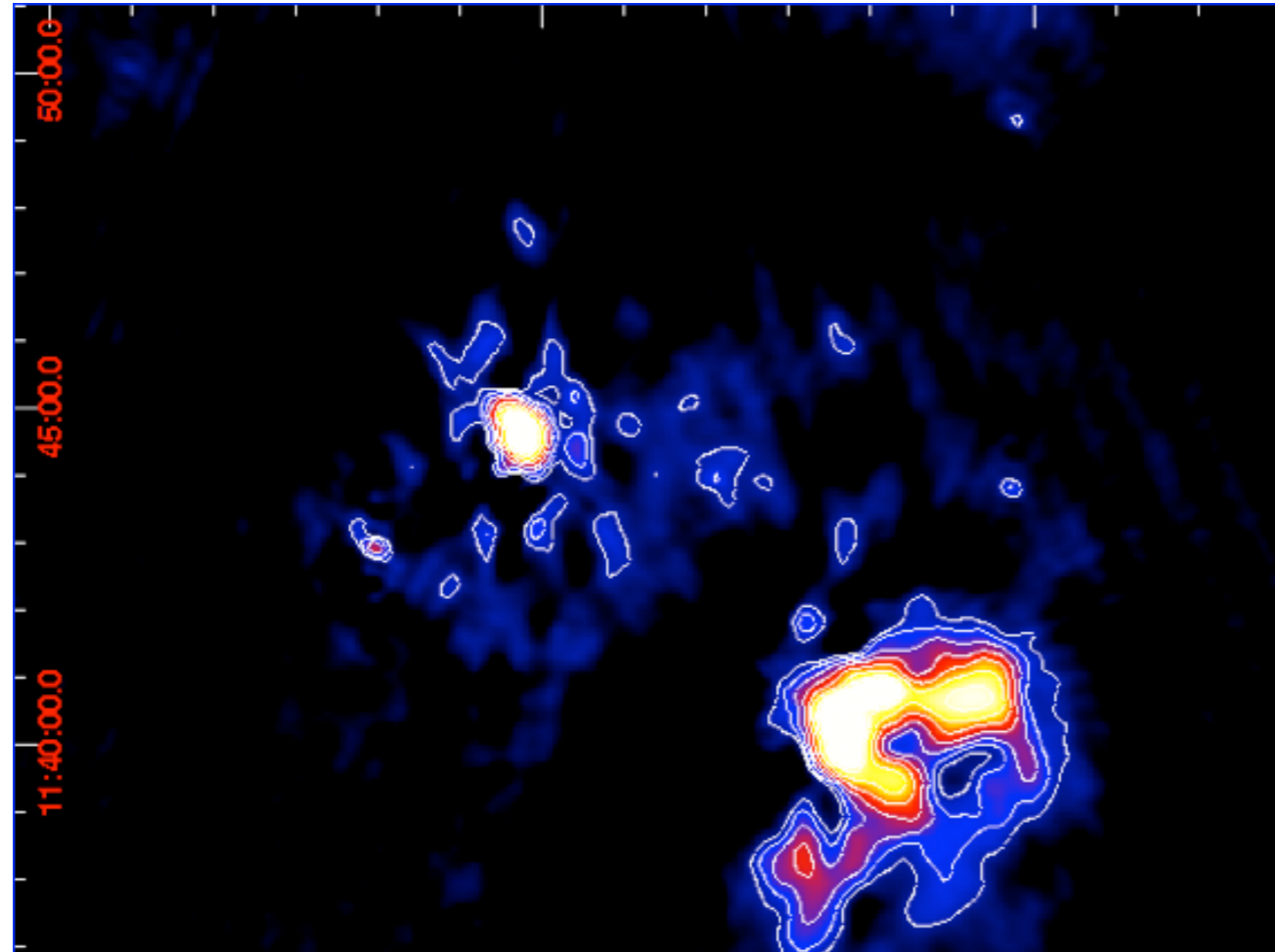


- Non detection at 1.4 GHz
 -> $\alpha \leq -1.3$
- Synchrotron ageing + energy equipartition
 -> $B \sim 6.3 \mu\text{G}$
- $\alpha_0 = -0.5$ and a JP model
 -> more than 60 Myr

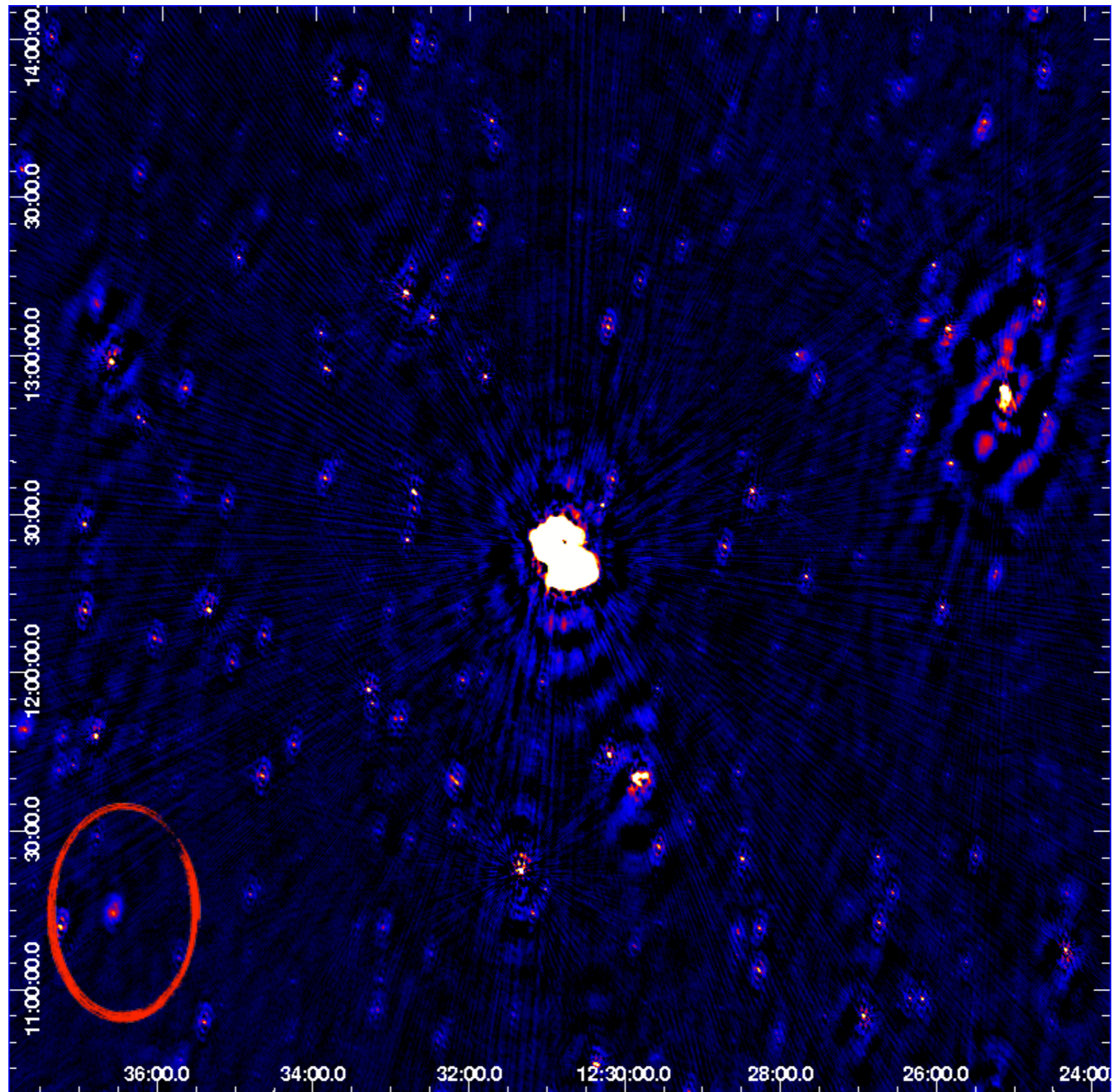
Abell 1552



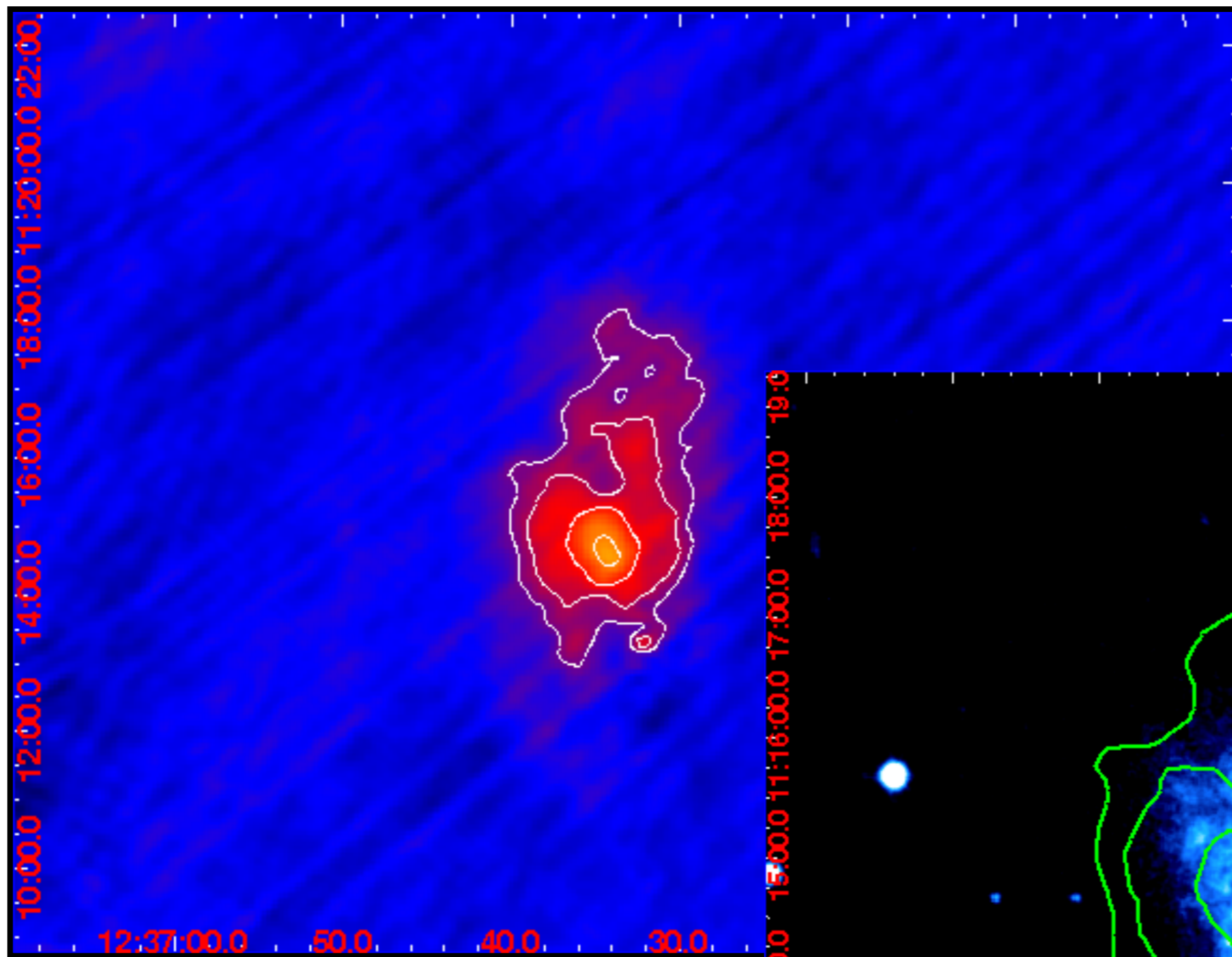
Abell 1552



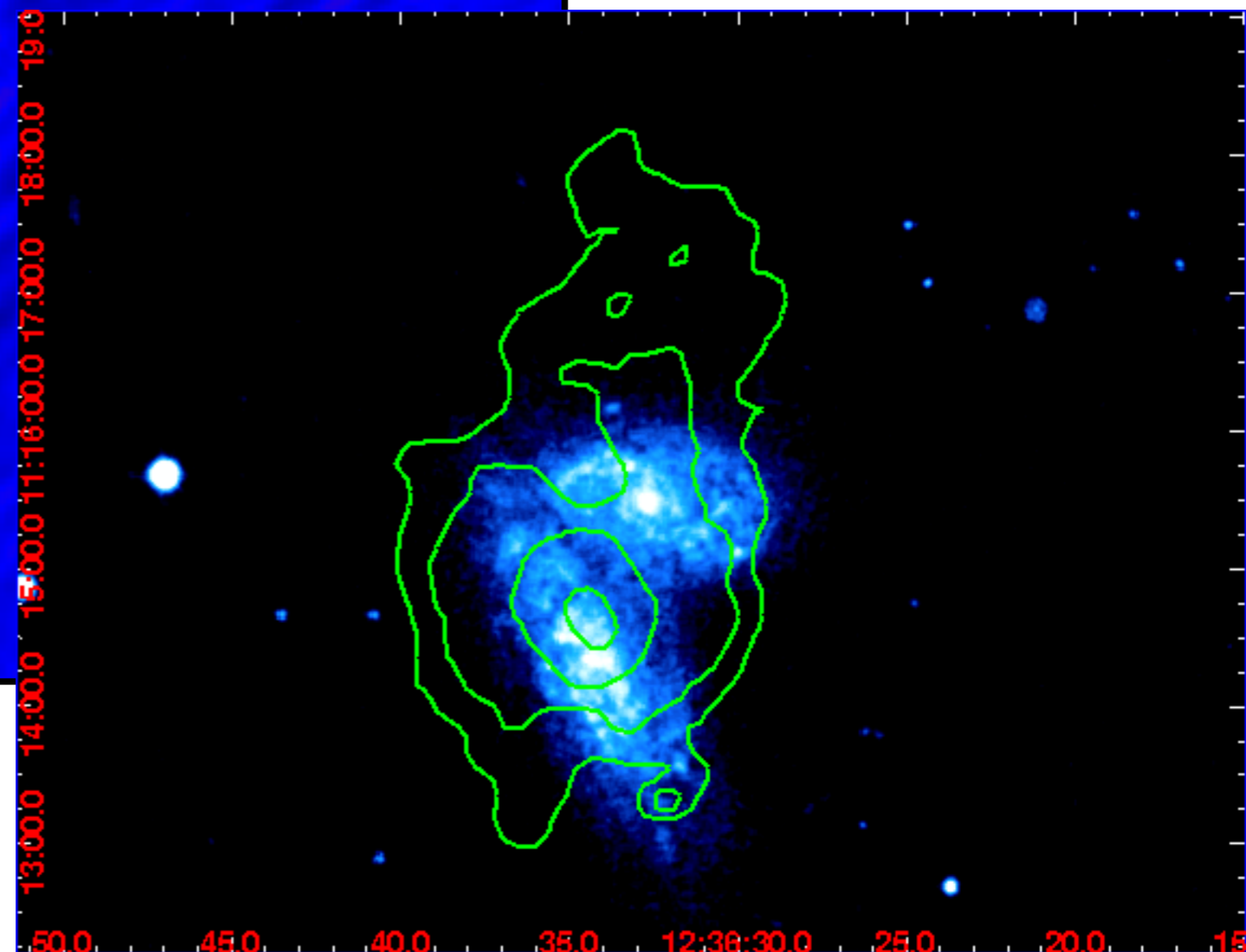
Galaxy Merger



Galaxy Merger



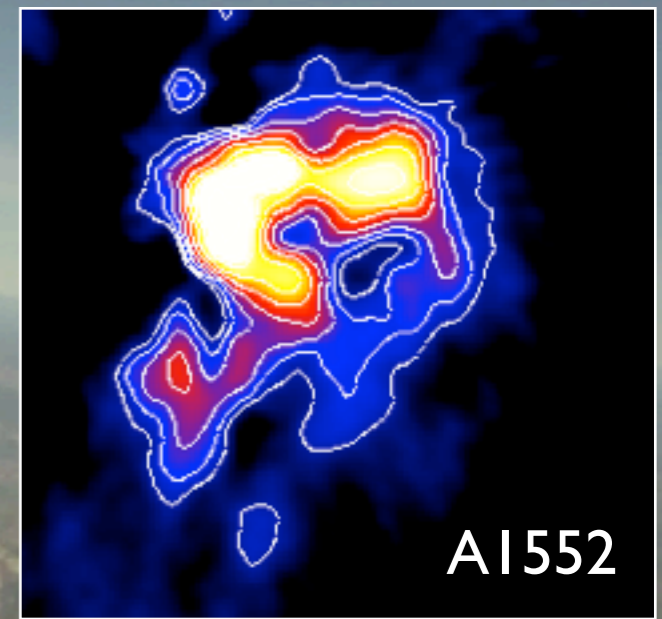
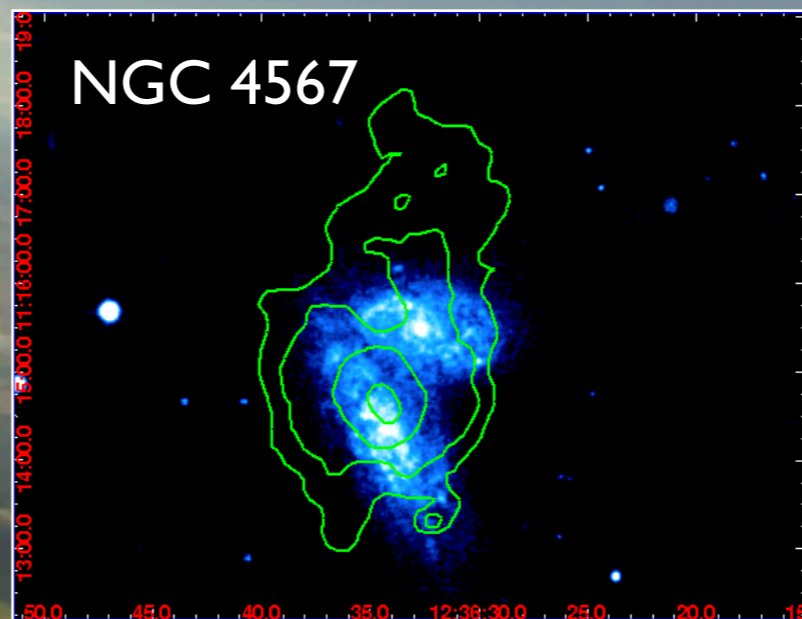
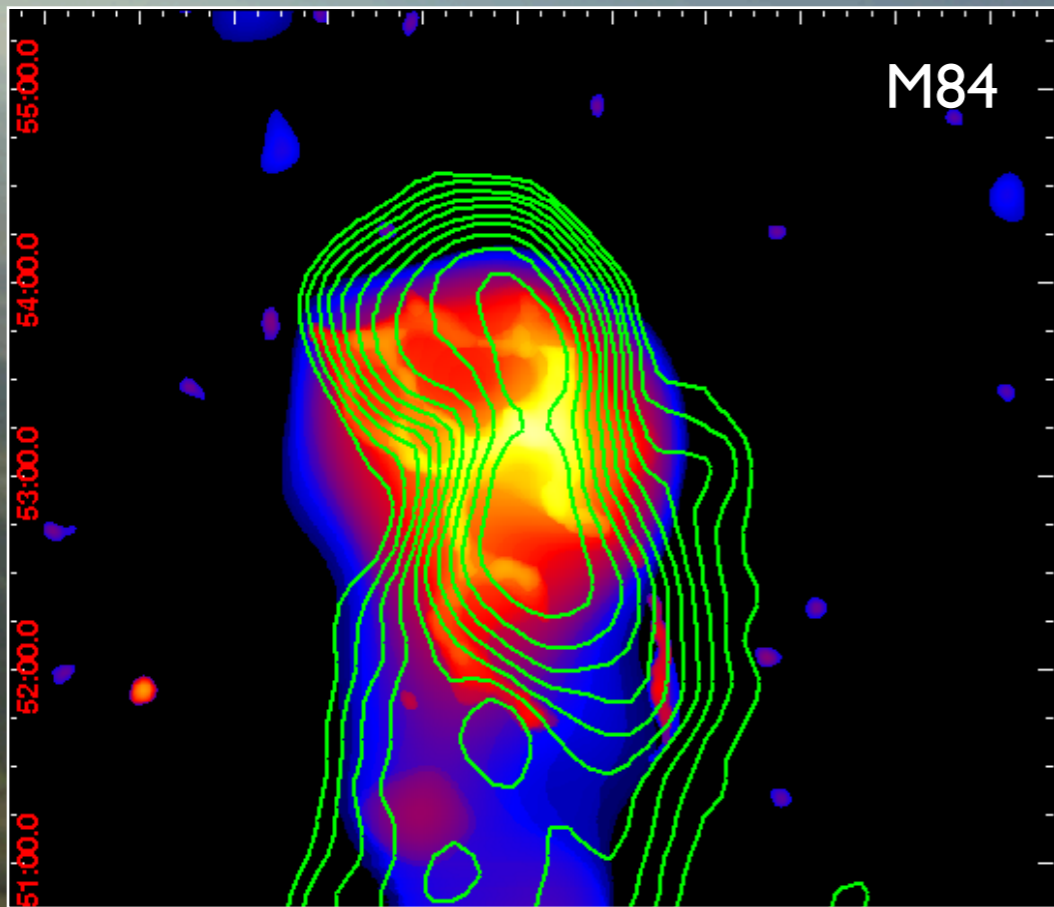
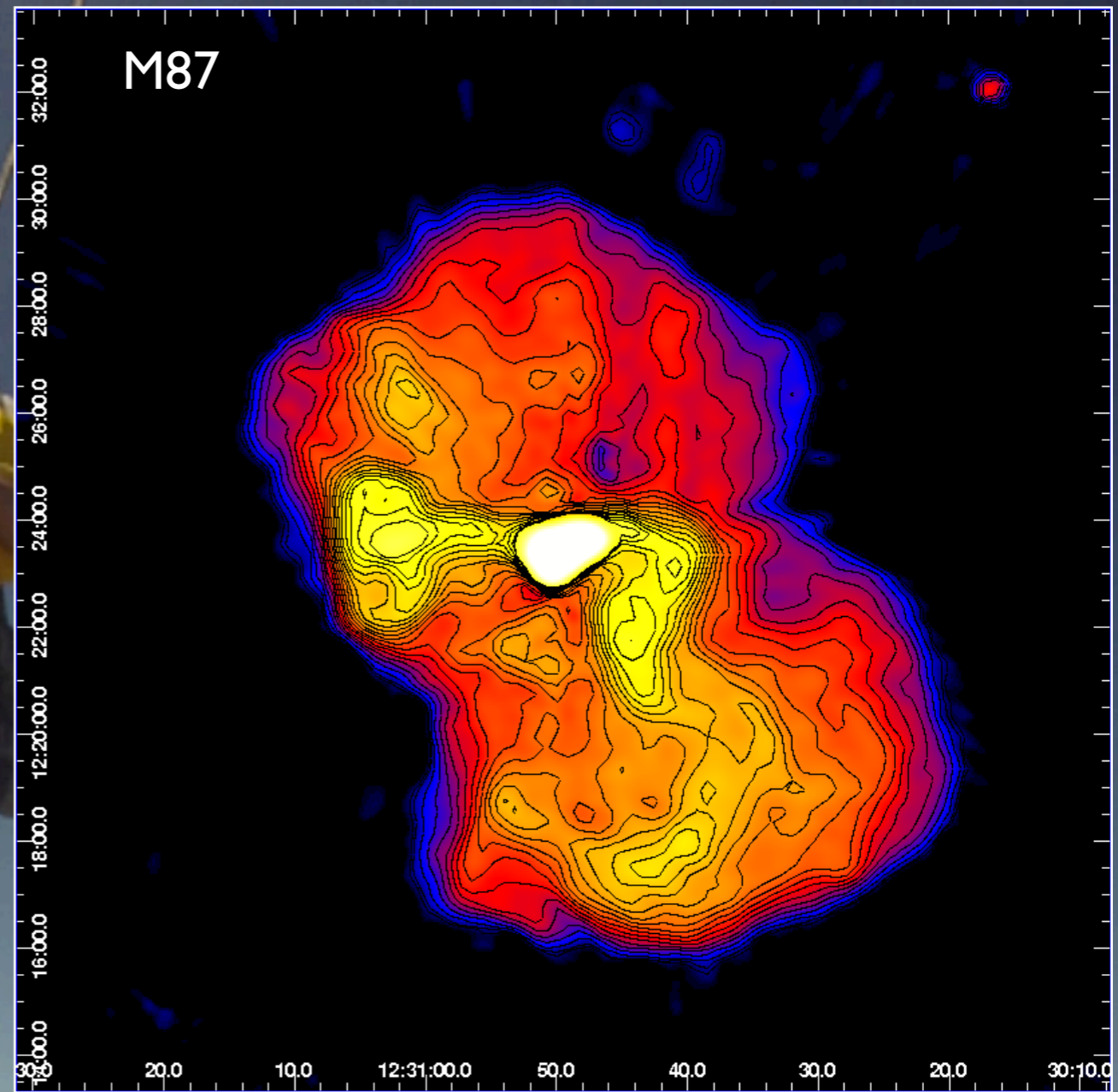
NGC 4567
NGC 4568
merging?



NOTE:

- Virgo A calibrated and uv-subtracted
- Other strong sources uv-subtracted
- Beam correction not included!
- Source too weak to recalibrate in its direction.

Thank you



The Observations

LBA (low):

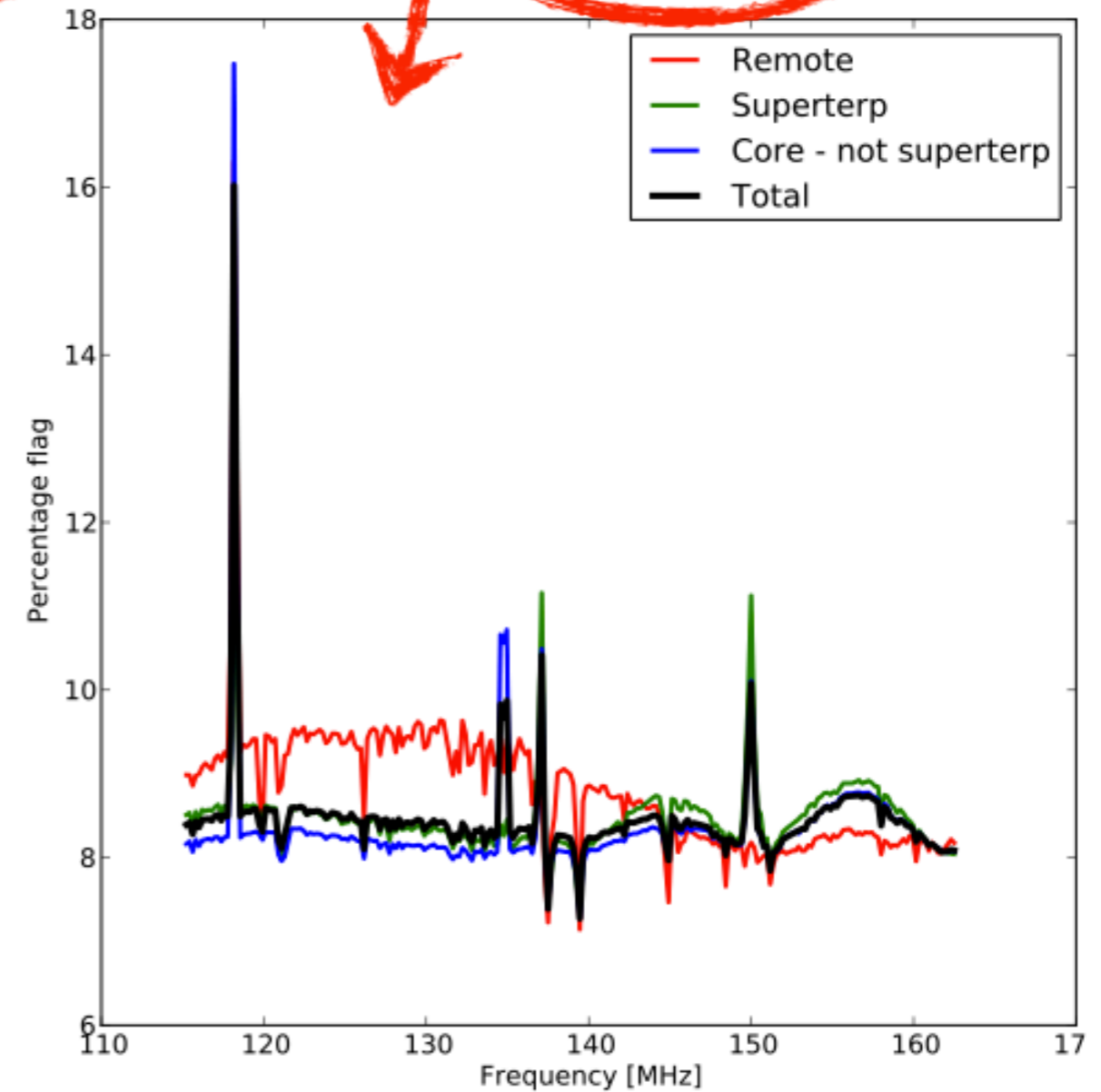
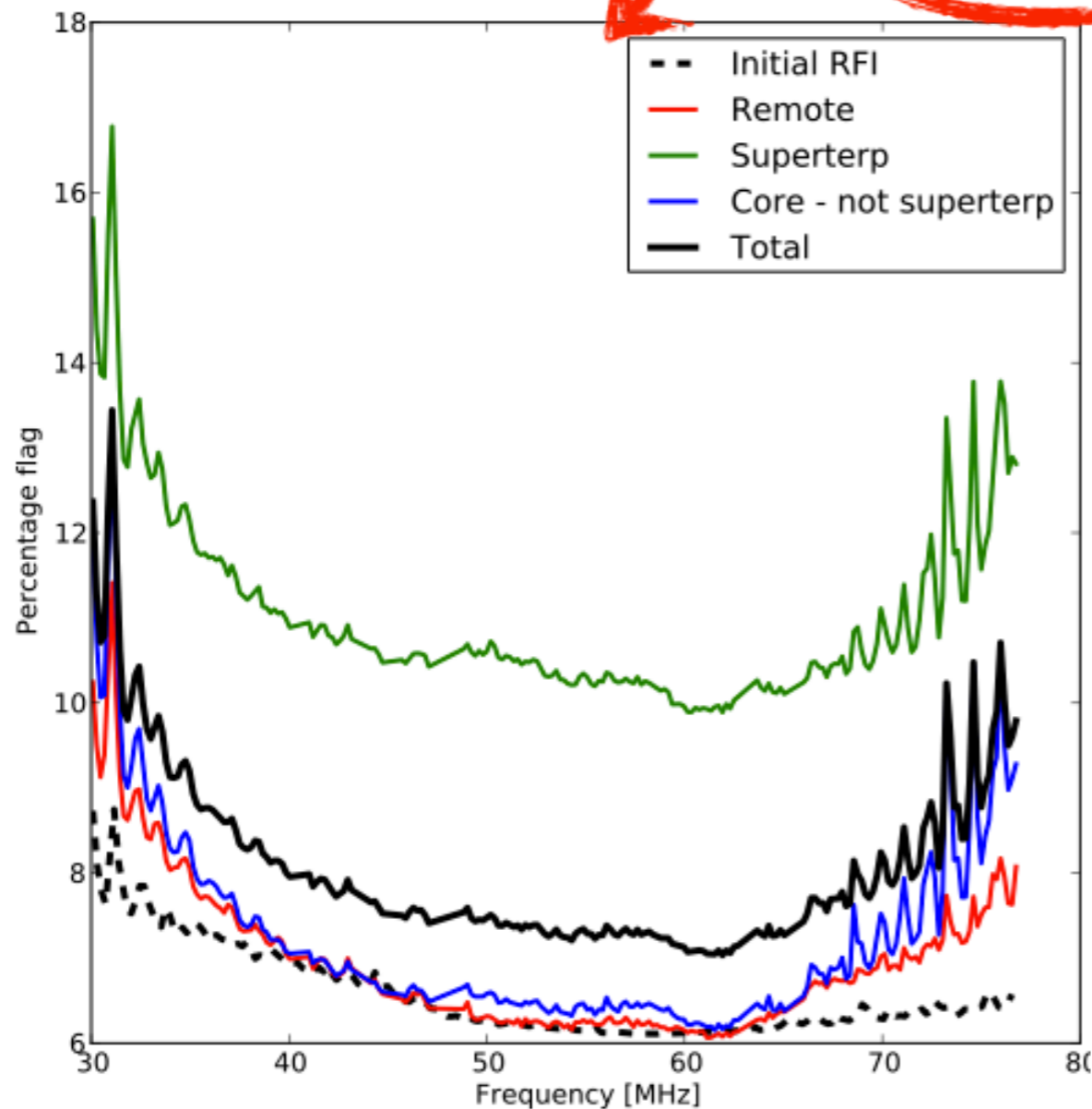
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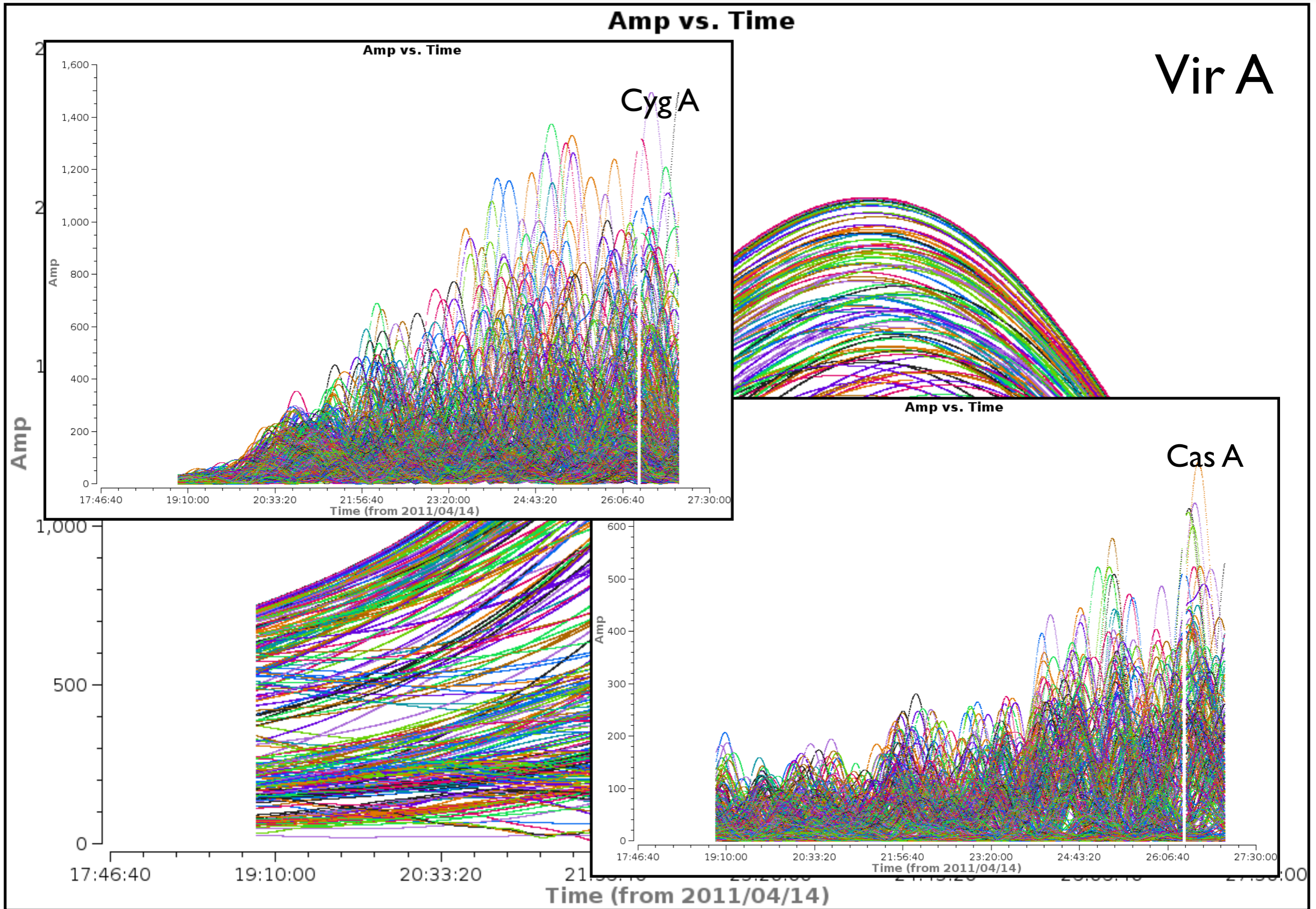




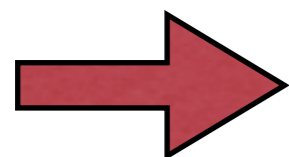
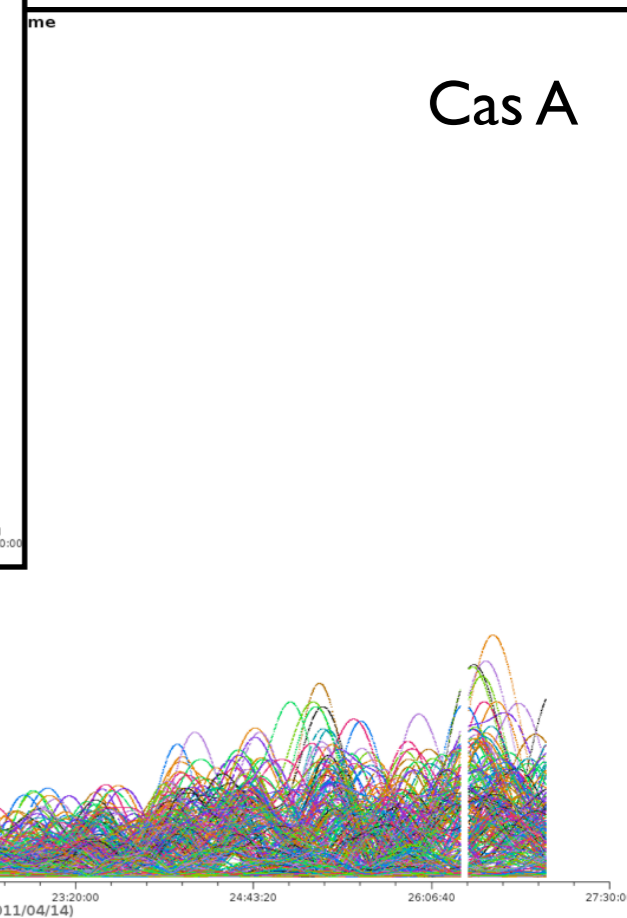
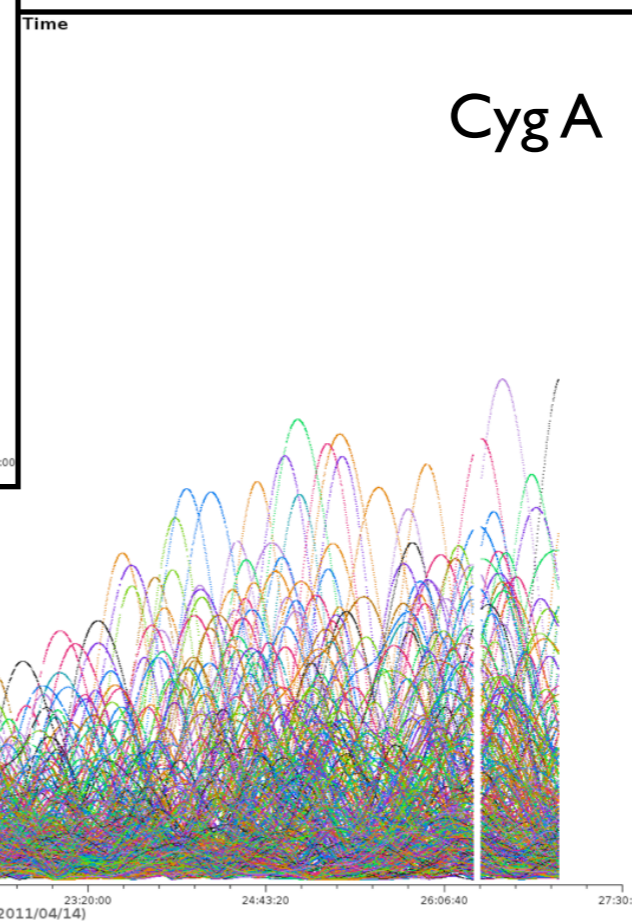
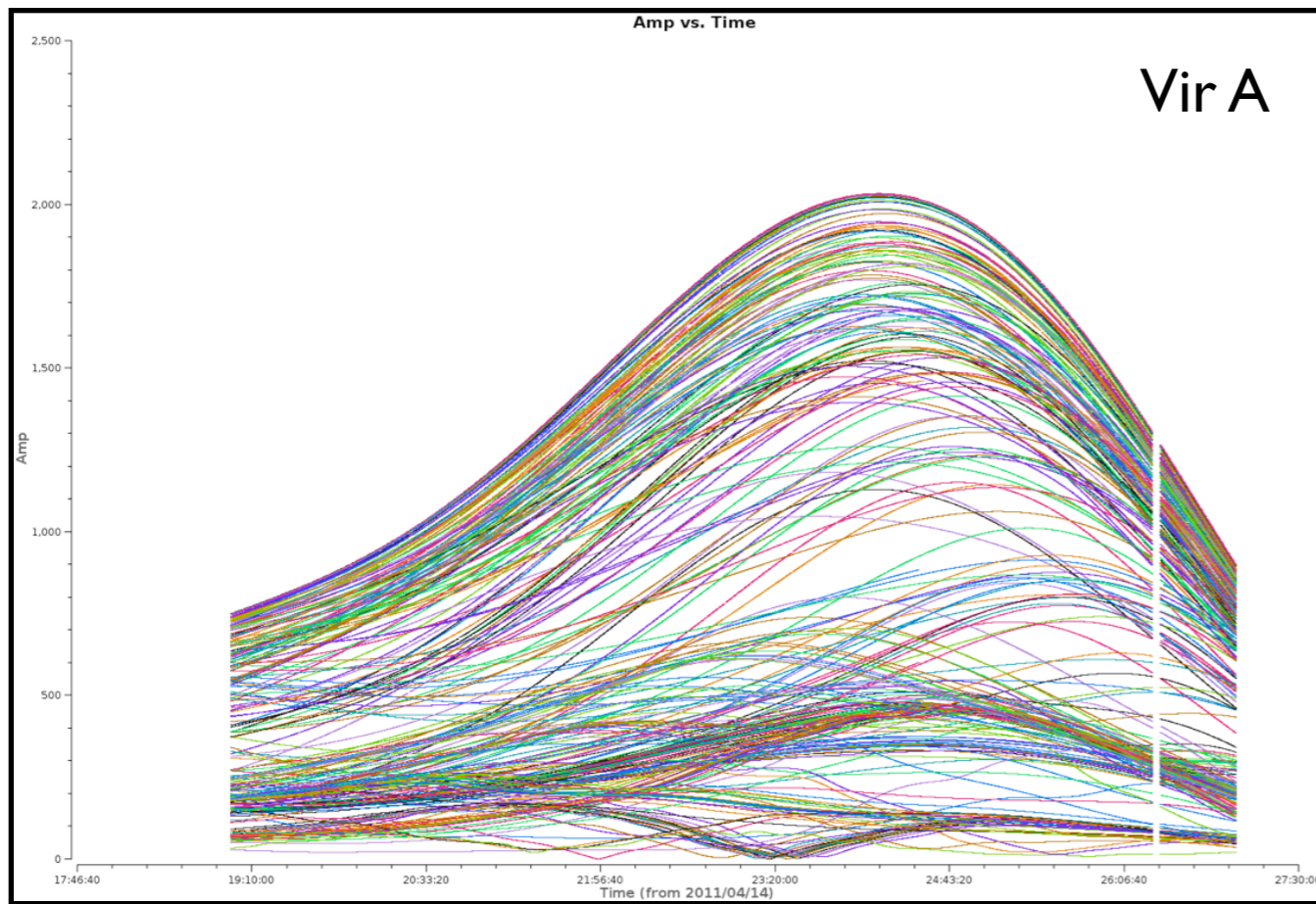
HBA Widefield

Frequency range from 115 to 162 MHz

The Calibration



The Calibration



Demixing