The ultra-steep diffuse emission observed in the cool-core cluster RXJ 1720.1+2638 at low frequencies

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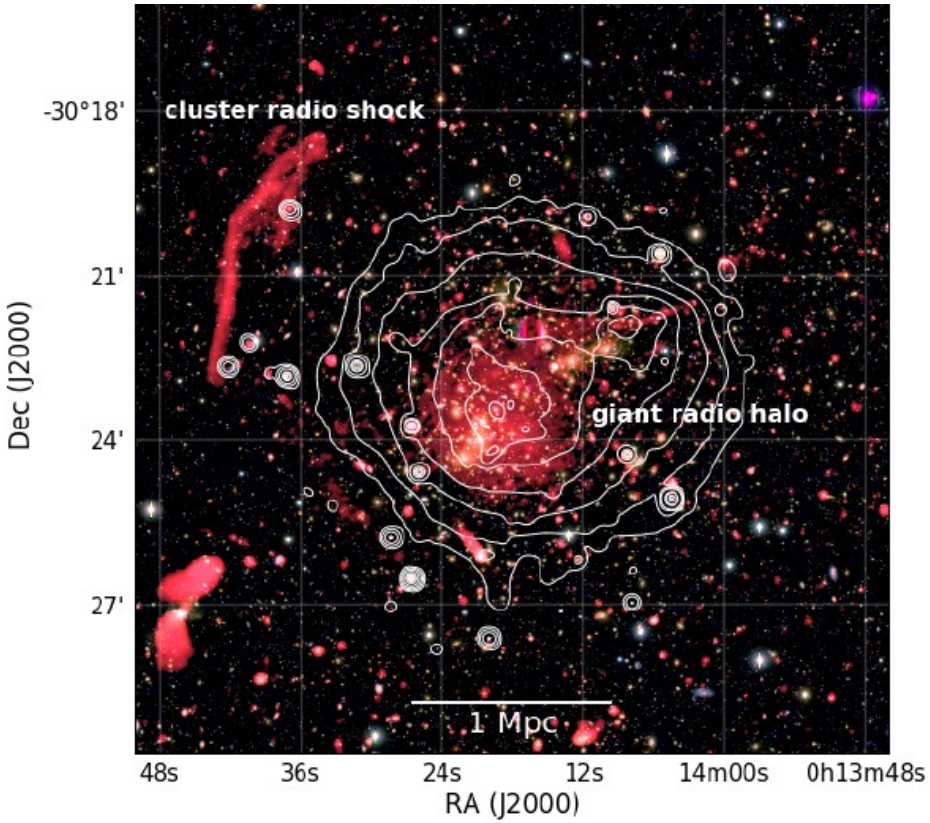
DRANOEL
ERC - Stg16 714245

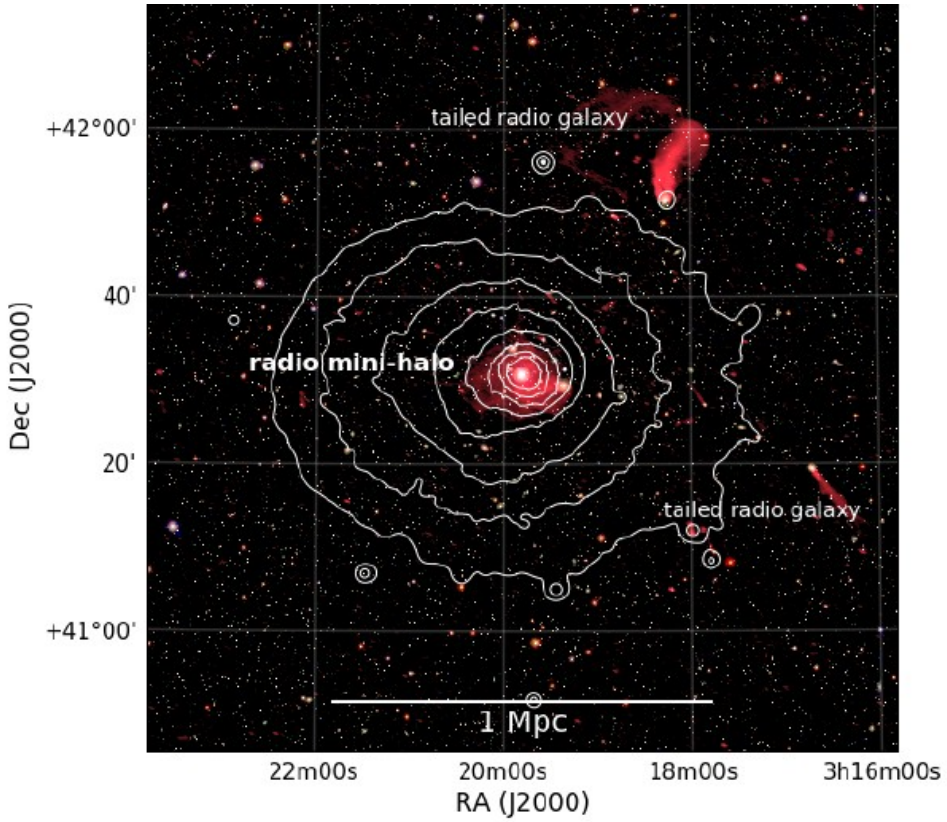
Diffuse emission in galaxy clusters

Giant Halo



- Mpc size
- Merging clusters

Mini halo



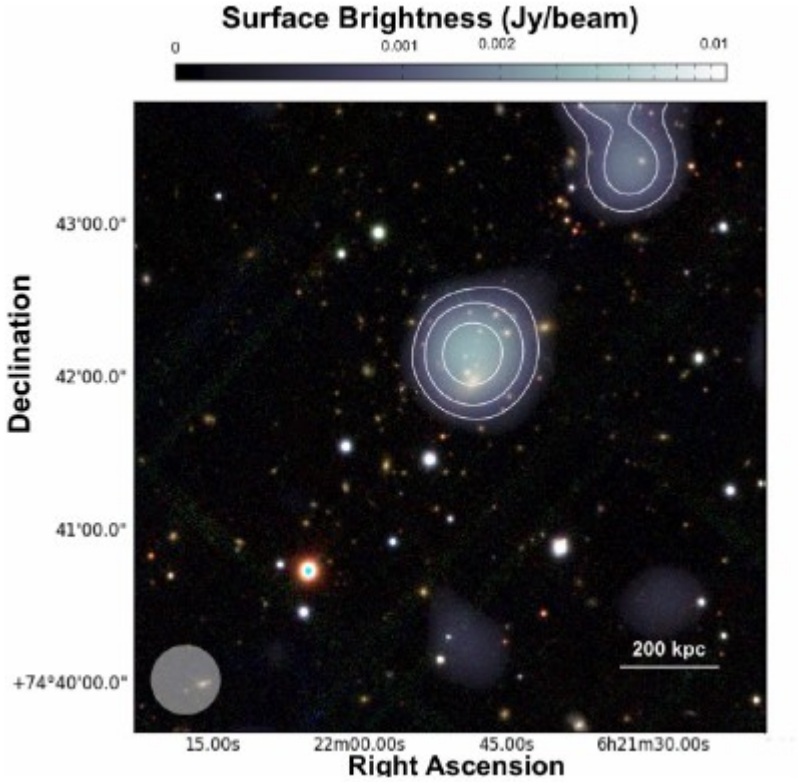
- 100-500 kpc size
- Cool-core clusters

Characterized by a steep radio spectrum ($\alpha > 1$)

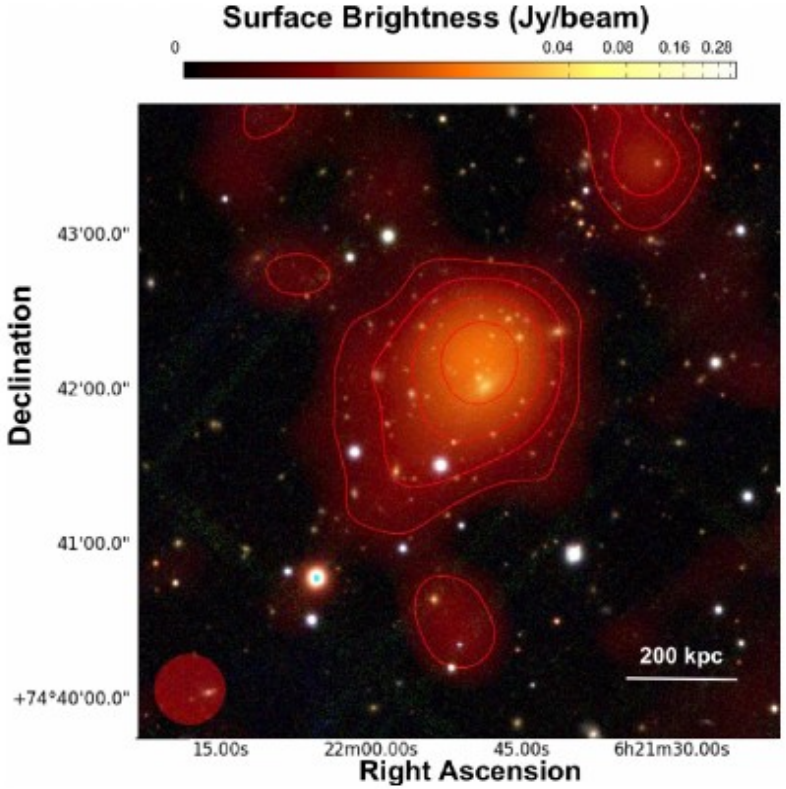
A more complex picture..

- **PSZ1G139.61+24**

GMRT – 610 MHz



LOFAR HBA – 144 MHz



(Savini et al. 2018)

- Diffuse emission beyond the cluster core
- Steep spectrum $\alpha > 1.5$

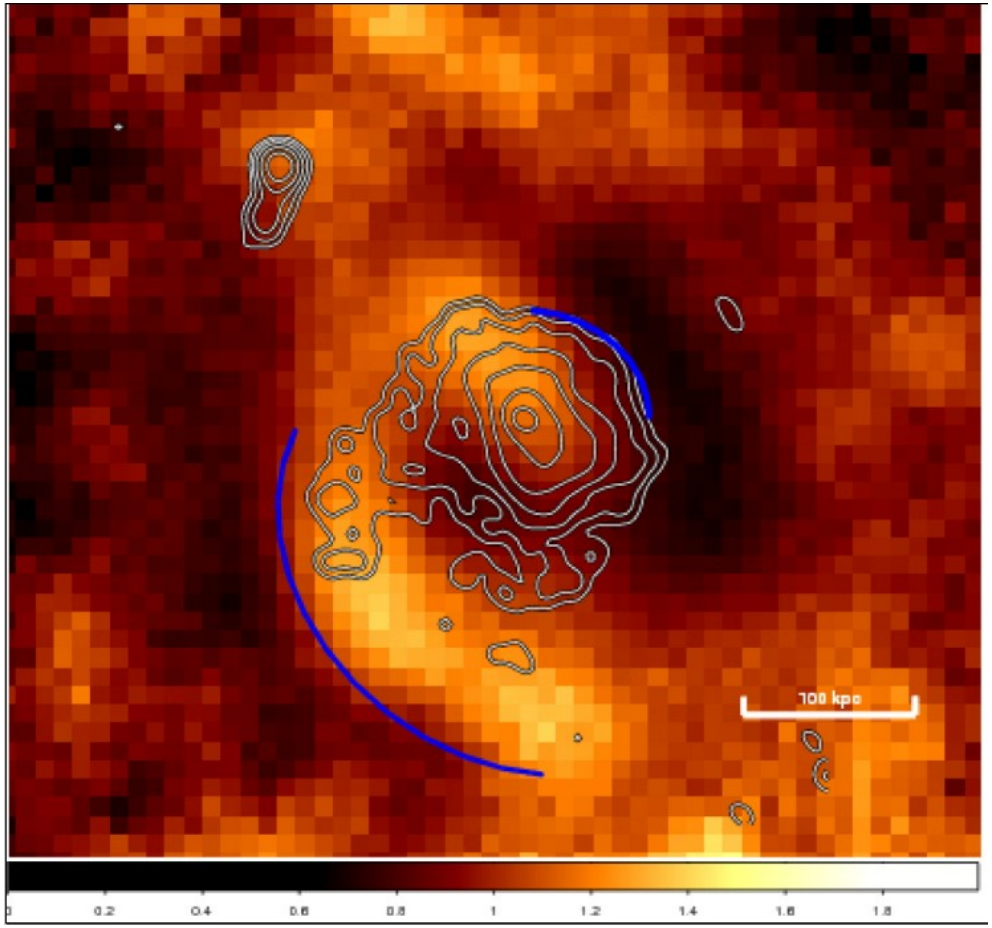
RXJ 1720.1+2638

Cool-core
galaxy cluster

z = 0.16

Mini halo + Cold fronts

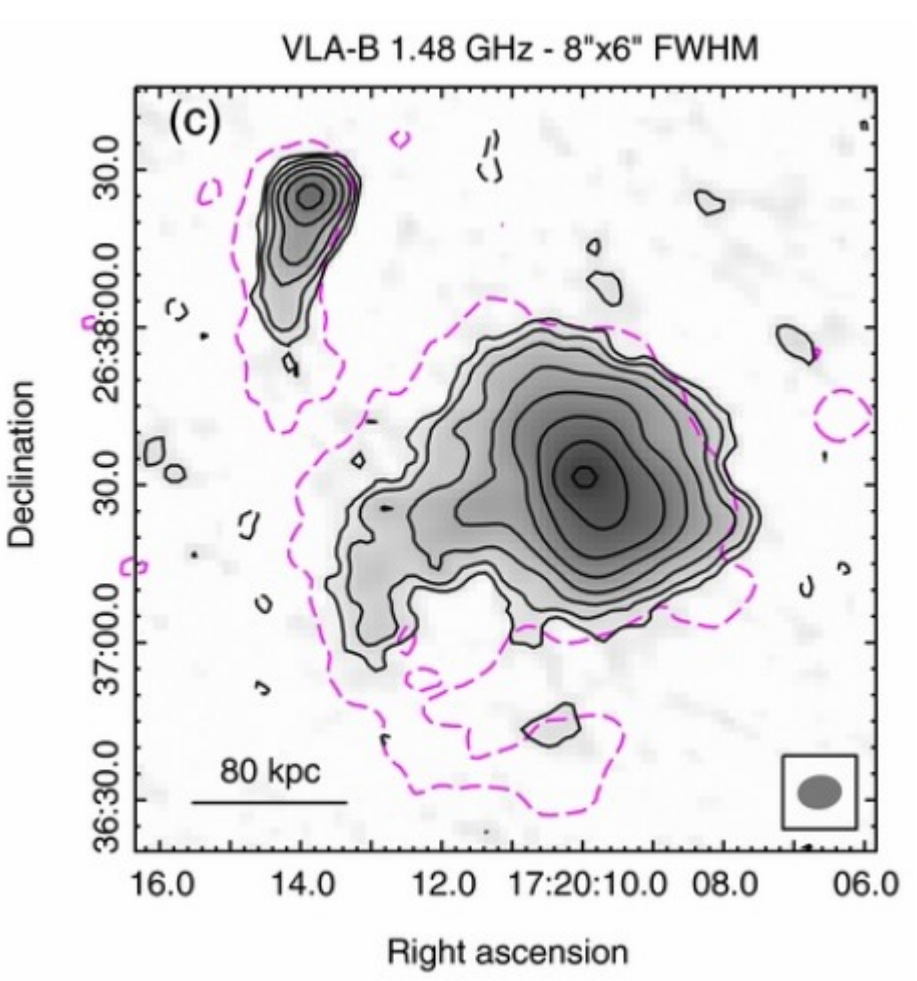
Spatial correlation
due to gas sloshing?

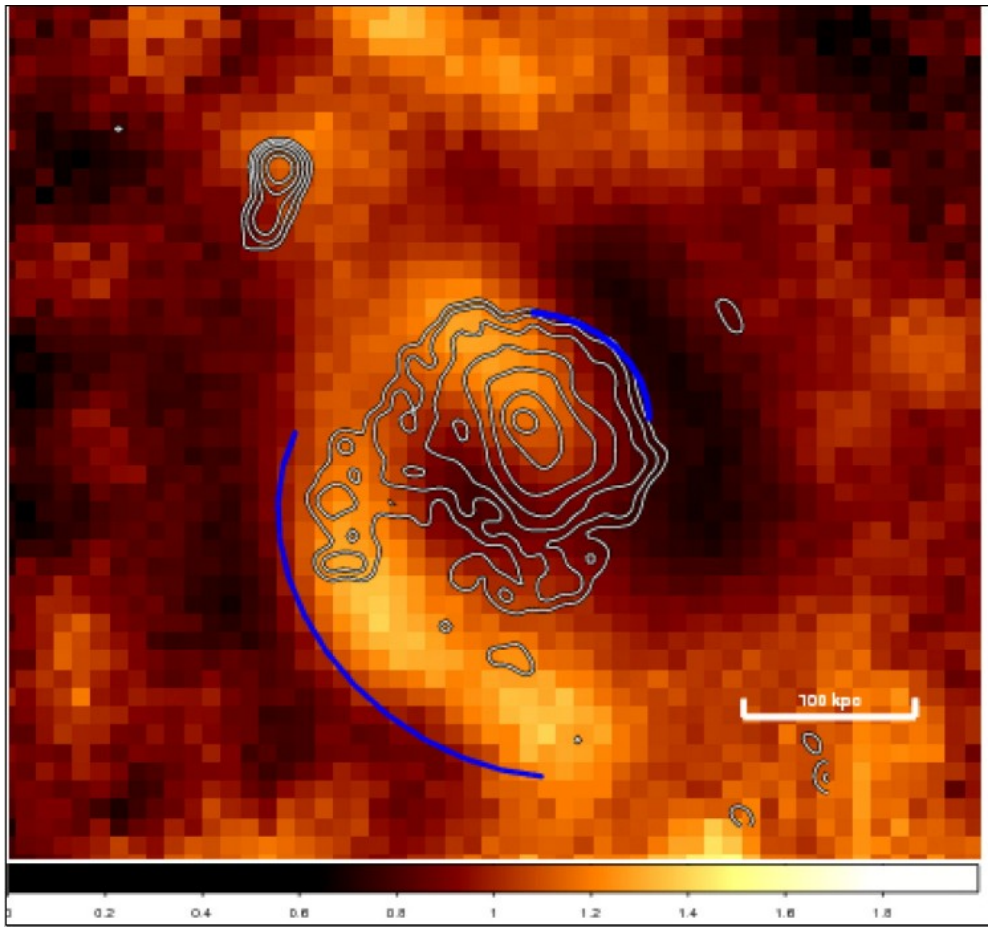


Ratio Chandra X-ray image in the [0.5, 2.5] keV band overlaid on the 1.5 GHz VLA-B contours.

(Mazzotta & Giacintucci 2008)

RXJ 1720.1+2638



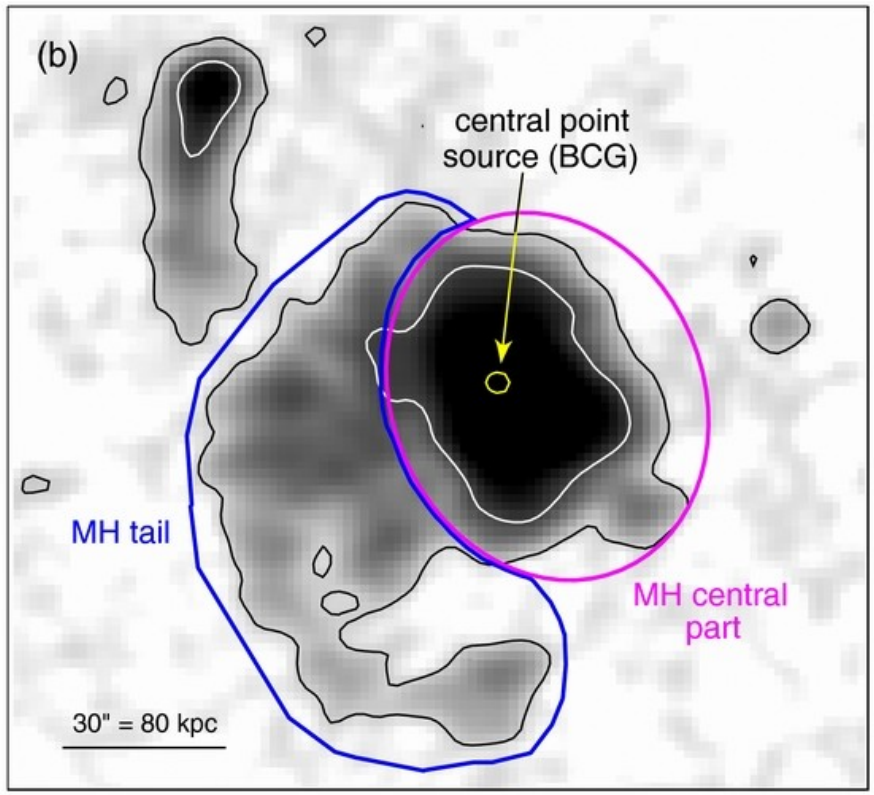


(Mazzotta & Giacintucci 2008)

GMRT 610 MHz

(Giacintucci et al. 2014)

RXJ 1720.1+2638



(Giacintucci et al. 2014)

GMRT + VLA
317 MHz – 4.86 GHz

Spectral index:

- MH central part

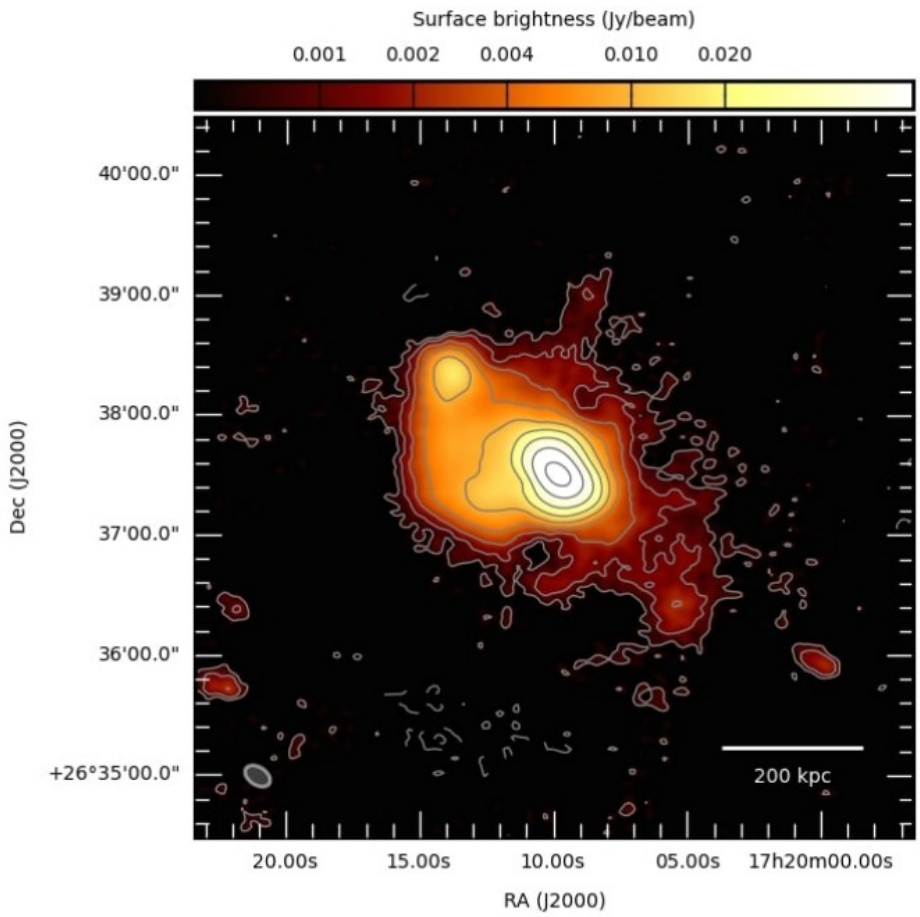
  $\alpha = 1.0 \pm 0.1$

- MH tail

  $\alpha = 1.4 \pm 0.1$

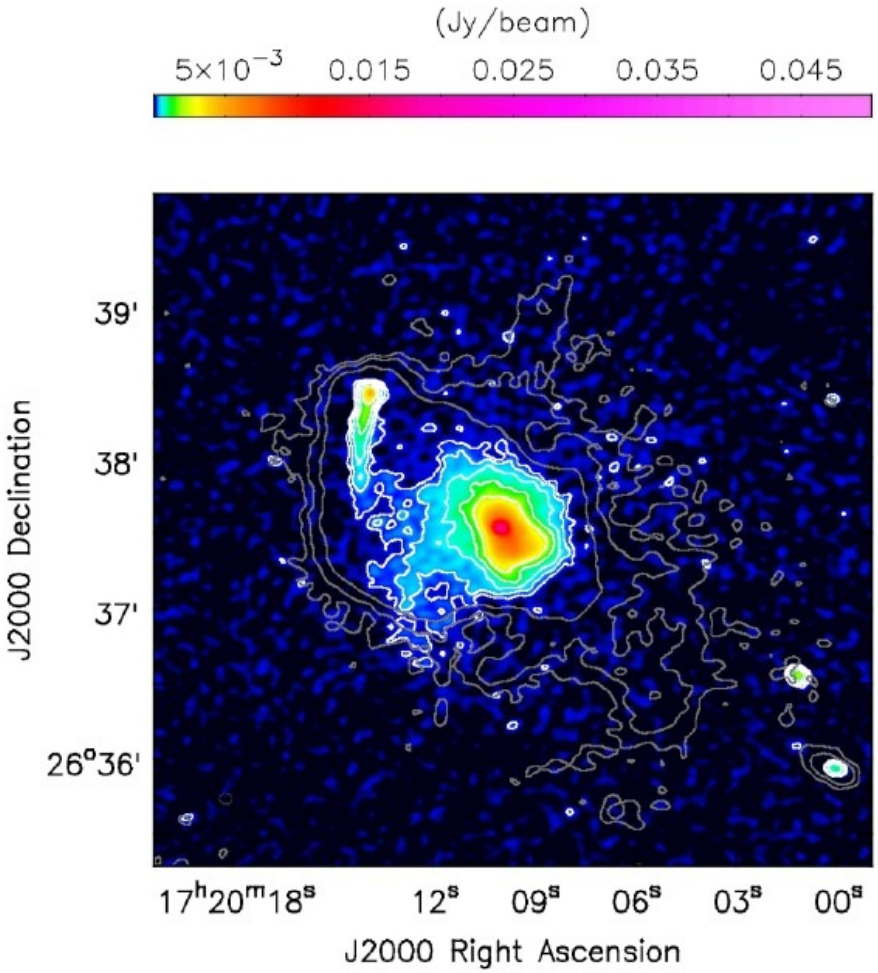
RXJ 1720.1+2638 – LOFAR HBA

LOFAR HBA – 144 MHz



(Savini et al. 2019)

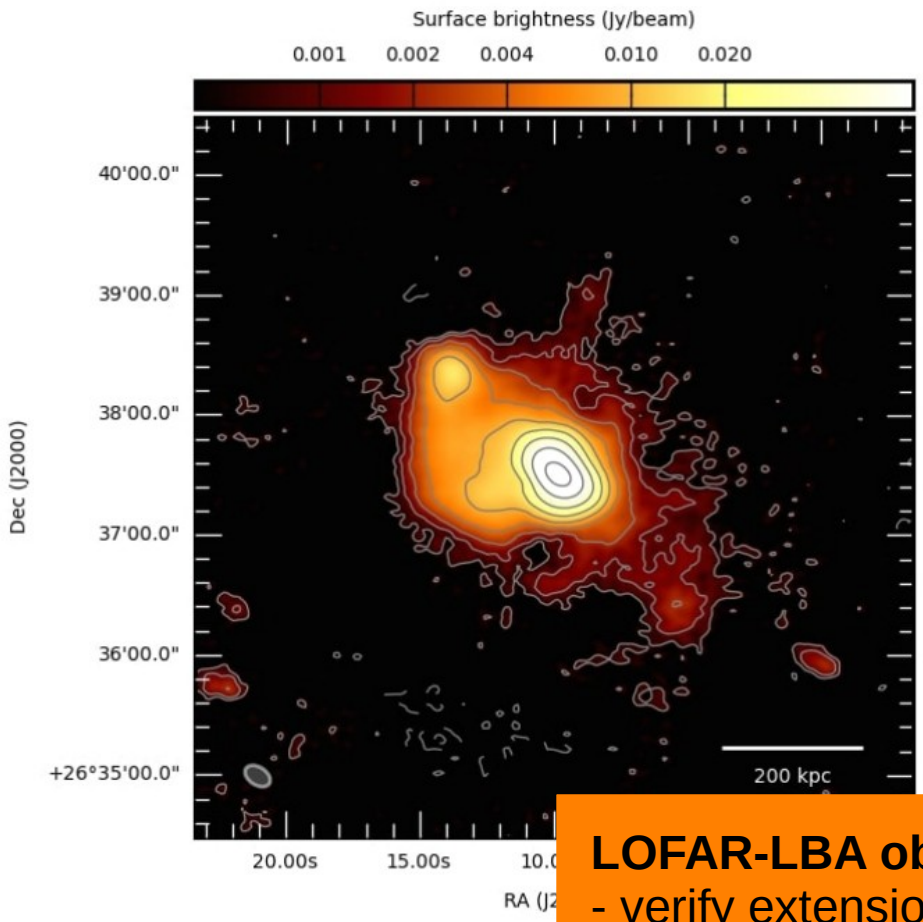
GMRT – 610 MHz



Diffuse emission beyond the cluster core, with $\alpha > 2.1$

RXJ 1720.1+2638 – LOFAR HBA

LOFAR HBA – 144 MHz



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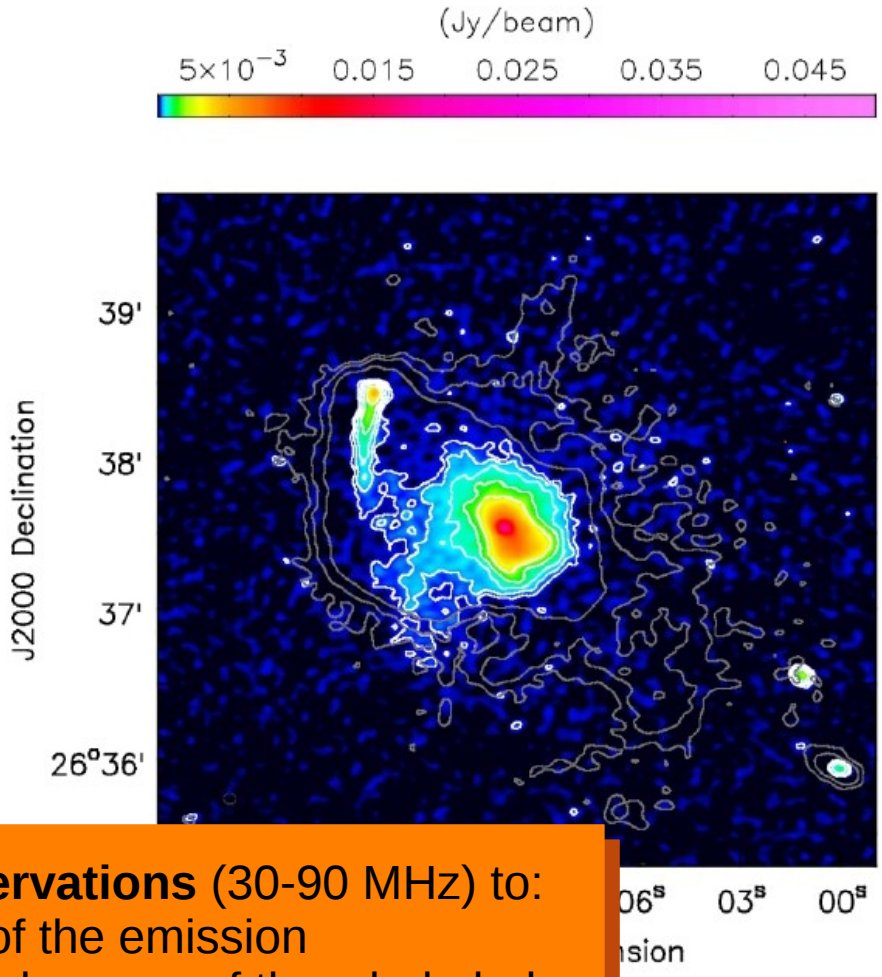
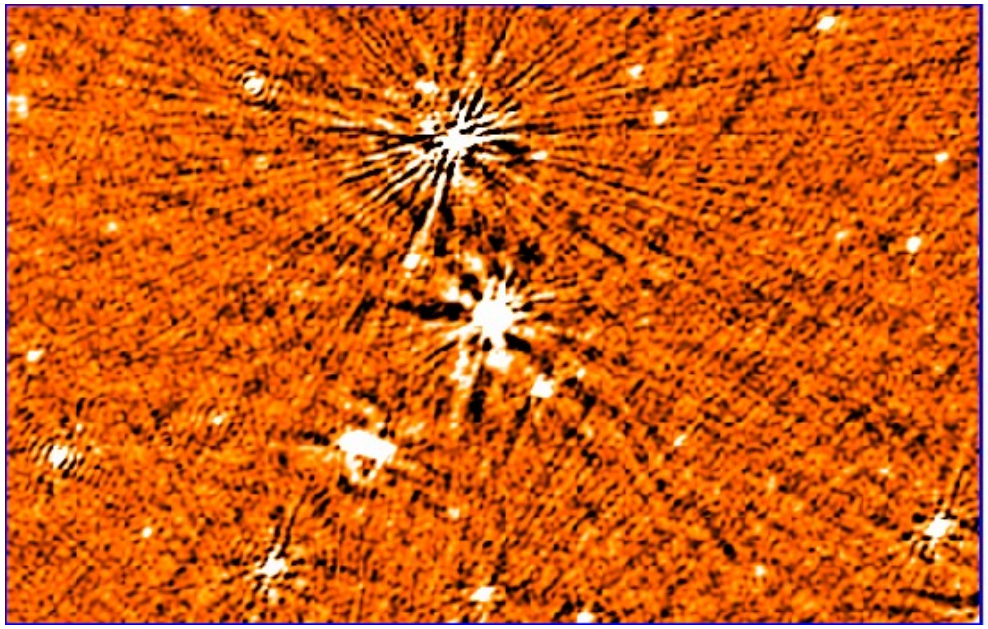
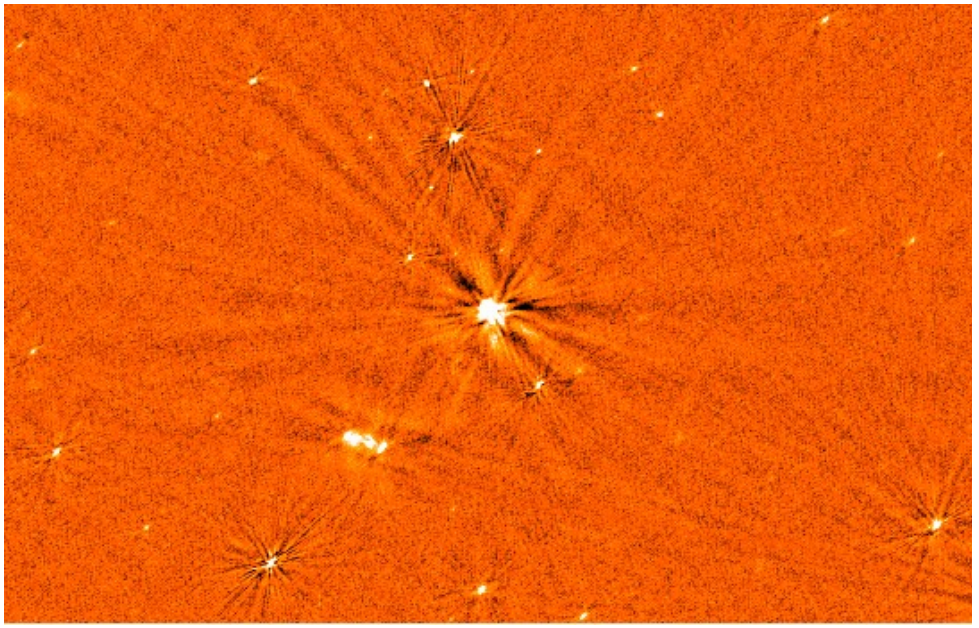


LOFAR-LBA observations (30-90 MHz) to:
- verify extension of the emission
- create spectral index map of the whole halo
- unserstand the origin of the emission
→ 10 h awarded in cycle XX

RXJ 1720.1+2638 – LOFAR LBA





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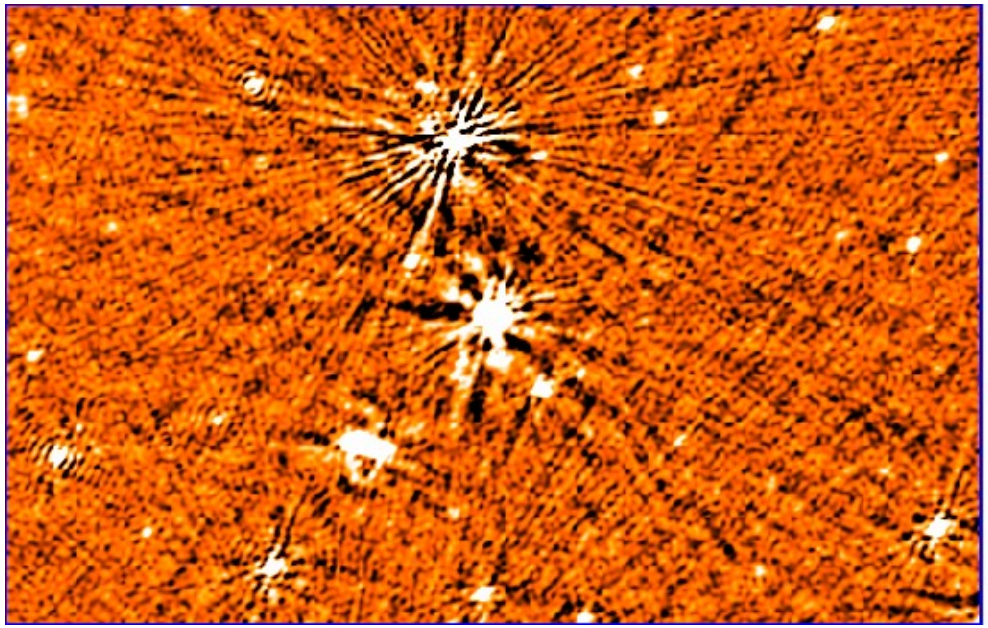

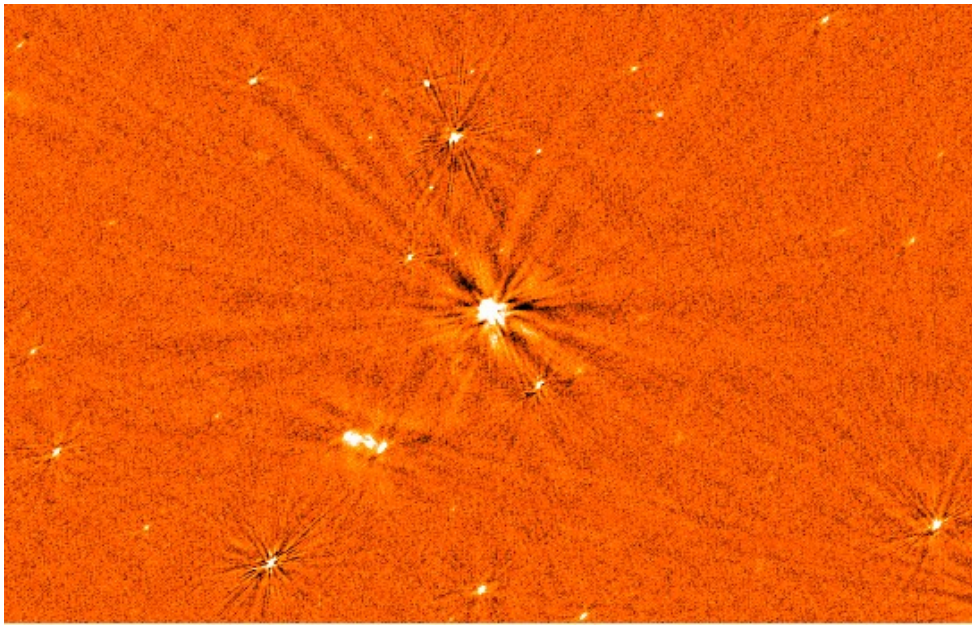

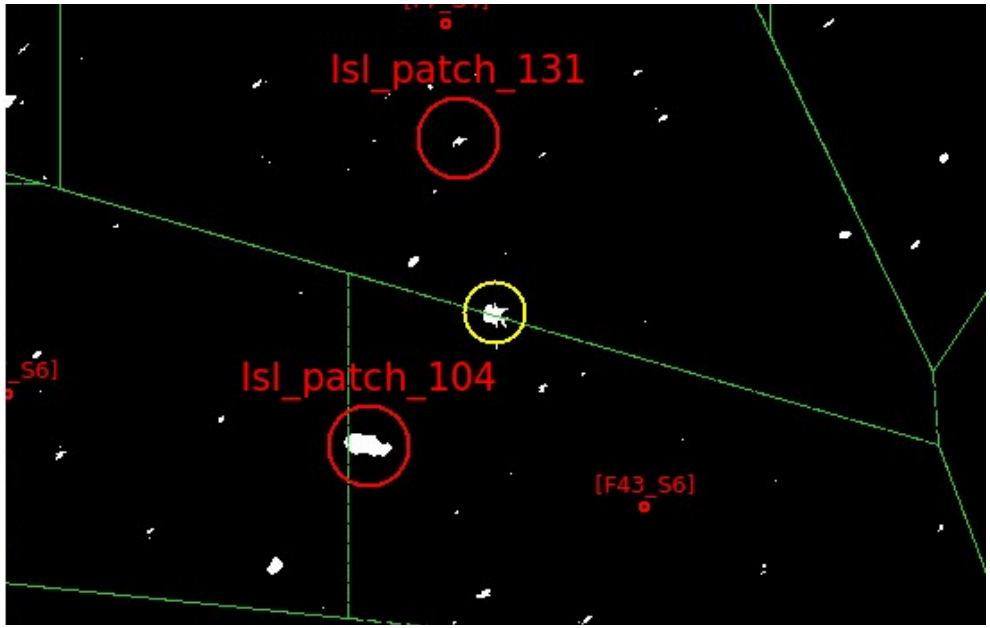

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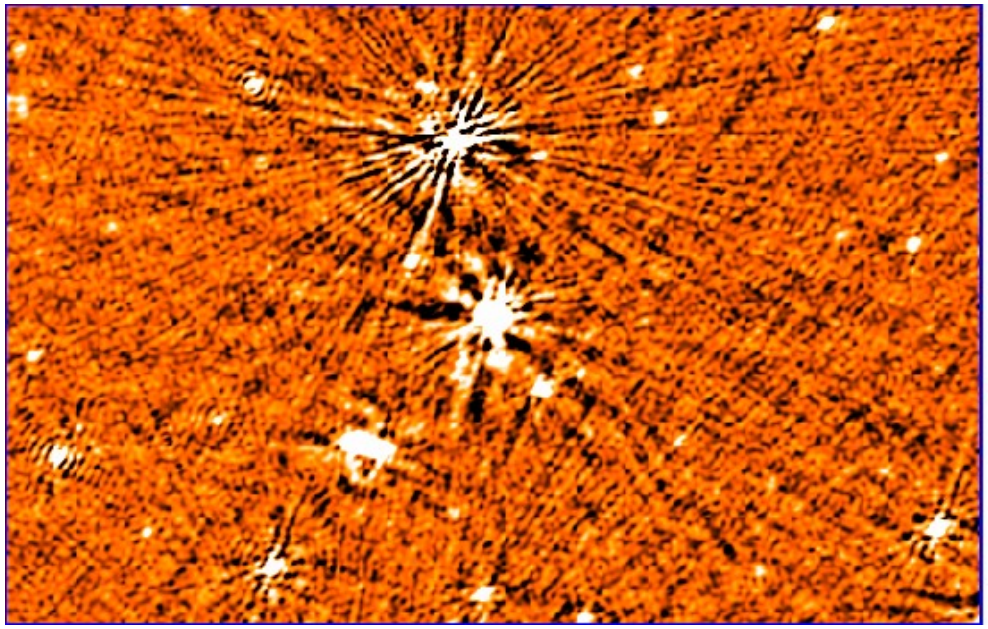

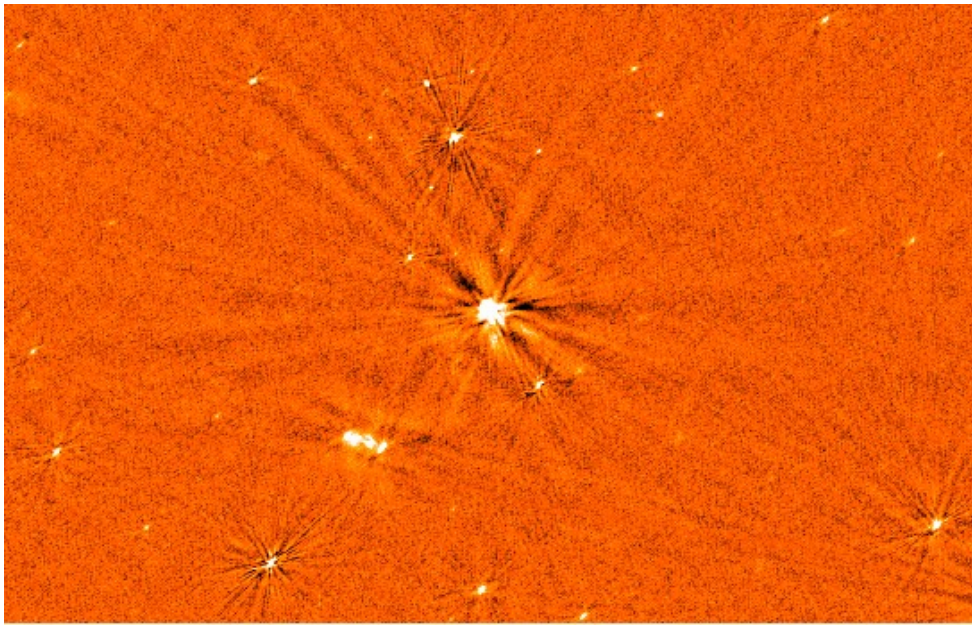

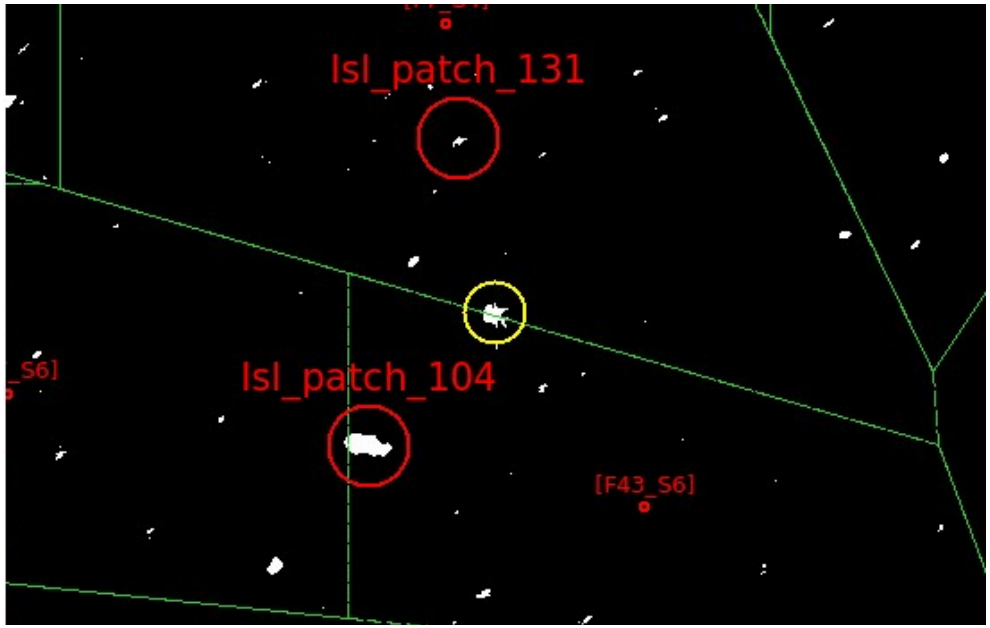

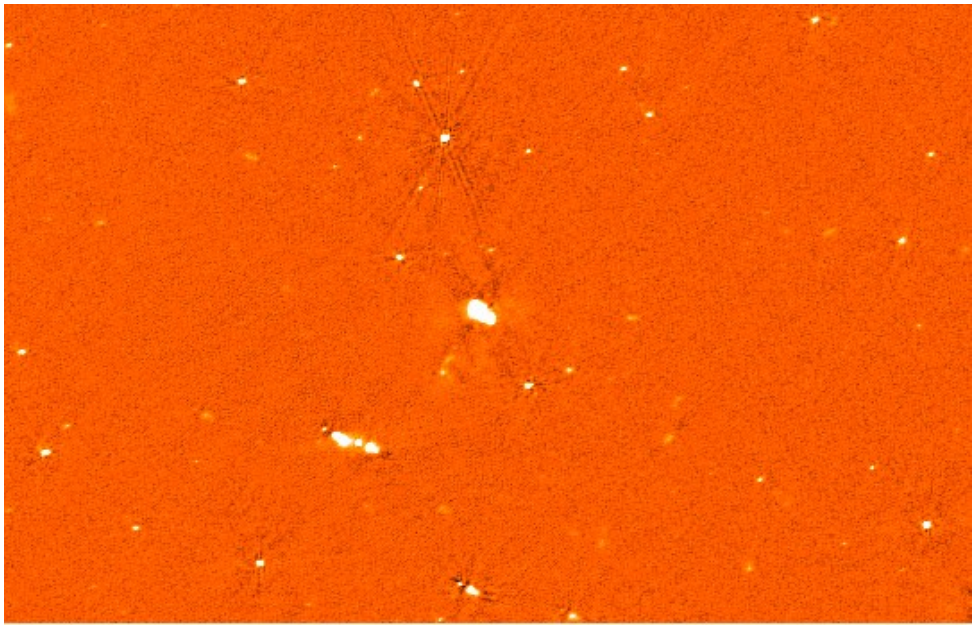

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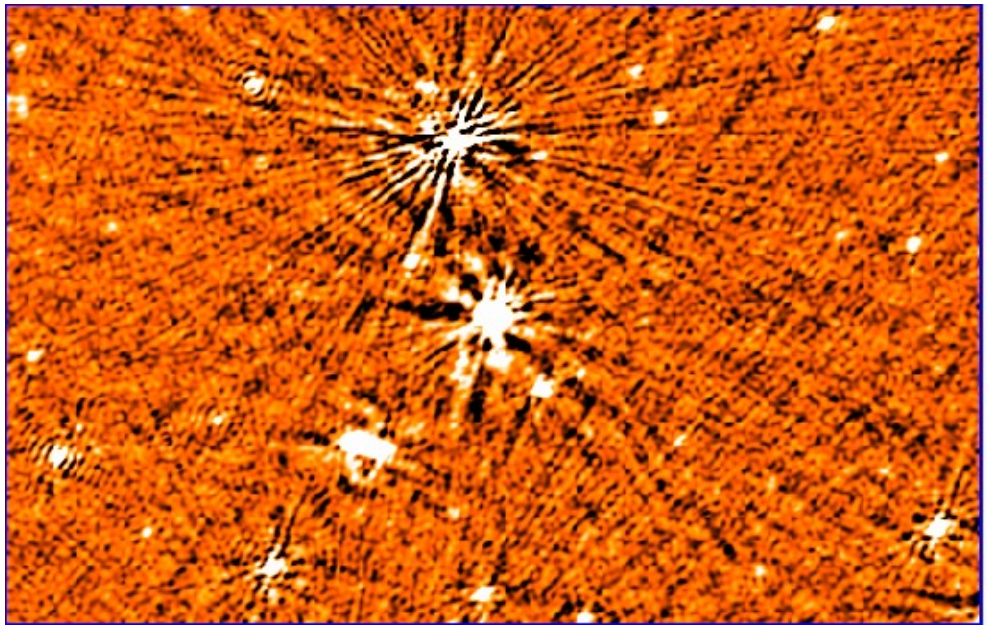

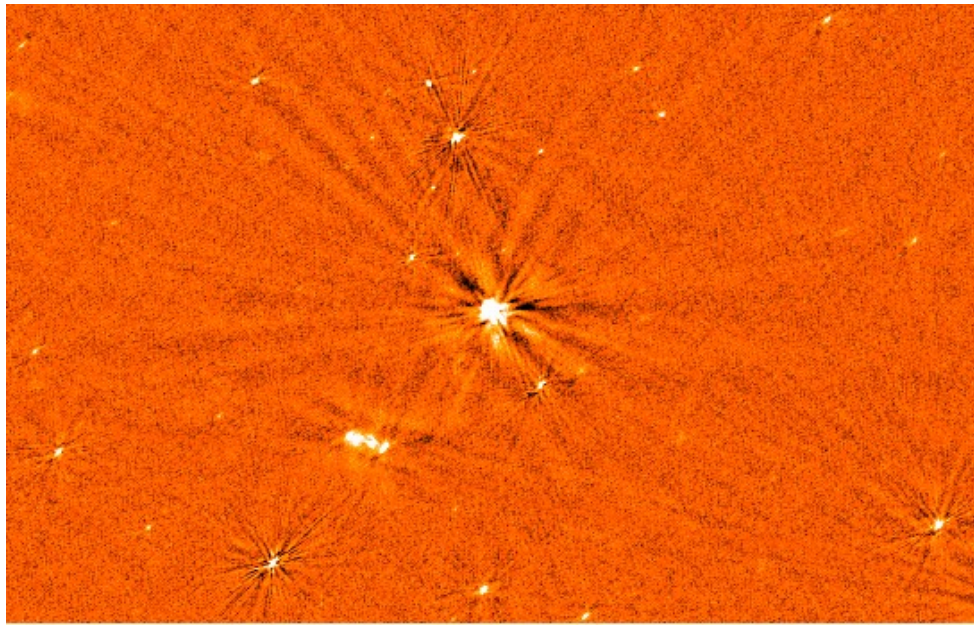

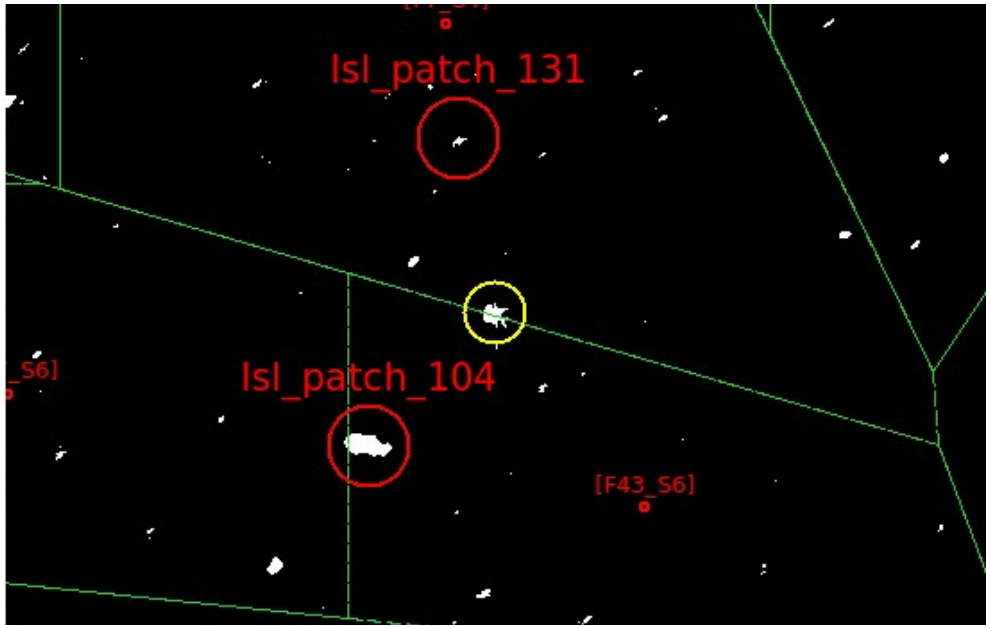

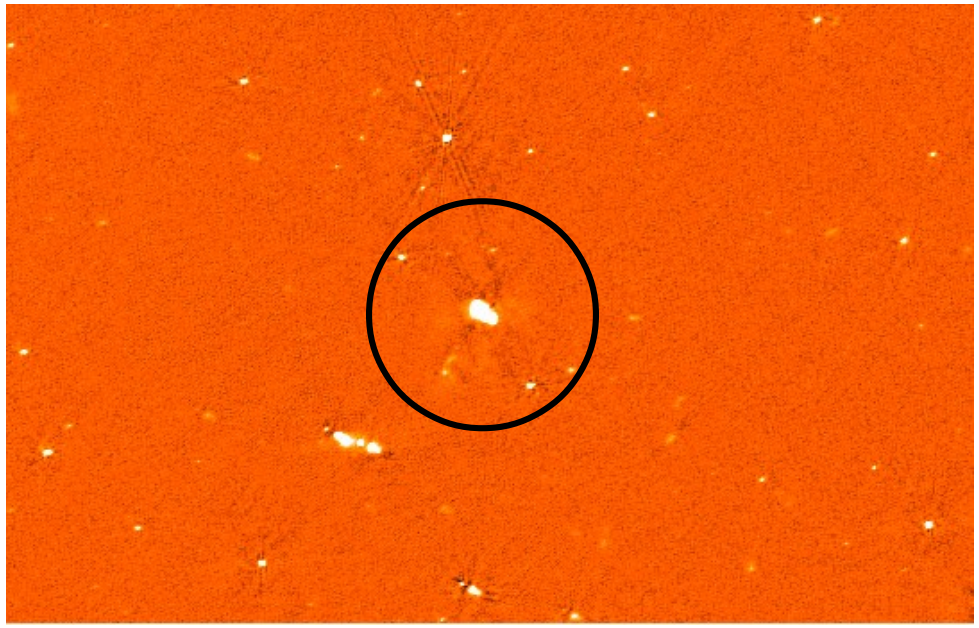

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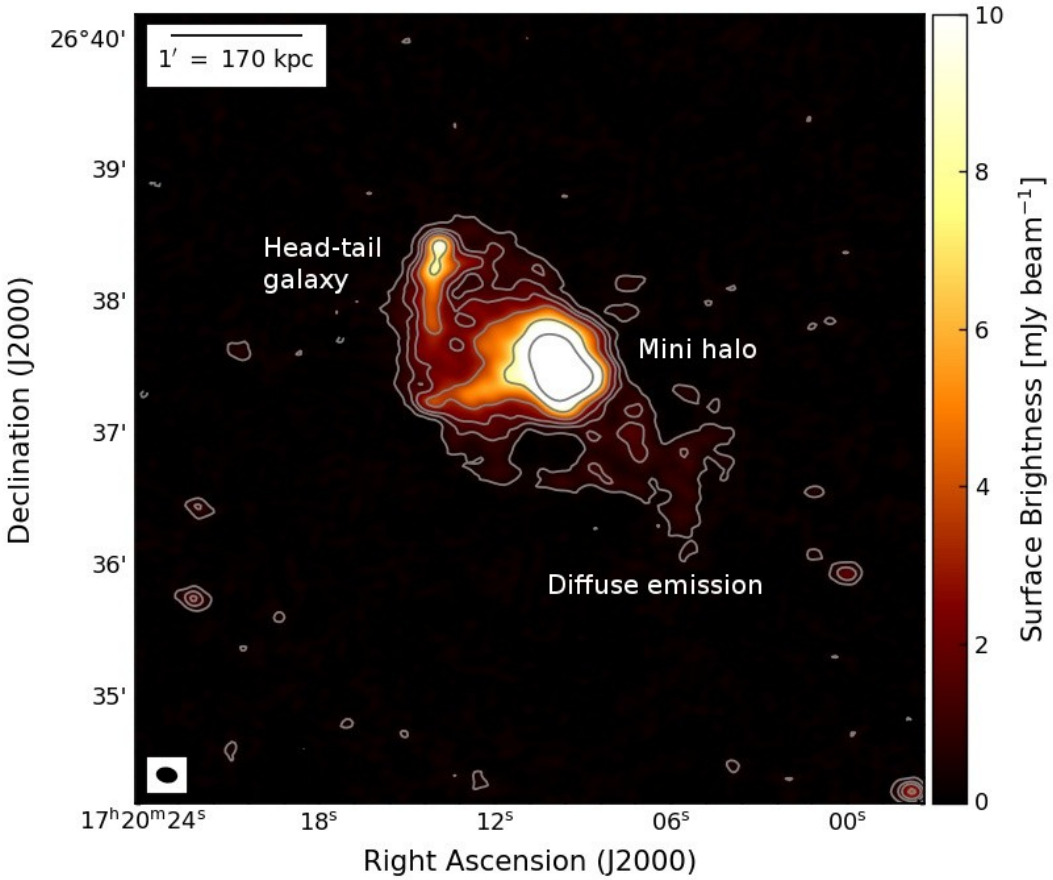
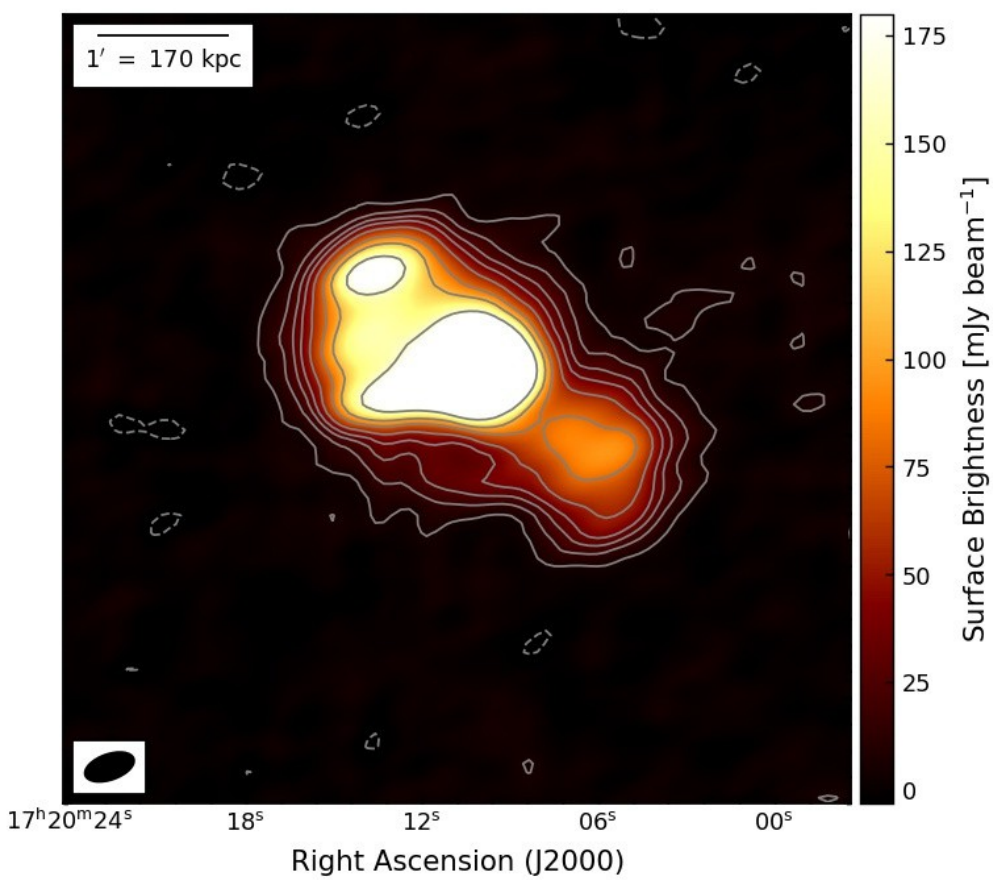
LOFAR HBA – 144 MHz



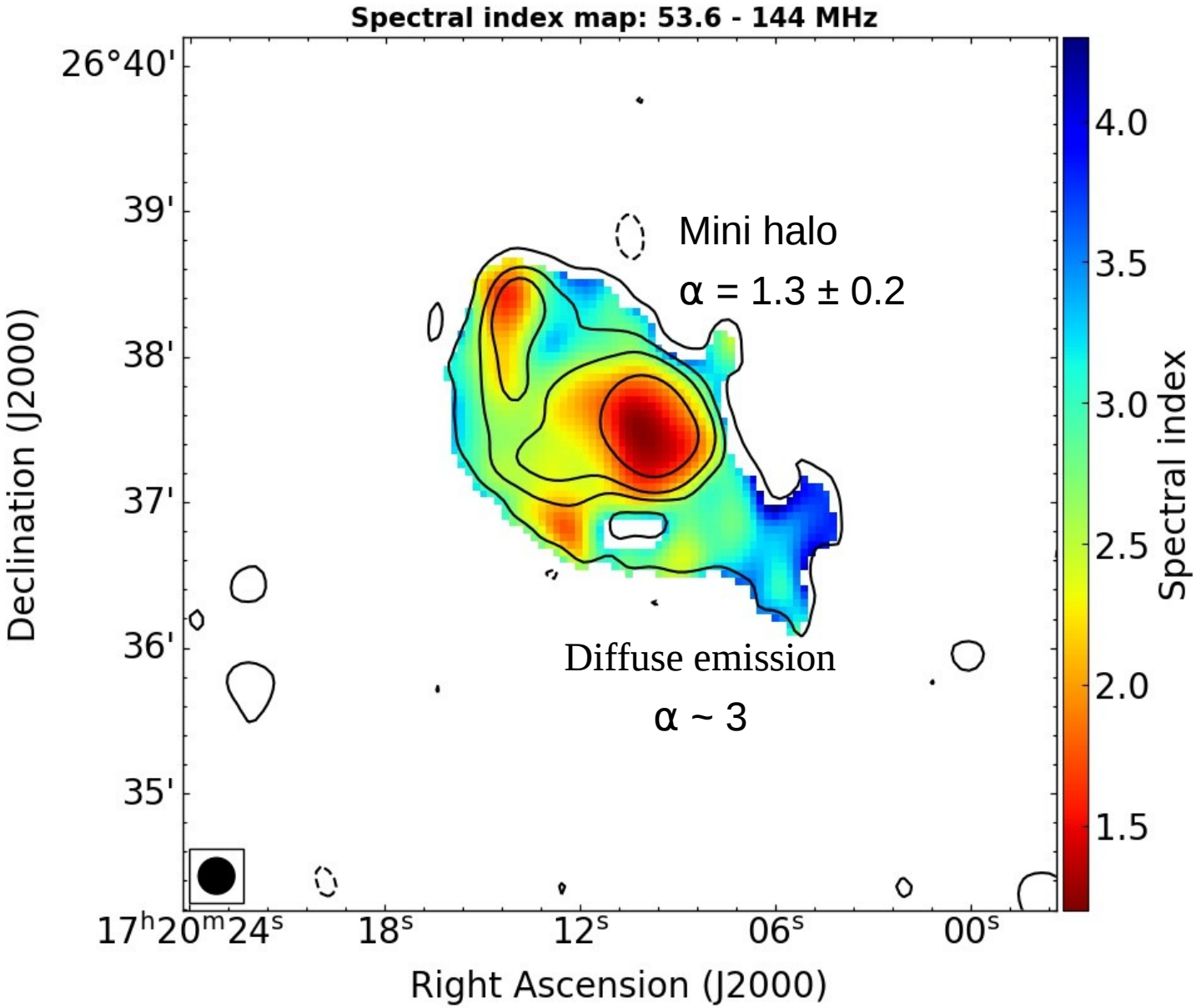
Res: 9” x 7”
Rms: 1.3 x 10^{-1} mJy

LOFAR LBA – 53.6 MHz

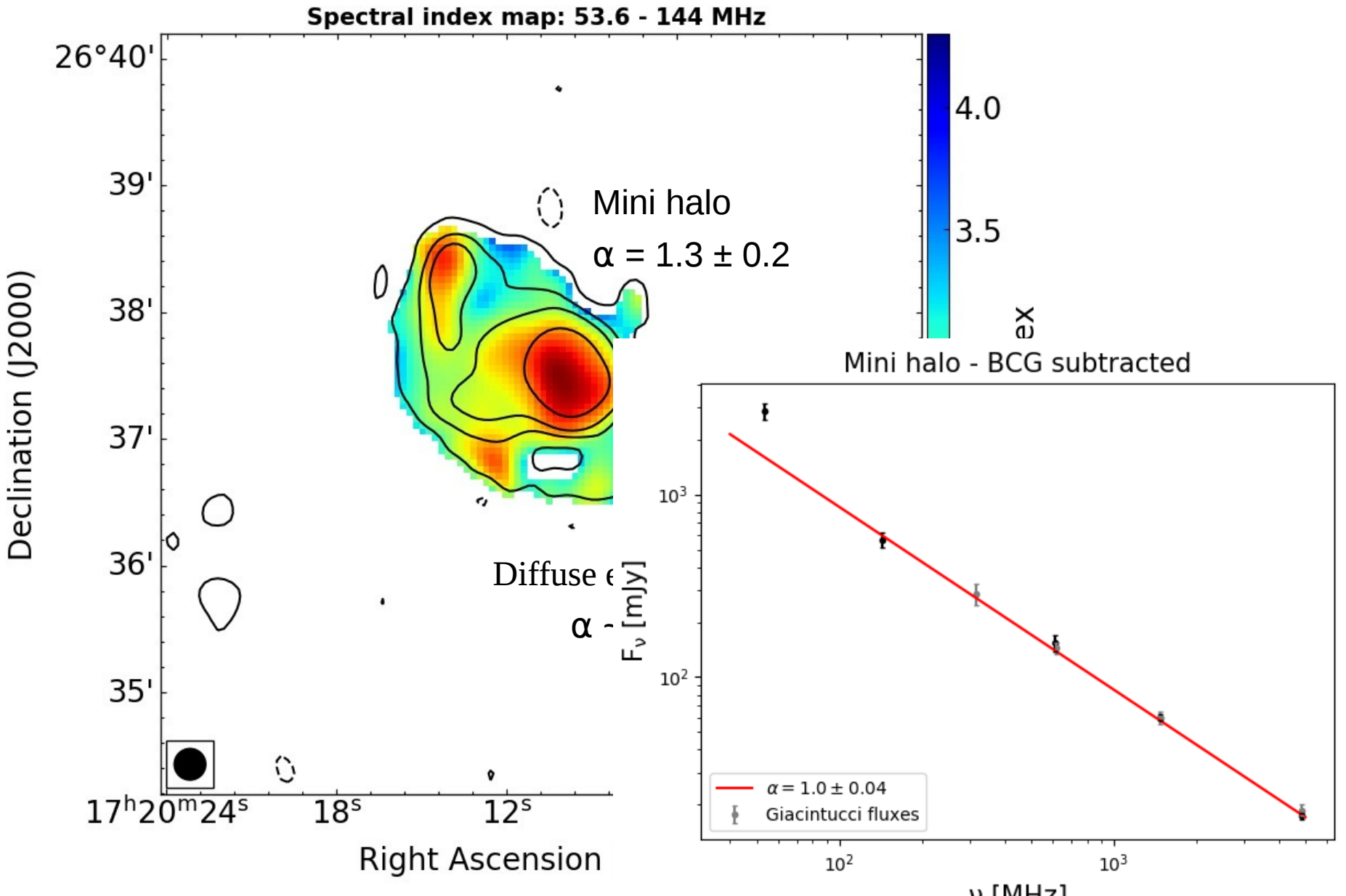


Res: 23” x 12”
Rms: 1.8 mJy

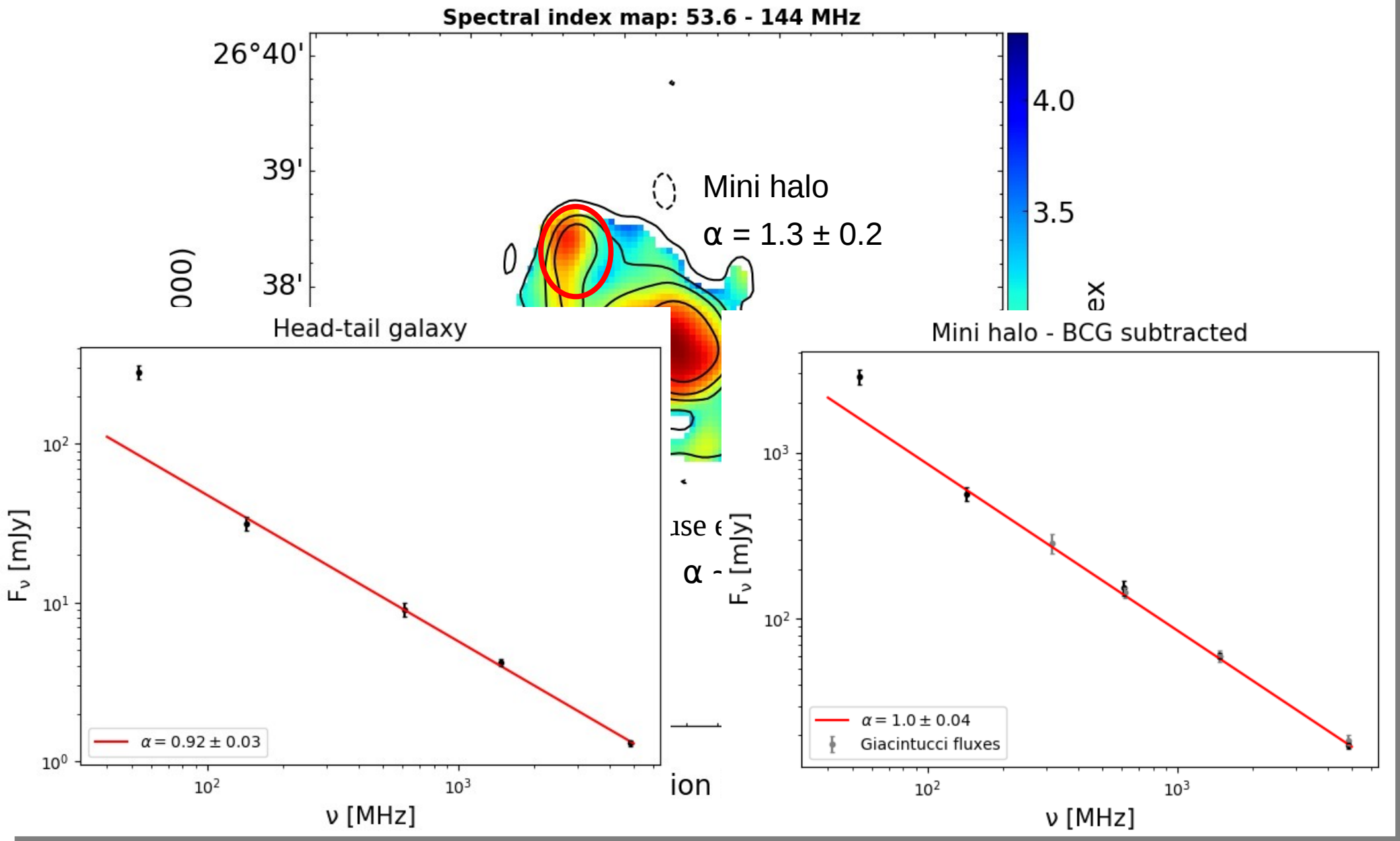
Spectral index map



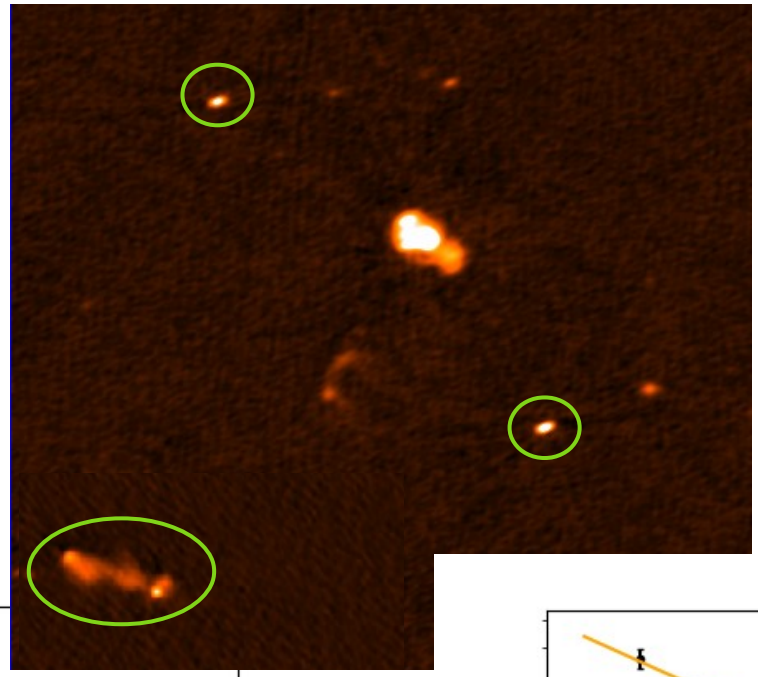
Spectral index map

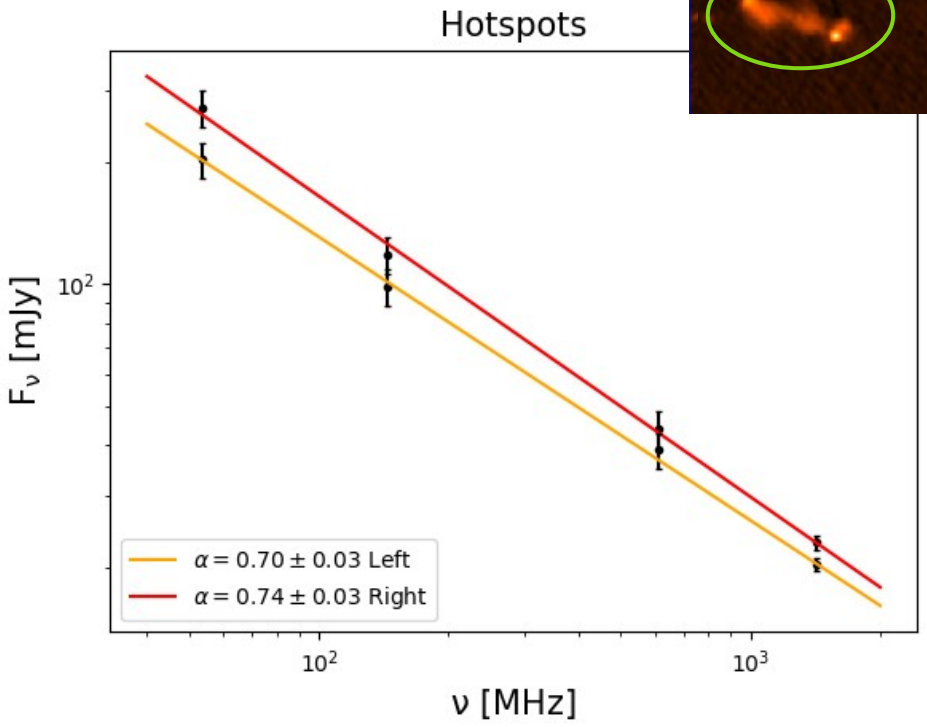


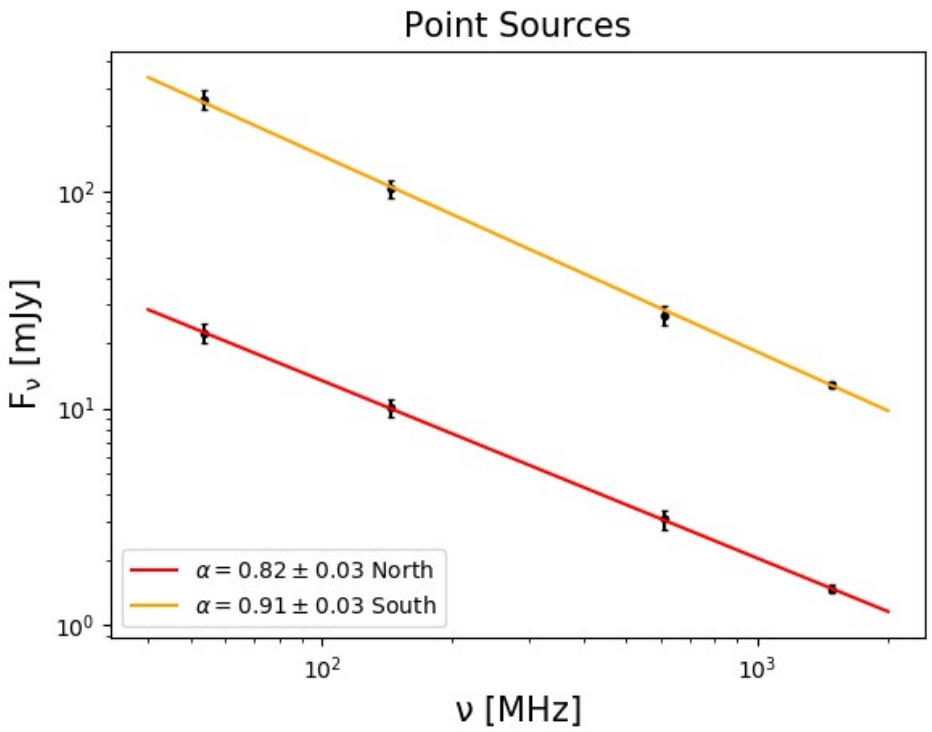
Spectral index map



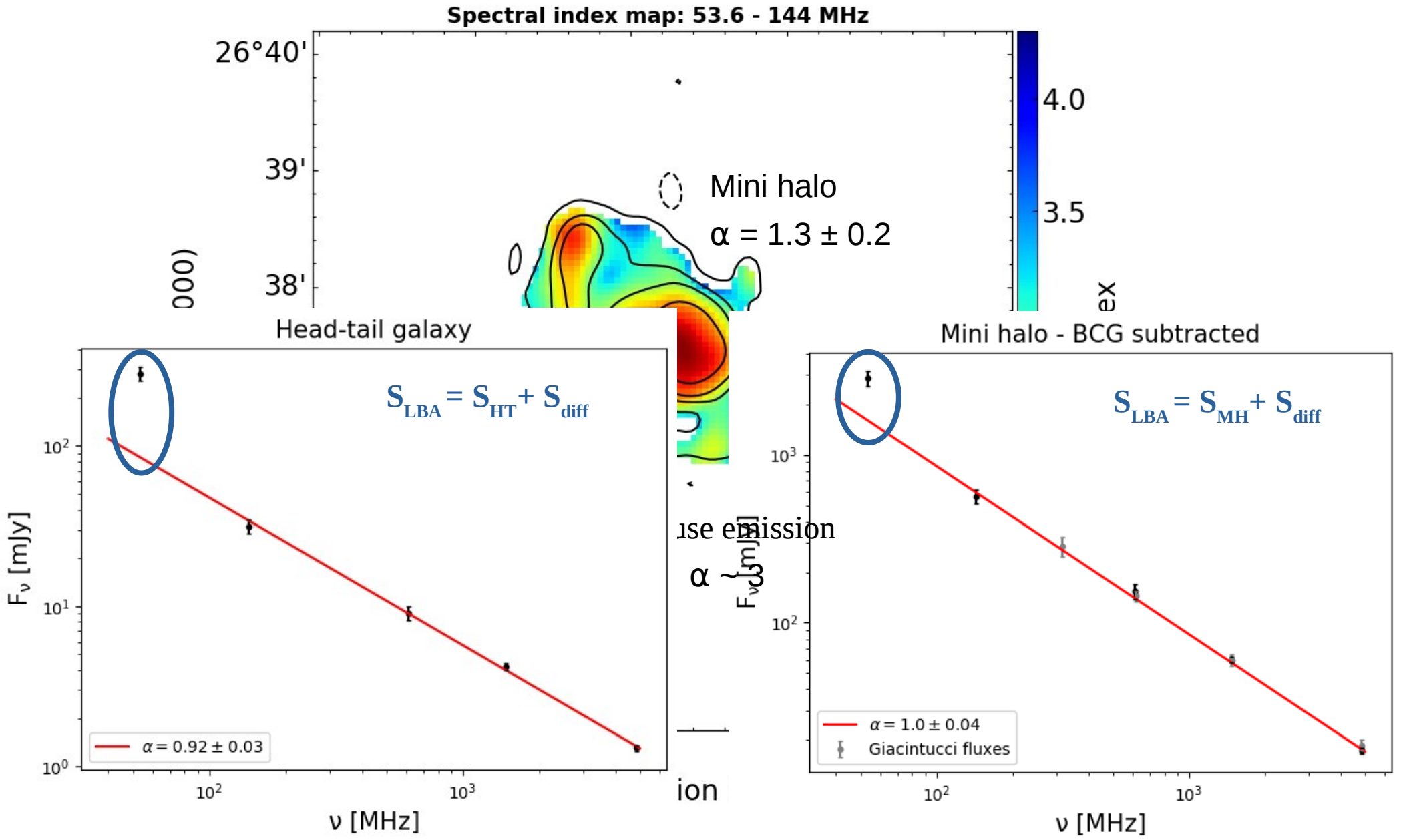
Spectral index map







Spectral index map



Conclusions

- The diffuse emission detected with LOFAR has an ultra-steep spectrum.
- There is a net difference in the spectral index of the two components.

Next steps

Analysis of X-ray data to check for a possible:

- spatial correlation between radio and X-ray surface brightness of the two components.
- cavity in correspondence of diffuse emission.

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Thank you for the attention