



Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

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HAMBURG OBSERVATORY

LBA MINI SYMPOSIUM 09/03/2021

ABELL 1033 – THE GREET AND A RADIO HALO AT ULTRA-LOW FREQUENCIES

ABELL 1033 – FACT SHEET

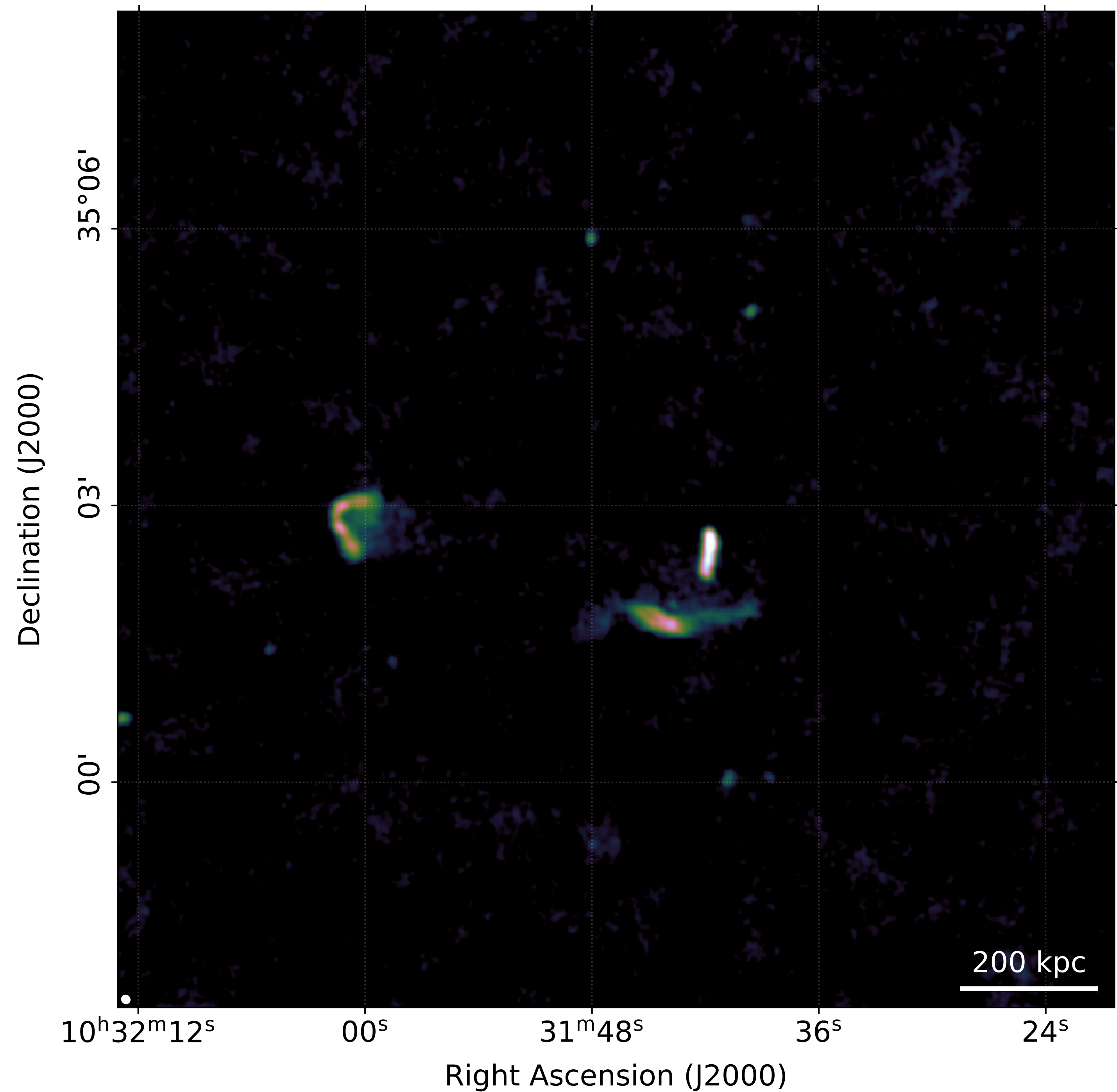
- ▶ $z = 0.126$
- ▶ $M_{500} = 3.2 \cdot 10^{14} M_{\odot}$
- ▶ Merger activity
- ▶ Hosts prototype of GReET category

NEW DATA:

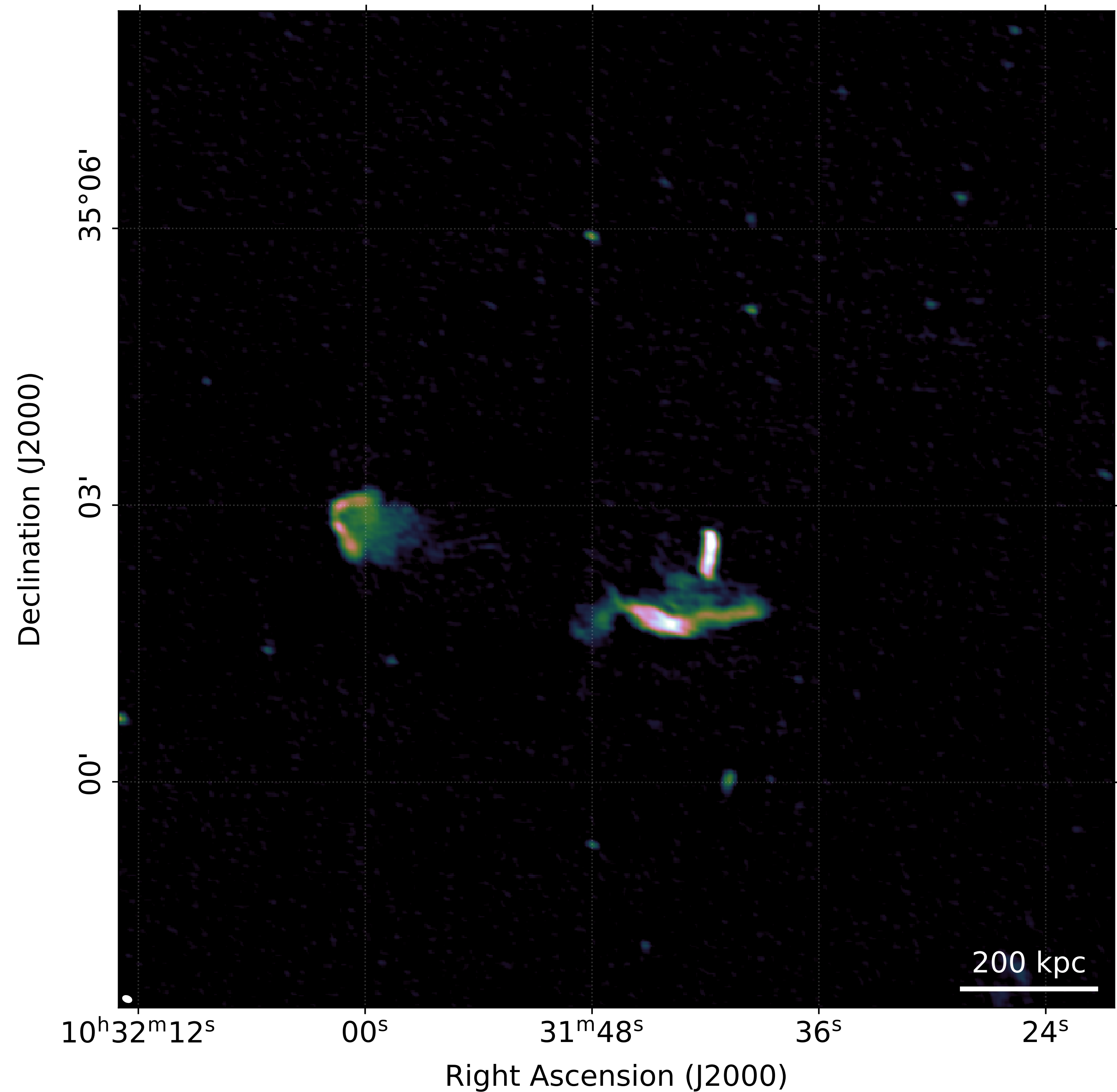
- ▶ 8h LBA, calibrated with **LiLF**
- ▶ Second LoTSS pointing



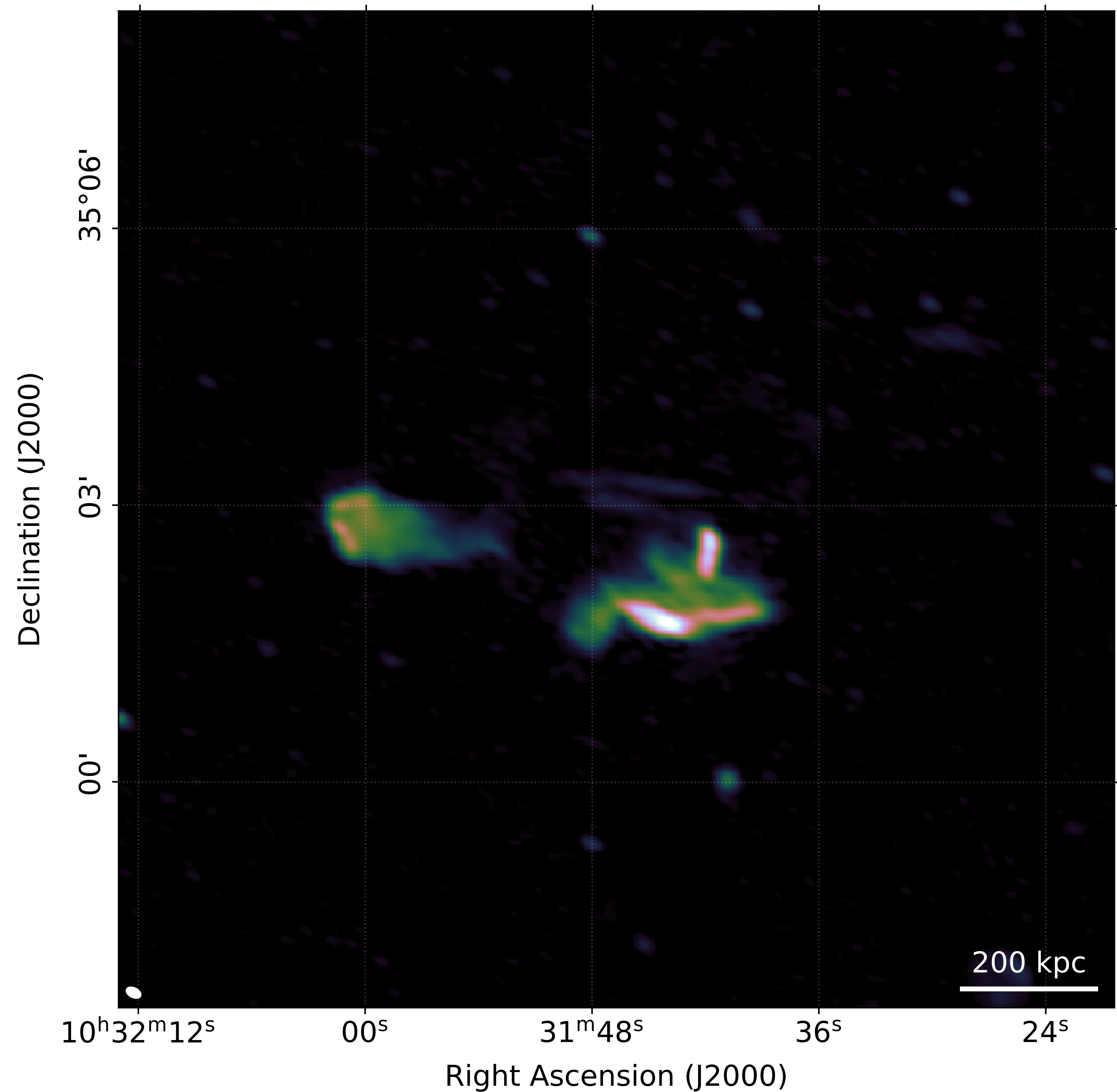
VLA 1400 MHz



GMRT 610 MHz

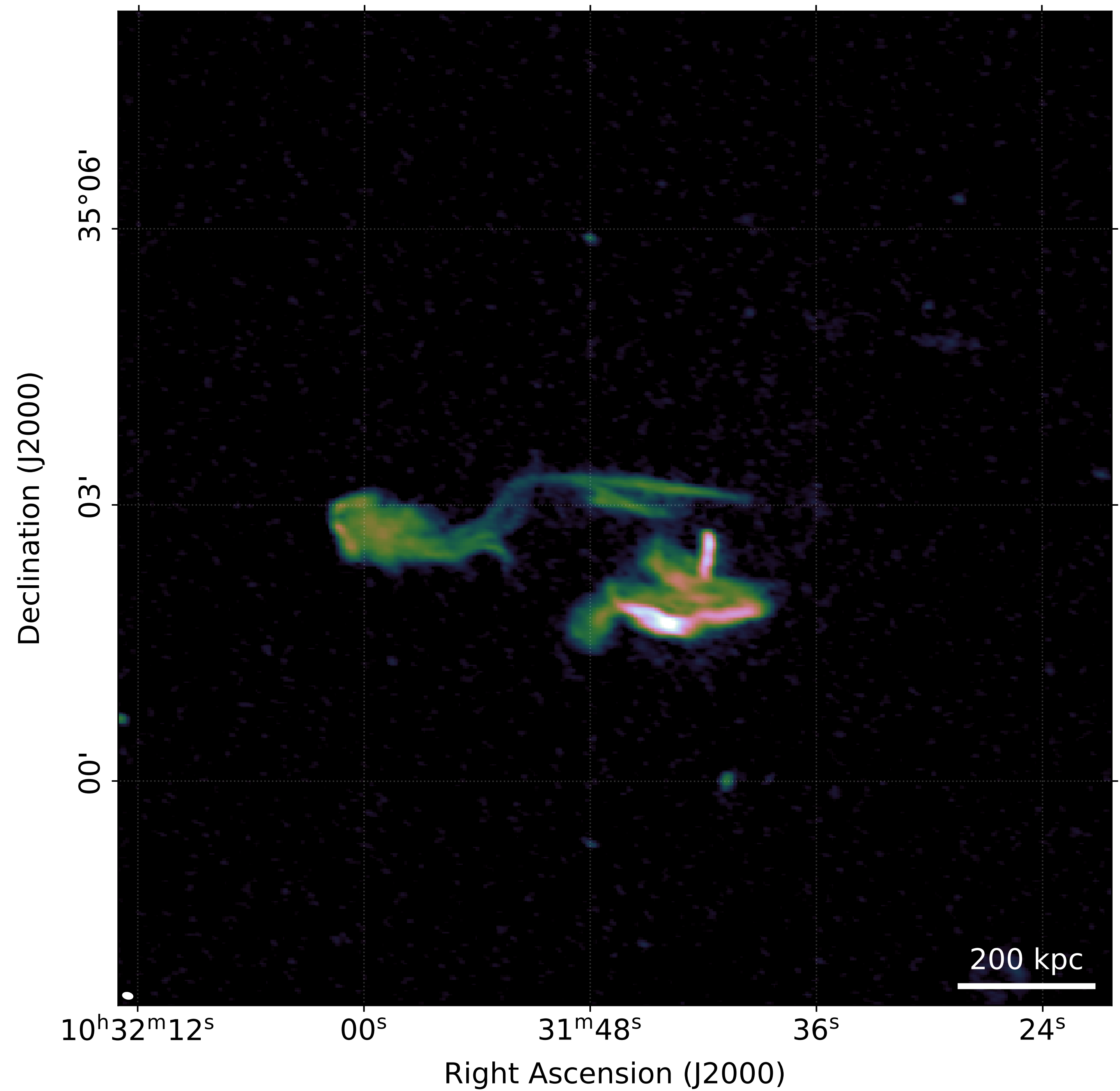


GMRT 325 MHz



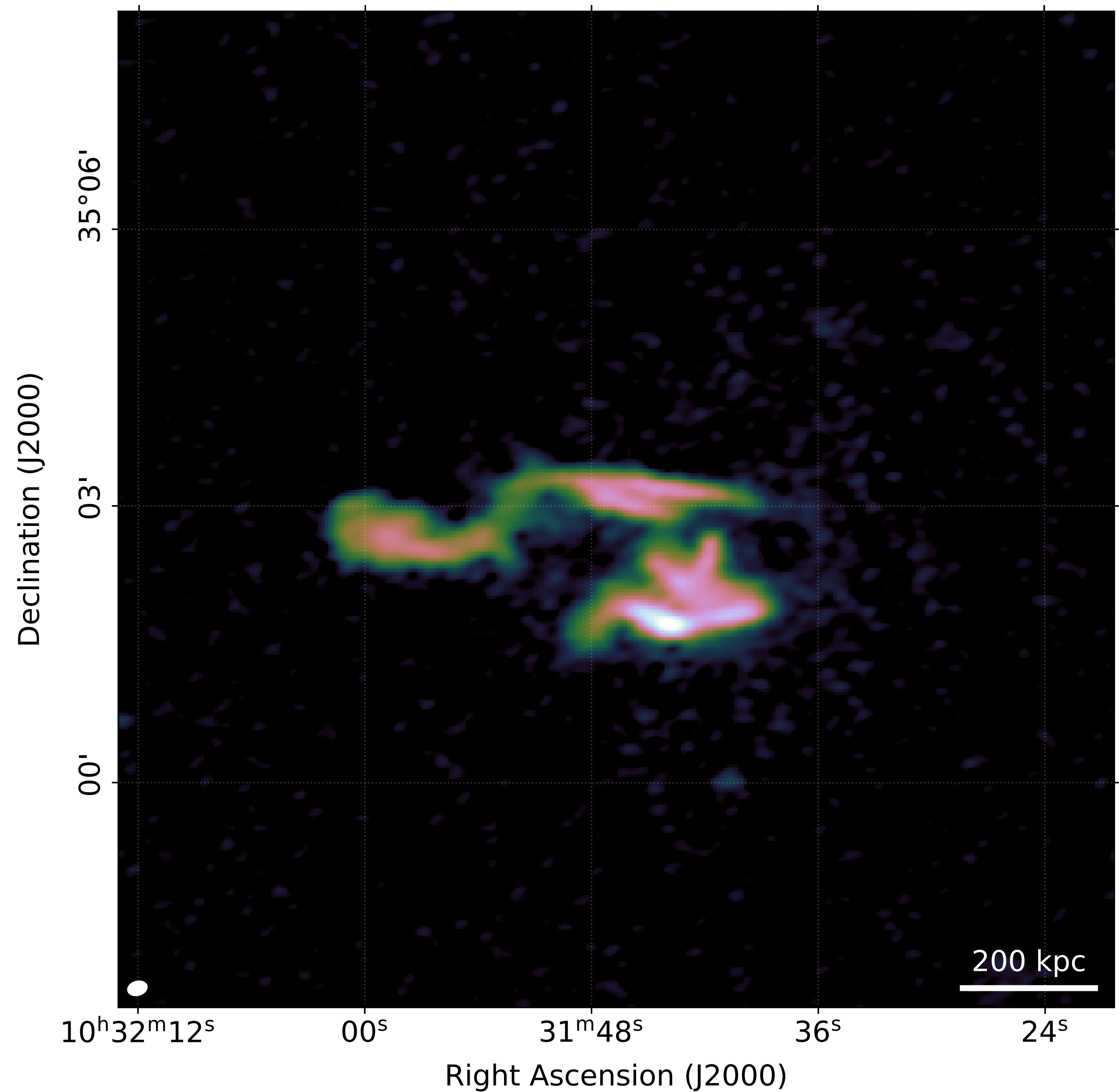
LOFAR HBA 144 MHz

- Second pointing: 40% deeper

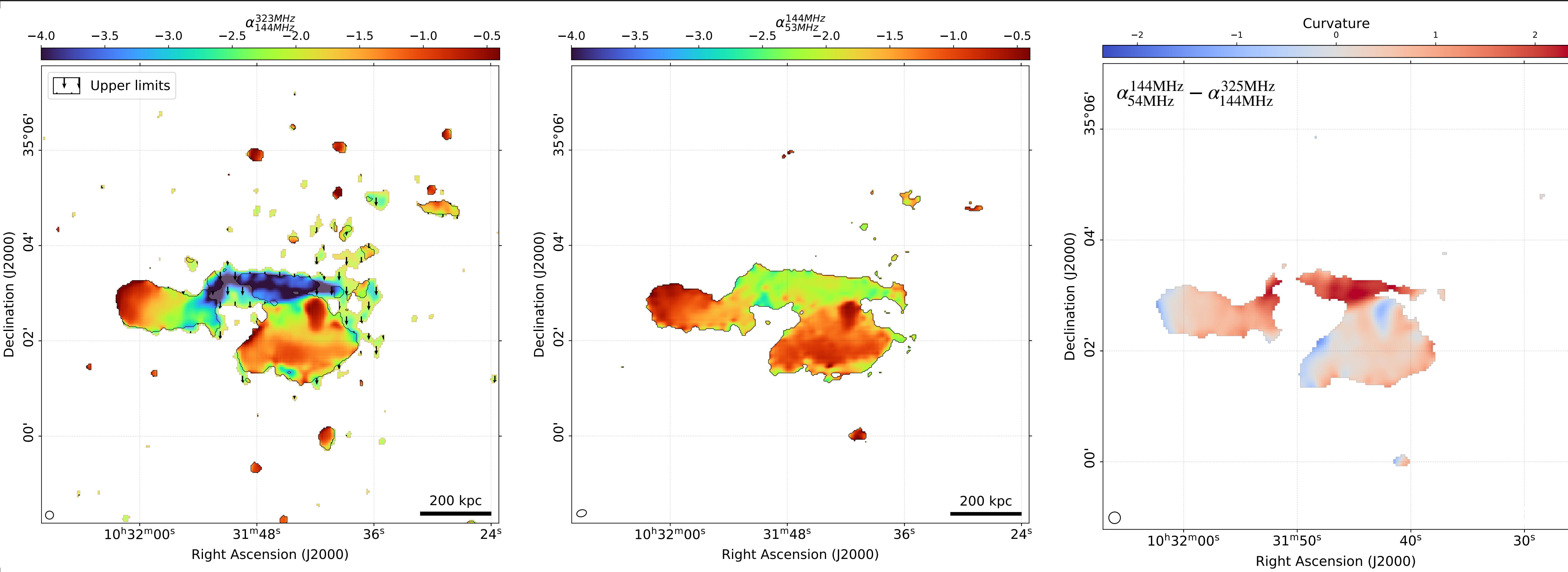


LOFAR LBA 54 MHz

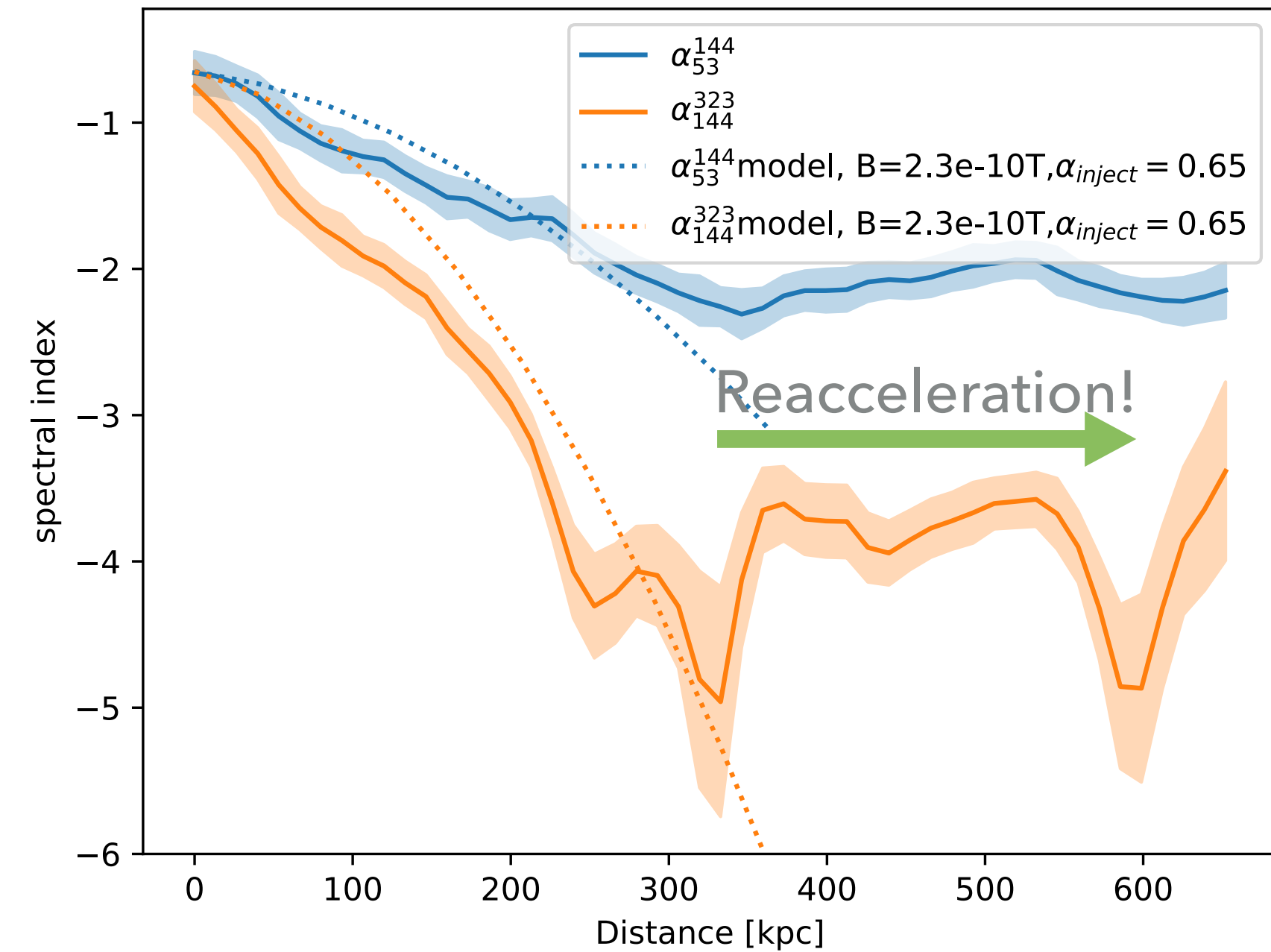
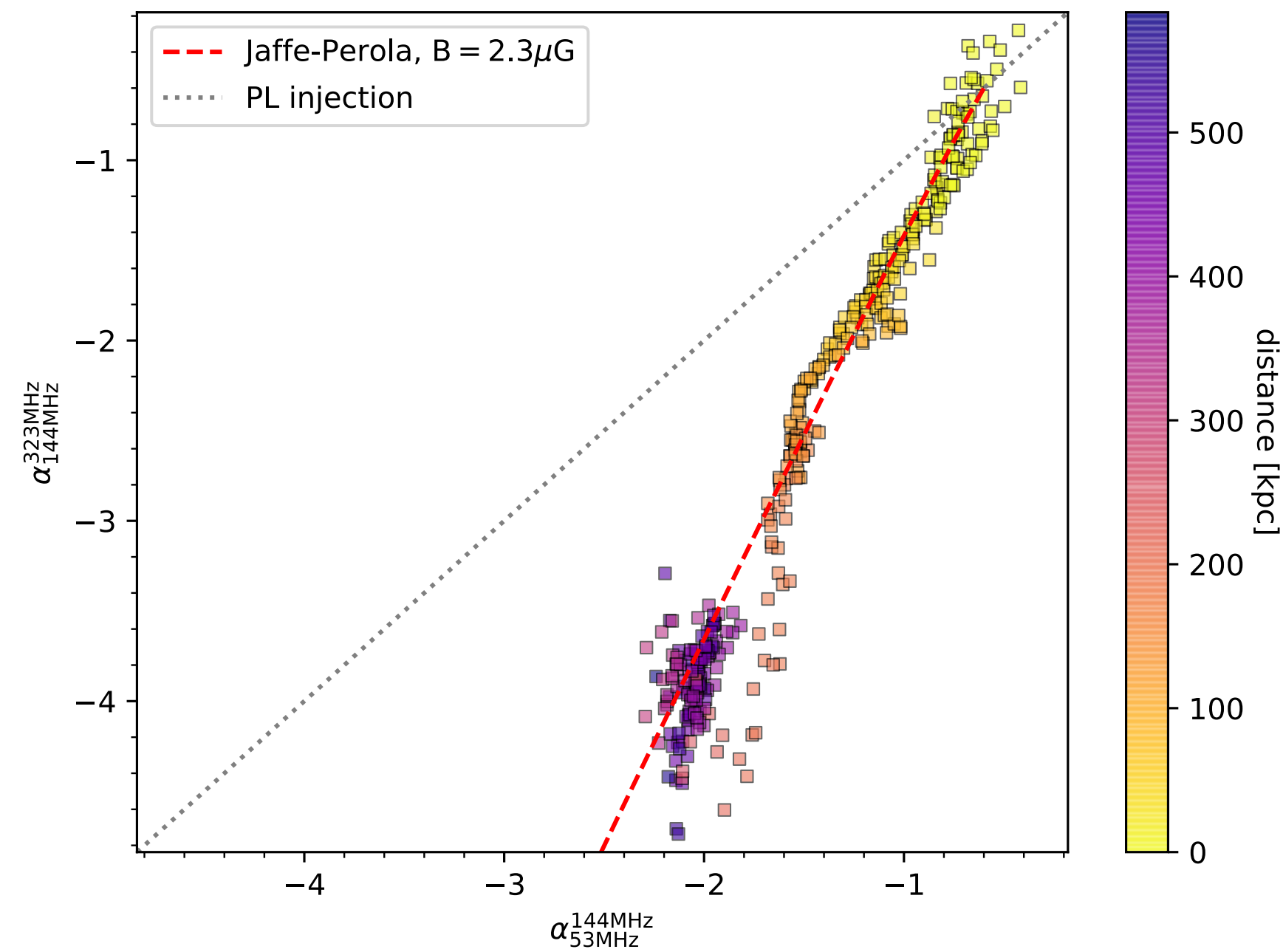
- ▶ High resolution image quality:
 - ▶ $12'' \times 9''$
 - ▶ $\text{rms} < 1.7 \text{ mJy beam}^{-1}$
(next to 11 Jy source!)



STRONG CURVATURE IN THE GREET



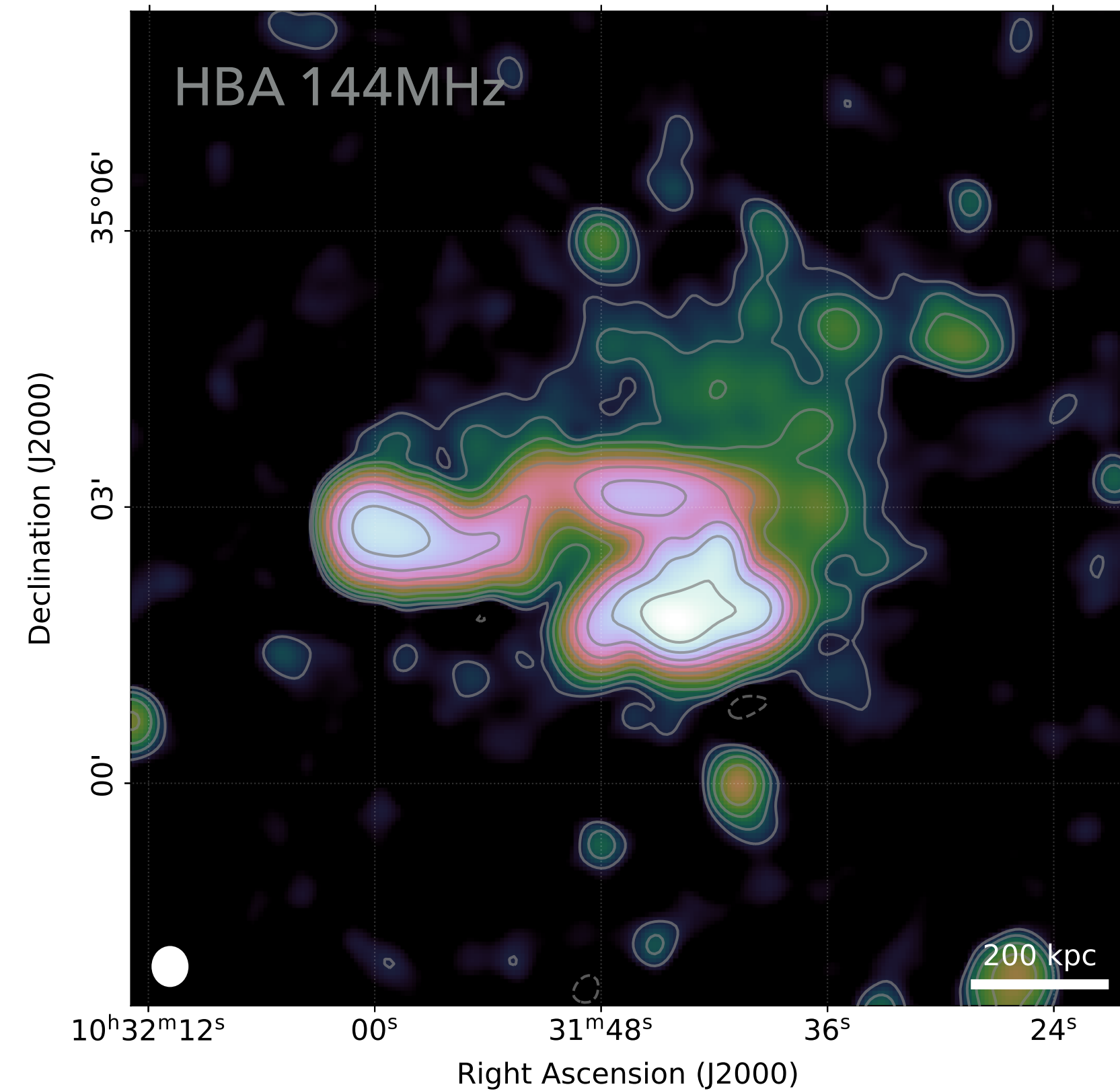
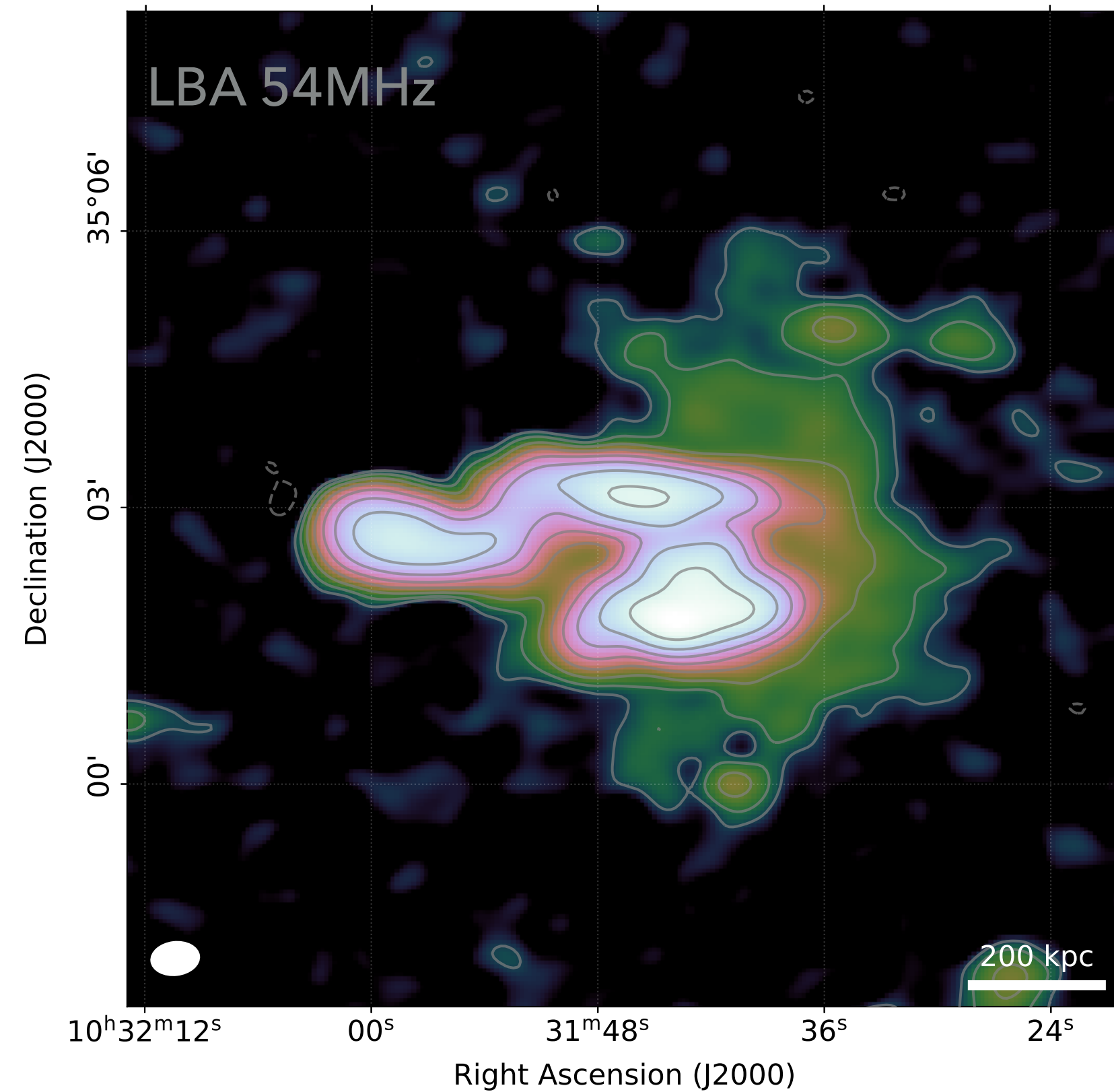
SPECTRAL ANALYSIS OF THE TAIL



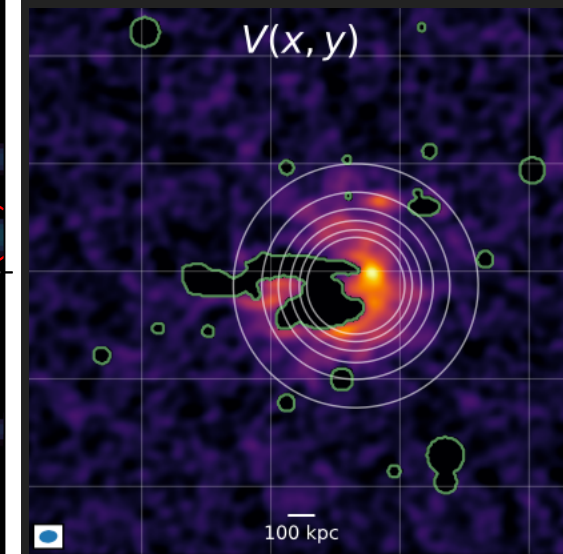
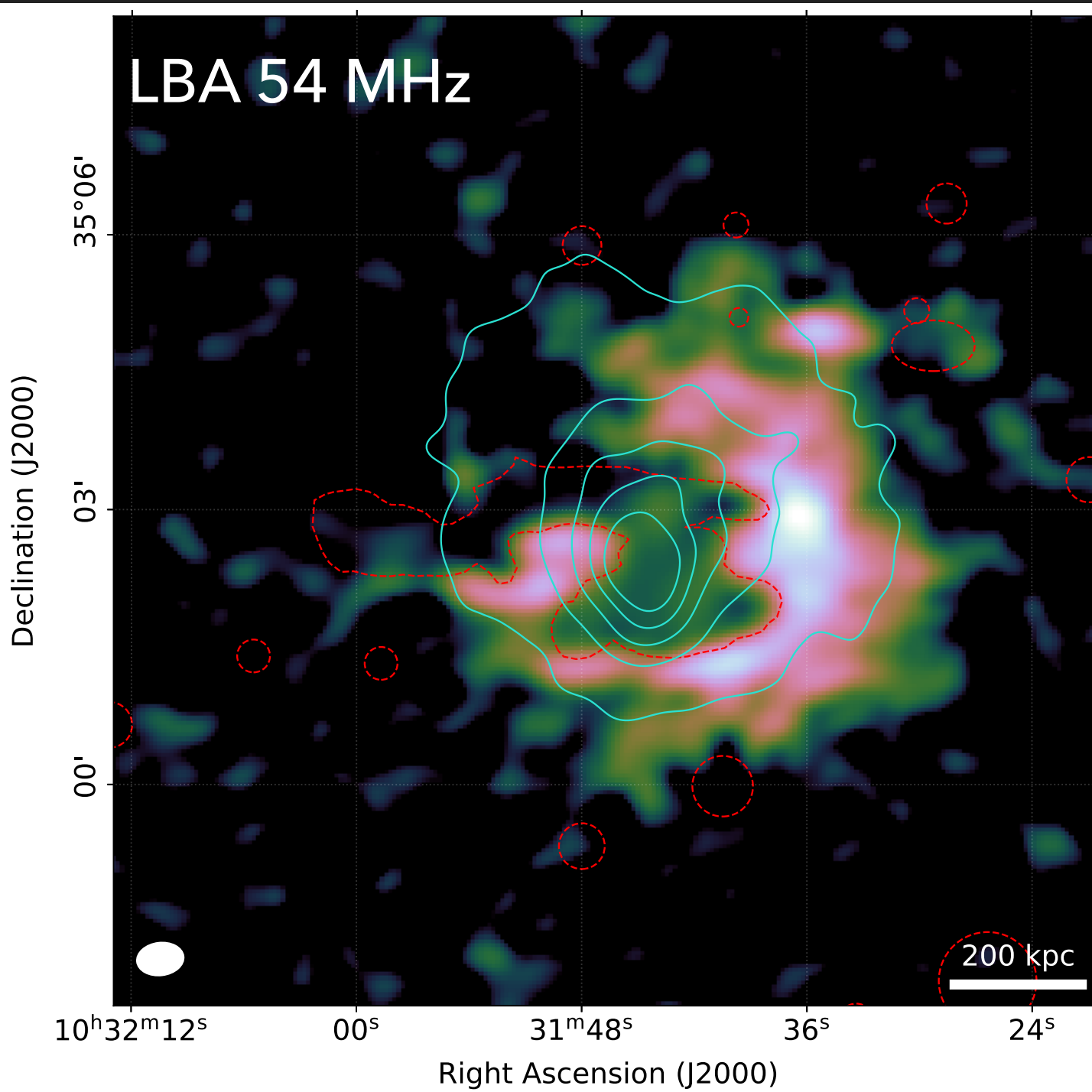
► Can reacceleration mechanism be constrained?

A1033 AT LOW-RESOLUTION

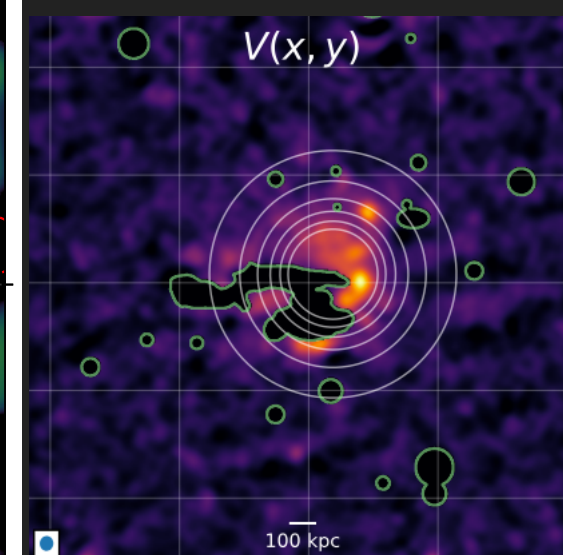
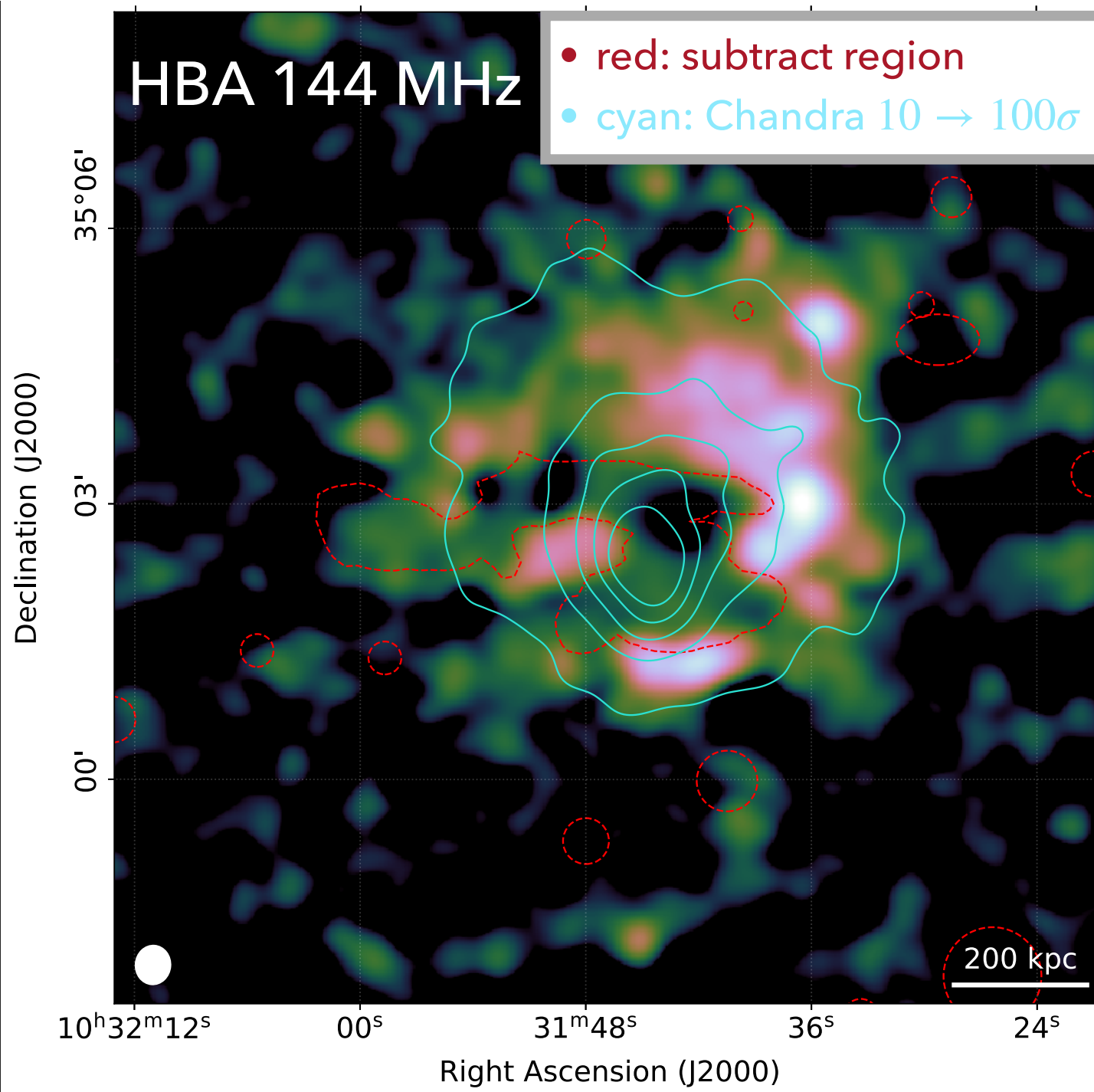
- Strong hints of a radio halo



THE HALO IN ABELL 1033



Fit: $1.46 \pm 0.03 \text{ Jy}$
(Manual: $1.08 \pm 0.02 \text{ Jy}$)

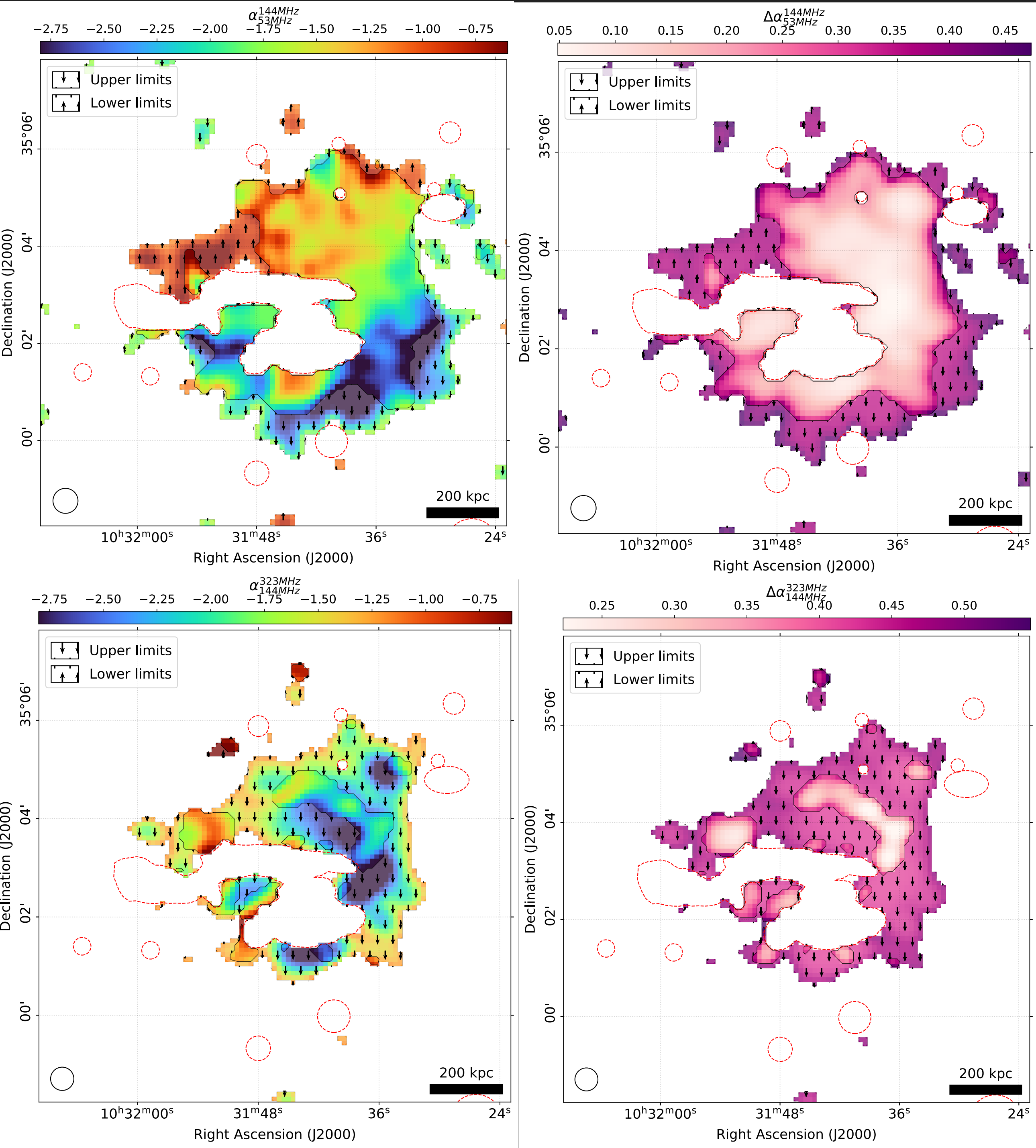


Fit: $288 \pm 7 \text{ mJy}$
(Manual: $188 \pm 4 \text{ mJy}$)

$$I(r) = I_0 e^{-r/r_0}$$

Fitting code: Boxelaar et al. (in prep)

- ▶ Halo with similar morphology in LBA + HBA
- ▶ LBA more extended towards SW
- ▶ Extension $\sim 700 \text{ kpc}$
- ▶ Fit offset from x-ray peak by $\sim 200 \text{ kpc}$ (possibly bias by mask)

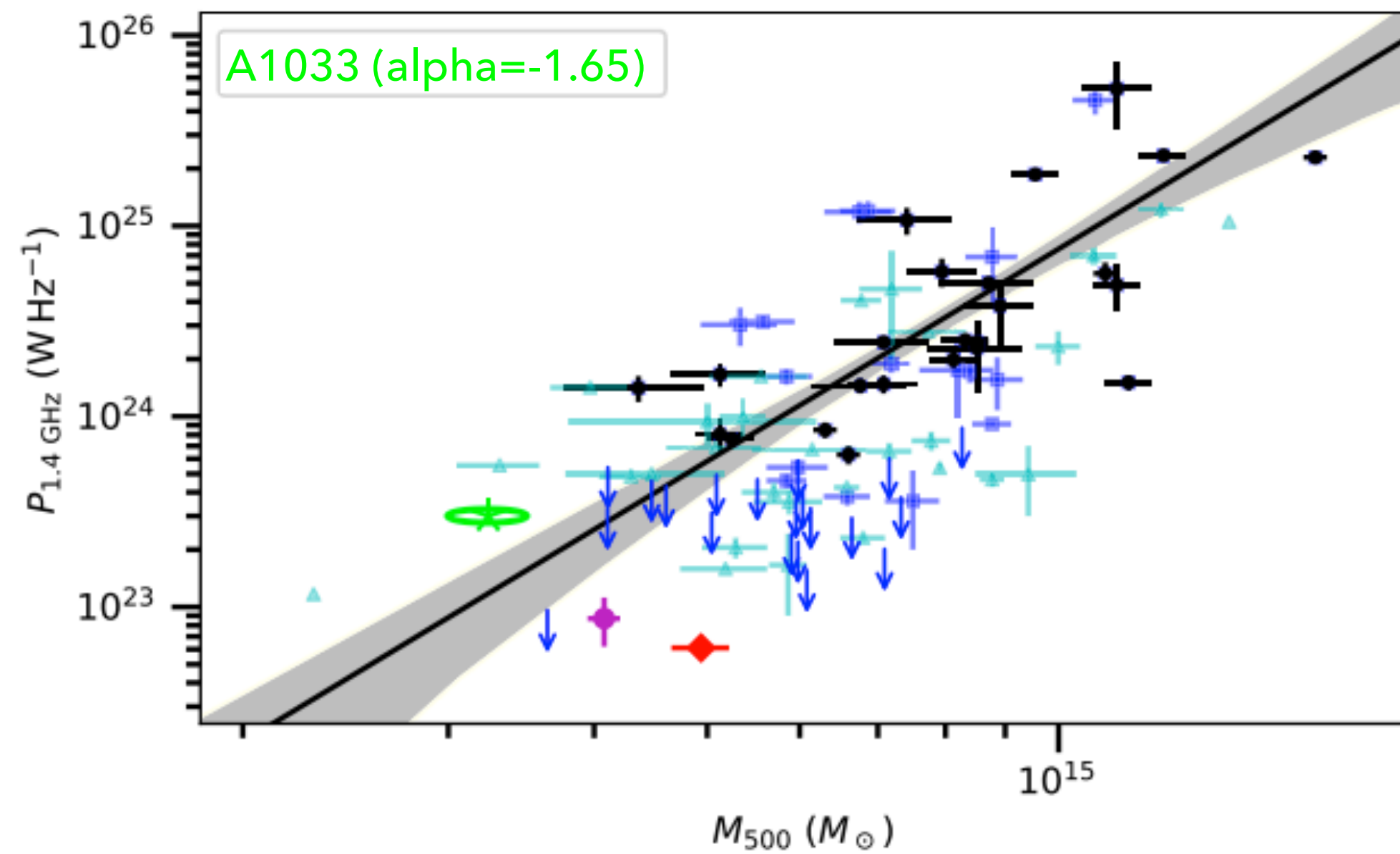


Method	Spectral Index
SI-map	-1.4 to -2.5
Fit integrated	-1.65±0.17
Manual	-1.79±0.15

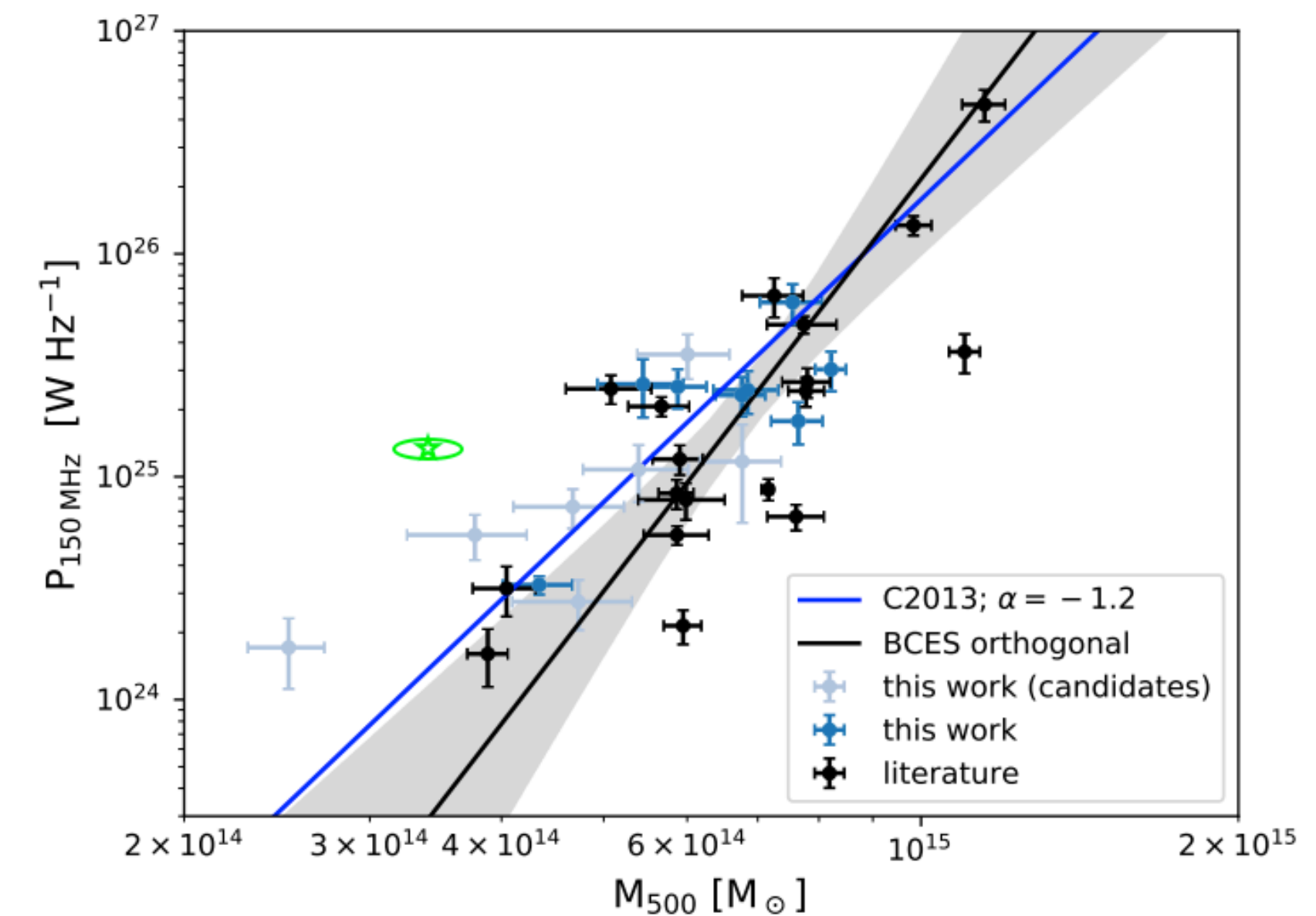
- ▶ Ultra-steep spectrum
- ▶ Only partially detection at 325 MHz
- ▶ Evidence of curvature

COMPARISON OF HALO POWER

► $P_{150\text{MHz}} = (1.26 \pm 0.03) \cdot 10^{25} \text{ W Hz}^{-1}$



Plot: Hoang et al. 2021; data: Bîrzan et al. 2019, Martinez Aviles et al. 2016 and Cassano et al. 2013



Plot: van Weeren et al. 2020; data: van Weeren et al. 2020 and references therein