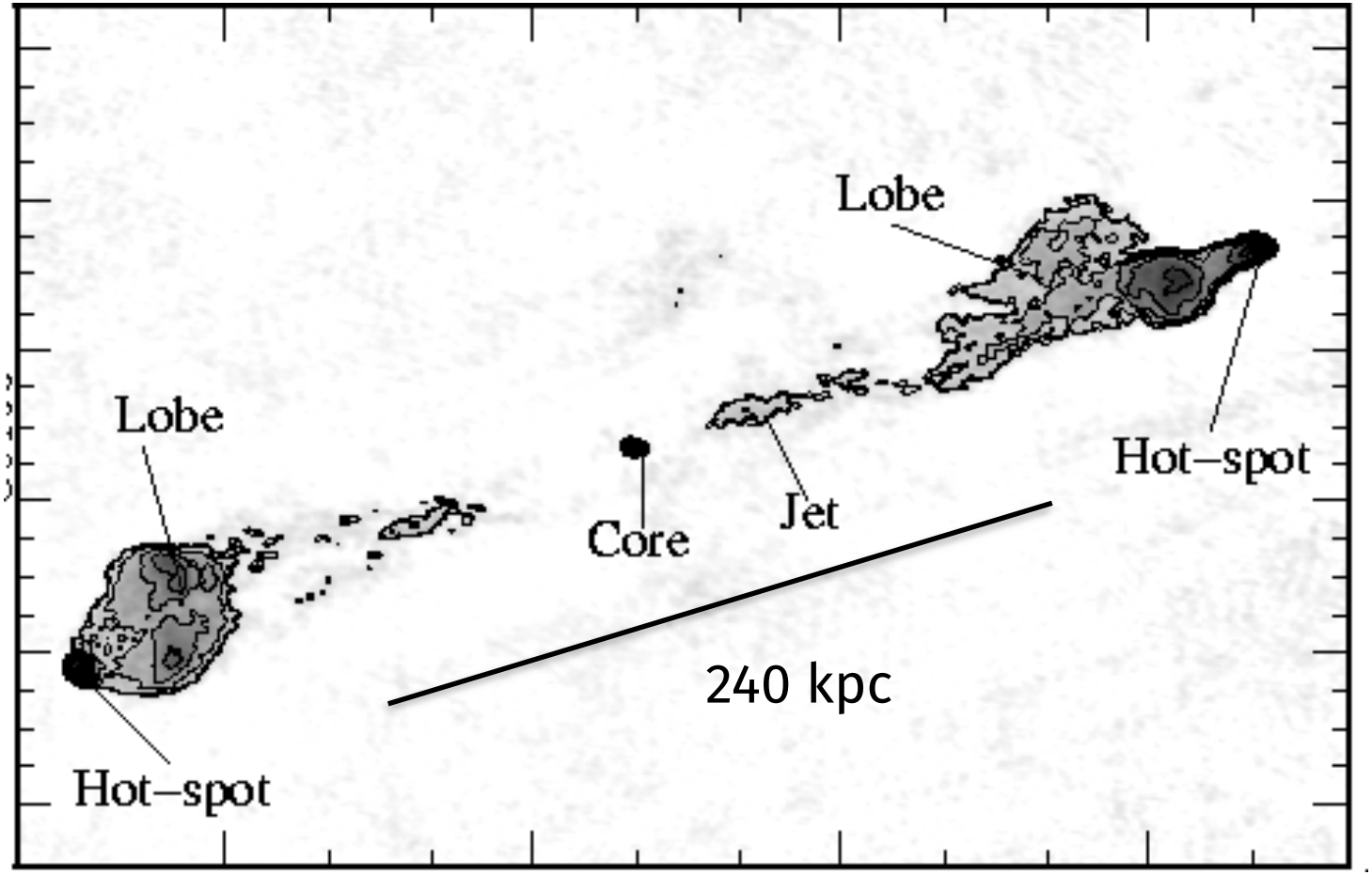
Active or relics? Searching for remnants among young radio sources

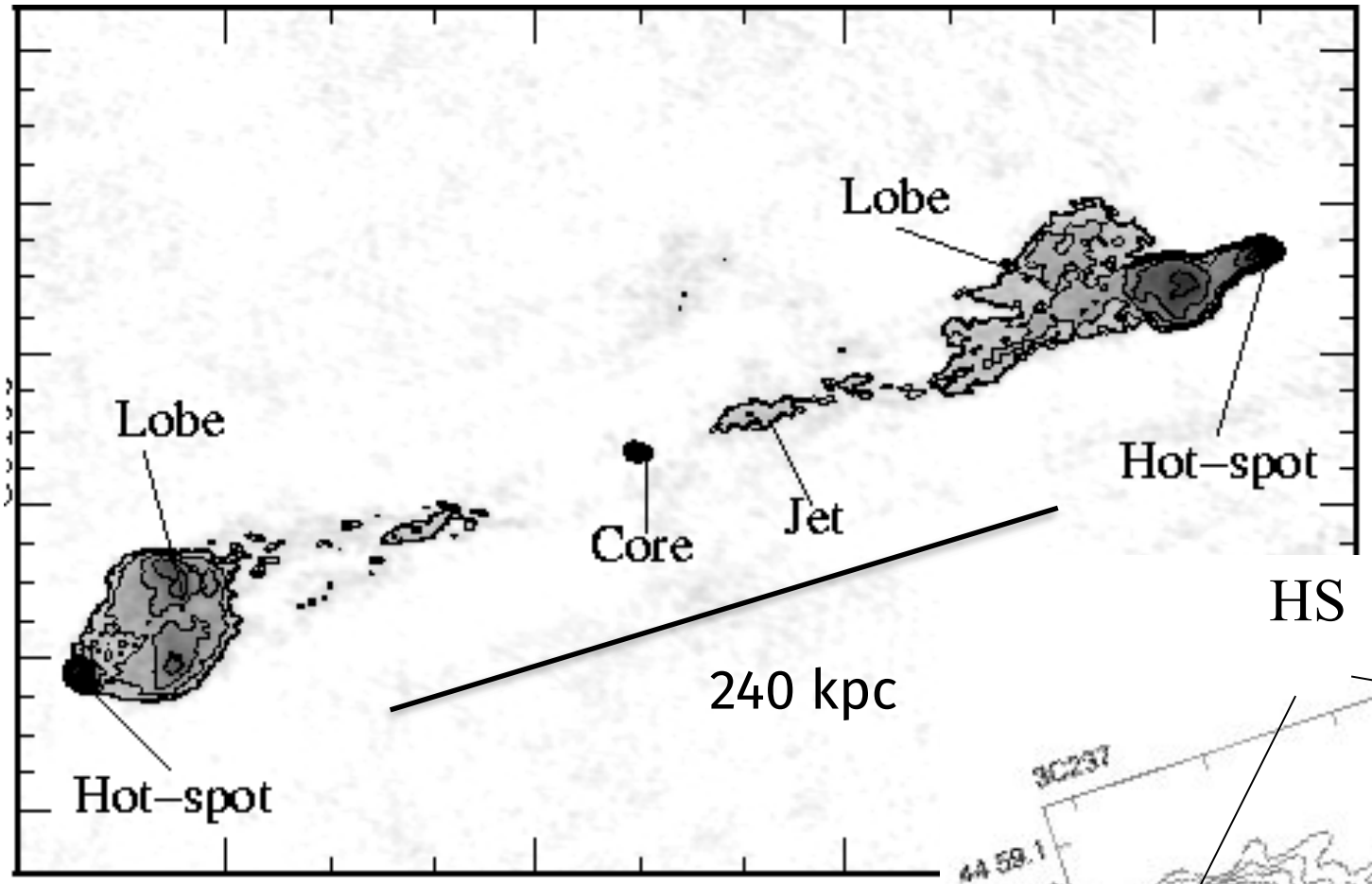
Monica Orienti
(INAF-IRA)

Co-I: M. Murgia, D. Dallacasa, F. D'Ammando, G.Migliori, K.K.L. Charlton

Radio galaxies

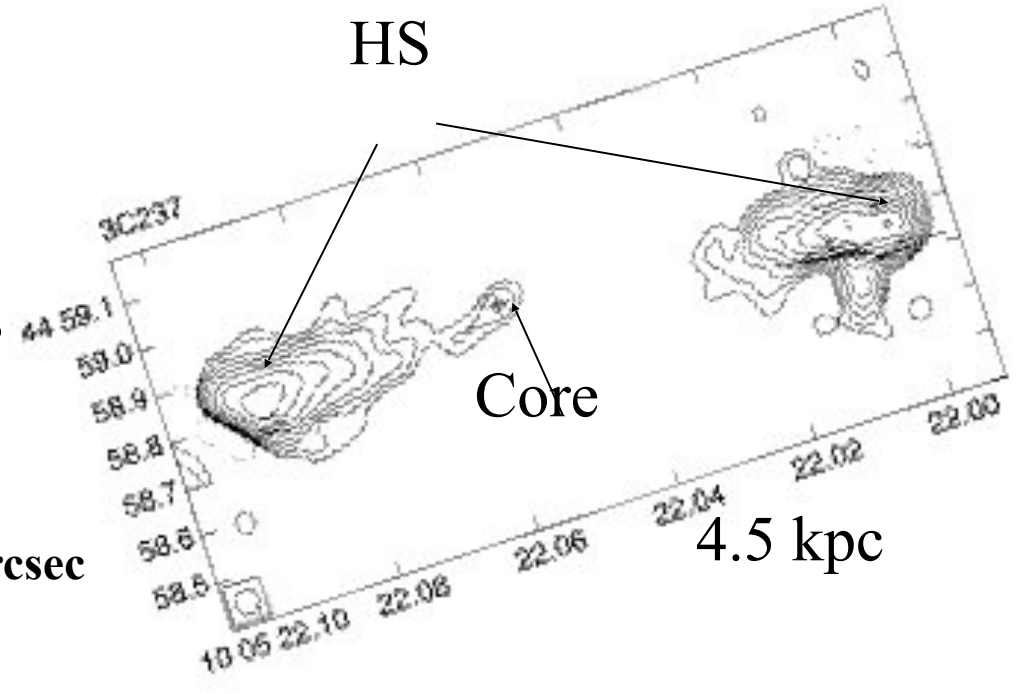


Radio galaxies



240 kpc

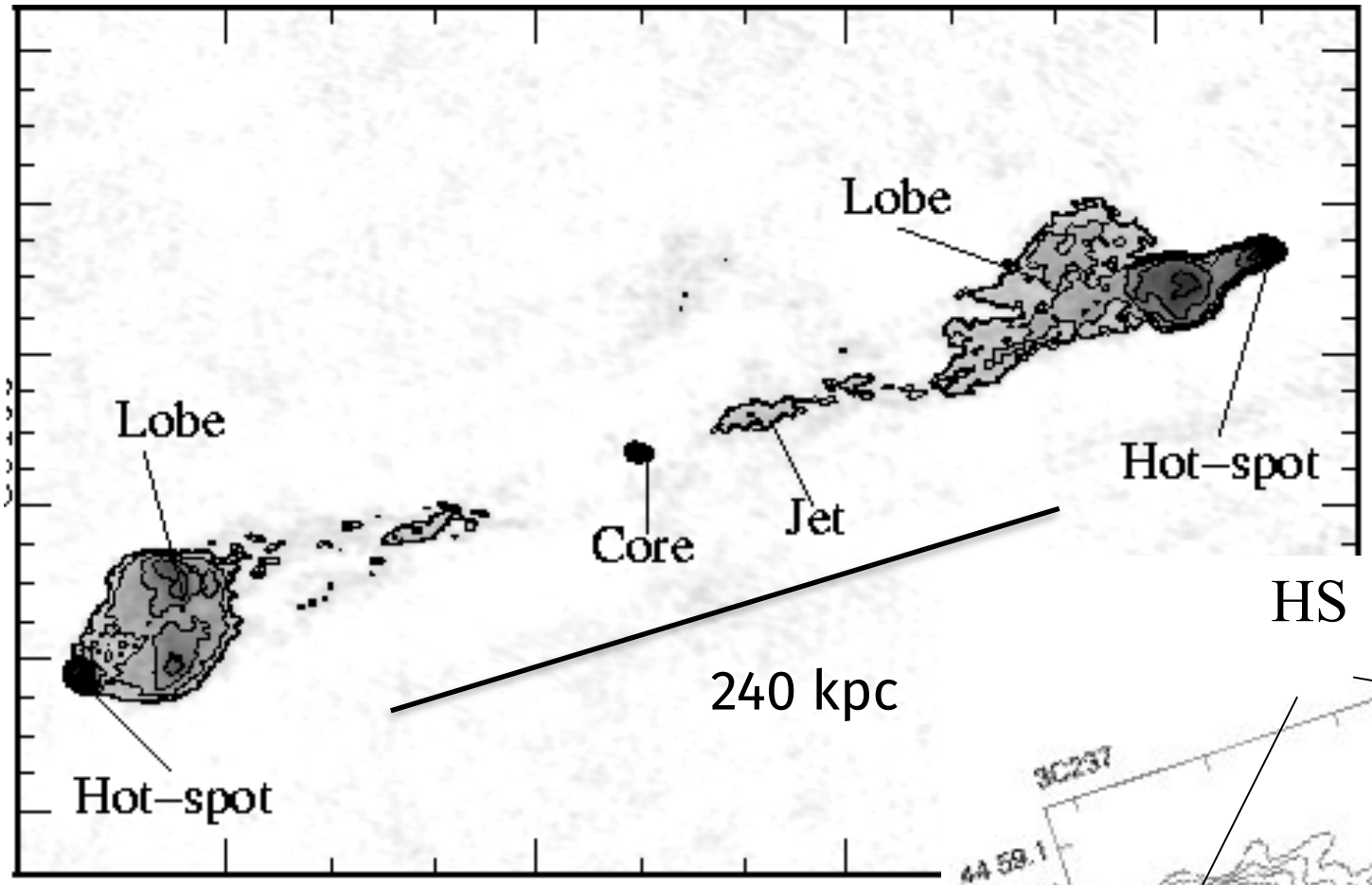
HS



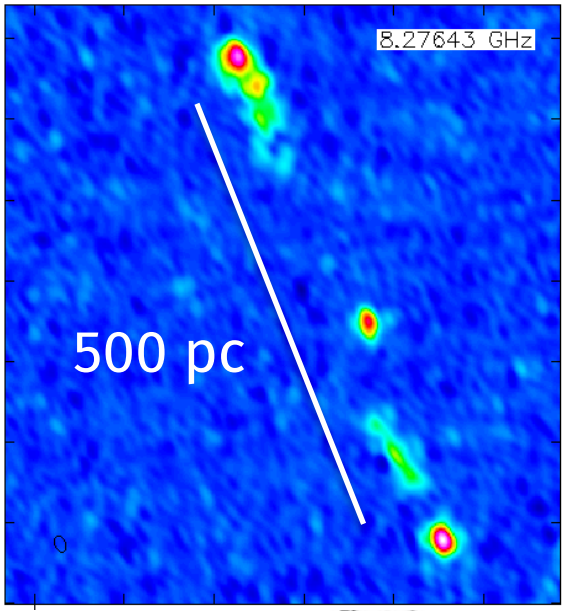
4.5 kpc

MSO: sub-arcsec

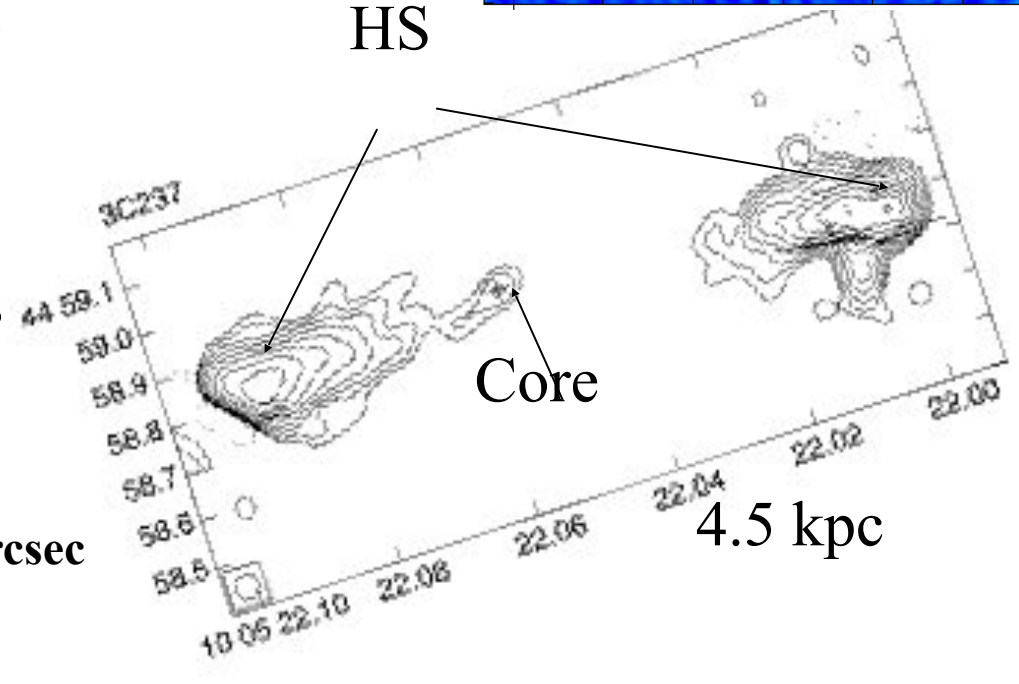
Radio galaxies



CSO: milli-arcsec



HS

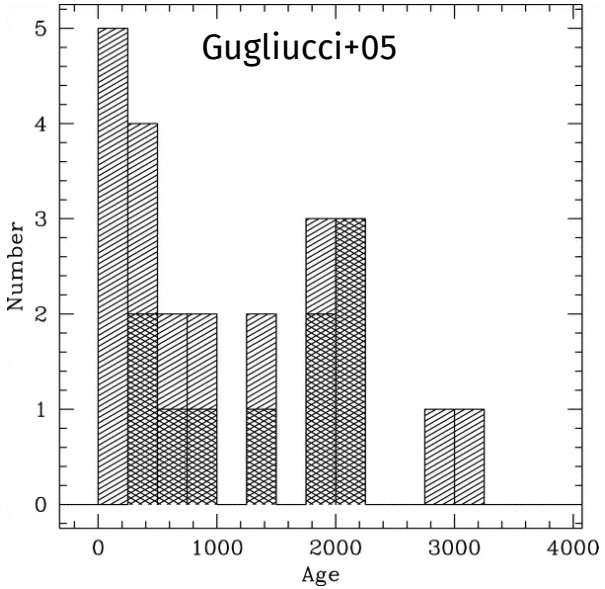


MSO: sub-arcsec

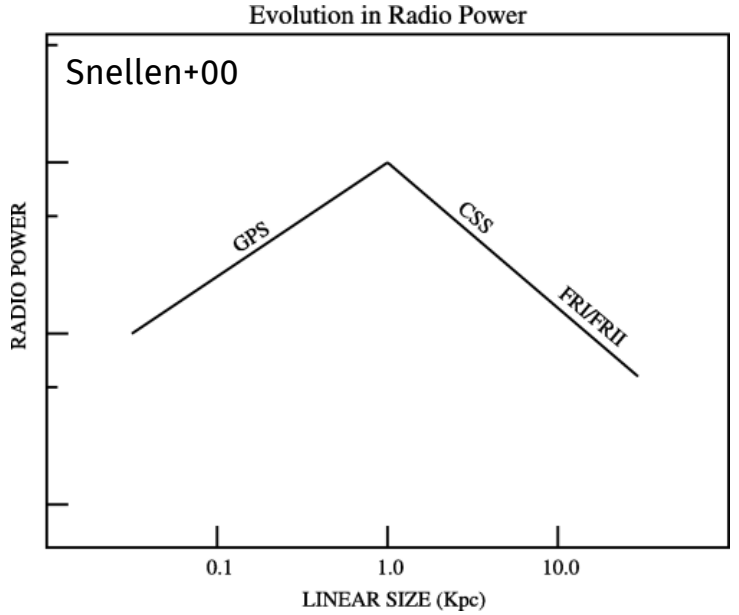
Count excess

The age distribution of CSOs peaks ~500- 1100 yr.

(Gugliucci+05; An&Baan 12, Kiehlmann+23)



Excess of young radio sources in flux-density limited catalogs cannot be explained with luminosity evolution.



Power-law distribution of the source ages and existence of a dominant population of short-lived sources. (Shabala+20)

Searching for short-lived radio sources

AIM: constraining the incidence of fading objects at different evolutionary stages.

MODELS:

1) intermittent radio emission lasts $10^{4\text{-}5}$ yr and recurs $10^{5\text{-}6}$ yr; (Reynolds&Begelman97)

2) intermittent radio emission lasts $<10^{3\text{-}4}$ yr and recurs $10^{4\text{-}5}$ yr. (Czerny+03)

2*) TDE, episodic $<10^{3\text{-}4}$ yr (Readhead+24; Sullivan+24)

EXPECTATIONS:

1) excess of **MSOs** (LS > 1 kpc);

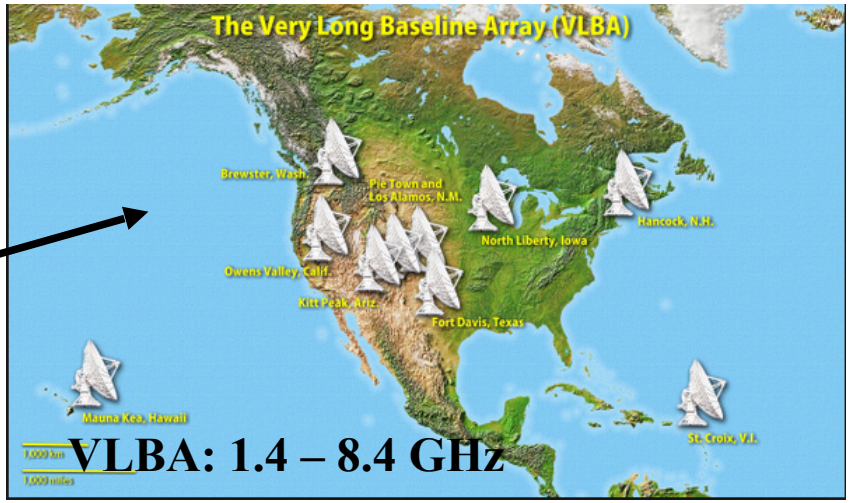
2) excess of **CSOs** (LS < 1 kpc).

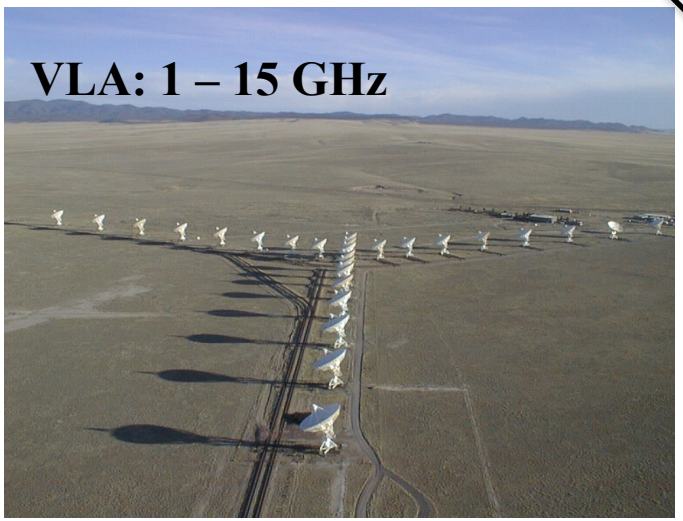
Searching for faders

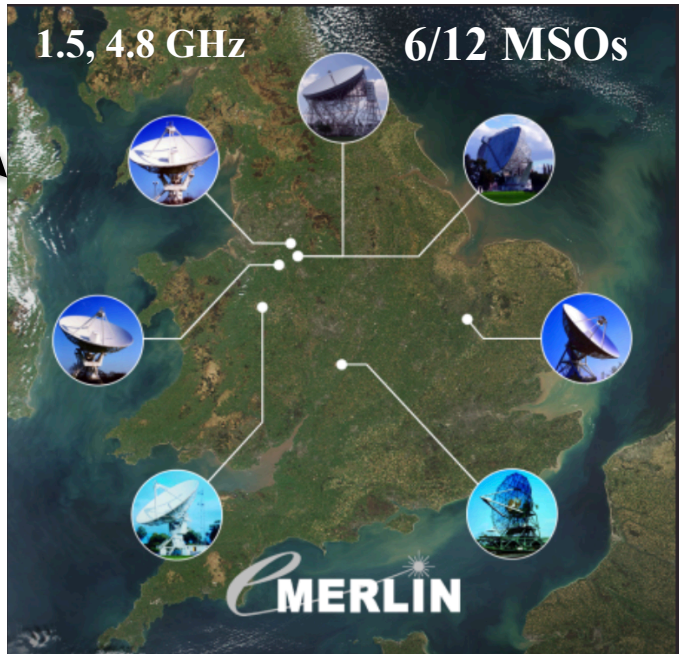
B3-VLA CSS: **87** sources: **28 CSOs** and **59 MSOs**.

- Steep spectrum with α > 1.0;
- No evidence of active regions.

18/87 sources: **12** MSOs, **6** CSOs.

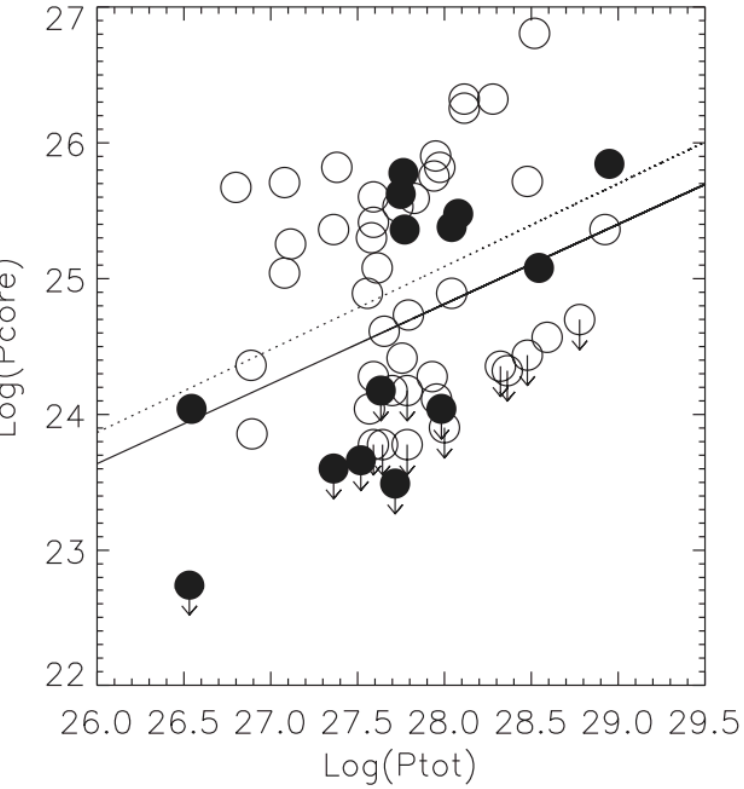




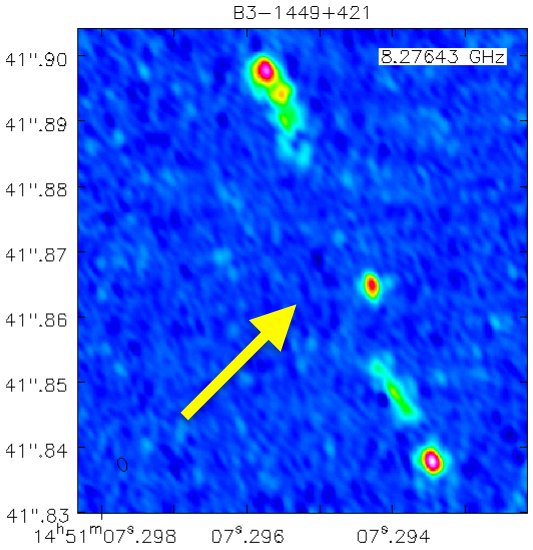


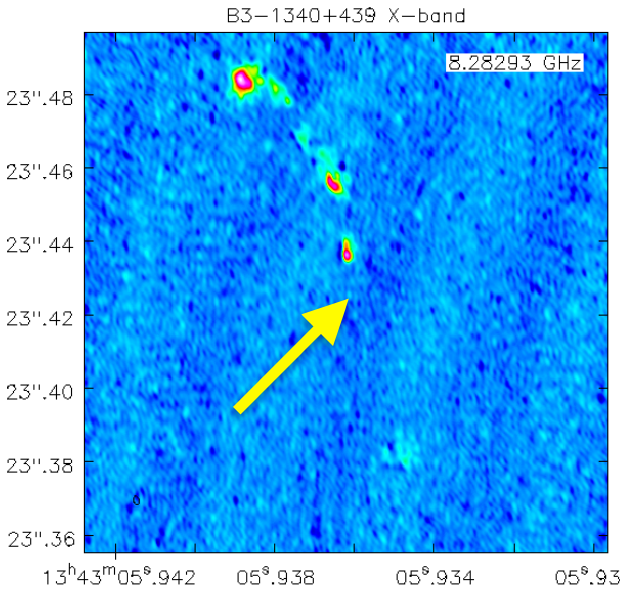
Results

- **Many cores.....10/18!**

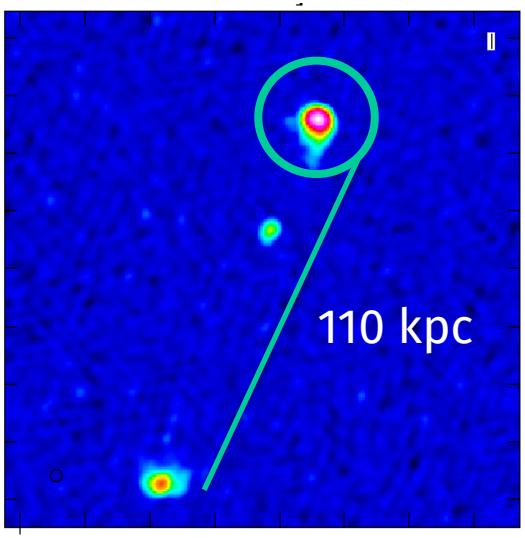


Same slope as for 3CR radio galaxies.





Orienti+23



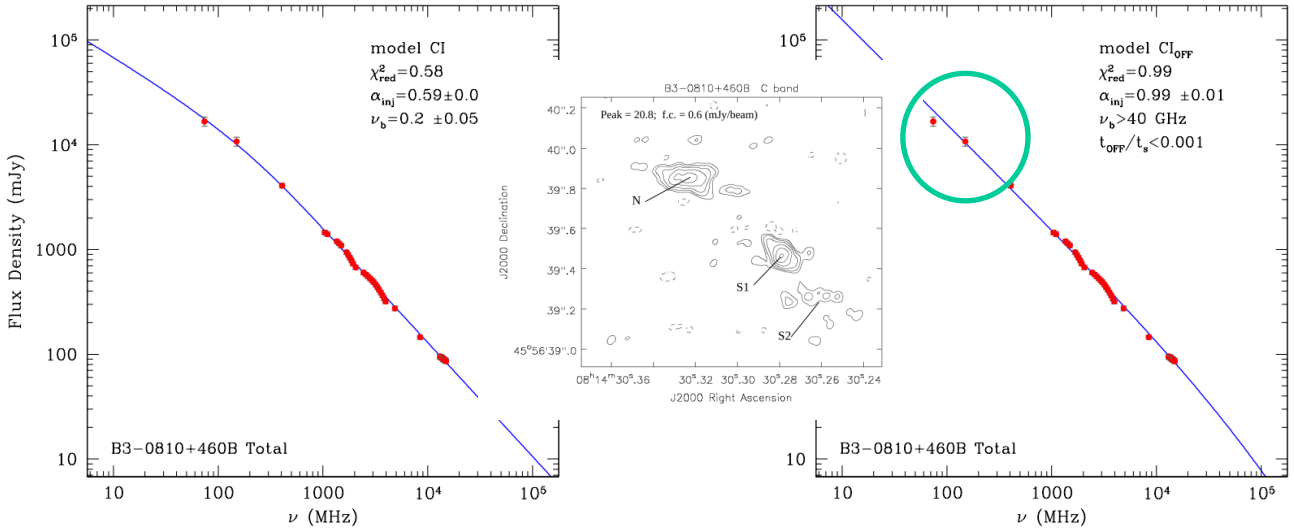
3 LSOs misidentified as CSS.

15 CSS: 9 MSOs and 6 CSOs.

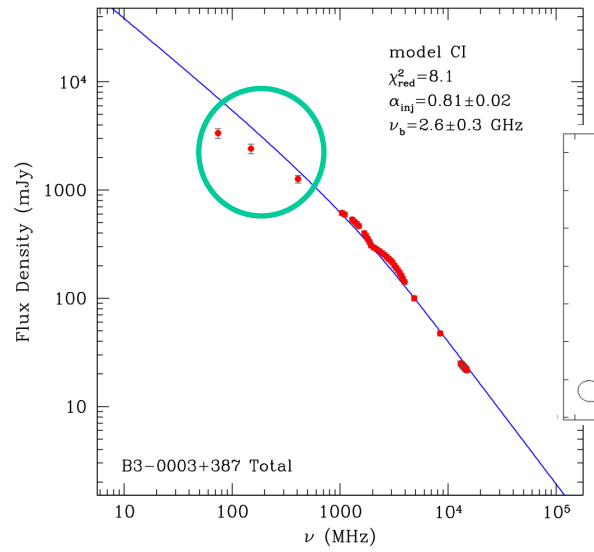
Orienti+23

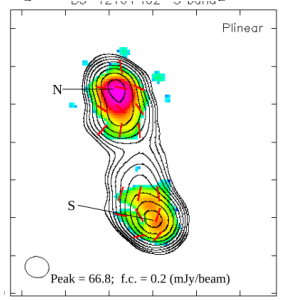
Spectral fit

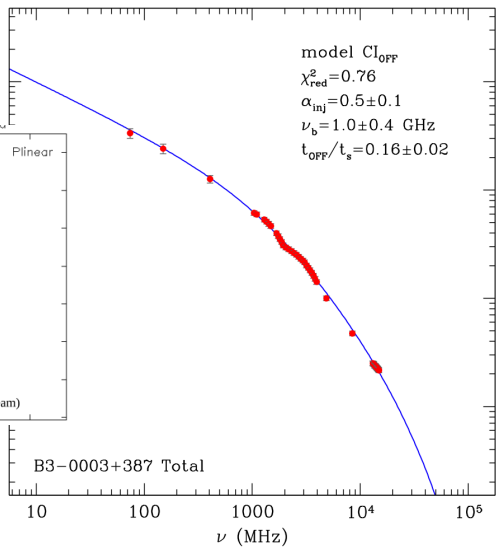
Continuous injection of plasma (**CI**)



No supply of fresh plasma (**CI OFF**)







- 5 sources better fitted by CI;

  Either with or without core detection.

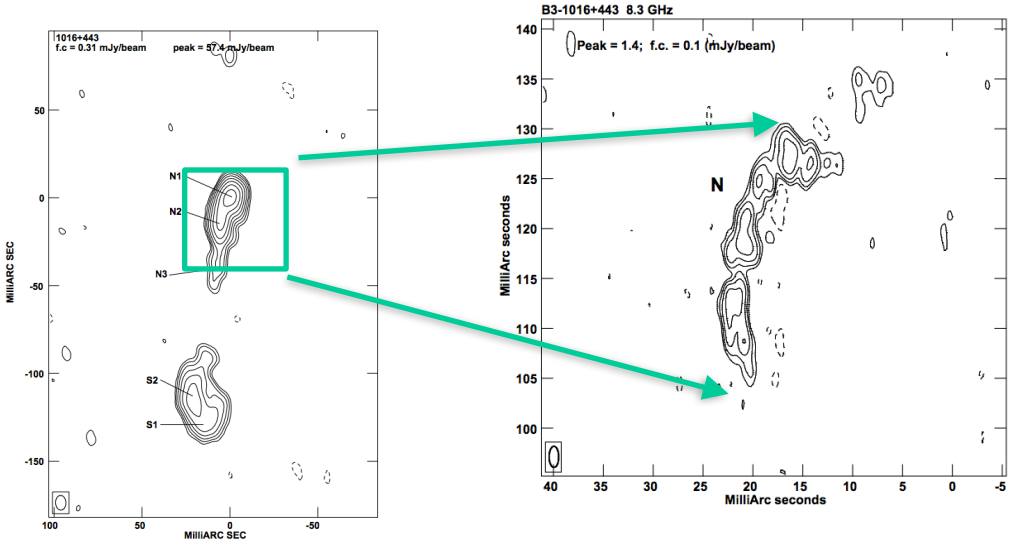
- 5 sources better fitted by CI OFF;

  Either with or without core detection.

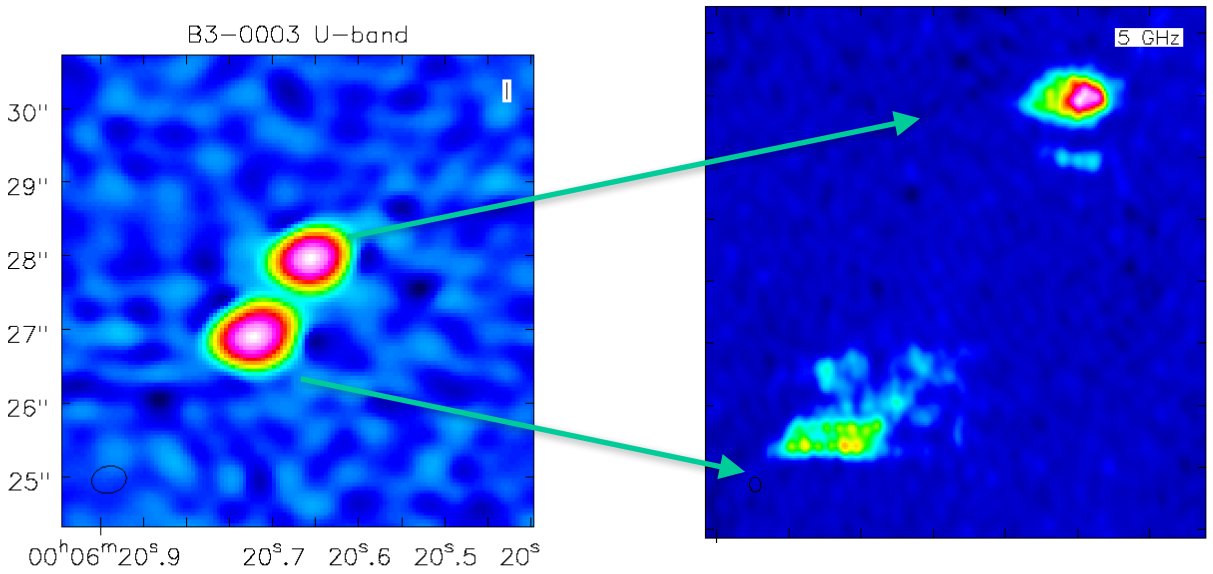
- 5 sources with similar fit results.

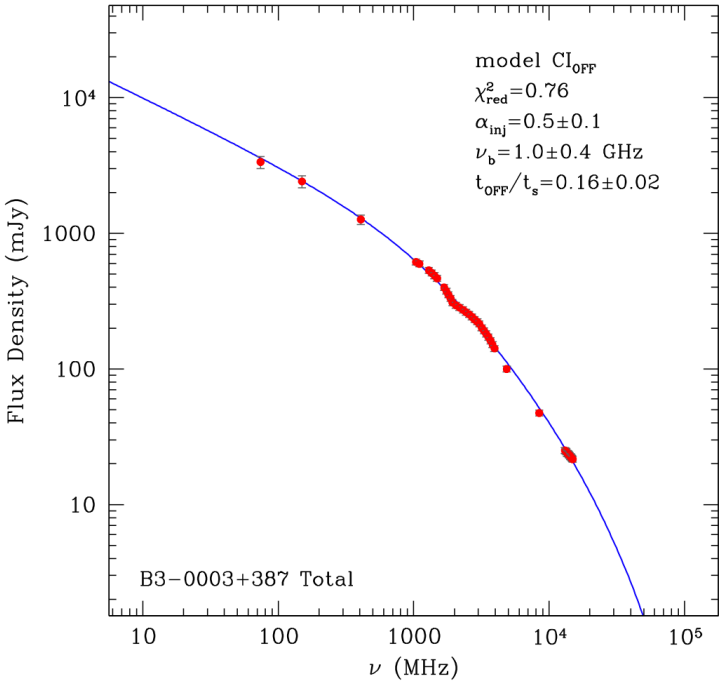
Remnants

2 Remnants (CSO + MSO) + 1 candidate (MSO)



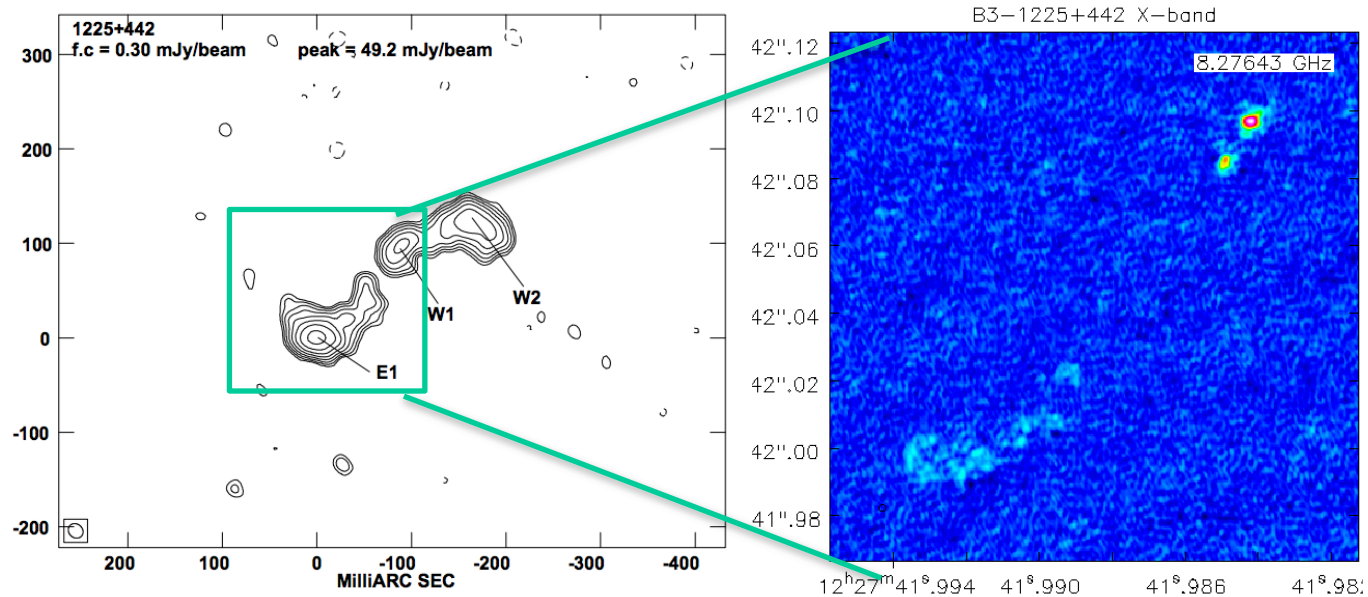
- Steep spectrum
- No core
- No hotspots
- CI OFF



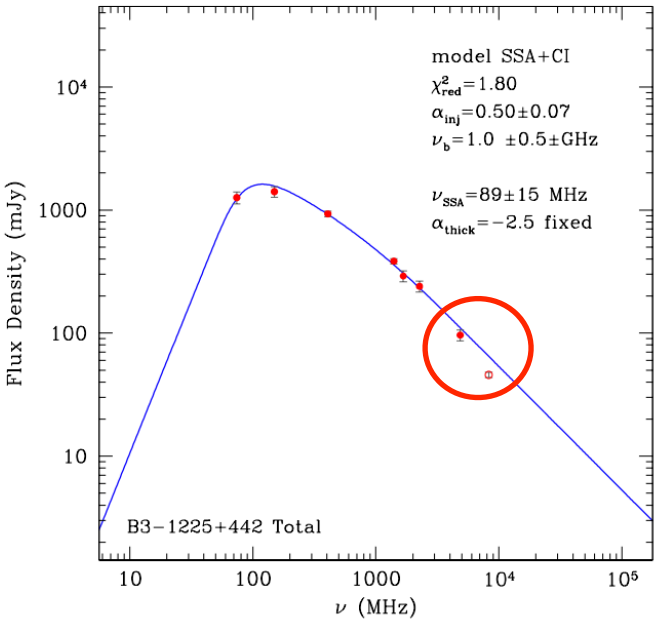


Restarted sources

1 Restarted (CSO) + 2 candidates (MSO + CSO).



Core detected but no hotspots.



CI model.

Restarted sources

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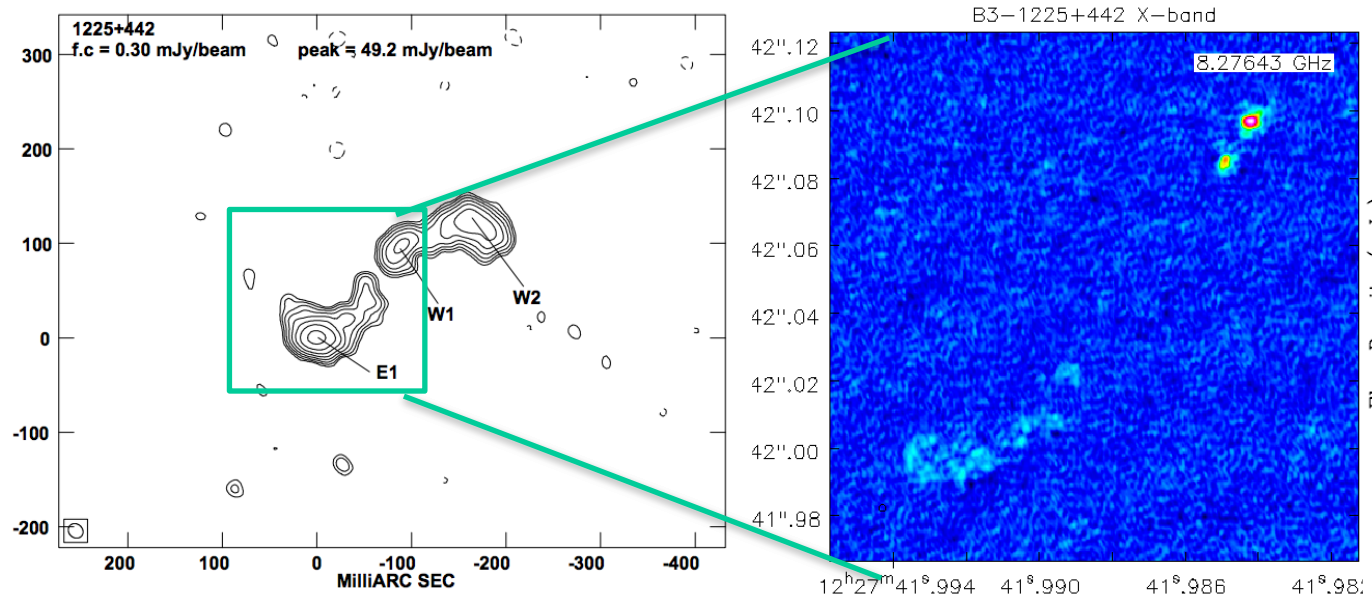

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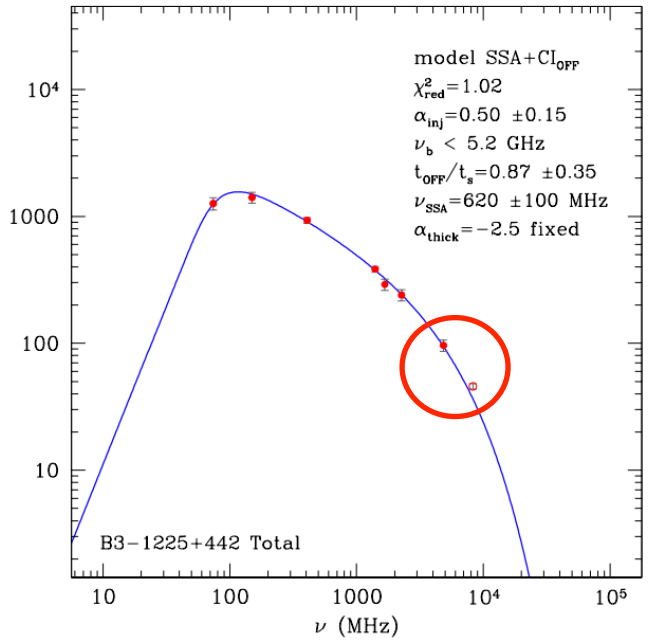


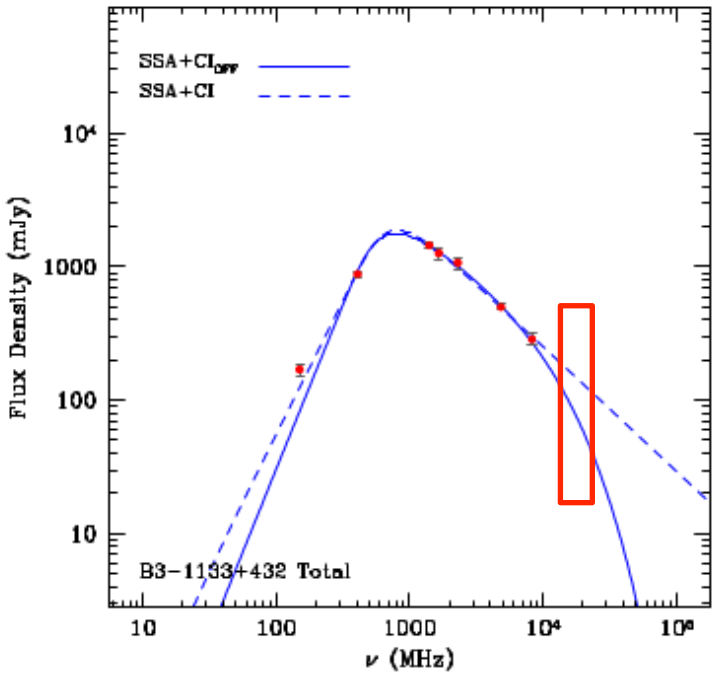
CI OFF model.

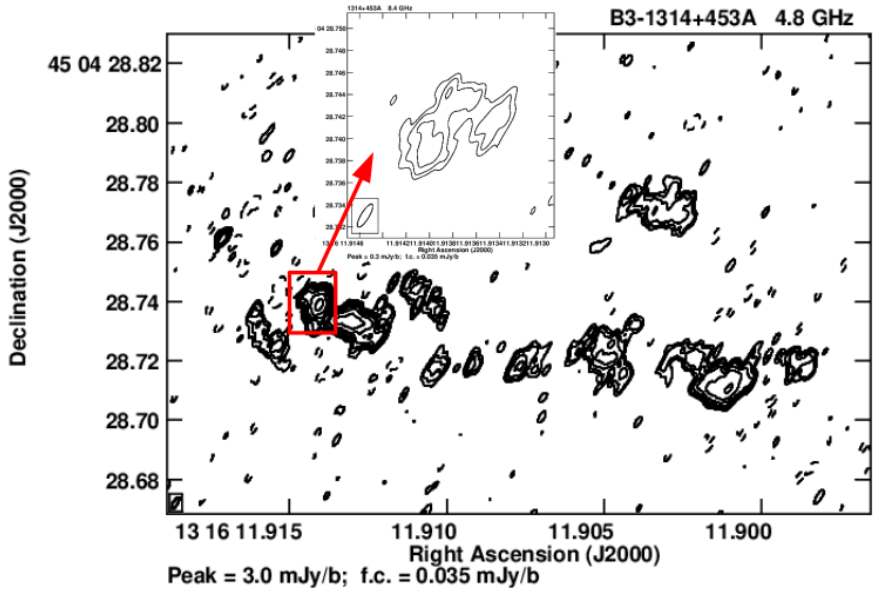
What's next

Kathleen Charlton - PhD project

Remnants/restarted in the complete B3-VLA CSS sample and in MSO and CSO sub-populations.

- VLA observations at 12-26 GHz of 11 sources to discriminate between CI and CI OFF models.



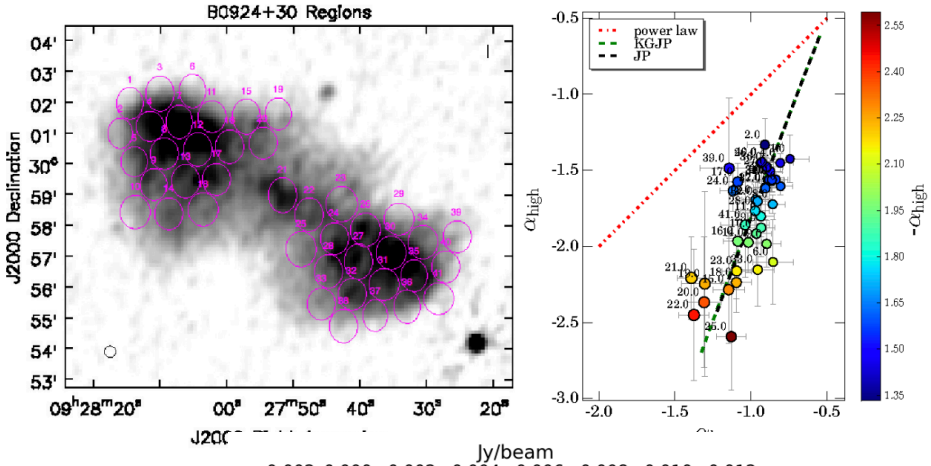


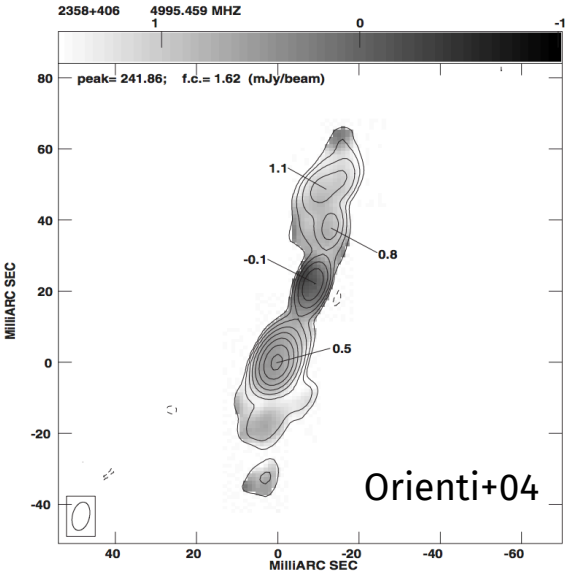
- VLBI observations of the remaining 9 sources with poor pc-scale information.

Challenges

Spectral index analysis and remnant detection is “easier” for giant sources.

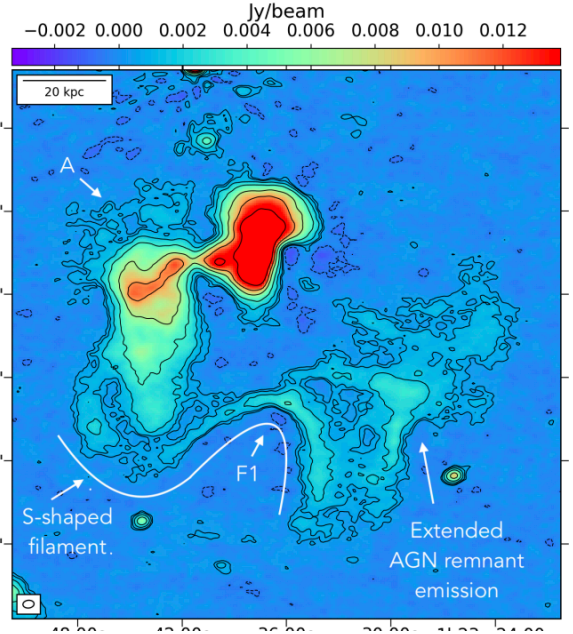
Shulevski+17



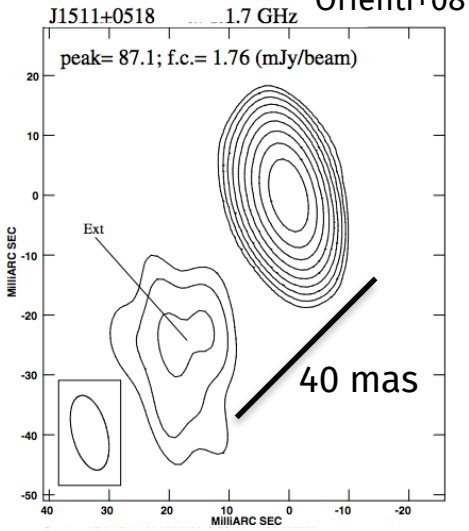


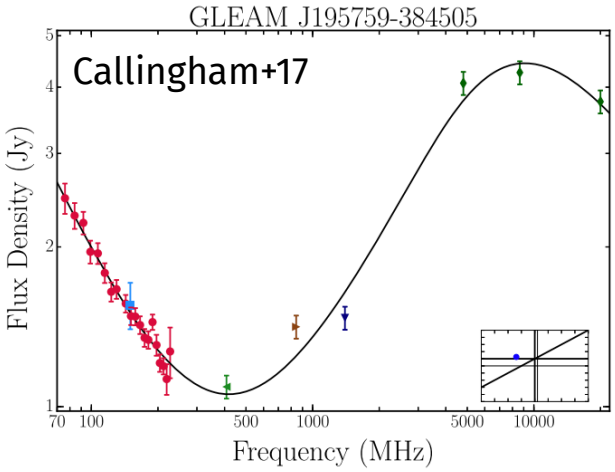
A few resolution beams in CSOs/MSOs

Brienza+22

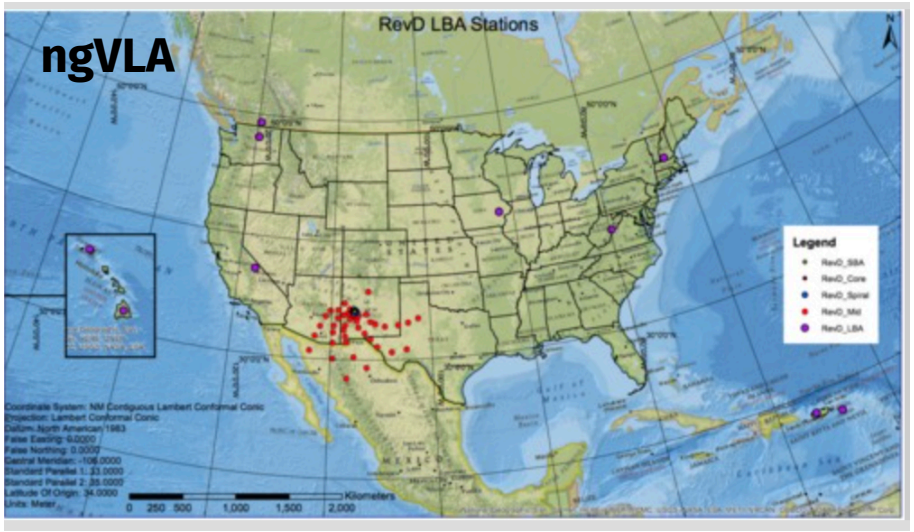


Orienti+08





Remnants and future facilities



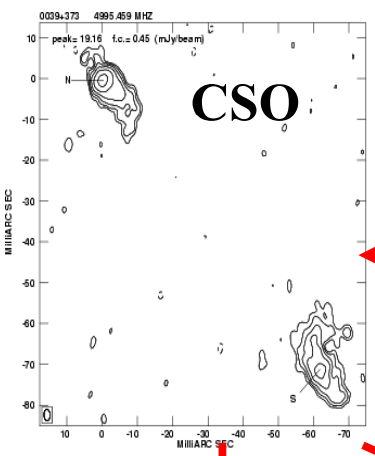
GHz regime:

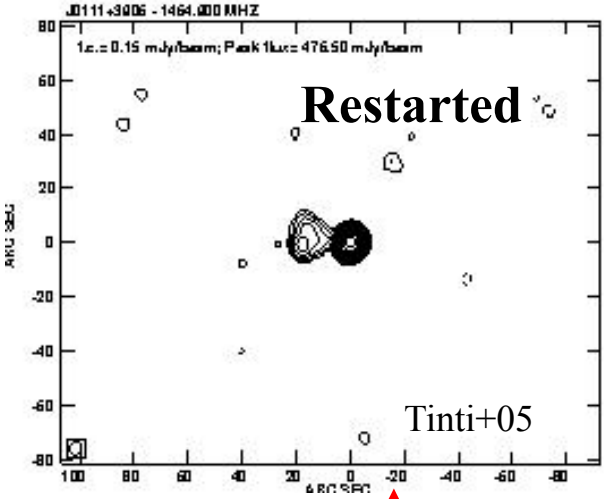
- Sensitivity: (sub-)μJy/b
- Resolution: sub-arcsec/mas
- Largest angular scale

MHz regime:

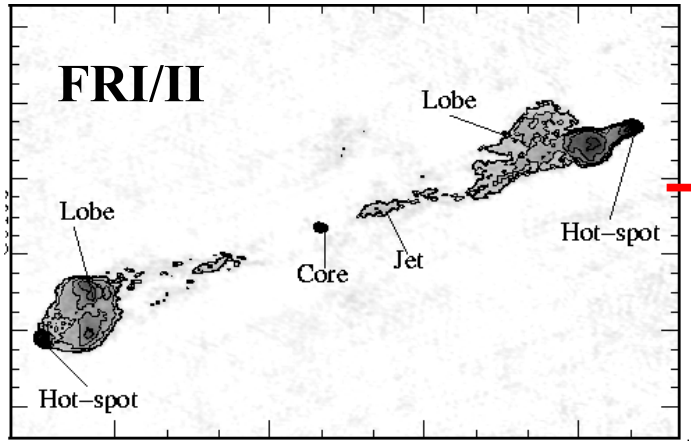
- Sensitivity: μJy/b
- Resolution: sub-arcsec

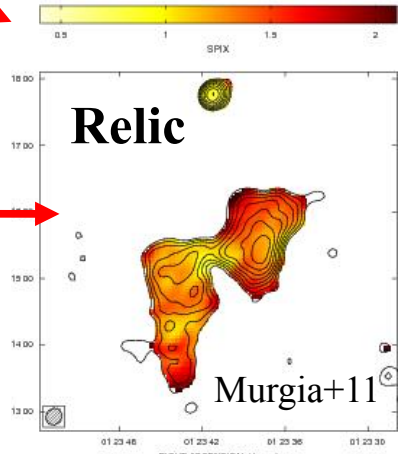
Summary





Orienti 16





Thank you

Summary

- Finding remnants/restarted among young radio sources is a tough job!

- The time scale of the radio emission is still far to be constrained;

- SKA, ngVLA and their precursors are crucial for our knowledge of the life cycle of the radio emission and will provide for the first time the possibility to investigate the **cosmological evolution** of young radio sources thanks to the study of the MHz-peaked spectrum population.