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Multiwavelength study of an extended powerful radio galaxy 4C 70.19

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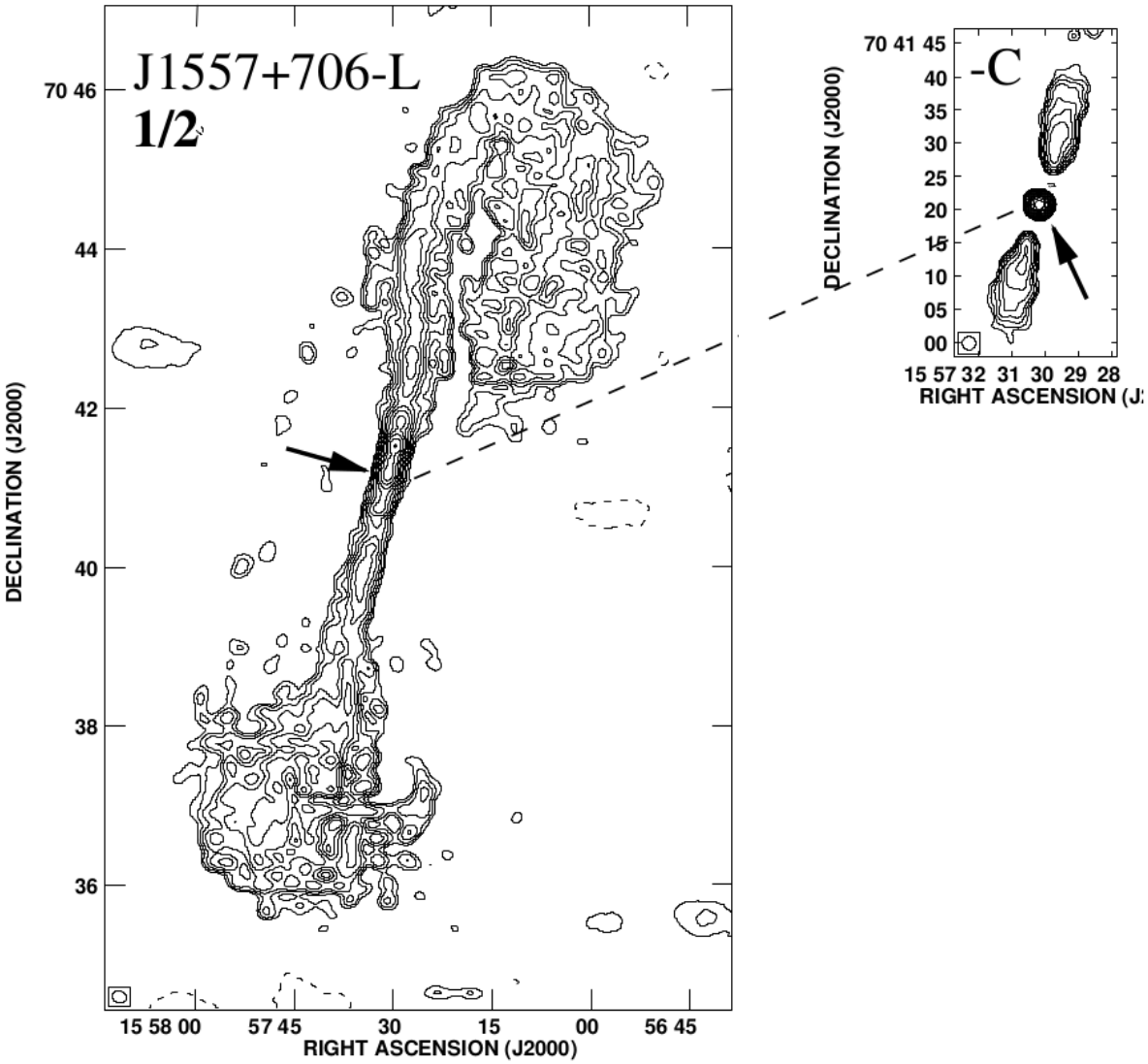
LOFAR Family Meeting, Olsztyn, 14th June 2023

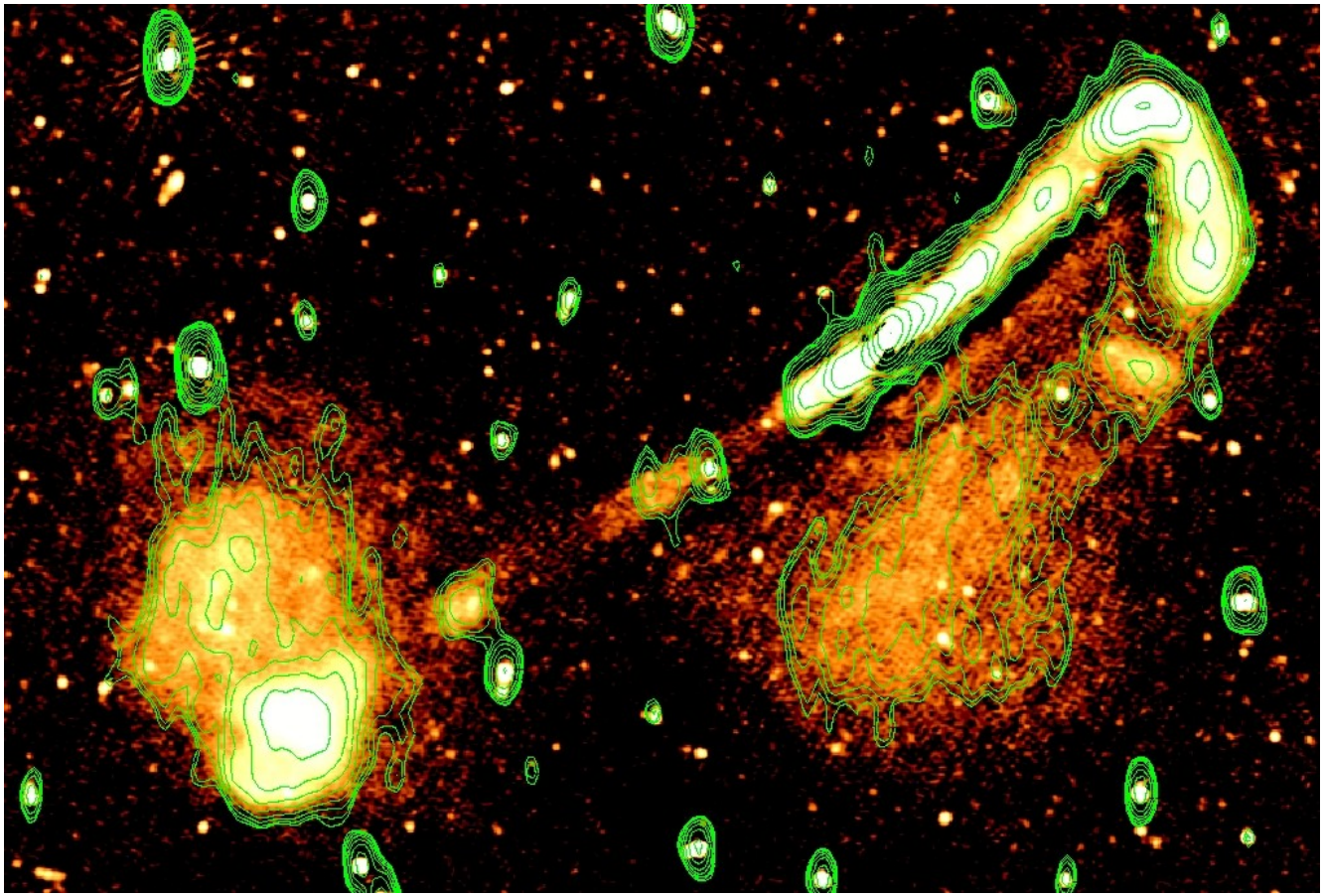
Well known (?) radio source

Lara et al., 2001, A&A, 370, 409:

J1557+706 (4C+70.19): it presents an FR I type morphology in the N-S direction. The northern jet bends by 180º towards the south, becoming diffuse and extended beyond the bend. The southern jet ends in an extended lobe-like region. At 4.9 GHz we only detect a compact core and the beginning of two rather symmetric jets, separated from the core by symmetric gaps.



Well known (?) radio source

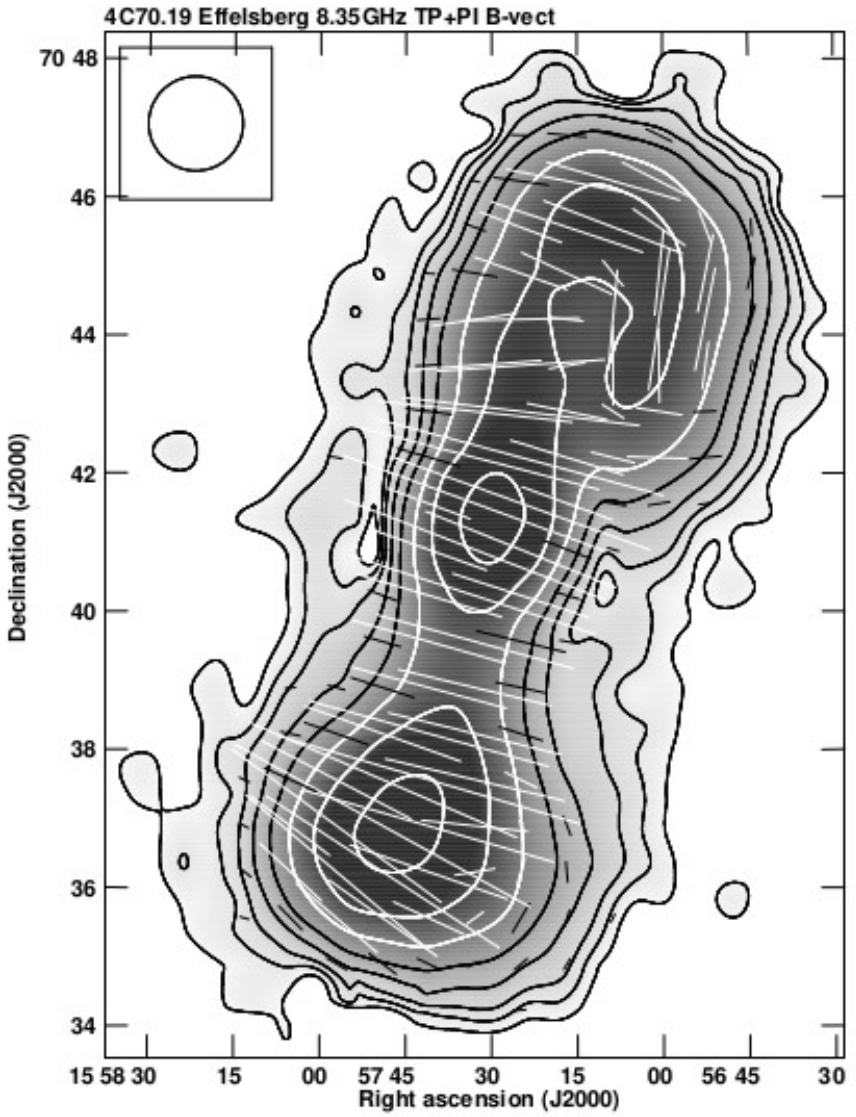


WSRT 326 MHz cont. (Mack et al. 1997, A&ASS, 123, 423) on LOFAR LOTSS 145MHz map

Observations

Dedicated Effelsberg observations:

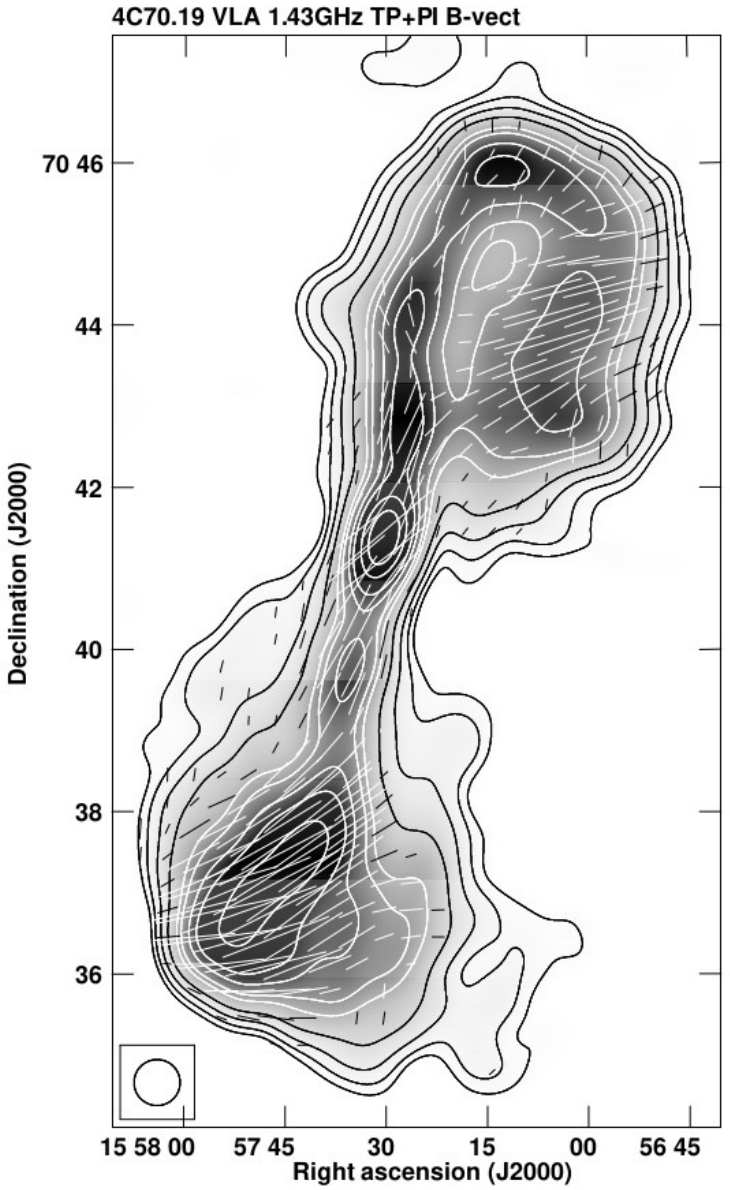
- 2.67 GHz; beam 264”
- 4.85 GHz; beam 150”
- 8.35 GHz; beam 82” →



Observations

Archival VLA observations:

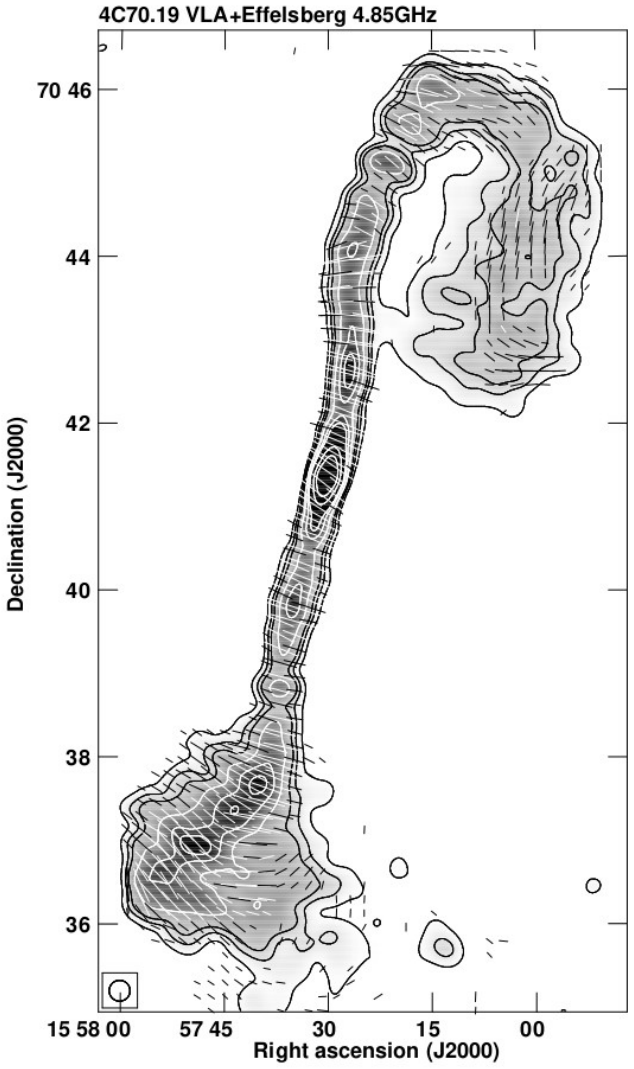
- 1.43 GHz C-conf; beam 34” →



Observations

Archival VLA observations:

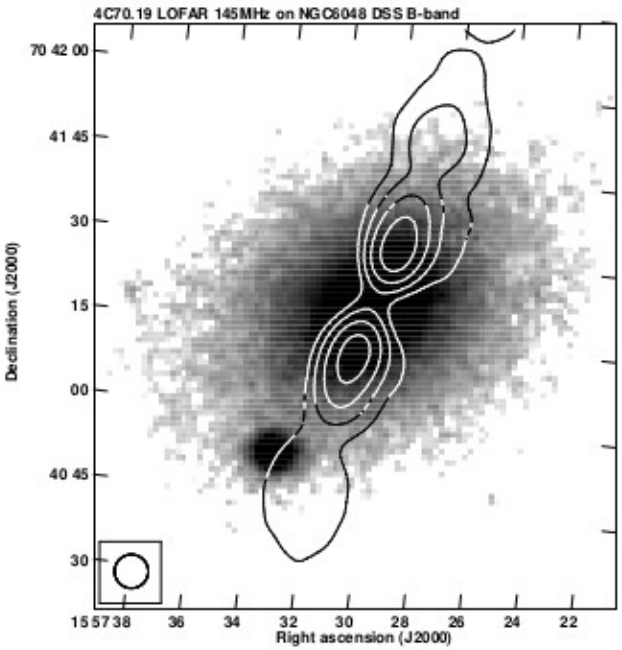
- 4.85 GHz C+D-confs; beam15” → (Effelsberg data added)

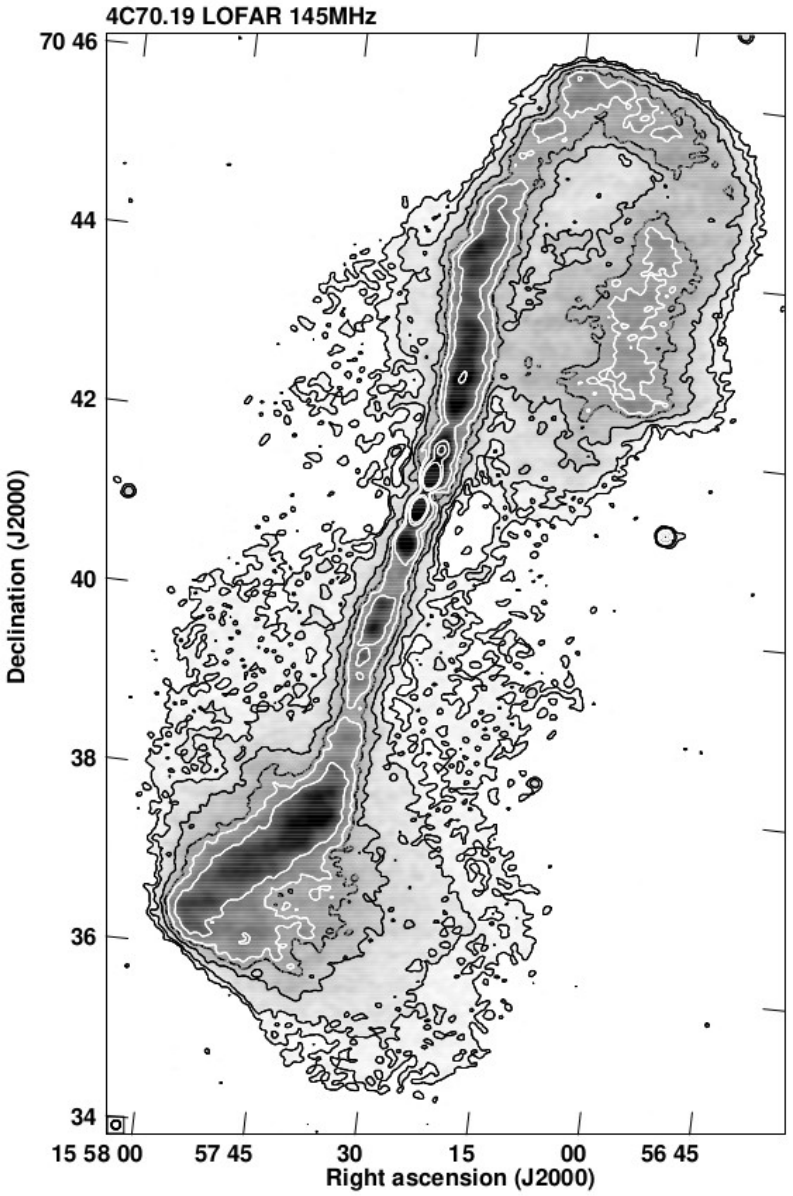


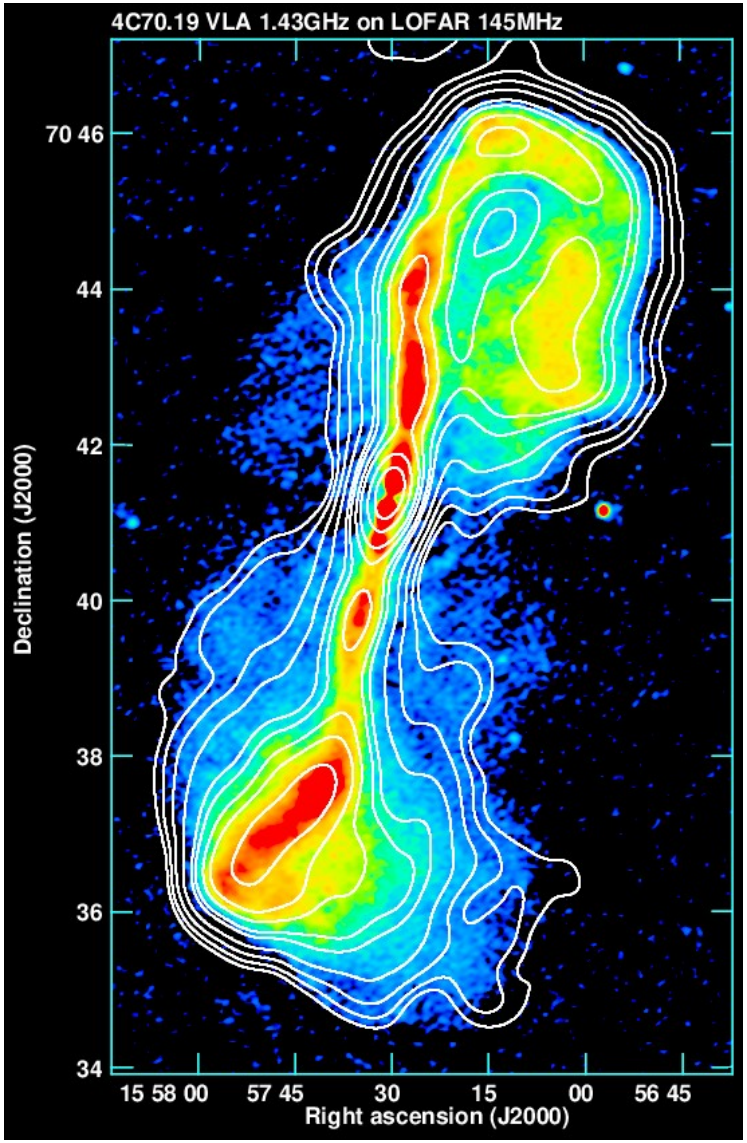
LOFAR

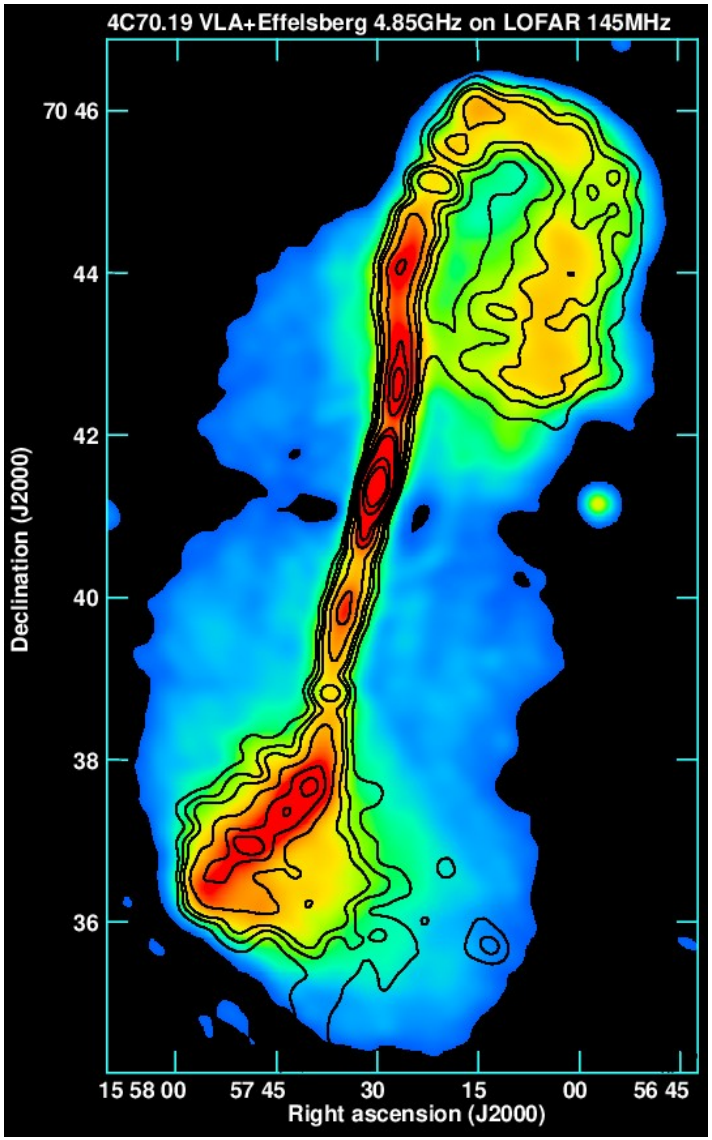
LOTSS 145 MHz @ 6”

- core not visible
- otherwise a combination of ALL previous findings



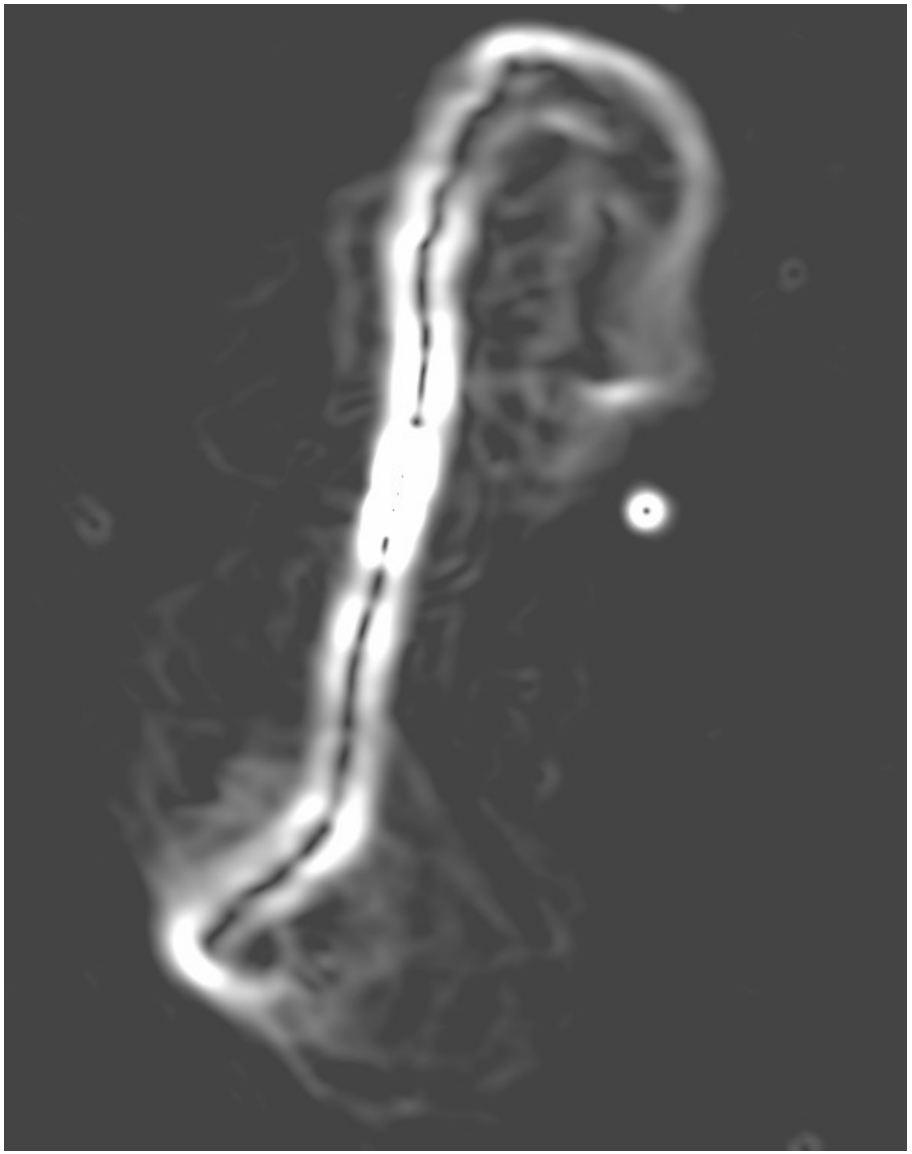



4C70.19 VLA 1.43GHz on LOFAR 145MHz
70 46
44
42
40
38
36
34
Declination (J2000)
15 58 00
57 45
30
15
00
56 45
Right ascension (J2000)


4C70.19 VLA+Effelsberg 4.85GHz on LOFAR 145MHz
70 46
44
42
40
38
36
Declination (J2000)
15 58 00
57 45
30
15
00
56 45
Right ascension (J2000)

Jet propagation

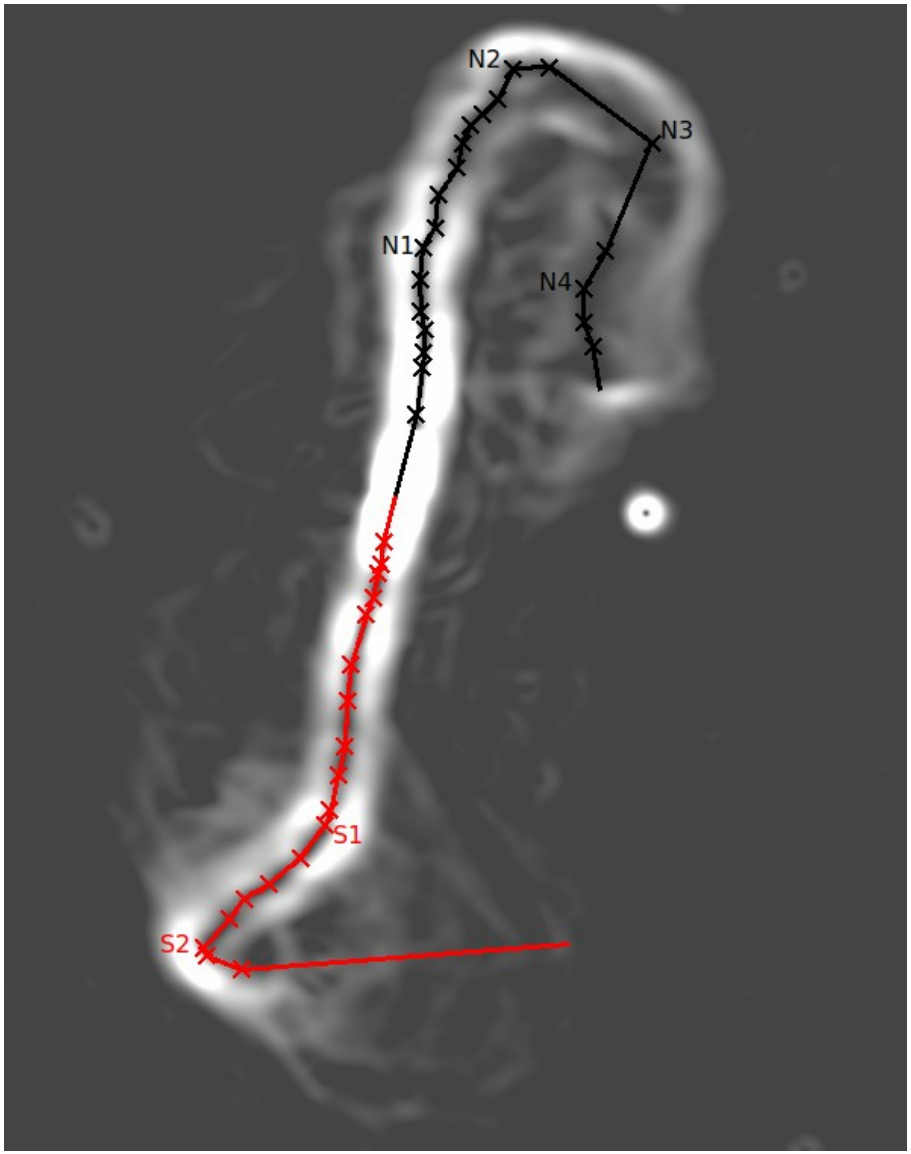
We took the LOFAR map and used the sobel filter to highlight the propagation of the jets...



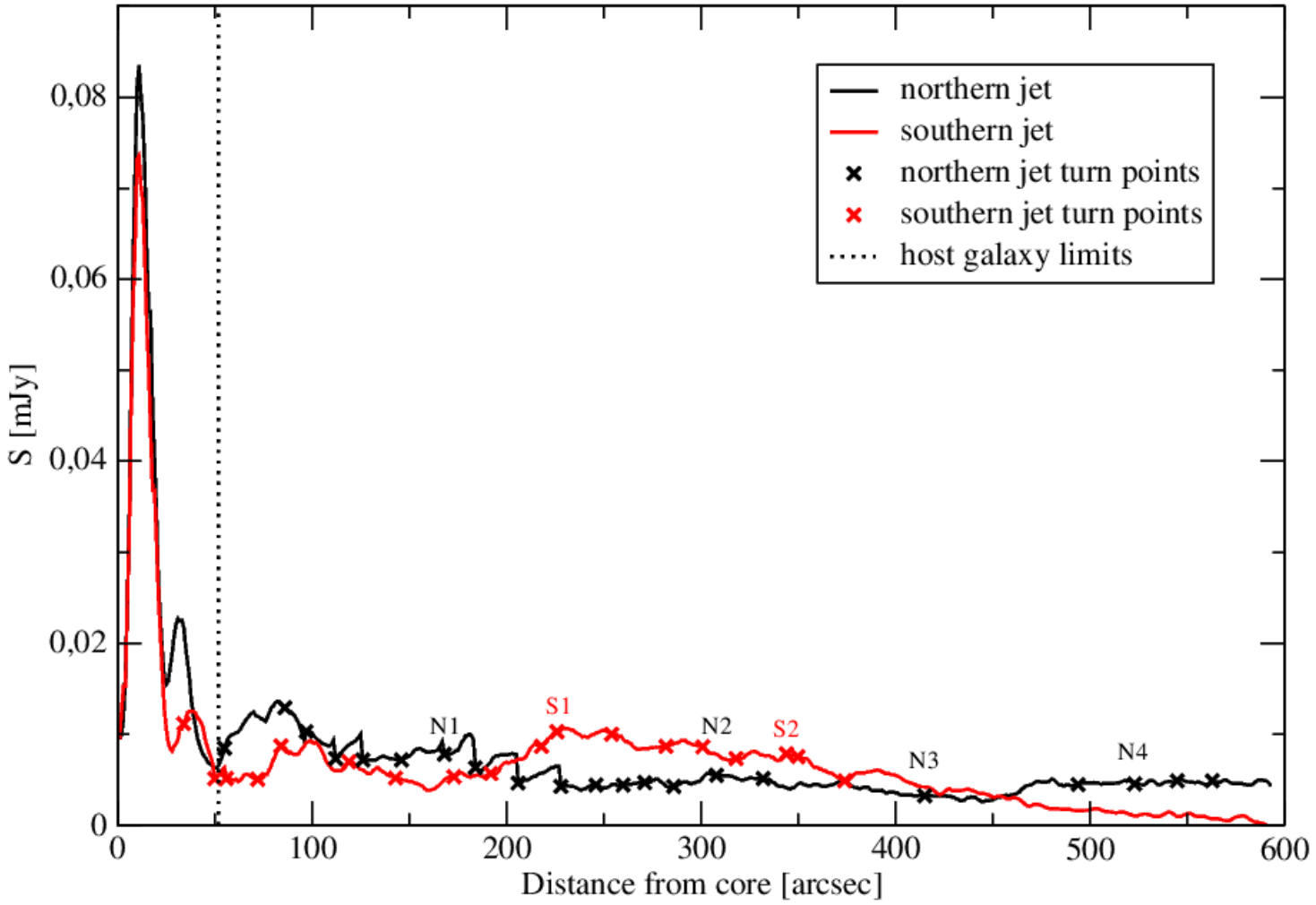
Jet propagation

We took the LOFAR map and used the sobel filter to highlight the propagation of the jets…

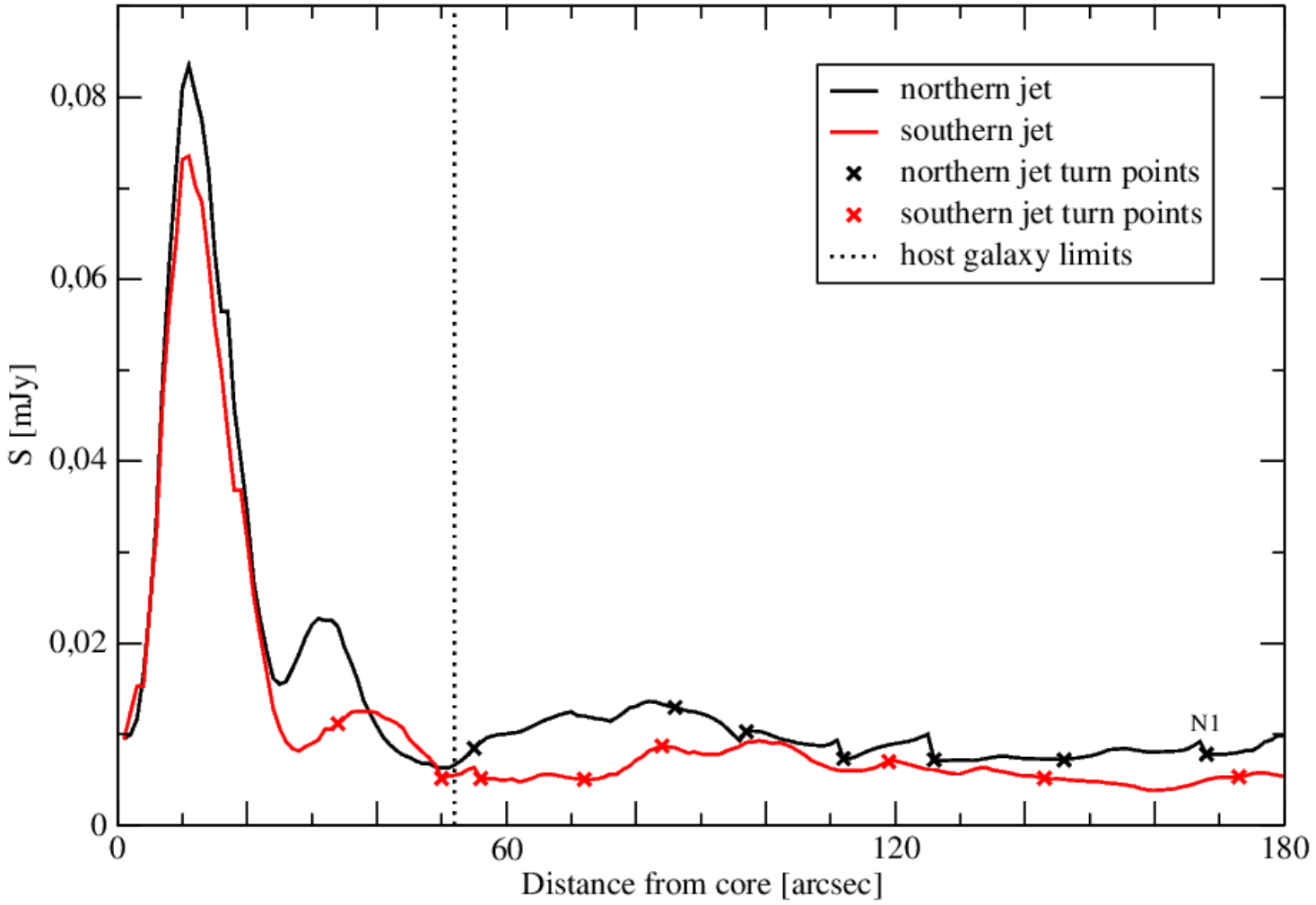
...and constructed the profiles.



Jet propagation

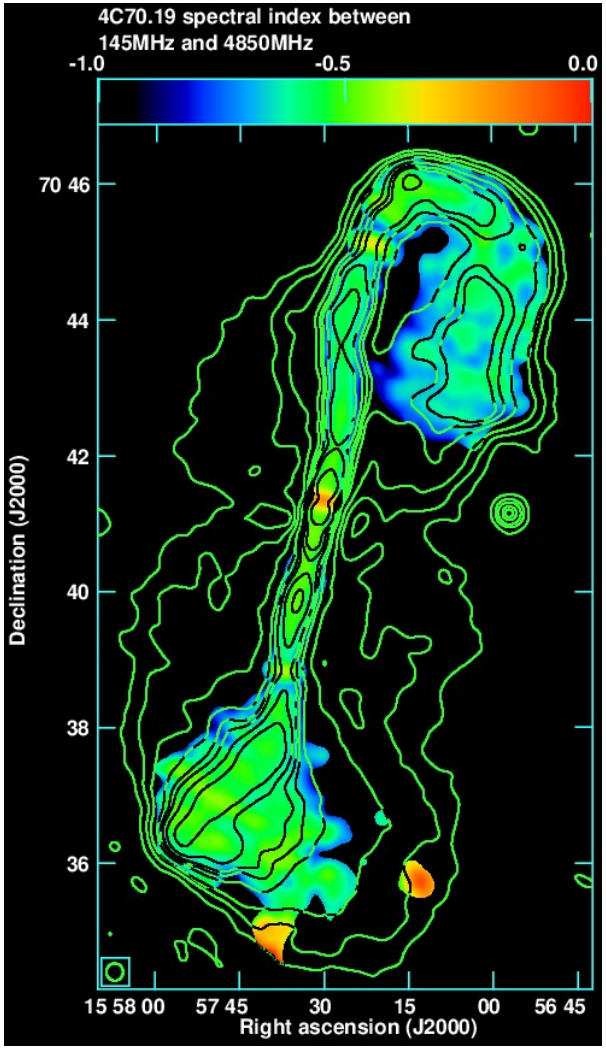


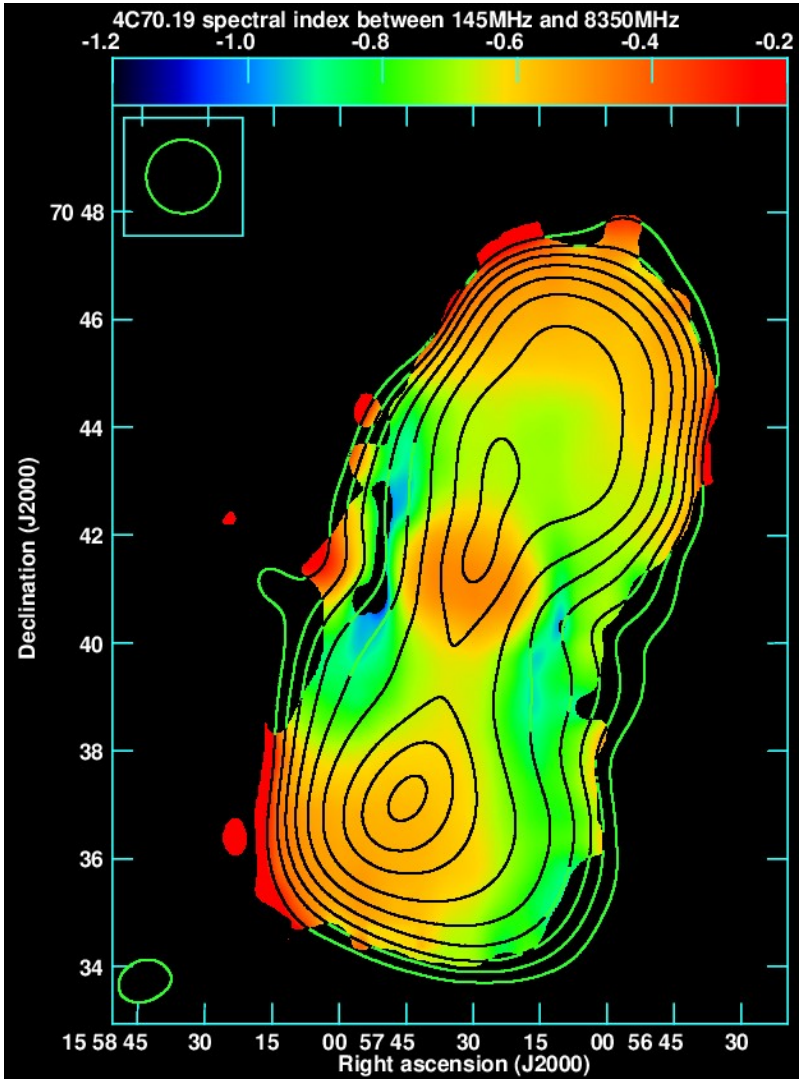
Jet propagation



Spectral index

- Rather uniform index in the jets → no compressions, but interesting knots just before the plumes start
- Relatively ‘flat’ index of the diffuse emission
- Re-acceleration?





Morphology of the source

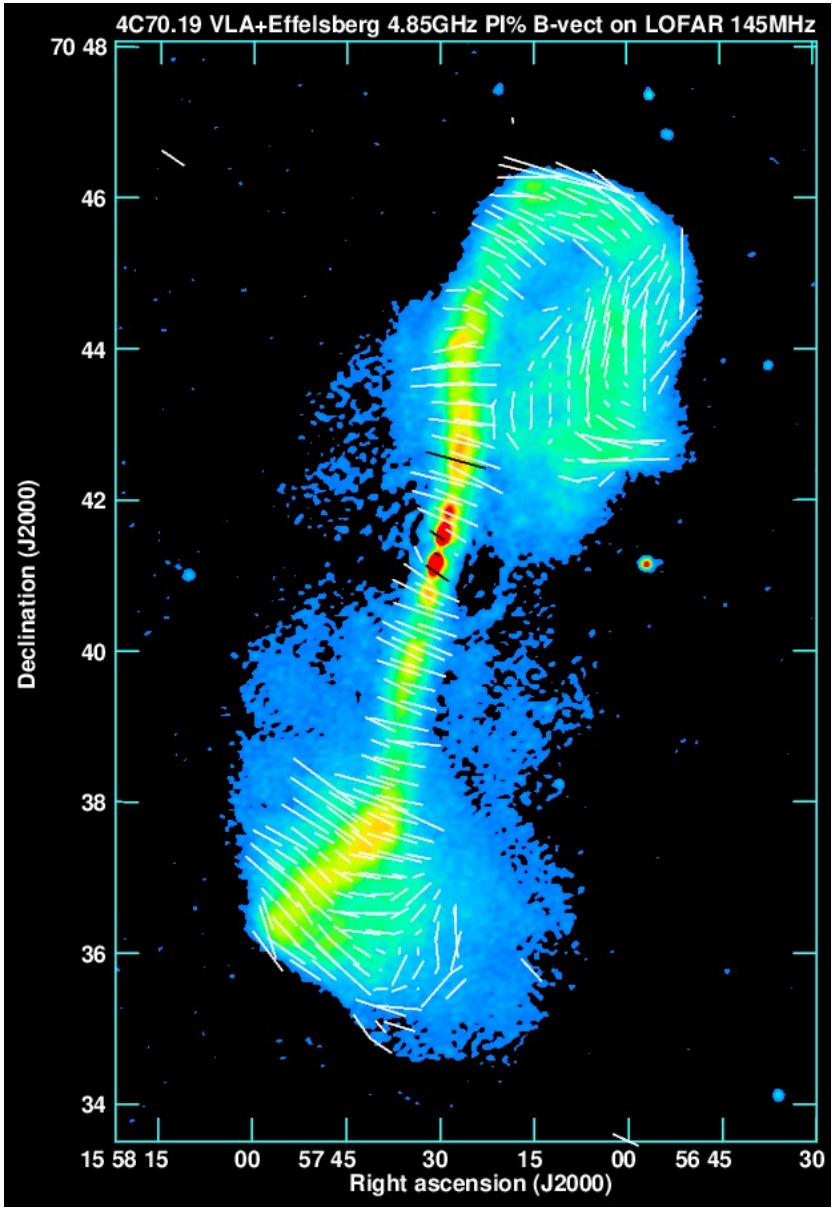
No notable brightenings rather exclude compressions → the increase in the degree of polarisation might point at shearing of the magnetic field (at decelleration point?).

Toroidally dominated magnetic field in the jets, longitudal in the N-plume (S-plume?)

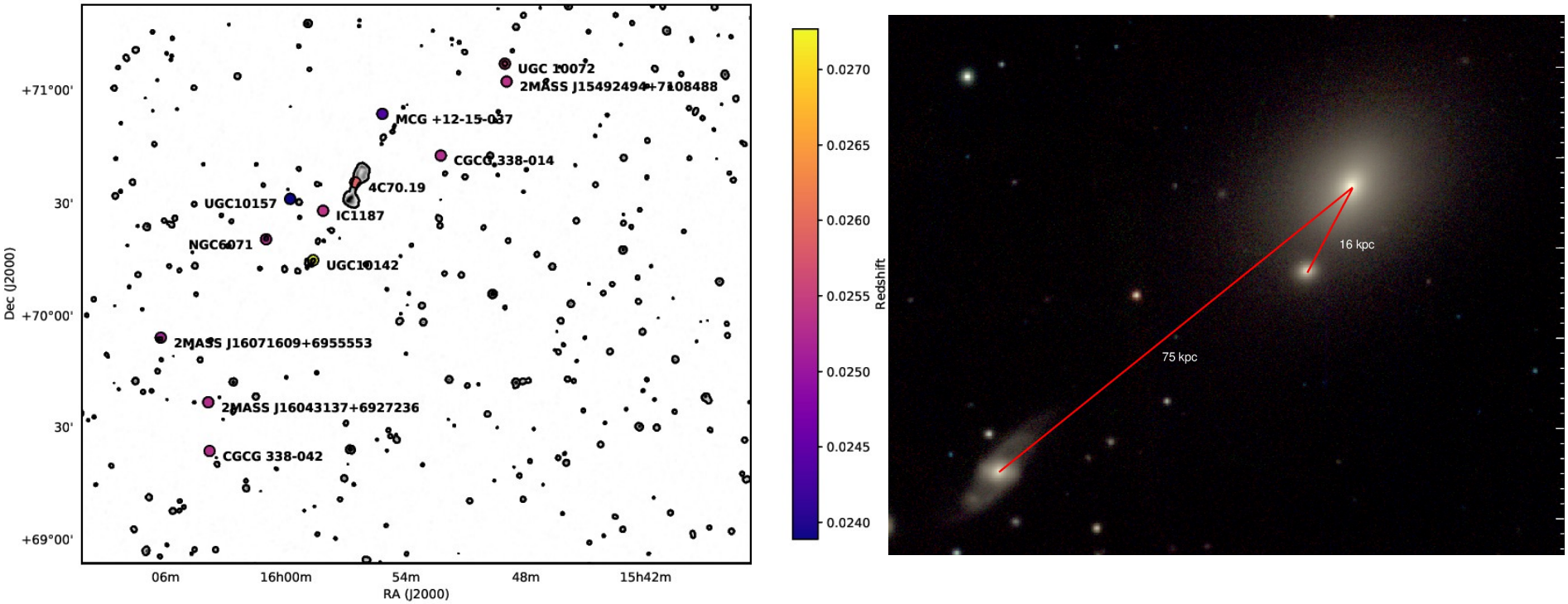
Termination of deflected flow at the end of N-jet's path → change of B-vectors

Is the magnetic field responsible for keeping the jets collimated out to ~150 kpc?

In the jets B ~ 1.5 μG. Cocoon gas density from RM map ~ 10^{-3} cm^{-3}



Environment



NGC6048/4C70.19 likely interacts with fellow galaxies

Summary

- 4C70.19 is an FR I with jets that are well collimated over distances up to ~150 kpc, likely due to magnetic fields
- Both jets end with a plume, but the southern one is bent more outwards and hidden from a direct view
- The ‘twisted’ shape of 4C70.19 results from interactions between the host galaxy NGC6048 and other group objects, as well as the disturbed propagation of the jets
- Interactions between the jets and the surrounding IGM are also imprinted in their magnetic fields
- Rotation Measures derived for 4C70.19 suggest/confirm a gaseous ‘cocoon’ with densities of the order of 10^{-3} cm^{-3}