A GMRT study of cometary-shaped radio galaxies

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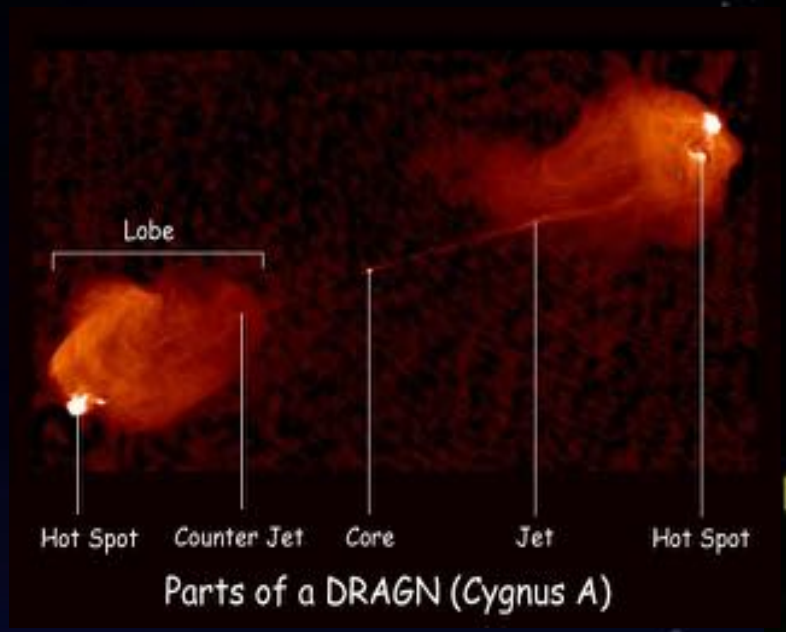
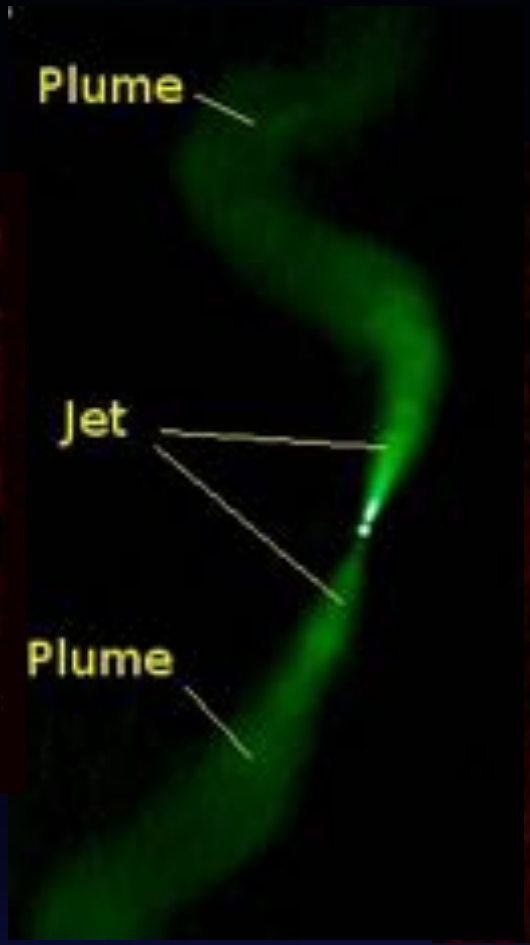
NCRA

Outline

- Introduction
- Sample Selection
- Imaging Results & Discussion
- uGMRT Results
- Summary

Head Tail Radio Galaxies?





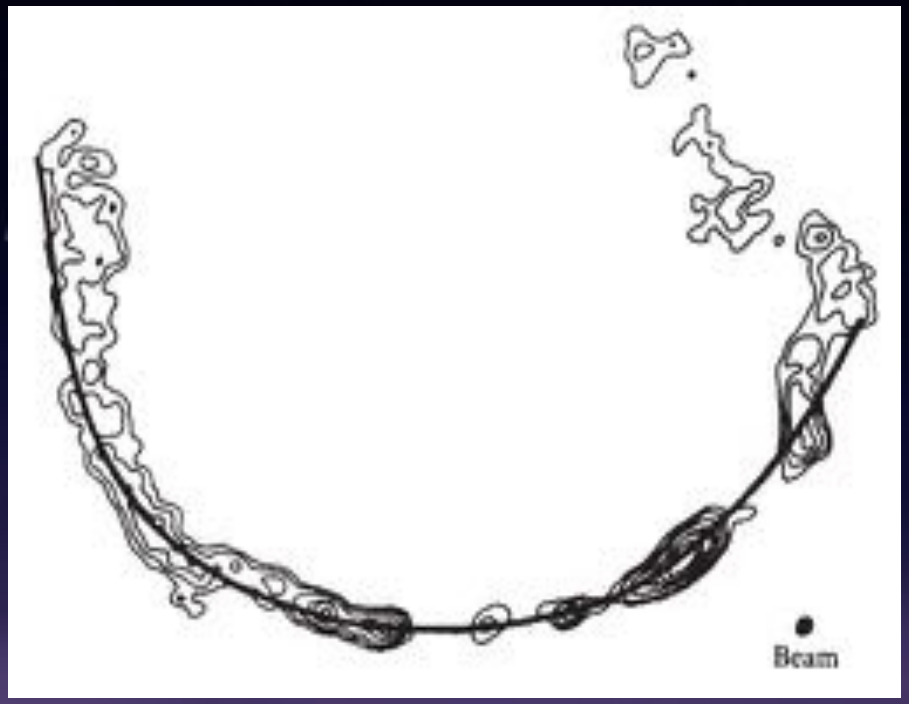
3C31

3C129

(Lane et al., 2002)

Head Tail Radio Galaxies

- Beam model (*Begelman et al., 1979, Jones and Owen, 1979)*

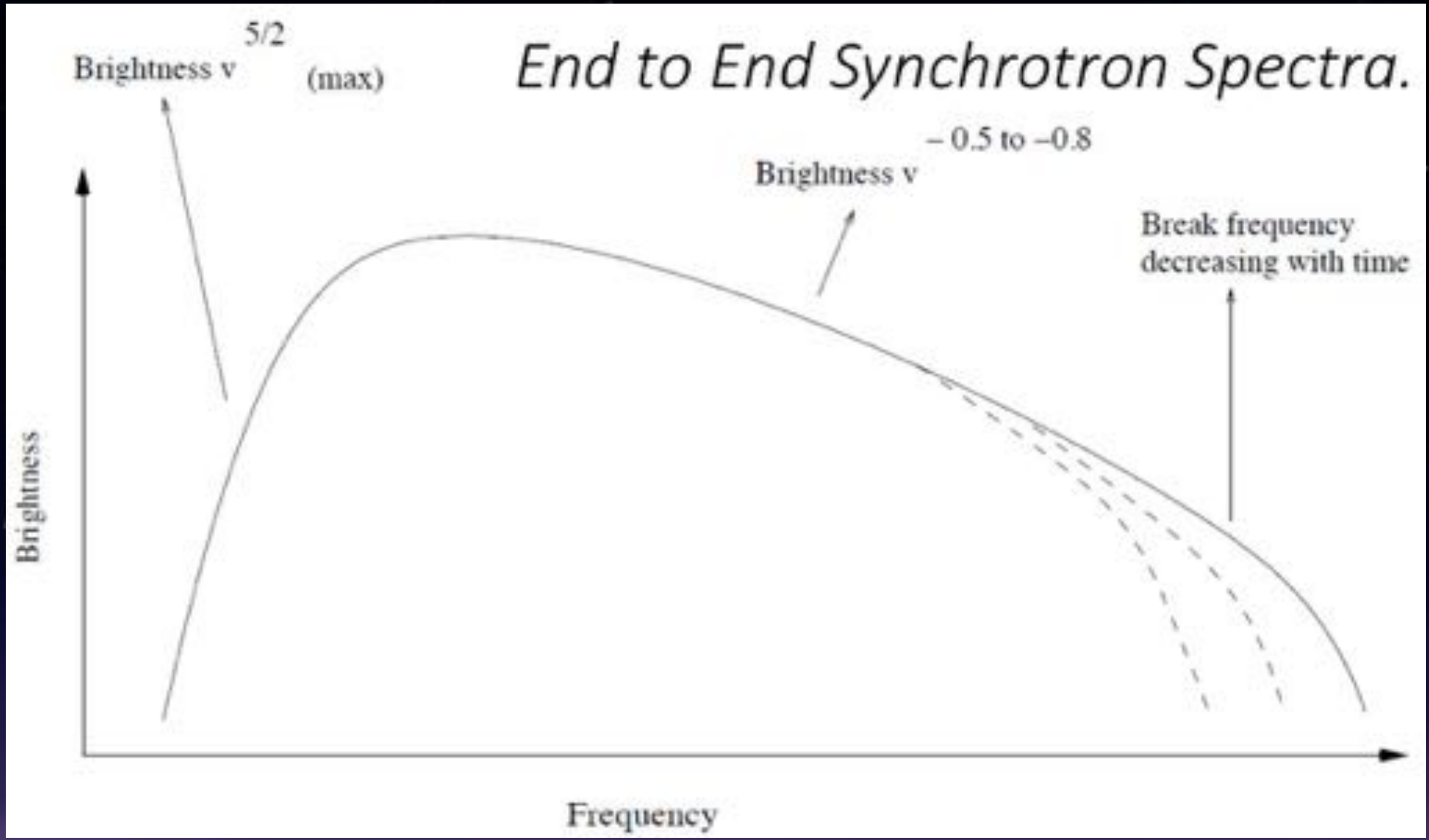


- Underlying physics causing the peculiar morphology.
- Method for cluster detection (*Blanton et al. 2003*, *Mao et al. 2010*)
- Cluster environmental probes => constraining ICM density, magnetic fields and velocity flows

Why observe with the GMRT?

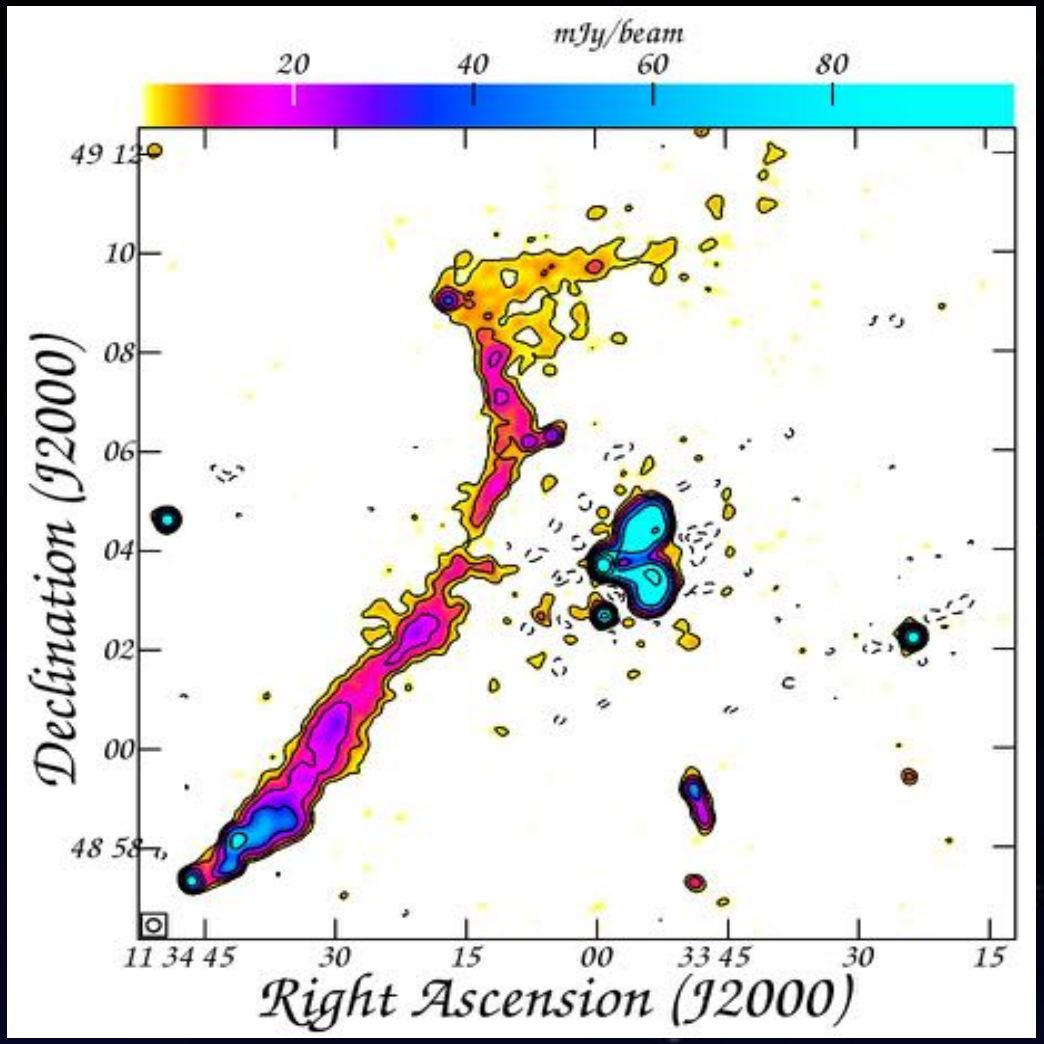
- Steepening of spectral index along the tail.
- Diffuse emission is brighter at low frequencies.
- Relatively better resolution provided by the GMRT at such low frequencies.
- Hence most ideal for studying the morphology and spectral structure..

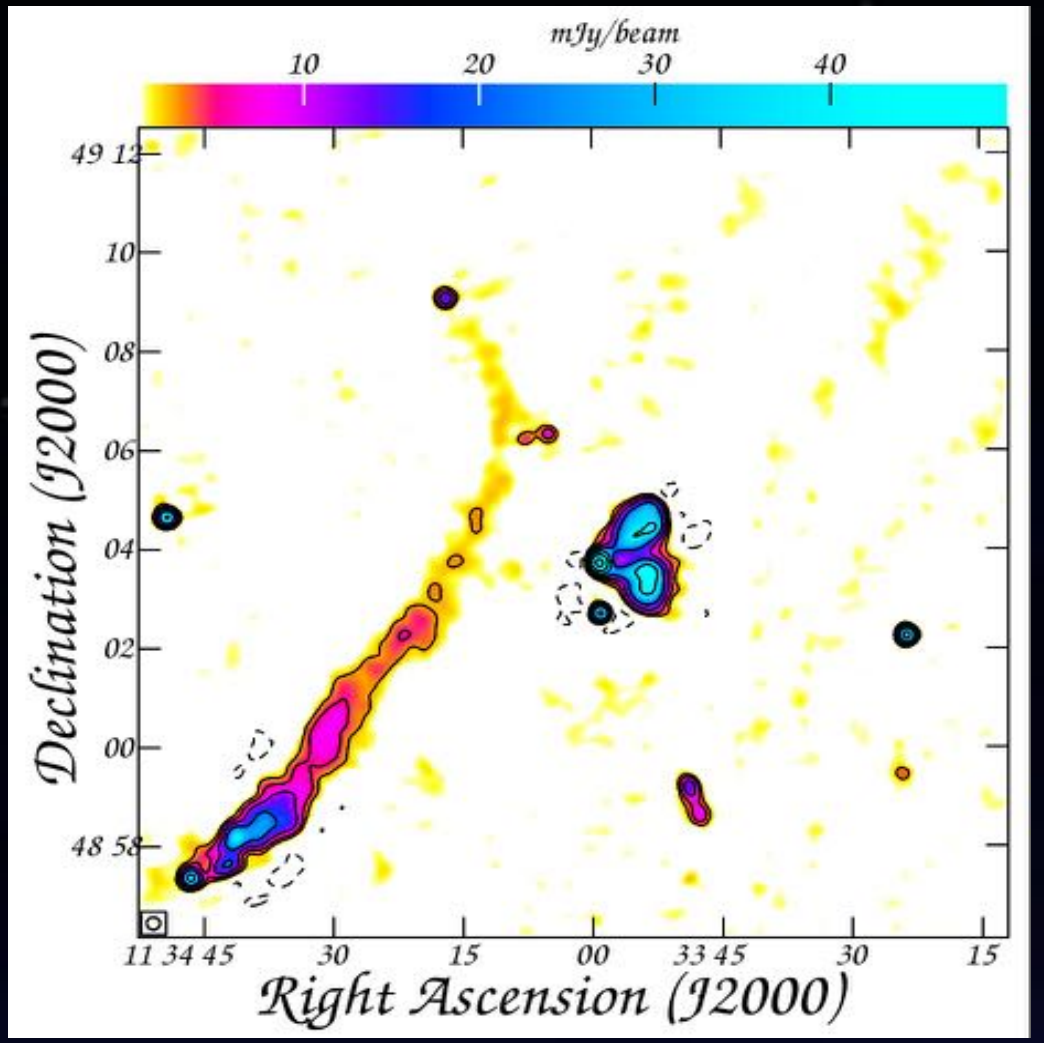
Spectral Ageing Theory



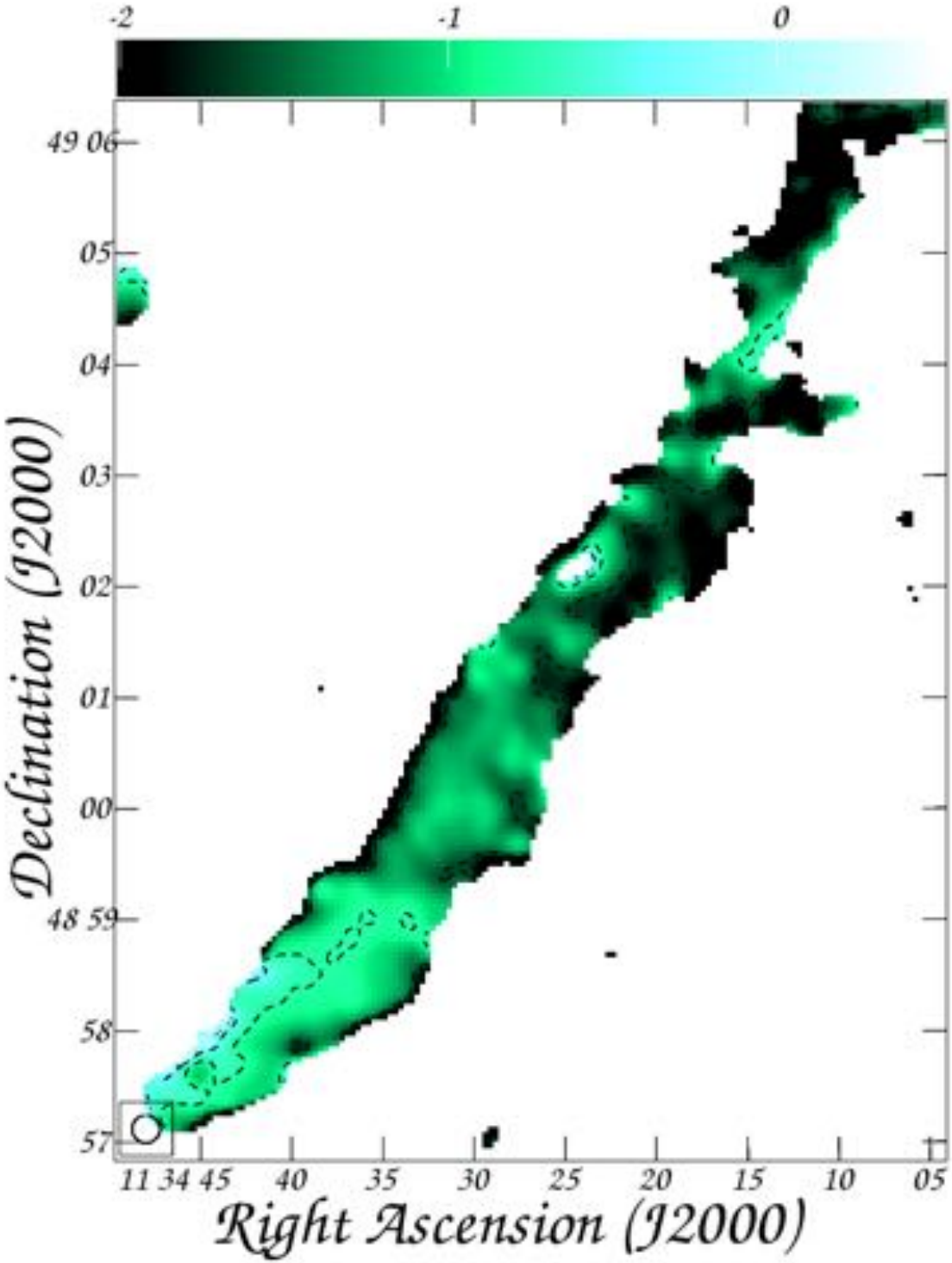
Sample Selection

Target Name	Bandwidth (MHz)	Central Frequency(MHz)
IC310	8/8	240.3/609.6
IC711	8/8	240.3/609.6
NGC1265	8/8	240.1/609.6
NGC7385	8/8	240.2/609.9
GB6B0335+0955	8/16	240.0/618.33
PKS 0053-015	32/32	322.7/607.9
PKS B0053-016	32/32	322.7/607.9
4C 13.17a		
3C264		
1709+397		
NGC 6109		



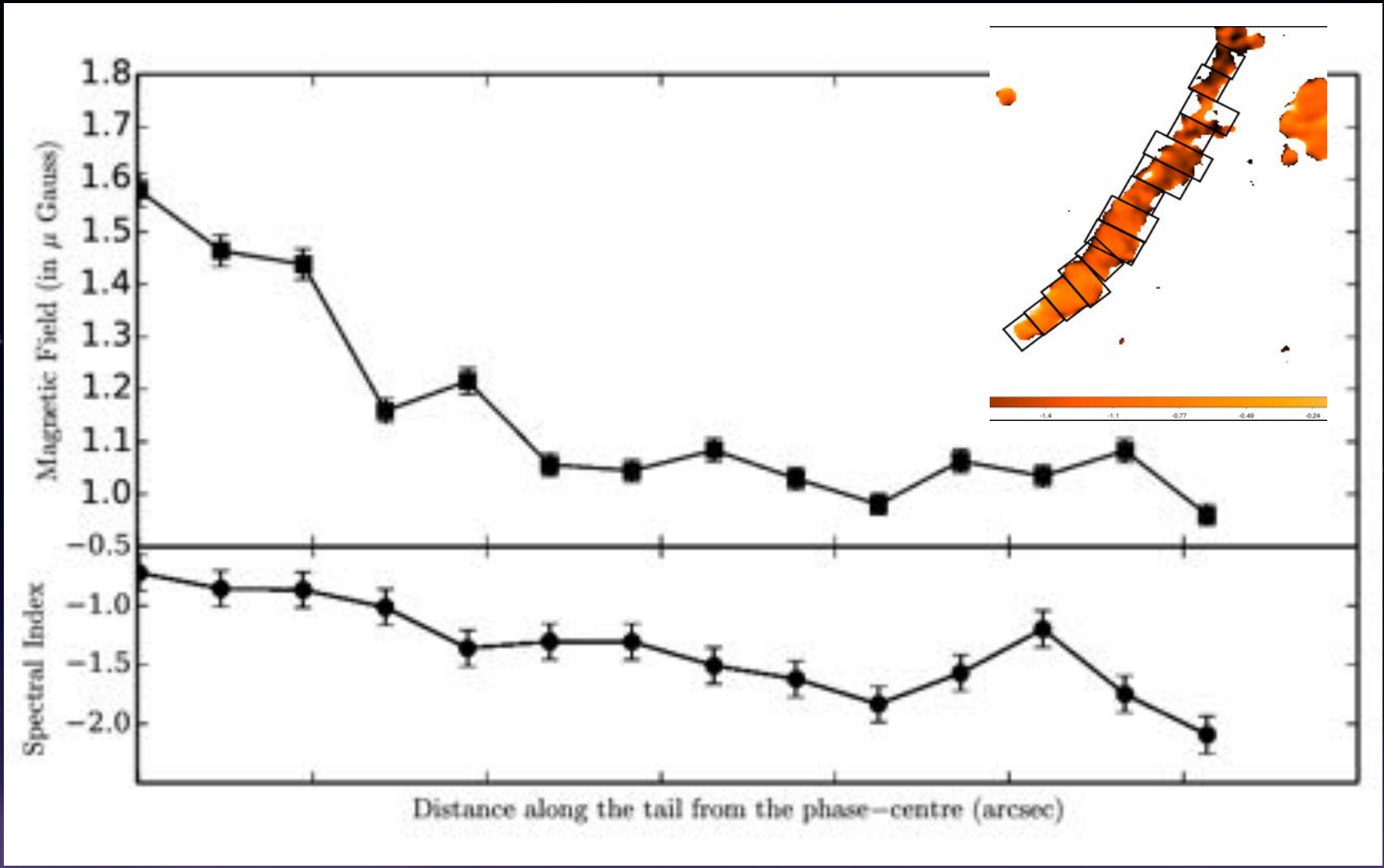


Frequency	Beam Size	Rms noise
240 MHz	15”x15”	0.93 mJy/beam
610 MHz	15”x15”	0.58 mJy/beam

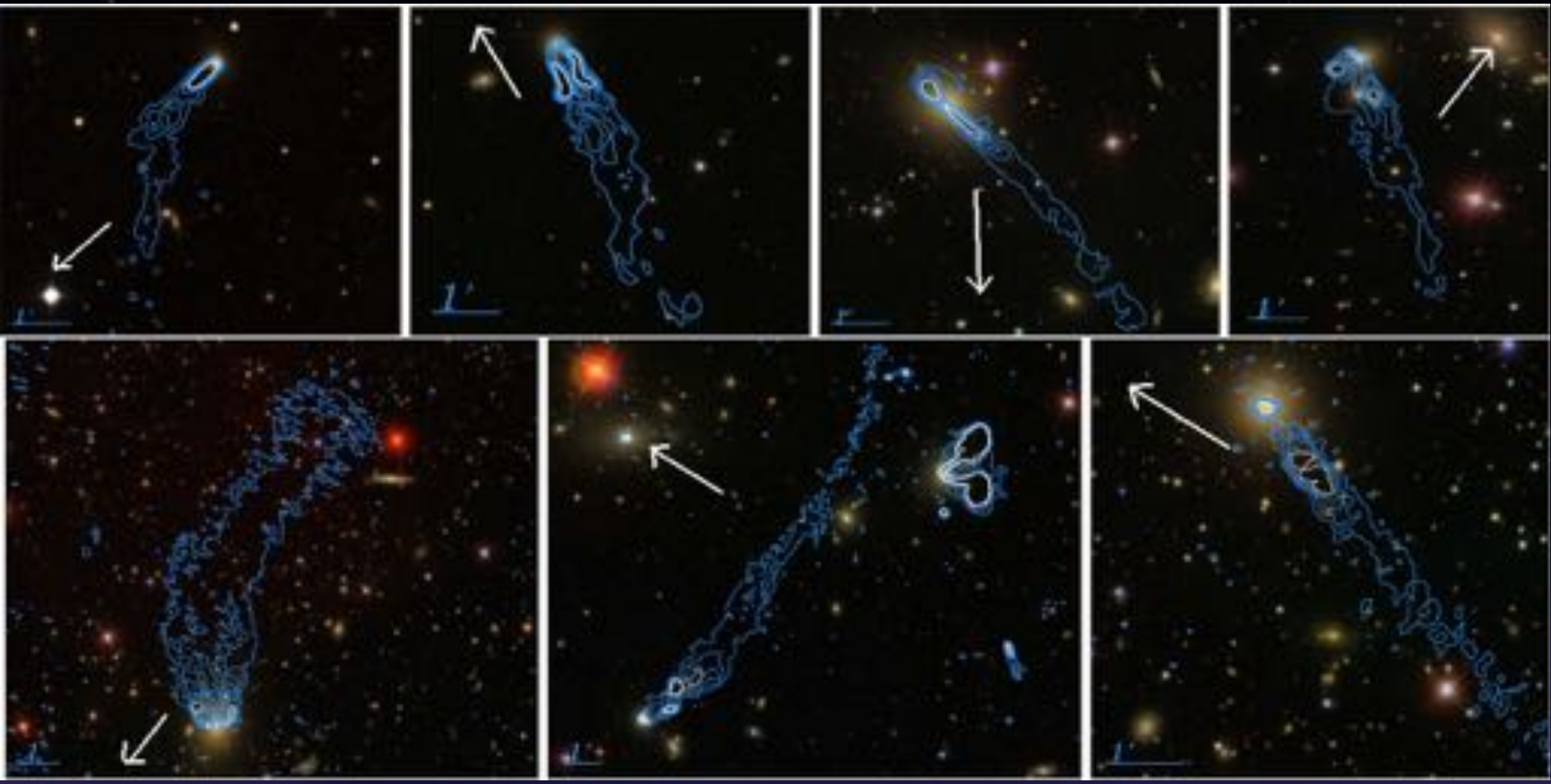


Spectral Index map

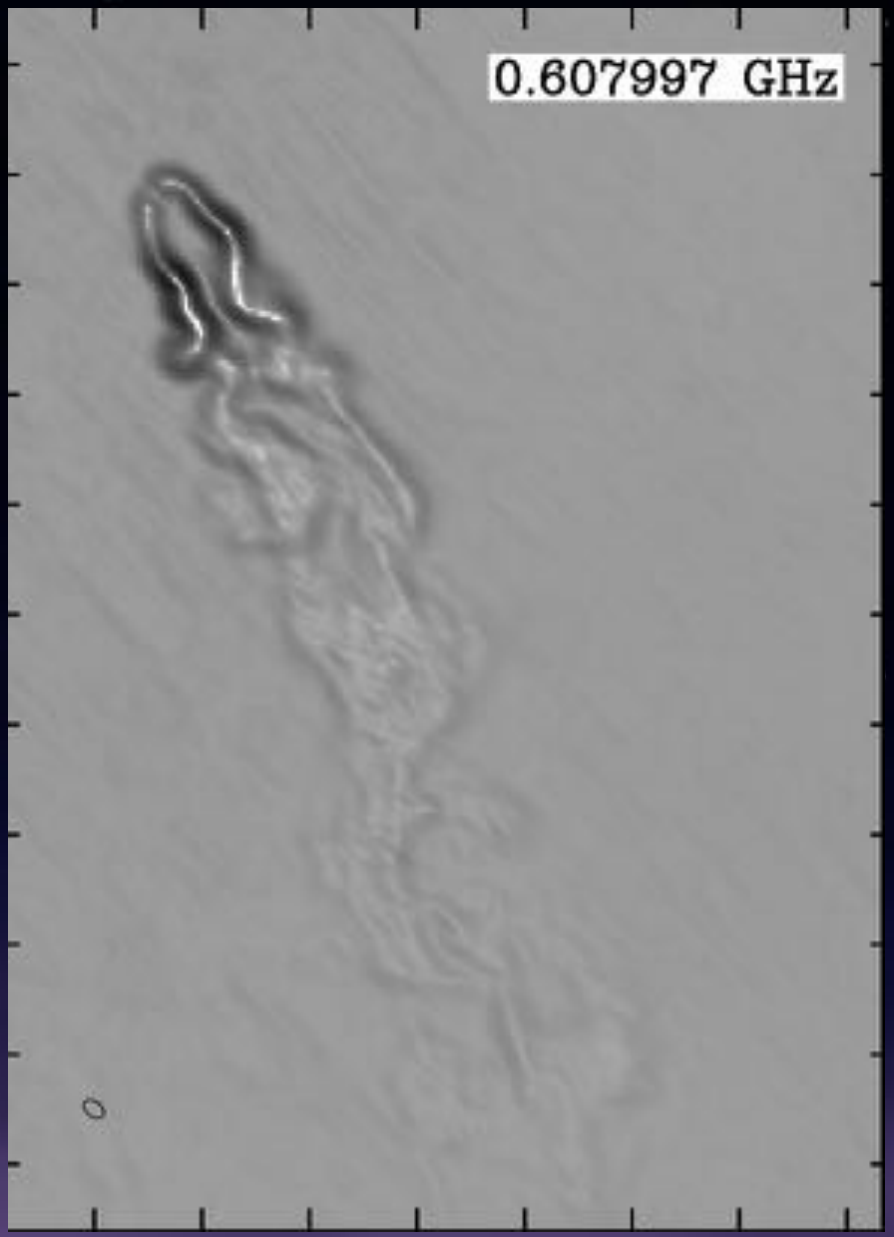
Equipartition Magnetic field

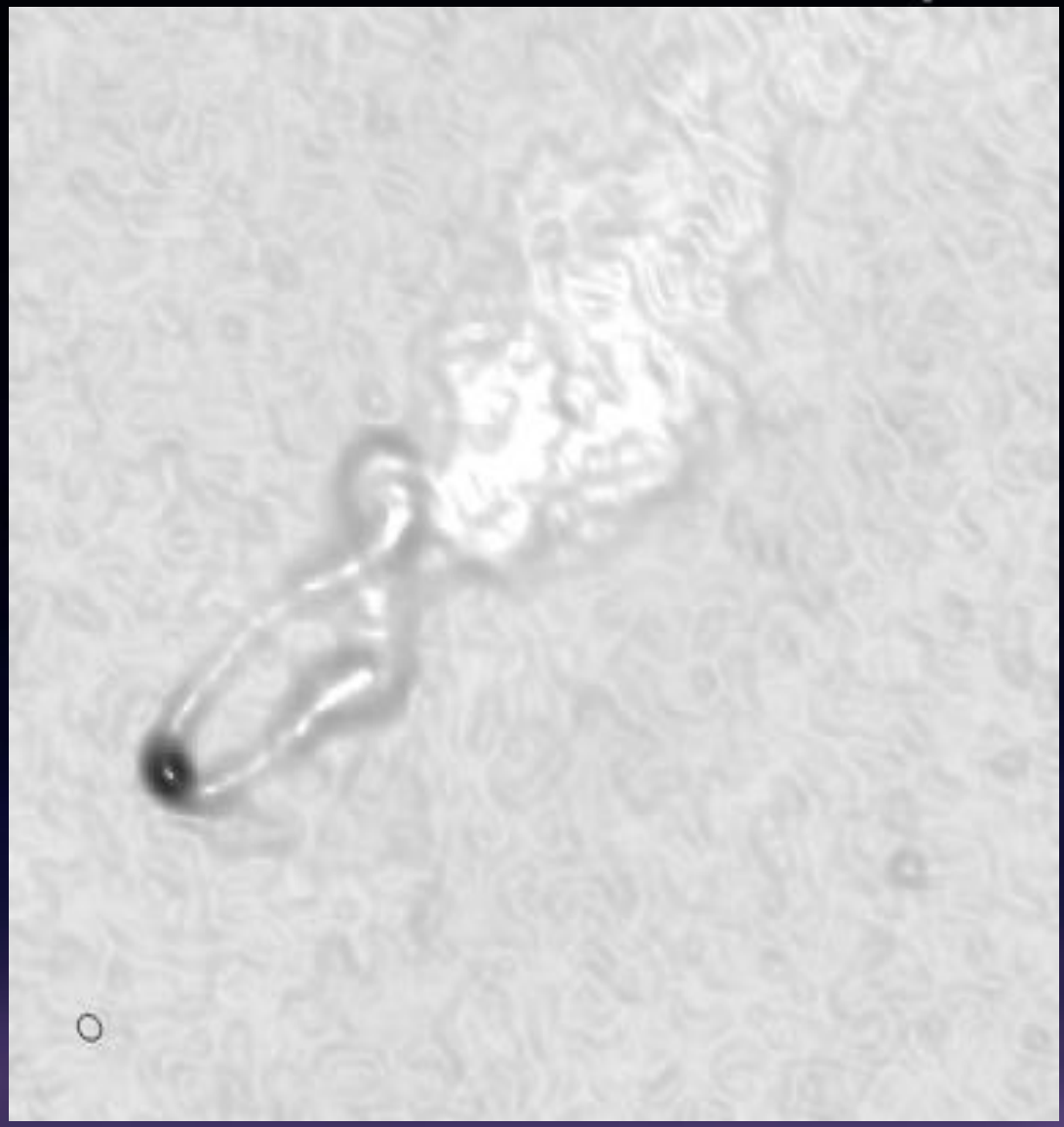


Optical Counterpart

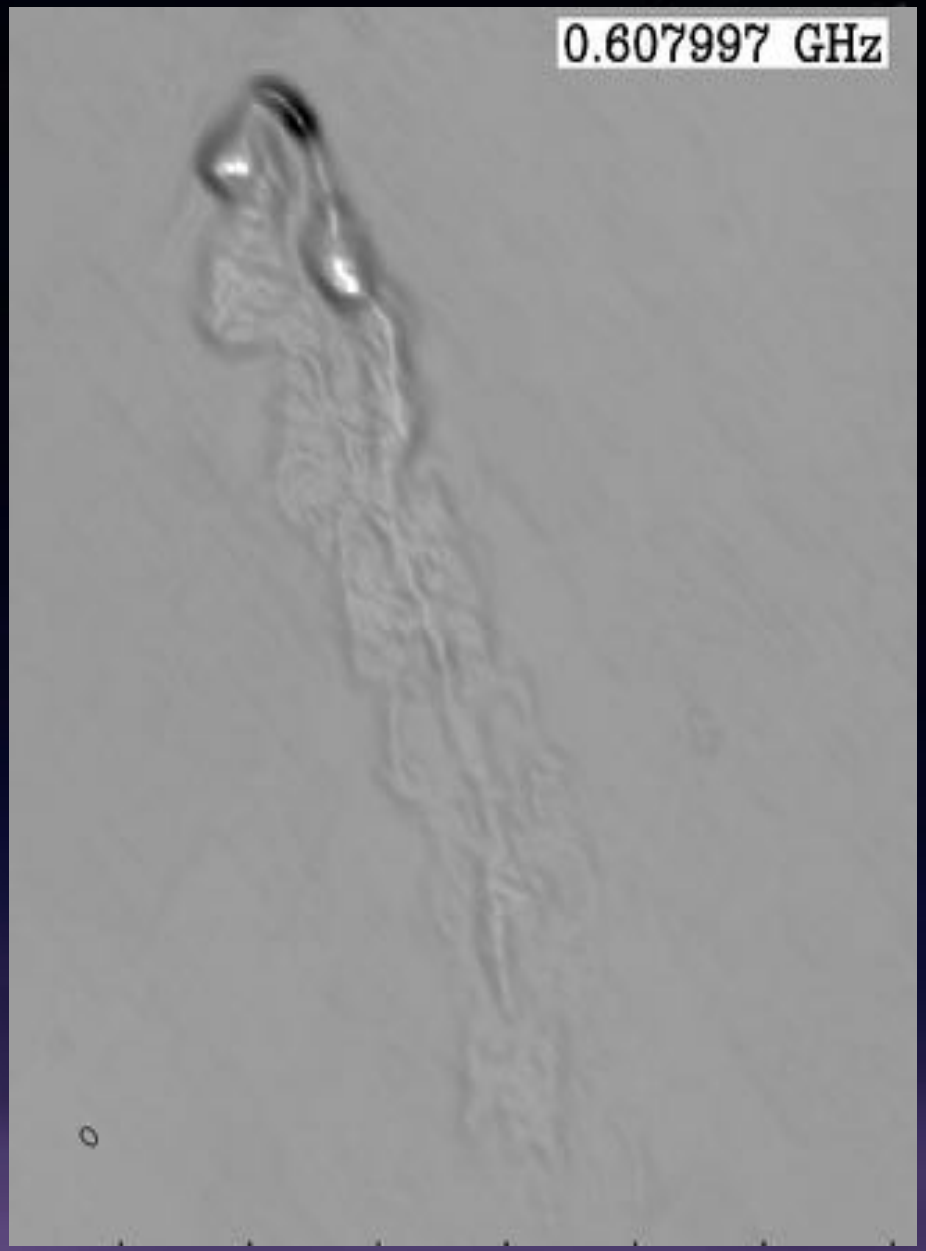


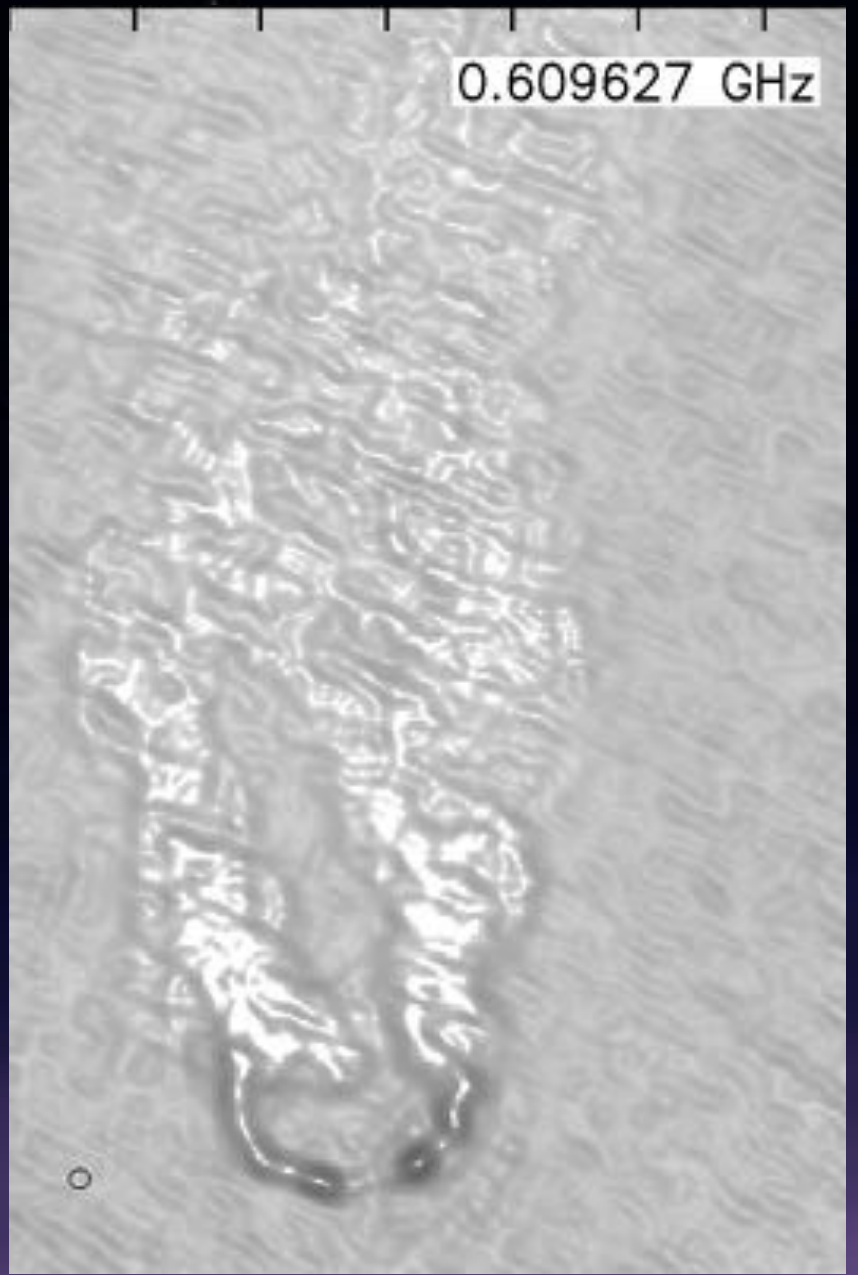
Morphology





Morphology

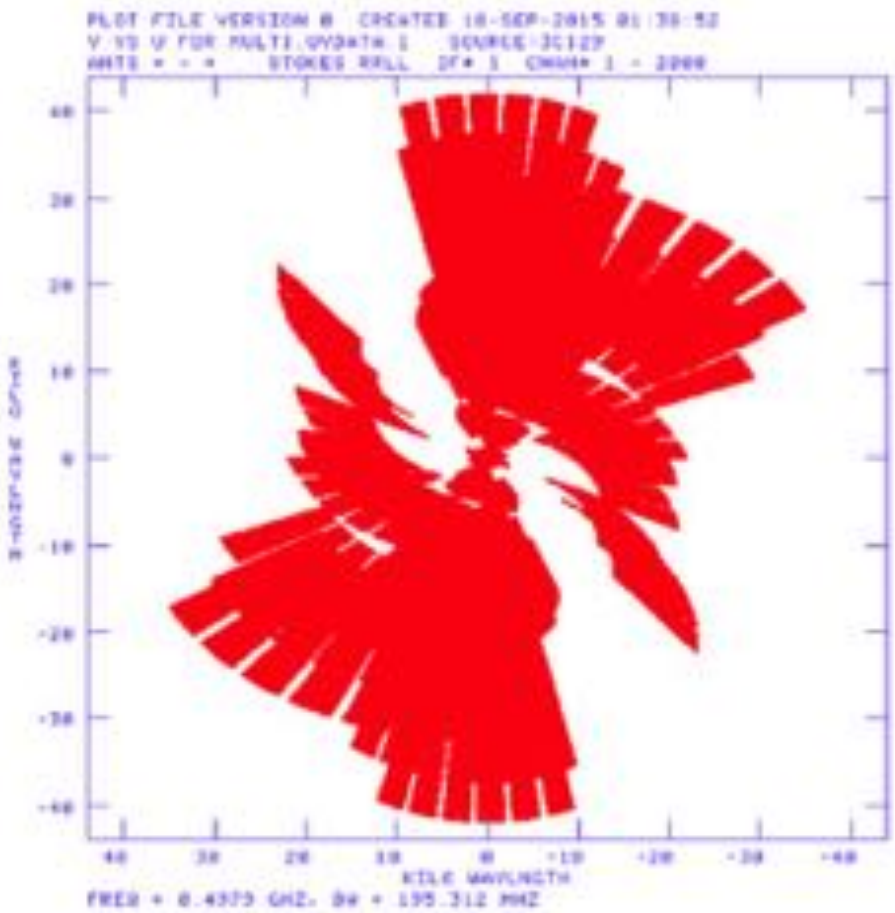


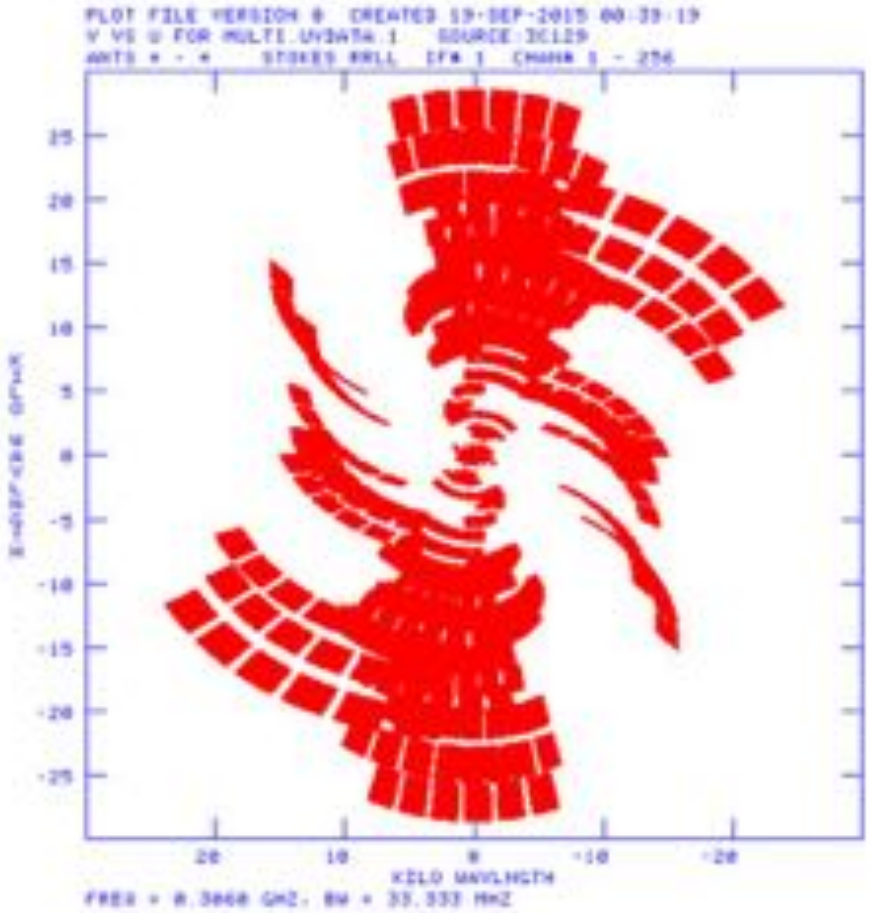


uGMRT Results

- 3C129: Observation details
  - Time on source :3hrs
  - Central Frequency- 400 MHz
  - Bandwidth- 200 MHz
  - Number of antennas used -14

3C129: UV Coverage





Wide-Band Imaging

- Sky Brightness Spectra
  - Bandwidth Synthesis
  - Narrow band imaging and stacking
  - Solution : Multi Scale-Multi Frequency Synthesis algorithm
- Primary Beam
  - HPBW varies with frequency as λ/D
  - F.O.V at 250 MHz = twice F.O.V at 500 MHz

Data Analysis

- AIPS was used to edit and calibrate the data.
- A few channels were collapsed before imaging.
- Imaging was done in CASA.
- W-projection was used to take care of the wide-field corrections.
- MS-MFS algorithm was used while imaging.

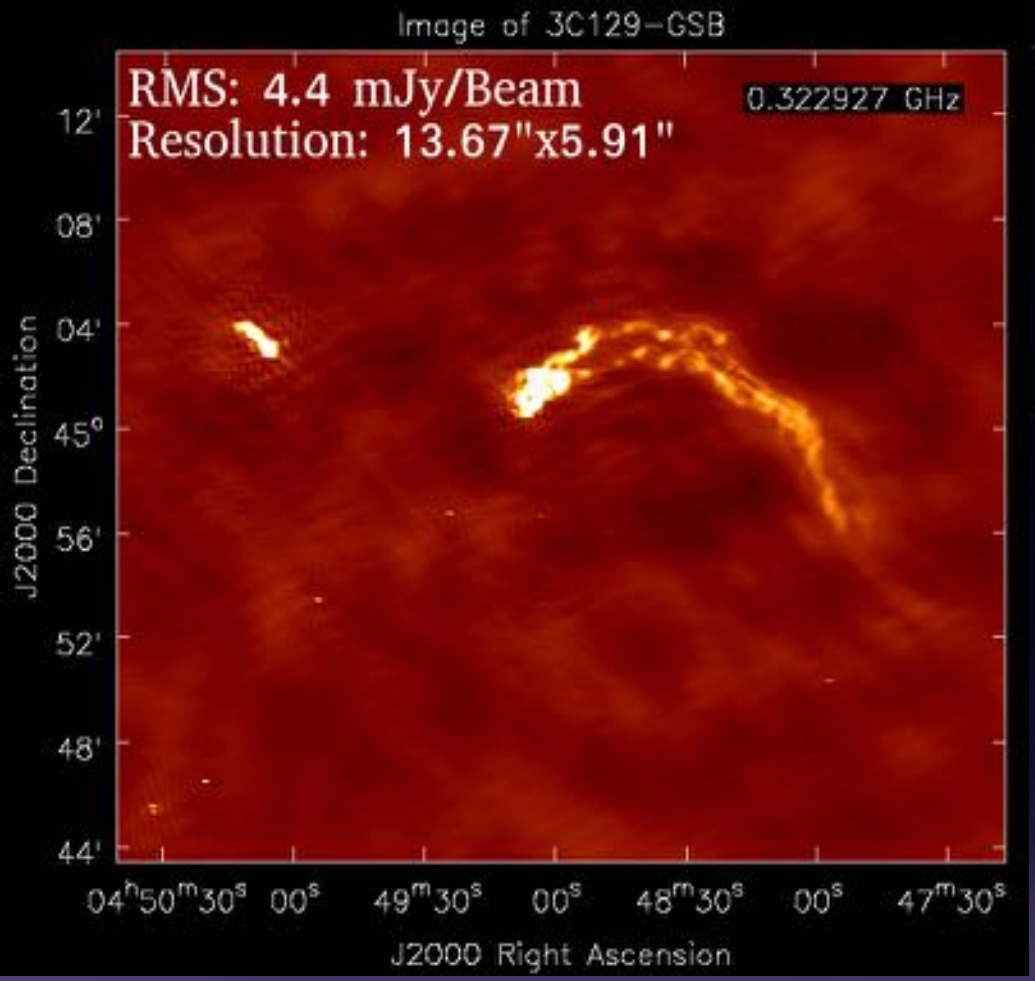


Image of 3C129-GSB
RMS: 4.4 mJy/Beam
Resolution: 13.67"x5.91"
0.322927 GHz
12'
08'
04'
45°
56'
52'
48'
44'
J2000 Declination
04h50m30s
00s
49m30s
00s
48m30s
00s
47m30s
J2000 Right Ascension

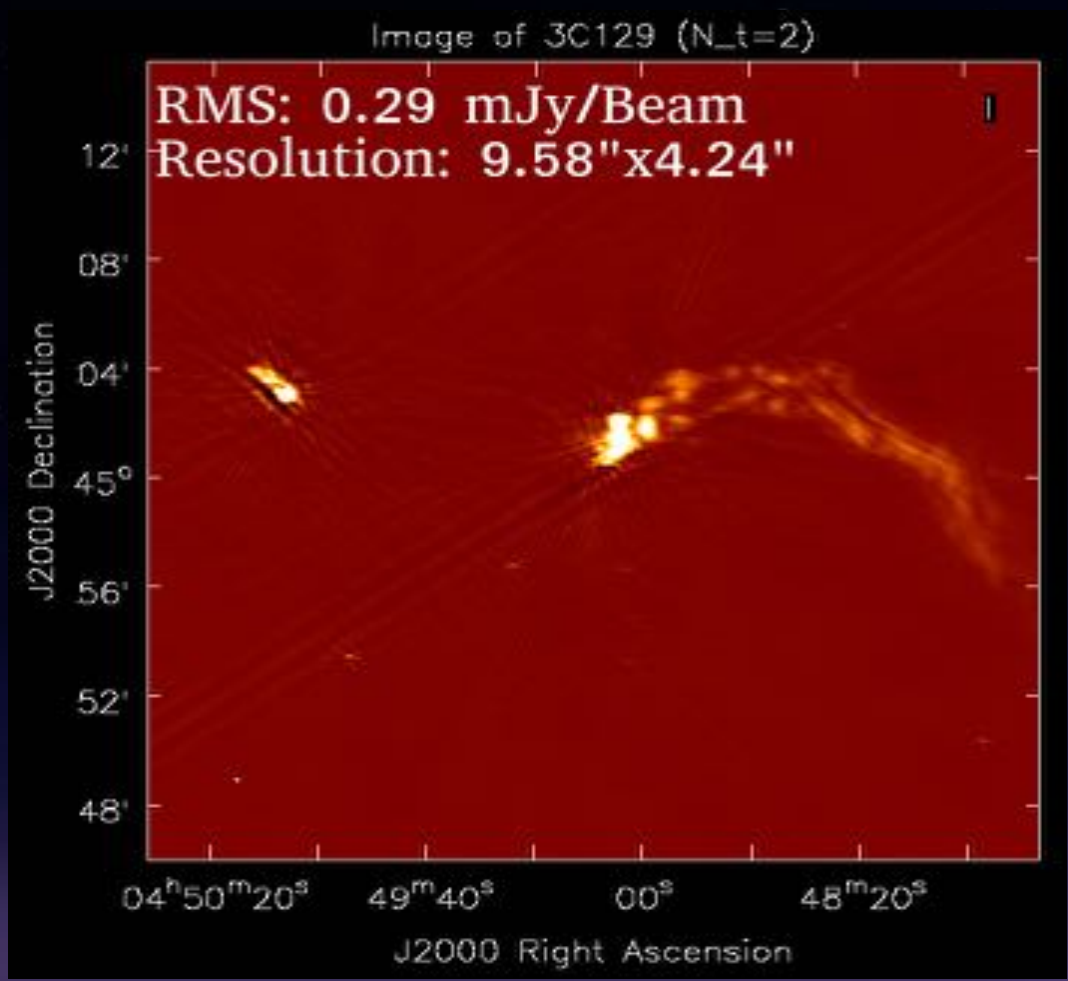
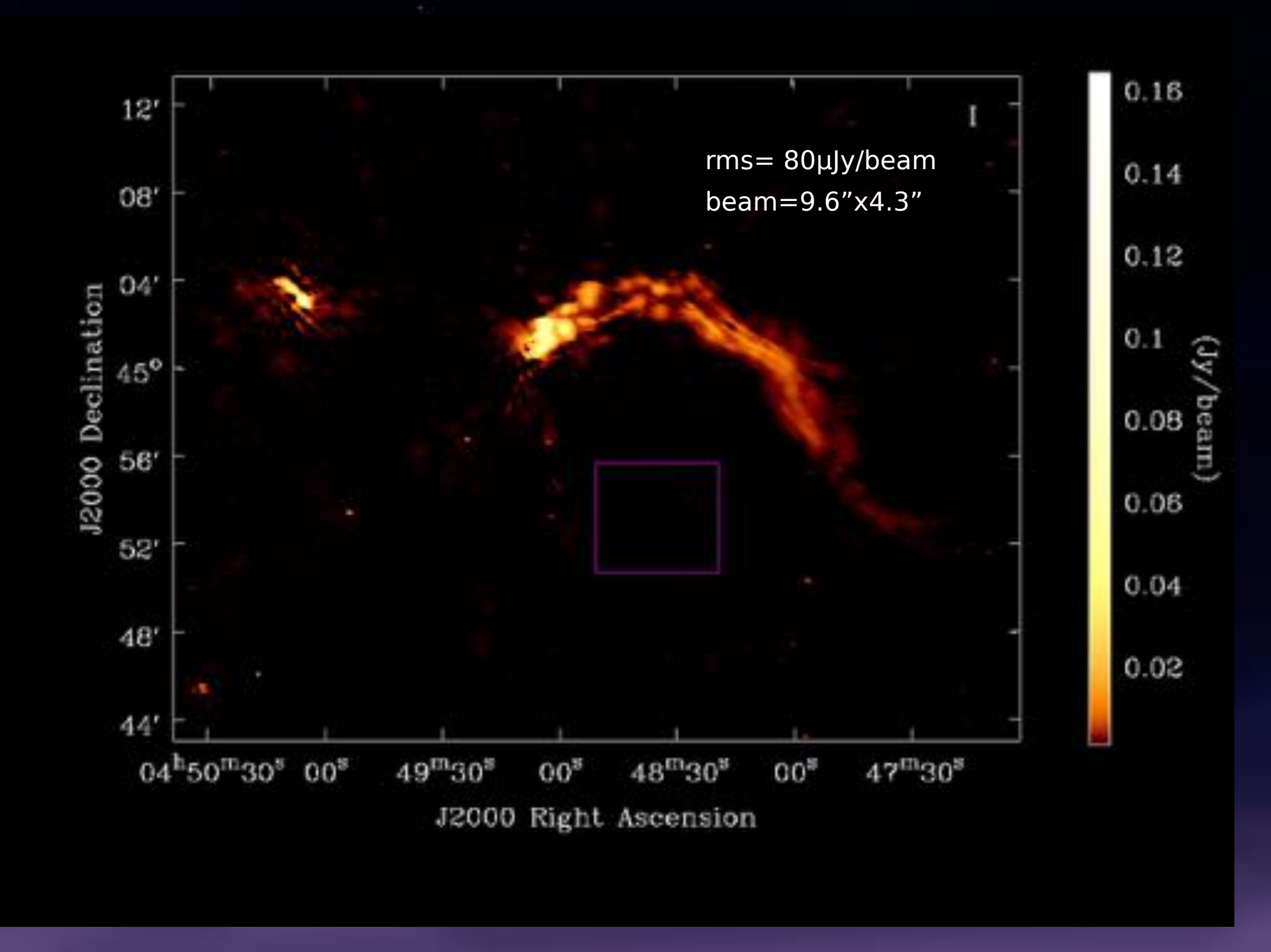
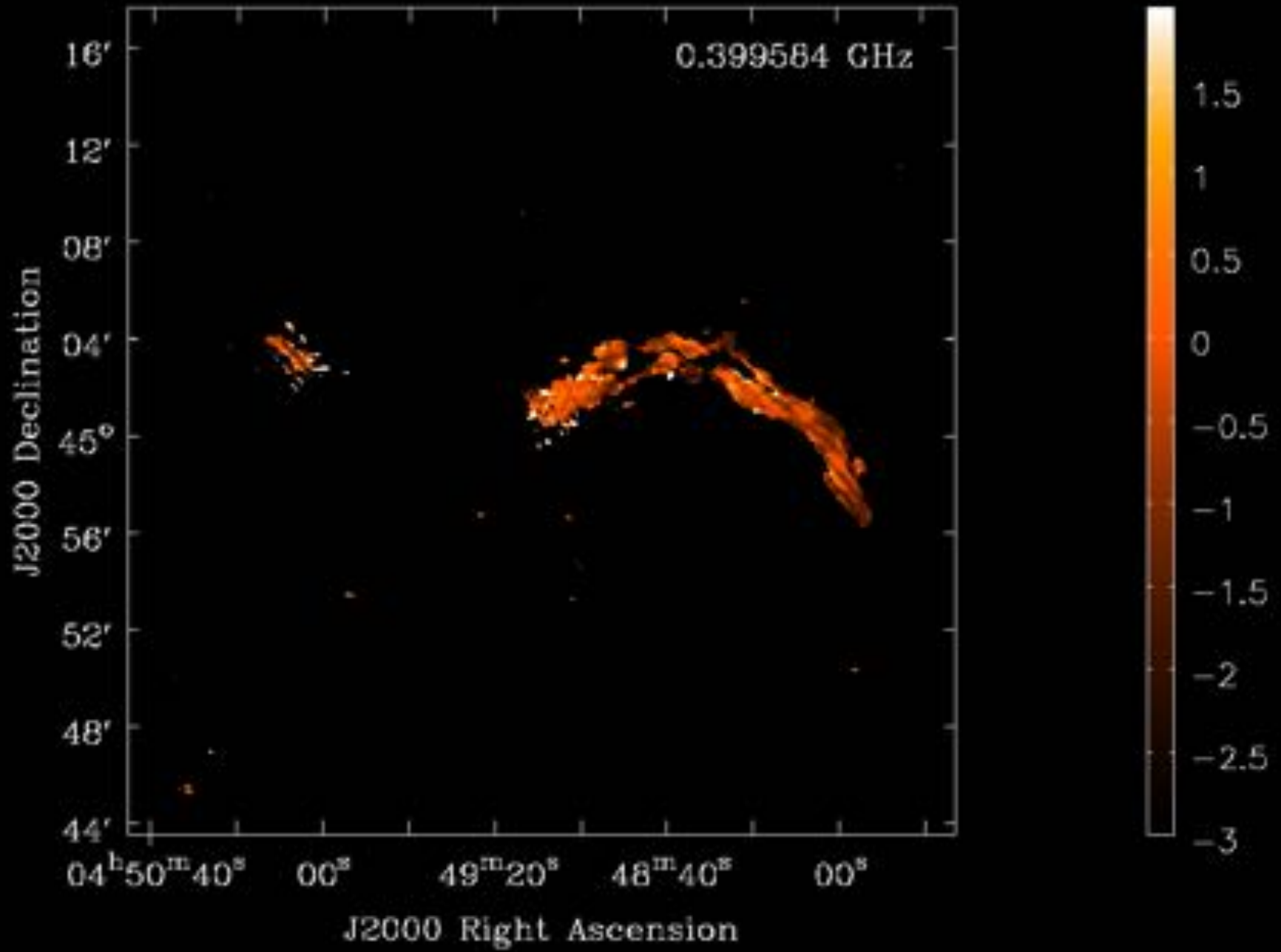


Image of 3C129 (N_t=2)
RMS: 0.29 mJy/Beam
Resolution: 9.58"x4.24"
12'
08'
04'
45°
56'
52'
48'
J2000 Declination
04h50m20s
49m40s
00s
48m20s
J2000 Right Ascension


rms= 80μJy/beam
beam=9.6”x4.3”
12'
08'
04'
45°
56'
52'
48'
44'
J2000 Declination
04h50m30s
00s
49m30s
00s
48m30s
00s
47m30s
J2000 Right Ascension
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
(Jy/beam)


0.399584 GHz
16′
12′
08′
04′
45°
56′
52′
48′
44′
J2000 Declination
04h50m40s
00s
49m20s
48m40s
00s
J2000 Right Ascension
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
−3

Summary

- Low frequency images and spectral index imagesof seven of the head-tail radio galaxies were made.
- Steepening of spectra towards the tails was clearly seen in all sources.
- Equipartition magnetic field was estimated along the tail.
- Presence of wiggles in all the sources with resolved jets in the sampe is probably due to precession or Helical instability or ?.
- GWB data of 3C129 was reduced and images were made making use of the MS-MFS algorithm.

IC 711

Cluster Name	ABELL 1314
Cluster Redshift	0.0335
Galaxy Redshift	0.0316
Length	17.8'/ 720.6 kpc
Galaxy Velocity	800 km/s
Dynamical Age	875 Myr