Extremely Superluminal motion in the curved jet of 1502+106

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Outline

1. Introduction
2. Observations
3. Image analysis
4. Discussion&summary

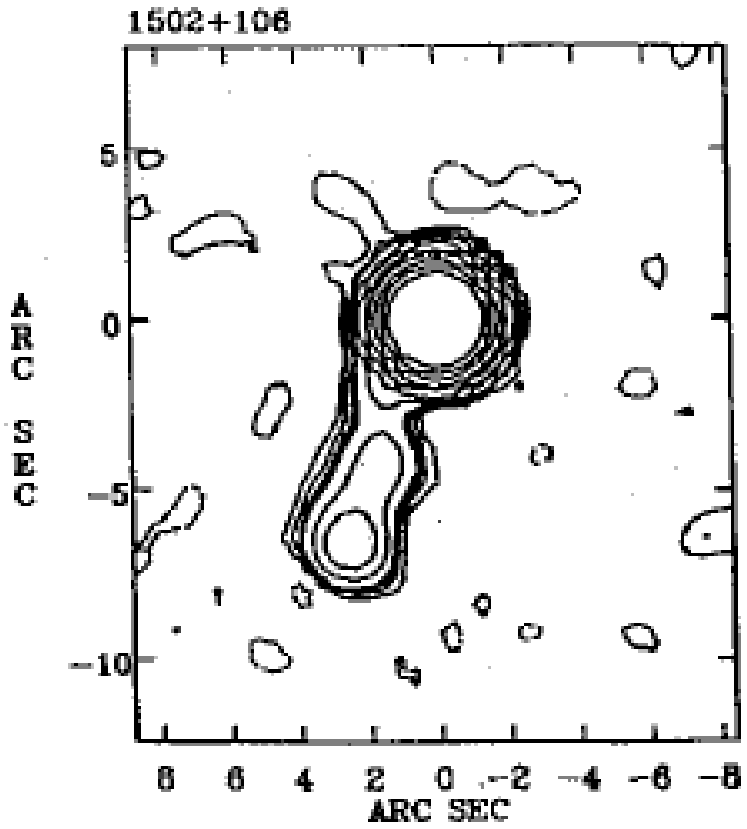
1.1 PKS 1502+106

- Z=1.833, 19.5mag[1] 1mas~6.4pc
- HPQ, linear p%~3% , variable optical polarization[2]
- Bright and variable on radio, optical, X-ray bands[3] flat-spectrum
- Gamma-rays flux 1st EGRET Survey[4]

1:Veron-Cetty&Veron 1998
2: Tapia&Inoue 1980; Impey&Tapia 1988
3: George et al. 1994 and references in it
4: Fichtel et al. 1994; Hartman et al. 1999

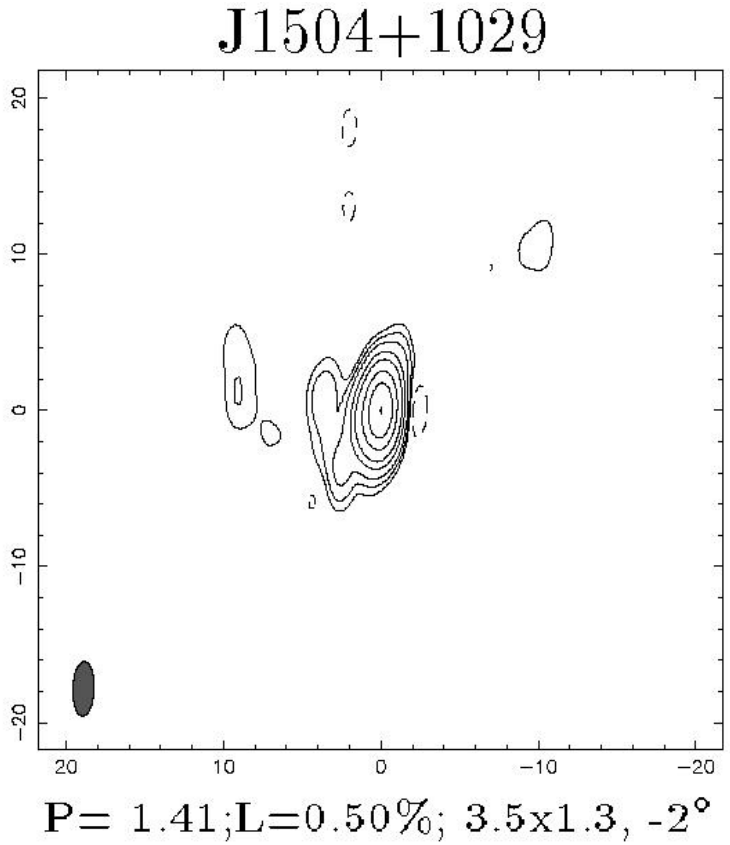
1.2 Radio Maps

VLA@1.66GHz



Murphy et al.1993

VLBA@5GHz



Fomalont et al. 2000

1.3 Scientific Motivation

- **Are all gamma-ray AGNs more beamed ?**

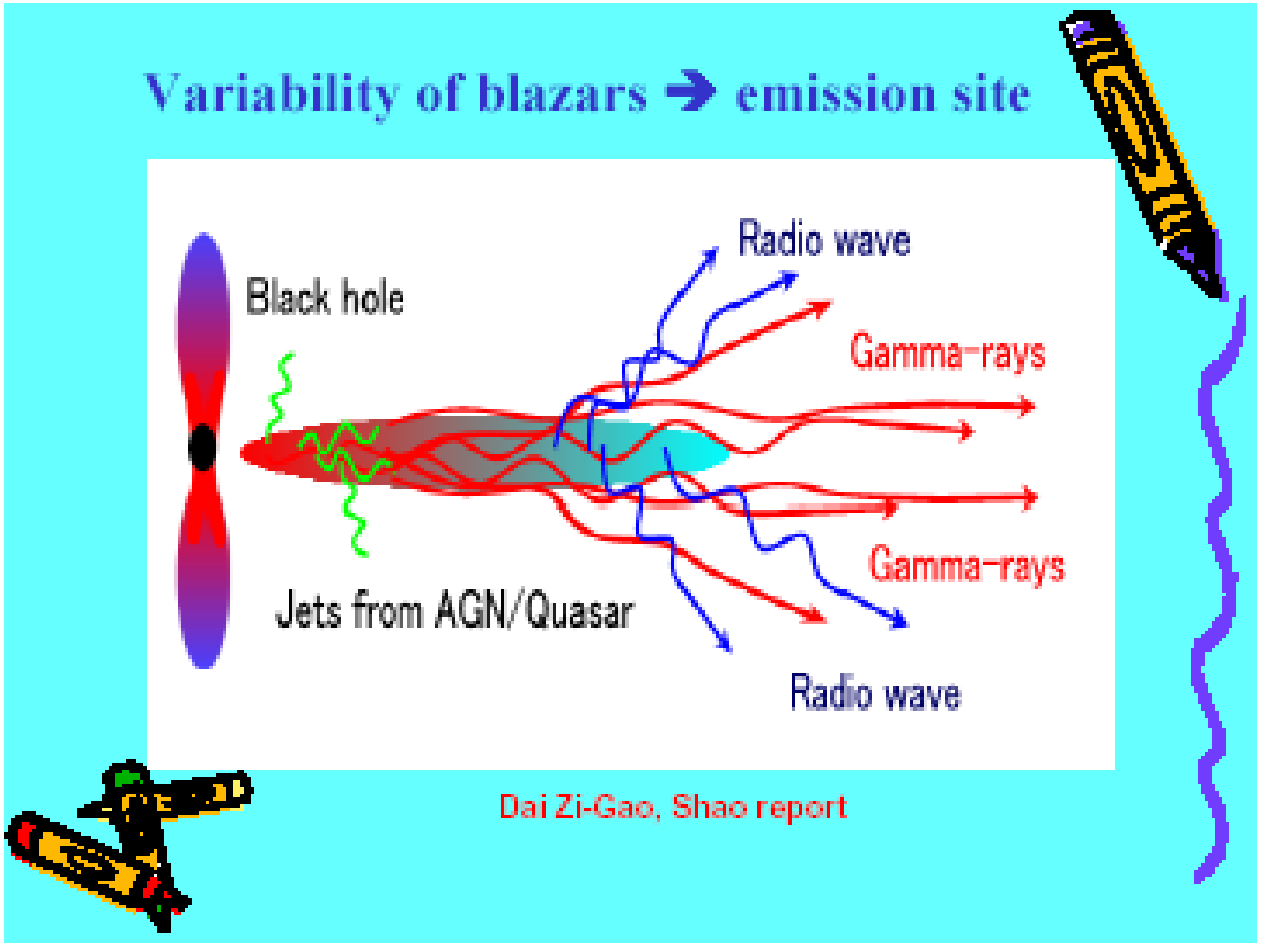
  Delta PA --- beaming indicator[1][2]

- **Gamma-ray & Radio emission correlation**
- **multiF observations of subsample blazar[3]**

1 Hong et al. 1998; 2 Conway&Murphy 1993;

3; Hong et al. in preparation

1.3 Scientific Motivation



2 multiepoch,multifreq. Obs.

- EVN 5 GHz, 28MHz, 4X13min

  1997 Nov. 7

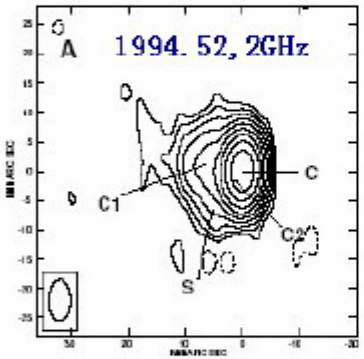
- Archival VLBA

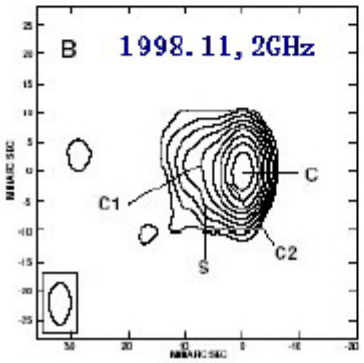
2.3,8.3,24.4,43.1GHz

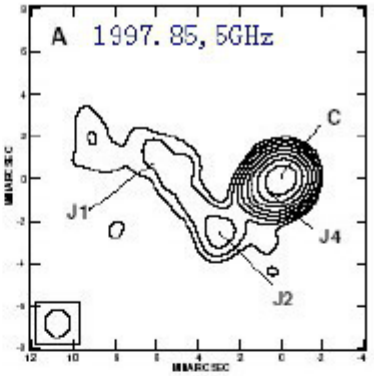
  1994.July – 2002 Dec.

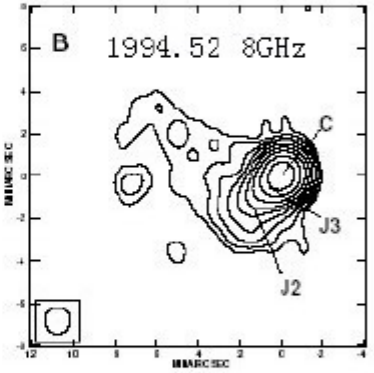
- archival MERLIN 5GHz, 1992 May 16

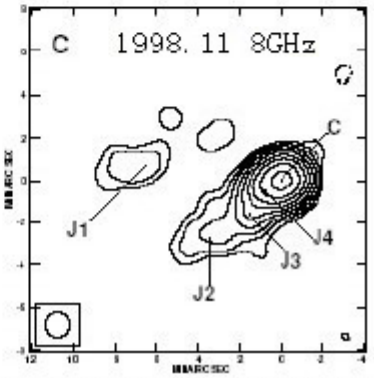
3.1 Image analysis-VLBI

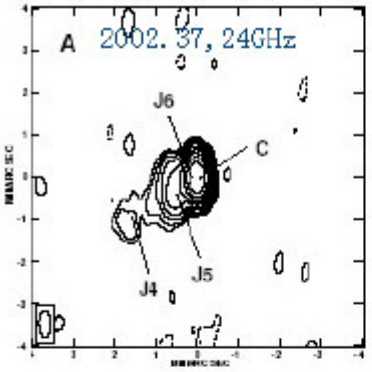

A 1994.52, 2GHz
C
C1
C2
S

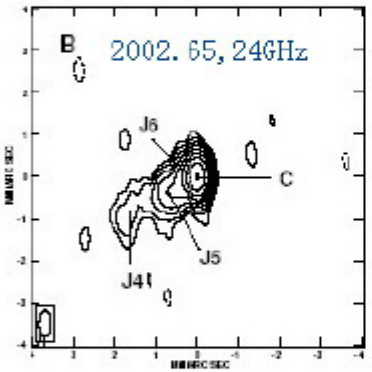

B 1998.11, 2GHz
C
C1
C2
S

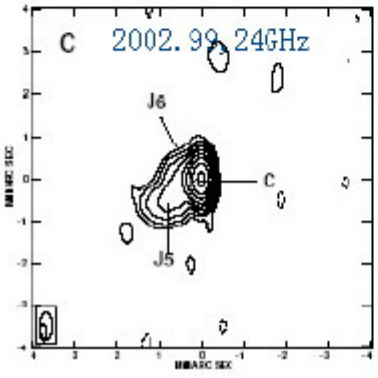

A 1997.85, 5GHz
C
J1
J2
J4

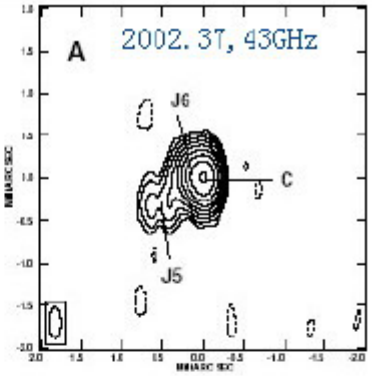

B 1994.52 8GHz
C
J2
J3

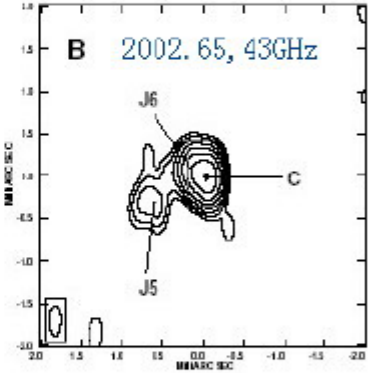

C 1998.11 8GHz
C
J1
J2
J3
J4

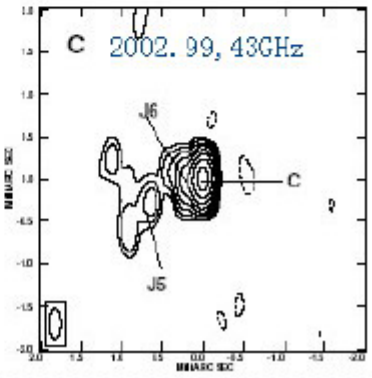

A 2002.37, 24GHz
J6
C
J4
J5

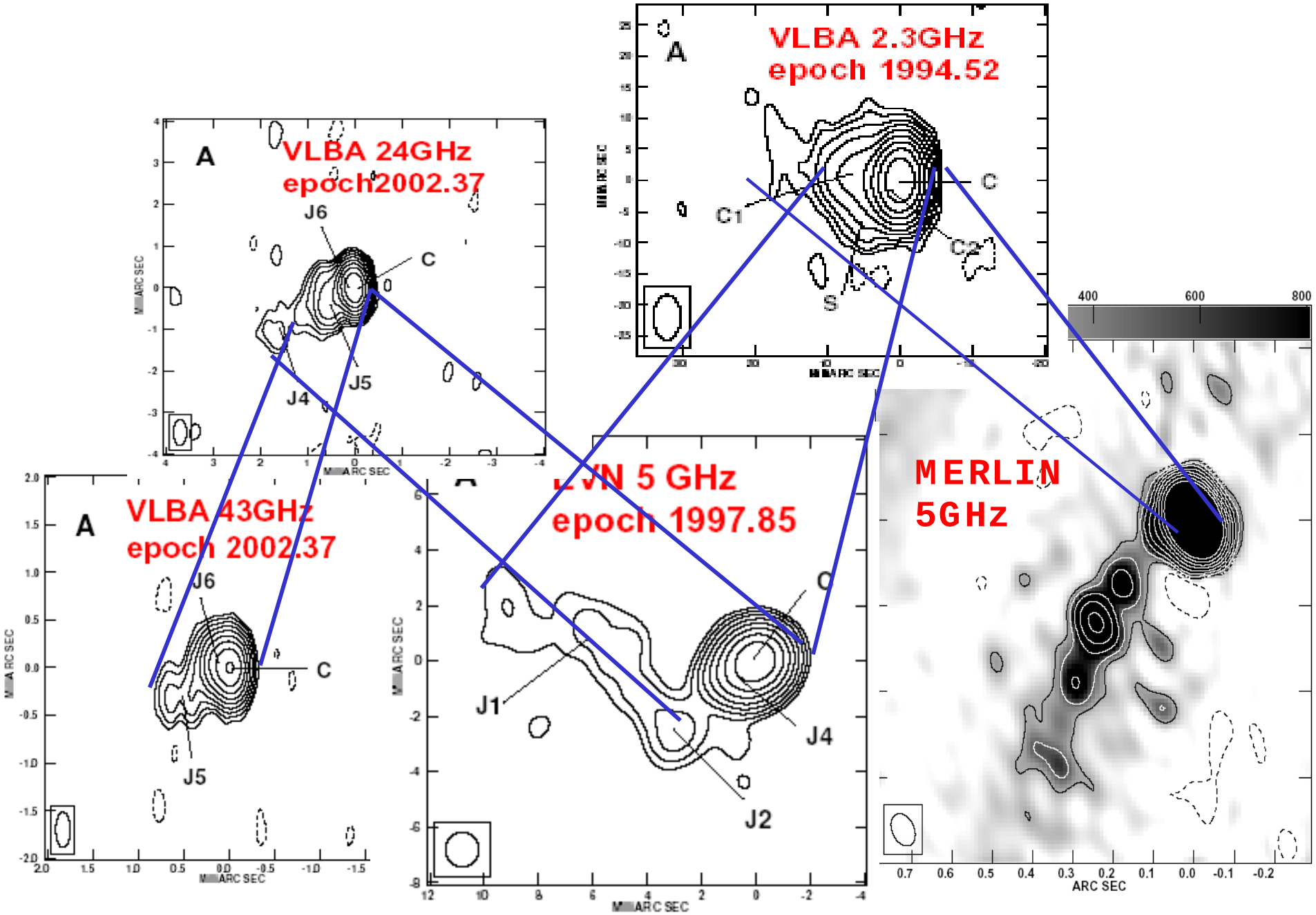

B 2002.65, 24GHz
J6
C
J4
J5

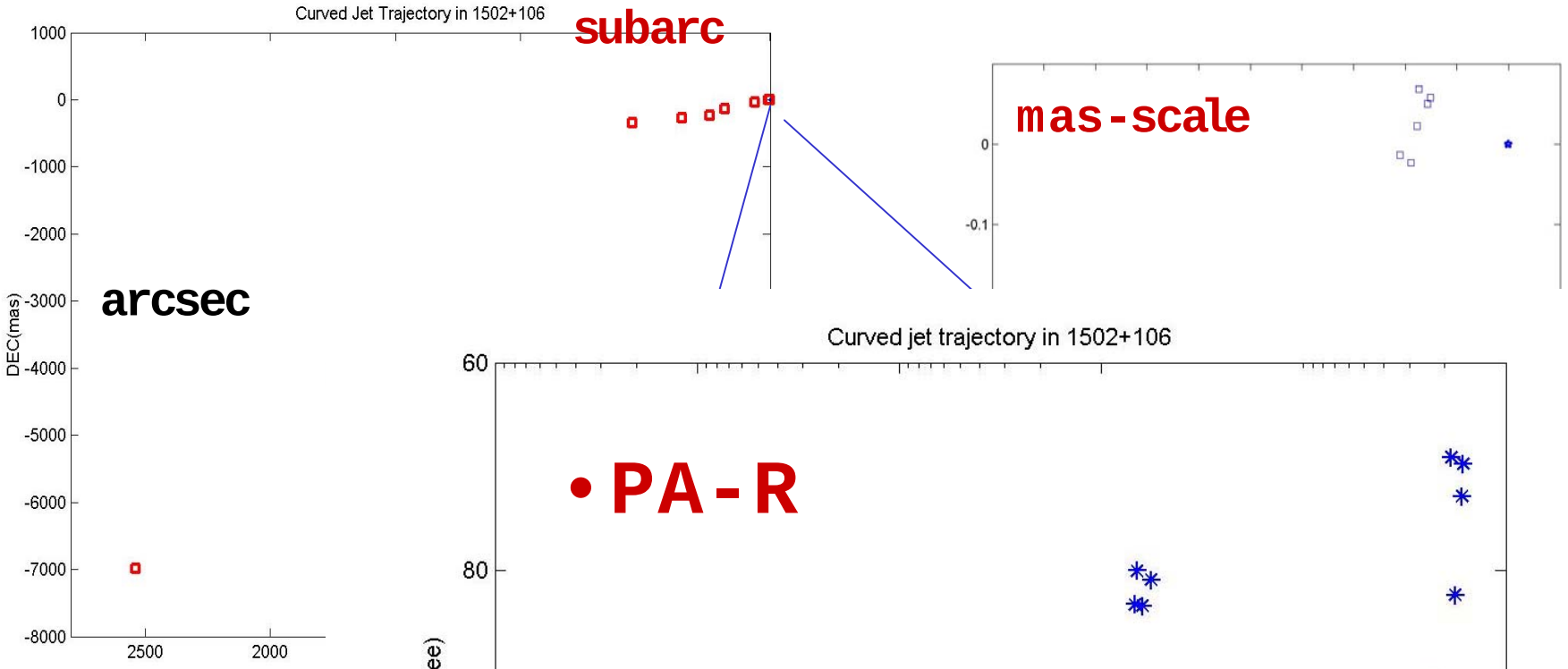

C 2002.99, 24GHz
J6
C
J5


A 2002.37, 43GHz
J6
C
J5


B 2002.65, 43GHz
J6
C
J5

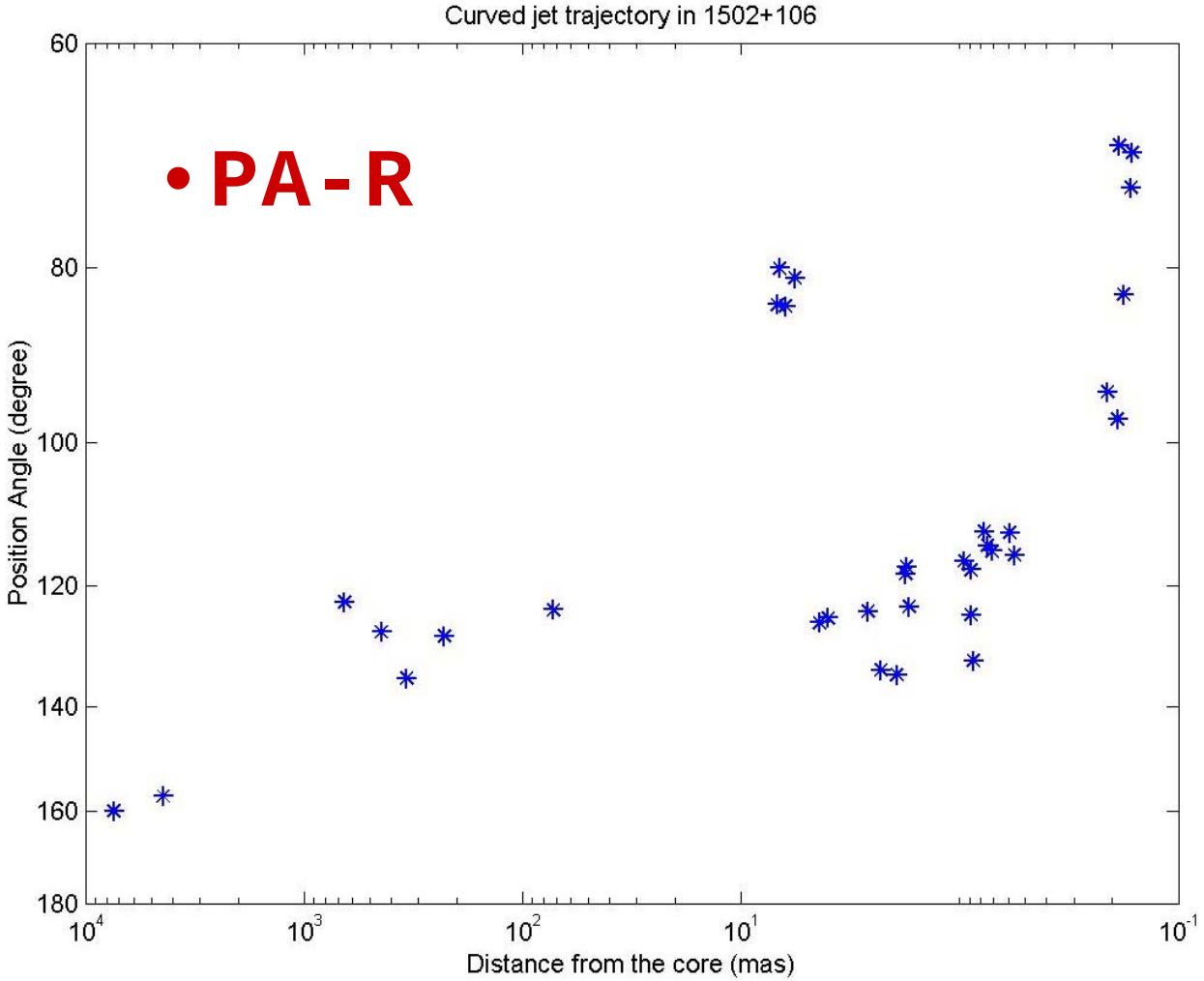

C 2002.99, 43GHz
J6
C
J5

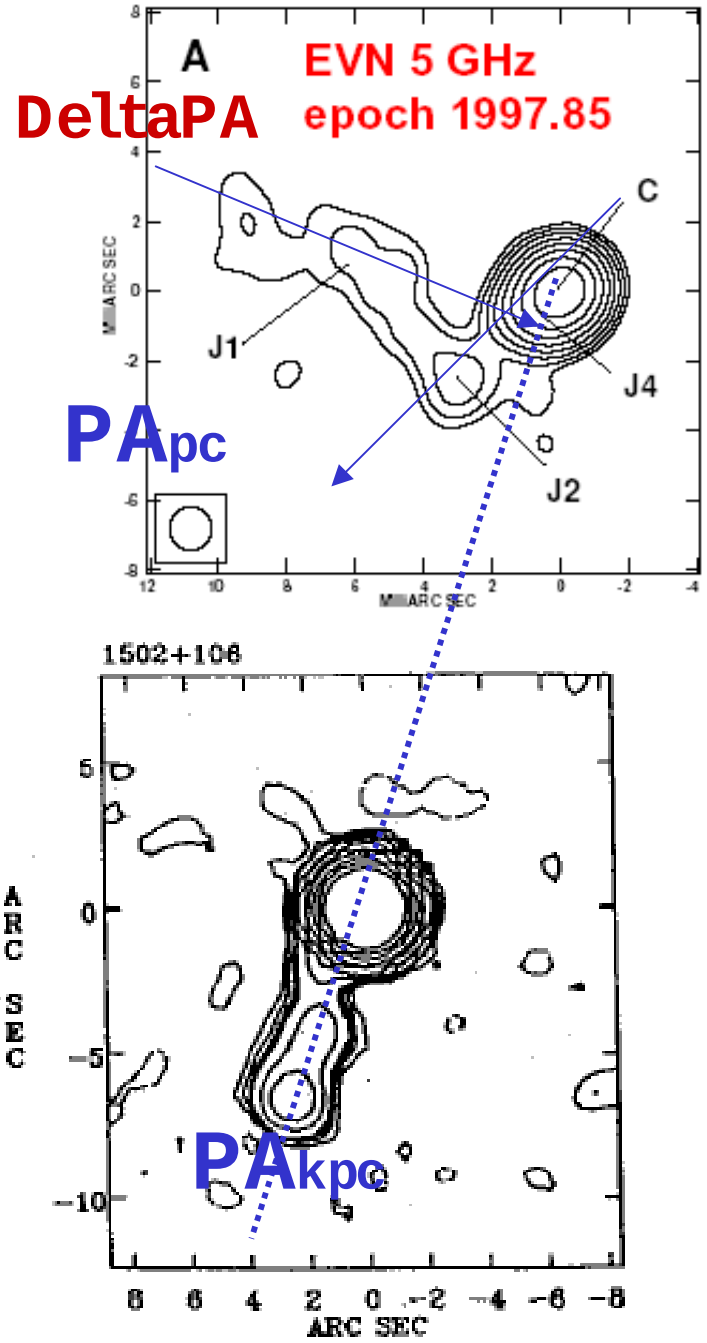

VLBA 2.3GHz
epoch 1994.52
A
C
C1
C2
S
VLBA 24GHz
epoch2002.37
J6
C
J5
J4
VLBA 43GHz
epoch 2002.37
J6
C
J5
EVN 5 GHz
epoch 1997.85
C
J1
J4
J2
MERLIN
5GHz
400
600
800
MILLIARC SEC
ARC SEC


Curved Jet Trajectory in 1502+106
subarc
mas-scale
arcsec
DEC(mas)
1000
0
-1000
-2000
-3000
-4000
-5000
-6000
-7000
-8000
2500
2000
0
-0.1

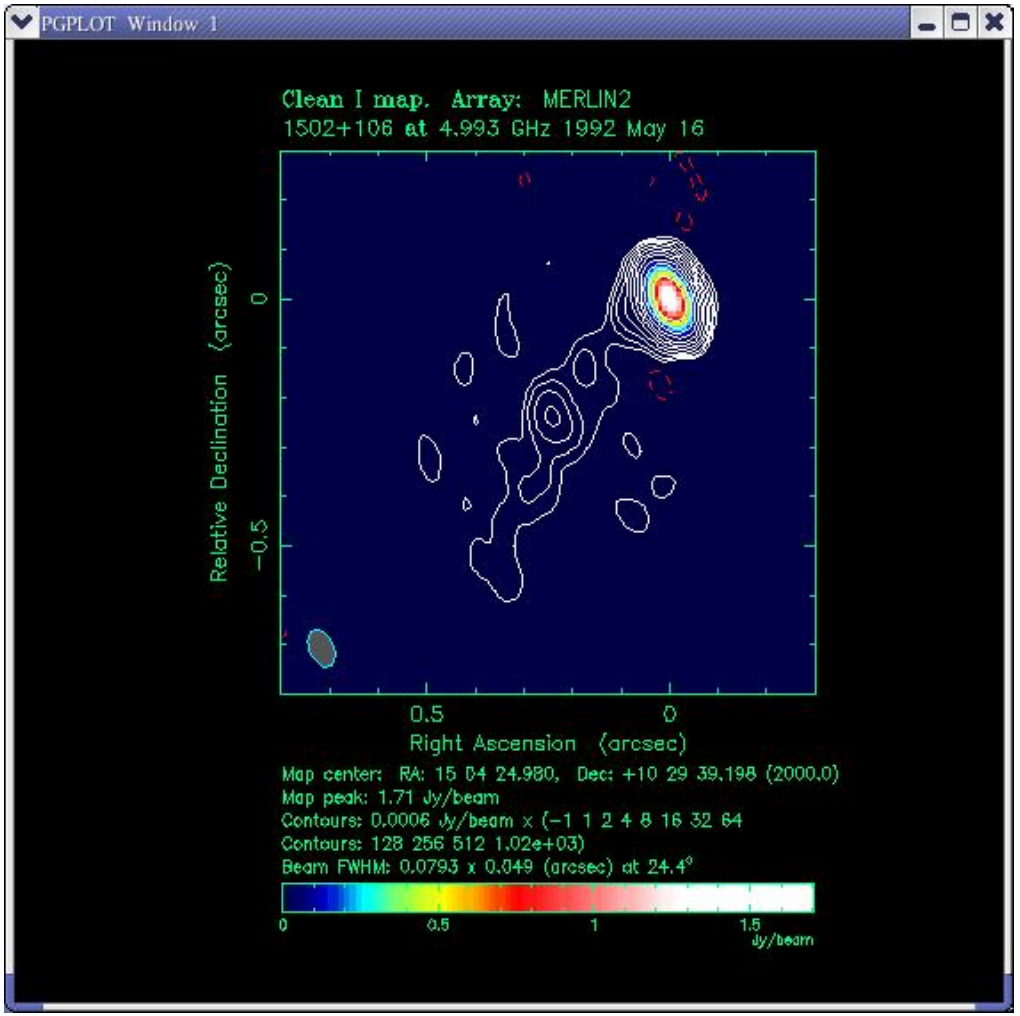
RA-DEC

• PA-R


Curved jet trajectory in 1502+106
Position Angle (degree)
60
80
100
120
140
160
180
10^4
10^3
10^2
10^1
10^{-1}
Distance from the core (mas)



- Alignment on pc and kpc scales



4.1 Beaming indicators- R

- Core-domination R:

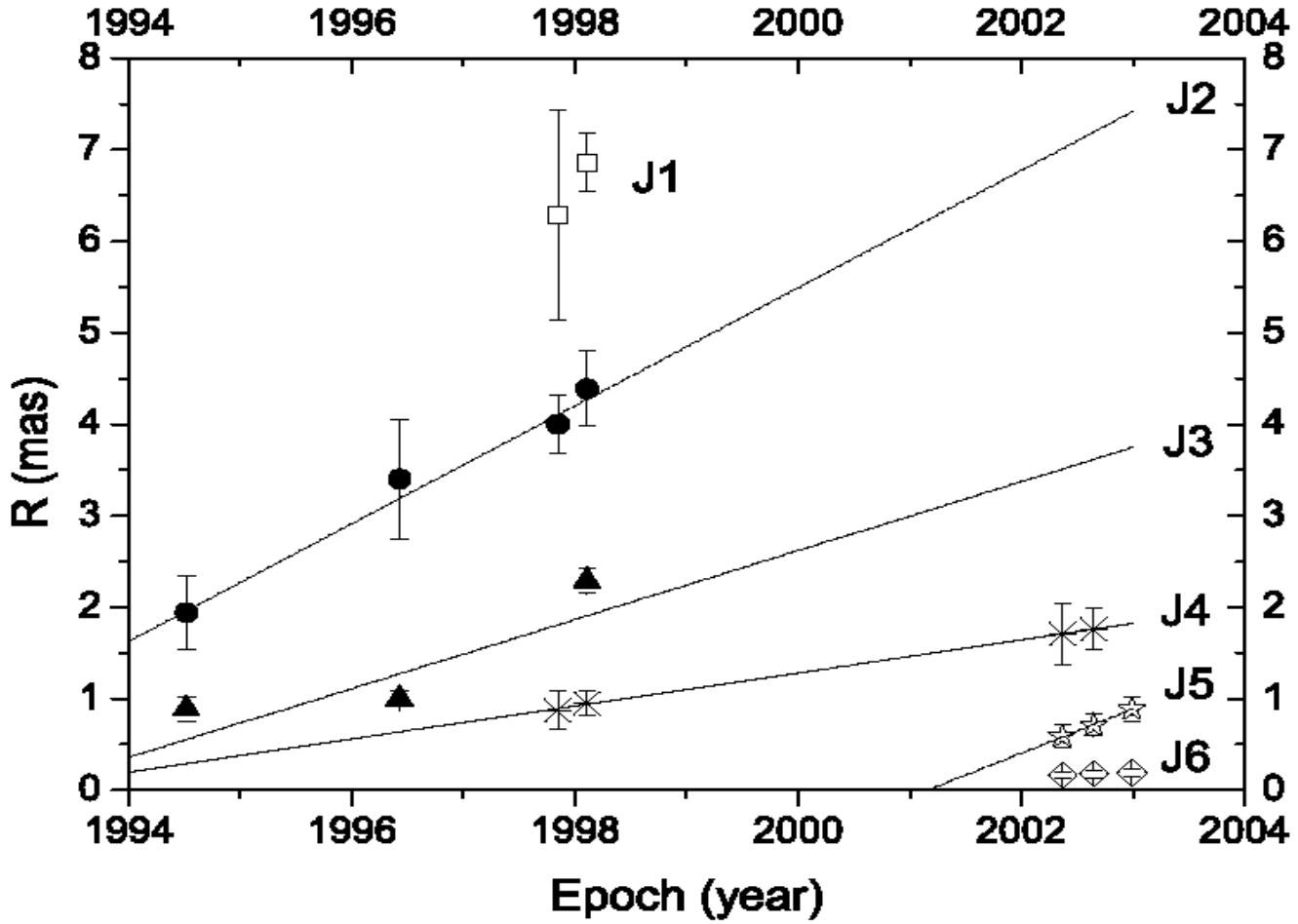
99%(VLA map) 98%(MERLIN map)

4.2 Beaming Indicator- VLBI core T_b

- Spectral index -0.31<a<0.03
- Brightness Temperature

  (2.0+/-0.5)X10^11 K
- “Core” in low f. = “core+inner jet”
- jet expansion steepen spectrum, lower T_b

4.3 Beaming Indicator-apparent motion

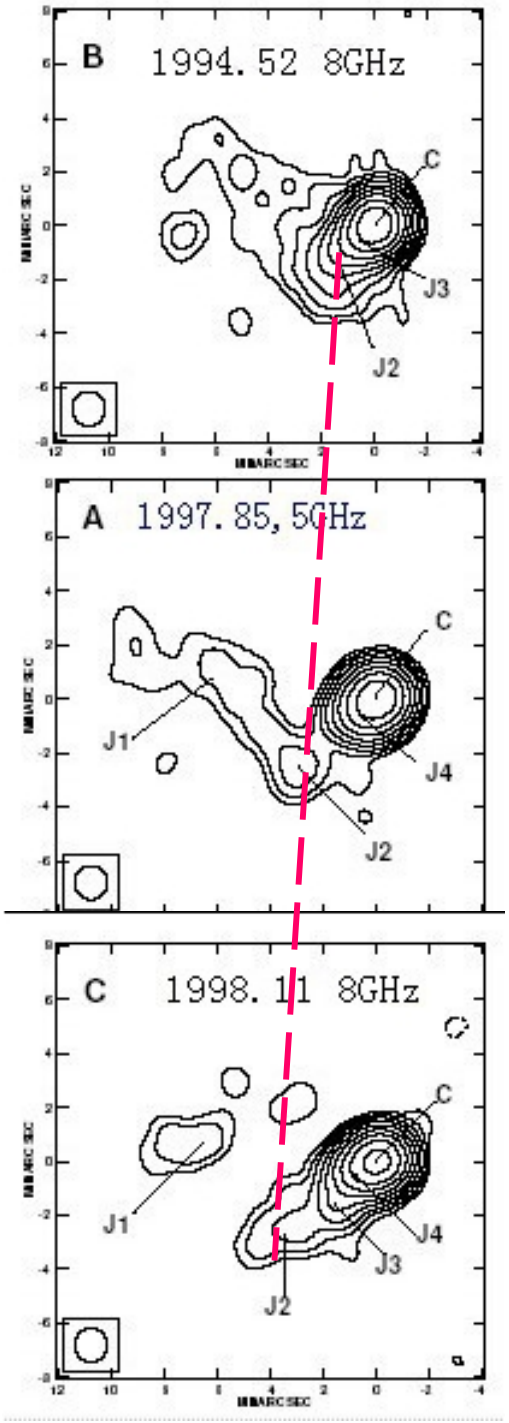


J2:24.2h^{-1}c

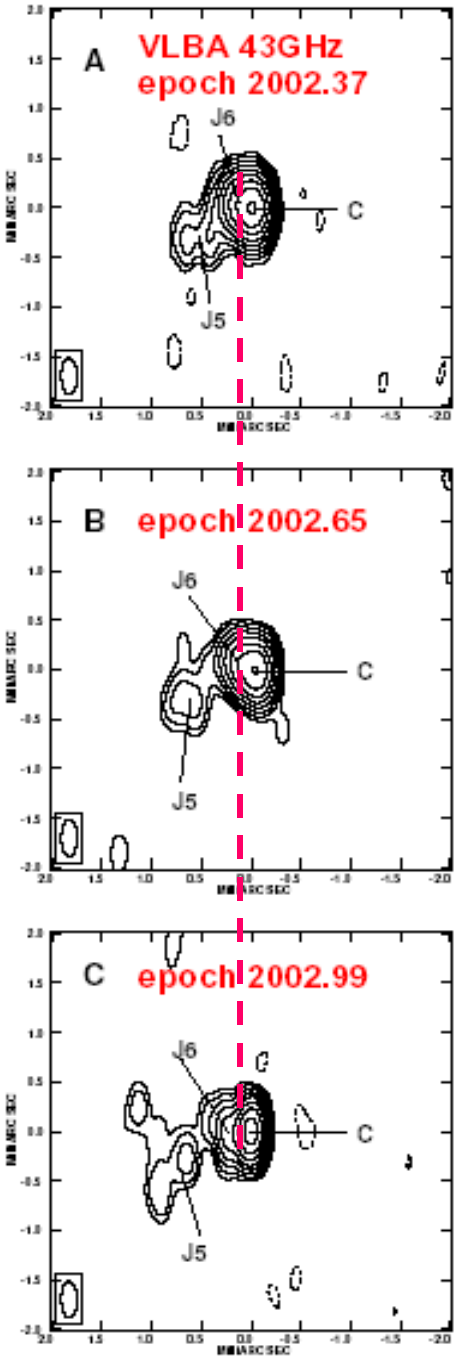
J3:14.3h^{-1}c

J4:6.8 h^{-1}c

J2


B 1994.52 8GHz
C
J3
J2
A 1997.85,5GHz
C
J1
J4
J2
C 1998.11 8GHz
C
J1
J4
J3
J2

J6


A VLBA 43GHz
epoch 2002.37
J6
C
J5
B epoch 2002.65
J6
C
J5
C epoch 2002.99
J6
C
J5

5 Summary

- wiggling jet ridge line on mas to arcse cscale

  ---- Helix projection? Other instable jet dynamics

  =>Further : helical motion;

- Apparent radio morphology and extremely relativistic beaming in parsec jet (T_b,β,…)

  --- more like gamma-ray loud population

  => further gamma-ray identification

Thank you!