The evolution of the nuclear structure of 3C84 at sub-mas resolution

Gabriele Giovannini (IRA/INAF and Bologna University)

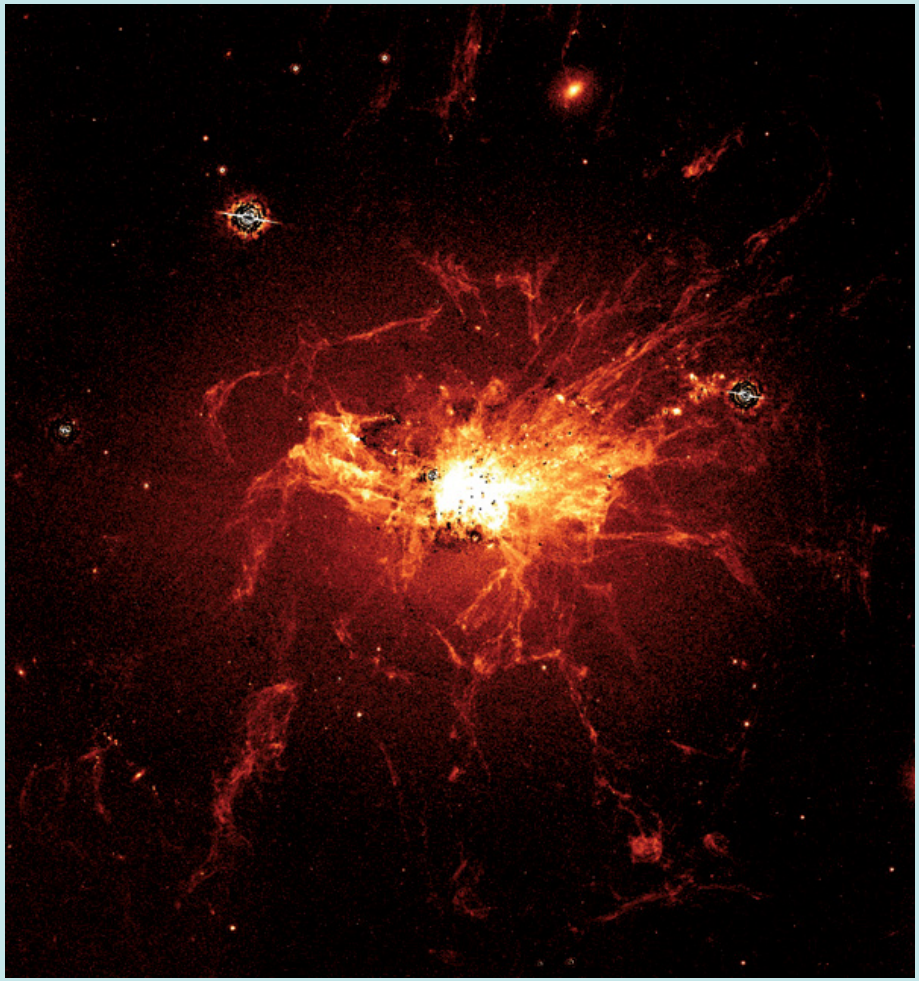
T. Savolainen, M.Orienti, G.Bruni, F. D'Ammando, M.Giroletti, K.Hada, M.Honma, M.Kino, Y.Y.Kovalev, T.P. Krichbaum, A.Lobanov, H.Nagai, B.W.Sohn, K.V.Sokolovsky, J.A.Zensus, et al.

3C 84

Nearby radio source (z = 0.0176)

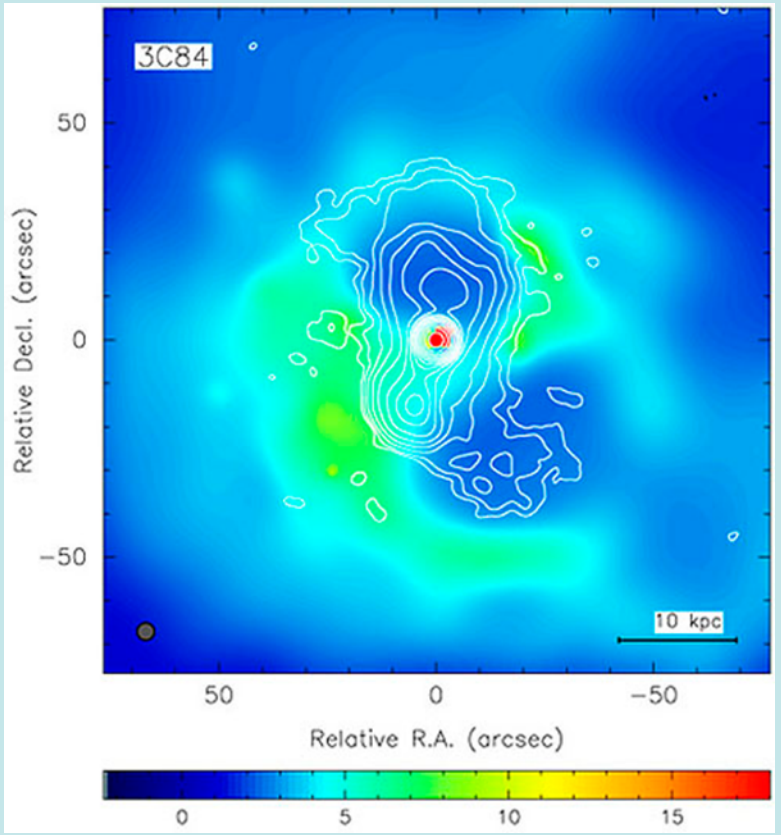
Giant cD galaxy in the centre of the prototypical **cooling flow**
Perseus cluster

Radio lobes fill the X-ray cavities

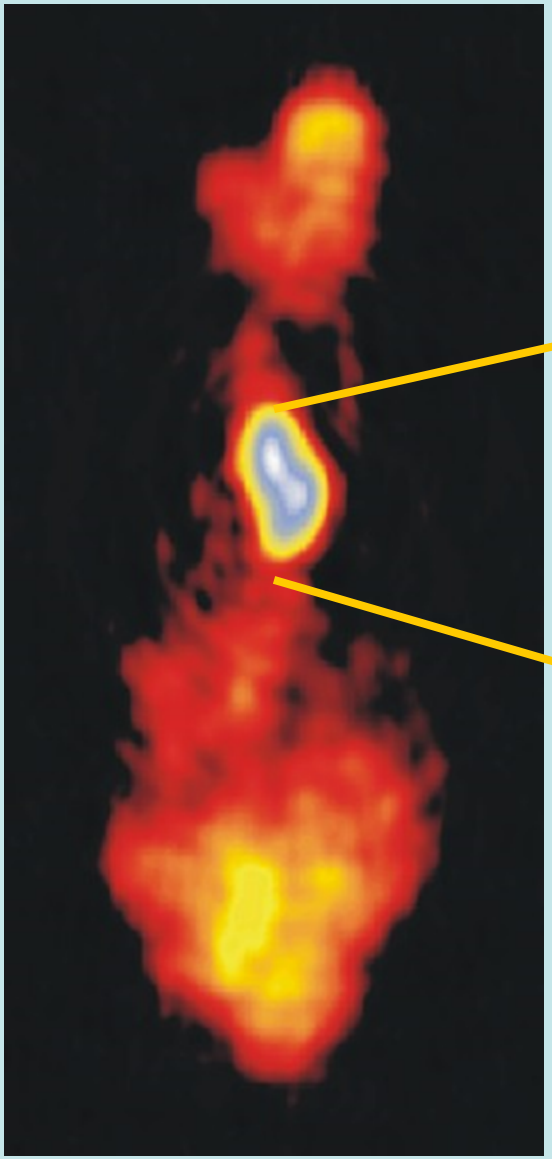


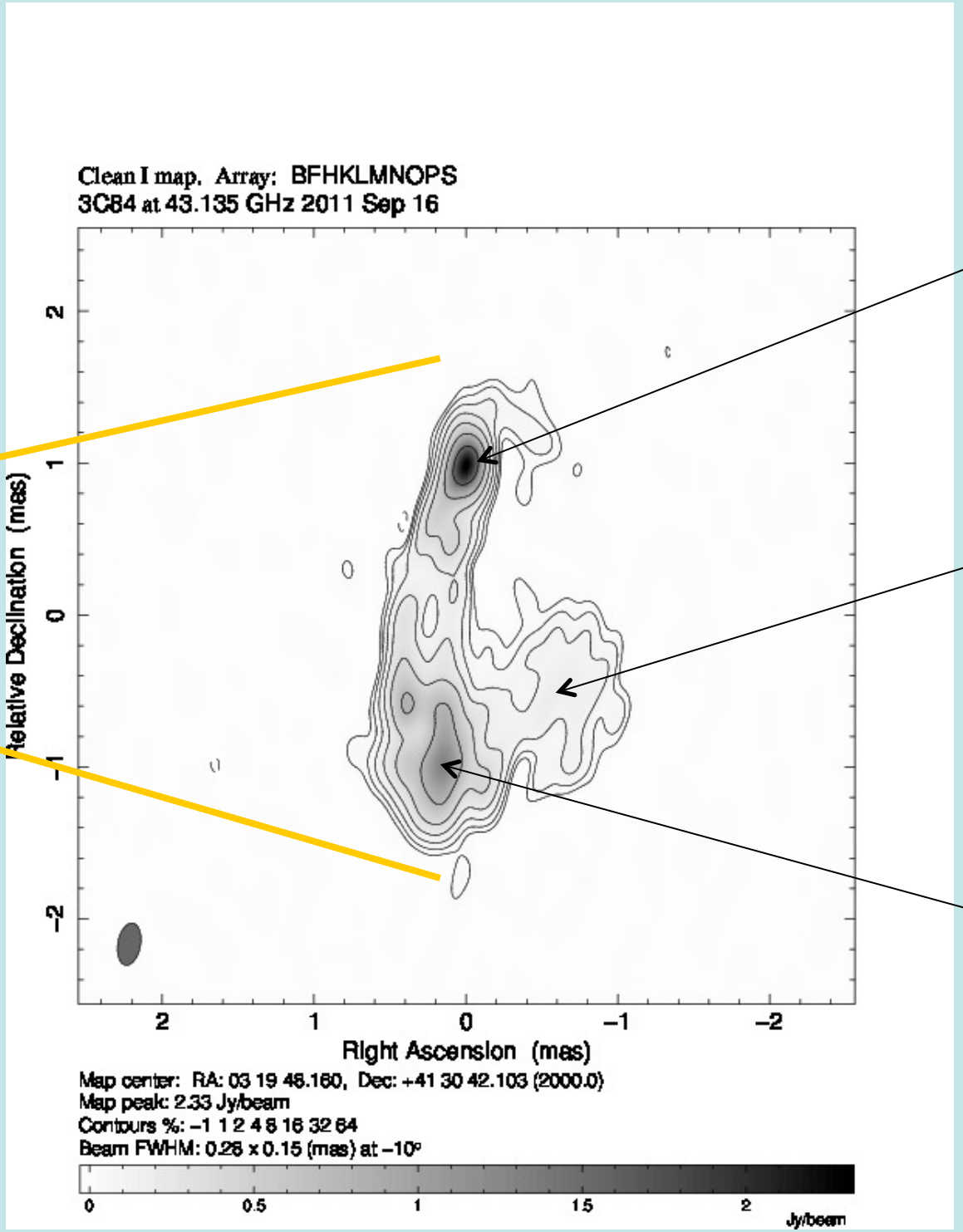
HST image of NGC1275 – red filter + H alpha line (Fabian et al. 2008)

Chandra+VLA



10^3 R_s = 0.22 mas





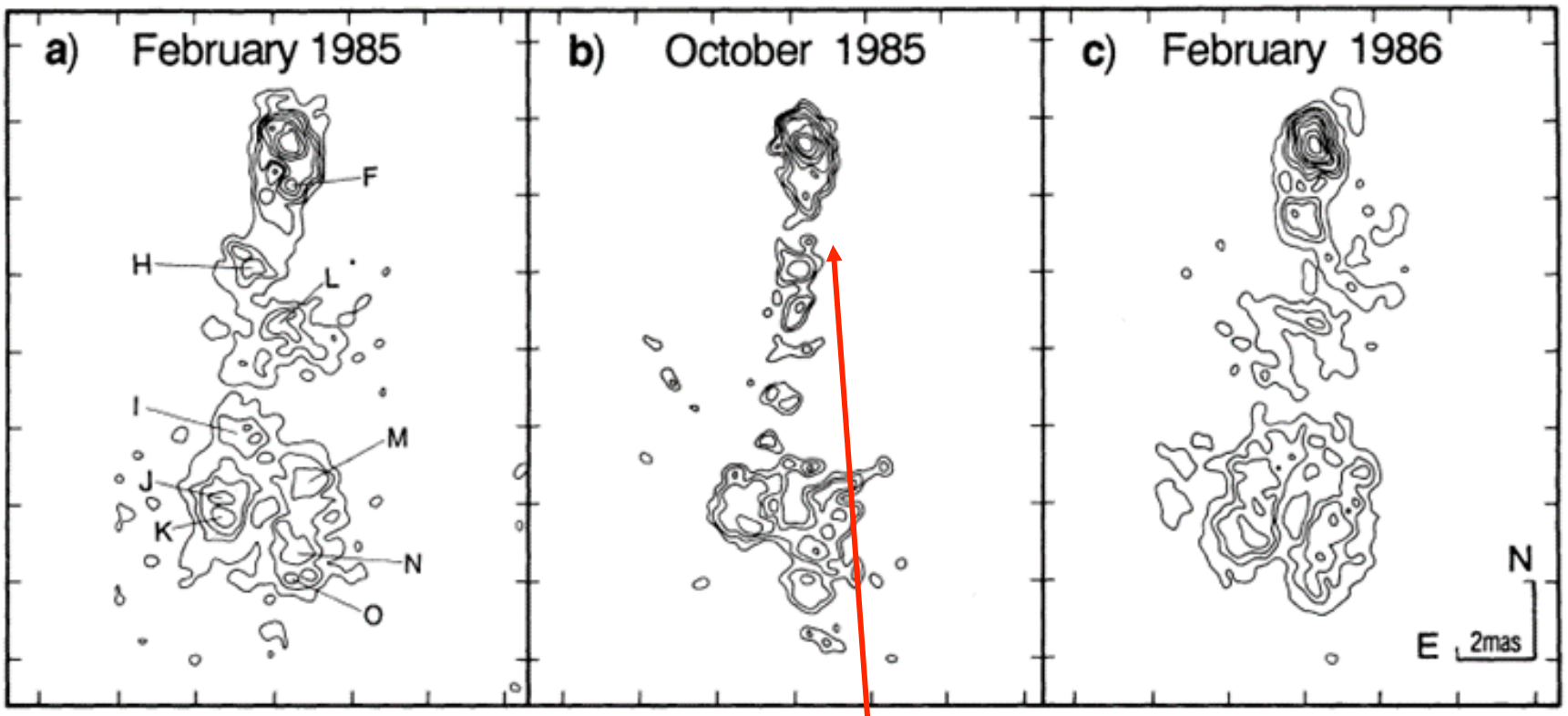
Core C1

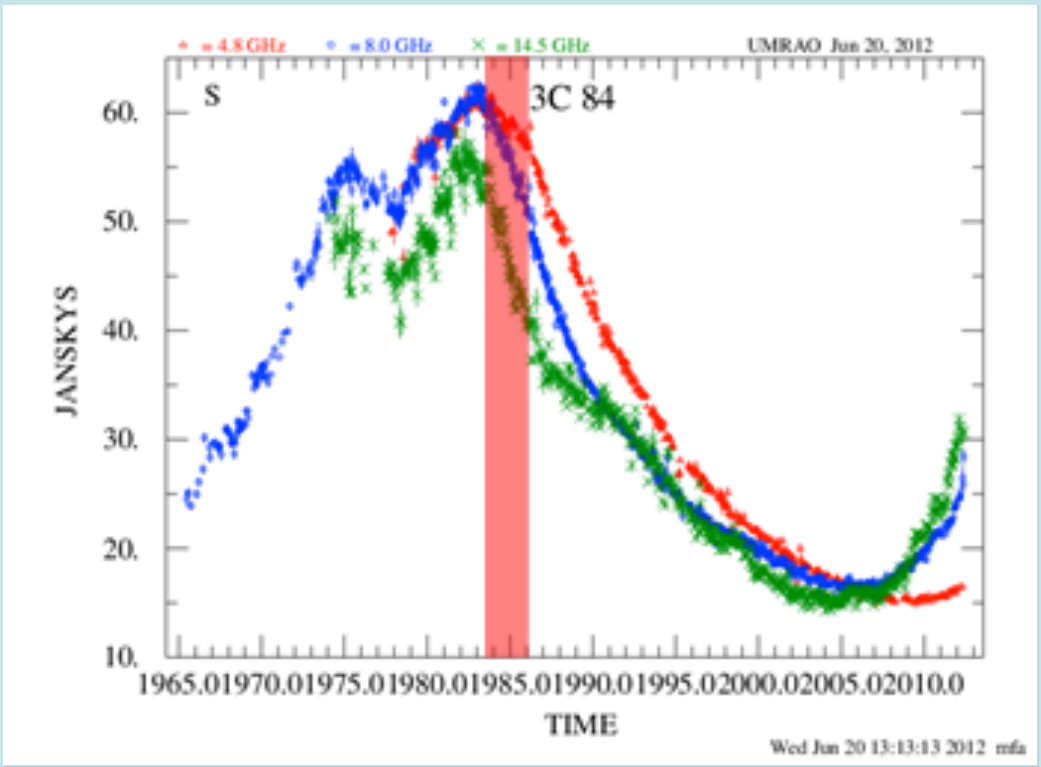
C2

C3

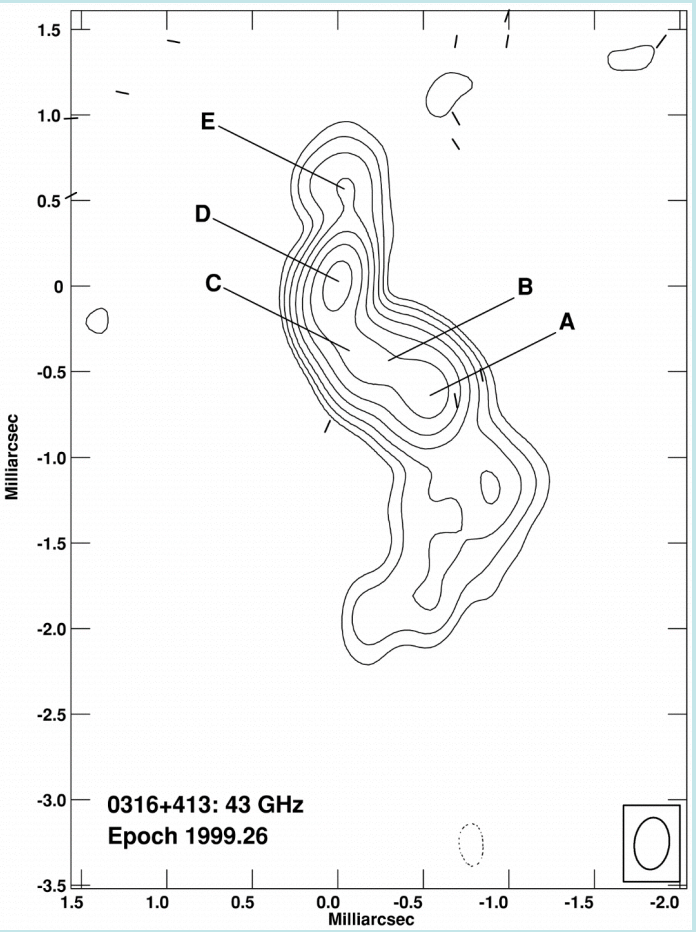
4.5 10^3 R_s/mas

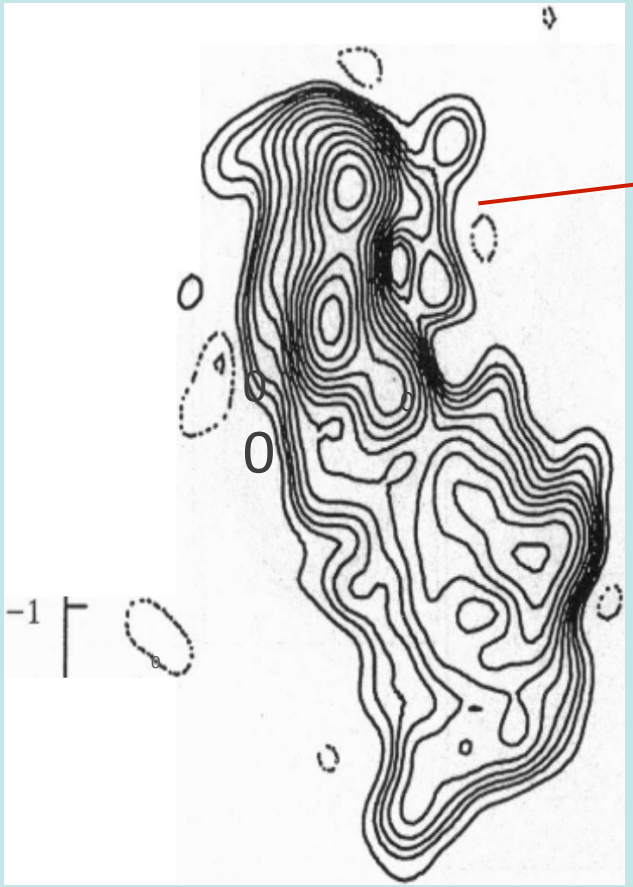
1985


a) February 1985
b) October 1985
c) February 1986
F
H
L
I
M
J
K
N
O
N
E
2mas


= 4.8 GHz
= 8.0 GHz
= 14.5 GHz
UMRAO Jun 20, 2012
S
3C 84
60.
50.
40.
30.
20.
10.
JANSKYS
1965.0 1970.0 1975.0 1980.0 1985.0 1990.0 1995.0 2000.0 2005.0 2010.0
TIME
Wed Jun 20 13:13:13 2012 mfa


C1
C2

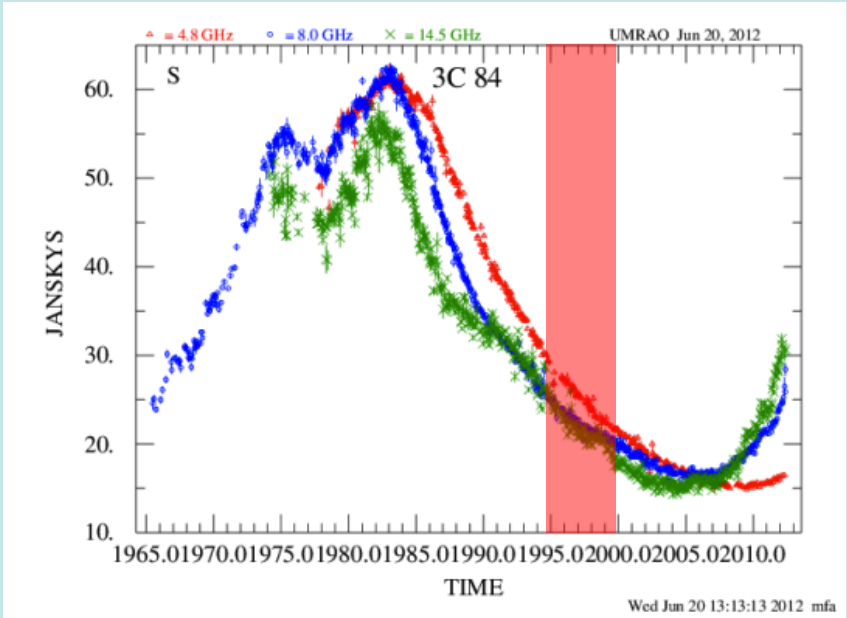




Core C1

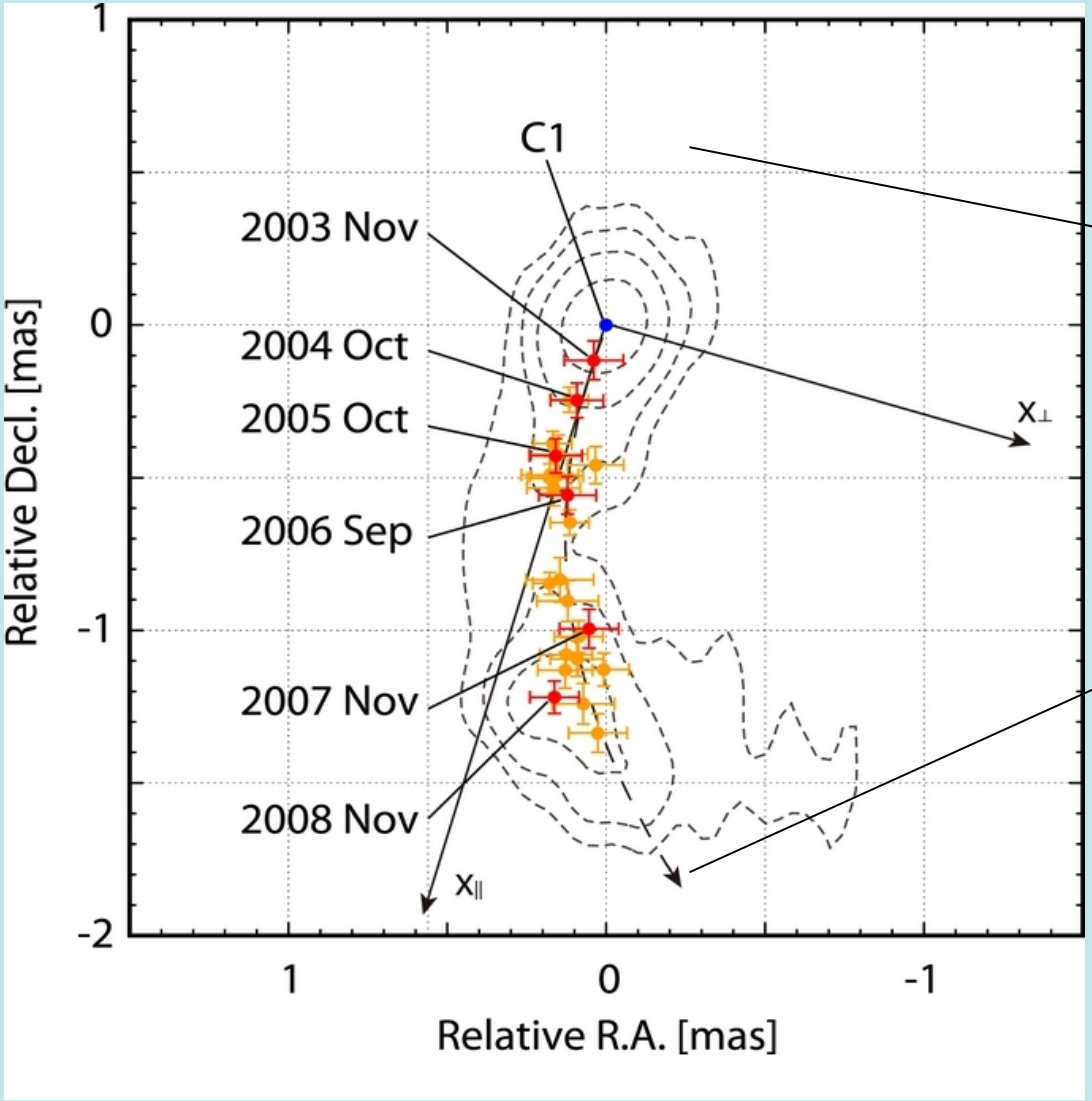
C2

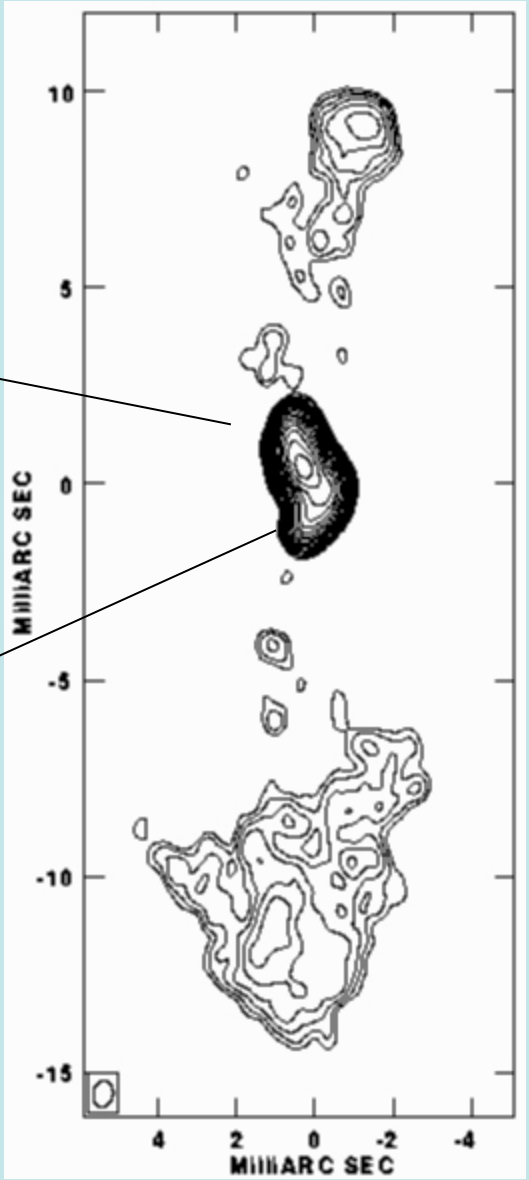
Romney et al. 1995



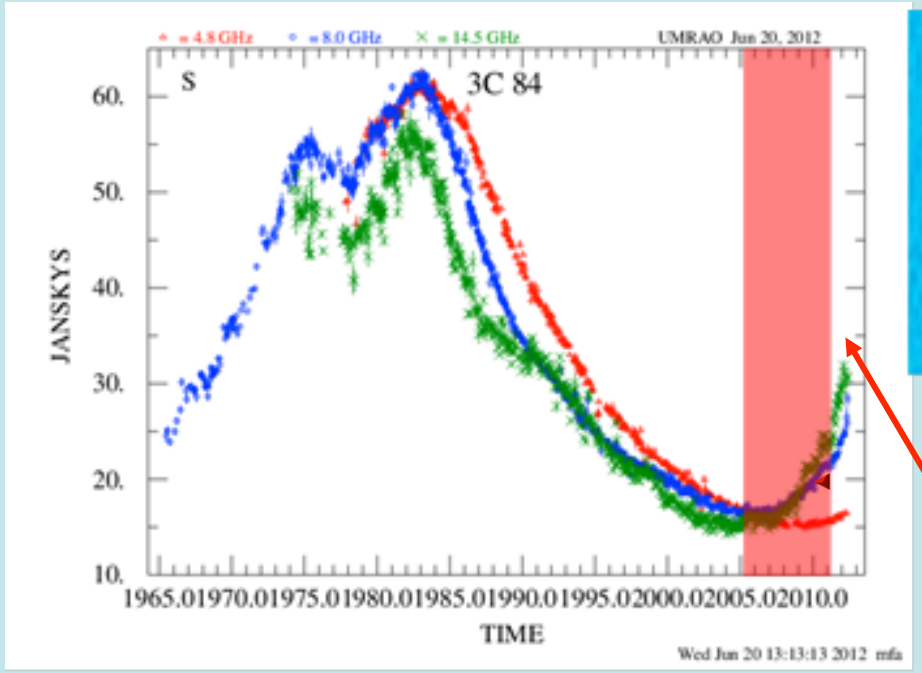
1995

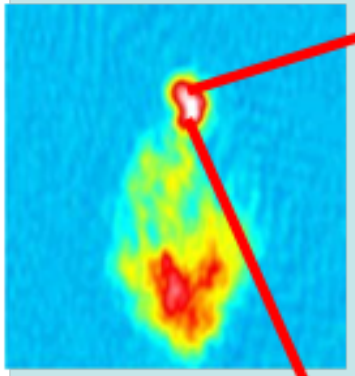
VLBA at 43 GHz in the period of 2002–2008. New component C3
Kenta Suzuki et al. 2012

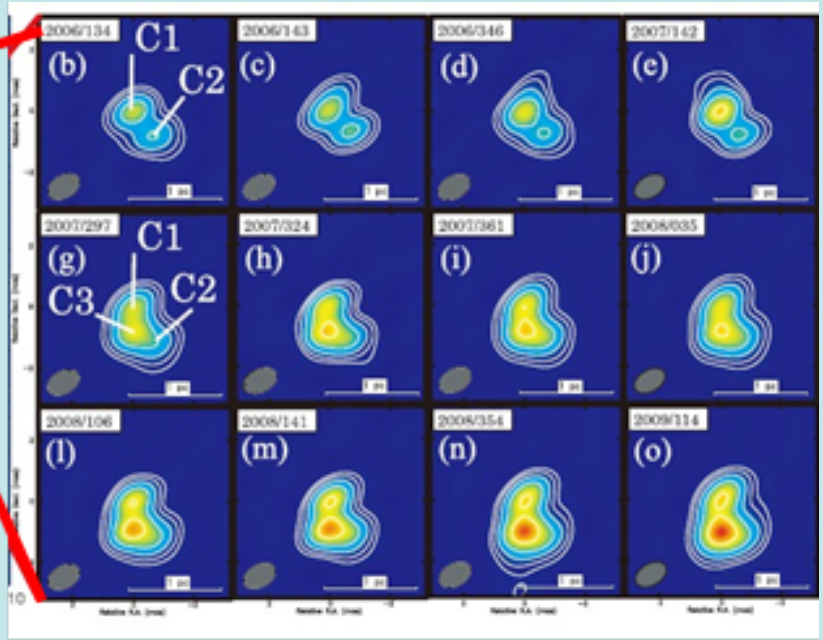




Peak position of C3



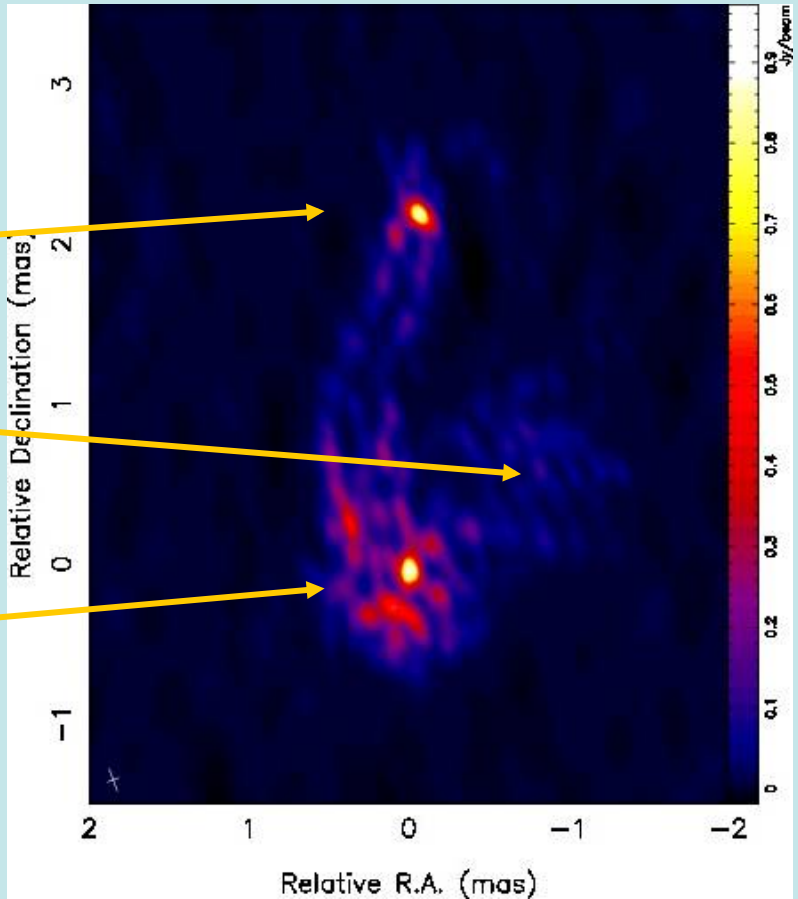




C1

C2

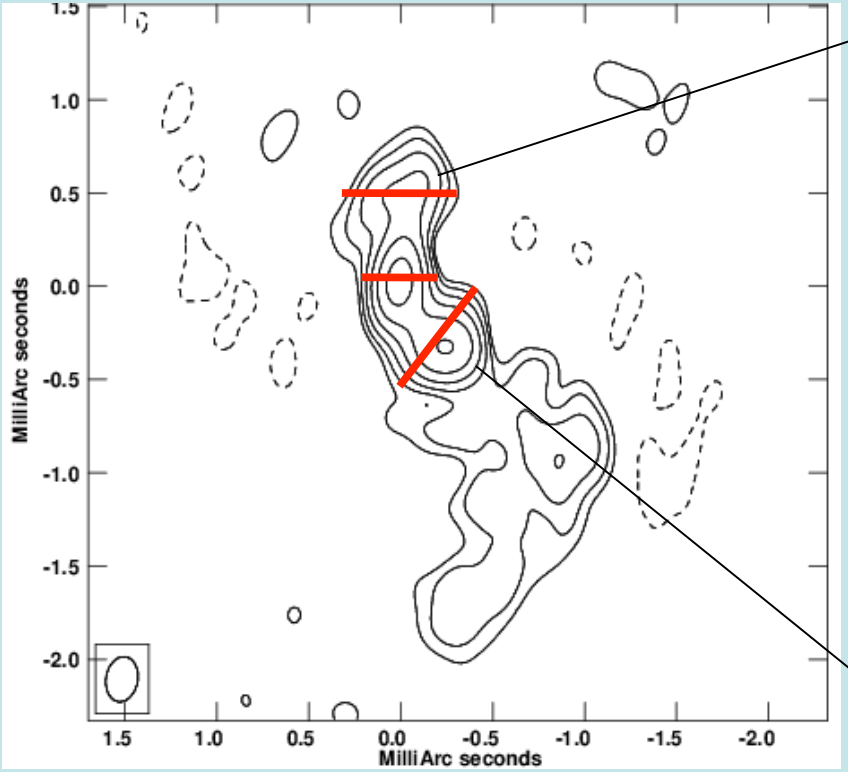
C3

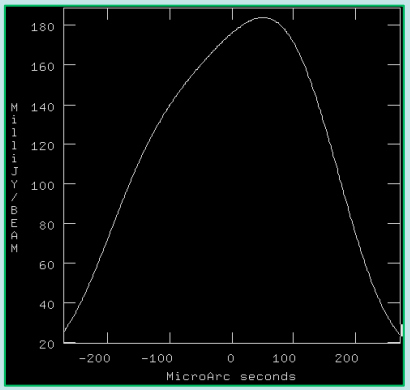


2013-Sept. 21

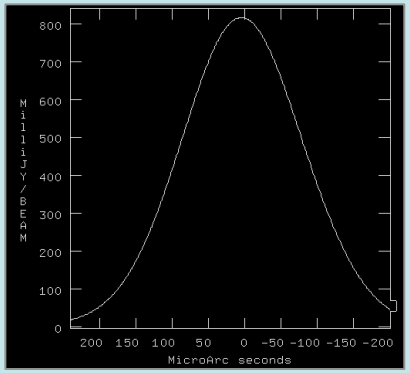
The jet structure: 1995

43-GHz VLBA image

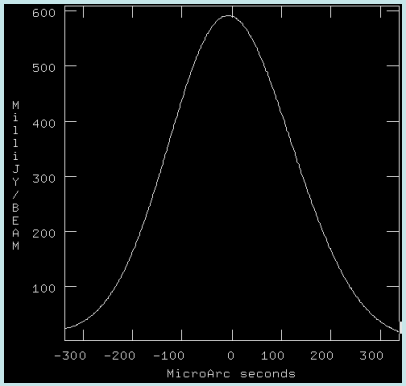




Peak ~ 0.2 Jy/b
D ~ 0.5 mas



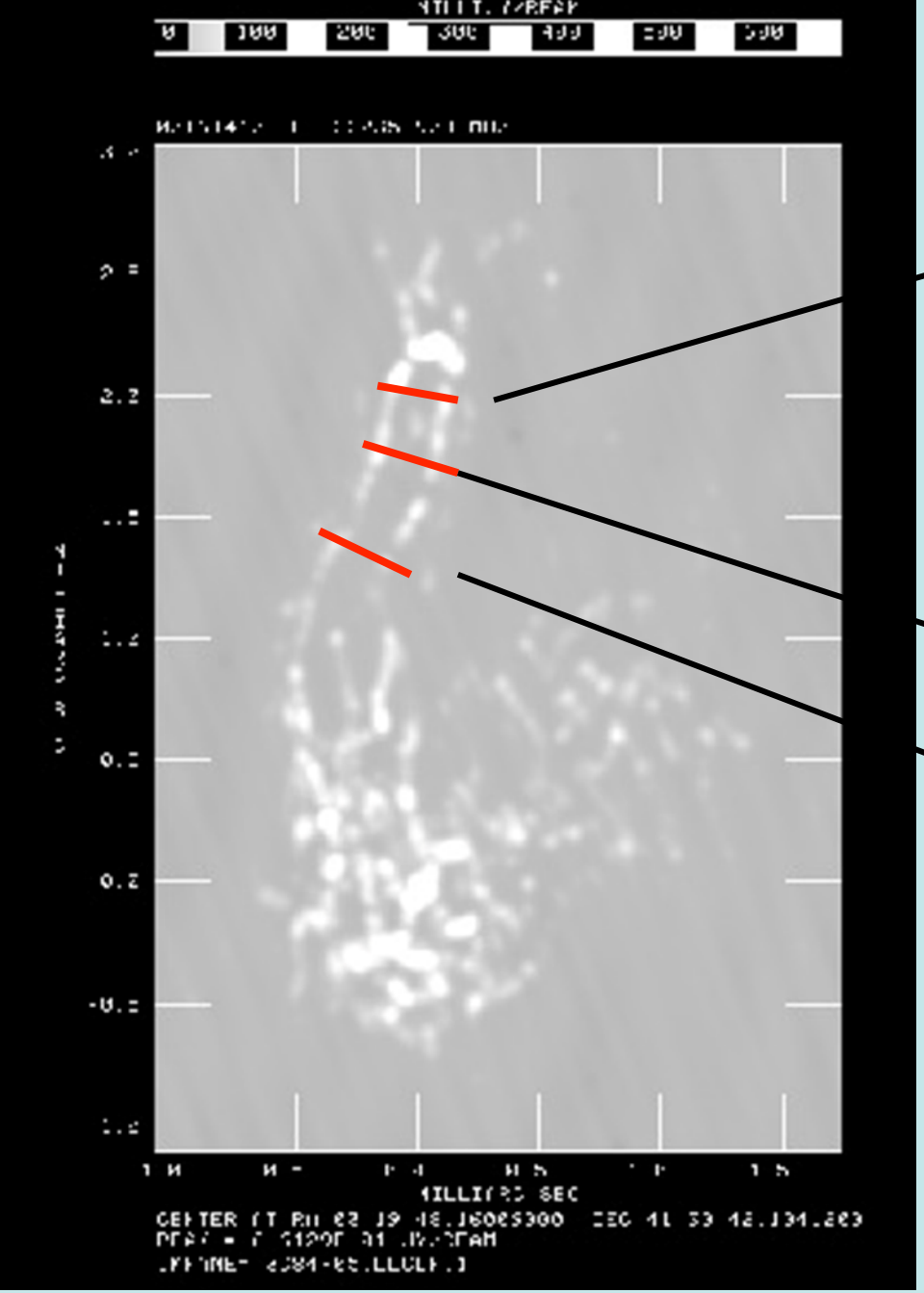
Peak ~ 0.8 Jy/b
D ~ 0.5 mas

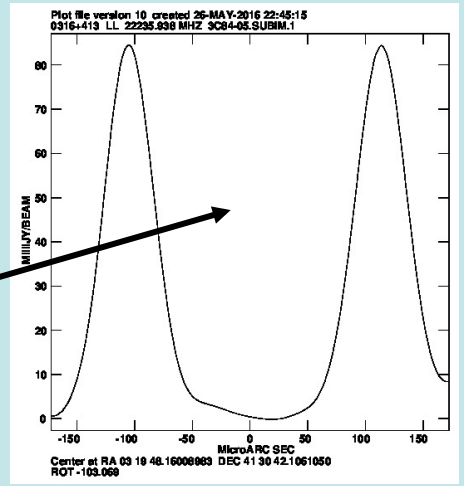


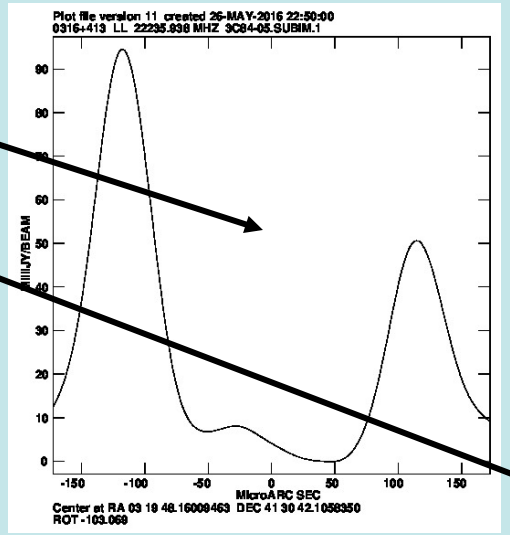
Peak =0.6 Jy/b
D ~ 0.4 mas

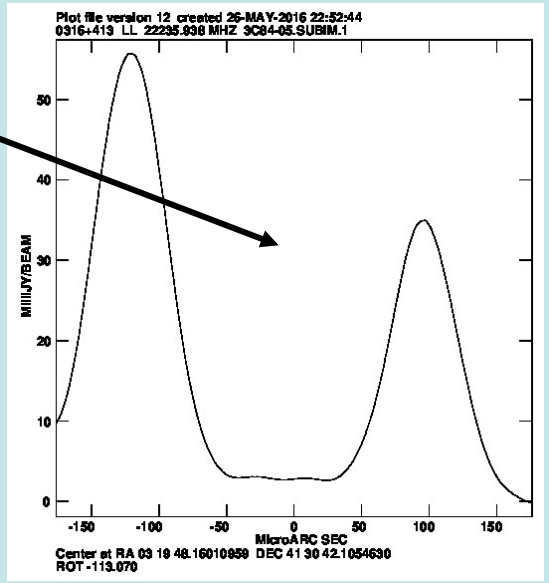
p ~ 0.8 Jy/b; f.c. ~ 18 mJy/b

FWHM ~ 0.24 x 0.17 mas







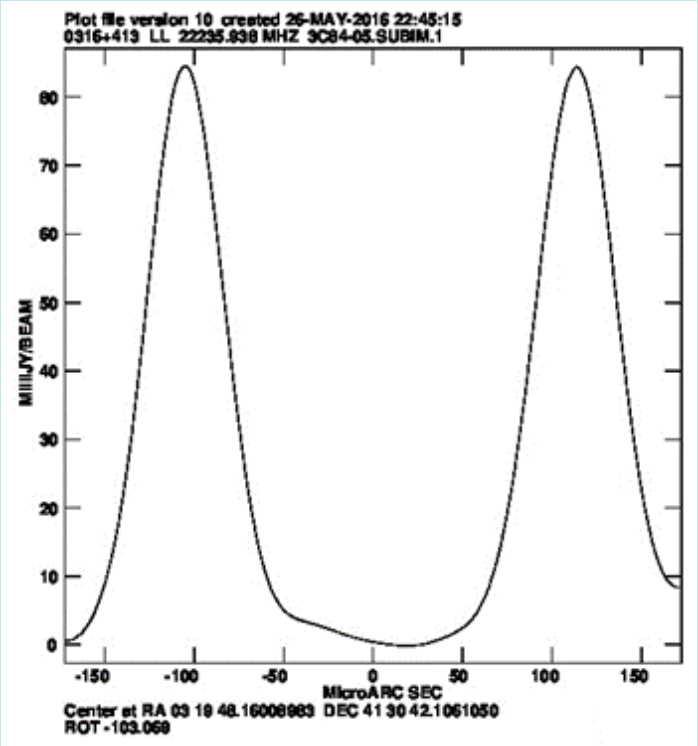


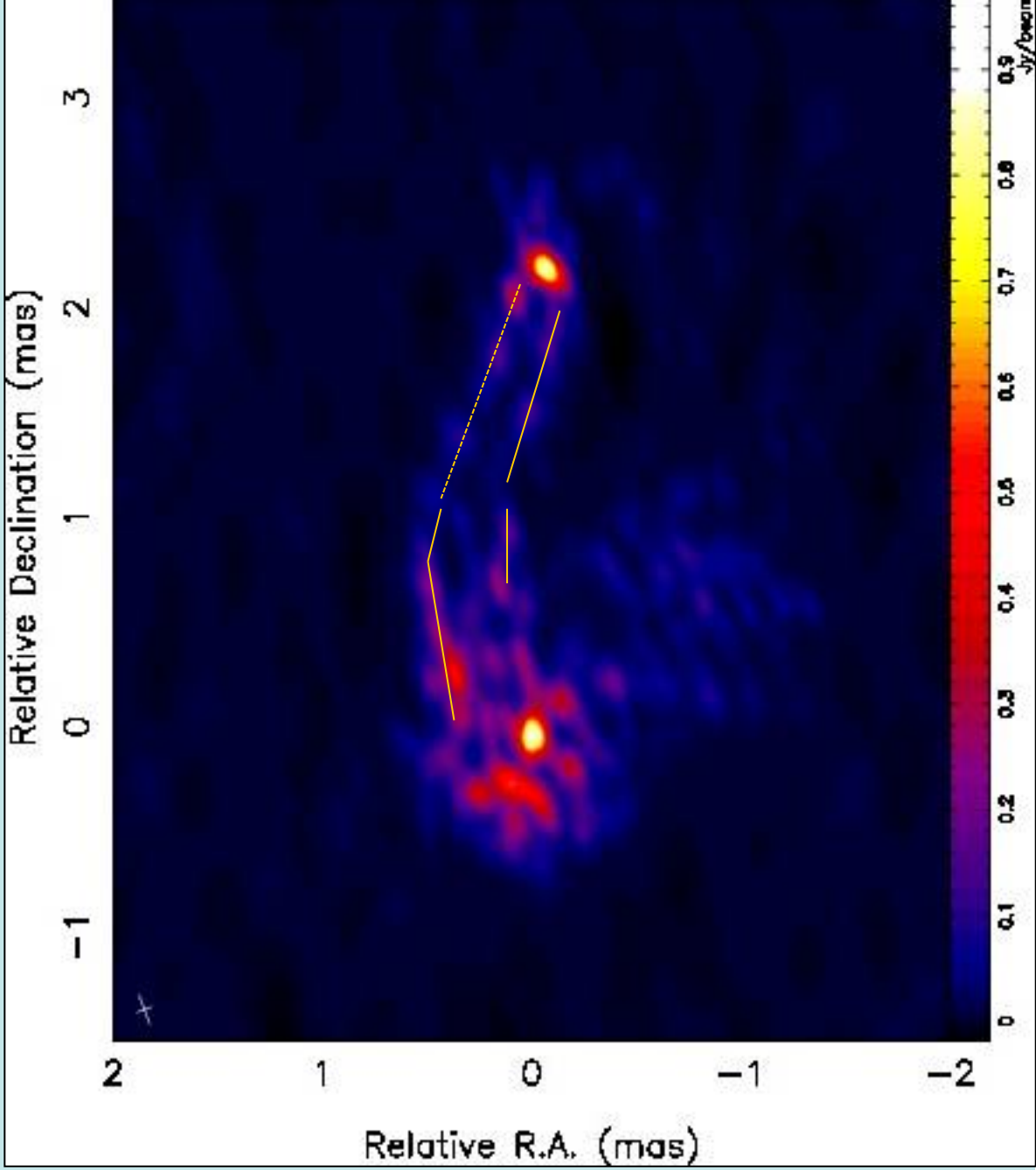
The jet structure Sept. 2013

Shear (external jet region) collimated,
≈ unresolved: deconvolved size is < 15 microarcsec at the beginning and about 40 ± 8 microarcsec at 1 mas

Hollow jet or velocity structure?
Brightness ratio between the shear and the spine is about a factor 20.
Assuming intrinsic same brightness with θ 18 degree

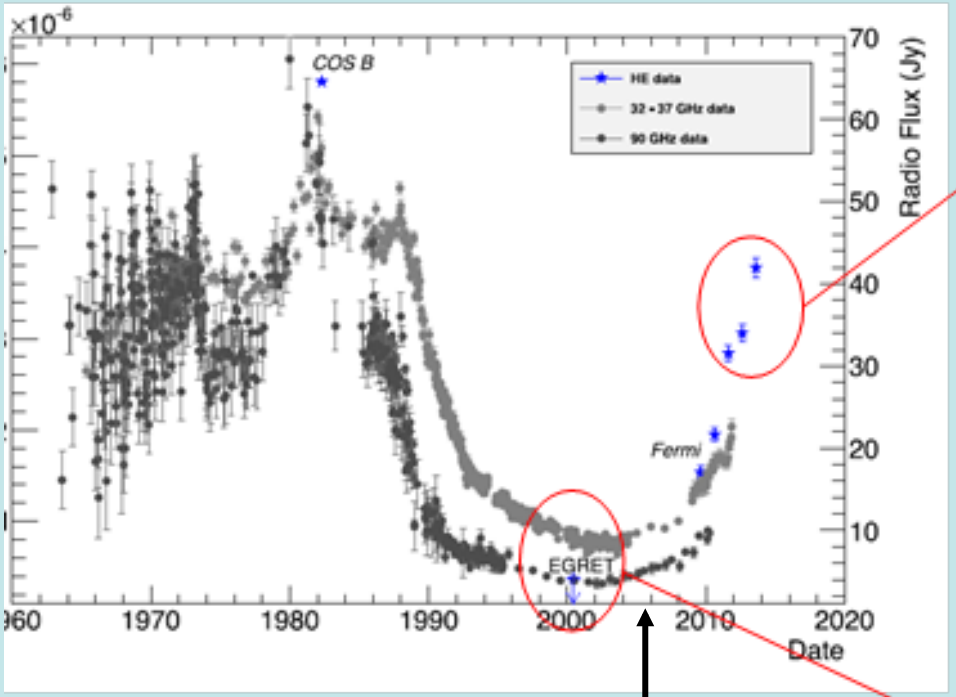
Shear Γ = 3 δ = 3.23
Spine Γ = 20.5 δ = 0.97



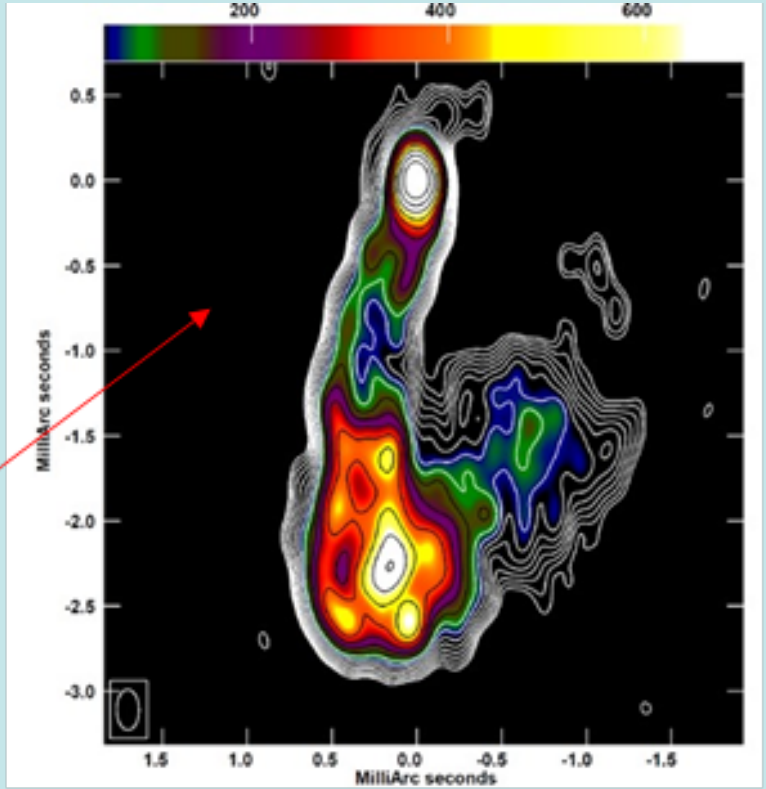


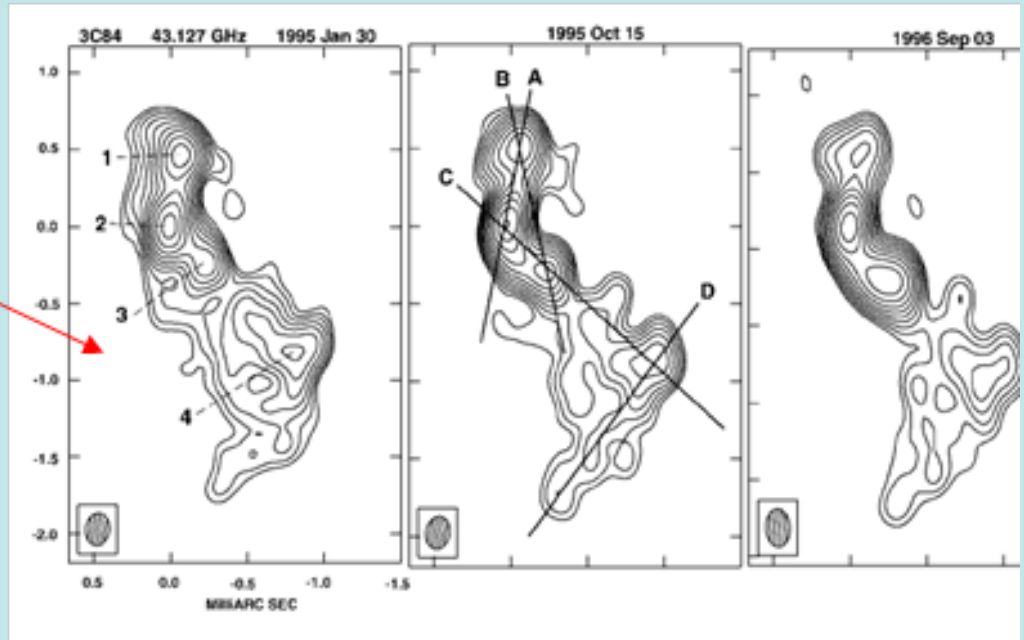
Alternatively inner structure intrinscally fainter?

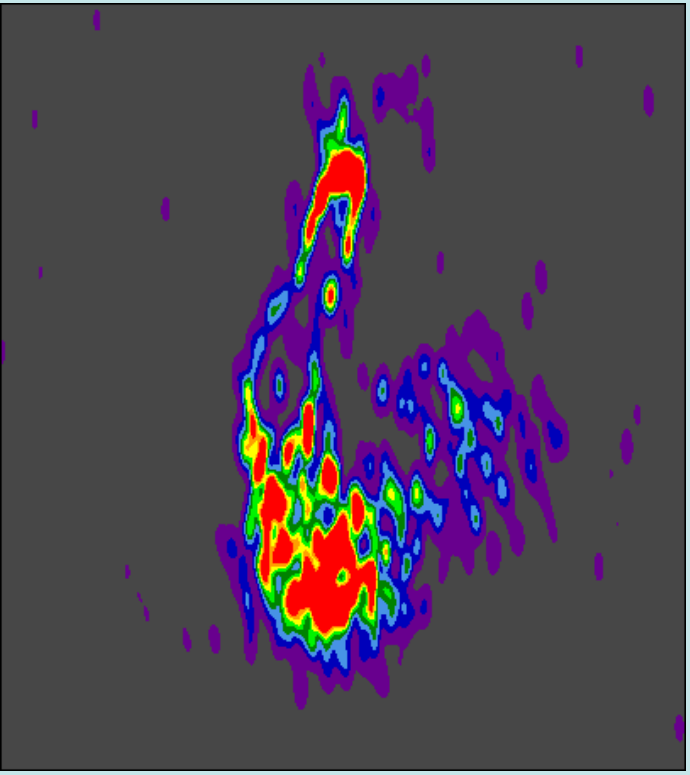
Gamma ray different properties:



C3 starts

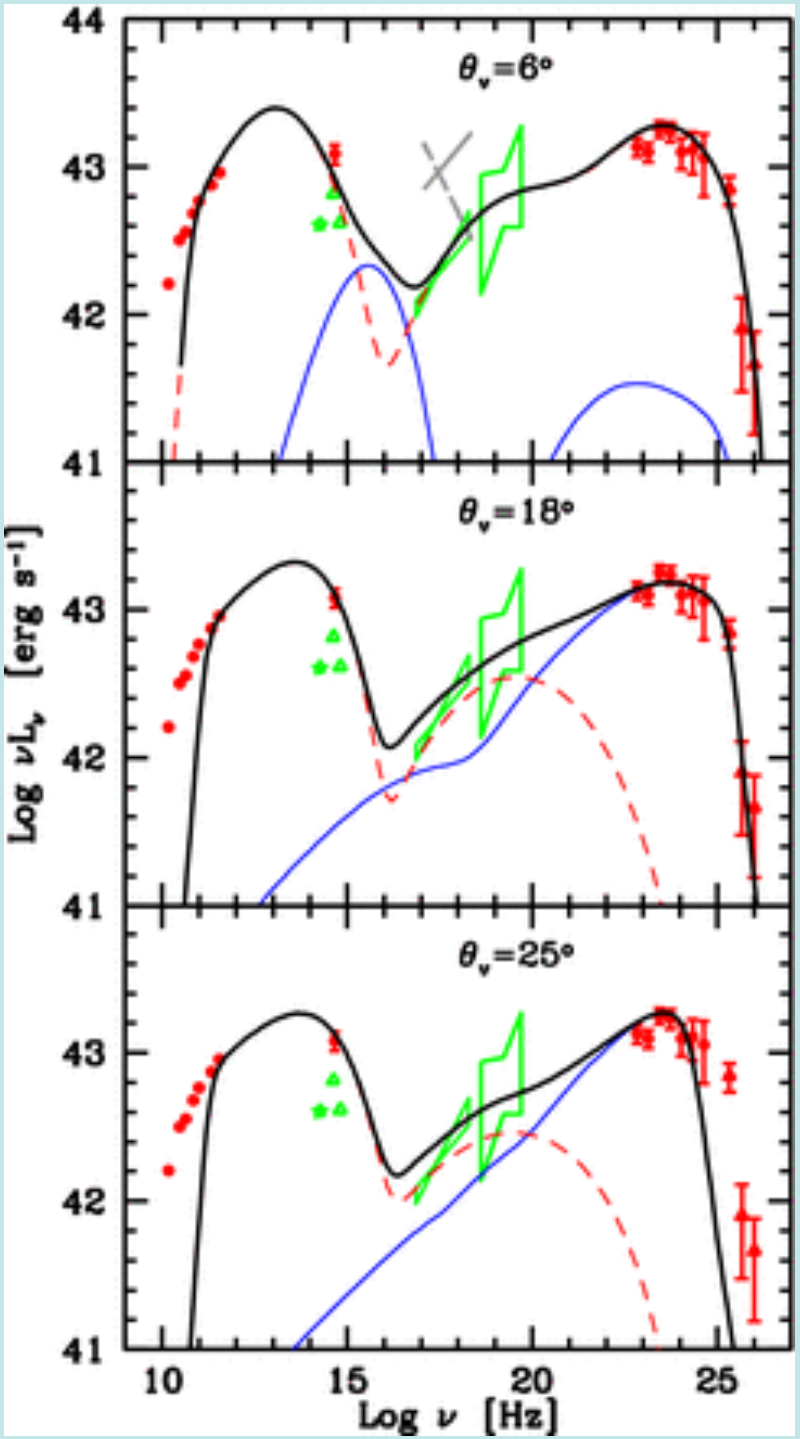






Giovannini+,in prep

Tavecchio&Ghisellini 14



One-zone SSC implies unreliable high Doppler factor.

Small angle: spine dominated, not in agreement with radio

Spine-layer model well reproduces the SED with theta ~ 18 degree

Large jet size
Large opening angle
Large inner/external brightness ratio (velocity structure):
Different Jet origin?

theta > 20 unllikely due to strong internal absorption.

conclusions

1) 3C 84 core: complex region
   edge brightened jet with large opening angle near the core

2) Large difference in brightness between the jet shear and spine ➔ different Doppler factor and Lorentz factor

3) Structured jet different properties and origin

4) The shear is well defined and collimated: strong confinment by the external medium

5) 3C 84 different from M87 and Cygnus A: BCG in a strong cooling flow cluster?


RadioAstron jet
Thank You
18/07/2011 04:48