

# Kinematics of radio jets



.... *some ideas about task 4*



# Team in Bonn

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Veronika Meyer

Arno Witzel

Anton Zensus

et al.

....



Uwe Bach



Lars Fuhrmann

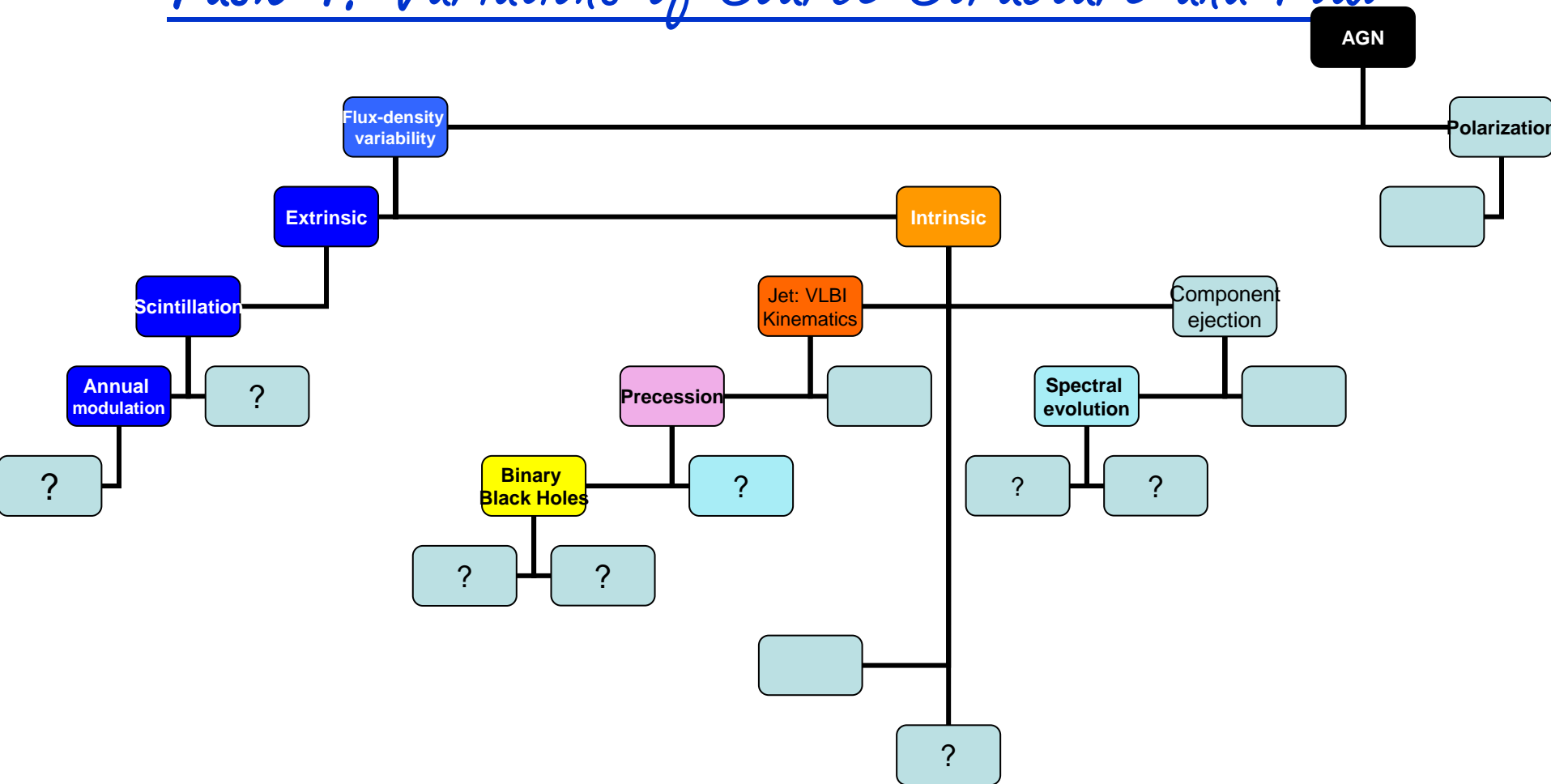


# *This talk is .....*

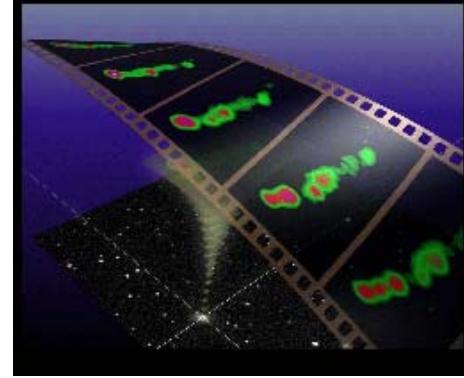
- By no means complete!
- Possibly (radio)-biased
- Not exclusively referring to ENIGMA-related publications
- ... and based on a personal recollection !



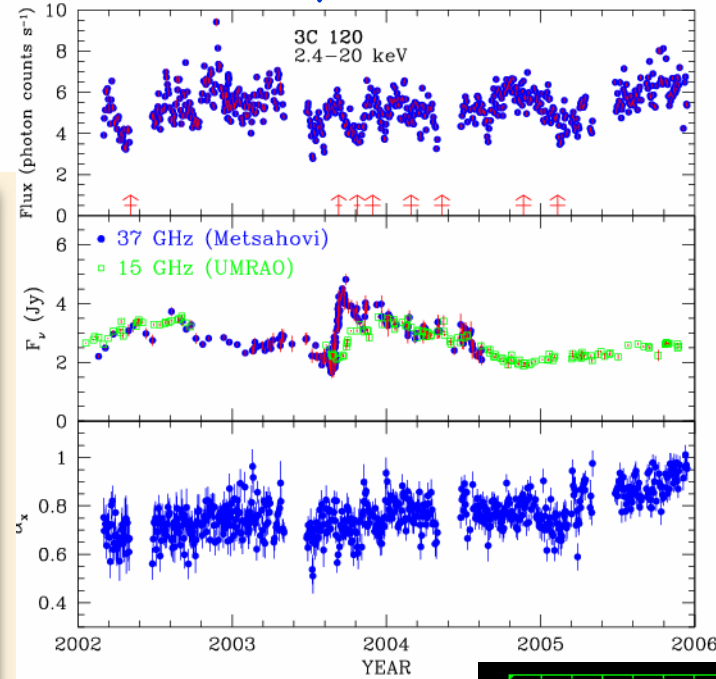
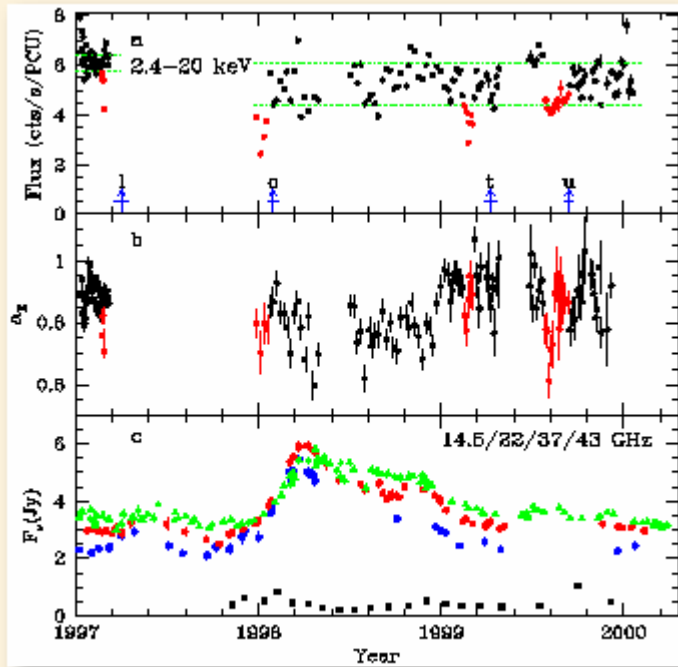
# Task 4: Variations of Source Structure and Flux



# 3C 120 (and its implications)

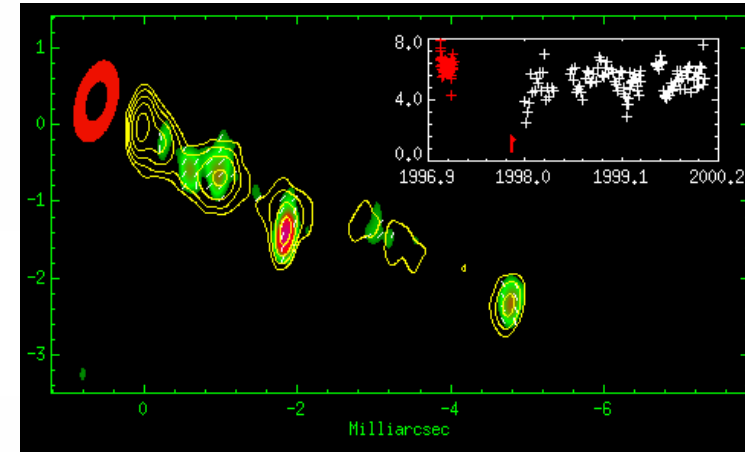


Marscher et al., 2002, Nature



P. Ogle et al. 2005,  
Astrophysical Journal,  
618, 139

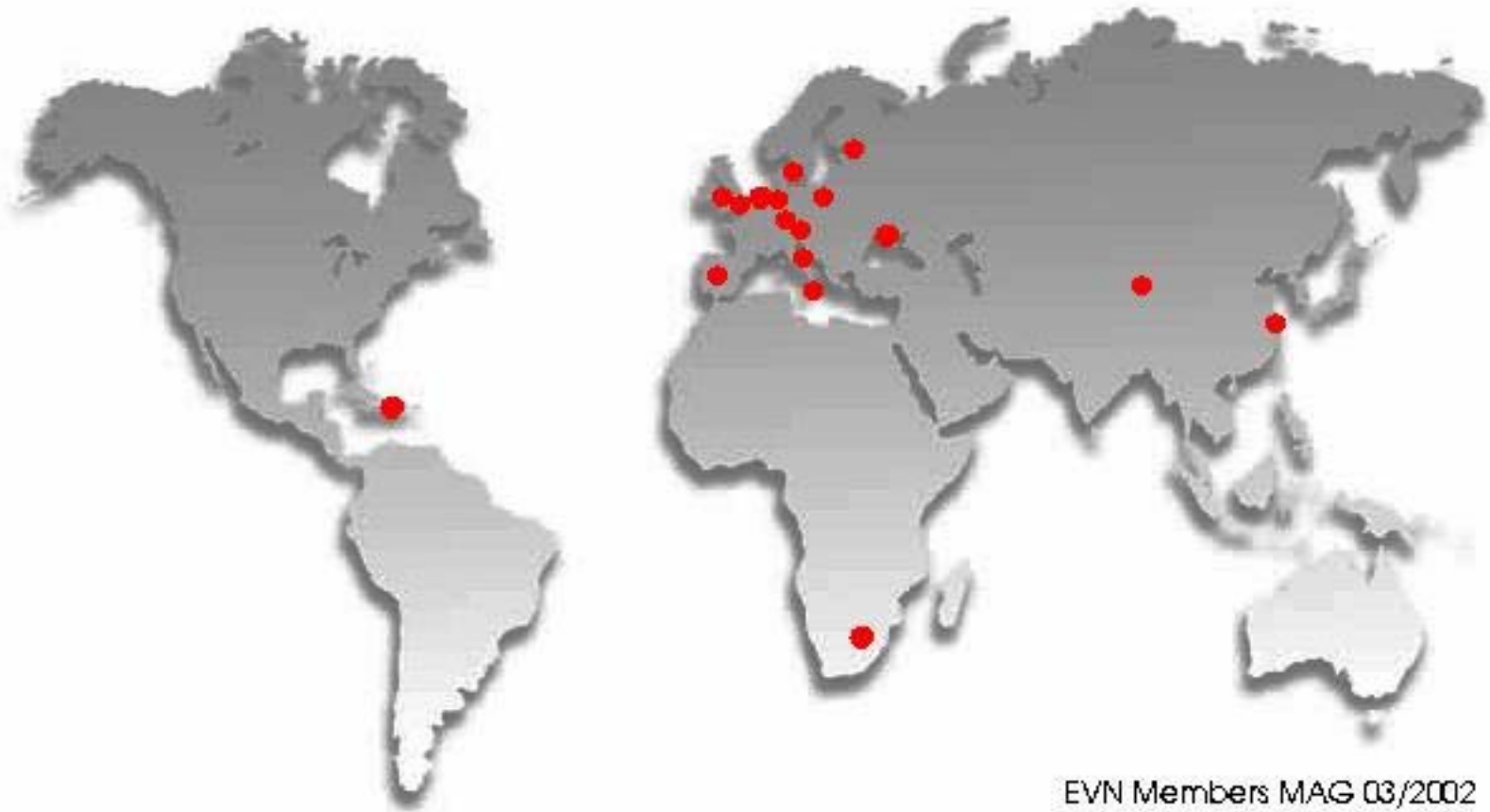
Gomez et al.; 3C120, 43 GHz, VLBA



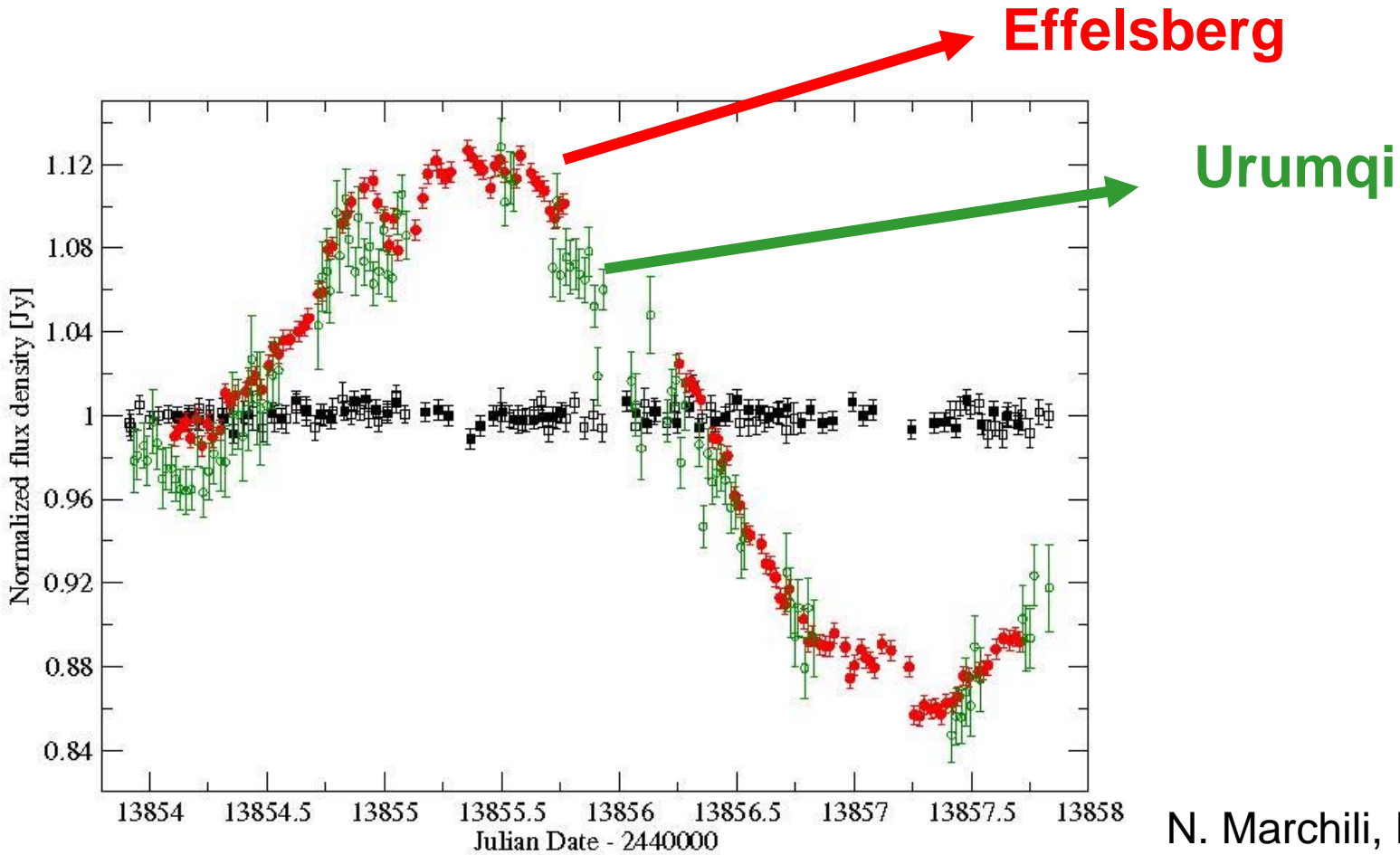
1DV, 1DV, 1DV, 1DV



# IDV-observations with Urumqi



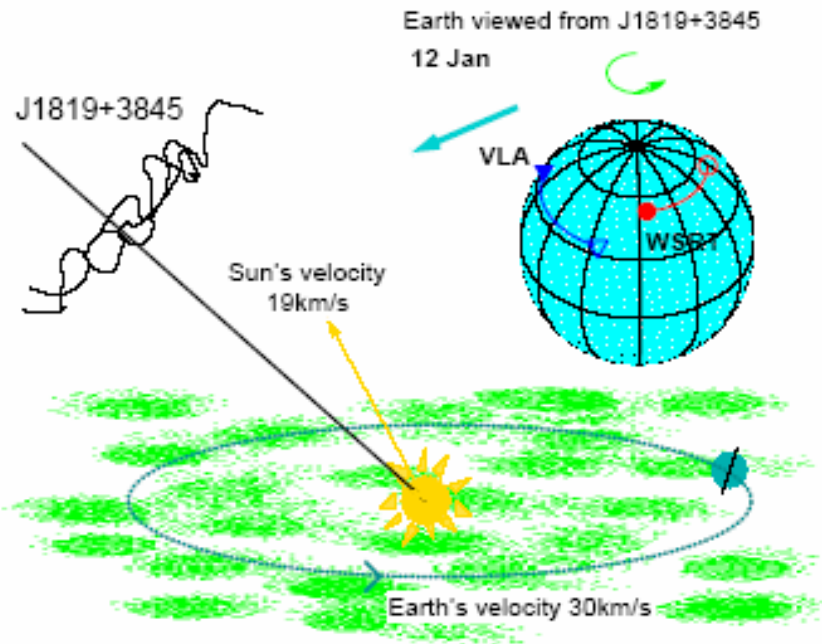
# Effelsberg + Urumqi monitoring



N. Marchili, K. Gabanyi,  
T. Krichbaum, et al.

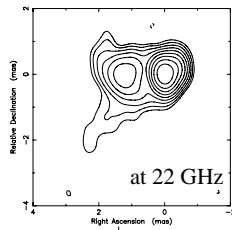


# Scintillation: Annual modulation



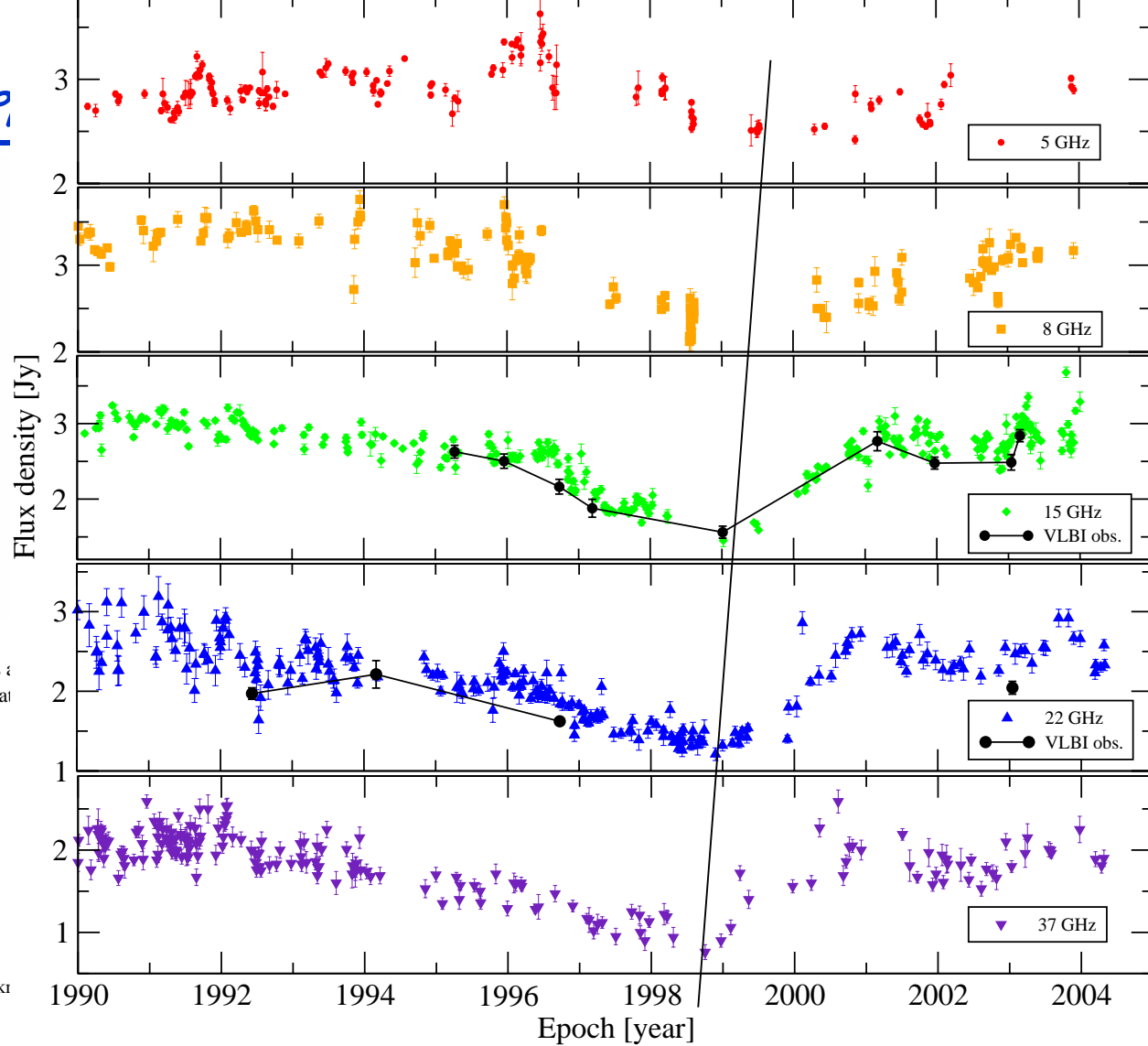
- Currently being successfully modelled for the source 1128+592 (Gabanyi, Krichbaum, Marchili, et al.)  
Already claimed for 0917+624 (e.g., Rickett et al.), J 1819+3845 (Dennett-Thorpe & de Bruyn 2003), PKS 1257-326 (Bignall et al. 2003), PKS 1519-273 (Jauncey et al. 2003), maybe 0954+658 (L. Fuhrmann et al.)





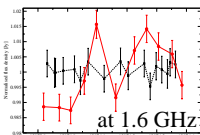
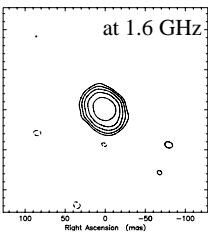
2005+403

Flux-dens.

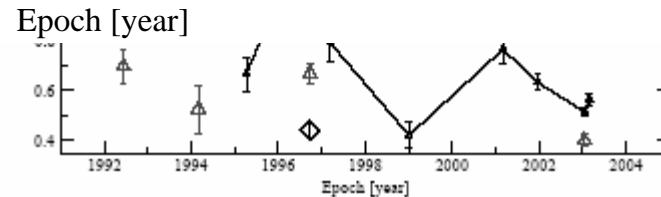


$L=2.35$  kpc  
 $v=200$  km/s  $t=12$  days :  
 $v=47$  km/s  $t=52$  days at

$9$  pc  $< L < 40$  pc  
 $50$  km/s  $< v < 220$  km/s



Gabanyi et al. 2006



# Helical Structures .....

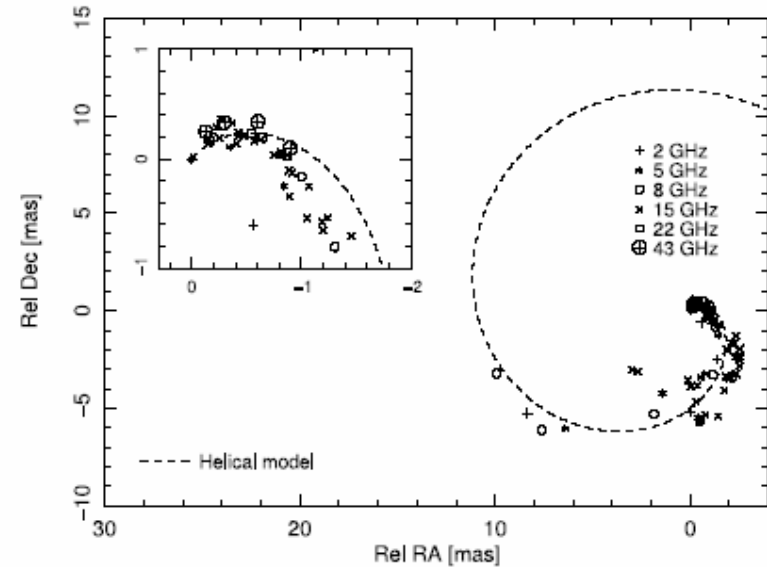
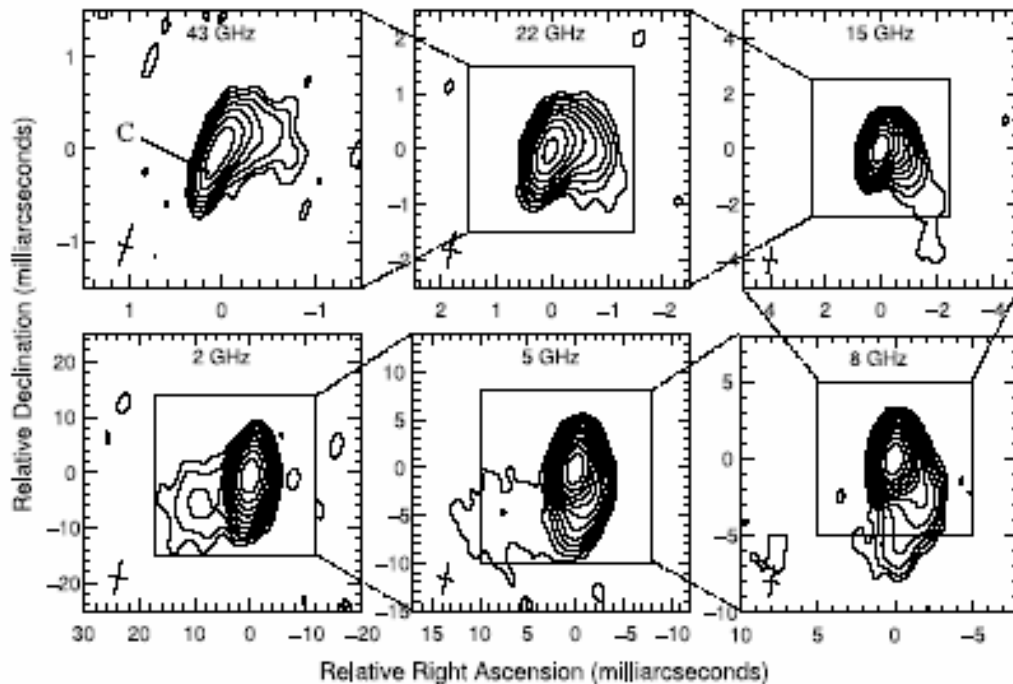


FIG. 12.—Best-fit trajectory and component centroid positions at different frequencies for the model describing a low-frequency helical fundamental mode of Kelvin-Helmholtz instability.

Savolainen et al., 2006ApJ...647..172

2136+141



# Rotating something?

## NRAO 150; etc.

7 degrees  
per year;

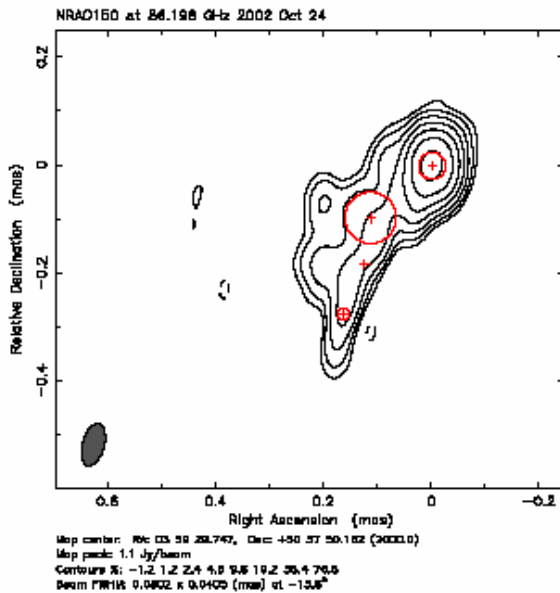


Fig. 4. 3mm-VLBI image of NRAO 150 taken on October 2002. The positions of the fitted Gaussian components are indicated by the crosses and the circles (of radius equal to the FWHM of each Gaussian) symbolize their size.

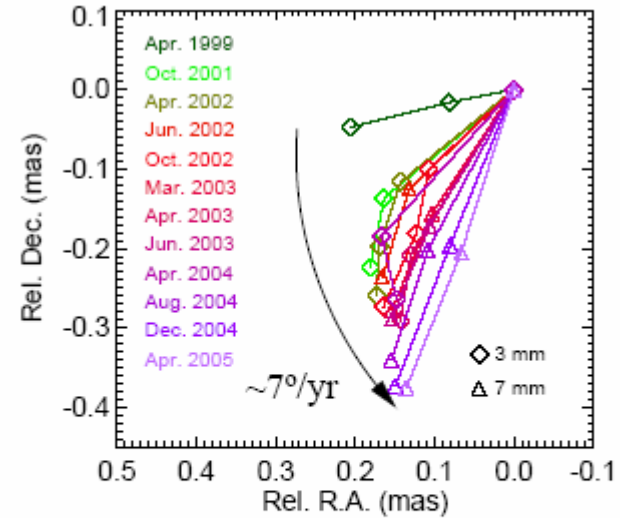


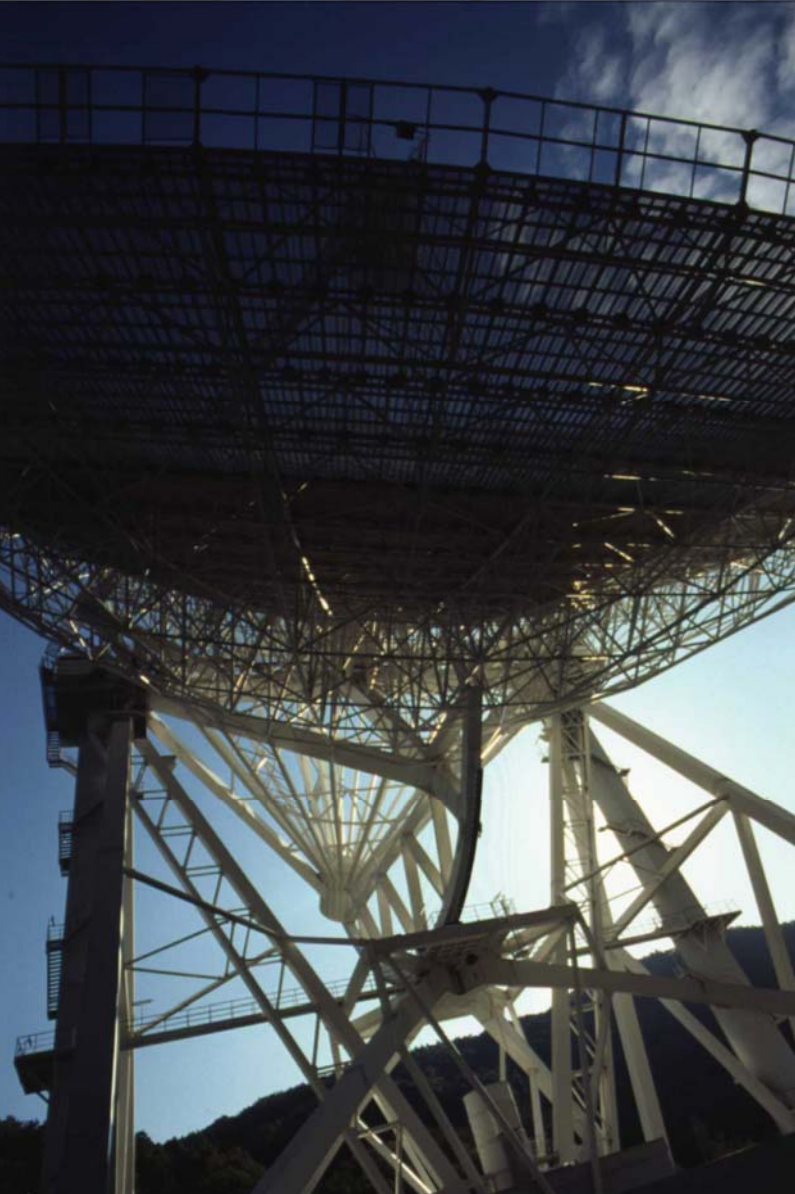
Fig. 6. Position –with respect to the core of the jet emission– of the inner model-fit components in NRAO 150. Only results from observations performed between 1999 and 2005 at 3 mm and 7 mm are drawn. The plot shows a fast change of the jet initial direction with a mean angular speed of  $\sim 7^\circ/\text{year}$ .

Agudo et al. 2005, Agudo et al. in prep.

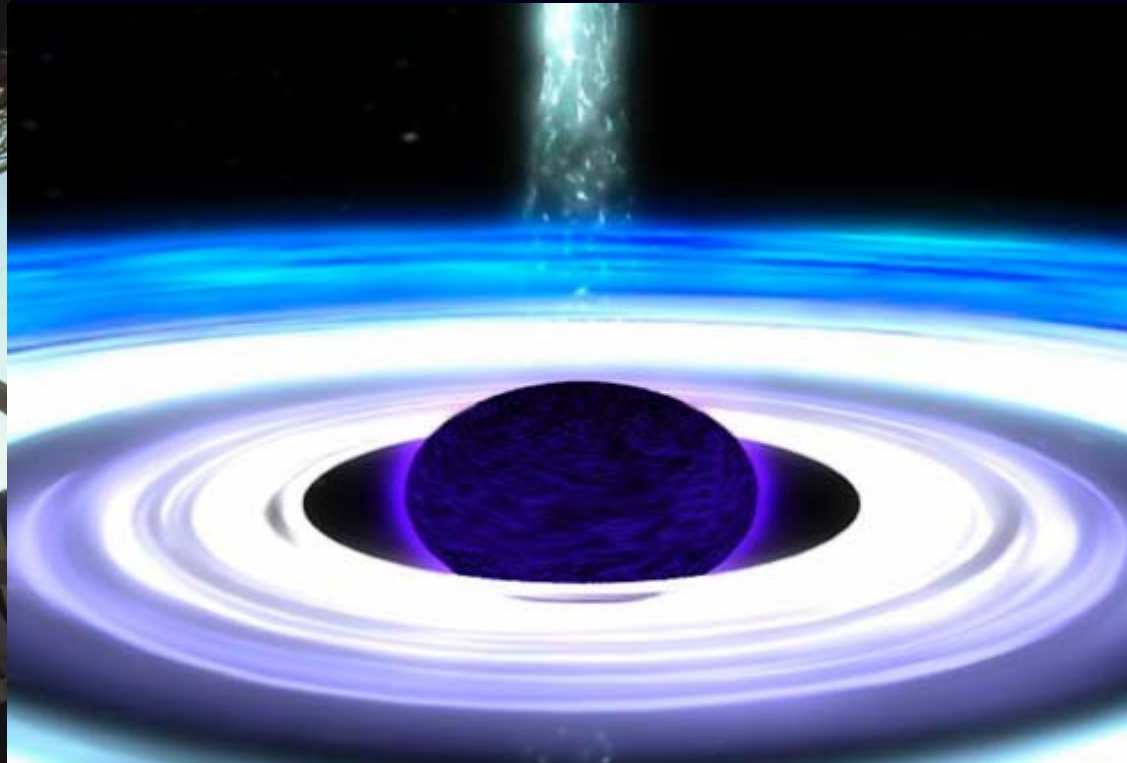


Highest-  
Resolution

Radio  
Astronomy

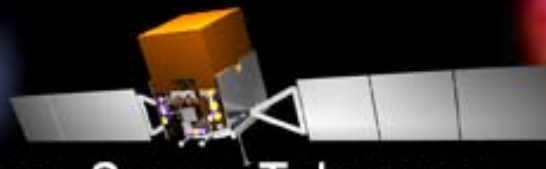


The Quest for the  
Black Hole

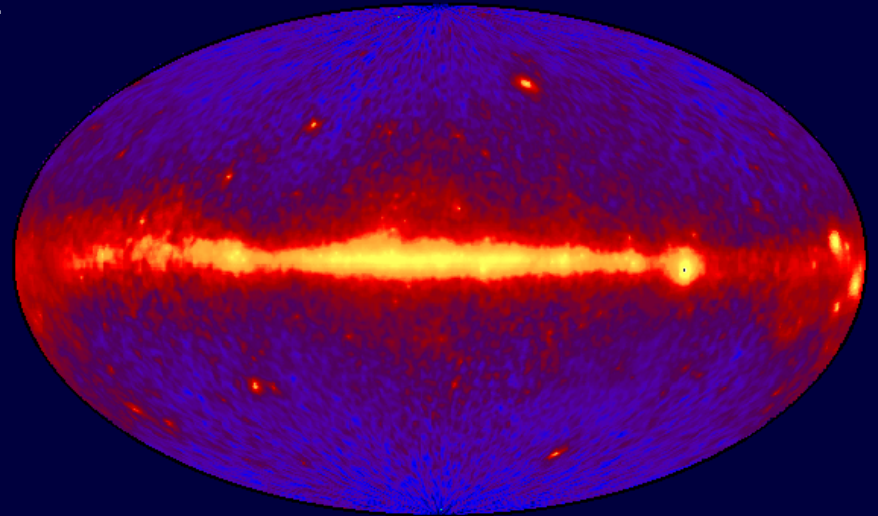


# GLAST

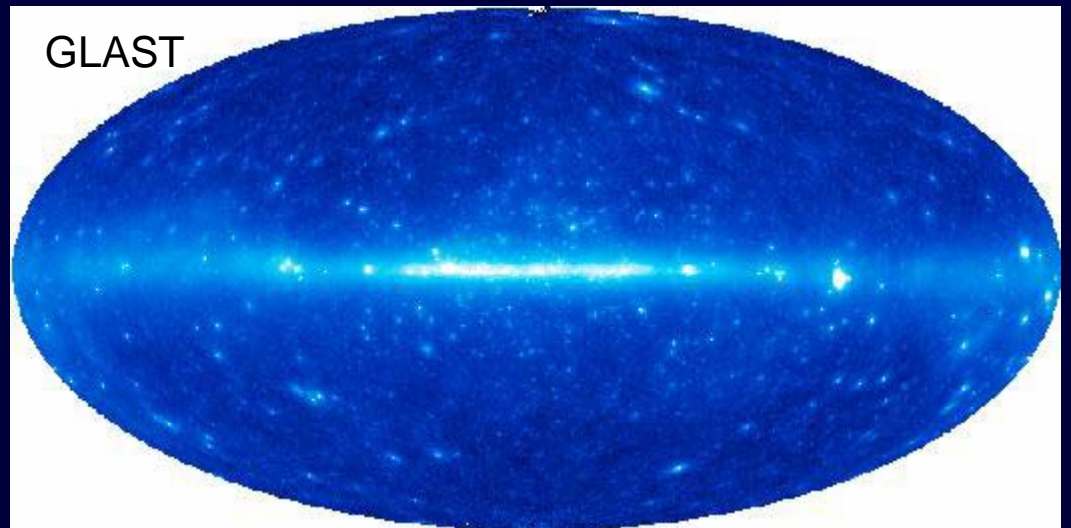
The Gamma-ray Large Area Space Telescope



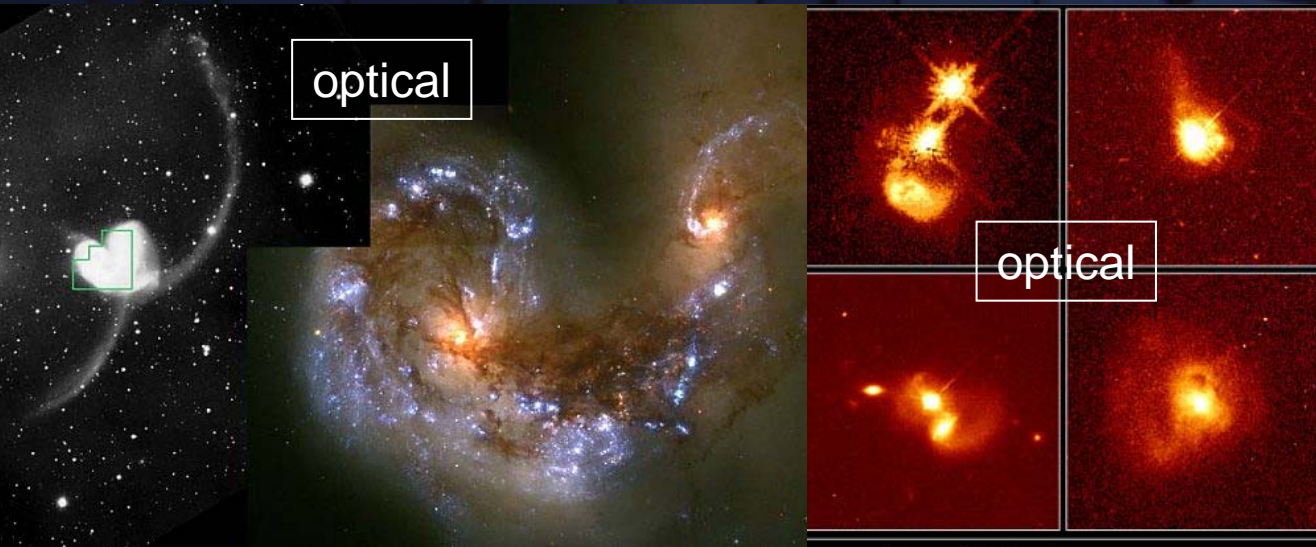
## EGRET



## GLAST

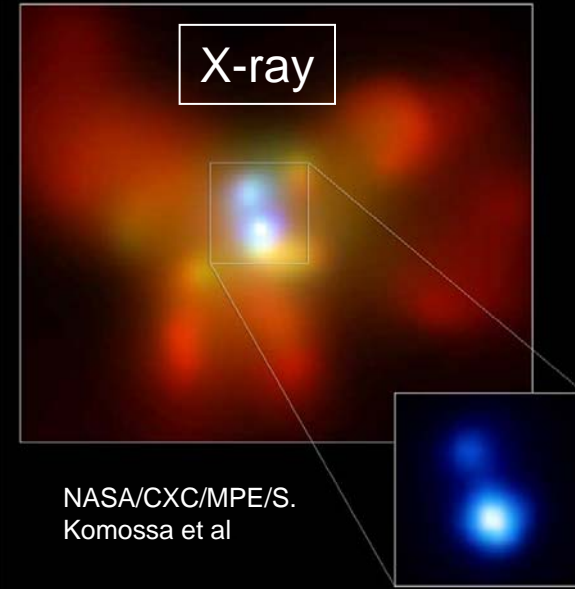


# Supermassive Binary Black Holes in different evolutionary stages?



optical

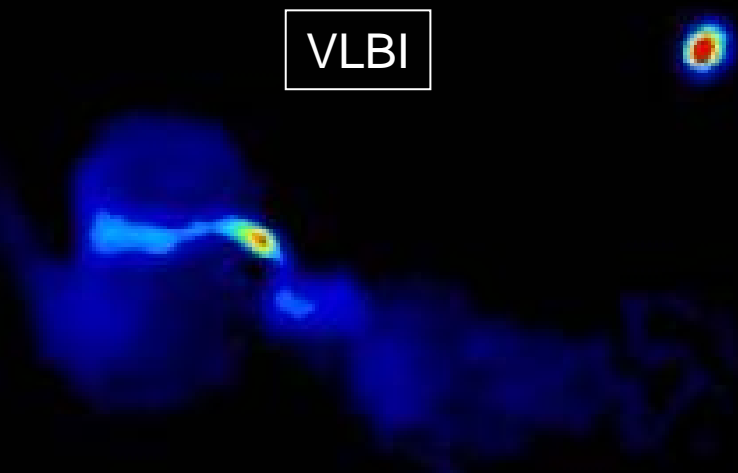
optical



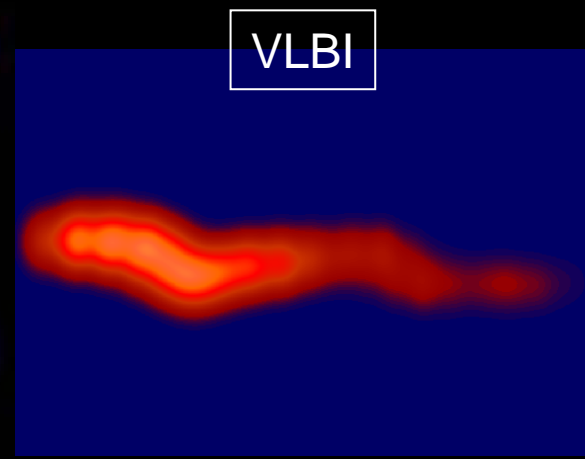
X-ray

**Quasar Host Galaxies**  
Hubble Space Telescope - Wide Field and Planetary Camera 2  
J. Bahcall (Institute for Advanced Study), M. Disney (University of Wales) and NASA

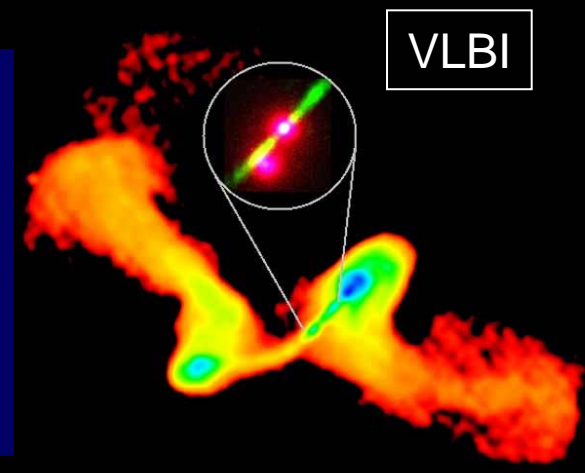
NASA/CXC/MPE/S.  
Komossa et al



VLBI



VLBI



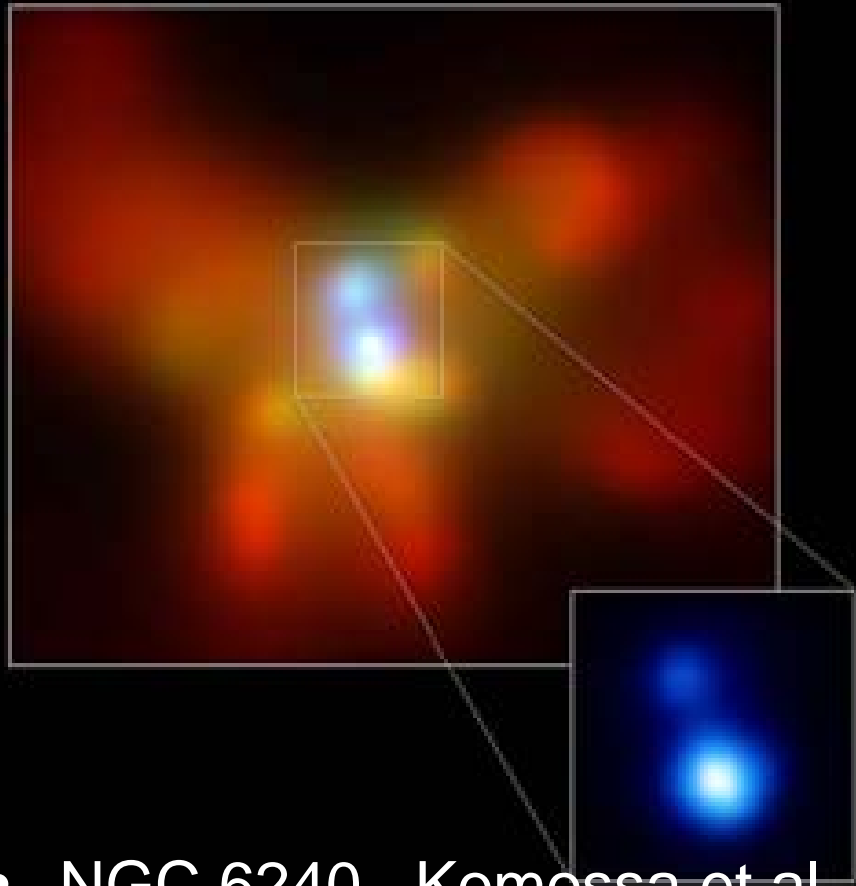
VLBI

Hardcastle et al. 1996

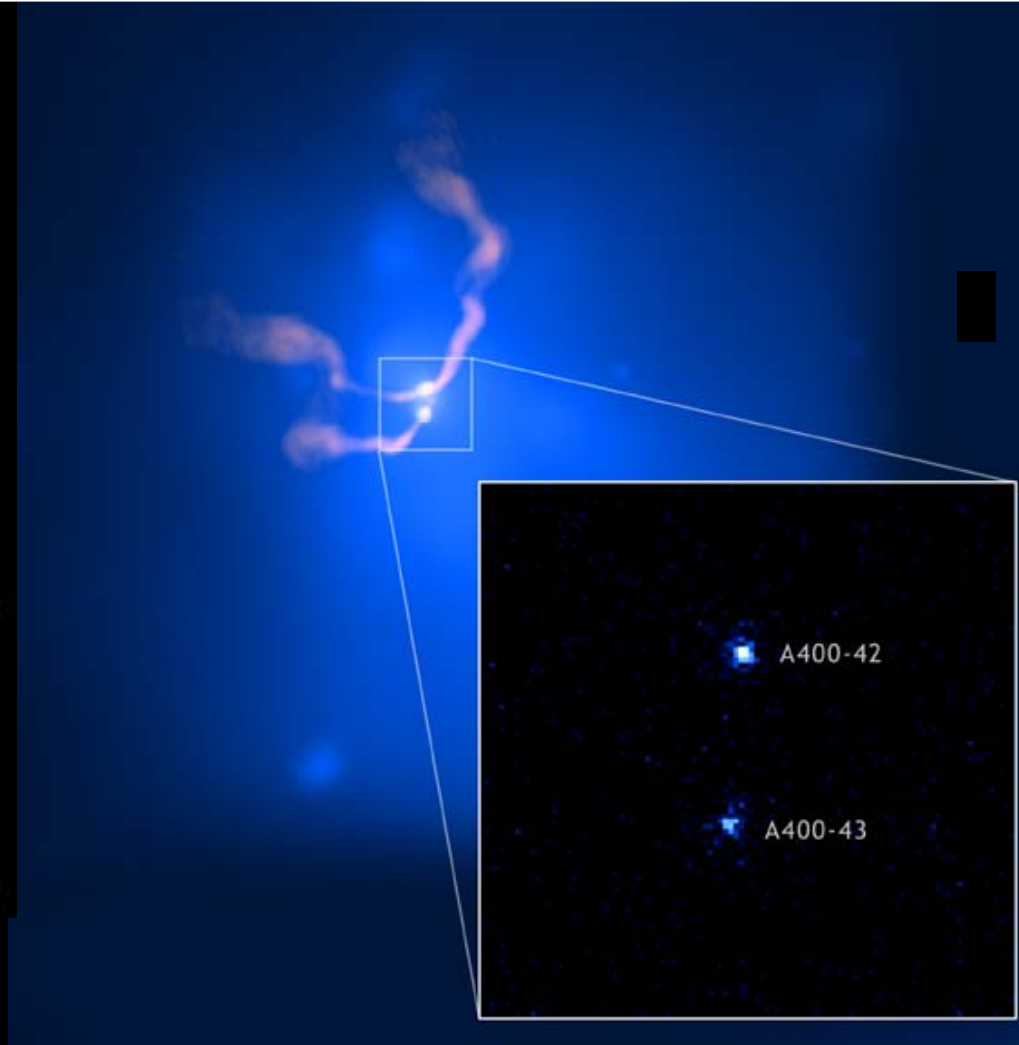
Lobanov & Roland 2004

Murgia et al.

# *Supermassive Binary Black Holes: when OJ287 fails to flare ...*



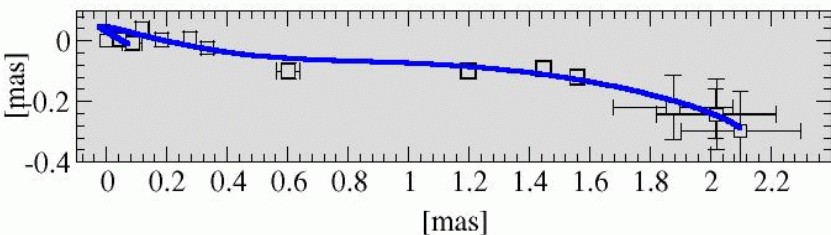
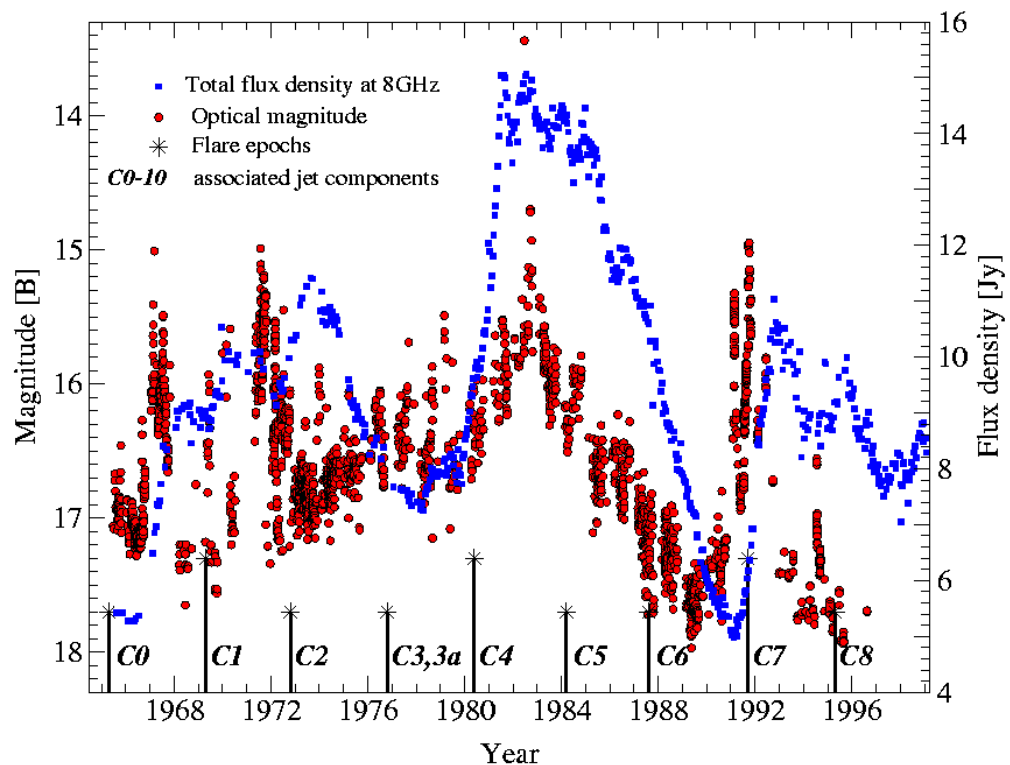
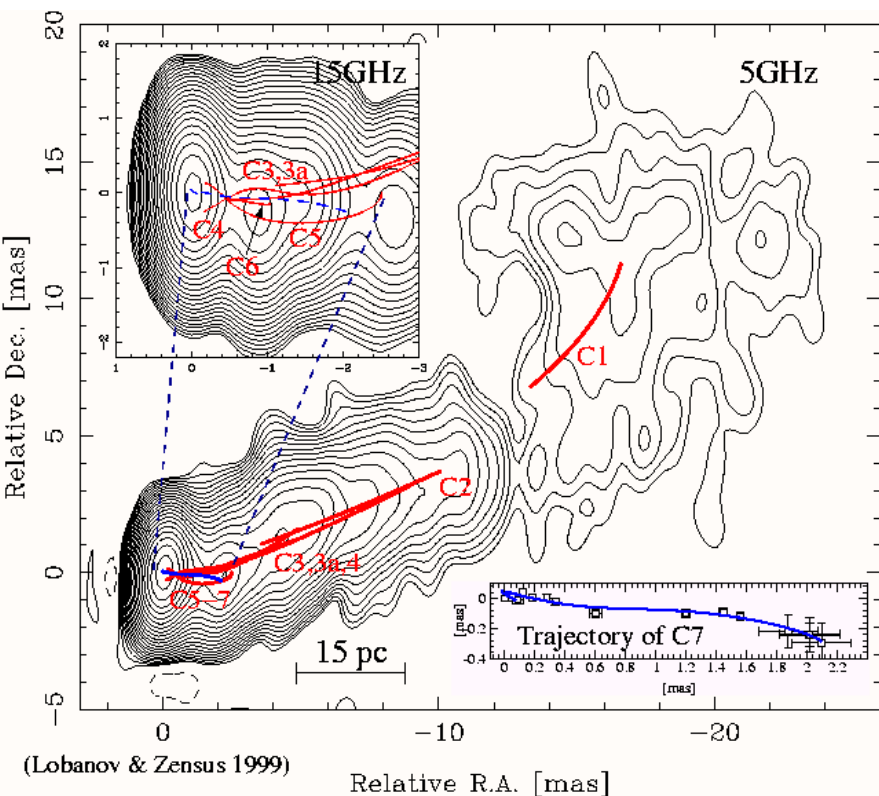
- NGC 6240 , Komossa et al.
- 3000 light years apart
- "starburst" galaxy
- Merger: 30 million years ago



3C75 in Abell 400, X-ray, Radio

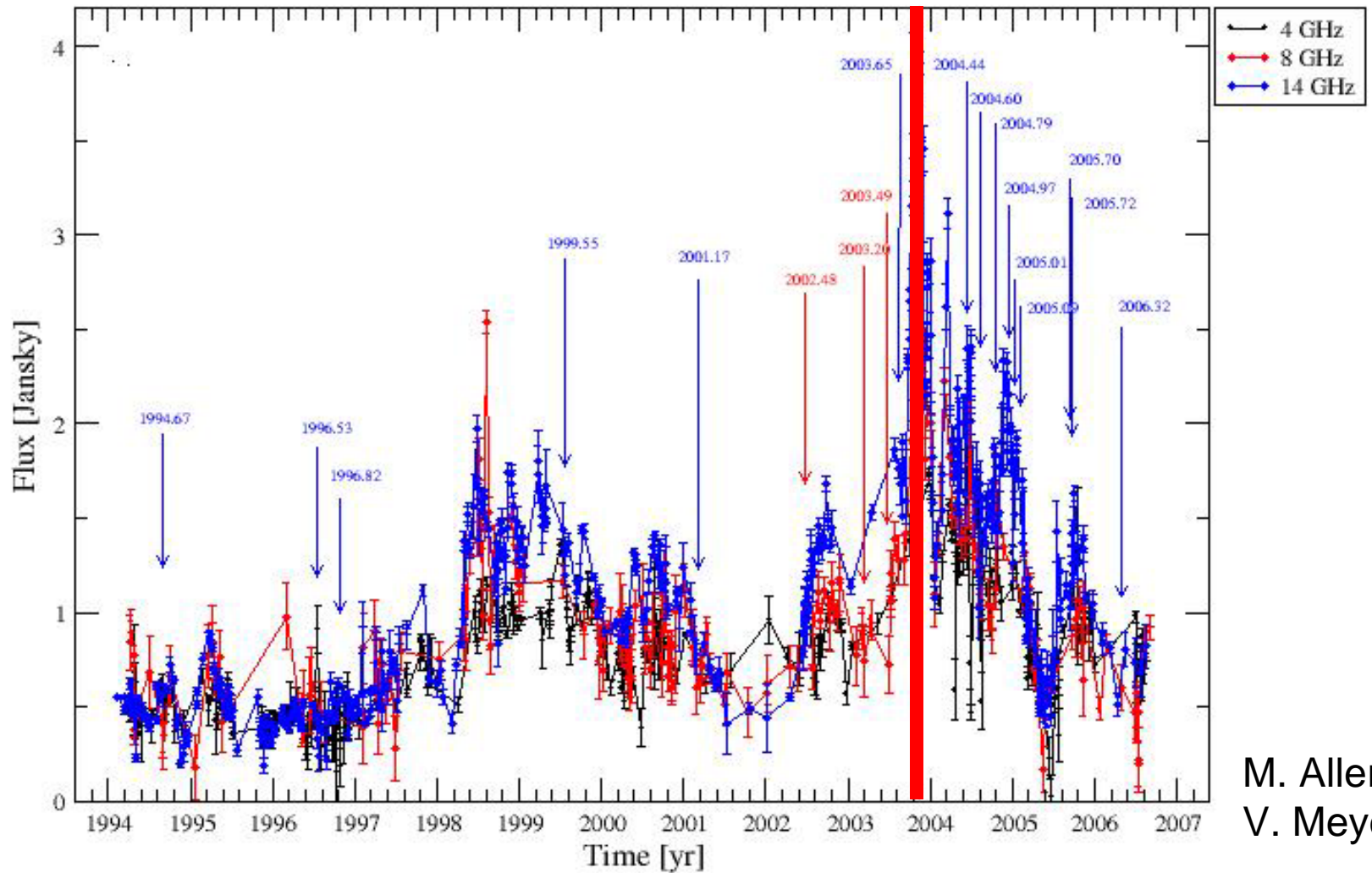
F.N. Owen, C.P. O'Dea, M. Inoue, & J. Eilek

# Supermassive Binary Black Hole in 3C345



Optical data: 1965- (>2500)  
 Radio data: 1965- (>3000)  
 VLBI data: 1979- (>280)

Lobanov & Roland 2005



M. Aller  
V. Meyer



Thanks!!

