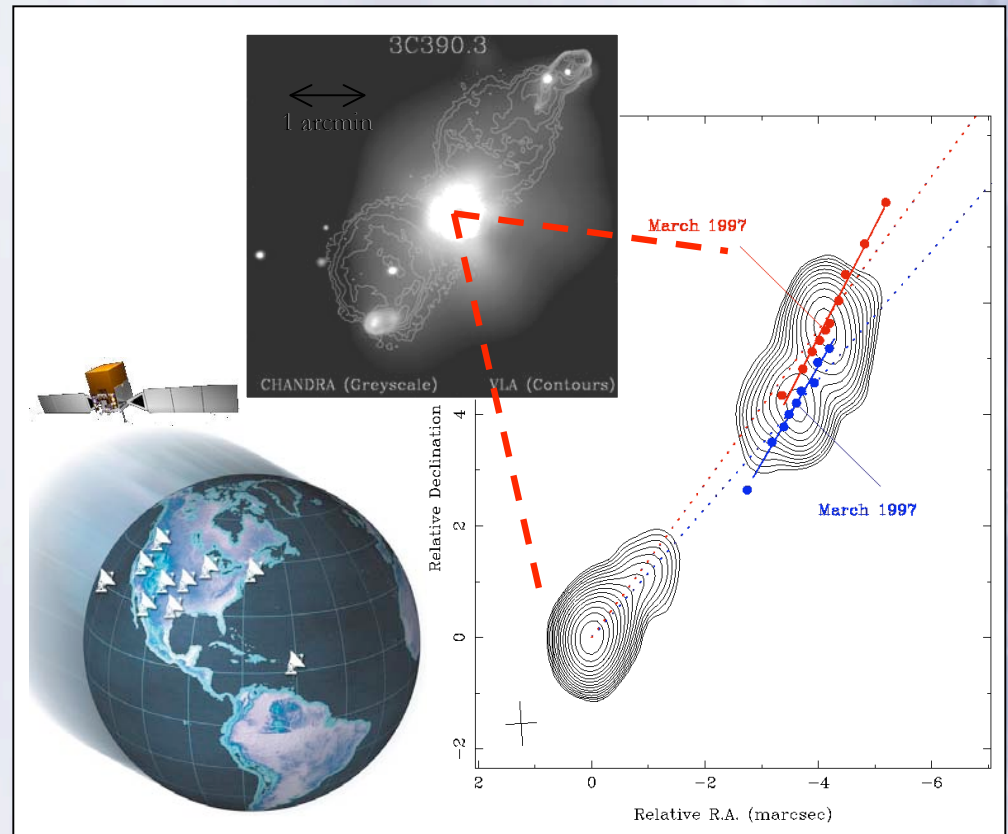


*AGN with compact  
radio cores*

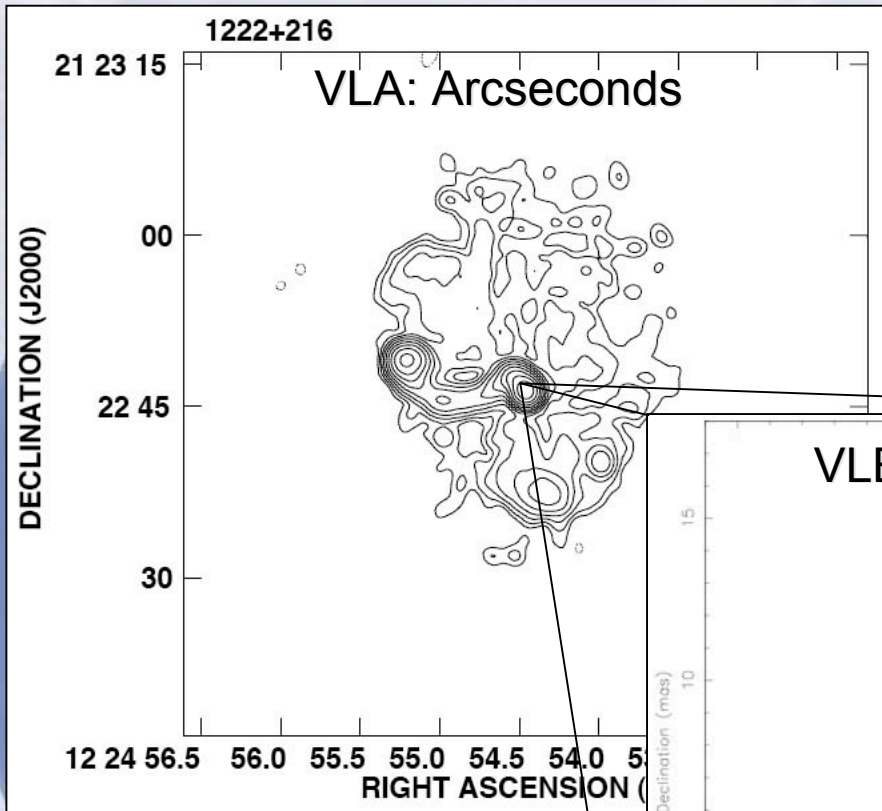
# *VLBI Observations of GLAST ~~Blazars~~*



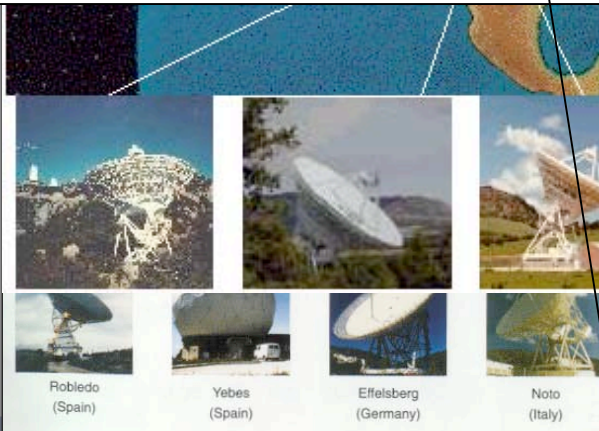
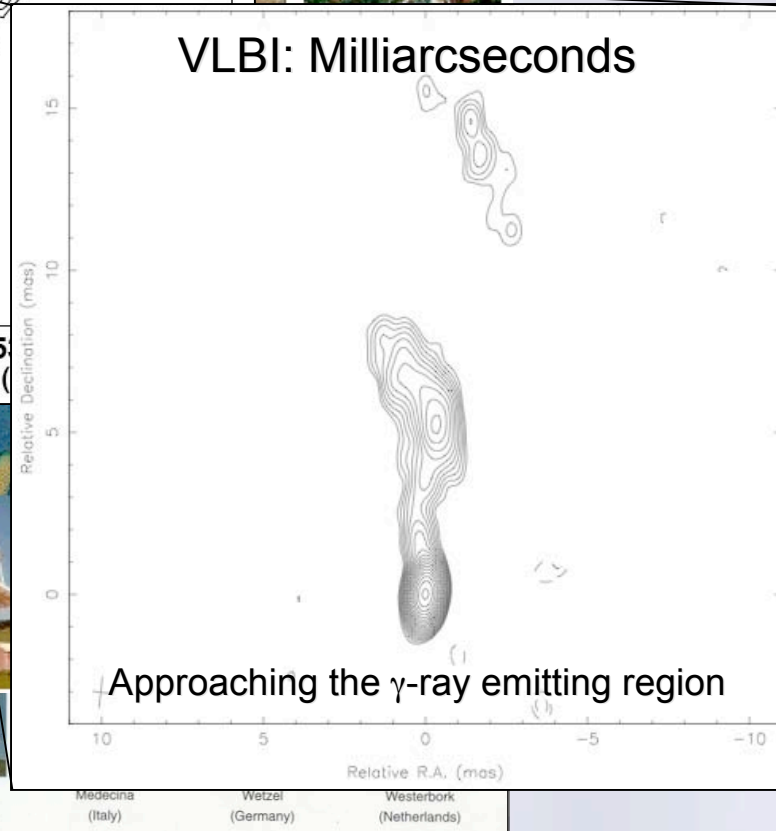
*Matthias Kadler  
(Building 2, Office 0.39)*

*Greenbelt, MD, January 17<sup>th</sup> 2007*

# VLBI: Very Long Baseline Interferometry



- Resolution  $\propto \lambda / D$ 
  - ✧  $\lambda \sim \text{cm to mm}$
  - $D \sim 10^4 \text{ km}$
  - Submilliarcsecond Resolution
  - as antennas built for other reasons like the EVN or VLBA





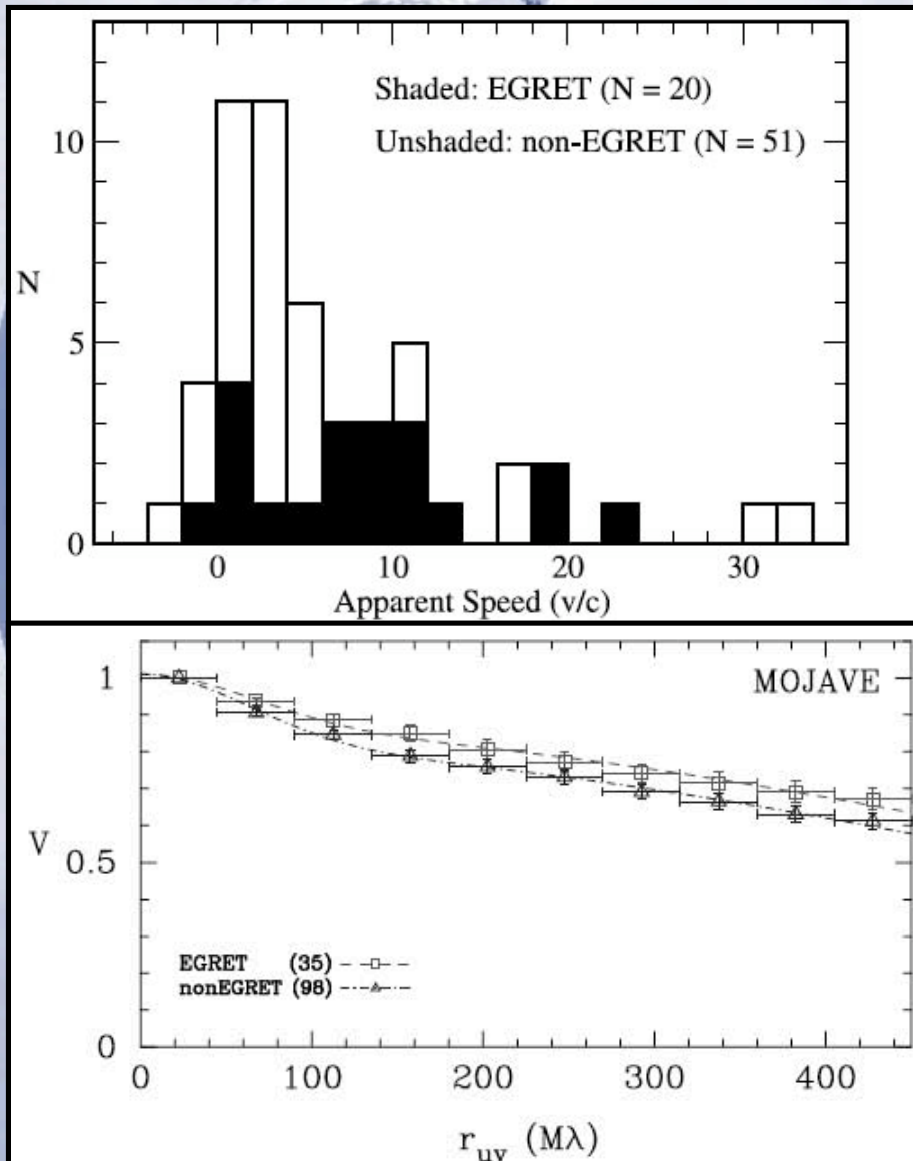
# *VIPS: The VLBA Imaging and Polarimetry Survey*

- ✧ Combined 5 GHz and 15 GHz survey with the VLBA of ~1100 AGN
- ✧ Complete down to 85mJy at 8GHz
- ✧ Full polarization
- ✧ The parent sample is the CLASS survey (flat-spectrum radio sources) in the region covered by the Sloan Digital Sky Survey
- ✧ Check the pc-scale structure of your GLAST source in the VIPS data base

[www.phys.unm.edu/~gbtaylor/VIPS/](http://www.phys.unm.edu/~gbtaylor/VIPS/)



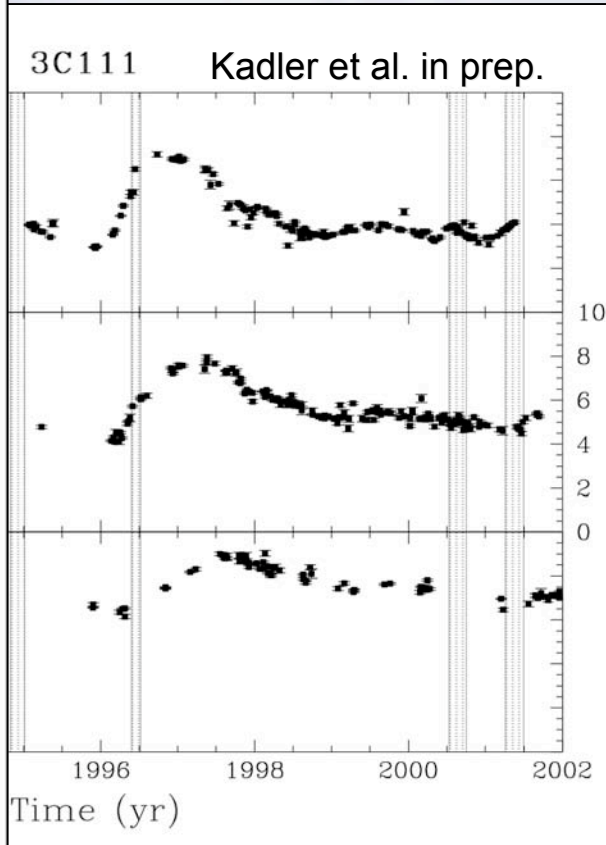
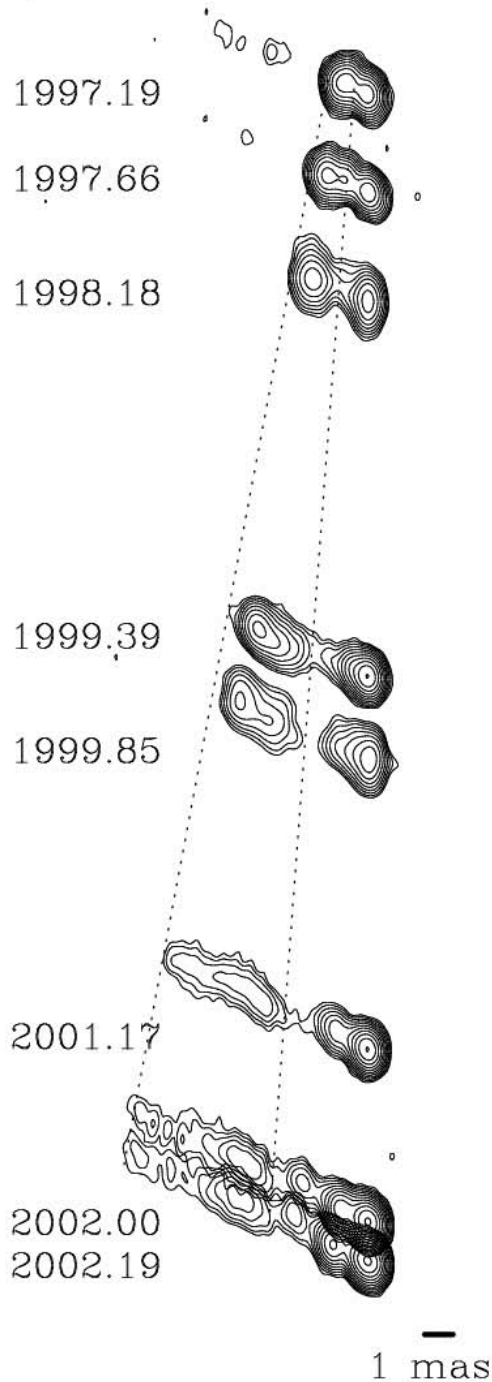
# MOJAVE: Monitoring of Jets in Active galactic nuclei with VLBA Experiments



- Extensive study of compact, radio loud, core-dominated sources since 1994
- Monitoring of a sample of  $>200$  targets using the VLBA at  $\nu=15$  GHz ( $\lambda=2$  cm)
- Structure and kinematics of AGN jets (superluminal motion!) and their relationship to other source properties such as  $\gamma$ -ray brightness
- Statistically complete Sample
  - ✧ Strong sources:  $S_{15\text{ GHz}} > 1.5$  Jy
  - ✧ Flat Spectrum:  $\alpha > -0.5$  for  $S \propto \nu^\alpha$
- Since 2006: Extended MOJAVE sample contains all known EGRET AGN above declination  $-20^\circ$
- EGRET sources are faster (Kellermann et al. 2004, ApJ, 609, 539), more compact (Kovalev et al. 2005, AJ, 130, 4273), and have higher Doppler factors (Lister & Homan 2005, AJ, 130, 1389)

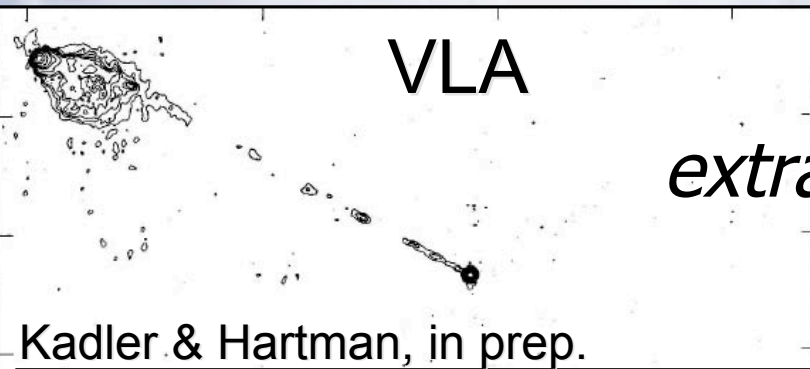


# Compact Radio Cores are not only in blazars - Example: 3C111

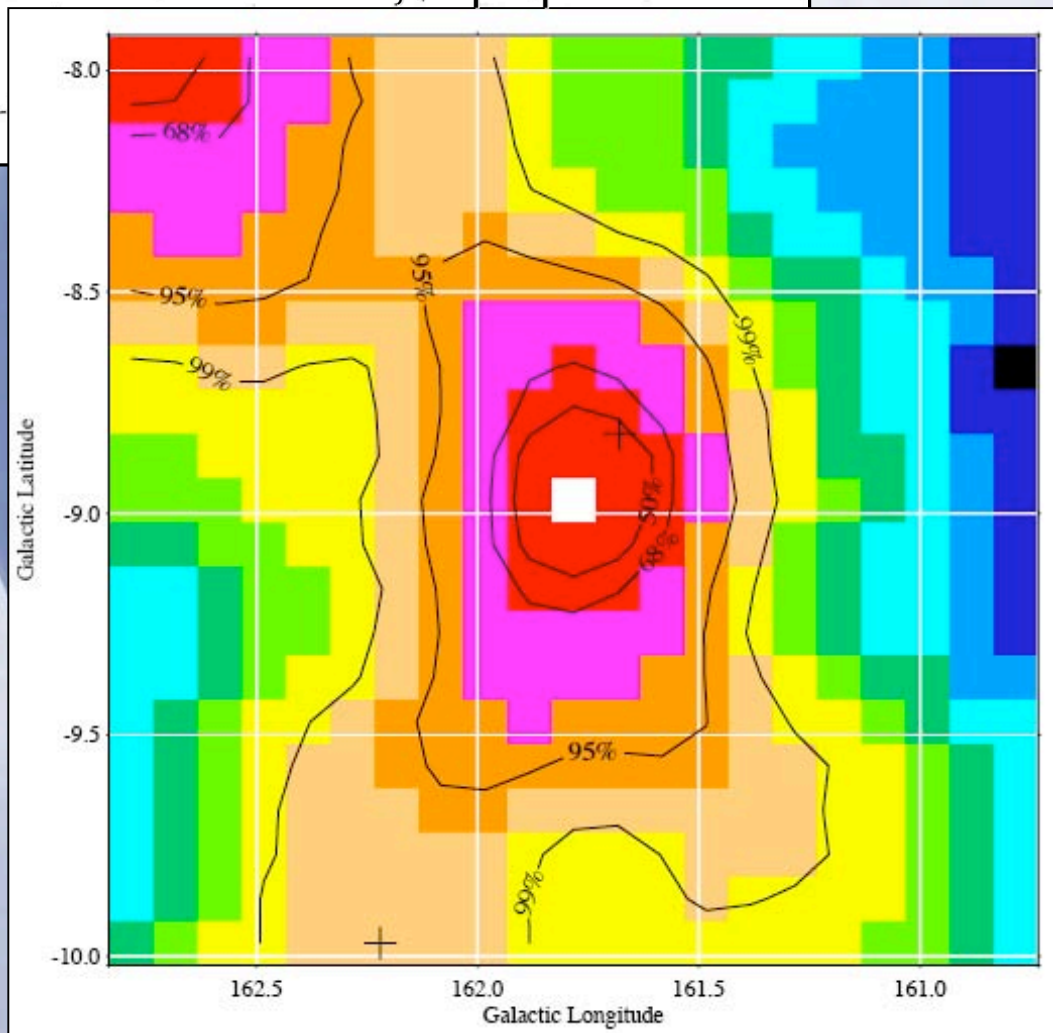


- ✧ Major flux-density radio outburst in 1996
- ✧ Flare first visible at mm- and short cm-wavelengths
- ✧ Propagation through spectrum as new jet component travels outwards, expands and becomes optically thin

Component speeds:  
3-6 times the speed of light



*...and blazars are not the only extragalactic  $\gamma$ -ray sources, either - Example: 3C111*



- 3C111 is NOT a blazar but a NLRG
- 3EGJ0416+3650 is a bright 3rd-EGRET catalog source  $\sim 1$  arcmin offset from 3C111
- Detection of 3C111 at  $>1$  GeV more than 6 years after CGRO's "return to earth"
- 3EGJ0416+3650 is actually the superposition of two sources
- See also Cen A (Sreekumar et al. 1999, *Astropart.Phys.*, 11, 221)
- Stratified Jets? (Ghisellini et al. 2005, *A&A*, 432, 401)



# *What VLBI+GLAST may tell us...*

- 1) Are all core-dominated radio-loud AGN bright  $\gamma$ -ray emitters?
- 2) How correlates  $\gamma$ -brightness with jet speeds, brightness temperatures, compactness, etc...
- 3) How do quasars, BL Lacs and galaxies (with bright radio cores) differ at  $\gamma$ -rays? How do these differences compare to the ones found on parsec-scales in the radio?
- 4) Are  $\gamma$ -ray flares an "omen" for VLBI component ejections?
  - If so, what are the time delays, i.e., how much closer to the action are we at  $\gamma$ -rays?
  - Can we use time delays to constrain jet structures and physical parameters?

***VLBI in the GLAST ERA:***

Workshop to be held at GSFC on April 23/24, 2007



# *The MOJAVE Collaboration*

- ✧ NRAO: Ken Kellermann
- ✧ MPIfR: J. Anton Zensus, Eduardo Ros, Tigran Arshakian, Yuri Kovalev, Andrei Lobanov
- ✧ Purdue: Matt Lister
- ✧ Denison: Dan Homan
- ✧ GSFC: Matthias Kadler, Julie McEnery, Rita Sambruna, Jack Tueller, Neil Gehrels
- ✧ ASTRON: René Vermeulen
- ✧ Caltech: Marshall Cohen
- ✧ Michigan: Hugh & Margo Aller



Max-Planck-Institut  
für  
Radioastronomie



DENISON

