Extending and Exploring the 2cm Survey Sample

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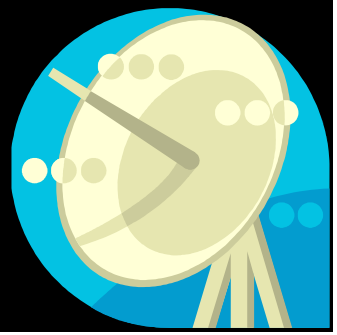
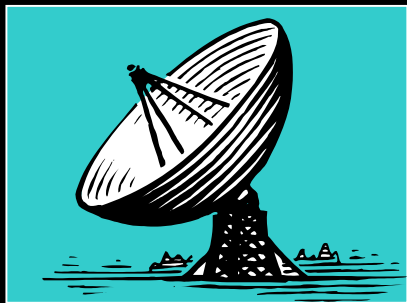
and the 2cm Survey Team
7th EVN Symposium
Toledo (not in Ohio) 2004/10/12



The 2cm Survey Collaboration – Team Members

- NRAO: Ken I. Kellermann, Yuri Y. Kovalev
- MPIfR: J. Anton Zensus, Matthias Kadler, Eduardo Ros, Tigran A. Arshakian, Andrei P. Lobanov
- Purdue: Matt L. Lister
- Denison: Dan C. Homan
- ASTRON: René C. Vermeulen
- Caltech: Marshall H. Cohen
- Michigan: Hugh & Margo Aller



The 2cm VLBA Survey

- Monitoring of a sample of »180 radio sources using the Very Long Baseline Array at ν=15GHz (λ=2cm)
- Observations since 1994; more than 60 VLBA runs; over 1000 images to date
- Goal: systematic characterization of the kinematics of AGN jets and their relationship to other source properties

- ***This presentation: Results from additional observations in 2001/2002 (BR077) to consolidate (sampling, kinematics, etc.) the observational effort***

The 2 cm Survey Images

- Integration times of » 50 min per source and epoch: noise level of »1 mJy/beam
- Dynamic ranges over » 1:1000
- Synthesized beam of FWHM » 0.5mas
- Automatic imaging (CLEAN+self calibration) using DIFMAP

- See archive at `http://www.nrao.edu/2cmsurvey`

Sample Definition

- Strong sources:
  - $S_{15\ GHz}$>1.5 Jy for $\delta>0^{\pm}$
  - $S_{15\ GHz}$>2 Jy for $0^{\pm}>\delta>-20^{\pm}$
- Flat Spectrum:
  - δ>-0.5 for S_{ν} » ν^{α} above 500 MHz
- Some additional sources:
  - Lobe-dominated with strong core
  - Compact Symmetric Objects

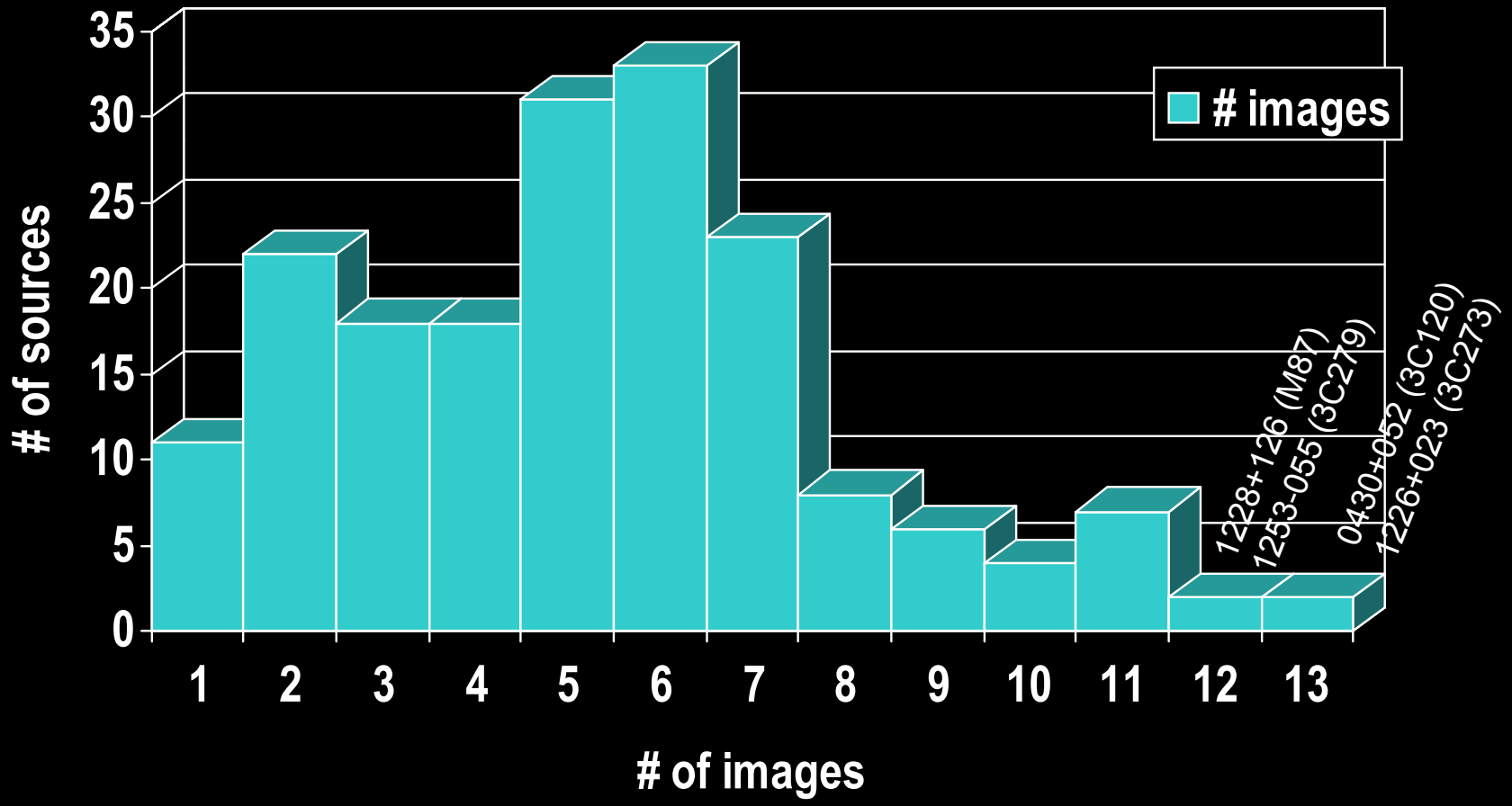
- » 110 QSOs
- » 35 BL Lacs
- » 22 Radio Galaxies

! Complete Sample: MOJAVE (133 objects)

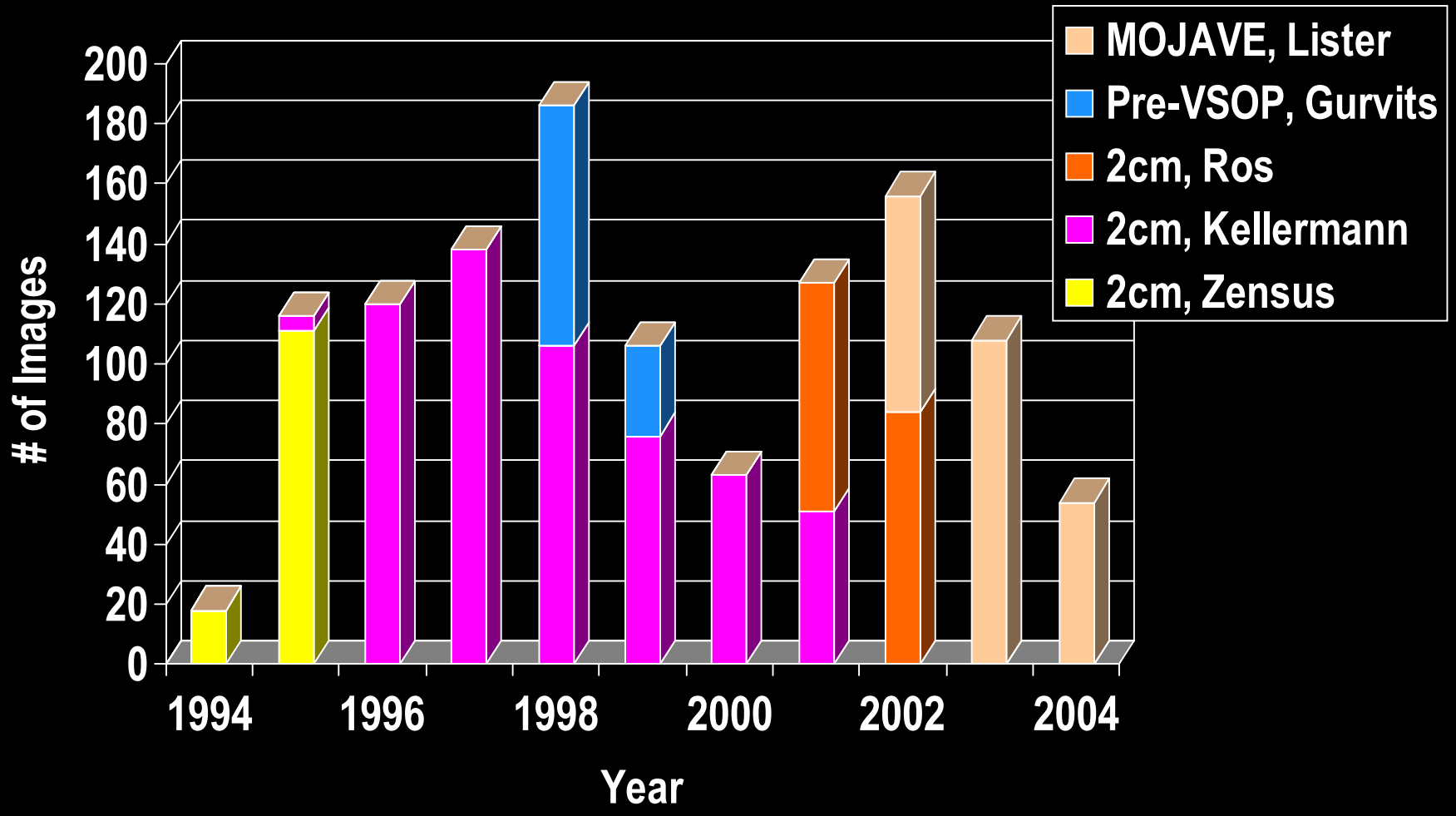
Results so far - Imaging

- First 132 sources: Kellermann et al. AJ 115, 1295 (1998)
- Additional 39 sources: Zensus et al. AJ 124, 662 (2002)
- Individual source studies:
  - NGC 1052: Vermeulen et al. A&A 401, 113 (2003)
  - 3C 279: Homan et al. ApJ 589, L9 (2003)
  - PKS 1345+125 (4C +12.50): Lister et al. ApJ 584, 135 (2003)

Source Sampling



Imaging on the Production Line

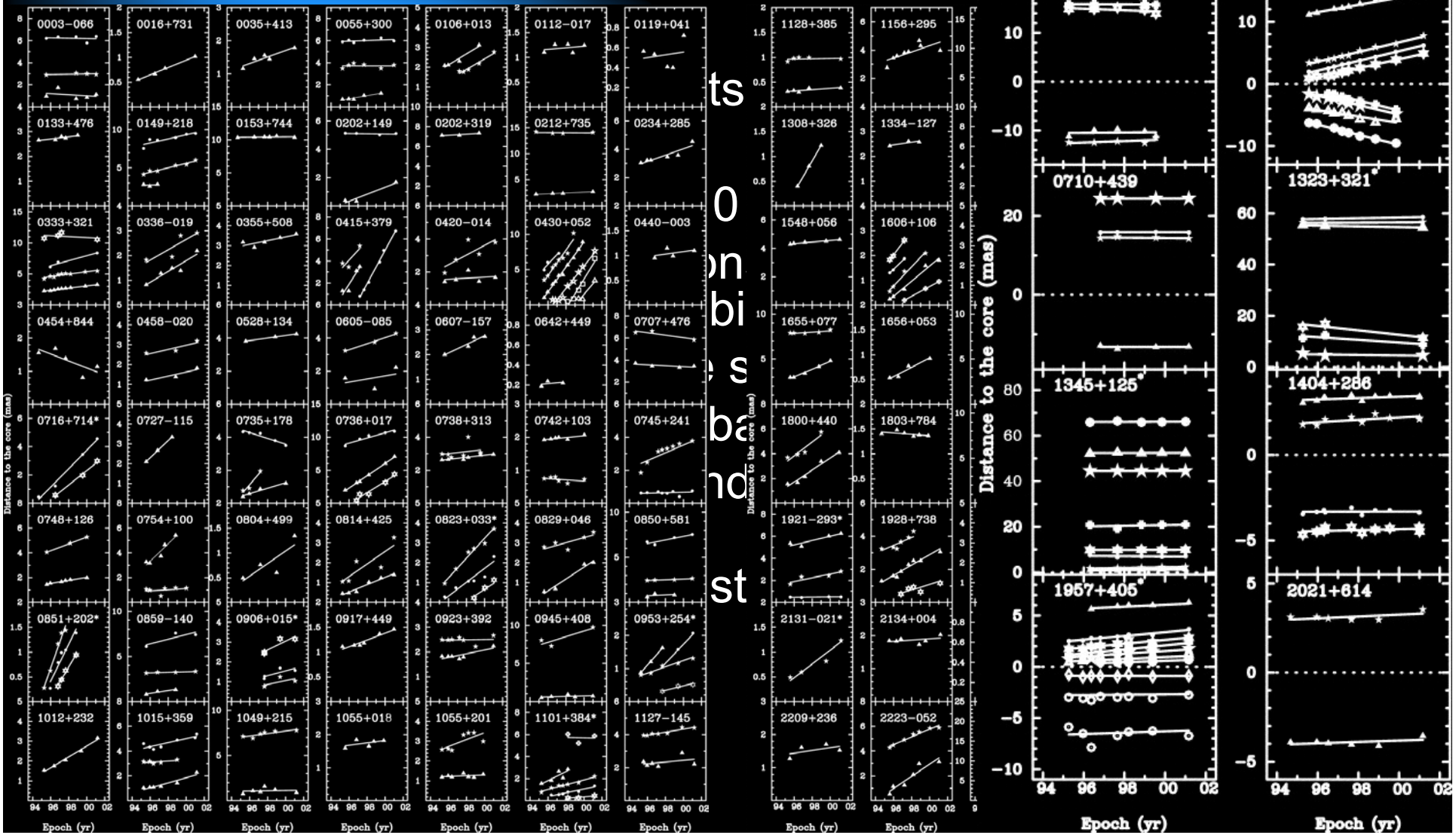


Kinematics - Analysis

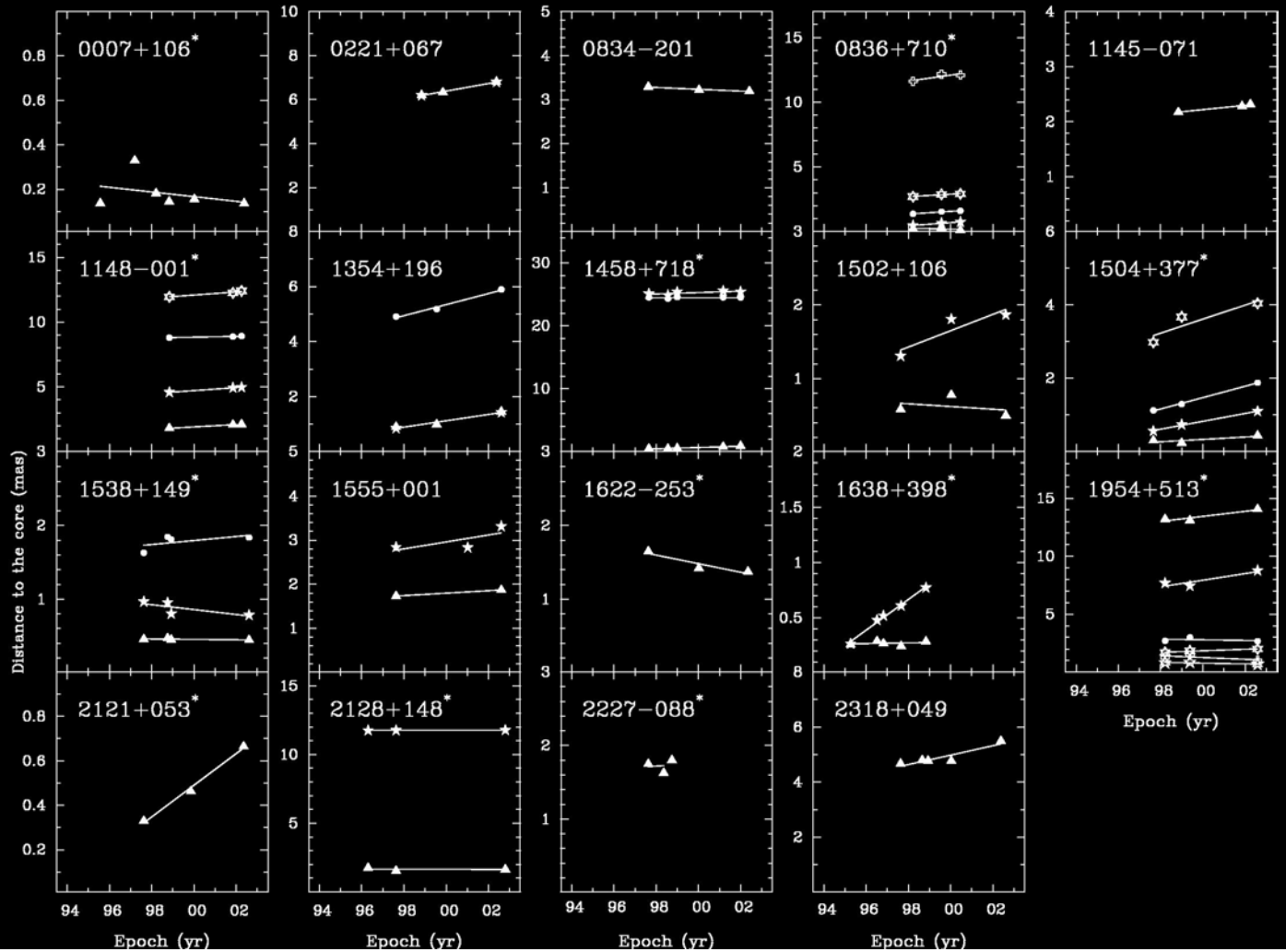
- Measurement of component positions using
  - JMFIT in AIPS
  - MODELFIT in DIFMAP
- Measured parameters:
  - Flux densities ! luminosities
  - Distance to core vs. time ! slopes ! β_{app}
  - XY positions ! non-radial motions?
  - Comparison with another parameters, like T_b, δ_{var}, etc.

Kinematics over 8 yr:

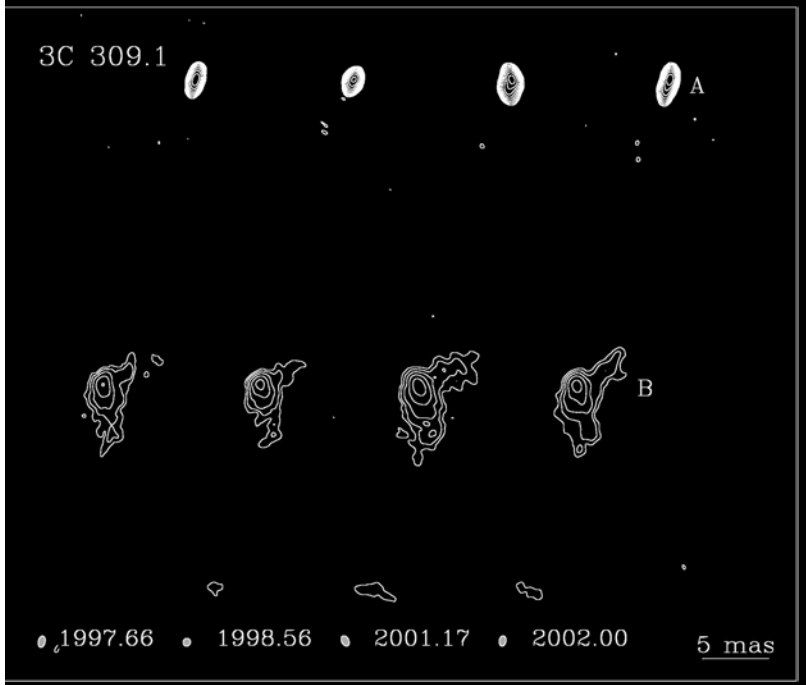
Kellermann et al. ApJ 609, 539 (2004)

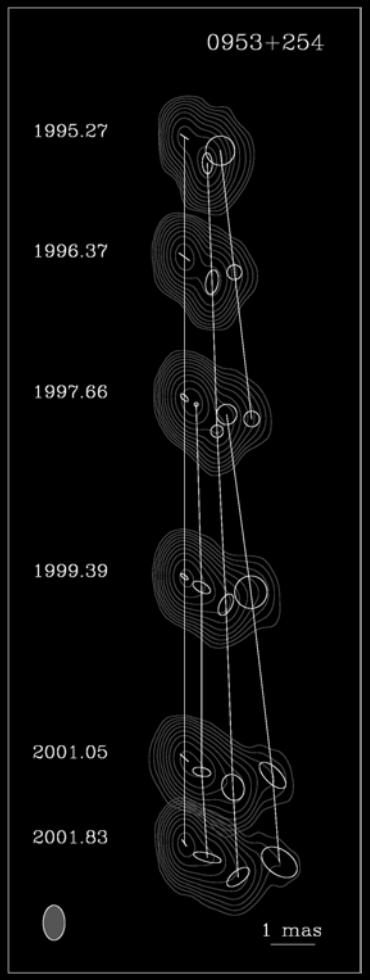


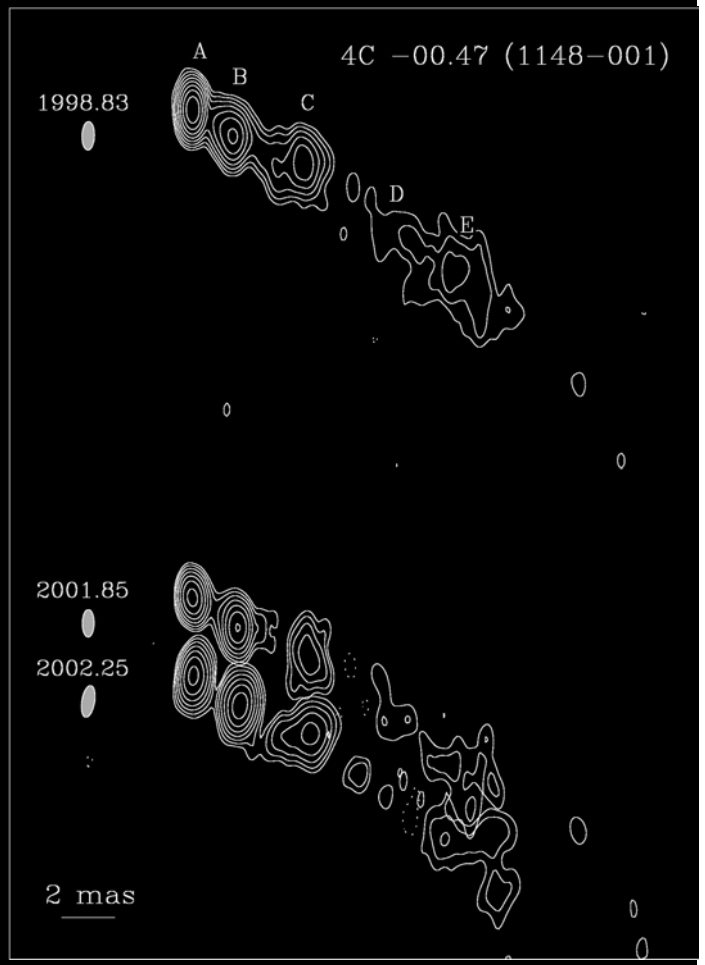
New measured kinematics (this work)



Additional Observations: Imaging Results

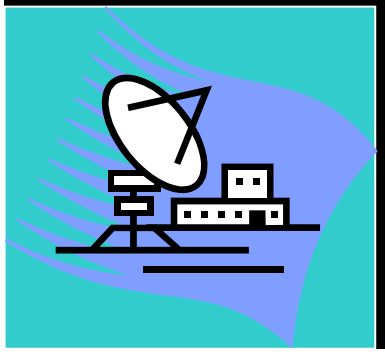






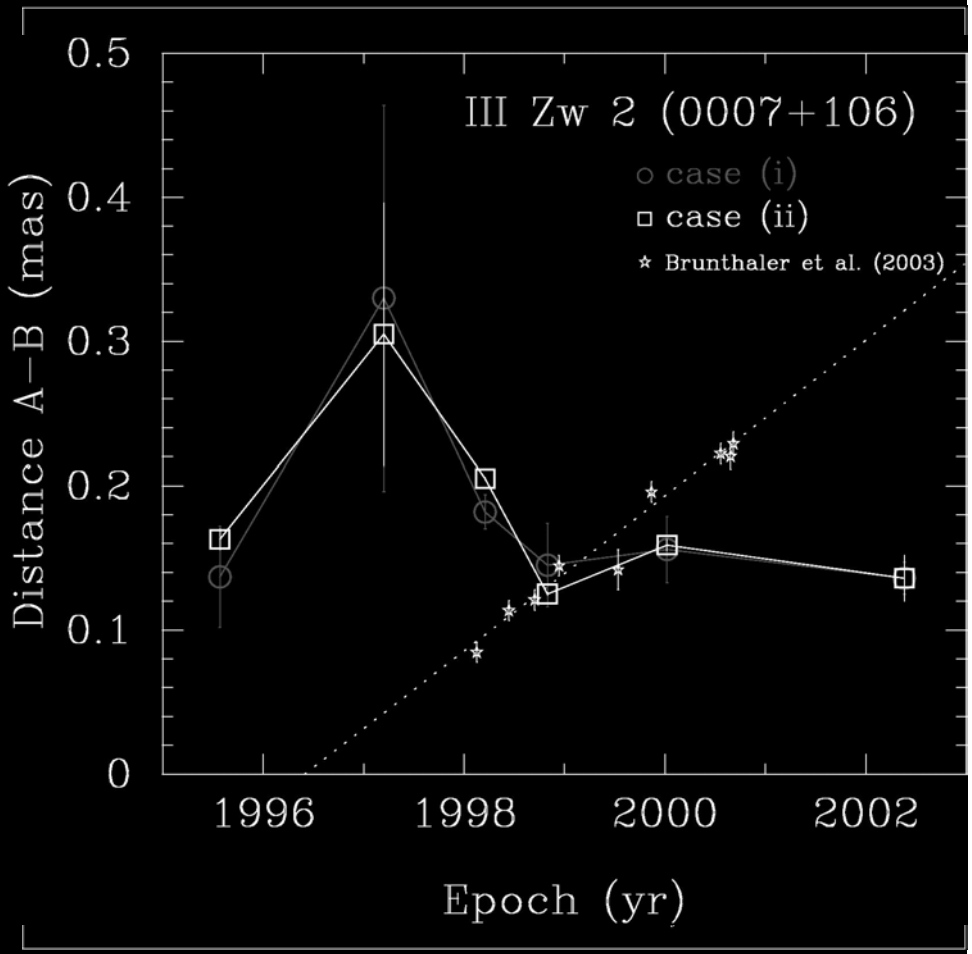
Compact Sources: not-so-unresolved

- 33 sources remain without measured kinematics
- 12 of those are compact (“naked” cores)
- ...but, are they so compact ?

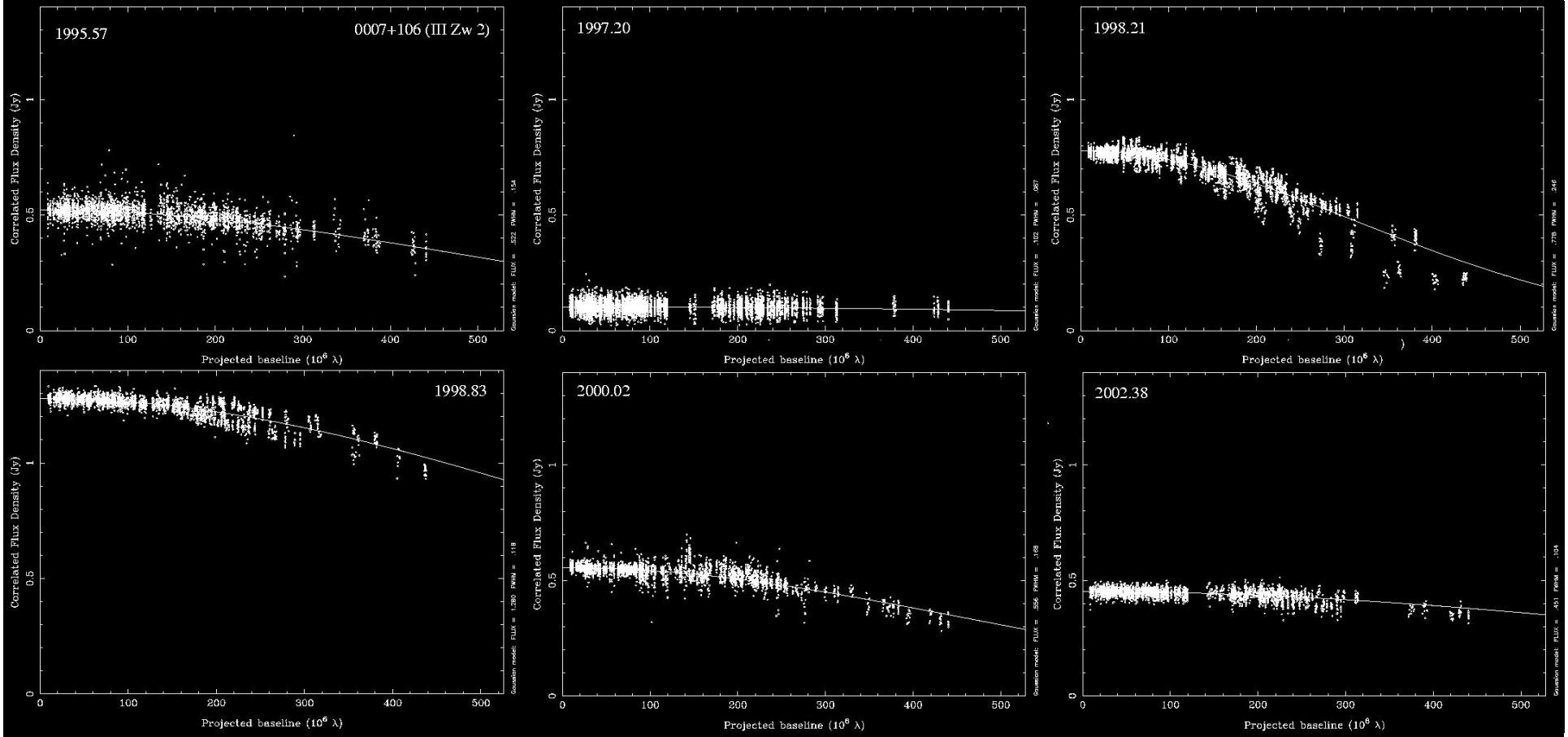


III Zw 2 (0007+106)

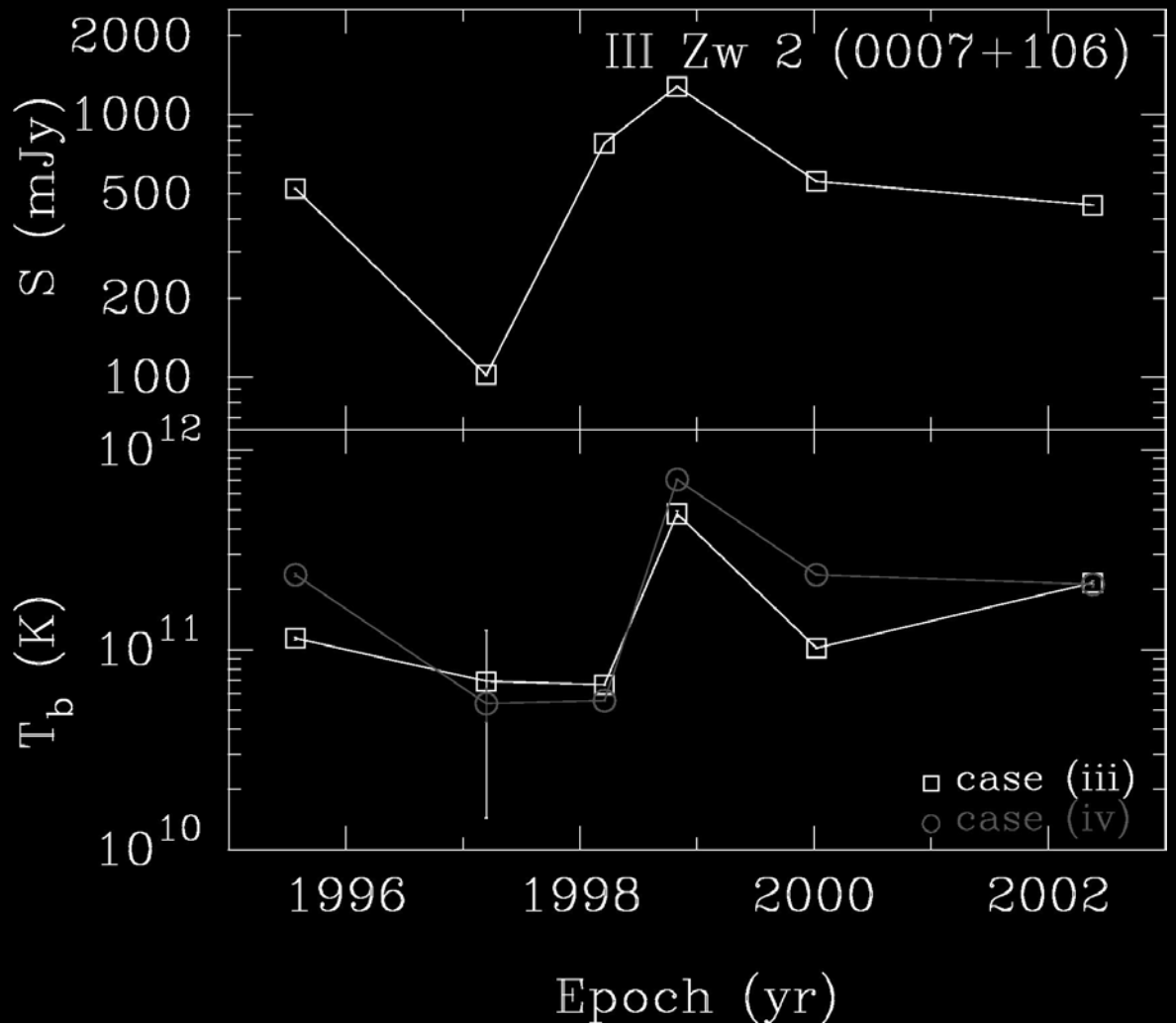
- Compact “radio intermediate quasar” (Falcke et al. ApJ 514, L17, 1999)
- Strongly variable
- Kinematic analysis (Brunthaler et al. PASA 20, 126, 2003): speeds of 0.6c
- We analyze the source with model fitting using one & two components (elliptical & circular)



III Zw 2: Visibility Plots

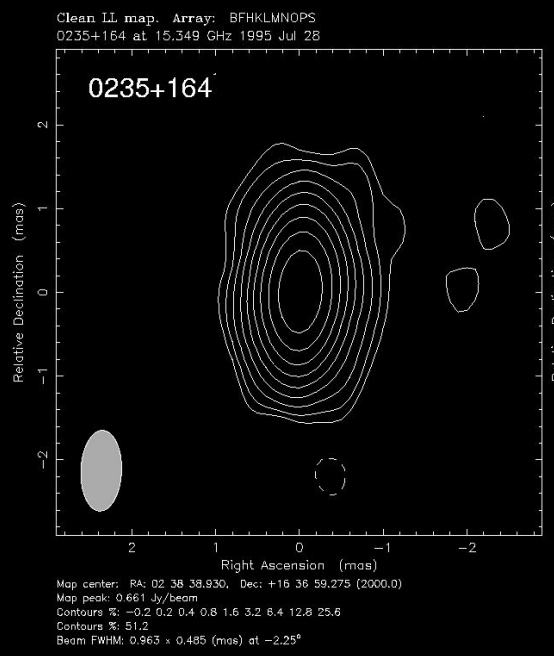


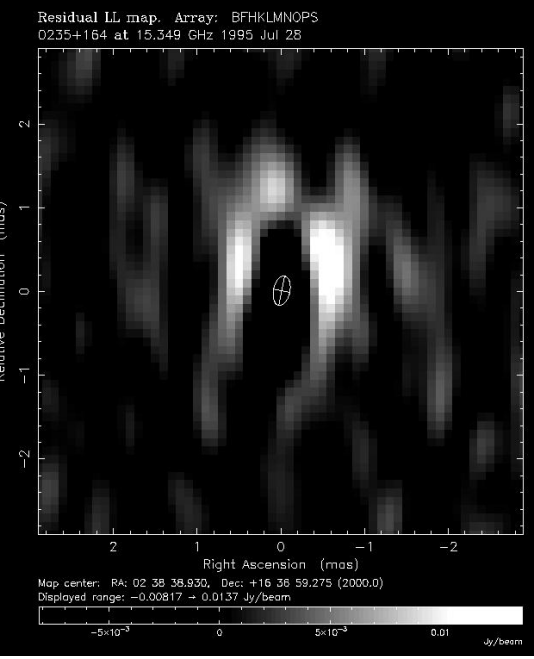
III Zw 2: S & T_b Evolution

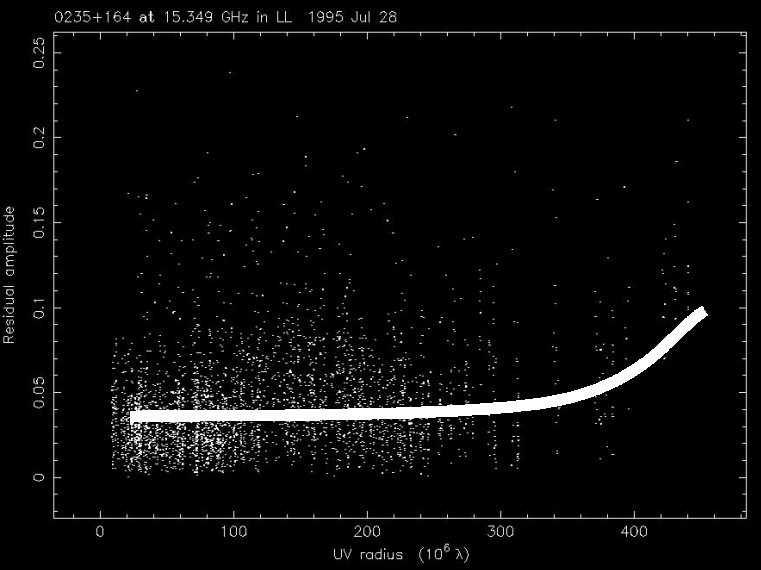


AO 0235+16 and its compactness

- Highly variable (Quirrenbach et al. A&A 258, 1992)
- Source shows very high T_b measurements (Frey et al. PASJ 52, 975)
- Hints for nortward jet (e.g., Kovalev, priv. comm.)
- Single Gaussian model fitting show residuals







Coming soon…

- Fine Scale Structure Study: Kovalev et al. (in prep.)
- MOJAVE sample: 133 objects. Linear & Circular Polarization Images: Lister et al., Homan et al. (in prep.)
- Homogeneity of Sources & Cosmological Evolution: Arshakian et al. (in prep.)
- NGC 1052 with VLBI and with X-rays: Kadler et al. (submitted), Ros et al. (in prep.)
- Brightness Temperature Analysis: Lobanov et al. (in prep.)
- X-ray properties of the 2cm Survey sources: Kadler et al. (in prep.)
- …

Summary – The VLBA 2 cm Survey Continued

- Unprecedented VLBI imaging database at high radio frequencies
- Monitoring: jet kinematics, flux density measurements, general physical properties of a representative sample of AGN
- Additional observations in 2001/02 extend and deepen into the sample
- Have a look to your favourite source at http://www.nrao.edu/2cmsurvey !