The VIPS Program: Outline, Results, Plans

presented by
Joe Helmboldt

The VIPS collaboration is:
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Motivation

Our knowledge of the physics/evolution of AGN and jets would be significantly improved by VLBI imaging/polarimetry survey of large (~1,000 AGN) sample

*will provide mas/pc-scale images of sources that will be detected by GLAST

*will yield sample of polarized core-jets large enough to statistically explore any relation between jet direction and core magnetic field and nature of B-fields within jets

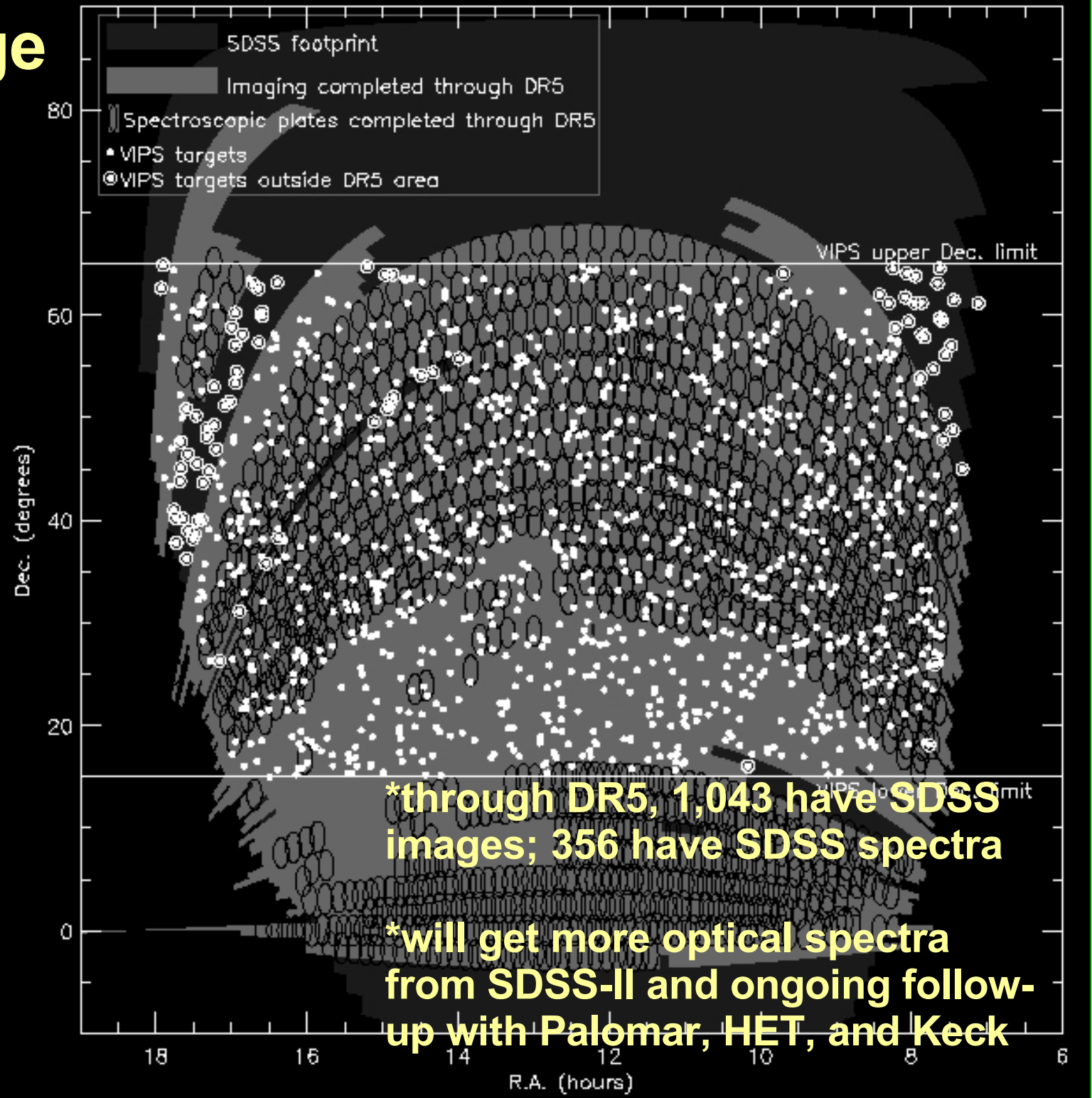
*will provide relatively large samples of Compact Symmetric Objects (CSOs) and small separation supermassive binary BH candidates

=> Selected 1,127 flat spectrum (spec. index>-0.5) sources from CLASS brighter than 85 mJy at 8.5 GHz

Sky Coverage

*169 sources observed previously with VLBA at 5 or 15 GHz

*have obtained new VLBA data at 5 GHz for remaining 958 sources in full polarization



*through DR5, 1,043 have SDSS images; 356 have SDSS spectra

*will get more optical spectra from SDSS-II and ongoing follow-up with Palomar, HET, and Keck

Observations and Data Reduction

*observed each source with four 8 MHz wide, full polarization IFs => 4609, 4679, 4994, and 5095 MHz

*had bit rate of 256 Mbps thanks to Mk 5 disks purchased by UNM and Stanford for VLBA

*observations completed in 18 runs of about 11 hours each with 52-54 VIPS sources per run from January to August 2006 => each VIPS target observed for ~500s over 10 scans

*scheduling was done with updated version of VLBA SCHED program

*calibration and imaging done in automated way using VLBA reduction pipeline and DIFMAP scripts => maps of <1% of sources redone "by-hand" in DIFMAP (usually emission beyond boundary of default image size)

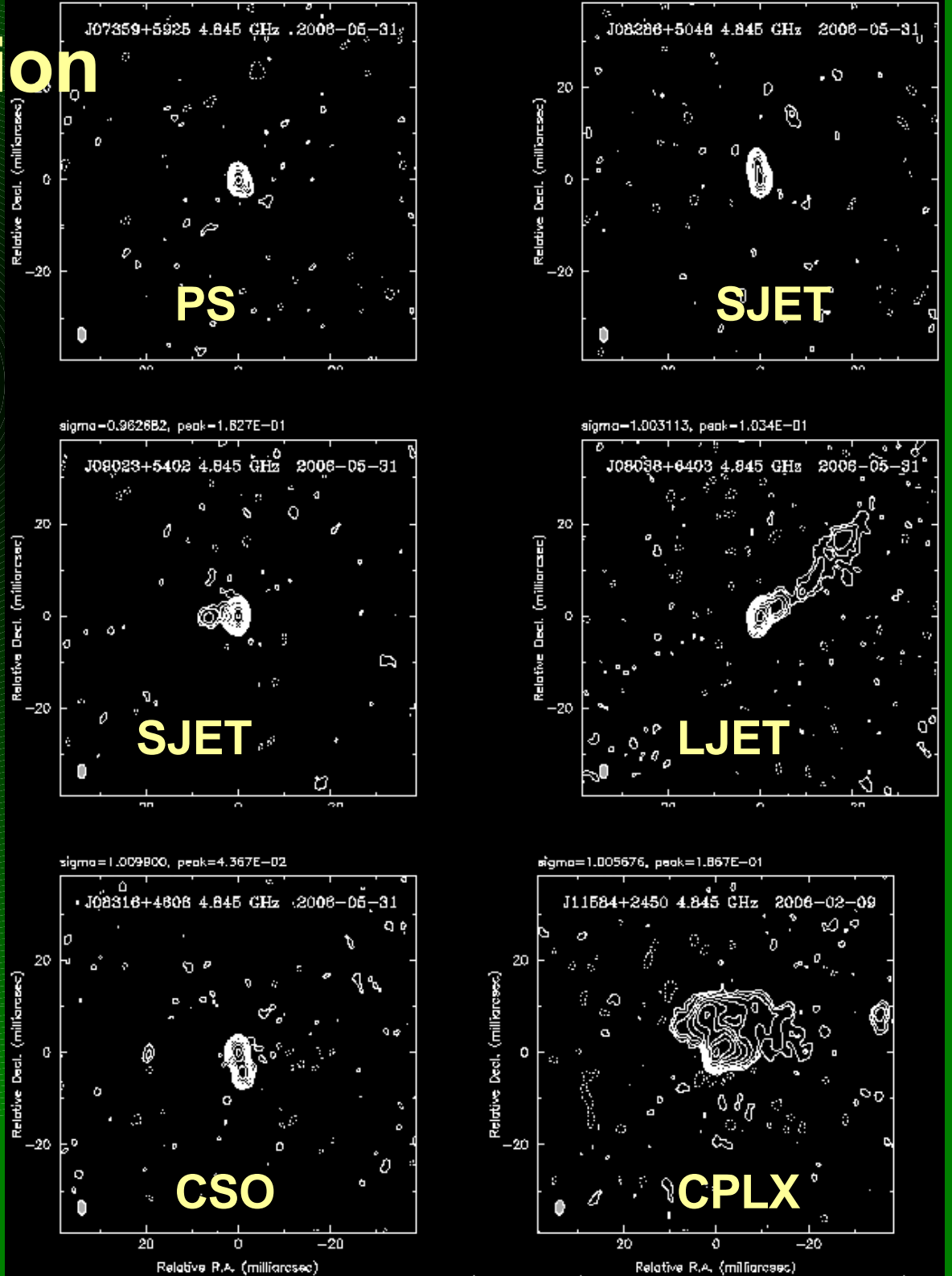
*reached typical rms noise level of 0.2 mJy/beam; inspected visibility data for sources with peak <20 mJy to make sure no false point sources created by self-cal => flagged 11 out of 27 of these as non-detections

Source Classification

*developed an algorithm that uses Gaussian components fit to peaks in I images. Put sources in one of 5 categories: PS, SJET, LJET, CSO, or CPLX

*automatic classifications agree well with “by-eye” approach, especially for peak flux densities > ~50 mJy

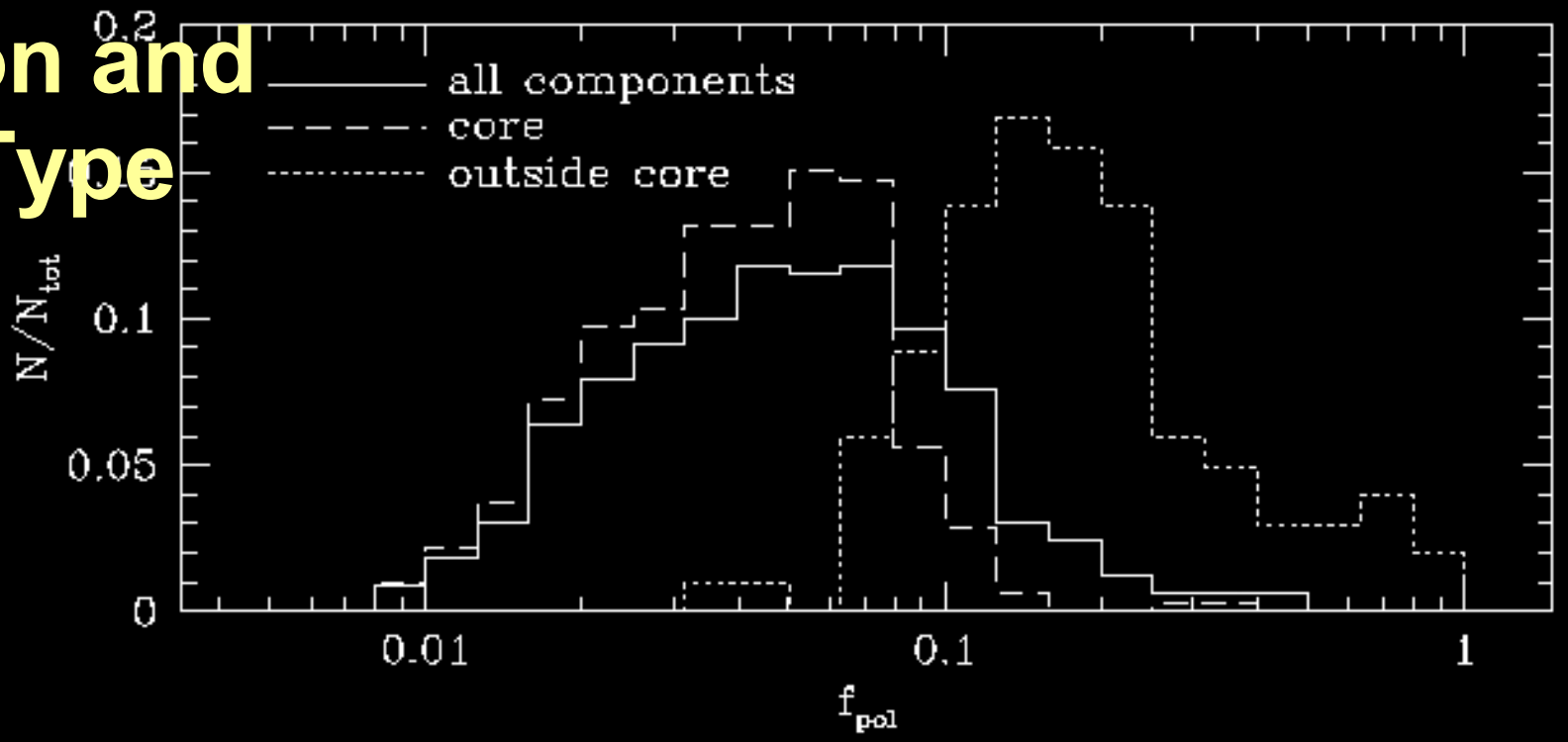
*still agrees ~80% of the time for faint (<20 mJy) sources

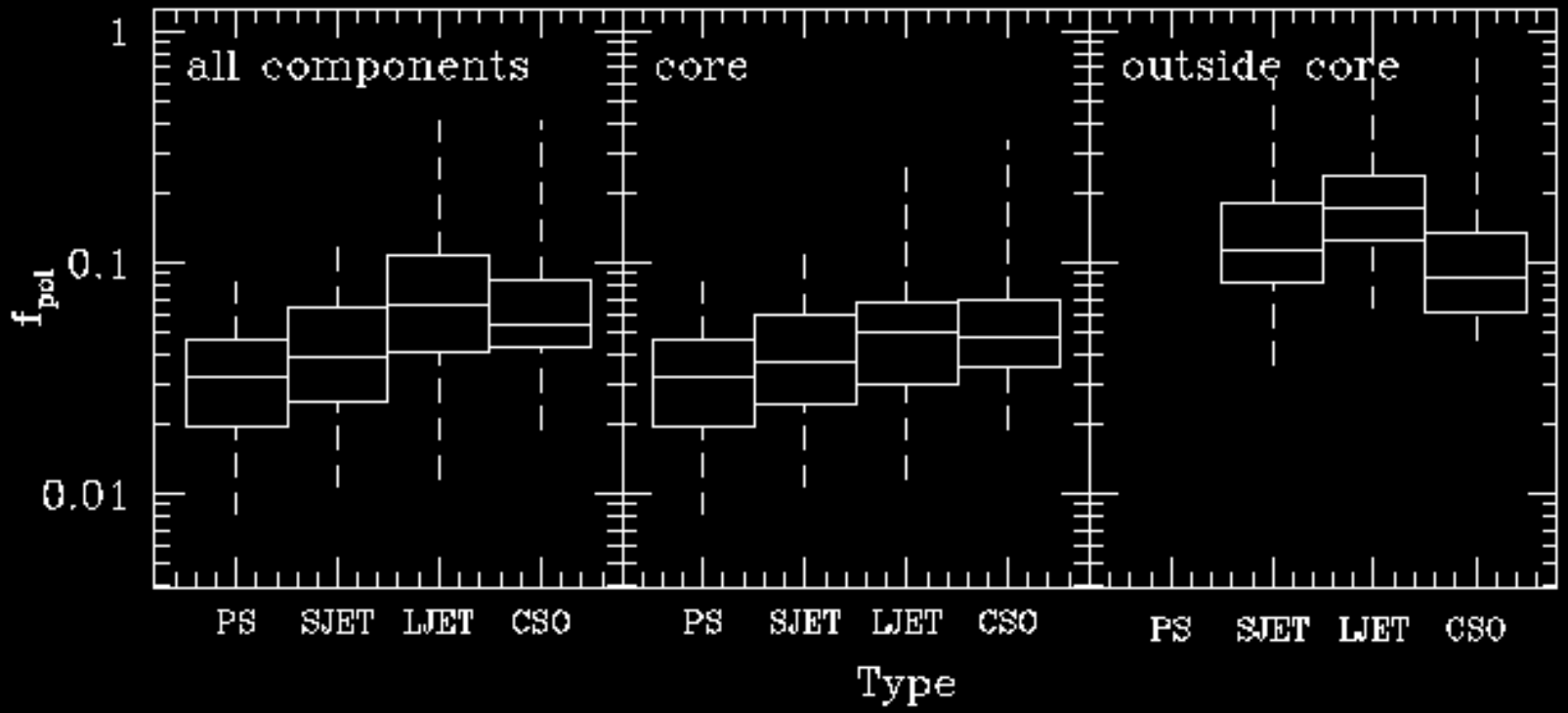


Polarization and Source Type

*fractional polarization typically ~5%; about 3 times higher outside core

*also, typically higher for LJET sources that for other types

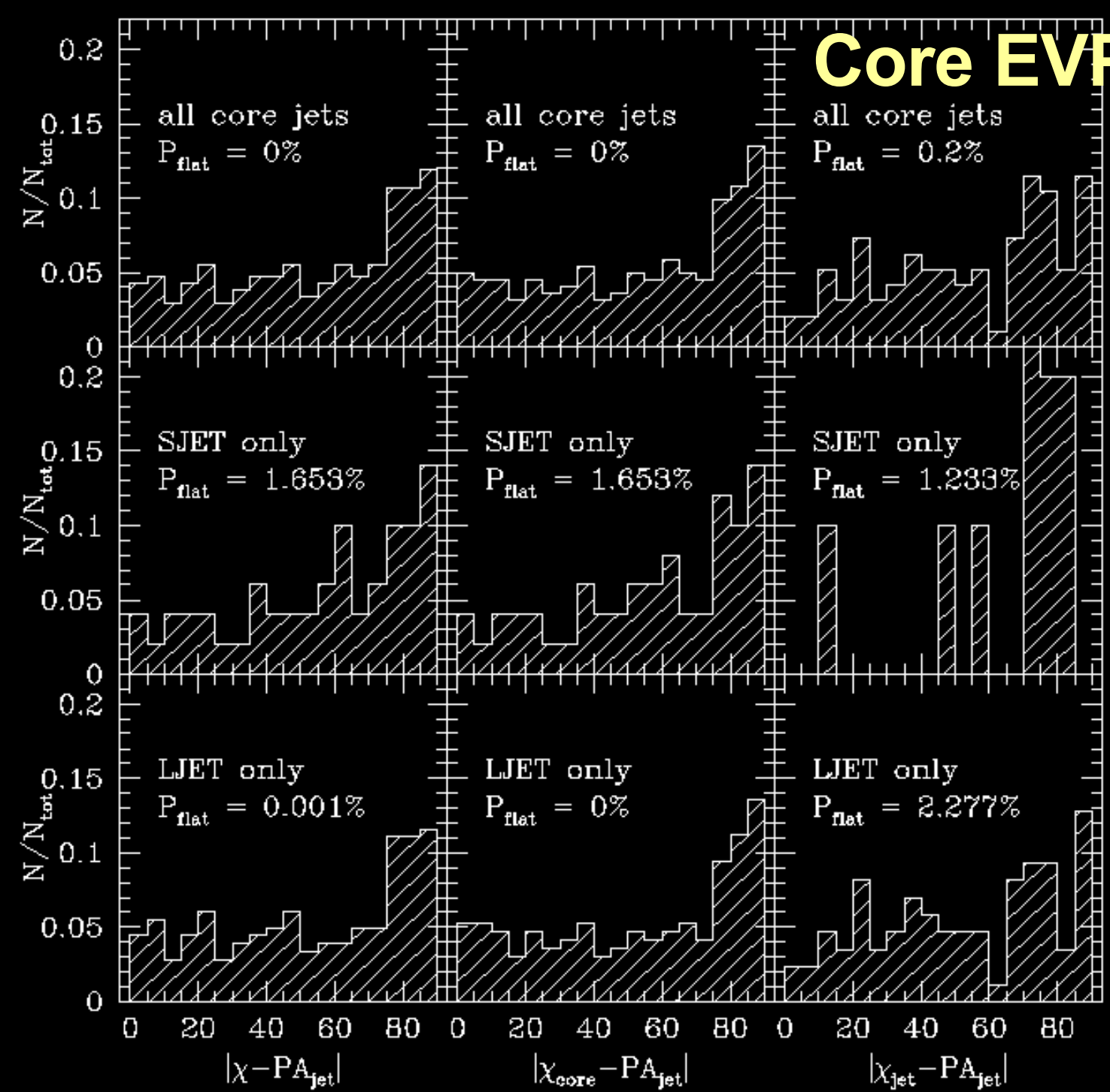


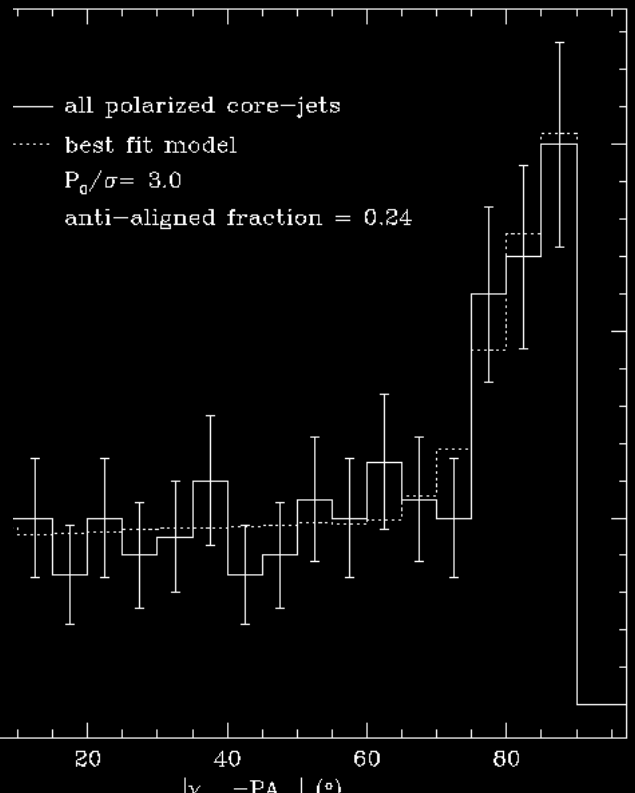


Core EVPA and Jet PA

*data indicate that core EVPA is perpendicular to jet PA in about 24% of core-jets

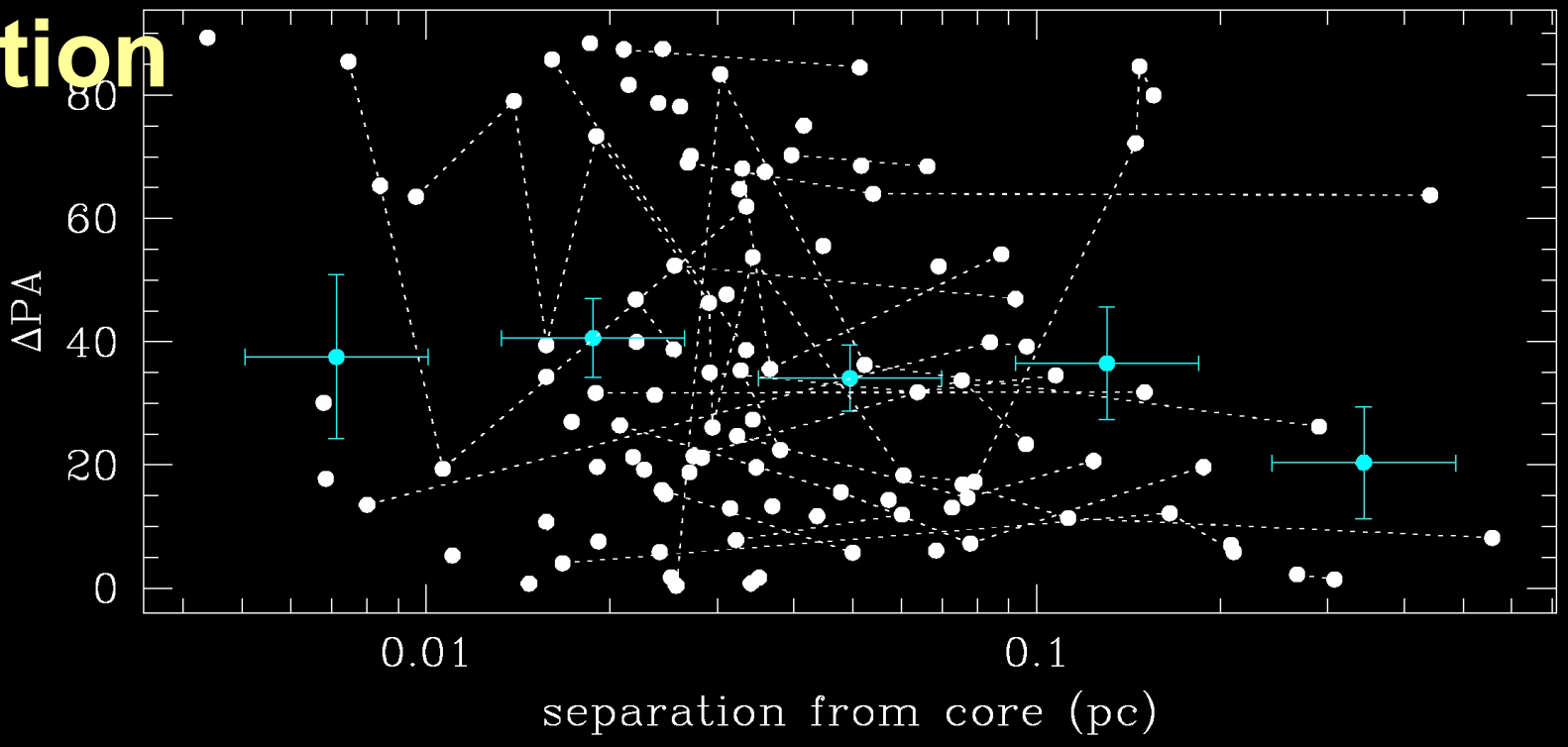
*Faraday rotation affects this analysis significantly

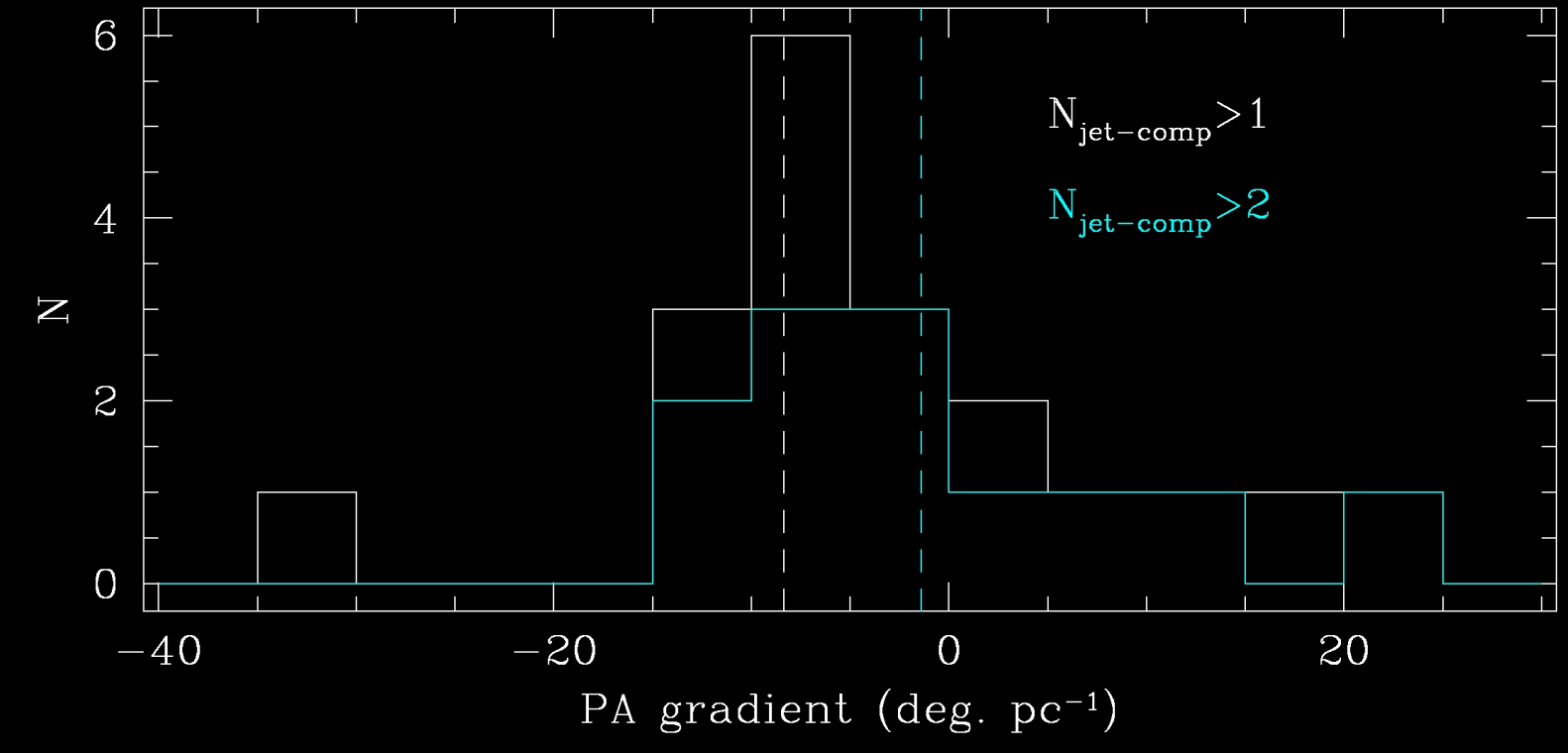




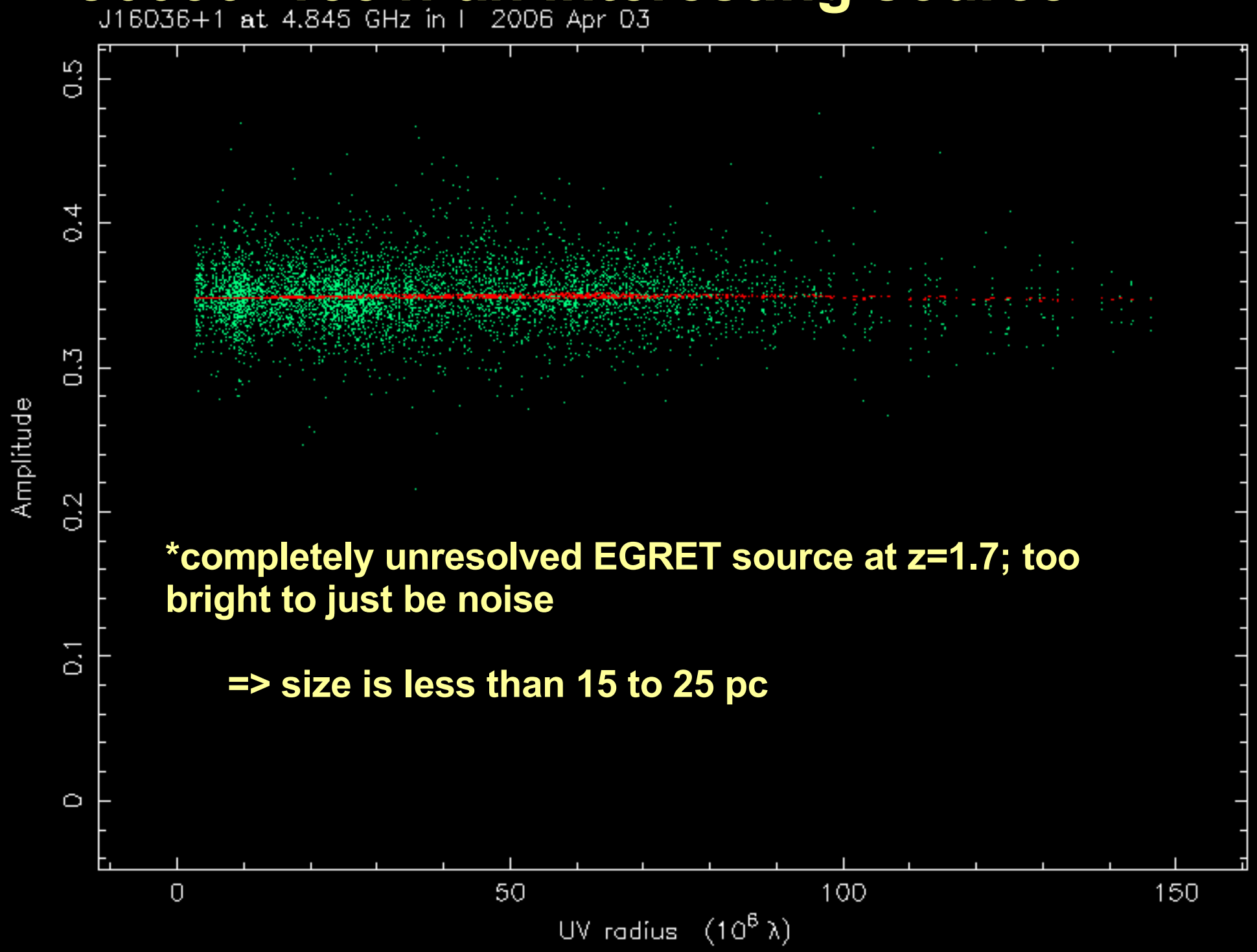
Jet Collimation

*combination of VIPS and FIRST provides some statistical evidence for jet collimation from pc to kpc scales





J6036+1554: an interesting source



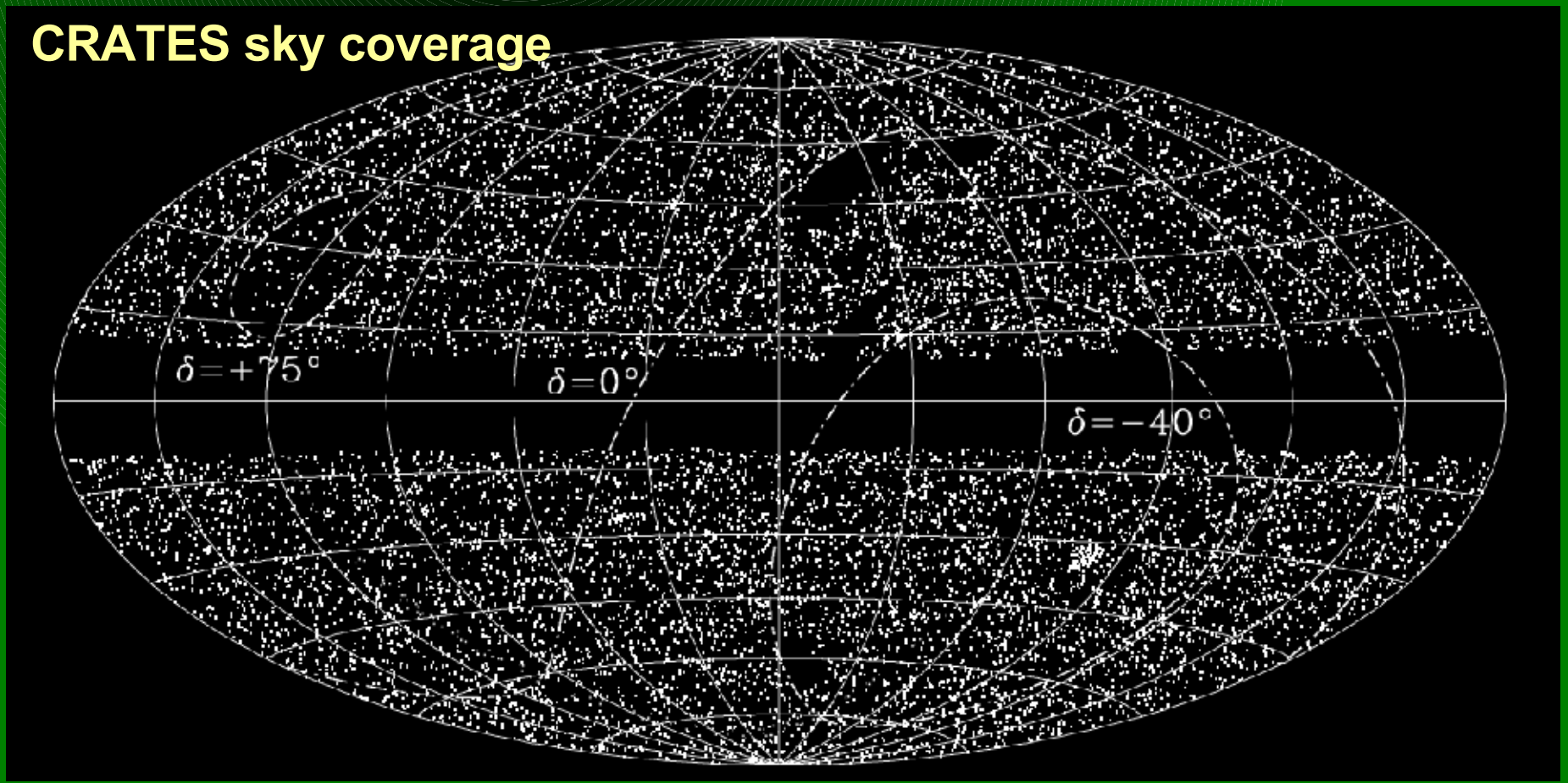
***completely unresolved EGRET source at z=1.7; too bright to just be noise**

=> size is less than 15 to 25 pc

Data at Other Wavelengths

*SDSS+ongoing optical follow-up will give us redshifts/distances as well a classifications (e.g., FSRQ, BL Lac)

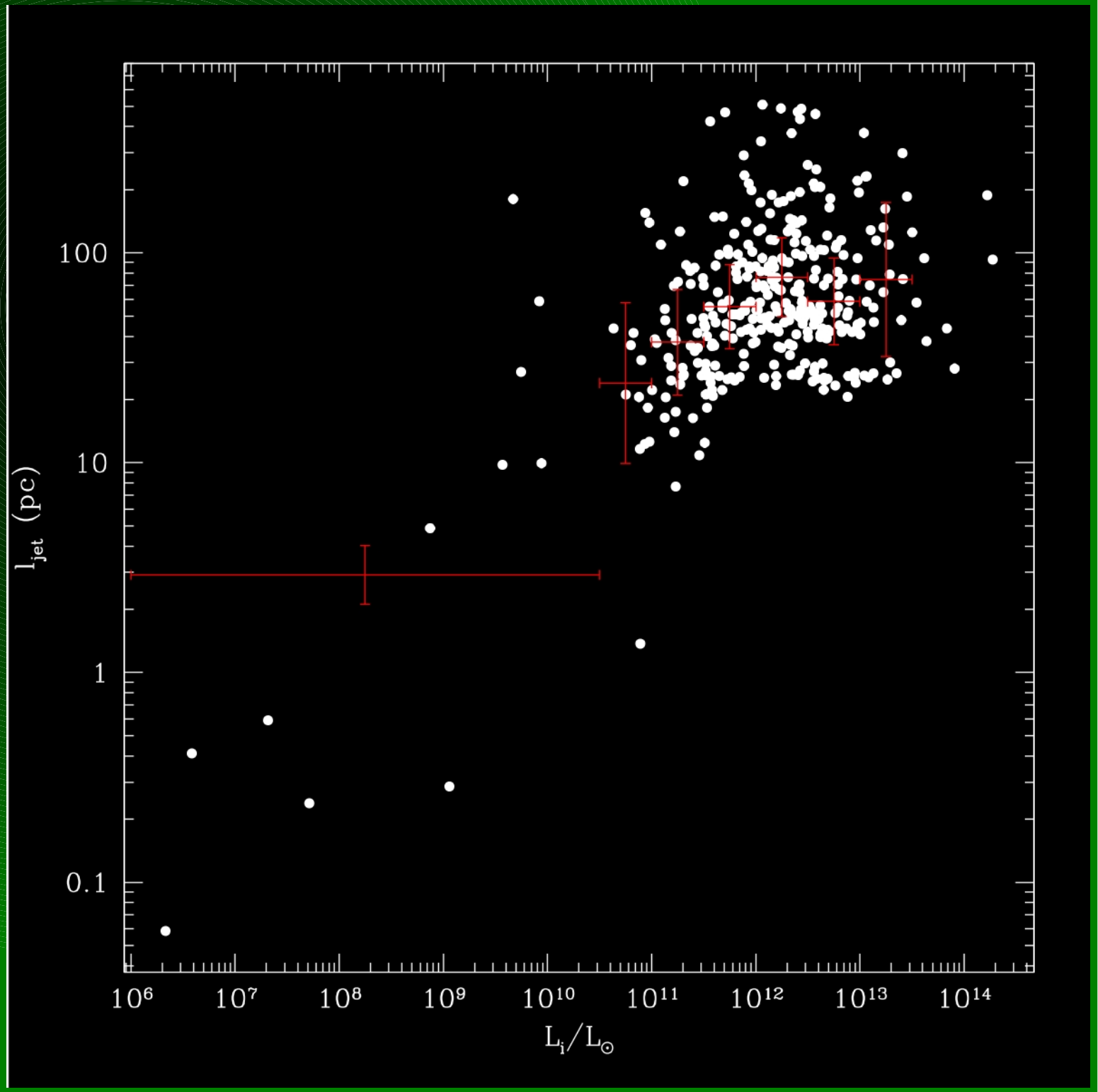
*also have help from spectral index and morphology info within the Combined Radio All-sky Targeted Eight GHz Survey (CRATES; Healey et al. 2007) catalog of 11,131 sources



Jet Length and Optical Luminosity

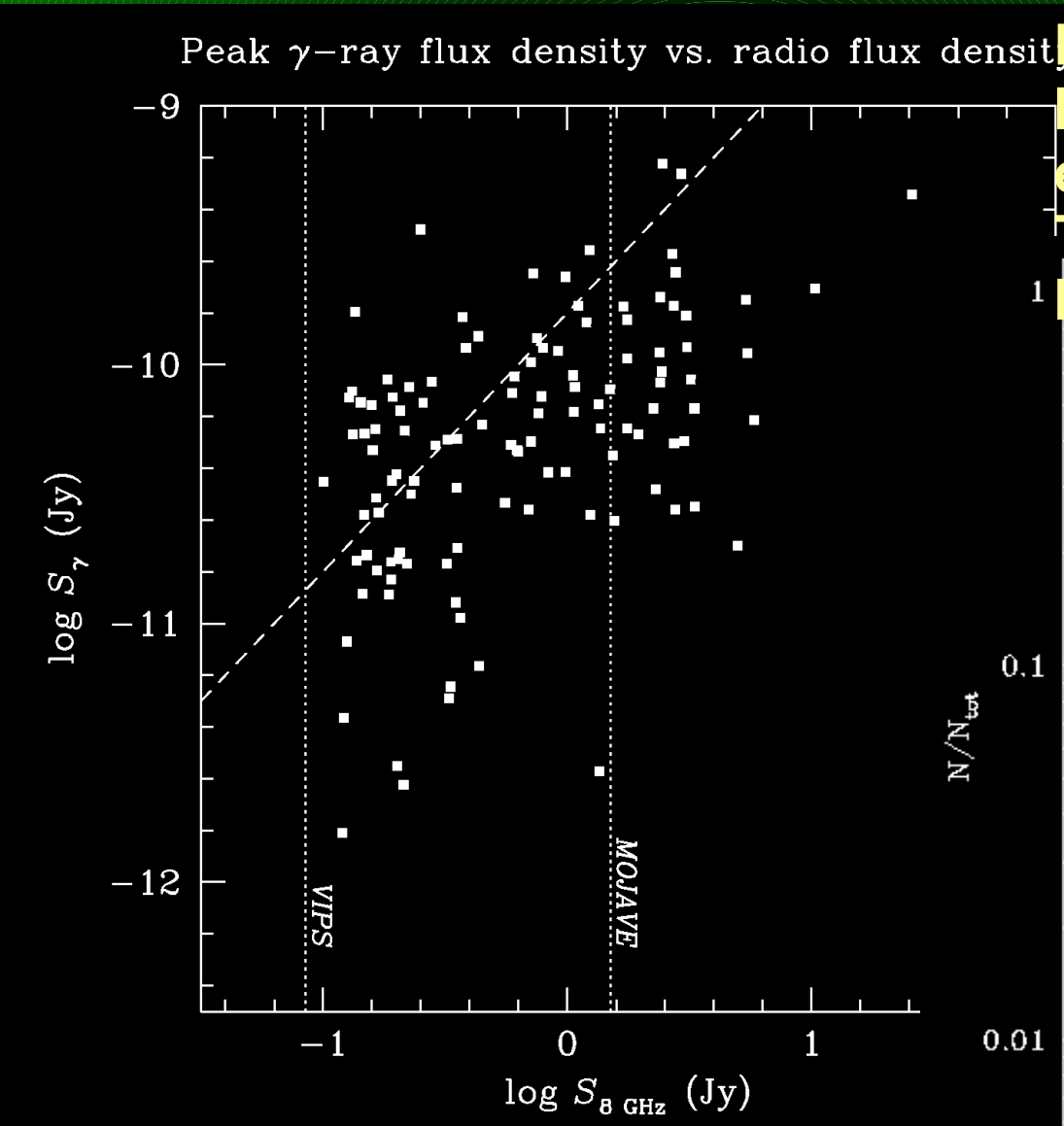
*current optical data reveals existence of trend between optical (SDSS i-band) luminosity and jet length

*once optical follow-up is complete, will be able to better explore this at lower optical luminosity

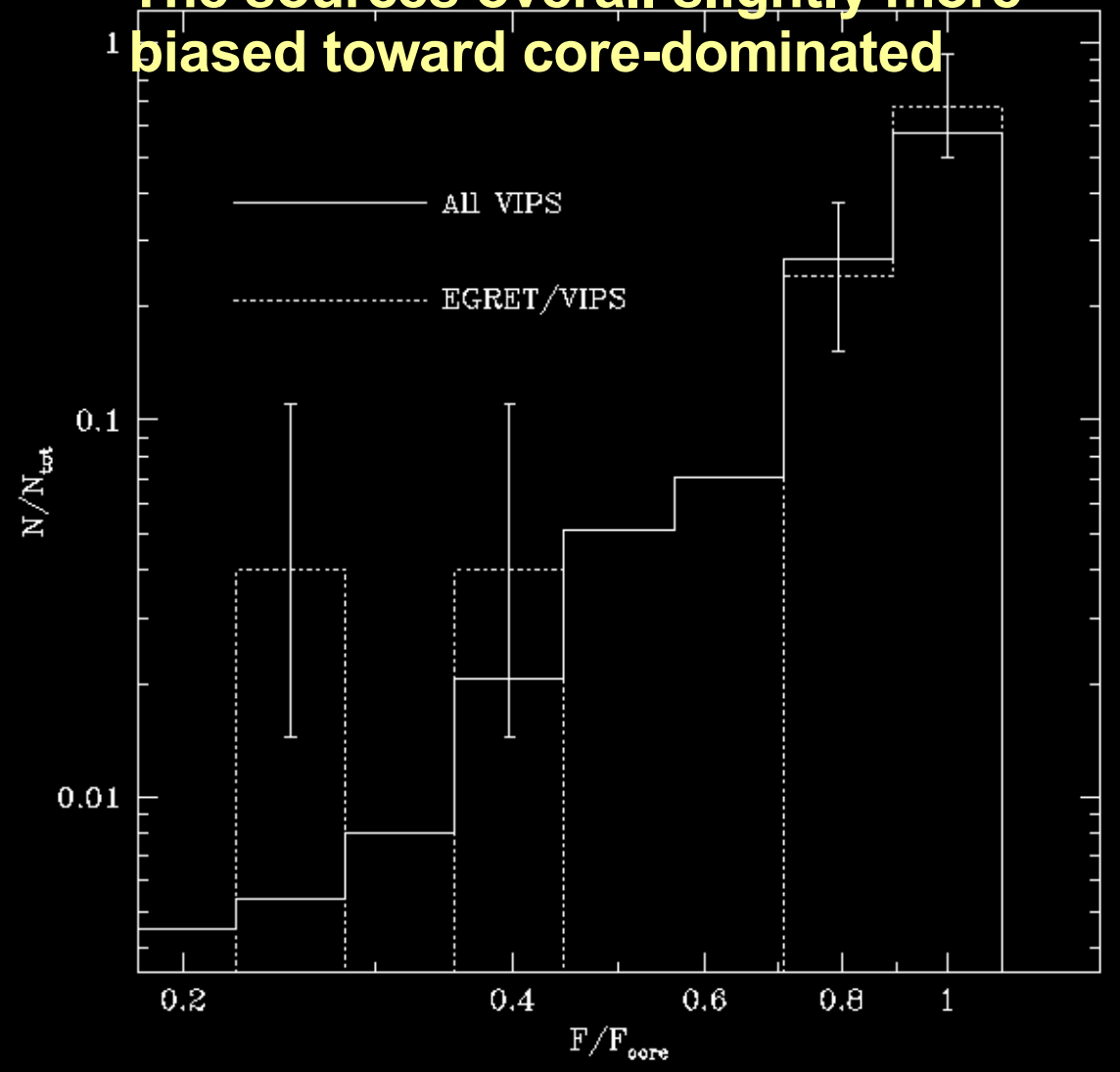


VIPS and the Gamma-ray Regime

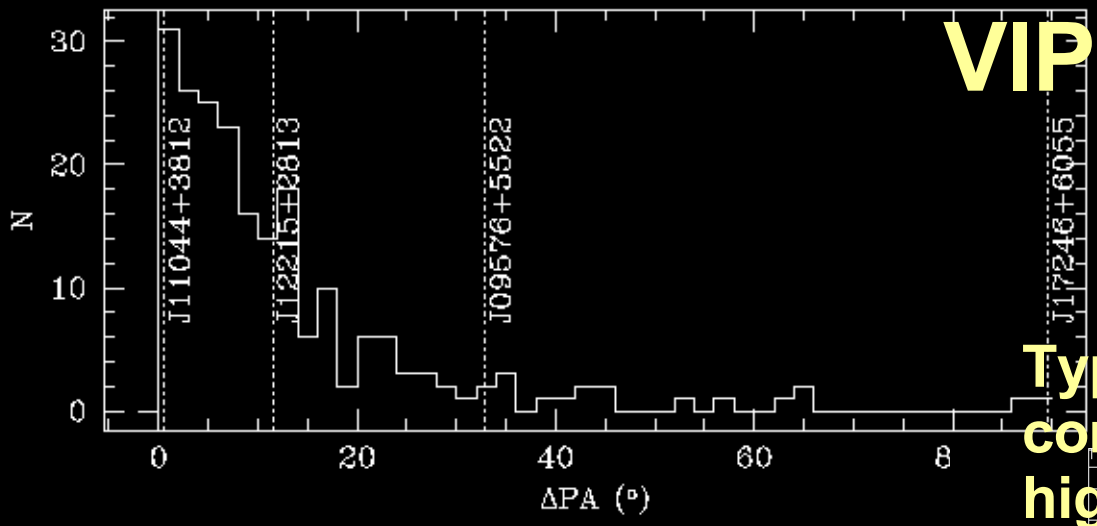
EGRET sources in CRATES

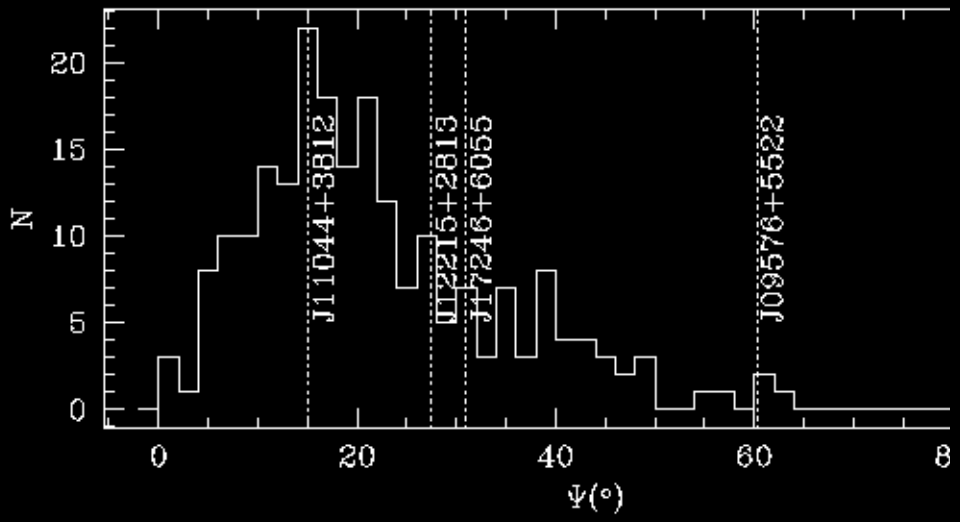


EGRET sources in VIPS: significant lack of CSO candidates (none) and excess of core-jets (factor of ~1.5). The sources overall slightly more biased toward core-dominated

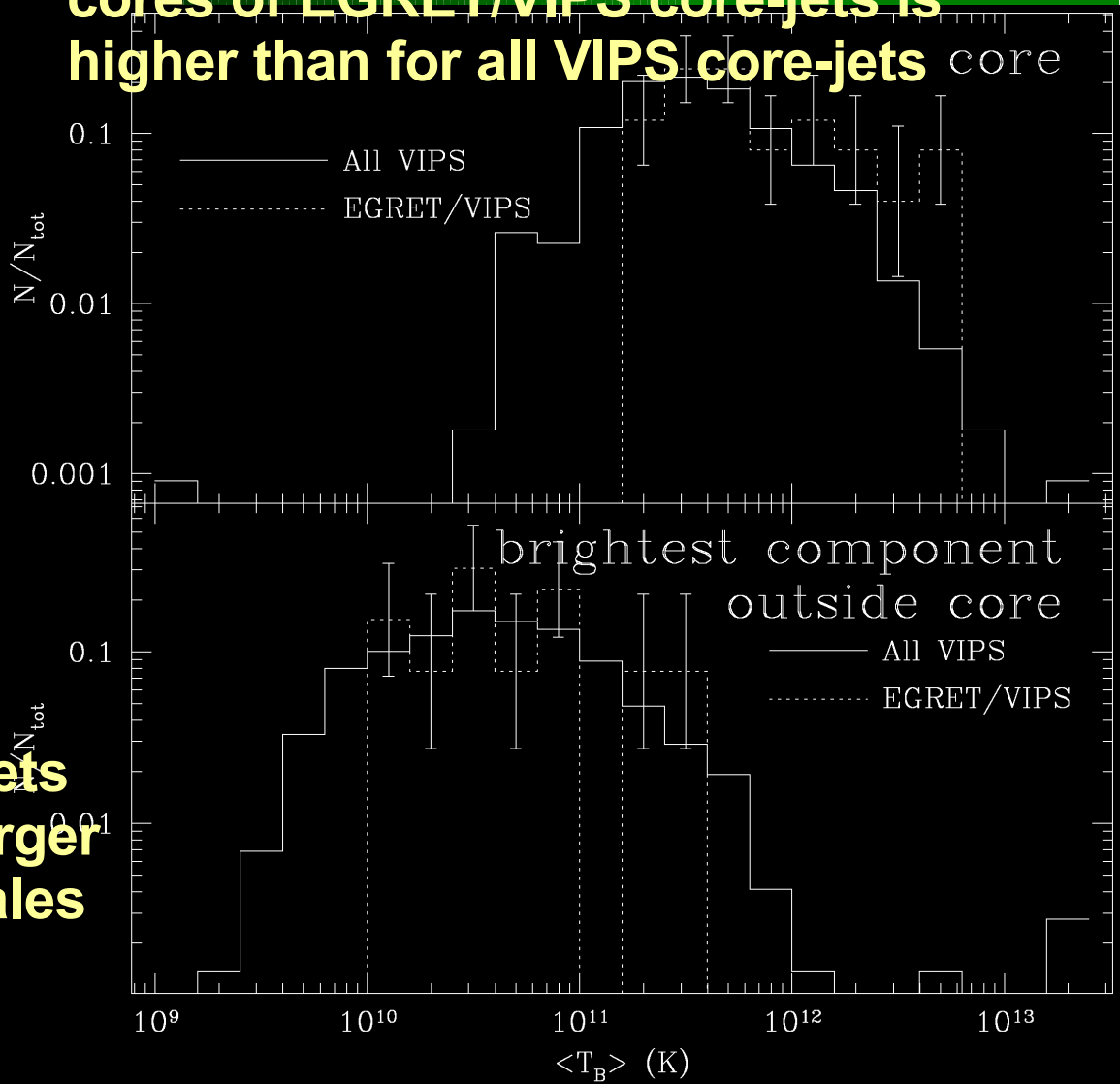


VIPS and the Gamma-ray Regime (cont.)





Typical brightness temperature for the cores of EGRET/VIPS core-jets is higher than for all VIPS core-jets



Some hint that EGRET/VIPS core-jets have larger amount of bend and larger opening angle on mas (~50 pc) scales than all VIPS core-jets

http://www.phys.unm.edu/~gtaylor/VIPS

*lots of data products available on the web:

PDF and GIF contour maps and visibility plots

FITS uv data and I, Q, and U maps

Q and U maps for each of 4 IFs and for two pairs of IFs

*also see recent paper: Helmbodt et al. 2007, ApJ, 658, 203

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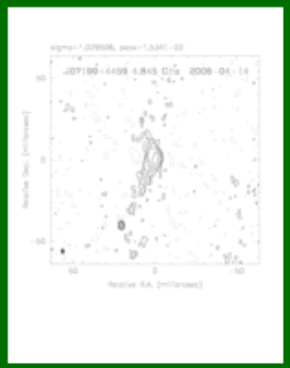
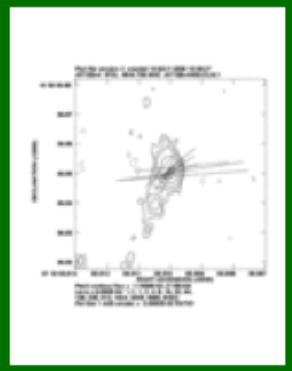
The VLBA Imaging and Polarization Survey, VIPS for short, is initially a high dynamic range 5 GHz polarization survey with the Very Long Baseline Array of about one thousand Active Galactic Nuclei (AGN). The parent sample is the Cosmic Lens All Sky Survey in the region covered by the Sloan Digital Sky Survey in order to facilitate multi-wavelength science. Interesting sources are followed up for simultaneous new 5 GHz and higher frequency (15 GHz anticipated) observations to obtain Spectral Index and Rotation Measure maps.
The VIPS collaboration

J07199+4459

07h19m55.5116s +44d59'06.854"

VIPS source # 2

5 GHz polarization data

5 GHz Stokes I image	5 GHz Polarization image	5 GHz visibility plot	FITS files
			VLBA UV data Stokes I image Stokes Q image Stokes U image
PDF GIF	PDF GIF	PDF GIF	

Follow-up Programs

*optical follow-up is ongoing (~50% done); aiming for ~90% completeness in redshifts and ~95% completeness in identifications

*follow-up with the VLBA at 5, 8, and 15 GHz is currently underway for about 20 good SBBH systems

*follow-up VLBA proposal at 5, 8, and 15 GHz for ~90 CSO and SBBH candidate systems has been submitted

*considering proposals to monitor a modest sample of polarized core-jets at 5, 8 and 15 GHz that should be detected by GLAST and to trigger VLBA monitoring of VIPS sources that are observed by GLAST to flare