Compact Symmetric Objects in the VLBA Imaging and Polarization Survey

A study of half-pint radio galaxies

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Compact Radio Sources
Blazars

Size:
No Limit

Orientation:
Looking down the jet

Characteristics:
High Variability
High Polarization
Superluminal Motion

Marscher et. al
Compact Symmetric Objects

Size:
< 1 kpc (projected)

Orientation:
‘Close’ to the plane of the sky

Characteristics:
Low Variability
Low Polarization
Often CSS/GPS sources

Sources could be:
Young
Frustrated
Periodic
VIPS: Source Classification

- Point Source 276
- Short Jet 241
- Long Jet 471
- CSO Candidate 103
- Complex 17
- Not Detected 11
CSO Candidates
Follow-up Observations
- 5, 8, 15 GHz VLBA
- Full polarization

Spectral classification:
$$F_{\nu} \propto \nu^\alpha$$

Kinematic Analysis
Ages/Dynamics

Polarization Analysis
The Numbers

- Confirmed CSOs - 24 (~2% VIPS)
- FR1 morphologies - 4 (~17%)
- Cores detected - 16 (~67%)
- Redshifts - 16 (~67%)
- Detected @ 15 GHz - 15 (~63%)
- Polarized - 2 (~8%)
- CSO Candidates - 33 (~3% VIPS), 5 ‘Hybrid’
Histogram of CSO Sizes (Hotspot-Hotspot)
Q&D Age Estimates

CSO 'Age' Histogram

Age (years) vs. Number

Age values range from 500 to 9000 years.
Size and Luminosity

Size vs. Luminosity

Luminosity_5GHz (W)

Size (pc)

CSOs
FRI-like CSOs

Graph showing the relationship between size and luminosity.
**Size and Angle Subtended**

**Correlation Coefficient: 0.63**
Core to Hotspot Length Ratios

CSO Arm Ratio Histogram

R_{bright}/R_{dim}

Number
Hotspot Flux and Arm Ratios

Flux Ratio vs. Arm Ratio
Hotspot Flux and Arm Ratios

Flux Ratio vs. Arm Ratio w/o J07414+271
Hotspot Flux and Arm Ratios

Flux Ratio vs. Arm Ratio w/o J07414+271

Correlation Coefficient: -0.28
Things not (or weakly) Correlated

- Size & Flux Ratio: -0.07
- Angle & Flux Ratio: -0.1
- Angle & Arm Ratio: -0.17
- 4.1% of 5 GHz total lobe flux density is polarized
- B-Fields ~ 0.06 - 2 µG
- Lobe flux density ratio (5 GHz): 1.59
1. 1.1% of 8 GHz total lobe flux density is polarized
2. B-Fields \( \sim 0.36 - 12 \mu G \)
3. Lobe flux density ratio (5 GHz): 19.36
VIPS CSOs

• Increases number of known CSOs by at least 1/2

• Gives ‘complete’ sample to study

• Indicates CSOs tend to ‘straighten out’ with size

• Polarization results consistent with Unification

• Needs further multi-frequency, multi-epoch ‘follow up’
Backup Slides
<table>
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<th>Source Name</th>
<th>Obs. Core?</th>
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Multi-scale SEDs
Polarized CSOs

• 3/4 Show abnormally high flux density ratios
• 4/4 Polarization detected in brightest Hotspot
• 1/4 additional detection of jet polarization closer to core as well
• 2/3 Exhibit low (100s rad m\(^{-2}\)) RMss