# THE ARCSECOND MORPHOLOGY OF COMPACT RADIO SOURCES

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As part of the VLA calibration program, 404 small angular size sources have been observed in the "A" array at both 6 and 20 cm with resulting resolutions of 0.4" and 1.2" respectively. Use of self-calibration techniques has allowed a search for associated extended structure to a level of ~0.3% of the peak. Here we report preliminary analysis of the results.

Fifty-two sources had spectral indices $\alpha>0.5$ (defined as $S = C\nu^{-\alpha}$), and seven others were missed at one frequency from the survey. The analysis is based on the remaining 345 flat-spectrum sources. The search for secondary structure was conducted within a window of radii of 0.3" to 3.2" at 6 cm, and 1.2" to 16" at 20 cm. Although not complete, the sample includes almost all flat spectrum sources with $\delta>-40°$ and $S_6>1$ Jy, as well as ~150 with $S_6<1$ Jy. The only bias used in selection was spectral shape, so the sample should be a fair representation of bright flat spectrum objects as a whole.

The basic results are:

1. All 345 sources are dominated by an unresolved core.

2. 166 (48%) contain unambiguous evidence of secondary structure. The following results pertain to these 166 sources.

3. The angular and physical size distributions are both roughly exponential. The median source size is ~20 Kpc with a maximum size of ~120 Kpc (using $q_o = 0$, $H_o = 75$).

4. The brightness ratio distribution at 20 cm between the secondary structure and the core is also exponential, with a median of ~4%. There is no correlation between the brightness ratio distribution and flux of the core.

5. The brightness ratio distribution between detected lobes (or between the lobe and noise for asymmetric sources) is very different from steep spectrum sources. Two-thirds of the sources have only one



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detected lobe, with a median brightness ratio lower limit of ~5:1. For those sources with two lobes, the brightness distribution has a median of 2:1.

6. Seventy-nine sources had secondary structure detected at both bands. For every source, the secondary has a normal, steep spectrum. In only one are the spectral indices of the core and secondary similar.

The morphology of the secondary structures is remarkably simple. Although this is surely partially due to limited dynamic range, more detailed studies (see below) indicate that the simplicity remains after higher dynamic range is achieved. The sources can be separated into two simple classes:

1. "Blobs". There is a single (rarely, two) often unresolved secondary. A bridge (often curved) of emission is frequently found linking the secondary to the core, but the brightest secondary structure is always at the end. About 70 to 80% of the 166 sources are in this group. The "typical" sources are 3C273, 3C345 and 3C454.3.

2. "Jets". Much more varied in structure, with bending commonly found. Diffuse emission enveloping core and brighter secondary structure is sometimes present. These sources are generally of lower luminosity. "Typical" souces are 3C371 and 0716+714.

It must be emphasized that <5% of the 166 sources show "classical double" structure.

Twenty-one sources with exceptional secondary structure have been observed in greater detail with particular emphasis on mapping all angular scales. The detailed results will be published elsewhere, but the basic results are:

1. The lobe brightness ratios are extremely high for 3C454.3, 3C345 and 3C273, exceeding 70:1 for the latter.

2. No depolarization is found in any "jet" or "blob". The $\underline{B}$-field is always parallel to the main axis of elongated emission.

3. The spectral indices of all secondary emission is typical of extended steep sources. The secondary component of 3C273 has $\alpha = 0.85$. No spectral index gradient is found in any "jet" or "bridge".

Perley, Fomalont and Johnston (submitted to Ap.J.) have argued that the extreme asymmetry of the secondary structure implies that the flat-spectrum soucres are fundamentally different than normal, well resolved, steep spectrum doubles. Either the flat-spectrum sources are intrinsically one-sided, or relativistic beaming has caused or enhanced the observed imbalance. The latter explanation is favored as the arc-second structure is often linked to superluminal, milliarcsecond scale structure (Perley, Johnston and Fomalont, in preparation).