VLBI-selected sample of Compact Symmetric Object candidates and frequency-dependent position of hotspots

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The Compact Symmetric Objects (CSOs) are small (<1 kiloparsec) and powerful extragalactic radio sources showing emission on both sides of an active galactic nucleus and no signs of strong relativistic beaming. They may be young radio sources, progenitors of large FRII radio galaxies. We aim to study the statistical properties of CSOs by constructing and investigating a new large sample of CSO candidates on the basis of dual-frequency, parsec-scale morphology. For the candidate selection we utilized VLBI data for 4170 extragalactic objects obtained simultaneously at 2.3 and 8.6 GHz (S and X band) within the VLBA Calibrator Survey 1-6 and the Research and Development - VLBA projects. Properties of their broad-band radio spectra were characterized by using RATAN-600 observations. Numerical modeling was applied in an attempt to explain the observed effects. A sample of 64 candidate CSOs is identified. The median two-point S-X band spectral index of parsec-scale hotspots is found to be -0.52; with the median brightness temperature ~10^9 K at X band. Statistical analysis reveals a systematic difference between positions of brightest CSO components (associated with hotspots) measured in the S and X bands. The distance between these components is found to be on average 0.32+/-0.06 mas greater at 8.6 GHz than at 2.3 GHz. This difference in distances cannot be explained by different resolutions at the S and X bands. It is a manifestation of spectral index gradients across CSO components, which may potentially provide important physical information about them. Despite our detailed numerical modeling of a CSO hotspot, the model was not able to reproduce the magnitude of the observed positional difference. A more detailed modeling may shed light on the origin of the effect.

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