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Multi-frequency Gaussian modeling of AGN jets with the extended Korean VLBI Network

Very long baseline interferometry (VLBI) observations provide high sensitivity and high resolution, allowing us to resolve relativistic jets from active galactic nuclei (AGNs) into several knot-like features. In addition, spectral analysis of such resolved plasma populations can be performed when combined with (quasi-)simultaneous multi-frequency observations. In particular, high-frequency observations, with increased angular resolution and reduced jet opacity, play a crucial role in further resolving the inner jet. Additionally, the coherence time of high-frequency observations can be increased through the frequency phase transfer (FPT) technique, emphasizing the importance of simultaneous multi-frequency facilities. We present multi-frequency modeling results of AGN jets using the extended Korean VLBI Network (KVN) from 22 to 129 GHz. The modeling was performed by decomposing the jet structure into multiple Gaussian components and by employing closure relations and visibility amplitude. Three main assumptions are applied in the modeling: (i) jet brightness distribution can be approximated by Gaussian models within the KVN's beam size, (ii) the emission regions are common across the observed frequencies, and (iii) the spectrum of each emission region is described by either synchrotron self-absorption or a simple power-law. With the improved resolution provided by this method, we find that the structures are resolved into several Gaussian components in the KVN resolution scales. In addition to the improved resolution, this method enables a direct spectral analysis. A simple comparison with the Very Long Baseline Array (VLBA) at 15 GHz within a uv-radius up to approximately 200 $\mathrm{M}\lambda$ (i.e., maximal uv-radius of the KVN at 129 GHz) reveals that the results are comparable. We plan to further assess the performance of this method through, for example, hybrid multi-frequency observations from the East Asia VLBI Network.

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