

Resolving the Geometry of the Innermost Relativistic Jets in Active Galactic Nuclei

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In the current paradigm, it is believed that the compact VLBI radio core of radio-loud active galactic nuclei (AGNs) represents the innermost upstream regions of relativistic outflows. These regions of AGN jets have generally been modeled by a conical outflow with a roughly constant opening angle and flow speed. Nonetheless, some works suggest that a parabolic geometry would be more appropriate to fit the high energy spectral distribution properties and it has been recently found that, at least in some nearby radio galaxies, the geometry of the innermost regions of the jet is parabolic. We compile here multi-frequency core sizes of archival data to investigate the typically unresolved upstream regions of the jet geometry of a sample of 56 radio-loud AGNs. Data combined from the sources considered here are not consistent with the classic picture of a conical jet starting in the vicinity of the super-massive black hole (SMBH), and may exclude a pure parabolic outflow solution, but rather suggest an intermediate solution with quasi-parabolic streams, which are frequently seen in numerical simulations. Inspection of the large opening angles near the SMBH and the range of the Lorentz factors derived from our results support our analyses. Our result suggests that the conical jet paradigm in AGNs needs to be re-examined by millimeter/sub-millimeter VLBI observations.