

POLARIMETRY OF BLAZAR JETS: FROM RADIO TO X-RAYS

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ABSTRACT

Blazars represent the most extreme manifestation of relativistic jets in active galactic nuclei, where Doppler boosting amplifies non-thermal emission across the entire electromagnetic spectrum. Their spectral energy distributions (SEDs) display the characteristic double-humped structure, commonly interpreted within leptonic or hadronic frameworks. Despite extensive multiwavelength modeling, however, SED fitting alone often remains degenerate, allowing different physical scenarios to reproduce similar spectral shapes.

Polarimetry has long provided essential insights into jet physics, from early radio measurements establishing the synchrotron origin of emission to decades of optical monitoring revealing complex variability patterns. The degree and angle of polarization encode information about magnetic field ordering, particle acceleration, and emission-site localization. I review the phenomenology of radio and optical polarization in blazars, including variability patterns, polarization–flux relations, and quasi-periodic behavior, and discuss their interpretation in terms of particle acceleration processes, magnetic field structure, and jet geometry.

Recent advances extend these diagnostics into the X-ray band with the Imaging X-ray Polarimetry Explorer (IXPE). In high-synchrotron-peaked blazars, X-ray polarization probes the highest-energy synchrotron-emitting particles and provides new constraints on competing emission scenarios. Polarimetry across multiple energy bands thus offers a multi-dimensional approach to understanding the magnetic structure and energetics of relativistic jets.