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Multi-band Variability Analysis of the Blazar OJ 014

Blazars are a subclass of active galactic nuclei (AGN) characterized by relativistic jets oriented close to our line of sight, exhibiting extreme variability across multi-band observations. This study performed variability analysis of multi-band light curves for the blazar OJ 014 (J0811.4+0146) using data from Fermi-LAT, Swift-XRT/UVOT, and RATAN observations spanning from August 2008 to November 2024. Time series analysis reveals a significant quasi-periodic oscillation (QPO) with a period of 4.35 ± 0.34 years in the γ-ray emission, detected at a significance level of 4.5σ. Cross-correlation analysis between different energy bands was performed to investigate the relationships between multiband light variations. The spectral energy distribution across all observed frequencies exhibits the characteristic double-humped structure typical of blazars, well-described by a leptonic model dominated by synchrotron radiation and inverse Compton scattering. The detected QPO behavior can be attributed to Newtonian-driven jet precession in a Supermassive Black Hole Binary system, with estimated masses of $7.33 \times 10^9 M_\odot$ and $2.13 \times 10^9 M_\odot$ for the primary and secondary black holes respectively. This configuration yields a secondary black hole orbital period of 1.15 years and a jet precession period of approximately 42.49 years.

Collaboration(s)

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