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Gamma-Ray Periodicity in Jetted AGN: Revisiting Periodicity Candidates with >17 years of Fermi-LAT Data

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Abstract

We reanalyze previously reported gamma-ray periodicity candidates in jetted active galactic nuclei using more than 17 years of Fermi-LAT observations. The updated data provide a robust test of whether earlier results correspond to persistent periodic behavior, to transient quasi-periodic oscillations (QPOs), or to fluctuations produced by stochastic variability. We apply complementary timing methods, including the Generalized Lomb–Scargle periodogram, Phase Dispersion Minimization, and Singular Spectrum Analysis, and estimate the test statistics using artificial light curves generated from different variability models, including simple and bending power-law power spectral densities, as well as ARIMA and ARFIMA autoregressive models. We find that most previously proposed candidates in literature are not confirmed when the longer baseline is considered, indicating that many reported periods were likely driven by limited temporal coverage and red-noise variability or transient QPO-like features rather than persistent periodic behavior. Only eight sources retain hints of periodic behavior at the ≥ 2 sigma local test statistics. Among them, PG 1553+113 and S5 1044+71 remain the most significant cases, with local test statistics above 3 sigma, and with a global significance consistent with ~ 0 sigma (because of the large trial factor). In addition, we assess predictions from previous studies as an independent test of the proposed periods and find that some are consistent with the new observations.

