

TDEs and other variable phenomena in galactic nuclei

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How to separate the variability by TDE from others is important? We need to understand the variability in the nuclei better. We investigate the underlying stochastic processes driving the multi-wavelength variability of the blazar BL Lacertae over the past two decades by comprehensive multiband data set including Fermi-LAT (γ -ray), Swift-XRT (X-ray), Swift-UVOT (ultraviolet), and the MOJAVE program (radio), as well as optical data including observations from Weihai Observatory over 224 nights. The results reveal that the power spectral slopes of intra-night variability (INV) follow a Gaussian distribution, ranging from approximately 0.4 to 2.6, with an average trend consistent with the long-term variability (LTV) power spectrum. Using power spectral analysis methods, such as the classical periodogram and the Lomb-Scargle periodogram (LSP), in combination with modeling techniques like PSRESP, multiple fragments variance function (MFVF), and continuous-time autoregressive moving average (CARMA), we examine the multi-band power spectral density (PSD) characteristics across a wide range of timescales (~ 7 dex). The results demonstrate that, at lower frequencies, the PSD across different bands shows remarkable consistency, suggesting that these variations may be driven by a common stochastic process linked to the accretion disk. However, significant discrepancies arise at higher frequencies, indicating the presence of multiple stochastic processes. We propose that the variability is governed by at least two distinct processes: one related to disk stochastic processes (DSP), dominating the long-term variability, and another associated with jet stochastic processes (JSP), which may result from turbulence, particle acceleration, and shock interactions within the jet, and drive the short-term, high-frequency variations. These findings provide unique insights into the complex mechanisms underlying blazar variability and suggest an intrinsic connection between the accretion disk and jet dynamics.

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