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Recurrence plot analysis of blazar gamma-ray light curves: exploiting the time-domain capabilities of Fermi-LAT

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Fermi-LAT has accumulated continuous, high signal-to-noise, flux monitoring of bright blazars for over a decade in the gamma-ray band, measuring the dynamics of the particle acceleration and radiation zone in the blazar jet. The statistical methods often used to characterize the measured time variability, such as techniques based on the Fourier transform, rely on the underlying assumption that the time series data is stationary, with mean and variance remaining constant over time. However, this is not the case for blazar light curves.
We will present a different approach to characterize the flux variability observed in bright gamma-ray blazars using the recurrence plot analysis technique.
Recurrence plot analysis is well-suited for non-stationary time series, and can provide a quantitative description of complex as well as recurrent variability patterns, providing insight into the stochastic and chaotic processes that cause the observed flux variability. In addition, recurrence plots are robust against noise fluctuations and are applicable to long data sets such as Fermi-LAT light curves.
We will employ this method to gain insight into the non-linear and stochastic behavior of blazar jets at γ-ray energies and probe the importance of processes occurring in time scales from weeks to several years such as the connection between accretion power and jet launching, quasi-periodic oscillations, dynamics of energized plasma in the blazar jet, and jet precession.

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