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Multi-frequency, broad-band variability study of BL Lac OJ 287

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The main results from our analysis are :
(1) nature of processes generating flux variability at optical/radio frequencies is different from those at GeV freqeuncies ($\beta \sim 2$ and 1, respectively); this could imply, that $\gamma-$ray variability, unlike the Synchrotron (radio-to-optical) one, is generated by superposition of two stochastic processes with different relaxation timescales, (2) the main driver behind the optical variability is same on years, months, days, and hours timescales ($\beta \sim 2$), which argues against the scenario where different drivers behind the long-term flux changes and intra-night flux changes are considered, such as internal shocks due to the jet bulk velocity fluctuation (long-term flux changes) versus small-scale magnetic reconnection events taking place at the jet base (intra-night flux changes). Implications of these results are discussed in the context of blazar emission models.

Summary

The power spectral densities (PSDs) of blazar light curves, $P(f) = Af^{-\beta}$, where A is the normalization and β is the slope, indicate that the variability is generated by the underlying {\it stochastic} processes (i.e., $\beta \simeq 1 - 3$, characteristic of flicker/red noise). Study of power-law slopes, normalization or characteristic timescales (if any), in the PSD is important for constraining the physics of emission and energy dissipation processes in the blazar jets. We present the results of PSD analysis of the BL Lac object OJ 287 at GeV ({\it Fermi}-LAT), optical (R-band) and radio (GHz band from UMRAO and OVRO programmes), covering few decades to sub-hours timescales. The novelty of this study is that at optical frequency, by combining long-term (historical optical light curve starting from 1986), Kepler 2 mission data and densely sampled intra-night lightcurves, the PSD characterisitics are investigated for temporal frequencies ranging over 7 orders of magnitude.

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