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Optical variability modelling of newly identified blazars and blazar candidates behind Magellanic Clouds

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We present results of optical variability study of 44 newly identified blazars and blazar candidates behind the Magellanic Clouds (Żywucka et al. 2018). The sample contains 27 flat spectrum radio quasars (FSRQs) and 17 BL Lacertae objects (BL Lacs), but only nine of them are recognized as blazars, while the classification of 35 objects is still uncertain. All objects possess high photometric accuracy and infrequently sampled optical light curves (LCs) from the long-term ($\sim$2 decades) monitoring conducted by the Optical Gravitational Lensing Experiment in V and I filters. The LCs were modelled with the Continuous-time Auto-Regressive Moving Average (CARMA) process using the publicly available Markov Chain Monte Carlo sampler described by Kelly et al. (2014) and with the Lomb-Scargle (LS) periodogram.

The CARMA models allow to investigate variability features of irregularly sampled LCs, especially their power spectral density (PSD), to determine variability-based classification of astrophysical objects and to detect quasi-periodic oscillations (QPOs). We found that some of the examined objects require high-order fits, implying a deviation from the simple single-Lorentzian PSD.

The power law PSD is indicative of a self-affine stochastic process characterised by the Hurst exponent H, underlying the observed variability. An estimation of the H values was performed with a wavelet lifting transform (Knight, Nason & Nunes 2017). We find that most objects have $H \leq 0.5$, indicating short-term memory, but four BL Lacs and two FSRQs have $H > 0.5$, implying long-term memory.

The power law PSDs of blazars are thought to be the result of synchrotron, synchrotron self-Compton and external Compton emission. The higher-order CARMA fits suggest there are additional variations present in blazar jets and/or accretion discs that affect both the overall shape of the PSD, and can give rise to QPOs. The non-power law features are also visible in some of the LS periodograms, and signs of flattening of the PSD at low frequencies observed in some of the CARMA fits hints at the blazar nature of the objects.

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