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Tools for Period Searching in AGN in the Era of "Big Data"

AGN persistently emit across the electromagnetic spectrum; emission is dominated by stochastic, aperiodic variability that overwhelms any periodic/quasi-periodic signal (QPO) if one exists. Pure stochastic red noise processes can spuriously mimic few-cycle sinusoid-like periodicities. Hence, while using different statistical tools one needs to account for red noise which can impact the statistical significance of periodicity detections and calibration of false alarm probabilities (FAP). We have entered the era of "Big Data," with current and near-future large-area monitoring programmes facilitating data trawls for periodicities; developing the proper know-how for period searching is essential. In our project we try to account for red noise using various methods: Auto-correlation Function (ACF), Phase dispersion minimization (PDM), wavelet analysis, & Bayesian CARMA analysis. We test if each method can robustly distinguish between pure red-noise and mixtures of red noise and strictly-/quasi-periodic signals, and check how FAP depends on broadband continuum PSD shape. We determine how QPO detection sensitivity depends on QPO strength and broadband red noise shape for evenly-sampled and for realistically-sampled data (e.g., with data gaps). I will present the results from analysis using the ACF and PDM. We also compare the results on using the PDM and the periodogram. We apply the results to realistic systems, namely gravitational lensing from highly-inclined binary supermassive black hole systems, to check the conditions under which a periodic flux signal can be robustly separated from the red noise using these statistical tools.

Primary author: Ms KRISHNAN, Saikruba (Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences)

Co-authors: Mr MARKOWITZ, Alex (Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences); Mr SCHWARZENBERG-CZERNY, Aleksander (Nicolaus Copernicus Astronomical Centre of the Polish Academy of Sciences)

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