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# Distortions in Periodicity Analysis of Blazars II: The Impact of Gaps

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# Abstract

Time series analysis is fundamental to characterizing the variability inherent in multi-wavelength emissions from blazars. However, a major observational challenge lies in the need for well-sampled, temporally uniform data, which is often hindered by irregular sampling and data gaps. These gaps can significantly affect the reliability and accuracy of methods used to probe source variability. This paper investigates the impact of such observational gaps on time series analysis of blazar emissions. To do so, we systematically evaluate how these gaps alter observed variability patterns, mask genuine periodic signals, and introduce false periodicity detections. This evaluation is conducted using both simulated and real observational data. We assess a range of widely used time series analysis methods, including the Lomb-Scargle periodogram, Phase Dispersion Minimization, and the recently proposed Singular Spectrum Analysis (SSA). Our results demonstrate a clear and significant degradation in period detection reliability when the percentage of gaps exceeds 50%. In such cases, the period-significance relationship becomes increasingly distorted, often leading to misleading results. Among the tested methods, SSA stands out for its ability to yield consistent and robust detections despite high data incompleteness. Additionally, the analyzed methods tend to identify artificial periodicities of around one year, likely due to seasonal sampling effects, which can result in false positives if not carefully recognized. Finally, the periods detected with >= 3 sigma confidence are unlikely to result from stochastic processes or from the presence of gaps in the analyzed time series.

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