

PHOTOMETRIC VARIABILITY AND DETECTABILITY OF SUPERMASSIVE BLACK HOLE BINARIES ON SUB-PARSEC SCALES

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ABSTRACT

Supermassive black hole binaries are expected to form during galaxy mergers and represent an important stage in the evolution of active galactic nuclei. On the sub-parsec scales, their orbital motion can induce photometric variability through periodic changes in the accretion flow, broad-line region geometry, and observed continuum emission. However, such signals are difficult and time-consuming to detect, making the investigation of the optimal parameter range for searches of great importance. In this work, we investigate the photometric variability and detectability of sub-parsec supermassive black hole binaries using a grid of synthetic models. The models include different black-hole masses, mass ratios, orbital separations, eccentricities, and redshifts. For each configuration, we generate continuum and line-emission light curves, using PoSKI model, with red and white noise taken into account, and analyze the detectability of periodic signatures using Lomb-Scargle periodogram, where special attention is given to the comparison between magnitude and color variability.

We found that period recovery is significantly more reliable in color than in magnitude time series, indicating that color variability can provide a more robust diagnostic of binary-induced periodicity. This suggests that color-based searches may reduce the impact of stochastic variability and observational noise.