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Phase lags of quasi-periodic oscillations across source states in the low-mass X-ray binary 4U 1636-53

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A step towards to understanding how radiative processes give rise to the rich set of variability features, namely the quasi-periodic oscillations, actually seen in the X-ray light curves of low-mass X-ray binaries is given by the study of the energy and frequency dependence of the phase lags of the QPOs in the light curves. Here we studied the phase lags of all QPOs in the range of 1 Hz to 1300 Hz detected in the low-mass X-ray binary 4U 1636-53 using a methodology that allowed us to study, for the first time, the dependence of the phase lags upon energy and frequency as the source changes its states as it moves through the colour-colour diagram. Our results suggest that within the context of models of up-scattering Comptonization, the phase lags dependencies upon frequency and energy can be used to extract size scales and physical conditions of the medium that produces the lags.

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