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The fast variability properties of Galactic black hole binaries: An explanation of soft/hard time lag

The fast variability properties of Galactic black holes binaries can be satisfactorily explained by considering multiple physical mechanisms, such as Comptonization, reflection, variation in accretion geometry, focusing due to gravitational bending, and the effect of disk-jet connections. The nature of variability i.e., soft/hard time lag in Black Hole Transients, is complex due to the interplay of multiple nonlinear physical mechanisms. In the Propagatory shock Oscillation Solution (POS) scenario, the observed QPO frequency gives out the location of shock i.e., the size of the Comptonizing region. The frequency drifting implies the geometrical variation of the Comptonizing region, i.e., a radial movement of the shock front. This drifting is triggered by the cooling of the post-shock region due to the variation in Keplerian and Sub-Keplerian accretion rates. We have studied a few Galactic Black hole transients e.g., GRS 1915+105, XTEJ 1550-564, GX 339-4, H 1743-322, XTE J1650-500 etc. and found that the evolution of QPOs is independent of inclination because the shock movement depends on the accretion rates and not the inclination. However, the time lag evolution changes sign when the accretion rate and disk geometry vary for both high and low inclination sources. We conclude that the origin of soft/hard lag can be satisfactorily explained by the these changes in the accretion geometry result in alterations in the dominant physical mechanisms of the governing accretion dynamics.

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