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Probing Radiation Pressure Instabilities in Neutron star LMXBs

X-ray binaries hosting compact objects exhibit various variabilities in their X-ray spectra, often attributed to thermoviscous instabilities within their accretion disks. In particular, short-term variabilities , believed to arise from radiation pressure instabilities (RPIs) from the inner regions of the disk, have been well studied in black hole (BH) X-ray binaries. Recent observations suggest that similar variability patterns are also present in neutron star (NS) X-ray sources. Vincentelli et al. (2023) reported such behavior in the NS system Swift J1858.6−0814, suggesting a possible shared instability mechanism between BH and NS systems.

Our work aims to investigate these short-term variabilities by modeling the accretion disks of neutron star low-mass X-ray binaries (NS LMXBs). In order to better understand the structure of the flow in the case of the neutron star and to properly formulate the boundary conditions for time evolution we attempt an analytical approach, with averaged equations to obtain a tentative solution for the boundary layer radius and its other properties in equilibrium state. This poster presents the key aspects of modelling the time-independent structure of the accretion disk and a few preliminary results.

In future work, we plan to employ the Global Accretion Disk Instability Simulator (GLADIS) code, originally developed by Janiuk et al. (2002) to simulate RPIs in BH systems. To adapt the code for neutron star systems, we will incorporate the effects of the NS boundary layer and irradiation feedback from the star onto the disk. This involves modifying the heat transfer equations and introducing radial transport of momentum to capture the sub-Keplerian structure of the disk near the NS surface.

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