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Mass Accretion Rate Fluctuations in Black Hole X-Ray Binaries.

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This thesis is about the first systematic and quantitative application of propagating mass accretion rate fluctuations models to black hole X-ray binaries. Black hole X-ray binaries are systems consisting of a solar mass star orbiting around a stellar mass black hole. Eventually, the black hole accretes material from the companion star. This material, because of its angular momentum, does not fall directly onto the the black hole, but it forms an accretion disc around it. The material in the disc is so hot that, during an outburst, the flux of the system is dominated by X-ray radiation. Analyzing this radiation, and in particular the short timescale variability, it is possible to study the behavior of matter in extreme conditions and, ultimately, general relativity predictions.
For studying this variability, we applied for the first time systematically and quantitatively the hypothesis of propagating mass accretion rate fluctuations in the accretion flow. This hypothesis was first proposed by Lyubarskii in 1997 and rapidly became popular in the X-ray binary community as one of the best physical scenarios for consistently explaining many of the observational properties of these systems. Our analysis on four X-ray binaries, in different accretion states, revealed that by itself the propagating fluctuations paradigm cannot always quantitatively explain the rapid variability. However, our results do suggest that propagating fluctuations are an important ingredient in the physical processes producing the variability of black hole accretion flows.