A unified accretion ejection paradigm for X-ray binaries

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Abstract

The hysteresis behavior of X-ray binaries during their outbursts remains a mystery. In this work, we developed the paradigm proposed in Ferreira et al (2006) where the disk material accretes in two possible, mutually exclusive, ways. In the Standard Accretion Disk (hereafter SAD) mode, the dominant local torque is due to MHD turbulence that transports radially the disk angular momentum. In the Jet Emitting Disk (hereafter JED) mode, magnetically-driven jets carry away mass, energy and all the angular momentum from the disk. Within our framework, the transition from one mode to another is related to the magnetic field distribution, an unknown yet.

We computed the thermal balance at each radius for a large ensemble of disk parameters, as well as the global emitted spectrum. The radiative cooling term and related spectrum (Comptonized Bremsstrahlung and Synchrotron emission) obtained using the BELM code (Belmont et al. 2008, 2009), the other calculations are analytics.

It will be shown that Hard States can be quite nicely reproduced by dynamical configurations harboring an inner JED. They radiate a power-law spectrum from 0.001 to $>$ 0.1 Eddington luminosities. On the contrary, Soft States require an inner SAD configuration, emitting a multicolour disk blackbody spectrum. We produced also a full theoretical Disk Fraction Luminosity Diagram that could be successfully compared to the 2010-2011 outburst of GX339-4. This is, to our knowledge, the first time that such an accretion-ejection cycle is reproduced. We will finally discuss the implications of our results on the physical evolution of XrBs.

Keywords: black hole physics, accretion, accretion disks, magnetohydrodynamics (MHD), ISM: jets and outflows, X, rays: binaries

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