Magneto centrifugal winds from accretion discs around black hole binaries

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Abstract

High resolution X-ray spectra of black hole X-ray binaries (BHBs) show blueshifted absorption lines from outflowing winds. We tested if self-similar magneto-hydrodynamic (MHD) accretion-ejection models can explain accretion disk winds in BHBs. In our models, the density at the base of the outflow, from the accretion disk, is not a free parameter, but determined by solving the full set of dynamical MHD equations. Different MHD solutions were generated for different values of the ejection efficiency (p). We generated two kinds of MHD solutions depending on the absence (cold) or presence (warm) of heating at the disk surface. Only the warm solutions could have sufficiently high values of p ($> \tilde{} 0.1$) which is required to explain the observed physical quantities in the wind. In the Hard state a range of ionisation parameters were found to be thermodynamically unstable, which makes it impossible to detect any wind, in the Hard state. Our MHD outflow models were able to explain the currently established observed trends - i) that the winds are equatorial and ii) that they are observable in the Soft states (and not in the Hard state) of the BHB outbursts. Encouraged by the success of the models we have built methods to predict theoretical high resolution spectra to be fitted to absorption line observations from XMM-Newton and Chandra gratings. Fits Using our models will enable one to constrain the MHD parameter p (the ejection efficiency) of the accretion disk, and the extent of the launching zone of the wind.

Keywords: Black hole X, ray binaries, Accretion disk winds, Outflows, Atomic processes, Absorption lines

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