Broad-band X-ray properties of magnetic cataclysmic variables

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Abstract. Intermediate Polars (IPs), the hardest X-ray emitting Cataclysmic Variables (CVs), thanks to the Integral, Swift and RXTE slew surveys, are now believed to constitute a potentially important population of galactic X-ray sources with detections up to \( \sim 90\) keV. A significant fraction of IPs was recently discovered to exhibit a soft, black-body component spanning a broad range of temperatures (30–100 eV). Their broad-band X-ray spectral properties are however known for a handful of bright sources which could be observed simultaneously from 0.2 to 100 keV. A full characterization of this class of accreting magnetic CVs is still missing but well suited for the broad-band, high sensitivity Simbol-X mission.

Key words. Stars: binaries:close – Stars: Cataclysmic Variables – X-rays: binaries

1. Introduction

Cataclysmic Variables (CVs), close binaries containing an accreting white dwarf (WDs) from a late type Roche-lobe filling secondary star, represent a large fraction of the galactic population of compact interacting binaries. The magnetic systems (mCVs) constitute a conspicuous group representing \( \sim 25\%\) of all CVs. They are divided into the Polars (63\%) with field strength high enough \( (\sim 10-230\) MG) to lock the WD rotation with the orbital period and the Intermediate Polars (IPs) (37\%), which are instead highly asynchronous \((P_{\text{rot}} \ll P_{\text{orb}})\) with likely lower magnetic field WDs. The latter are the brightest and hardest X-ray sources among CVs with \( L_X \sim 10^{32} - 10^{33}\) erg s\(^{-1}\). Interest in IPs has grown recently, being a potentially important population of galactic X-ray sources (Muno et al. 2004; Ruiter et al. 2006;
Fig. 1. The remarkable broad-band X-ray spectrum of the IP RX J2133+5107 observed by Suzaku fitted with a composite model (Mukai et al. 2007).

Sazonov et al. 2006; Barlow et al. 2006). New IP candidates have increased this group by ~ 50% in the last 4 yrs (Gänsicke et al. 2005; Bonnet-Bidaud et al. 2006, 2007). Also, 5% of the Integral source catalogue are CVs most of them IPs (Masetti et al. 2006; Bird et al. 2007; Bonnet-Bidaud et al. 2007), suggesting that they may represent a still hidden population of galactic X-ray binaries.

2. X-ray spectral properties

The X-ray emission of IPs, was found to extend up to about 90 keV (de Martino et al. 2001, 2004; Falanga et al. 2005; Bonnet-Bidaud et al. 2007; de Martino et al. 2007). A few systems were studied above 30 keV and, as of today, only a handful of bright IPs were observed simultaneously on a wide energy range (0.2–100 keV) with BeppoSAX and Suzaku (de Martino et al. 2001, 2004; Mukai et al. 2007) (see Fig. 1). A broad-band coverage is important because the X-ray emission is known to be complex with multiple components. These provide important information on the post-shock and pre-shock accretion flow as well as on the WD mass. A multi-temperature optically thin plasma, from few keV up to 30–40 keV, is generally required. A Compton reflection component is also identified at high energies and is related to the fluorescent Fe Kα 6.4 keV line (EWs up to 300 eV). The spectra are also heavily affected by complex absorption with densities up to $N_H \sim 10^{23}$ cm$^{-2}$. This material, located in the pre-shock flow, is generally the major responsible for the observed X-ray pulses. Because of the lack of detection of a soft X-ray black–body component in the majority of IPs, it was believed that the reprocessing of hard X-rays in the WD atmosphere affects wide areas shifting this component in the EUV. However, the recent detection of a soft X-ray, heavily absorbed, component in an increasing number of IPs with temperatures covering a wider range (30–100 eV) than in the Polars, is a new and challenging result that BeppoSAX and XMM-Newton have brought into light (Haberl et al. 2002; de Martino et al. 2004, 2006, 2007). The simultaneous study of broad-band X-ray spectra with high sensitivity instrumentation is then essential to characterize this class of accreting magnetic CVs, forseen to substantially increase in the near future. This is a well suited project for the Simbol-X mission which will be operative after Suzaku.

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References