

CYG X-2: ITS RECURRENT X-RAY BEHAVIOUR

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Abstract. We find evidence for the occurrence of three different types of behaviour which as their basic distinction have different X-ray brightness levels. They are found to be recurrent.

1. Introduction

Z-sources are the brightest known low-mass X-ray binaries (Hasinger & van der Klis 1989): Sco X-1, GX 5-1, GX 17+2, GX 349+2, GX 340+0 and Cyg X-2. Most of these sources trace out a 'Z' in the so-called X-ray colour-colour diagram [CD; analogous to the $(U - B)$ versus $(B - V)$ diagram]. The three limbs of the Z are called horizontal branch (HB), normal branch (NB) and flaring branch (FB), from top to bottom, respectively.

2. Results

We analyzed the X-ray spectral variations of Cyg X-2 using all EXOSAT ME ($\sim 2 \dots 20$ keV) data of this source between 1983 and 1985. We describe these variations in terms of the shifts and shape changes of the 'Z' pattern in X-ray colour-colour and X-ray hardness-intensity diagrams [HID; analogous to, e.g. $(U - B)$ versus V]. For a full report we refer to Kuulkers, van der Klis & Vaughan (1996).

Colour, or hardness, is defined as the ratio of the dead-time corrected count rates in two X-ray energy bands, while intensity is defined as the total dead-time, background and collimator-response corrected count rate in the X-ray energy band of interest.

A CD and HID of all the observations are displayed in Fig. 1. A close look at the data reveals that Cyg X-2 varies between three intensity levels:

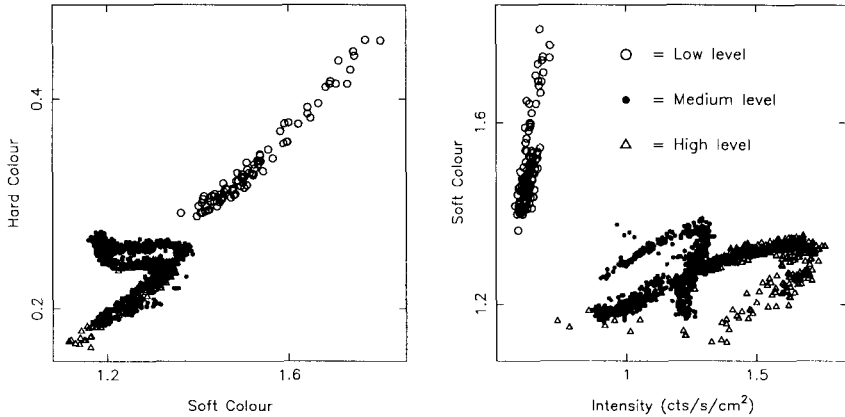


Figure 1. Colour-colour (left) and hardness-intensity (right) diagram of all EXOSAT ME observations of Cyg X-2. [Soft colour: $(3.1 \dots 6.4 \text{ keV}) / (0.9 \dots 3.1 \text{ keV})$; hard colour: $(6.4 \dots 19.7 \text{ keV}) / (3.1 \dots 6.4 \text{ keV})$; intensity: $0.9 \dots 19.7 \text{ keV}$]

‘high’, ‘medium’ and ‘low’. During a *high* level episode the Z pattern is shifted to higher overall intensity ($\gtrsim 1.3 \text{ counts s}^{-1} \text{ cm}^{-2}$) with respect to the pattern of a *medium* level episode (between 0.7 and $1.3 \text{ counts s}^{-1} \text{ cm}^{-2}$). There are also differences in the *shape* of the Z pattern between the *high* and *medium* level. During the *medium* level both the CD and HID show a FB. In the upper part of the FB of this episode the intensity drops while the colours increase. During one of the *high* levels a branch connected to the lower part of the NB is seen in the HID, but *not* in the CD. We interpret this as FB behaviour. In this branch the intensity drops while the colours remain the same. During a *low* level episode, when the source showed the lowest observed overall intensity ($\lesssim 0.7 \text{ counts s}^{-1} \text{ cm}^{-2}$), no Z shape was seen but only one large, curved branch.

The Ginga LAC observations of Hasinger et al. (1990) show episodes reminiscent of the *medium* and *high* levels. The Einstein MPC data of Vrtilik et al. (1986) also shows evidence for the occurrence of the three different modes of behaviour, i.e. *low*, *medium* and *high* episodes.

We investigated whether the occurrence of the three levels is periodic as would be expected from e.g. a precessing disk. We found, however, no periodic recurrence time for the different episodes using the EXOSAT, Ginga and Einstein MPC data.

References

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