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X-RAY SPECTROSCOPY OF THE HIGH-MASS X-RAY BINARY 4U 1700-37

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We present the first results of a monitoring campaign of the high-mass X-ray binary system 4U 1700-37/HD 153919, carried out with *XMM-Newton*.

We have observed the high-mass X-ray binary (HMXB) 4U 1700-37 with *XMM-Newton* at four orbital phases in February 2001. 4U 1700-37 is powered by the dense stellar wind of the O supergiant HD 153919. Numerous X-ray flares are observed with a typical duration of the order of half an hour. We focus on three intervals in which the data are not affected by pile up: the eclipse, the eclipse egress and a low-flux part around orbital phase $\phi \sim 0.28$.

The high-energy part of the spectra is modelled as two power laws modified by different absorption columns. They represent a direct component originating from the near surroundings of the compact object and a component produced by scattering in the extended stellar wind of the O supergiant. In all cases a soft excess remains in the low energy part of the spectrum, of which the nature is not clear. It is best modelled as another power law, which represents scattering in the far outskirts of the system. However, a blend of emission lines can not be excluded. A bremsstrahlung component as proposed by Haberl & Day 1992 and Haberl et al. 1994 does not fit well. A black body component is possible but results in an emitting surface with a radius of ~ 0.1 km.

As in other HMXBs, 4U 1700-37 shows many emission lines in the eclipse and egress spectrum, when the continuum emission is at a minimum (see Fig. 1). They can be identified with fluorescent emission lines from near-neutral species and discrete recombination lines from He- and H-like species, with ionisation parameters in the range $2 \leq \log \xi \leq 4$. The ionisation parameter ξ determines the local ionisation conditions of the plasma.

At these relatively high values of ξ ions like C IV, Si IV and N V are expected to be totally absent inside this ionised region. This should result in an observable orbital modulation of the UV resonance lines formed by these ions. This modulation has been predicted for 4U 1700-37 (Hatchett & McCray 1977), but it has not been observed (Dupree et al. 1978; Kaper et al. 1993). A possible explanation for the absence of this Hatchett-McCray effect in 4U 1700-37 is that the stellar wind has a non-monotonic ("turbulent") velocity structure which can hide the presence of an ionisation zone from detection in an UV resonance line (Kaper et al. 1993). Our observations indicate that an ionisation zone with an extent of around the size of the O supergiant must be present.

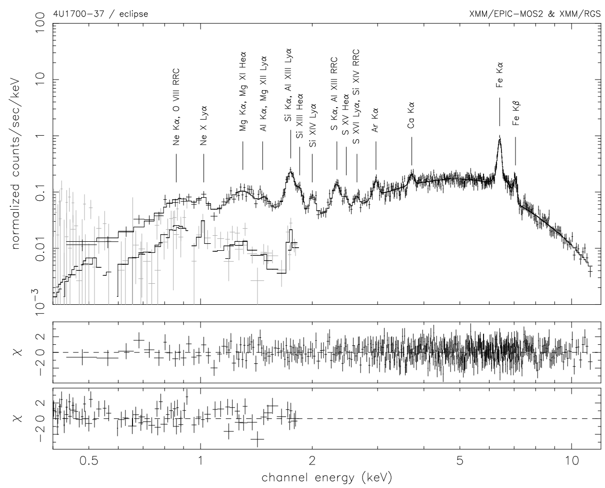

Fig. 1. EPIC/MOS-2 and RGS observations of 4U 1700-37 during eclipse.

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