NEW EXOSAT OBSERVATIONS OF TV COLUMBAE: PRELIMINARY RESULTS

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ABSTRACT. The first results of the analysis of new EXOSAT observations of the DQ Her type cataclysmic variable TV Col are presented. The period of the 1-10 keV X-ray pulsation associated with the white-dwarf rotation is now established as 1911 s. The pulsations are most pronounced in the lower energy channels (1-3.5 keV). The X-ray light curve shows absorption features associated with the orbital period of the system.

1. INTRODUCTION

TV Columbae (2A0526-328) (Charles et al. 1979) is a DQ Her type cataclysmic variable: the magnetic field of the white dwarf is supposed not to be strong enough to couple the white dwarf rotation and the orbital movement, as in the case of AM Her type systems. On the other hand, the field is strong enough to prevent a full accretion disk being formed, so that accretion near the white dwarf takes place in a funnel-like fashion and the X-rays are modulated with the white-dwarf rotation period.

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The case of TV Col is especially complicated and interesting, since no less than four periodicities are now known: two photometric periods of 0.2163 and 4.02 days (Motch, 1981), a spectroscopic period of 0.2286 days associated with the orbital motion of the system (Hutchings et al. 1981) also found by UV photometry (Bonnet-Bidaud et al. 1985), and an X-ray period of 32 minutes interpreted as the white-dwarf rotation period (Schrijver et al. 1985). This last period was derived from previous EXOSAT observations (conducted in November 1983) to be most probably 1943 ± 5 s, although due to the time structure of the observations, a period of about 1911 s could not be excluded.

2. OBSERVATIONS

TV Col was observed again by EXOSAT from 17 November 1985 18:45 until 19 November 1985 02:55 UT with an interruption from 17 November 20:20 until 18 November 01:20.

Significant detections were obtained with the LE and the ME instruments. The measurements with the ME detectors were made in the standard mode in which the detector halves are swapped alternatively each 10000 s on and off the source in order to obtain a good background determination.

In this paper we present only results from a partial analysis of the ME data (1-10 keV).

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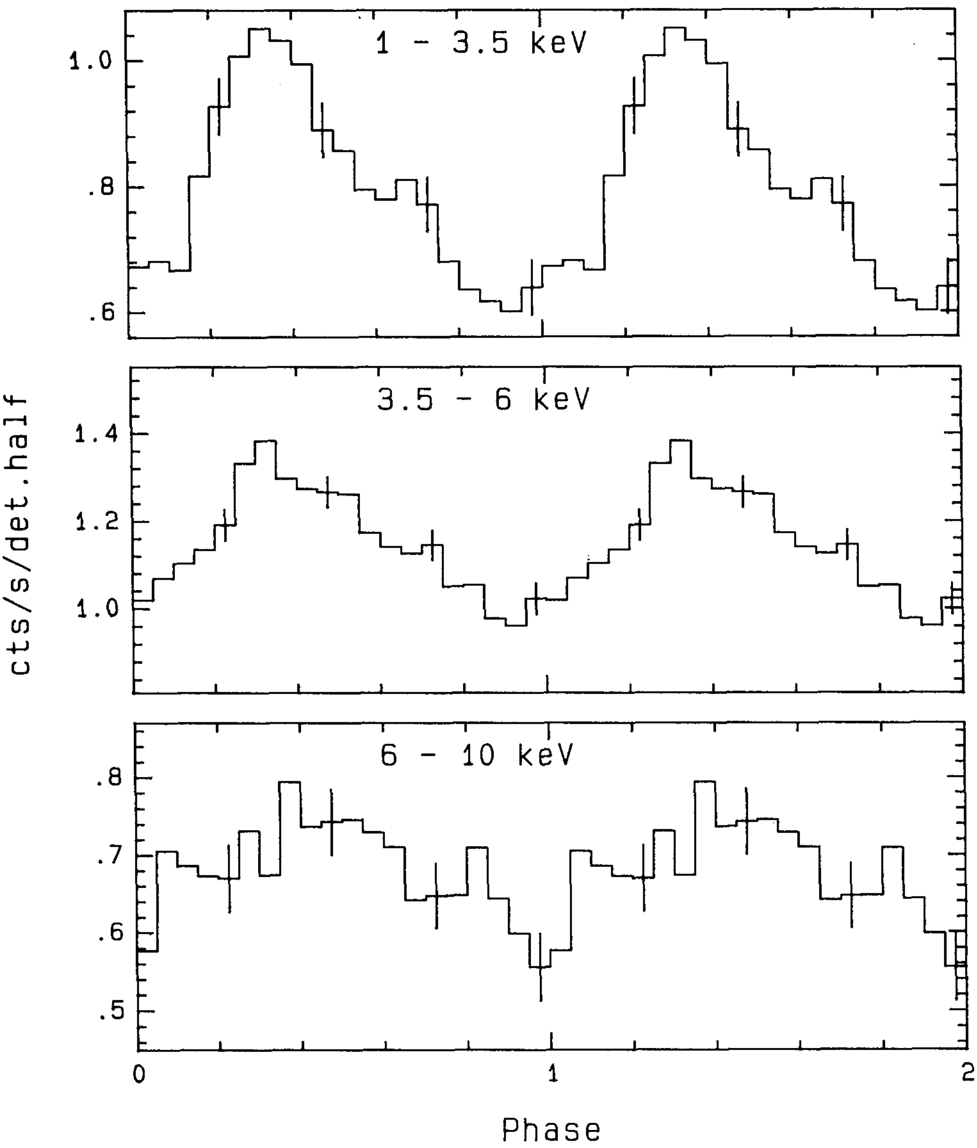

Figure 1. Light curves of TV Col in three energy bands folded modulo the X-ray pulsation period of 1911 s. The three curves have been scaled to the mean flux, so that modulation depths can be compared directly.

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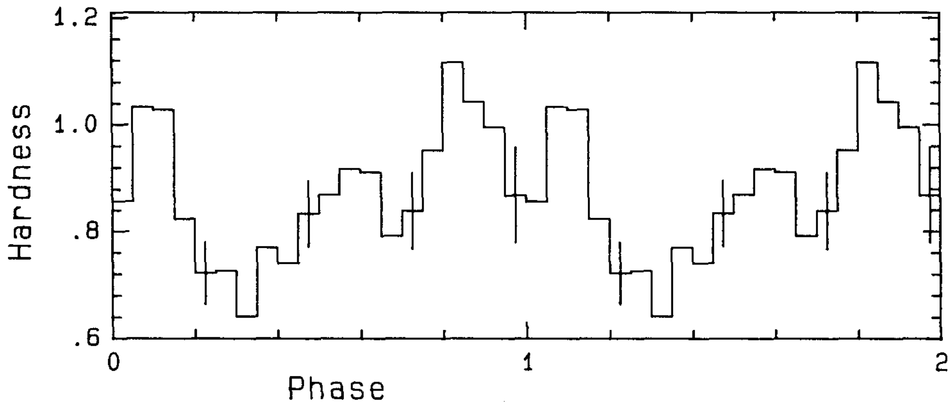

Figure 2. Hardness ratio (6-10 keV)/(1-3.5 keV) of the lightcurves folded modulo 1911 s.

3. RESULTS

3.1. X-ray pulsation period

The time structure of the new observations allow a more precise determination of the pulsation period than was possible with the November 1983 data (Schrijver et al. 1985). For the new data, the period versus χ^2 diagram for the folded data has no sidebands. It turns out that the period of 1911 s, suggested as an alternative possibility in the analysis of the older data, is indeed the real X-ray pulsation period.

We have produced light curves folded modulo the period in three energy bands (Figure 1). There is a clear decrease of the modulation depth with increasing energy. This effect is shown best in terms of a

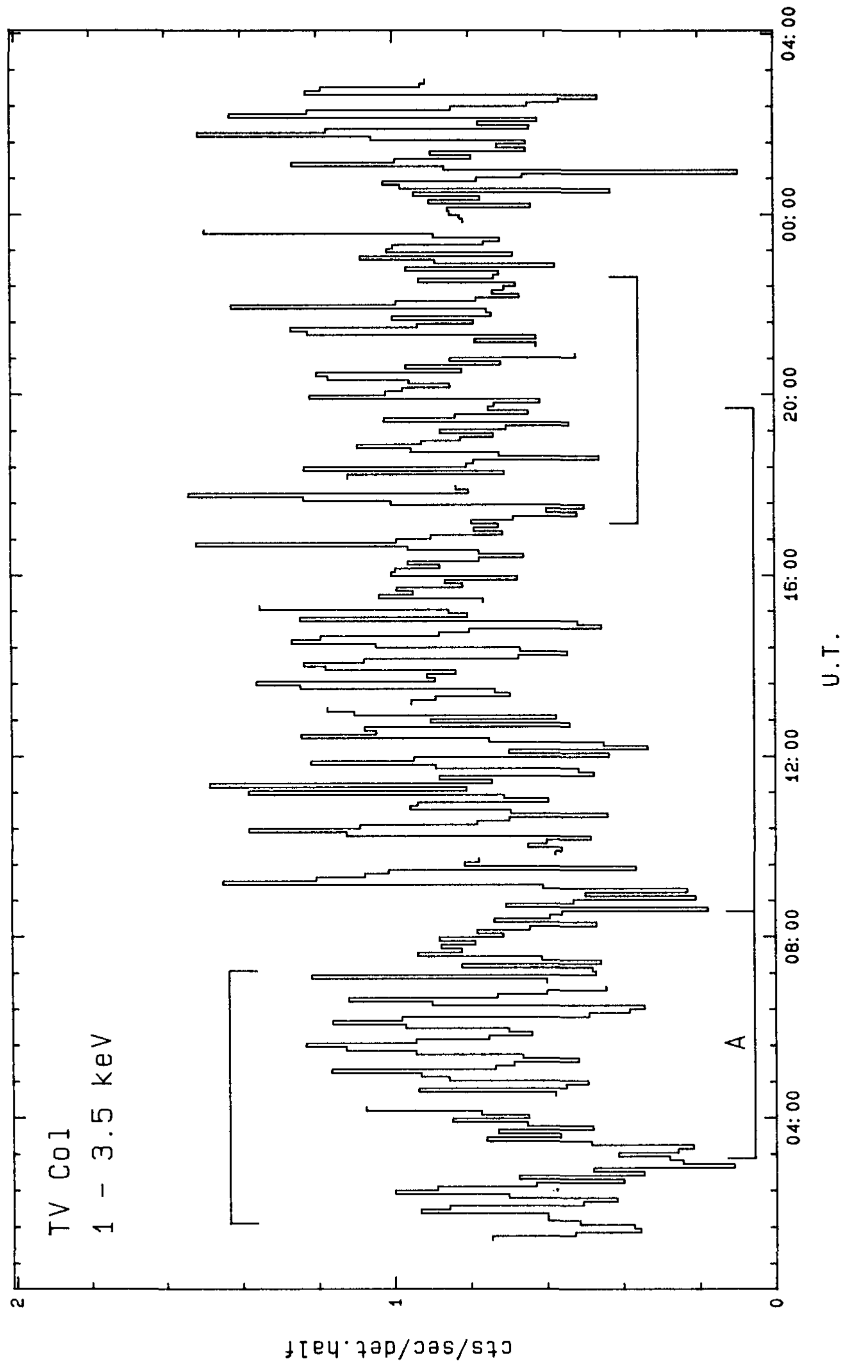

Figure 3. 1-3,5 keV lightcurve of TV Col from 18 November 1985 01:20 UT until 19 November 1985 02:55 UT. The vertical lines indicate the minima (absence of 32-minute pulsations). The horizontal lines connect minima separated by an integer number of spectroscopic periods. The minima indicated by A occur at the same phase as the minima found in the November 1983 observations.

hardness ratio of the folded light curves (Figure 2). Thus, besides an overall modulation of the X-rays due to the movement of the emitting region with the white-dwarf rotation, there is an extra effect in the softer X-rays probably due to absorption by the accreting matter. This, however, needs confirmation by a pulse-phase spectroscopy analysis of the X-ray data that has still to be performed.

3.2. Phenomena related to spectroscopic period

In the 1983 observations two minima in the X-ray light curves were found. They were shown to be due to absorption of the lower energy X-rays (1-3 keV). The minima occurred at the same phase of the spectroscopic period and were therefore interpreted as absorption related to the orbital motion of the system.

The 1985 observation covers more than five spectroscopic periods. Figure 3 shows a large part of the 1-3.5 keV light curve obtained. The 32-minute pulsation is prominently present during most of the observation, but it is absent from time to time. The lightcurve has been searched in detail for the absence of the pulsation. We have found several such minima as indicated in Figure 3 by vertical lines. The minima occur at different phases of the spectroscopic period. However, it is possible to arrange them into groups of minima occurring at the same spectroscopic phase (indicated by horizontal lines in Figure 3). On the other hand, there are not always minima at times where they would be expected. The deep minima near the beginning (labeled A) occur at the same spectroscopic phase (± .07) as the minima found in the 1983 observations.

This suggests that persistent absorption features related to the orbital phase are present, but that the depth of the absorption varies from one passage to the next. Quantitative results related to these phenomena will follow from a detailed analysis of the X-ray spectra obtained during these new observations.

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