DETECTION OF THE SECONDARY STAR IN X1822−371

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Abstract. We have detected He I absorption from the companion star to X1822−371 and find a lower limit to its K−velocity of $230 \pm 50\,\mathrm{km\,s^{-1}}$. We interpret the He I as arising on the X–ray heated inner face of the companion star.

1. Discussion

The prototype accretion disc corona (ADC) source is X1822−371 whose orbital light curve on its 5.57 h period indicates significant structure in the outer disc at orbital phases 0.8 and 0.3 (Hellier & Mason 1989). We observed X1822−371 with the AAT in 1993 June (5 orbital cycles for a total of 110 spectra) with the aim of investigating the disc structure and the elusive nature of the companion star. A full account of these observations will be given in Harlaftis et al. (1996, in preparation).

An image of the variation of the Hα profile on 1993 June 26 is given in Fig. 1 as trailed spectra (intensity scale −0.1 to 0.5 mJy). The Hα profile of X1822−371 is complex, with a double-peaked emission profile. The absorption or emission wings of the profiles do not show any binary motion. The peaks of the profiles appear to become stronger at phases 0.4 and 0.8. In the core of the emission profile, there is absorption which shows maximum intensity at phases 0.6 and 0.2 and could perhaps be part of a weak, complex, sinusoidal-like wave. During eclipse, the velocity separation of the Hα peaks is only $460 \pm 20\,\mathrm{km\,s^{-1}}$. Note that the strength of the eclipse profile appears stronger because there is no absorption below the subtracted continuum.

We find the weak He I triplet 5875.6 Å in absorption moving with the binary cycle. The trailed spectra (23 bins resulted from all spectra) are shown

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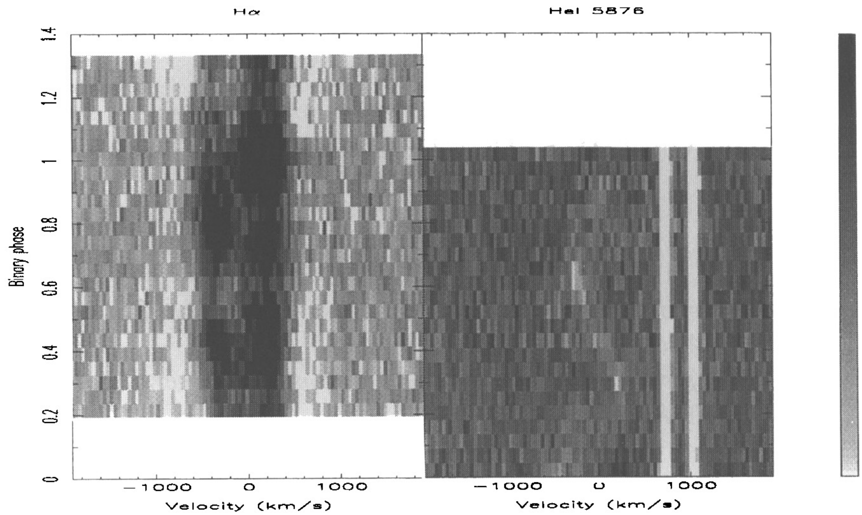

Figure 1. The trailed spectra of Hα (left) and He I λ5876 and the interstellar Na D lines (right). The He I absorption line moves from red to blue at phase 0.5, indicating its association with the companion star.

in Fig. 1 together with the NaD interstellar lines for comparison (intensity scale −0.1 to 0.1 mJy). The sinusoidal wave crosses zero velocity from red-to-blue at phase 0.5 and is much narrower between phases 0.3...0.7 which indicates the companion star as its source. This is consistent in phase with Cowley et al. (1982) who claimed that the Hδ absorption core was moving in anti-phase to the He II emission (the latter arising in the accretion disc). The presence of Balmer and weak He I lines in absorption make the companion star spectrum resemble that of an early B-star (∼20 000 K). However, during eclipse there is no trace of He I in absorption (e.g. a B9 star) which indicates that the back of the companion star is cooler than the inner face by ∼10 000 K. The above observations suggest that the hard X-rays from the vicinity of the compact object irradiate the photosphere of the companion star severely enough to change its spectral characteristics from those possibly of an M-star to those of a B-star. Extraction of the radial velocity curve between phases 0.3...0.8 using Gaussian fits gives a semi-amplitude of $\sim 230 \pm 50\,\mathrm{km\,s^{-1}}$, which with modelling of the irradiation of the inner face of the companion star will constrain the mass function of the compact object.

References

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Hellier, C., Mason, K.O., 1989, MNRAS, **239**, 715