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SPECTROSCOPIC MONOTORING OF THE SYMBIOTIC STAR BX MONOCEROTIS

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Abstract. Low resolution optical spectra of the symbiotic star BX Monocerotis in the 3500–9000 Å range obtained during 1999–2010 are described. The spectrum of BX Mon at all phases is dominated by the cool component, with a red continuum and TiO absorption. Emission lines, predominantly due to H I, He I, He II, Fe II, Ca II and [O III] are seen superimposed on the spectrum of the M5 III star, with variable intensities. The observed variations in the spectra seem to be correlated with the orbital phases.

Key words: stars: binaries: symbiotic – stars: individual (BX Mon)

1. INTRODUCTION

BX Monocerotis is a S-type symbiotic star with a M5 III cool component (Murset & Schmid 1999). It is an eclipsing system with orbital parameters derived by various authors as: $P_{\rm orb}$ = 1410 d (Dumm et al. 1998), 1259 d, (Fekel et al. 2000), 1290 d (Brandi et al. 2009) and 1256 d (Leibowitz & Formiggini 2011), and e = 0.49 (Dumm et al. 1998) and 0.44 (Fekel et al. 2000). Zamanov et al. (2007) find that the orbit is in a circularization process. The hot component has a mass of 0.6 $M_{\odot}$, a luminosity of 230 $L_{\odot}$ and is most probably a shell flashed white dwarf.

2. OBSERVATIONS

We obtained low resolution spectra of BX Mon covering various orbital phases since 1999. Spectra during 1999–2003 were obtained with the OMR spectrograph on the 2.3 m VBT located at the Vainu Bappu Observatory, Kavalur, India. These spectra cover the wavelength range ∼4000–8800 Å, at a resolution of ∼8 Å. All observations since 2005 have been obtained with the HFOSC instrument on the 2 m HCT located at the Indian Astronomical Observatory, Hanle, India. These spectra cover the wavelength range of ∼3500–9000 Å, at a resolution of ∼6 Å.

Table 1 gives the log of observations. The orbital phases corresponding to the observations are calculated with the ephemeris given by Fekel et al. (2000): $2449680 + 1259 \times E$.

Table 1. Journal of observations of BX Mon.

Date	Phase	Date	Phase	Date	Phase
1999 Feb. 8	0.2216	2005 Nov. 23	0.1914	2008 Apr. 29	0.8967
2002 Apr. 5	0.1366	2006 Jan. 27	0.8316	2008 Dec. 4	0.0706
2002 Dec. 2	0.3280	2008 Feb. 15	0.8379	2008 Dec. 5	0.0714
2003 Feb. 4	0.3788	2008 Feb. 16	0.8387	2010 Jan. 21	0.3987
2005 Apr. 4	0.0060	2008 Apr. 27	0.8951	2010 Dec. 9	0.6544

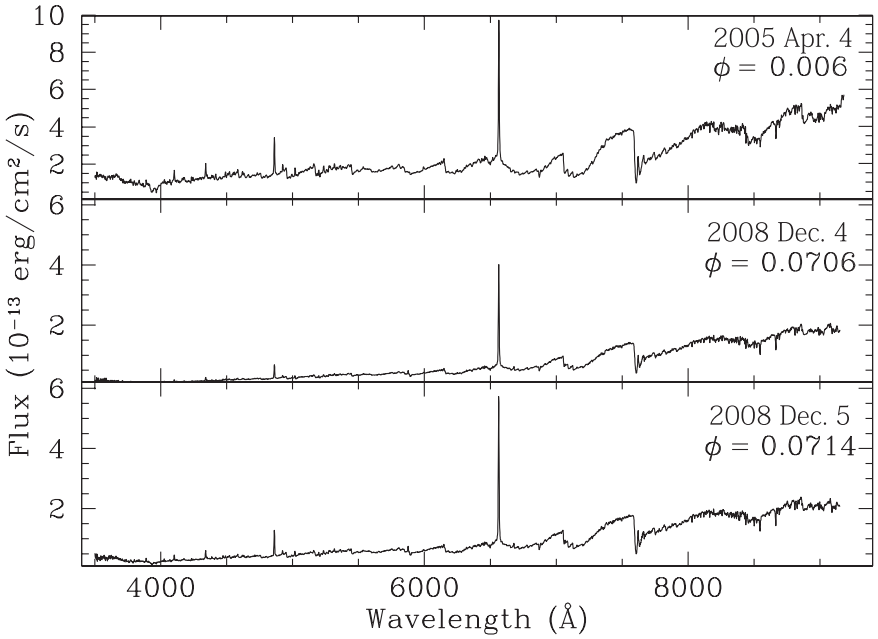

Fig. 1. The spectra of BX Mon during phases 0.0–0.1. The dates of observations and the corresponding phases are shown in each panel.

3. RESULTS AND DISCUSSIONS

The spectrum of BX Mon at all phases is dominated by the cool component, with a red continuum and TiO absorption. Emission lines, predominantly due to H I, He I, He II, Fe II, Ca II and [O III] are seen superimposed on the spectrum of the M5 III star, with variable intensities. We describe below the spectrum at different orbital phases.

Phases 0.0–0.1: the spectra are shown in Figure 1. The spectrum of 2005 Apr. 4 (phase 0.006) shows Ca II H&K doublet and the near infrared triplet (NIR) in strong absorption. No He II 4686 or [O III] lines are seen. The spectra of 2008 Dec. 4 and 5 (phase 0.071) also show the Ca II H&K as well as the NIR triplet in absorption. He I 6678 line is clearly seen, while no He II or [O III] lines are detected.

Phases 0.1–0.3: the spectra are shown in Figure 2. All the spectra show the Ca II H&K and the NIR triplet in absorption. He II and [O III] emission lines are clearly seen in the spectra of 2002 Apr. 5 (phase 0.137) and 1999 Feb. 8 (phase 0.222), while these lines are not present in the spectrum of 2005 Nov. 23 (phase

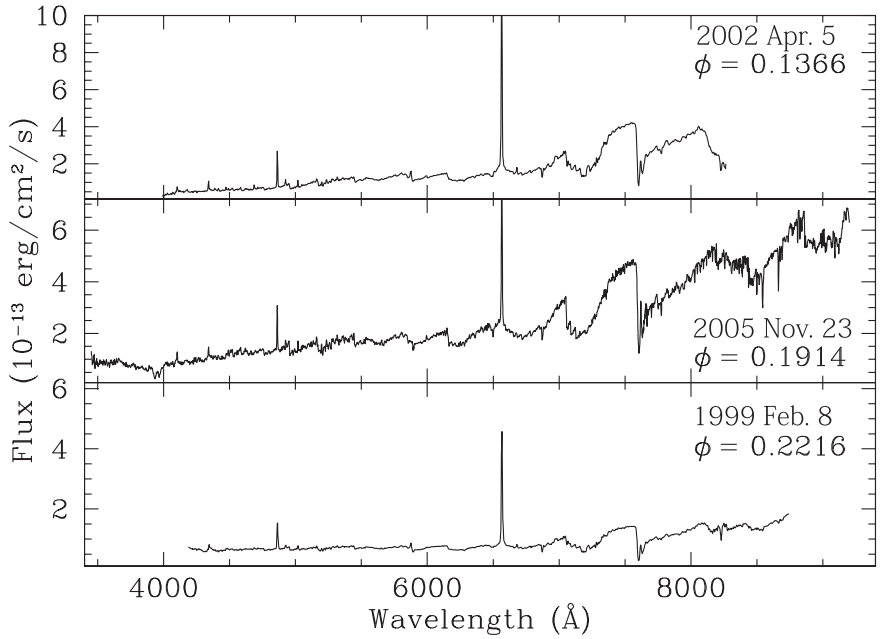

Fig. 2. The spectra of BX Mon during phases 0.1–0.3.

0.191). O I 8446 line is seen in emission in the spectrum of 1999 Feb. 8, while O I 7774 in the same spectrum is in absorption.

Phases 0.3–0.7: the spectra are shown in Figure 3. The spectra of 2002 Dec. 2 (phase 0.328) and 2003 Feb. 4 (phase 0.379) show He I and He II lines, while no [O III] lines are present. While Ca II H&K lines are seen in absorption, the NIR triplet lines are in emission. O I 8446 is also seen in emission. The spectra of 2010 Jan. 21 (phase 0.399), 2006 Nov. 16 (phase 0.476) and 2010 Dec. 9 (phase 0.654) are without He II and O I 8446 emission lines. The Ca II NIR triplet is seen in absorption again.

Phases 0.7–0.9: the spectra are shown in Figure 4. Except for the spectrum on 2006 Jan. 27, all other spectra during these phases show strong [O III] lines. In addition, Ca II H&K and O I 7774 and 8446 lines are also in emission. He I and He II lines are present in the 2008 April spectra. The 2008 spectra show a clear increase in activity.

4. CONCLUSIONS

The spectra of BX Mon at different orbital phases are presented. The observed variations in the spectra are seen to correlate with the orbital phases. The spectra of 2008 indicate an enhancement in the activity of the hot component. BX Mon is known to undergo cyclic outbursts. The visual light curve, based on AAVSO magnitudes (Figure 5) clearly shows the beginning of an outburst around the year 2008.

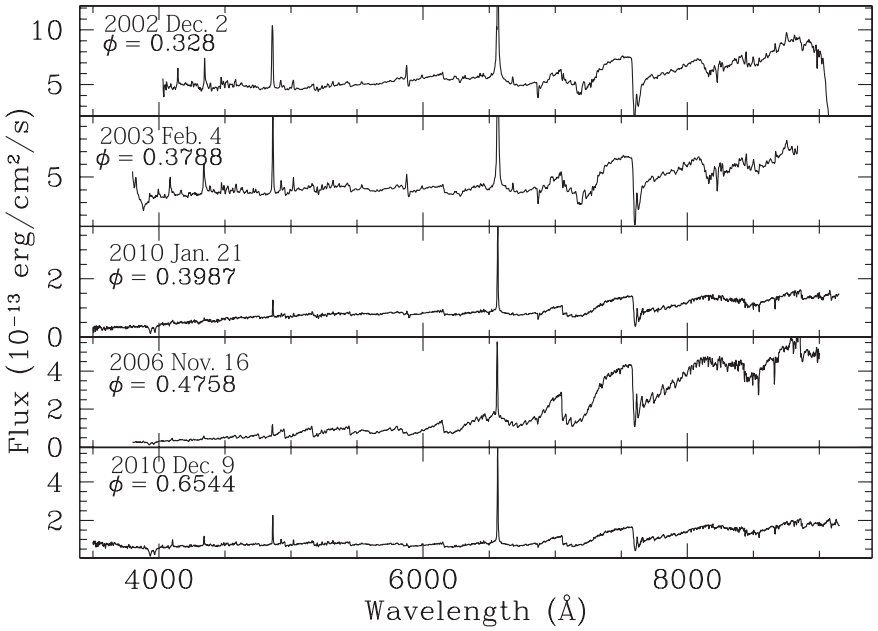

Fig. 3. The spectra of BX Mon during phases 0.3–0.7.

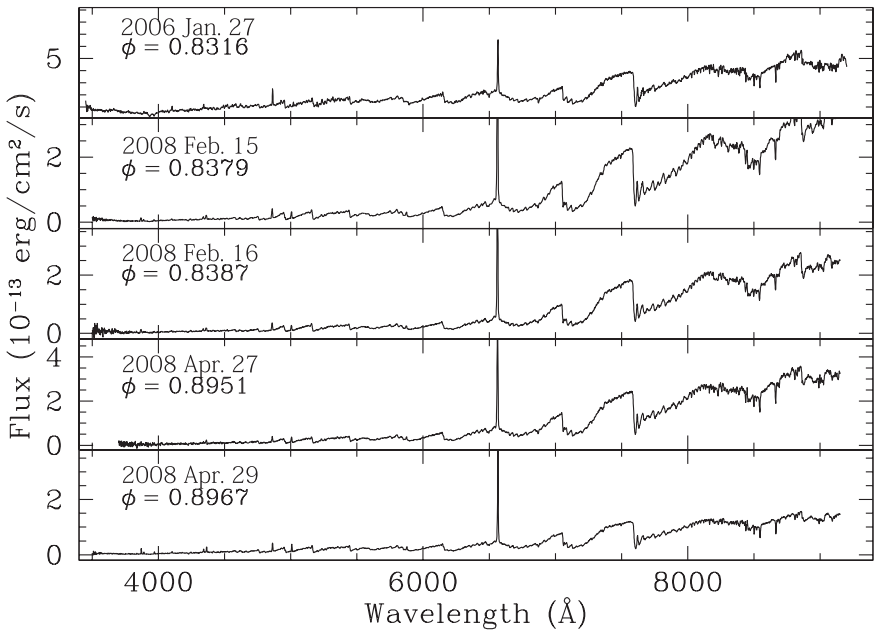

Fig. 4. The spectra of BX Mon during phases 0.7–0.9.

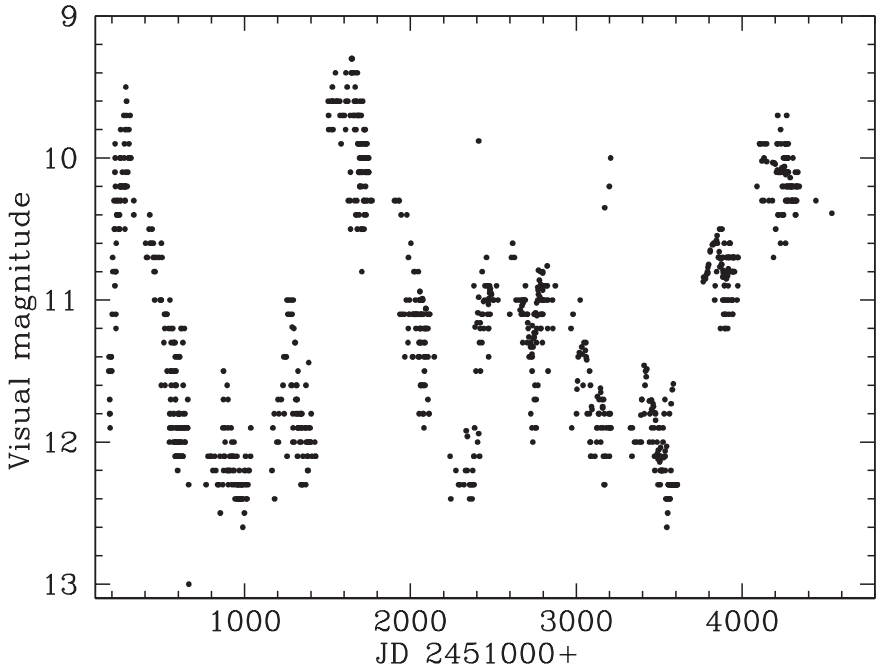

Fig. 5. The visual light curve of BX Mon.

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