FIGHTING FOR ACCRETION:

The 2008-2009 low state of BB Doradus

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Abstract

Our photometric monitoring of southern nova-like CVs with the 1.3-m SMARTS telescope found BB Doradus in a deep low state at *V* ~ 19.2. Here we present time-resolved optical spectroscopy of BB Dor in this faint state, which allowed to measure an orbital period of 3.70 h. The line profiles are mainly dominated by emission from the donor star, although the spectral features of the white dwarf and a M-dwarf secondary star are also detected. For the first time, we have detected episodic accretion events which veiled the spectra of both stars and radically changed the line profiles within a timescale of tens of minutes. This shows that accretion is not inhibited for the duration of a low state. The combined action of irradiation from a moderately hot white dwarf and magnetic activity of the donor star are likely responsible for the intermittent accretion.

The spectrum of BB Dor in quiescence

We took spectra of BB Dor during the period January 1-7, 2009 (70 days after the onset of quiescence) with the EFOSC spectrograph attached to the 3.5-m *New Technology Telescope* on La Silla Observatory. The exposure time was fixed at 900 s. Figure 1 presents the average spectrum in true quiescence, when the spectra of the white dwarf (WD) and the donor star are apparent. Strong and narrow emission lines of the Balmer series and HeI forming on the red dwarf are also visible. A preliminary WD+M-dwarf composite fit resulted in a WD temperature exceeding 25,000 K and a mid-M (likely M3-M4) donor star.

A radial velocity study of the narrow Hα emission line provided the orbital period of BB Dor: 3.70 h.

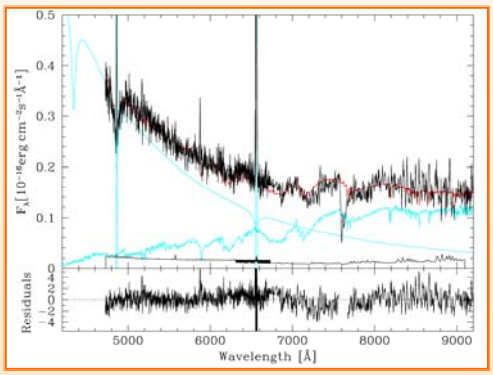

Fig 1. Average spectrum of BB Dor in quiescence (black) fitted with WD + M-dwarf templates + emission (blue). The red spectrum is the best fit.

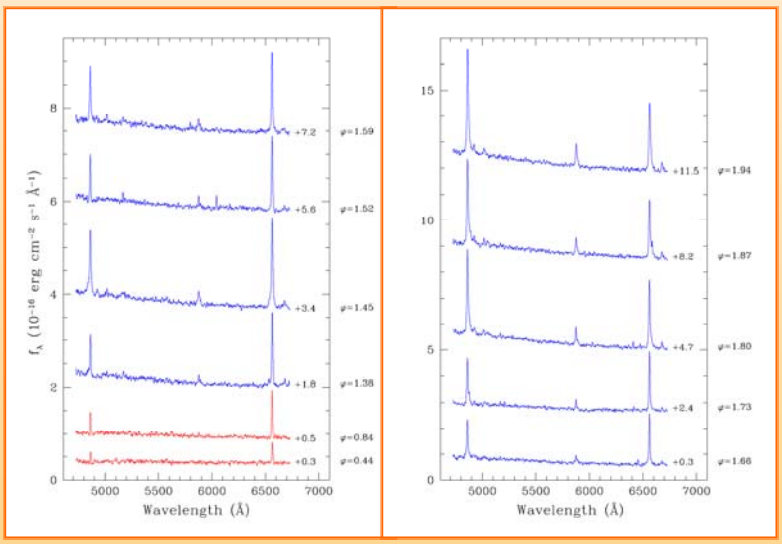

Fig 2. Time evolution of the spectrum of BB Dor during an accretion event. Each individual spectrum has been shifted in flux by the amount quoted just to the right for plotting.

Discovery of sporadic accretion events

Figure 2 to the left shows the time evolution of the spectrum of BB Dor. The first "red" spectrum was taken in true quiescence and shows narrow Balmer emission lines, almost no sign of He I emission and the Hβ broad absorption of the WD.

Then an accretion event starts, making the emission lines much stronger and the continuum bluer. The He I λ5876 and λ6678 lines are apparent. Enhanced line wings also develop. The blue wing is clearly visible in the first "blue" spectrum (orbital phase φ=1.38), while the red wing appears half an orbit later (φ=1.87).

At the climax of the accretion event, the Hβ emission line becomes stronger than Hα. However, the system's magnitude didn't increase significantly. The emission profiles are now made of a broad component originating in the accretion flow and a narrow one from the donor star.

An intermittent SW Sextantis star

We observed other accretion events during our one-week observing run. An Hα trailed spectra diagram constructed only from spectra obtained while accretion was active is shown in Fig. 3. Zero phase was defined by assuming that the narrow emission seen in quiescence come from the red dwarf. An SW Sex-like, high-velocity S-wave which peaks in the blue at φ ~ 0.5 can be seen in the trailed spectra. The radial velocity curve of the Hα extreme wings is shown as blue points in the right panel of Fig. 3. It shows a ~ 0.2-cycle delay with respect to the motion of the WD.

While in the high state BB Dor behaves as an SW Sex star (1). The fact that some of the distinctive SW Sex features are also seen during accretion events in the low state (when the accretion disc is believed to have vanished), suggests that discless accretion can be responsible.

The red dwarf in BB Dor is very active (L. Schmidtobreick's talk). Irradiation of the red dwarf by the hot WD and changes in the starspot density in the vicinity of the L1 point due to the magnetic cycle can work together to produce intermittent accretion during the low state.

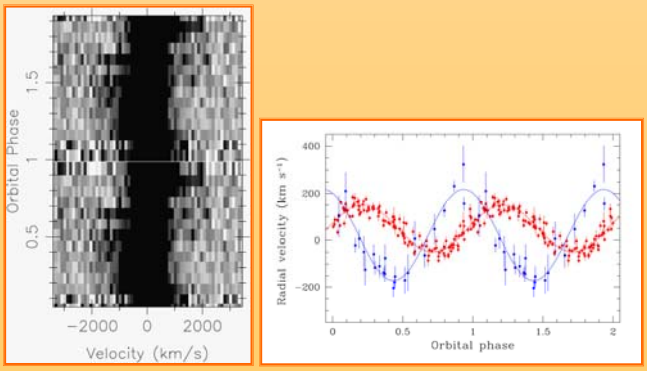

Fig3. Hα trailed spectra while accretion was active (*left*). Hα radial velocity curves and best sine fits of the narrow emission from the red dwarf during quiescence (red) and the line wings (blue) during accretion events (*right*).

References

(1) Schenker M. A., et al., 2009, ApJ, in preparation