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SPECTROSCOPIC DETECTION OF A SPECTACULAR FLARE ON DX Cnc

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We announce the serendipitous spectroscopic detection of a spectacular flare event on DX Cnc. To our knowledge, this is the first spectroscopically detected strong flare on this star. DX Cnc, classified as a UV Ceti star (Samus et al., 2004), is one of the most nearby stars (GJ1111, LHS248) at a distance of 3.6 pc. Because of its proximity and late spectral type (M6.5) it has been used as a spectroscopic comparison star in various studies (e.g., Basri & Marcy, 1995; Teegarden et al., 2003; Caballero et al., 2006). In a similar sense we used DX Cnc for the classification of late-type stars in a systematic search for so far unidentified candidates for members of the immediate solar neighbourhood (Scholz & Meusinger, 2002; Scholz et al., 2005). In this context DX Cnc has been repeatedly observed with the low-resolution long-slit Nasmyth spectrograph NASPEC at the Tautenburg 2-m telescope and with the faint-object spectrograph CAFOS at the 2.2-m telescope on Calar Alto, Spain. The grisms V200 (Tautenburg) and B400 (Calar Alto) were used resulting in nominal resolutions (FWHM) of about 12 Å (Tautenburg) and 30 Å (Calar Alto), respectively. The corresponding wavelength coverage is 4500 to 9000 Å (Tautenburg) and 3500 to 8000 Å (Calar Alto).

Table 1. Table of observations and measured Hα equivalent widths

year–month–day	J.D. (start)	instrument	$t_{\rm exp}$ [s]	EW(Hα) [Å]
2006–09–24	2454002.6479	NASPEC V200	300	3.2 ± 0.2
2006–09–24	2454002.6443	NASPEC V200	60	2.7 ± 0.3
2006–09–23	2454001.6556	NASPEC V200	180	86.9 ± 9.9
2006–09–23	2454001.6529	NASPEC V200	180	82.2 ± 9.9
2006–09–22	2454000.6553	NASPEC V200	180	4.2 ± 1.0
2006–09–22	2454000.6540	NASPEC V200	60	4.0 ± 0.6
2003–03–03	2452702.3248	CAFOS B400	60	-
2002–03–18	2452352.3622	CAFOS B400	120	-
1999–03–24	2451293.3266	CAFOS B400	120	-

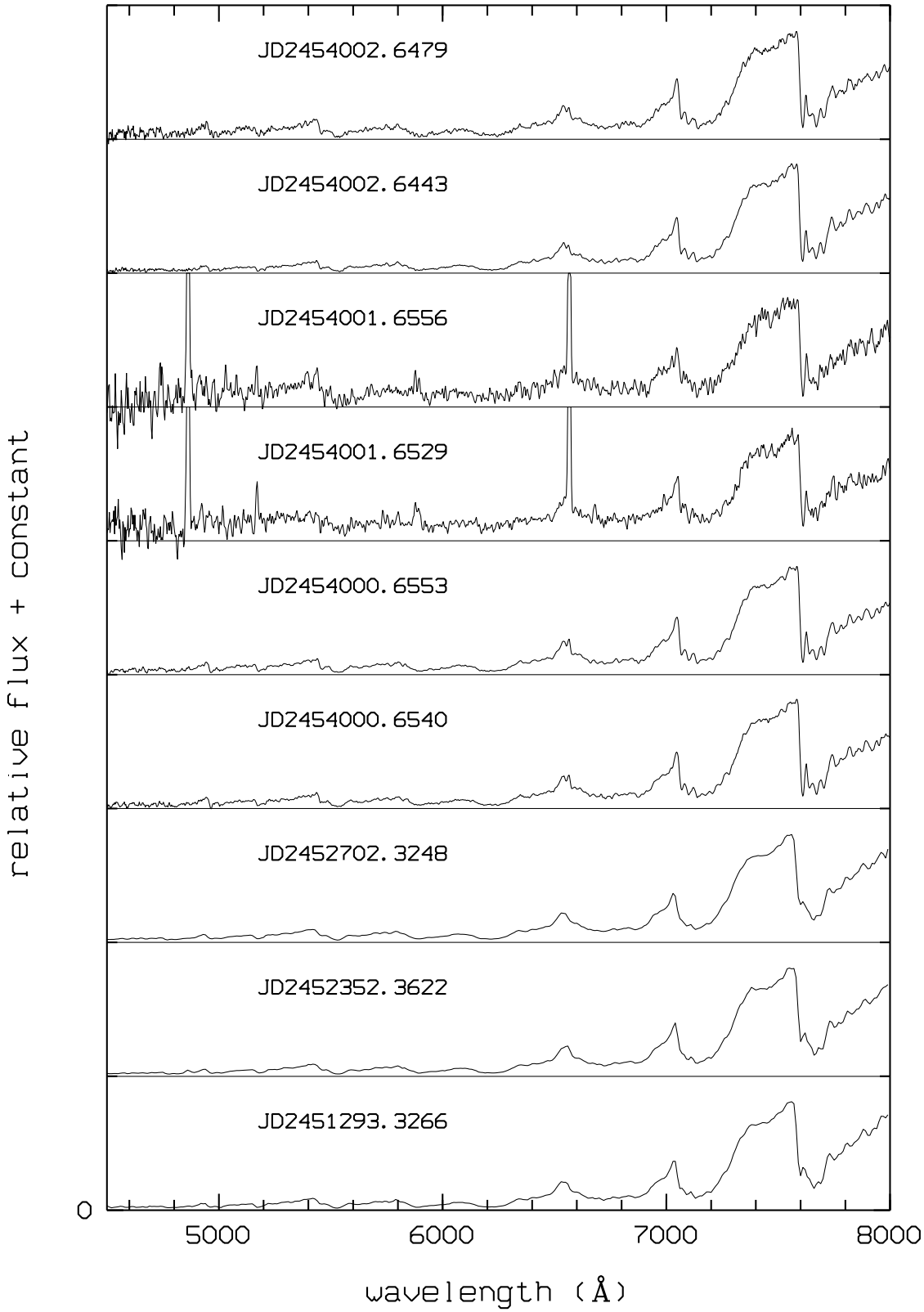

Figure 1. Series of 9 low-resolution spectra of DX Cnc at different epochs normalized at 7500 Å. The Balmer lines in the two flare spectra were truncated for lucidity

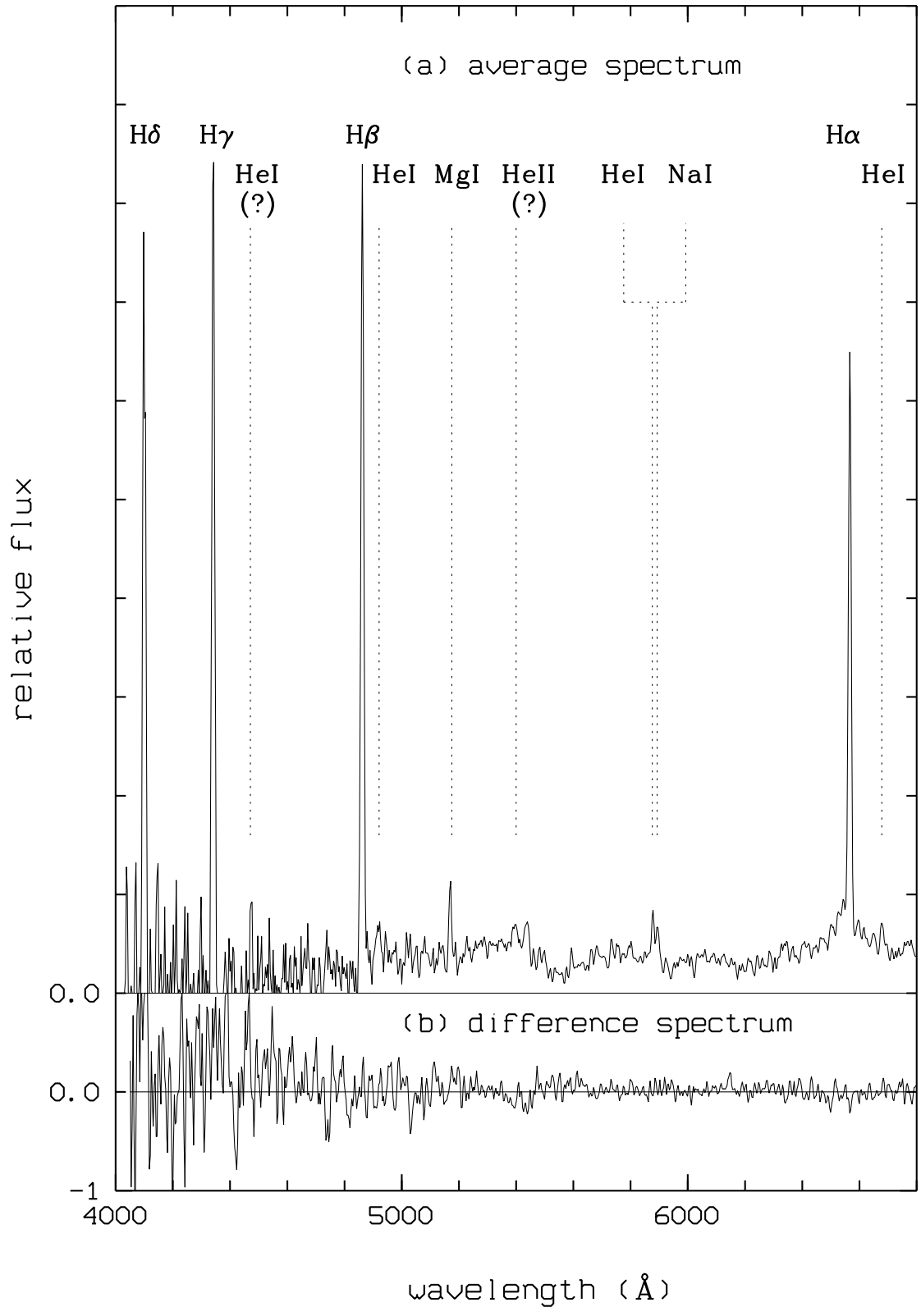

Figure 2. Average (a) and difference (b) of the two normalized flare spectra (relative flux) of DX Cnc from 2006 Sep 23 in the wavelength range of the Balmer lines. The scales of the two panels are different

The flare was detected on two spectra taken at the end of the night of 2006 September 22/23. Actually, the target of these observation was the star USNO-B1.0 1167-0167382 at a distance of about 10 arcsec from DX Cnc. Although the spectrograph slit was not positioned on DX Cnc, the stray light from DX Cnc passing through the long-slit was bright enough to enable the extraction of useful spectra, however with poor S/N below $\sim$ 5000 Å. The time-lag between the end of the first exposure and the beginning of the second exposure was 50 s, hence the two spectra cover a time interval of 430 s. Unfortunately, no other spectra could be taken in the same night because of the break of dawn. The series of all available spectra is shown in Fig. 1. All other spectra of DX Cnc do not show substantial flare activity. The star was obviously in its quiescence stage on the spectra observed in the night before the flare as well as on the spectra from the night after the flare. The two flare spectra do not significantly differ. This is most likely explained by the assumption that the duration of the flare was longer than the time interval covered by the observations. It appears hence useful to compute an average flare spectrum with reduced S/N from the two single spectra. Both the difference spectrum and the average spectrum are shown in Fig. 2. In addition to very strong Balmer lines, HeI emission lines at $\lambda\lambda$ 5876, 6678 and metal lines (Na, Mg) are clearly identified; the identification of the lines HeI λ 4471 and HeII λ 5412 is not safe.

Weak Hα emission is seen in all other Tautenburg spectra. The higher Balmer lines, the He lines, and the metal lines, on the other hand, are usually not seen in emission. For Hα we measure an equivalent width of EW(Hα) = 3 . . . 4 Å in the quiescence stage around the epoch of the flare, in good agreement with the data found in the literature (Liebert, 1976; Martín et al., 1996; Mohanty & Basri, 2003; Fuhrmeister et al., 2005). With their lower resolution, the Calar Alto spectra do not allow to measure Hα in quiescence. From the average flare spectrum we derive EW(Hα) = 95 $\pm$ 10 Å. To measure the equivalent width of Hβ, the continuum was estimated by fitting a mean spectrum from the quiescence stage which yields EW(Hβ) = 580 $\pm$ 10 Å. For the higher Balmer lines it is not possible to estimate the continuum from our spectra.

Finally, it is worth mentioning that both flare spectra seem to indicate an enhanced blue continuum. Such a behaviour has been found for other late-type stars by e.g., Liebert et al. (1999) and Scholz et al. (2004). However, the quality of our flare spectra is not sufficient for a clear-cut statement on the continuum variation during the flare of DX Cnc.

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