The interacting binary V 393 Scorpii: another clue for Double Periodic Variables

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Abstract. We give a brief report on spectroscopic properties of V 393 Scorpii. Hα emission and shape and radial velocity of He I 5875 are modulated with the long cycle. The long cycle is explained as a relaxation cycle in the circumprimary disc, that cumulates the mass transferred from the donor until certain instability produces disc depletion.

**Keywords.** binaries: mass loss, evolution.

1. Introduction

After the discovery of a long periodicity in the V 393 Sco ASAS light curve by Pilecki & Szczygiel (2007), we realized that this star is a bright Galactic member of the new class of interacting binaries Double Periodic Variables (DPVs), that are characterized by two closely related photometric periodicities (Mennickent *et al.* 2003, 2009c). They have been interpreted as intermediate mass semi-detached binaries experiencing cyclic mass loss into the interstellar medium (Mennickent *et al.* 2008, Mennickent & Kołaczkowski 2009 a,b,c). The mechanisms for cyclic mass loss still is a matter of research, and a study of V393 Sco could yield important insigths on the DPV phenomenon.

2. Observations

During the last two years we have monitored V 393 Sco with several high resolution spectrographs (e.g. CORALIE, UVES, FEROS, CRIRES) covering several orbital cycles and a couple of long cycles. We have also used the published ASAS V-band light curve and a special code (Djurasevic *et al.* 2008, 2009) for modeling the system.

3. Results

Spectral lines of the donor are clearly visible and follow the orbital motion without interference during the long cycle, but the gainer (primary) is apparently (at least partially) hidden by a circumprimary disc and He I absorption lines follow peculiar motions during orbital/long cycles (Fig. 1). The Hα double emission indicates an outer optically thin part of the circumprimary disc. A Feros spectrum obtained at orbital phase 0.00 and long phase 0.94 shows Hα emission much stronger than a UVES spectrum taken at orbital phase 0.97 and long phase 0.57 (Fig. 1). This implies that the Hα emission (eventually the disc) is larger on the long cycle maximum. The central absorption deeper than the continuum at this epoch suggests that the disc is eclipsed by the donor. If we interpret the He I absorption lines as produced in a deeper, optically thicker disc region,
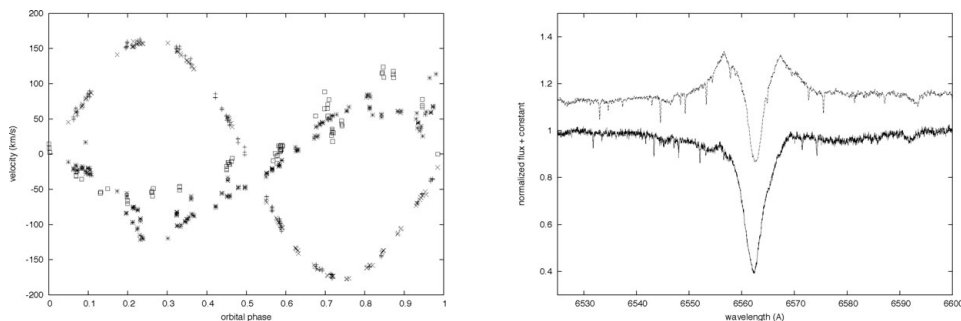
Figure 1. (Left) Radial velocities of the donor star yield $K_2 = 169.7 \pm 0.6$ km/s (crosses and pluses) whereas He I 5875 radial velocities at different long cycle phases, $0.2 < \Phi_l \leqslant 0.8$ (asterisks) and $0.8 < \Phi_l \leqslant 0.2$ (squares), are peculiar. Orbital ephemeris is from Kreiner (2004). (Right) Hα emission at $\Phi_l = 0.94$ ($\Phi_o = 0.00$, above) and $\Phi_l = 0.57$ ($\Phi_o = 0.97$, down).

their RVs indicate strong changes in the structure of this region during the long cycle. The presence of strong line absorption wings at specific phases at the He I 1083.3 nm line indicates mass exchange/loss in the system. The strong modulation of the FWHM for the He I 5875 line during long cycle could reflect a rotational instability of the circumprimary disc (Mennickent *et al.* 2009c). He I 6678 is strongly influenced by emission shoulders and does not show this behavior. A comparison with a grid of spectra from NLTE atmosphere models provided by Dr. Ewa Niemczura yields $T_2 = 7900 \pm 100$ K and log $g_2 = 3.0 \pm 0.1$. It is difficult to estimate the mass ratio, since the helium lines, that could be indicators of the primary motion, do not show a consistent value for K_1. However, the best fit to the light curve of V 393 Sco always requires the presence of a circumprimary disc under reasonable assumptions. Using $q = 0.25$ and $q = 0.41$ as trials we obtain $T_1 = 16910 \pm 150$ K and $T_1 = 17400 \pm 300$ K, respectively. These figures agree with the spectral type for the primary we derive from an analysis of archival IUE spectra, viz. B2–3 III. A detailed study of V 393 Sco is in preparation.

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