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THE 2006 OUTBURST OF THE RECURRENT NOVA RS OPH

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Abstract. We present the results of our intensive photometric (BVR_CI_C passbands) and spectroscopic monitoring (high and low resolution) throughout the 2006 outburst of the symbiotic star and recurrent nova RS Oph. Photometrically as well as spectroscopically the 2006 event closely followed the pattern already traced by the previous outbursts that occurred in 1898, 1933, 1958, 1967 and 1985. The decline time scales in the B band were $t_2 = 6.2$ and $t_3 = 17.1$ d. Coronal emission lines reached maximum intensity around day ~ 70. A fast drop in brightness set in at day ~ 80 and brought the nova below quiescence mean level by day ~ 90, where it is still now, varying widely both in brightness and color.

Key words: stars: binaries: symbiotic – stars: novae – stars: individual (RS Oph)

In February 2006 RS Oph went through its 6th recorded nova outburst. The new eruption occurred 21 years after the last one in 1985. We have carried out an intensive photometric and spectroscopic monitoring of the evolution of the 2006 outburst of RS Oph as part of the ANS (Asiago Novae and Symbiotic stars) Collaboration. Optical spectra and BVR_CI_C photometry (with both CCD and photoelectric detectors) were collected with the 1.82 m and 1.22 m telescopes (operated in Asiago by the INAF Astronomical Observatory of Padova and by the Department of Astronomy, University of Padova, respectively) and with telescopes operated by AFAM (Remanzacco, UD), ARAR (Bastia RA), AAVC (Cembra, TN), Museo Civico di Rovereto (TN) and Osservatorio Astronomico Monte Baldo (VR). All photometric observations were accurately placed on the $UBVR_CI_C$ comparison sequence of Henden & Munari (2006).

The photometric evolution of the 2006 outburst based on our observations is presented in Figure 1. The maximum brightness was reached on February 13.5 (UT) at $V = 4.95$ and $B = 5.80$ mag. The decline has been smooth and quite similar to previous outbursts that occurred in 1898, 1933, 1958, 1967 and 1985, this time the decline time scales in the B band being $t_2 = 6.2$ and $t_3 = 17.1$ d. Compared with previous events, the 2006 outburst presents a clearer plateau phase from day ~ 45 to ~ 75, and a similarly fast drop in brightness starting around day 80 and taking the star below quiescence level ($B \sim 11.75$) by day ~ 90. Hachisu & Kato (2006) models predict that an optically thick wind originating from the WD

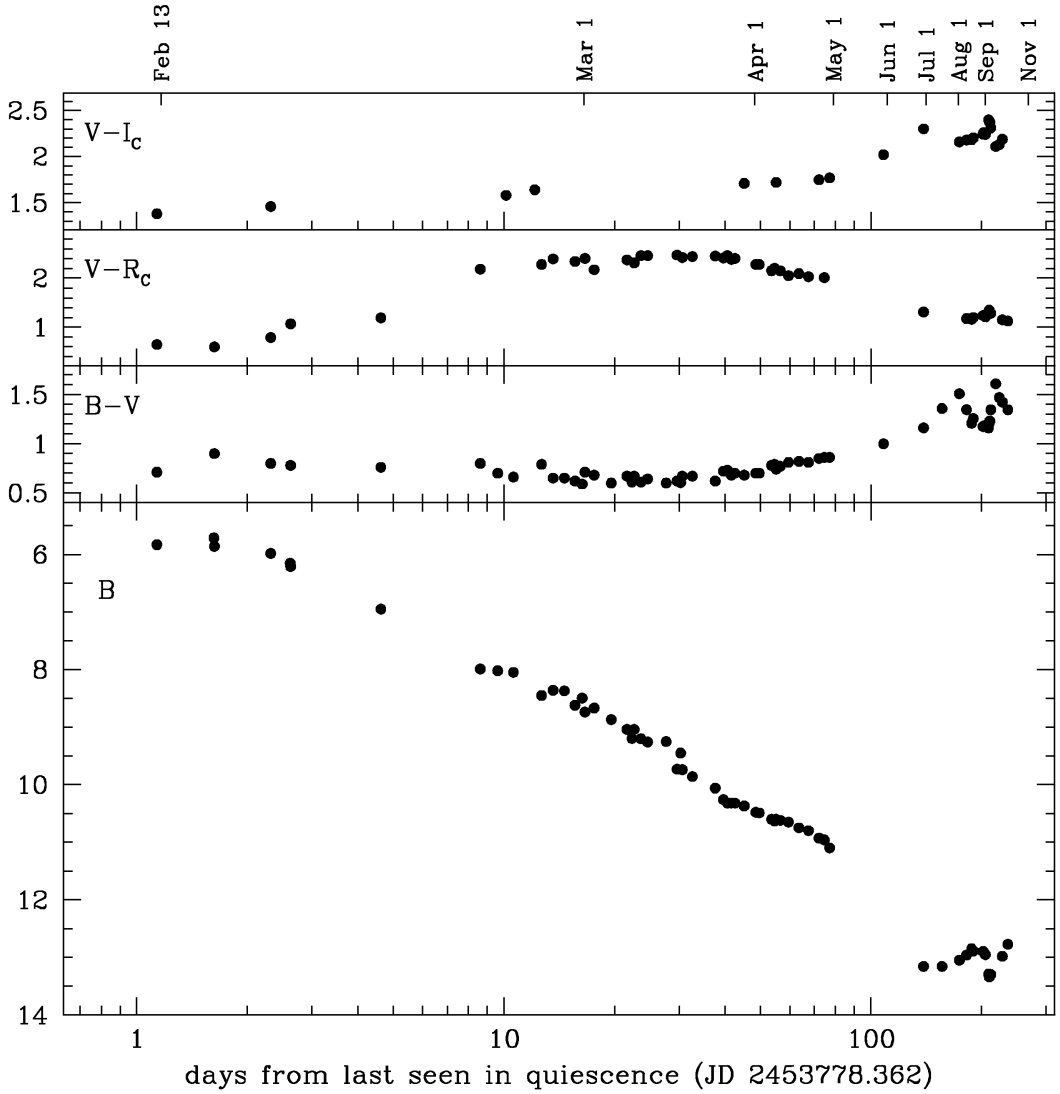

Fig. 1. Light- and color-curves of RS Oph from our observations of the 2006 outburst. The time is counted from JD 2453778.362, the last time RS Oph has been reported at quiescence level (by K. Kanai at $V = 11.0$) before the discovery a day later of the object already close to maximum brightness.

stops at this time and allows supersoft X-rays to emerge from the central source, which is still burning hydrogen in the envelope.

The bluest B–V color was reached on day $\sim$25, and the reddest V–$R_{\rm C}$ color on day $\sim$30 (V–$R_{\rm C}$ evolution is strongly affected by behavior of Hα emission line which accounted for $\sim$70% of the whole flux recorded in the $R_{\rm C}$ band at that time; cf. Figure 2 for emission line profiles on this date). The V–$I_{\rm C}$ color has been monotonously increasing throughout the whole event, as a consequence of the gradual decrease in brightness of the outbursting component compared with the photometrically stable cool giant companion.

The spectroscopic evolution of the star is presented in Figure 2. It is characterized by an increasing degree of ionization during decline from maximum, culminating in the development of a rich and strong forest of coronal lines up to [Ni XV] that peaked in intensity (with respect to Balmer lines) around day $\sim$70. A

system of very broad (a few thousand km/s) P-Cygni profiles affected Balmer and He I emission lines on the very first days, at the time when the massive mass loss from the outbursting WD impacted upon the pre-existing circumstellar material originating from the wind of the cool companion, giving rise to the X-ray emitting blast wave discussed by Sokoloski et al. (2006). He I lines flared in intensity during the third and fourth week. The first appearance of Fe X 6374 Å, the strongest of coronal lines, was recorded on day ∼20. Spectroscopic evolution after day ∼75 was characterized by a progressive reduction in excitation, with at the same time strengthening of [O III] and [N II] lines. By day ∼110 the only coronal lines still visible were Fe X and Fe XI. By day ∼200 the spectrum returned to quiescence appearance.

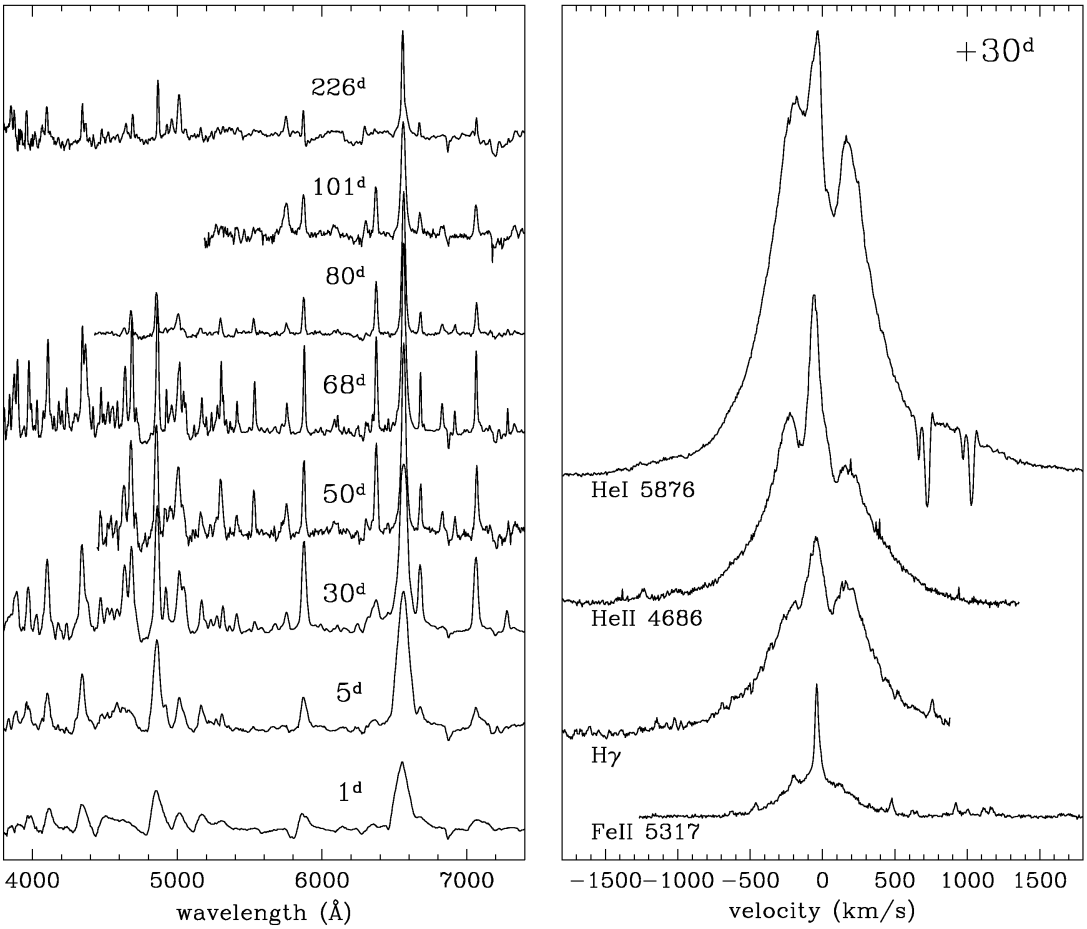

Fig. 2. Left panel: spectroscopic evolution of RS Oph during the 2006 outburst. Right panel: velocity profiles of selected emission lines at the day +30. The spectra have been continuum normalized to 1.0 and shifted for clarity. The ordinate scale is the same for all spectra. Times are given relative to the maximum on February 13.5 (UT).

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