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Study of the Classical Novae V2467 Cyg and V2468 Cyg

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Abstract. The *B* and *V* photometric light curves of the classical novae V2467 Cyg and V2468 Cyg were used to determine their basic parameters: absolute magnitudes in maximum, interstellar extinction and distance. Analysis of our $UBV(RI)_c$ CCD observation lead to the determination of the exact orbital period and short period oscillations of V2467 Cyg. Possible orbital period 0.28326 d was found for V2468 Cyg. The cycles of activity in both novae were investigated. Their tracks on the color-indices diagrams are presented. Our spectroscopy revealed non-spherical ejection of V2468 Cyg shell.

1. Introduction

Classical novae V2467 Cyg and V2468 Cyg were discovered by Akihiko Tago (see Nakano 2007) on March 15, 2007 and Hiroshi Kaneda (see Nakano 2008) on March 7, 2008, correspondingly. Both objects were classifided as Fe II novae.

Most of our CCD $UBVR_CI_C$ observations of both novae were taken with the SBIG ST10-XME camera of the 0.5 m reflector at the Stará Lesná Observatory. Our observations of V2467 Cyg were also obtained with the 1 m reflector at Simeiz observatory in Crimea and V2468 Cyg with the 0.6 m reflector in Crimea Laboratory of the Moscow University, using the portable CCD camera Apogee-47p. For the determination of the basic parameters of novae, we also used available CCD data from the AAVSO,VSNET and MEDÚZA.

Our spectroscopic observations of both novae were taken with the 1.88m telescope of the David Dunlap Observatory, The resolution power of the slit spectrograph was R = 12 000 in the H_α region.

2. The main characteristics of the novae V2467 Cyg and V2468 Cyg

The *B* and *V* photometric light curves of the novae were used to determine their basic parameters: absolute magnitudes in maximum, interstellar extinction and distance. The

formula, given by Livio (1992): $MB_{max} = -8.3 - 10.0\log(M_{wd}/M_{\odot})$, was used to estimate the mass of the white dwarfs in novae. The main results are presented in Table 1:

Table 1. Basic parameters of the novae

Star	V_{max}	B_{max}	R_{min}	t_2, V	t_2, B	t_3, V	t_3, B
V2467	7.67	9.39	18.5	9	12	18	25
V2468	7.57	8.50	18	9	10	20	22

Star	$M_{V(max)}$	$M_{B(max)}$	M_{wd}	$E_{(B-V)}$	A_V	A_B	d,kp
V2467	-8.76	-8.18	0.97	1.38	4.3	5.7	2.5
error, ±	0.07	0.02	0.01	0.12	0.4	0.5	0.3
V2468	-8.70	-8.27	0.99	0.68	2.1	2.8	6.5
error, ±	0.07	0.03	0.01	0.07	0.2	0.3	0.4

2.1. V2467 Cyg

As seen in Fig. 1, our R_c light curve of the nova and the residuals after the trend removal, show periodic brightness variations, found in the Fourier analysis periodogram, as follows:

1) JD 2454200 – 54330: $P_1 = 21.4$ days.

2) JD 2454550 – 54970: $P_2 = 0.159618$ days.

3) JD 2454550 – 54750: $P_3 = 0.02469$ days.

The peaks of the periodogram show also one day aliases (P'_3) of the P_3 period and the beat periods of the P_2 and P_3 (or P'_3). The phased light curves for the P_2 and P_3 periods are depicted in Fig. 1, too.

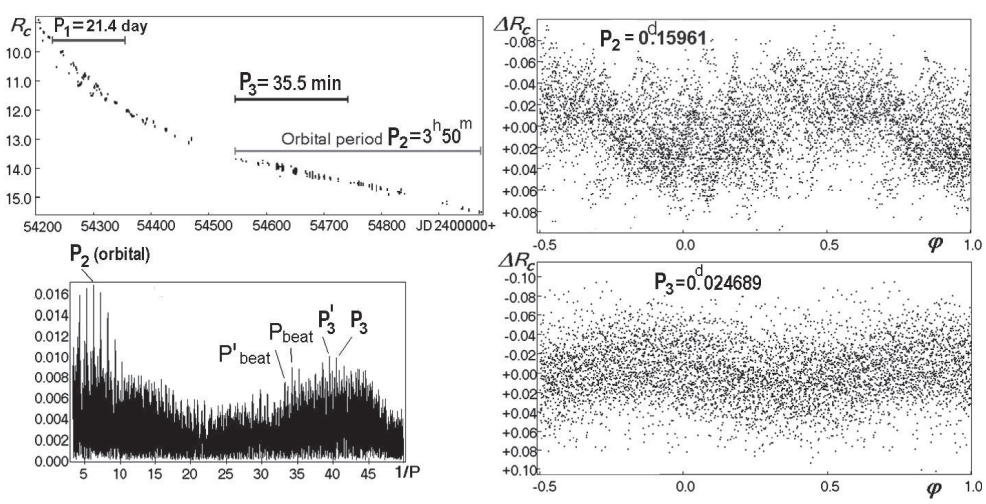

Figure 1. V2467 Cyg: light curve, periodogram and phased light curves after the trend removal.

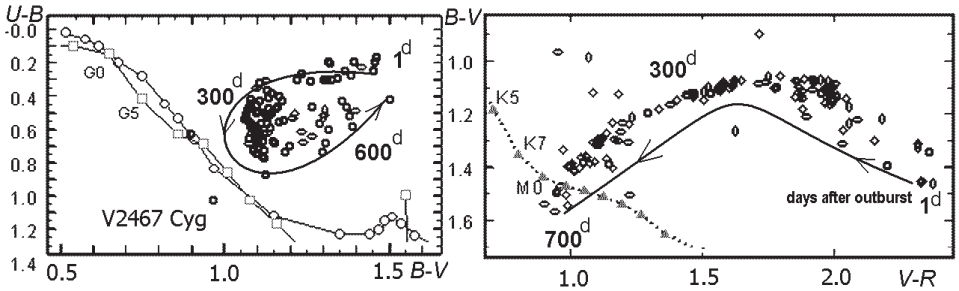

Figure 2. V2467 Cyg: tracks in two colour diagrams. The main and giant sequences are depicted.

The period P_1 = 21.4 days is the mean period of the quasi-periodic ($P \sim 20 - 24$ days) brightness variations, which started soon after the outburst and lasted about 130 days. They were caused either by the presence of the third body in the system or pulsations of the nova envelope (Schenker 2002).

The period P_2 is the orbital period of the binary system. Orbital light curve variations started one year after the outburst and continue till present time.

The period P_3 started one year after the outbust and lasted about 200 days. he form of the light curve and its amplitude was very unstable. The nature of these variations may be either spin-rotation period (Swierczynski et al. 2008) or pulsation period of the WD.

The tracks of Nova at the two-colour diagrams are shown in Fig. 2. While the position of V2467 in $U - B, B - V$ diagram made a 600 days loop, the colours in $B - V, V - R$ changed continuously due to $V - R$ decreasing.

The H_α and [OIII] 500.7 nm emission line profiles of V2467 Cyg, taken in a nebular stage of the nova on July 31, 2007, showed a non-spherical expansion of the shell. Radial velocities of the expanding equatorial ring and polar blobs, determined as RV_{ring} = –750 km/s and 780 km/s, RV_{blobs} = – 190 km/s and 330 km/s, suggest a high orbital inclination of the system.

2.2. V2468 Cyg

During the first ~ 100 days after the outburst, the light curves of V2468 Cyg occasionaly exhibited unusual brightness variations - small flares, with the cycle 2.36 days. These variations was later replaced by larger flares with the cycle 64.7 days. The phased light curve for this period is presented in Fig. 3. Period analysis of the data at the time interval JD 2454930 – 975 revealed a possible orbital period 0.28326 days. The tracks of V2468 Cyg at the two-colour diagrams are shown in Fig. 4.

H_α profiles of the nova V2468 Cyg taken on March 17, 2008 show P Cygni type absorptions with RV = 1140 km/s and 2300 km/s as signatures of the expanding outer envelope and wind with the terminal velocity 2600 km/s. On March 23, 2008 the RV of the P Cygni absorption increased to 1210 km/s, caused by the acceleration of the outer envelope by the wind.

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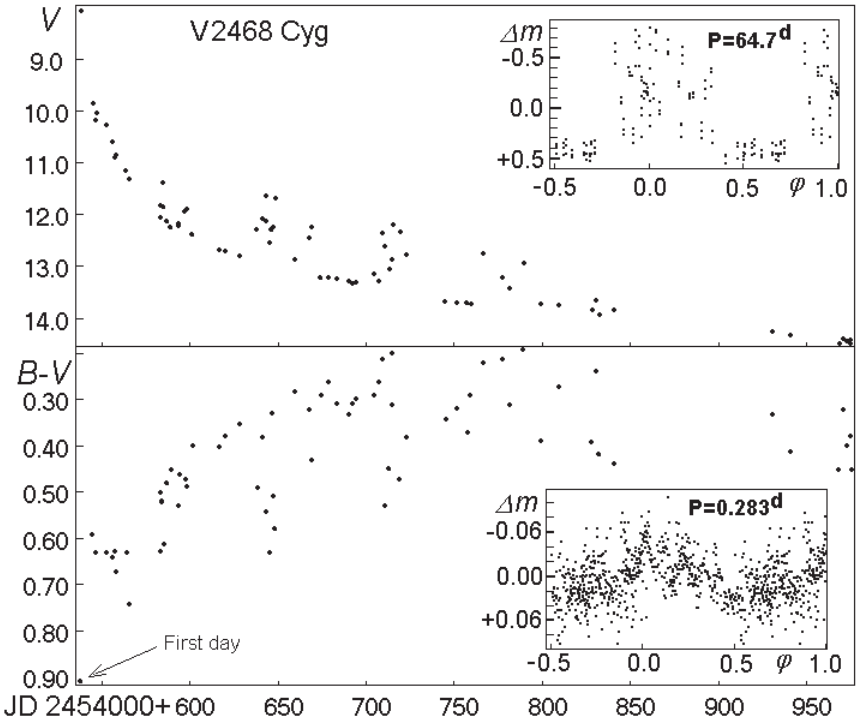

Figure 3. V2468 Cyg: V and $B-V$ light curves. The phased light curves after the trend removal.

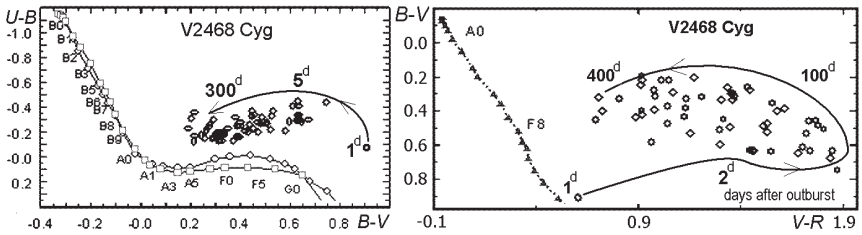

Figure 4. V2468 Cyg: tracks in two colour diagrams. The main and giant sequences are depicted.

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