OUTBURST DECLINE OF SLOW NOVA RT SERPENTIS (1909) FROM 1940 TO 1993.

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ABSTRACT. We present observations of the Nova RT Ser (1909) from 1940 to 1978 (photograhic magnitudes) and from 1983 to 1993 (B, V, R). Light variations with typical time of 10 years have been detected. Brightness declines at a rate of 0.06 magnitude per year during last 70 years..

Key words: Stars: Novae – symbiotic stars – photometry.

Introduction

RT Ser was discovered on the Harvard plates during its 5300 day rise from 16 to about 9 visual magnitude (Shapley 1919). The nova remained at maximum visual light for few years before beginning a tediously slow decline.

This object was listed by Payne–Gaposchkin (1957) as one of the slowest of all classical novae and it was classified as the prototypical symbiotic nova by Kenyon (1986). Infrared observations show that this symbiotic star contains a normal M giant (Feast and Glass 1974). An M6 spectral type to the giant component on the basis of the 2.3 micron CO absorption band was assigned by Allen (1980).

A photographic outburst light curve up to 1936 was given by Payne–Gaposchkin and Gaposchkin (1938). Here we present the Gissar photographic observations from 1940 to 1978 and the B, V, R photometry, obtained in the Crimean Astrophysical Observatory (CrAO) from 1983 to 1993.

Observations

RT Ser have been regularly observed in the CrAO at the 0.5–meter meniscus telescope (F=6.5m), equipped with a sensitive TV system, since 1983. An image intensified isocon LI–804 tube was used as a detector. Field of view is about 10×10 arc minutes. The diameter of used photocathode's part is 22 mm. Dry cold air is used to cool the tube up to $\approx 0°$ C.

Eight stars were selected in the observed region as secondary photometric standards (Fig. 1). Their instrumental b, v, r magnitudes were obtained with the method described by Prokof'eva et al. (1993). and based on absolute calibration of TV observations by using artificial stellar images. Extinction derived from the observations of extinction stars was taken into account to reduce the observations of RT Ser.

For seven nights the instrumental v magnitudes were obtained by using another method. According to this method the investigated region (near RT Ser) and the photometric standard (galactic cluster NGC 188) were observed by using the same regimes of TV technique and with minimal time interval (less than 20 minutes in our case). Then the calibration curve for NGC 188 was used to determine the stellar magnitudes of stars near RT Ser. The value

$$\Delta m = (Fz_1 - Fz_2) \cdot \alpha \qquad (1)$$

must be added to the derived magnitudes because Here Fz_1 – air mass of NGC 188, Fz_2 – air mass of RT Ser, α – the extinction coefficient of the existence of the difference in air mass between the two regions.

The instrumental b, v, r magnitudes are transformed to standard B, V, R magnitudes of Johnson and Morgan's photometric system by using the reduction formulae by Prokof'eva

Table 1: Brightness of the comparison stars for RT Ser

Star	V	σ_V	B–V	σ_{B-V}	V–R	σ_{V-R}
1	14.43	0.05	1.53	0.08	1.87	0.06
2	14.19	0.05	1.29	0.07	1.70	0.05
3	14.81	0.06	1.00	0.07	1.65	0.06
4	14.77	0.05	1.04	0.08	1.64	0.06
5	15.31	0.07	1.15	0.08	1.97	0.09
6	13.45	0.07	1.66	0.08	1.99	0.08
7	14.57	0.07	0.68	0.08	1.64	0.07
8	15.13	0.06	0.77	0.08	1.59	0.07

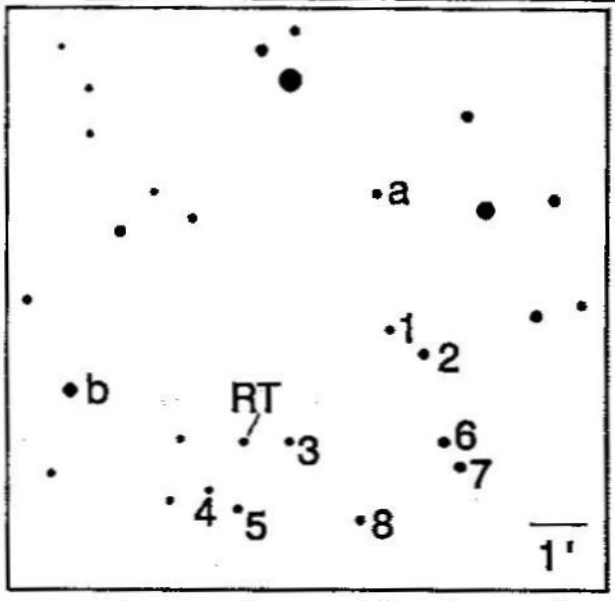

Figure 1: Region near RT Ser with north–east at the upper left. 1–8 – secondary photometric standards, a,b – stars, used in reduction of Gissar photographic observations to B standard band.

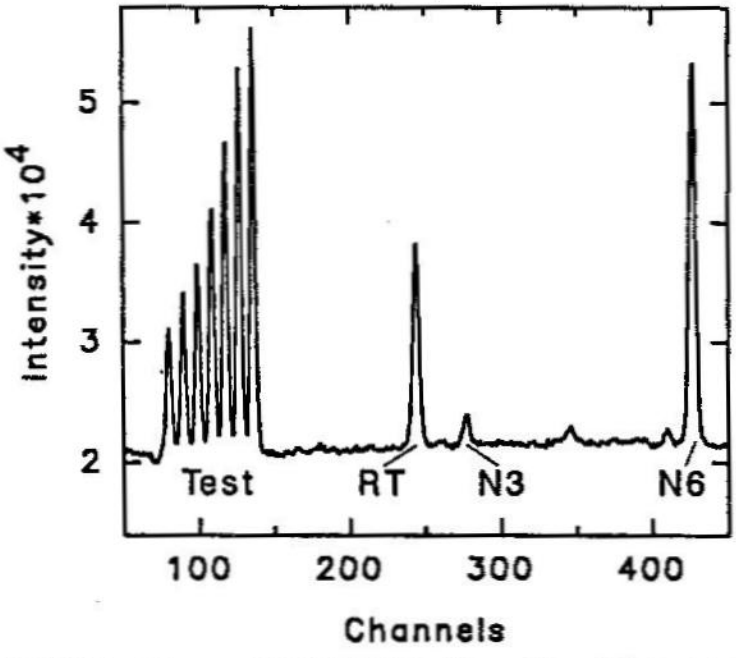

Figure 2: TV record of RT Ser taken on JD 2448400.5 in filter r. From left to right: seven artificial stars images (test), RT SER, star N3, star N6.

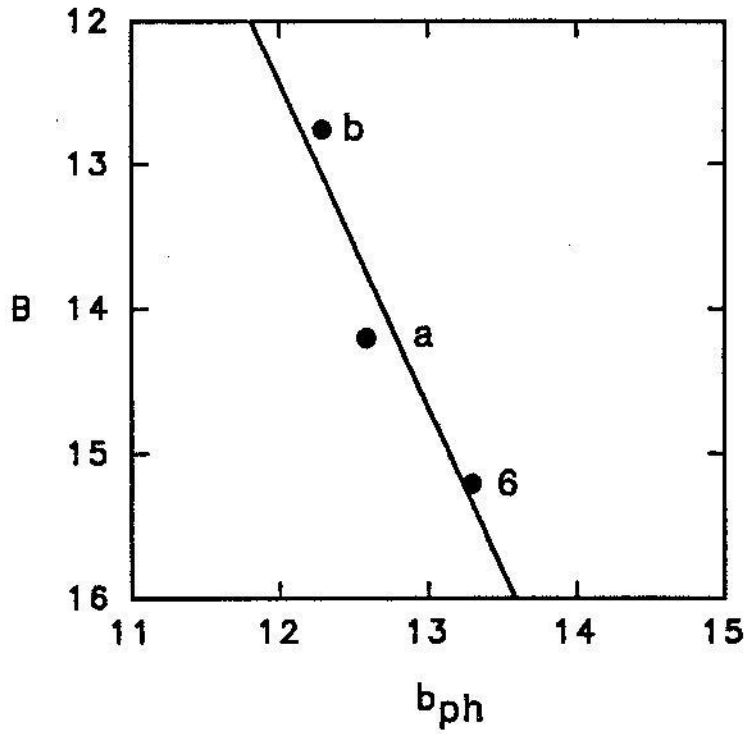

Figure 3: Connection between photographic magnitudes (b), obtained in Gissar observatory and B magnitudes of standard photometric system.

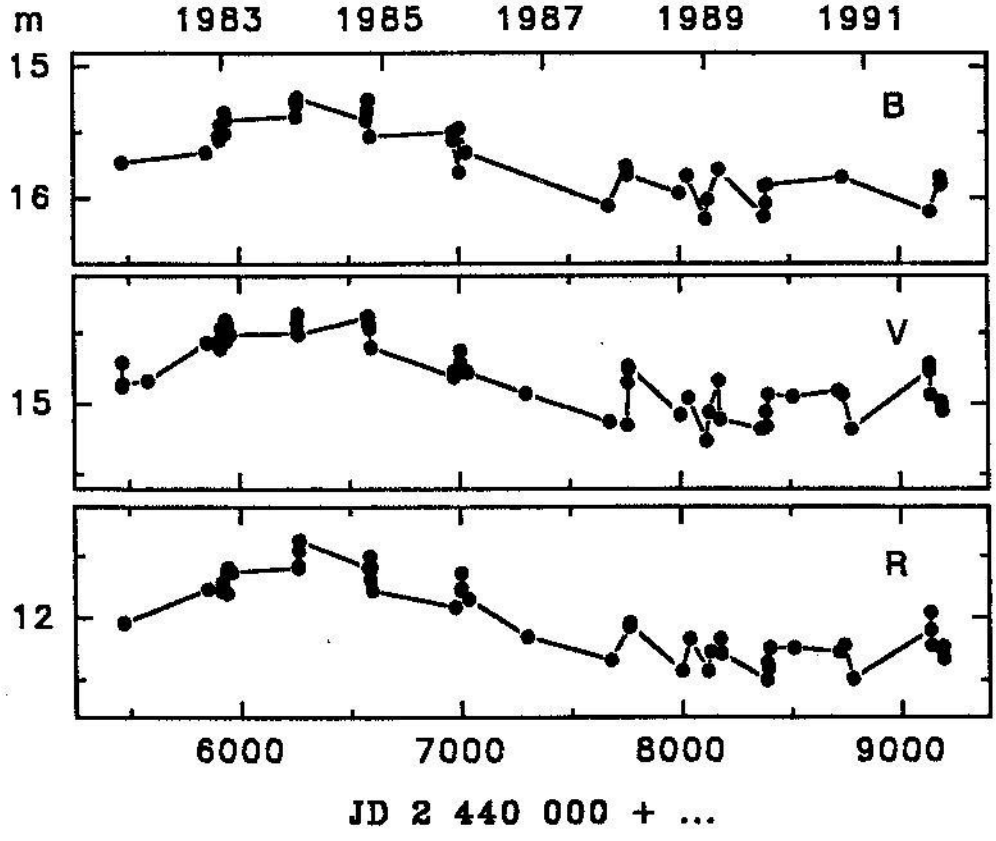

Figure 4: B, V, R photometry of Nova RT Serpentis (1909).

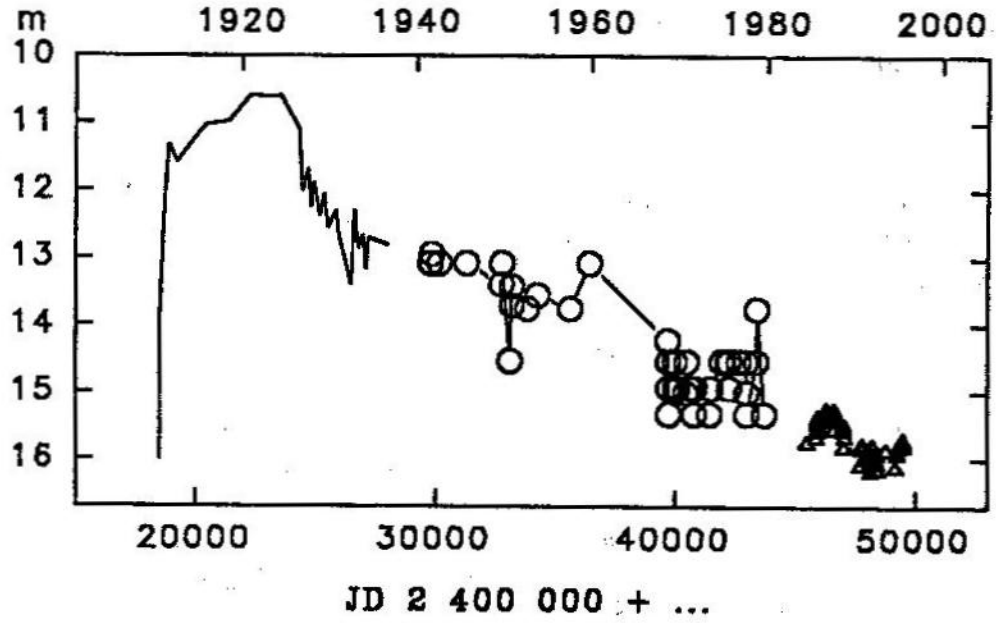

Figure 5: Optical light curve of Nova RT Serpentis (1909). Observations: line – Harvard, circles – Gissar, triangles – Crimean Astrophysical observatory.

et al. (1993).

The V magnitudes and B–V, V–R color-indexes and their root mean squared errors of the secondary standards are listed in Table 1.

The image of the observed region on the monitor was photographed with camera during first seven years: from 1983 to 1990. Stellar images of nova and neighboring stars were measured with the microphotometer MF-2 having constant diaphragm. The instrumental magnitudes of RT Ser were derived from the characteristic curve fitting the secondary standards. The accuracy of the observed data are about 0.05 mag for V magnitudes and 0.09, 0.06 mag for B–V and V–R colors respectively.

From the beginning of 1990 the brightness of RT Ser and one or two comparison stars was recorded in digital form. Special technique select the part of every TV line, summarize the whole energy of this part, and then transform the energy to digital form. In that way the strobe are formed on every TV card. The strobe size on TV line is about 9 seconds of arc. The strobe size of whole card is 600 channels. An example of the TV record is displayed at Figure 2. There are present photometric contours of seven images of the artificial stars (test), RT Ser, star N3, star N6 in the strobe.

The logarithm of the square of a contour is used as the measure of the whole energy, kept by the photocathode from the star. Images of seven artificial stars with known brightness (calibrating marks) are projected onto the input photocathode of TV pick up tube during exposures. They are used for photometric calibration of TV records. The accuracy of observed data are about 0.04 mag for V magnitudes and 0.07, 0.04 mag for B–V, V–R color-indexes, respectively.

To complete the curve of the RT Ser outburst, we used photographic observations obtained in Gissar observatory from 1940 and to 1978. These observations were obtained with Industar–17 camera (F = 50 cm, A = 1:5).

Vasiljanovskaja looked through more than 1000 plates and could measure the brigthness of RT Ser only on 43 plates. To reduce the photographic magnitudes to B spectral band of Johnson and Morgan's photometric system, Vasiljanovskaja had make visual measurements of the stars from the region around RT Ser observed at the TV complex. This reduction is shown in Fig. 2. Stars, named as *a* and *b* (Fig. 1) are very bright at the TV

images, so they haven't been included in the group of secondary standards because of low accuracy of their V and R magnitudes.

Results

The light curve of RT Ser obtained from 1983 to 1993 in B, V, R color bands is displayed in Figure 4. Light variations with typical time of ten years are present in these bands. The whole amplitudes are 0.94, 0.89, 1.13 mag in B, V, R bands, respectively. The B–V, V–R color–indexes vary in a range of 0.5 mag and their mean values are 0.90, 2.78 respectively.

To display the whole picture of development of the outburst of RT Ser, three groups of observations are plotted in Figure 5. Line – Harvard photographic observations published by Payne–Gaposchkin and Gaposchkin (1938), circle – Gissar photographic observations, reduced to the B band, triangles – television observations in the B band. The complex light curve demonstrate the brightness decline at a mean rate of 0.06 mag per year during last 70 years. The brightness variations of a few tenths of the stellar magnitude are probably present with characteristic time of decades of days.

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PHOTOMETRIC STUDY OF TY CRA

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ABSTRACT. The UBVRI photometric data of TY CrA have been compiled mostly unpublished. The new period and epoch have been derived: Min I = JD 2442954.301+2.888782·E. The errors are about 2 units in the last digit. At the first time the V light curve have been solved. The elements are: $r_1 = r_2 = 0.13$, $L_1 = 0.92$, $i = 81.7°$. The light curve has no phase effect. No color variation have been seen. There is some depression near phase 0.5. If it is real, the relative surface brightness evaluation leads to conclusion that the secondary may be a F0 star with 2 $M_\odot$.

Key words: Stars: Binaries: Eclipsing.