

BINARITY OF NOVAE

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The continuous and complex investigations showed that Nova Delphini 1967=HR Del has two types of changeable minima on the orbital light curve with different periods – ($P_1 \approx 0.14$ days and $P_2 \approx 0.19$ days) and amplitudes $\Delta m_1 \approx 0^m.70$ and $\Delta m_2 \approx 0^m.90$). It is a triple star as the repeated Nova T CrB (1866, 1946).

Establishment of the binary nature of Novae plays the fundamental role in interpretation of this phenomenon. Duplicity of stars is a key in understanding of the mechanism and reason of flare of Nova and is basic for the whole modern picture of the phenomenon.

At observing of former Nova DQ Her in 1956, Walker [1] for the first time has found regularly repeating deep decreases of the brightness of this star with period 4h39min - the eclipses. In 1963 he has also discovered that Auriga Nova is the eclipsing binary star with the period 4h59min.

P. Kraft [2] has discovered the binary nature of Nova Agl 1918 from periodic changes of the radial velocity of this star. In 1980 it was reported that the brightness of this star varied with the same period (3h19min), which was established by Kraft [3]. It was revealed that the light curve was eclipsing (the duration of eclipse was 33 min, and the deepness – 0.36). The same author [4] from spectral data has detected binarity of Nova Per 1901. Its orbital period was determined ambiguously; according to Kraft [4] it was 1.904 days, but Paczynski [4] has found the value of 0.685 days.

In the last years it was discovered binarity of HR Del 1967 (period is 4h35min) VD Pav (4h18min), 1500 Cyg (about 3.5hours). Vaikoff and Vekhinger [4] confirmed with the help of spectral observations, that for the slow Novae RR Pic the exact value of the orbital period is 3h29min. Many observations of Nova confirm the presence of periodic changes of their brightness as in binaries.

Similarity of periods of typical Nova is not casual, it specifies similarity of the structure of binary systems where Novae outburst. The discovery of binarity has allowed for the first time to obtain directly an estimation of masses of Nova. In 1964 R. Kraft has obtained masses of components of the binary system of Novae based on the analysis of light curves and radial velocity curves. Finally, he has shown that Novae were low mass stars with masses from 0.2 to 0.6 mass of the Sun, but the mass of repeated Nova T CrB is considerable larger - 3.7 masses of the Sun.

Now, it is commonly believed that all Novae are close binary systems. The binary star consists of a blue hot star, being white dwarf, and cold component of Red dwarf. The blue component in result of burst gives Nova. It is surrounded by the disk formed in result of gas stream from the red component. The matter gradually falls on to the surface of the white dwarf. This process refers to as accretion, and the disk itself is called the accretion disc. Observations of binary Novae, carried out in last years, have confirmed the existence of disks around white dwarfs. The disk manifests itself well in those systems, where eclipses are observed.

The periodic fluctuations of brightness were found by Kohoutek and Pauls [5] and M. Babaev [6] for slow Nova

HR Del 1967 (fig.1). Recently the binarity was revealed with the help of the spectrophotometrical method. In 1979 Hutchings [7] has found that the Nova HR Del is the binary and the period of variability of this system was -0.17098 days (=4h06min). After this we carried out photographic observations during 12-14.06.1978, 27-29.08.1979, 16-18.09.1980 and 30-31.07.1981 on the 350 mm AST - 452 telescope at Shemakha Astrophysical Observatory (ShAO) of the Azerbaijan Academy of Sciences and 70 images of HR Del have been received.

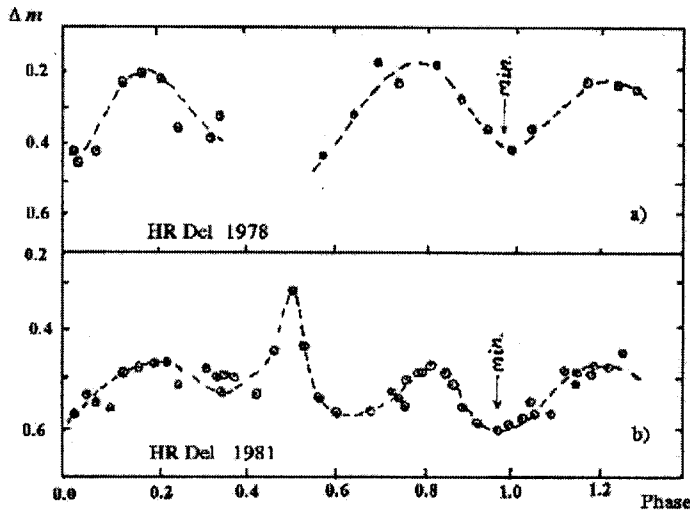


Fig. 1. Light variation of Nova HR Del with period $P=0^d.177125$

a) 1978; b) 1981

Nova HR Del was observed by us photographically with the aim to investigate the changes of the brightness and to determine the orbital period. Therefore for revealing of the binarity of Nova HR Del in 1978, 16 images with 6 minutes expositions was taken again for one night and 36 pictures in 1981 also for one night with an exposition 6 minutes (fig.1). In this figure the change of photographic magnitude of the star with the phase is shown, which was calculated with elements which we determined [8].

$$Min I = J.D. 2443674^d.242750 + 0^d.177125E$$

The period determined by us is in the good accordance with the data received in 1978 and 1981 and with the value of the period obtained by Hutchings [7]. The amplitude of variation of the brightness of HR Del in the first minimum is $0^m.15 \div 0^m.20$. So, for the period of HR Del we have adopted the value $P=0.1771250 \pm 0.0007$ days. The shape of the light change shows, that in addition to the founded period there is the period of 0.13 days with variable amplitude.

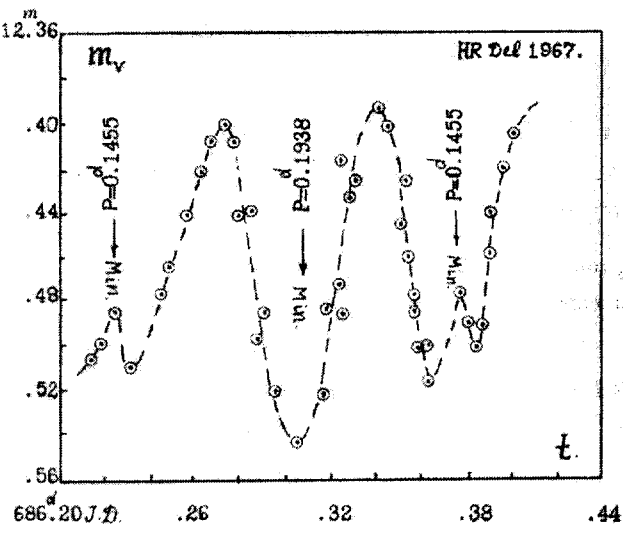


Fig. 2. Light curve of HR Del in 1986

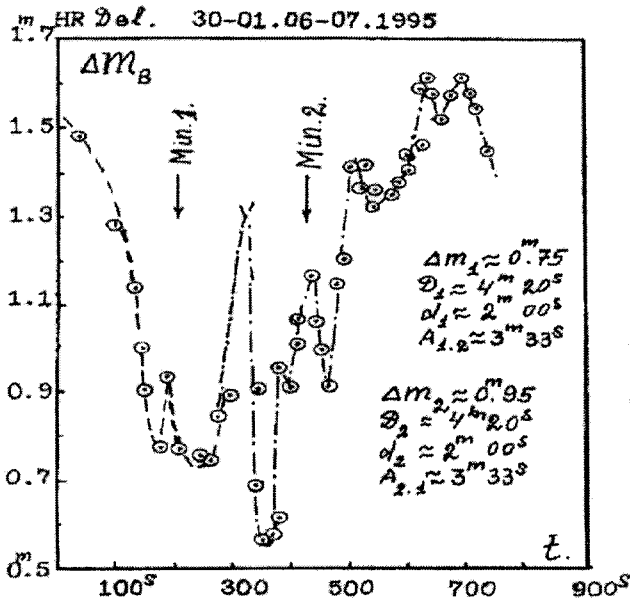


Fig. 3. Light curve of HR Del in 1995.

The periods are variable with mean values of ~ 0.1455 and 0.1938 days (fig. 2) [8].

As can be seen from fig. 2 except the minimum 0.17 ± 0.21 days $- P = 0.1938$ days (according to different authors) connected, apparently, with the binarity of HR Del, there are also minima with periods 0.13 ± 0.14 days ($\sim P = 0.1455$ days) [8]. Thus, it was found that Nova Del 1967 is the cataclysmic variable star with some peculiarities, one of them is the double minima. Therefore we observed the Nova Del 1967 from 30.01., 06.07.1995 to 26-27.07.1995 with the aim of determination of the orbital period and detection ultra-short changes of brightness by the photoelectrical method.

The observations were carried out on the telescope CEIS - 600 at ShAO with the help of the photometer AFM-6 by the methods of photon counting as it was done earlier. Photometric observations were carried out mainly with the filter "B" in system UBV for increase the accuracy.

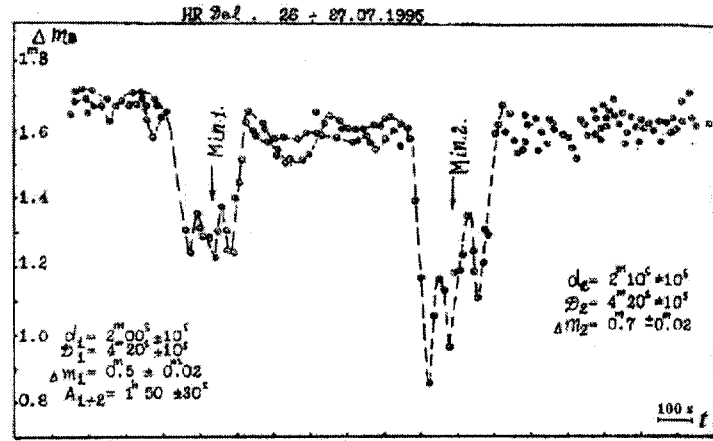


Fig. 4. Light curve of HR Del in 1995

The processing of this material showed, that Nova Del 1967 has double minima with different periods and amplitudes which alternate each other (fig. 3 and 4). As it can be seen in these figures, the observational material obtained in different nights again demonstrate that this Nova has periodic changes in brightness with two minima not similar to any other type of Novae. The comparison of these two figures shows that these minima have approachements and removals as in the triple system. Such character of changes gives us an opportunity to say, that in this system either two stars were burst or the star which was burst has been broken up into two parts. Probably the further continuous and detailed observations will confirm this phenomenon if it is the real one and it will be unique for Novae.

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During 13 nights from August 12 to September 13, 1986 at fist with the telescope AZT-8, and then from August 13 to August 14, 1987 with the 2 m telescope ShAO with the help of the photometer AFM-6 by the method of photon counting, we carried out photo-electrical observations of HR Del for specification of the orbital period, for which different authors give different values. In spite of this, by using these observational materials we revealed that Nova HR Del has two types of brightness changes, which are due to the binarity of the Nova.

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YENİLƏRİN QOŞALILIĞI

Uzunmüddətli, ardıcıl və hərtərəfli müşahidələrin tədqiqi göstərdi ki, Yeni Delfin 1967-HR Del ulduzunun orbital işıqlılıq əyrisində müxtəlif periodlu – ($\sim 0^d, 14 \div \sim 0^d, 19$) və amplitudalı – ($\sim 0^m, 70 \div \sim 0^m, 90$) iki minimumu vardır.

М.Б. Бабаев

ДВОЙСТВЕННОСТЬ НОВЫХ

Продолжительные и комплексные исследования показали, что у Новой Дельфина 1967=HR Del имеется два типа изменчивого минимума на орбитальной кривой блеска с разными периодами – ($P_1 \approx 0^d.14$ и $P_2 \approx 0^d.19$) и амплитудами – ($\Delta m_1 \approx 0^m.7$ и $\Delta m_2 \approx 0^m.9$). Она является тройной звездой как повторная Новая звезда Т СгВ (1886, 1946)

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