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THE UNIQUE MANIFESTATION OF THE MATTER OUTFLOW IN THE ECLIPSING BINARY SYSTEM V 361 Lyr

The variable star V 361 Lyr was mentioned as an ordinary RR Lyr type star in the third edition of the General Catalogue of Variable Stars. Its period was unknown at that time. The photographic light curve obtained by one of us (M.G.) revealed the eclipsing nature of this object with periodic light variations ($P=7^h.5$). The shape of the light curve of V 361 Lyr is similar to that of β Lyr systems but in the case of V 361 Lyr the light maxima differ by $0^m.5$ from each other what is incompatible with our knowledge about β Lyr type and similar systems. Light curves with different maxima are observed in the case of eclipsed cataclysmic variables (CV) but the "hump" on CV light curves is observed just before the primary minimum and is due to the bright spot on an accretion disk around the white dwarf. On the contrary, the more prominent maximum on the light curve of V 361 Lyr is Max I after the primary minimum. As to our knowledge, there are no other binaries with similar light curves. So we decided to carry out photoelectric photometry of the object to clarify the situation.

Classical CVs are specified by an UV excess in their energy distribution and Hα emission in the spectrum. Observations of V 361 Lyr have not revealed such peculiarities. Colour indices of V 361 Lyr indicated a spectrum ∿ K.

During the last 4 years detailed B, V light curves and a somewhat worse U light curve have been obtained (see Fig. 1). The light curve of V 361 Lyr can be presented by a sinusoidal wave with the superimposed minima due to eclipses. The difference in maxima heights is then due to the fact that Max I occurs almost in the maximum phase of the sinusoid whereas Max II - in the end of decline.

The colour index in the primary minimum ($B-V=0^m.92$) is very close to those in the secondary one ($B-V=0^m.85$). In the "hump" (Max I) the colour indices are $B-V=0^m.59$, $U-B=-0^m.10$. The light in both eclipses (Min I and Min II) seems to come from the same, more luminous companion. The secondary compan-

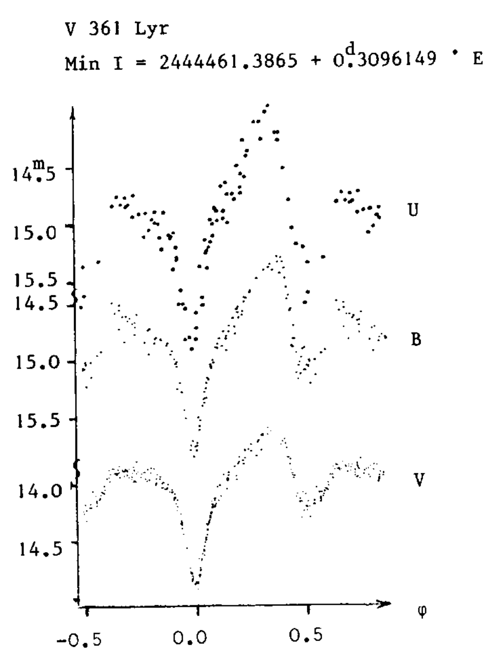

Figure 1. The light curves of the binary V 361 Lyr

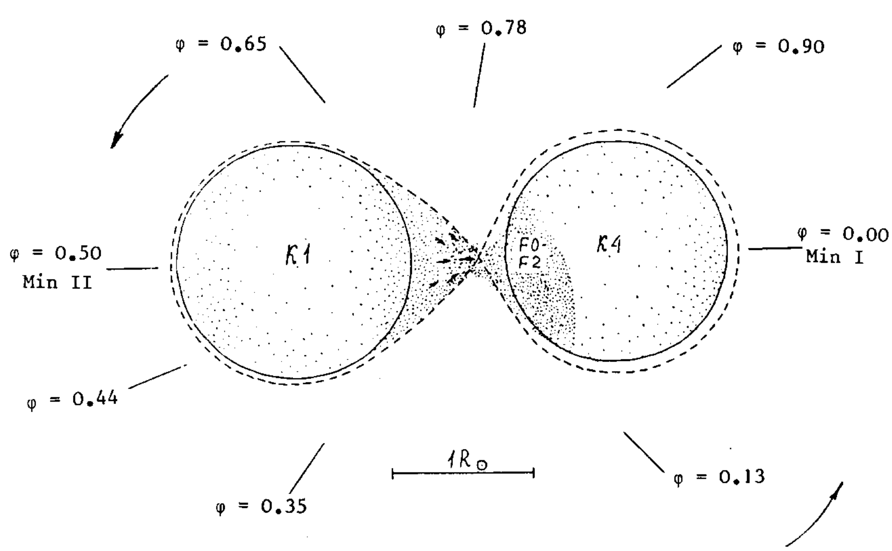

Figure 2. The model of the binary system V 361 Lyr

ion is assumed to be more evolved (less luminous), with nonuniform temperature distribution on the surface. The simplified scheme of the binary model is shown in Fig. 2 where the secondary component (on the right) is accreting matter from the primary component, and a bright spot is formed as a result of this accretion in the place of accreting matter shock onto the surface. The bright spot can explain a sinusoidal shape of the light curve (Fig. 1). During the primary minimum ($\Phi = 0\overset{P}{.}0$) the spot and the main part of the luminous companion are hidden from the observer (see Fig. 2). Further, on the ascending branch, the bright star appears gradually from behind its companion, conditions for the spot appearance become better and better and at the phase $\Phi = 0\overset{P}{.}35$ of the orbital period we can see the spot in the best way (Max I). After this an occultation of the spot by the bright star begins and becomes total at the orbital phase $\Phi = 0\overset{P}{.}5$. Subsequently, the spot appears again and becomes brightest at the phase $\Phi = 0\overset{P}{.}65$ (Max II). At the phase $\Phi = 0\overset{P}{.}80$ the spot disappears again.

Let us remember that CVs have a hump before the primary minimum which is explained by the spot on an accretion disk around the white dwarf. In the case of CVs the matter flows from the secondary companion (red dwarf) to the primary one (white dwarf surrounded by the accretion disk). On the contrary, in the binary system V 361 Lyr matter flows from the more luminous star to its companion and forms on it an extended spot being responsible for an extraordinary shape of the light curve of the binary V 361 Lyr.

We have placed both components on the colour-colour diagram (see Fig. 3). The magnitude of the bright star is $V=14\overset{m}{.}25$, the colour indices are $B-V=+0\overset{m}{.}85$, $U-B=+0\overset{m}{.}50$ which correspond to the spectrum K1. The companion ($V=16\overset{m}{.}1$) with the colour index $B-V=+1\overset{m}{.}1$ is apparently classified as K4V. The mean spot colour indices are $B-V=+0\overset{m}{.}3$, $U-B=-0\overset{m}{.}2$, its temperature is 7000 - 8000 K.

The binary system V 361 Lyr is assumed to be observed at the first mass exchange evolutionary stage when the brighter and more massive star is outflowing to its low-mass companion. A number of such binaries must be considerably less than those at the second mass exchange stage (i.e., CVs), after the common envelope phase and shrinkage of the system. The first mass exchange can be realized only in the binaries with initially small separations between the components. Hence it is rather serendipitous chance to observe such a system.

V 361 Lyr is obviously a binary system worthy of further photometric and detailed spectroscopic investigation.

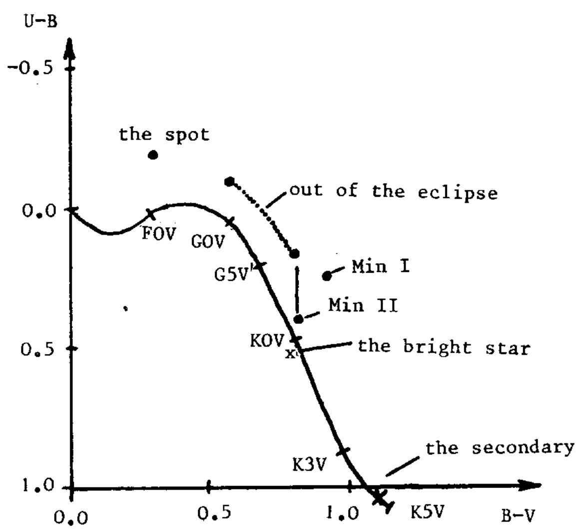

Figure 3. The colour-colour diagram

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