SYNTHETIC LIGHT CURVE OF R CORONAE BOREALIS

A. F. Pugach, G. U. Kovalchuk
Main Astronomical Observatory, Ukrainian Academy of Sciences
Golosiiv, Kiev 252127 Ukraine

ABSTRACT. The model for brightness variations of CrB is proposed.

Key words: Stars: R CrB

The so-called it "expanding model" of R CrB-type stars phenomenon which was elaborated in 1990-1993 is now capable of calculating light curve for any elementary light fading taking into account the solid carbon mass M of the dust cloud, its distance D (in a plane) from the star's center and the heterogeneity of the dust distribution. The it "synthetic light curve" would then be drawn as a superposition of numerous elementary light curves.

We have collected all available photometric observations of R Coronae Borealis covering the time span of 1850 - 1990 yrs and then tried to properly match the full observed light curve and the synthetic one. The preliminary result shows quite satisfactory coincidence at the majority of observed minima.

The synthetic light curve consists of 152 elementary light curves. Each of them was calculated using individual values of M, D and the moments T of onsets of the declines. Some important physical parameters might be inferred from a statistical analysis of M, D and T distributions.

1. The masses M of elementary dust clouds range within the limit of $1.3 \cdot 10^{20}$ g$\leq M \leq 2.7 \cdot 10^{23}$ g, average cloud mass of solid carbon being near $2 \cdot 10^{2}$ g. The total mass Md of solid carbon ejected from the R Coronae Borealis within 1850-1990 in the direction of the observer equals $Md \approx 1.7 \cdot 10^{24}$ g. However, the computed value of Md seems to be very underestimated (probably 2 -3 times) because of a non-monotony and a non- homogeneity of the dust distribution inside the clouds.

2. Distribution of the D-values can be fairly fitted by formula N = 40 exp[-0.66 D]. The formula reflects the quite obvious relation: the more mass M of the cloud the more distance D is. Not enough massive clouds seem hardly to absorb noticeable quantity of the parameter ΔT (ΔT is the time interval between the onset of two successive minima) has shown that the distribution of ΔT turns out to be very far from the uniform one. The values ΔT seem to form some peaks 1/2 A, B, A, 2B, 2A, 4B to be centered near time intervals: 1/2 A = 27.82 days; B = 39.28 days; A = 54.37 days; 2B = 77.44 days; 2A = 104.8 days; 4B = 152.7 days. Apparently all intervals are multiple to 38 and 54 days. On the other hand numerous direct photometric observations pointed out several periods of pulsations, the most pronounced of them being just close to 40 and 53 days. We interpret this distribution as being due to the presence of two independent periods of pulsations which are initiators of the dust forming process.

Thus the connection between the ΔT values and phases of pulsating process is established using *all available photometric data* covering time span 140 years. The reliability of the conclusion is believed to eliminate a certain ambiguity previously existed.

Conclusions:

1. During the history of photometric observations of R CrB at least 152 dust clouds turned out to be ejected from the star in a direction of observer.

2. The moments of the dust ejections are phased locked to the 40^d and 54^d periods of the pulsations.

3. The above-mentioned result rules out the possibility the dust clouds to be orbiting the star at the stationary orbits.