DISTRIBUTION OF LIGHT MINIMA OF R CORONAE BOREALIS TYPE STARS

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Deep light minima of R CrB type stars are considered to occur due to the carbon abundance excess in the atmospheres of these stars, and condensation of carbon into graphite dust leads to light decrease (Zhilyaev et al., 1978). The cause and conditions of dust formation are not clear. Therefore, it is necessary to find out regularities in the occuring of light minima and to search for correlations between different parameters of this type stars. This paper deals with the time intervals between the series of consecutive light minima.

A long series of observations of the R Coronae Borealis variables brightness allowed to study repeatedly their light curves in order to obtain their periodicity or other parameters in occuring of deep light minima. The work by Sterne (1935) was the first, in which the conclusion was made that R CrB is an irregular variable. Next investigations contained the analyses of light curves and calculations of the number of minima planned in the definite intervals, f.ex., 0-300, 300-600 days etc. (Howarth, 1977; 1978). Other papers (Tempesti et al., 1975) considered the duration of minima and maxima states. In all these investigations the time was counted off from the moment when a star reached a definite light decrease magnitude, f.ex., $\Delta m = 1^m$. The conclusions obtained were similar: the considered parameters were in agreement with Poisson statistics.

The procedure which led to this conclusion is wrong. This can be seen from the following fact established by Pugach (Zhilyaev et al., 1978): the start of deep light minima of RY Sgr falls always on one and the same phase of light pulsation with the mean period $P = 38.6^d$. Hence, it is necessary to consider the moment of the beginning of light decrease as the starting moment in a given minimum, and δ analyse the actually observed time interval between the consecutive minima.

In this investigation we accepted as minima the light decreases of 0.5^m and more as well as light decreases occurring during the phase when the star returned from the previous minimum, e.g. at JD 2439380 for R CrB. We used the combined light curves of R CrB (Isles, 1973; Mayall, 1960; Schweitzer, 1982) and of RY

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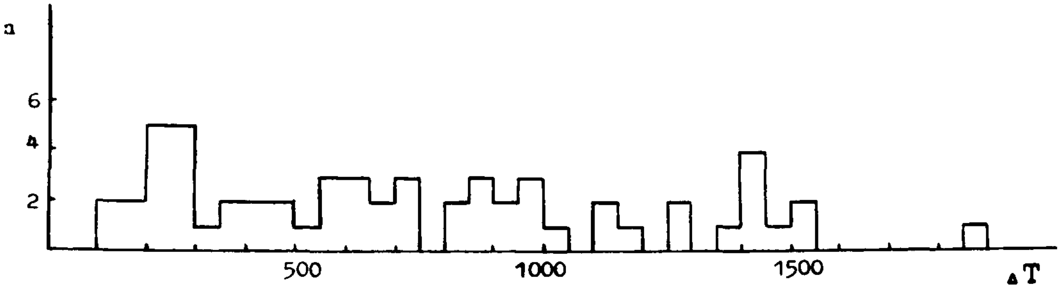
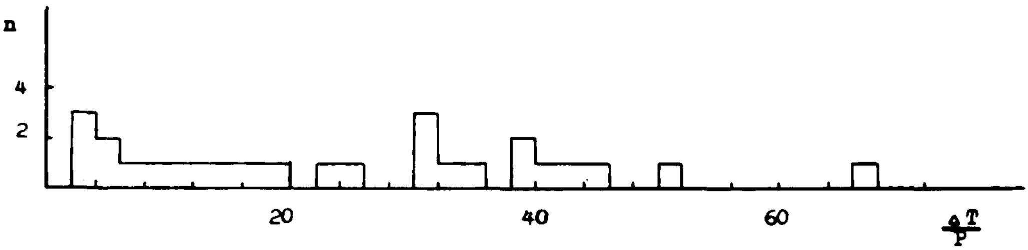
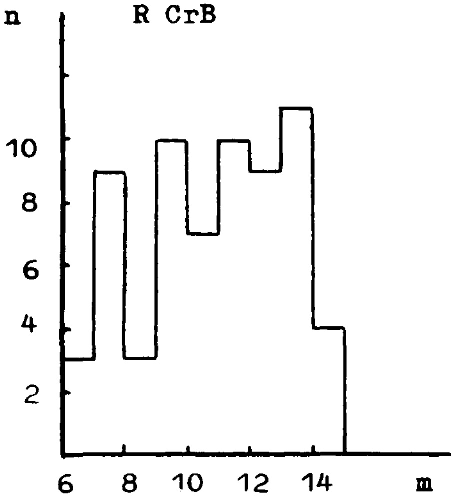
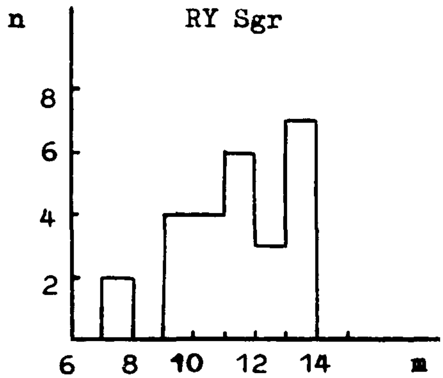
Sgr (Mayall, 1972; Circ IAU, 1977, 1982a). The accuracy of determination of the minima starting date using these light curves is not worse than 10-15^d . Histograms of the time intervals T (for R CrB) and the number of pulsations K = $\Delta T/P$ (for RY Sgr) between the consecutive light minima are given in Figs 1 and 2.



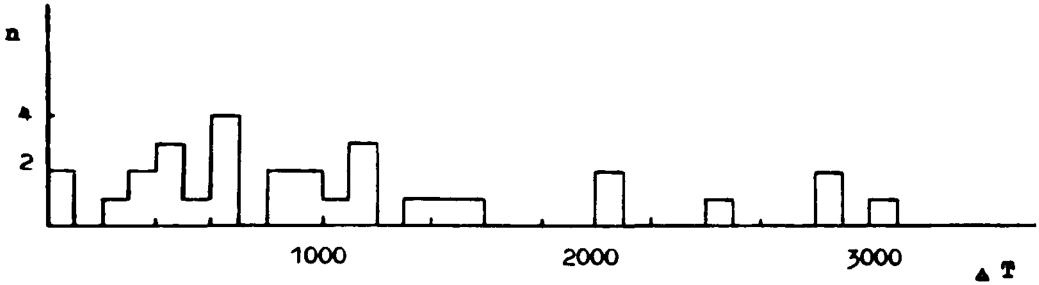


Calculation of the number of light minima for R CrB is carried out within the intervals of 101-150, 152-200 days etc., for RY Sgr within the intervals of 2.1-4.0, 4.0, 4.1-6.0 number of pulsations etc. "Instantenous" value of pulsation period (according to Marraco et al., 1982) was used in the case of RY Sgr. The number of pulsations was not an integor value, because the observed period of pulsations varies in the of 8^d . Figs 1 and 2 show that the time intervals ΔT upto 1540^d , or the number of pulsations K upto 46 are distributed regularly between the consecutive minima. The use of statistical criteria testifies this conclusion. A conclusion may be drawn that there are maximum time intervals between the consecutive light minima: about 1800^d for RY Sgr and about 1540^d for R CrB. Figs 1, 2 show that there are 1 or 2 time intervals for each of two stars that are larger than those values, and that may be to omitted small, not observed light minima. This may indicate that there exists a mechanism that impels the star to diminish its brightness not later than after this maximum interval of time.





Another interesting fact can be noted if we consider the number of light minima of a definite depth (Fig.3): deeper minima occur more often. This dependence is more clear for RY Sgr. This dependence is not connected with the selection of small light minima observed out of deep minima, because the minima, at least, with $\Delta m > 1^m$ cannot remain not observed. Some shortage of minima can be supplied with the small ones occured at some phase of deeper light minimum, f.i. unaccounted $\Delta m \simeq 0.8^m$ weakening of brightness of R CrB at JD 2442800 at the stage when its brightness was increasing after minimum with $\Delta m \simeq 5^m$. The value of the deepest brightness decreases is quite definite: it is approximately 8^m for R CrB and 7^m for RY Sgr.



The similar time interval distribution between the consecutive minima has place also for SU Tau (Fig.4). The initial data were taken from Doroshenko et al. (1978); Campbell (1940); Howarth (1977); Jacchia (1933); IAU Circ. (1979; 1982b). The maximum time interval between the consecutive light minima appears to be about 1500^d, because for some minima with $\Delta T > 2000^d$ it is not known whether there occurred other minima during these intervals.

REFERENCES

Campbell L. 1940. Harv.Observ.Reprint.No. 250,1.
Doroshenko V.T. et al. 1978. Astrophysik 14,5.
Howarth J.D. 1977. Asta Astron, 27,65.
Howarth J.D. 1978. J.Brit.Astron.Assos. 88,145.
Isles J.E. 1973. J.Brit.Astron.Assos. 83, 368.
Jacchia L.1933. Publs.Observ.Astron.Univ.Bologna. 2, 242.
Marraco H.G., Milesi G.E. 1982. Astron.J. 87, 1775.
Mayall M. 1960. J.Roy.Astron.Soc.Can. 54, 194.
Mayall M. 1972. J.Roy.Astron.Soc.Can. 66, 233.
Circ.Cent.Astron.Telegrams.Astron.Union. 1977, No. 3098; 1979, 3407; 1982a, No 3663; 1982b, No 3740.
Schweitzer E. 1982. L'Astronomie 96, 356.
Sterne T.E. 1935. Bull.Harv.Observ. No 896, 17.
Tempesti P. De Santis R. 1975. Mem.Soc.Astron.Ital. 46, 451.
Zhilyaev et al. 1978. R Corona Borealis stars. Naukova dumka. Kiev.