COMMISSION 27 OF THE I. A. U.
INFORMATION BULLETIN ON VARIABLE STARS
Number 1424

Konkoly Observatory
Budapest
1978 May 12

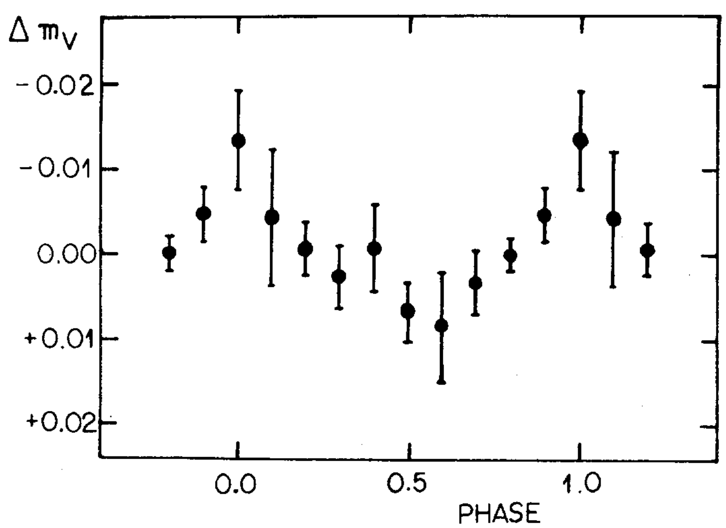
OPTICAL PULSES IN HD 153919 = 3U1700-37

An O6f supergiant star HD 153919 is the counterpart of the eclipsing X-ray source 3U1700-37 with the binary period $3^{d}.4$ (Jones et al. 1973). The optical light curve shows two shallow minima. The secondary optical minimum coincides with the X-ray eclipse (Penny et al. 1973, Jones and Liller 1973, van Paradijs et al. 1978). Recently the X-ray pulses with a period of 97 $\pm$ 1.5 min ($0^{d}.0674$ $\pm$ $0^{d}.0010$) were discovered by Matilsky and Jessen (1978). The optical variations of HD 153919 on the time scale of one to three hours had been already reported by van Genderen and Uiterwaal (1976) and by Kemp (1973).

This note presents results of a search for 97 min optical pulsations in an extensive set of the five-colour photometric observations of HD 153919 published by van Paradijs et al. (1978).

The observations made with the yellow filter have been examined for presence of the 97 min variability. An upper limit of about 0.002 mag can be set for the amplitude of such variations in observations obtained during the X-ray eclipse. Outside the X-ray eclipse the periodic pulsations are of very small amplitude, if present at all, with an exception of the orbital phases 0.44 - 0.55 when the periodic variations are clearly visible and attain an amplitude of 0.02 mag. These phases correspond to the primary optical minimum which occurs when the X-ray source is seen in front of the hot companion star. There are observations from four nights which fall in this range of phases. For these four nights it was possible to phase the short term variability with a period of $0^{d}.06678$ which is comfortably close to the X-ray period. A normal time of the light maximum is J.D. 2443024.272.

Fig. 1 presents the average light curve of the short term variations in HD 153919 obtained from observations with yellow fil-



ter for the interval of the orbital phases 0.44 - 0.59. If observations from all orbital phases are used then this light curve is again well defined but with 5-fold decrease in the amplitude. If other filters are used we obtain very similar light curves. A slight dependence of the amplitude and/or the time of the maximum on the wavelength is possible. Because the short term variability persists only during limited time every $3^{d}.4$ days many aliases can fit the observations almost as well as the period derived. The closest among aliases is a period of $0^{d}.06809$ which is also consistent with the X-ray period. It is very likely that the pulsation period of this object decreases quickly with time (Matilsky and Jessen 1978, Ziołkowski 1978). The optical observations have been obtained 200 days earlier than the X-ray data, therefore the $0^{d}.06809$ or even longer period is plausible for the considered set of the photometry.

There is another set of the photometric data (van Genderen and Uiterwaal 1976) taken 400 days earlier than the observations of van Paradijs et al. The short term variability during the primary optical minimum is clearly seen in Fig. 1 in the van Genderen and Uiterwaal paper. An attempt to determine possible periods from their data resulted in values $0\overset{d}{.}06638$, $0\overset{d}{.}06770$ and $0\overset{d}{.}06907$. Neither of them coincides with any period that can be fitted to the van Paradijs et al. data. A tentative picture is the period of $0\overset{d}{.}06907$ for the van Genderen and Uiterwaal data, then 400 days later $0\overset{d}{.}06809$ and finally still 200 days later $0\overset{d}{.}0674 \pm 0\overset{d}{.}0010$ from the X-ray data. A faster decrease of the period is also possible.

The presence of the optical pulses and especially their confinement to the narrow range of the orbital phases should be explained. This can be tentatively done by assuming that the primary optical minimum is at least partly due to a transit in front of the optical component of the semi-transparent cloud of gas situated around the X-ray source. This cloud of gas may have form of an accretion disc, or an accretion wake.The X-ray pulsations modify periodically the physical conditions and the velocity field in the nearby gas and this in turn influences the transparency of the gas cloud and consequently the fractional light loss and the optical brightness of the system.

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