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FIRST GROUND-BASED PHOTOMETRY AND PRELIMINARY PHOTOMETRIC ELEMENTS OF CONTACT BINARY DN Cam

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The variability of DN Cam (NSV 1685, HD 29213, HIP 21913, $4^{\rm h}42^{\rm m}46^{\rm s}.2$, $+72^\circ 58' 41''.9$, 2000.0) was first suspected by Strohmeier (1959). Since the object is quite bright ($V_{max} = 8.23$, $V_{min} = 8.73$) it was included into the Hipparcos mission. According to the Hipparcos photometry the system was classified as an EB type variable with the following ephemeris for the primary minimum (ESA, 1997):

$$\text{Min I} = 2\,448\,500.488 + 0.498312 \times E \qquad (1)$$

The system was observed spectroscopically by Rucinski et al. (2001). Careful analysis of the broadening functions lead to the following spectroscopic elements $V_0 = 6.04 \pm 0.98$ km.s^{-1}, $K_1 = 105.45 \pm 0.65$ km.s^{-1}, $K_2 = 250.62 \pm 1.91$ km.s^{-1}, $q = K_1/K_2 = 0.421 \pm 0.006$ resulting in $(m_1 + m_2)\sin^3 i = 2.336 \pm 0.05$ M$_\odot$ and spectral type F2V. The authors noted discrepancy between the absolute magnitude determined from the Hipparcos parallax $\pi = 4.49 \pm 0.89$ mas and that determined from the period-colour-luminosity relation of Rucinski & Duerbeck (1997). Apart from the Hipparcos photometry no photoelectric or CCD light curve of the system has been published. Therefore we included the system into the photoelectric monitoring of contact binaries.

New UBV light curves of DN Cam were obtained at the Stará Lesná observatory of the Astronomical Institute of the Slovak Academy of Sciences. The observations were taken on three nights September 3, October 4 and November 2, 2001. The 0.6-m Cassegrain telescope equipped with a single-channel photoelectric photometer was used. Data reduction, the atmospheric extinction correction and transformation to the standard international UBV system were carried out in the usual way (see Pribulla et al., 2001). SAO 5285 was used as the comparison star for all observations. All individual observations are available in file 5200-t1.txt.

Our observations were used to determine 4 new minima times (Table 1) using Kwee & van Woerden method. UBV observations, shown in Fig. 1, were phased using the linear ephemeris:

$$\begin{array}{lll} \text{Min I} = \text{HJD } 2\,452\,156.5817 & + 0.4983091 & \times E, \\ \qquad\qquad\qquad\quad \pm 7 & \pm 2 & \end{array} \qquad (2)$$

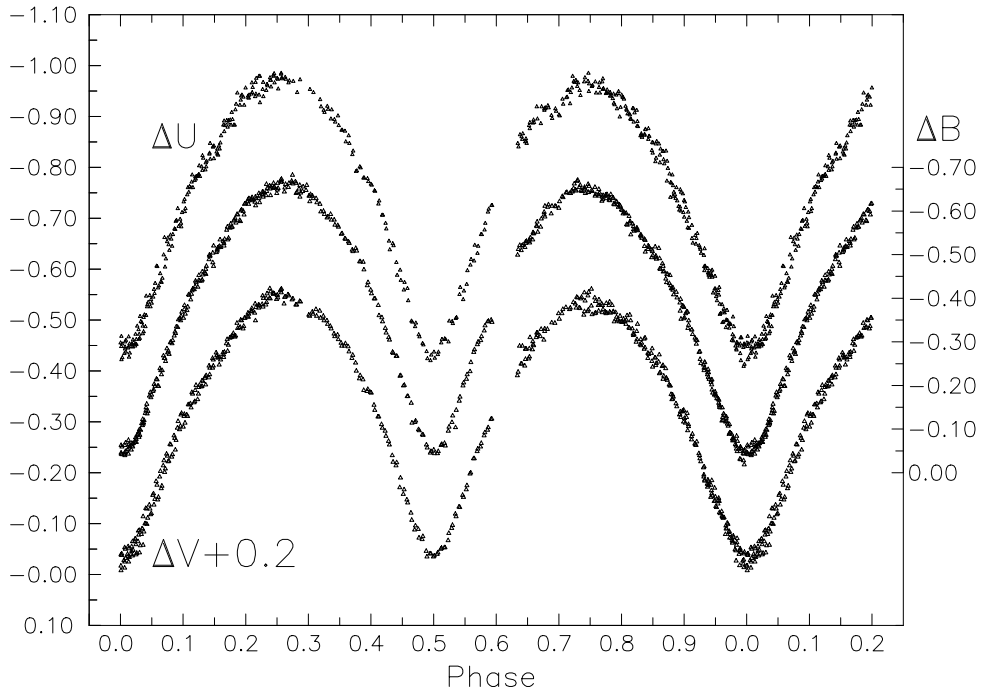

Figure 1. *UBV* light curves of DN Cam with respect to SAO 5285 according to ephemeris (2)

determined from our 4 photoelectric minima ($w = 2$), Hipparcos $JD_0 = 2\,448\,500.4880$ ($w = 2$) and time of the conjunction determined from the spectroscopy $T_0 = 2\,451\,679.6954$ ($w = 1$).

The shape of the minima (Fig. 1) indicates that the system is very probably partially eclipsing. It is interesting to note that the minima are nearly of the same depth. Since the mass ratio was reliably determined, we tried to found preliminary photometric elements.

The photometric elements were determined using the 1992 version of the Wilson & Devinney (1971) code. Mean temperature of the primary $T_1 = 6700$ K was fixed according to F2V spectral type using the calibration of Popper (1980). The limb and gravity darkening coefficients as well as bolometric albedos were fixed appropriate to the convective envelope and a mean effective temperature. The third light was set to zero because there is no indication of the third component in spectroscopy. The resulting photometric elements are: $q = 0.421$ (adopted from spectroscopy), $i = 71.9 \pm 0.1°$, fill-out $= 0.50 \pm 0.02$, $T_2 = 6911 \pm 11$ K. The corresponding fits are depicted in Fig. 2. Although the V passband

Table 1: New times of the primary (I) and secondary (II) minima obtained at the Stará Lesná observatory. The standard errors of the minima are given in parentheses. The (O-C) residuals are given with respect to ephemeris (1)

JD_{hel} 2 400 000+	type	(O-C)
52156.5825(2)	I	-0.0206
52186.4815(1)	I	-0.0204
52216.3785(1)	I	-0.0221
52216.6283(2)	II	-0.0214

fit is quite good, there are discrepancies in the maxima heights in the U and B passbands. The secondary minimum in U is much deeper than predicted.

The secondary component is hotter so the system is of a W subtype. Its characteristics (relatively long orbital period, early spectral type and high fill-out) are, however, in disagreement odds with those of most W-subtype contact binaries. The inclination angle combined with spectroscopic elements leads to the following masses of the components: $m_1 = 1.915 \pm 0.036$ M$_\odot$ and $m_2 = 0.805 \pm 0.012$ M$_\odot$.

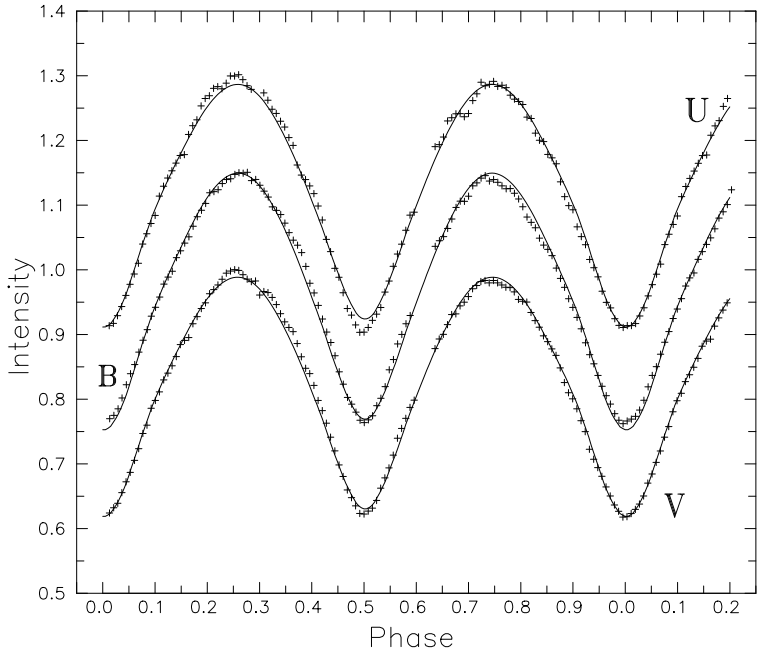

Figure 2. The best fits to the UBV observations. The U and B passband observations are shifted in intensities by 0.15 and 0.30, respectively

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