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THE VARIABILITY TYPE AND PERIOD OF HD 143213

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The variability of HD 143213 = SAO 121294 = GSC 353-301 was discovered by the TYCHO instrument of the HIPPARCOS satellite (Makarov et al., 1994). Among the 103 usable measurements in the B_T and V_T photometric channels there were a few discordant (fainter) ones which indicated a possible eclipsing binary. The small number and unsuitable temporal distribution of them made any more definite statement impossible.

E. Born therefore made 310 visual magnitude estimates between June 1996 and August 1997, using 10×70 binoculars. This resulted in the classification of HD 143213 as an Algol-type variable with a period of 3.4500 days (±0.0003 days). The lightcurve constructed from Born's observations is displayed in Fig. 1. It is an Algol-type lightcurve with an eccentric secondary minimum. The primary and secondary minima are about 0.5 mag and 0.3 mag deep, respectively. The width of the minima is about $D = 0.2$ days. The secondary minimum is located at phase 0.545 (±0.006). The period was computed from 3 individual primary minima which were sufficiently well covered to determine precise timings, a conservative estimate of the uncertainty being 0.02 days in each case. The temporal distribution of the 310 observations is such that any period other than 3.45 days can be safely excluded. The ephemeris for primary minima is:

$$\mathrm{JD(min)} = 2450304.35\ (\pm 0.02) + 3.4500\ (\pm 0.0003) \times \mathrm{E}$$

Using this information, the TYCHO measurements were folded with the now known period. This resulted in the lightcurve shown in Fig. 2. It is a curious coincidence that the random scatters of the visual and the satellite measurements are almost the same. Both the character and the parameters of the variability derived from the visual estimates are fully confirmed by the TYCHO data. In particular, the relative phase of the secondary minimum (0.550 ±0.007) is identical. Unfortunately, there are only 3 measurements within a single primary minimum (made within 20 minutes), and 6 measurements within two different secondary minima. Obviously, this temporal distribution of the TYCHO measurements could not have allowed to derive a period. Also, it is not possible to derive the widths or precise locations of the minima from the TYCHO data. Nevertheless, the time difference between the two sets of secondary minimum points (103.99 periods, see Table 1) confirms the period to within 0.0002 days.

Despite the perfect agreement between the period and shape of the two lightcurves, there is a strong discrepancy in the phase. Usually, such a phase shift between two observational sets separated by a long time interval can be used to improve the period.

However, in the particular case of HD 143213 this turned out to be impossible. Any modification of the period to force the primary minima of both Born and TYCHO to be at about phase zero resulted in a very significant separation in phase of Born's 3 primary minima *and* of the 2 TYCHO secondary minima. Thus, any "improved" period was inconsistent with *both* sets of observational data. But, again, both sets agree on the period itself. It perfectly fits the two TYCHO secondary minima, as well as their separation from the one observed TYCHO primary minimum. And it also fits all data of Born (unambiguously; no alias periods are possible). This point is strengthened by the perfectly identical phase of the secondary minima in the two independent sets.

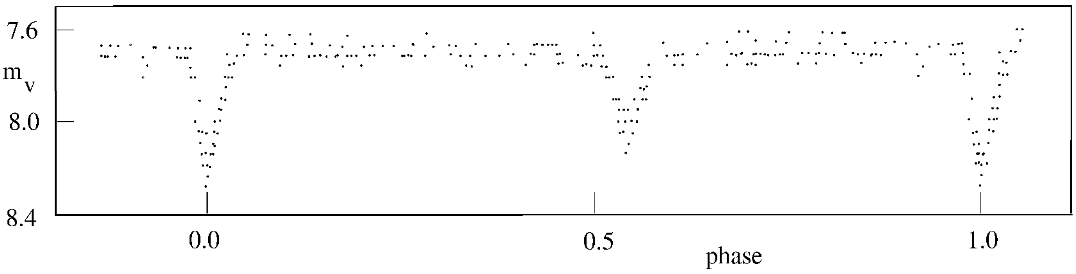

Figure 1. Visual light curve of HD 143213; 310 estimates folded with the period of 3.4500 days.

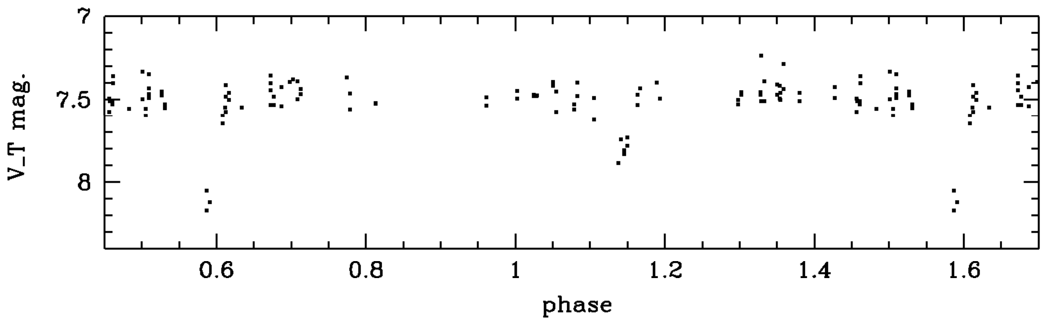

Figure 2. TYCHO lightcurve of HD 143213; 103 V_T measurements folded with the same period. Note the phase shift of about 0.59.

The second problem is that it is not obvious *which* period should be used, since the TYCHO minimum is at phase 0.59. So, should a period modification shift it to phase 0.0 or to phase 1.0? In other words, should a slight increase or a slight decrease of the period be applied? There is no way to decide which is better (actually, both are equally bad, as explained above). Thus, in addition to contradicting the data, a correspondingly changed period would be ambiguous.

These arguments led us to the conclusion that the discrepancy cannot be resolved with the existing data. We decided to publish this intermediate result rather than to wait for years until the discrepancy can be solved by us. The publication will surely ease the case for other observers, and give them a guide on what to do. To this end, we give the existing timings in Table 1.

Observations in the visibility periods 1998 and 1999 or data from sky patrol plate archives will resolve the discrepancy. Table 1 will allow to combine such data with TYCHO and/or Born, and thus to see where the cause might be. It could be in the observations or in the star. On one hand, a real phase shift of about a day within 7 years is somewhat unlikely. But, on the other hand, the observational data are very clear.

Table 1

BJD	E	Comment
2450304.35	0.00	min. I from vis. obs. (± 0.02 d)
2450604.50	87.00	min. I from vis. obs. (± 0.02 d)
2450649.35	100.00	min. I from vis. obs. (± 0.02 d)
2450606.37	-	min. II from vis. obs. (± 0.03 d)
2450637.39	-	min. II from vis. obs. (± 0.03 d)
2448257.072	−593.41	TYCHO obs. at min. I magnitude
2448257.072	−593.41	TYCHO obs. at min. I magnitude
2448257.087	−593.41	TYCHO obs. possibly on the rising branch
2447907.100	-	TYCHO obs. at min. II magnitude
2447907.100	-	TYCHO obs. at min. II magnitude
2447907.114	-	TYCHO obs. possibly on the rising branch
2447907.114	-	TYCHO obs. possibly on the rising branch
2448265.873	-	TYCHO obs. at min. II magnitude
2448265.887	-	TYCHO obs. possibly on the rising branch

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Reference:

Makarov, V., et al., 1994, *IBVS*, No. 4118