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ON THE PROBABLE VARIABILITY OF HR 1861

In a recent investigation of σ Orionis E, Hesser et al. (1977) have used the uvbyβ standard star HR 1861 (B1 IV) as comparison star. The purpose of their extended series of measures has been to impose constraints on the several models proposed for σ Ori E, a unique helium rich B star. In their discussion, Hesser et al. note a secular variation in σ Ori E relative to HR 1861, and they cannot unequivocally rule out a variation in HR 1861 as the cause. Since HR 1861 is very conveniently located 1^{o} from σ Ori E several observers (e.g. Pedersen and Thomsen 1977) have used it as comparison star and it is of some importance to investigate its possible variability.

The purpose of this note is to present a short analysis of about 250 uvby and β measures made by the author and the late Dr.B. Grønbech in the years 1971-76. All the observations have been obtained with the Danish 50 cm reflector located on Cerro La Silla, ESO, Chile. The four-channel uvby photometer has been described by Grønbech et al. (1976, paper I) and the two-channel β photometer by Grønbech and Olsen (1977, paper II). Observation and reduction procedures are fully discussed in paper I and II.

In order to minimize the uncertainties all quantities discussed below are kept in the instrumental systems. In Table 1 and 2 mean values (relative to the instrumental systems) of y, (b-y), m_1, c_1 and β are given in units of $0^{m}.001$. The columns w and nn give the number of observations and the number of nights, respectively. The errors given are the rms errors of the means, i.e. $(\Sigma d^2/w(w-1))^{\frac{1}{2}}$ where d is the deviation of an individual measure from the mean. The mean instrumental values may be found in paper I, table 11 and paper II, table 2, except y which is $5^{m}.348$ ($V=5^{m}.343$).

Table 1

(unit $0^m.001$)

Epoch	$\overline{y}$	$\overline{(b-y)}$	$\overline{m_1}$	$\overline{c_1}$	w	nn
1971 Nov	0±1.1	1±0.6	−2±1.0	1±0.8	39	13
Dec	−1±0.7	0±0.5	0±0.6	0±0.6	60	14
1972 Jan	−1±1.2	−1±0.6	2±0.9	−3±1.0	19	9
Feb	3±1.8	−5±1.5	5±1.5	−1±1.4	15	8
Nov	−1±1.7	0±1.1	0±1.3	−2±1.4	9	7
1974 Dec	0±2.0	1±1.2	−1±2.4	−2±2.9	6	4
1975 Oct	−5±1.2	7±1.4	−7±1.4	−3±0.8	24	12
1976 Feb	−5±1.6	−1±0.5	1±0.7	−3±0.9	18	10

Table 2

(unit $0^m.001$)

Epoch	$\overline{\beta}$	w	nn
1974 Oct 25–Nov 2	−4±1.2	13	6
Nov 2– 21	+3±1.0	31	16
Nov 21–Dec 3	−2±1.2	22	11

The stability of the instrumental uvby system over the five years 1971-76 has been discussed thoroughly on the basis of 9000 standard star observations (Olsen 1977) and it was concluded that the system has remained constant within $0^m.001$-$0^m.002$. In this discussion HR 1861 was frequently the most troublesome star with the largest residuals. The β measures cover only 5 weeks and it is safe to conclude that the instrumental β system has remained constant in this period, especially since no closing errors were found in the discussion of 3476 standard star observations covering all right ascensions (cf. paper II).

An inspection of Table 1 is very suggestive of variability in HR 1861. To test the significance of the variations in the means a "Student's" t-test has been made on the $\overline{y}$ values from February 1972 and October 1975. The probability that the means should differ by $0^m.008$ is less than 0.001, if the two samples of y values have been chosen from the same population as they would have been if HR 1861 is constant. The conclusion is that HR 1861 is probably variable within a total range of about $0^m.010$. The secular variation over two years in σ Ori E found by Hesser et al. (1977) is of the same size, and may therefore be, at least partly, explained by variations in HR 1861.

To test the above conclusion a t-test has been made on the $\overline{y}$ values of HR 1552 and 2880 (B2 III and FO III) for exactly the same nights as for HR 1861. The probability changes from 0.001 to 0.34 and 0.39, respectively, thus confirming the variability of HR 1861.

Table 2 shows that HR 1861 probably also has a small variation in the strength of the Hβ line, probably due to very small amounts of emission. A t-test on the two first lines in Table 2 gives a probability of constant β less than 0.001.

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