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NOTE ON THE PERIOD VARIATION IN THE WHITE-DWARF ECLIPSING BINARY BD + 16°516

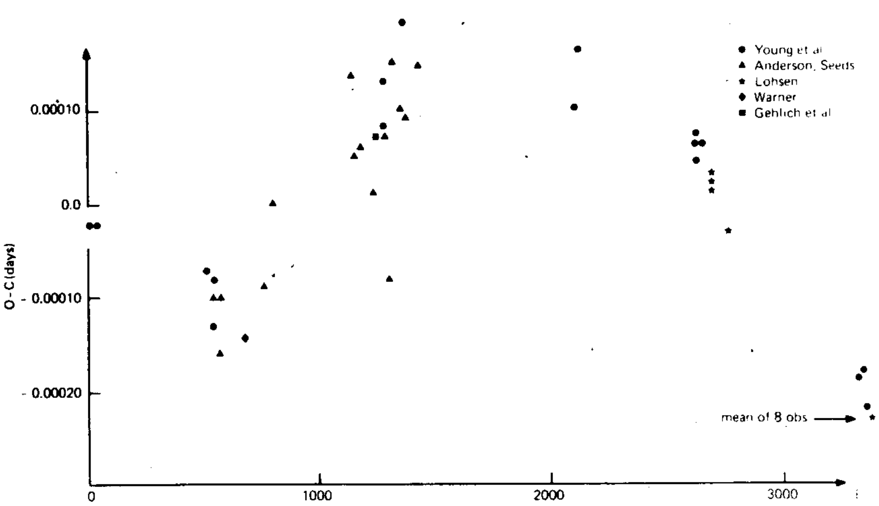
Since the discovery of eclipses in this remarkable system in December 1969 by Nelson and Young (1970) sufficient photometric material has been collected to allow a discussion of the period variations (Young and Lanning 1975). The following remarks have the intention to widen the basis of possible interpretations. Before embarking on speculations concerning the nature of interaction between the components, based on the observed time residuals (O-C values), we should explore possible alternative explanations, too.

Residuals for all minima with both ingress and egress well observed are shown in Fig.1. These eclipses allow an unusually good timing, accurate to a few seconds, or in case of the later determinations even better. The pertinent data we extricated from the papers by Young and Lanning, Andersen and Seeds (1972) and Lohsen (1974); the O-C values are calculated with Young's and Lanning's formula: Min hel.= JD 2440610.06490 + $0.^{d}52118346$E.

We should like to emphasize two points. (1) As a glance at Fig. 1 shows, it is very hard to tell from the published observations whether the period change around E = 600 occurred gradually or discontinuously. (2) There has been manifestly an increase and later an apparently gradual decrease in the eclipsing period; statements like this: "Future observations might reveal that what we have termed increases and decreases were variations in the rate of increase only" are not correct. The length of the period was, for instance, about $0.^{d}52118386$ near E = 1000 (June 1971) and $0.^{d}52118310$ near E = 3000 (May 1974); a period decrease between these dates of 0.065 ± 0.005 sec is "definitive". Transformations of the 0-C diagram by using other mean periods would alter the corresponding slopes but not their difference, *i.e.* value and sign of the period variation over these 2000 epochs will remain the same.

It is obviously not easy to interpret these alternating changes of the period in terms of mass transfer; we also have to bear in mind that the system is clearly detached, that there are no emission lines suggesting a ring or disk around the white-dwarf component and repeated search for rapid flickering activity failed to reveal any (Warner et al. 1971, Nather 1973). The possible "chromospheric event" in April 1971 (see Young and Nelson 1972) is the only sign of activity discovered hitherto and it may or may not have triggered the period increase. It is then worth looking into possibly continuous changes of the period, caused by geometric effects. The "curve" of residuals is certainly compatible with such a hypothesis.

Apsidal motion was put forward tentatively in a conference lecture, in July 1975, by the present writer. The catalog value of the orbital eccentricity (0.02 ± 0.008) may well be spurious and both the required small eccentricity of 0.001 and the resulting apsidal motion coefficient of log k = -1.9 are well acceptable. Nevertheless, the 0-C values in Fig. 1 suggest rather a distorted sine curve, corresponding perhaps to a light-time effect in an eccentric orbit, with a third body in the system. This possibility, mentioned earlier in the literature, was dismissed somewhat too easily. Higher eccentricities of the large orbit in triple systems are quite usual and it is also clear that an orientation of the periastron nearly toward us cannot rule out the light-time hypothesis. (Probability arguments to this point would be strongly objectionable.) Assuming for a moment the presence of a third body, the combination of a small light-time amplitude (about 30 lightseconds) and an orbital period around 5 years is, indeed, worth noting. These data lead to a very small mass-function of the order of $10^{-5}M_{\odot}$; which again means that for any reasonable value of the third mass, the orbit is nearly perpendicular to the line of sight. With M_3 between $0.2M_{\odot}$ and $0.7M_{\odot}$, for instance, we find inclinations between $i = 8.^{\circ}1$ and $2.^{\circ}8$, respectively. The two orbits in the triple system with $P = 0.52$ days and $P' \approx 5$ years, would be nearly perpendicular to each other — a rare but not unprecedented case.



Calculation of an orbit is certainly premature at the time being, since the shape of the time-delay curve depends too strongly on the mean value of the period accepted for the calculation of the O-C values. However, the maximum angular separation AB-C turns out to be of the order of 0."10 or perhaps 0."12, for all masses in question. This would make an eventual visual detection of the third component very difficult though not entirely impossible.

All these considerations remain, of course, highly hypothetical. Observations made during the current season may already contribute to the clarification of the situation.

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