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# PHOTOMETRY OF THE ECLIPSING BINARY W Cru

The brightness of W Cru (HD 105998; $AR_{50}=12^h09^m20^s$, $D_{50}=-58^\circ30'.3$) has been estimated on 205 plates which are in the archives of the Bamberg Observatory (taken in the years 1964-1971 at the Boyden Observatory, South Africa, and at the Mount John Univ.Observatory, New Zealand; 10" Metcalf and 3" Ross, blue sensitive emulsions Gevaert 67A50 and Perutz Astro, exp.time 30-60 min, observers Clark, Fischer, Knigge, Meier, Paterson, Schöffer, Sosna). The times of one Min.I and of two Min.II have been determined using 103 plates measured with the iris-photometer of the Hamburg Observatory in Bergedorf (see Table I). The comparison stars given by O'Connell (1936) and marked on the chart 801 (Bateson,Morel,1985) were measured photoelectrically at La Silla, Chile (ESO 50cm tel.,May 1987,EMI 6256 photomultiplier); they are listed in Table II (our star g =100 is that near W Cru). The mean difference between our brightness of the comparison stars a-f ($m_{pg}$= B - $0^m.11$ was used) and those given by O'Connell (1936) is $-0^m.06$. New elements of the light curve have been derived according to our Min.I and according to all primary minima summarized from the literature in Table I. Mean errors of the times of Min.I were either published by the respective authors, or estimated in this study; they serve for the calculation of the weights used for determining the elements. The derived elements of the light curve

$$\text{Min.I} = \text{JD } 2440731.84 \pm .23 + 198^d.537 \pm .007 \cdot E \quad \text{m.e.}$$

differ only very slightly from those given by Plavec (1984).

The whole light curve is represented by 21 mean points given in Table III. We can compare it with that observed by O'Connell (1936):

Table I. Observed minima

| JD 2400000+ (Phase) | Min. | Author |
|---|---|---|
| 10158$^d$ ±1.0 | I pg | Russell (1912) |
| 27628.5 ±0.5 | I pg | O'Connell (1936) |
| 38544.5 ±1.0 | I pg | present paper |
| 40731.6 ±0.3 | I pe | Knipe (1972) |
| 45695.5 ±0.3 | I pe | Kviz,Rufener (1988) |
| 45893.7 ±0.1 | I pe | Menzies,Jones (1984) |
| 45894.08 ±0.13 | I pe | Marino et al.(1984) |
| 10254 ±2.5 (0.484) | II pg | Russell (1912) |
| 27726.0 ±1.5 (0.491) | II pg | O'Connell (1936) |
| 38848.5 ±2.0 (0.514) | II pg | present paper |
| 39241.2 ±1.5 (0.492) | II pg | present paper |
| 45795.45 ±0.40 (0.503) | II pe | Marino et al.(1984) |

Table II. Comparison stars

| Star | C.P.D. | V | B-V | U-B | $m_{pg}$ | n |
|---|---|---|---|---|---|---|
| a | -58°4135 | 7.80 | +0.99 | +0.68 | 8.68 | 4 |
| b' | -58 4153 | 8.88 | +0.24 | +0.12 | 9.01 | 5 |
| d | -58 4147 | 9.55 | +0.07 | -0.08 | 9.51 | 5 |
| e | -57 5312 | 9.50 | +0.70 | +0.20 | 10.08 | 6 |
| f | -58 4145 | 10.29 | +0.15 | +0.05 | 10.33 | 6 |
| g | | 9.92 | +1.23 | +1.16 | 11.04 | 5 |

Table III. Mean points

| Phase | $m_{pg}$ | n | Phase | $m_{pg}$ | n |
|---|---|---|---|---|---|
| 0.019 | $10^m.05$ | 9 | 0.565 | $9^m.38$ | 8 |
| 0.040 | 9.79 | 8 | 0.630 | 9.19 | 10 |
| 0.077 | 9.39 | 8 | 0.661 | 9.13 | 8 |
| 0.151 | 9.13 | 11 | 0.703 | 9.08 | 9 |
| 0.187 | 9.01 | 12 | 0.754 | 9.01 | 10 |
| 0.259 | 9.07 | 10 | 0.780 | 8.99 | 12 |
| 0.289 | 9.14 | 8 | 0.811 | 9.04 | 8 |
| 0.324 | 9.17 | 9 | 0.853 | 9.15 | 12 |
| 0.371 | 9.28 | 10 | 0.890 | 9.23 | 11 |
| 0.436 | 9.36 | 12 | 0.942 | 9.63 | 10 |
| 0.496 | 9.47 | 10 | | | |

a) The light curve shows again continuous light changes with broad minima; nevertheless the width of Min.II respective to Min.I was greater than in 1932-1936.

b) There was very probably no difference in the brightness of the two succeeding maxima (before and after Min.I).

c) We found the following photographic brightness of the maximum, Min.I and Min.II, respectively: $9^m.02$, $10^m.1$, $9^m.45$. May be that the depth of Min.I was somewhat greater and that of Min.II somewhat smaller than before. There is no totality visible at Min.II; nothing can be said about the totality of Min.I.

The secondary minimum is very shallow and the determination of its time is about 2.5-3 times worse than that of the primary minimum. Nevertheless it shows a changing displacement from a point midway between two primary minima.This displacement can also be seen if we calculate the period using Min.II only: this result $198^d.560 \pm^d.012$ is somewhat greater than the period of the binary.(The mean value of the Min.II determined from the Bamberg plates was used for this calculation.) The value of $\Delta\omega$ is difficult to derive due to the very small excentricity. Adopting e = 0.048 (Woolf,1962) and $i = 78^\circ.1$ (Kopal,1941), we find $\omega = 85^\circ.8 - 0^\circ.41(t-1980)$, so that we estimate the period of the apsidal motion to be about 880 years. This is the first apsidal motion stated for a G-type supergiant.

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