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1991 ECLIPSE TIMINGS FOR 44 i BOOTS AND UP-TO-DATE EPHEMERIS

The eclipsing binary 44 i Boo was observed photoelectrically by our
group in the summer of 1991. We wanted to see whether the recent period
increase suggested by Oprescu et al. (1991) would be confirmed.

Our observations were made at Braeide Observatory near Flagstaff, Ari-
 zona using the computer-controlled 16-inch Cassegrain telescope and photo-
electric equipment of the second author. The last three authors are high
school students who did much of the observing and initial analysis for this
project under the guidance of the first author as part of an N.S.F. summer
program conducted by Northern Arizona University.

Times of both primary and secondary minima derived from our photometry
are presented in Table 1, where cycle numbers and O-C residuals are computed
with the ephemeris

\[ C_t = 2443604.5880 + 0.267811753 \times E \]  

(1)
given by Oprescu et al. (1991) to describe eclipse times after an earlier
period increase suggested by Oprescu et al. (1989). It will be seen that
primary eclipse was observed on two of the nights and secondary on the
other.

Figure 1 is an O-C curve based on the ephemeris in equation (1). Plotted
are all of the times listed by Oprescu et al. (1991) with E \( > 0 \), along
with our new times from Table 1. We were forced to recompute O-C values
from the Julian dates given because of numerous errors and omissions. The
largest error was at JD 2445473.8187, given as O-C = 0.00018 when it should
have been O-C = -0.00018. The most serious omission was the five times of
Willmitch and Hall (1989). Coincidently, this was the reference which the
bibliography of Oprescu et al. (1991) mistakenly attributes to Willmitch and
Douglas.

Oprescu et al. (1991) claimed that the period increased "after 1987" but
did not specify the epoch more precisely than that. They estimated the
size of the increase to be \( AP = 1502666 \times 10^{-6} \), although surely 5 decimal
places of accuracy are not warranted. For the new ephemeris "after 1987"
they proposed

\[ C_t = 2443604.5880 + 0.26781856 \times E \]  

(2)

although the initial epoch in this ephemeris must be grossly in error, as
one can see by inspection of their second figure.
Figure 1. O-C curve for 44 i Boo, with residuals based on the ephemeris in equation (1). Points are from the Julian dates given by Oprea et al. (1991) with $E > 0$, and from our Table 1. The solid curve represents the quadratic ephemeris in equation (3). Note the increasing period.

Table 1. New times of minimum of 44 i Boo.

<table>
<thead>
<tr>
<th>JD(bhel.)</th>
<th>E</th>
<th>O-C (days)</th>
<th>Filter</th>
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<tr>
<td>2440000+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8429.8634</td>
<td>18017</td>
<td>+0.0070</td>
<td>V</td>
</tr>
<tr>
<td>8429.8629</td>
<td>18017</td>
<td>+0.0064</td>
<td>B</td>
</tr>
<tr>
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<td>18017</td>
<td>+0.0068</td>
<td>U</td>
</tr>
<tr>
<td>8437.7649</td>
<td>18046.5</td>
<td>+0.0078</td>
<td>V</td>
</tr>
<tr>
<td>8437.7663</td>
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<td>+0.0093</td>
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<tr>
<td>8439.7690</td>
<td>18054</td>
<td>+0.0033</td>
<td>U</td>
</tr>
</tbody>
</table>

We found that points in Figure 1 are fit better with a quadratic ephemeris than with two straight-line segments, although both fitting techniques indicate a period increase. Our quadratic ephemeris, determined by least
squares with all points given equal weight, is

\[ C(t) = 2443604.844 + 0.26781696 E + 0.042 \times 10^{-10} E^2, \]

where the algebraic sign of the quadratic term does indicate an increasing period. In this fit two points rejected by the 3-sigma test were not included in the fit and are not plotted in Figure 1.

Our recent timings do confirm the period increase suggested by Oprescu et al. (1991), in that they fall in line with the solid curve in Figure 1 which represents the quadratic ephemeris in equation (1). Moreover, our fit itself is consistent with the value of the current period suggested by Oprescu et al. (1991). One can write

\[ P = \frac{dC}{dE}, \]

(4)

where \( C \) is the computed eclipse time given by any ephemeris and \( P \) is the instantaneous period at any epoch. For the ephemeris in equation (3) one gets

\[ P = 0.26781696 E + 0.084 \times 10^{-10} E^2, \]

(5)

which, at \( E = 18054 \), yields \( P = 0.26781848 \pm 0.000000045 \). This is perfectly consistent with the value 0.26781856 suggested (with no uncertainty indicated) by Oprescu et al. (1991).

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