THE PERIOD OF BX SCUTI

JODY A. SIGISMONDI
Maria Mitchell Observatory
Nantucket, MA   02554

Abstract

Observations of BX Scuti, a Type I Cepheid variable, show no
discernible change in period from 1933 to 1984. A refinement
of the period based on the observations has been calculated.
The new elements are:

$$JD_{(max)} = 2434594.901 + 6.411322 \ n.$$

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BX Scuti is a Population I Cepheid variable star for which the
published period ranges from 6.41133 days (Kurochkin 1959) to 6.414
days (Harwood 1933).

To test the constancy of the period, magnitudes were estimated
from 776 plates taken at the Maria Mitchell Observatory on Nantucket
between 1933 and 1983. Phases were computed and light curves drawn
using the elements

$$JD_{(max)} = 2427901.830 + 6.41133 \ n \tag{1}$$

(Kurochkin 1959). Eleven light curves were plotted for the 50-year
interval. A mean light curve was drawn based on a typical graph, and a
nominal maximum was marked off. The mean light curve was then
superimposed on each graph. The phase of the nominal maximum could
then be read easily and used in plotting an O-C diagram. A straight
line was fitted to the O-C diagram using the least squares method. The
slope of the line was negative, implying that the period used (6.41133
days) was too large, thus causing the observed maxima to occur at
successively earlier phases. After several trials the elements

$$JD_{(max)} = 2439153.355 + 6.4113224 \ n \tag{2}$$

were found to give an O-C diagram with a slope not significantly
different from zero, implying a further correction of 0.0000004
$\pm$0.0000110. The fact that the mean error of the correction was larger
than the correction itself implies that the correction was so close to
zero as to make the deviation from zero nearly insignificant.

In Kurochkin's (1959) reference was a table of 49 observations
from 1948 to 1955. After computing phases and drawing light curves for
these, using the elements in equation 2, I discovered that I could not
use the same mean light curve as I had used for the Nantucket data. I
believe that this was largely because Kurochkin had used a different
set of sequence stars resulting in a different magnitude system. I
therefore used the following method (Belserene and Larson 1980).

I picked a point on the ascending branch of the mean light curve
of the Nantucket data where the difference in phase with the point on
the descending branch having the same magnitude was 0.40. I then
measured the difference between the phase of this point on the
ascending branch and the phase of the nominal maximum which had been
marked off earlier. See Figure 1a. This phase difference was 0.11. A
mean light curve was then drawn for the second set of light curves and
the first half of the above process was repeated. This time, however,
the nominal maximum was defined as being the point occurring at a phase
shift of 0.11 after the point on the ascending branch. See Figure 1b.

The second mean light curve could now be superimposed on the individual curves and the observed phase of maximum determined for use in an O-C diagram.

Figure 2 is an O-C diagram showing values of O-C, in units of the period, plotted against the mean Julian Day of the group of observation. The black dots are the Nantucket data; the open circles are Kurochkin's data. A least squares straight line has been drawn through the points using only the Nantucket data. (Using Kurochkin's data does not significantly alter the line. His points do not deviate very much from the line, as may be seen in the diagram.)

I have concluded that 50 years of data and the O-C diagram show no discernible change in the period of BX Scuti. The new elements derived from the least squares line for this star are:

$$JD_{(max)} = 2434594.901 + 6.411322 \, n. \qquad (3)$$
$$\pm 0.011 \quad \pm 0.000011$$

REFERENCES

Belserene, E. P. and Larson, W. 1980, Journ. Amer. Assoc. Var. Star Obs. 9, 61.

Harwood, M. 1933, Bull. Harvard Coll. Obs. 893.

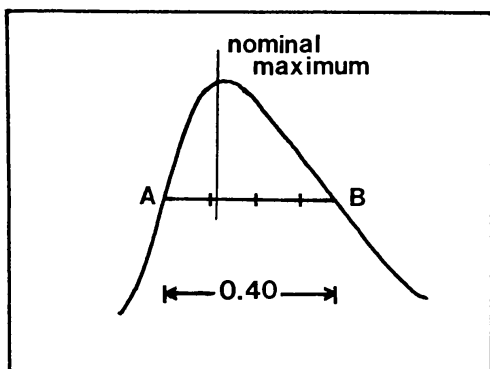Kurochkin, N. E. 1959, Perem. Zvezdy 12, 277.

Figure 1a. Light curve for BX Scuti drawn and nominal maximum picked. Point on the ascending branch (A) chosen such that point on descending branch (B) with same magnitude is out of phase by 0.40. Nominal maximum measured to be at a phase difference of 0.11 from A.
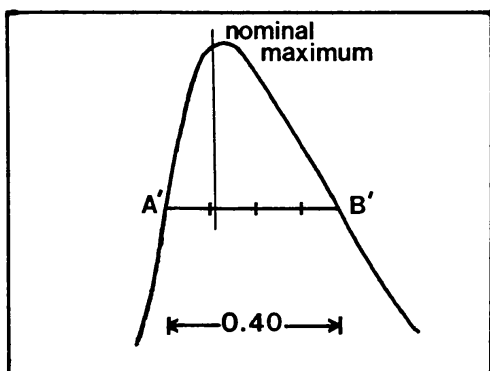

Figure 1b. Light curve drawn for BX Scuti. A' chosen on ascending branch such that B' on descending branch has same magnitude as A' and is 0.40 phase shift away. Nominal maximum is placed, by definition, at a phase difference of 0.11 from A'.
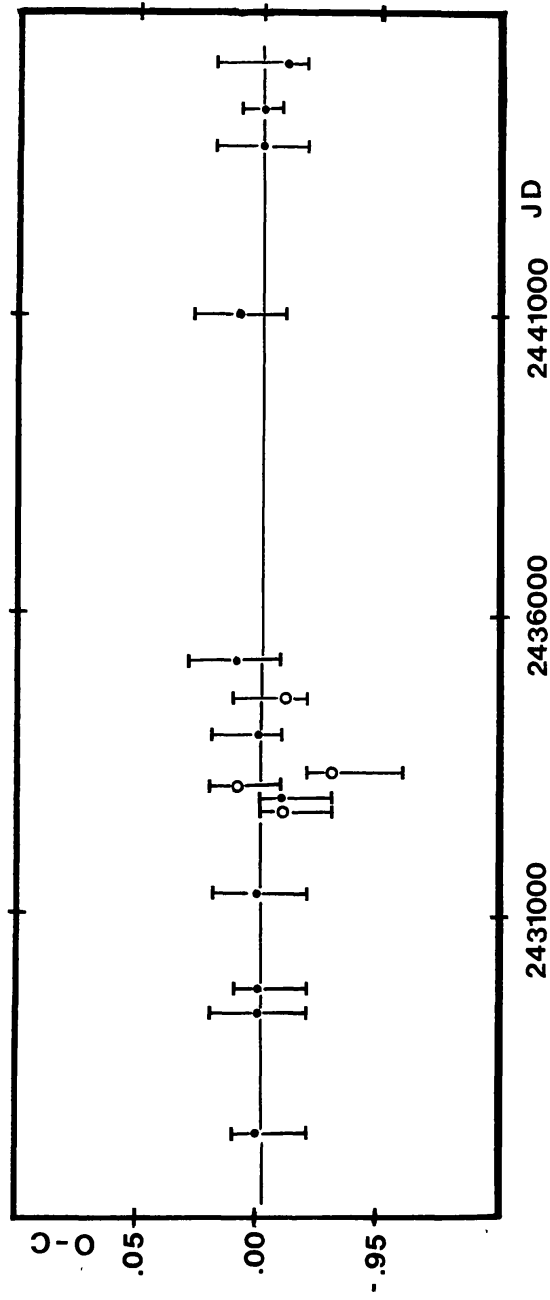
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Figure 2. Values of O-C, in units of the period, versus mean Julian Day of the group of observations. Black dots are Nantucket data; open circles are Kurochkin's data.

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