COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4477

Konkoly Observatory
Budapest
9 May 1997
HU ISSN 0374 – 0676

ECLIPSE OBSERVATIONS OF AB ANDROMEDAE

AB Andromedae (G5+G5V, R=8.95, $23^h11^m31^s.90$, $+36°53'35''.7$, (J2000) is a frequently observed close eclipsing binary. This system is on the AAVSO list of eclipsing binaries (Baldwin and Samolyk 1993). The AAVSO bulletin reports eclipse minimum observations made between the dates JD 2442909.879 and 2448835.813. An O$-$C plot of the AAVSO observations shows the published period of 0.33189215 days is decreasing with time.

The present note describes CCD photometry of AB And from the University of Iowa Automated Telescope Facility located in Iowa City, Iowa. The system consists of an 18cm refractor, a Spectrasource HPC-1 CCD camera (format 512×512 binned pixels, $3''.00$ per pixel), and a Johnson R-band filter. We used the nearby Guide Star Catalog (GSC) stars GSC 2763.484 [$23^h12^m14^s$, $+36°58'30''$]; GSC 2763.683 [$23^h11^m14^s$, $+36°51'15''$]; GSC 2763.848 [$23^h11^m01^s$, $+36°58'20''$, (J2000)] as check stars and the nearby star GSC 2764.1629 [$23^h12^m08^s.$, $+36°46'50''$, (J2000)] as the comparison star. A 60 second exposure of a field containing AB And as well as the check and comparison stars was repeated every two minutes for three hours. Differential aperture photometry was performed by an automated procedure after aligning all images to a common stellar reference. No air mass or color corrections were applied. The AB And system was observed during the nights of 29 October 1995 UT and 12 July 1996 UT. Light curves were produced by plotting the data obtained on these nights. These plots are shown in Figure 1.

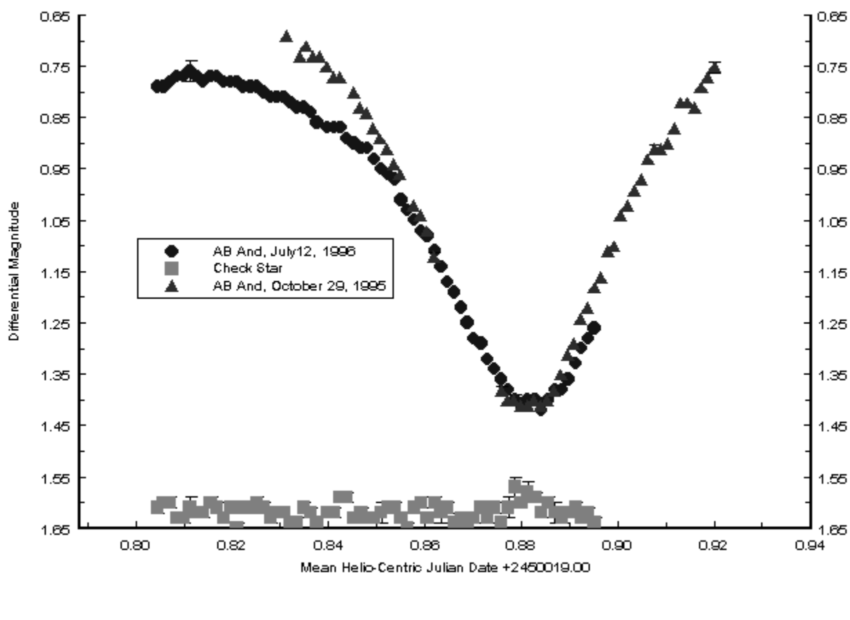

Figure 1. Two light curves for AB And from the nights of October 29, 1995 and July 12, 1996. The primary minimum of October 29 has been superimposed over the secondary minimum of July 12. The abscissa is correct for October 29

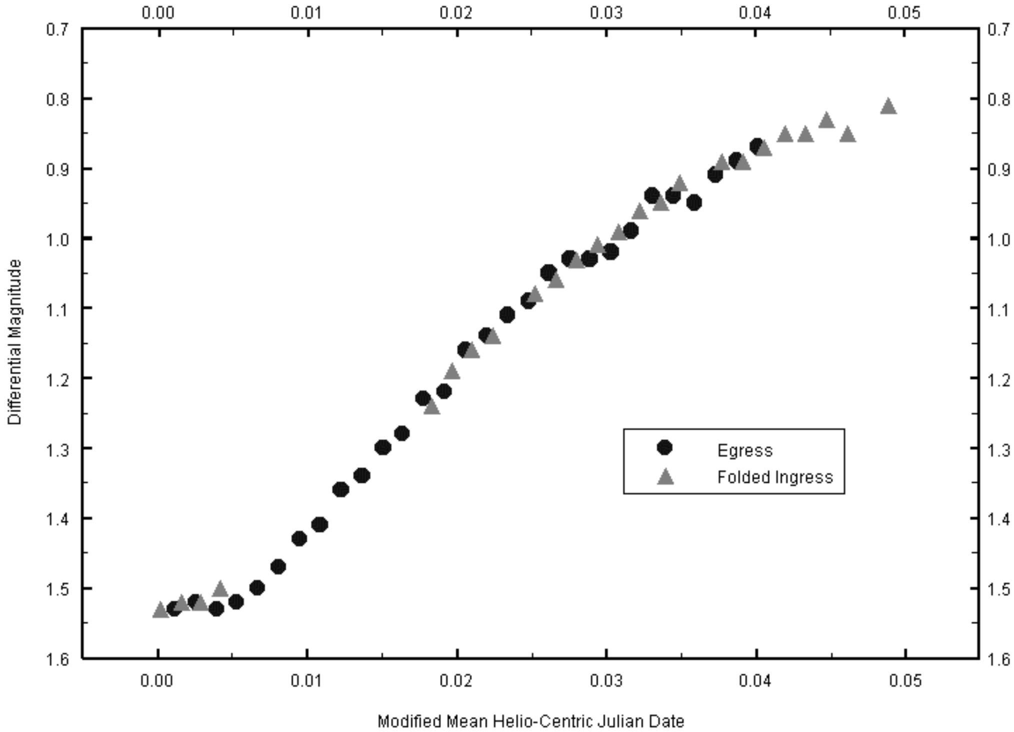

Figure 2. A sample folded light curve. The MHJD of minima has been set to zero and the absolute value of the MHJD has been plotted. The data shown is for October 29 1996 UT

We observed a primary minimum at 2450019.8290±0.0005 Heliocentric Julian Date (HJD) and a secondary minimum at 2450275.8824±0.0005 HJD. The errors in the minima were found by 'folding' the light curves, i.e. setting the HJD at the time of minimum to zero and plotting the differential magnitude versus the absolute value of the modified HJD to produce a folded light curve for each night. As our original curves were almost perfectly symmetric, any shift in the minimum HJD greater than ±0.0005 HJD caused noticeable discrepancies between the two halves. A folded light curve is shown in Figure 2.

The O−C measurements available from the AAVSO compilation clearly show that the linear ephemeris published in the AAVSO bulletin,

$$JD_{min} = 2,436,109.5793 + 0.33189215 \times E$$

where JD_{min} is the time of primary minima, is not precise any longer. Demircan *et al.* (1994) has shown that a sinusoidal function provides a satisfactory fit to the O−C residuals from a linear ephemeris:

$$JD_{min} = JD_0 + 0.3318890 \times E - A_s cos(2\pi \cdot (E - T_s)/P_s)$$

where JD_0 is the reference epoch, A_s is the semi-amplitude in days, T_s is the period in orbital cycles, and P_s is the minimum time in units of E. Numerical values of the parameters are listed in the table.

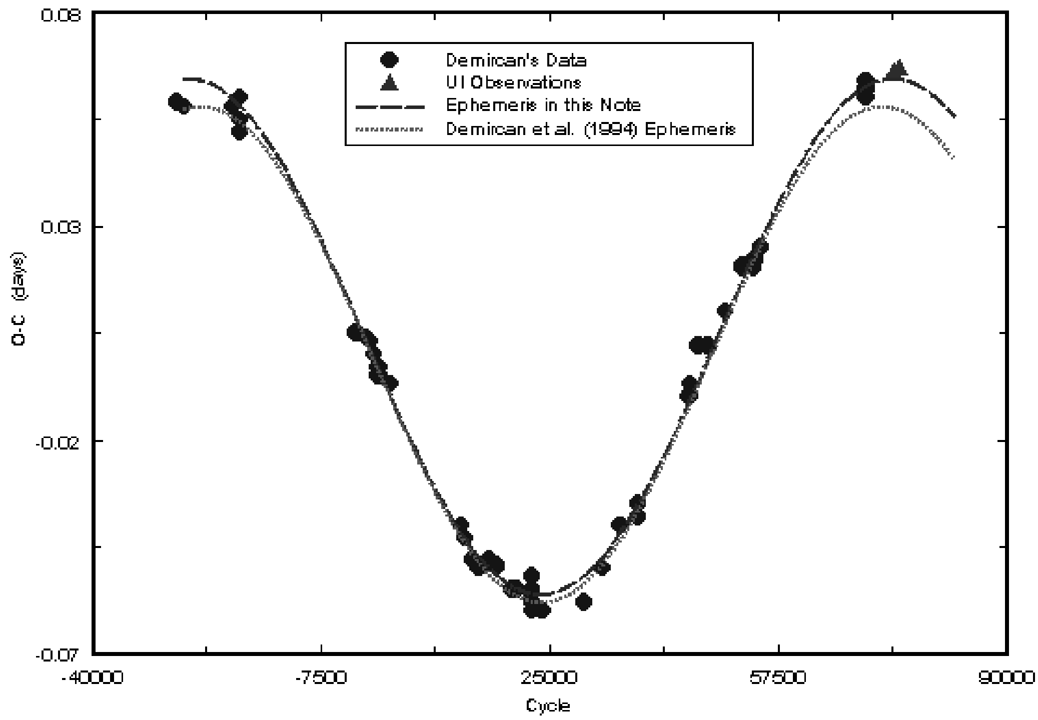

Figure 3. O−C graph of the historical data of Demircan et al. (1994) along with the minima reported in this note. The data has been fitted with Demircan's ephemeris and the ephemeris reported in this note

Our times of minima do not agree with this ephemeris. They are consistent with a phase shift of 0.06 days with respect to Demircan *et al.'s* ephemeris. We have solved for a new periodic ephemeris that fits both his historical data and our data. The table below shows our revisions to Demircan's ephemeris. The change in JD_0 is due to a residual offset required to best fit all data points.

Reference	JD_0	A_s	T_s	P_s
Demircan *et al.* (1994)	2425297.4805	0.0580	23800	96800
Nellermoe and Reitzler (this note)	2425297.4846	0.0603	23707	100230

Figure 3 is a plot of Demircan's data along with the minima reported in this note fitted with the revised ephemeris equation. The fit has a root mean square uncertainty of 0.0028 days.

This sinusoidal trend in the O−C plot suggests the presence of a third-body with a period of approximately 91 years. Demircan *et al.* suggest a similar result, with a third-body period of 88 years.

The authors would like to thank Leslie Simon Sauerbrei, Britt Scharringhausen and Professors Lawrence A. Molnar and Steven R. Spangler for their help with this note.

Interested parties can obtain the raw photometric data from the authors at the following e-mail address: *atfproj@astro.physics.uiowa.edu*.

This research has been supported by the Iowa Space Grant Consortium and the National Science Foundation.

B.L. NELLERMOE
L.E. REITZLER
Van Allen Observatory
Dept. Physics and Astronomy
University of Iowa
Iowa City IA 52242
USA

References:

Baldwin, M. and Samolyk, G. 1993, AAVSO Observed Minima Timings of Eclipsing Binaries No. 1

Demircan, O. *et al.* 1994, *Mon. Not. R. Astron. Soc.*, **267**, 19