COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4559

Konkoly Observatory
Budapest
24 February 1998
HU ISSN 0374 – 0676

ECLIPSE TIMING OBSERVATIONS OF THREE CLOSE BINARIES

M. BUCKNER, B. NELLERMOE, R. MUTEL

Van Allen Observatory, University of Iowa, Iowa City, IA, 52242, email: ccdoper@astro.physics.uiowa.edu

T Leonis Minoris, EQ Tauri, and WW Cygni are frequently observed close eclipsing binaries. These systems are on the AAVSO list of eclipsing binaries (Baldwin and Samolyk 1993). The AAVSO database of O−C observations (largely from visual timings) showed some evidence for either period changes or incorrect periods in all three systems.

The present note describes CCD photometry of T LMi, EQ Tau, and WW Cyg using the University of Iowa's Automated Telescope Facility located in Iowa City, Iowa. The system consists of an 18cm refractor, a Spectrasource HPC-1CCD camera (format 512×512 binned pixels, $3\farcs00$ per pixel), and a Johnson R-band filter. A series of 60 second exposures of a field containing the target star as well as 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. At R band, we estimate this will introduce errors less than 0.05 mag.

The central time and uncertainty of each eclipse minimum was determined by a least-squares algorithm which 'folds' the light curve about the center of the eclipse, i.e. setting the heliocentric Julian date (HJD) at the time of minimum to zero and plotting the differential magnitude versus the absolute value of the 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.

For all three stars, we used the published ephemerides given by Danielkiewicz-Krosniak and Kurpinska-Winiarska (1996; hereafter DK96) to determine O−C values. We determined new periods by fitting the AAVSO observations along with the minima reported in this note. We used a least-squares linear regression weighted by the uncertainty of each observation. For the AAVSO data, we assumed the mean uncertainty ± 0.003 days.

T LMi

For T LMi (A0, R=12.95, $9^{h}48^{m}28\fs54$, $+33^\circ 17' 20''$, J2000) we used the nearby Guide Star Catalog (GSC) star 2505.1038 $9^{h}48^{m}35\fs4$, $+33^\circ 13' 06''$) and GSC 2504.252 ($9^{h}47^{m}53\fs0$, $+33^\circ 16' 57''$) as the check and comparison star respectively. T LMi system was observed during the night of 15 February 1997 UT. We observed a primary minimum at HJD = 2,450,494.8857$\pm$0.0005 (Figure 1a). The O−C plot, using the AAVSO database, and a period P = 3.019846 days and JD0=2,446,910.332 (DK96) is shown in Figure 2a, along with the best-fit linear regression. The revised period is slightly shorter, P = 3.019841 ± 0.0000015 days.

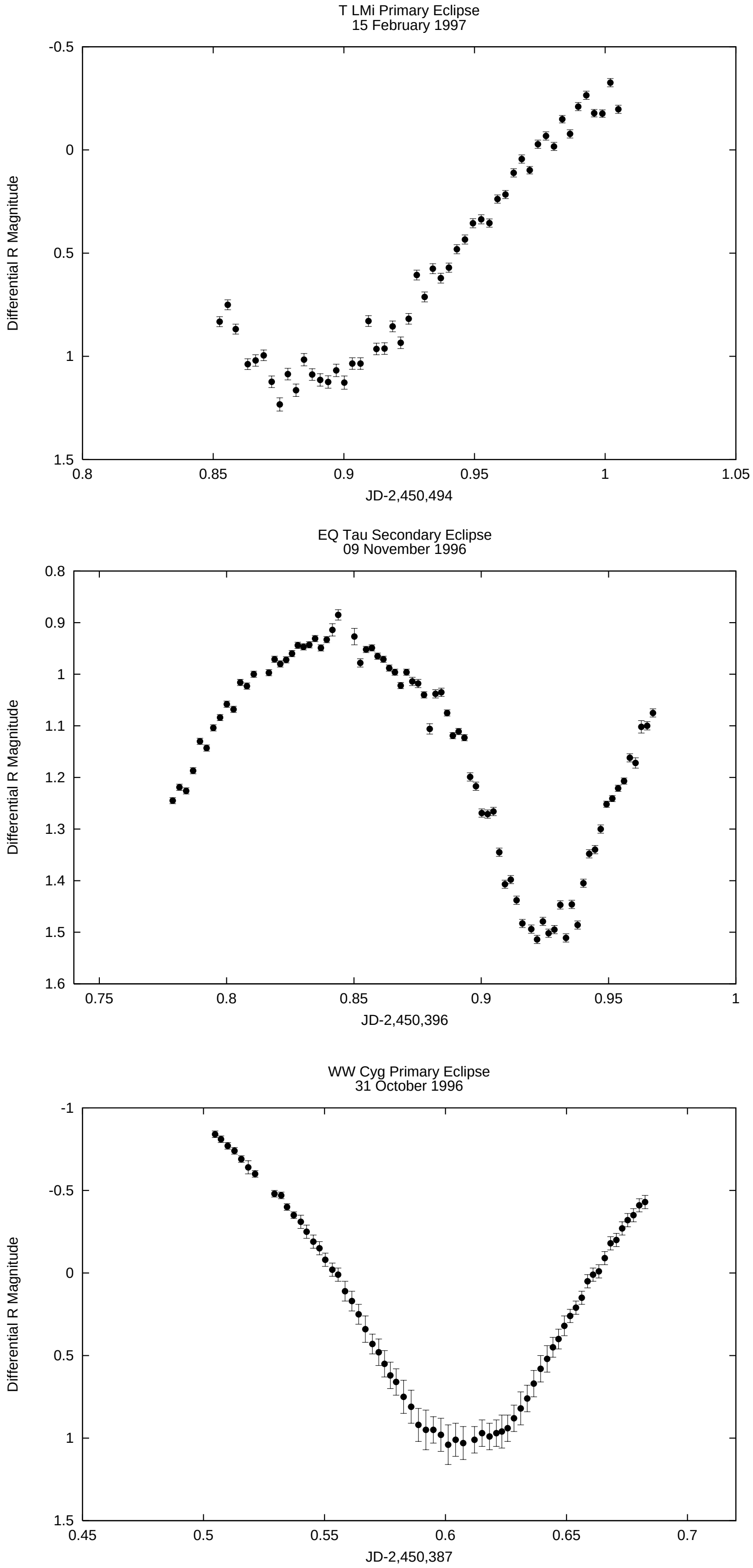

Figure 1. Light curves for T LMi (primary eclipse), EQ Tau (secondary eclipse), and WW Cyg (primary eclipse)

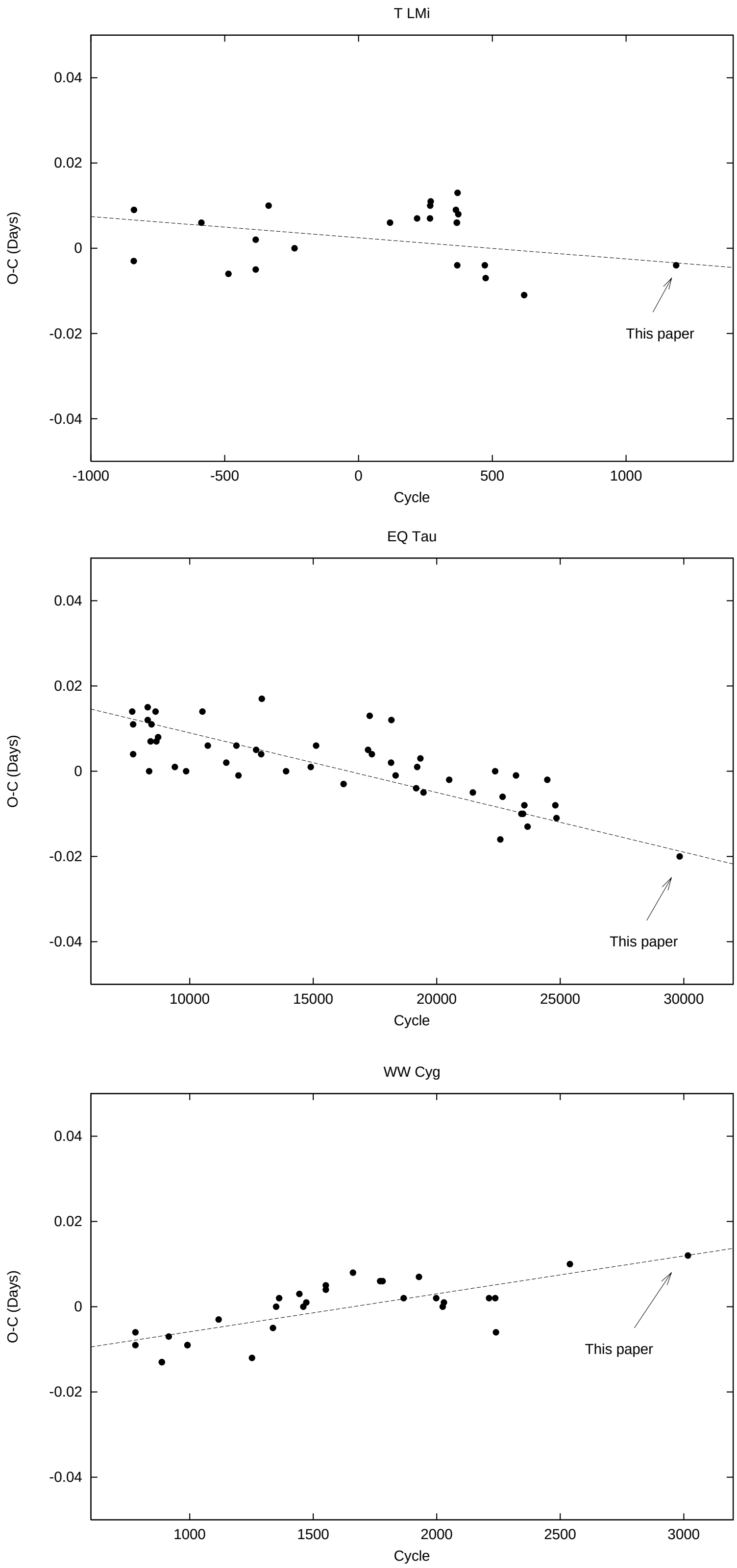

Figure 2. O−C plots for T LMi, EQ Tau, and WW Cyg. Historical data are from the AAVSO Archives (Observed Minima Timings of Eclipsing Binaries). The straight lines are weighted least-squares linear regressions

EQ Tau

For EQ Tau (G1, R=11.07, $3^h48^m13\overset{s}{.}38$, $+22°18'51\overset{''}{.}4$, J2000) we used the nearby star GSC 1260.642 ($3^h48^m42\overset{s}{.}9$, $+22°21'32''$) and GSC 1260.575 $3^h48^m16\overset{s}{.}4$, $+22°17'30\overset{''}{.}2$) as check and comparison star respectively. EQ Tau was observed during the night of 09 November 1996 UT. We observed a secondary minimum at HJD = 2,450,396.9250±0.0005 (Figure 1b). The O−C plot, using the AAVSO database, a period $P = 0.3413485$ days and $JD0 = 2,440,213.325$ (DK96), is shown in Figure 2b. The linear regression fit resulted in a slightly shorter period $P = 0.3413471 \pm 0.0000001$ days.

WW Cyg

For WW Cyg (B8V+, R=10.94, $20^h04^m02\overset{s}{.}69$, $+41°35'17''$, J2000) we used the nearby stars GSC 3158.220 ($20^h04^m25\overset{s}{.}2$, $+41°30'16''$) and GSC 3158.1498 $20^h04^m12\overset{s}{.}5$, $+41°33'06''$) as the check and comparison star respectively. We observed a primary minimum at HJD = 2,450,387.6074±0.0005 (Figure 1c). The O−C plot, using the AAVSO database, a period $P = 3.317769$ days and JD0=2,440,377.886 (DK96), is shown in Figure 2c. The linear regression fit resulted in a slightly longer period $P = 3.3177779 \pm 0.0000007$ days.

Table 1 summarizes the new ephemerides determined for all three systems.

Table 1. Revised Linear Ephemerides

Star	JD0	P(days)
T LMi	$2,450,494.8857 \pm 0.0005$	3.019841 ± 0.0000015
EQ Tau	$2,450,397.0957 \pm 0.0005$	0.3413471 ± 0.0000001
WW Cyg	$2,450,387.6074 \pm 0.0005$	3.3177779 ± 0.0000007

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

References:

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

Danielkiewicz-Krosniak, E. and Kurpinska-Winiarska M., T. 1996, SAC - Supplemento ad Annuario Cracoviense, 67. (DK96)