TIMES OF MINIMUM LIGHT FOR
FOUR ECLIPSES OF FOUR BINARY SYSTEMS

We report on a continuing program to observe systems suggested by Hegedüs (1988) that show apsidal motion, or that are likely candidates to show apsidal motion, but have not been observed extensively enough to confirm such motion.

The observations were made with the 0.61 m B&C reflector and Photometrics PM512 CCD at the Whitin Observatory. The UBVRI filter set used was described by Bessell (1990). The data were acquired via a Macintosh IIci running IPLab. Data were taken in only one filter for a given eclipse, in order to minimize the time between points. This technique, along with the greater sensitivity of CCD's over PMT's, and the use of comparison stars in the same field as the variable, allows much fainter systems to be observed or much faster sampling on brighter systems.

The data were bias, dark, and flat corrected using standard scripts in IRAF. The data were then shifted to a common coordinate reference frame and photometered using custom scripts in IRAF developed by the authors (Downey and Hawkins, 1994). V/C intensity ratio and photometric errors were then calculated with the SC spreadsheet.

Once V/C intensity ratios had been calculated, the times of minimum light and standard errors in Table 1 were calculated via the method of Kwee and van Woerden (1956), using a program written by Ghedini (1982). This algorithm has been shown to give the most accurate estimation of conjunction for asymmetric or distorted light curves (Caton 1989). The comparisons used are listed by their coordinates from version 1.1 of the GSC CD-ROM (Epoch J2000). All comparisons were compared to two check stars, and found to be stable within the photometric errors over the time scale of the observations. Since the data were only intended for timing analysis, they were not transformed to Johnson standard magnitudes.

Table 1

System	Type of Eclipse	HJD (-2400000)	Standard Error	Comparison Coordinates	Filter
AP Tau	Secondary	48687.5562	0.0002	$04^h54^m36^s+26°54'07"$	I
XX Cas	Primary	49308.5557	0.0001	01 29 49 +60 58 00	R
XZ And	Primary	49313.5336	0.0001	01 56 53 +42 08 39	I
V 456 Cyg	Secondary	49589.6918	0.0002	20 28 35 +39 14 43	R

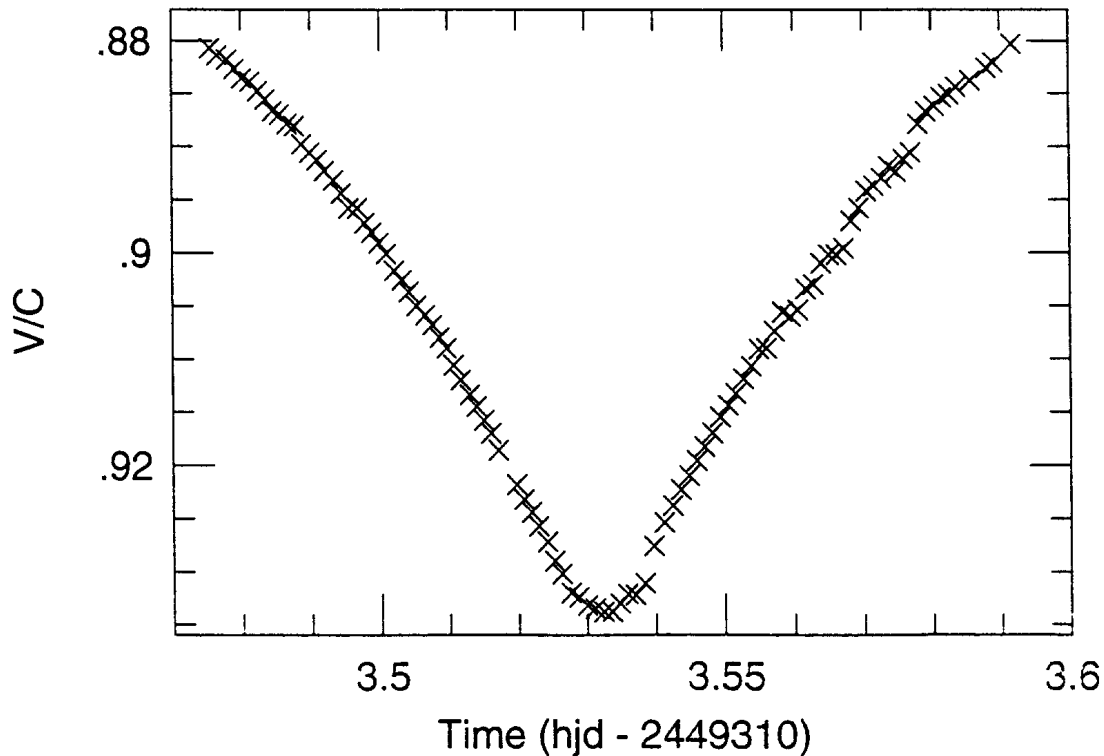## XZ And Primary —— T_0 = 2449313.5336 +/− 0.0001

Figure 1

Figure 1 is a light curve of XZ And near the time of minimum light, showing the low scatter and large number of points attainable with a CCD system.

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