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A LIGHT CURVE AND TIME OF MIMIMUM FOR W UMa OBTAINED WITH THE IUE SATELLITE

The eponymous late spectral type contact binary system W Ursae Majoris BD + 56° 1400, HD 83950; period ~8 hours) has been the subject of many theoretical and observational studies. During a programme to obtain ultraviolet spectra of W UMa we obtained an optical light curve and time of minimum using the Fine Error Sensor (FES) detector onboard the International Ultraviolet Explorer Satellite (IUE).

The IUE satellite and its instrumentation are described by Boggess et al. (1978). The FES is usually used either as a star tracker to assist satellite pointing or as a field camera which scans a region of sky to enable a target star to be selected for observation. In this Bulletin we describe the use of the FES as a photometer.

The telescope has a 45 cm diameter mirror and an f/15 Cassegrain beam. The FES is an image dissector tube with an S-20 response. Roughly the wavelength range 4000 Å to 7000 Å is covered with a broad peak near 5000 Å and effective bandwidth of order 2000 Å. Thus an FES magnitude, m_F, is a broad band measurement at effective wavelength 5000 Å and is roughly similar to a J magnitude from a IIIaJ plate.

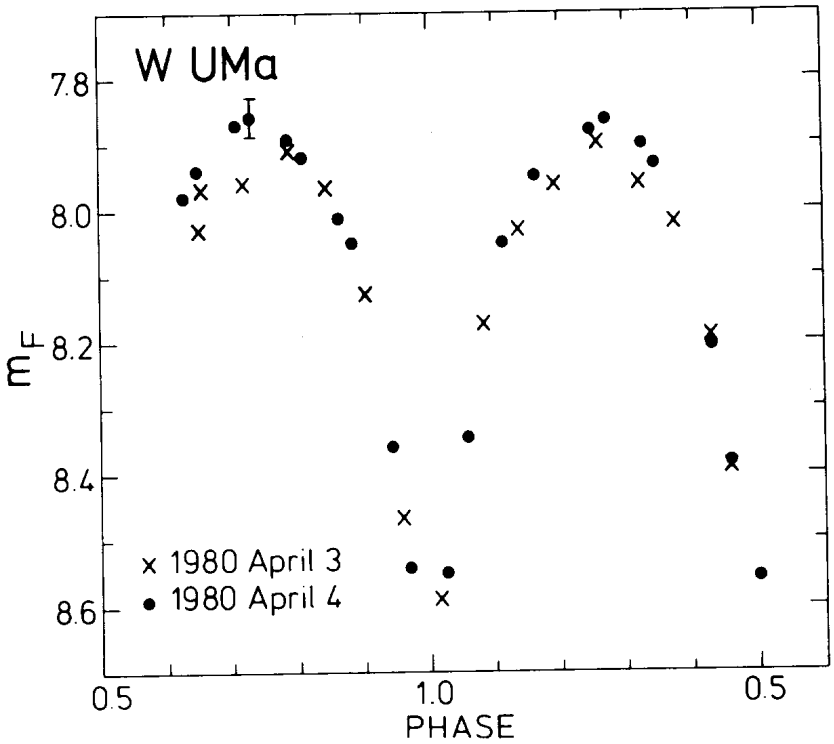
The effective integration time of a measurement was 2.5s composed of many shorter samples of the image dissector to avoid saturation. The count value detected is nearly equivalent to a photon count. However, the "object plus sky" is detected; no separate sky count is made. The sky count is composed of astronomical skylight and zero point detector counts (dark current). It is not important for W UMa. The FES countrate(N)

has been calibrated into FES magnitudes (m_F) and to B and V of the UBV system, using 129 stars, by Stickland (1979):

$$m_F = 16.71 - 2.58 \log N \quad (1)$$
$$m_V = m_F - 0.28\ (B-V) \quad (2)$$

The relative error in calibration (1) over the range of magnitudes relevant to W UMa < 0.01 mag. The error due to countrate is of order $\lesssim$ 0.02 mag giving a combined error better than 0.03 mag.

The lightcurve for W UMa obtained on 1980 April 3 and 4 (U.T) is shown in Fig. 1. A period P = 0.3336381 days was used, and ephemeris 2



below. Different symbols are used for the different days. From the data we conclude: (i) the light curve in the F band is similar to those observed at B and V (e.g. Breinhorst 1971); the amplitude $\Delta F \sim 0.71 \pm 0.02$ mag compares with $\Delta V = 0.71$ mag and $\Delta B = 0.74$ mag. (ii) apart from two points on 3 April the light curves from the two

days are in very good agreement with each other; the difference of order 0.03 mag near maxima may be due to the errors or to a small change in W UMa itself; (iii) combining the two light curves in phase enables the time of deeper minimum to be measured:

$$\text{min I at 1980 April 3 } 6^h24^m \pm 2^m \qquad (3)$$

$$\text{HJD } 2444332.768 \pm 0.001$$

(iv) using equation (2) and a mean maximum value $m_F^{(max)} \sim 7.88 \pm 0.02$ and (B-V) = 0.66 gives V(max) $\simeq$ 7.71 $\pm$ 0.04 where the extra error is due to errors in calibration (2). V $\sim$ 7.71 from the IUE FES agrees well with the ground-based telescope, atmospheric extinction corrected value V(max) $\sim$ 7.7 (Eggen, 1965).

The time of minimum given in (3) above enables us to discuss the currently available ephemerides for W UMa presented in the following table:

Code	J.D. Hel	P	(O-C) (d)	reference
	2400,000.0+			
1	42829.3939	0.3336370	0.006	Eaton (1976)
2	35918.4154	0.3336381	0.000	Baldinelli, Ghedini (1978)
3	41738.3989	0.3336370	0.008	Piirola (1976)
4	41004.3977	0.3336370	0.008	Kukarkin et al. (1976)
5	37986.9742	0.33363808	-0.003	Tümer (1980)

The current observed time of minimum is consistent with ephemeris 2 above. Our time of minimum is further confirmed by recent times of minimum for W UMa obtained by Tümer et al. (1980).

We conclude that ephemerides 2 and 5 above currently best describe the times of minima of W UMa. We also note that the IUE Fine Error Sensor detector gives photometric magnitudes in detailed agreement with ground

based data and that it can prove a useful tool in the study of variable stars.

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