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AW UMa OBSERVED WITH MOST SATELLITE[†]

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Since its discovery by Paczyński (1964), AW UMa (HD 99946) has played a special role in efforts to understand structure of W UMa-type binaries. This particular importance was realized after it had been shown by Mochnacki & Doughty (1972) that model light curves computed following the contact model of Lucy (1968a, 1968b) imply a very small mass-ratio of $q \simeq 0.080 \pm 0.005$. The agreement with the model for such a large disparity of masses has since been interpreted as a very strong support for the model. While the small mass ratio has been photometrically confirmed many times following the investigation of Mochnacki & Doughty, new spectroscopic observations of Pribulla & Rucinski (2008) revealed that AW UMa is a complex semi-detached binary with a significantly larger mass ratio ($q \geq 0.10$). These observations showed complicated flows in the system, with the undersized primary and a tiny secondary embedded in what may be interpreted as an accretion disk. One of the spectroscopically detectable features was the presence of inhomogeneities on the primary component which could possibly be non-radial oscillations. Such oscillations would not be excluded on an F2 main-sequence star which is located exactly in the middle of the δ Sct instability strip.

Continuous MOST observations with effective exposure times of one minute were obtained between 25 February and 9 March 2013 resulting in 14,020 individual observations

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[†] Based on data from the MOST satellite, a Canadian Space Agency mission, jointly operated by Microsatellite Systems Canada Inc. (MSCI; formerly Dynacon Inc.), the University of Toronto Institute for Aerospace Studies and the University of British Columbia, with the assistance of the University of Vienna.

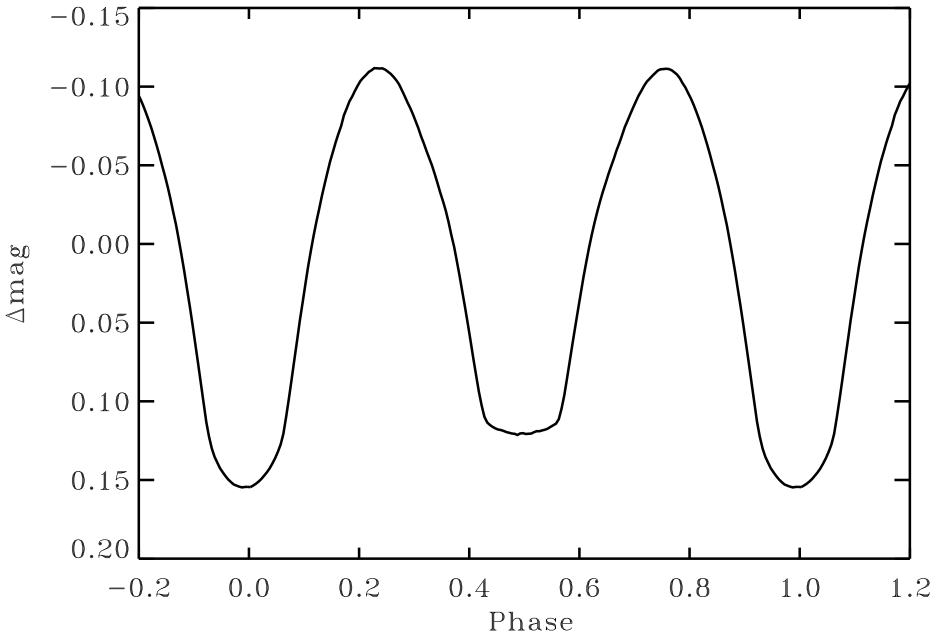

Figure 1. The mean light curve of AW UMa obtained from averaging all MOST observations in orbital phase is very well defined with errors smaller than the thickness of the line.

with a median error per point of 0.0005 mag. The mean, phased light curve obtained from averaging of 27 orbital cycles does not show any asymmetries which could be associated with spots or any other peculiarities (Figure 1). However, such a light curve is not convenient for modelling attempts because MOST uses one filter with a wide spectral band. Thus, we searched only for variability in the *deviations* from the mean light curve. A periodogram analysis for coherent oscillations and a wavelet analysis for localized oscillatory trains reveal no features which could not be explained as vestiges of the orbital binary (2.28 c/d, 4.56 c/d) and orbital satellite (1.0 c/d, 2.0 c/d and the explicitly removed 14.3 c/d) periodicities, their harmonics and combinations. Thus, no unexplained features larger than 0.0001 mag appear in the variability spectrum of the residuals from the average light curve (Figure 2).

The MOST observations gave the mean moments of eclipses:
Primary $HJD = 2,456,354.6668 \pm 0.0002$,
Secondary $HJD = 2,456,354.8866 \pm 0.0002$.
The $O - C$ diagram for AW UMa is shown in Figure 3. The eclipse timing data for the figure, covering the range $HJD\,2,438,045 - 2,455,669$, have been taken from the compilation in the Web page of the Czech Amateur Observers:
http://var.astro.cz/ocgate/ocgate.php?star=AW+UMa&submit=Submit&lang=en
where the assumed ephemeris was: $HJD = 2,452,311.81 + 0.438726 \times E$.

It has been known that AW UMa shortens its orbital period. However, the rate of the period change is not constant so that the eclipse moments cannot be fitted by a quadratic function. This is demonstrated in Figure 3 where the quadratic fit versus the epoch E is shown. The fit parameters are: $a_0 = +0.007 \pm 0.006$, $a_1 = (-8.6 \pm 1.7) \times 10^{-7}$, $a_2 = (-1.12 \pm 0.07) \times 10^{-10}$, where the quadratic term implies the e-folding time scale of

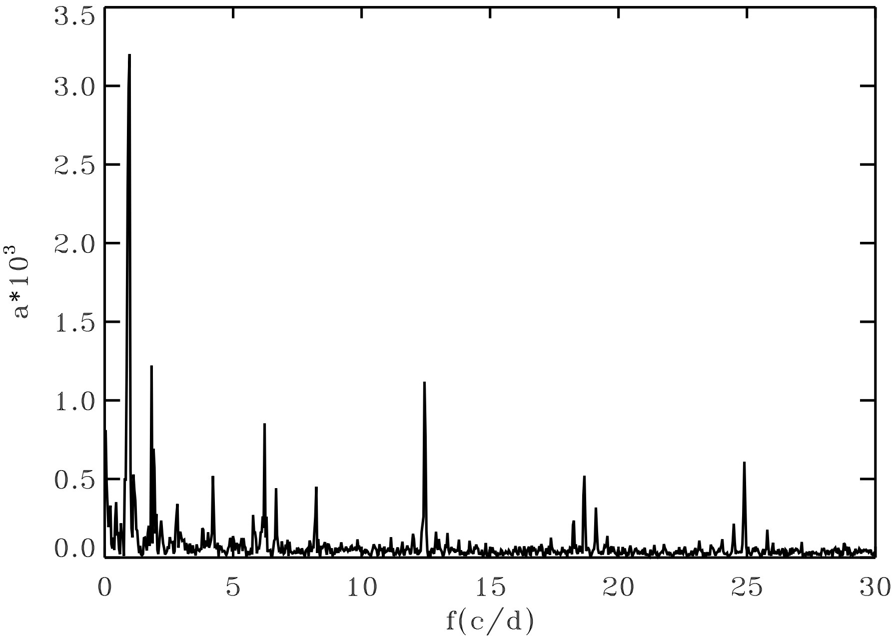

Figure 2. The periodogram of deviations from the average light curve of AW UMa. The frequencies are expressed in cycles per day while the vertical axis gives the amplitudes in units of 0.001 of the mean flux.

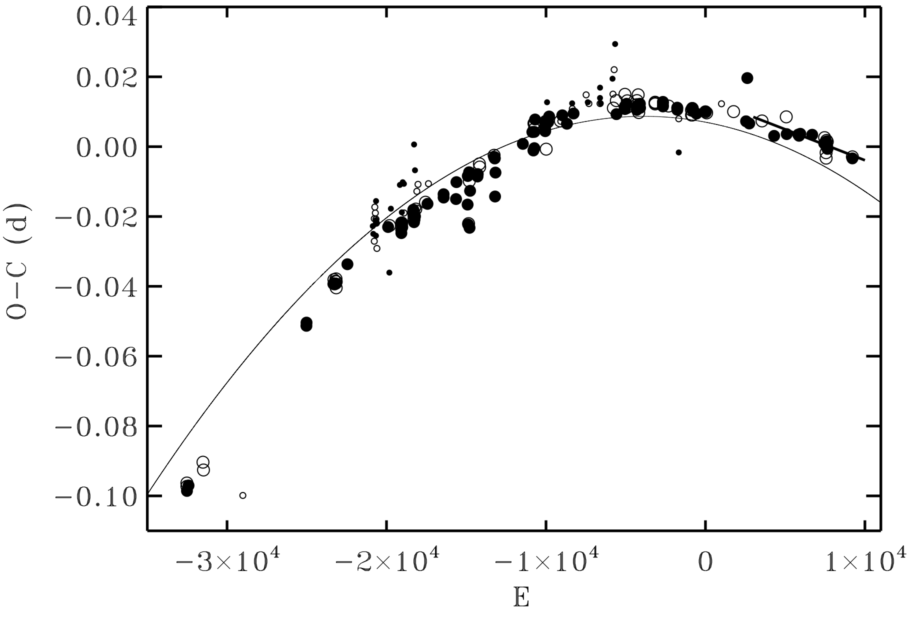

Figure 3. Deviations from the linear ephemeris of the Czech Amateur Observers for the primary (filled circles) and secondary eclipses (open circles) with visual observations marked by small symbols. The last symbol to the right is for the MOST observations. The short line for $E > 3000$ represents the current linear trend.

$\simeq 2.4 \times 10^8$ years. It appears that short segments better represent the observed $O-C$ curve. Because we needed a new linear ephemeris for the 2011 extensive spectroscopic observations of AW UMa at CFHT, we fitted a linear ephemeris for epochs $E > 3000$: $HJD = 2,455,632.9660(18) + 0.43872420(25) \times E$ where the mean errors, in parentheses are in units of the last decimal places.

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ERRATUM FOR IBVS 6079

The last paragraph of the paper contains major errors which propagated into Fig.3. The corrected text and figure are given below.

It has been known that AW UMa shortens its orbital period. Figure 3 shows the quadratic fit versus the epoch E with the fit parameters: $a_0 = +0.0109(4)$, $a_1 = -4.5(6) \times 10^{-7}$, $a_2 = -1.16(4) \times 10^{-10}$, where the mean errors, in parentheses, are in units of the last decimal places. The quadratic term implies the e-folding time scale for the period change of 2.3×10^6 years. The rate of the period change may vary in time so that short segments may better represent the observed $O-C$ curve. Because we needed a new linear ephemeris for the 2011 extensive spectroscopic observations of AW UMa at CFHT, we fitted a linear ephemeris for epochs $E > 3000$: $HJD = 2,455,632.9660(18) + 0.43872420(25) * E$.

Acknowledgement: Thanks are due to Dr. Miloslav Zejda for pointing the substantial error in the paper.

The Author

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*This version of the paper contains corrections, and differs from the one appeared on-line originally. Date of last modification: Mon Jan 27 10:03:55 CEST 2014

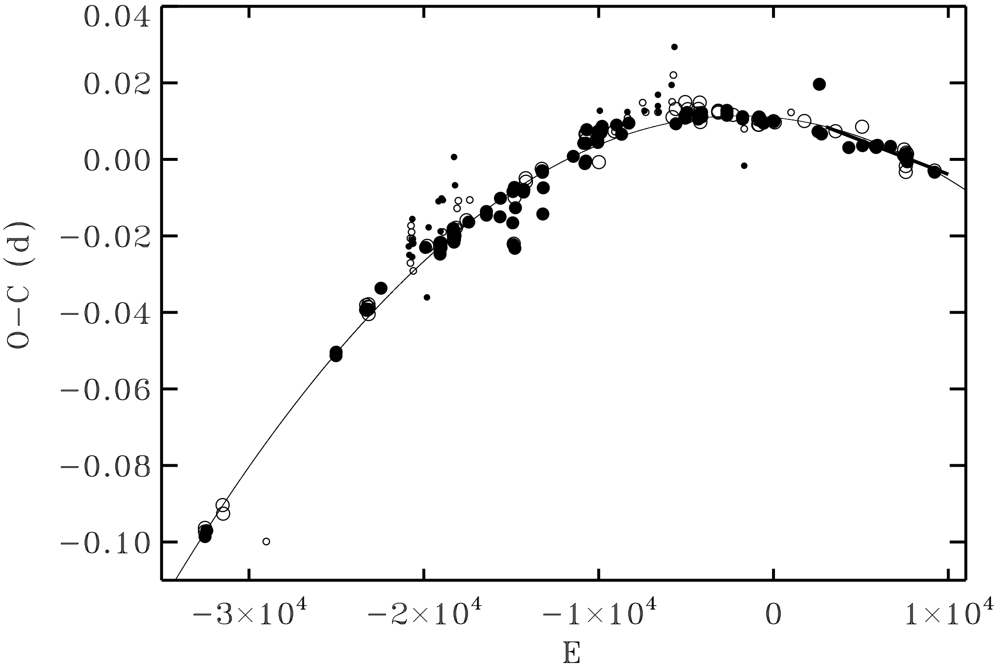

Figure 3a. Deviations from the linear ephemeris of the Czech Amateur Observers for the primary (filled circles) and secondary eclipses (open circles) with visual observations marked by small symbols. The last symbol to the right is for the MOST observations. The short thick line for $E > 3000$ represents the current linear trend.