

# The Variable Star W UMi:

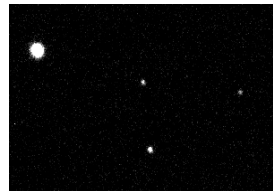
By Greg Morgan and Randy Steiner

Ursa Minor has many variable stars. The sixth one discovered was designated as W Ursae Minoris or W UMi. It is located on the inside of the curve in the handle of the Little Dipper. Randy picked this variable star because it could be studied at any time of the year. It is a semidetached eclipsing binary system with a short period of 40h 50m and tracking errors are minimized because the star is so close to Polaris. Randy also noted that there is very little known about this variable. As yet, we have not found a recent published light curve. Once Randy found information on the last published minima, we were able to “synchronize” our observations. The system changes magnitude as one star crosses in front of the other. The duration of the eclipse is 5h 31m. During the ingress of the eclipse, the magnitude drops from 8.8 to 9.9 in about 2h 45m.

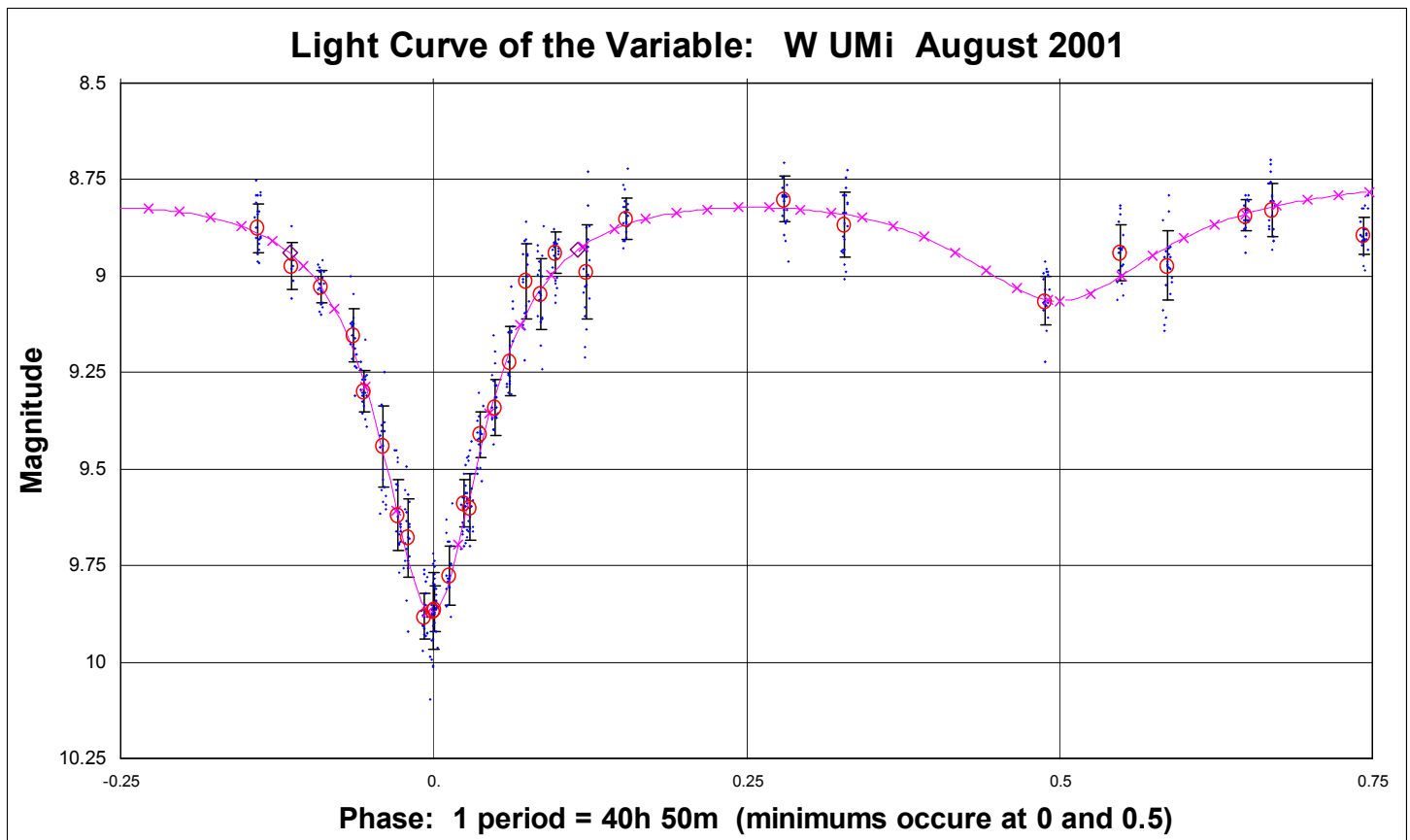
During August of 2001, 620 images of W UMi were collected. 20 frames were taken per block and each block was taken at a different part of the cycle. Most data were collected at the eclipse ingress and egress to better model the light curve at the dominant minima (see fig 1). Each image was a 20 second integration at prime focus of the 10” LX200 f/6.3 with the ST-7 unfiltered. The scope was set up outside in a semi robotic fashion. The controls of the scope and camera could be made from in the house sitting (and sleeping) on the couch. The images could be viewed on the 36” TV via a PC to TV S video cable. This made those all night data runs much more comfortable.

In the field of view are 4 stars (see fig 2). W UMi is designated as V, the variable. The center star was used as the K or check star at magnitude 13.8. The center bottom star was used as the C or comparison star at mag13.0. These were used as a reference and calibration in W UMi’s magnitude calculations as follows;  $Magnitude = -2.5 * \text{Log}_{10}(d_1/d_2) + m_C$  where  $d_1/d_2$  is the ratio of the instrument response to the C and V stars respectively and  $m_C$  is the known magnitude of the comparison star.

The differential photometry measurements were made with a software program supplied by Dr. Fred Ringwald (thanks Fred) called AIP<sub>4</sub>WIN by Richard Berry and James Burnell. Magnitude uncertainties were higher than expected for two reasons. Photometry measurements require the antiblooming gate (ABG) to be in the off position if the CCD camera has the feature. Data collected for W UMi had the ABG in the on position. Secondly, there was a 4 magnitude difference between the C and V stars. If the magnitudes were closer, the accuracy would be better. Uncertainties are at the 0.20 level (20% photometry). Future measurements may get down to or better than the 0.02 level. Comments and questions welcome. [gmorgan@valdental.com](mailto:gmorgan@valdental.com) or [astigeo@sierratel.com](mailto:astigeo@sierratel.com)



**Fig 2.** W UMi is in the UL corner. It is made up of an A0 V and F0 IV pair. The other three stars are, starting in the center and going clockwise, mag 13.8, 14.7 and 13.0. These were used as reference or calibration stars.



**Fig 1.** The light curve of W UMi. Over 600 images were taken in August 2001. The magnitudes were calculated and graphed in Excel. The open circles are the median values of each run of 20 frames. The error bars are 1 standard deviation. The Light Curve was hand fit with a bipolar cubic spline with each x indicating a one hour interval.