

COMBINING COLLABORATIVE WORK

Robert D. Stephens
11355 Mount Johnson Court
Rancho Cucamonga, CA 91737
rstephens@foxandstephens.com

(Received: 21 September Revised: 1 October)

Many amateur photometric observations are not converted to the Standard System. Combining results from collaborative work is difficult when using instrumental observations. Canopus software by BW Publishing can be used to combine instrumental observations from different systems.

Thanks to recent publicity, in publications and at conferences, there is a growing community of amateur astronomers desiring to do photometry of asteroids in order to determine rotational periods. It is only natural, that with the growth of the Internet, many of these amateur astronomers would wish to collaborate on projects. The benefits are obvious; (1) more complete coverage can be obtained on lightcurves from observatories stationed around the globe and, (2) the collaborative work can be used to verify each other and reduce errors.

However, on the downside, there are problems in trying to combine work from remote observatories. Most important is that most amateur observatories tend to make instrumental measurements as opposed to absolute magnitude determinations. In calculating these instrumental measurements, the amateur observatories typically calculate the slopes, but not the zero points. This is simply because they often use comparison stars in the same field of view without transforming to a standard system. So the problem becomes how to combine data from different observatories that are not adjusted to the standards system. One approach is to calibrate each observatories data by determining a minimum or maximum, for the lightcurve in comparison with data from the other observatories. In order to do this, start with an observing session whose length of time covers at least 25 percent of the asteroid's rotational period. This will typically contain at least one minimum or maximum of the curve. Having both, or other identifiable features is an extra advantage. I use Brian Warner's Canopus software to measure and analyze the data. This software has the ability to import data from other observatories, if measured using the same software.

As stated in the accompanying article on 27 Euterpe, four observatories contributed observations to an observing campaign on the asteroid. This was a very difficult target for which to find a solution, as it turned out not have the traditional two-peaked curve. My first step was to identify which sessions had the longest continuous amount of data, typically at least four hours long. I selected the six best sessions, all of which had at least a minimum or a maximum. Several had other identifying features. The Canopus program has the ability to adjust the zero point with what it calls a 'DeltaComp' adjustment. This adjustment is used to correct differences resulting from different comparison stars used on different nights, different cameras used, or the asteroid being at a different distance from Earth during different sessions. The six sessions were roughly adjusted with the DeltaComp adjustment. Then, using the Fourier Analysis portion of Canopus, every period between 5 and 18 hours was checked at 0.01 hour increments. A few possibilities were found for the six sessions used. One of which was the previously published 8.5-hour period. However, by far the best fit was a 10.41-hour period with the data

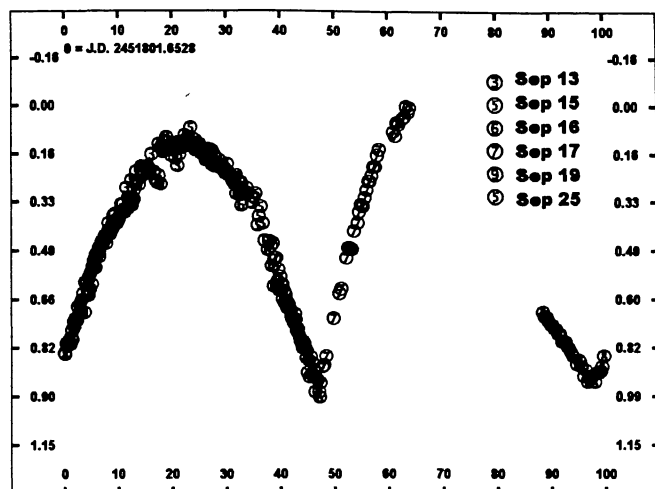


Fig. 1 – The lightcurve plot for 706 Hirudo. The period is $22.072 \pm 0.02h$ with an amplitude of 0.98m. Note the sharp inflection point at first minimum versus the very rounded first maximum.

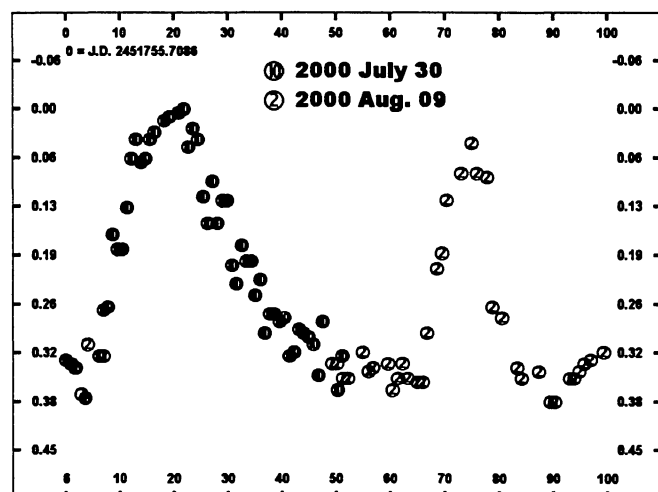


Fig. 2 – The lightcurve plot for 957 Camelia. The derived period is $5.391 \pm 0.02h$; the amplitude is 0.32m. The shape of the two maximums is distinctly different with the first showing a curved shape on the descending slope.

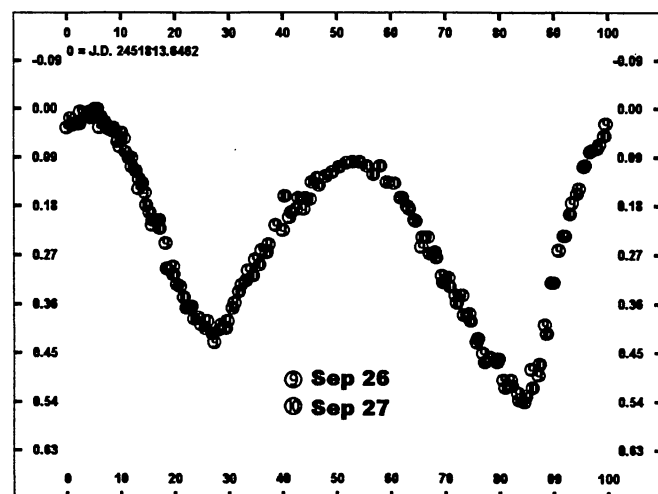


Fig. 3 – The lightcurve plot for 1719 Jens. The period is $5.867 \pm 0.02h$ and the maximum amplitude is 0.54m. The first, shallower minimum has an amplitude of about 0.40m.

from various nights. Fine tuning of the DeltaComp adjustment provided significant overlap along 75 percent of the curve. In essence a zero point adjustment was simulated by matching curve features.

Later sessions and previously obtained shorter sessions were added and served to confirm the 10.41-hour period. One of the issues in combining these sessions was that, from time to time, the amplitudes of a few sessions were a poor match. This was likely due to the spectral response of the various cameras and the comparison stars used. In future campaigns the comparison stars used need to be checked to see that they are similar in color to the asteroid. Taking an image of the field during the session through Visual and Red filters could determine color indexes for the comparison stars.

Acknowledgements

Many thanks to Brian Warner for his continuing help and guidance, and for his continuing development of the software programs 'Connections 2000' and 'Canopus' which makes it possible for amateurs to automatically gather the data, measure and analyze the light lightcurves.

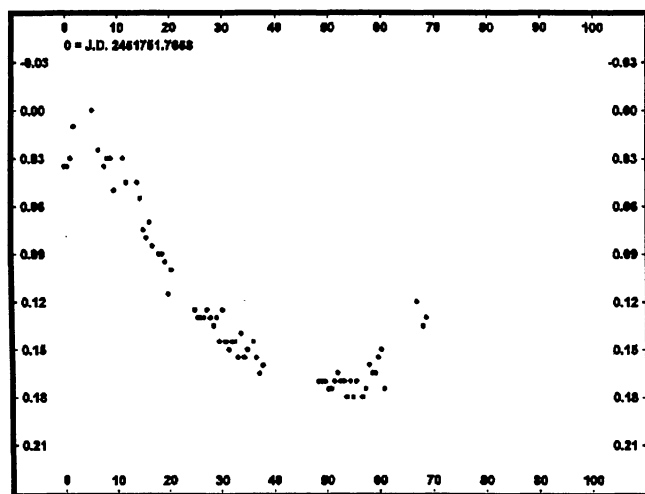


Figure 1. Partial lightcurve of 27 Euterpe with data from Session 6.

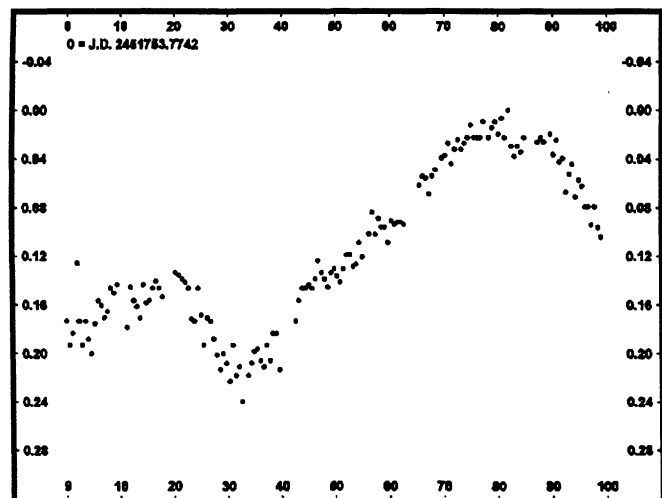


Figure 2. Partial lightcurve of 27 Euterpe with data from Session 9.

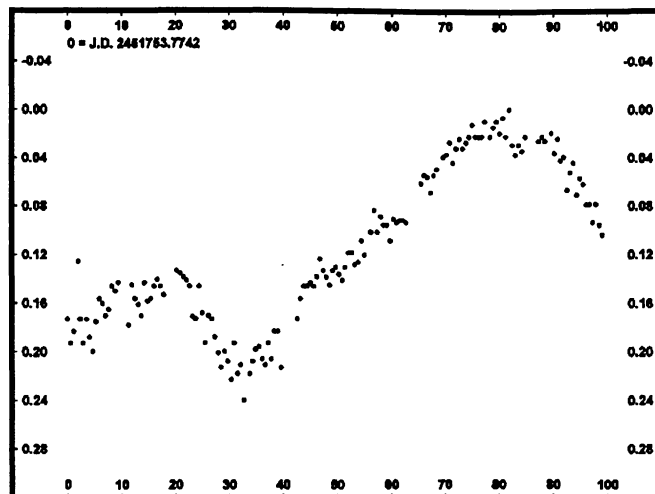


Figure 3. Partial lightcurve of 27 Euterpe with data from Session 11.

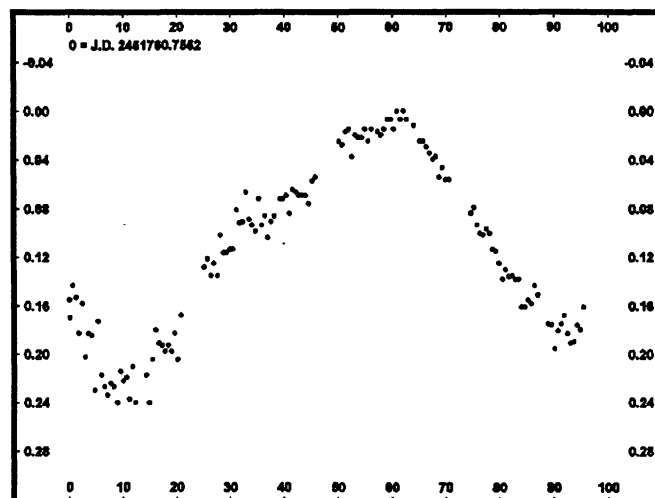


Figure 4. Partial lightcurve of 27 Euterpe with data from Session 13.

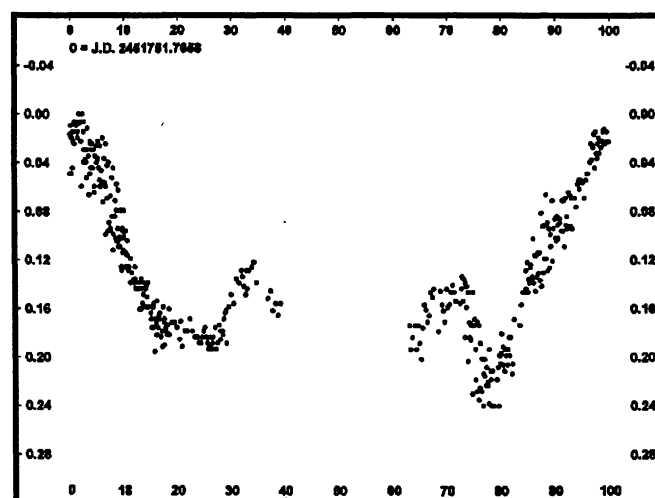


Figure 5. Partial lightcurve of 27 Euterpe combining Sessions 6, 9, 11 and 13.