Letters

‘Eclipsing dwarf novae’ – corrections and an update

From Dr W. J. Worraker

I am writing to correct some errors in the recent *Journal* paper by Nick James and myself on eclipsing dwarf novae,[1] and to update readers on the list of currently known eclipsing systems.

Equations [2] and [3] of section 3.1, which were quoted from Brian Warner’s book,[2] were misleading because the original formatting was changed in the course of preparing the paper. Equation [2] for the angle of inclination of a system should read

$$\sin^2 i \approx \{1-[R_L(2)/a]^2\} / \cos^2 2\pi\phi_p \quad [2]$$

and equation [3] for the secondary volume radius as a function of the mass ratio

$$R_L(2)/a = 0.49\, q^{2/3} / [0.6\, q^{2/3} + 1n(1+q^{1/3})] \quad [3]$$

where the symbols are defined in section 3.1 of the paper.

Table 1 of our paper contains a list of 17 known eclipsing dwarf novae (the figure of 18 cited in section 6.3 should thus be reduced by 1). Since the final draft was submitted I have come across two further examples. The first of these, CW Monocerotis, was seen in outburst in October/November 2002 and time-series photometry undertaken by several observers. Although eclipses were not seen by everyone (mainly because of poor sky conditions), sufficient data was obtained to show that CW Mon is a grazing eclipser. A sample light curve from the preprint of a paper by Kato *et al.*[3] is shown here; an eclipse about 0.2 mag deep and lasting about 35 minutes is visible around BJD 2452582.18. It turns out that eclipses had been observed by Richard Stover many years ago,[4] but the data never published. There is currently some debate about the system’s orbital period, but Stover’s data and recent spectroscopic observations by John Thorstensen[5] clearly indicate a value of 4 hours 38.6 minutes. CW Mon has J2000.0 coordinates of RA 06h 36m 54.53s, Dec +00° 02' 16.3", an approximate magnitude range of 12–16 in V, and according to Kato *et al.*,[3] an average outburst interval of ~150 days. Its sub-type is SS Cyg (or UGSS). It seems well worth further observing effort.

The second new eclipsing system is XZ Eridani (RA 04h 11m 25.76s, Dec –15° 23' 24.3"), a SU UMa star which was observed in superoutburst in January.[6] It has a very short orbital period of 1 hour 28.13 minutes and a peak brightness around magnitude 14.5. Eclipses in 2003 January reached about 0.4 mag in depth. Outbursts seem to be fairly rare, but for southern observers with sufficient telescopic aperture XZ Eri makes another interesting target.

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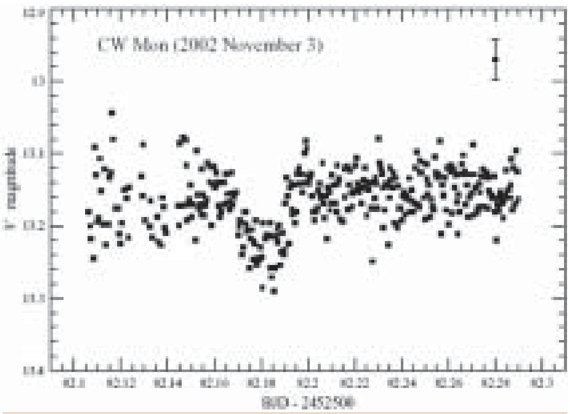


Lightcurve of CW Mon during a recent outburst. Reproduced from Kato *et al.*, ref. 3.

References

1 Worraker W. J. and James N., ‘Eclipsing dwarf novae’, *J. Brit. Astron. Assoc.*, **113**(2), 84–101 (2003)
2 Warner B., *Cataclysmic variable stars*, Cambridge University Press, 1995
3 Kato T. *et al.*, ‘Grazing eclipsing dwarf nova CW Monocerotis: Dwarf nova-type outburst in a possible intermediate polar?’, *Publ. Astron. Soc. Jap.*, submitted, 2003
4 Stover R. J. & Allen S. L., ‘The semirecurrent eclipsing double-lined dwarf nova CW Mon’, *Bull. Amer. Astron. Soc.*, **19**, 1058, 1987
5 Thorstensen J. R., *private comm.*, 2003 April
6 Kato T., *vsnet-alert* messages 7619, 7620 & 7621, 2003 January

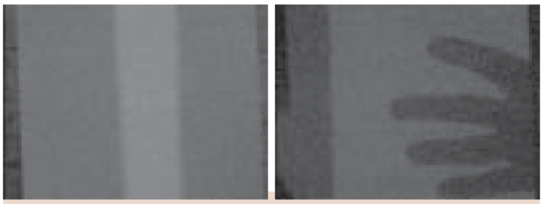
Earthshine on Venus and the 'Ashen Light'

From Mr B. G. W. Manning

Richard Baum's paper (*J. Brit. Astron. Assoc.*, **110**(6), 2000, p.325) refers to Rheinauer's 1861 calculation that earthshine on Venus would be equivalent to a 13th magnitude star. I assume that this means how a 13th magnitude star would appear if expanded to the diameter of Venus. I have not seen Rheinauer's calculations, but this would seem to rule out any possibility of Earthshine being the cause of the Ashen Light.

On the other hand, Venus-shine on Earth is fairly easily visible and has been seen by many people, and it is easy to show that Earthshine on Venus would be several times brighter. The problem may be the extreme observational difficulty. The two accompanying images of Venus-shine using my TC245 Cookbook CCD camera were made in our southeast facing kitchen with the curtains closed, except for a small gap of about 35mm for the band of light and a larger gap for my hand. The light fell onto a white card which was also faintly illuminated by light filtering through the curtains from the sky, and some from the sky through the curtain gap.

From the electron charge on the image pixels, and also on the sky, I have tried to determine the ratio of sky-light intensity to the Venus-shine on my card. If I am correct, and I have had difficulty accepting this, the 'dark' sky is more than 50 times brighter. My location is classed as rural, but even so the Milky Way in Cygnus is only faintly visible. Perhaps this figure also shows how extremely sensitive is the fully dark adapted eye in dark surroundings.



The light of Venus seen through a curtain gap, and casting a clear shadow. See text.

Further than this I find that the daylight sky is more than one hundred thousand times brighter than my Venus-shine image. From simple calculations (below) I find that Earthshine on Venus at inferior conjunction is 7 times brighter than Venus-shine, and at elongations when in a dark sky 3 or 4 times brighter. In a good dark sky the contrast between the sky and Venus would be quite good, the sky only two or three times brighter than the Earthshine. In the daytime though, I would think it quite impossible to detect the light, unless perhaps with Lyot's coronagraph adapted for the observation. One has only to consider how difficult it is to observe Saturn in daylight, unless in a very clear blue sky.

The other problems of course are the adjacent brilliant Venus crescent and scattered light in the telescope optics. Assuming that these problems could be overcome it occurred to me that a large telescope would be an advantage because the apparent brightness of an extended object is a function of one's pupil size, and for a large Venus disk, which is desirable, with a large exit pupil, a large telescope would be preferable. My 25cm (10 inch) reflector using an eyepiece giving a 5mm pupil has a magnification of only ×50, and more than ×100 would be desirable.

In putting forward this argument of course I am not trying to discount other possible reasons for the Ashen Light, just pointing out that logically Earthshine should be visible under the best possible conditions, or add to other phenomena.

Calculation of apparent brightness of Earth as seen from Venus

Data for the following was taken from the BAA *Handbook* 2002 at dates near to conjunctions.

Magnitude of Venus near superior conjunction, i.e. seen full face: –3.8
Distance from Earth (δ): 1.709 AU, phase 0.999.
δ near inferior conjunction: 0.271 AU, phase 0.005.

To estimate the magnitude of Earth as it would be seen from Venus near inferior conjunction, I first obtained the magnitude of Venus as it would be if by some miracle we could observe the sunward face at that time, by using the ratio of the least and greatest distances from Earth.

1.709/0.271 = 6.306. The brightness ratio is $(6.306)^2$ = 39.77.
2.5 × log 39.77 = magnitude difference = –4.
Venus would be mag –3.8 + –4 = –7.8.

Next adjust for Earth, which is 1.37 times more distant from the Sun than Venus. Illumination is $1/(1.37)^2$ = 0.53 that of Venus: albedo ratio is Earth/Venus = 0.37/0.67 = 0.57. Ignoring that Earth is 5% larger, the magnitude is +1.3 relative to Venus i.e. –6.5, which is 2.1 magnitudes greater than Venus when I saw it in early December (Venus then was –4.5) i.e. nearly 7 times brighter.

Therefore if I am correct, at inferior conjunction earthshine on Venus is 7 times greater than Venus-shine on Earth, but in a bright daylight sky. For elongations when in a dark sky, Earth, even though slightly gibbous, would be approximately 3 times brighter.

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