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THE LIGHT ELEMENTS AND A PRELIMINARY PHOTOMETRIC SOLUTION FOR THE BINARY GSC 2530-488

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Recently Blättler and Diethelm (2001) published the unfiltered light curve of the 13th magnitude eclipsing binary GSC 2530-488. To confirm and improve the light elements and to provide a preliminary solution to filtered light curves, we recorded 96 R images and 125 V images of the star using the Air Force Academy 61-cm reflector with a 512×512, Photometrics, liquid nitrogen-cooled CCD camera. After flat fielding all the images, we used IRAF aperture photometry to extract magnitudes of the variable and two nearby field stars. The stars are identified in Figure 1.

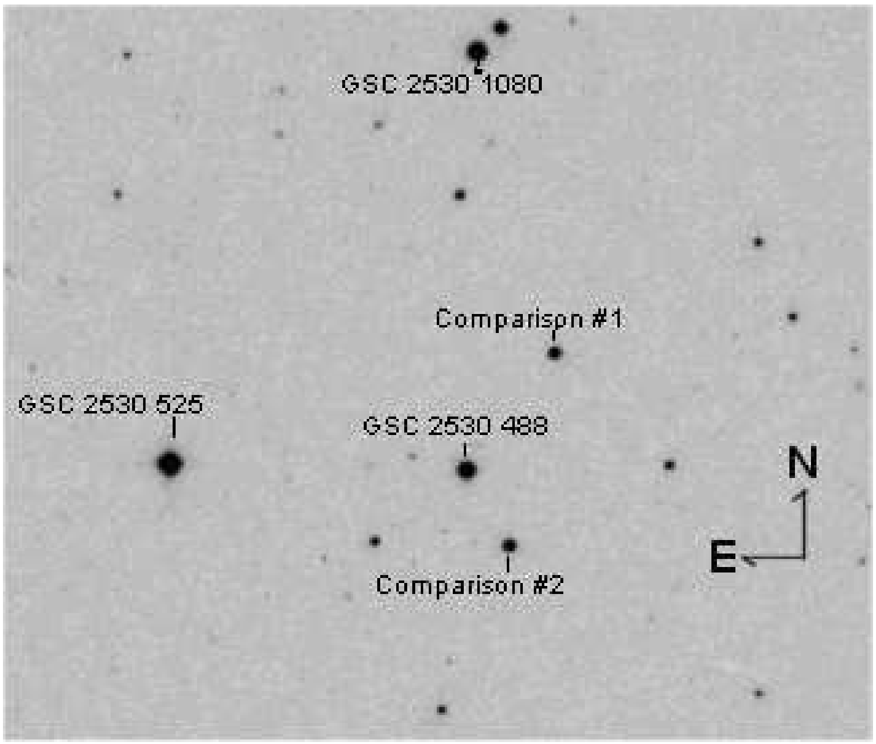

Figure 1. Finder chart for GSC 2530-488

To check on the photometric stability of the comparison stars, we computed the standard deviations of difference between the two stars. In V, for 125 differences on six nights, the standard deviation was $0^{\mathrm{m}}.035$, and in R, for 96 differences on five nights, the standard deviation was $0^{\mathrm{m}}.024$. Based on our observations we believe that these two stars are suitable comparison stars, and they were combined (by adding their luminosities) into a "super-comparison star" for the purposes of differential photometry with the variable.

We were able to find four new times of minimum light shown in Table 1.

Table 1: Times of minimum light

Source	HJD	Epoch	$O-C$	Filter
Akerlof et al.	2451244.6766	−2190	0.0031	Clear
Akerlof et al.	2451246.6826	−2184.5	−0.0028	Clear
BBSAG	2451951.4176	−258	0.0038	Clear
BBSAG	2451951.5965	−257.5	−0.0002	Clear
BBSAG	2451955.4379	−247	0.0002	Clear
BBSAG	2451959.4522	−236	−0.0094	Clear
BBSAG	2451967.3280	−214.5	0.0015	Clear
BBSAG	2451967.5094	−214	0.0000	Clear
BBSAG	2451984.5213	−167.5	0.0019	Clear
Present	2452045.7926	0	0.0004	R and V
Present	2452052.7426	19	0.0001	R
Present	2452053.8398	22	−0.0002	R
Present	2452054.7561	24.5	0.0016	R and V

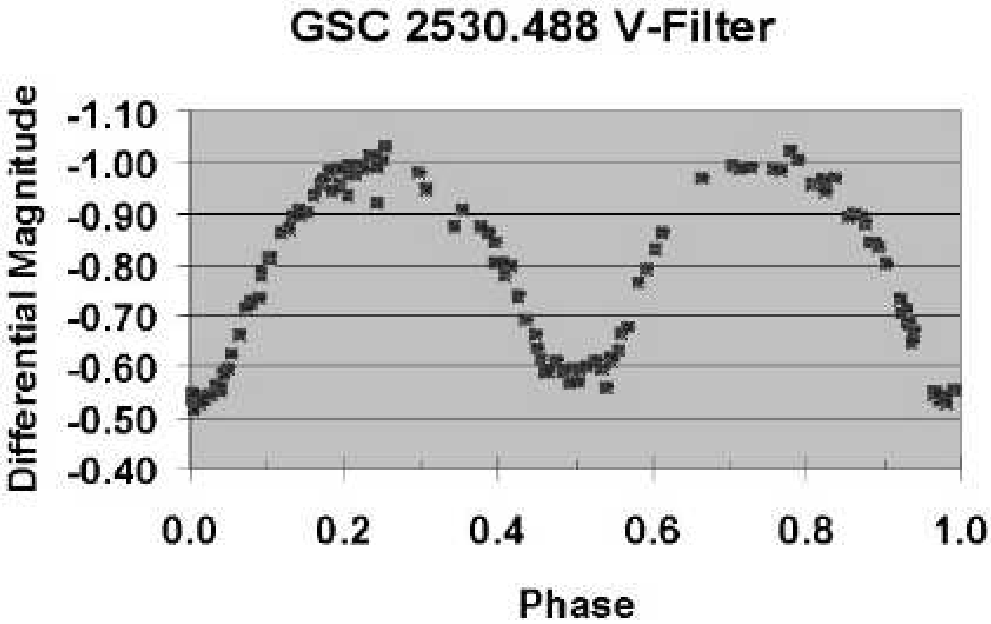

Figure 2. V light curve

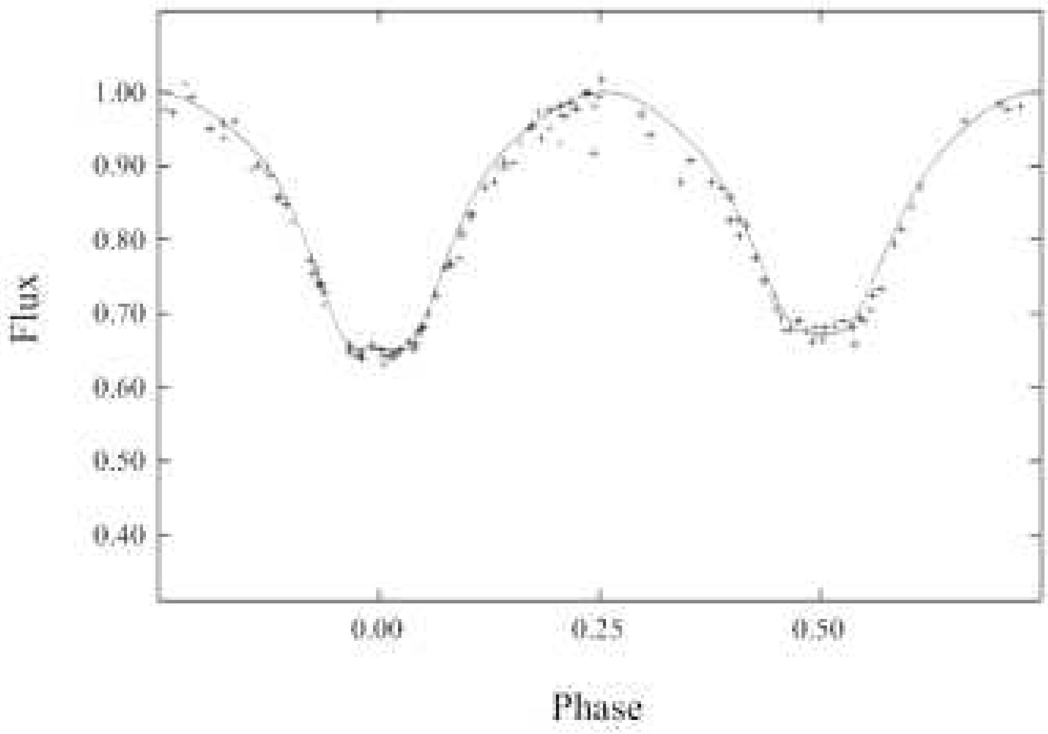

Figure 3. V intensity curve and fit

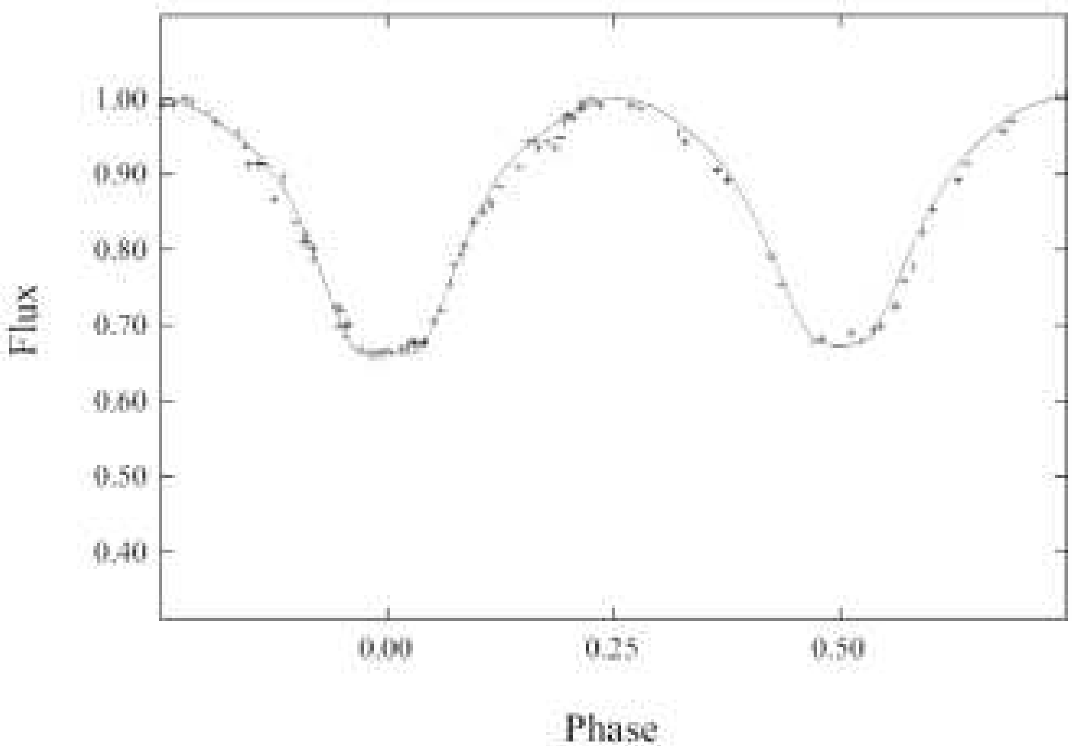

Figure 4. R intensity curve and fit

We found the new times using a tracing-paper method. The obvious asymmetry in the bottom of the R primary eclipse was ignored for this purpose. With these thirteen times of minimum a linear least squares fit yields the following light elements:

$$\begin{array}{rl} \text{Min I} = \text{HJD } 2452045.7922 + 0.365808 \times E. \\ \pm 0.0011 \;\; \pm 0.000001 \end{array}$$

Based upon our light curves, we have redefined the primary and secondary eclipses. With our new elements we built light curves such as the V curve shown in Figure 2. We observe that this is indeed an eclipsing binary with W Ursa Majoris-type light variations and total eclipses. The primary eclipse in V, an occultation, has a depth of about $0\overset{\mathrm{m}}{.}47$ and the secondary eclipse, a transit, has a depth of $0\overset{\mathrm{m}}{.}40$. In R light the depths are $0\overset{\mathrm{m}}{.}45$ and $0\overset{\mathrm{m}}{.}42$ on our instrumental system.

We used *Binary Maker 2.0* by David Bradstreet (1993) to obtain preliminary solutions to the light curves. We were unable to locate a spectral type for this system. However, our best fits were achieved assuming the two stars had temperatures of 7100 K and 7200 K. We used the following minor parameters characteristic of radiative stars: albedo and reflection coefficients = 1.0 and limb darkening coefficients = 0.5. Our best fits, shown in Figures 3 and 4, indicate that the stars are just in contact with an orbital inclination of 82°, and a photometric mass ratio of 4.15. The primary eclipse is an occultation of the hotter and smaller star. This model produces total eclipses that are almost flat during the total phases.

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