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HD 82780 – A NEW ECLIPSING BINARY

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As a part of a continuing program to search for eclipses in known double-line spectroscopic binaries (Wolf and Caffey 1996), the star HD 82780 has been observed on 32 nights at the Baker Observatory of SW Missouri State University. The observations in BVR_cI_c at most spectroscopic phases of its 1.6815 day period were obtained using a Photometrics CCD photometer attached to the 0.4 meter Cassegrain telescope. The light curves showing a primary eclipse about 0.08 and a secondary eclipse about 0.05 magnitude deep are plotted in Figure 1.

Since the spectroscopic (and now eclipsing) binary HD 82780 is itself the brightest component of the visual triple ADS 7438, the B component of the visual system was chosen as the comparison star and the C component as the check star for our photometry. All CCD images have been analyzed and reduced to magnitudes using the standard procedures and packages within IRAF. Because the comparison star has almost the same colors as the variable, the B, R and I curves in Figure 1 have been arbitrarily shifted on this graph respectively by -0.2, 0.2 and 0.4 in delta magnitude for clarity. The light curves have been plotted with an ephemeris based on a time of primary minimum observed by us and with the spectroscopic period given in Batten et al. (1988). The linear light elements are

$$\text{Pri. Min.} = \text{HJD } 2450511.8460 + 1^{\text{d}}.6815 \times E.$$

To our knowledge, no complete spectroscopic study of HD 82780 has been published. However, Batten et al. (1988) presented spectroscopic elements for this star obtained from Northcott (1965). The high values listed for $\text{m} \times \sin^3 i$ indicated to us the possibility of eclipses and were instrumental in adding this star to our program list. We have combined Northcott's spectroscopic elements and our light curve data to obtain a preliminary solution for this eclipsing system using Bradstreet's (1993) Binary Maker 2.0 and then Wilson's (1979) DC light curve modeling program. An excellent fit to the light curves was possible with the values listed in Table 1.

We have dereddened the photometric indices for HD 82780 tabulated by Wolff and Simon (1997) and used the resulting values in conjunction with the temperature–gravity grids of Moon and Dworetsky (1985) to determine a temperature of 6950K for the primary star. This agrees well with the F2V spectral type listed by Batten et al. and others.

Table 1: Model parameters from Wilson DC program.

Parameter	Combined	B	V	R_c	I_c	Adjusted
T_1 (K)	6950					
T_2 (K)	6588					x
i (°)	74.76					x
Ω_1	5.883					x
Ω_2	6.245					x
q (m_2/m_1)	0.726					
$g_1 = g_2$	0.32					
$A_1 = A_2$	0.50					
$F_1 = F_2$	1.0					
r_1 (pole,side)	0.194					
r_1 (point,back)	0.196					
r_2 (pole,side)	0.142					
r_2 (point,back)	0.143					
x_1		0.71	0.59	0.51	0.43	
x_2		0.72	0.60	0.52	0.44	
$L_1/(L_1+L_2)$		0.708	0.699	0.693	0.687	x
$L_2/(L_1+L_2)$		0.292	0.301	0.307	0.313	

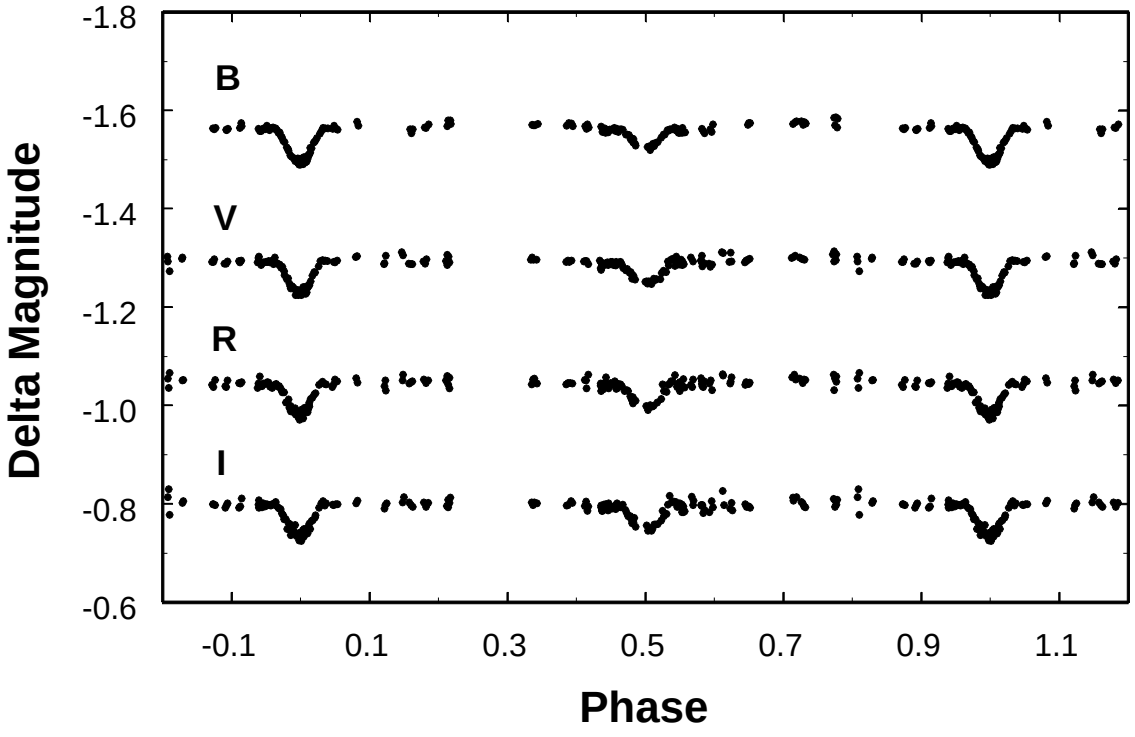

Figure 1. Observed light curves of HD 82780

Table 2: Physical Parameters

Parameter	Value
A (Separation)	5.65×10^6 km.
K_1	99.1 km/sec
K_2	136.5 km/sec
M_1	$1.47M_\odot$
M_2	$1.07M_\odot$
R_1	$1.57R_\odot$
R_2	$1.15R_\odot$

Individual solutions were computed for each light curve as well as a combined solution for all curves together. Since the results were similar for each, only those of the combined solution are given. Because the observed eclipses are shallow and partial, only the more obvious parameters have been adjusted in the solutions.

The computed orbital inclination varied by only ± 0.20 degrees among the individual light curve solutions, but it appears to be somewhat sensitive to the assumed mass ratio. For example, if the mass ratio were to be increased by 0.10, the inclination would drop to 73.70 degrees; if the mass ratio were to be decreased by 0.10, the inclination would increase to 76.00 degrees. On the other hand, the T_2 parameter varied by about ± 200K among the individual solutions, but was generally insensitive to these changes in mass ratio.

Using the results of the light curve modeling and Northcott's radial velocity data we have calculated preliminary absolute dimensions and masses for the eclipsing system. These values are given in Table 2. Since the accuracy of the radial velocity data is not known, it is not possible to estimate the accuracy of these values. The calculated mass of the secondary component seems low for its computed temperature. If a more definitive spectroscopic analysis of this system were to become available, HD 82780 might be marginally useful in the study of the radiative flux scale discussed by Popper (1998) since its *Hipparcos* parallax indicates a distance of less than 100 parsecs.

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