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NEW VARIABLES IN THE FIELD OF RE J0725-002

The sky was surveyed in the extreme ultraviolet (EUV) region of the spectrum by the EUVE satellite (Malina et al., 1994) and the ROSAT satellite (Pounds et al. 1993) and catalogs of the sources included RE J0725-002 = EUVE J0725-00.4 = BD $-00°1712$ = GSC 4817_468. The star was one of the subjects of an investigation by Jeffries (1995), who concluded from spectral observations that it was a pair of nearly identical K5 dwarf stars orbiting with a $1\overset{d}{.}40$ period.

The automated 0.5-m. telescope, Cousins R filter and CCD camera of the Climenhaga Observatory of the University of Victoria (Robb and Honkanen, 1992) were used to make photometric observations of RE J0725-002. Using IRAF [1] routines the frames were de-biased and flat fielded, and the magnitudes were found from 5 arc second aperture photometry after using the Gaussian centering option of the PHOT package.

The field of stars we observed is shown in Figure 1 and their designations, coordinates (J2000) and magnitudes from the Hubble Space Telescope Guide Star Catalog (GSC) (Jenkner et al., 1990) and the ΔR magnitudes are tabulated in Table 1. The ΔR differences in magnitude are found from our data in the sense of the star minus GSC 4817_386. The standard deviation of the differences during a night ranged from $0\overset{m}{.}006$ for a bright star on a good night to $0\overset{m}{.}030$ for the faint stars on poor nights. The ΔR magnitude given in the table is the mean of the thirteen nightly mean differential magnitudes and the standard deviations measure night to night variations. The stars 4817_468 and 4817_788 have large standard deviations and are variable from night to night. Due to the small field of view extinction effects were negligible and no corrections have been made for them. No corrections have been made to transform the R magnitude to a standard system.

Photometric observations were made from 25 February to 25 March 1996 UT. Brightness variations in RE J0725-002 were evident both during a night and from night to night. A least squares fit of a single sine wave to the data shows a deep minimum in χ^2 at a period of $1\overset{d}{.}404$. A period finding routine based on that of Jurkevich (1971) found the best period to be $1\overset{d}{.}412$. Two other possible periods are rendered less likely by the spectral observations (Jeffries 1995); namely $0\overset{d}{.}5836$, which is a one cycle per day alias, and $2\overset{d}{.}824$, which is twice the adopted period.

So in agreement with Jeffries (1995) the best ephemeris from our data is:

$$\begin{aligned} \text{HJD of Minima} = 2450137\overset{d}{.}46 &+ 1\overset{d}{.}412 \times E \\ \pm\overset{d}{.}10 \quad &\pm 0\overset{d}{.}024 \end{aligned}$$

A plot of the 1051 differential R magnitudes phased at this period is shown in Figure 2 with different symbols for each of the different nights. While the light curve does show a possible "primary eclipse" the lack of a corresponding secondary eclipse leads us to believe that this is not an eclipsing system; a possibility suggested by Jeffries (1995). We suspect

[1] IRAF is distributed by National Optical Astronomy Observatories, which is operated by the Association of Universities for Research in Astronomy, Inc., under contract to the National Science Foundation

Table 1. Stars observed in the field of RE J0725-002

GSC No.	RA J2000.	Dec. J2000.	GSC Mag.	ΔR Mag.
4817_468	$07^h25^m14^s$	$-00°25'39''$	10.2	$-1.698 \pm .034$
4817_788	$07^h25^m05^s$	$-00°24'24''$	12.4	$-0.767 \pm .130$
4817_386	$07^h25^m15^s$	$-00°27'42''$	10.5	–
4817_508	$07^h24^m59^s$	$-00°24'44''$	13.9	$+2.298 \pm .013$
4817_1294	$07^h25^m02^s$	$-00°24'55''$	12.7	$+1.780 \pm .010$
4817_904	$07^h25^m22^s$	$-00°24'29''$	13.1	$+1.923 \pm .009$
4817_1422	$07^h25^m07^s$	$-00°24'21''$	13.9	$+2.862 \pm .018$

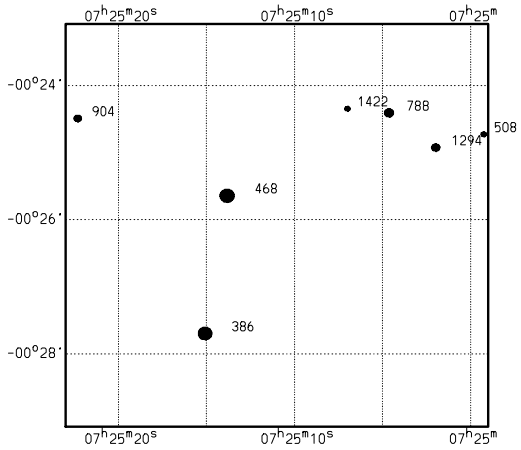

Figure 1. Finder chart of the field labeled with the GSC numbers (Jenkner et al., 1990)

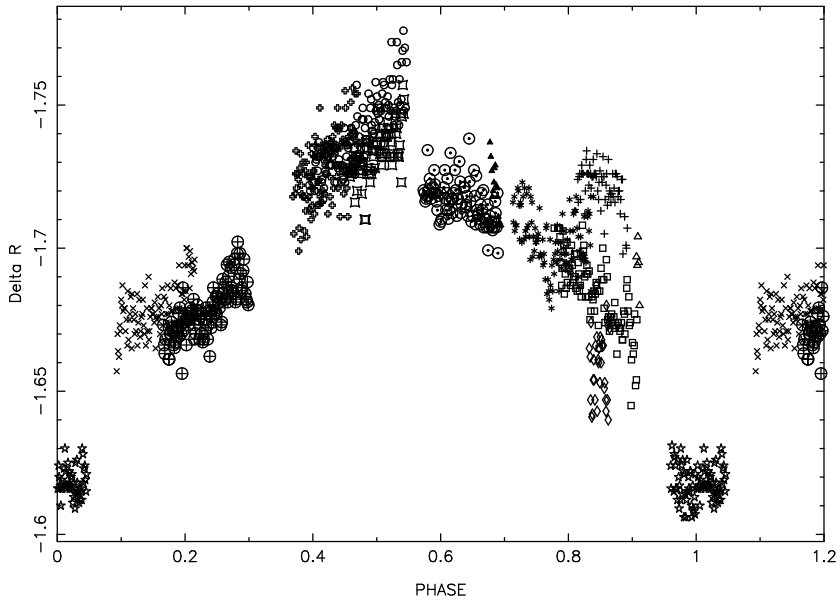

Figure 2. Light curve of the differential R data of RE J0725-002 for 1996

Table 2. Differential observations of GSC 4817_788

HJD	ΔR	HJD	ΔR	HJD	ΔR	HJD	ΔR
2450138.7	−0.627	2450145.7	−0.646	2450156.7	−0.803	2450165.7	−0.917
2450142.8	−0.619	2450148.6	−0.677	2450160.8	−0.870	2450166.7	−0.928
2450143.8	−0.638	2450154.7	−0.788	2450162.7	−0.887	2450167.7	−0.938
2450144.7	−0.636						

that one or both stars have large active regions on them causing the brightness variations and the large EUV emission. The light curve does show shifts of a few hundredths of a magnitude in mean level from night to night, likely due to differential rotation or active region evolution and could be studied by further photometric observations.

As a possible comparison star GSC 4817_788 was monitored but was found to vary from night to night. The differential R magnitudes are given in Table 2. The star was at maximum brightness on approximately HJD 2450142 and decreased in brightness at roughly $0\overset{m}{.}01$ per day during our observations.

The star GSC 4817_508 was also found to vary in brightness during a night. Using a period finding routine based on that of Jurkevich (1971) our best estimate is 3.465 cycles per day. Using the method of Kwee and Van Woerden (1956), Heliocentric Julian dates of primary minimum were found to be 2450144.6908 and 2450154.7935 and times of secondary minimum were 2450142.8352, 2450145.7157 and 2450156.6867. The precision of the minima determinations were nominally $\pm 0\overset{d}{.}0010$, but this does not include an allowance for the asymmetry of the minima. In Figure 3 the data are plotted as a function of phase according to the ephemeris:

$$\text{HJD of Minima} = 2450138\overset{d}{.}64 + 0\overset{d}{.}2886 \times E \pm \overset{d}{.}10 \pm 0\overset{d}{.}0005$$

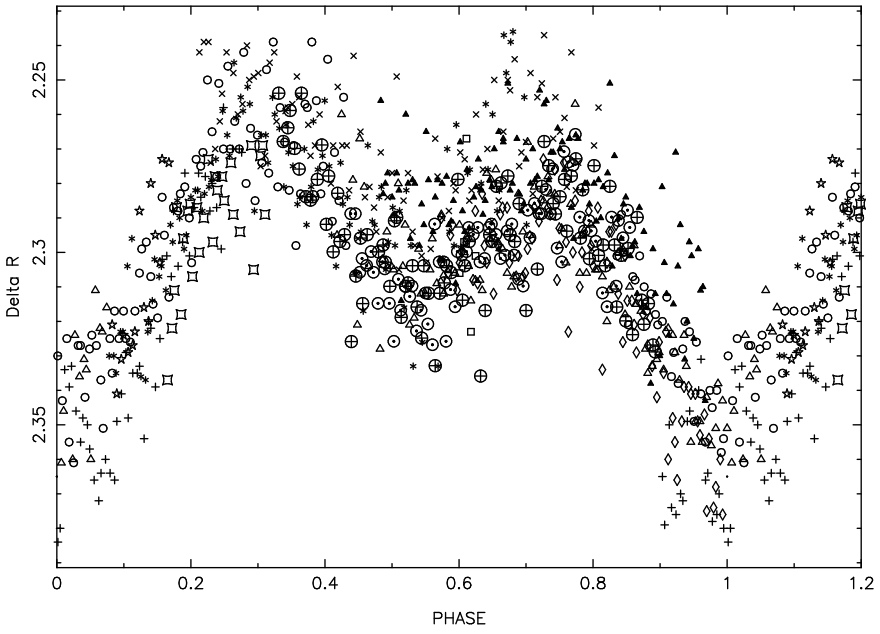

Figure 3. Light curve of the differential R data of GSC 4817_508 for 1996

To help classify the two serendipitously discovered variable stars color information was sought. Unfortunately only a V frame and an I frame were obtained under non-photometric conditions. While not definitive they are indicative of the type of stars. Assuming RE J0725-002 has the V−I of a normal K5V (Jeffries 1995), then GSC 4817_788 is an extremely late M star and GSC 4817_508 has the color of approximately an early K star. Therefore GSC 4817_788 is likely a long period or irregular variable and GSC 4817_508 is most likely an ellipsoidal or eclipsing binary and not a Delta Scuti type star. The shape of the light curve, small amplitude and difference in maxima are consistent with a W UMa star seen with a small inclination.

Further photometric and spectroscopic observations will be valuable to confirm our conclusions as to the reason for the variability of these stars.

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