PHOTOMETRY OF THE HELIUM-WEAK STAR HR 1063

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Abstract

Photometry of the helium-weak star HR 1063 (V396 Per) was carried out during the fall of 1984 and spring of 1985. The light curve was determined in the **B** band and found to agree well with the period of 2.49246 days determined by Percy (1985).

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1. Introduction

HR 1063 (HD 21699, SAO 038917, sp. B8) is a helium-weak member of the Alpha Persei cluster. Its variability has been studied by Winzer (1974), Mallama and Molnar (1974), Landis et al. (1985), and Percy (1985). The interest in this star stems from the peculiar carbon line profiles found by Brown et al. (1984) which seem to be synchronized with the rotational period.

2. Observations

HR 1063 was observed on 15 nights from December 1984 to March 1985. Since the period determination was of primary interest, all observations were made through one filter (**B**). This allowed heavy averaging of the data to bring out the low amplitude (0.03 magnitude) of the light curve. Over 400 blue measures of the variable and over 200 measures of the check star were made.

The comparison star used was HR 1051 (HD 21551, SAO 038893, sp. B9). This star is the same one used in most of the other recent studies. The check star was HD 21641 (SAO 038908, sp. B9). All three stars lie within a half a degree of each other so differential air masses and extinction corrections are small.

A photon-counting photometer was used with an uncooled 1p21 phototube. The telescope was a 32-cm automated telescope (Skillman 1981) which sequentially measured the brightness of the comparison star, sky, variable, and check star. The sequence used was C, S, V, Ch, V. A diaphragm of 45 arc seconds was used. Each star was centered in both axes and then integrated for 30 seconds. This photometer uses the standard **UBV** filters, but for a determination of the period the data are left untransformed to the standard system. Comparisons with other studies of this star show that the correction would be well below 0.01 magnitudes. The transformation coefficient (epsilon) for this photometric system is 0.020.

With a period of about 2.5 days it is difficult to get thorough phase coverage from a poor-weather site. To improve the phase coverage, data were sometimes taken in less than perfect photometric conditions with the intent of producing at least a single averaged data point that had the required accuracy.

To ensure that no systematic effects were introduced by the comparison star, a check star observation was obtained for every two observations of the variable. The reduced measures of the comparison to the check star were stable to better than 0.01 magnitude and the plot of the relative brightness of this pair showed no structure when phased with the period of the variable.

After the standard data reduction, the data were phased with Percy's ephemeris of JD 2446001.659 + 2.49246 E. Table I presents the time of observation, the phase calculated from this ephemeris, the averaged delta **B**, the number of points included in that average, and the formal internal error of that measure as calculated from the standard deviation divided by the square root of the number of observations.

3. Results

Figure 1 shows the delta magnitudes, in the sense HR 1063 - HR 1051, plotted versus phase. The resulting light curve verifies the low amplitude variability and the low scatter in the data verifies the period as determined by Percy.

A more detailed analysis of these data was performed by Percy (1986) in which the data in this paper were combined with the extant data on this star to better define the period. His conclusions, based on Deeming's method of Fourier analysis of unequally spaced data, are:

a) The data in this paper alone give a period of 2.506 ± 0.01 days.

b) This paper, plus Percy's data, gives a period of 2.4925 ± 0.001 days.

c) This paper, plus data from Percy and Landis *et al.*, gives a period of 2.4913 ± 0.001 days.

d) This paper, plus all published data, gives periods of either 2.49103 or 2.49246 days. The first period produces a slightly higher peak in the power spectrum; the second period was chosen by Percy on the basis of the result published by Mallama and Molnar.

4. Acknowledgement

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REFERENCES

Brown, D. N., Shore, S. N., Bolton, C. T., Hulbert, S. J., and Sonnenborn, G. 1984, **The Future of Ultraviolet Astronomy Based on Six Years of IUE Research**, J. M. Mead, R. D. Chapman, and Y. Kondo, eds., NASA CP-2349, p. 483.

Landis, H. J., Louth, H., and Hall, D. S. 1985, **Inf. Bull. Var. Stars**, No. 2662.

Mallama, A. D. and Molnar, M. R. 1974, **Bull. Amer. Astron. Soc. 6**, 307.

Percy, J. R. 1985, **Publ. Astron. Soc. Pacific 97**, 856.

_____ 1986, private communication.

Skillman, D. R. 1981, **Sky & Telescope 61**, 71.

Winzer, J. E. 1974, **Astron. Journ. 79**, 45.

TABLE I

Observations of HR 1063

JD(geo) (2440000+)	phase	delta B	n	sigma (milli-mags)	JD(geo)	phase	delta B	n	sigma (milli-mags)
6036.5490	0.998	-0.436	9	2.0	6064.6474	0.271	-0.415	7	2.2
6036.6106	0.023	-0.434	9	1.3	6064.6824	0.286	-0.418	7	2.4
6036.6434	0.036	-0.435	9	2.2	6064.7109	0.297	-0.420	7	4.2
6036.6760	0.049	-0.431	9	1.4	6071.5035	0.022	-0.429	7	2.4
6036.7112	0.063	-0.439	9	1.8	6071.5424	0.038	-0.431	7	2.9
6036.7530	0.080	-0.439	9	2.3	6078.5340	0.843	-0.432	7	2.3
6036.7922	0.096	-0.429	9	3.2	6078.5601	0.854	-0.428	7	3.4
6038.5032	0.782	-0.422	9	3.5	6078.5859	0.864	-0.437	7	3.1
6038.5684	0.808	-0.430	9	3.1	6078.6118	0.874	-0.431	7	2.2
6038.6235	0.831	-0.430	9	3.6	6078.6455	0.888	-0.434	7	4.3
6043.4990	0.787	-0.414	9	2.3	6078.7112	0.914	-0.448	7	4.8
6043.5341	0.801	-0.432	9	3.4	6088.5333	0.855	-0.433	6	3.5
6043.6077	0.830	-0.432	9	2.5	6088.5564	0.864	-0.428	6	2.4
6043.6511	0.848	-0.437	9	3.1	6088.5784	0.873	-0.433	6	3.2
6043.6831	0.860	-0.433	9	3.2	6088.5980	0.881	-0.438	6	1.8
6043.7255	0.877	-0.439	9	4.0	6088.6220	0.890	-0.444	6	3.6
6043.7592	0.891	-0.443	9	3.9	6088.6502	0.900	-0.439	6	0.6
6043.7915	0.904	-0.440	9	4.1	6103.5426	0.877	-0.426	27	4.6
6043.8531	0.929	-0.444	9	4.0	6125.5169	0.693	-0.416	8	2.4
6046.5665	0.017	-0.423	10	10.4	6125.5471	0.705	-0.415	8	3.3
6052.5306	0.410	-0.403	12	5.5	6127.5306	0.501	-0.413	18	6.2
6058.6180	0.853	-0.434	7	3.9	6127.6063	0.531	-0.413	18	4.6
6058.6503	0.866	-0.432	7	3.8	6128.5249	0.900	-0.441	6	3.8
6058.6864	0.880	-0.429	7	3.9	6135.5262	0.709	-0.409	11	2.8

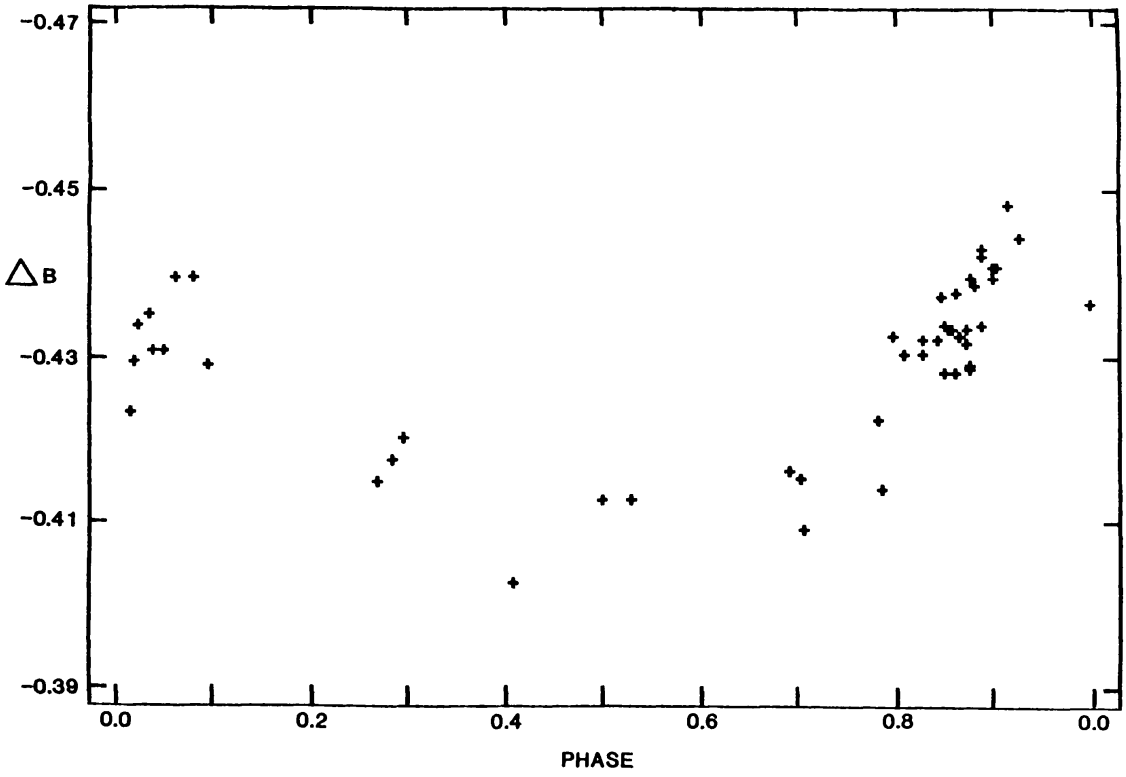

Figure 1. Photoelectric B band observations of HR 1063 relative to HR 1051, phased together with a period of 2.49246 days.