

Photometric variations of the helium-weak star HR1063

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UBV observations of the helium-weak star HR1063=HD21699 are presented. It is found to be variable in light with a period of either 2^d 4761 or 1^d 6780 and amplitudes of 0.03, 0.04, and 0.05 mag in *V*, *B*, and *U*, respectively. The light variations are similar to those observed for the silicon Ap stars. This is the only helium-weak star in which periodic variations have so far been established.

INTRODUCTION

The helium-weak stars are early B-type stars characterized by helium lines that are abnormally weak. Typically, these stars have spectral classifications near B8 on the basis of helium line strengths, and near B4 on the basis of their intrinsic colors. The criteria for membership in this class have been discussed by Garrison (1971) and Molnar (1972). In many respects these helium-weak stars resemble the hotter Ap stars (in particular the silicon stars), the main difference being that the helium-weak stars do not show the strong peculiarities at classification dispersions which are characteristic of the Ap stars.

The star HR 1063=HD 21699, a member of the α Persei cluster, was first suggested as being a helium-weak star by Garrison (1967), on the basis of its color-spectrum discrepancy. This has been confirmed by Morgan *et al.* (1971) who showed that it has an MK type of B8 III but intrinsic colors $(B-V)_0 = -0.17$, $(U-B)_0 = -0.61$, corresponding to B4 or B5. HR 1063 has been studied spectroscopically by Brückner (1973), who has made a detailed line identification, and by Molnar (1972), who has made a model atmosphere analysis of abundances.

I. OBSERVATIONS

Observations were obtained at Kitt Peak National Observatory during October 1971 and October 1972. A 16-in. reflector, with a refrigerated 1P21 photomultiplier, standard *UBV* filters, and a charge-integration data system, was used throughout this investigation.

All observations were obtained differentially with respect to two nearby comparison stars: HR 1051=HD 21551 (B8 Vnn, $V=5.85$, $B-V=-0.04$, $U-B=-0.32$) and HD 22136 (B8 V, $V=6.92$, $B-V=-0.02$, $U-B=-0.32$). The differential measurements, HR 1063-HR 1051, corrected for extinction through the use of mean extinction coefficients, are listed in Table I. Individual observations are probably accurate to better than 0.003 mag, although it was not possible to verify this as the second comparison star, HD 22136, was found to be slightly variable.

These data show HR 1063 to be variable. The data are well fitted by a period of 2^d 4761, however, a period

TABLE I. Differential photometric observations, HR 1063-HR 1051.

JD (2440000+)	Phase ($P=2^d4761$)	ΔV (mag)	ΔB (mag)	ΔU (mag)
1239.765	0.456	-0.342	-0.401	-0.648
1243.810	0.089	-0.365	-0.433	-0.684
1244.769	0.477	-0.348	-0.403	-0.642
1245.837	0.908	-0.363	-0.433	-0.690
1604.778	0.870	-0.365	-0.434	-0.685
1605.839	0.299	-0.351	-0.410	-0.653
1606.792	0.684	-0.354	-0.417	-0.668
1612.855	0.132	-0.363	-0.426	-0.680
1613.835	0.528	-0.346	-0.402	-0.649
1616.819	0.733	-0.352	-0.416	-0.668
1618.817	0.540	-0.340	-0.397	-0.642
1619.832	0.950	-0.370	-0.437	-0.695

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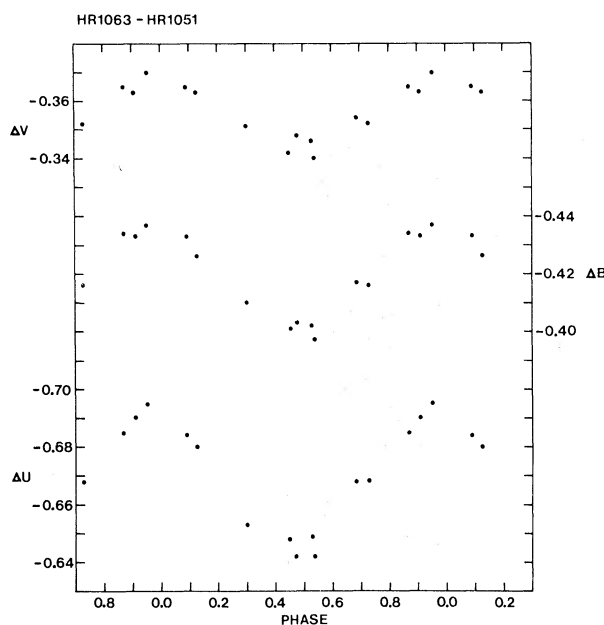


FIG. 1. Light curves of HR 1063. A period of 2^d 4761 is assumed and epochs of *U* light maxima are given by $JD(U_{\max}) = 2441619.956 + 2.4761E$.

near 1^d678 is also possible. This ambiguity in periods arises from a resonance between the one-day periodicity in the observations and the true period of the star. If we assume the longer period, we obtain the light curves shown in Fig. 1, with epochs of U light maxima given by

$$\text{JD } (U_{\text{max}}) = 2441619.956 + 2.4761E. \quad (1)$$

These show a symmetrical, almost sinusoidal variation with the largest amplitude in U light (0.05 mag). If the shorter period had been used, light curves that are almost the mirror image of those in Fig. 1 would have been obtained, with epochs of U light maxima given by

$$\text{JD } (U_{\text{max}}) = 2441619.748 + 1.678E. \quad (2)$$

II. DISCUSSION

There are a number of arguments in favor of the point of view that the helium-weak stars are an extension of the Ap sequence of stars. Sargent and Strittmatter (1966) have shown that the helium-weak stars, like the Ap stars, are intrinsically slow rotators. Magnetic fields in excess of 1000 G have been detected in two helium weak stars, HD 37058 and HD 36629, by Sargent *et al.* (1967), although these observations have been questioned by Conti (1970). The helium-weak stars possess colors only slightly bluer than the silicon Ap stars, and both types are characterized by enhanced silicon and weak helium. There is an indication that some of the helium weak stars are spectrum variables (Molnar 1972; Brückner 1973).

The fact that HR 1063 has now been shown to have light variations similar to those of silicon Ap stars such as HD 215441 (Śtepień 1968) or CU Vir (Hardie 1958), and with a period typical of the Ap stars, is another strong argument that the helium-weak stars are similar to the Ap stars. However, since light variability has only been detected in one such star, perhaps no general conclusions should be drawn until a number of other helium-weak stars have been searched for light variations.

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