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# HD 91816: A NEW BY DRACONIS STAR

An article by Bidelman (1981) noted that the star HD 91816 (SAO 156090, BD -11°2916), of spectral type dKO, showed slightly fuzzy absorption lines on objective prism spectra of dispersion 108 Å $mm^{-1}$. Causes of this might include rapid rotation or unresolved double lines in a spectroscopic binary. Either way, the late spectral type and rapid rotation suggested that HD 91816 should be chromospherically active, and the star was added to our photometric and spectroscopic monitoring programs at Cloudcroft, McDonald and Kitt Peak Observatories. In this note we report the detection of low amplitude photometric variability in HD 91816 with a period of 3.1448 days. This variation is presumably due to the presence of starspots in a syncronously rotating double-line spectroscopic binary (SB2) of about the same period. HD 91816 is thus a new BY Draconis variable.

Photometry was obtained in the UBV bandpasses with the 48-inch telescope at Cloudcroft Observatory, the 30- and 36-inch telescopes at McDonald Observatory, and the #2 36-inch telescope at Kitt Peak National Observatory (KPNO). The Cloudcroft and McDonald measures used SAO 156079 as the comparison, and the differential magnitudes are presented in Table 1. The measures are in the same variable minus comparison, and have been corrected for differential extinction and transformed differentially to the UBV system. Before JD 2445150 the photometry was obtained at Cloudcroft; after that date it was obtained at McDonald.

TABLE I

Cloudcroft and McDonald Photometry of HD 91816

| JD(Hel.) | ΔV | ΔB | ΔU |
|---|---|---|---|
| 2445106.680 | -1.114 | -1.424 | -- |
| 107.637 | -1.115 | -1.423 | -- |
| 116.633 | -1.115 | -1.415 | -- |
| 118.644 | -1.116 | -- | -- |
| 119.632 | -1.109 | -- | -- |
| 120.647 | -1.119 | -- | -- |
| 121.652 | -1.125 | -- | -- |
| 128.638 | -1.119 | -- | -- |
| 130.639 | -1.127 | -- | -- |
| 137.641 | -1.127 | -- | -- |
| 138.648 | -1.110 | -- | -- |
| 145.634 | -1.126 | -- | -- |
| 320.948 | -1.109 | -1.397 | -2.040 |
| 337.875 | -1.117 | -1.425 | -2.043 |
| 368.917 | -1.126 | -1.439 | -2.051 |
| 372.812 | -1.134 | -1.443 | -2.064 |
| 2445394.758 | -1.134 | -1.444 | -2.071 |

TABLE II

Kitt Peak Photometry of HD 91816

| J.D.(Hel.) | V | (B-V) | (U-B) |
|---|---|---|---|
| 2445330.989 | 8.052 | 0.851 | 0.505 |
| 424.693 | 8.046 | 0.849 | 0.518 |
| 485.651 | 8.048 | 0.867 | 0.479 |
| 683.970 | 8.048 | 0.853 | 0.513 |
| 684.934 | 8.035 | 0.850 | 0.505 |
| 723.962 | 8.051 | 0.845 | 0.513 |
| 724.924 | 8.043 | 0.848 | 0.506 |
| 725.966 | 8.027 | 0.851 | 0.491 |
| 778.763 | 8.036 | 0.854 | 0.499 |
| 2445779.773 | 8.028 | 0.854 | 0.499 |

The data were examined for periodicity using several algorithms, and the best fit was found at P = 3.1448 days. The light curve is plotted using this period in Figure 1, where zero phase is taken arbitrarily as JD 2445106.680. This small range of variability might make the period suspect, were it not for the independent set of photometry from KPNO, which confirms this period.

The KPNO photometry used SAO 156086 as comparison, for which the following magnitudes and colors were obtained:

$V = 7.583 \pm 0.007$, $(B-V) = 1.024 \pm 0.002$, $(U-B) = 0.853 \pm 0.005$

The differential magnitudes and colors were transformed to the UBV system using the matrix inversion method described by Harris, Fitzgerald, and Reed (1981). These data are presented in Table II. Period analysis of the KPNO data, which partially overlap the McDonald data in time, showed the same period of 3.1448 days; we plot the KPNO data, using the same period and epoch, in Figure 2. There may be a small phase shift between the two data sets, though the amplitude appears unchanged.

The most recent photometry was obtained on three nights in April 1984, with the 14-inch telescope at Barksdale's observatory. Nightly means are

| | |
|---|---|
| JD (hel.) = 2445791.680 | $\Delta V = -1^{m}.102 \pm 0^{m}.006$ |
| = 2445792.605 | $= -1.090 \pm 0.005$ |
| = 2445797.648 | $= -1.120 \pm 0.007$, |

where $\Delta$ is in the sense HD 91816 minus SAO 156079, the same comparison star used at Cloudcroft and McDonald. The brightest and faintest measures reflect the full amplitude found previously. Moreover, when phases are computed with the same ephemeris, the faintest point (at $0^{p}.12$) falls near minimum in Figure 1 and the brightest point (at $0^{p}.72$) falls near maximum.

We obtained two CCD scans of the H$\alpha$ region of HD 91816 using the coudé feed telescope at KPNO. A scan obtained on 5 April 1982 UT shows double absorption lines of approximately equal intensity; the velocity separation

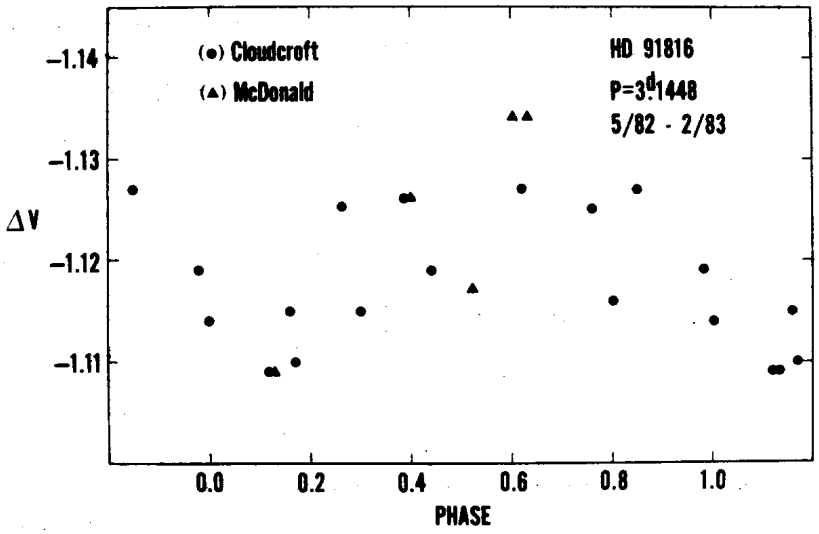


Figure 1

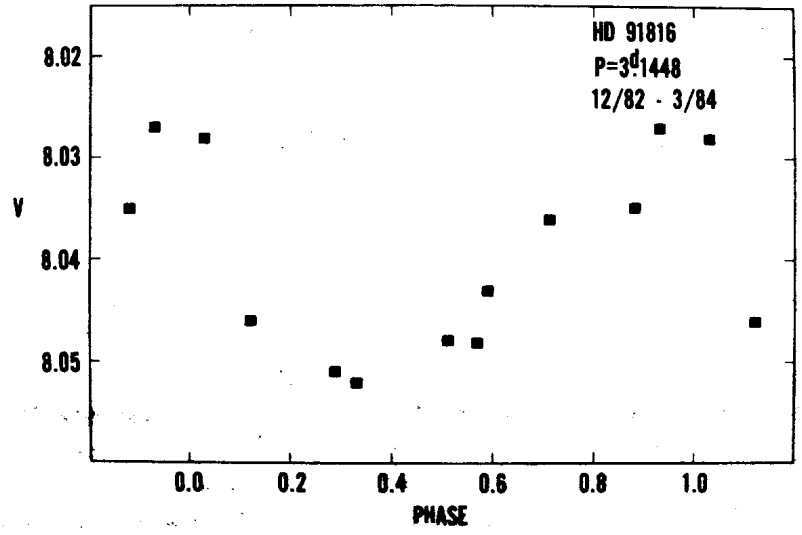


Figure 2

is about 100 km $s^{-1}$. The other scan, obtained on 27 March 1983 UT, shows single lines. H$\alpha$ does not appear to be affected by emission on either scan.

In summary, HD 91816 is a dKO star that is an SB2 and shows small brightness variations with a period of 3.1448 days. The star is a BY Dra variable (Bopp and Fekel 1977), with the photometric period representing the rotation period of the stars. It is likely that the rapid rotation suggested by the photometric period is the result of synchronism in this SB2. (The equatorial rotation velocity of a KO dwarf with R = 0.85 $R_\odot$ and a three day rotation period is about 15 km $s^{-1}$). If this is the case, then an orbital period very near 3.1 days is expected.

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