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**STARSPOTS ON THE YOUNG SINGLE K0V STAR HD 82443**

HD 82443 (Gl 354.1; K0V;  $V = +7^m00$ ;  $B-V = +0.76$ ) is a single, main-sequence K-star with very strong chromospheric and transition-region line emissions, most likely arising from strong magnetic activity (Soderblom, 1985). It is a high proper motion star with a relatively large parallax of  $\pi = 0''.054$  (Gliese, 1969). High precision radial velocity measures carried out on the CORAVEL program (Duquennoy et al., 1991; Duquennoy & Mayor, 1991) show HD 82443 to have a constant radial velocity of  $V_r = +8.2 \pm 0.24$  km/s, indicating that HD 82443 is probably not a member of a close binary system. Independent radial velocity measures of the star obtained by Griffin (1994) yield a mean value of  $V_r = +8.9 \pm 0.5$  km/s and also show no indication of variability. The projected rotational velocity of the HD 82443 has been measured by Benz and Mayor (1991) as  $v \sin i = 4.6 \pm 1.0$  km/s; while Soderblom (1995) estimates a slightly larger value of  $v \sin i = 7.0 \pm 2$  km/s. As pointed out by Soderblom and Clements (1987), HD 82443 has U,V,W space velocity components  $(-14, -24, -1)$  (km/s) that are very close to those of the Pleiades star cluster  $(-9, -29, -12)$ . This indicates that it is a probable member of the Pleiades moving group with an age of about 70 Myr. The implied young age of HD 82443 is consistent with the observed high levels of chromospheric, transition-region and coronal emissions. Activity-Period-Age relationships for cool stars indicate that HD 82443 should have a rotation period of a few days (Soderblom & Clements, 1987).

The photometric observations of HD 82443 reported here were obtained on 67 nights from 10 February through 21 May, 1989 using the Phoenix-10 automatic photoelectric telescope (APT), located on Mt. Hopkins, AZ. The Phoenix-10 APT is a 25-cm reflecting telescope which is completely computer controlled (see Boyd & Genet, 1986). The photometer is equipped with standard U, B, V filters and the observations were made using HD 82191 (A0 V;  $V = +6.58$ ;  $B-V = +0.08$ ) as the comparison star while HD 81146 (K5 III;  $V = +4.46$ ;  $B-V = +1.22$ ) served as the check star. Ten second integrations were used and the usual observing sequence of sky-comparison-check-variable-comparison-sky was employed. The observations were corrected for atmospheric extinction and the instrumental differential magnitudes were converted to the standard UBV system. Because of the close angular separations between the comparison and the variable and check stars, the atmospheric corrections were very small. No significant light variations were detected from the differential measures of the comparison and check stars, indicating that the comparison star is constant in light to within about  $\pm 0.015$  mag.

To determine the photometric period, the data in each filter were analyzed using a Scargle-Press period search routine (Scargle, 1982). These period searches revealed a period of  $P = 5.400 \pm 0.012$  days. The observations from the first two months (February-March) are plotted against phase in Figure 1 using this period; the phases are reckoned from the first observed light minimum at HJD 2447573.78. The observations were split

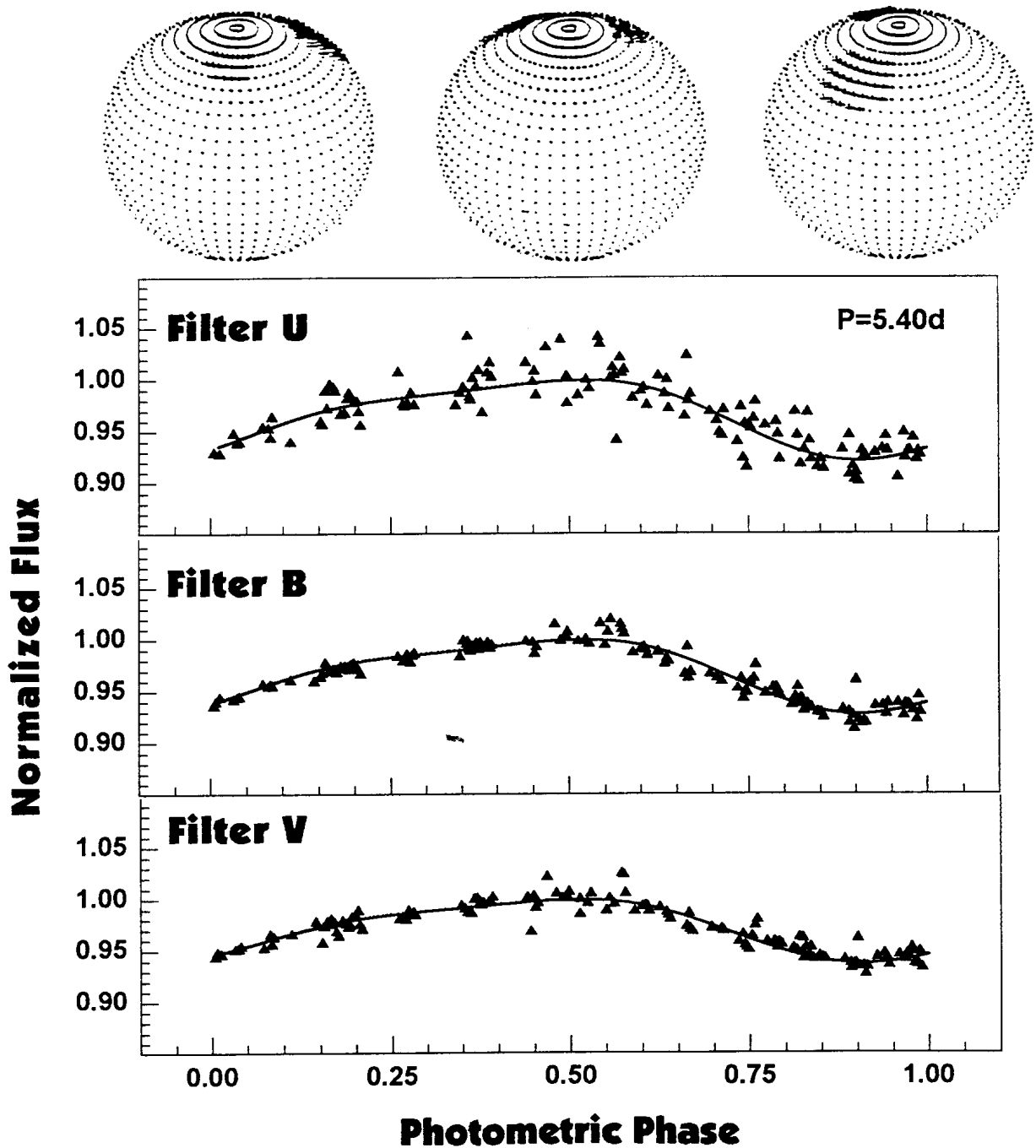


Figure 1. The normalized fluxes from UVB photometry of HD82443 are plotted versus photometric phase. These observations cover the interval from 10 February through 31 March 1989. The phases were computed with the photometric period of 5.40d. The best fitting spot model curves (see Table 1) are shown among the observations and the corresponding 3-dimensional representation of the spot configuration on the star's surface is depicted at three different phases: 0.25P, 0.50P and 0.75P.

Table 1

<b>HD 82443 Spot parameters:</b>					
Rotational period = 5.40d					
Effective temperature = 5370K					
Inclination = 60°					
Limb Darkening					
0.68 ( $\lambda = 5500\text{\AA}$ ) – 0.81 ( $\lambda = 4500\text{\AA}$ ) – 0.83 ( $\lambda = 3700\text{\AA}$ )					
<b>02.10.1989 – 03.31.1989</b>					
Spot	Longitude	Colatitude	Radius	Area	Temperature
1	80°	25°	10°	5.6%	4300±100K
2	320°	38°	17°	9.5%	4300±100K
Total spotted surface = 15.1%					
<b>04.02.1989 – 05.21.1989</b>					
Spot	Longitude	Colatitude	Radius	Area	Temperature
1	80°	25°	10°	5.6%	4300±100K
2	332°	38°	16°	8.9%	4300±100K
Total spotted surface = 14.5%					

into two time intervals because the light curve slowly changed with time. As shown in the figure, the light variations are quasi-sinusoidal and show a wavelength dependence; the light amplitudes in the UBV bandpasses are:  $0^m11$ ,  $0^m09$ , and  $0^m09$ , respectively. The theoretical spot model fits are also shown in Figure 1 along with the 3-dimensional representations of the star with starspots depicted at three different rotational phases. The periodic 5.400 day light variation is interpreted to arise from the presence of starspots, unevenly distributed over the surface of the chromospherically-active K-dwarf. The photometric period is assumed to be the star’s rotational period.

We analyzed the light curves on the assumption that the light variations arise from dark starspots. The light curves were modelled using Binary Maker V 2.0 (Bradstreet, 1994) in which the second component is essentially “turned off” (i.e. assigned a near zero mass and luminosity) in order to model a single rotating star. Circular, cool spots of uniform temperature were assumed and the light curves were fit by manual iteration. For the modelling we adopted a temperature of  $T_{eff} = 5370\text{K}$  for the unspotted photosphere of the star, inferred from its B–V index and K0 V spectral type (see Novotny, 1973); the limb-darkening coefficients of Al-Naimy (1978) were also adopted. The inclination of the star’s rotational axis (relative to our line of sight) was assumed to be 60°. This value was obtained from the measured rotation period, assuming a mean  $v \sin i = 6 \text{ km/s}$  and adopting a stellar radius of  $R \simeq 0.80 R_{\odot}$ , appropriate for its spectral type. After a number of iterations, we were able to obtain satisfactory fits to the U, B, V light curves. The best fits to the February-March observations are shown in Figure 1 along with the geometric model of the star with starspots. Because of the asymmetries in the light curves, it was necessary to model them with two dark (cool) spots, separated in longitude by 120° for the February-March 1989 data; the best fit to the April-May observations was achieved by adopting a longitudinal separation of 132°. The temperatures of the starspots were found to be about 1100K cooler than the photospheric temperature. The two spots were located within 40° of the rotational pole and the total spotted area was about 15%. Table 1 gives a summary of the modelling results for both data sets along with

the input parameters used in the analysis. The values given for the spot properties are not unique, however, but should be considered as representative of spot areas, distributions and temperatures.

Additional photoelectric photometry of HD 82443 has been obtained in subsequent years. These observations indicate systematic year-to-year changes in the light amplitude and mean light level, possibly arising from a starspot cycle. We plan to present these results in the future in a more detailed paper.

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S. MESSINA  
Inst. of Astronomy  
University of Catania  
Catania, Italy

E. F. GUINAN  
Dept. of Astronomy and  
Astrophysics  
Villanova University  
Villanova, PA  
USA

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