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ROTATION OF THE MAGNETIC Ap STAR 56 Ari

The magnetic Ap star 56 Ari was investigated in the UBV system by several authors: Provin (1953), Rakosch (1963), Hardie and Schroeder (1963), Blanco and Catalano (1970) and Hildebrandt et al. (1985). Additional measurements were made in the U band at the Bialkow Station of the Astronomical Institute of the Wroclaw University. All the data cover the interval J.D. 2434322 - 2447176 and span 17660 rotational cycles. These data yield the mean rotational period P_o=0.72789761 days. Then trigonometric polynomials of the second order were fitted to the individual data sets, by the least squares method:

$$m = m_o + \Sigma A_k \cdot \cos(2\pi \cdot ((JD-JD_o) \cdot k \cdot f_o - \Phi_k)). \qquad (k=1,2) \qquad (1)$$

The frequency $f_o=1/P_o$=1.3738196 and the starting epoch JD_o=2437667.728 were adopted in the calculations. Calculated phases of minimum brightness of the first and second order components (Φ_1 and Φ_2) vs. Julian Date together with the least squares fits of parabolas to these phases are exhibited in Figures 1 and 2. The fits indicate a decrease in the frequency. Calculated coefficients of the parabolas yield the following mean relationship between the frequency and JD:

$$f = 1.3739186 - 2.42 \cdot 10^{-9} \cdot (JD-2400000). \qquad (2)$$

Such decrease of frequency corresponds to an increase in the rotational period of 4 seconds per 100 years.

Magnetic braking may be the reason for the increase of rotational period. The calculated time for the e-folding loss of angular momentum is equal to $1.6 \cdot 10^6$ years. This result is an accord with calculations of hydromagnetic deceleration made by Fleck (1981). He gives estimate of the braking time equal to 10^6 years for "perpendicular rotators". From the model of Borra and Landstreet (1980) follows, that 56 Ari is a "perpendicular rotator" i.e. the magnetic field axis is nearly perpendicular to the rotational axis ($\beta=80^o$).

Another result is presented in Figure 3, which exhibits phases of maximum β index obtained in four observational runs vs. Julian Date. For comparison the calculated phases of minimum light in the U band are also exhibited. The

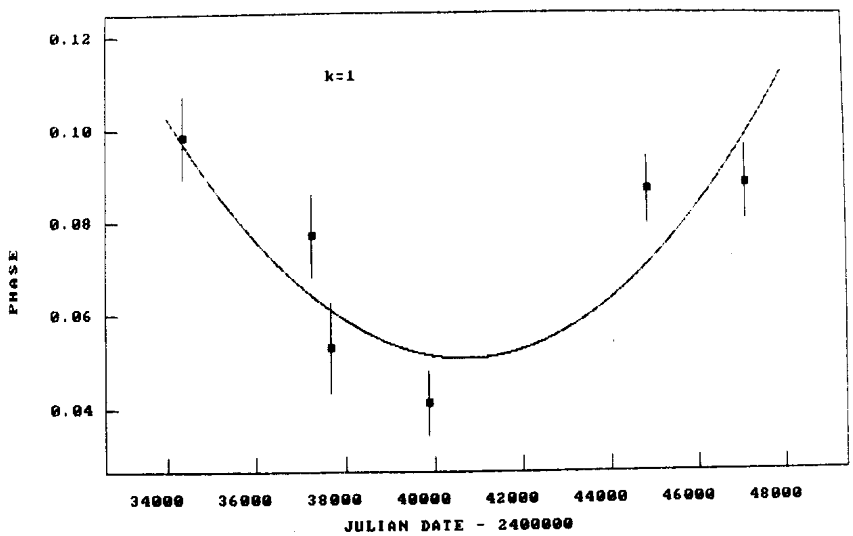

Figure 1. The phases of minimum brightness of the first order component vs. Julian Date.

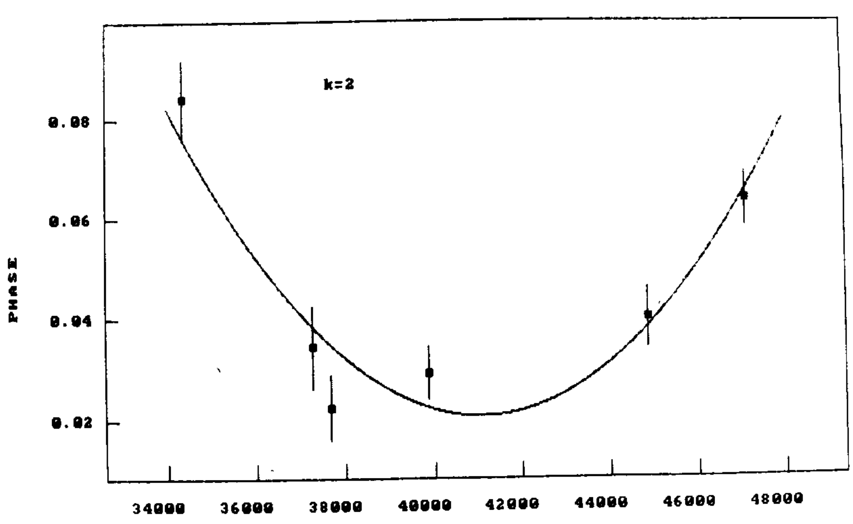

Figure 2. The phases of minimum brightness of the second order component vs. Julian Date.

The JD_o and f_o remain the same as those used for calculation of the data presented in Figures 1 and 2. The β indices for the time interval J.D. 2446307-2446746 were published by Musielok (1986), and by Musielok and Madej (1988). Additional measurements were made between J.D. 2447028 and 2447239. The increase of phases of maximum β index in Figure 3 is steeper than the calculated increase of phase of minimum light in U. This implies that the period of β variations is larger than the period of light variations in the U band. The period calculated from β measurements is equal to $0^d.7279534$, whereas the period of light variations in U calculated from equation 2 for the corresponding Julian Date is equal to $0^d.7279048$.

Musielok and Madej (1988) suggest that nonhomogeneities of the β index over the surface of 56 Ari are a consequence of Lorenz forces, which arise from interaction between macroscopic electric currents, which flow in the atmosphere and the large scale dipole magnetic field measured by Borra and Landstreet (1980). Variations of the β index reflect variations of the visibility of regions, where the Lorenz forces are most effective - "β-spot", during the rotational period. On the other hand, light variations reflect variations of visibility of the chemical spot. The positions of the photometric spot and the "β-spot" on the surface of 56 Ari are not the same because we

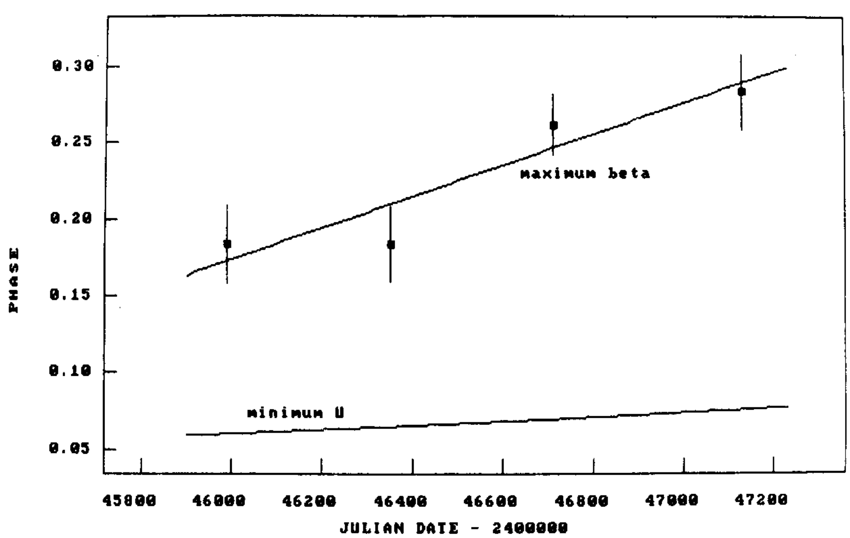

Figure 3. The phases of maximum beta index vs. Julian Date.

observe a shift between the phases of maximum β and photometric minimum (cf. Figure 3). The difference of both rotational periods could be interpreted as a result of relative migration of these features on the surface of 56 Ari.

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References:

Blanco, C., Catalano, F.A., 1970, Astron. J. 75, 53.
Borra, E.F., Landstreet, J.D., 1980, Astrophys. J. Suppl. Ser. 42, 421.
Fleck, R.C., 1981, 23rd Coll. Liege, p. 341.
Hardie, R.H., Schroeder, N.M., 1963, Astrophys, J. 138, 350.
Hildebrandt, G., Schoeneich, W., Lange, D., Zelwanowa, E., Hempelmann, A., 1985, Publ. Astrophys. Obs. Potsdam, 112, 1.
Musielok, B., 1986, Acta Astron. 36, 131.
Musielok, B., Madej, J., 1988, Astron. Astrophys., in press.
Provin, S.S., 1953, Astrophys. J. 118, 281.
Rakosch, K.D., 1963, Acta Phys. Austriaca 16, 70.