The longitudinal magnetic field of the Ap star HD 47103

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1 Introduction

A magnetic field in the Ap star HD 47103 has recently been detected by Babel et al. (1995). Using the ELODIE spectrograph and a cross-correlation technique, they discovered magnetically split lines in the spectrum of this star from which they inferred a mean magnetic field modulus of about 17.5 kG. When we compare the field modulus of HD 47103 with the results of Mathys et al. (1996), we find that the magnetic field of this star is one of the strongest ever studied. By obtaining mean longitudinal magnetic field measurements we hope to begin modeling the magnetic field geometry of this very interesting object, and to obtain constraints on the physics which operates in such an uncommon, strong-field environment.

2 Observations

We have obtained eight Zeeman spectra of HD 47103 using the Main Stellar Spectrograph and the circular polarization analyzer (Bychkov et al., 1988) installed on the 6 m telescope. We employed the second camera, with the 530 **X** 580 pixel CCD (Borisenko et al., 1991) as the detector. The spectra obtained cover the two wavelength regions ~ 6083 — 6205 Å and ~ 6286 — 6408 Å. The spectral resolution is approximately 0.45 **A,** and the signal-to-noise ratio obtained is typically ~ 100. Reduction of the 2-dimensional CCD images was performed using the DECH package developed by Galazutdinov (1992).

The longitudinal magnetic field B_e was determined from the Zeeman shift between the left and right circular polarization spectra for a number of spectral lines. To measure the centre of gravity of each spectral line we employed the programme VECVIZ (Vlasyuk, 1994).

3 Radial velocity

We determined radial velocities (RV) from Si II λ6347 and λ6371, the strongest lines in our spectra. These results are shown in Table 1. Radial velocities were calculated using the intensity spectrum computed from the average of the left and right circular polarization spectra. The radial velocities are somewhat lower than those found by Babel et al. (1995), and appear to be slightly variable. The precision of our radial velocities is around 0.5 km s^{-1}.

4 Magnetic field

Our eight spectra of HD 47103 show a variable longitudinal field with a negative polarity. The field varies from -2.7 kG to -4.4 kG. These measurements are also presented in Table 1. While the resolution of our spectra is not particularly high, the field is quite strong and the shifts between the left and right circular polarization spectral lines are evident. This is illustrated in Fig. 1, where

Table 1: Longitudinal magnetic field of HD 47103.

JD-240 0000	B_e (G)	$\pm\sigma_B$ (G)	RV(km/s)	central wavelength
50059.592	-3400	70	-6.5	6347
50060.601	-2700	310	-10.1	6347
50061.583	-4170	610		6145
50061.608	-4415	480		6145
50087.581	-2430	300	-10.7	6347
50091.282	-2890	210		6145
50118.441	-4050	410		6347
50119.451	-3615	250	-12.3	6347

we show part of one Zeeman spectrum containing Si II λ6371. The asymmetry of the line in Fig. 1 appears to be real, as is also apparent in another spectrum obtained in this region. The Zeeman splitting of Si II λ6371 has a simple structure: two π and two σ components (67< 1000 > 133 (1000)). From the shift between the two σ components we can calculate the value of surface field. From four spectra we obtain a mean field modulus B_s = 11 ± 0.9 kG.

5 Rotational period

There are no previous data concerning the rotational period of this star. Babel et al. (1995) proposed that period should be more than 33 days.

In Fig.2 we show the relation between mean field modulus and period for a number of cool Ap stars, from the list compiled by Glagolevskij et al. (1986) and also taken from paper by Mathys et al. (1996). Only several stars have mean field moduli greater than 10 kG, and all of them have periods shorter than 10 days. A small group of stars with period more 30 days have mean surface fields near 10 kG. On this (admittedly not very significant) evidence we can speculate that period of HD 47103 is also shorter than 10 days or more than 30 days. A period search of our longitudinal field data indicates a number of possible periods. We are unable to select among the most significant period. Clearly more data are necessary to determine the rotational period of this star.

6 Discussion

Our lower value of B_s in comparison with the results of Babel et al. (1995) could be connected with the low resolution of our spectra. This difference may also be due to the fact that the magnetic quantity which Babel et al. (1995) calculate from their spectra is poorly defined (since they employ a blend of many lines with many different Lande factors). A final possibility is that, since our measurements of B_s and the measurement of Babel et al. (1995) were acquired at different times, and likely at different phases, we expect to find a difference between them.

We observed HD 47103 during a four-month span, and it is clear that we have observed the star near the negative magnetic pole. As the star has low $v_e \sin i$ = 4.4 km s^{-1} (Babel et al., 1995), it is quite possible that the line of sight is not far from the rotational axis. If this is the case, we would not expect to see a change in the sign of the longitudinal field with phase.

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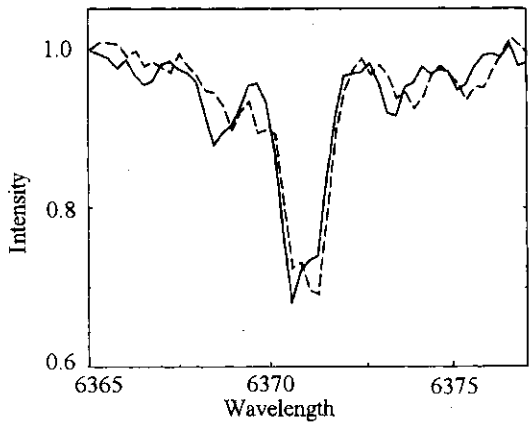

Figure 1: Part of one spectrum of HD 47103 around Si II λ6371. The solid line is right circular polarization, dashed line is left circular polarization.

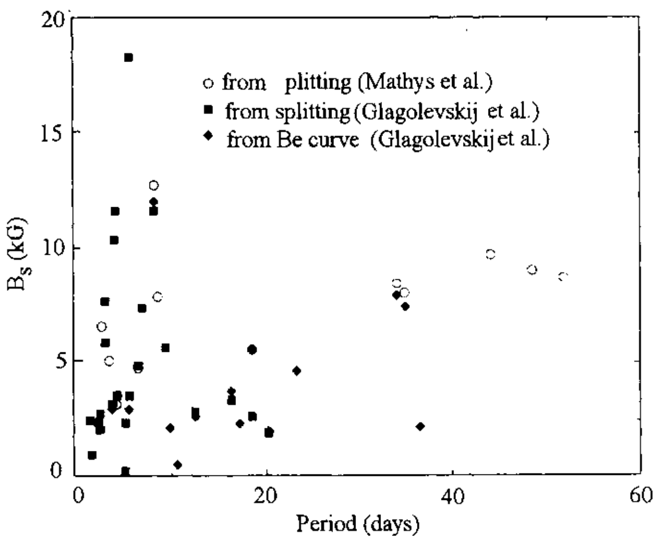

Figure 2: Mean field modulus versus period for some cool Ap stars.

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