Radial and Nonradial Pulsations as Probes of Stellar Physics
ASP Conference Series, Vol. 259, 2002
C. Aerts, T.R. Bedding, & J. Christensen-Dalsgaard, eds.

Search for a Magnetic Field in the B2 IV Star V 2052 Oph

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Abstract. We have searched for magnetic signatures in the B2 IV star V 2052 Oph, a β Cep star with stellar wind behavior typical for an oblique magnetic rotator, as β Cep itself. From UV spectroscopy we determined an accurate rotational period and $v \sin i$, and present the magnetic measurements as a function of rotational phase. The (small) class of magnetic pulsating early B stars are of great asteroseismological interest.

1. Introduction

The B2 IV star V 2052 Oph is a β Cep variable with a $3^{\rm h}21^{\rm m}$ pulsation period. The variability of its UV wind lines is typical for oblique magnetic rotators (Henrichs et al., 1998; Henrichs, 2001), as was convincingly demonstrated for β Cep itself, which shows similar stellar wind variability and hosts a dipole field of about 300 G (Henrichs et al., 2001; Donati et al., 2001). So far, only three early B stars are known with this type of signatures. Analysis of the pulsation properties of a rotating magnetic star gives very strong constraints on its parameters and its evolutionary stage, which is of great asteroseismological interest.

2. UV and spectropolarimetric observations

UV Spectroscopy: We obtained 41 IUE spectra (1150–2000 Å) during 1981–82 and 1994–95. The C IV, Si IV and N V wind lines are strongly modulated at 3.63890 d, which we identify as the rotational period. From the photospheric UV lines we determined $v \sin i = 85$ km/s, implying $R_* = 6.1 R_\odot$ and $i = 80°$, using a distance of 254 pc and a luminosity of $L = 3.74 L_\odot$. The C IV equivalent width as a function of rotational phase is plotted in Fig. 1b. As in β Cep (Fig. 1a), there is one deep minimum (i.e., maximum emission) and two unequal maxima.

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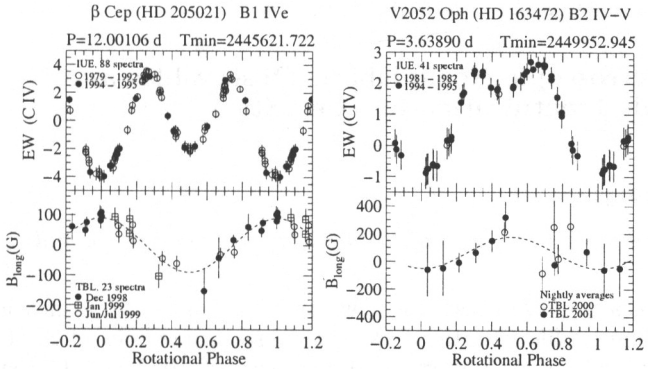

Figure 1. The magnetic star β Cep and the candidate V 2052 Oph.

Spectropolarimetry: Observations were obtained with the MUSICOS echelle spectropolarimeter (R=35000, 4500–6600 Å) at the 2m Telescope Bernard Lyot at Pic du Midi, France in 2000-01. A least-squares deconvolution (Donati et al., 1997) allows the detection of a stellar magnetic field (longitudinal component only) through the Zeeman signatures generated in the Stokes V line profiles. Due to the relative faintness of the star, the individual measurements have large error bars. In Fig. 1b we present the nightly averages of 1–5 magnetic measurements.

3. Results and conclusions

Although no strong signatures appear in the individual Stokes V profiles, the varying nightly averages point towards the presence of a magnetic field. A best-fit sine wave gives an amplitude of $B_l = 114 \pm 48$ G, with an average value of $B_0 = 63 \pm 30$ G and reduced $\chi^2 = 1$. This is consistent with a rotationally modulated magnetic dipole field, but measurements with a better S/N are needed. Note, however, the striking resemblance in phase correlation with β Cep. From the phase difference between the UV equivalent-width maxima we derive $65° < i < 82°$, and $45° < \beta < 17°$ for the angle of the magnetic axis.

New generation spectropolarimeters like Espadons are needed to confirm the detection of a field in V 2052 Oph. Such magnetic pulsating stars are apparently rather rare, but will provide the most massive examples of stars useful for asteroseismological (and hence evolutionary) tests.

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https://doi.org/10.1017/S025292110001602X Published online by Cambridge University Press