Magnetic Stars, 2011, pp. 458 – 461

Magnetic Variability of the Ap Star HD 9996

Bychkov V. D.[1], Bychkova L. V.[1], Madej J.[2], Shatilov A. V.[1]

[1] Special Astrophysical Observatory, Nizhny Arkhyz, Russia
[2] Warsaw University Observatory, Poland

Abstract. The star HD 9996 (HR 465, GY And) belongs to the subclass of long–period magnetic Ap stars. Its phase magnetic curve exhibits two components. Long-term variations of the longitudinal field are covered by faster oscillations with the period conterminous to the orbital period. We discuss a possible explanation of such a behaviour as a regular precession of the rotation axis of the main component.

1 Long–Period Magnetic Phase Curve

Compilation of early photometric measurements of HD 9996 allowed us to constrain the corresponding period P in the range of $7750 < P_{ph} < 8550$ days (Pyper & Adelman, 1986). The period obtained from magnetic measurements is $P_{mag} = 7842$ (Bychkov et al., 1997), and $P_{mag} = 7692$ (Bychkov et al., 2005). Since the magnetic phase curve was still poorly constrained, the monitoring project for HD 9996 is active as now. As this object is relatively bright, magnetic monitoring was performed in the coude-focus of the 1-m Zeiss-1000 reflector at the SAO RAS, equipped with the CEGS spectrometer and an analyzer of circular polarization (Bychkov, 2008). Finally, we collected 41 measurements of B_e during the last 15 years. Figure 1 shows the object's long-period magnetic phase curve. We plotted all the available data from 60 years of observations. The magnetic curve has a double wave with the period $P_{mag} = 8019.24$ days, and the parameters $B_0 = -429$ G, $B_1 = 1330$ G and $B_2 = 332$ G. A large scatter of B_e points suggests the existence of a possible short time variability.

2 Short–Term Magnetic Variability

We only selected the B_e observations obtained by us in the search for a short magnetic period. We measured $V_e \sin I$ on all the spectra and determined that it is ≤ 8 km/s. The star has a radius of nearly 2.4 solar radii, therefore, the rotational period should be longer than 15.2 days. We have found the short magnetic period measuring the B_e deviations from the mean magnetic curve. The short period coincided with the orbital period of $P_{orb} = 272.99$ days (Scholz, 1978). Figure 2 shows magnetic variations plotted with that Julian date. Figure 3 as well shows the phase curve of the short-term variability with the parameters $B_0 = 4$ G and $B_1 = 128$ G about the long-term magnetic mean phase curve.

3 Discussion

We attempted to explain the magnetic behaviour by the precession about the rotational axis of the primary component in the double system with the period of 8020 days similarly as Lehmann (1987). the rotation period of the star is synchronized with the orbital period, and makes 272.99 days, angle

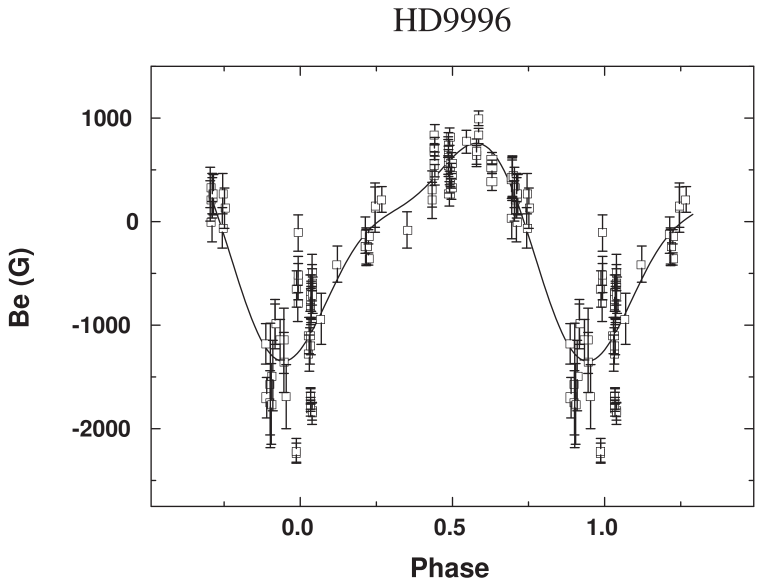

Figure 1: Long-period magnetic phase curve. The data from 60 years of observations are plotted.

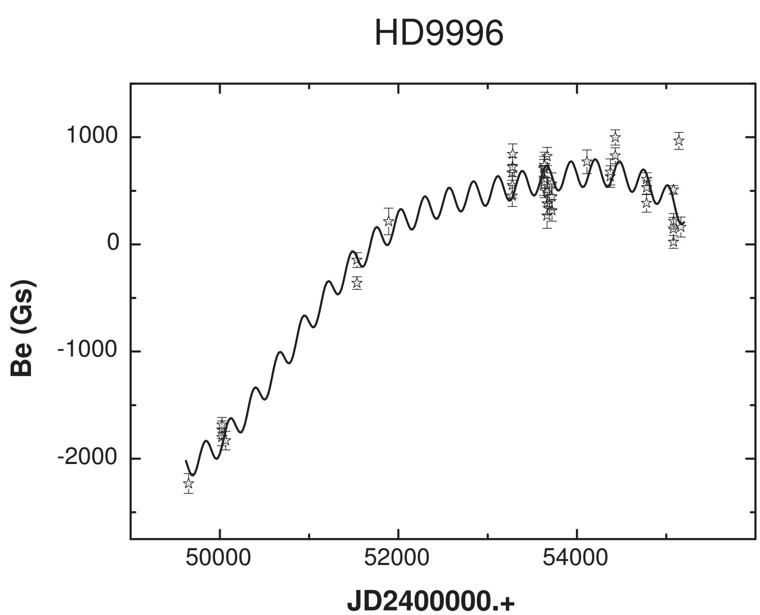

Figure 2: Magnetic variations plotted with the Julian date

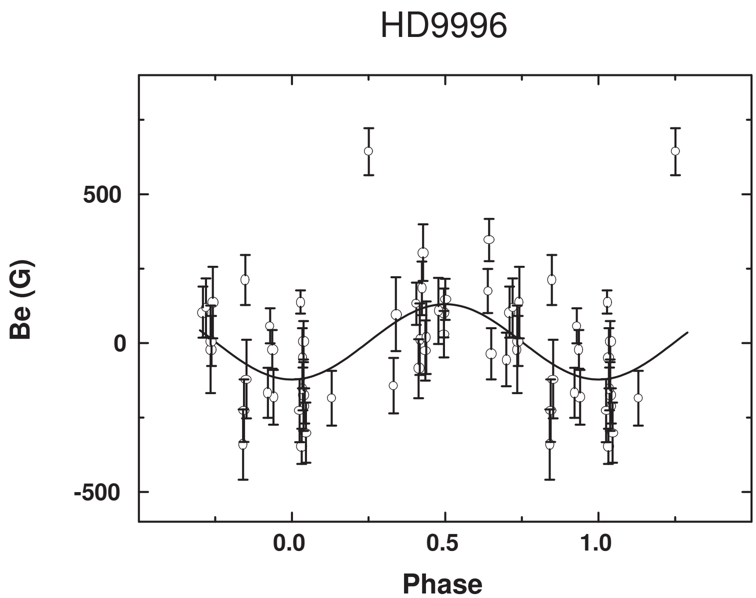

Figure 3: Pphase curve of the short–term variability with the parameters $B_0 = 4\,\mathrm{G}$ and $B_1 = 128\,\mathrm{G}$ about the long–term magnetic mean phase curve

$\beta = 18°$, Eulers angle $\Theta = 43°$. We assumed that the magnetic field of the main component is well approximated by a centered (not displaced) dipole described by the standard formalism of Preston (1967).
This assumption is contradicted by the following data:

1. The amplitude of short-term variation should be maximal at at the phase when the averaged $B_e = 0$ (the axis of rotation lies in the plane of the sky), and minimal when the averaged $B_e = max$ (the angle i is minimal).

2. Variability caused by the slow precession should be strictly harmonic, and does not exhibit a double wave.

4 Our Plans for the Future

We plan to continue regular magnetic monitoring of this object.
1. We wish to study its magnetic behaviour in greater detail.
2. Modulation of the magnetic field with the orbital period is very interesting. Possibly it is not only a tidal effect. It may result from the interaction of magnetic fields if the secondary component is a magnetic white dwarf.
3. We wish to understand whether the rotation of the main component is synchronized with the orbital period or not.

Acknowledgements. We acknowledge the support from Polish Ministry of Science and Higher Education grant No. N N203 511638.

References

Bychkov V.D., Astrophysical Bulletin, 2008, 63, 83

Bychkov V. D., Bychkova L. V., Madej J., 2005, A&A, 430, 1143
Bychkov V. D., Gerth E., Kroll R., Shtol V. G., 1997, in: Glagolevskij Yu. V., Romanyuk I I. (eds), Proc. Int. Conf., “Stellar Magnetic Fields”, Nizhny Arkhyz, 204
Lehmann T., 1987, Astron. Nachr., 308, 333
Preston G. W., ApJ, 1967, 150, 547
Pyper D. M., Adelman S., 1986, IAPPP Communication, 25, 76
Scholz G., 1978, Astron. Nachr., 299, 81