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Spectropolarimetric study of selected cool supergiants

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Abstract. Cool supergiants offer a good opportunity to study the interplay of magnetic fields and stellar evolution. We present the results of spectropolarimetric study of the cool supergiants and classical Cepheids η Aql and ζ Gem.

Keywords. Stars: magnetic fields, supergiants, Cepheids, stars: individual (η Aql, ζ Gem)

1. Introduction

Supergiants are the descendants of massive O- and B-type main sequence stars. In recent years, magnetic field in the atmospheres of a small number of such stars has been confirmed by direct measurements (Plachinda 2005, Grunhut 2010, Auriere 2010). Because these fields are usually quite small, the real surface geometry as well as the origin of the magnetic field on cool supergiant stars have not yet been understood. Another interesting but unsolved problem is the magnetic field variability due to pulsation period of Cepheids.

We have analyzed circular polarized spectra of two Cepheids (η Aql and ζ Gem). The spectra were obtained in the wavelength region 6210–6270 Å with the coudé spectrograph mounted on the 2.6-m Shajn telescope of the Crimean Astrophysical Observatory. The technique of longitudinal magnetic field calculation is described in detail by Butkovskaya & Plachinda (2007).

2. Magnetic field and pulsation of η Aql and ζ Gem

Plachinda (2000) and Butkovskaya (2014a,b) obtain that the longitudinal magnetic field of η Aql varies with the radial pulsation period of 7.176726 day in 1991, 2002, and 2004, but find virtually no changes in 2010 and 2012. The amplitude B, mean field B_0, and phases of maximum and minimum field vary from year to year. The reason for this behavior of the magnetic field remains unknown.

A spectropolarimetric study of ζ Gem has been performed during 8 nights in 2003 and 2004. In December 2002–January 2003, the longitudinal magnetic field varies in range from –9 to 26 G, while the difference between maximal and minimal values is 35 G (see left panel of Fig. 1). In December 2003–March 2004, the longitudinal magnetic field varies from 4 to 12 G (mean B per 5 nights is 8.2 ± 1.6 G and $B/\sigma = 5.1$).

In the right panel of Fig. 1, the radial velocity and longitudinal magnetic field are folded in phase with the pulsation period. We use the ephemeris JD = 2443805.927+10.15073E, where E is the number of pulsation cycle.

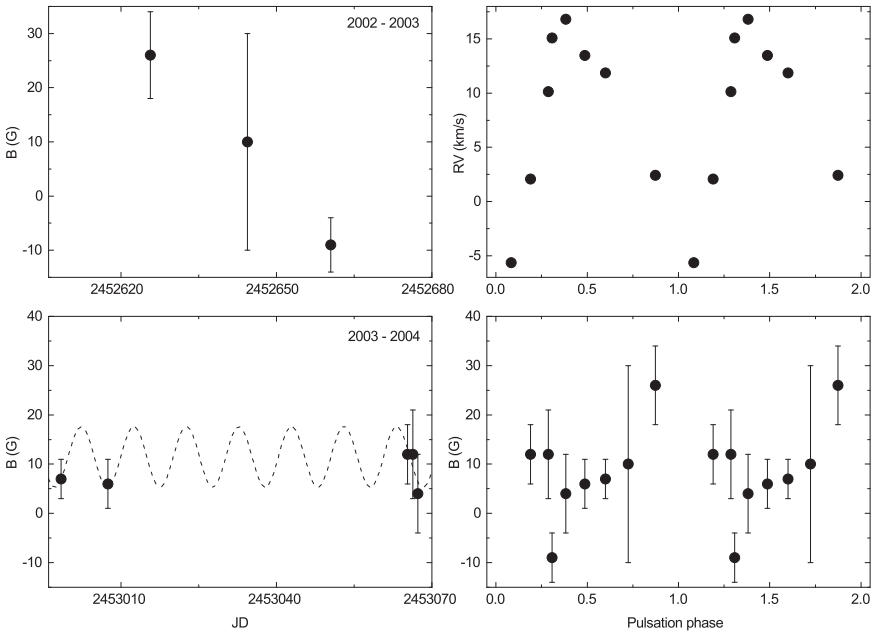

Figure 1. Longitudinal magnetic field of ζ Gem (left panels). Sinusoidal fit is shown by dashed line. Radial velocity (top right panel) and longitudinal magnetic field (bottom right panel) of ζ Gem folded in phase with the 10.15073-day radial pulsation period.

3. Conclusion

Due to long pulsation periods of Cepheids and possibly unstable behavior of the magnetic field from year to year, long sets of observations during every single year are needed.

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