Magnetic Fields throughout Stellar Evolution
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Binary and multiple magnetic Ap/Bp stars

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Abstract. We present the results of speckle interferometric observations of 273 magnetic stars most of which are Ap/Bp type. All observations were made at the 6-m telescope of the Special Astrophysical Observatory of the Russian Academy of Sciences. We resolved 58 binary and 5 triple stars into individual components. Almost half of these stars were astrometrically resolved for the first time. The fraction of speckle interferometric binaries/multiples in the sample of stars with confirmed magnetic fields is 23%. We expect that the total fraction of binaries/multiples in the sample with account for spectroscopic short-period systems and wide common proper motion pairs can be twice higher. The detected speckle components have a prominent peak in the ρ distribution that corresponds to the closest resolved pairs. Full version of present paper is available in electronic form at http://arxiv.org/abs/1308.3168.

Keywords. magnetic stars, binary and multiple stars, speckle interferometry

1. Sample

A sample of objects for observations was based on the Catalog of Magnetic Stars (Romanyuk & Kudryavtsev 2008). It contains a list of 355 chemically peculiar objects (mostly Ap/Bp) with detected global magnetic fields. We added 17 new magnetic stars discovered after the publication of the catalog. Therefore the total number of stars in the sample is 372. For the majority of stars in the list (322 objects) only the value of the longitudinal component of the field Be is known. For 48 stars the surface fields are determined from the splitting of Zeeman components. The vast majority of the sample objects are brighter than 10^m in the V-band. The stars are uniformly distributed on the celestial sphere, although a relatively small number (about 20%) of objects belong to open clusters of different ages. The BTA can capture only 273 objects from our sample with declinations $\delta > -30°$.

2. Observations

The speckle interferometric observations of 273 magnetic CP stars were carried out at the BTA in 2009–2012. They were performed with the speckle interferometer engineered at the SAO RAS (Maksimov *et al.* 2009). We used the PhotonMAX512 camera based on an internal electron multiplying CCD97 (EMCCD) produced by Princeton Instruments with a 512×512 pixel array. The limiting magnitude of our speckle interferometer is $\approx 15^m$ in the V-band depending on seeing conditions. Basically we employed two filters: 550/20 and 800/100 nm (central wavelength/bandwidth). We took 2000 short exposure images in each filter for almost all observed objects. High quantum efficiency and linearity of the detector permits the maximum magnitude difference between the components to reach up to 5-6^m depending on angular separation and weather conditions (Fig. 1 of Rategaev *et al.* 2013). The minimum angular separation between the components is determined by

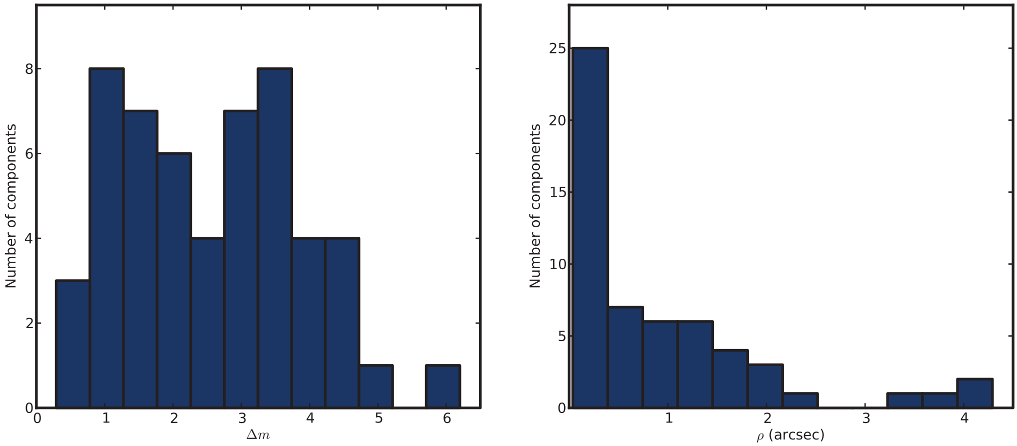

Figure 1.

the diffraction limit of the 6 m telescope. It is $0.022''$ and $0.033''$ for 550/20 and 800/100 nm filters, respectively. The size of the detector's field $4.4 \times 4.4''$ allowed secondary components to be discovered at angular separations as large as $3''$ from the primary star. The accuracy of our speckle interferogram processing method may be as good as 0.02^m, $0.001''$, and 0.1° for the component magnitude difference, angular separation, and position angle, respectively.

3. Results

For 63 stars in our sample, we observed speckle interferometric companions. Among the resolved systems 58 are binaries and 5 are triples. Twenty nine companions were resolved astrometrically for the first time. The fraction of speckle interferometric binaries/multiples in the sample of 273 stars with confirmed magnetic fields is 23%. Magnitude difference and angular separation distributions for resolved pairs are shown in Fig. 1. To plot these histograms we used 56 measurements of ρ and 53 Δm. We want to draw attention to the unusual profile of the ρ distribution. Speckle interferometric components of magnetic stars tend to be located close to the primary star. Half of the resolved stars have companions with $\rho < 0.32''$. This result is not a selection effect because close interferometric components are harder to detect than the wide pairs. The distribution of Δm for 28 resolved speckle companions with $\rho < 0.32''$ resembles that on the left half of Fig. 1. Reconstructed images of six systems resolved for the first time on BTA are presented in Fig. 2 of Rategaev *et al.* (2013). The Tab. 1 of Rategaev *et al.* (2013) is a list of all the stars that have speckle components. The systems resolved astrometrically for the first time are marked in bold.

4. Conclusion

According to our research the fraction of speckle interferometric binary and multiple systems in the sample of 273 CP stars with confirmed magnetic fields makes up 23% without account for undetected companions. Generally the speckle interferometric components have orbital periods larger than spectroscopic and smaller than common proper motion pairs. We expect that the total fraction of binaries/multiples in the sample with account for spectroscopic short-period systems and wide common proper motion pairs can be twice higher. The detected speckle components have a prominent peak in the

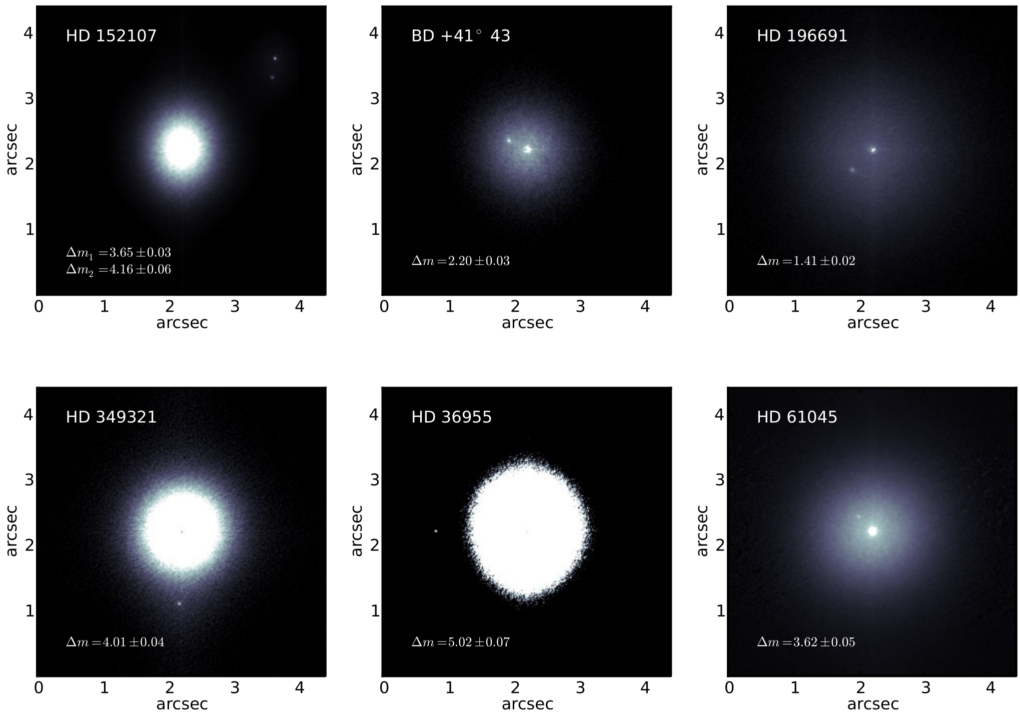

Figure 2.

ρ distribution that corresponds to the closest resolved pairs. More detailed and refined results of the presented study will be published soon.

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