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Rotation and kinematics for a sample of new magnetic stars

D. O. Kudryavtsev[1], I.I. Romanyuk[1], E. A. Semenko[1], G.A. Solov'ev[2]

[1] Special Astrophysical Observatory of the Russian AS, Nizhnij Arkhyz 369167, Russia
[2] Stavropol State University, ul. Pushkina, 1, Stavropol, Russia

Abstract. The spectra taken with the 6 m telescope are used to determine the radial velocities and projected rotational velocities for 32 newly discovered magnetic CP stars. Eight of them are found or confirmed to be binary and binarity is suspected for another four stars. Six objects are members of open clusters and associations of various age.

1 Introduction

An extensive program of the search for new magnetic stars is now carried out at the 6-m telescope of the Special Astrophysical Observatory of the Russian Academy of Sciences (Kudryavtsev et al. 2006).

We suggested a new efficient technique to search for such stars, which allowed us to discover more than 70 such objects in a relatively short time (about five years). Our observational data — Zeeman spectra taken within the framework of the program for the search for new magnetic stars can be used for determination of radial velocities (V_r) and projected rotational velocities (v_e sin i).

2 Observations and data reduction

Observations were made in 2000–2005 with the Main Stellar Spectrograph of the 6 m telescope equipped with 1160 × 1040 and 2000 × 2000 CCDs. We reduced the data using the LONG context of ESO MIDAS environment and programs developed by Kudryavtsev (2000).

We took our spectra in the wavelength interval 4450–4650 Å with spectral resolution R∼ 15000.

Note, that the lower limit for the projected rotational velocity (v_e sin i) which can be achieved with our moderate-resolution spectra is equal to 18 km/s. Since an essential part of magnetic stars are slow rotators, we obtain for them only the instrumental profiles of spectral lines.

We determined the radial velocities in a standard way by comparing the wavelength of the lines of the object with the computed wavelengths adopted from Vienna Atomic Line Database (VALD)(Kupka et al. 1999). We inferred the radial velocities from the combined spectrum made up by coadding the spectra of left and right circular polarization. We used a hollow-cathode Th–Ar lamp to perform the wavelength calibration of our spectra.

Our studies of standard stars demonstrated the correctness of the adopted approach. Our median radial velocity agrees accurately with the published values for all the four standard stars employed.

3 Results

Table 1 lists the rotation and radial velocities of the 32 newly-discovered magnetic stars. HIPPARCOS catalog (ESA, 1997) gives the parallaxes and proper motions for 27 stars of our list. For these stars we determined their space-velocity components in the Cartesian coordinate system (U, V, W).

Table 1. Rotation and kinematics of 32 magnetic CP stars

HD	$v_e \sin i$ km/s	VR km/s	U km/s	V km/s	W km/s
2957	27 ± 3	$+11.0 \pm 1.4$			
5601	22 ± 2	$+11.2 \pm 2.1$	7.2	9.4	-2.3
6757	$\leqslant 18$	-6.5 ± 1.5	-18.1	6.0	-3.6
9147	23 ± 2	-30 var			
19712	42 ± 3	$+17.6 \pm 1.3$	0.4	6.1	-8.1
27404	37 ± 3	$+10.0 \pm 3.3$	5.9	-20.1	-0.7
34162	23 ± 2	$+36.7 \pm 1.3$	14.6	-8.4	-24.0
34719	49 ± 6	$+16$ var	5.5	-0.3	2.6
36955	37 ± 3	$+27.8 \pm 2.8$			
38823	20 ± 2	-8.5 ± 1.2	-16.4	21.0	-0.3
39082	60 ± 2	$+25.2 \pm 1.2$	13.6	2.0	2.3
39658	32 ± 5	-5.6 ± 1.1			
40711	20 ± 2	-16.2 ± 4.4	-25.1	13.6	11.3
40759	25 ± 3	$+33.1 \pm 1.9$	20.6	1.9	-7.4
41403	28 ± 3	$+0.9 \pm 0.4$	-9.0	20.9	-21.7
43819	$\leqslant 18$	$+49.0 \pm 1.0$	-0.2	9.7	-1.9
47756	28 ± 2	$+20.8 \pm 1.4$	11.1	5.7	0.8
49040	24 ± 2	$+20.7 \pm 0.4$	20.0	-20.0	-7.9
66350	30 ± 2	$+28.4 \pm 1.1$	14.6	-4.8	9.6
115606	22 ± 2	-18.3 ± 1.9	33.4	-6.9	-4.8
142554	27 ± 2	-31.9 ± 1.6			
149822	64 ± 2	$+20.8 \pm 3.4$	-33.9	2.5	20.4
151199	55 ± 2	-51.9 ± 2.8	22.6	-5.7	-49.0
158450	20 ± 2	-17.2 ± 1.4	1.8	-11.9	3.8
169842	50 ± 7	-30.8 ± 2.9	17.9	-3.2	4.0
170973	$\leqslant 18$	-11.7 ± 1.4	6.5	16.3	-5.9
178892	$\leqslant 18$	-19.4 ± 1.0	-17.7	-20.9	-5.7
184471	$\leqslant 18$	-35 var	-13.9	-26.2	-12.2
196606	42 ± 3	-17 var	1.5	-3.4	0.1
205087	25 ± 2	-10.7 ± 0.7	14.0	2.2	-4.2
207188	43 ± 3	-8.1 ± 2.1	8.3	8.5	3.0
343872	20 ± 2	-10.0 ± 1.1			

We determined radial and rotational velocities for 32 new magnetic stars. It was the first stage of an extensive program aimed at the study of the space distribution, kinematics and physics of magnetic stars in our Galaxy. The stars studied belongs to the most numerous classes of CP stars with Si, Si+ and SrCrEu anomalies. Earlier, magnetic stars of this type were observed only in the immediate vicinity of the Sun (at heliocentric distances of up to 100–200 pc). Our new sample features more distant objects.

Of the 32 new magnetic stars 14 have parallaxes smaller than 4 mas and five more objects have no parallaxes determined by HIPPARCOS satellite (ESA, 1997). Given that they are faint objects of 9–10th magnitude, it is safe to assume that they are located at the heliocentric distances greater than 250 pc.

Eight out of the total number of these stars are binary and four other stars are suspected binaries. Hence, the fraction of binaries somewhat exceeds the common 20 % level for magnetic stars.

Six objects are members of open clusters and associations of various age. Their detailed study is of special interest for understanding of origin and evolution of stellar magnetism.

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