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SOME PROBLEMS OF NON-REVERSIVE CP STARS. I. SPATIAL DISTRIBUTION

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ABSTRACT. *Some distinguishing features of the sign spatial distribution of the longitudinal component are investigated using the technique proposed in this paper. The "minus" sign measurements for the directions with the galaxy longitude 20°- 120° and 220°- 290° at distances less than 1000 pc are found deficient.*

A comparison of photographic and photoelectric magnetic measurements obtained at different observatories shows no "zero-point" systematic shifts (i.e. false magnetic fields). Various factors affecting the measurements are analysed. Additional observations are needed to reveal if the non-uniform spatial distribution we detected is real or simply the false effect of the small number of observations.

1. INTRODUCTION

Although there exist different methods for investigations of stellar magnetic fields, the most efficient is the study of spectral line splitting in the magnetic field (Zeeman effect measurements). It is known that the magnetic fields of CP stars are relatively weak, and the splitting of the Zeeman components is not visible. Therefore the measurements of polarization or shifts of the σ-components are used to calculate the magnetic field longitudinal component B_e (i.e. the magnetic field vector projection onto the line of sight).

Following Babcock (1958) we assume that fields directed towards the observer have positive polarity. In this case the left-circularly-polarized radiation gives the high-frequency σ-components of splitting. These components pass through the analyzer that transmits the left-circularly-polarized radiation, while the right-circularly-polarized low-frequency σ-components will be completely stopped by the analyzer.

To explain the photometric, spectral and magnetic variability of CP stars the oblique rotator model with a dipole (in a first approximation) magnetic field is used. The sign of the longitudinal field B_e is determined only from the conventionally taken "zero-point", and there should be no reason for the appearance of any differences in the atmospheric physical conditions of stars with a predominance of fields of different polarity.

Stellar magnetism researchers have repeatedly compared their measurement systems with each other (for example, Hensberge, 1978). From the data available it can be concluded that discrepancies between magnetic field values obtained at different observatories exist but they do not exceed 30%, while the "zero-point" shifts (i.e. false magnetic fields) have not been registered.

There is a great body of data obtained from more than 40 years of active magnetic measurements, which offers the possibility of a new comparison analysis of magnetic field data from different telescopes. Besides, a sign analysis of B_e can give information about whether there exists any dominant direction of the magnetic field in the neighbourhood of the Sun.

A comparison of the different physical characteristics of stars with different signs of B_e is of certain interest too. We propose two ways for the accomplishment of this research:

1. Comparison analysis of the mean parameters for non-reversive CP stars (visible dominantly from one pole);
2. Investigation of the dependence of magnetic field variations, spectral and photometric characteristics of reversive CP stars on the rotational period phase, and further comparison analysis in fields of different polarity.

2. COMPARATIVE CHARACTERISTICS OF NON-REVERSIVE CP STARS

2.1 Selection criteria

Let us pick out the CP stars whose longitudinal component is dominantly of one polarity - non-reversive (agreed upon dipole model). Magnetic measurements for more than 150 CP stars are known from the literature. For about 30% of them magnetic curves of B_e variations with rotational period have been plotted, while the magnetic fields of the rest of the stars have been imperfectly studied. Most of the used observational data were obtained by Babcock, Landstreet with his colleagues, and ourselves at the 6 m telescope. These data were collected in the original Babcock catalogue (1958), and in the later compilative catalogue of Didelon (1983). Additionally we used our data and the new data of other investigators lacking in the first two catalogues.

Since it is occasionally impossible to clearly define whether only one polarity is dominant, we used two samples labelled 1 and 2. Sample 1 contains magnetic CP stars with a large number of measurements and a clearly observed predominance of one polarity fields. Sample 2 comprises CP stars for which the predominance of one sign field (B_e) is not confidently established due to the small number of measurements.

The results of our work in the selection of CP with a prevailance of positive "+" or negative "-" components are presented in Table 1. Columns of the Table contain: HD, the catalogue number of the star; m_v, visual magnitude (Rufener, 1988); peculiarity (Glagolevskij and Chunakova, 1986); T_e, effective temperature (Glagolevskij and Chunakova, 1986); [n], number of measurements; B_e(min-max), extreme values of B_e; source of information.

Table 1. General information about non-reversive CP stars

HD	m_v	Pec	T_e	n	B_e(min-max)	References
		SAMPLE 1				
		a) Stars "+"				
11187	7.14	SiCr	9940	7	-70 - +1250	Babcock
24712	5.98	SrCrEu	7350	25	-50 - +1400	Didelon
25823	5.19	Si	12900	17	-400 - +1300	Didelon
30466	7.27	SiCr	10800	8	+400 - +2000	our+Babcock
37058	7.33	He-w?	19600	6	+30 - +2500	Didelon
50169	8.99	SiCr	9150	6	+670 - +2120	Didelon
55719	5.30	SrEu	9150	27	-1040 - +2010	Didelon
58260	6.73	He-r	20200	5	+1900 - +2200	Didelon
74521	5.64	SiCr	10600	9	-180 - +1450	Babcock
109026	3.83	He-w	16050	5	+140 - + 470	Didelon
119213	6.28	CrEu	9800	55	-200 - +1800	Our
133029	6.36	SiCr	11000	48	+300 - +4300	Didelon
137949	6.66	SrCrEu	7500	15	+980 - +1810	Babcock
152107	4.80	SrCr	8800	>100	0 - +2000	Our + Didelon
188041	5.63	SrCrEu	8650	72	-200 - +1500	Babcock
192678	7.36	Cr	9000	12	+800 - +2200	Babcock + our
215441	8.85	Si	14900	>50	+4000 -+25000	Didelon + our
		b) Stars "-"				
2453	6.89	SrCrEu	8500	27	-250 - -1030	Didelon
14437	7.26	CrEuSr	10700	10	-400 - -2300	Our
15144	5.87	SrCr	8375	60	-300 - -1100	Babcock
25267	4.62	Si	11825	7	0 - -400	Didelon
27309	5.37	Si	12250	6	-200 - -1260	Our+Didelon
35502	7.33	He-w	16400	6	-100 - -2250	Didelon
37017	6.55	He-r	20450	12	+400 - -2300	Didelon
42616	7.17	SrCrEu	9000	4	-430 - - 840	Babcock
73340	5.79	Si	12900	5	-810 - -2310	Bohlender
92664	5.50	Si	15550	18	-130 - -1190	Bohlender
94660	6.11	Si	10800	4	-2100 - -3300	Bohlender
96446	6.69	He-r	23550	6	-1100 - -1800	Didelon
96707	6.09	Sr	8000	6	+830 - -3900	Didelon
111133	6.32	SrCrEu	9500	>30	-200 - -1400	Babcock+our
112381	6.50	SiCr	10825	5	-3060 - -3700	Bohlender
116458	5.67	SrEu	9950	7	-1500 - -2400	Didelon
118022	4.92	SrCr	9450	>80	0 - -2000	Didelon

Table 1. (continued)

HD	m_v	Pec	T_e	{ n }	B_e (min-max)	References
130559	5.31	SrCr	9950	7	-200 - -1300	Didelon
142990	5.42	He-w	18450	14	+600 - -2500	Didelon
147010	7.37	SiSr	12850	10	-3500- -5000	Our
149911	6.05	CrEu	8450	6	+400 - -2100	Didelon
151965	6.33	Si	13150	8	-540 - -3730	Bohlender
168733	5.32	He-w	14300	17	-260 - -1620	Didelon
196178	5.77	Si	13400	9	-500 - -1500	Didelon
		SAMPLE 2				
		a) Stars "+"				
22920	5.52	He-w	14850	4	+ 200 - + 400	Didelon
24155	6.30	Si	9900	6	-630 - +1540	Bohlender
34452	5.39	Si	15650	7	-390 - +1080	Bohlender
36526	8.29	He-w	16400	6	- 980 - +3480	Didelon
51418	6.62	pec	9450	11	- 220 - + 750	Didelon
81009	6.52	CrEuSr	8000	4	+ 45 - + 870	Didelon
115708	7.79	SrCrEu	10450	2	+ 680 - + 740	Babcock
143473	7.41	Si		4	+4280 - +5140	Bohlender
144661	6.31	He-w	15700	5	- 400 - +1100	Didelon
146001	6.04	He-w	13700	5	- 200 - +1300	Didelon
205087	6.70	SiSr	10840	4	+ 300 - + 790	Bohlender
		b) Stars "-"				
9996	6.38	CrEu	9670	18	+ 400 - -1700	Didelon
25354	7.84	SrCrEu	8900	4	0 - -380	Didelon
37776	6.99	He-r	23050	7	-2000 - +250	Didelon
101065	8.02	pec	-	3	-2100 - -2500	Didelon
108662	5.26	SrCr	10000	18	+ 450 - -1050	Didelon
119419	6.45	SiCr	12600	6	+1210 - -2540	Bohlender
128898	3.17	Eu	7900	18	+300 - -1500	Didelon
133652	5.97	SiCr	12660	9	+660 - -2170	Bohlender
140160	5.32	SrCr	9100	8	-1840 - + 760	Didelon
142301	5.86	He-w	17300	8	-3500 - +1600	Didelon
143699	4.88	He-w	15750	4	- 250 - - 50	Didelon
144334	5.90	He-w	16350	12	-1400 - + 500	Didelon

Thus, we picked out 64 non-reversive CP stars: 28 "+" and 36 "-". All ar brighter than 9^m, i.e. they are located in the nearest neighbourhood of the Sun. detailed consideration of spatial distribution is given below.

2.2. Spatial distribution

In Table 2 are tabulated equatorial α and δ, galactic l^{II} and b^{II} coordinat (from Rufener, 1988), distance modulus (m_v-M_v). The m_v values are taken from Table 1 M_v for most non-reversive stars are taken from Lebedev (1986), for the lackin ones we calculated them using the known effective temperature and analytic expres sions from Lebedev (1986). Note that M_v values determined by different authors ar largely dissimilar (up to 1^m). However, in the present work we need only a roug istance estimate to create a general picture of spatial distribution of non-eversive CP stars, so the indicated inaccuracies in distance evaluations will not reatly affect our conclusions. The information about the cluster membership (from opylov, 1987 and Lebedev, 1986) is given in the notes.

able 2. **Spatial distribution of non-reversive CP stars**

HD	α_{1950}	δ_{1950}	l^{II}	b^{II}	$m_v - M_v$	Notes
	SAMPLE 1					
	a) Stars "+"					
11187	$01^h48^m.2$	$+54^\circ10$	132°	-7°	6.9	
24712	03.52.9	-12.15	203	-44	4.1	
25823	04.03.5	+27.28	167	-18	3.5	Pleades group
30466	04.46.1	+29.29	172	-10	7.5	
37058	05.33.1	-04.52	209	-19	8.1	Orion OB1 c
50169	06.49.4	-01.35	214	-1	8.4	
55719	07.10.6	-40.25	252	-14	5.8	
58260	07.21.5	-36.15	249	-10	8.4	
74521	08.42.0	+10.16	217	30	5.9	Pleades group
09026	12.29.5	-71.51	301	-9	5.6	
19213	13.38.5	+57.28	110	59	6.2	
33029	14.58.9	+47.28	80	58	6.9	
37949	15.26.8	-17.16	348	31	5.0	
52107	16.47.8	+46.04	72	40	3.6	UMa
88041	19.50.7	-03.15	37	-15	4.6	
92678	20.12.3	+53.20	89	10	6.9	
15441	22.42.1	+55.20	106	-3	9.6	
	b) Stars "-"					
2453	00.25.8	+32.09	117	-30	5.2	
14437	02.17.3	+42.51	140	-17	7.5	
15144	02.23.6	-15.34	189	-65	4.2	
25267	03.57.8	-24.09	220	-48	4.8	
27309	04.16.6	+21.39	174	-20	5.7	Pleades group
35502	05.22.5	-02.52	205	-20	8.1	Orion OB1 a
37017	05.32.9	-04.32	208	-19	8.3	Orion OB1 c
42616	06.10.2	+41.43	172	11	6.6	
73340	08.34.2	-50.47	268	-6	6.8	
92664	10.38.5	-64.50	290	-6	6.0	IC 2602
94660	10.52.8	-41.58	304	8	6.3	
96446	11.04.0	-59.41	290	0	9.2	
96707	11.06.5	+67.29	137	47	4.2	
111133	12.44.5	+06.13	300	69	5.9	
112381	12.56.8	-54.33	304	8		
116458	13.22.2	-70.22	306	-8	5.6	
118022	13.31.6	+03.55	328	64	3.3	
130559	14.46.6	-13.56	341	40	5.4	Sco-Cen
142990	15.55.6	-24.41	348	21	6.4	Upp Sco B
147010	16.17.2	-19.56	355	21	8.2	Upp Sco B
149911	16.35.3	-06.26	9	26	4.9	
151965	16.51.5	-40.33	344	2	6.3	
168733	18.19.5	-36.42	357	-11	6.3	
196178	20.32.3	+46.31	85	4	6.4	

Table 2. (continued)

HD	α_{1950}	δ_{1950}	l^{II}	b^{II}	$m_v - M_v$	Notes
	SAMPLE 2					
	a) Stars "+"					
22920	3.38.2	-05.22	192	-44	6.3	
24155	3.48.5	12.54	176	-31	6.2	
34452	5.15.7	33.41	173	-2	6.6	
36526	5.28.7	-01.36	205	-18	8.7	Orion Ass 52b
51418	6.55.8	+42.33	174	+19	6.2	
81009	9.20.4	-09.37	242	+27	5.1	
115708	13.16.2	+26.38	27	84	7.7	
143473	15.58.7	-37.24	340	11	-	
144661	16.04.9	-24.20	350	20	7.0	Upper Sco B
146001	16.11.9	-25.21	350	18	6.6	Upper Sco B
205087	21.30.2	+23.10	75	-20	6.9	
	b) Stars "-"					
9996	1.35.5	+45.09	132	-17	6.1	
25354	3.59.9	+37.55	159	-11	6.8	
37776	05.38.4	-01.32	206	-16	8.7	Orion OB1 b
101065	11.35.2	-46.26	290	14	7 ?	
108662	12.26.4	+26.11	225	85	4.5	
119419	13.41.1	-50.46	311	11	7.3	
128898	14.38.4	-64.46	314	-5	1.7	
133652	15.03.5	-30.43	334	24	6.8	
140160	15.39.4	+13.00	22	48	4.3	
142301	15.51.7	-25.06	347	22	7.6	Upper Sco B
143699	16.00.1	-38.28	339	10	6.1	Upper Sco B
144334	16.03.1	-23.28	350	21	6.4	Upper Sco B

Let us consider Tables 1 and 2 in more detail. We will start with the appar magnitude analysis to reveal if there are any differences, as a whole, between reversive stars of different polarity.

1. In sample 1 the mean apparent magnitude m_v of the stars "+" is 6.43, that of stars "-" is 6.10; in sample 2, m_v "+" is 6.27, m_v "-" is 6.00.

Thus, the mean visual magnitude of the stars "+" is 6.37±0.22, that of the st "-" is 6.06±0.16.

Although the differences are insignificant, there is some evidence that the st "-" are visually by 0.3^m brighter and the distribution dispersion of apparent mag tudes of the stars "-" is a little lower.

2. In general sample (1+2) there are 9 stars "-" and 4 stars "+" in the yo Orion and Scorpion clusters. Two stars "+" in Orion have m_v=7.81; for three stars m_v=6.98. Similar is the picture in Scorpion, m_v = 6.17 for two stars "+" and m_v =5 for six stars "-". In spite of the small number of stars one can not but notice same trend; the stars "-" are brighter, and their membership in the young clusters larger than that of the stars "+".

Let us emphasize once again that we discuss the distribution of apparent mag udes, and the obtained differences, if they actually exist, may result from both the eal peculiarities in spatial distribution of CP stars in the solar neighbourhood and he differences in physical parameters of the investigated stars.

Below we will consider in more detail the spatial distribution of non-reversive tars on the basis of Table 2 and Fig. 1 data.

Fig. 1a displays the distribution of the tars "+" from our samples against the ga- actic coordinates l and b, Fig. 1b the istribution of the stars "-".

Analysing Fig. 1(a,b) one can see that he distribution of the stars "+" with ga- actic coordinates is uniform enough, while here are some peculiarities in the distribution of the stars "-": in the region of alactic longitudes from 220° to 290° they re absent, and for the region from 20° to 20° there is only one CP star, HD 196178, ith a predominance of magnetic field of "-" polarity.

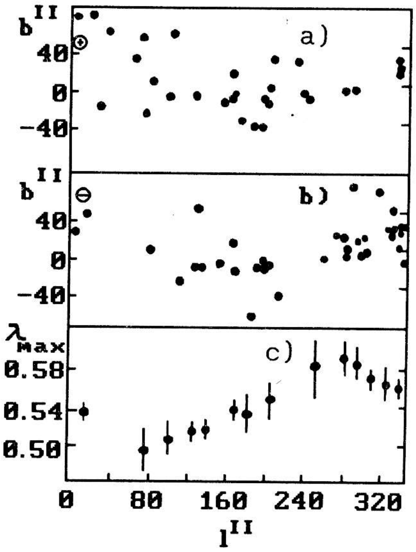


Fig. 1. *Spatial distribution of non-reversive CP stars.*

The small body of data restricts us only to an approximate qualitative escription, which necessitates a new observing program: check for reality of the B_e ign differences in the solar neighbourhood.

Let us name the direction, where there are no stars "-", and the direction normal o it A and B, respectively. Near the Sun (at the distance less than 500 pc) agnetic field of the Galaxy is parallel to its plane and directed to l=40°-50° Spoelstra, 1977), that approximately coincides with the direction A. Thus, the on-reversive stars "-" are concentrated predominantly perpendicularly to the local piral arm of the Galaxy plane. Note that there exist other evidences that two di- ections are dissimilar in the circumstellar space. For example, the variation of $_{max}$ (the wavelength of maximum interstellar polarization) with galactic longitude t distances less than 500 pc, presented in the paper by Whittet (1979), has extrema n direction A (Fig. 1c). The variability of λ_{max} is most likely to be associated with he different size and orientation of dust particles in the nearest neighbourhood Gould belt).

The distribution of non-reversive CP stars versus the distance from the Sun is of ertain interest too. Since, as we note above, only a small sample of stars has been nvestigated and their M_v-values only roughly estimated, we restrict ourselves nly to a qualitative description.

In Fig. 2 one can see the distribution of the stars "+" and "-" with galactic ongitude l (in azimuth) and distance modulus m_v-M_v (in radius). Data analysis shows hat no differences in the dependence of distribution of different polarity non-reversive stars on the distance modulus are observed.

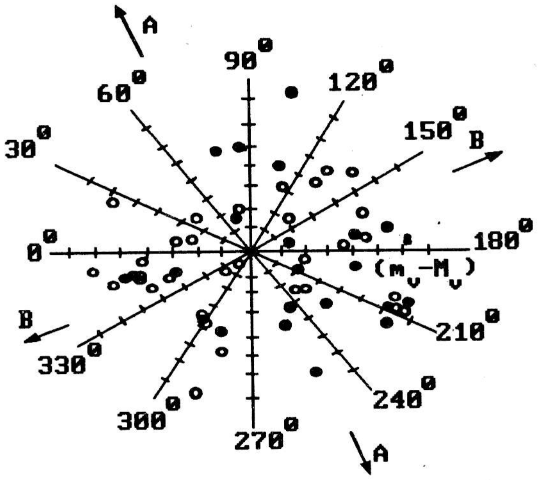


Fig.2. *Spatial distribution of non-reversive CP stars. Coordinates: in azimuth - galactic longitude* l^{II}, *in radius - distance modulus* m_v-M_v. o - *stars "-",* ● - *stars "+".*

As has been repeatedly mentioned above, the quantitative analysis of this distr bution makes no sense because of the paucity of stars in the sample, therefore t deficit of CP-stars in direction A is considered a problem to be solved in t future.

One of the possible reasons for the spatial inhomogeneity of the B_e signs to ari may be the observational selection, because magnetic measurements are relatively ra and magnetic observations are mainly conducted at the few largest telescopes in th northern hemisphere.

We can not expect an essential increase (2-3 times or more) in the number of no reversive CP stars in the next few years, so the cardinal solution to this probl will be postponed.

We will attempt to analyse this problem from a different view point: on the basi of investigation of the B_e signs obtained from each individual magnetic, spectral o photoelectric measurement. The total number of magnetic measurements is over 200 and we hope to obtain results whose reliability will be estimated quantitatively. L us inspect the signs of individual magnetic measurements of reversive and no reversive CP stars and compare the B_e sign distribution in different directions i the nearest neighbourhood of the Sun.

3. COMPARISON ANALYSIS OF SIGNS OF INDIVIDUAL MAGNETIC MEASUREMENTS

3.1. Photographic magnetic measurements

Most information about magnetic fields of CP-stars has been obtained, up to no by photographic techniques. The known catalogue of Babcock (1958) contains more th half of all the published measurements. The magnetic field measurement results for 8 sharp-line CP stars, observed at the Mt. Wilson and Palomar Observatories for ove 10 years, are given, and we believe that the various peculiarities associated wi the discretness of observing and weather conditions must be averaged.

Let us analyse Babcock's data in more detail. For this purpose we will construct a histogram of distribution of all 590 individual measurements of the longitudinal components (for stars with quantitative estimates) with a step of 200 Gs, which is consistent with the typical accuracy of magnetic field measurements (Fig. 3). It is essential to point out that the histogram (Fig.3) presents the data for both reversive and non-reversive stars, the number of measurements for them strongly differ. It is clearly seen in Fig. 3 that the distribution of measurements with "-" is more compact, whereas for "+" a large dispersion is noted. Attention is attracted to the small number of "zero-field" measurements.

The quantitative statistical analysis shows that the sample of all the measurements is described by normal distribution with the following parameters: average +131 Gs, standard deviation 1083 Gs, standard error 43 Gs, skewness 0.36, kurtosis 1.56.

We will consider below if there are differences in the distribution of field measurements in the earlier selected directions in space for non-reversive stars: direction A (parallel to the Galaxy magnetic field direction, Fig. 4a) and direction B (perpendicular to the Galaxy magnetic field direction, Fig. 4b)

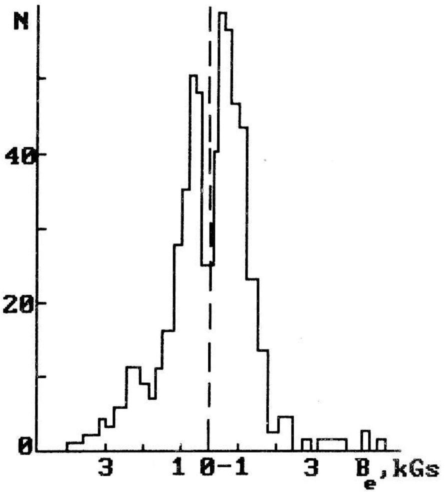


Fig.3. *Distribution of magnetic field measurements from Babcock's (1958) catalogue.*

The distribution of 330 CP stars from Babcock's catalogue in direction A is given in Fig. 4a: 203 of them are "+" and 127 are "-". This sample, as the previous one, is described by the normal distribution with the parameters: average +483 Gs, standard deviation 1025 Gs, standard error 56 Gs, skewness 0.68, kurtosis -0.10.

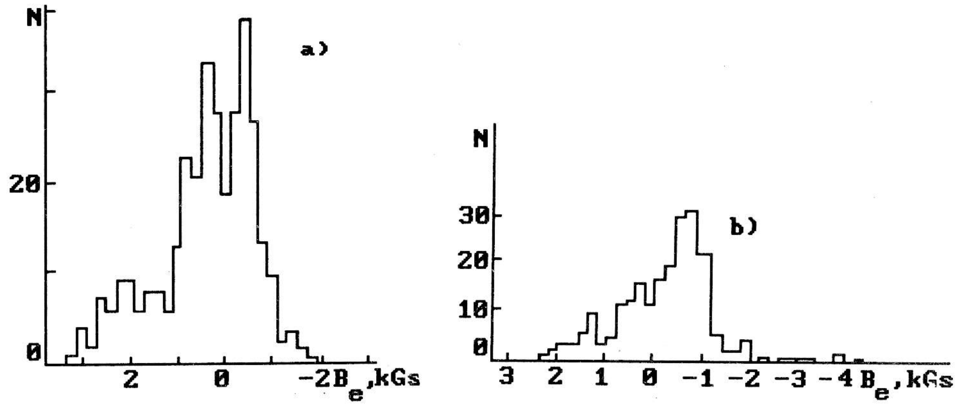


Fig. 4a. *Distribution of non-reversive CP stars from Babcock's (1958) catalogue in A (a) and B (b) directions.*

The distribution of 260 B_e measurements in direction B from the same catalogue is shown in Fig.4b. A comparison with Fig.4a reveals a large difference: 83 measurements "+" and 177 measurements "-". This sample is described by the normal distribution also: average, -318 Gs, standard deviation, 1027 Gs, standard error, 64 Gs, skewness, -0.46, kurtosis, 2.31. Using the t-distribution of Student criteria (comparison of average $\bar{X}_1$ and $\bar{X}_2$ in 2 samples) we obtain

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} - \frac{\sigma_2^2}{n_2}}} = 9.45,$$

that shows that the samples from Fig. 4a and Fig. 4b differ with the high degree of reliability (more than 99.9%). Standard deviations in both samples are equal, only average parameters differ.

Thus, we have shown that not only the spatial distribution of non-reversive stars (Fig.1), but the distribution of magnetic measurements of reversive stars (Fig. 4a,b) indicates that "-" B_e measurements in direction A are deficient.

However, our list of non-reversive stars mainly contains measurements from Babcock's catalogue and therefore we cannot consider the distributions in Fig. 1 and Fig. 4a,b independent.

As independent with respect to the list of non-reversive stars we proposed the sample of measurements of reversive stars from Babcock's (1958) catalogue. In Table 3 is presented a list of 26 stars with the reversive longitudinal component of the field: 15 stars in direction A and 11 in direction B.

Table 3. Reversive CP stars from Babcock's catalogue

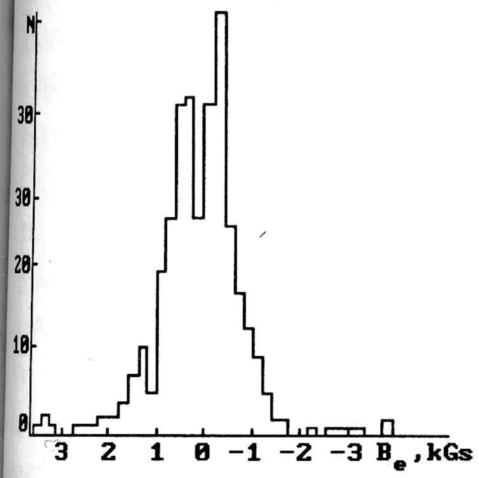
Direction A l = 20°- 120°; l = 220°- 290°	Direction B l = 120°- 220°; l = 290°- 20°
HD	HD
89822, 90569, 98088, 110066,	4174, 8441, 10783, 18296,
125248, 126515, 137909, 143807,	32633, 33254, 33904, 65339,
153882, 173650, 176232, 179761,	78316, 129174, 134793.
191742, 192913, 208816.	

For the 26 reversive stars mentioned above Babcock's catalogue contains different number of B_e measurements, whose normal distribution is shown in Fig.5.

The general picture is more symmetrical than in Fig.3. Let us see if there are differences in the distribution of B_e measurements in directions A and B in space (Fig. 6a,b).

In Fig.6a (similarly to Fig.4a) the distribution of measurements in direction A and in Fig. 6b (similarly to Fig.4b) in direction B is presented.

The distribution of 82 measurements with the sign "+" and 77 measurements with the sign "-" is shown in Fig. 6a, and that of 33 measurements with sign "+" and 43 easurements with sign "-" is shown in Fig. 6b.



ig. 5. *Distribution of the field easurements of reversive CP stars n the basis of Babcock's (1958) atalogue.*

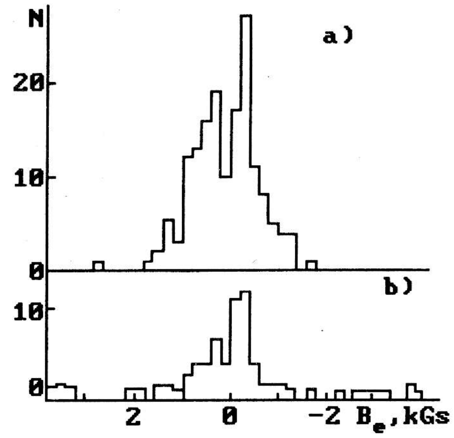
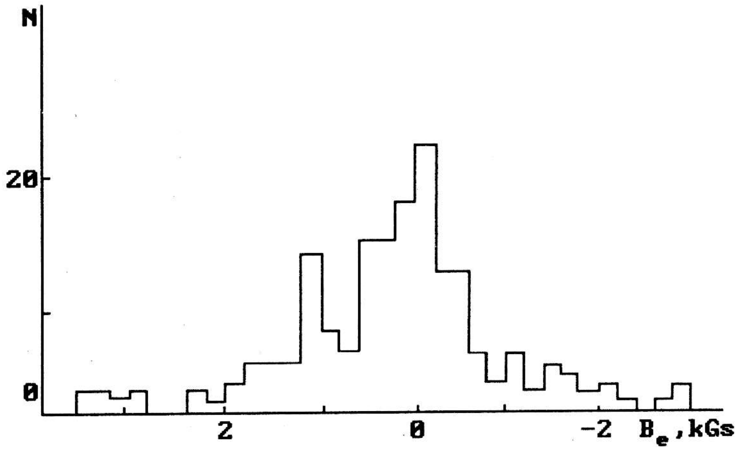


Fig. 6. *Distribution of the field measurements of reversive CP stars on the basis of Babcock's (1958) Catalogue, a) A direction, b) B direction.*

Distribution of the field measurements in both samples (Fig.6a and b) is normal. here are no statistically significant distinguishes between them, though in the sky egions, where non-reversive stars "-" are absent, the reversive stars apparently how a not clear deficit of field measurements "-" too.

Inspection of all the histograms shows that there are no B_e "zero-point" shifts in abcock's measurements, there are no such shifts in the photographic magnetic easurements on the 6 m telescope either (Fig. 7).



ig. **7.** *Distribution of magnetic ield longitudinal component B_e, easured on the 6 m telescope (stars with vsini ⩽ 40 km/s).*

The SAO list of stars essentially differs from the Babcock's list. While Babcock tried to investigate a maximum number of stars with the purpose of search for a magnetic field, our list contains information on only about 20 stars with the rotational elocity vsini<40 km/s. For each of the 20 stars a large number of spectra were obtained for a detailed investigation. Measurements are distributed normally.

Since we investigated, on average, more rapidly rotating stars, the dispersion of our measurements is larger. However, there exist common distribution properties for both lists: more gentle sloping towards "+" and more compact disposition of "-" measurements. As we have noted above, the "zero-point" shifts are absent in our photographic measurements.

3.2. Photoelectric measurements

To analyse photoelectric magnetic field measurements, we used both the data o Landstreet and our own. The field determination techniques differ essentially fro photographic: the V-Stokes parameter (i.e. differences in circular polarization valu in the spectral line wings) is measured, but not the shift of the centres of gravit of orthogonal circularly polarized Zeeman components.

Landstreet with his co-authors observed magnetic fields photoelectrically, mainl in the USA and Canada, but measurements from the southern observatories are available too.

Most measurements were made for He-rich (Fig. 8) (Borra and Landstreet, 1979; Landstreet and Thompson, 1987; Bohlender et al., 1993)) and He-weak (Fig. 9) (Borra et al., 1983) stars. Both reversive and non-reversive stars with anomalous He lines were investigated simultaneously.

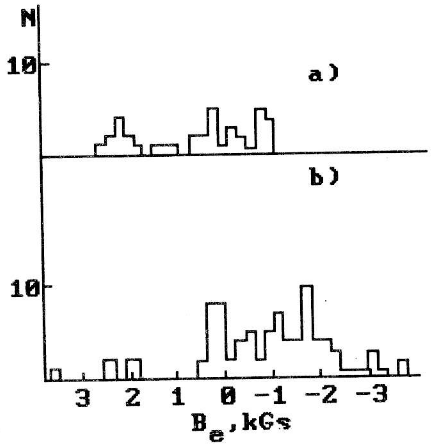


Fig. 8. *Distribution of photoelectrical measurements of magnetic field for He-r stars from the data of Borra and Landstreet (1979), Landstreet et al. (1987), Bohlender et al. (1993).*
a) A direction,
b) B direction.

For further analysis, as well as for the photographic measurements, let us construct histograms with a step of 200 Gs.

Fig.8(a,b) shows the measurements of He-r stars in direction A (Fig.8a) 23 measurements "+" and 15 measurements "-", in direction B (Fig 8b) 25 measurements "+" and 58 measurements "-". Both samples are distributed normally with the following parameters. Fig.8a: average +590 Gs, standard deviation 1202 Gs, standard error 195 Gs, skewness 0.43, kurtosis -1.24. Fig.8b: average -875 Gs, standard deviation 1330 Gs, standard error 142 Gs, skewness 0.65, kurtosis 0.97, t criterion of Student distribution 6.08, that mean a very great difference between averages in 2 compared samples. In Fig.8 one can see a very great difference in the distribution of measurement of He-r stars in directions A and B. It is very important that this difference is in good agreement with that taken from the independent photographic measurements. A second remarkable feature is the much larger number of measurements in direction B (83) than in direction A (38). Observational selection effects could not produce such a great discrepancy. Here we deal rather with the actual reason: a larger concentration of hot He-r stars in direction B.

We observe more striking differences in the number of measurements of He-r stars in direction A (21, Fig. 9a) and B (125, Fig. 9b), clear evidence of the very high degree of reliability of the differences in the concentration of He-r stars with the observed magnetic field in the two different directions.

As to the signs of measurements, the picture is the following: in direction A - 11 measurements "+" and 10 measurements "-"; in direction B - 52 measurements "+" and 73 measurements "-". It can be seen that we have very few measurements with a small field value in direction A, and many "-" measurements in direction B (the same as for He-r stars), besides, the field "-" has a larger mean value and a larger dispersion.

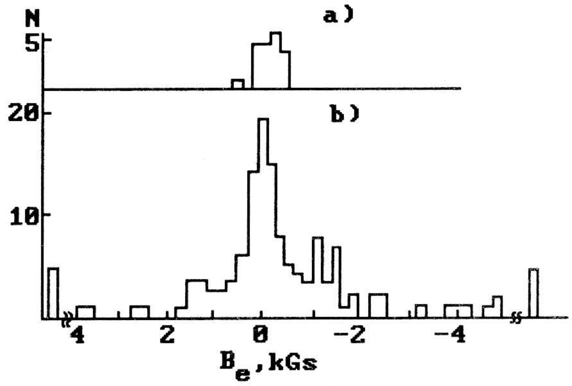


Fig. 9. *Distribution of magnetic field measurements for He-w stars from the data of Borra et al. (1983).*
a) A direction,
b) B direction.

Inspection of these and other photoelectric measurements shows that no "zero-point" shifts are observed for them.

The distributions of photoelectric magnetic measurements obtained with the SAO 6 m telescope is shown for illustration in Fig. 10, where it is clearly seen that "false" fields do not arise due to instrumental errors.

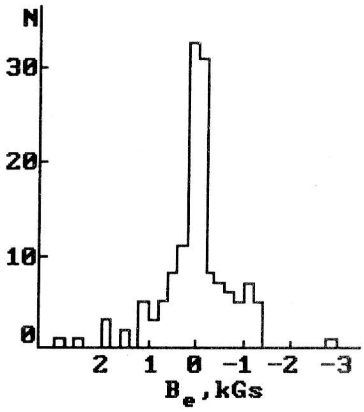


Fig. 10. *Distribution of photoelectric measurements obtained on the 6 m telescope.*

DISCUSSION OF RESULTS

Analysis of accessible magnetic measurements shows that the longitudinal magnetic field component is distributed inhomogeneously in space: at the galactic longitudes

20°-120° and 220°-290°(along the local spiral arm) the deficiency of non-reversive "-" stars and the deficiency of measured fields "-" are observed in the nearest neighbourhood (<1000 pc) of the Sun. This conclusion is confirmed independently: 1) by distribution of non-reversive stars, 2) by distribution of all magnetic measurements from Babcock's list, 3) by distribution of He-r star photoelectric measurements, 4) by distribution of photoelectric measurements of He-w stars.

The independent support for the existence of inhomogeneous distributions and the absence of the "zero-point" shifts indicate that the effect revealed is highly probable, while, on the other hand, the large uncertainties in the matter of sample completeness, insufficient body of data and possible effects of observational selection left out of account restrict us only to a quantitative discussion.

The aim of the present paper is to inform the investigators of stellar magnetic fields that the recent observations provided new information, which is somewhat unexpected and has not been discussed earlier. The joint efforts of many investigators are needed to decide whether we have revealed the true inhomogeneity in the spatial distribution of the signs of magnetic fields, or this is a false effect due to the small number of observations.

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