A search for magnetic stars in late stages of stellar evolution

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Two well-known types of stars with strong dipolar magnetic fields have been extensively studied. These are the magnetic CP stars and the magnetic white dwarfs. In a number of papers, it is suggested that these types of stars may be related by evolution: CP stars could be progenitors of magnetic white dwarfs (Angel et al. 1981). Investigation showed that magnetic fields in CP stars do not change significantly during their lifetime on the main sequence (Glagolevskij et al. 1986).

What happened with the magnetic field later on, after the star has left the main sequence? Stępień (1993) proposed that some very slowly rotating yellow giants or subgiants with strong chromospheric and spot activity, could be former Ap stars with strong magnetic fields.

When the stars become red giants, they undergo a deep convective mixing (first dredge-up) at the red giant branch (RGB), before helium ignition in the core. At the asymptotic giant branch (AGB), they have a second dredge-up (Iben 1991). The internal structure of the star significantly changes in this case.

After the RGB and AGB, the star looses a large part of its own mass. If the field is not completely destroyed at these episodes, it must also change much. This can be traced if the magnetic fields are investigated in stars of intermediate evolution stages, between the main sequence and white dwarfs.

In this context, it is our opinion that there are two types of stars which should be examined for the presence of strong dipolar magnetic fields: the horizontal branch A and B stars, and the hot subdwarfs. These stars are appropriate for direct magnetic measurements using Zeeman spectroscopy, since they show strong and narrow absorption lines in their spectra. In addition, some of them may possess chemical abundance anomalies similar to main sequence CP stars (Bashek and Sargent 1976, Kodaira and Philip 1984, Heber 1992), suggesting an intriguing link between the CP stars and the evolved A and B stars.

Here, we present the results of a continuing search for strong magnetic fields in horizontal branch stars and in hot subdwarfs, using Zeeman spectra obtained at the 6-metre telescope.

Contrib. Astron. Obs. Skalnaté Pleso **27**, (1998), 452– 454.

Table 1. Stellar parameters of Field Horizontal Branch stars

Star	M_v	$T_{\rm eff}$	log g	$vsini$	[Fe/H]	$M/M_\odot$
HD 60778	0.95	8200	3.2	17	-0.5	
HD 74721	1.0	8700	3.6	9	-1.11	
HD 86986	0.9	7900	3.1	20	-1.3	0.48
HD 97859		15300	4.0	105	-1.2	
HD 109995	1.1	8300	3.2	15	-1.3	0.37
HD 117880	2.5	8400	3.6		-1.7	
HD 161817	0.8	7500	2.9	10	-1.0	0.42
HD 169027	0.3	11600	3.8			

Table 2. Magnetic fields and radial velocities of FHB stars

Star	B_e (G)	$\pm\sigma$ (G)	RV (km/s)
HD 60778	+150	115	+74
HD 74721	+240	150	+40
HD 86986	-430	580	+3
HD 97859	-400		+66
HD 109995	-820	470	
	+700	520	-139
HD 117880			+142
HD 161817	+30	110	
	-550	140	-368
	-90	80	
	+100	160	-366
HD 169027	-320	820	-26

Table 3. Parameters for hot subdwarfs

Star	Sp	M_v	$T_{\rm eff}$	log g
HD 4539	sdB	3.6	25000	5.4
Feige 87	sdB		28000	5.6
HD 76431	sdB	2.0	35000	4.5
BD+75°325	sdO	4.0	50000	5.3
BD+25°2534	sdOp	4.1	34000	5.5
BD+25°4655	sdO		42200	6.7
HD 128220	sdO+G		42500	4.5
HD 149382	sdOB	4.5	35000	5.5

Table 4. Magnetic field measurements of hot subdwarfs

Star	B_e (G)	$\pm\sigma$(G)	Comment
HD 4539	-1300	2100	$\lambda 4000-4600$ Å
	+670	500	HeI λ 5876 2 spectra
Feige 87	-1800	3500	H-magnetometer.
HD 76431	-50	130	$\lambda 4000-4600$ Å
BD + 75°325	+1260	870	$\lambda 4000-4600$ Å
	-1680	60	HeI λ 5876 3 spectra
	+970	140	HeI λ 4471 3 spectra
	-80	280	HeI λ 5876 2 spectra
BD + 25°2534	+460		$H\alpha$ 1 spectrum
	+1750	230	$H\alpha + HeI$ λ 5876
	-1300	600	HeI λ 5876 2 spectra
	-1100	390	HeI λ 5876 2 spectra
	-100	400	HeI λ 5876, 6678
BD+25°4655	+240	340	HeI λ 6678 2 spectra
	400	280	$\lambda 4400-4500$ Å
	-400	240	$\lambda 4400-4500$ Å
HD 128220	-520	950	$\lambda 4000-4600$ Å
	-340	400	HeI λ 5876 3 spectra
	170		HeI λ 5876 1 spectrum
HD 149382	-10	890	$\lambda 4000-4600$ Å
	-1200	900	HeI λ 5876 3 spectra

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