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High resolution spectroscopy over $\lambda\lambda$ 8500–8750 Å for GAIA*

IV. Extending the cool MK stars sample

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Abstract. A library of high resolution spectra of MK standard and reference stars, observed in support to the GAIA mission, is presented. The aim of this paper is to integrate the MK mapping of Paper I of this series as well as to consider stars over a wider range of metallicities. Radial velocities are measured for all the target stars.

Key words. atlases – standards – stars: fundamental parameters

1. Introduction

This paper is the fourth of a series devoted to the spectroscopy of the ESA Cornerstone mission GAIA. The GAIA Radial Velocity Spectrometer (RVS) will provide the 6th component of the phase-space coordinates for all stars brighter than V = 17.5 magnitude. High resolution ($R \sim 20\,000$) high signal to noise ($S/N \geq 100$) spectra of cool (later than F0) MK standard and reference stars in the GAIA wavelength range ($\lambda\lambda$ 8480–8750 Å, centered on the Ca II triplet) are presented, with the awareness that some of them could be peculiar in the far red (Jaschek & Andrillat 1998). The aim of this paper is to extend and integrate the MK atlas by Munari & Tomasella (1999, Paper I) by obtaining a finer grid for F, G, K stars, a wider metallicity range and a larger sample of M stars. Table 3 shows the MK system mapping by this paper (crosses) and Paper I (open circles) combined, for the cool stars that will account for the vast majority of all GAIA targets.

These spectral libraries will be of aid in the preparatory studies and training of the reduction pipeline of the GAIA mission as already described in Paper I. General discussions of the diagnostic capability of this spectral range and review of existing literature can be found in Munari (1999); Chmielewski (2000); Cenarro et al. (2001); Munari (2002, 2003). Figures 1, 2 and 3 give examples of the collected spectra and illustrate respectively the effect of gravity and metallicity at G5 (compare with Fig. 2 in Paper I), the effect of gravity at F5 and at K4.

2. Target selection

Table 1 lists the target stars, ordered by spectral type, and Table 2 the references to it. We selected stars with MK classification obtained from spectroscopy (targets belonging to Keenan and collaborators' lists were favored) and considered only spectroscopic [Fe/H] determinations. We preferred: *a)* bright stars; *b)* stars of luminosity classes I, III and V, to better define the main groups and *c)* slowly rotating stars. We avoided: *i)* eclipsing and/or spectroscopic binary stars; *ii)* visual binaries with angular separation lower than 0.5 arcsec, unless the magnitude difference is greater than 4 mag; *iii)* highly variable stars. The above constraints are further restricted by observational limits ($V \lesssim 10$ mag and $\delta \gtrsim -25°$). Thus no attempt was made to include M dwarfs or L and T ultracool stars, given their faintness. Concerning [Fe/H], even accurate determinations obtained from high resolution spectroscopy show discrepancies (Cayrel de Strobel et al. 1997, 2001). Straight mean values have no direct meaning because of the lack of homogeneity of the sources. We thus preferred Taylor (1995, 1999) weighted means, which were obtained after a shift to a common zero point, but adopted Cayrel de Strobel et al. (1997, 2001) ranges when Taylor's values where not available. The analysis of M stars spectra is a complicated task, so only few of them have reliable [Fe/H] measurements.

Large amplitude photometric variability usually leads to spectral variations and thus must be considered. All the program stars were searched for in the GCVS (General Catalogue

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* The spectra are available in electronic form (ASCII format) at CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via
http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/406/995
and from the web page http://ulisse.pd.astro.it/MoreMK/, where further bibliographical information for the target stars is given.

Table 1. Target stars. ϕ denotes the variability index, and η the chromospheric activity index. Details are given in the text, Sect. 3.

	V_T	$(B-V)_T$	Spectral Type	[Fe/H]	Var. name	ϕ	η	$v_{rot}\,sini$ (km/sec)	Refs.	HJD (−2451000)	$v_\odot$ (km/sec)	S/N
HD 130817	6.181	+0.40	F2 V	− 0.39 / − 0.51				~15	4 ,5a, , ,11	716.4	− 36.8 ±1.2	120
HD 182835	4.729	+0.61	F2 Ib		NSV 12021	*S*		3.8 ± 2.0	1d, ,10, ,11	770.4	− 4.8 ±0.8	206
HD 91752	6.337	+0.45	F3 V	− 0.246 ± 0.044				9.0 ± 3.0	4 ,6b, , ,11	681.3	− 25.7 ±0.3	177
HD 101606	5.790	+0.46	F4 V	− 0.82 / − 0.74				<15.	4 ,5a, , ,11	681.5	+ 33.8 ±0.4	162
HD 71433	6.657	+0.55	F4 III	+ 0.100 ± 0.100				20	4 ,6a, , ,11	951.4	+ 50.8 ±1.4	108
HD 87141	5.764	+0.52	F5 V	+ 0.047 ± 0.053				15.0 ± 3.0	4 ,6b, , ,11	951.6	− 20.5 ±0.8	107
HD 171802	5.419	+0.40	F5 III	+ 0.10			M	~8	4 ,5a, ,15,11	770.3	− 33.2 ±1.2	229
HD 193370	5.235	+0.71	F5 Ib	+ 0.00	NSV 12994	*S*		10.0	1d,5b,10, ,11	770.5	− 9.2 ±1.0	150
HD 20902	1.866	+0.55	F5 Ib	− 0.02	NSV 01125	*S*		17.9 ± 1.0	1c,7 ,10, ,11	919.3	− 6.8 ±1.7	173
HD 142860	3.882	+0.52	F6 V	− 0.201 ± 0.047	NSV 07350	*C*	L	~10	1d,6b,10,15,11	716.4	+ 5.6 ±0.6	172
HD 124850	4.126	+0.55	F6 III	− 0.129 ± 0.043	NSV 06604	C	L	~15	4 ,6a, 9,15,11	655.5	+ 10.8 ±0.7	193
HD 99373	6.376	+0.47	F7 V					~8	4 , , , ,11	681.4	− 25.0 ±0.5	140
HD 14662	6.383	+0.94	F7 Ib		V 440 Per	S		10.0	4 , , 9, ,11	951.3	− 3.7 ±0.7	132
HD 171635	4.832	+0.68	F7 Ib				L	4.8 ± 2.3	2b, , ,15,11	770.4	− 12.9 ±0.7	196
HD 90839	4.880	+0.56	F8 V	− 0.220 ± 0.136			L	10	4 ,6b, ,15,11	681.3	+ 9.4 ±0.4	181
HD 47703	6.538	+0.53	F8 III					~6	4 , , , ,11	955.4	+ 84.7 ±0.8	117
HD 102870	3.649	+0.61	F9 V	+ 0.180 ± 0.044		C		~5	1c,8 , 9, ,11	656.4	+ 4.9 ±0.5	140
HD 74462	8.790	+1.12	G0 III	− 1.61 / − 1.36					3a,5a, , ,	565.5	−168.8 ±0.4	152
HD 208110	6.230	+0.88	G0 III					~4	4 , , , ,11	770.5	− 8.0 ±0.4	141
HD 16901	5.534	+1.01	G0 Ib-IIa	+ 0.01			L	6.3 ± 2.2	1a,5a, ,14,11	565.4	− 1.0 ±0.6	156
HD 119605	5.655	+0.88	G0 Ib-IIa	+ 0.11					1b,5a, , ,	655.4	+ 0.2 ±0.6	197
HD 65448	6.151	+0.76	G1 III					~2.4	4 , , , ,11	655.4	+ 23.4 ±0.3	203
HD 188650	5.867	+0.87	G1 Ib-II	− 0.40		C			1b,5b, 9, ,	715.6	− 24.3 ±0.8	164
HD 74395	4.716	+0.92	G1 Ib	− 0.11			L	~7.5	1b,5a, ,14,11	955.4	+ 28.0 ±0.6	100
HD 76151	6.069	+0.74	G2 V	+ 0.132 ± 0.051			M	1.6 ± 1.1	1a,6b, ,14,11	955.5	+ 31.3 ±0.6	107
HD 67594	4.456	+1.11	G2 Ib				M	7.2	1a, , ,14,12	951.4	+ 28.6 ±0.5	156
HD 71148	6.390	+0.69	G5 V				H	<15	4 , , ,15,11	655.4	− 30.4 ±0.3	169
HD 71369	3.436	+0.97	G5 III	− 0.043 ± 0.061	NSV 04093	C	L	~3	1a,6a, 9,14,11	565.4	+ 20.6 ±0.4	226
HD 88609	8.735	+1.01	G5 III	− 3.01 / − 2.10					5b,5a, , ,	565.6	− 36.5 ±1.0	148
HD 9900	5.696	+1.65	G5 Iab:	− 0.144 ± 0.121			L	5.5 ± 1.0	5a,6a, ,15,13	565.4	− 10.6 ±0.4	205
HD 110184	8.431	+1.32	G5 I	− 2.56 / − 2.18					5b,5a, , ,	569.6	+139.6 ±0.3	132
HD 117043	6.574	+0.86	G6 V						4 , , , ,	951.6	− 30.7 ±0.5	143
HD 79452	6.070	+0.93	G6 III	− 0.625 ± 0.072			M	~4.6	4 ,6a, ,14,11	656.4	+ 56.4 ±0.3	234
HD 67767	5.806	+0.92	G7 V			S	M		4 , , 9,14,	655.3	− 43.6 ±0.6	167
HD 77912	4.653	+1.19	G7 IIa	+ 0.38			M	4.4 ± 1.1	1a,5a, ,14,11	656.3	+ 17.5 ±0.4	208
HD 101501	5.390	+0.83	G8 V	− 0.070 ± 0.134	NSV 05291	S	M	2.3 ± 0.8	1a,6b, 9,14,11	681.4	− 5.0 ±0.4	138
HD 113226	2.917	+1.08	G8 IIIab	+ 0.041 ± 0.042	NSV 06064	*S*	L	~2.5	1a,6a,10,14,11	656.4	− 13.9 ±0.4	208
HD 90125	6.419	+1.14	G9 V						4 , , , ,	656.3	− 14.1 ±0.3	187
HD 108225	5.117	+1.09	G9 III	− 0.001 ± 0.052		C	L	1.4 ± 1.2	1b,6a, 9,14,11	951.6	− 4.9 ±0.4	158
HD 136442	6.452	+1.27	K0 V			C			4 , , 9, ,	715.4	− 47.4 ±0.5	153
HD 44391	7.823	+1.61	K0 Ib	+ 0.21					2b,5a, , ,	530.6	− 13.7 ±0.4	150
HD 102224	3.818	+1.41	K0.5 IIIb	− 0.388 ± 0.048	NSV 05319	*S*	M	1.1 ± 0.13	1b,6a,10,14,11	530.7	− 9.2 ±0.4	231
HD 218356	4.900	+1.52	K0.5 II	− 0.20 / − 0.15	NSV 14429	S	H	~4	1b,5a, 9,14,11	716.6	− 28.9 ±0.7	198
HD 108381	4.466	+1.32	K1 III	+ 0.085 ± 0.045			M	1.6 ± 1.0	1b,6a, ,14,11	279.5	+ 4.1 ±0.4	195
HD 94600	5.155	+1.27	K1 III	− 0.187 ± 0.078				1.3 ± 1.0	4 ,6a, , ,11	681.4	− 22.1 ±0.4	187
HD 81146	4.599	+1.45	K2 IIIb	− 0.028 ± 0.058			M	<1.9	1a,6a, ,14,11	279.4	+ 28.1 ±0.4	150
HD 85503	4.013	+1.48	K2 IIIb	+ 0.243 ± 0.027			M	~2.4	1a,6a, ,14,11	563.5	+ 13.1 ±0.4	199
HD 50877	4.041	+2.13	K2 Iab	− 0.11	ø[1] CMa	M	M	≤20	1a,8 , 9,14,11	570.4	+ 33.0 ±0.7	184
HD 102328	5.398	+1.51	K2.5 IIIb	+ 0.223 ± 0.049			M	1.1 ± 1.0	1b,6a, ,14,11	563.5	+ 0.9 ±0.5	154
HD 122064	6.611	+1.22	K3 V						4 , , , ,	955.5	− 26.7 ±0.5	99
HD 125560	4.981	+1.47	K3 III	+ 0.133 ± 0.053	NSV 06631	*S*	M	<1.0	4 ,6a,10,14,11	655.5	− 8.0 ±0.6	261
HD 150567	7.820	+1.44	K3 III	+ 0.34					3b,3b, , ,	592.6	− 51.7 ±0.5	119
HD 9138	4.995	+1.63	K3 III	− 0.452 ± 0.060			M	<1.0	1a,6a, ,14,13	563.3	+ 35.7 ±0.5	219
HD 107325	5.643	+1.28	K3 III	+ 0.191 ± 0.093	NSV 05559	*S*		<1.0	1b,6a,10, ,11	279.5	− 17.1 ±0.6	169
HD 131977	5.880	+1.28	K4 V	+ 0.016 ± 0.133			H	~1	1b,6b, ,14,11	655.5	+ 26.3 ±0.4	190
HD 79354	5.457	+1.90	K4 III		NSV 04427	S	H	3.0 ± 1.0	1a, , 9,14,11	279.3	− 31.6 ±0.4	188
HD 120539	5.075	+1.70	K4 III	− 0.184 ± 0.064			H	2.0 ± 1.3	4 ,6a, ,14,11	655.5	− 3.7 ±0.4	260
HD 219978	6.985	+2.77	K4.5 Ib	− 0.15	NSV 14501	S			1b,7 , 9, ,	771.5	− 24.6 ±0.5	246
HD 237025	8.969	+2.59	K5-M0 II						2a, , , ,	919.3	− 41.6 ±0.4	177
HD 17709	4.735	+1.86	K5.5 III	− 0.335 ± 0.089	NSV 00963	S	H	<15	1a,6a, 9,14,11	530.4	+ 14.9 ±0.4	221
HD 80493	3.291	+1.86	K6 III	− 0.191 ± 0.200	NSV 04456	S	M		1a,6a,10,14,	656.4	+ 40.0 ±0.4	205
HD 95578	4.912	+1.93	M0 III	− 0.23	NSV 05059	S	H	<20	1a,5a, 9,14,11	593.5	− 12.9 ±0.4	189
HD 100029	3.987	+1.94	M0 III		NSV 05231	S	H		1b, , 9,14,	279.4	+ 8.8 ±0.4	197
BD +56.595	8.409	+2.54	M0 Iab	Per OB1	V 439 Per	L			2a, , 9, ,	563.3	− 41.8 ±0.6	173
BD +63.2073	10.408	+3.38	M0 Ib						2a, , , ,	797.5	− 58.7 ±0.6	105
HD 102212	4.209	+1.79	M1 III		NSV 05318	S	H		1b, , 9,14,	656.4	+ 50.5 ±0.4	263
HD 35601	7.567	+2.70	M1.5 Iab-Ib	− 0.24	V 362 Aur	S			2a,5a, 9, ,	563.4	− 5.0 ±0.8	241
HD 14330	8.210	+2.49	M1 Iab	Per OB1	FZ Per	S			2a, , 9, ,	542.3	− 41.2 ±0.6	147
HD 117675	4.897	+1.92	M2.5 III		NSV 06297	S	H		1b, , 9,14,	955.5	+ 17.5 ±0.3	117
HD 202380	6.887	+2.82	M2 Ib	+ 0.07	NSV 13609	M			1b,5a, 9, ,	594.6	− 15.6 ±0.4	202
HD 13136	7.994	+2.71	M2 Iab-Ib	Per OB1					1a, , , ,	531.4	− 39.4 ±0.4	246
HD 36389	4.639	+2.44	M2 Iab-Ib	+ 0.11	CE Tau	M	M		1a,5a, 9,14,	563.5	+ 23.1 ±0.5	256
HD 217906	2.654	+1.96	M2.5 II-III	− 0.11	*β* Peg	S	H		1b,5a, 9,14,	716.6	+ 6.4 ±0.7	205
HD 120933	4.940	+1.94	M3- III	+ 0.50	AW CVn	S	H	5.1 ± 1.0	1b,5a, 9,14,11	569.5	− 43.0 ±0.5	218
HD 76827	4.942	+1.82	M3 III		NSV 04344	S	H		1a, , 9,14,	279.3	+ 5.6 ±0.4	168
HD 84335	5.311	+1.87	M3 III		CS UMa	S			1a, , 9, ,	655.3	+ 8.6 ±0.3	294
HD 236871	8.854	+2.65	M3 Iab-Ib		V774 Cas	M			2a, , 9, ,	951.4	− 44.3 ±0.6	134
BD +60.2613	9.120	+3.28	M3 Ia		PZ Cas	L			1b, , 9, ,	797.5	− 47.8 ±0.8	192
HD 112300	3.577	+1.80	M3+ III	− 0.09 / − 0.16	NSV 06026	S	M		1b,5a, 9,14,	951.6	− 21.3 ±0.4	186
HD 101153	5.487	+1.76	M4 III	− 0.08	*ω* Vir	*S*			4 ,5a, 9, ,	951.6	+ 7.2 ±0.6	193
HD 11401	8.140	+2.31	M4 III		NSV 00647	*S*			2a, ,10, ,	797.5	+ 3.7 ±0.6	173
BD +56.512	9.705	+2.11	M4 Ib	Per OB1	BU Per	L			2a, , 9, ,	531.5	− 35.7 ±0.5	222
HD 12401	8.053	+2.42	M4 Ib	Per OB1	XX Per	M			2a, 9, ,	951.3	− 22.8 ±1.0	160
BD +62.207	9.618	+3.25	M4 Ia		HZ Cas	L			2a, , 9, ,	797.5	− 53.5 ±0.8	166
HD 123657	5.394	+1.74	M4.5 III	− 0.03	BY Boo	S	M		1b,5a, 9,14,	955.5	− 36.8 ±0.4	257
HD 76830	6.518	+1.80	M4.5 III		NSV 04332	S			1a, , 9, ,	951.5	+ 21.7 ±0.5	287
HD 130144	6.021	+1.54	M5 IIIab		NSV 06796	L			4 , , 9, ,	715.4	− 23.8 ±0.6	413
HD 55690	8.341	+1.94	M5+ III		NSV 03466	*M*			1a, ,10, ,	951.4	− 11.7 ±0.4	130
HD 94705	6.116	+1.46	M5.5 III		VY Leo	M	M		1a, , 9,14,	951.5	− 8.5 ±0.5	282
HD 148783	5.047	+1.52	M6- III	− 0.06 / + 0.02	g Her	L	M		1b,5a, 9,14,	951.7	+ 0.2 ±0.6	277
HD 18191	5.951	+1.47	M6- III		RZ Ari	M			1a, , 9, ,	951.3	+ 47.1 ±0.6	311
HD 25725	8.745	+1.63	M7+ II		V Eri	L			1a, , 9, ,	951.3	+ 6.4 ±1.1	315

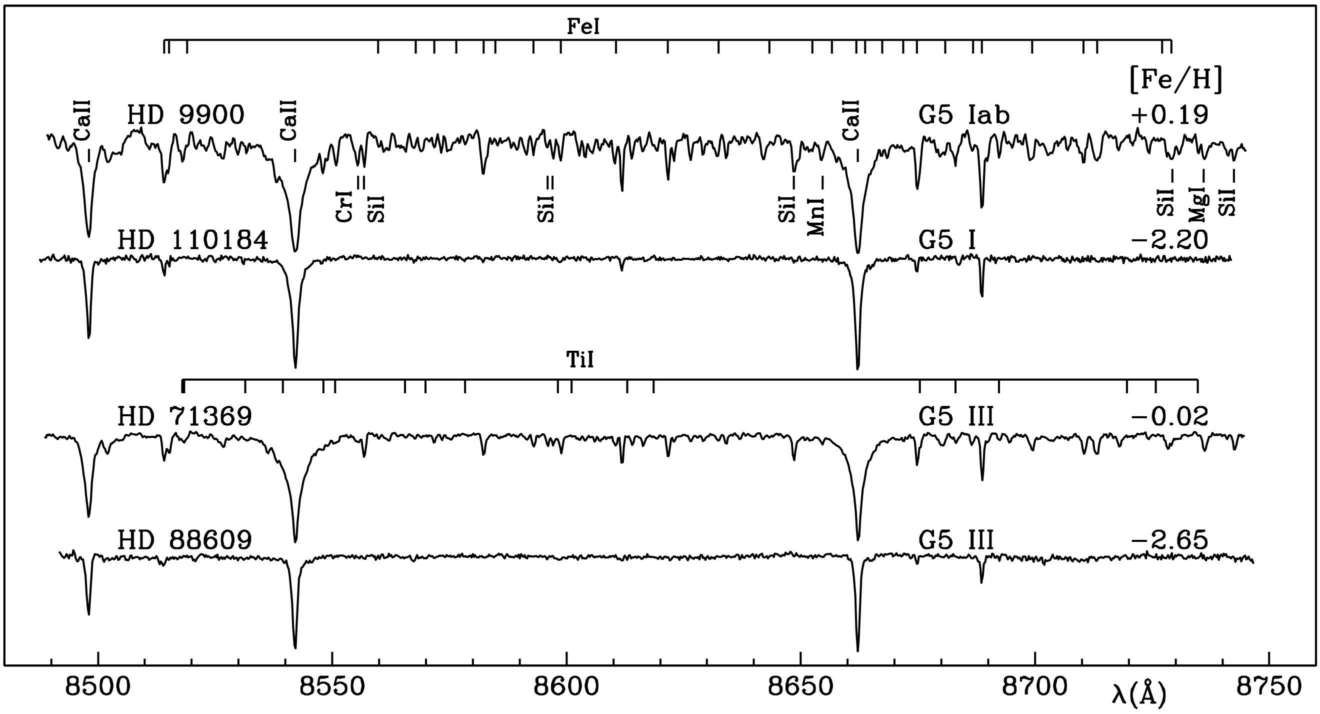

Fig. 1. Metallicity effects for G5 giants and supergiants. Spectra are shifted to null radial velocity.

Table 2. Reference codes for Col. 12 of Table 1.

Spectral Types	
1a	Keenan, P.C., Newsom, G.H. 2000, http://www.astronomy.ohio-state.edu/MKCool
1b	Keenan, P.C., MCNeil, R.C. 1989, ApJS 71, 245
1c	Morgan, W.W., Keenan, P.C. 1973, ARA&A 11, 29
1d	Johnson, H.L., Morgan, W.W. 1953, ApJ 117, 313
2a	Humphreys, R.W. 1970, ApJ 160, 1149
2b	Humphreys, R.W. 1970, AJ 75, 602
3a	Eggen, O.J. 1998, AJ, 115, 2397
3b	Eggen, O.J. 1993, AJ 106, 80
4	Hoffleit, D., Warren, W.H. 1991, CDS Cat. V/50
[Fe/H]	
5a	Cayrel de Strobel, et al. 2001, A&A 373, 159
5b	Cayrel de Strobel, et al. 1997, A&AS, 124, 299
6a	Taylor, B.J. 1999, A&AS 134, 523
6b	Taylor, B.J. 1995, PASP 107, 734
7	Thevenin, F. 1998, CDS Cat. III/193
8	Luck, R.E., Bond, H.E. 1980, ApJ 241, 218
ϕ = Variability	
9	ESA, 1997, *The Hipparcos Catalogue*, ESA SP-1200
	ESA, 1997, *The Tycho Catalogue*, ESA SP-1200
	Hog, E., et al. 2000, A&A 355, L27
	Adelman, S.J. 2001, A&A 367, 297
	Adelman, S.J. 2001, Balt.A 10, 589
	Piquard, S., et al. 2001, A&A 373, 576
	Koen, C., Eyer, L. 2002, MNRAS 331, 45
10	Kholopov, P.N., et al. 1998, CDS Cat. II/214A
η = Chromospheric activity	
14	Glebocki, R., et al.1980 AcA 30, 453
15	Duncan, D.K., et al. 1991, ApJS 76, 383
$v_{rot}\sin i$	
11	Glebocki, R., et al. 2000, AcA 50, 509
12	Pasquini, L., et al. 2000, A&A 361, 1011
13	de Medeiros J.R., Mayor, M. 1999, A&AS 139, 433

of Variable Stars, Kholopov et al. 1998) & NSV (New Suspected Variables Catalogue, Kazarovets 1999) and in the Hipparcos & Tycho catalogues. As reported by Hoffleit (1999) there are discrepancies on magnitude amplitudes between these two groups of sources (especially for semiregular variables). GCVS & NSV catalogue amplitudes are not an homogeneous data set and for some stars only photographic or visual measurements are reported. On the other hand Hipparcos observations cover 3.4 years and the amplitudes in successive cycles may not be constant. We thus decided not to report amplitudes in Table 1, but only an index (see next section) which gives a rough idea of the variability of the stars. Among M type supergiants and giants photometric and spectral variability is very common: several stars for each spectral type were observed in the attempt to map a mean spectrum by averaging over individual cycle phases, as suggested by Keenan et al. (1987). In a separate paper we plan to investigate the spectral variations of Cepheids and Miras as a function of phase.

The chromospheric activity (which is generally correlated with rotation in the sense that faster rotating stars show a higher activity) plays an important role affecting both the strength and shape of the line profiles. As core emissions in H&K Ca II lines and in Ca II triplet are correlated (Montes & Martin 1998), we report in Table 1 about the activity of a star whenever this information were available in the literature.

3. The data

All the spectra presented in this atlas were obtained with the Echelle + CCD spectrograph mounted on the Padova Observatory 182-cm telescope operated in Asiago at Cima Ekar. The spectral range covered was $\lambda\lambda$ 8480–8750 Å and the dispersion was 0.25 Å/pix. We usually worked in the slit-limited regime and the actual resolution was 0.43 Å equivalent

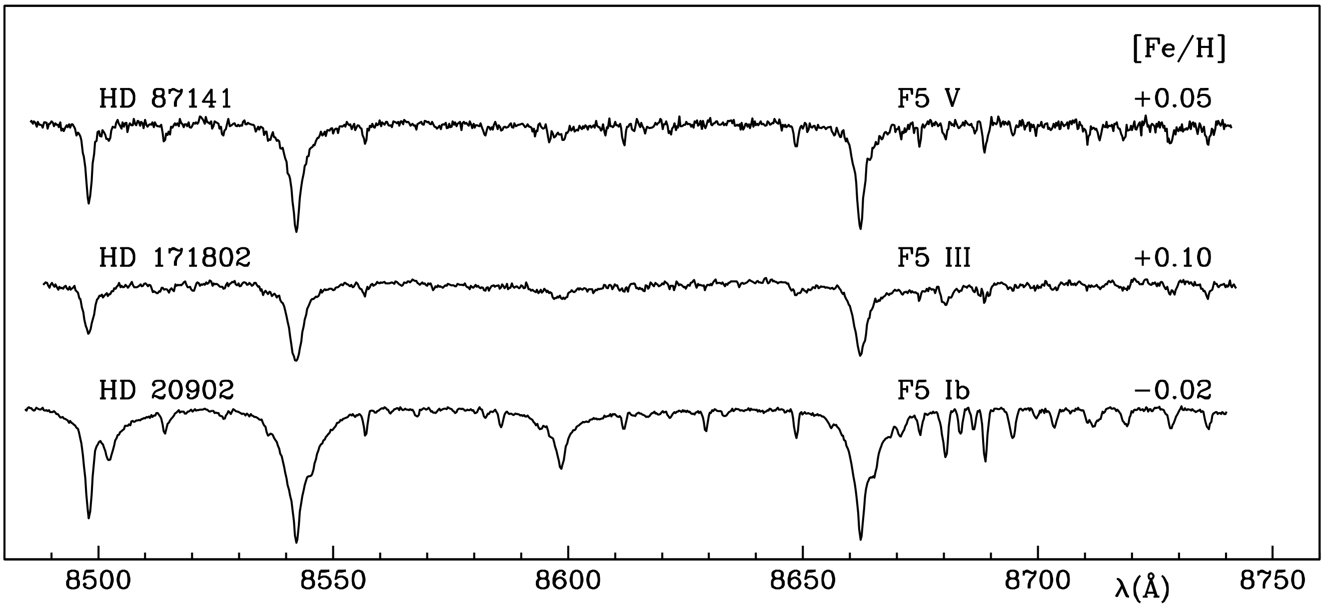

Fig. 2. Gravity effects at F5. Spectra are shifted to null radial velocity.

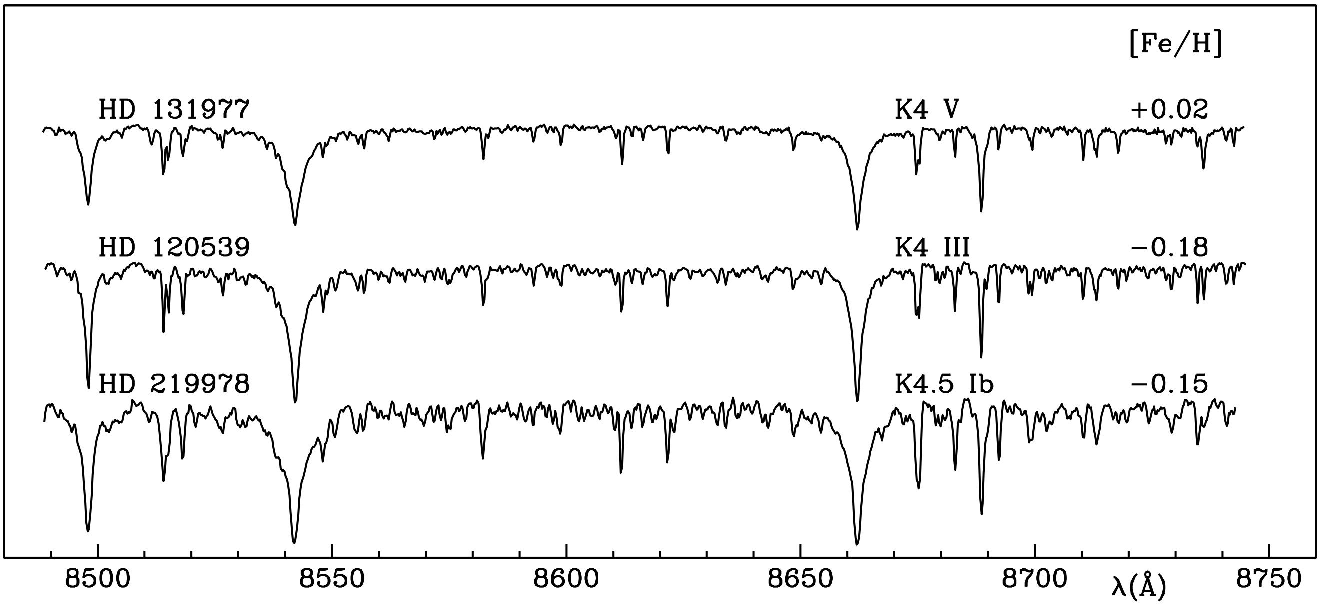

Fig. 3. Gravity effects at K4. Spectra are shifted to null radial velocity.

to a resolving power of $R = 20\,000$. We were slightly undersampled in the Nyquist sense, as the projected slit width was 1.72 pixels on average.

The spectra were extracted using the standard reduction procedures in the IRAF packages. The spectra were bias-corrected, sky-subtracted and flat-fielded. The wavelength calibration was performed using thorium lamp spectra and the heliocentric correction applied. The spectra were then normalized to the observed continuum by a Legendre polynomial fit of 6th order. An order six was chosen because it is typically required for the normalization of the instrumental blaze function in flat field spectra. Usually three or more spectra were obtained consecutively for each target star and individual spectra were weight summed according to the individual S/N to produce the final spectra presented in this atlas.

Radial velocities were measured for all the observed stars by cross-correlation to a proper synthetic Kurucz template. Templates were chosen on the base of the Straizys & Kuriliene (1981) calibration of MK spectral types and selected among the complete grid of synthetic spectra of Munari & Castelli (2000) and Castelli & Munari (2001) (Papers II and III), which were calculated to match the spectral resolution adopted in this series of papers. The measurements are reported in Table 1 along with the Heliocentric Julian Date of observation.

Table 3. MK system coverage of this paper (crosses) and Paper I (open circles).

	V	III	II	I		V	III	II	I
F0	o	o	o	o	K0	xo	xo	x	xo
F2	xo			xo	K1		x		
F3	xo	o			K2		x		x
F4	x	x			K3	xo	xo	o	o
F5	xo	xo		xo	K4	x	xo		x
F6	x	x			K5	o	xo	x	o
F7	x			x	K6		x		
F8	xo	x		o	K7	o	o	o	
F9	x				M0	o	xo		xo
G0	o	xo		xo	M1	o	xo		x
G1		x		x	M2	o	xo	xo	xo
G2	xo	o		xo	M3	o	xo	o	xo
G3					M4	o	xo		xo
G4					M5		xo		o
G5	xo	xo		xo	M6	o	xo		
G6	x	x			M7			x	
G7	x		x		M8		o		
G8	xo	xo		o					
G9	x	x							

The column content of Table 1 is as follows:

Column 1: identification (HD or BD number);

Column 2−3: V_T and $(B-V)_T$ from the Hipparcos and Tycho Catalogues;

Column 4: spectral classification (references are given in Col. 12);

Column 5: [Fe/H] is given as a value with standard deviation, as a range of values or as a value with no error, according to the original source (Col. 12);

Column 6: variable star name either from the GCVS or NSV;

Column 7: ϕ = variability index based on amplitudes obtained from either the Hipparcos and Tycho catalogues (roman characters) or from the GCVS and NSV catalogues (slanted characters). The indices are:
C = constant ($\Delta m \le 0.01$); S = small amplitude ($0.01 \le \Delta m \le 0.2$); M = medium amplitude ($0.2 \le \Delta m \le 0.4$); L = large amplitude ($\Delta m \ge 0.4$);

Column 8: η = chromospheric activity index. It is based on the Ca II K core emission line intensity measured on the Wilson scale (0−5, Wilson 1976) or on the S photometric index defined by Baliunas (1995). The indices are:
L = no activity ($0 \le I_K \le 1$; $0.0 \le S < 0.2$)
M = medium activity ($2 \le I_K \le 3$; $0.2 \le S < 0.35$)
H = high activity ($4 \le I_K \le 5$; $S \ge 0.4$);

Column 9: $v_{\rm rot} \sin i$ in km s^{-1};

Column 10: references are ordered in five columns (*a,b,c,d,e*) where: a = ref. to spectral type; b = ref. to [Fe/H]; c = ref. to variability; d = ref. to chromospheric activity and e = ref. to $v_{\rm rot} \sin i$. Number coding according to Table 2;

Column 11: HJD of observation;

Column 12: heliocentric radial velocity and standard deviation (km s^{-1});

Column 13: S/N ratio of the continuum.

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