DETERMINATION of THE FUNDAMENTAL CHARACTERISTICS of COLD STARS

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ABSTRACT. The effective temperatures, logarithms of surface gravities and parameters of metallicities [Fe/H] for stars of spectral classes G and K from the list of the Odessa catalogue of energy distributions in spectra of stars 555 are received. The different grids of Kurucz models of atmospheres are used. The comparison of the received results is carried out.

Key words: Stars: cold stars: fundamental characteristics

Plenty of the catalogues of energy distributions in spectra of stars now are saved; the mechanisms of accounts of theoretical spectra of stars are developed on the basis of models of star atmospheres. All this represents an opportunity to lead search of fundamental parameters of atmospheres of stars, directly comparing theoretical flows with observable. We carried out the work in this direction in some stages.

Using the models of atmospheres (Kurucz, 1979, 1988, 1993) and the program for computation of the synthetic spectra of stars (Tsymbal, 1996), we have calculated synthetic flows for comparison with distributions of energy in spectra of cold stars. The observed flux distribution was taken from the catalogue by Komarov et al. (1995). The random errors of results of the catalogue are nearly equal to 2-3(to 5%) in the visual range of a spectrum and 5-10% at the edges of the spectral bands - near ultraviolet and near infrared regions. For reduction of time of accounts firstly we carried out calculations not on all observable area of a spectrum, but only in sites of width 10 nm in 7 characteristic points - in the "windows of a transparency" (Dragunova, 1996). Selecting model giving the best concurrence of a theoretical spectrum with observable, we received thus the values of $T_{\rm eff}$, lg g and the metallicity parameter [Fe/H]. As a criterion of best agreement, the achievement of the minimal value of sum of modules of differences of compared sizes was considered.

Later, with occurrence of the calculated synthetic spectra (Kurucz, 1994) for a wide set of $T_{\rm eff}$, lg g and [Fe/H] values, we began to compare the theoretical flows with the observable spectra on all area, i.e. in 103 points (Belik, 1997; Komarov, 1999). We estimate the accuracy of reception of temperature in 50, and lg g in 0.5, that is conditioned by a step of a grid of set parameters in theoretical spectra. The parameter of metallicity has appeared for the majority of stars close -1. For an exit from this situation we have carried out search of sites in spectra of stars sensitive to change lg g and [Fe/H].

For the further work two wavelengths areas were chosen: 365 - 415 nm and 480 - 530 nm. The following stage of our searches of fundamental parameters became calculations under the following circuit: effective temperature is determined by comparison of distributions of energy in spectra of stars with the calculated spectra and selection of the most suitable theoretical spectrum with its values of $T_{\rm eff}$, lg g and [Fe/H]; then with fixed $T_{\rm eff}$ also [Fe/H] the closest theoretical spectrum is selected by a variation lg g, but the comparison will be carried out in a narrow site of a spectrum from 480 to 530 nm; then with the already found and fixed values of $T_{\rm eff}$ and lg g the search of the most suitable theoretical flow on parameter [Fe/H] is made in the range 365 - 415 nm. Control search lg g with new value of [Fe/H] further will be carried out, and, if the meaning which is distinct from already turns out received the new cycle of searches is carried out.

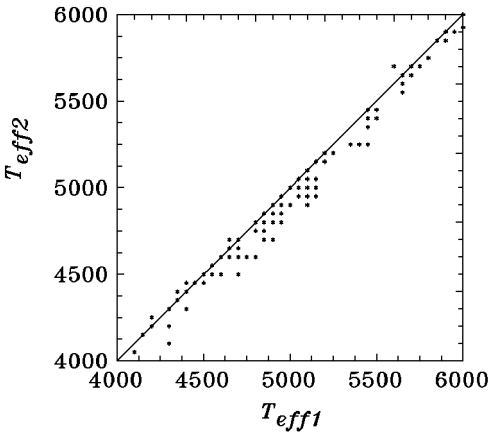

Figure 1: Comparison of temperatures, received on different model grids: $T_{\rm eff1}$(old), $T_{\rm eff2}$(new).

Table 1. The fundamental characteristics of stars.

HD	Sp	$T_{\rm eff}$	lg g	Fe/H	$T_{\rm eff}$	lg g	Fe/H	$T_{\rm eff}$	lg g	Fe/H	$T_{\rm eff}$	lg g	Fe/H
1	2	3	4	5	6	7	8	9	10	11	12	13	14
74	K2III				4670	2.1	0.09	4550	1.5	-0.5	4550	1	-0.5
163	G5III	4843	2.58	-0.67				5050	2.5	-0.5	5050	2.5	-0.5
		4950*	2.1*	-0.63*									
188	K0III				4995	2.6	0.01	4800	2.5	-0.5	4800	2	-0.5
219	G0V	5920	4.37	-0.3				5650	2.5	-0.5	5650	3.5	-0.5
265	G8-IV	4785	2.55	-0.75	4810	2.6	-0.49	4850	3	-0.5	4700	2.5	-0.5
		4800*	2.5*	-0.19*									
285	K2III				4600	2.1	0.07	4550	1.5	-1	4500	1	-1
456	G8II-III							4900	0	-1	4800	1	-1
489	K3III	4070	1.41	-0.27	4150	1.7	-0.13	4350	0.5	-1	4350	0.5	-1
509	G8V							5450	2	0	5400	3	-0.5
		5270*	4.2*	-0.56*									
510	K0III				4960	2.6	-0.22	5000	0	-0.5	4900	2	-0.5
660	G0V	5594						5700	4	-1	5650	5	-1
788	F9V							5950	4	-0.5	5900	5	-0.5
937	G4V	5944	4.08	0.03				5650	3	-0.5	5600	3	-0.5
941	K0III	5958	4.4	-2.01	5040	2.6	-0.03	5050	2.5	-0.5	5000	2.5	-0.5
1017	F5Ia							6000	1	-1	6000	1	-0.5
1030	G8III				5075	2.85	-0.23	5150	0	-1	5050	2.5	-0.5
1052	K3III				4130	1.7	-0.16	4300	1	-1	4300	1	-1
1136	K0IV							5100	4	-0.5	5050	3.5	-0.5
1311	G5III							5200	1.5	-0.5	5150	2	-0.5
1325	K0V							5250	4	-0.5	5200	4	-0.5
1346	K0III				5050	:2.6	-0.03	4850	2.5	-0.5	4800	2.5	-0.5
1373	K0III				5070	2.65	0	5100	2.5	0	5100	2.5	-0.5
1409	G9III				5050	2.6	0.05	4950	3	-0.5	4950	3	-0.5
1454	G8II							4350	0.5	-1	4400	1	-1
1580	K2III				4515	2.15	-0.26	4650	2.5	-0.5	4600	2.5	-0.5
1601	K2II							4600	0.5	-0.5	4500	1	-1
1729	G0V	5840	4.16	0				5850	3.5	0	5850	4	0
1995	G8III				4960	2.7	-0.3	5100	0	-0.5	5100	0	-1
2012	K0III	4597	2.17	-0.1	4725	2.35	-0.06	4650	2	-0.5	4600	2.5	-1
2035	G8III				4725	2.55	-0.7	4800	3	-0.5	4800	2	-0.5
2047	G0V	5913	4.38	-0.02				5800	3.5	-0.5	5750	3	-1
2134	G5III							5000	3	-1	5000	2.5	-1
2473	G8Ib							4350	0.5	-1	4350	0.5	-1
2693	F8Ia							5650	0	-1	5650	0	-1
2985	G8III	4950	2.78	-0.08	5030	2.75	-0.17	5100	1	-0.5	4950	1	-0.5
2990	K0III	4850	2.71	-0.02	4950	2.6	-0.1	4950	0	-0.5	4850	1	-0.5
3323	G5III							5350	2	0	5250	2	-0.5
3547	K0III	4870	2.49	-0.01	4910	2.6	-0.18	4950	2.5	-0.5	4900	2.5	-0.5
3748	K3III				4185	1.7	0.02	4200	1.5	-1	4250	1.5	-1
3771	G2IV							5450	3.5	0	5250	3.5	-0.5
3873	G0II							5250	0	-1	5200	0	-1
3905	K2III	4511	2.32	0.3	4775	2	0.32	4350	1.5	-0.5	4350	2	-0.5
4166	G2II							5200	2	-0.5	5200	1.5	-0.5
4301	K0III				4945	:2.6	-0.05	4700	1.5	-1	4700	1	-1
4418	G8II-III							4900	1	-0.5	4900	0.5	-0.5
4471	G9III				4845	2.6	-0.36	5050	0	0	5000	0	-0.5
4518	K0III	4360	1.62	-0.44	4430	2.2	-0.36	4600	1.5	-0.5	4500	2	-1
4527	G5III-IV							5650	0.5	-1	5550	0	-1

Table 1 (continued)

HD	Sp	$T_{\rm eff}$	lg g	Fe/H	$T_{\rm eff}$	lg g	Fe/H	$T_{\rm eff}$	lg g	Fe/H	$T_{\rm eff}$	lg g	Fe/H
1	2	3	4	5	6	7	8	9	10	11	12	13	14
4785	G0V	5887	4.39	-0.14				5750	2	-0.5	5700	2.5	-0.5
4932	G9III	5028	2.81	0.12	5105	2.75	-0.08	5200	0.5	-1	5200	3	0
4983	G0V	5979	4.34	0.01				5900	1.5	0	5900	2	0
5235	G0IV				6100	3.5		6000	3.5	0	5925	3.5	0
5315	K3III				4155	1.8	-0.3	4150	1	-1	4150	1	-1
5340	K2III				4250	2		4400	2.5	-1	4300	2	-1
5544	G8V							5200	4	-0.5	5200	4	-0.5
5601	K0III				4765	2.5	-0.26	4650	1	-1	4700	0.5	-1
5602	G8III				4950	2.7	-0.24	5150	3	-0.5	4950	2.5	-1
5616	K2III				4475	2.1	-0.13	4500	1.5	-0.5	4450	2	-1
5681	G8III				4835	2.6	-0.5	5000	0	-1	4900	0	-1
5787	G8-IV				4805	2.55	-0.42	4800	1.5	-0.5	4600	1.5	-1
5868	G0V							5900	3.5	0	5850	4	0
5889	G5-IV				5130	2.95	-0.5	5500	2	-0.5	5450	3	-0.5
5968	G2V							5500	4	-1	5400	3.5	-1
6075	G8III				4855	2.65	-0.34	4900	1.5	-0.5	4850	2	-1
6148	G8III	4967	2.62	-0.27	5000	2.8	-0.26	5150	0	-1	5000	0	-1
6212	G0IV	5793	3.77	0.03				5700	3.5	0	5700	4	0
6526	K4III				4120	1.6	-0.04	4300	2	-1	4200	1.5	-1
6623	G5IV	5518	3.87	0.19				5500	3	0	5400	3	-0.5
6695	K1III				4300	0.75		4600	0	-1	4600	0	-1
6698	K0III				4940	2.5	-0.08	4900	2.5	-0.5	4800	2.5	-0.5
6703	K0III	5011	2.71	0.09	5040	2.7	-0.17	5150	1.5	-0.5	5050	1.25	-1
6752	K0V	5094	5	-0.25				5100	4	-0.5	4900	4	-0.5
6770	G8-IV				4975	2.65	-0.18	5050	0	-1	5050	0	-1
6895	K2III				4580	2.1	-0.14	4700	2.5	-1	4500	2.5	-1
7063	G5II							4750	0	-1	4600	0	-1
7150	K1III				4820	2.4	-0.03	4700	2.5	-1	4600	2	-1
7176	K2III				4945	2.35	0.08	4850	2.5	-0.5	4750	2.5	-0.5
7193	K1III				4715	2.3	-0.14	4650	2	-1	4650	2	-1
7310	G9III	4818	2.54	-0.14	4835	2.6	-0.29	4950	0.5	-0.5	4800	1	-1
7314	K0II							4350	1.5	-1	4400	1.5	-1
7352	K3III				4480	2		4450	3	-1	4450	3	-1
7417	K3II							4400	2.5	-1	4400	2.5	-1
7478	G8III				5000	2.65	-0.1	5050	1	-0.5	4950	0	-1p
7479	G0II							5400	1.5	-0.5	5250	2.5	-0.5
7488	G8II				4800	2.7		4850	2	-1	4850	2	-1
7576	K3III				4350	2.25		4400	2.5	-1	4400	2.5	-1
7602	G8IV	5120	3.14	-0.08				5050	2	-0.5	5050	2.25	-0.5
7660	K1Ib							4700	1.5	-1	4600	1.25	-1
7685	K3III							4400	2.5	-1	4450	2.5	-1
7744	K3III				4210	1.7	-0.37	4100	1	-1	4050	1	-1
7747	G3Ib							4900	0	-1	4700	1	-1
7754	G9III				5005	2.65	-0.2	5100	3	-0.5	5000	3	-0.5
7796	F8Ib							5600	0.5	-0.5	5700	1	-0.5
7806	K3III				4275	1.75	-0.04	4150	1	-1	4150	1	-1
7896	G5IV	5513	3.54	-0.08				5450	3	-0.5	5450	3	-0.5
7949	K0III	4780	2.52	-0.12	4750	2.45	-0.32	4900	0.5	-0.5	4900	0	-0.5
8008	K4III				4110	1.5	0.02	4300	2	-1	4100	0.5	-1
8115	G8II	4945	2.49	0				5150	0	-1	5050	0	-1
8167	G8III	5129	2.74	-0.05	5045	2.8	-0.28	5150	2	-1	5050	1	-1
8232	G0Ib	5452	1.38	-0.04				5450	2.5	0	5350	0	-1
8308	K2Ib	4290	0.96	-0.07				4200	0	-1	4200	0.5	-1
8321	K0Ib							4400	0.5	-1	4450	0.5	-1

Table 1 (continued)

HD	Sp	$T_{\rm eff}$	lg g	Fe/H	$T_{\rm eff}$	lg g	Fe/H	$T_{\rm eff}$	lg g	Fe/H	$T_{\rm eff}$	lg g	Fe/H
1	2	3	4	5	6	7	8	9	10	11	12	13	14
8308	K2Ib	4290	0.96	-0.07				4200	0	-1	4200	0.5	-1
8321	K0Ib							4400	0.5	-1	4450	0.5	-1
8414	G2Ib	5246	1.32	0.18				5150	0	-0.5	5150	0	-0.5
8465	K1Ib							4150	1	-1	4150	1	-1
8538	G9III				4760	2.5	-0.4	4700	1.5	-1	4650	1.5	-1
8667	G8II-III	4775	2.47	-0.09				4850	0.5	-1	4850	0.25	-1
8684	K0III	4991	2.78	-0.09	4960	2.7	-0.31	5100	2.5	-0.5	4900	3	-1
8694	K1III	4748	2.35	0.01	4820	2.5	-0.12	4800	2.5	-1	4750	2	-1
8796	K0II							4500	2.5	-1	4500	2	-1
8812	K0III				4870	2.4	0.09	4500	2.5	-1	4500	2	-1
8852	G7III	4861	2.54	-0.44	4910	2.75	-0.52	4950	0.5	-0.5	4800	1.5	-1
8916	K1III				4815	2.4	-0.08	4800	3	-1	4800	3.5	-1
8923	G8III				5080	2.7	-0.1	4900	3	-1	4900	2.5	-1
8974	K1IV	4833	2.99	-0.01	4810	3		4900	3	0	4800	3.5	-0.5
9003	G5Ib							4600	2	-1	4600	2	-1

Later F.Castelli found out the mistakes in ATLAS9, and R.Kurucz has amended to the program and has presented the new convective models and flows (Kurucz, 1996) we have lead repeated definitions of parameters on new flows. The received results differ from former (Fig. 1) a little.

In the Table 1 the characteristics of stars found by various methods from different sources are given: in columns 3-5 from Cayrel de Strobel (2001), Mishenina (2001); in columns 6-8 from Korotina (1998); and also our old (columns 9-11) and new (columns 12-14) data . The undertaken attempt to improve accuracy of definition [Fe/H] has not resulted in success. Apparently, the technique, developed by us, can be applied to definition of temperature and tentative estimation lg g and [Fe/H]. The accuracy of definition can be increased if to use distributions of energy with a smaller step, at least, about 10 A, i.e. - with higher spectral resolution.

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