N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
PHYSICO-MATHEMATICAL SERIES
ISSN 1991-346X **https://doi.org/10.32014/2019.2518-1726.23**
Volume 3, Number 325 (2019), 42 – 55

UDC 524.31

V. M. Tereschenko

Fesenkov Astrophysical Institute

THE ESTIMATION OF THE RELIABILITY OF THE DATA FROM THE SHAMAKHA SPECTROPHOTOMETRIC CATALOGUE

Abstract. On the basis of existing spectrophotometric catalogues and individual articles we plan to create a joint uniform catalogue of stars with known distributions of energy in their spectra. As original catalogues we intend to use catalogues which were created in the Fesenkov astrophysical institute, Sternberg astronomical institute, Main astronomical observatory RAS, Odessa astronomical and Shamakha astrophysical observatories. At the preliminary stage of the proposed project, it is necessary to assess the reliability of the data of initial catalogues. The first three catalogues are already investigated in this respect. In this paper, we analyze the data of the Shamakha catalogue. The reliability of the data is estimated by indirect means – according to the similarity of magnitudes calculated from the energy distribution with the directly observed star magnitudes using the most accurate photometric WBVR-system. Calculations of the magnitudes and color-indexes are made using standard formulas for synthetic photometry. Then, the difference (residuals) between calculated and directly observed stellar magnitudes was computed. The results of calculations are presented in the table. On their basis the dependencies of residuals from the V- magnitudes and color-indexes were plotted. From them follows that noticeable systematic errors in Shamakha spectrophotometric catalogue are absent. However, there are a significant number of accidental residuals reaching 0.20^m and higher. The results of the calculations will be used for creating joint catalogue and for the selection of standard stars from it.

Key words: stars, energy distribution, Shamakha spectrophotometric catalogue, catalogue WBVR-magnitudes, comparison.

Introduction. Since the astronomical observations are performed on different instruments and at different conditions, they must be standardized. Standardization of spectrophotometric observations are carried out by binding the observations of the studied bodies to the B-G-stars with a known distribution of energy in their spectra. We intend to create the joint spectrophotometric catalogue, which covers all existing catalogues and articles in which the absolute energy distributions are represent. Similar catalogues were created previously as well, see, for example [1, 2]. The catalogue planned by us is similar to the compile catalogue [2], but is more complete. In addition, its data will be reduced in more common calibration of Vega - main spectrophotometric standard.

In the joint catalogue the stars will be marked that can be used for the purposes of standardization and calibration of receiving-recording equipment. At present, the most frequently used three spectrophotometric catalogues, which were created in FAI [3], SAI [4] and MAO RAS [5]. All three catalogues are detailed investigated. There are still three analogues catalogue, created in Odessa Astronomical Observatory [6,7] and Shamakha Astrophysical Observatory [8]. It is obvious that the joint catalogue will greatly facilitate users to find suitable standards.

The method of calculations. The present paper is a first step in creating the joint catalogue. It is devoted to the estimation of the reliability of the data of the Shamakha catalogue. Analysis carried out by indirect means, namely, by comparing the magnitudes and color-indexes calculated from the distribution of energy with directly observed indexes. Such comparison is necessary because the authors of Shamakha directory used as standards, in addition to the 8 primary standards, 20 other stars being zonal standards [9]. Accuracy of zonal standards is lower than primary. In addition, some of them are suspected of variability. Note that due to the lack of spectrophotometric data other authors' method of comparison with photometric data is used quite often. In this comparison, of course, information about errors and faults of

energy distribution in narrow spectral intervals is lost. Comparison with photometric data helps to identify only big errors in the spectral energy distribution of the stars under investigation. Such an analysis is made by the authors of Shamakha catalogue in the UBV-system. Photometric data were taken from the compile catalogue Nikolet [10]. The accuracy and homogeneity of the data of this catalogue is relatively low. We, however, took the most precision photometric catalogue WBVR-magnitudes [11]. Magnitude in band V and color-indexes W-B and B-V calculated with the next formulas [12]:

$$V = -2.5\ \lg\Sigma E(\lambda)\times S_V(\lambda)\times\Delta\lambda + C_V; \quad (1)$$

$$W\text{-}B = -2.5\ \lg\ [\Sigma E(\lambda)\times S_W(\lambda)\times\Delta\lambda] / [\Sigma\ E(\lambda)\times S_B(\lambda)\times\Delta\lambda] + C_{U\text{-}B}; \quad (2)$$

$$B\text{-}V = -2.5\ \lg\ [\Sigma E(\lambda)\times S_B(\lambda)\times\Delta\lambda] / [\Sigma\ E(\lambda)\times S_V(\lambda)\times\Delta\lambda] + C_{B\text{-}V}; \quad (3)$$

where $E(\lambda)$ - monochromatic illumination on wavelength λ; S_W, S_B and S_V - response curves photometric bands W, B and V; $\Delta\lambda$ - length averaging interval energy distribution curves, histogram step.

Reaction curves of the corresponding bands were taken from the directory [11]. Numerical values of the constants depend on the adopted zero-point scale of magnitudes, absolute calibration of primary standards and physical units. Note that in Shamakha catalogue the "old" Vega-calibration was used, which was obtained in FAI in 1968. [9]. The constants in equations (1-3) are defined using the star HD221525, which served as the primary standard in catalogues [3, 11]. For bands W, B and V they respectively amount to 1.285^m, 2.629^m and 2.039^m. Then residuals $\delta V = V_{cal} - V_{obs}$, $\delta(B\text{-}V) = (B\text{-}V)_{cal} - (B\text{-}V)_{obs}$ и $\delta(W\text{-}B) = (W\text{-}B)_{cal} - (W\text{-}B)_{obs}$ were calculated. The numeric values of the residuals are put into table (see annex).

Results and discussion. The table shows that for some stars the residuals reach 0.2^m or more, which is much larger than the errors of observation listed in the Shamakha catalogue. Large values of residuals can be explained both with variability of studied stars and with errors of observations. One of the reasons for significant differences can be used as primary standards for variable stars, or stars, for which the energy distribution in their spectra is erroneous. Each case requires special consideration. This was not intended in this work. For visualization of results our calculations the different dependencies for residuals were formed (figures 1-4). The graphs were constructed according to date for stars of first half of catalogue (number from 1 to 212). The stars with residuals > 0.30^m (in table they by asterisk marked) on graphs are not represent.

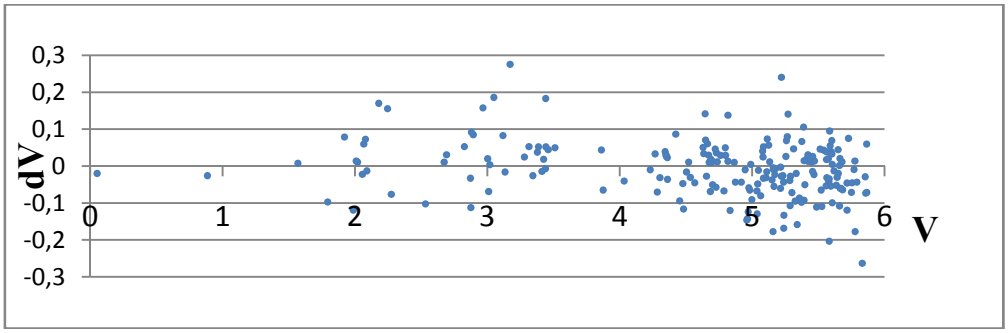

Figure 1 - The dependence of the residuals δV from magnitude V

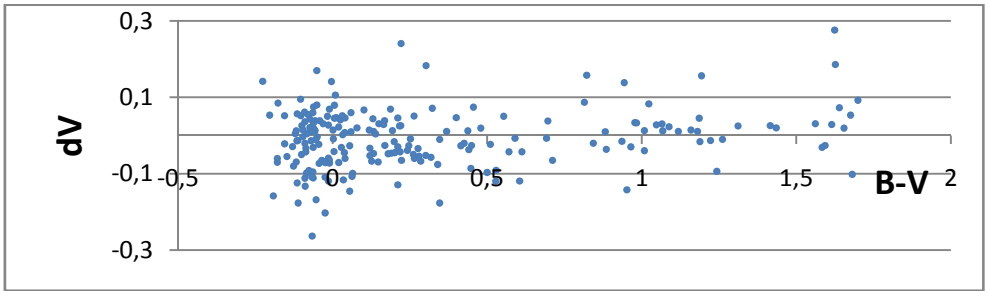

Figure 2 - The dependence of the residuals δV from color-indexes B-V

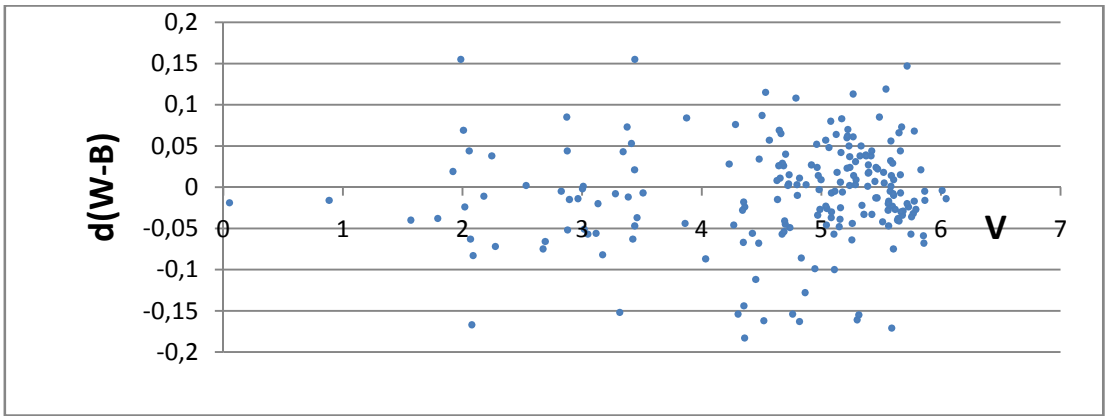

Figure 3 - The dependence of the residuals δ(W-B) from V

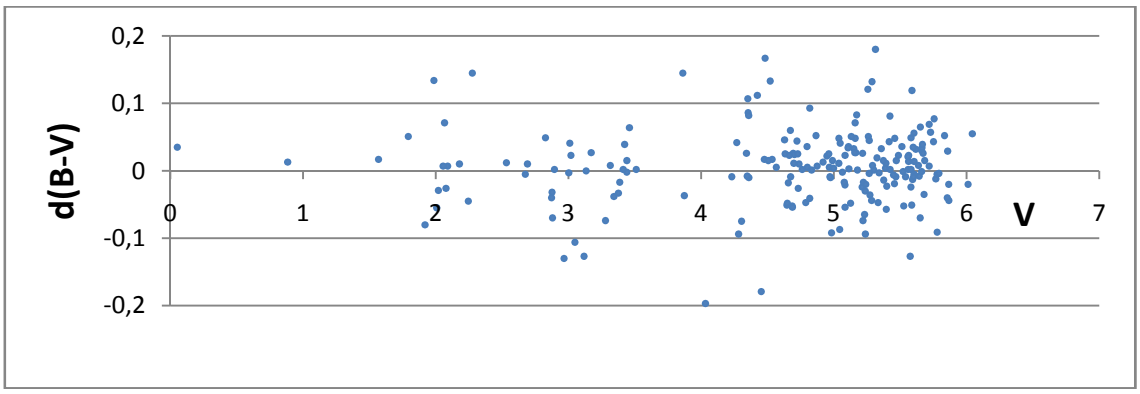

Figure 4 - The dependence of the residuals δ(B-V) from V

The results of our calculations might be used by other observers in case of choosing the spectrophotometric standards from Shamakha catalog. For the standardization of observations it is advisable to use standard stars with residuals less than 0.03^m-0.04^m.

Table 1 - The values V, (W-B) and (B-V) and residuals δV, δ (W-B) and δ (B-V)

№	HD	Sp	V	δV	W-B	δ(W-B)	B - V	δ(B-V)
1	3	7	4	5	6	7	8	9
1	144	B9IIIe	5.582	-0.203	-0.225	0.056	-0.024	0.049
2	358	B8IVp	2.067	0.060	-0.566	-0.063	-0.064	0.071
3	432	F2III-IV	2.275	-0.076	0.068	-0.072	0.34	0.145
4	560	B9Vn	5.541	0.043	-0.251	0.119	-0.074	-0.009
5	886	B2IV	2.826	0.053	-1.054	-0.005	-0.204	0.049
6	1976	B5IV	5.586	0.095	-0.735	0.014	-0.104	-0.051
7	2011	B9IIIe	5.388	0.106	-0.168	0.001	0.009	0.004
8	2054	B9IV	5.729	0.075	-0.380	-0.024	-0.062	0.057
9	2628	A7III	5.214	-0.060	0.071	0.060	0.264	-0.024
10	2772	B8Vn	4.731	0.036	-0.401	0.015	-0.09	-0.026
11	3240	B7III	5.085	0.052	-0.460	-0.007	-0.103	0.023
12	3546	G8IIIp	4.360	-0.036	0.295	-0.024	0.885	-0.010

13	3627	K3III	3.279	0.025	1.352	-0.008	1.311	-0.074
14	3712	K0IIIa	2.245	0.156	0.966	0.038	1.193	-0.045
15	4222	A2Vs	5.416	0.022	0.073	0.038	0.019	0.043
16	4382	B8III	5.422	0.013	-0.508	0.044	-0.057	0.081
17	4614	G0V+M	3.439	-0.007	-0.154	0.021	0.590	-0.002
18	4813	F7IV-V	5.171	-0.023	-0.154	0.083	0.510	0.083
19	5015	F8V	4.797	0.050	-0.082	0.003	0.553	0.036
20	5112	M0III	4.761	0.029	1.795	-0.154	1.614	0.002
21	5394	B0IVe	2.179	0.170	-1.315	-0.011	-0.051	0.010
22	5395	G8.5IIIb	4.634	0.034	0.481	-0.015	0.977	0.025
23	5408	B9IVn	5.563	0.018	-0.393	-0.047	-0.061	0.023
24	5848	A5V	3.861	0.044	0.152	-0.044	0.130	0.145
25	6186	K0IIIa	4.268	0.033	0.528	-0.046	0.983	0.042
26	6582	G5Vp	5.177	-0.007	-0.092	-0.006	0.692	0.001
27	6676	B8Vn	5.769	-0.009	-0.355	-0.032	0.002	-0.012
28	6805	K1.5III	3.46	0.045	1.040	-0.037	1.186	0.064
29	6860	M0IIIa	2.078	0.073	1.888	-0.167	1.639	-0.026
30	6960	B9.5V	5.564	-0.031	-0.151	-0.017	-0.063	0.014
31	6961	A7V	4.342	0.039	0.143	-0.028	0.168	0.026
32	6972	B9IV	5.576	0.020	-0.374	-0.005	0.079	-0.127
33	7034	F0V	5.161	-0.009	0.261	-0.025	0.252	0.071
34	7106	K0IIIb	4.520	0.011	0.845	-0.162	1.118	0.133
35	7318	K0III	4.672	0.030	0.680	-0.057	1.065	0.060
36	7439	F5V	5.150	-0.037	-0.168	-0.048	0.441	0.033
37	7927	F0Ia	4.982	-0.065	0.597	-0.003	0.711	-0.092
38	8374	A1m	5.594	-0.054	0.085	-0.023	0.279	-0.013
39	8491	K0III	4.737	0.012	0.777	-0.049	1.068	0.010
40	8538	A5III-IV	2.674	0.011	0.179	-0.075	0.132	-0.005
41	8890	F7Ib-IIv	1.986	-0.119	0.332	0.155	0.605	0.134
42	9408	G9IIIb	4.699	0.013	0.578	-0.045	1.008	0.011
43	10204	sgA9	5.643	-0.030	0.138	-0.038	0.211	-0.008
44	10221	A0pSi	5.560	0.039	-0.295	-0.020	-0.057	0.002
45	10425	B8IIIn	5.777	0.014	-0.381	-0.017	0.001	-0.005
46	10982	B9.5V	5.858	-0.073	-0.146	-0.068	-0.044	0.029
47*	11415	B3III	3.351	1.577	-0.722	0.163	-0.125	0.083
48	11443	F6IV	3.424	0.019	-0.063	-0.063	0.479	0.039
49	11502/3	B9V+A1p	3.874	-0.065	-0.135	0.084	-0.035	-0.037
50	11857	B5III	6.011	0.027	-0.508	-0.004	-0.014	-0.020
51	11909	K1Vp	5.110	-0.015	0.539	-0.100	0.936	0.036
52	11946	A0Vn	5.300	-0.072	-0.001	-0.161	-0.010	0.001
53	11973	0.239	4.788	-0.067	0.064	0.108	0.285	-0.047
54	12471	A2V	5.513	0.046	0.094	-0.042	0.040	0.036
55	12533/4	K3IIb+B8	2.089	-0.013	0.778	-0.083	1.222	0.007
56	12573	A5III	5.423	0.031	0.185	-0.033	0.150	0.002

57	12869	A2m	5.037	-0.067	0.098	0.057	0.126	0.048
58	12929	K2IIIab	2.019	0.011	0.953	-0.024	1.180	-0.029
59	13161	A5III	3.018	0.004	0.154	-0.051	0.139	0.023
60	13869	A0V	5.259	0.069	-0.059	-0.044	-0.011	0.051
61	13974	G0V	4.873	-0.043	-0.144	0.003	0.612	0.007
62	14191	A1Vn	5.580	-0.042	0.049	0.032	0.004	-0.024
63	15089	A5pSr	4.477	-0.047	0.040	-0.068	0.132	0.017
64	16161	G8III	4.865	0.010	0.382	-0.128	0.882	0.052
65	16739	F9V	4.918	-0.043	-0.025	0.027	0.570	0.013
66	17584	F2III	4.230	-0.010	0.057	0.028	0.346	-0.009
67	17904	F4IV	5.333	-0.020	-0.056	0.050	0.425	-0.047
68	18411	A2Vn	4.694	0.010	0.157	-0.041	0.059	0.026
69	18449	K2III	4.947	-0.010	1.142	-0.099	1.261	0.022
70	18604	B6III	4.702	-0.050	-0.549	0.040	-0.101	0.024
71	18883	B7V	5.618	-0.013	-0.511	-0.027	-0.113	0.032
72	18884	M1.5IIIa	2.532	-0.102	1.875	0.002	1.681	0.012
73	19058	M4II	3.315	0.053	1.731	-0.152	1.675	0.008
74	19787	K2IIIv	4.351	0.028	0.750	-0.018	1.047	0.107
75	20315	B8V	5.486	-0.111	-0.437	0.085	-0.063	0.023
76	20365	B3V	5.160	-0.004	-0.724	0.006	-0.050	0.048
77	20418	B5V	5.047	-0.011	-0.694	-0.026	-0.055	0.041
78	20677	A3V	4.961	-0.146	0.067	0.052	0.055	0.025
79	20809	B5V	5.324	-0.095	-0.683	0.038	-0.064	0.019
80	20902	F5Ib	1.793	-0.097	0.398	-0.038	0.500	0.051
81	21278	B5V	4.989	0.005	-0.689	-0.027	-0.083	0.015
82	21362	B6Vn	5.597	0.039	-0.583	0.029	-0.042	0.035
83	21428	B3V	4.663	0.061	-0.735	0.065	-0.091	0.023
84	21447	A1V	5.106	-0.031	0.069	-0.057	0.028	0.034
85	21552	K3III	4.353	0.026	1.429	-0.144	1.416	0.086
86	21699	B8IIIpMn	5.458	0.026	-0.724	0.024	-0.100	0.048
87	21770	F4III	5.314	0.047	-0.125	-0.155	0.400	0.180
88	22780	B7Vne	5.589	0.055	-0.528	-0.171	-0.079	0.119
89	22928	B5III	3.010	-0.069	-0.621	0.001	-0.118	0.041
90	22951	B0.5V	4.975	-0.059	-1.041	0.014	-0.014	-0.010
91	23016	B9Vne	5.684	-0.064	-0.340	-0.029	-0.011	0.015
92	23193	A2m	5.605	-0.099	0.116	-0.010	0.065	-0.005
93	23288	B7IV	5.467	-0.023	-0.421	-0.013	-0.045	-0.009
94	23300	B6V	5.661	-0.108	-0.590	0015	-0.067	0.030
95	23324	B8V	5.663	0.021	-0.447	-0.007	-0.074	0.034
96	23630	B7IIIe	2.872	-0.033	-0.420	0.085	-0.087	-0.040
97	23753	B8V	5.456	-0.014	-0.390	-0.013	-0.070	-0.019
98	23793	B3V+F5V	5.064	-0.080	-0747	0.048	-0.127	-0.002
99*	23862	B8Vpe	5.116	0.990	-0.333	-0.115	-0.074	0.025
100	23985	A2V+A5V	5.237	-0.043	0.052	0.002	0.218	-0.030

101	24504	B6V	5.392	-0.092	-0.615	0.017	-0.077	0.011
102	24546	F5IV	5.291	-0.027	-0.127	0.009	0.415	0.008
103	24760	B0.5V+A2	2.894	0.085	-1.210	-0.015	-0.177	0.002
104	25204	B3V+A4IV	3.413	-0.014	-0.757	0.053	-0.116	0.002
105	25330	B5V	5.661	0.002	-0.551	0.044	0.032	-0.001
106	25570	F2V	5.449	0.011	-0.111	0.007	0.369	-0.006
107	25604	K0III	4.359	0.023	0.815	-0.183	1.088	0.082
108	26793	B9Vn	5.216	-0.003	-0.405	0.023	-0.096	0.026
109	26965	K1V	4.424	0.087	0.259	-0.056	0.814	0.112
110	27397	F0IV	5.582	-0.034	0.028	0.001	0.276	0.002
111	27459	F0V	5.256	0.026	0.084	-0.064	0.220	0.121
112	27749	A1m	5.637	-0.052	0.119	-0.040	0.301	0.008
113	27819	A7V	4.800	0.029	0.117	-0.010	0.165	0.005
114	28556	F0V	5.398	-0.050	0.061	0.018	0.261	-0.023
115	28910	A8V	4.656	-0.027	0.071	0.011	0.246	-0.018
116	29139	K5III	0.885	-0.026	1.834	-0.016	1.593	0.013
117	29365	B8V	5.866	-0.071	-0.454	-0.016	-0.024	-0.044
118	29479	A4m	5.085	-0.033	0.136	-0.030	0.120	-0.054
119	29488	A5Vn	4.685	-0.069	0.153	0.026	0.147	-0.052
120	30780	A7IV-V	5.083	0.025	0.103	-0.037	0.216	-0.021
121	31373	B9V	5.791	-0.043	-0.570	-0.027	-0.087	-0.004
122	31398	K3II	2.692	0.031	1.632	-0.066	1.561	0.010
123	32549	A0p	4.675	0.010	-0.100	0.029	-0.070	-0.009
124	33167	F5V	5.679	0.012	-0.079	-0.034	0.437	-0.035
125	33959	A9IV	5.038	-0.129	0.136	-0.023	0.211	0.011
126	34029	G5IIIe+G0	0.052	-0.020	0.285	-0.019	0.843	0.035
127	34203	A0V	5.526	-0.109	0.022	0.005	-0.024	-0.052
128	34557	A3V	5.471	0.014	0.102	0.022	0.118	0.015
129	34559	G8III	4.965	-0.142	0.537	0.024	0.952	0.005
130	34790	A1V	5.667	-0.060	0.064	-0.030	0.040	0.039
131	34904	A3V	5.559	-0.053	0.149	-0.028	0.121	0.021
132	34989	B1V	5.778	-0.177	-1.099	0.068	-0.112	-0.091
133	35296	F8V	4.998	-0.091	-0.140	0.009	0.529	0.004
134	35600	B9Ib	5.718	-0.046	-0.202	-0.020	0.190	0.007
135	35671	B5V	5.394	0.015	-0.684	0.027	-0.096	-0.057
136	36371	B5Iab	4.727	-0.057	-0.656	0.004	0.318	0.025
137	36653	B3V	5.605	0.005	-0.788	0.009	-0.121	0.014
138	36819	B2.5IV	5.373	-0.098	-0.795	0.039	-0.085	0.015
139	36861/2	O8e	3.386	0.052	-1.268	-0.012	-0.156	-0.017
140	36881	B9IIIp	5.601	0.069	0.143	-0.008	0.187	-0.009
141	37098	B9IV-V	5.833	-0.263	-0.477	0.021	-0.066	0.052
142	37147	F0V	5.521	-0.065	0.081	0.018	0.223	-0.001
143	37269	B9.5V+F9	5.357	-0.086	0.197	-0.033	0.447	0.033
144	37320	B8III	5.865	0.060	-0.453	-0.005	-0.059	-0.020

145	37438	B3IV	5.165	-0.055	-0.867	0.042	-0.148	0.027
146	38656	G8III	4.534	-0.030	0.513	0.115	0.965	0.017
147	38771	B0.5Iav	2.056	-0.022	-1.257	0.044	-0.155	0.007
148	39291	B2IV-V	5.340	-0.158	-1.039	-0.022	-0.192	-0.003
149	40394	B9.5p	5.718	-0.119	-0.121	0.147	-0.014	0.069
150	40536	A6m	5.043	-0.048	0.175	-0.046	0.179	-0.087
151	40967	B5III	4.970	-0.124	-0.752	-0.034	-0.115	-0.009
152	41040	B8III	5.132	0.012	-0.530	0.018	-0.118	0.051
153	41117	B2Iaev	4.629	0.051	-0.900	0.008	0.263	0.046
154	41335	B2Ven	5.238	-0.168	-1.082	0.037	-0.054	-0.094
155	42087	B2.5Ibe	5.755	-0.045	-0.813	-0.036	0.201	0.077
156	42477	A0Vnn	6.044	0.047	0.056	-0.014	0.012	0.055
157	42995	M3III	3.172	0.276	1.549	-0.082	1.624	0.027
158	44478	M3IIIab	2.879	0.092	1.914	-0.052	1.699	-0.070
159	46089	A3V	5.232	-0.026	0.107	0.050	0.169	-0.065
160	46553	A0Vnn	5.267	-0.400	-0.027	0.113	-0.019	0.045
161	47105	A0IV	1.920	0.079	0.099	0.019	0.006	-0.080
162*	47152	B9np	5.765	-0.448	-0.084	0.111	-0.003	0.050
163	47839	O7Ve+B7	4.645	0.142	-1.309	0.026	-0.226	-0.051
164	48097	A2V	5.220	-0.027	0.062	0.062	0.055	-0.074
165	48329	G8Ib	3.003	0.020	1.305	-0.002	1.435	-0.003
166	48433	K0III	4.505	-0.016	0.996	0.087	1.188	0.015
167	48737	F5III	3.343	-0.026	-0.062	0.043	0.449	-0.038
168	49606	B7III	5.854	-0.029	-0.621	-0.059	-0.130	-0.040
169	49908	A2V	5.271	0.141	0.082	0.014	-0.004	-0.036
170	50635	F0Vp	4.649	0.071	0.003	0.069	0.322	-0.048
171	58187	A5IV	5.375	0.067	0.159	0.038	0.101	-0.014
172	58715	B8Ve	2.876	-0.112	-0.318	0.044	-0.090	-0.032
173	58923	F0III	5.222	0.241	0.179	0.070	0.221	-0.017
174*	59037	A4V	5.076	-0.352	0.118	-0.043	0.121	-0.006
175	60178/9	A1V+A2Vm	1.568	0.008	-0.003	-0.040	0.039	0.017
176*	62509	K0IIIb	1.138	-0.433	0.671	-0.055	1.024	0.355
177	63975	B8II	5.125	0.057	-0.552	0.064	-0.115	-0.048
178*	64145	A3V	4.972	-0.474	0.141	-0.384	0.100	-0.114
179	65900	A1V	5.650	0.045	0.040	0.066	0.006	-0.070
180	73471	K2III	4.452	-0.094	1.123	-0.112	1.243	-0.179
181	74280	B3V	4.283	-0.070	-0.928	0.076	-0.179	-0.094
182	74521	A1p	5.651	-0.020	-0.309	-0.041	-0.090	0.065
183	74738/9	A3V+G7.5III	4.033	-0.040	0.612	-0.087	1.008	-0.197
184	74874	G5III+A8IV	3.377	0.038	0.230	0.073	0.696	-0.033
185	75137	A0Vn	4.348	0.031	-0.019	-0.067	-0.031	-0.008
186	76294	G9II-III	3.117	0.083	0.616	-0.056	1.023	-0.127
187	76644	A7IV+dM1	3.133	-0.016	0.045	-0.020	0.199	0.000
188	77309	A2V	5.750	-0.071	0.080	-0.057	0.020	0.043

189	78316	B8IIIp	5.240	-0.133	-0.549	0.024	-0.089	-0.020
190	78556	B9.5III	5.603	0.033	-0.164	-0.075	-0.062	0.056
191	79439	A5V	4.818	0.013	0.068	0.011	0.193	0.093
192	80586	G8III+F5V	4.818	0.138	0.501	-0.163	0.943	-0.041
193*	81797	K3II-III	1.988	0.386	1.591	-0.022	1.491	-0.091
194	82308	K5III	4.304	-0.031	1.819	-0.154	1.583	-0.075
195	82621	A2V	4.481	-0.116	0.094	0.034	0.035	0.167
196	84441	G1III	2.966	0.158	0.317	-0.014	0.822	-0.130
197	85235	A3IV	4.566	-0.045	0.121	0.057	0.038	0.005
198	85376	A5IV	5.285	-0.039	0.032	0.003	0.242	-0.044
199	85558	A1V+A4V	5.079	0.041	0.050	0.080	0.025	-0.017
200	85795	A3III	5.287	-0.107	0.095	0.031	0.063	0.132
201	86146	F6Vs	5.114	0.074	-0.121	-0.005	0.455	0.003
202	86360	B9IV	5.267	0.080	-0.114	0.061	-0.051	-0.004
203	96663	M2IIIab	4.688	0.019	1.909	-0.054	1.654	-0.054
204	87015	B2.5IV	5.672	-0.060	-0.905	0.073	-0.179	0.026
205	87737	A0Ib	3.510	0.050	-0.225	-0.007	-0.017	0.002
206	89021	A2IV	3.441	0.052	0.108	0.155	0.031	0.015
207	89025	F0III	3.440	0.183	0.181	-0.047	0.302	-0.202
208	89484/5	K1IIIb+G7	2.008	0.014	0.795	0.069	1.159	-0.055
209	89758	M0III	3.048	0.186	1.816	-0.057	1.626	-0.106
210	90839	F8V	4.833	-0.120	-0.166	-0.086	0.527	0.001
211	91312	A7IV	4.721	0.046	0.052	0.002	0.211	0.044
212	91480	F1V	5.157	-0.177	-0.114	-0.039	0.346	0.027
213	94334	A1Vs	4.672	0.026	-0.033	-0.022	-0.039	0.069
214	95128	G0V	5.037	0.005	-0.056	-0.018	0.622	-0.024
215	95418	A1V	2.345	0.126	0.026	-0.050	-0.012	0.053
216	95608	A1m	4.406	0.035	0.075	-0.019	0.046	-0.018
217	95689	K0IIIa	1.793	-0.071	0.748	-0.042	1.093	-0.022
218	96738	A3IV	5.703	0.017	0.152	0.042	0.068	0.004
219	96833	K1III	3.016	0.039	0.963	-0.111	1.177	0.028
220	97603	A4V2	2.547	0.225	0.133	0.008	0.127	-0.032
221	98230/1	G0V	3.762	0.121	-0.153	-0.067	0.595	-0.019
222	98262	K3IIIp	3.478	0.082	1.434	-0.183	1.442	-0.031
223*	100203	F6V+G3V	5.466	-0.331	-0.171	0.016	0.507	0.048
224	102212	M1IIIab	4.031	0.007	1.754	-0.059	1.561	-0.062
225	102647	A3V	2.123	0.054	0.085	0.080	0.102	0.009
226	108283	F0p	4.920	-0.016	0.203	0.089	0.266	-0.025
227	110423	A2V	5.578	0.011	-0.017	0.018	-0.008	0.031
228	112413	A0p	2.904	0.047	-0.419	0.013	-0.098	0.068
229	113797	B9V	5.198	0.045	-0.224	-0.043	-0.069	0.122
230	115004	K0III	4.949	0.041	0.757	-0.094	1.079	0.085
231	115271	A7V	5.786	0.010	0.113	-0.052	0.195	0.114
232	115604	F3III	5.718	0.014	0.203	-0.063	0.307	0.116

233	116656/7	A1Vp+A1m	2.033	0.099	0.040	0.012	0.032	0.060
234	116842	A5V	3.999	-0.001	0.074	0.065	0.171	0.002
235	118022	A1p	4.929	0.085	-0.011	-0.001	0.028	-0.002
236	118098	A3V	3.377	0.197	0.091	0.042	0.119	-0.035
237	118232	A5V	4.669	0.014	0.144	-0.085	0.141	0.072
238	119228	M2IIIab	4.649	0.019	1.901	-0.023	1.686	0.073
239	120136	F6IV	4.489	0.053	-0.101	-0.041	0.488	0.092
240	124897	K1IIIb	-0.089	-0.087	1.096	0.172	1.270	0.099
241	125161	A9V	4.753	-0.166	0.033	-0.070	0.213	-0.010
242	126661	F0m	5.412	0.070	0.190	-0.068	0.229	0.108
243	128167	F2V	4.465	0.058	-0.195	-0.050	0.373	0.082
244	129174/5	B9p+A6V	4.504	0.055	-0.365	0.034	-0.008	0.022
245	129988/9	A2V+K0II	2.371	0.137	0.600	-0.104	0.986	0.091
246	133582	K2III	4.528	0.086	1.187	-0.136	1.293	0.051
247	134083	F5V	4.928	0.071	-0.161	-0.089	0.443	0.123
248	135722	G8III	3.479	0.144	0.492	-0.056	0.977	0.041
249	136849	B9Vn	5.384	-0.005	-0.219	0.000	-0.053	0.000
250	137391	F0V	4.313	0.028	0.003	0.034	0.315	0.006
251	137759	K2III	3.311	-0.036	1.066	-0.004	1.195	0.043
252	137909	F0p	3.669	-0.042	0.070	-0.042	0.279	0.012
253	138917/8	F0IV	3.797	0.035	0.095	-0.068	0.257	0.026
254	139006	A0V	2.219	0.071	0.007	-0.027	-0.019	0.055
255	140573	K2IIIb	2.631	0.098	1.107	-0.099	1.200	0.083
256	140775	A0V	5.568	0.034	0.077	-0.069	0.032	0.205
257	141004	G0V	4.419	0.003	-0.064	-0.075	0.611	0.079
258	141653	A2IV	5.197	-0.042	0.082	0.013	0.052	0.031
259	141714	G3.5III-IV	4.652	0.018	0.192	-0.091	0.805	0.031
260	146926	B8V	5.49	0.048	-0.453	0.022	-0.096	0.027
261	1476777	K0III	4.861	-0.010	0.638	-0.148	0.993	0.122
262	148387	G8IIIab	2.730	-0.018	0.468	0.083	0.922	-0.018
263	148856	G7IIIa	2.783	-0.009	0.494	0.088	0.945	0.006
264	150680	G0IV	2.811	-0.033	0.032	0.002	0.654	-0.013
265	151525	B9p	5.229	0.065	0.017	0.111	-0.017	0.050
266	151956	A3m	5.479	0.147	0.116	0.071	0.110	0.072
267	153210	K2III	3.195	0.145	1.026	0.140	1.181	0.060
268	154029	A3IV	5.279	0.053	0.069	-0.106	0.015	0.089
269	154494	A4IV	4.871	-0.039	0.111	-0.052	0.137	-0.013
270	155103	A5m	5.408	-0.103	-0.002	0.031	0.310	0.022
271	156014/5	M5Ib-IIa	2.933	0.115	0.948	-0.133	1.507	0.007
272	156164	A3IV	3.118	0.036	0.072	0.106	0.085	0.057
273	156729	A2V	4.615	-0.081	0.055	-0.011	0.039	0.010
274	157087	A3III	5.372	0.046	0.148	0.100	0.051	0.004
275	157198	A2V	5.131	0.001	0.079	0.112	-0.004	0.053
276	157728	F0IV	5.714	0.043	0.021	0.094	0.226	0.004
277	157778/9	B9.5III+	4.154	-0.088	0.019	0.032	-0.029	0.022
278	158352	A8V	5.415	0.074	0.087	-0.025	0.242	0.046

279	159139	A1V	5.652	0.068	-0.010	0.064	-0.002	0.005
280	159181	G2Ib-IIa	2.795	-0.140	0.465	-0.089	0.980	0.001
281	160181	A2Vn	5.754	-0.002	0.052	0.070	0.119	0.001
282	161797	G5IV	3.416	0.280	0.208	0.016	0.761	0.006
283	161858	A0V	3.743	0.011	0.066	0.057	0.040	0.004
284	163472	B2IV-V	5.821	0.025	-0.845	0.068	0.098	-0.006
285	163506	F2Ibe	5.416	0.026	0.383	0.007	0.332	0.065
286	164136	F2II	4.403	-0.102	0.168	-0.010	0.379	0.051
287	164284	B2Ve	4.610	-0.070	-1.068	0.111	-0.001	0.000
288	164577	A2Vn	4.436	0.056	0.036	0.147	0.031	-0.013
289	165908	F7V	5.059	-0.124	-0.213	-0.018	0.529	0.079
290	166045	A3V	5.857	-0.083	0.092	0.014	0.129	0.058
291	166046	A3V	5.878	-0.155	0.039	0.056	0.142	0.029
292*	167006	M3III	4.967	-0.089	1.912	-0.377	1.685	0.009
293	168723	K2IIIab	3.251	-0.018	0.478	-0.086	0.955	0.050
294	169702	A3IVn	5.127	-0.151	0.123	-0.009	0.040	0.036
295	174044	B8II-IIIp	5.408	0.074	-0.611	-0.074	-0.095	0.074
296	173417	F1III-IV	5.688	-0.066	-0.037	0.014	0.353	0.025
297	173582/3	A4V+F1V	4.681	-0.054	0.073	-0.007	0.174	0.039
298	173607/8	A8Vn+F0Vn	4.604	-0.107	0.084	0.021	0.185	0.046
299	173648	Am	4.344	0.009	0.178	-0.025	0.201	0.041
300	174602	A3V	5.226	-0.129	0.136	-0.052	0.098	0.066
301	175426	B2.5V	5.584	-0.035	-0.823	-0.016	-0.133	0.042
302	175588	M4II	4.316	-0.094	1.614	-0.073	1.726	-0.020
303*	175751	K2III	4.835	-0.121	0.841	-0.570	1.111	0.008
304	176051	F9V+K1V	5.220	0.003	-0.110	0.000	0.601	0.058
305	176318	B7IV	5.890	-0.028	-0.521	-0.037	-0.090	0.101
306	176437	B9III	3.246	-0.031	-0.005	0.007	-0.041	0.042
307*	176524	K0III	4.829	-0.409	0.935	-0.022	1.176	0.386
308	176678	K1III	4.017	0.075	0.846	0.095	1.131	0.052
309	176984	A1V	5.394	0.006	0.025	-0.037	0.013	0.061
310	177178	A4V	5.824	-0.044	0.067	0.021	0.194	0.017
311	177756	B9Vn	3.419	0.036	-0.310	-0.075	-0.081	0.082
312	178125	B8III	5.068	-0.127	-0.480	-0.016	-0.054	0.105
313	178475	B6IV	5.246	0.081	-0.652	-0.023	-0.105	0.040
314	178596	F0III-IV	5.239	-0.055	-0.050	0.028	0.344	-0.010
315	180482	A3IV	5.583	-0.042	0.219	0.209	0.091	-0.087
316	180868	F0IV	5.289	-0.095	0.210	-0.039	0.191	0.084
317	181276	G9III	3.803	-0.026	0.559	0.012	0.966	0.054
318	181333	F0III	5.5228	-0.148	0.170	0.012	0.270	0.083
319	182568	B3IV	4.985	0.039	-0.893	0.133	-0.107	-0.049
320	182572	G8IV	5.179	-0.075	0.244	0.009	0.777	-0.052
321	182640	F3IV	3.368	-0.040	-0.031	0.038	0.338	0.035
322	182835	F2Ib	4.678	-0.026	0.657	0.078	0.593	-0.047
323	183912/4	K3II+B0.5V	3.067	0.009	0.456	0.059	1.163	-0.028
324	184406	K3IIIb	4.460	-0.025	1.101	-0.013	1.204	0.071

325	184759	A0V+F8III	5.415	0.027	0.268	0.107	0.581	0.001
326	184875	A2V	5.342	0.085	0.151	0.030	0.066	0.029
327	184905	A0p	6.632	-0.088	-0.320	-0.105	-0.023	0.002
328	185351	G9IIIb	5.183	0.065	0.513	0.053	0.954	-0.031
329	185507	B3V+B3V	5.148	0.001	-0.784	0.031	0.047	0.052
330	185734	G8III-IV	4.692	0.798	0.613	-0.032	0.994	-0.849
331	185758	G1IIab	4.386	-0.014	0.273	-0.086	0.789	0.006
332	185762	A3IV	5.640	-0.047	0.110	0.125	0.115	-0.043
333	185872	B9III	5.409	0.081	-0.218	0.047	-0.060	0.035
334	186155	F5II/III	5.067	0.054	0.103	0.008	0.413	0.013
335	186203	dF3+A3	5.291	-0.039	-0.155	-0.055	0.604	0.076
336	186791	K3II	2.718	-0.002	1.589	-0.191	1.567	0.066
337	186882	B9.5IV+F1V	2.869	0.102	-0.074	0.016	-0.028	0.002
338	187691	F8V	5.121	-0.049	-0.080	0.032	0.564	0.067
339	187879	B1III+B3V	5.655	0.086	-0.996	0.106	-0.029	0.046
340	188209	O9.5Ib	5.634	0.056	-1.210	0.075	-0.063	0.049
341	188252	B2III	5.906	0.115	-1.080	0.068	-0.163	-0.001
342	188260	B9.5III	4.581	-0.070	-0.142	0.042	-0.041	-0.012
343	188310	K0IIIb	4.721	-0.015	0.730	0.033	1.071	0.038
344	188728	A1IV	5.278	-0.039	0.017	0.009	0.009	0.059
345	189319	M0III	3.508	-0.036	1.857	-0.050	1.617	0.011
346	190940	K3III	4.522	-0.041	1.370	-0.038	1.363	-0.017
347	191610	B2.5Ve	4.942	0.047	-0.971	0.080	-0.141	0.050
348	191692	B9.5III	3.232	-0.033	-0.121	0.029	-0.061	0.004
349	192640	A2V	4.945	-0.058	0.031	-0.005	0.160	0.062
350	192806	K3III	4.511	-0.087	0.995	-0.218	1.302	-0.006
351	193237	B2pe	4.752	0.001	-0.826	0.013	0.416	0.059
352	193495	F8V+A0	3.089	0.076	0.159	0.035	0.814	0.041
353	194093	F8Ib	2.233	-0.069	0.469	0.049	0.674	0.066
354	195050	A3V	5.642	0.010	0.104	-0.030	0.066	0.064
355	195556	B2.5IV	4.944	-0.106	-0.805	0.094	-0.065	0.011
356	196178	B9p	5.785	-0.122	-0.664	0.086	-0.141	0.084
357	196502	A0p	5.207	0.007	0.132	-0.089	0.085	-0.026
358	196524	F5IV	3.627	-0.064	-0.039	-0.643	0.448	0.004
359	196662	B7III	-	-	-	-	-	-
360	197345	A2Iae	1.267	-0.045	-0.243	0.044	0.102	0.055
361	197392	B8II-III	5.677	-0.049	-0.534	0.018	-0.094	0.021
362	197963/4	K1IV+A2Ia	3.890	-0.046	0.372	-0.104	0.863	0.043
363	198149	K0IV	3.430	0.085	0.420	-0.041	0.929	-0.032
364	198183	B5Ve	4.526	0.062	-0.616	0.052	-0.098	0.007
365	198478	B3Iae	4.834	-0.027	-0.640	0.061	0.382	0.063
366	198639	A4m	5.064	-0.033	0.103	0.002	0.205	0.015
367	198809	G7III	4.570	-0.058	0.302	-0.119	0.866	0.039
368	199081	B5V	4.778	-0.033	-0.725	0.073	-0.123	0.023
369	199629	A1Vn	3.943	-0.104	0.046	0.019	0.017	0.036
370	200120	B1nne	4.765	-0.065	-1.186	0.060	-0.051	0.084

371	200310	D1Ve	5.365	0.032	-1.172	0.120	-0.176	0.022
372	202275	F5V+G0V	4.488	-0.036	-0.158	-0.013	0.512	-0.003
373	202444	F2IV	3.731	-0.045	-0.068	0.006	0.409	0.059
374	202850	B9Iab	4.260	-0.024	-0.455	0.069	0.127	-0.027
375	202904	B2Vne	4.225	0.045	-0.978	0.114	-0.087	0.016
376	203467	B3IVe	5.122	0.183	-0.827	0.070	0.004	-0.037
377	204724	M1III	4.524	-0.047	1.874	-0.125	1.650	0.113
378	204770	B7V	5.431	-0.048	-0.534	0.008	-0.112	0.058
379	204867	G0Ib	2.885	0.168	0.446	0.029	0.852	0.035
380	205021	B2IIIev	3.241	0.033	-1.181	0.026	-0.213	0.030
381	206267	O6f+B0V	5.629	-0.034	-0.979	0.017	0.208	0.046
382	206672	B3IV	4.682	-0.003	-0.836	0.015	-0.106	-0.006
383	206778	K2Ib	2.376	0.028	1.532	0.125	1.581	0.001
384	206952	K0III	4.550	-0.022	0.954	-0.004	1.124	0.012
385	207330	B3III	4.235	-0.066	-0.889	-0.018	-0.117	0.026
386	208057	B3Ve	5.094	0.040	-0.826	-0.046	-0.150	0.082
387	208565	A2Vnn	5.536	0.004	0.091	0.033	0.057	0.009
388	209409	B7IVe	4.695	0.129	-0.538	0.083	-0.084	0.004
389	209459	B9.5V	5.831	0.014	-0.111	0.078	-0.050	0.005
390	209481	O8.5III+O9	5.555	0.074	-1.096	0.012	0.075	0.003
391	209750	G2Ib	2.938	0.144	0.579	-0.030	0.996	0.077
392	209790	F3III/IV	4.273	-0.060	0.030	-0.044	0.351	0.083
393	209975	O9Ib	5.112	0.000	-1.090	0.013	0.079	0.030
394	210418	A2V	3.519	0.003	0.114	0.041	0.085	-0.014
395	210745	K1.5Ib	3.343	0.010	1.549	0.037	1.611	-0.022
396	210855	F8V	5.258	-0.039	-0.055	0.034	0.522	-0.061
397	210884	F2V	5.480	0.002	-0.115	-0.017	0.399	0.022
398	212097	B9III	4.798	-0.050	-0.240	0.071	-0.011	-0.033
399	212120	B6V	4.556	-0.036	-0.651	-0.019	-0.099	0.003
400	212710	B9.5Vn	5.276	0.079	--0.069	-0.088	-0.033	0.084
401	212943	K0III	4.789	0.068	0.708	0.076	1.076	0.022
402	213323	B9.5V	5.643	0.107	-0.090	-0.036	-0.033	-0.003
403*	213798	A3V	5.469	0.440	0.105	-0.001	0.072	0.032
404	214035	A2V	5.705	0.074	0.107	-0.001	0.009	0.049
405	214994	A1IV	4.802	0.094	0.039	-0.037	-0.012	0.015
406	215182	G2II+F0V	2.936	0.140	0.423	0.038	0.874	-0.006
407	215648	F6III/IV	4.207	0.002	-0.146	-0.008	0.502	0.020
408	216131	G8III	3.511	-0.021	0.496	0.023	0.951	-0.004
409	216228	K0III	3.513	0.072	0.763	-0.092	1.064	0.095
410	217906	M2.5IIIe	2.365	0.151	1.921	0.001	1.730	-0.027
411	218376	B0.5IV	4.850	0.053	-1.070	0.026	-0.045	0.099
412	218634	M4III+A2V	5.052	-0.022	1.161	0.180	1.541	0.160
413	218658	G2III+F3V	4.404	0.032	0.323	0.080	0.808	-0.038
414	219485	A0V	5.901	0.038	0.011	0.078	-0.020	0.071
415	219615	K0III	3.701	0.022	0.407	0.021	0.940	-0.023
416	220061	A5V	4.595	-0.068	0.110	0.011	0.181	0.130

417	220222	B6III	5.343	0.016	-0.561	0.075	-0.099	0.050
418	220954	K1III	4.280	0.044	0.825	-0.021	1.095	0.079
419	221253	B3IV	4.890	-0.024	-0.800	-0.009	-0.121	0.034
420	221525	A7IV	5.571	0.054	0.176	0.021	0.226	0.155
421	222368	F7V	4.129	0.047	-0.131	0.041	0.511	0.014
422	222404	K1III-IV	3.241	0.031	0.771	0.052	1.050	0.070
423	222439	B9IVn	4.140	-0.062	-0.258	-0.041	-0.076	0.043
424*	224427	M3III	4.678	-0.088	1.593	-0.357	1.635	0.092
425	224893	F0III	5.576	-0.091	0.536	0.049	0.402	0.052

- - numbers of stars with residuals more 0.2^m marked by asterisks;
- - star HD196692 is absent in catalogue [11].

Acknowledgement. I express sincere gratitude to T. Bobryashova for help in calculations, N. Morozova for digitizing the Shamakha catalogue and L. Usoltseva for remarks to manuscript of this article.

This work has been carry out in the frame of PGF AC MDAI RK, code BR05336383.

В. М. Терещенко

Fesenkov Astrophysical Institute

ШАМАХИН СПЕКТРОФОТОМЕТРЛІК КАТАЛОГЫНЫҢ ДҰРЫСТЫҒЫН БАҒАЛАУ

Аннотация. Жеке мақалалар және танымал спектрофотометрлік каталогының негізінде біз спектрлерінде энергияның талалуы анықталған жұлдыздардың бірыңғай және жинақталған каталогын құруды жоспарлаудамыз. Жұмыстың алғашқы сатысында берілген каталогтардың дұрыстығын бағалау. Бұл жұмыста, Шамахин обсерваториясында құрылған каталогтың мәліметтеріне талдаулар жүргізілді. Мәліметтердің дұрыстығы– WBVR фотометрлік жүйесінің тікелей бақыланатын және энергияның таралуы бойыншаесептелген жұлдыздардық шамалармен сәйкестігін салыстыру бойынша анықталған жанама жолмен бағаланған. Жұлдыздық шамаларды есептеу белгілі синтетикалық фотометрия өрнегімен анықталған. Одан кейін, бақыланатын және есептелген шамалардың арасындағы (қателіктер) айырмасы есептелді. Түс көрсеткіштігі және V шамасы бойынша қателіктер тәуелділігінің графиктері тұрғызылды. 0.20^m шамадан асатын, айтарлықтай қателіктер саны бар. Алынған нәтижелер жұлдызды-стандарттар таңдап алуға және жинақталған каталог құруға қолданылады.

Түйін сөздер: жұлдыздар, энергияның таралуы, Шамахин спектрофотометрлік каталогы, WBVR-шамаларының каталогы, тенеу.

В. М. Терещенко

Fesenkov Astrophysical Institute

ОЦЕНКА ДОСТОВЕРНОСТИ ШАМАХИНСКОГО СПЕКТРОФОТОМЕТРИЧЕСКОГО КАТАЛОГА

Аннотация. На базе существующих спектрофотометрических каталогов и отдельных статей мы планируем создать сводный и однородный каталог звезд с известным распределением энергии в их спектрах. В качестве исходных каталогов мы намерены использовать каталоги, созданные в Астрофизическом институте им. В.Г. Фесенкова, Государственном астрономическом институте им. П.К. Штернберга, главной астрономической обсерватории РАН, Одесской астрономической и Шамахинской астрофизической обсерваториях. На первом этапе работы необходимо оценить достоверность данных исходных каталогов. В настоящей работе мы анализируем данные каталога, созданного в Шамахинской обсерватории. Достоверность данных оценивается косвенным путем - по сходимости вычисленных из распределения энергии звездных величин с непосредственно наблюдаемыми величинами в фотометрической системе WBVR. Вычисления звездных величин выполнены по известным формулам синтетической фотометрии. Затем были вычислены разности между вычисленными и наблюдаемыми величинами (невязки). Результаты вычислений представлены в таблице. По ним были построены зависимости невязок от звездной величины V и показателей цвета. Из них следует, что заметные систематические ошибки в Шамахинском каталоге отсутствуют. Однако, имеется значительное число случайных невязок, достигающих 0.20^m и более. Полученные результаты будут использованы при создании сводного каталога и при выборке из него звезд-стандартов.

Ключевые слова: звезды, распределение энергии, Шамахинский спектрофотометрический каталог, каталог WBVR-величин, сравнение.

Information about author:
Tereschenko Vladimir Mikhaylovich – candidate of phys.-math. sciences, leading science collaborator of Fesenkov Astrophysical Institute. volter2307@mail.ru

REFERENCES

[1] Breger M. Second spectrophotometric catalogue // Astrophys. J. Suppl. Vol. 32. **1976.** P. 1-86.

[2] Burnashev V. I. Spectrophotometry of 1588 stars // SIMBAD. **1985.** http://vizier.u-strasb.fr./ III/126/stars

[3] Tereschenko V. M., Kharitonov A. V., Knyazeva L. N. // Spectrofotometricheskiy catalog zvezd. Alma-Ata. "Kazak University". **2011**. 304p. (in Russ.)

[4] Voloshina I.B., Glushneva I.N., Doroshenko V.T,. Kolotilov E.A,. Mossakovskaya K.I., Ovchinnikov S.L., Fetisova T.S. pod red. I. N. Glushnevoy // Spektrofotometriya yarkikh zvezd. M. Nauka. **1982.** 256 p. (in Russ.)

[5] Alekseeva G. A., Arkharov A. A., Galkin V. D., Hagen-Thorn E. I., Nikanorova I. N., Novikov V. V., Novopashenny V. B., Pakhomov V. P., Ruban E. V., Shchegolev D. E. The Pulkovo spectrophotometric catalog of bright stars in the range from 320 to 1080nm // Baltic astronomy. **1996.** Vol. 5, № 4. P. 603-838.

[6] Komarov N.S., Pozigun V.A., Belik S.I., Dragunova A.V., Gopka V.F., Zakozhurnikova N.N., Kantsen L.E., Karamysh V.F., Mishenina T.V., Orlova L.F., Pereverzentsev A.F., Russo T.A., Cherkass A.G. Spektrofotometriya zvezd v diapazone λλ 550 - 900 nm // Kiev. Naukova dumka. **1983.** 312 p. (in Russ.)

[7] Komarov N. S., Arkhipov M.G., Basak N.Yu., Belik S. I., Cherkass A.G., Chuprina R. I., Depenchuk E. A., Dragunova A. V., Dulapchi I. F., Gorbaneva T. I., Karamysh V. F., Kantsen L.E., Korotin S.A., Kovtyukh V.V., Orlova L.F., Motrich V.D., Pereverzentsev A.F., Shevchuk T.V., Zakozhurnikova N.N. The New Spectrophotometric Star Catalogue // Odessa Astronomical Publication. Vol. 11. **1998.** P. 3–48.

[8] Omarov S.Z., Gadzhiev M.S., Goldberg E.P., Omarova G.P., Shestopalov D.I., Shustarev P.N. Raspredelenie energii v spektrakh 425 yarkikh zvezd // Tsirkulyar Shamakhinskoy astrofiz. observ. im. Tusi. № 104. **2002,** P. 3-174. (in Russ.)

[9] Tereschenko V. M., Kharitonov A. V. Zonalnie spectrophotometricheskie standarty // Alma-Ata. "Nauka Kaz SSR". **1972** . 126 p. (in Russ.)

[10] Nicolet B. Astron. and Astrophys. Suppl. Ser. // Vol.34. **1978**, P.1.

[11] Kornilov V.G., Volkov I.M., Zakharov A.I., Kozyreva V. C., Kornilova L.N., Krutyakov A.N., Krylov A.V., Kusakin A.V., Leontyev S.E., Mironov A.V., Moshkalev V.G., Pogrosheva T.M., Sementsov V.N., Khaliullin Kh. F. Katalog WBVR-velichin yarkikh zvezd severnogo neba // Trudy Gos. astron. in-ta im. P.K. Shternberga. Vol. 63. **1991.** 400 p. (in Russ.)

[12] Mironov A.V. Osnovy astrofotometrii. M. Fizmatlit. **2008.** 260 p. (in Russ.)