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A LUMINOSITY INDEX FOR BRIGHT K0—K5 STARS

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An index for luminosity classification of K0—K5 stars based upon broad band *UBRI* observations has been obtained and discussed. This index has been employed to obtain the MK-luminosity classifications for 21 bright stars for which only the spectral classification is so far available.

Показатель светимости для ярких звезд K0—K5

На основании широкополосных *UBRI* наблюдений выводится и обсуждается показатель для классификации светимости звезд типов K0—K5. С использованием этого показателя выполнена классификация по МК — светимости 21 ярких звезд, для которых известны только спектральные классы.

Introduction

We have taken as our starting point the broad band *UBRI* photometric observations made by Johnson et al. (1966) of single stars brighter than $V = 6^m.5$, lying in the spectral range K0—K5. Out of a total of 284 such stars photometric data for which is available in the above referred paper, 170 stars have well defined two dimensional MK-classification when the various catalogues (Hoffleit, 1964; Jascheck et al., 1964, Blanco et al., 1968) are compared inter se. The BS catalogue numbers of these 170 stars in the form of a spectrum luminosity array are given in Table 1. The remaining 114 stars (vide Table 2) have uncertainties in at least one of the parameters of classification, when the various catalogues referred to above are compared.

Discussion

It is well known that in a given MK-spectral type a more luminous star is cooler than a less luminous one. Based on this, we have tried to define an index Z ,

which serves to separate stars of given spectral type into various luminosity classes and vice versa. We find that the index Z (expressed in magnitudes), defined by the relation

$$Z = (U + B) - (R + I)$$

is one such index.

Figure 1, gives the spectral type vs Z , plot of the 170 stars referred to above, for which well defined two dimensional classification is available. An inspection of the figure reveals the capabilities of the proposed index. Least square straight line fits for the different luminosity classes were found to be as under:

$$Z_{Ib} = 6.81 (\pm 0.40) + 0.53 \times (\text{K-subclass})$$

$$Z_{II} = 6.15 (\pm 0.40) + 0.50 \times (\text{K-subclass})$$

$$Z_{III} = 4.98 (\pm 0.60) + 0.54 \times (\text{K-subclass})$$

$$Z_V = 3.78 (\pm 0.50) + 0.38 \times (\text{K-subclass}).$$

In the above, the relation for luminosity class IV has not been attempted because of the extremely small population of that class, as is apparent from Table 1. If, however, we include the stars of luminosity class IV

Table 1

Spectrum luminosity array for 170 stars of spectral type K0—K5 with well defined classification, used in Fig. 1. The bracketed number in the lower right hand corner of a square denotes the frequency of that square while the other numbers are the Bright Star Catalogue numbers of the stars concerned.

LC \ Sp	K0	K1	K2	K3	K4	K5	Total
Ib	8796 (1)	8465 (1)	8308 (1)	834, 2580 (2)	—	8726 (1)	6
II	7314 (1)	6695 (1)	991, 1601, 6896 (3)	1577, 2854, 6498, 7525 (4)	1908, 8089 (2)	429 (1)	11
III	(45)	(12)	see (25)	lists (21)	below (10)	(20)	134
IV	1136, 1743 (2)	—	—	—	—	—	2
V	166, 511, 857, 6171, 7462, 7722 (6)	493, 1325 (2)	222, 1084, 6806 (3)	753, 8832 (2)	—	5568, 8085, 8387, 8721 (4)	17
Total:	55	16	32	29	12	26	170

Lists: K0 III:	25, 1464, 3809, 7615,	194, 2012, 3994, 7942,	294, 2077, 4287, 7949,	315, 2120, 4725, 8317,	399, 2506, 5502, 8780,	402, 2701, 5601, 8820,	485, 2970, 6104, 8841,	509, 2990, 6546, 8892,	794, 3046, 6746, 8997.	941, 3211, 6884,	1106, 3427, 7180,	1256, 3461, 7595,
K1 III:	3,	824,	2478,	2973,	4080,	5068,	7150,	7193,	7234,	7746,	8173,	8916.
K2 III:	253, 3418, 6945.	617, 3614,	882, 3731,	951, 3905,	1481, 4813,	1580, 5287,	2040, 5616,	2113, 5744,	2697, 6299,	2864, 6415,	3145, 6688,	3403, 6872,
K3 III:	464, 6973,	489, 7064,	1551, 7120,	1726, 7352,	2227, 7685,	3834, 7744,	3845, 7806,	4377, 8632,	5315, 8702.	5370,	5429,	5947,
K4 III:	834,	2527,	3141,	3518,	3980,	4546,	5430,	5824,	8413,	8748.		
K5 III:	224, 5794,	843, 5899,	1457, 6271,	1654, 6705,	2773, 7635,	3003, 8207,	3275, 8804,	3773, 8906.	4945,	5381,	5485,	5705,

belonging also to Table 2, we get the equation:

$$Z_{IV} = 4.42 (\pm 0.40) + 0.31 \times (\text{K-subclass}).$$

The figure defining the limits of uncertainty of the constant term in each of these equations has been obtained essentially by an inspection of Fig. 1.

On the basis of the index Z defined as in the above equations we have tried to resolve the uncertainties in the two dimensional MK-classification for the stars in Table 2. We find that the MK-classification on the basis of the criterion suggested by us agrees with that of Johnson et al. (1966) for 38 stars, while for the remaining 76 stars the classification obtained by us is as indicated in the last column of Table 2.

Remarks

It is realized that the index Z cannot be used as such, without applying suitable corrections for reddening, to faint stars for which something of a pair-index will be more suitable. We are thankful to Dr K. Gyldenkerne for pointing this out to us.

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Table 2

Star B. S.	Available classification (with references)	Index, Z (in magnitudes)	MK type obtained by us
74	K2 III (27); K0 III (12)	5.90	K2 III
99	K0 III (27); K3 III (9)	5.27	K0 III
165	K3 III (27); K5 III (13)	6.54	K3 III
168	K0 II—III (22)	5.62	K0 III
188	K1 III (22); K0 III (34)	4.85	K0 III
215	K1 II (27); K2 III (22); G8 III (17)	5.40	K1 III
285	K2 III (27); K2 II—III (35)	6.13	K2 III
334	K3 III (27); K2 III (7,35)	5.75	K2 III
352	K0 III—IV (27)	5.42	K0 III
360	K0 III (27); K0 II—III (37)	4.93	K0 III
390	K0 III—IV (27)	5.28	K0 III
440	K0 III—IV (27)	4.69	K0 III
539	K2 III (27); K0 III (6)	5.49	K2 III
602	gK5 (27)	8.13	K5 III
699	K4 III (27); gK5 (3)	8.19	K5 III
850	K0 III (27)	4.28	K0 IV
874	K1 III—IV (27)	5.38	K1 III
947	K0 III (27); K1 III (2)	5.47	K1 III
999	K4 III (27); K3 II—III (2)	8.13	K4 II
1052	K3 III (27); K3 V (19)	7.13	K3 III
1066	K0 II—III (27)	5.36	K0 III
1326	K1 III (27); K2 III (24)	5.52	K1 III
1346	K0 III (27); K2 III (6)	4.72	K0 III
1355	gK5 (27); gK1 (20)	5.44	K5 V
1373	K1 III (27); K0 III (20)	4.73	K0 III
1409	K1 III (27); K0 III (24)	4.85	K0 III
1437	K3 II—III (27)	6.60	K3 III
1517	gK4 (27)	6.13	K4 IV
1614	dK5 (27); K3 (38)	5.31	K3 IV
1652	gK3 (27)	6.06	K3 III
1862	gK1 (27)	5.60	K1 III
1925	dK2 (27); dK1 (2)	4.00	K1 V
1963	K1 III (27); K0 III (20)	5.77	K1 III
2382	K0 III (22); K0 V (5)	4.75	K0 III
2427	K3 II—III (27)	6.16	K3 III
2429	K1 IV (27); K1 III (33)	5.18	K1 III—IV
2443	K1 II—III (27); K1 III (14)	5.66	K1 III
2450	K3 III (27); K2 II (35)	7.45	K3 II
2574	K4 III (27); K3 III (24)	7.59	K4 III
2821	K0 (27); G9 III (34)	4.96	K0 III
2993	gK5 (27)	8.83	K5 Ib—II
3017	cK (16, 27); K5 (3)	8.86	K5 Ib—II
3225	cK (27); cK5 (28)	8.39	K5 II—III
3243	gK0 (27); K2 (24)	5.43	K1 III
3249	K4 III (27); K5 III (31)	7.75	K5 III
3441	K1 III (27); G8 III (30)	5.23	K1 III
3547	K0 II—III (27)	4.73	K0 III
3634	K5 Ib (27); K2 Ib (21)	8.53	K3 Ib
3682	gK0 (27); K2 (8)	5.43	K1 III
3748	K4 III (27); K3 III (21)	7.47	K4 III
3749	gK3 (27)	5.75	K3 IV
3751	K3 III (27); gK5 (3)	7.68	K5 III
4094	K4 III (27); K5 III (10)	7.83	K5 III
4232	K2 III (27); K3 III (20)	6.25	K2 III
4247	K0 III—IV (27)	5.20	K0 III
4299	K5 III (27)	8.78	K5 II
4301	K0 III (27); K0 II—III (1)	5.26	K0 III

Table 2 (Continued)

Star B. S.	Available classification (with references)	Index, Z (in magnitudes)	MK type obtained by us.
4335	K1 III (27); K2 III (31)	5.65	K1 III
4518	K0 III (27); K2 III (31)	5.88	K2 III
4630	K3 III (27); K2 III (23)	6.65	K3 III
4695	K1 III (27); K0 III (1)	5.86	K1 III
4737	K1 III—IV (27)	5.59	K1 III
4831	gK1 (27)	5.28	K1 III
4888	gK2 (27)	7.03	K2 II
4955	K1 III (27); K2 III (30)	5.62	K2 III
5200	K5 III (27); gM0 (3)	8.18	K5 III
5219	K5 III (27); gM2 (3)	9.62	K5 Ib
5288	K0 III—IV (27)	4.93	K0 III
5340	K2 IIIb (27); K0 III (32)	6.33	K2 III
5361	K0 III (27); K1 III (1)	5.09	K0 III
5526	gK4 (27)	7.17	K4 III
5563	K4 III (27); K5 III (31)	7.69	K5 III
5600	K4 III (27); gK5 (3)	8.00	K5 III
5686	gK0 (27)	5.45	K0 III
5763	K5 III (27)	8.56	K5 II
5777	K1 IV (27); K1 III (3)	4.93	K1 IV
5838	K5 III (27); gM0 (3)	9.10	K5 Ib
5854	K2 III (27); K2 III—IV (31)	5.77	K2 III
5901	K0 III—IV (27)	4.88	K0 III
5908	K0 III—IV (27)	4.80	K0 III
5924	K4 III (27); M0 III (11)	8.60	K4 Ib
6018	K0 III (27); K0 III—IV (30)	4.93	K0 III
6076	K5 III (1, 27)	5.19	K5 V
6103	K0 III (27); K0 II—III (18)	4.66	K0 III
6159	K4 III (31); K5 III (1)	8.06	K5 III
6166	gK6 (27)	5.45	K6 III
6241	K2 III—IV (27)	5.80	K2 III
6418	K3 II (27); gK3 (3)	7.18	K3 III
6526	K4 III (27); K3 III (31)	7.39	K4 III
6603	K2 III (27); K2 III—IV (31)	5.79	K2 III
6713	K0 II—III (27)	6.08	K0 II
6842	gK5 (27)	8.47	K5 II—III
6859	K2 III (27); K4 III (7)	6.99	K4 III
6869	K0 III—IV (27)	4.43	K0 IV
6895	K2 III (27); K1 III (11)	5.82	K2 III
6913	K2 III (27); gK1 (3)	5.04	K1 III
7116	cK2 (27)	6.79	K2 II
7125	K0 II—III (27)	5.86	K0 II
7176	K2 III (27); gK0 (3)	5.24	K0 III
7317	K3 III (27); gK4 (20)	7.50	K4 III
7429	K3 III (27); K0 III (29)	6.03	K2 III
7604	gK3 (27)	7.25	K3 II—III
7939	K2 III (27); K0 III (32)	5.84	K2 III
7957	K0 IV (22); K0 III—IV (35)	4.28	K0 IV
8079	K5 Ib (27); cK4 (3)	8.40	K4 II
8255	K1 III (27); K0 III (36)	5.34	K1 III
8461	K1 III (27); gG7 (3)	4.56	K1 IV
8485	K3 III (27); gK4 (3)	6.98	K4 III
8498	K3 II—III (27)	7.26	K3 III
8551	K0 III (27); K0 III—IV (19)	5.12	K0 III
8649	K4 III (27); K3 III (30)	6.94	K4 III
8694	K1 III (27); K0 III (31)	5.17	K1 III
8812	K2 II (27); K0 III (20)	5.96	K2 III
8974	K1 IV (22); K0 IV (32)	5.02	K1 IV

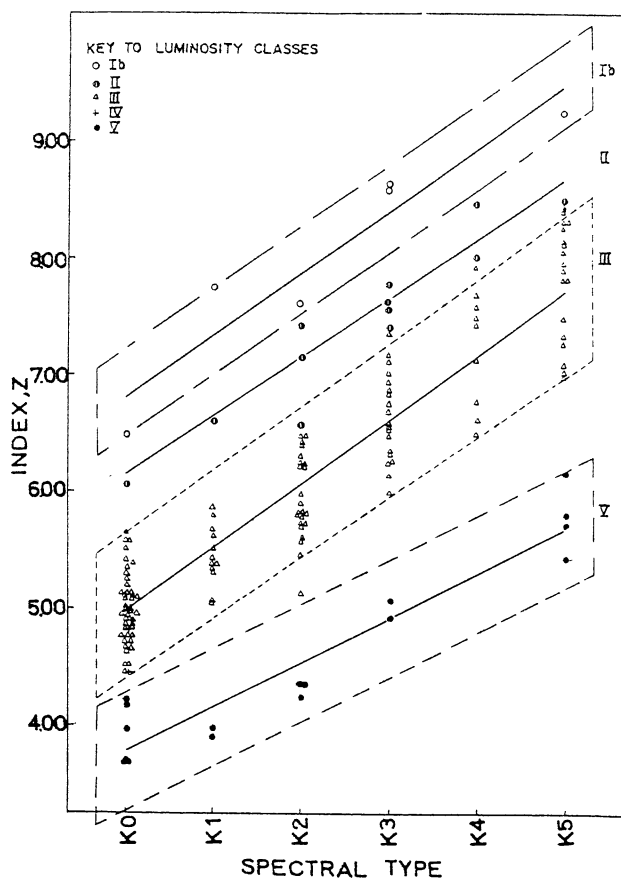


Fig. 1.

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