MKJ AND MSS CLASSIFICATION OF SOLAR-TYPE STARS WITHIN 100 PARSECS OF THE SUN: PRELIMINARY RESULTS

M. Fracassini, L. E. Pasinetti and M. Borella

Physics Department, University of Milan

A. Pasinetti

CERN, Geneva

ABSTRACT. A study of the distribution of spectral types of Solar Type Stars (STS) in the revised MKJ and MSS classifications is made on 3919 F8-K3 HD spectral-type stars brighter than m_V=10. By means of the solar color indices U-B and B-V 697 STS were selected. The spectral types G3V and G5V have the highest percentages in MSS and MKJ, respectively, confirming statistically the results published by Keenan and Pitts (1980) and by Hardorp (1982). The distribution of the color indices U-B and B-V in the revised G2V spectral type shows that these are good selection criteria for STS and are in the range $0.06 \leq U-B \leq 0.10$ and $0.58 \leq B-V \leq 0.65$.

1. INTRODUCTION

The search for solar spectral analogs, the stars that match the solar line spectrum as well its energy distribution, is clearly important for several astronomical domains. In particular, for problems of standards calibration, it is essential to know solar analogs in as many parts of the sky as possible, where the brightest G2 stars are contained.

The HR diagrams derived from the Michigan Spectral Catalogue show that the 4700 HD stars within 100 pcs have spectral types between F3 and G8 with a maximum at G0, and the majority of the 184 HD stars within 25 pcs are early G dwarfs (Houck and Fesen 1978).

An extensive survey of the HR and color-luminosity diagrams of nearly 500 stars in the solar neighborhood (within 32 pcs) shows also systematic effects on luminosity due to the errors in trigonometric parallax measurements but also, in a smaller part, to the spectral classification (Gliese 1978).

Moreover, the color and metallicity of the Sun relative to other stars remains controversial and there is evidence that the color and spectrum of the Sun are more similar to G3 and G4 than G2 (Barry 1978). Since 1978, Hardorp has performed extensive and careful investigations of solar spectral analogs. One of them in particular (Paper V; Hardorp 1982) has been very useful to the present study, which is a statistical study of solar-type stars within 100 pcs of the Sun by means of

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color and spectral type.

2. DATA AND RESULTS

A list of 3919 stars, between F8 and K3 HD spectral types and magnitudes $m_V \leqq 10$, was kindly provided by the Centre de Données Stellaires of Strasbourg. This list contains equatorial coordinates (1950), U-B and B-V color indices, revised spectral types by Jaschek et al. (MKJ, 1964) and Houk and Cowley (MSS 1975, 1978), and a complete and updated bibliography for each star. Taking into account the solar color indices U-B= 0.20 and B-V=0.66 (Hardorp 1982) we have selected 697 STS which are divided into the following three groups:

1) Solar Type stars (ST, 48), with U-B = 0.20 ±0.02 and B-V = 0.66 ±0.01, which are reported in Table I;
2) Solar Analog stars (SA, 311), with $0.07 \leqq$ U-B $\leqq 0.28$ and $0.62 \leqq$ B-V $\leqq 0.71$, and the CN 3850 Å, Fe 3740 Å indices relative to the Sun (Hardorp 1982) in the range ΔCN, ΔFe = ±0.05;
3) Solar Candidate stars (SC, 338) within the limits of the list (Table I) by Hardorp (1982) $0.02 \leqq$ U-B $\leqq 0.38$ and $0.41 \leqq$ B-V $\leqq 0.80$.

The distributions of the revised MKJ and MSS spectral types give the following maximum percentages:

1) ST : MKJ = G5V (46%), MSS = G3V (47%), MKJ+MSS = G5V (44%);
2) SA : MKJ = G5V (38%), MSS = G3V (45%), MKJ+MSS = G5V (34%);
3) SC : MKJ = G0V (45%), MSS = G0V (35%), MKJ+MSS = G0V (42%);

The whole group of the STS (arbitrarily weighted 3xST, 2xSA, 1xSC) give: MKJ = G5V (30%), MSS = G3V (36%), MKJ+MSS = G5V (28%). A secondary maximum in the spectral type G2V is shown for all groups in the MKJ and MKJ and MSS revision and in SC for the MSS revision. On the other hand, a secondary maximum in the spectral type G5V is shown for groups ST, SA and STS in the MSS revision.

The distribution of color indices for the spectral type G2V in the revised MKJ and MSS classifications gives:

MKJ : U-B (90) = 0.06 (9%), 0.12 (8%), $0.02 \leqq$ U-B $\leqq 0.12$ (61%), $\overline{\text{U-B}} = 0.10$;
B-V(110) = 0.60(13%), 0.66(11%), $0.60 \leqq$ B-V $\leqq 0.68$ (83%), $\overline{\text{B-V}} = 0.64$;
MSS : U-B (22) = 0.07(13%), 0.19(13%), $0.02 \leqq$ U-B $\leqq 0.12$ (55%), $\overline{\text{U-B}} = 0.11$;
B-V (50) = 0.60(20%), 0.64(16%), $0.59 \leqq$ B-V $\leqq 0.66$ (64%), $\overline{\text{B-V}} = 0.62$;
MKJ $\bigcap$ MSS : $0.06 \leqq$ U-B $\leqq 0.10$, $0.58 \leqq$ B-V $\leqq 0.65$.

3. CONCLUSIONS

These results confirm statistically those published by Keenan and Pitts (1980) and Hardorp (1982). The common agreement, as regards the revised MKJ and MSS classifications, among the solar groups emphasizes that the color indices U-B and B-V are good selection criteria for the STS and points out also the spectral homogeneity of these stars within 100 pcs of the Sun.

The range $0.58 \leqq$ B-V $\leqq 0.65$, found for the G2V stars in common between the revised MKJ and MSS classifications, may be considered at present as the range of color precision for the spectral classification of ST stars

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(Taylor 1984).

Finally, it would be useful to consider also the dynamical homogeneity of these solar groups. A study of the color-luminosity arrays of stellar groups within 20 pcs from the Sun was made by Woolley and Eggen (1958) showing that the Sun could belong to groups similar to Hyades and Praesepe. In this regard, a further investigation has been proposed (and accepted) for the ESA Astrometry Satellite Mission HIPPARCOS.

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TABLE I. Solar-Type Stars

HD	U-B	B-V	m_v	MSS	MKJ	HD	U-B	B-V	m_v	MSS	MKJ
11112	0.22	0.65	7.13	G3V	G4V	101563	0.19	0.66	6.44		G0S
16141	.21	.66	6.83		G5IV	104212	.21	.66	8.38	G3V	
16417	.22	.66	5.79		G5IV	105585	.22	.67	8.49		G5V
27149	.22	.67	7.51		G5V	110314	.22	.65	8.31		G2V
27685	.22	.67	7.84		G4V	111398	.19	.66	7.07		G5V
29461*	.20	.66	7.96		G5V	112257	.18	.66	7.84		G2V
32963	.21	.66	7.58		G5IV	112502	.22	.66	9.86		G3V
34052	.20	.67	8.83		G2V	112753	.18	.65	7.97		G1V
44594	.20	.66	6.60	G3V	G4V	114174	.18	.67	6.80		G5IV
45289	.20	.67	6.65	G5V	G5V	132256	.22	.66	7.31		G2V
50787	.20	.65	8.33	G3V		141690	.19	.65	8.66		G0IV
64184	.19	.67	7.52	G5V		146233	.18	.65	5.48		G0V
66653	.18	.67	7.55	G5V		150680	.20	.66	2.81		G0IV
67738	.20	.65	8.46	G3IV		153344	.21	.67	7.06		G5IV
70081	.21	.66	8.91	G3V		159656	.19	.65	7.16	G2V	G4V
71334	.18	.67	7.82		G4V	165271	.21	.66	7.66	G5V	G5IV
74497	.20	.66	7.81	G3V	G3V	183877	.21	.67	7.15		G5IV
76440	.18	.65	8.44	G5V		186408	.18	.65	5.87		G2V
76943	.19	.65	5.97		G5V	186427*	.20	.66	6.20		G5V
78429	.20	.66	7.30	G5V		191069	.21	.67	8.11		G5V
78418	.20	.65	6.00		G5IV	206301	.20	.65	5.18		G2IV
90520	.21	.65	7.52	G0V	G3V	206828	.19	.65	8.45		G2V
93215	.19	.67	8.05		G5V	215274	.20	.67	8.03		G5V
98562	.21	.66	8.78		G2V	217014	.21	.67	5.49		G4V

MSS = Revised Spectral Types by Houk and Cowley (1975, 1978)
MKJ = Revised Spectral Types by Jaschek et al. (1964)
HD = Solar Analogs (* Closest Analogs) in the list of Hardorp (1982)

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DISCUSSION

SCARFE: I notice that the (U-B) values for the 48 "solar" stars is much redder than the range for G2 V stars in the last part of the paper. This discrepancy is larger than for (B-V). Why was this value of (U-B) chosen for the "solar" group?

FRACASSINI: We adopted values of (U-B) or (B-V) from Hardorp (1982) for the "Solar Type" stars.

GARRISON: As I pointed out in my paper yesterday, it is extremely dangerous to take averages of inhomogeneous data to make any inference about the standard stars, including the Sun. Fracassini et al. were only interested in a sample of stars for future dynamical studies and this list serves their purposes, but I wish they would not try to make any inferences about either the color or the spectral type of the Sun. While the Houck (MSS) catalogue is homogeneous, the rest of the data they have used in their study is so inhomogeneous as to be completely inconclusive for determination of the color of the Sun. The exercise is, however, interesting, just so long as it is not misinterpreted or overinterpreted.

CODE: The (U-B) index of the Sun is in as good agreement with the (U-B) of solar analog stars as the (B-V) index. These comparisons go back as early as the work of Stebbins and Kron which still appear valid.

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