ABSOLUTE MAGNITUDES OF SEVERAL PECULIAR STAR GROUPS

C. Jaschek, D. Egret, J.-L. Vergely
Observatoire de Strasbourg, 67000 Strasbourg, France

ABSTRACT

We present absolute magnitude estimates for a number of peculiar star groups, defined on the basis of their spectral characteristics: Subdwarfs OB, He-strong stars, He variables, A-type shell stars, λ Bootis stars, Cool subdwarfs, Weak G-band stars, Subgiants CH, Barium stars. A series of numerical simulations is used for deriving systematic corrections to be applied to the derived M_V. These results are used to assess the location in the HR diagram of the stars, and, when the size of the group is statistically significant, the evolutionary status of the group.

Key words: absolute magnitude; calibration; peculiar stars.

1. INTRODUCTION

We use in this work only stars for which the relative parallax error is ≤ 0.14, which implies an uncertainty of ± 0.3 mag on the absolute magnitude of the star. With one exception (see below), this choice has the consequence that generally only a few stars are available in each group, the results being more trustworthy than if stars with a large variety of errors were included.

Absolute magnitudes were corrected for interstellar extinction if the average distances were larger than 10^2 pc. The classical procedure using UBV photometry was followed, further assuming that $Av = 3E(B-V)$. In all cases in which information is available, the magnitude was corrected for binarity. In the case of visual binaries, where the difference of magnitude between components is known, and in the case of spectroscopic binaries with both components visible (SB2), the procedure is straightforward. In the case of radial velocity or spectroscopic binaries with only one spectrum visible (SB1) we adopted a uniform correction of 0.2 mag which corresponds to a magnitude difference of 0.6 mag between both components.

Table 1 gives the number of stars selected for each spectral type.

Table 1. Hipparcos star sample with parallax error $\sigma_\pi/\pi < 0.14$.

Spectral peculiarity	number of stars
Subdwarfs OB	3
Hpoor (He strong)	7
Ae and A-type shell stars	25
λ Boo	6
Subdwarfs	34
Weak G-band stars	4
Subgiants CH	2
Barium stars	28

2. THE EARLY TYPE STARS

2.1. Subdwarfs OB

Three stars provide $\overline{M_v} = 4.3 \pm 0.3$. No extinction correction was applied because of the small heliocentric distance.

2.2. He-strong Stars

We have one star with $M_v = -1.0$. If, exceptionally, three other stars with less accurate parallaxes are included, we find -1.7 ± 0.64 for $(U-B)_0 = -0.79$, which makes them lie slightly above the main sequence, or to a bluing of 0.06 mag.

2.3. He Variables

From seven stars we derive $\overline{M_v} = -0.9 \pm 0.5$ at $(U-B)_0 = -0.66$, which corresponds to 0.2 mag above the main sequence, or to a bluing by 0.15 mag of the $(U-B)_0$ index. We included only stars for which the variability was confirmed by narrow-band measures of HeI lines.

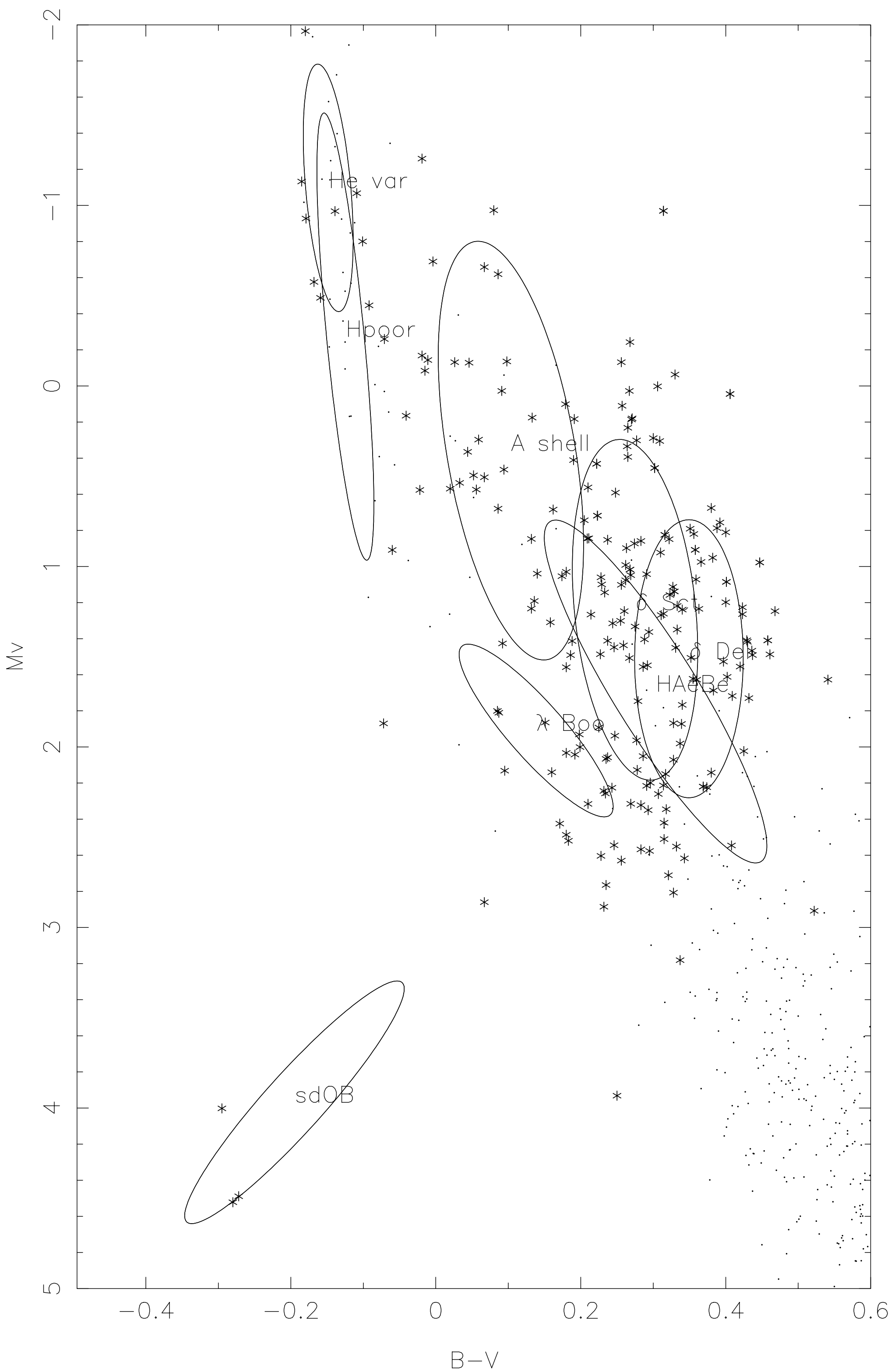

Figure 1. Confidence ellipses at 39 per cent and spectral types in the HR diagram. Stars with $\sigma_\pi/\pi < 0.25$.

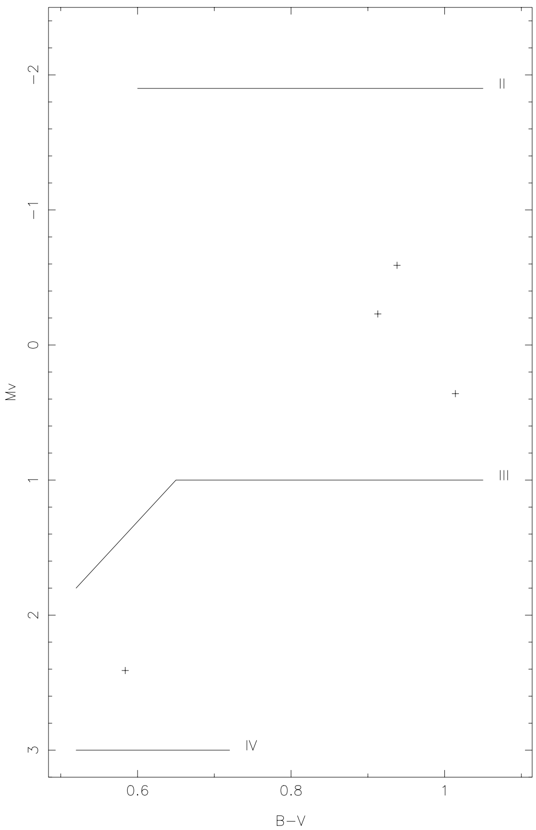

Figure 2. Weak G-band stars.

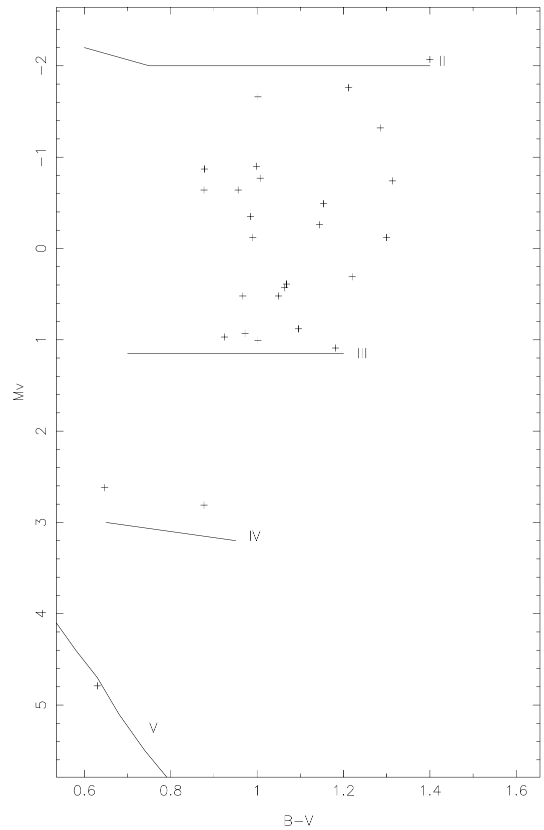

Figure 3. Barium stars.

2.4. A and A-type Shell Stars

Members of this group were selected from Jaschek et al. (1988), Andersen & Nordstrom (1977) and Bidelman & McConnell (1973).

Twenty-five stars are available which provide $M_v = 0.9 \pm 0.8$ at $(B-V) = 0.14 \pm 0.10$. A colour dependence is visible of the type: $M_v = 6.328(B-V) + 0.198$. With this relation the dispersion of M_v lowers to ± 0.7 mag.

The $(M_v, B-V)$ relation implies that A-type shell stars lie on the average about 1.5 magnitudes above the main sequence. This confirms earlier work by Jaschek et al. (1988).

2.5. λ Boo

Members of this group were selected from Hauck & Slettebak (1983) and Andrillat et al. (1995). Six stars provide 1.9 ± 0.42 with $B-V = 0.13 \pm 0.12$. This places them on the main sequence, and not 'on or slightly above' (Oke 1967).

3. THE LATE TYPE STARS

3.1. Subdwarfs

Members of this group were selected according to their [Fe/H] as given in the catalogue of Cayrel de Strobel et al. (1992). We find: $-0.3 >$ [Fe/H] $>$ -0.9; $\overline{\mathrm{M_v}} = 4.4 \pm 0.25$; $\overline{\mathrm{B-V}} = 0.53 \pm 0.04$
$-0.9 >$ [Fe/H] > -2.0 a band parallel to the main sequence.

The band is displaced by -1.0 mag in M_v or by -0.2 mag in $B-V$. As an additional fact our absolute magnitudes disagree with those calculated by Axer et al. (1995) by one magnitude (-1 ± 1). (In a private communication, Dr. K. Fuhrmann has informed us that the differences disappear practically when improved data and theories are used, as will be shown in a forthcoming paper). As for the 'mild metal-weak group' they fall slightly (by 0.2 mag) below the main sequence, a fact which is in line with the small iron underabundance.

It is interesting to see that the band parallel to the main sequence does not correspond to a uniform composition anomaly. In fact one finds stars with [Fe/H] between -0.6 and -2.3.

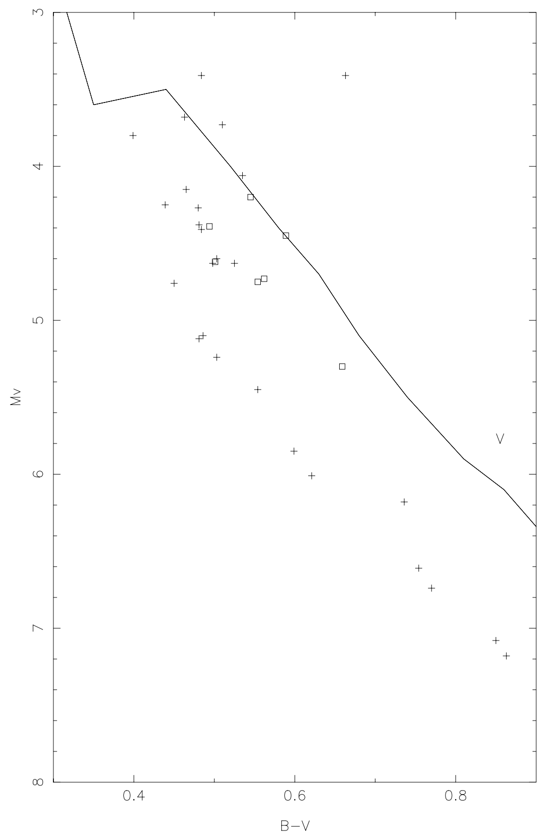

Figure 4. Subdwarfs F-G. Crosses show stars which have [Fe/H] < − 0.9 and squares [Fe/H] > − 0.9.

3.2. Weak G-band Stars

Members of this group were selected from Keenan & Yorka (1985) and Bidelman & McConnell (1973). One star is a subgiant classed F8III, $M_v = 2.4$, $B-V = 0.58$. Three other stars give -0.15 ± 0.05 at $B-V = 0.95 \pm 0.05$, thus being intermediate between luminosity classes II and III. The group is thus not homogeneous.

3.3. Subgiants CH

Two members of this small group of stars, selected on the basis of Luck & Bond (1982), have $\overline{M_v} = 4.35$ at $B-V = 0.59$, which places them 0.2 mag above the main sequence, but far away from the subgiants.

3.4. Barium Stars

We selected 28 stars; the selection is based mainly upon stars analysed for composition (Zacs 1994) plus some additions from the bibliography (McConnell et al. 1972, McClure & Woodsworth 1990, Williams 1975 and Warner 1965). No clear separation is found between the behaviour of the 'mild' and the 'pronounced' Ba stars. We find Ba stars in four groups:

- one main-sequence object at $M_v = 4.8$, $B-V = 0.63$;
- two subgiants at 2.57 mag at $\overline{B-V} = 0.76$;
- fifteen giants at $\overline{M_v} = 0.55 \pm 0.55$, $\overline{B-V} = 1.13 \pm 0.27$;
- ten bright giants at $\overline{M_v} = -1.1 \pm 0.5$, $\overline{B-V} = 1.14 \pm 0.16$.

These four groups confirm statistical magnitudes derived by Luri & Gomez (1997).

4. CONCLUSIONS

It should be added that because of the fact that Hipparcos is a magnitude-limited survey and because the stars of our samples were selected according to specific conditions, a statistical correction should be applied to the results. One of us (C.J.) has made with A. Valbousquet a series of numerical simulations, reproducing the conditions imposed in our work. Although details will be published in full, the general result is that a systematic correction of −0.1 mag (in the sense of making the objects brighter) should be applied to all our above-mentioned results.

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