THE HR DIAGRAM OF G5–M3 STARS NEAR THE GIANT BRANCH FROM HIPPARCOS TRIGONOMETRIC PARALLAXES

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ABSTRACT

The absolute magnitude calibration of stars on the red giant branch (types G, K, and M) analysed in an earlier work by the same authors (Egret et al., 1982) is now revisited with the trigonometric parallaxes and proper motions measured by Hipparcos. The same sample of stars, carefully classified in the MK system, is studied, and absolute magnitudes are derived for those stars for which trigonometric parallaxes have been obtained by Hipparcos with an accuracy better than 15 per cent.

Key words: Giant Branch; HR diagram.

1. INTRODUCTION

The absolute magnitude calibration of stars on the red giant branch (types G, K, and M), have been analysed in an earlier work by Egret et al. (1982), using both trigonometric and statistical parallaxes, from a sample of 212 stars classified in the revised MK system (Keenan & Pitts 1980). The same sample had been proposed for observation by Hipparcos, and the absolute magnitude calibration is now revisited using the trigonometric parallaxes measured by Hipparcos, with special emphasis on parallaxes better than 15 per cent.

2. HR DIAGRAM OF THE GIANT BRANCH

Trigonometric parallaxes, measured by Hipparcos, of 287 G5–M3 giants constituting proposal 137, were made available to us in January 1997. These data have been used to estimate the average absolute magnitude for each spectral type. The size of the sample is mostly significant for G8–K5 stars. In this first approach, no correction of the interstellar reddening has been attempted for these stars. In Figure 1, we present the HR Diagram ($M_V/V-I$) for the Giant Branch. The $V-I$ index provided in the Hipparcos Catalogue is more appropriate than $B-V$ for unfolding the giant branch in a temperature sequence. Giant stars with $\sigma_\pi/\pi < 0.15$ are plotted as asterisks. Background dots are stars of different types, from another sample, illustrating the general shape of the HR diagram. Figures 2 and 3 show the spectral type correlation ellipses (39 per cent confidence ellipses assuming two-dimensional gaussian distribution) in the ($M_V/V-I$) diagram for G8–K5 III stars (Figure 2) and for the whole giant branch (Figure 3). In the latter case we have adopted the limit $\sigma_\pi/\pi < 0.25$ in order to include enough M-type stars.

Table 1 gives the average absolute magnitudes for each spectral type, before any bias correction (column 3), and after correction of Malmquist bias, assuming a complete sample up to visual magnitude 7.0 (column 4). Estimations of intrinsic dispersions σ_{M_V} are also given in both cases. Figure 4 is derived from the paper by Robin (1989) in which several absolute magnitude calibrations of the G and K giants were compared. We have added the values derived in the present work which, after the bias corrections, appear to be less luminous than in our previous determination (Egret et al. 1982) but remain brighter than most of the other determinations, at least in the G8–K0 and K4–K5 range.

3. CONCLUSION

The present work is only a first attempt to show how Hipparcos data will change our understanding of the luminosity of the giant branch. In a further work, we plan to present a more complete study of the luminosity of giant stars as a function of their MK classification; it will be based on a larger sample derived from the whole Hipparcos Catalogue, using both trigonometric and statistical parallaxes, and from new spectral classifications now available. Additional numerical experiments on these larger samples will help to understand how selection effects affect the absolute magnitude determinations of stars near the giant branch.

REFERENCES

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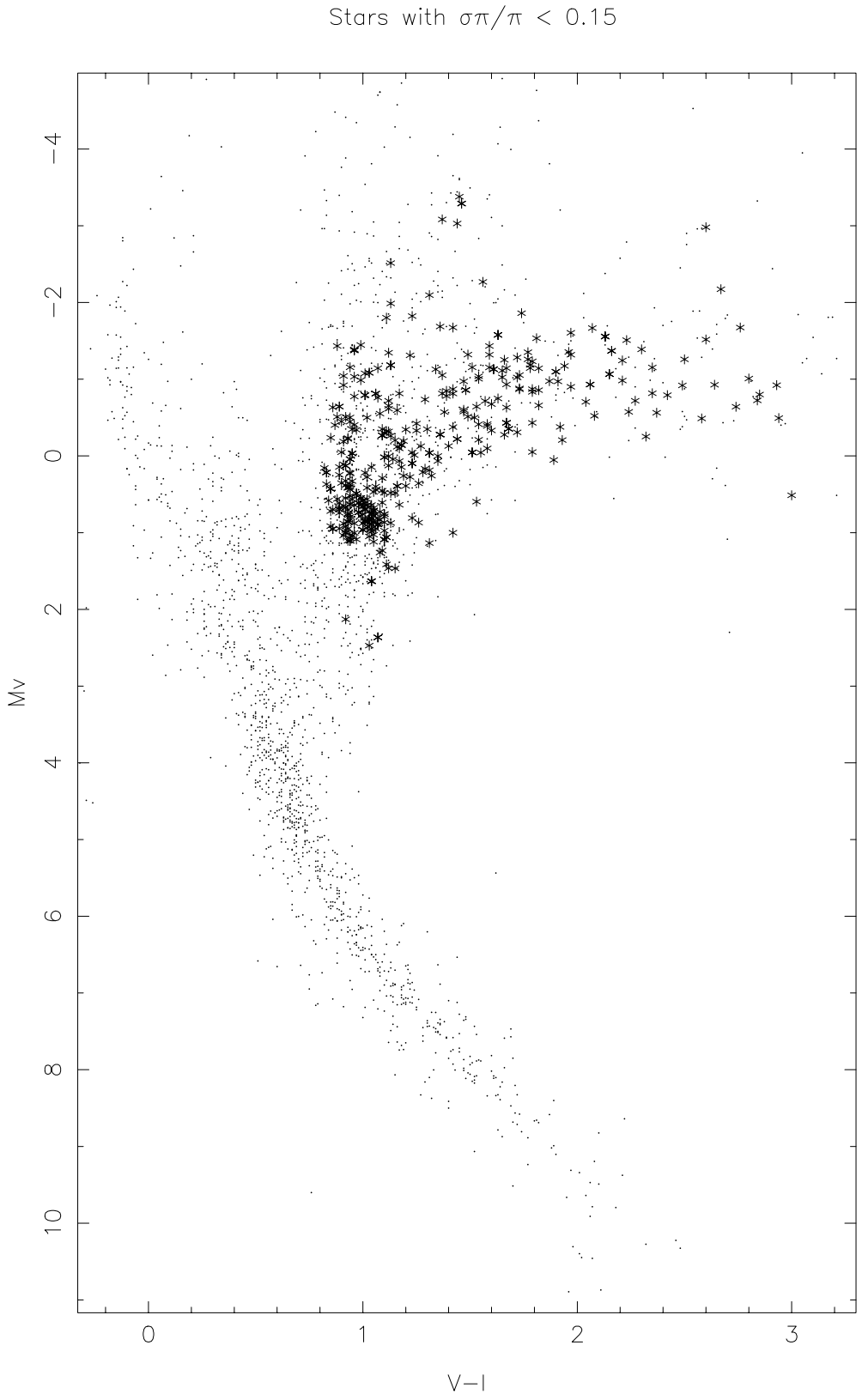

Figure 1. HR Diagram (M_V /$V-I$) for the Giant Branch. Giant stars with $\sigma_\pi/\pi < 0.15$ are plotted as asterisks. Dots are stars of various spectral types, from another sample, illustrating the general shape of the HR diagram.

Table 1. Determination of mean M_V and σ_{M_V}, before and after Malmquist correction from numerical simulations, for stars of luminosity class III, $\sigma_\pi/\pi < 0.25$ and $V_{lim} = 7.0$.

Spectral Type	Number of stars	$\overline{(M_V)_{\rm biased}}$	$\overline{(M_V)}$	$(\sigma_{M_V})_{\rm biased}$	σ_{M_V}
G8	45	0.25	0.87±0.09	0.68	0.66±0.05
G9	25	0.46	1.06±0.12	0.66	0.66±0.07
K0	53	0.47	1.12±0.10	0.69	0.68±0.04
K1	36	0.27	1.23±0.18	0.85	0.84±0.06
K2	34	0.23	1.48±0.22	0.96	0.97±0.07
K3	25	-0.51	0.85±0.29	0.99	1.00±0.10
K4	19	-0.65	-0.02±0.20	0.67	0.67±0.07
K5	23	-0.85	-0.31±0.16	0.64	0.62±0.07

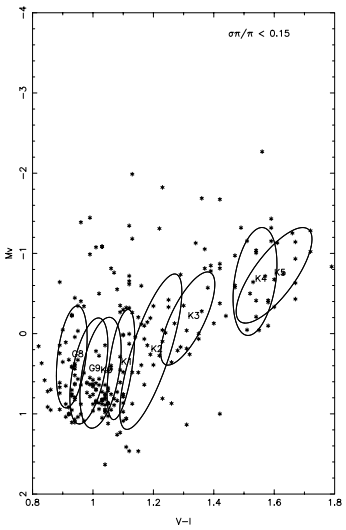

Figure 2. G8–K5 III stars: spectral type correlation ellipses.

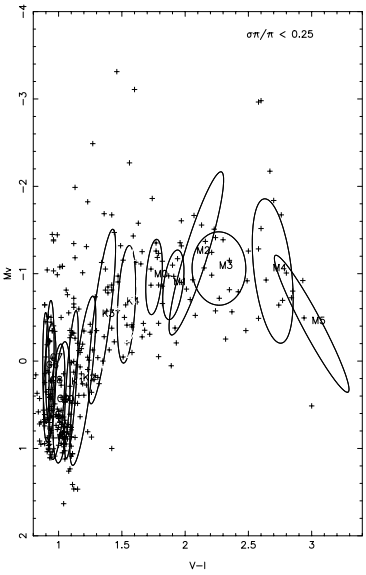

Figure 3. G5–M5 III: spectral type correlation ellipses.

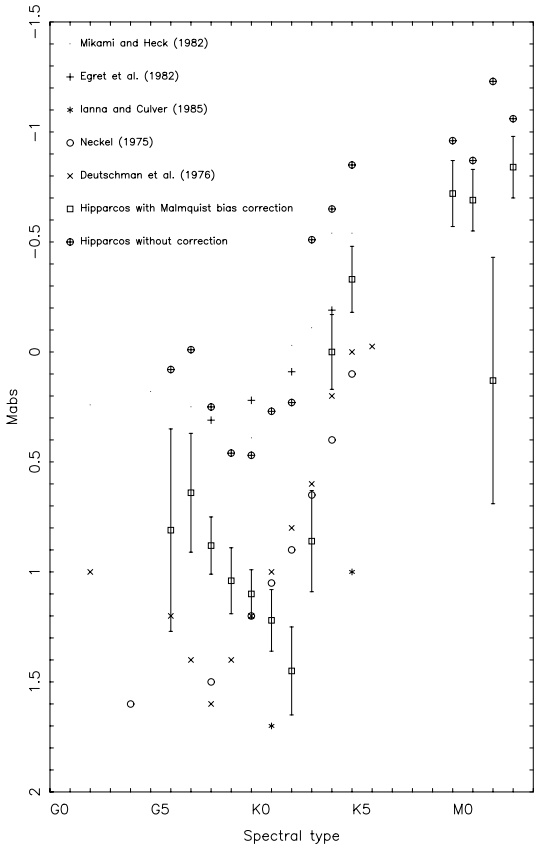

Figure 4. Comparison of present work, based on Hipparcos data, with previously published calibrations (from Robin 1989).