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Theoretical Evolutionary Tools for the Magellanic Clouds

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Abstract. Updated evolutionary models for the chemical compositions suitable for the Magellanic Clouds are presented. Quantities useful for comparison with observations and cluster age determination are provided. The effect of a not negligible overshooting efficiency and of a variation of the helium content on the relevant parameters is also investigated.

1. Introduction

The study of the stellar clusters of the Magellanic Clouds is of primary importance to understand the formation process of galaxies because, at variance with Galactic globulars, they cover a significant range of ages. One of the most common methods to determine the cluster age is based on the difference $\Delta M_V \, {}^{TO}_{HB}$ between the turn-off (TO) and the helium burning phase (He clump or horizontal branch) magnitude. The aim of this work is to provide updated theoretical constraints to the ΔMV^{TO}_{HB} parameter for chemical compositions representative of the Magellanic Clouds to be compared with accurate observational data.

We have computed an extensive set of evolutionary models from the main sequence (MS) to the onset of the thermal pulses for a wide range of stellar masses ($0.6 \leq M/M_\odot \leq 10$) and for metallicities Z=0.008 and Z=0.004, representative of the Large Magellanic Cloud (LMC) and the Small Magellanic Cloud (SMC), respectively. By assuming a primordial helium content $Y_P = 0.23$ and

ΔY/ΔZ ~2.5 (see e.g. Pagel & Portinari 1998, Castellani, Degl'Innocenti, Marconi 1999) the adopted helium abundance is Y=0.24 for Z=0.004 and Y=0.25 for Z=0.008. To account for current uncertainties on the relative helium to metal enrichment and to investigate the effect of a variation of Y at fixed Z, additional models for Z=0.004 Y=0.27 have been computed. The adopted physical inputs are described in Cassisi et al. (1998) and Ciacio, Degl'Innocenti & Ricci (1997). The overshooting efficiency is modeled according to Castellani et al. (2000) and the adopted mixing length parameter is α=1.9. The linear extension of the overshooting region beyond the Schwarzschild boundary is expressed in terms of the pressure scale height $l_{ov} = \beta H_p$. The adopted β values cover the range suggested in the recent literature (see e.g. Pols et al. 1998). On the basis of the computed evolutionary tracks, isochrones are produced covering ages from $\sim$ 50 Myr to $\sim$ 6 Gyr. As an example, figure 1 shows $\Delta M_V \, {}^{\rm TO}_{\rm HB}$ as a function

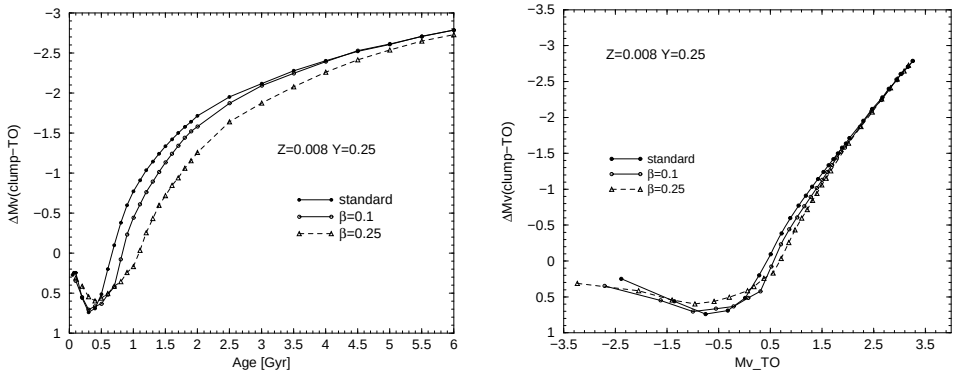

Figure 1. $\Delta M_V \, {}^{\rm TO}_{\rm HB}$ as a function of age (left panel) and versus M_V^{TO} (right panel) for Z=0.008, Y=0.25.

of age (left panel) and versus M_V^{TO} (right panel) for Z=0.008, Y=0.25 both for standard models and the ones with overshooting (β =0.1 and 0.25). For a more detailed description of the models and of the results see Castellani et al. 2002.

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