Synthetic Stellar Clusters for Pop III

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Abstract. We present preliminary results of an incoming theoretical work concerning the integrated properties of the Population III clusters of stars. On the basis of synthetic Color-Magnitude Diagrams, we provide a grid of optical and near-IR colors of Simple Stellar Populations with very low metallicity (Z=10^{-10} and Z=10^{-6}) and age which spans from 10 Myr to 15 Gyr. A comparison with higher metallicities up to 0.006 is also shown, disclosing sizable differences in the CMD morphology, integrated colors and Spectral Energy Distribution (SED).

1 Metal deficient simple star populations

In the last two decades a great theoretical effort has been devoted to investigate the integrated properties of metal rich and metal poor star populations in the local universe (Bressan et al. 1994; Leitherer et al. 1996) providing a modellization of integrated colors and spectra as a function of the IMF, age, chemical content etc... However, till now a complete evaluation of the integrated properties for first generation of stars which should directly form from matter emerged from the big bang is still missing.

As a part of a project devoted to investigate the integrated properties of stellar clusters in a homogeneous and complete framework (Brocato et al. 1999, Brocato et al. in preparation), we approach here the analysis of the spectro-photometric behavior of metal deficient star systems. By relying on the extended grid of evolutionary models for very metal poor stars (Z=10^{-10} and Z=10^{-6} with Y=0.23), including evolutionary phases from the MS up to the double shell burning, previously calculated (Cassisi et al. 1996; Cassisi and Castellani, 1993) we performed synthetic population models for a wide range of age from 10 Myr to 15 Gyr adopting a Salpeter mass distribution (IMF).

Selected integrated colors in the optical and near-IR bands are reported in Fig. 1*a*. As expected from the synthetic CM Diagrams, the integrated colors become bluer and bluer as the metallicity decreases for the older cluster. Moreover, the younger clusters appear to show similar colors even with very different assumptions on metallicity (up to Z=10^{-4}), since the hotter and bluer stars dominate the spectral energy distribution.

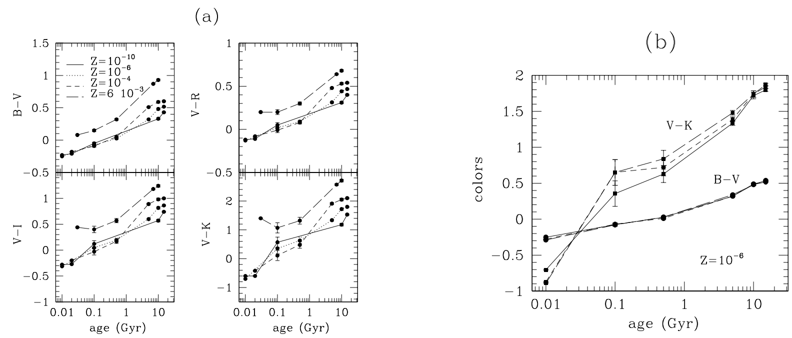

Fig. 1. (*a*) Integrated colors for four different star chemical contents: Z=10^{-10} (solid line), Z=10^{-6} (dotted line), Z=10^{-4} (dashed line) and Z=$6 \cdot 10^{-3}$ (long dashed line). (*b*) The variability in B−V and V−K colors calculated assuming: *i*) a power law with a Salpeter slope (solid line), *ii*) the Larson form with $M_p \sim 1.5 M_\odot$ (dashed line) and *iii*) the Larson form with $M_p \sim 3 M_\odot$ (long dashed line). Z=10^{-6} is adopted.

2 Effect of the IMF on the integrated colors

The long standing debate on the universality of the IMF is of particular relevance in the case of first star generation. Both theory and observation seem to suggest that the IMF has a typical power low at more massive stars and the deviation from this form should be confined at the lower part of the mass distribution. The thermo-dynamical conditions of primordial gas should imply a larger value of “mass-scale” (M_p) (Larson 1998) compared to the present one (some tenth of solar mass), causing a deficiency of less massive stars. We investigate the effect of changing the IMF on the integrated colors adopting the analytic form suggested by Larson (1998): a Salpeter power law at larger masses, which peaks at M_p and falls exponentially at lower masses. We find (Fig. 1*b*) that the B−V color does not change for the three assumptions on the IMF. The V−K color shows the most evident variations, since it is strongly affected by the differences of the number of stars in the mass intervals.

References

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