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He-rich and He-poor populations in RGB stars. Results on a sample of 19 globular clusters

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Abstract. We use about 1400 red giant branch stars observed in 19 Galactic Globular Clusters (GCs) to compare colours, metallicities, and RGB bump luminosities of stars assigned to first and second generations. We find subtle differences which we attribute to the different He content. In general these differences are visible only when we consider the extreme second generation stars, with the exception of NGC 2808. When using various indicators, the implied helium enhancements are similar, but the absolute calibration is still uncertain.

Keywords. Stars: abundances, Population II – Galaxy: globular clusters

1. He differences from globular clusters red giant stars

We exploit the unprecedented database of about 1400 stars on the Red Giant Branch (RGB) observed with FLAMES@VLT in 19 Galactic Globular Clusters (GCs) in the course of our project on the Na-O anticorrelation. For a description of our survey and for results see Carretta *et al.* (2009a), Carretta *et al.* (2009b); for a description of the influence of He, see Gratton *et al.* (2010) and Bragaglia *et al.* (2010).

Stars with different He are expected to have different temperatures (i.e., different colours), slightly different [Fe/H] values, and different magnitudes of the RGB bump. All these differences are small, but our study has the necessary precision, statistics, and homogeneity to detect them.

We derive the differences in colours, metallicities and RGB bump magnitudes in the Primordial (P), Intermediate (I) and Extreme (E) population (Carretta *et al.* 2009a), which are associated with different levels of pollution and correspond to different He enhancements, as is expected in a scenario of intra-cluster pollution by material processed through hot H-burning (e.g. CNO cycle) in a previous generation of stars. We find that P stars show significant differences in colour and metallicity only compared to E stars (see Fig. 1, left panels). If we interpret this as an effect of He, these differences imply a $\Delta Y \sim 0.05$-0.10. NGC 2808 is an exception, since differences are visible both between P and I stars and between P and E stars (indicating a $\Delta Y \gtrsim 0.10$-0.12).

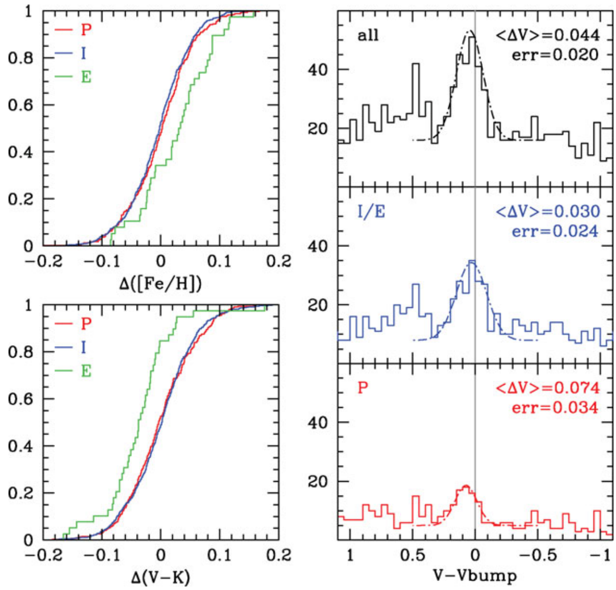

Figure 1. Left panels: Cumulative distributions of the differences in metallicity (upper panel) and in colour (lower panel) for the three populations: the P and I ones are similar, while the P and E ones are significantly different. Right panels: Histograms of the difference in magnitude between individual V values and V_{bump} (for each cluster), zoomed near the RGB bump. We show for al stars (upper panel), second-generation I and E, and first-generation P stars (middle and lower panel, respectively), with gaussians fitting each bump. In each panel the peak of the bump and the associated error are indicated.

We find that the level of the RGB bump defined by first-generation P stars is fainter than the one defined by second-generation I and E stars (see Fig. 1, right panels). The interpretation in terms of different He is complex. We explore two cases with different mixtures of heavy elements: one with "normal" α-enhancement (Pietrinferni *et al.* 2006) and one that takes into account the observed anticorrelations in the chemical abundances observed in GCs (Pietrinferni *et al.* 2009). We obtain results in fair agreement with those obtained with the other methods.

We conclude that *i*) RGB stars in GCs show indication of different He levels, *ii*) that different methods produce similar results, but that *iii*) the absolute calibration of the derived ΔY is still uncertain.

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References

Bragaglia, A., Carretta, E., Gratton, R., D'Orazi, V., Cassisi, S., & Lucatello, S. 2010, *A&A*, subm.

Carretta, E., Bragaglia, A., Gratton R. G., Leone, F., Recio-Blanco, A., & Lucatello, S. 2006, *A&A*, 450, 523

Carretta, E., *et al.* 2009a, *A&A*, 505, 117

Gratton, R. G., Carretta, E., Bragaglia, A., Lucatello, S., & D'Orazi, V. 2010, *A&A*, subm.

Pietrinferni, A., Cassisi, S., Salaris, M., & Castelli, F. 2006, *ApJ*, 642, 797

Pietrinferni, A., Cassisi, S., Salaris, M., Percival, S., & Ferguson, J. W. 2009, *ApJ*, 697, 275

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