Stellar Populations as Building Blocks of Galaxies
Proceedings IAU Symposium No. 241, 2006
A. Vazdekis & R. F. Peletier, eds.

doi:10.1017/S1743921307008009

Reconstructing the spatial distribution of the Galactic stellar halo

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Abstract. The VLT Survey Telescope (VST) is going to offer a unique chance to collect deep and wide field photometry in multi-directions, opening the door to a definitive mapping of the Galactic halo. In this shortcoming scenario, we present a pilot study aimed at recovering the halo stellar density using the Capodimonte Deep Field (OACDF, Alcalá *et al.* 2004). Turn-off stars are isolated and the relative color-magnitude diagram (CMD) is compared with synthetic CMDs. Our result is consistent with a power law exponent $n \approx 3$ over a range of Galactocentric distances from 8 to 40 kpc.

Keywords. Galaxy: halo, Galaxy: structure, Galaxy: stellar content, Stars: Hertzsprung-Russell diagram, Methods: statistical

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1. Introduction

The observed star counts from the OACDF photometric survey‡ are investigated. This survey covers about 0.5 square degree in the B, V, R optical filters and is located at a high galactic latitude ($l \sim 293$, $b \sim 50$), making available a sample of halo stars with low contamination of disk and thick-disk stars.

To derive the spatial distribution of the Galactic halo, one needs to identify stars in a precise evolutionary phase and use them to map the observed CMD density. Turn-off stars have many advantages:

- They can be univocally selected (definitely bluer than halo red giants);
- They are readily distinguishable from the disk stars in the main sequence (only very young and massive disk stars may have similar colors, but they are rare);
- They are numerous, in fact HB stars and red giants are less frequent than turn-off stars of a factor larger than ≈ 100.

On this basis, we have explored the OACDF color-magnitude diagram selecting turn-off stars by color ($0.3 \lesssim B-V \lesssim 0.6$). Contamination by galaxies is reduced by choosing objects with stellarity index higher than 0.9 (simultaneously in B and V filters). The adoption of a V-magnitude range of 18 to 23 ensures respectively thick disk removal and completeness. Finally, the most probable spatial distribution is obtained by comparing the turn-off density in the observed CMD with that in model CMD.

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‡Acquired with the Wide Field Imager (WFI) at the ESO 2.2-m telescope.

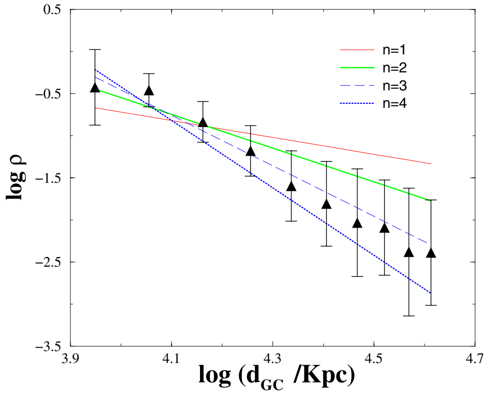

Figure 1. The recovered density distribution. For comparison, different power law densities are also shown (with the labeled exponents).

2. Method

Following the Monte Carlo framework, an artificial CMD is populated with a large number of stars randomly built by means of a set of theoretical ingredients (see Cignoni *et al.* 2006 per a complete description). This synthetic halo population is modeled as originating from a short period of star formation (constant between 10 and 12 Gyr). Moreover, the metallicity is fixed at $[Fe/H] \sim -1.6$ with a Gaussian spread ($\sigma_{[Fe/H]} = 1.0$) and the IMF is a power law with a Salpeter index. For each stellar model of a given mass, age and chemical composition, colors and magnitudes are estimated by interpolating a library of stellar tracks (Pisa Evolutionary Library, Cariulo, Degl'Innocenti & Castellani 2004). In order to reconstruct the halo structure, this synthetic population is placed at different distances, randomly placing stars in the j-th heliocentric interval $[d_{\odot,j}, d_{\odot,j} + 4\,kpc]$†. The final product is a base of partial CMDs, each one representing the same population but at different distance moduli. The code searches (through a simplex algorithm) for the linear combination of these basic CMDs which best matches the observed CMD.

3. Results

We have combined a star count model with an updated stellar library to reconstruct the Galactic halo stellar density in the direction of the Capodimonte Deep Field. Our results confirm a steep decline. In particular, a power-law index $n \approx 3$ (see Fig. 1) gives a reasonable fit out to $\approx$ 40 Kpc from the galactic center.

Acknowledgements

Financial support for this study was provided by MIUR, under the scientific project "On the evolution of stellar systems: fundamental step toward the scientific exploitation of VST" (P.I. Massimo Capaccioli).

References

Alcalá, J. M. *et al.* 2004, A&A, 428, 339

Cariulo, P., Degl'Innocenti, S., & Castellani 2004, A&A, 421, 1121

Cignoni, M., Ripepi, V., Marconi, M., Alcalá, J. M., Capaccioli, M., Pannella, M., & Silvotti, R. 2006, A&A, DOI: 10.1051/0004-6361:20066598

† $d_{\odot,j}$ is the heliocentric distance of the j-th volume bounded by the field of view.

https://doi.org/10.1017/S1743921307008009 Published online by Cambridge University Press