Dynamical Evolution of Dense Stellar Systems
Proceedings IAU Symposium No. 246, 2007
E. Vesperini, M. Giersz & A. Sills, eds.

doi:10.1017/S1743921308015986

Environmental Effects on the Globular Cluster Blue Straggler Population: a Statistical Approach

Alessia Moretti[1,2], Francesca De Angeli[3] and Giampaolo Piotto[1]

[1]Dipartimento di Astronomia - Università di Padova,
Vicolo dell'Osservatorio 3, I-35122 Padova
email: alessia.moretti@unipd.it

[2]INAF - Osservatorio Astronomico di Padova,
Vicolo dell'Osservatorio 5, I-35122 Padova

[3]Institute of Astronomy,
Madingley Road, CB3 0HA Cambridge, UK

Abstract. Blue stragglers stars (BSS) constitute an ubiquitous population of objects whose origin involves both dynamical and stellar evolution. We took advantage of the homogeneous sample of 56 Galactic globular clusters observed with WFPC2/HST by Piotto *et al.* (2002) to investigate the environmental dependence of the BSS formation mechanisms. We explore possible monovariate relations between the frequency of BSS (divided in different subsamples according to their location with respect to the parent cluster core radius and half mass radius) and the main parameters of their host GC. We also performed a Principal Component Analysis to extract the main parent cluster parameters which characterise the BSS family.

Keywords. stars:blue stragglers-luminosity function–Hertzsprung-Russell diagram- globular clusters:general

1. Introduction

BSS are located blue-ward and at brighter magnitudes than the turnoff (TO) in the color-magnitude diagram (CMD). The simple presence of such stars in a CMD poses serious challenges to the stellar evolution theory, since cluster stars with masses higher than the TO mass should have already been evolved off the main sequence (MS) toward the red giant branch (RGB). Explanations of the existence of these objects must take into account both the dynamical processes happening during the cluster lifetime and the stellar evolution itself. Two different mechanisms have been proposed so far to account for the existence of these peculiar objects: one describes BSS as the by–product of primordial binaries that simply evolve transferring their masses up to a complete coalescence (McCrea 1964, Carney *et al.* 2001), while the other one predicts that BSS are formed from the merger (collision) of two main sequence stars during the dynamical evolution of the cluster (Baylin 1995). We will refer to BSS of the first and second types *primordial* and *collisional* BSS, respectively. Recent results show that both formation mechanisms could be at work in a given cluster (Ferraro *et al.* 1997, Piotto *et al.* 2004, Davies *et al.* 2004, Mapelli *et al.* 2004, Mapelli *et al.* 2006).

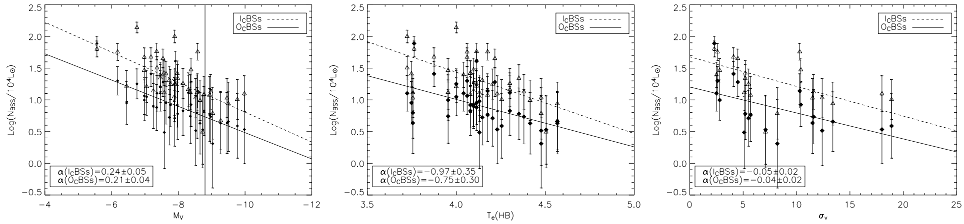

Figure 1. From left to right: normalized number of BSS as a function of the host cluster integrated absolute magnitude, the maximum temperature along the Horizontal Branch and the central velocity dispersion. Diamonds refer to the number of BSS outside the core radius of the host cluster, triangles to the number of BSS inside the core.

2. Analysis and Results

BSS selection was performed in two steps: first, BSS candidates were identified by eye in the CMDs (a visual inspection of each diagram is particularly important to disentangle BSS candidate from HB stars); later on, the BSS candidates were further selected by drawing a line approximately parallel to the sub-giant branch and at 0.7 magnitudes from the turnoff locations published by De Angeli *et al.* 2005. Most importantly, our selection has been made on the basis of our accurate error analysis, which stems from appropriate artificial star experiments (see Piotto *et al.* 2002 for more details).

After having selected BSS from the CMD diagrams we divided them according to their location with respect to the cluster center. In particular we analyzed BSS inside the core radius and outside it, as well as BSS inside the half mass radius and outside it. We studied monovariate relations with most of the characterizing cluster parameters and derived the possible significance of the fitted relations through the related errors coming from a bootstrap analysis. We used two main quantities, i.e. the total number of BSS and the normalised number of BSS (number of BSS in a given region divided by the total luminosity in the same region in unit of $10^4 L_\odot$).

We find that any subpopulation of BSS strongly depends on the luminosity of the cluster, on the extension of the cluster horizontal branch and on the central velocity dispersion (see Fig.1): more luminous clusters, clusters with a smaller central density, and a smaller central velocity dispersion have a higher BSS frequency. Moreover, we find that clusters having higher mass, higher central densities, and smaller core relaxation timescales possess on average more luminous BSS. Finally, different dependencies seem to hold for clusters with different integrated luminosity: brighter clusters show a BSS population that depends on the collisional parameter, while BSS in fainter clusters are mostly influenced by the cluster luminosity and the dynamical time–scales.

References

Bailyn, C. D. 1995, *ARAA*, 33, 133
Carney, B. W., Latham, D. W., Laird, J. B., Grant, C. E., & Morse, J. A. 2001, *AJ*, 122, 3419
Davies, M. B., Piotto, G., & De Angeli, F. 2004, *MNRAS*, 349, 129
De Angeli, F., Piotto, G., Cassisi, S., *et al.* 2005, *AJ*, 130, 116
Ferraro, F. R., Paltrinieri, B., Fusi Pecci, F., *et al.* 1997, *A&A*, 324, 915
Mapelli, M., Sigurdsson, S., Colpi, M., *et al.* 2004, *ApJL*, 605, L29
Mapelli, M., Sigurdsson, S., Ferraro, F. R., *et al.* 2006, *MNRAS*, 373, 361
McCrea, W. H. 1964, *MNRAS*, 128, 147
Piotto, G., King, I. R., Djorgovski, S. G., *et al.* 2002, *A&A*, 391, 945
Piotto, G., De Angeli, F., King, I. R., *et al.* 2004, *ApJL*, 604, L109

https://doi.org/10.1017/S1743921308015986 Published online by Cambridge University Press