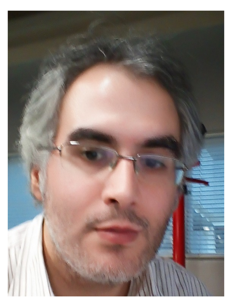

Mass-loss from multiple populations: hint of a universal mass loss-law for Pop II stars?

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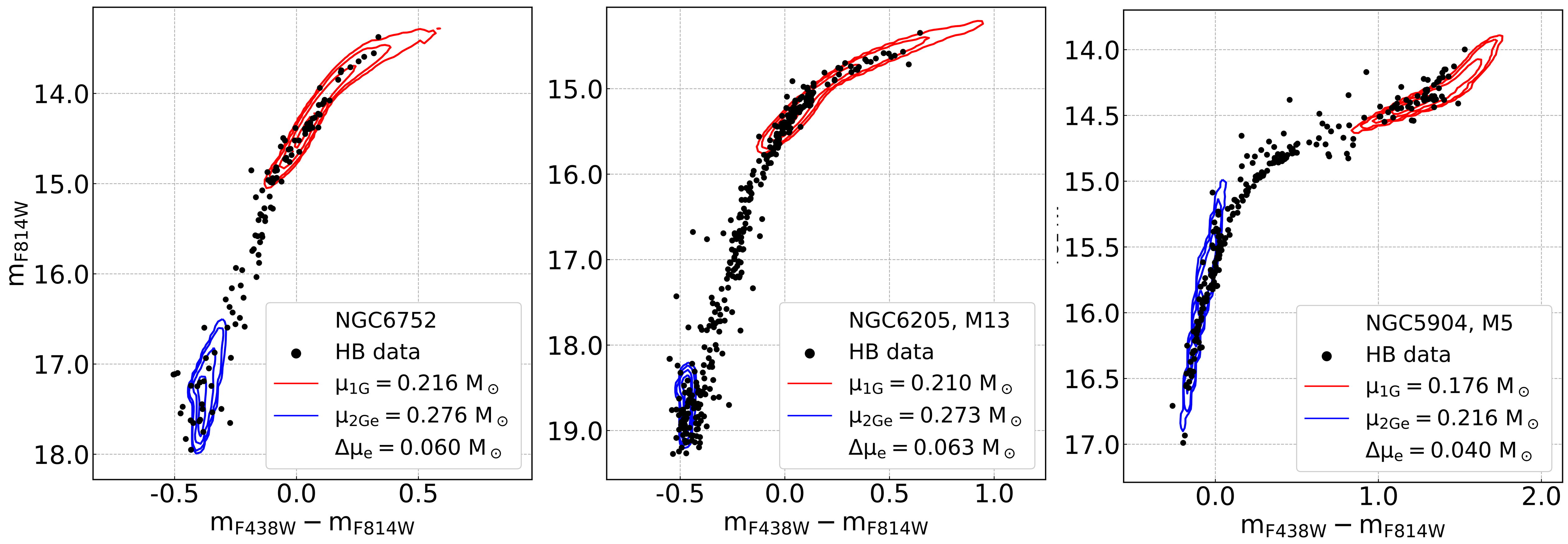
The amount of mass lost by stars during the red-giant branch (RGB) phase is one of the main parameters to correctly study later stages of stellar evolution. In spite of its importance, a fully-comprehensive understanding of this phenomenon is still missing and we mostly rely on empirical formulations. The Galactic Globular Clusters (GCs) are ideal targets to derive such formulations of mass loss, but the presence of multiple populations has been a major challenge.

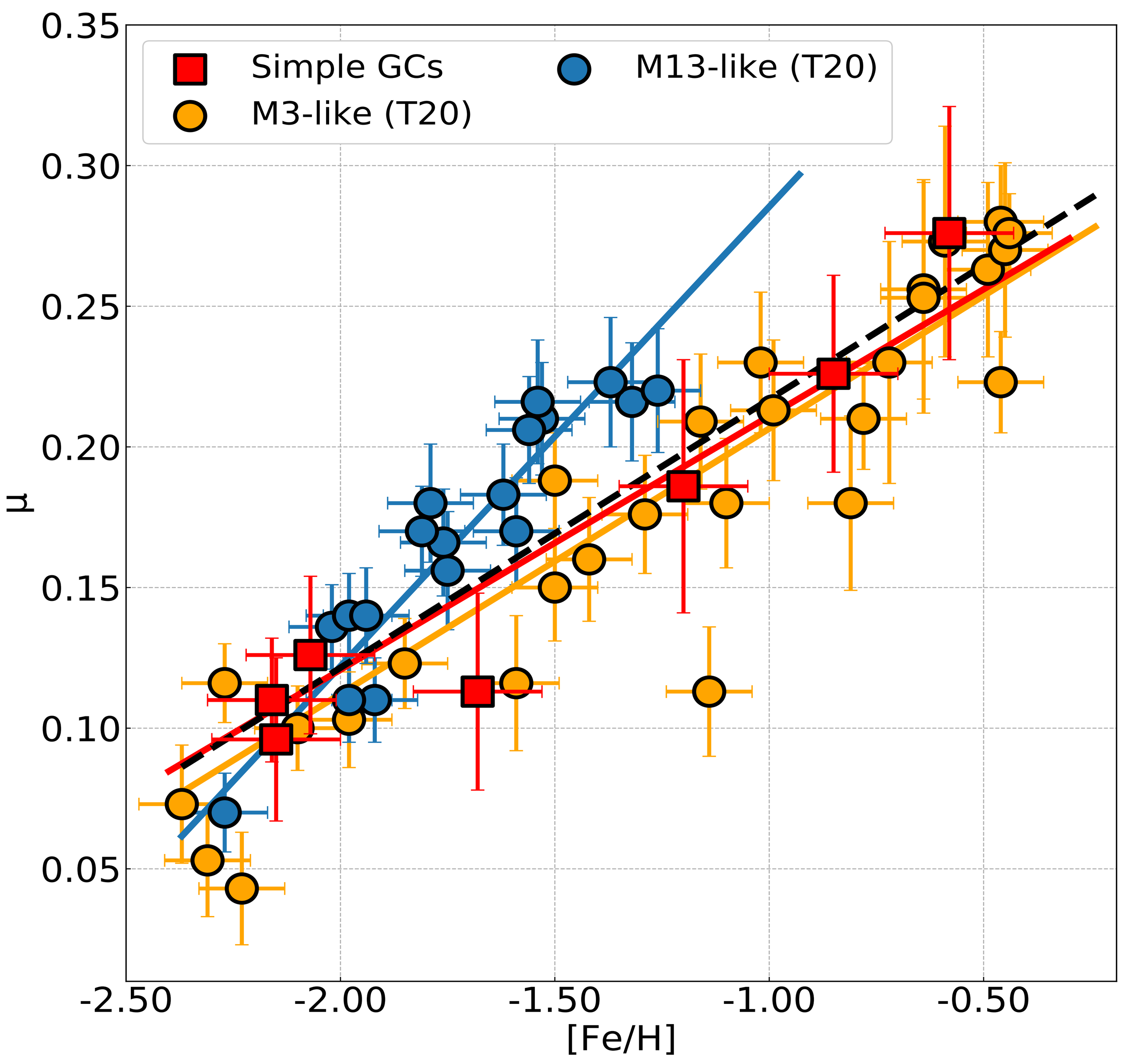
We combine Hubble Space Telescope photometry with stellar evolutionary models, to analyse the horizontal branch (HB) stars in 53 GCs. We constrained the helium abundance for the first and the "extreme" second generations stars using independent measurements based on the RGB. With these new constrains the parameters degeneracy traditionally associated to these stars has been broken for the first time.

Our main results are: the mass loss of first generation stars is tightly correlated with cluster metallicity; the location of helium enriched stars on the HB is reproduced only by adopting a higher RGB mass loss, compared to the first generation; and, finally, the difference in mass loss tightly correlates with helium enhancement and cluster mass.

We analysed the HB stars in more than 50 GCs. We isolated the first generation (1G) and the extreme second generation (2Ge) stars. The helium in the latter is constrained using the spectrophotometric study by Milone et al. (2018).

We estimated the average mass and the average mass-loss (μ) of both populations. We found that 2Ge stars of all clusters lose more mass than the 1G ones.





The mass loss of the 1G stars in our GC sample tightly correlates with the metallicity of the population (left).

We divide all GCs in three groups. The first two groups are the M3- and M13- like clusters (orange and blue points respectively). The morphology of their HB loci resembles the one of the eponymous GCs. The third group is composed of GCs that do not host multiple population, hence simple GCs (red squares). Standard stellar evolution, which includes Reimers (1975) mass loss formula, does not describe the data well. Based on our results we derive the following mass loss relations:

$$\mu = (0.095 \pm 0.007) \times [Fe/H] + (0.312 \pm 0.012)\ M_{sun}$$

For the entire sample. The M3-like and the Simple GCs have similar relations.

$$\mu = (0.164 \pm 0.015) \times [Fe/H] + (0.450 \pm 0.029)\ M_{sun}$$

For the M13-like GC.

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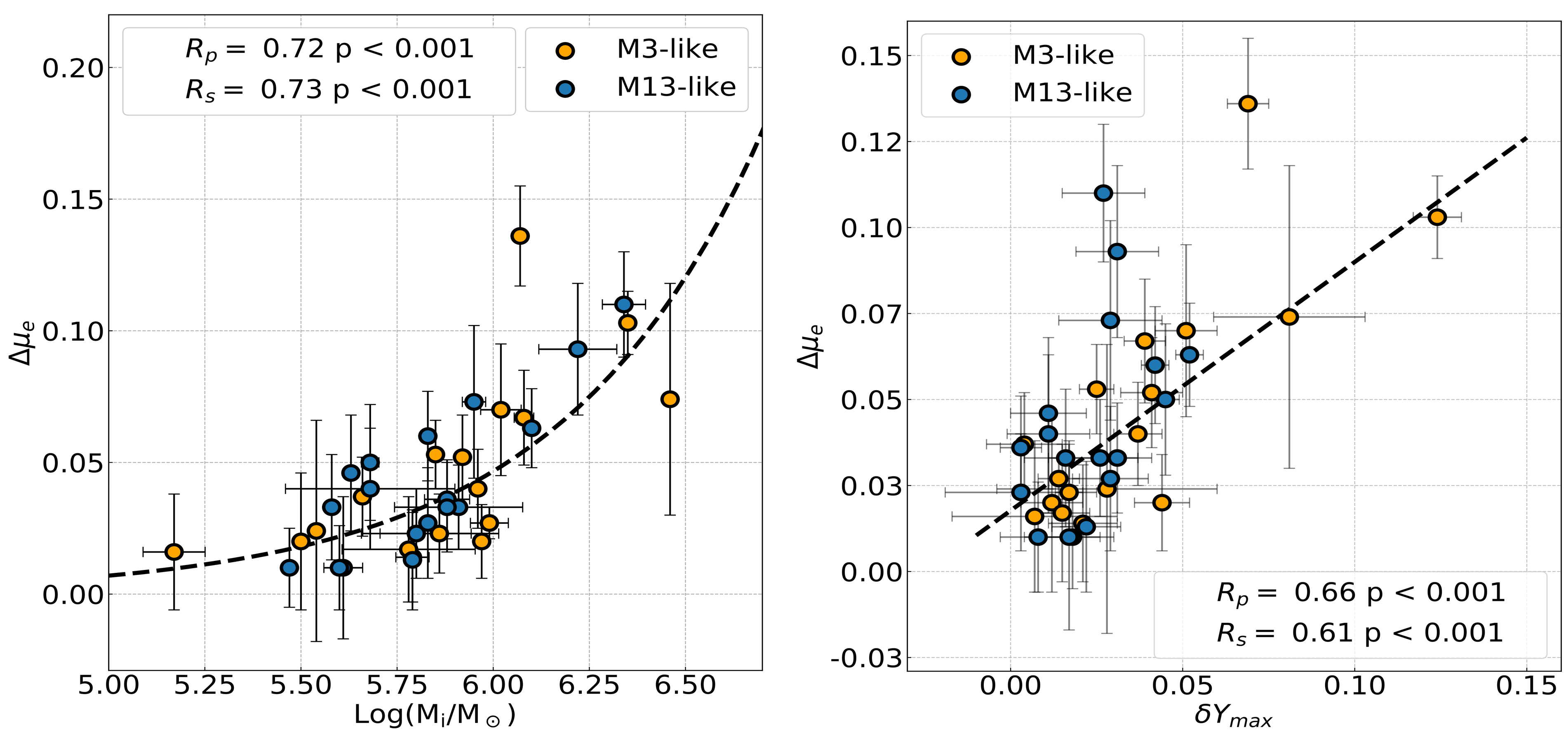
Or follow these links:
Tailo et al. (2020)
Tailo et al. (2021)

The difference between the 1G and the 2Ge mass loss ($\Delta\mu_e$) correlates correlates with the mass of the host cluster (left) and the helium abundance of the extreme 2G (right).

The separation between M3- and M13-like clusters, representing the traditional second parameter problem, does not exist in these planes.



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