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Blue straggler stars in open clusters

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On this proceeding we present the most homogeneous and large *Gaia* based catalog of Blue and Yellow straggler stars (BSS and YSS) in Galactic open clusters (OCs). We provide valuable information on a handful of clusters, including binary fractions and orbital periods. Additionally, we have investigated potential correlations between the straggler numbers and the structural and dynamical parameters of their parent clusters.

BSS should not exist! However, due to their formation mechanisms, which involve stellar mergers, the collision of stars, and/or mass transfer (MT) from a companion in binary systems, their study contributes to our understanding of stellar and galactic evolution, binary star dynamics, and formation of complex astrophysical systems.

The new list includes 897 BSS and 77 YSS candidates. For all of them we provide positions, colors, proper motions, parallaxes, distance to the cluster center (in arcmin) and membership probability –based on the Gaia astrometric solution (Gaia Collaboration et al., 2018). All relevant information such as methodology, candidate selections, field contamination treatment and main statistical results can be found in Rain et al. (2021).

In addition to the catalog, we conducted three complementary studies summarized as follows:

i) BSS can be used as a tool to determine the dynamical ages of galactic stellar clusters. Thus, here we infer the dynamical state for all OCs in our sample hosting a number of stragglers $N_{BSS} \geq 10$. In general, we found BSS are more centrally concentrated than normal stars in clusters older than 1 Gyr. For all these clusters we computed the A_r^+, an observational parameter that quantifies the level of BSS segregation –see Alessandrini et al. (2016) for more details regarding A_r^+.

ii) Using the Automated Stellar Cluster Analysis `ASteCa` code (Perren et al., 2015) we calculate the binary fraction (N_{bin}) in a handful of clusters. Figure 1 shows the correlation between N_{BSS} and N_{bin}. Here we found a dependence of $N_{BSS} \propto M_{Tot}^{\delta}$ with δ=0.6±0.2. For the first time in OCs, we have quantified and confirmed a correlation between both parameters.

iii) Finally, we conducted a time-series analysis using data from the Transiting Exoplanet Satellite Survey (TESS, Ricker et al., 2015) with a baseline no longer than one month. We identified nearly 70 short-period (SP) binaries, with 90% of them being new discoveries. These binaries exhibit periods ranging from 0.1 to 14 days. Furthermore, we observed that at least ∼7% of the straggler candidates in our sample are part of short-period binary systems. Moreover, our findings indicate that seven clusters exhibit an intriguingly high rate of SP-BSS, surpassing the reported rates in emblematic cases such as NGC 188 and M67, specifically exceeding 10%.

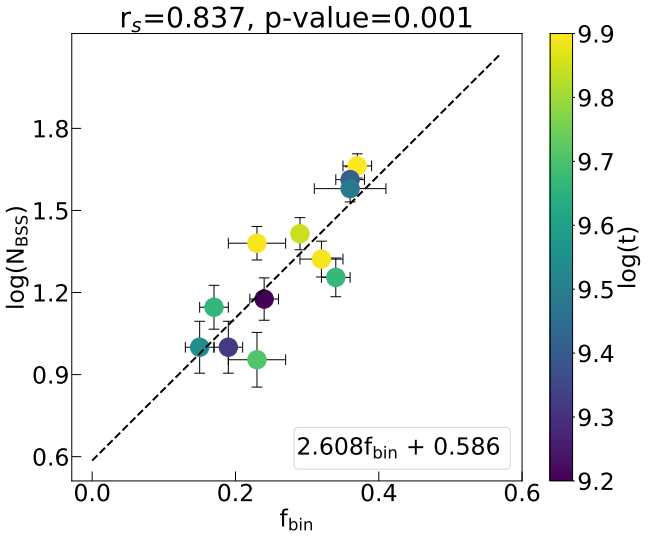

Figure 1. Logarithm of the observed number of BSS as a function of the number of binaries on each cluster. The dashed black line indicates the best fit to the data. Errors are Poissonian.

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