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On the binary origin of short-period Blue straggler stars in Collinder 261

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We study whether binary stellar evolution is a viable formation channel for the short-period blue straggler stars (BSS) in the Collinder 261 open cluster. We find that models with non-conservative mass transfer are plausible progenitors for the fainter observed BSS.

BSS exhibit characteristics of youth, higher temperature, and greater mass than expected according to the standard stellar evolution. They occupy a position above and to the left of the main sequence turn-off point in the optical color-magnitude diagrams (CMDs). The prevailing consensus is that BSS were originally main-sequence stars that acquired additional mass via mass transfer from an evolving primary star through Roche lobe overflow (RLOF), and/or via collisions involving single, binary, or triple stars.

Based on Gaia DR2 data Gaia Collaboration et al. (2018), we focus on the short-period BSS found in Collinder 261. Our investigation delves into the potential of mass transfer in binary systems in accounting for the presence and properties of these stars. We use an adaptation of the binary evolution code presented in Benvenuto & De Vito (2003), which allows us to perform comprehensive calculations on the structure of both stars within the binary system, as well as the orbital evolution and mass transfer rate simultaneously. The aim is to identify potential progenitor candidates matching observations at the same age as that determined for Collinder 261 (namely, $T_c = 7.94$ Gyrs).

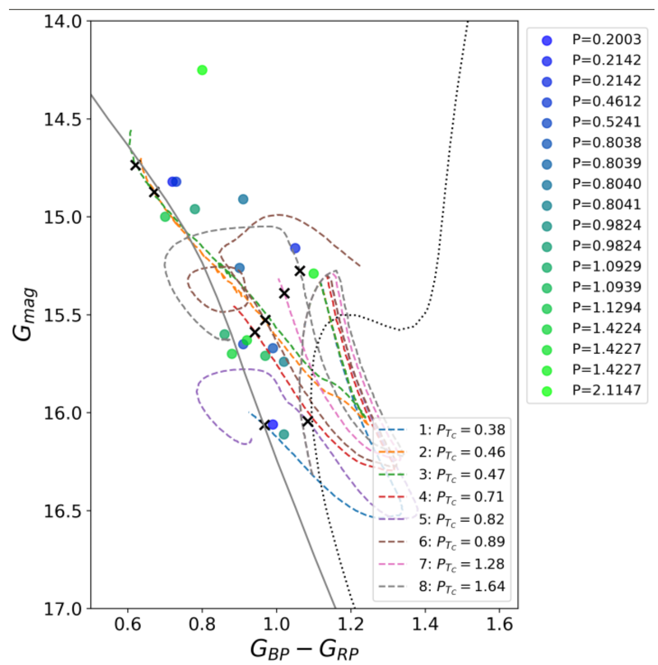

Figure 1. Observed BSS (dots from blue to green) and simulations (dashed lines) in the CMD. Black crosses indicate the moment at which the models reach the age T_c. P indicates the orbital period of the observed BSS in days, and P_{T_c} the orbital period of the simulations at the age T_c in days. The dotted line represents the binary isochrone at T_c and the solid line is the ZAMS.

Figure 1 shows the observed BSS in the CMD together with simulations of binary systems composed initially by stars of $1.15 M_{\odot}$ and $0.75 M_{\odot}$. We simulate systems under conservative ($\beta = 1$) and non-conservative ($\beta < 1$) mass transfer. In what follows, we detail the initial orbital period (P_i) and mass transfer efficiency (β) of the eight simulated systems: 1) $P_i = 0.80$ d, $\beta = 0.40$; 2) $P_i = 0.80$ d, $\beta = 0.75$; 3) $P_i = 0.80$ d, $\beta = 0.80$; 4) $P_i = 0.85$ d, $\beta = 0.50$; 5) $P_i = 0.87$ d, $\beta = 0.35$; 6) $P_i = 0.87$ d, $\beta = 0.50$; 7) $P_i = 0.90$ d, $\beta = 0.50$; 8)$P_i = 0.92$ d, $\beta = 0.50$.

We find that binary evolution serves as a viable mechanism for producing these BSS and that the efficiency of mass transfer plays a key role in accurately matching the fainter objects. The orbital period of the simulated binaries at the age of Collinder 261 is in the same range as the one measured in the observed BSS.

References

Benvenuto, O. G., & De Vito, M. A. 2003, MNRAS, 342, 50, doi: 10.1046/j.1365-8711.2003.06458.x

Gaia Collaboration, Babusiaux, C., van Leeuwen, F., et al. 2018, A&A, 616, A10, doi: 10.1051/0004-6361/201832843

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