Impact of binary interaction on the evolution of blue supergiants

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A large fraction of massive stars evolve in interacting binary systems, which dramatically modifies the outcome of stellar evolution. We investigated the properties of blue supergiants in binary systems and whether they are suitable for extragalactic distance determinations using the flux-weighted gravity luminosity relationship (FGLR). This is a relationship between the absolute bolometric magnitude Mbol and the spectroscopically determined flux-weighted gravity $g_F = g/T^4$, where g is the surface gravity and Teff is the effective temperature. We computed a grid of binary stellar evolution models with MESA and use the v2.1 BPASS models to examine whether they are compatible with the relatively small scatter shown by the observed relationship. Our models have initial primary masses of 9 â€“ 30 MâŠ™, initial orbital periods of 10 â€“ 2511 days, mass ratio q = 0.9, and metallicity Z = 0.02. We find that the majority of prima that produce blue supergiant stages are consistent with the observed FGLR, with a small offset towards brighter bolometric magnitudes. In between 1% â€“ 24% of cases, binary evolution may produce blue supergiants after a mass transfer episode, that lie below the observed FGLR. A very small number of such stars have been found in extragalactic FGLR studies, suggesting that they may have evolved through binary interaction. Some models with shorter periods could resemble blue hypergiants and luminous blue variables. We used CMFGEN radiative transfer models to investigate the effects of unresolved secondaries on diagnostics for Teff and g, and the biases on the determination of interstellar reddening and Mbol. We find that the effects are small and within the observed scatter, but could lead to a small overestimate of the luminosity, of Teff and of g for extreme cases. We conclude that the observed flux-weighted gravity luminosity relationship can, in principle, be well reproduced by close binary evolution models. We outline directions for future work, including rotation and binary population synthesis techniques.

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