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Binary Stars as Sources of Chemical Anomalies in Stellar Clusters

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Globular clusters (GCs) are often regarded as simple stellar populations with uniform ages and chemical compositions. However, observations, particularly from the Hubble Space Telescope (HST), reveal peculiar abundance patterns, known as multiple populations (MPs). MPs are characterized by enhancements in He, N, and Na, alongside depletions in O and C. The origin of these abundance variations remains an open question in stellar population studies.

This work explores the role of binary stellar systems as a potential source of MPs in GCs. Previous studies have demonstrated that mass transfer in binary systems can produce chemically enriched material consistent with observed MPs. A study from our group simulated isolated binaries, showing that expelled material from interacting binaries exhibits signatures of hot hydrogen burning, consistent with observed abundance spreads in MPs.

Not only does mass transfer between individual binary systems play a role in the formation of MPs, binary systems are remarkably prevalent in clusters and have been shown to be highly sensitive to changes in their clustered environments. For example, denser, more massive clusters induce more rapid and extensive changes in their binary systems.

My research lies at the intersection of binary evolution and their host cluster environment, focusing on how binary systems contribute to the emergence of MPs. More specifically, I will modify the physical characteristics of isolated binary models by varying primary mass, orbital period, and mass ratio. I will investigate the resulting yield due to such dynamical changes and compare them with observational data to assess the appropriateness of the model parameters.

My results will significantly contribute to the ongoing debate about the sources of enriched material in GCs by highlighting the critical role of binary star systems.

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