

Binary Nature of NGC 2323?

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Abstract

As a well-known open cluster, NGC 2323 (also called M50) has been widely investigated for over a hundred years and has always been considered a classical single cluster. In this work, with the help of *Gaia* DR3, we study the binary structure nature of this cluster. Although indistinguishable in the spatial space, the small but undeniable difference in the proper motion indicates that they may be two individual clusters. After investigating the properties of the two clusters, it is found that they have very close positions (three-dimensional $\Delta_{\text{pos}} = 12.3$ pc, $\sigma_{\Delta_{\text{pos}}} = 3.4$ pc) and similar tangential velocities (two-dimensional $\Delta V = 2.2$ km s⁻¹, $\sigma_{\Delta V} = 0.02$ km s⁻¹), indicating the existence of their physical association. Moreover, the best isochrone fitting ages of the two clusters are the same (158 Myr), further proving their possibly common origin. To comprehensively understand the formation and evolution of this binary cluster, we employ the PETAR *N*-body code to trace back their birthplace and deduce their dynamical evolutionary fate. With observational mean cluster properties, the simulations suggest that they may form together, and then orbit each other as a binary cluster for over 200 Myr. After that, because of their gradual mass loss, the two clusters will eventually separate and evolve into two independent clusters. Meanwhile, the numerical *N*-body simulation suggests that the less massive cluster is unlikely to be the cluster tidal tails created by the differential rotation of the Milky Way.

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