The evolution of globular clusters: Analysis of external effects and determination of progenitor populations

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Abstract

We include external effects in the Fokker-Planck scheme for studying globular cluster evolution. We use this method to study cluster evolution under the combined influence of relaxation, tidal heating and binary heating of the core in the Milky Way and M87 and related systems in fundamental plane ellipticals. The investigations examine the physical behavior as a function of internal cluster properties and external orbit in a galaxy and use likelihood-based statistical inference to examine possible progenitors of present-day populations.^ In M87, cluster evolution is driven by spheroidal heating on low-eccentricity orbits and relaxation on high-eccentricity orbits. The rapid evolutionary rate in the dense inner regions of the galaxy produces the large core in the cluster distribution through depletion. Depletion also leads to an estimated 35% reduction in the specific frequency of globular clusters, $S\sb{N}.$ Because smaller fundamental plane ellipticals (FPEs) are denser at a given fiducial radius than larger FPEs, homologous cluster populations evolve more rapidly in the smaller FPEs. This partially explains differences in $S\sb{N}$ observed in FPEs.^ In the Milky Way, cluster evolution is dominated by disk heating on low-eccentricity orbits and relaxation on high-eccentricity orbits, regardless of inclination. Disk influence leads to strong evolution with approximately 55% reduction in the initial population. Evaporation on high-eccentricity orbits dominates leading to greater tangential bias in both disk and halo populations as a function of time. The inferred initial halo population appears to match the kinematics of the observed halo field star population. Conversely, the inferred initial disk population does not appear to match the kinematics of any disk populations. These results suggest that the flattened component of the cluster population formed in the dissipative collapse that preceded the formation of the Galactic disk. ^

Subject Area

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