

Abstract

Gaia DR3-based Identification of Extra-tidal Stars in the Globular Cluster NGC 5272 (M3)

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Globular clusters accreted with dwarf galaxies and other satellite systems during the hierarchical assembly of the Milky Way lose stars to the Galactic tidal field, and these escapees can populate regions beyond their nominal tidal radii. These extra-tidal populations provide valuable information on cluster mass loss and dynamical evolution. NGC 5272 (M3), a globular cluster likely a Helmi-stream member, has previously been reported to exhibit extended tidal structures. Here, we investigate its immediate extra-tidal region using Gaia astrometric and photometric data.

We search Gaia DR3 sources out to $10r_t$, where the adopted tidal radius is $r_t = 28.7\text{arcmin}$. After the astrometric quality cuts, candidate members were selected using a proper-motion-based membership probability derived from a Gaussian-mixture model of the cluster's clumpy proper-motion space. The colour–magnitude diagram was then used to retain stars consistent with the cluster's evolutionary sequence, followed by a parallax criterion to select sources with distances compatible with NGC 5272. These combined astrometric and photometric criteria yielded a sample of extra-tidal candidates extending to several tidal radii from the cluster centre. We additionally employed distant control fields to assess the contribution of field contamination, but no overdensities were found up to $20r_t$.

We identify 76 extra-tidal candidates, including nine candidate potential escapers located within $0.65r_j$, where $r_j = 0.727^\circ$ is the adopted Jacobi radius. The spatial distribution of the candidates exhibits a mild northwest–southeast elongation, broadly consistent with the cluster's orbital direction, currently approaching perigalacticon. However, no prominent large-scale tidal tail is detected within our search region.