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Simulations suggest globular clusters fling out fast stars that Gaia mostly cannot see

Encounters with binaries holding dead-star remnants have likely ejected some 6,300 stars in 500 million years, a modelling study estimates, but few of the fastest would be visible to Gaia.

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Photo: Nasa Hubble Space Telescope

Globular clusters are tight, ancient balls of hundreds of thousands of stars that orbit the Milky Way. In their crowded cores, stars pass close enough to swap energy, and occasionally one is kicked out of the cluster altogether. A study published in The Astrophysical Journal in 2026, by researchers at the University of Toronto and York University, asks how often the most violent of these kicks happen, how fast the ejected stars travel, and whether telescopes could spot them.

The encounters in question involve a single star meeting a binary in which at least one partner is a compact object, the dense remnant left when a star dies. The authors call these star plus compact object binary (S+COB) interactions. According to the paper, they can launch stars at up to several hundred kilometres per second, which approaches or exceeds the speed needed to escape the Galaxy entirely. Stars moving faster than the Galaxy's escape speed are known as hypervelocity stars, and the open question is whether these interactions help supply them.

The work is a modelling study, not a direct observation. The team combined Monte Carlo N-body simulations, which follow the gravitational evolution of a cluster using statistical shortcuts rather than tracking every pair of stars exactly, with observed properties of real Milky Way globular clusters. A particle spray code, a technique for following escaped stars as they spread out along their parent cluster's path through the Galaxy, then turned those ejections into a synthetic population of stars that should be out there today.

The authors report that over the past 500 million years, S+COB interactions have likely ejected about 6,300 stars from the Galaxy's globular clusters. Some of these would today be moving faster than 500 kilometres per second.

Finding them is another matter. Using mock photometry, simulated measurements of how bright each star would appear, the team estimates that only part of the ejected population would be detectable in Gaia Data Release 3, the European Space Agency's catalogue of stellar positions and motions. Among stars faster than 500 kilometres per second, however, the expected number of detections is just 1, with a range running from zero to three.

The authors are more hopeful about the Legacy Survey of Space and Time, an upcoming deep survey at the Vera C. Rubin Observatory, though the abstract does not say how many such stars it might reveal. They argue that fast stars detected outside globular clusters in future would offer a useful way to probe the clusters' dense cores.

The figures rest on simulations and their assumptions, and only the abstract was available for this report, so the paper's full treatment of its uncertainties could not be examined.

PAPER	*The Ejection and Detectability of High- and Hypervelocity Stars by Compact Object Binaries in Globular Clusters*
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