

Fuzzy dark matter dynamical friction and the survival of globular clusters

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At cosmological scales, physics is well described by Λ CDM, a model which involves that 27% of the universe is composed of dark matter. The nature of this matter remains unknown so far. Although Λ CDM has been successful, it still has some difficulty matching the observations at galactic scales. One of these deficiencies relates to dynamical friction in dwarf galaxies, which is expected to have caused most of the globular clusters to fall in the central region of the galaxies. This is not observed in Fornax dwarf galaxy, for instance. A possible answer is to look for alternative cosmological models for dark matter. An exotic model called fuzzy dark matter describes dark matter as an extremely light boson particle of mass $m_\chi \sim 10^{-22}$ eV. We present a new implementation of dynamical friction in the fuzzy dark matter framework, using the galpy code to follow the orbital evolution of globular clusters over a wide range of masses and halo properties. In this scenario, dynamical friction can be strongly reduced due to stochastic heating by fuzzy dark matter density fluctuations.

We explore how this effect impacts the orbital decay and long-term survival of globular clusters. We find that the largest deviations from the standard cold dark matter picture occur in dwarf galaxies, where dynamical friction can be significantly slowed down or even stalled over a Hubble time. This prevents clusters from sinking to the galactic center, in contrast with standard expectations.

These results suggest that globular cluster systems provide a new way to probe fuzzy dark matter, with promising prospects for recent Euclid observations, and offer a natural explanation for the long-standing Fornax timing problem .

Keywords: dark matter, globular clusters, dwarf galaxies, galactic dynamics

References

- [1] Szpilfidel, A., Boldrini, P., Bovy, J., & Di Matteo, P. (2026), *Fuzzy dark matter dynamical friction: stalling of globular clusters induced by dynamical heatings*, arXiv:2510.00927 (accepted in *Astronomy&Astrophysics*)