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Globular Clusters in Dwarf Spheroidal Galaxies

Eva Harris*

Department of Space Technology, Debre Tabor University, Debre, Ethiopia

About the Study

The dynamical friction timescale of massive globular clusters (GCs) in the inner regions of cuspy dark haloes in dwarf spheroidal (dSph) galaxies can be much shorter than the Hubble time. This implies that a small fraction of the GCs is expected to be caught close to the centre of these galaxies. We compare the radial distribution of GCs predicted in simple Monte Carlo models with that of a sample of 38 spectroscopically confirmed GCs plus 17 GC candidates, associated mainly to low-luminosity dSph galaxies. If dark matter haloes follow an NFW profile, the observed number of off-center GCs at projected distances less than one half the galaxy effective radius is significantly higher than models predict. This timing problem can be viewed as a fine-tuning of the starting GC distances. As a result of the short sinking timescale for GCs in the central regions, the radial distribution of GCs is expected to evolve significantly during the next 1 – 2 Gyr. However, dark matter haloes with cores of size comparable to the galaxy effective radii can lead to a slow orbital in-spiral of GCs in the central regions of these galaxies, providing a simple solution to the timing problem. We also examine any indication of mass segregation in the summed distribution of our sample of GCs.

The radial migration of GCs in dSph and dIrr galaxies could provide clues on the dark matter density profile in these galaxies and about the mechanisms for building up NSCs. While the rotation curves of dwarf galaxies favour dark matter haloes with a constant-density core, determinations of the value of the inner slope of the dark matter profile from the stellar kinematics in pressure-supported dwarf galaxies is a delicate issue. Many investigations have modelled the stellar kinematics of the classical Milky Way dSph galaxies to infer their dark matter distribution. Most of the studies favour a cuspy dark matter inner profile for Draco. As a further step towards understanding the role of dynamical friction and its effect on GCs orbiting dwarf galaxies, we investigate the spatial distribution of GCs in a sample of low-luminosity dwarf galaxies. Using a probabilistic approach, we explore if the main properties of the summed distribution of GCs in these galaxies can be accounted for, in a simple scenario where the orbits of the GCs decay towards the centres of galaxies due to dynamical friction with the dark matter particles in a cuspy halo or, on the contrary, it requires a finely tuned set of initial conditions.

We have performed simple Monte Carlo simulations to predict the radial distribution of the number and luminosity of the GCs, assuming that their orbital evolution is driven by dynamical friction with the dark matter. If all dSph galaxies in our sample have an NFW dark halo, the predicted number of non-nuclear GCs inside one half effective radius is considerably smaller than observed. In the models, effective radius is low because GCs spend little time in that inner region given that the timescale to sink is very short. Therefore, the timing problem of the orbital decay of GCs is not exclusive of the Fornax dSph galaxy.

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***Address for Correspondence:** Eva Harris, Department of Space Technology, Debre Tabor University, Debre, Ethiopia; Tel: +251931883823; E-mail: harevaris@gmail.com*

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