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Analytical Solution for Stellar Density in Globular Clusters

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Abstract. In this paper, four parameters analytical solution will be established for the stellar density function in globular clusters. The solution could be used for any arbitrary order of outward decrease of the cluster's density.

Key words. Stellar density in globular clusters—theoretical astrophysics—statistical astronomy.

1. Introduction

A globular cluster is a spherical collection of stars that orbits a galactic core as a satellite. They are generally composed of hundreds of thousands of low-metal, old stars. The types of stars found in a globular cluster are similar to those in the bulge of a spiral galaxy but confined to a volume of only a few cubic parsecs. Observations of globular clusters show that these stellar formations arise primarily in regions of efficient star formation, and where the interstellar medium is at a higher density than in normal star-forming regions. Globular clusters are fairly common; there are about 158 (Frommert & Hartmut 2007) currently known globular clusters in the Milky Way, with perhaps 10–20 more undiscovered. Andromeda, for instance, may have as many as 500 globular cluster (Barmby & Huchra 2001); whereas some giant elliptical galaxies, such as M87 (Strom *et al.* 1981), may have as many as 10,000 globular clusters. These globular clusters orbit the galaxy out to large radii, 40 kiloparsecs (approximately 131 thousand light-years) or more.

Galactic globular clusters, which are ancient building blocks of our Galaxy, represent a very interesting family of stellar systems in which some fundamental dynamical processes have taken place on time scale shorter than the age of the universe. For example, horizontal branch (HB) stars in globular clusters offer an investigation of the mass loss mechanisms taking place in red giants (Valcarce & Catelan 2008). Moreover, it was proposed to use the HB to infer which is today the relative number fraction of 'normal' and anomalous stars in clusters (D'Antona & Caloi 2008). In contrast with galaxies, it was known since the last twenty years that globular clusters represent unique laboratories for learning about two-body relaxation, mass segregation from equipartition of energy (Spitzer 1987), stellar collisions (Binney & Tremaine 1987), stellar mergers, and core collapse.