THE DYNAMICS OF GLOBULAR CLUSTER SYSTEMS

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ABSTRACT: This paper describes a project whose aim is to study the dynamics of a globular cluster system using an N-body code modified to include the gravitational field of an isothermal galaxy model. The galaxy and the globular cluster system have the same radii, are spherically symmetric and non-rotating. The evolution is to be followed up to a Hubble time.

1. INTRODUCTION

The dynamics of an isolated, self-gravitating N-body system has been reasonably well understood for single-mass models; but that of a subsystem like the globular cluster system has not received much attention. Studies of two- and multi-component systems has given some insight into the behaviour of subsystems (Aarseth 1985, Cohn 1985, and Inagaki 1985). An attempt to compare the globular cluster system of our galaxy with multi-component systems that have been studied so far shows that the relevant ratios of the individual masses and total masses of the two components, viz. the globular clusters and the stars constituting the parent galaxy fall well outside the range of ratios chosen by earlier studies. With (i) the mass of a globular cluster as 10(+5) M⊙, (ii) the mass of the galaxy as 6x10(+11) M⊙ and (iii) the number of globular clusters as 200, the ratio of the stellar mass to globular cluster mass is 10(-5) and the ratio of the mass of the globular cluster system to the mass of the parent galaxy is 3x10(-5).

2. AIM

We intend to follow the dynamical evolution of a self-gravitating N-body system under the additional gravitational field of a parent galaxy, after suitably modifying the simple N-body code to include its presence.

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Initially it is planned to study (i) the density and velocity profiles, (ii) the rate of evolution using the radius of sphere containing a given fraction of total mass, (iii) velocity anisotropy, (iv) the distribution of orbital eccentricities, and (iv) the formation and disruption of binaries due to three-body encounters.

3. ASSUMPTIONS

1. The globular cluster system initially has (i) clusters uniformly distributed in radius, (ii) an isotropic velocity distribution and (iii) no rotation.

2. The parent galaxy (i) has a mass profile M(r) = Kr out to some cutoff radius, (ii) is spherically symmetric and (iii) is non-rotating.

4. MODEL

The globular cluster system is modelled with 200 equal-mass particles and the galaxy with the value of K chosen to have a good fit with a standard mass model of our galaxy (Ostriker and Caldwell 1980). The cutoff radius is chosen to be 50 kpc for both.

5. RESULTS

This study has just begun and the preliminary tests show that the modified code conserves energy as well as the unmodified code does over a comparable period of time.

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