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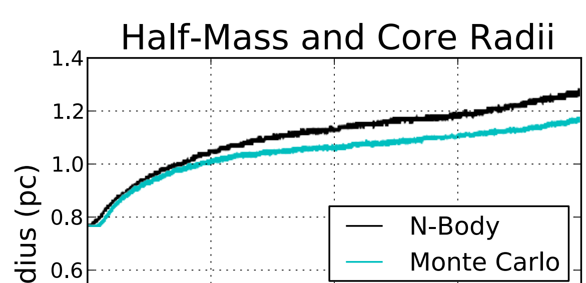
1. COMPARISON WITH N-BODY

The Monte Carlo approach requires one to compute the local average of several physical quantities. For instance, the physics of binary formation via three-body encounters and the selection of the relaxation time both depend upon local averages of the number density, velocity dispersion, and average mass of the cluster at a specific radius (**??**). However, it is not the case that these averages should be computed over the same number of stars. While three-body binary formation should depend only on the properties of the closest stars, the relaxation time step should be broadly applied to the entire cluster. We both expect and require three-body binary formation to be more sensitive to local spikes in number density and velocity dispersion than the cluster-wise relaxation time. Therefore, we must adjust the number of stars over which to compute an average depending on the scale of the physics in question.

As in previous studies (**?**) we determine the optimal code parameters by direct comparison to N-body simulations with identical initial conditions. The primary focus of this study is the retention of black holes, so we choose as our comparison an idealized two-component model recently studied in **?**. These models are a realization of standard Plummer sphere populated by a large population of stellar mass objects and a smaller population of heavy objects. We consider models with an individual mass ratio of $m_2/m_1 = 20$, and a total cluster mass ratio of $M_2/M_1 = 0.02$, where m_1 and m_2 are the masses of individual particles, and M_1 and M_2 are the total masses of each component. We consider runs with $64k$ and $128k$ number of particles, although only the $64k$ runs are illustrated here.

In Fig. **??**, we compare the cluster properties as reported by the N-body simulations of **?** to the results of our Monte Carlo technique. Empirically, we find optimal agreement by computing the average quantities over the nearest 40 stars for two-body relaxation, and the nearest 6 stars for three-body binary formation. In particular, the evaporation rate of the black-hole subcluster from the Monte Carlo replicates the N-body results extraordinarily well up to the ejection of the final black-hole binary from the cluster. Furthermore, we find the Monte Carlo approach correctly replicates the half-mass expansion to within 8% after 2×10^5 N-body time units.

Of the measured cluster properties, only the core radius cannot be reproduced correctly by the Monte Carlo approach. Immediately following core collapse, the measured core radius for the Monte Carlo differs from the N-body results by as much as 65%. Unfortunately this is to be expected: once mass segregation and core collapse have occurred, the cluster core is comprised almost entirely of black holes which have dynamically decoupled from the rest of the cluster. Correctly modelling the internal dynamics of an $N \sim 100$ system using a Monte Carlo has very little hope of success; however, as the black holes are ejected, and the core becomes populated with a larger number of lighter halo stars, the validity of the Monte Carlo approach is restored, and the core radius better resembles that of the N-body approach. New techniques are under investigation that will correctly evolve the subcluster dynamics while maintaining the speed of the Monte Carlo approach.



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