Contribution ID: **38** Type: **not specified**

Relaxation of self-gravitating systems on a long time scale according to the results of direct numerical simulation

Thursday 27 April 2023 14:10 (15 minutes)

In our project we investigate the long term relaxation processes in the initially equilibrium self gravitating stellar systems. As an initial condition for our model star cluster we use the well described and well studied Plummer mass distribution (Plummer, 1911, MNRAS, 71, 460). We try to cover a wide range of observable stellar clusters in our Galaxy, so we generate the models starting from 16k particles (star cluster with ˜9200 \(M_\odot\)) up to 128k particles (star cluster with ˜73000 \(M_\odot\)). After the initial initialization of the system (give to each point mass the virial equilibrium 3D coordinates and velocities) we start our N-body direct summation and individual time step 4th order Hermite integration. As a basic code we use the publicly available version of phi-GPU: https://github.com/berczik/phi-GPU-mole program. For the unit normalization of our runs we use the commonly accepted, so-called, "N-body units"or "Henon units"(Aarseth, Henon, Wielen, 1974, A&A, 37, 183). In each timestep of our time integration we check the total energy (kinetic + potential) of each particle and compare these values with the initial values for the same particles. In the end we obtain the relative energy change distribution for each particle and for each timestep. Based on our energy changes analysis we estimate the relaxation time for each of our model stellar systems. From the obtained numerical results we construct the numerical fitt formula and compare this equation with the well known Spitzer equation (Spitzer, 1987, Princeton University Press. p. 191).

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Session Classification: Extragalactic astrophysics and cosmology