Abstract for an Invited Paper
for the APR07 Meeting of
The American Physical Society

Parallel n-body algorithms for charged particles in external fields, with applications to accelerator physics[1]

GEORGE BELL, Tech-X Corp.

In an effort to increase the luminosity of Brookhaven National Lab's Relativistic Heavy Ion Collider (RHIC), a novel electron cooling system has been proposed. Although the ions and electrons are highly relativistic in the lab frame, their motion is non-relativistic in the beam frame. The dynamics shares similarities with the classical n-body problem of astrophysics, but with charged particles interacting through Coulomb forces, rather than (for example) the stars of a globular cluster interacting through gravitation. In arbitrary external fields, the dynamical friction force on ions (and, hence, the cooling rate) is difficult to estimate. We present two numerical algorithms that simulate the friction force from first principles. The first algorithm is a Hermite n-body scheme adapted from astrophysics, while the second is a new algorithm where the interaction between pairs of particles is calculated exactly. We compare the two algorithms, and present results relevant to the RHIC cooling system.

[1]Work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics under contract DE-FG02-04ER84094.