SIMULATING DYNAMICAL FRICTION IN WIGGLER-BASED HIGH-ENERGY ELECTRON COOLERS, INCLUDING FINITE-TIME EFFECTS

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Abstract

The proposed RHIC-II luminosity upgrade includes a novel electron cooling section, using ~55 MeV electrons to cool fully-ionized gold. We present simulations of the dynamical friction force exerted on the Au ions. Rather than a strong solenoid, a long helical wiggler magnet is used to provide focusing and suppress recombination. In the rest frame of the relativistic electron and ion beams, with non-relativistic motion and electrostatic fields, the Lorentz transformed wiggler field yields strong, rapidly-varying electric fields. The VORPAL simulation framework applies a semi-analytic binary collision algorithm, in which ion-electron collisions are modeled pairwise. This model is combined with standard particle-in-cell (PIC) techniques, through an operator-splitting approach, to include the effects of external fields. Charge shielding due to electron-electron interactions is also included via PIC. Simulated friction results are compared with BETACOOL, which integrates the standard unmagnetized formulas. With finite interaction times and electron wiggle motion correctly included, we find good agreement with VORPAL.

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