REDUCTION OF THE FRICTION FORCE IN ELECTRON COOLING SYSTEMS DUE TO MAGNETIC FIELD ERRORS

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Abstract

Magnetic field errors can limit the dynamical friction force on co-propagating ions and, hence, increase the cooling time. We present theoretical and numerical results for reduction of the friction force due to bounded transverse magnetic field errors, as a function of wavelength. VORPAL * simulations using a binary collision algorithm ** show that small-wavelength field errors affect the friction logarithmically, via the Coulomb log, while long-wavelength errors reduce the friction by effectively increasing the transverse electron temperature. A complete understanding of finite-time effects and the role of small impact parameter collisions is required to correctly interpret the simulation results. We show that the distribution of electron-ion impact parameters is similar to a Pareto distribution, for which the central limit theorem does not apply. A new code has been developed to calculate the cumulative distribution function of electron-ion impact parameters and thus correctly estimate the expectation value and uncertainty of the friction force.

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