THREE-DIMENSIONAL SIMULATION OF ELECTRONS AND IONS IN ECRIS

J. H. Andrä, Westfaelische Wilhelms-Universität Muenster, Muenster

Abstract

Electron-Cyclotron-Resonance-(ECR)-Heating (ECRH) is known to produce non-equilibrium plasmas with the total non-Maxwellian energy in the electrons while the ions stay below 1 eV. Theories based on Maxwell distributions are thus unable to correctly describe ECR-Ion Sources (ECRIS). Particle In Cell (PIC)-techniques are feasible only with significant approximations in the extremely complicated magnetic structure of an ECRIS. This is the reason to concentrate all efforts on the calculation of various electron distributions in an ECRIS taking into account all three-dimensional static fields, dynamic microwave fields, and all collisions of the electrons. To this end the Boris-algorithm is introduced which is shown to be very efficient and precise for all conditions in an ECRIS including the resonance transitions. The electron distributions clearly show the low efficiency of ECRH in a standard ECRIS with a central minimum of the axial magnetic field compared to the high ECRH-efficiency in a plateau-ECRIS with a flat central minimum. A non-relativistic version of the code is used to demonstrate the positive effects of ion-CRH on the confinement of the ions with far reaching consequences.

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