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COMPUTER SIMULATIONS OF DUSTY SHEATHS

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There are several models using at computer simulations of dusty sheaths including the classic Bohm's model, the model with self-consistent boundary conditions for sheaths, the evolution model with self-consistent boundary conditions in presheaths, and some other. However the models need to support the boundary conditions at edges of simulation regions using iterative procedures that can cause an appearance of non-physical oscillations influencing parameters of dusty sheaths. Therefore for the computer simulations of dusty sheaths (including magnetized dusty sheaths) it was developed a relaxation-evolution model which consists of boundary conditions fixed only at electrodes (walls) adsorbing electrons and ions from dusty slab plasma. The boundary conditions do not need iterative procedures causing non-physical oscillations in sheaths.

Using PIC/MCC method (1D3V model) and developed a relaxation-evolution model, a temporal evolution is simulated of one-dimensional slab plasma with given initial parameters. It is assumed that the quasi-neutral slab plasma is uniform initially and consists of motionless dust particles of given radius R_d. Two plane walls collecting electrons and ions from the plasma bind the slab plasma. The magnetic field B is applied to the plasma under a given angle to the plane walls. In addition, a neutral gas can be added between the plane walls so that collisions of electrons and ions including the ionisation and the charge transfer take place in the plasma.

The slab plasma evolution is caused by the collisions as well as by the collection of background electrons and ions by the walls and dust particles, which are charged self-consistently due to the collection. The choice of slab plasma parameters provide a slow plasma evolution comparing to a sheath relaxation with the scale of the ion plasma frequency and charging dust particles that allow to get self-consistent dusty sheaths.

Obtained results show that properties of dusty sheaths including magnetized sheaths can be essentially differed from properties usual sheaths. In particular, spatial distributions of the dust particle charge are non-trivial due to the non-equilibrium of an electron energy distribution function caused by a selective collection of electrons and ions by dust particles and intensive mixing of fast electrons in non-uniform quasi-neutral dusty plasmas.