Numerical study of a dust-contaminated electron plasma

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The DuEl (Dust-Electron) device, a modified Penning-Malmberg trap for the confinement of dust-contaminated electron plasmas, is currently under construction at the University of Milano with the aim of investigating the dynamics of magnetized complex (dusty) electron plasmas [1]. The overall behaviour of such plasmas is heavily affected by the addition of a small fraction of micrometric or sub-micrometric dust grains which collect a large surface charge and are hence subjected both to electromagnetic and gravitational forces [2]. While laboratory dusty plasmas are usually quasi-neutral, this experiment will deal with a non-neutral plasma, thus yielding a long confinement time as well as ample manipulation and diagnostic opportunities in a Penning-Malmberg device.

A two-dimensional 'hybrid' Particle-In-Cell code has been developed whose first goal is the simulation of the transverse dynamics of such plasmas in order to support and complement the experimental work. While the highly magnetized electron population can be treated by means of a mass-less fluid approximation (drift-Poisson), a kinetic description is necessarily adopted for the dynamics of the dust component, including gravity effects. A range of simulations with different initial conditions for the electrons and the dust are performed to observe the influence of the dust on the fluid (Kelvin-Helmholtz) instabilities developing in the electron plasma.

References

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