Local and global properties of dusty plasmas

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Volume-filling dust clouds show interesting features such as a central dust-free void or large-amplitude self-excited dust density waves. Such dust clouds can be produced by confining a large number of particles in the plasma of an rf discharge, e.g., where the gravitational force on the dust is balanced by thermophoresis or under the microgravity conditions on parabolic flights.

Local properties can be studied by illuminating thin 2D slices through the dust cloud or by observing a small 3D volume using stereoscopic techniques [1, 2]. Now, the light extinction of a homogeneously illuminated dust cloud directly allows to measure the global dust density along the line of sight. From the Mie extinction coefficient the dust density is derived and by Abel inversion the radial dust density distribution is reconstructed (see Fig. 1). This global density measurement will then directly be compared to local density measurements.

Also dynamic phenomena like the dust-density waves will be studied are studied on a global and local scale and their mutual correlation is determined. Dust-density of small amplitude that appear well behaved on the local scale are found to be globally incoherent whereas large-amplitude waves with very chaotic local appearance are globally well correlated.

References


Figure 1: Radial dust density distribution (from Abel inversion) measured by light absorption.