The kettle on the stove: voids in dusty plasmas

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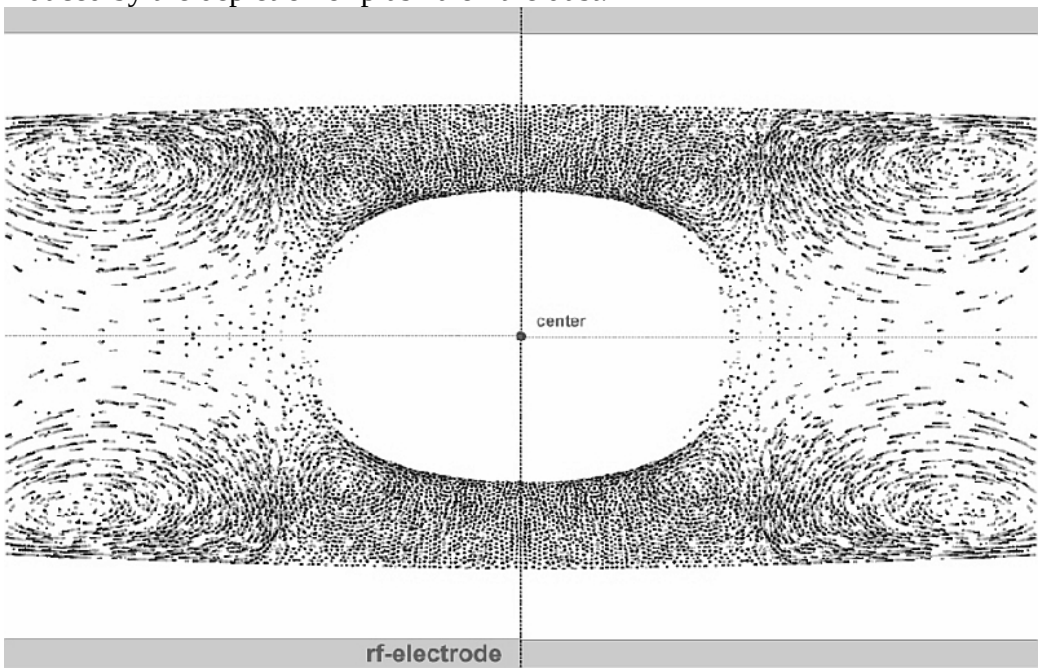
Dust particles embedded in plasma collect ions and electrons. This means that the dust particles cause extra losses of plasma. One then expects these losses to be compensated by extra ionization. Since there are fewer electrons left, the probability that an electron can cause ionization has to increase, which requires an increase of the average electron temperature. So, the conceptual picture of dusty plasmas then becomes that in the dust cloud the resistivity is increased, which heats the electrons, which increases the ionization to compensate for the losses induced by the depletion of plasma on the dust.



Dusty plasma experiments under microgravity conditions show the intruiging behaviour captured in the figure above. A dust free void is formed in the center of the discharge, which is due to ions drifting to the outside of the discharge, while being collected and scattered by the dust particles. In these processes, they transfer momentum and blow a dust free hole in the dust cloud.

This fascinating structure becomes even more surprising when we try to fit it with the conceptual picture of dusty plasmas discussed in the beginning. We expect the losses in the dust cloud to be compensated by ionization, but somehow we find the ionization in a completely different volume, which has no extra losses whatsoever, since the ionization itself removes the dust from this volume.

In this pre-seminar I'll unravel the engine which drives the existence of this complex structure, with one of the models for dusty plasma simulations, developed in the Computational Plasma Physics group and I will try to show what is the kettle, and what is the stove.