Complex plasma experiments with grid electrodes

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Complex plasmas consist of charged, micron-sized particles immersed in a low-temperature plasma. The particles can be observed directly by optical cameras, allowing the study of fundamental properties of the particle dynamics on the kinetic level. The particles acquire a high charge in the plasma due to the streams of electrons and ions onto their surface. While in a low-temperature rf-plasma, the ion temperature T_i is typically close to room temperature, the electron temperature T_e can reach several eV due to ohmic and stochastic heating processes, thus dominating the charging process.

If the region of plasma production is separated by a conductive grid from the rest of the plasma chamber, the grid will function as a barrier for slow electrons if it is grounded or negatively biased. Only electrons with energies sufficient to overcome the potential barrier of the grid can pass it, and then produce, by ionisation, a secondary plasma on the other side. There, due to the absence of heating mechanisms, T_e is low, and its quantity can be controlled by e.g. varying the dc bias of the grid [1].

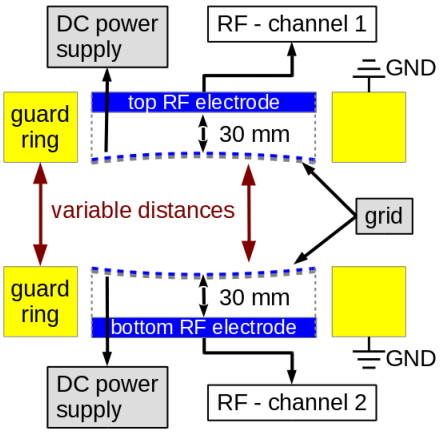

Figure 1: *Sketch of a cross-section of the Zyflex plasma chamber with two grid electrodes.*

To utilise controlling T_e as a way to control micro-particle charge and interaction in a complex plasma, an experimental setup has been designed in the scope of the PlasmaLab project: Two parallel grid electrodes (see Fig. 1) are mounted in a cylindrical plasma chamber. Plasma production regions are located between the grids and the respective rf-electrodes. Micro-particles are injected into the region between the two grids, and their behaviour is studied in dependence of grid voltage. Since no, or only very weak, electric fields are present to levitate particles against gravity, most experiments were performed in micro-gravity conditions during a parabolic flight campaign in 2015. First results of these experiments are presented alongside with results of plasma diagnostics of the secondary plasma and additional experiments performed in the laboratory.

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References

[1] K. Kato, S. Iizuka and N. Sato, Appl. Phys. Lett. **65 (7)**, 816 (1994)