

'Void, or no void', that's the question

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During the last four years, I have been working towards my Ph.D. degree at this institute, using several numerical techniques, together with the old 'pen-and-paper routine', to obtain a better understanding of the physics of dusty plasma. Of course, covering 4 years of research in just 45 minutes is impossible. Therefore, I will focus my attention on a central object (even in a literal sense) of my research, called 'void'.

As an introduction, I will show where and how dusty plasma -plasma containing small solid particles- is important. Examples of dusty plasma are found in space, in the atmosphere of the Earth, in fusion devices, but also in several industries, which deliver many everyday appliances, such as solar cells, computer chips, and even coatings on medical implants. A more fundamental aspect of dusty plasma is that it provides unique systems to study a multitude of phenomena from different fields of physics, such as solid state physics and fluid physics, on a scale visible to the naked eye.

This recent realisation has led to a demand for large, isotropic, three-dimensional dust crystals. On Earth, these are hard to find, since gravity typically dominates, and dust crystals in dusty plasma are reduced to two-dimensional slabs. Using thermophoresis to lift particles against gravity is possible, but is practical only for dusty plasma containing a small number of dust particles, typically a few hundred. Experiments under micro-gravity, on sounding rockets, during parabolic flights, or even on board of the International Space Station, do produce three-dimensional dust structures, containing hundreds of thousands, or even millions of dust particles. However, due to some process, a dust-free region in the centre of the discharge forms, called the void. This void really breaks the isotropy of the crystal, which is unwanted for studying, for instance, phonons in solid state physics, by using dust crystals as model-systems.

During this talk, I will discuss the formation of the void, from the point of view of the forces acting on the dust particles, but also with the aspect of *self-organization* in dusty plasma in mind, which plays an important role in void-formation. Finally, I will discuss ways in which we can close the void. Again, the role of self-organization in dusty plasma is essential.

In the end, I hope you will have a better idea of what dusty plasma is, why it is interesting to study dusty plasma, and how we have performed our studies. I will also suggest routes for the continuation of the study of dusty plasma at this institute.