Magnetized dusty plasma: Challenges and Solutions

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The magnetization of a plasma leads to numerous new effects and instabilities. This is particularly true for plasmas containing micrometer or nanometer sized particles. The magnetization of particles requires low pressure and high magnetic fields, both having strong influence on plasma production and plasma stability. Since available super-conducting magnets can only provide magnetic inductions up to 4-5 Tesla, nano particles are the only option to create magnetized dust. Current investigation of particles in magnetized plasmas follows two branches: (i) 2D systems with particle numbers between two and some hundred (dust in plasma) and (ii) 3D clouds of nano particles with up to billions of particles (dusty plasma). Whereas the 2D systems are excellent playgrounds to study charging and coupling under strong correlation, the 3D clouds can be used to study the influence of the dust on the plasma environment and the dynamics of a fluid-like many particle system. From the diagnostic point of view both situations are challenging. While the recently developed high precision diagnostic of single particles is adapted to the specific demands of a magnetized plasma environment and provides interesting insight into the charging of particles, the nanodust clouds demand for a completely different diagnostic approach. We have shown that the dynamics of the whole dust cloud, e.g. dust density waves, can be utilized to determine important parameters like particle charge, plasma densities, and Havnes parameter. By changing the plasma source configuration new dynamical phenomena, like radial dust ejections can be observed. In-situ diagnostics like Imaging Mie Ellipsometry are necessary to characterize the nano particles and to clarify about the effects of particle size separation and particle size distribution.

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