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Effective magnetization of the dust particles in a complex plasma[1]

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The large mass and size of the dust particles in a complex plasma has several advantages, including low characteristic frequencies on the order of a few Hz and the ability to record their motion with video cameras. However, these properties pose major difficulties for achieving strong magnetization. While the light electrons and ions can be magnetized by (superconducting) magnets, magnetizing the heavy dust component is extremely challenging. Instead of further increasing the magnetic field strengths or decreasing the particle size, we use the analogy between the Lorentz force and the Coriolis force experienced by particles in a rotating reference frame to create "effective magnetic fields" which is a well-established technique in the field of trapped quantum gases [1]. To induce rotation in a complex plasma, we take advantage of the neutral drag force, which allows to transmit the motion of a rotating neutral gas to the dust particles [2]. The equations of motion in the rotating frame agree with those in a stationary gas except for the additional centrifugal and Coriolis forces [3]. Due to the slow rotation frequencies ($\sim$ Hz) and contrary to the situation in a strong magnetic field, only the properties of the heavy dust particles are notably affected. Experiments with a rotating electrode realize the desired velocity profile for the neutral gas and allow us to verify the efficiency of the concept [3].

This work was performed in collaboration with J. Carstensen, M. Bonitz, H. Löwen, F. Greiner, and A. Piel.

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