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Dusty Plasmas - Kinetic Studies of Strong Coupling Phenomena

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“Dusty plasmas” can be found almost everywhere - in the interstellar medium, in star and planet formation, in the solar system in the Earth’s atmosphere and in the laboratory. In astrophysical plasmas the dust component accounts for only about 1% of the mass, nevertheless this component has a profound influence on the thermodynamics, the chemistry and the dynamics. Important physical processes are charging, sputtering, cooling, light absorption and radiation pressure, connecting electromagnetic forces to gravity. Surface chemistry is another important aspect. In the laboratory there is great interest in industrial processes (e.g. etching, vapor deposition) and at the fundamental physics level - the main topic here - the study of strong coupling phenomena. Here the dust (or microparticles) are the dominant component of the multi-species plasma. The particles can be observed in real time and pace, individually resolved at all relevant length and time scales. This provides an unprecedented means for studying self-organisation processes in many particle systems including the onset of cooperative phenomena. Due to the comparatively large mass of the microparticles (10⁻¹² to 10⁻⁹ g) precision experiments are performed on the ISS. The following topics will be discussed: Phase transitions, phase separation, electrorheology, flow phenomena including the onset of turbulence at the kinetic level.