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Microgravity Sciences Onboard the International Space Station and Beyond - Part 1 (6)

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COMPLEX(DUSTY)PLASMAS RESEARCH ONBOARD THE INTERNATIONAL SPACE STATION

Abstract

The review of results for investigating the dusty plasma physics under microgravity conditions with the help of the unique experimental facilities "Plasma Crystal-3" and "Plasma Crystal-3Plus" is presented. The possibility to study phenomena in strongly-coupled three-dimensional dusty-plasma system at the kinetic level has been demonstrated. In the case of an action of an external low frequency electric field in the dusty plasma the structural phase transition from an isotropic system to electrorheological plasma that is identical to electrorheological liquid has been observed. The data on the liquid-crystal transition in the large, three-dimensional dusty-plasma system, consisting of more than a million highly charged dust particles are presented. Important differences between the melting process of 3D complex plasmas under microgravity conditions and that of flat 2D complex plasma crystals in ground based experiments are discussed. The dynamical onset of lane formation is studied in experiments with binary complex plasmas. Small microparticles are driven and penetrate into a cloud of big particles, revealing a strong tendency towards lane formation. Subsonic motion of a large particle moving through the bulk of a dust crystal formed by negatively charged small particles is investigated. In the hydrodynamic approximation, we develop a theory of nonviscous dust particle motion about a large particle and calculate particle trajectories.