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IDEAL STATES OF GRANULAR MATTER IN MICROGRAVITY

Abstract

Granular matter at various densities is susceptible to the influence of gravity and hence benefits from microgravity experiments: On ground, granular gases sediment quickly, agitated granular fluids are strongly anisotropic, and granular solids exhibit large pressure gradients. For all three of those states, experiments on several platforms such as parabolic flight, drop tower, sounding rocket and ISS demonstrate access to unique and ideal ensembles under microgravity. Granular gases can be agitated homogeneously, granular fluids observed under isotropic conditions, and granular solids monitored free of gradients. Diagnostics applied to those ideal states comprises video imaging, light-scattering, X-ray radiography, stress-birefringence, and sound transmission. A synopsis shall be given how the results from these experiments provides valuable insight into the behavior of granular matter and provides invaluable contributions and tests regarding its modeling that is not available through ground experiments or numerical simulation. Special emphasis will be put on the new ISS instrument Soft-Matter Dynamics that shall be deployed on board the ISS in mid 2018 during the Horizons mission. The goal of the granular matter experiments inside this instrument is both the fundamental understanding of light scattering from an assembly of particles without permanent contacts as well as the inference of the dynamics of granular media through the light-scattering signal. Results from the experiment shall provide important calibration for the utilized methods for applications both on ground and for use in space. As a perspective for the future it shall be outlined how the understanding of the granular dynamics shall stimulate the development and test of a first-principles granular rheology which can be put to test in microgravity and utilized on ground as well as for granular process engineering in space in such important applications as additive layer manufacturing and in-situ-ressource utilisation.