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Cooling of 3D Granular Gases: Experiments in Microgravity[1]

KIRSTEN HARTH, SANDRA WEGNER, TORSTEN TRITTEL, RALF STANNARIUS, Institute of Experimental Physics and MARS, Otto von Guericke University Magdeburg — Granular gases are ensembles of macroscopic grains, which move randomly and interact through inelastic collisions. This non-equilibrium statistical system is easy to picture, but still insufficiently understood. Numerous theoretical treatments have been performed, favorably with spherical grains and periodic boundaries, starting from a homogeneous state. Experimentally, such a gas in 3D can only be realized with strong external forcing or in microgravity. We have recently demonstrated that the use of elongated grains facilitates the realization of 3D experiments beyond the Knudsen regime (1). Main findings in a sounding rocket experiment were non-Gaussian velocity distributions and a violation of the equipartition of kinetic energy in the steady state. Rotational degrees of freedom are under-excited. When the excitation is stopped, energy is dissipated, the granular gas is "cooling". We present the first quantitative study of the cooling of a granular gas, based on a 3D data evaluation, from drop tower experiments. The evolution of the kinetic energy in translational and rotational degrees of freedom is compared to Haff's law and recent numerical studies. Additionally, we analyze velocity and density distributions.
(1) K. Harth et al., Phys. Rev. Lett. 110 144102 (2013)

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