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Breakage of the energy equipartition and aggregate formation in sheared system

Y. Baibolatov and F. Spahn
University of Potsdam, Germany (14476 Potsdam, Germany, Karl-Liebknecht Str 24-25)

Abstract

In classical thermodynamics any mixture of gases with different masses with any sort of initial temperature differences tend to relax into a stationary state with a unique temperature along the whole system. But this is not true in case of granular mixtures, where energy is dissipated during each collision between particles. As a result, in a granular mixture of species with different masses, the system does not have a unique thermodynamic temperature but each species has its own temperature. This effect has been paid much attention recently [1, 2, 3]. Apart from the dissipative particle interaction, the main reason for this behaviour is due to the mass difference of the colliding particles, causing an asymmetric energy loss of particles. The loss of energy can be compensated by external heating of the system. In the case of planetary rings system, the role of heating is played by gravitational shear caused by the planet.

In this work we consider the model consisting of identical spherical and adhesive particles. Although the constituents are identical, they can form aggregates and effectively create particles with larger masses. The differences in masses lead to different velocity dispersions (granular temperatures) of the aggregates. This interplay between heat transfer among aggregates and the distribution of the aggregate sizes under the gravitational shear is of crucial importance for the formulation of mean-field balance equations for the ring particle ensembles.

References

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