Dynamics of a confined and ultraconfined vibrated granular system

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A granular system is an ensemble of macroscopic particles, characterised by dissipative interactions. This means that, when two particles interact, part of the kinetic energy of the center of mass of the two particles is transferred to another internal degree of free- dom. Many elements of nature can be identified with granular matter: from dessert to interstellar dust or planetary rings, and they are also relevant because of its technological applications [1]. From a theoretical point of view, granular systems are especially interesting because, due to its dissipative character, they are intrinsically out of equilibrium. Although, Stationary states of a granular medium can be reached experimentally in a simple way in order to compare theoretical predictions with experimental results. This is achieved, for example, by vibrating the walls that contains the system. In stationary states, the energy that is injected compensates for the energy dissipated in the collisions. The price to pay is that the stationary state becomes highly inhomogeneous [2, 3]. However, there exist a granular systems that allows to simplify the analitical study. This is a dilute granular gas confined into vibrating box.

This work will be focused on studying one of the main outcomes derived in the context of the kinetic theory of gases, the Boltzmann equation, which will be adapted in order to describe granular systems. Complementary, a dynamic equation for confined systems will be derived by using a simplified model consisting of a gas of inelastic hard spheres confined between two plane-parallel plates. These plates are spaced a distance H. Both plates vibrates in a manner that injects kinetic energy into the system in the normal direction allowing to reach a non-trivial stationary state. From the proposed kinetic equation, closed evolution equations for the horizontal and vertical temperatures are derived, assuming spatial homogeneity. An acceptable agreement between the theoretical predictions and Molecular Dynamics simulation results is obtained.

[1] Campbell, C S, *Rapid Granular Flows*, Annual Review of Fluid Mechanics, **22**,1,(1990).

[2] J. J. Brey y D. Cubero, *Hydrodynamic transport coefficients of granular gases*, Granular Gases (Springer, 2001), pgs. 59-78.

[3] Brey, J. Javier and Dufty, James W. and Kim, Chang Sub and Santos, Andrés, *Hydrodynamics for granular flow at low density*, Phys. Rev. E **58**,4638 (1998).