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3D SIMULATIONS OF GRANULAR GAS IN A VIBRATING BOX: DEMONSTRATION OF A LARGE BOUNDARY EFFECT DUE TO DISSIPATION BY COLLISIONS WHICH IS NOT PROBAGATING SHOCK WAVE

Abstract

The paper concern the dynamics of N equal size spheres in a 3d rectangular cell excited along Oz in 0g gravity.(N=100, 500, 1000, 1200, 2000, 3000, 4000, 4500). Due to collision the system of N balls is dissipative, and the problem is to understand the statistical mechanics of such a system, whatever the excitation. Here we will consider vibrating wall, in the z direction. Due to the absence of gravity, cells are more dense in the center as soon as the particle number is such that dissipation becomes important. This occurs in normal condition of excitation as soon as the mean free path is smaller than the cell length.

The main topic of this paper (part 4) is the interpretation of data obtained from these simulations. Different kinds of excitation have been used (symmetric and non symmetric biparabolic, symmetric and non symmetric saw teeth, thermal wall). No rotation is included, dissipation is introduced via a restitution coefficient e= V'n/Vn , where V'n and Vn are the relative ball speed along normal to ball centres after and before collision. It is proved that the local speed distribution along z is fundamentally dissymmetric in most part of the cell while the mean local speed is 0. This demonstrates the inability of a model based on a thermal bath (with a single local temperature) to describe this dissipative granular gas system, even when assuming that this temperature varies in space. The results are coherent with simple mechanics principle; there were not really well described and discussed.

We demonstrate these points using different local variations of distribution, such as the distribution of local speed Vz according to the position z in the cell for (a) a biparabolic excitation (sine) and (b) thermal excitation: near edges (z=0, z=L) the distributions are not symmetric. The asymmetry is however weaker in sine than in sawteeth excitation. Also, the temperature for paticles in +z direction is different from those ones going in -z direction, what gives the asymmetry; and this asymetry varies with z.

Besides we demonstrate the absence of propagating sdhock waves in such dense system with continuous excitation.