Anomalous self-diffusion in a granular gas near the shearing instability

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ABSTRACT

The self-diffusion coefficient of a granular gas in the homogeneous cooling state (HCS) is analyzed near the shearing instability. Self-diffusion is the prototype transport process, and the diffusion equation the prototype hydrodynamic equation for macroscopic transport. Both have been investigated for granular fluids in the HCS. Here, we will use mode-coupling theory to show that this coefficient diverges logarithmically as the shearing instability is approached, due to the coupling of the diffusion process with the shear modes. It is shown that the divergence is not dominated by the mode with the shortest wave-vector, but by a combination of modes in the hydrodynamic region. This divergent behaviour disappears in the elastic limit. The theoretical predictions are compared with Molecular Dynamics simulation results of a system of inelastic hard disks, and a good agreement is found.

REFERENCES