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Energy decay of freely cooling granular gases in three dimensions ZAHERA JABEEN, Department of Physics, University of Michigan, Ann Arbor, MI 48109-1040, SUDHIR N. PATHAK, RAJESH R., Institute of Mathematical Sciences, CIT Campus, Taramani Chennai-600 113, India — Freely cooling granular gases, wherein a dilute system of macroscopic particles with uncorrelated initial velocities lose energy through inelastic collisions, have been extensively studied both as a simple model for granular systems as well as a nonequilibrium system showing nontrivial coarsening at late times. As the system cools, inelasticity induces clustering, making the system inhomogeneous. While the form of energy decay ($E(t) \sim t^{-\theta}$) in the initial homogeneous regime is well established by Haff's law ($\theta = 2$), the energy decay in the clustered regime is still unresolved in higher dimensions. Within mean field theory, $\theta = 2d/(d+2)$ (where d is the spatial dimension), while a correspondence to Burgers equation implies an exponent $\theta = 2/3(d = 1), d/2(d > 1)$. In one and two dimensions, the two formulae predict the same exponents. By performing extensive event driven molecular dynamics simulations, we show that in three dimensions, the energy decays asymptotically with a power ≈ 1.2, for all coefficients of restitution $r < 1$, consistent with the mean field exponent. However, we argue that the mean field arguments fail due to non local interactions between mass clusters.

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