Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

A universal scaling law for the evolution of granular gases MATHIAS HUMMEL, JAMES CLEWETT, MARCO G. MAZZA, Max Planck Institute for Dynamics and Self-Organization — Dry, freely evolving granular materials in a dilute gaseous state coalesce into dense clusters only due to dissipative interactions. This clustering transition is important for a number of problems ranging from geophysics to cosmology. Here we show that the evolution of a dilute, freely cooling granular gas is determined in a universal way by the ratio of inertial flow and thermal velocities, that is, the Mach number. Theoretical calculations and direct numerical simulations of the granular Navier–Stokes equations show that irrespective of the coefficient of restitution, density or initial velocity distribution, the density fluctuations follow a universal quadratic dependence on the system's Mach number. We find that the clustering exhibits a scale-free dynamics but the clustered state becomes observable when the Mach number is approximately of O(1). Our results provide a method to determine the age of a granular gas and predict the macroscopic appearance of clusters.

Marco G. Mazza
Max Planck Institute for Dynamics and Self-Organization

Date submitted: 06 Nov 2015 Electronic form version 1.4