[Talk 20] Scaling concepts for dense granular flows

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Concept of scaling has been successfully applied to many systems undergoing a second-order phase transition. Examples include Ising model and percolation. Recently this concept has found applications in systems that are considered as unorthodox topics for standard critical phenomena. As an example, granular materials, such as ping-pong balls and marbles, undergo a second-order like phase transition near their maximal packing point called the random-close packing (RCP). In such systems, shear rate and packing fraction are control parameters and shear stress, pressure, and granular temperature are observable quantities. In a large amount of literature, the latter quantities are collapsed mostly based on their distance from RCP. However, different groups reported different critical points and critical exponents. We perform a careful analysis to pin down the origin of this diversity. We show that there is a large range of different critical points and exponents which give rise to similar data collapses. Moreover, all these data collapses look very pleasant for the naked eye. We establish a robust method to calculate the transition point and derive the critical exponents for sheared dense granular flows. We argue that this method can be applied to any type of phase transition.

† J. Vollmer, A. A. Saberi, H. Park, and S. H. Ebrahimnazhad Rahbari, In preparation (2016).