MAR09-2008-001379

Abstract for an Invited Paper
for the MAR09 Meeting of
the American Physical Society

Measurement of growing dynamical length scale on approach to jamming in granular systems

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The flow of granular materials is of widespread practical and fundamental interest. One challenge to understanding and controlling behavior is that the response is nonlinear, with a forcing threshold below which the medium is static. Furthermore, just above threshold the response may be intermittent even though the forcing is steady. Two familiar examples are avalanches on a heap and clogging in a silo. Another example is dynamical heterogeneities for systems brought close to jamming, where intermediate-time motion is correlated in the form of intermitted string-like swirls. Here this will be illustrated with experiments on air-driven beads, where jamming is approached by lowering the effective temperature, as well as by experiments on rapid heap flow, where jamming is approached as a function of depth from the free surface. Use of novel statistical quantities and optical spectroscopies reveal a growing dynamical length scale on approach to jamming. Collaborators: Adam Abate, Hiroaki Katsuragi, Aaron Keys, Sharon Glotzer.