MAR06-2005-005148

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Experimental studies of jamming in colloids, grains and emulsions

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We review experimental progress towards the development of a statistical mechanics description of jamming in colloids, granular matter and emulsions. The approach is to consider the application of equilibrium concepts such as temperature, entropy and thermalization to this variety of jammed systems. We first present a study of the correlation and response functions to external fields in an aging colloidal glass. Our analysis reveals that even though the system is aging far from equilibrium, it behaves as if it were equilibrated at a constant temperature, independent of its age. This temperature is larger than the bath, and can be rationalized by the cage dynamics of the system and also in terms of theoretical descriptions of mean field models of spin-glasses. A scaling theory is shown to describe the global and local fluctuations of the observables. We then investigate the effective temperature of jammed granular matter. The measurement of the effective temperature is realized in the laboratory by slowly shearing a closely-packed ensemble of spherical beads confined by an external pressure in a Couette geometry. All the probe particles, independent of their characteristic features and the shear rate, equilibrate at the same temperature, given by the packing density of the system. This suggests that the temperature reveals the "thermalization" of the jammed system. Finally, jammed emulsions are investigated under the confocal microscope. Owing to a new technique to identify the contact network in a 3D assembly of droplets, we reveal new signatures of jamming from micromechanics to statistical mechanics.