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Rigidity vs. Glass transition of a granular system close to Jamming

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"Jamming" is associated with two rather different notions, not always well distinguished in the literature. One, the glass transition, is that of dynamical arrest and the divergence of the structural relaxation time, the second, the proper jamming transition, is the appearance of mechanical rigidity. Both may in principle be different. In the past few years we have investigated the dynamics of a bi-disperse monolayer of disks under two different mechanical forcing i.e. cyclic shear and horizontal vibrations. (i) In the first case, one observes the so-called cage effect: at short times, any given particle is trapped in a confined area by its neighbors until the particle has managed to leave its cage and is able to diffuse through the sample by successive cage jumps [1]. Such features are reminiscent of what is observed in colloidal suspension, super-cooled liquids or other glass formers, close to the glass transition. In the present case, we have shown that cage jumps organize in clusters which avalanche in a facilitation like process to build up long term dynamical heterogeneities [2,3]. (ii) In the second case, the quench protocol produces very dense configurations with structural relaxation time much larger than the experimental time scales. One observes that long-time correlations, accompanied by the growth of spatial correlations are maximal at a volume fraction , where a snapshot of the displacement field reveals the existence of a super-diffusive motion organized in channel currents meandering between blobs of blocked particles [4,5]. We will discuss these results focusing on the distinction between the glass and jamming transitions also underlying the key role of friction in granular media as opposed to other glass formers.

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