CEA / Saclay – 91191 Gif-sur-Yvette Cedex
Service de Physique de l'Etat Condensé

SEMINAIRE

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Lundi 6 décembre 2010 – 15h45

Orme des Merisiers SPEC – Salle Itzykson, Bât. 774

Statistics, Jamming and Shear for Granular Materials

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Granular materials exhibit a range of striking behavior, with some of the most fascinating phenomena occurring for dense states--dense granular solids and fluids. This talk will present some of the interesting open questions for granular materials, and then explore these questions through a series of experiments. In a number of these experiments, we use special particles made of a photoelastic material. This allows us to experimentally determine all relevant particle-scale properties, including contact forces, stresses, particle displacements and rotations. A question of great recent interest is how systems of particles jam, i.e. become mechanically rigid as some relevant variable changes. Most often, jamming refers to the onset of mechanical stability as the density increases above a critical value. We find that real granular systems, i.e. collections of frictional particles, subject to isotropic compression, jam in ways that are very similar to what is found in simulations of frictionless particles. For such systems, we also show that granular materials jam under shear at densities well below isotropic jamming. These novel jammed states are highly anisotropic and fragile, in the sense of Bouchaud et al.
That is, under shear strain reversal, the fabric, or equivalently, the contact network rearranges, with a concomitant reversal of the stress anisotropy. By imlication, friction is important for the formation of these shear-jammed states, which appear to be generic for a range of densities below jamming. Experiments suggest that the fabric and shear stress play roles that are rougly similar to the magnetization and field for a magnetic system, where the terminus of the ordered states is the isotropic jamming point, point-J. As time permits, I will also explore experiments that consider diffusion, non-affine motion, stick-slip and rate-dependence in granular shear flows.

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