TIFR Centre for Interdisciplinary Sciences
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Seminar

Origin of Rigidity in Dry Granular Solids

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Solids are distinguished from fluids by their ability to resist shear: a non-vanishing zero-frequency shear modulus. In traditional solids, the resistance to shear is associated with the emergence of broken translational symmetry as exhibited by a non-uniform density pattern. In this work, we focus on the emergence of shear-rigidity in a special class of solids: dry (non-cohesive) granular materials which have no energetically or entropically preferred density modulations. We show that, in contrast to traditional solids, the emergence of mechanical rigidity in these granular solids is a collective process, which is controlled solely by boundary forces, the constraints of force and torque balance, and the positivity of the contact forces. We develop a theoretical framework based on these constraints, and show that these solids are characterized by broken translational symmetry in the space of forces, and not positions of grains. We apply our theory to experimentally generated shear-jammed (SJ) states and show that these states are indeed characterized by a persistent, non-uniform density modulation in force space, which emerges at the shear-jamming transition.

Wednesday, Jun 3rd 2015

4:00 PM (Tea/Coffee at 3:45 PM)

Seminar Hall, TCIS