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Shear-induced rigidity in athermal materials BULBUL CHAKRABORTY, SUMANTRA SARKAR, Martin Fisher School of Physics, Brandeis University — In this talk, we present a minimal model of rigidity and plastic failure in solids whose rigidity emerges directly as a result of applied stresses. Examples include shear-jamming (SJ) in dry grains and discontinuous shear thickening (DST) of dense non-Brownian suspensions. Both SJ and DST states are examples of non-equilibrium, self-assembled structures that have evolved to support the load that created them. These are strongly-interacting systems where the interactions arise primarily from the strict constraints of force and torque balance at the local and global scales. Our model is based on a reciprocal-space picture that strictly enforces the local and global constraints, and is, therefore, best suited to capturing the strong correlations in these non-equilibrium systems. The reciprocal space is a tiling whose edges represent contact forces, and whose faces represent grains. A separation of scale between force fluctuations and displacements of grains[1] is used to represent the positional disorder as quenched randomness on variables in the reciprocal space. Comparing theoretical results to experiments, we will argue that the packing fraction controls the strength of the quenched disorder.

[1]Sumantra Sarkar et al, Phys. Rev. Lett. 111, 068301 (2013)

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