MATERIALS SCIENCE COLLOQUIUM

SPEAKER: Thomas Witten
University of Chicago

TITLE: Solidity Without Elasticity: Anomalous Forces and Vibrations in a Granular Solid

DATE: Thursday, July 19, 2007

TIME: 11:00 a.m.

PLACE: Building 212, A-157

HOST: Igor Beloborodov

Refreshments will be available at 10:45 a.m.

Abstract:

The arrangement of grains in a static sandpile is dictated by kinetics. The particles are mutually trapped in the first stable configuration they encounter. Glassy materials share this quenched or jammed character. Both systems share another property: a great excess of slow vibrational modes. The slowly vibrating modes are qualitatively more numerous than in an ordinary elastic solid. Thus granular packs seem to have solidity without elasticity. This talk reviews several aspects of this anomalous soft solidity. We show with a simple example that stress propagates qualitatively differently in a granular pack than in an elastic solid. We exhibit the anomalous vibrations seen in the recent simulation of marginal jamming by the Nagel group. We describe a theory of these anomalous modes by Matthieu Wyart, Sidney Nagel and T. Witten. The theory shows how to build the anomalous modes from the unconstrained "floppy" modes known to exist for a marginally unjammed assembly. The theory allows us to understand how the marginally jammed solid becomes an ordinary elastic solid as it is progressively compressed.