The Statistical Mechanics of Athermal Materials

Overview

The physics of materials is founded upon the principles of Statistical Mechanics and Thermodynamics. This well established framework, however, cannot be applied to understand the properties of a large class of materials such as sand, cement, grains of rice, pharmaceutical tablets, and even asteroids in the asteroid belt. The constituents of these athermal materials range in size from millimeters to meters and, therefore, thermal fluctuations are irrelevant. In addition, the interactions between these constituents, which lead to the collective behavior, are dissipative and frictional. These athermal materials are abundant in nature and are crucial industrial elements. Our inability to predict their behavior leads to catastrophic events such as earthquakes and avalanches, and industrial uses of these materials are costly and inefficient

The primary objectives of this course are (a) introduce students to phenomena that are peculiar to athermal materials, (b) discuss the fundamental postulates of statistical mechanics and why they fail in the case of athermal materials, (c) lay down the foundations of a generalized statistical mechanical theory that can be applied to athermal materials, and (d) provide students with the technical tools needed to calculate properties of athermal materials. The course is organized into four modules as shown below. The course will be taught adopting a "flipped classroom" model in which students will participate actively in the learning process through TQs (Thoughts or Questions) on assigned reading that will guide the lectures, and interactive tutorials based on current research topics.

Modules	**1&2: Introduction to Athermal Materials: August 8 - 12** **3 &4: Statistical Mechanics and Phase transitions in Athermal Materials: August 16-19** **Number of participants for the course will be limited to fifty.**
You Should Attend If…	▪ you are a physicist or materials scientist interested in the physics of granular materials and dense suspensions. ▪ you are geologist or geophysicist interested in understanding earthquakes and avalanches. ▪ you are a student or faculty from an academic institution interested in recent developments in the statistical mechanics of disordered systems, especially the jamming transition.
Fees	The participation fees for taking the course is as follows: **Students from Academic Institutions: Rs. 1000** **Faculty from Academic Institutions: Rs. 2500** **Scientists from Government Research Laboratories: Rs. 2500** **Participants from Industry: Rs. 5000** **Participants from abroad : US $100** The above fee include charges for all instructional materials, tutorials and assignments, internet facility during class hours. The participants will be provided with accommodation, depending on the availability, on payment basis.

The Faculty

Prof. Bulbul Chakraborty is the Enid and Nate Ancell Professor of Physics at Brandeis University. She is a fellow of the American Physical Society (APS). She has been a pioneer in extending the equilibrium statistical mechanics framework to systems that are non-ergodic, and whose properties are shaped by external driving.

Dr. Kabir Ramola is a postdoctoral associate at Brandeis University. Kabir received his PhD from TIFR, Mumbai. His expertise is in the area of nonequilibrium statistical mechanics.

Prof. Debashish Chowdhury is the "Prof. S. Sampath Chair" Professor and Head of the Department of Physics at IIT Kanpur. He is a J. C. Bose National Fellow and a leading expert on applications of non-equilibrium statistical mechanics.

Course Co-ordinator

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