The duality between floppy and rigid modes in the jamming/unjamming transitions.

Gustavo Düring

Instituto de Física, Universidad Católica de Chile

A fundamental and elusive question that lies in the interface of statistical physics and materials science is: how do athermal amorphous materials transition continuously between fluid and solid states of matter. This phenomenon, coined as jamming or unjamming depending on whether the fluid $\rightarrow$ solid, or solid $\rightarrow$ fluid transition is considered, displays critical behavior with diverging length scales and power law behavior of macroscopic material-properties. The Jamming point has been shown to be controlled by geometric constraints imposed by the microscopic structure of the material. Such constraint are know to determine the nature of low-energy excitations in amorphous materials, and therefore control their mechanical and thermodynamic properties. In this talk I will particularly discuss the spectral properties of disordered networks of Hookean springs, and how this simple model helps us understand the mechanical responses of a variety of systems: from the elastic properties of glasses and polymer networks, to the rheology of suspension flows. I will show that the spectra of simple elastic networks can be understood in terms of two classes of geometric objects: floppy modes, which are displacements that preserve the distance between nodes, and rigid modes, which are sets of pairwise forces that balance the net force over the nodes.