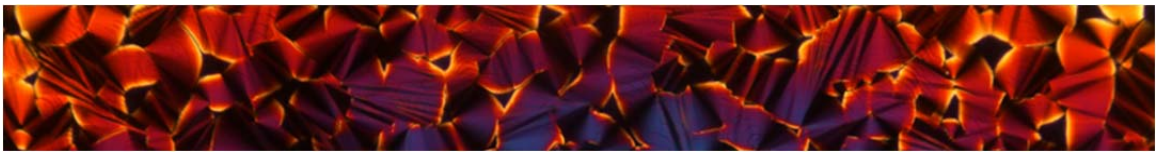

SOFT MATERIALS RESEARCH CENTER

SPECIAL SEMINAR SERIES

Mechanics of Dynamic Networks: From Individual to Collective Behavior

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Dynamic networks are found in a majority of natural materials, but also in engineered materials, such as entangled polymers and physically cross-linked gels. Owing to their transient bond dynamics, these networks display a rich class of behaviors, from elasticity, rheology, self-healing or growth. Although classical theories in rheology and mechanics have enabled us to characterize these materials, there is still a gap in our understanding on how individuals (i.e., the mechanics of each building block and its connection with others) affect the emerging response of the network.

In this presentation, I will discuss an alternative way to think about these networks from a statistical point of view. More specifically, a network will be seen as a collection of individual building blocks connected by elastic chains that can associate and dissociate over time. From the knowledge of these individual chains (elasticity, transient attachment, and detachment events), we will construct a statistical description of the population and derive an evolution equation of their distribution based on applied deformation and their local interactions. Upon appropriate averaging operations, I will then show that these distributions can be used to determine important macroscopic measures such as stress, energy storage and dissipation in the network.

Based on this approach, I will then illustrate how different behaviors at the scale of individual chains lead to well-known macroscopic response such as Newtonian and non-Newtonian behaviors, shear thinning, shear thickening, and viscoelasticity. The case of active networks in fire ant aggregation will also be discussed.

Wednesday, November 29th at 1:30 p.m. in Duane Physics G126

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