Chez Pierre

Presents ...

Friday, February 13, 2015
10:00am
MIT Room 4-331

Special Biophysics Chez Pierre Seminar

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"Design principles for heterogeneous materials synthesis : Lessons from biology"

In contrast to traditionally studied systems, biological materials are often highly heterogeneous — the number of kinds of degrees of freedom (e.g, number of particle species) is large and comparable to the system size. Examples include self-assembled macromolecular complexes and structures formed by the folding of polymers like RNA, proteins and membranes programmed with locally varying properties. By unraveling the principles behind such heterogeneous systems, we can not only improve existing synthetic methods of materials science but also discover completely new kinds of materials.

In this talk, I will first show that even basic questions about the assembly of heterogeneous structures, such as the optimal concentrations of different species in the structure, have counter-intuitive answers from the homogeneous perspective. Second, I will examine an assumption underlying current bottom-up approaches - namely, that only one target structure or behavior can be programmed into the properties of building blocks. In contrast, I will show, using ideas from theoretical neuroscience and spin glasses, that we can ``store'' and ``retrieve'' multiple desired structures in the frustrated interactions of a highly heterogeneous system. My framework has implications both for the evolution of biological assemblies as well as for synthetic materials ranging from DNA brick assemblies to novel mechanical meta-materials.