CCT Colloquium Series

Geometry and Optimization in Disordered Materials

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Abstract:
A number of disordered materials have extremely slow dynamics, due to competing interactions that create large barriers to thermal relaxation. Even given faster, numerous CPUs, it can be difficult to study the long time behavior of the system using direct simulation techniques. I will give an overview of such problems and describe the optimization techniques adapted from computer science to study both the equilibrium behavior in models of disordered materials and extensions to dynamical modeling. The goal is to test models for the complex, apparently hiercarchical, dynamics of glassy materials such as spin glasses and random magnets.

Speaker's Bio:
Alan Middleton does theoretical research in the areas of condensed matter and statistical physics. Topics which he has published work on include: the dynamics of magnetic flux lines in superconductors; the current-voltage characteristics in arrays of "quantum dots" (lithographically created electronic devices); materials with sliding charge-density waves. These physical systems are related in that they are examples of dynamical systems with many degrees of freedom; such systems can exhibit complex behavior and novel phase transitions. A major focus of Middleton's work is the use of computers to understand these complicated systems. In particular, he has worked on developing algorithms and computational approaches which obtain the answers for large systems quickly. He therefore works with computer scientists on some of these problems and applies techniques developed in computer science. Professor Middleton is principal investigator of the theoretical condensed matter physics grant "Phases and Dynamics of Disordered Condensed Matter Systems" from the National Science Foundation and a co-principal investigator on a National Science Foundation Information and Technology Research grant "Statistical Physics and Computational Complexity".

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