Modern Mathematics Workshop 2018

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SPEAKER TITLES/ABSTRACTS

MINI-COURSE 2:

Katie Newhall
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Bio:

Dr. Katherine Newhall is an assistant professor of mathematics at the University of North Carolina at Chapel Hill working on a diverse set of interdisciplinary applied math problems ranging from magnetic systems to granular media and active matter. She is tackling difficult problems in the field of stochastic dynamics to understand the large-scale and long-time behavior of physical and biological systems described by high-dimensional equations that evolve randomly in time. The mathematical problems she works on also help to explain experimentally observable phenomena, exposing the underlying mechanisms to intuitively explain the system's behavior.

Abstract:

"Stochastic Dynamics on Energy Landscapes"

Many intriguing dynamical properties of complex systems, such as metastability or resistance to applied forces, emerge from the underlying energy landscape. This course will address some of the fundamental connections between energy and dynamics while also touching on interesting research questions. We will derive energy conserving Hamiltonian systems as well as damped dynamics and investigate bifurcations in the energy function with applications in ferromagnetic systems. Adding noise to these systems, we will look at basic properties of Brownian motion, form a Langevin system, and derive the steady state Gibbs distribution and mean noise-induced transition time; both are functions of the energy and temperature of the system. The same Gibbs distribution can also be formed using the Metropolis Hastings algorithm and we will investigate the equivalence of dynamics coming from the Langevin stochastic differential equation and the Metropolis Hastings created Markov chain under certain limits. Intriguing research questions are raised when increasing the dimension of the underlying energy landscape. A basic knowledge of (undergraduate course in) ordinary differential equations and probability would be helpful.