LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

ARNOLD SOMMERFELD CENTER FOR THEORETICAL PHYSICS

Arnold Sommerfeld Lecture Series

Professor James P. Sethna

Cornell University, USA

Biophysics Seminar:

Statistical Physics in Biology
Twisting Transitions for DNA, and Ising Models for Cell Membranes

The theory of phase transitions splits between abrupt transitions (nucleation and growth, critical droplets) and continuous transitions (scaling and universality). I'll discuss wonderful biophysics examples for each: Michelle Wang's twisting single molecules of DNA, and with Sarah Veatch's discovery of universal Ising critical fluctuations in living cell membranes.

(1) Plectonemes are the helically wound loops formed in garden hoses and electrical cords when they are overtwisted. Wang's group studies their equilibrium formation in overtwisted DNA, where they observe reversible transitions over the free energy barrier. This system, with well-known continuum elasticity and a controlled disorder, forms an unusual opportunity to test our ideas about the nucleation of phase transitions, and to generalize them to include randomness.

(2) Sarah Veatch in Baird's group has recently made an amazing discovery – cell membranes, when stripped from the cytoskeleton, sit just above an Ising critical point. Cooled by 5%, they phase separate into two components: differing mixtures of lipids and proteins. We've tried to answer three questions: Why don't intact cells undergo this phase separation? Why would a cell want to sit near a critical point? What does statistical mechanics tell us about lipid rafts and the formation of protein aggregates?

Wednesday, January 15, 2014, 14:15h, Room A348/349, Theresienstr. 37/III, LMU

Prof. U. Gerland, Prof. J. v. Delft, Prof. E. Frey