Disorder and noise in physical systems

Jan Wehr

The unifying theme of these talks is role of randomness in mathematical physics models. Accordingly, all the problems discussed will involve probability. I am not assuming any graduate probability theory and will appeal to intuitive understanding of probability concepts. I will also provide the necessary physics background. My main goal is to state a number of problems in mathematical physics of disordered and noisy systems, discuss their context and natural mathematical tools to attack them. The problems will be drawn from my own research, including past and current joint work with graduate students as well as several open questions. Relation to experiments will be discussed. The rough outline is:

1. Mathematical models of disordered systems

    a) Ground states of disordered magnets and spin glasses
    b) Linear random Schroedinger operators and electron localization.
    c) Nonlinear random Schroedinger equation and cold atom systems.

2. Stochastic differential equations

    a) Modeling Brownian motion and diffusion
    b) Stationary states, Lyapunov functions and taming explosions
    c) Multiscale analysis and applications