BLAISE BOURDIN, McMaster University
Phase-field approximation of diffusion-driven fracture

This talk focusses on a class of problems where crack propagation is driven by a diffusion process. This general framework encompasses a broad range of phenomena including thermal and dessication cracks, fracture in fluid-saturated porous media, or fracture of materials undergoing phase-change.

The main difficulty in building a rigorous phase-field model of such problems is the different time scales involved in the fracture and diffusion processes. The former is often assumed to remain in an equilibrium state at all time, whereas the later is inherently driven by its non-equilibrium nature. Γ-convergence, commonly used to derive the convergence of phase-field models to their sharp interface counterparts do not provide any insight on out-of-equilibrium evolutions. Instead, we propose to reformulate the diffusion problem in terms of the minimizing motion of an energy, and the coupled problem as a PDE-constrained optimization problem. We then propose compatible phase-field approximations of the fracture and diffusion process can be derived, and the convergence of the constrained minimization problem can be proved.