The discrete charm of nonlinearity: kinetics of lattice phase transitions

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Tuesday, December 3, 2013

Propagation of phase boundaries, cracks and dislocations in crystal lattices is associated with energy dissipation that takes place in atomically sharp transition zones. Classical continuum theories represent these lattice defects as singularities, and the information about their kinetics is lost. This can lead to non-uniqueness of solutions of the associated initial value problem unless an additional function that relates the velocity of a moving defect to the driving force is specified. This kinetic relation can be extracted from the underlying discrete model by constructing a heteroclinic traveling wave solution that represents a moving defect. In general, this requires solving a nonlinear advance-delay differential equation, but under some simplifying assumptions explicit and semi-analytical solutions can be obtained. In this talk, I will illustrate this by considering some prototypical discrete systems with nonconvex interactions that describe displacive phase transitions. I will discuss how the interplay of nonlinearity and dispersion, nonlocal interactions, lattice dimension and heterogeneity affect the resulting kinetics.

The lecture will take place in Thackeray 704 at 3:00pm.
Refreshments will start at 2:30pm.