1057-65-268 **Steven M Wise*** (swise@math.utk.edu). *Energy Stable FInite Difference Schemes for the Phase Field Crystal (PFC) and Modified Phase Field Crystal (MPFC) Equations.*

The PFC and MPFC equations decribe crystals at the atomic scale in space but on diffusive scales in time. The models account for the periodic structure of a crystal lattice through a free energy functional of Swift-Hohenberg type that is minimized by periodic functions. The models naturally incorporate elastic and plastic deformations, multiple crystal orientations and defects and have been used to simulate a wide variety of microstructures. In this talk I describe energy stable and convergent finite difference schemes and their effcient solution using nonlinear multigrid methods. A key point in the numerical analysis is the convex splitting of the functional energy corresponding to the gradient systems. In more detail, the physical energy in both cases can be decomposed into purely convex and concave parts. The convex part is treated implicitly, and the concave part is updated explicitly in the numerical schemes. I will discuss both first- and second-order accurate convex splitting schemes. The proposed schemes are unconditionally stable in terms of the physical energy and unconditionally solvable, which allows for arbitrarily large time step sizes. This property is vital for coarsening studies that require very long time scales. (Received January 25, 2010)