1116-65-2838 **Steven M Wise*** (`swise1@utk.edu`). *Unconditional Energy Stability and Optimal-Rate Error Analysis of a Second Order Mixed Finite Element Method for the Cahn-Hilliard Equation.*

The Cahn-Hilliard equation is a nonlinear, fourth-order parabolic PDE modeling phase transformations. In this talk, I will describe and analyze an unconditionally stable, second-order-in-time finite element numerical scheme for the Cahn-Hilliard equation in two and three space dimensions. I will prove that our two-step scheme is unconditionally energy stable and unconditionally uniquely solvable. Furthermore, I show that the discrete phase variable is bounded in $L^\infty(0,T;L^\infty)$ and the discrete chemical potential is bounded in $L^\infty(0,T;L^2)$, for any time and space step sizes, in two and three dimensions, and for any finite final time T. Using these stabilities, I will show that the approximations converge with optimal rates in the appropriate energy norms in both two and three dimensions. (Received September 22, 2015)