1113-65-204 **Amanda Diegel**, **Cheng Wang** and **Steven Wise***, Mathematics Department, University of Tennessee, Knoxville, TN 37996. *Unconditional Energy Stability and Optimal-Rate Analysis of a Second Order Mixed Finite Element Method for the Cahn-Hilliard Equation.*

In this talk I will describe and analyze an unconditionally stable, second-order-in-time 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. This is joint work with Amanda Diegel, LSU, and Cheng Wang, UMass, Dartmouth. (Received August 21, 2015)