# Mathematical Sciences Colloquium Series

## Fall 2022


## Dr. Natasha Sharma

The University of Texas at El Paso


**In person at Bell Hall 130 and online via Zoom**

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**Friday, October 7** **3pm**

# Convergence Analysis of a Continuous Interior Penalty Method for the Modified Phase Field Crystal Equation

## Abstract


The so-called phase-field crystal (PFC) approach proposed by Elder et al. has been employed as a continuum model to describe the microstructure of solid-liquid systems such as the crystal growth in a supercooled liquid and provides an accurate way to model crystal dynamics, especially defect dynamics in atomic-scale resolution. However, it fails to distinguish between elastic relaxation and diffusion time scales. To overcome this difficulty and to incorporate both the faster elastic relaxation (e.g., in a rapid quasi-phononic time scale) and the slower mass diffusion, the modified phase-field crystal (MPFC) equation has recently been proposed by P. Stefanovic and co-authors. The MPFC is a generalized damped wave equation and can be thought of as a singular perturbation of the PFC equation characterized through the presence of a second-order time derivative weighted by a positive parameter. Mathematically, the presence of the second order time derivative is a nontrivial modification of the PFC since unlike the sixth-order parabolic type equation PFC equation, the solutions to MPFC do not regularize in finite time. Furthermore, the MPFC equation does not admit a gradient structure in general. In this talk, we present a continuous interior penalty finite element method for the sixth-order modified phase field crystal equation. We prove that the numerical scheme is uniquely solvable, unconditionally energy stable, and convergent. Finally, we close this talk with a numerical experiment demonstrating the performance of our proposed method.



This is a joint work with Amanda E. Diegel (Mississippi State University) and Daniel Bond (University of Tennessee) . This work has been supported by NSF DMS-2110774.



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