Physics Colloquium

Wednesday

Sept 12

4:00 P.M.

Rm 118 NSH

Understanding Massive Stellar Death: Predictive Simulation of Core-collapse Supernovae

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Core-collapse supernovae are the luminous explosions that herald the death of massive stars. While core-collapse supernovae are observed on a daily basis in nature, the details of the mechanism that reverses stellar collapse and drives these explosions remain unclear. While the most recent high-fidelity simulations show promise at explaining the explosion mechanism, there remains tension between theory and observation. I will discuss the recent developments in the study of the supernova mechanism that could lead to a predictive theory of massive stellar death. In particular, I will discuss the important role turbulence is playing in the supernova mechanism and what might be required for accurately modeling turbulence in our simulations. I will also describe our efforts to develop more realistic initial conditions for supernova simulations with fully 3D massive stellar evolution calculations. Such realistic 3D initial conditions turn out to be favorable for successful explosions, in large part because they result in stronger turbulence behind the stalled supernova shock. We are also studying the role of ubiquitous rotation and magnetic fields in altering the character of supernova explosions. As the realism of our supernova simulations improves, it is crucial to make connection with observational and experimental data. I will conclude with a discussion of the impacts of improved physics on observational features of supernovae, including on the gravitational wave emission from these stellar explosions.

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