Title: Core-Collapse Supernovae: Neutrinos and Explosions!

Abstract:

Core-collapse supernovae are a cornerstone of astrophysics. Their shock waves are responsible for heating the interstellar medium, regulating star formation, and producing cosmic rays. These same shock waves spread the products of massive star nucleosynthesis throughout the galaxy, enriching the next generations of stars with the building blocks of life: carbon, oxygen, and nitrogen, among others. Core-collapse supernovae are also the birth place of neutron stars, magnetars, pulsars, and black holes. However, the central engine of these explosions is not completely understood. We understand that the energy for this explosion must come from the gravitational binding energy released when the inert iron core in the center of an evolved massive star becomes too massive and collapses to nuclear densities. What we don't understand is the precise mechanism that coverts a mere ~1% of this released energy into the observed explosion energy, although we are fairly certain it involves neutrinos, as most of the the remaining energy, ~99%, is ultimately radiated in neutrinos.

In this talk, I will focus on the physics of the core-collapse supernovae central engine, the impact and current state-of-the-art treatment of neutrinos and neutrino interactions, how we hope to learn about the core-collapse supernova central engine via observations of neutrinos, and finally I will present new multidimensional simulations that show the importance of considering general relativistic gravity.