



**Wednesday**  
**November 16, 2022**  
**1:00 pm**  
**Room 3213 LEC**

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## Unraveling Implosion Physics in Inertial Confinement Fusion: Direct-drive Simulations, Experiments, and Physics-informed Data Science

Direct-drive Inertial Confinement Fusion (ICF) implosions can potentially provide high fusion yield and gain. These implosions are performed at the 60-beam, ~30-kJ OMEGA laser at the U. of Rochester. The nominally identical beams implode a cryogenic layer of deuterium-tritium fuel enclosed in a polymeric shell. In this talk, I will describe the physics and status of these implosions. Design and interpretation of OMEGA cryogenic implosions are performed using integrated radiation-hydrodynamic codes that include the physics of laser plasma interactions, heat conduction, radiation transport, and material properties. However, differences in experimental signatures compared with models indicate that these codes have limited quantitative predictability. Predictive modeling requires targeted experiments to improve physics models in integrated codes with an emphasis on diagnostics. Targeted platforms including solid spheres, planar foils, and cones embedded in shells are used to validate laser drive models, shock propagation etc. An alternate approach based on semi-empirical data science has helped identify experimental fusion yield dependencies on parameters that may not be captured a-priori in simulations and has improved implosion performance. I will also discuss the path forward for direct-drive ICF implosions, including extrapolations for the prediction of gain and required improvements in physics understanding.

**About the Speaker:** Radha is a Distinguished Scientist at the U. of Rochester's Laboratory for Laser Energetics, LLE. Her research focuses on understanding the physics of plasmas. She models the behavior of high temperature plasmas with the goal of developing predictive simulations for fusion experiments. Her work was the first that helped experimentally identify the role of hydrodynamic instability in ICF implosions. She has been instrumental in identifying nuclear astrophysics related questions and initiating experiments to address them using high-power lasers. Radha has led research at the National Ignition Facility to study various aspects of direct-drive. Previously, Radha led the Integrated Modeling Group and was Chair of the High-Performance Computing Group at LLE. She has served on several national panels and committees reviewing ICF, including as an advisor to the Under Secretary of Energy for Science. Radha also leads a group of women at LLE called the Women in Science and Engineering at Rochester or WISER. Radha is a Fellow of the American Physical Society and is the recipient of the Leadership Award for fusion energy from Fusion Power Associates. She has a Ph.D. in Theoretical Nuclear Physics from the California Institute of Technology.