Nuclear Seminar

Plasma Nuclear Science: Nuclear Science in Hot, Dense, and Dynamic Laboratory Plasmas

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Room 124 Nieuwland Science Hall

Harnessing the energy of the sun and stars has been a science goal for the past ~60 years. The National Ignition Facility aims to be the first inertial confinement fusion facility to demonstrate a self-sustaining fusion burn, required to provide enough energy gain to make fusion energy feasible. The plasma environments created using laser-driven inertial confinement fusion implosions at the National Ignition Facility [1] and OMEGA Laser Facility [2] closely resemble the burning core of a star where the reactants are ionized and the electrons are in continuum states. The fusion reactions in these plasmas can also lead to an extremely high neutron brightness, ~10 orders of magnitude higher than produced in conventional accelerator and reactor facilities. The brightness is potentially high enough that a significant number of nuclei could sequentially undergo to two nuclear reactions within ~10 ps, providing a capability to study reactions on short-lived excited states. These capabilities offers some intriguing opportunities to improve our understanding of how the elements originated and the stars, stellar objects and stellar events that produce the elements. However, these facilities also present challenges because the plasma environment is a complex and dynamic system that is difficult to model. I will discuss some of these challenges and recent progress that has been made by nuclear scientists to disentangle these complexities and exploit them to better understand the reactions that power the stars and create the elements that we observe in our world today.

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