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Michigan Institute for Plasma Science and Engineering

Wednesday
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3:30 pm
Room 1005 EECS

Dr. Denise Hinkel

Lawrence Livermore National Laboratory

To Ignition and Beyond

The National Ignition Facility (NIF) at Lawrence Livermore National Laboratory is the world's most energetic laser now capable of providing 2.2 MJ of laser light at 351 nm to the target chamber. The primary goal of NIF is to demonstrate fusion ignition (and then as high-as-possible yield), an unprecedented proof-of-principle. On August 8, 2021, fusion ignition was demonstrated at NIF according to several ignition metrics. This was achieved using the indirectly driven laser fusion concept, where laser light is converted to x-rays upon striking the interior of a high-Z cavity, creating a radiation oven for a capsule comprised of heavy hydrogen fuel (which when driven to appropriate conditions undergoes fusion) surrounded by an ablator. The experiment, N210808, burned about 2% of the fuel, using 1.9 MJ of laser energy and producing 1.37 MJ of fusion yield. Repeat experiments showed variability to unintentional degradations such as capsule quality and low mode asymmetries, and so, to enhance robustness, a larger capsule was fielded, using 7% more laser energy, i.e., 2.05 MJ. This experiment (N221204), and its repeat (N230729), achieved 3.15 and 3.88 MJ of fusion yield, or a target gain of 1.5 -1.9, burning up to 5% of the fuel.

This presentation reviews background material and guiding principles, as well as important lessons learned. Additionally, the challenges that lie ahead of the national inertial confinement fusion program will be outlined.

About the Speaker: Dr. Denise Hinkel is a physicist at Lawrence Livermore National Lab and serves as Modeling Lead for the Inertial Confinement Fusion (ICF) Program as well as Associate Division Leader for ICF and High Energy Density Physics (HED) in the Design Physics Division. She is also technical coordinator of a special program. Denise's expertise spans theoretical analyses to massively parallel computing, basic plasma physics to reduced model descriptions and design and analysis of laser-based experiments using radiation-hydrodynamics simulations. She applied her design expertise to a series of NIF shots known as the "High Foot", where for the first time the energy released in fusion reactions exceeded the energy used to compress the fuel. Denise has served as the point-of-contact for Laboratory Directed Research and Development, managing the portfolio and developing strategic plans with her directorate and institution. Denise received the MS and PhD in Physics from UCLA and became Fellow of the American Physical Society (APS) in 2007. In 2022, she served as Chair of the APS Division of Plasma Physics. She has received multiple awards, has provided physics outreach to students of all ages, and has served on many review committees.