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Katherine E. Weimer Award Talk: Studying 3D asymmetries and resulting flows in ICF implosions, and using ICF implosions to study nuclear reactions relevant to stellar nucleosynthesis[1]

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This broad talk will cover two topics. Firstly, low-mode asymmetries have emerged as one of the primary challenges to achieving high-performing inertial confinement fusion (ICF) implosions. These asymmetries seed flows in the implosions, which manifest as modifications to the measured ion temperature (Tion) and as directional flow inferred from the broadening and energy shift of primary neutron spectra. The effects are important to understand both to learn to control and mitigate low-mode asymmetries, and to more closely capture thermal Tion used as input in implosion performance metric calculations. We report on intentionally asymmetrically driven OMEGA implosions, which demonstrate the importance of interplay of flows induced by various asymmetry seeds. Tion, peak shift, areal-density asymmetry and x-ray imaging measurements are brought to bear and contrasted to CHIMERA, xRAGE, ASTER and DRACO simulations, providing insights into implosion dynamics and the interplay between different asymmetry sources, including laser drive non-uniformity, the stalk, and capsule offset. Secondly, thermonuclear reaction rates and nuclear processes have been explored traditionally by means of accelerator experiments, which are difficult to execute at conditions relevant to Stellar Nucleosynthesis. ICF plasmas closely mimic astrophysical environments and are an excellent complement to accelerator experiments. We describe ICF experiments to study the T+T reaction at the OMEGA laser facility, and the mirror solar 3He+3He reaction at the National Ignition Facility (NIF), as well as discuss future directions for exploring light-ion reactions at OMEGA and the NIF. In particular, we show how measurements of the T+T reaction at OMEGA at Tion from 4 to 18 keV provide the first conclusive evidence of a variant T+T-neutron spectrum over the corresponding center-of-mass energy range (16-50 keV).

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