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SIMULATIONS EXAMINE PERFORMANCE OF PURE BORON, BORON CARBIDE, HIGH-DENSITY CARBON AND BORON NITRIDE ABLATORS—THE MATERIAL

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Abstract-
The performance of pure boron, boron carbide, high-density carbon and boron nitride ablators—the material that surrounds a fusion fuel and couples with the laser or hohlraum radiation in an experiment—in the polar direct drive exploding pusher (PDXP) platform. The platform uses the polar direct drive configuration to drive high ion temperatures in a room-temperature capsule and has potential applications for plasma physics studies and as a neutron source. Our simulations predict that the platform is not amenable to the electron-ion coupling measurements due to a lack of implosion symmetry, these alternate materials do enable better coupling between the lasers and capsule, we can test those predicted impacts on future neutron source experiments.
Examining the improvement in coupling because it could help improve the yield of the polar direct drive neutron sources, and ultimately provide data on the validity of laser modeling for direct drive simulations. Inertial confinement fusion simulation code developers implement more advanced models for electron-ion coupling, and modeling the direct drive implosions have been closely coupled with that code development. One of the main goals has been to create ignition in deuterium-tritium plasma in the laboratory. The design of these experiments relies heavily on computer models that are based on an understanding and assumptions about the behavior of these hot plasmas. In these experiments, ions are heated more rapidly than the electrons via a very strong laser-generated shock. Intended to use time resolved spectroscopy, which is a measure of how much light is being emitted from the plasma at a specific frequency, in order to measure the temperatures of both the ions and the electrons as a function of time during the experiment. Electron-ion coupling is a parameter that describes how ions and electrons exchange energy in plasma. The PDXP platform was developed to study electron-ion equilibration but ended up being an ideal neutron source for several other campaigns. The great advantage of this platform is that it is simple —spherical shell filled with fuel—and allows multiple diagnostics from any ports to take data and produces high neutron yield. This research did a theoretical study of performance (neutron yield) versus composition of the shell materials and its thickness.Based on these models predicting a particularly useful improvement in performance, like higher yield, or the model predicting a large change in a measured quantity, like the trajectory of the imploding capsule or the temperature of the nuclear burn, we can execute to test if the calculation was indeed successful at predicting the change in performance.

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