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Fast electron transport in laser-driven shock heated warm dense matter and its implication for fast ignition[1]

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Understanding of relativistic electron transport from the region of laser interaction in a high-Z cone tip, and onward through a low-Z low density plasma is of great importance to cone guided fast ignition. We have performed experiments using the Titan laser at LLNL to investigate electron transport in warm dense matter (WDM) with foam package targets consisting of Au/CRF foam/Cu/CH. WDM is created by a long laser pulse (300 J, 3 ns, 600 μm spot) driven shock compression and heating of the low density foam with initial density of 150 mg/cm^3. Shock propagation in the foam is investigated using the side-on x-ray radiography complemented with radiation hydro simulations. At its maximum compression, low-Z WDM with solid density and a temperature of 5-10 eV is assembled right behind the Au foil. Transport of the high intensity laser (I_{peak} $\sim 10^{20}$ W/cm^2) produced relativistic electrons from the Au foil in the WDM is characterized by measuring Kα emissions from the Cu fluorescence layer. A large angular spread of fast electrons is observed in the 2D spatial profiles of the Kα emission when fast electrons propagate through WDM. In addition, a 5X increase in the number of escaped electrons at a large off-normal angles is seen, consistent with the observed large angular spread. PIC simulations suggest that the large angular spread could be due to the randomization of fast electrons by the intense Weibel-like magnetic fields generated at the interface between the high density Au and the low-Z lower density plasma.[2] Detailed experimental and PIC simulation results will be presented and their implications for fast ignition will be discussed.

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[2]B. Chrisman et al., Phys. Plasmas 15, 056309 (2008).