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Interferometric characterization of preplasma density for laser created plasmas

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High intensity laser plasma interactions are often affected by the preplasma created by leakage laser light (typically millijoules over nanoseconds) prior to the main high energy laser pulse (typically 100's of joules). Even small amounts of preplasma can alter the absorption of laser light and creation of high energy electrons and ions in the interaction process. This can have significant effects on the application of such pulses for areas such as Fast Ignition Laser Fusion Energy. In order to correctly model the interaction process it is important to know the plasma density profile accurately prior to the main interaction process. The current study is focussed on characterizing the expected preplasma conditions for experiments carried out at the Titan laser facility at the Lawrence Livermore National Laboratory (LLNL). Interferometric measurements for accurate characterization of the plasma density profile of an aluminum plasma created by nanosecond duration 532nm Nd:YAG laser pulses are carried out using a femtosecond-laser probe pulse (400nm/130fs). The main laser pulse is focussed onto an aluminium rod using f/20 optics producing a 20μm diameter focal spot and the interferometry is carried out using a Mach Zehnder Interferometer. The interferograms are used to determine the evolution of the density profile of the plasma with time over a time scale of 1 to 5 nanoseconds. The results are then compared to 2D hydrodynamic modeling of the plasma expansion and used to determine the equation of state models which best fit the experiment. From these results, we expect that more accurate preplasma density models can be developed and incorporated into the analysis of high intensity laser plasma interaction experiments. The experimental results will be presented and discussed.

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