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High Resolution Radiography for Inertial Confinement Fusion Fuel Capsule Target Metrology from Laser-Plasma Acceleration based X-ray Sources

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The goal of this work is to use Laser Wakefield Acceleration (LWFA) based X-ray sources to develop a diagnostic capable of improved target metrology for Inertial Confinement Fusion (ICF) fuel capsules. We aim to develop a sub-ps, sub-10 micron X-ray source, which is capable not only of imaging ICF fuel capsules with high resolution, but could additionally be deployed for dynamic radiography of High Energy Density Science (HEDS) phenomena. Using the Self-Modulated LWFA X-ray sources at the Jupiter Laser Facility (LLNL), we were able to develop radiography based tools to calculate the spatial resolution of X-ray sources. A Fresnel-diffraction based code is used for straight edge radiographs, and a modified X-ray ray tracing code for curved objects. Here, we present on the results of a Texas Petawatt experiment, where 2-3 GeV generated X-rays were used to capture radiographs of a 400 micron radius Tungsten sphere, and compare spatial and spectral data from self-injection and nanoparticle injection mechanisms. We will discuss preliminary results using X-ray Phase Contrast Imaging radiography to image ICF fuel capsules at the Advanced Laser Light Source, part of a demonstration of current LWFA application capabilities which will be compared to industrial methods.

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