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Time-resolved Measurements of ICF Capsule Ablator Properties by Streaked X-Ray Radiography

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Determining the capsule ablator thickness and peak laser or x-ray drive pressure required to optimize fuel compression is a critical part of ensuring ICF ignition on the NIF. If too little ablator is burned off, the implosion velocity will be too low for adequate final compression; if too much ablator is burned off, the fuel will be preheated or the shell will be broken up by growth of hydrodynamic instabilities, again compromising compression. Avoiding such failure modes requires having an accurate, in-flight measure of the implosion velocity, areal density, and remaining mass of the ablator near peak velocity. We present a new technique which achieves simultaneous time-resolved measurements of all these parameters in a single, area-backlit, x-ray streaked radiograph. This is accomplished by tomographic inversion of the radiograph to determine the radial density profile at each time step; scalar quantities such as the average position, areal density, and mass of the ablator can then be calculated by taking moments of this density profile. Details of the successful demonstration of this technique using backlit Cu-doped Be capsule implosions at the Omega facility will be presented. This work was performed under the auspices of the U.S.Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 and in collaboration with Brian Spears, David Braun, Peter Celliers, Gilbert Collins, and Otto Landen at LLNL and Rick Olson at SNL.