STREAKED X-RAY IMAGING OF ULTRAFAST IONIZATION WAVES INSIDE A METAL

P.M. Nilson[1,2], G. Fiksel[1], A.A. Solodov[1], C. Stoeckl[1], P.A. Jaanimagi[1], C. Mileham[1], W. Theobald[1], J.R. Davies[1,2,3], D.H. Froula[1,4], R. Betti[1,2,3,4], D.D. Meyerhofer[1,2,3,4]
[1]Laboratory for Laser Energetics, University of Rochester, Rochester, NY, USA
[2]Fusion Science Center, University of Rochester, Rochester, NY, USA
[3]Dept. of Mechanical Engineering, University of Rochester, Rochester, NY, USA
[4]Dept. of Physics, University of Rochester, Rochester, NY, USA
pnil@lle.rochester.edu

Generating intense flows of energy inside matter is essential for a wide range of basic and applied high-energy-density science. When a high-intensity laser is focused onto the surface of a solid, a high-current electron beam is generated that provides a large and ultrafast-energy input into matter. Monochromatic, streaked x-ray imaging has been developed and deployed on the OMEGA EP laser to study ionization-wave dynamics driven by hot electrons inside a metal. Spatial, spectral, and temporal resolution is obtained by coupling a spherical crystal imager to a 2-ps-resolution x-ray streak camera. The instrument measures the spatial location of the Cu K_α emission across a 1-D lineout of a thin-foil target as a function of time with a spatial resolution of ~15 μm, tracking the hot-electron flow through the background plasma. The measurements are in good agreement with implicit-hybrid particle-in-cell and collisional-radiative code calculations that predict the hot-electron transport and the K-shell ionization-front dynamics inside the target.

This material is based upon work supported by the Department of Energy National Nuclear Security Administration under Award Number DE-NA0001944, the University of Rochester, and the New York State Energy Research and Development Authority. The support of DOE does not constitute an endorsement by DOE of the views expressed in this abstract.