Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

Modeling dynamic plasmas driven by ultraintense nano-focused x-ray laser pulses in solid iron targets[1] RYAN ROYLE, University of Oxford, YASUHIKO SENTOKU, Institute of Laser Engineering, Osaka University, ROBERTO MANCINI, University of Nevada, Reno — The hard x-ray free electron laser has proven to be a valuable tool for high energy density (HED) physics as it is able to produce well-characterized samples of HED matter at exactly solid density and homogeneous temperatures. However, if the x-ray pulses are focused to sub-micron spot sizes, where peak intensities can exceed 10^{20} W/cm^2, the plasmas driven by sources of non-thermal photoelectrons and Auger electrons can be highly dynamic and so cannot be modeled by atomic kinetics or fluid codes. We apply the 2D/3D particle-in-cell code, PICLS—which has been extended with numerous physics models to enable the simulation of XFEL-driven plasmas—to the modeling of such dynamic plasmas driven by nano-focused XFEL pulses in solid iron targets. In the case of the smallest focal spot investigated of just 100 nm in diameter, keV plasmas induce strong radial E-fields that accelerate keV ions radially as well as sheath fields that accelerate surface ions to hundreds of keV. The heated spot, which is initially larger than the laser spot due to the kinetic nature of the fast Auger electrons, expands as ion and electron waves propagate radially, leaving a low density region along the laser axis.

[1]This research was supported by the US DOE-OFES under Grant No. DE-SC0008827, the DOE-NNSA under Grant No. DE-NA0002075, and the JSPS KAKENHI under Grant No. JP15K21767.

Ryan Royle
University of Oxford

Date submitted: 14 Jul 2017 Electronic form version 1.4