USE OF LASER-GENERATED ION BEAMS FOR ISOCHORIC HEATING TO STUDY PLASMA MIX AT INTERFACES

B. J. Albright[1], J. C. Fernández[1], W. Bang[1], P. A. Bradley[1], D. C. Gautier[1], C. E. Hamilton[1], S. Palaniyappan[1], M. A. Santiago Cordoba[1], E. L. Vold[1], L. Yin[1], B. M. Hegelich[2], G. Dyer[2], R. Roycroft[2]

[1]Los Alamos National Laboratory, Los Alamos, NM, USA
[2]University of Texas, Austin, Austin, TX, USA
balbright@lanl.gov

The evolution and mixing of high-Z/low-Z plasma interfaces in high energy density plasmas is of profound importance to understanding plasma-phase mix in settings of thermonuclear burn, as encountered in inertial confinement fusion (ICF) experiments.

One of the reasons this problem has proven challenging is that making dense plasma for study in the laboratory typically requires a large facility such as the National Ignition Facility at LLNL or the Z Machine at Sandia National Laboratory. In such, the time scale of assembly of such media, of order nanoseconds, is comparable to the disassembly time, making it difficult to achieve conditions of sufficient uniformity to perform controlled experiments. Instead, these media often have large gradients in temperature and density, making interpretation of the data difficult and often ambiguous.

Recently, experiments performed at the LANL Trident laser facility have applied novel, laser-generated aluminum ion beams [1] created under conditions of relativistic induced transparency [2] to the isochoric and uniform heating (over tens of ps) of solid-density, multi-material targets, attaining plasma temperatures of several eV in solid-density plasma. Recently, both optical [3] and gated x-ray observations have been made of the evolution of these multi-component dense plasma media.

Experiments such as these evince a new path for the controlled preparation and study of high energy density physics and warm dense matter. In this presentation, we will summarize results from our ongoing project. Recent experimental data and associated radhydro modeling from our Trident campaigns will be reported and complementary kinetic simulations of interface evolution using the VPIC [4] particle-in-cell code, showing anomalously rapid atomic mixing under conditions relevant to ICF experiments, will also be discussed.

Work performed under the auspices of the U.S. DOE by the LANS, LLC, Los Alamos National Laboratory under Contract No. DE-AC52-06NA25396. Funding provided by the Los Alamos National Laboratory Directed Research and Development Program.

[1] S. Palaniyappan et al., "Efficient ion beams with narrow energy spread from laser-driven relativistic plasma accelerators using giant self-generated plasma fields," *Nature* (submitted).
[2] L. Yin et al., *Phys. Plasmas* **14**, 056706 (2007); B. M. Hegelich et al., *New Journal of Physics* **15**, 085105 (2013).
[3] W. Bang et al., "Visualization of expanding warm dense matter heated isochorically by laser-generated ion beams," *Physical Review Letters* (submitted).
[4] K. J. Bowers et al., *Phys. Plasmas* **15**, 055703 (2008).