Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

A Simple Monte-Carlo Model of the Late-Time Evolution of Laser-Produced Plasmas for Laboratory Astrophysics PETER HEUER, ROBERT DORST, University of California, Los Angeles, MARTIN WEIDL, Max-Planck-Institut fur Plasmaphysik, DEREK SCHAEFFER, Princeton University, CARMEN CONSTANTIN, CHRISTOPH NIEMANN, University of California, Los Angeles — Laboratory astrophysics experiments that employ large scale (¿10 cm) laser-produced plasmas (LPPs) often depend strongly on the LPP density, but the computational cost of modeling the time evolution of the LPP density presents challenges when designing experiments. Large ion gyroradii relative to experimental scales preclude fluid approximations, while large experimental volumes make particle-in-cell (PIC) and 3D hybrid models computationally expensive. In some cases, this problem can be made tractable by using a simple model in which ion interactions are collectively modelled as a single cross-field diffusion process such that ions follow cyclotron orbit trajectories with diffusing gyrocenters. Under this approximation, a Monte-Carlo approach can be applied to numerically estimate the evolution of the LPP density. The computational diffusion coefficient can be adjusted to match experimental results, improving the accuracy of the model and giving physical insight into the experimentally-relevant diffusion processes. In this presentation we discuss this model in depth, present an example application of this technique to model the expansion of a LPP over ten meters through a background plasma, and show how the model can be used to inform the design of future experiments.

Peter Heuer
University of California, Los Angeles

Date submitted: 24 Jun 2020 Electronic form version 1.4