SIMULATING PROTON RADIOGRAPHIC IMAGES OF HOHLRAUMS[1]

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Recent proton radiography images taken down the axis of hohlraums fielded at the Omega laser facility in Rochester [1] have produced considerable speculation as to the origin of the electric and magnetic fields that cause the complex and diverse patterns observed on the CR39 track imagers. We consider how well a simple model of the hohlraum, consisting only of electric fields, does in predicting the proton images observed in experiment. By comparing images from modeling to experimentally observed images, we identify two regions in the hohlraum: a region that corresponds to laser interacting with the critical surface, and a region where the gas and the wall interpenetrate. The E field in the first region arises from the gradient in the electron temperature. The field in the second region is due to the E-field that arises at the interface where the gas and wall materials diffuse into each other. Results from a simple 3D computer model consisting of the fields of the hohlraum, the material opacity of the hohlraum, the proton source, and the detector show that the experimental images are well described by this model. If this interpretation holds, this points to an entirely new diagnostic of the laser-wall interaction region, and more importantly, a diagnostic of the gas-wall interface in a gas-filled (or lined) hohlraum. The former is a surface that current diagnostics like X-ray radiography cannot easily diagnose, whereas the latter is an important surface that hydro codes typically do not calculate well. New experimental designs to test this model will be presented. In addition, we present multi-ion species hybrid LSP simulations, where the ions are treated kinetically and the electrons are treated in the fluid approximation, of the diffusive gas-wall interface.

[1] C. K. Li et al., Phys. Rev. Lett. 108, 025001 (2012).

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