Characterizing Implosion Targets using X-ray Thomson Scattering

Andrea Kriecher1, T. Döppner1, O.L. Landen1, S. H.Glenzer1
1Lawrence Livermore National Laboratory

Abstract

Spectrally resolved x-ray Thomson scattering has been applied at the Omega Laser Facility to investigate the capsule ablation of cone-in-shell inertial confinement fusion targets. Here, the technique of scattering from transmitted x-rays (transmission imaging) at very short exposure times (≤100 fs) is presented. The technique employs the well-established Thomson scattering theory to relate the atomic density and temperature (Te=Ti) to experimental data. Here, the combination of high x-ray brightness from Omega (30 TW/gauss) and improved detection sensitivity allows for the measurement of transition regions (e.g., the transition from plastic to liquid) at critical times during the implosion. Theoretical fits to the x-ray scattering data yield densities, temperatures, and ionization states of the compressed material. A detailed description of the x-ray Thomson scattering experiment is presented, and a comparison between experimental data and theoretical simulations is given. The experimental data provide a direct measurement of the x-ray Thomson scattering signal at very short exposure times (≤100 fs), which is important for understanding the dynamics of x-ray Thomson scattering in future experiments.

Experimental Setup

Omega Chamber

Simulations

CH Shell: LA370901p

Be Shell: LA370901p

Be Shell: LA2201

Experimental Measurements

In Figure 8, the measured x-ray Thomson scattering data are compared to theoretical predictions. The data are consistent with the theoretical predictions, indicating that the x-ray Thomson scattering technique can be used to measure the density and temperature of compressed materials.

In Figure 11, the x-ray Thomson scattering data are compared with theoretical predictions. The data are consistent with the theoretical predictions, indicating that the x-ray Thomson scattering technique can be used to measure the density and temperature of compressed materials.