X-Ray Thomson Scattering from Spherical Implosions on the OMEGA Laser

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X-ray Thomson scattering (XRTS) is an experimental technique that can directly probe the complicated physics of warm and hot dense matter. The Compton-shifted profile of inelastically-scattered x-rays reflects the electron velocity distribution and provides a way of measuring the electron density and temperature [1]. The ratio of elastically versus inelastically scattered x-rays is related to the number of tightly bound versus free electrons, and thus reflects the ionization state of the sample [1]. Recent experiments performed on the Linac Coherent Light Source at SLAC, the Omega laser at LLE, and at the National Ignition Facility (LLNL) shed light on uncertainties in the ionization models often used to describe warm dense matter [2-4]. More experimental validation of these models is needed to understand the complex behavior of warm dense matter.

We present experimental platforms to conduct XRTS measurements on directly-driven and hohlraum-driven solid spheres at the OMEGA Laser Facility; the platforms extend upon previously successful XRTS measurements from directly driven spherical shells [3,5]. Twenty to fifty laser beams drive the hohlraum or directly drive the spherical sample. Six to eight laser drive a zinc foil to produce a zinc He-α x-ray source at 9 keV used for the XRTS measurements. The laser drive can be scaled in intensity to scale the conditions reached in the compressed spherical sample. We will present experimental results from carbon-containing samples, which were driven into conditions where carbon K-shell ionization becomes possible.

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