- IFSA2025 –

Mechanisms of hard x-ray generation in foam-filled hohlraums using non-thermal electrons accelerated by laser plasma interactions

L. S. Leal[1], P. L. Poole[1], G. E. Kemp[1], M. A. Belyaev[1], Y. Ping[1], and M. J. May[1]

[1] *Lawrence Livermore National Laboratory (USA)*

X-ray sources in the 20-50 keV range are challenging to generate at the high fluences required for extreme radiation material testing and related applications. Current methods rely on laser heating of high-Z nanowire foams to achieve extreme plasma temperatures. We are exploring an alternative approach using non-thermal electrons generated by laser-plasma interactions, such as Stimulated Raman Scattering (SRS) and Two-Plasmon Decay (TPD). These non-thermal electrons produce bremsstrahlung radiation when interacting with high-Z materials, such as the gold wall in hohlraums. Foam filled hohlraum targets have been developed, allowing tunable fill densities and gradients to optimize laser-plasma interactions and control the resulting x-ray spectra.

New experiments on the OMEGA laser system focused on the sensitivity of hard x-ray generation to the type laser plasma interaction expected. Diagnostics, including an SRS streak camera and TPD imager, are used to correlate laser-plasma interactions with hard x-ray signals from the hard x-ray detector (HXRD) and spectra from dual crystal spectrometer (DCS). The hohlraums are filled with CH foam at densities of 4.0 mg/cc and 7.5 mg/cc, corresponding to 0.15 and 0.25 of the laser's critical density, respectively, to disentangle the contributions of SRS and TPD to hard x-ray generation. The lower density fill produced the highest SRS gains in both experiments and simulations, however the higher density fills saw considerably more hard x-ray signal. We produce fits to estimate the hot electron distribution that could produce the spectra seen in DCS and compare HYDRA simulations post-processed with FLIP to simulate SRS gains better understand the dominant mechanism in hard x-ray generation.

*This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.