Laser irradiated gold foils could be viable as a long duration (>1ns) x-ray source.

- High-energy laser facilities are useful for studying matter in the high-energy-density regime.
- Lasers systems operate primarily between the IR and UV portions of the EM spectrum.
- For photoionization experiments these energies are too low and a long-pulse, soft x-ray source is needed.
- Hohlraums have a high x-ray conversion efficiency but produce plasmas that can affect the relevant physics. It is also more difficult to properly characterize their emission.
- Gold foils are cheaper and allow for more flexibility in experimental design.
- Little work has been done characterizing long-pulse gold foil emission.

Previous studies of x-ray emission from laser irradiated foils have been limited to 1ns and below.

- When driving an x-ray source, plasma generated from laser ablation could affect the relevant physics. This can be mitigated by using the non-irradiated (rear) side of the foil as the source.
- Previous experiments using foils <0.5µm and pulse lengths of 1.0ns have shown that emission intensity decreases with foil thickness.
- Longer pulse-length x-ray sources require thicker targets in order to avoid burn-through.
- To understand how thicker foils and longer drive times affect emission we performed time resolved measurements of x-ray emission using 6ns pulses.

OMEGA experimental setup

- Using the Omega-60 laser system, 2kJ of energy was directed on target and time-resolved spectra were taken by the Dante spectrometer.
- Key Diagnostic: The Dante spectrometer is an x-ray photodiode array that allows for time resolved intensity measurements in up to 11 x-ray energy bands. The is bandwidth is set by using a specific combination of cathode materials, filters, and mirrors, so that each detector is only sensitive to x-rays within a certain energy range.

Experimental Details

- Pulse length: 6ns
- Number of Beams: 8
- Beam Intensity: 1e14 W/cm²
- Gold Foil Thicknesses: 0.5, 1.0, 2.0µm
- Acrylic cones provide additional support to the foils, and act as a mounting point for shielding.

Preliminary results found an inverse relationship between foil thickness and emission temperature.

- The Dante diagnostic outputs its results as a voltage signal. Processing is underway to convert the raw output signal of Dante into an emission temperature.

Future Directions

- Perform shots that have a greater variety of foil thickness to increase the number of data points in our burn-through and emission measurements
- Compare experimental results with different approaches to modeling gold foil heating and emission to attempt to create an analytical model for determining optimal foil thickness

References


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