INVESTIGATION OF BRIGHT 13 KEV KR K-SHELL X-RAY YIELDS AT THE NATIONAL IGNITION FACILITY

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High conversion efficiency (CE) K-shell sources are being developed for High Energy Density (HED) experiments and for the testing of materials exposed to high x-ray fluences. Recently, sources with high CE in the Kr K-shell have been developed at the National Ignition Facility. The previous work in 2012 [1] has reported ~ 3% conversion of the laser energy into Kr K-shell (≈13 keV) radiation, consistent with theoretical predictions. These targets were 4.1 mm in diameter 4.4 mm tall hollow epoxy tubes having a 40 μm thick wall holding either 1.2 or 1.5 atm of Kr gas. For these shots, the laser delivered ≈700 kJ of 351 nm (3ω) light in a 5 ns flattop pulse at a peak power of ≈140 TW.

The CE of Kr is dependent upon the peak electron temperature in the radiating plasma. In the NIF experiments, the available energy was not sufficient to heat the targets to a high enough temperature (T_e(NIF) = 6-7 keV) for the Kr CE to be optimal. The CE is a steep function of the peak electron temperature in this region. A spatially averaged electron temperature can be estimated from measured He(α) and Ly(α) line ratios. Some disagreement has been observed in the simulated and measured line ratios for some of these K-shell sources. This implies that some uncertainties in the model may exist. To help understand this issue, additional Kr gas pipes have been shot in 2014 with ≈750 kJ at ≈210 and ≈120 TW power levels with 3.7 and 6.7 ns pulses, respectively. The power and pulse length scaling of the measured CE and K-shell line ratios and their comparison to simulations will be discussed.

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