

Hard X-Ray Bremsstrahlung Measurements: A spectrometer to diagnose the hot-electron source in high-intensity, laser-solid target interactions has been developed and successfully demonstrated on OMEGA EP. The diagnostic is designed to characterize solid-target interactions at laser energies and pulse durations of up to 2.5 kJ, 5 to 10 ps, and laser intensities between 10^{18} to 10^{20} W/cm². This instrument [Fig. 1(a)] combines a stack of differentially filtered image-plate detectors contained inside a lead- and plastic-lined housing. The diagnostic nosepiece incorporates a magnet to deflect electrons away from the entrance aperture and a set of lead collimators. Figure 1(b) shows the hard x-ray spectrum measured during the first OMEGA EP target shot (shot 3676). The target interaction was a single high-intensity laser pulse, delivered by the OMEGA EP sidelighter beam, focused to a planar-copper-foil target. The laser delivered 80 J of energy to target with a pulse duration of 8 ps, providing an on-target intensity of around 1.5×10^{18} W/cm². The target was a $500 \times 500 \times 20\text{-}\mu\text{m}^3$ copper foil rotated 45° to the sidelighter beam. The hard x-ray spectrometer was located in the forward direction, collinear with the laser propagation direction. The instrument successfully collected data with no saturation. A comparison of the reduction in x-ray signal as a function of image-plate layer inside the filtered image-plate stack with Integrated Tiger Series (ITS) Monte Carlo (MC) electron-photon transport calculations indicates a hot-electron-slope temperature $T_H = 350 \pm 70$ keV. This is in good agreement with the hot-electron temperature that is predicted by the ponderomotive scaling $T_H = 400$ keV.

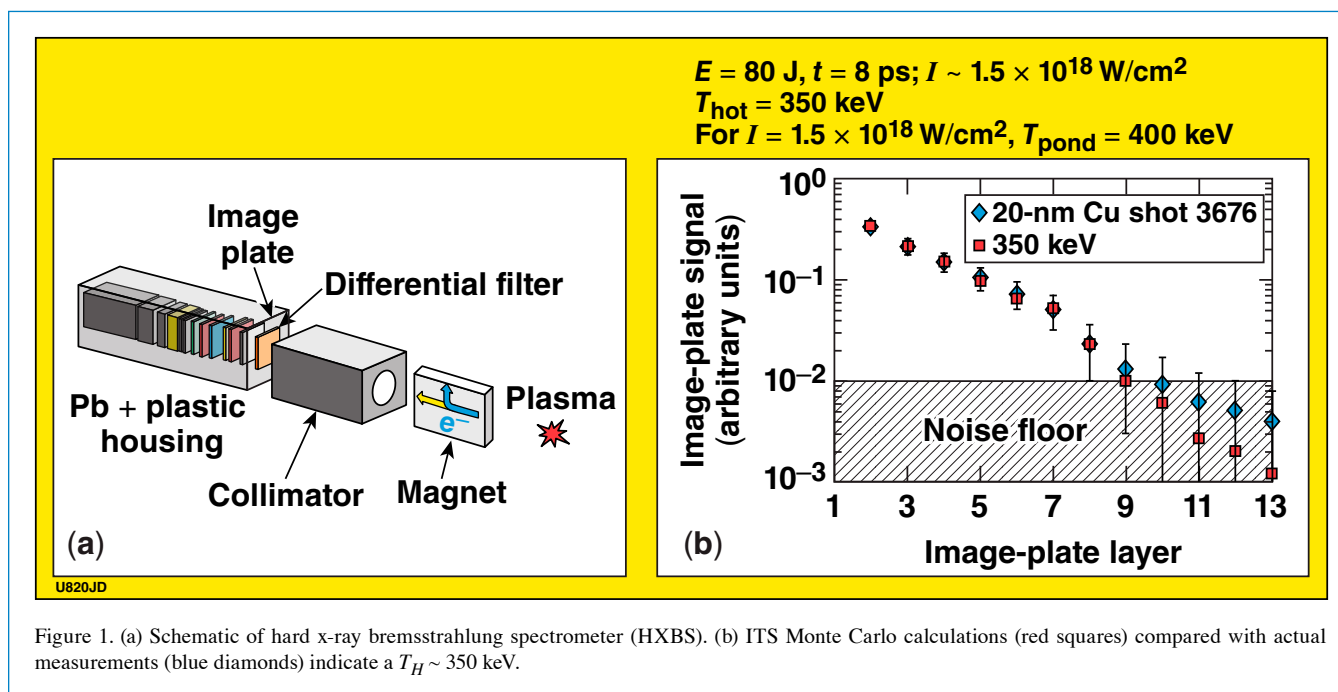


Figure 1. (a) Schematic of hard x-ray bremsstrahlung spectrometer (HXBS). (b) ITS Monte Carlo calculations (red squares) compared with actual measurements (blue diamonds) indicate a $T_H \sim 350$ keV.

OMEGA Operations Summary: OMEGA conducted 22 target shots in August with an average experimental effectiveness of 97.7%. In the first week of August, six shots were conducted for the DDI NIC campaign by LLE scientists, and LANL scientists conducted eight HEDP target shots. The laboratory was on a voluntary “safety stand down” for three weeks as a result of an accident that took place on 6 August that seriously injured a laboratory employee. After a rigorous safety review and the implementation of corrective actions, OMEGA shot operations resumed on 28 August with an eight-shot focus scan.