***High-Resolution, Ultrafast Streaked X-Ray Spectrometer***: LLE is leading the development of a high-resolving-power, streaked x-ray spectrometer (HiResSpec) for OMEGA EP. Applications of the spectrometer include high-pressure materials research, temperature-equilibration dynamics, and high-temperature plasma opacity. The spectrometer concept was developed in collaboration with scientists at the Princeton Plasma Physics Laboratory. The instrument is based on two diagnostic channels, each with a spherical Bragg crystal (Fig. 1). Channel 1 couples a spherical Si crystal to an ultrafast x-ray streak camera. Channel 2 couples a second, identical crystal to an x-ray charge-coupled device (CCD), allowing for photometric calibration of the time-resolved spectrum. The instrument covers the spectral range of 7.97 to 8.11 keV, centered on the Cu $K_{\alpha_1}$ line. The time-resolved spectrometer is designed to achieve a resolving power of several thousand and a temporal resolution of 2 ps. HiResSpec will be packaged and deployed for high-power operations on OMEGA EP, with shielding assemblies to protect the electronic detectors from the high-energy photon background that is generated.

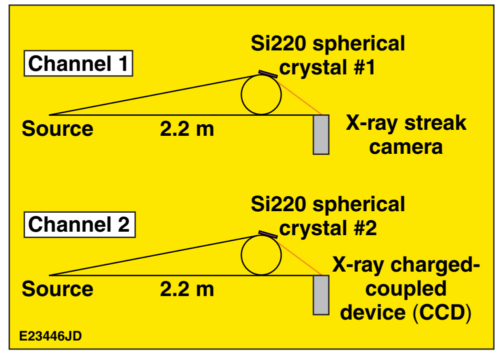


Figure 1. Layout of the HiResSpec diagnostic channels. Channel 1 couples a spherical Bragg crystal to an x-ray streak camera. Channel 2 couples a second spherical crystal to an x-ray CCD.

The time-dependent spectral shifts on the $K_\alpha$ line in isochorically heated solid Cu will be measured with HiResSpec. Figure 2(a) shows *PrismSPECT* collisional-radiative code calculations of the $K_\alpha$ emission generated from a thin-Cu foil heated by hot electrons. The target experiences a linear heating gradient from 1 to 350 eV over 10 ps. The calculation assumes a resolving power $\lambda/\Delta\lambda = 1000$ and a 2-ps temporal resolution. The synthetic streaked signal shows temporal spectral shifts of ~20 eV over the heating period. High thermal temperatures in the target lead to higher degrees of ionization and $K_\alpha$ line shifts. High-fidelity measurements of the temporal spectral shift provide direct insight into the mean ionization state of the target for detailed comparisons with energy transport and collisional-radiative model predictions.

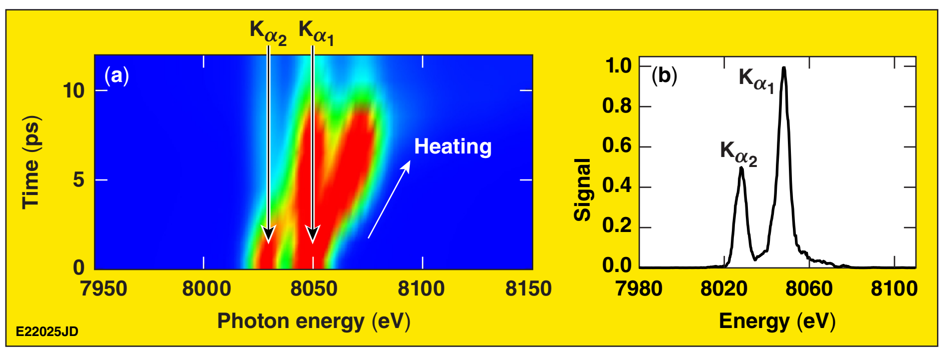


Figure 2. (a) *PrismSPECT* collisional-radiative code calculations of the temporal spectral shift on the $K_\alpha$ line emitted from rapidly heated, solid Cu. (b) Time-integrated $K_{\alpha_{1,2}}$ emission spectrum from a 500 × 500 × 20-$\mu$m Cu foil irradiated with a 100-J, 1-ps pulse from OMEGA EP.

To demonstrate the performance of the Si crystal under high-power conditions, initial experiments have been carried out on OMEGA EP. A survey spectrometer was built to replicate the HiResSpec geometry to test focusing fidelity, photon-throughput, and shielding assemblies. Figure 2(b) shows an example of a time-integrated $K_{\alpha_{1,2}}$ emission spectrum from a 500 × 500 × 20-$\mu$m Cu foil that was irradiated with a 100-J, 1-ps pulse from OMEGA EP. This data confirms the required performance (spectral shifts of ≲20 eV of the Bragg crystal and the instrument's fidelity shielding for high-power shots.

***Omega Facility Operations Summary***: The Omega Laser Facility conducted 207 target shots in March (140 on OMEGA and 67 on OMEGA EP) with average experimental effectiveness of 98.1%. The ICF program accounted for 80 target shots for experiments led by LLE, LLNL, and NRL. The HED program had 73 target shots for LANL-, LLNL-, and LLE-led experiments. Three NLUF experiments from the University of California, Berkeley, the University of Michigan, and Princeton University accounted for 21 targets shots. The LBS program had 33 shots for four LLNL and LLE experiments.