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5.1 Absolute Calibration of a Time-Resolved High Resolution X-ray Spectrometer for the National Ignition Facility

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A high resolution, Diagnostic-Instrument-Manipulator-based x-ray Bragg crystal spectrometer has been calibrated for and deployed at the National Ignition Facility (NIF) to diagnose plasma conditions and mix in ignition capsules near stagnation times. The spectrometer has two conical crystals in the Hall geometry focusing rays from the Kr He- α and He- β complexes onto a streak camera, with the physics objectives of measuring time-resolved electron density and temperature through observing Stark broadening and the relative intensities of dielectronic satellites. A third von Hámos crystal time-integrates the intervening energy range to provide in-situ calibration for the streak camera signals. The spectrometer has been absolutely calibrated using a microfocus x-ray source, an array of CCD and single-photon-counting detectors, and multiple K- and L-absorption edge filters. Measurements of the integrated reflectivity, energy range, and energy resolution for each crystal will be discussed. Spectra and images from a polar direct-drive exploding pusher target on NIF will be shown, with absolute intensity determined by pre-shot calibration. This work was performed under the auspices of the US DoE by PPPL under DE-AC02-09CH11466 and by LLNL under DE-AC52-07NA27344.

Primary author(s) : GAO, Lan (Princeton University)

Co-author(s) : KRAUS, presented by Brian F. (Princeton University); HILL, Kenneth W. (Princeton Plasma Physics Laboratory); BITTER, Manfred (Princeton Plasma Physics Laboratory); EFTHIMION, Philip C. (Princeton Plasma Physics Laboratory); SCHNEIDER, Marilyn B. (Lawrence Livermore National Laboratory); MACPHEE, Andrew G. (Lawrence Livermore National Laboratory); THORN, Daniel B. (Lawrence Livermore National Laboratory); KILKENNY, Joseph (General Atomics); AYERS, Jay (Lawrence Livermore National Laboratory); KAUFFMAN, Robert (Lawrence Livermore National Laboratory); CHEN, Hui (Lawrence Livermore National Laboratory); NELSON, David (University of Rochester Laboratory for Laser Energetics)

Presenter(s) : GAO, Lan (Princeton University); KRAUS, presented by Brian F. (Princeton University); HILL, Kenneth W. (Princeton Plasma Physics Laboratory); BITTER, Manfred (Princeton Plasma Physics Laboratory); EFTHIMION, Philip C. (Princeton Plasma Physics Laboratory); SCHNEIDER, Marilyn B. (Lawrence Livermore National Laboratory); MACPHEE, Andrew G. (Lawrence Livermore National Laboratory); THORN, Daniel B. (Lawrence Livermore National Laboratory); KILKENNY, Joseph (General Atomics); AYERS, Jay (Lawrence Livermore National Laboratory); KAUFFMAN, Robert (Lawrence Livermore National Laboratory); CHEN, Hui (Lawrence Livermore National Laboratory); NELSON, David (University of Rochester Laboratory for Laser Energetics)

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