Quantitative x-ray spectroscopy for energy transport in fast ignition plasma driven with LFEX PW laser

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Kα emission, caused by hot electrons propagation in a hot dense matter, can provide abundant information about the laser plasma interaction. Quantitative Kα line spectroscopy is a potential method to derive energy transfer efficiency from laser to hot electrons. A Laue spectrometer, composed of a cylindrically curved crystal and a detector, has been developed and calibrated absolutely for high energy x-rays ranging from 17 to 77 keV. Either a visible CCD detector coupled to a CsI phosphor screen or a sheet of imaging plate can be chosen as detector. The absolute sensitivity of the spectrometer system was calibrated using pre-characterized laser-produced x-ray sources and radioisotopes [1], for the detectors and crystal respectively. The integrated reflectivity for the crystal is in good agreement with predictions by an open code for x-ray diffraction.

The energy transfer efficiency from incident laser beams to hot electrons, as the energy transfer agency is derived as a consequence of this work [2]. The absolute yield of Au and Ta Kα lines were measured in the fast ignition experimental campaign performed at ILE Osaka U.. By applying the electron energy distribution from an electron spectrometer (ESM) or a high energy x-ray spectrometer (HEXS), energy transfer efficiency of incident LFEX, a kJ-class PW laser, to hot electrons was derived. Recently, double tracer method was also investigated to avoid complication arising from experimental data on hot electron temperatures measured with ESM and HEXS.

References

[1] Z. Zhang, et. al., Review of Scientific Instruments **83**, 053502 (2012).
[2] Z. Zhang, et al., High Energy Density Physics **9**, pp. 435–438 (2013)