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

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Abstracts: *Quantitative x-ray spectroscopy was made for the study of energy transfer in a PW-laser driven fast ignition plasma. A set of new type hard x-ray spectrometers have been developed and absolute sensitivity of them were calibrated with radio isotopes and radiation sources driven with an electron accelerator. Energy conversion from laser to hot electrons was derived in various types of targets mimicking the fast ignition plasma.*

Hard x-ray emission, caused by hot electrons propagation in a hot dense matter, can provide abundant information about laser plasma interactions. Quantitative x-ray 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 [1, 2] and radioisotopes, 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. In addition to the Laue spectrometer, new type of spectrometers have been developed to observe very hard x-ray emissions ranging from 0.1 to several 10 MeV by utilizing Compton scattering and photo-nuclear reactions [3, 4]

The energy transfer efficiency from incident laser beams to hot electrons, as the energy transfer agency is derived as a consequence of this work. 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 ESM data and scaling laws, energy transfer efficiency of incident LFEX, a kJ-class PW laser, to hot electrons was derived for various types of targets designed for fast ignition research.

References

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