Monte Carlo Simulation of Laser Compton Scattered (LCS) X-rays and it's Imaging Applicability

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Abstract. Tunable and quasi-monochromatic laser Compton scattered (LCS) X-rays are produced as a result of the interaction between accelerated electrons and a laser beam. The energy tenability of LCS X-rays is dependent on incoming electron and laser beam energies and the quasi-monochromatic nature of LCS X-rays offer much better signal-to-noise ratios, both qualitatively and quantitatively, for radiography applications. Previously, two sharp 20.94 keV and 98.4 keV LCS peaks were produced at the Idaho Accelerator Center (IAC) in two separate experiments based on electron beams tuned at ~34 MeV and ~37 MeV, that were brought in collision with the $(Power)_{peak} = 4\ GW$ Nd:YAG laser operating at 1064 nm and 266 nm wavelengths. The electron linear accelerator (linac) was operating at 60 Hz with an electron beam pulse length of about 50 ps and a peak current of about 7 A. A simulation has been performed using Geant4 Monte Carlo simulation toolkit to further understand features of the experiment such as energy distribution of incoming electron beam and Lorentz transformations between incoming, and relativistic, electrons with respect to electrons at rest i.e., Lab Frame. A comparison between simulated and experimental LCS X-rays of ~20 keV and ~98 keV as well as radiographic images of fish and lead samples will be shown in this paper.