Simulation of X-ray sources driven by the picosecond PETAL laser pulse interacting with a solid target

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Understanding X-ray sources driven by ultra-intense lasers is important for the development of shot-pulse backlighters suitable for radiography of rapidly evolving dense objects. For instance, the X-ray flashes generated by the Petawatt picosecond PETAL laser installed at the LMJ facility make it possible to image the dense plasmas created by the high-energy nanosecond LMJ laser pulses. We will present a simulation effort to model such X-ray sources from relativistic laser-plasma interactions under PETAL irradiation conditions. Three different codes are used successively. (i) The hydrodynamic TROLL code [1] simulates the effect of the laser prepulse on the backlighter solid-density target and notably the resulting pre-plasma formation. (ii) The particle-in-cell (PIC) CALDER code [2] describes the generation of fast electrons from the interaction of the main laser pulse with the expanded target. (iii) Finally, the Monte Carlo GEANT4 code computes the Bremsstrahlung and K_α photon emission produced by the fast electrons through the dense part of the target. This simulation chain enables us to understand the sensitivity of the X-ray source properties to the laser parameters (e.g. energy or pulse duration) as well as to the shape and composition of the backlighter target.

[1] E. Lefebvre *et al*., Nucl. Fusion **59**, 032010 (2019).

[2] E. Lefebvre *et al*., Nucl. Fusion **43**, 629 (2003).