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X-ray sources from laser-wakefield acceleration: development and applications at large scale facilities

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Hard x-ray sources, driven by electrons from laser-wakefield acceleration (LWFA), have unique properties to probe high energy density (HED) plasmas and warm dense matter. Such sources can be produced when relativistic electrons (i) oscillate in the plasma wake of a laser pulse (betatron radiation), (ii) oscillate in the field of a counter propagating laser pulse (Compton scattering), and (iii) collide with a high Z target (bremsstrahlung). This presentation will focus on the experimental challenges and results related to the development of sources driven by laser-wakefield acceleration for applications at large scale HED science laser facilities with picosecond lasers.

We will present recent experiments on the production of LWFA-based radiation, with photon energies from a few keV to a few MeV, using picosecond laser pulses. Using the Titan laser (LLNL, 150 J, ps), we demonstrated evidence of betatron, Compton scattering, and bremsstrahlung emission in the self-modulated regime of laser wakefield acceleration (SMLWFA), for laser intensities around 10^{18} W/cm^2 [1]. For each radiation generation mechanism, we will go over detailed experimental properties and characterization of the sources, as well as supporting Particle In Cell simulations [2].

Finally, we will discuss planned experiments to demonstrate LWFA-based x-ray sources at larger facilities, such as the Advanced Radiographic Capability at LLNL or the OMEGA-EP laser at the University of Rochester.

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References:

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2. N. Lemos et al, *Plasma Phys. Controlled Fusion* 58, 034018 (2016)