Characterising x-ray emission from high-intensity laser-solid interactions and QED plasmas

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With the commissioning of new multi-PW laser facilities, laser intensities up to 10^{23} Wcm^{-2} are now readily achievable in the near term and provide access to highly nonlinear regimes. These ultra-intense lasers can accelerate ions and electrons in solid targets to ultra-relativistic energies, generating a QED plasma where both relativistic and quantum effects must be considered [1]. QED plasmas are predicted to produce intense bursts of hard x-rays through nonlinear inverse Compton scattering (NCS). Previous simulation work has shown that a bright NCS x-ray flash is a key observable when we transition into the QED plasma regime [2]. However, at laser intensities of 10^{20} - 10^{22} Wcm^{-2}, bremsstrahlung emission dominates and generates x-rays that confound the signal from NCS x-rays.

Simulations play a key role in investigating optimal parameters that simultaneously enhance NCS emission and minimise bremsstrahlung emission including laser intensity, target shape, and target density. The work presented directly compares NCS and bremsstrahlung x-ray emission using results from simulations conducted using EPOCH2D and the hybrid-PIC EPOCH3D extension [3]. The results presented include a comparison of the angular distribution of x-ray energy and laser to photon conversion efficiency for a novel low-Z target in the intensity range 10^{20} - 10^{23} Wcm^{-2}. This work directly links to a recent experiment conducted at the ZEUS laser facility investigating the minimisation of bremsstrahlung emission and pushing towards observing NCS emission in a laboratory setting.

References:

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