Mapping the Power-Law Decay of High-Harmonic Spectra from Few-Cycle Laser-Solid Interactions

S Bhadoria[1], T Blackburn[1], A Gonoskov[1], and M Marklund[1]

[1]*Department of Physics, Univeristy of Gothenburg, Gothenburg, Sweden*
Contact Email: shikha.bhadoria@physics.gu.se

Visible or near infra-red light can be manipulated to produce bursts of coherent extreme ultraviolet (XUV) or X-rays via the relativistic high-order harmonic generation process when a laser irradiates a solid plasma target. The intensity of the spectral components of the reflected signal decays with the increase in harmonic order, and the efficiency of this non-linear process largely hinges on how prompt this decay is. This is governed by the conditions of the laser-plasma interaction for which various models have been proposed. At relativistic intensities, a spectrum exhibiting a power-law decay with an exponent of $8/3$ or $4/3$ is often stated. Here, we analyze the dependence of this exponent on interaction parameters, including the angle of incidence, the carrier-envelope phase, the intensity of the laser and the pre-plasma length, and discuss opportunities for optimization. Our simulations show that, rather than there being one universal exponent, the spectral decay is a continuous function of the laser-plasma interaction parameters.