AN OPTIMAL WAVEFORM AND THE EFFICIENCY LIMIT FOR LASER-DRIVEN COHERENT SYNCHROTRON-TYPE EMISSION FROM SOLIDS

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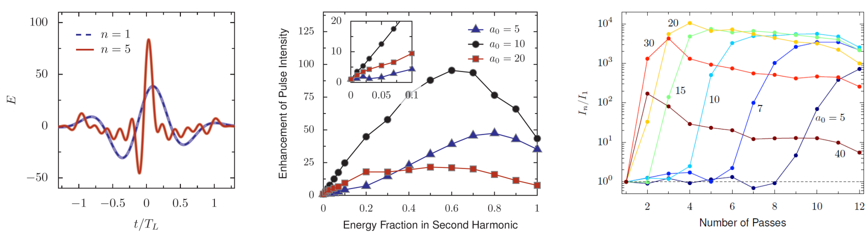
An optimal field waveform for driving laser-induced coherent synchrotron-type XUV/x-ray emission (CSE) from solids [1-6] is found by applying a genetic algorithm to particle-in-cell simulations to maximize the efficiency of CSE. We demonstrate and discuss the physical limit of CSE efficiency, which is approached with driving-field-waveform optimization. This limit is associated with the balance between the light-field and plasma-space-charge forces.

We show that, although the optimally-shaped waveform can be difficult to obtain in experiment, simpler waveform shaping through the addition of second harmonic light to the fundamental frequency of a driving laser pulse can substantially improve CSE efficiency. Under certain conditions two-color fields with 5% of energy in the second harmonic can enhance the maximum intensity of CSE by an order of magnitude [7].

We also demonstrate that the relativistic laser-solid interaction itself may be used to synthesize the optimally shaped waveform for CSE. Multiple successive reflections of a relativistically-intense laser pulse from a solid target can yield an electric field shape capable of improving CSE intensity by several orders of magnitude [8].



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