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Particle-in-Cell Simulations of Harmonic Generation from Relativistic Plasma Mirrors: Effects of Collisions on the Emitting Electron Bunch Width[1] NICHOLAS FASANO, Princeton University, MATTHEW EDWARDS, Lawrence Livermore National Laboratory, JULIA MIKHAILOVA, Princeton University — Relativistic high harmonic generation (RHHG) from plasma mirrors can generate high flux, coherent radiation spanning from infrared to soft x-ray wavelengths. Recent theoretical work and particle-in-cell (PIC) simulations of RHHG have extended the Coherent Synchrotron Emission (CSE) model to account for the finite duration of the emitting electron bunch, showing that the efficiency of RHHG is often limited by the electron bunch width rather than the Lorentz factor of the emitting electrons. However, the PIC simulations typically used to model RHHG do not correctly model the effects of collisions, leading to the appearance of unphysically narrow, high-density electron bunches. Here, we study the effects of adding relativistic binary collisions to the FDTD-based PIC scheme (EPOCH code). The main effects of collisions are to broaden the emitting electron bunch and to increase the number of emitting electrons within the bunch. This modification to the emitting electron bunch has important implications for the ultimate efficiency of RHHG in the relativistic limit. Namely, the extended duration of the emitting electron bunch results in an earlier bunch width dominated spectral cut-off.

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