Synchronized TeraHertz Radiation and Soft X-rays Produced in a FEL Oscillator

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Abstract

We present a scheme to generate synchronized THz and soft X-ray radiation pulses by using a free-electron laser oscillator driven by a high repetition rate (of order 10–100 MHz) energy recovery linac. The backward THz radiation in the oscillator cavity interacts with a successive electron bunch, thus producing a few 10^5 soft/hard X-ray photons per shot (namely 10^{12}–10^{13} photons/s) via Thomson/Compton back-scattering, synchronized with the mJ-class THz pulse within the temporal jitter of electron beams accelerated in the superconducting cavities of the linac (less than 100 fs). Detailed simulations have been performed in order to assess the capability of the scheme for typical wavelengths of interest, between 10 and 50 μm for the TeraHertz radiation and 0.5–3 nm for the X-rays.