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THz-driven short period undulators

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In a variety of electron accelerator based light sources relativistic electron bunches propagate through an undulator and emit intense narrow band radiation. Here, we propose new types of short period undulators, which are based on the alternating electromagnetic field pattern of THz-driven surface plasmon polaritons in sub-wavelength structures. Analytic undulator models are derived and numerical simulations are performed for the undulator fields, the generated wake fields and the emitted radiation. Different undulator structures based on graphene and based on metallic split ring resonators are considered. For a moderate electron beam energy of 100 MeV a 40 mm long undulator is shown to emit narrow band 1 keV X-ray pulses, and therefore has potential for a compact and low cost X-ray source.

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