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High efficiency x-ray source based on inverse Compton scattering in an optical Bragg structure

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Abstract
Existing x-ray sources based on inverse Compton scattering rely on free-space lasers and have modest efficiency due to the inherent limitation of maintaining their peak field intensity over a few Rayleigh lengths. Moreover, their typical interaction spots are tens of micrometres in diameter and they rely on large electron accelerators. We propose a new structure that mitigates many of these limiting factors by confining the interaction in an optical Bragg waveguide, specially designed to support a TEM mode within its sub-micrometre hollow core. This allows the e-beam–laser interaction to be as long as the waveguide itself, resulting in superior spectral quality of the emerging x-ray. Furthermore, the regular RF accelerator may be replaced by an optical Bragg accelerator. This two-stage design, from acceleration to x-ray emission, is expected to have a table-top size, and it is estimated to provide x-ray brightness of 3×10^{17} (photons s^{-1} mm^{-2} $mrad^{-2}$/0.1%BW), while utilizing laser power several orders of magnitude smaller than comparable free-space sources.