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Compact electron acceleration and bunch compression in THz waveguides

We numerically investigate the acceleration and bunch compression capabilities of 20 mJ, 0.6 THz-centered coherent terahertz pulses in optimized metallic dielectric-loaded cylindrical waveguides. In particular, we theoretically demonstrate the acceleration of 1.6 pC and 16 pC electron bunches from 1 MeV to 10 MeV over an interaction distance of 20mm, the compression of a 1.6 pC 1 MeV bunch from 100 fs to 2 fs (50 times compression) over an interaction distance of about 18mm, and the compression of a 1.6 pC 10 MeV bunch from 100 fs to 1.61 fs (62 times) over an interaction distance of 42 cm. The obtained results show the promise of coherent THz pulses in realizing compact electron acceleration and bunch compression schemes. These schemes are the key concepts toward achieving a coherent compact X-ray source in the framework of AXSIS project.

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