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Radiation sources based on laser-driven micro-scale plasma waveguide.[1] LONGQING YI, TNDE FLP, Chalmers University of Technology —

When a high-power laser propagating in a micro-scale plasma waveguide (MPW), the electromagnetic field takes the form of waveguide modes. New features emerge in the relativistic laser-solid interaction process that can be utilized to develop novel radiation sources from THz to X-rays. We show that high charge (10 nC) electron bunches can be produced in the MPW and accelerated to around 100 MeV by the transverse magnetic modes. As the beam co-propagates with the laser (waveguide modes), they are constantly wiggled by a transverse force that gives rise to bright synchrotron-like X-ray emission. In addition, as the electron beam exits the MPW, a substantial part of the electron energy is transferred to coherent diffraction radiation, whose wavelength is directly controlled by the duration of incident laser pulse. Thus, 100-mJ-strong, relativistic intense radiation from sub-THz to infra-red frequency range can be obtained in this stage. The underlying physical process depends strongly on the waveguide mode structure, which can be tailored by the micro-engineering of MPW. This enables a new degree of freedom to control over laser-plasma dynamics, which can be harnessed to reach radiation generation capability beyond the state of the art.

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