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Title

Conceptual Design of a Table-top Terahertz Free-electron Laser

Source

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Abstract

We have designed a table-top terahertz (THz) free electron laser (EEL). The main issue of the EEL design is to decrease radiation losses at the EEL resonator, except the outcoupling ratio. Also, reducing the number of undulator periods and the total undulator length is important to increase the EEL conversion efficiency and to reduce its size. The EEL consists of a magnetron-based microtron having an energy of similar to 5 MeV, a. strong electromagnetic helical undulator having a period of similar to 25 mm, and a cylindrical waveguide-mode optical resonator. The total diameter of the microtron is approximately 60 cm, and the macropulse current is more than 50 mA. The condition for a low-loss high-gain oscillator of the table-top EEL has been studied by using a 2-D EEL code. The injection scheme of the electron beam to the undulator was optimized by calculating beam trajectories with a 3-D particle-in-cell (PIC) code. The average THz power was calculated to be 1 W with a. tunable wavelength range from 200 mu m to 500 mu m. The size of the system is expected to be 1 x 2 m(2). The FEL is expected to be used for real-time imaging for security inspection.