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# THz Wakefield Source Powered by Nonrelativistic Electron Beam

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High peak power tunable THz sources are enabling tools for medicine and materials science, non-destructive evaluation, space exploration. There is a special class of military and defense applications that includes THz communication, atmosphere monitoring, stand-off weapon and contraband detection, crowd screening. All applications require highest possible power to increase the detection distance, signal-to-noise ratio, or the penetration depth for transmission applications. More specifically, development of sources providing the output power from 1 W to 1 kW at frequencies >0.3 THz would be a remarkable advancement. Up to now, this metrics can be obtained only at large scale facilities such as ultrarelativistic MeV synchrotrons and linear accelerators. This is, of course, might not be a practical solution for most applications.
It is possible to generate intense (few W peak power) THz radiation using nonrelativistic ($\gamma$~2) beam of ~200 keV via shock wave Cherenkov radiation. For this purpose, a long electron pulse is transmitted through a multimode dielectric lined slow wave cylindrical waveguide. A ~30 ps long uniform electron bunch with a charge of 1 nC (peak current of 10 A) can be considered. With the listed parameters, the Cherenkov condition is satisfied. Therefore, the electron bunch will start to radiate and produce a wakefield that will result in energy modulation of the bunch. The energy modulation will, in turn, cause different parts of the bunch to travel with different velocities, and so-called ballistic longitudinal compression and consequent microbunching should emerge if the bunch is to travel few cm in free space downstream the dielectric waveguide. It can be shown that the micro bunch train spectrum contains THz harmonics up to 2 THz. In our presentation, we will outline analytical estimations and detailed PIC simulations. Experimental verification and designs of the proposed source will be presented.

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