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Concept of tunable, high power source of coherent THz radiation

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Tunable, source of coherent THz radiation driven by pre-bunched electron beam is discussed. We consider the generation of the multi-bunch train by using either self-modulation instability in a plasma channel or radiating a photocathode with a train of femtosecond laser pulses. By changing the plasma density in the channel or distance between the laser pulses, variation of the bunch train modulation frequency can be controlled. Using the multi-bunched beam, frequency-tunable coherent THz radiation can be generated if the beam propagates above high-impedance surface and study of THz radiation generation when modulated beam propagates above the periodic shallow grating is presented.

Summary

When an electron bunch propagates above a metallic grating or a dielectric, coherent Smith-Purcell or Cherenkov radiation is generated [1-3]. The radiated frequency spectrum from a single bunch is broad band and is normally used for bunch diagnostics [4]. A train of micro-bunches can be used to generate narrow-band coherent THz radiation when it passes through a foil or near a dielectric [3,5]. In this case and if the electromagnetic system is designed correctly, the development of absolute instability and exponential growth of power (similar to BWO) at resonance frequency can be expected. The frequency of the generated radiation will be close to the one of the Fourier components of the modulated beam (in our case this will be the first beam current harmonic). This means that the radiation frequency can be tuned by adjusting the bunch train period.

In this paper, a coherent, tuneable THz radiation source driven by pre-bunched electron beam is discussed. We consider the generation of the multi-bunch train by using either self-modulation instability (SMI) observed in a plasma channel, or by irradiating the photocathode with a train of femtosecond laser pulses. By changing the plasma density in the channel or the separation between the laser pulses, the bunch train modulation frequency can be controlled. Using the multi-bunched beam, frequency-tuneable coherent THz radiation can be generated if the train propagates above a high-impedance surface. We present a study of THz radiation generation when a modulated beam [6] propagates above a periodic shallow grating.

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