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O2.202 Powerful electromagnetic emission from a plasma with counterstreaming different-size electron beams

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It was found recently [1] that counterpropagating plasma wakefields driven by a pair of femtosecond laser pulses with different transverse structures can produce powerful and narrowband EM emission near double plasma frequency. Such a nonlinear process can proceed in a homogeneous plasma, does not require the creation of superstrong magnetic fields, and is not sensitive to the effect of plasma screening. Therefore, using this scheme, it is possible not only to significantly increase the power and energy of THz pulses (up to 1 GW and 10 mJ) but also to provide a small width of the frequency spectrum (1%).
In order to excite colliding plasma waves more efficiently and increase the duration of the intense THz generation, we propose [2] to use kiloampere relativistic electron beams of picosecond and nanosecond duration instead of femtosecond laser drivers. Such beams can reach the high level of power (tens of GW) and are able to continuously pump plasma waves at ionic times via the two-stream instability. Our PIC simulations for the collision of low-density beams with different transverse sizes show that the produced radiation is characterized by a narrow line-width (~1%), and its power enables reaching several percent of the total beam power. It is also found that the same radiation mechanism can work with the close efficiency in a system of dense electron beams with initial equal sizes. In such a system, different beam density shapes and different amplitude profiles of excited waves are automatically produced by the filamentation instability. This new emission mechanism cannot only produce gigawatt-class narrow-band THz radiation by multi-gigawatt electron beams typical for linear induction accelerators, but also play the role in a natural beam and plasma environments such as type II and type IV solar radio-bursts in which emission regions may contain counterstreaming electron populations.
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References
[1] Timofeev, I. V., Annenkov, V. V., & Volchok, E. P. (2017). Physics of Plasmas, 24(10), 103106.
[2] Annenkov, V. V., Berendeev, E. A., Timofeev, I. V., & Volchok, E. P. (2018). Physics of Plasmas, 25(11), 113110.

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