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Parallel Particle-in-Cell based numerical model for the study of terahertz emission from laser-ionized gas targets

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A parallel numerical model for studying the generation of intense terahertz radiation in the interaction of bichromatic infrared laser pulses with a neutral gas and the results of simulations performed on its basis are presented. A fully kinetic model consisting of the Vlasov equations for the plasma distribution functions and Maxwell equations for the self-consistent electromagnetic field is used to simulate the macroscopic response of the plasma generated during ionization of a gas target by a laser field. Field ionization is taken into account within the framework of the cascade mechanism [1]. The numerical code is based on the Particle-in-Cell method and uses a finite difference time domain scheme (FDTD) for electromagnetic fields [2], a Boris pusher to update the positions and velocities of particles, and a charge conservation method [3] to fulfill Gauss's law for the electric field. The energy losses associated with ionization are accounted for by introducing an ionization current. Parallelization is achieved by domain decomposition. The distribution of numerical data between processing units and mutual exchanges are handled by MPI subroutines.

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