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Implementation of a 3D PIC/MCC Simulation to Investigate Plasma Initiation in Nitrogen at Atmospheric Pressure[1] ANDREW FIERRO, JAMES DICKENS, ANDREAS NEUBER, Texas Tech University — The particle-particle interactions involved in plasma formation are well suited to implement in a parallel environment due to the identical computations done for each particle. Specifically, a 3D PIC/MCC simulation was accelerated on an NVIDIA graphics processing unit (GPU) using the CUDA framework for a developing plasma in nitrogen gas at atmospheric pressure to study the initial phase of breakdown. For this simulation, the computational volume was $\sim$220 mm^3 with 15 μm spatial resolution containing two parabolic electrodes. The plasma development is typically characterized by the development of positive ion space charge creating a localized field enhancement thus accelerating ionization processes in this region. For instance, with the application of an 8 kV/cm electric field amplitude, after 1 ns into the simulation, the development of positive ion space charge near both anode and cathode is observed with the densities of $\sim 10^{16}$ cm^{-3} and $\sim 10^{14}$ - 10^{15} cm^{-3}, respectively, while the electron density sits at $\sim 10^{11}$ cm^{-3}. Already 100 ps into the simulation, the distribution of electron energies exhibits non-thermal characteristics with an average electron energy of 0.98 eV that increases to $\sim$10 eV at 1 ns.

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