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Simulation of electron avalanches using Geant4

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Self-sustained electron avalanches have been simulated using the toolkit Geant4, developed at CERN for Monte Carlo simulation of the passage of particles through matter. Some 100 keV seed electrons in air are accelerated by means of an electric field about tens of kV/cm. Air is simulated like a compound of 70% Nitrogen and 30% Oxygen. Geant4 calculates the trajectory of each electron and photon using tabulated values of cross section for electron-atom interactions (ionizations and elastic collisions). The main goal of this research is to evaluate the contribution of different physical processes to the avalanche time evolution at the microscopic scale. Also γ- and X- emissions from the avalanche are reported. The kinetic energy of electrons increases to relativistic values (MeV), which gives rise to the emission of γ-radiation from Bremsstrahlung process. This kind of radiation has a continuous energy spectrum from tens of keV up to MeV. Also a discrete X-ray emission spectrum has been obtained, which is originated from ionization of Nitrogen and Oxygen atomic K-shell.