



## Particle simulations of electron acceleration in electric discharges in the atmosphere

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Bursts of Gamma-rays have been observed from the atmosphere above thunderstorms. They are thought to be generated by bremsstrahlung from relativistic electrons accelerated in the electric fields associated with thunderstorm activity. It is currently debated if the source altitude of the emissions is close to the thunderstorm clouds in the thermosphere or at sprite altitudes in the mesosphere. To answer this question a particle code is used to simulate the development of discharges from thermal seed electrons through electron avalanches into streamers. The code is based on the particle-in-cell (PIC) technique for updating electron velocities and their positions and for calculating the self-consistent electric spacecharge fields. A Monte Carlo technique (MC) is used for simulating interactions with the ambient atmosphere. The code is in 2D cylindrical coordinates, giving realistic spatial variations of the fields during the initial stages of a discharge presented here. The conditions for accelerating electrons to relativistic energies are discussed for discharges in the troposphere (lightning) and the mesosphere (sprites).