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Modeling the production and acceleration of runaway electrons in strong inhomogeneous electric fields with GEANT4

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The mechanism responsible for the production of Terrestrial Gamma-ray Flashes (TGFs) is not yet fully understood. However, from satellite measurements we know that approximately 10^{17} relativistic electrons must be produced at a source altitude of 15 km in order to explain the measured photon intensity. It is also well established that TGFs and lightning are interlinked. One suggested mechanism is the production and multiplication of runaway electrons in the streamer-leader electric fields.

We report on a new study that uses the Geometry and Tracking (GEANT4) programming toolkit to model the acceleration and multiplication of electrons in strong inhomogeneous electric fields such as those occuring in lightning leaders.

In this model we implement a physics list of cross-sections developed by the GEANT4 collaboration to model low-energy particle interactions, the Low-energy Background Experiments (LBE). It has been shown that the choice of physics is crucial to obtain correct results. This physics list includes elastic scattering of electrons according to the møller-scattering method and bremsstrahlung according to the Seltzer-Berger method. In the model we simulate particle interactions explicitly for energies above 250 eV (10 eV for photons). Below 250 eV a continuous energy loss function is used.