

Simulating Terrestrial Gamma Ray Flashes due to cosmic ray shower electrons and positrons

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The University of Valencia has developed a software simulator LEPTRACK to simulate the relativistic runaway electron avalanches, RREA, that are presumed to be the cause of Terrestrial Gamma Ray Flashes and their powerful accompanying Ionization/Excitation Flashes.

We show here results of LEPTRACK simulations of RREA by the interaction of MeV energy electrons/positrons and photons in cosmic ray showers traversing plausible electric field geometries expected in storm clouds.

The input beams of MeV shower products were created using the CORSIKA software package from the Karlsruhe Institute of Technology.

We present images, videos and plots showing the different Ionization, Excitation and gamma-ray photon density fields produced, along with their time and spatial profile evolution, which depend critically on where the line of shower particles intercept the electric field geometry.

We also show a new effect of incoming positrons in the shower, which make up a significant fraction of shower products, in particular their apparent "orbiting" within a high altitude negative induced shielding charge layer, which has been conjectured to produce a signature microwave emission, as well as a short range 511 keV annihilation line.

The interesting question posed is if this conjectured positron emission can be observed and correlated with TGF orbital observations to show if a TGF originates in the macro E-fields of storm clouds or the micro E-fields of lightning leaders where this positron "orbiting" is not likely to occur.