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Terrestrial gamma-ray flashes, antimatter and hadrons correlated to lightning events

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For two decades thunderstorms have been observed to emit terrestrial gamma-ray flashes (TGFs), flashes of photons with single quantum energies of up to 40 MeV, as well as positron and neutron beams.
TGFs, the only known natural events with energies of several tens of MeV, are produced through the Bremsstrahlung process by high-energy electrons which are accelerated in the vicinity of conducting lightning channels. Although most electrons which are accelerated in the electric field of lightning channels, scatter with air molecules and do not gain sufficiently high energies, there is a small probability of some electrons not colliding too frequently and reach energies of up to tens of MeV. Once high-energy photons have been created, they can produce electron positron pairs through pair production at air nuclei and hadrons (neutrons as well as protons) through photonuclear processes.
We will present an overview of how to model the acceleration and scattering of electrons ahead of lightning channels as well as the motion of photons, positrons and hadrons through the atmosphere. We will present the spatial and energy distribution of these species at source altitude and at satellite altitudes (500 km) and briefly describe the relevance on human beings.

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