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Space-time simulations of photon, lepton, ionization and nucleon trails of TGF ignition in thunderstorm electric field geometries

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The origin of high energy electrons which contribute to the Relativistic Runaway Electron Avalanche of a TGF are not precisely known, or yet observed, though the most obvious source would seem to be the products of cosmic ray showers, or electron avalanches generated in the high electric field near the tips of lightning leaders.

With our new TGF simulation software package LEPTRACK we can now easily create any electric field geometry to be expected in stormclouds, any kind of electron source, and are investigating scenarios of TGF ignition, which may or may not be runaway, and in any direction - not just vertical.

Vidoes, lightcurves and spectra, presenting the detailed density structure and time evolution of TGF photon, electron, neucleon and ionization trails were presented for the first time at the AGU Fall Meeting in 2014 - showing the complicated effects of changing electric field strength and air density - and the as yet unrecognized importance of the earth magnetic field in trapping electrons and positrons in the upper atmosphere at the magnetic equator - possibly giving rise to the hard tail seen in some TGF spectra observed by AGILE.

We will present here an extension of this work to show the dynamics of TGF ignition scenarios of current interest - upward, downward and randomly directed - both from free electrons and from combinations of lightning leader micro-fields producing electron avalanches, which are then input to the macro-fields expected at or above thunderstorm cloudtops.

We will show the spatial shape and time evolution of TGF particle structures, along with their optical and gamma ray spectra emitted, and bring to life their essential physics.