Dansk Fysisk Selskab

Contribution ID: **4** Type: **not specified**

Modelling the production of terrestrial gamma-ray flashes in different cloud electric fields in conjunction with ASIM measurements

Terrestrial gamma-ray flashes (TGFs), the only known natural events on Earth with energies of several tens of MeV, are produced by energetic electrons accelerated in thunderclouds in the vicinity of conducting lightning channels. But what is the real production mechanism of energetic electron and photon beams?
Launched on April, 2nd, 2018, the Atmosphere-Space Interactions Monitor (ASIM) is a collaborative project amongst the Technical University of Denmark (DTU), the European Space Agency (ESA) and various international partners. One of its main scientific goals is to study the signatures of TGFs and their connection to the parenting lightning stroke.
Recent ASIM measurements indicate that the production of energetic electrons and TGFs occur immediately prior to intracloud lightning breakdown. Inspired by this finding, we model the acceleration of electrons and the subsequent production of energetic photons in the electric field of two lightning flashes of opposite polarity and of lightning channels moving into charged cloud regions. Applying a particle Monte Carlo code, we initiate an electron current of approx. 1–2 kA from the negative channel tip and explore the process at different cloud altitudes. The code traces electrons and photons from sub-eV to tens of MeV and takes into account the self-consistent electric field resulting from ionization and charge separation of electrons and ions. We present the temporal evolution of the
electron and photon densities, energies and spectra. Finally, we relate our results to consolidated ASIM measurements and discuss the relation between measurements and simulations.

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