

## From the Geosphere to the Cosmos: ASPERA Workshop

### Abstract

#### Terrestrial Gamma-Ray Flashes as powerful particle accelerators

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Terrestrial gamma-ray flashes (TGFs) are sudden (a few millisecond) bursts of energy associated with lightning in powerful thunderstorms.

TGFs are very energetic, and are characterized by a spectrum reaching energies up to 100 MeV. We will summarize the current satellite observations, and will focus on the results obtained by the AGILE satellite, a high-energy astrophysics mission operating in an equatorial orbit since mid-2007.

AGILE has been detecting hundreds of TGFs in about 3 years of operations, and substantially improved the high-energy detection of these impulsive phenomena. Contrary to previous expectations and current theoretical models, AGILE discovered substantial TGF emission well above 10 MeV.

A distinct power-law spectral component is detected up to 100 MeV with far-reaching consequences. Very efficient particle acceleration occurs in TGFs using potential differences of the order of the maximum values (hundreds of MegaVolts) that can be established in cloud-to-ground and inter-cloud discharges. We will discuss the relevance of these observations for theoretical studies of particle acceleration and atmospheric and climate studies. TGFs copiously produce accelerated electrons (and possibly positrons) that radiate an intense gamma-ray spectrum. Neutrons are also produced by photonuclear reactions in the atmosphere. We will discuss the atmospheric propagation properties of the particle/radiation output of TGFs and discuss their implications.

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