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Insight Into Lightning Initiation via Downward Terrestrial Gamma-ray Flash Observations at Telescope Array

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Due to the difficulty of direct measurement of the thunderstorm environment, in particular the electric field strengths, the initial stages of lightning breakdown remain mysterious. The 1994 discovery of Terrestrial Gamma-ray Flashes (TGFs) and their implications for megavolt potentials within thunderclouds has proved to be a valuable source of information about the breakdown process.

The Telescope Array Surface Detector (TASD) — a 700 km^2 scintillator array in Western Utah, U.S.A — coupled with a lightning mapping array, fast sferic (field change) sensor and broadband interferometer, has provided unique insight into the properties of this energetic radiation and of lightning initiation in general. In particular, microsecond-scale timing comparisons have clearly established that downward TGFs occur during strong initial breakdown pulses (IBPs) of downward negative cloud-to-ground and intracloud flashes. In turn, the IBPs are produced by streamer-based fast negative breakdown.

Investigations into downward TGFs with the TASD have significantly evolved with recent upgrades to lightning instrumentation. A second state-of-the-art broadband interferometer allows high-resolution stereo observation of lightning development. A high-speed optical video camera, set to be deployed in Spring 2021, will allow simultaneous observation of the visual component of lightning responsible for TGF production. Finally, a suite of ground based static electric field mills will provide new information on the large-scale properties of the thunderstorms in which downward TGFs arise.

In this talk, we present the most recent TGF observations from the Telescope Array.

Keywords

TA;TASD;LMA;lightning;terrestrial gamma-ray flash;TGF;streamer;leader;gamma

Collaboration

Telescope Array

other Collaboration

Subcategory

Experimental Results

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