



Contribution ID: 17

Type: **not specified**

## Thunderstorms and Atmospheric Gamma-ray Observations at the Telescope Array Detector.

*Thursday, 14 July 2022 10:30 (30 minutes)*

In this talk I will present observations of lightning and terrestrial gamma ray initiation at the Telescope Array (TA) detector. The Telescope Array detector is located in the southwestern desert of the State of Utah. The combination of size and elevation makes it a unique tool that allows us to study thunderstorms. Currently it is the largest ultra high energy cosmic ray experiment in the Northern Hemisphere. The surface detector array part of the TA experiment, used in these observations, is composed of 507 scintillator detectors on a 1.2 km square grid covering a 700-kilometer square in area, 1400 m above sea level.

I will present observations by the Telescope Array Surface Detector (TASD) of the effect of thunderstorms on the development of the low-energy cosmic ray showers.

Using the TASD, we can study the electric field inside thunderstorms, on a large scale, as it progresses on top of 700-kilometer square in area. Such observations allow us to study the electric field inside thunderstorms on a large scale without dealing with all the limitation of narrow exposure in time and space using balloons and aircraft detectors. Simulation work that aims to interpret these observations will also be discussed.

I will also present the first and new observation of the optical emission counterpart of an extremely energetic downward-directed terrestrial gamma ray flash (TGF). The optical emission was observed by a high-speed video camera Phantom v2012 in conjunction with the Telescope Array surface detector, lightning mapping array, interferrometer, fast antenna, and the national lightning detection network. Results from this study allow us to further the understanding of the initiation mechanism of terrestrial gamma ray flashes. In addition, they allow us to further our ability to compare the most recent satellite optical emissions counterpart of upward-directed TGFs to that of downward-directed TGFs.

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**Session Classification:** Atmospheric Electricity