Ground Level observation of Gamma-ray Showers in Coincidence With Downward Lightning Leaders

Terrestrial Gamma Ray flashes (TGFs) are bursts of gamma-rays associated with lightning and initiated in the Earth's atmosphere. TGFs have been detected by satellite experiments since 1994. In this talk, we report on observing TGFs at the ground level by the Telescope Array (TA) Ultra High Energy Cosmic Ray (UHECR) detector, located in Southwestern desert of Utah.

TA is a $\sim$700 km$^2$ detector, comprised of 507 (3 m$^2$) plastic scintillator detectors on a 1.2 km square grid. We report on data collected with the Telescope Array, along with a Lightning Mapping Array (LMA) and Slow Antenna (SA), which provides the first ground based evidence for TGFs correlated with the leader stage of lightning.

The gamma-ray showers were observed in the first 1-2 ms of downward negative breakdown with leader sources prior to cloud-to-ground lightning strikes. The shower sources were observed by the LMA detector at an altitude of a few kilometers or less above ground level. The detected energetic burst showers have a footprint on the ground typically $\sim$3–5 km in diameter. The duration of the bursts are of the order of several hundred microseconds. Simulation studies indicate that the showers are consistent with a forward-beamed primary gamma rays of $10^{12}$-$10^{14}$ primary photons. This result may provide a new insight into the theory of the TGF phenomenon.

Dr. Rasha Abbasi & Dr. John Belz
Department of Physics
University of Utah

Wednesday, January 17, 2018, at 3:15pm
110 INSCC
Refreshments and Meet the Speaker at 3:00pm