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A lightning detection system for studying transient phenomena in cosmic rays observatories

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Transients of the atmospheric electric field could cause anomalous events in the surface particle detectors of cosmic ray observatories. A better understanding of these incidents requires more accurate lightning data at the observation sites. We present the design and implementation of a monitoring system capable of detecting and storing lightning discharges. The acquisition window per event contains information of the first return stroke and the subsequent ones during 1.2 seconds at a sampling frequency of 100 kHz. The acquisition timing resolution (10 ns) allows a lightning strike location error < 10 m. The station also records environmental data, containing temperature, barometric pressure, relative humidity, and steady-state atmospheric electric field. A GPS receiver provides the absolute time of the station. 3-dimensional mapping of lightning discharge can be reconstructed in detail using a monitoring network of at least three stations.

We present preliminary measurements during a thunderstorm episode (2019-11-09). The event lasts about 2 hours, recording a maximum electric field peak $\sim$-15 kV/m. The atmospheric potential was $\sim$27 MV with an estimated thunderstorm cloud-base height of $\sim$2 km. At least four lightning events occurred during the thunderstorm period. Such discharges released an electric field >5 kV/m.

Keywords

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Collaboration

other Collaboration

Subcategory

Experimental Methods & Instrumentation

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