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Thunderstorm effects on shower rate with KM2A

The high-altitude location and the frequent occurrence of thunderstorms make LHAASO suitable to study the effects of thunderstorm electric fields on cosmic ray air showers. In this work, the thunderstorm episodes in 2022 are studied. According to the electric field structure, three typical types of thunderstorms are found at LHAASO site. By analyzing the KM2A data in shower mode, the variations of shower rates during thunderstorms without nearby lightning flashes are studied in detail. During a thunderstorm, the noise trigger recorded by the detector will increase, resulting in the change of the trigger rate. To better study the field effects on the flux variations of shower events, the noise during thunderstorm needs to be considered. After considering the interference of noise, we get a clear thunderstorm-related cosmic ray air shower variation. The variations of trigger rates are found to be correlated to the strength and polarity of electric field, and also strongly dependent on the primary zenith angle. Due to the acceleration/deceleration and deflection by the atmospheric electric field, the number and space-time of secondary particles with energy above the detector threshold are modified, leading to the changes in shower detection rates in KM2A. Our results are useful in the study of atmospheric physics and cosmic rays.

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