



Photonuclear reactions triggered by lightning discharge in a Japanese winter thunderstorm

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Winter thunderstorms and powerful lightning along the Japan sea are an ideal laboratory for studying high-energy radiation originated from accelerated electrons in the atmosphere. In 2006, our Gamma-Ray Observation of Winter THundercloud (GROWTH) collaboration started ground-based radiation measurements for Japanese winter thunderstorms and has detected gamma-ray glow events for our ten years operations (Tsuchiya, Enoto et al., 2007, PRL). Since 2016, we have newly developed low-cost and portable detectors for multi-point mapping observations of high-energy atmospheric events. On February 6, 2017, a series of gamma-ray events after a lightning discharge were recorded with our four radiation detectors at Kashiwazaki, Japan. An initial intense radiation flash was followed by an exponential decay gamma-ray afterglow with 40-60 ms decay constants. The gamma-ray line at 0.511 MeV was further detected about 35 second after the lightning discharge. This event was successfully explained as evidence for lightning-triggered photonuclear reactions in the atmosphere (Enoto, Wada et al. 2017, Nature).