Progress of Observation Project for High-energy Phenomena in Winter Thunderstorms

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In strong electric fields of thunderclouds and lightning, electrons are accelerated to relativistic energy, and emit bremsstrahlung gamma rays which are observed by space bourne, airbourne, and on-ground experiments. To reveal the mechanism and condition where the electron acceleration takes place, we have been performing the Gamma-Ray Observation of Winter Thunderclouds (GROWTH) experiments in coastal areas of Japan Sea since 2007. In 2015, we started multi-point observation campaigns with portable radiation detectors in Ishikawa and Niigata Prefectures. So far, we have revealed characteristics of long-lasting gamma-ray bursts from thunderclouds (long bursts: Tsuchiya et al. 2007), and photonuclear reacitons in the atmosphere triggered by terrestrial gamma-ray flashes coincident with lightning discharges (short bursts: Enoto et al. 2017). We are expanding the number of detectors to observe more events of such long and short bursts with multiple detectors. in the 2018-2019 winter season, we operated more than 20 radiation detectors. We are also promoting joint-observation campaigns with low-frequency radio and atmospheric electric-field measurements (Wada et al. 2018). We succeeded in the first simultaneous detection of long and short burst events in Kanazawa. Because the short-burst-triggering LF pulse took place within 1 km from the position where the long burst ceased, it is suggested that the strong electric field responsible for the long burst assisted the short burst. We will report the progress of the GROWTH project and this simultaneous detection event.

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