Multi-point radiation measurements for gamma-rays from accelerated electrons in winter thunderstorm

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Recent on-ground observations have revealed that winter thunderstorm along the Japan sea radiates gamma-rays with energy extending up to 10 MeV (Torii et al., 2002, Tsuchiya & Enoto et al., 2007). Inside the thunderstorm, electrons are thought to be accelerated to relativistic energy by strong electric field, and to radiate bremsstrahlung gamma-rays. Currently, since the number of observation sites is limited, it has been difficult to trace time- and space-dependent changes of gamma-ray spectra. In order to resolve the electron acceleration mechanism inside thunderstorms (e.g., generation, growth, and disappearance of the relativistic electron acceleration region), we started to construct a new multi-point mapping system of the gamma-ray radiation, which can trace a path of the radiation and can detect a change of gamma-ray intensity and spectral change. In 2016-FY, we have developed a small, inexpensive FPGA/ADC board and a front-end electronics board to be coupled with BGO scintillators and PMT photo-diodes (see also Wada et al., JpGU session at the M-IS 18). We installed these new small radiation detectors on roofs of several high school and universities in Kanazawa prefecture, which area is famous for energetic winder thunderstorms. Our acquisition system has been collecting energy and arrival time (with GPS time tag) of individual photons, with environmental information (e.g., temperature, pressure). On 2016 December 8 and 9, we detected the gamma-ray radiation from winter thunderstorms at Kanazawa and Komatsu cities. We will report current status of our project and future prospects on understanding of the micro physics in the thunderstorms.

Keywords: winder thunderstorm, gamma-ray, electric field, electron acceleration

