

Lightning: Ground observations of gamma radiation

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Recent satellite and ground observations of emissions in x and gamma-rays ascribing association with lightning phenomena have triggered interest in this natural phenomena. The incentive for this Ground Gamma Radiation (GGR) experiment in the Brazilian Geomagnetic Anomaly (BGA) region is due to the absence of satellite data. As a first step we want to test and calibrate the system with rocket triggered lightning flashes in the International Lightning facility in our Campus.

The lightning associated gamma rays can be inferred as due to bremsstrahlung associated with electrons released moments after the return stroke, and the likely radiation associated with radioactive decay products in the interactions of protons generated in the lightning with the atmospheric constituents. Initially, in 2005 to observe the later phenomena, a very large area NaI(Tl) detector of 40 cm diameter with a PHA system (monitoring every 10 s) was set up near the two rocket launchers for the induced lightning. In few months of operation in 2005, increases in gamma-rays above the ground radiation flux are observed due to many rain precipitation events and in one lightning event coincident with the rocket launch. To identify the association of emission due to the lightning we investigated both the decay period and the spectral information of these gamma rays. The radon progeny in rain has an associated decay period of ~ 30 min, but, however, the decay time associated with the lightning is different. Although the spectral information indicates a power law index for both lightning and rain, we report here an indication of a gamma-ray line at 1240 keV, exclusively in the former phenomena. Interestingly, proton interactions with Ar (an atmospheric constituent) produce an isotope ^{39}Cl which has emission at this energy. This season of 2006, our experiment has few NaI(Tl) detectors with pulse digitizers to monitor individual gamma rays for total durations of 0.5 millisecond, immediately after rocket launch. The results of these lightning monitoring will be presented along with the details of the experiment.