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Balloon-borne measurement of energetic electron fluxes inside thunderclouds

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High-energy radiation is routinely produced by thunderclouds and lightning. This radiation is in the form of x-rays and gamma-rays with timescales ranging from sub-microsecond (x-rays associated with lightning leaders), to sub-millisecond (Terrestrial Gamma-ray Flashes), to minute long glows (Gamma-ray Glows from thunderclouds seen on the ground and in or near the cloud by aircrafts and balloons). It is generally accepted that these emissions originate from bremsstrahlung interactions of relativistic runaway electrons with air, which can be accelerated in the thundercloud/lightning electric fields and gain up to multi-MeV energies. However, the exact physical details of the mechanism that produces these runaway electrons are still unknown.

In order to better understand the source of energetic radiation inside thunderclouds, we have begun a campaign of balloon-borne instruments to directly measure the flux of energetic electrons inside thunderclouds. In the current configuration, each balloon carries Geiger counters to record the energetic particles. Geiger counters are well suited for directly measuring energetic electrons and positrons and have the advantage of being lightweight and dependable. We transmit data at 900MHz, ISM band, with 115.2 kb/s transmission rate. This would provide us a high resolution radiation profile over a relatively large distance. Due to the nature of the thunderstorm environment, the campaign has many design, communication, and safety challenges. In this presentation we will report on the status of the campaign and some of the physical insights gained from the data collected by our instruments.

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