

Positron production within our atmosphere

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Positrons are commonly produced within our atmosphere by cosmic rays and the decay radioactive isotopes. Energetic positrons are also produced by pair production from the gamma rays generated by relativistic runaway electrons. Indeed, such positrons have been detected in Terrestrial Electron Beams (TEBs) in the inner magnetosphere by Fermi/GBM. In addition, positrons play an important role in relativistic feedback discharges (also known as dark lightning). Relativistic feedback models suggest that these discharges may be responsible for Terrestrial Gamma-ray Flashes (TGFs) and some gamma-ray glows. When producing TGFs, relativistic feedback discharges may generate large, lightning-like currents with current moments reaching hundreds of kA-km. In addition, relativistic feedback discharges also may limit the electric field that is possible in our atmosphere, affecting other mechanisms for generating runaway electrons. It is interesting that positrons, often thought of as exotic particles, may play an important role in thunderstorm processes. In this presentation, the role of positrons in high-energy atmospheric physics will be discussed. The unusual observation of positron clouds inside a thunderstorm by the ADELE instrument on an NCAR/NSF Gulfstream V aircraft will also be described. These observations illustrate that we still have much to learn about positron production within our atmosphere.