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A Puzzle in the Earth's Mesosphere: Runaway Electrons

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Gammay-ray flashes (GRF) of terrestrial origin with energy spectrum extending to 20 MeV and lasting in the order of a millisecond were detected in 2005 by the Reuven Ramaty High Energy Solar Spectroscopic Imager. These observations reveal the presence of relativistic electrons in the earth's mesosphere with 10^{15} electrons/GRF and electron energies up to 40 MeV. Possible collisional avalanche mechanisms for generating such large pulses of relativistic electrons must overcome two dampening factors: 1) the peak ambient electric fields in the mesosphere, in the order of 5 V/cm during thunderstorms, are too low for electrons to overcome collisional losses and accelerate to these high energies, and 2) the secondary energy spectrum in ionizing collisions decreases with the square of the energy of the secondary so that collisional avalanches of high energy electrons tend to grow at lower energies. This talk examines the origin of these bursts in runaway electrons, electrons that on average are not in dynamical-equilibrium with the background gas and progressively move towards higher energies.