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Modeling of Pulses in Terrestrial Gamma-ray Flashes

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Terrestrial Gamma-ray Flashes (TGFs) are high-energy photon bursts originating from the Earth's atmosphere that are associated with lightning activities. After their discovery in 1994 by the Burst and Transient Source Experiment (BATSE) detector aboard the Compton Gamma-Ray Observatory [*Fishman et al.*, Science, 264, 1313, 1994], this phenomenon has been further observed by the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) [*Smith et al.*, Science, 307, 1085, 2005], the Fermi Gamma-ray Space Telescope [*Briggs et al.*, JGR, 115, A07323, 2010] and the Astrorivelatore Gamma a Immagini Leggero (AGILE) satellite [*Marisaldi et al.*, JGR, 115, A00E13, 2010]. Photon spectra corresponding to the mechanism of relativistic runaway electron avalanches (RREAs) usually provide a very good agreement with satellite observations [*Dwyer and Smith*, GRL, 32, L22804, 2005]. On the other hand, *Celestin and Pasko* [JGR, 116, A03315, 2011] have shown theoretically that the large flux of thermal runaway electrons generated by streamers during the negative corona flash stage of stepping lightning leaders in intracloud lightning flashes could be responsible for TGFs. Recently, based on analysis of the temporal profiles of 278 TGF events observed by the Fermi Gamma-Ray Burst Monitor, *Foley et al.* [JGR, 119, 5931, 2014] have suggested that 67% of TGF pulses detected are asymmetric and these asymmetric pulses are consistent with the production mechanism of TGFs by relativistic feedback discharges. In the present work, we employ a Monte Carlo model to study the temporal distribution of photons at low-orbit satellite altitudes during TGF events. Using the pulse fitting method described in [*Foley et al.*, 2014], we further investigate the characteristics of TGF pulses. We mainly focus on the effects of Compton scattering on the symmetry properties and the rise and fall times of TGF pulses.