EGU21-3250
https://doi.org/10.5194/egusphere-egu21-3250
EGU General Assembly 2021

Constraining the Origin Altitude of the first Satellite-Detected Reverse-Beam Terrestrial Gamma-ray Flash Produced by a Cloud-to-Ground Lightning Leader.

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We provide an updated analysis of the gamma-ray signature of a terrestrial gamma ray flash (TGF) detected by the Fermi Gamma-ray Burst Monitor first reported by Pu et al. 2020. Gamma-ray photons were produced 3ms prior to a negative cloud-to-ground return stroke and were close to simultaneous with an isolated low frequency radio pulse during the leaders propagation, with a polarity indicating downward moving negative charge. This 'slow' low frequency signal occurring prior to the main discharge has previously been strongly correlated with upward directed TGF events (Pu et al. 2019, Cummer et al. 2011) leading the authors to conclude that the Fermi detected counts just prior to the return stroke are the result of a reverse positron beam generating upward directed gamma rays. We investigate the feasibility of this scenario and constrain the limits on the origin altitude from the perspective of the gamma-ray signature timing uncertainties, TGF Monte Carlo simulations, estimates of intrinsic brightness as a function of altitude, and meteorological analysis of the storm and its possible charge structure and altitude.