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Geolocation of Terrestrial Gamma Ray Flashes in Gamma Rays Using the Fermi Large Area Telescope

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We derive geolocations of bright Terrestrial Gamma ray Flashes (TGFs) directly in gamma rays using the Fermi Large Area Telescope (LAT) and compare with geolocations given by LF and VLF radio networks intended to study lightning discharges. We show that the Fermi LAT, which was designed to perform an imaging survey of the high-energy gamma ray sky, can geolocate bright TGFs in favorable geometries with accuracies <100 km, a factor of a few larger than radio geolocation accuracies. A large fraction of TGFs appear to be temporally coincident with radio pulses detected by lightning geolocation network. Recent work by Cummer et al. (2011), Connaughton et al. (2013), and Dwyer and Cummer (2013) strongly suggests that the pulse of relativistic electrons that generates the gamma rays via bremsstrahlung also generates the radio signal via its secondary ionization electrons. Our analysis confirms this picture by establishing that the radio and gamma ray signals are indeed temporally and spatially coincident.

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