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Temporal behaviour of Terrestrial Gamma ray Flashes

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Measurements done by the Burst and Trancient Source Experiment (BATSE) instrument on the Compton Gamma Ray Observatory (CGRO) have shown a softening of the energy spectra of Terrestrial Gamma Ray flashes (TGFs) with time. The time delays between high energy photons (> 110 keV) and low energy photons (< 110 keV) are in order of $100 - 200$ μs. We have done Monte Carlo simulations of TGFs propagating through the atmosphere. The time delays in our simulations increase as the TGFs production occurs at lower altitudes and as a satellites nadir angle of measurements increase. The largest time delay found in our simulations is 80 μs, which is less than found in the BATSE measurements. A closer study of the BATSE light curves shows that the TGFs have different temporal behaviour, i.e. single peaked, double peaked, multiple peaked and long duration burst, which last for more than 4 ms. The double and multi peaked TGFs contains peaks separated in order of 1-2 ms, which indicates that these TGFs contains two or more separate burst. The long duration burst are suggested to be electron beams occurring together with TGFs.