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# Observational evidence of two different populations of Terrestrial Gamma-ray Flashes

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Terrestrial Gamma-ray Flashes (TGF) are very short bursts of gamma-rays associated to thunderstorm activity, currently observed by detectors onboard satellites or research airplanes. TGFs are likely produced by Bremsstrahlung of energetic electrons accelerated by a mechanism (e.g., the Relativistic Runaway Electron Avalanche mechanism, RREA) in close association with the lightning leader propagation. The AGILE satellite is one of the only three currently active space instruments capable of TGF detection and is especially tailored for the detection of high-energy photons in the tens of MeV regime. Up to November 2011 the full AGILE TGF sample includes more than 300 events, with an average detection rate of about 10 TGFs/month. AGILE indicates that TGF high energy spectral behaviour deviates from the canonical RREA model, reporting photon energies as large as 100MeV which require electrons acceleration across a large fraction of the full available potential difference in a thundercloud. We will report on the most recent AGILE observations that suggest the existence of two distinct populations in our TGF sample. The first population includes about 90% of the TGFs and consists of events with maximum energy lower than 30 MeV, whose cumulative spectrum can be well described by a powerlaw with exponential cutoff well reproduced by the canonical RREA model. The geographical and local time distributions of this population well match those of standard lightning. The remaining 10% of the AGILE TGF sample include events with photon energy as large as 100 MeV and a cumulative spectrum well described by a powerlaw with no evidence for a spectral cutoff. This spectral behaviour can hardly be reconciled with the standard RREA model. The geographical distribution of this latter sub-class may be different from the low-energy sub-class. We discuss the hypothesis that this high-energy population is a separate class of TGFs whose production process and parent lightning can differ significantly from the bulk of TGFs population. We present the characteristics of the two TGF populations, with particular emphasis on their different spectral and geographical properties. Finally, we speculate on the properties of the parent lightning that can be conducive to the high-energy population.