Search for Terrestrial Electron Beams (TEB) in SAMPEX data

V. Aamodt[1], N. Østgaard[1], T. Gjesteland[1], B.E. Carlson[2], A. Collier[3]

[1] *Birkeland Centre for Space Science, Department of Physics and Technology, University of Bergen, Bergen, Norway*
[2] *Carthage Collage, Wi, USA*
[3] *Space Physics Research Institute, University of KwaZulu-Natal, Durban, South Africa*

SAMPEX was a satellite orbiting around the Earth from 1992 to 2012 in an low orbit with an inclination of 82 degrees. Terrestrial gamma-ray flashes, associated with lightning, are producing secondary electrons which is gyrating along geomagnetic field lines into space. The point of interest is where we have the intersection between a geomagnetic field line, where a Terrestrial Electron Beam is gyrating, and the SAMPEX orbit. If we can find such events, that is significant something else than background flux, we can follow the field line and predict the position of the footprint points. Our goal is to detect such terrestrial electrons with the HILT instrument on SAMPEX and look for some lightning activity in the footprint area.

1. General

1.1. TGF and TEB

Terrestrial gamma-ray flashes (TGF) are high energy bursts of photons that can be understood as bremsstrahlung from a source of runaway relativistic electron avalanche (RREA) in the Earth's atmosphere [1]. This source is from an altitude below 20 km and is closely associated with lightning. RREA is in most cases not propagating out of the atmosphere, but secondary electrons produced by gamma-rays might have been detected in space and are called Terrestrial Electron Beams (TEB).

1.2. Search for TEB

TEB are produced by Compton scattering and pair production [1]. They are gyrating along geomagnetic field lines into space. It has been shown that such electrons have been detected by SAMPEX [1]. SAMPEX is an satellite that was orbiting around the Earth from 1992 to 2012. On SAMPEX there was an instrument called Heavy Ion Large Telescope (HILT) consisting of a drift chamber, proportional counter, scintillators and solid state detectors with an geometric factor of 60 cm^2sr [1]. During the 16 last year of its operational time (1996-2012), it was switched to a mode with a time resolution of 20 ms and the opportunity to detect electrons with energies in excess of 1 MeV.

Data from every 20 ms interval in 16 years means that there are about 25 billion bins of data. If we can find some Terrestrial Electron Beams in SAMPEX data, we can follow the geomagnetic field line to its footprint and look for lightning activity that could be the source of the TGF. Terrestrial Electron Beams is a new way to explore and find out more about TGF.

2. Preliminary results

2.1. TEB candidates

Figure 1 is a plot of the particle flux of 150 bins of data, 20 ms each. This is from the 29th of August 2012, at 05:50:52.2 UT. The satellite was located east of Japan. The peak in the middle of the plot is a TEB candidate which is significant something else than background. In the future we will collect such events and look for lightning activity by WWLN data.

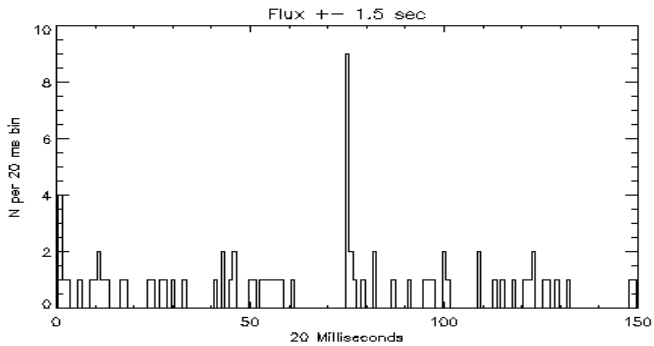

Figure 1: This is a TEB candidate from SAMPEX data. The plot is showing particle flux data from HILT. X-axis represents bins of data, 20 ms each. Y-axis represents counts (N) per bin. The peak in the middle of the plot is significant something else than the background flux.

3. References

[1] B.E. Carlson, N.G. L, U.S. Inan, Observations of terrestrial gamma-ray flash electrons (2009).