

# Natural Radio

*News, Comments and Letters About Natural Radio*

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**Dark Lightning** – A year ago I wrote an article in this column about Terrestrial Gamma-ray Flashes (TGFs). These flashes were discovered by the Compton Gamma-ray Observatory in 1994. These are gamma-ray emissions that come from thunderstorms on earth. The theory at that time was that the lightning produces emissions of electrons and positrons (the anti-matter equivalent of the electron) which are ducted along the earth's magnetic field lines. When the particles recombine and are annihilated, a gamma-ray flash is produced, but little was known about their creation.

In one beam detected by the Fermi telescope, the number of positrons was so large that the thunderstorm was briefly creating more radiation—in the form of positrons and gamma-rays—than what hits Earth's atmosphere from all other cosmic sources combined.

In mid 2010, scientists began testing the Gamma-ray Burst Monitor (GBM) aboard Fermi in a mode where the GBM directly downloads full-resolution gamma-ray data even when the on-board trigger hadn't detected a burst. This allowed the observation of many faint TGFs that had formerly been missed. This mode produced so much more useful data, that on Nov. 26 of 2010, the team uploaded new flight software to operate the GBM in this mode continuously.

Strong VLF bursts have been linked to TGFs for a long time, but researchers assumed that these signals were emitted by the lightning strokes associated with the gamma-ray emission. However, data from the improved measurements indicated that when a strong radio burst occurs almost simultaneously with a TGF, the radio emission is actually coming from the TGF itself.

Recently, however, a new theory has emerged to explain the generation of positrons and electrons that trigger the gamma-ray burst, Dark Lightning. What is hypothesized is that Dark Lightning may be a “competitor” to conventional lightning. Both act to neutralize the massive electrical charges that build up in thunderstorms.

Analysis of the new data indicated that these gamma-ray flashes were not associated with conventional lightning strokes. What is proposed is that under certain conditions, the growing electrical field in a thunderstorm can precipitate a powerful avalanche of electrons, shooting upwards at near light speed. These electrons collide with air molecules and produce gamma-rays. These are the gamma-ray bursts observed by the Compton, RHESSI and Fermi satellites.

Then, the gamma-ray radiation transforms into a positron and electron pair. Successive collisions between the new particles and air creates more positrons and electrons. Then the cycle repeats, like nuclear fission. Once this feedback loop gets going, it can quickly discharge parts of the thundercloud very quickly, just like a lightning stroke. Since this process generates a lot more gamma-rays than light, it's practically undetectable in the visible spectrum.

So, this is a new theory to explain the gamma-ray bursts that were once thought to be a product of ordinary lightning.

Currently, there's not a lot of information available as the study is new and ongoing. I would speculate that these upward electron blasts might be related to blue jets and the mysterious "giant jets". I'd also be interested in finding out if the propagation of the positrons and electrons along the earth's field lines is related in any way to whistlers and other whistler-mode phenomenon.

Also, does the VLF burst from a TGF have a different radio signature than a large lightning burst? There are lots of questions here that will hopefully be answered by further research.

NASA has produced a video about this Dark Lightning theory at <http://www.youtube.com/watch?v=hN0wGga5e0I>. I've embed the video on the [naturalradiolab.com](http://naturalradiolab.com) website, if you want to view it there.

***Naturalradio.com Updates*** – I made a few updates to the website this month. I fixed the email link in the contacts section, which appears to have been broken for awhile. If you emailed me and I didn't respond, I wasn't ignoring you, I just never got the mail.

I added a "SATELLITES" section to the "RESOURCES" menu. This is an updated version of my satellites guide that I published here a couple of years ago. The hyperlinks should make it a bit more useful than the printed article. Finally, I uploaded the last of the 2012 Lowdown articles to the archive.

If there is any other reference data that would be useful to you on the website, please email me at [info@naturalradiolab.com](mailto:info@naturalradiolab.com) or at [vlf@norwest.net](mailto:vlf@norwest.net).

***VLFRx Tools*** – Paul Nicholson has made available his VLFRx toolkit at <http://abelian.org/vlfrx-tools/>. This set of software will run under Linux and on the Raspberry Pi. It includes signal processing modules, stream and buffer programs, input/output programs, display and plotting programs, signal analyzers, storage and retrieval programs, utilities and timestamp programs. Having this kind of software available for the Raspberry Pi opens a whole world of custom and automated receiving and analyzing modules.

For those of you not familiar with the RaspberryPi, it is a credit-card sized computer that plugs into your TV and a keyboard. The model B, which has 512k of memory, 2 USB ports, an HDMI port, Ethernet port, and analog audio and video ports, sells for \$35. The unit accepts an SD card for program and auxiliary storage.

The unit runs under Linux and Python is the official programming language. Find more information at <http://www.raspberrypi.org/> The computer was designed to be a hackable education device.

I bought my son, Jeff, the starter kit for Christmas, but still haven't ordered one for myself. I'll let him become the expert and then he can teach his old man all the tricks.