

NASA Satellite Observes Mysterious Earth Energy

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Scientists using observations from NASA's Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) satellite detected flashes of gamma ray energy in Earth's upper atmosphere in greater detail than ever before. RHESSI is part of NASA's Sun-Earth Connection program. It was designed to study X-rays and gamma rays from solar flares. However, RHESSI's detectors pick up gamma rays from a variety of sources.

A team of researchers from the University of California, Santa Cruz (UC-SC), University of California, Berkeley (UC-Berkeley), and the University of British Columbia (UBC), Vancouver, Canada, reported new findings about these bursts of energy, called terrestrial gamma ray flashes (TGFs).

TGFs are very short blasts of gamma rays, lasting about one millisecond, emitted into space from Earth's upper atmosphere. They are thought to be emitted by electrons traveling at 99.99 percent of the speed of light (186,000 mps), when they scatter off of atoms and decelerate in the upper atmosphere.

The Burst and Transient Source Experiment (BATSE) on the Compton Gamma-Ray Observatory first discovered TGFs in 1994. However, BATSE's ability to count the TGFs or measure their peak energies was limited. Observations from RHESSI raised the maximum recorded energy of TGFs by a factor of 10, and indicate Earth gives off approximately 50 TGFs or more daily.

"This is a very interesting process involving extreme physics right here on Earth. If we can understand the process here, it might give us insights into similar processes in less accessible parts of the universe," said David Smith, an assistant professor of physics at UC-SC and first author of the paper. "The energies we see are as high as those of gamma rays emitted from black holes and neutron stars," Smith said.

While it remains unknown exactly how electron beams accelerate fast enough to produce TGFs, Smith said it may involve the build-up of electric charge at the tops of thunder clouds due to lightning discharges. This results in a powerful electric field between the cloud tops and the ionosphere, the outer layer of Earth's atmosphere.

"Regardless of the exact mechanism, there is some enormous particle accelerator in the upper atmosphere that is accelerating electrons to these very high energies, so they emit gamma rays when they hit the sparse atoms of the upper atmosphere," Smith said. "What's exciting is we are getting data good enough for the theorists to really test their models."

TGFs have been correlated with lightning strikes and may be related to visible phenomena that occur in the upper atmosphere over thunderstorms. RHESSI investigators plan to collaborate with other researchers to investigate how various phenomena are related, Smith said.

Smith worked with RHESSI principal investigator Robert Lin at UC Berkeley and Christopher Barrington-Leigh, now at UBC, to plan ways they could use the satellite for a range of investigations in addition to studying solar flares. Their report was published last week in the journal *Science*. It presents the first analysis for TGFs covering the results from a search of three months of RHESSI data. The analysis of additional data is ongoing.

RHESSI, a NASA Small Explorer spacecraft, was launched on Feb. 2, 2002. It is managed by NASA's Goddard Space Flight Center, Greenbelt, Md., and the University of California, Berkeley, Calif.

Source: NASA

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