RHESSI's Greatest Hits 2002 - 2018

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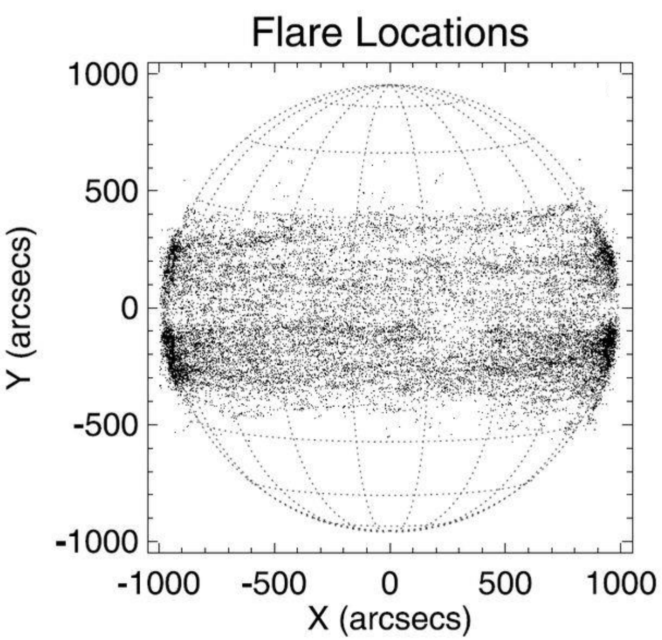
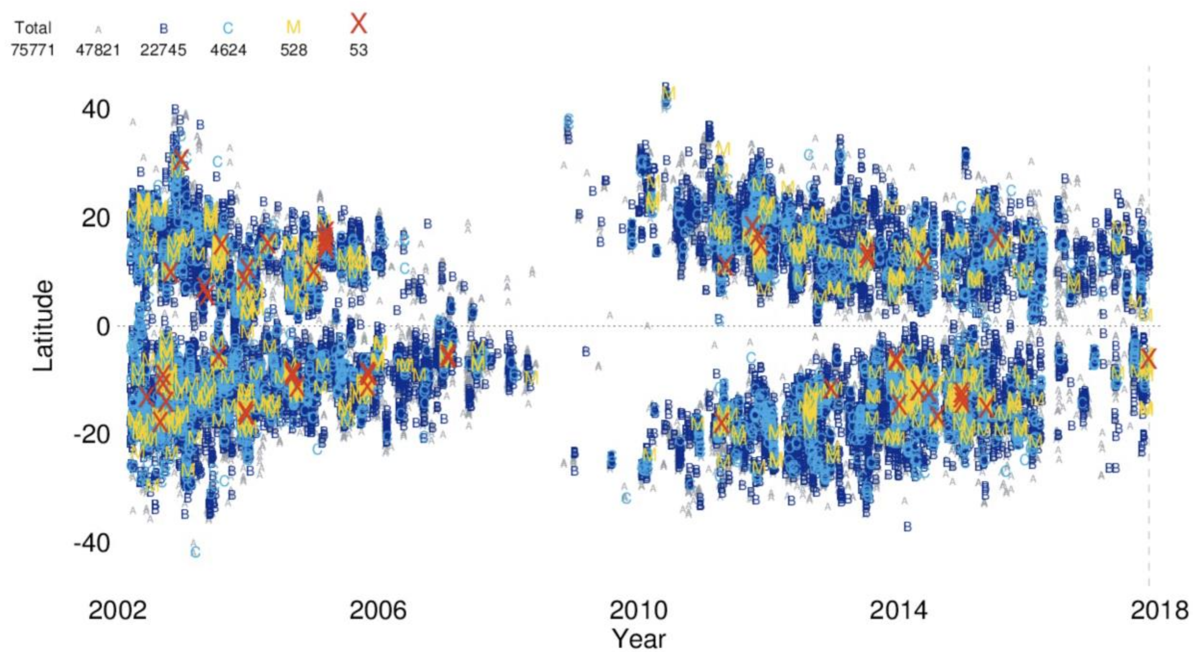
27 August 2018

Summary

- Understanding how energy is released and particles are accelerated in magnetized plasma is one of the key science goals of Heliophysics and Astrophysics.
- RHESSI broke new ground with high-resolution X-ray and gamma-ray observations of solar flares providing unique information addressing this science goal.
- RHESSI also made the most precise measurement of the Sun’s shape and invigorated the field of Terrestrial Gamma-Ray Flashes (TGFs).

RHESSI’s Butterfly Diagram Over 75,000 Flares

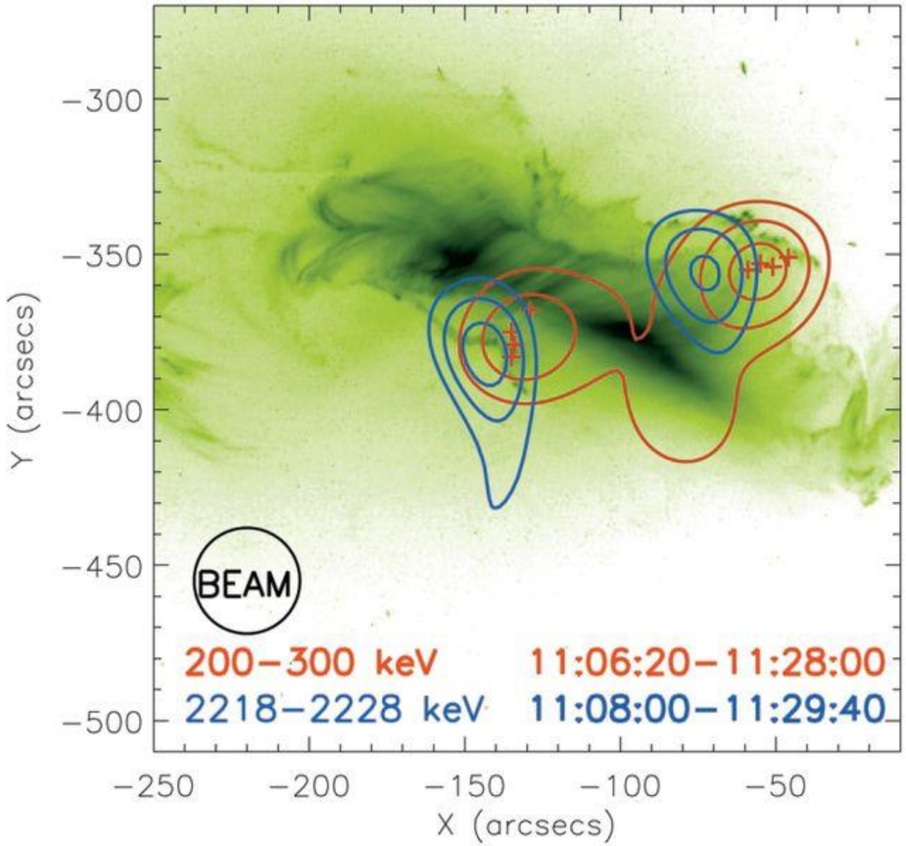




RHESSI shows that X-ray flare locations follow the same progression in solar latitude as active regions over two sunspot cycles.
Hence, flares must be magnetically driven.

First time to show where Gamma-Rays are produced in Solar Flares

(Hurford et al. 2006, Astrophysical Journal, 644, L93)



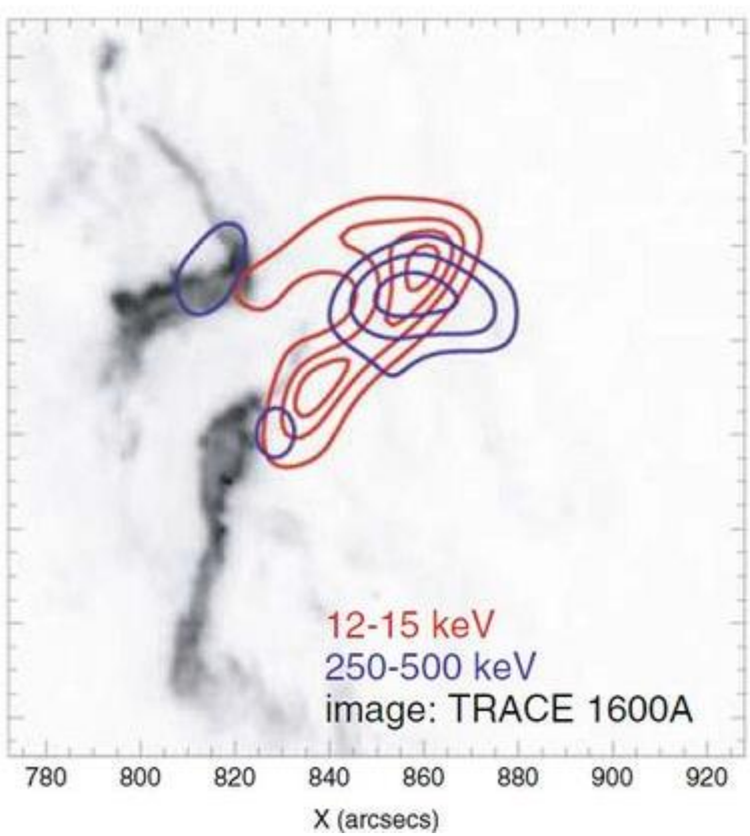
Contours show gamma-rays (blue) and X-rays (red) overlaid on an ultra-violet image (green) of a giant solar flare on October 28, 2003.

Knowing **where** the gamma-rays are produced by energetic particles is a critical first step in achieving a full understanding of the proton acceleration processes in solar flares.

Shows that protons are accelerated in the compact flare region in addition to an extended shock.

Detection of Unexpected Fluxes of Solar Flare Gamma-Rays from the Corona

(Krucker et al. 2008, Astrophysical Journal, 678, L63)



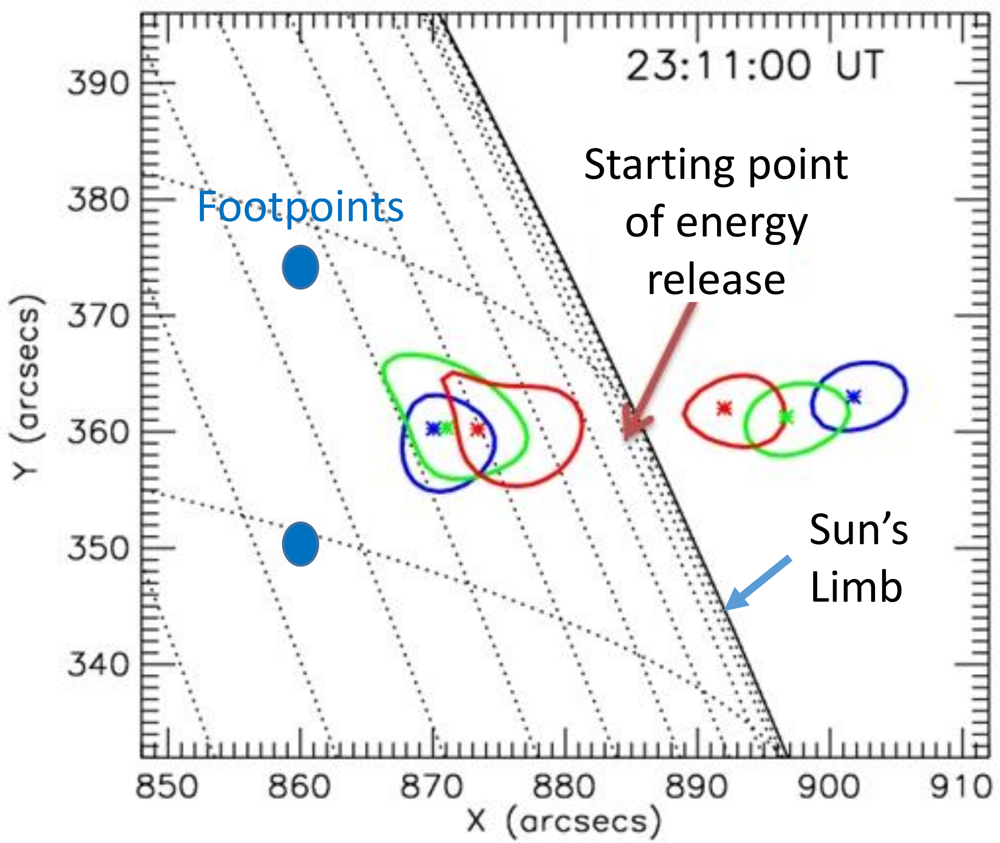
Contours show location of X-ray sources at different energies overlaid on an ultra-violet image in black.

Gamma-rays from the solar corona reveal where electrons are accelerated in flares and their temporal and spectral characteristics.

This new information is a giant step forward in understanding the particle acceleration processes involved in solar flares.

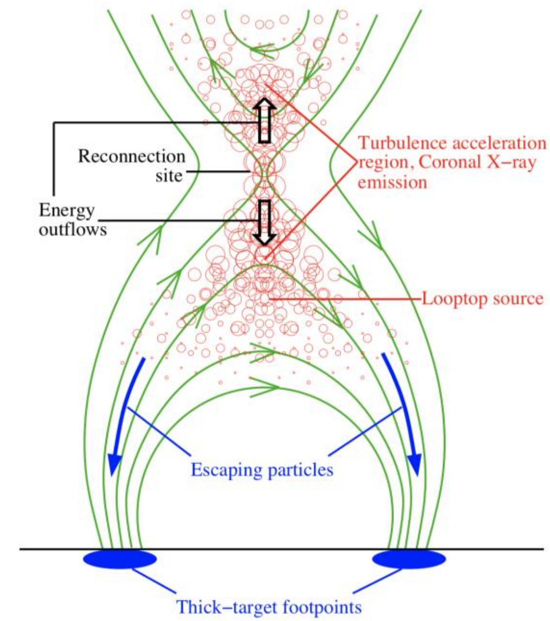
X-ray Location of Flare Energy Release Region

(Sui and Holman 2003, Astrophysical Journal, 596,L251)



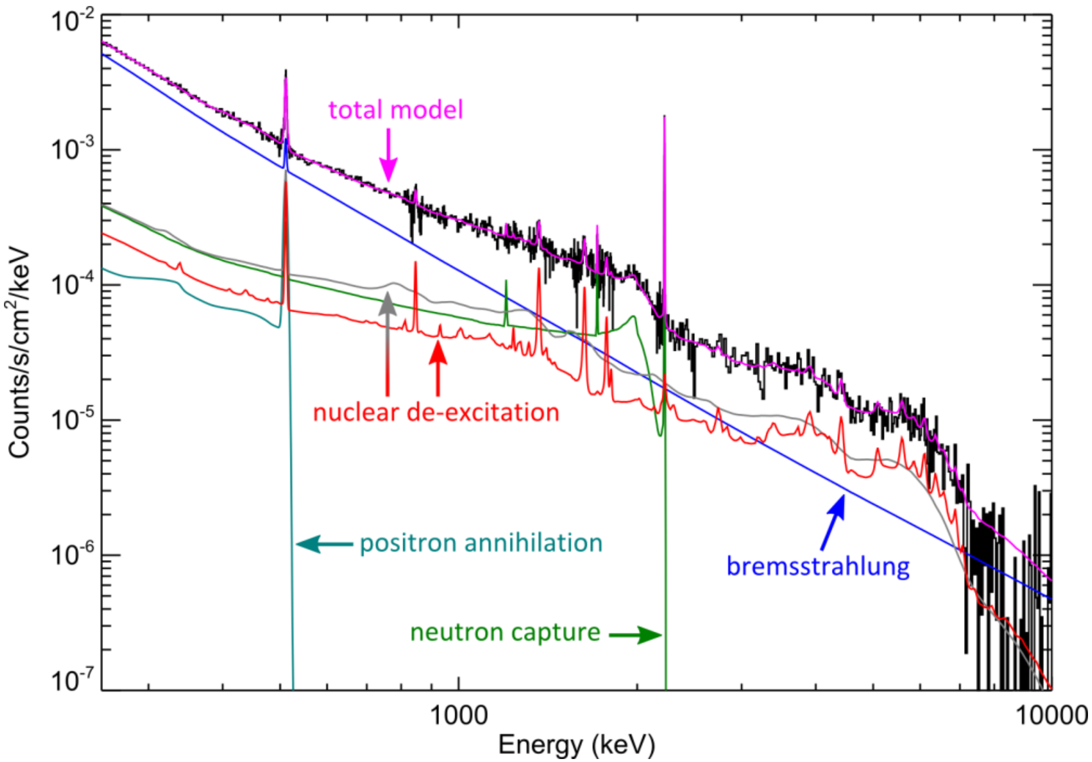
Twin coronal X-ray sources at color-coded energies with footpoints and presumptive location of energy release site indicated.

Identifying the energy release site in the corona between two X-ray sources is a major advance in understanding where and how energy is released in solar flares



Highest Resolution Gamma-Ray Spectrum Ever Obtained

(Smith et al. 2003, Astrophysical Journal, 595, L81)



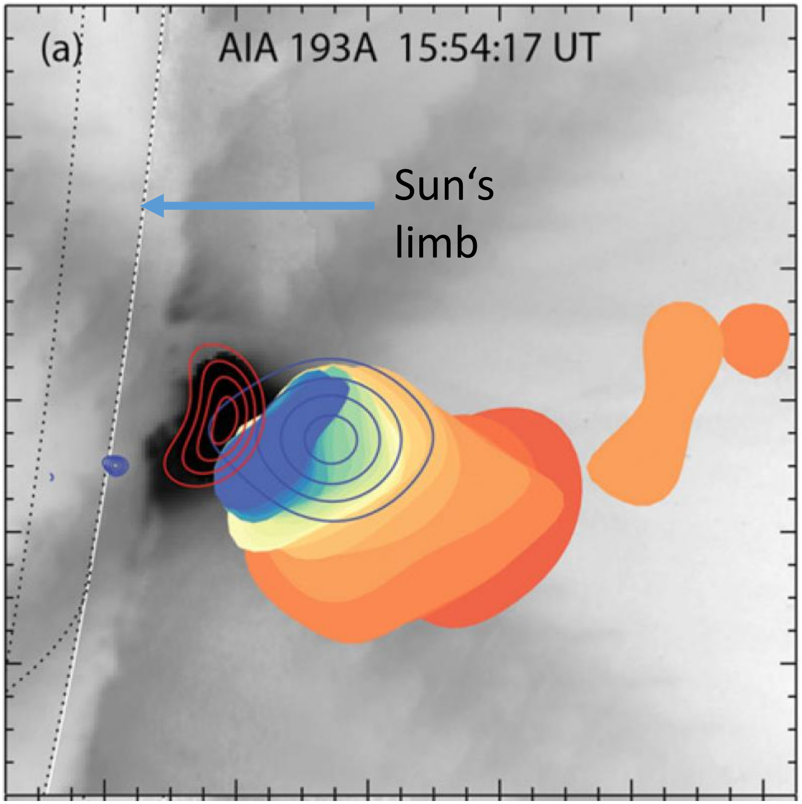
Energy spectrum of gamma-rays from a solar flare on July 23, 2002, showing all the different components produced by high energy electrons, protons, and heavy ions.

Gamma-rays uniquely reveal contributions from high energy electrons, positrons, protons, and heavy ions accelerated in solar flares.

This spectral information provides further crucial understanding of the processes of particle acceleration in solar flares.

Unprecedented Diagnostics of Energetic Electrons in Flares

(Gary et al. 2018, Astrophysical Journal, 863:83)

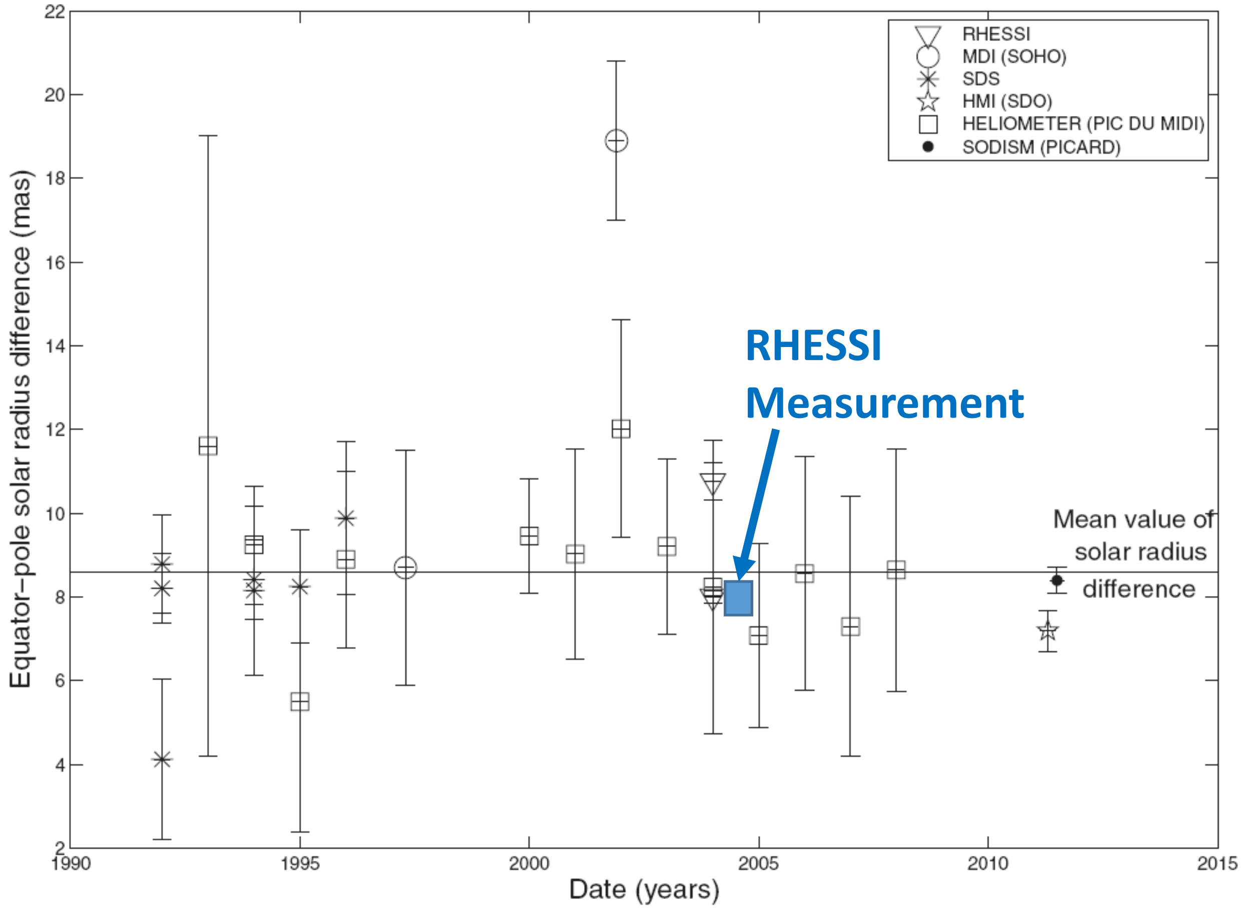


RHESSI color-coded X-ray contours and EOVSA colored microwave sources overlaid on an ultra-violet image of the corona above the Sun's limb.

Joint observations of a solar flare on 10 September, 2017, with RHESSI and the ground-based Expanded Owens Valley Solar Array (EOVSA) provide new and unprecedented diagnostics of energetic electrons in flares.

Most Precise Measure of the Sun's Shape

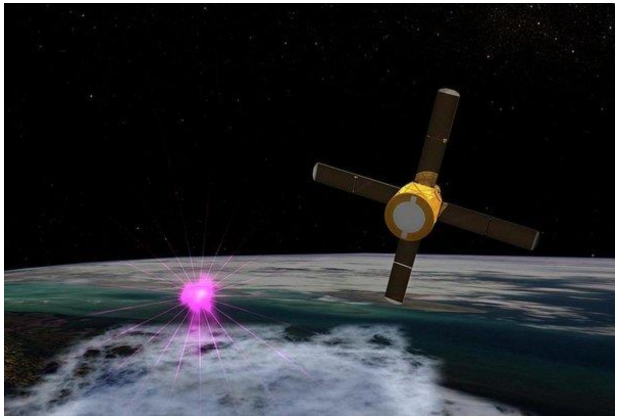
(Fivian et al. 2008, Science, 322, 560)

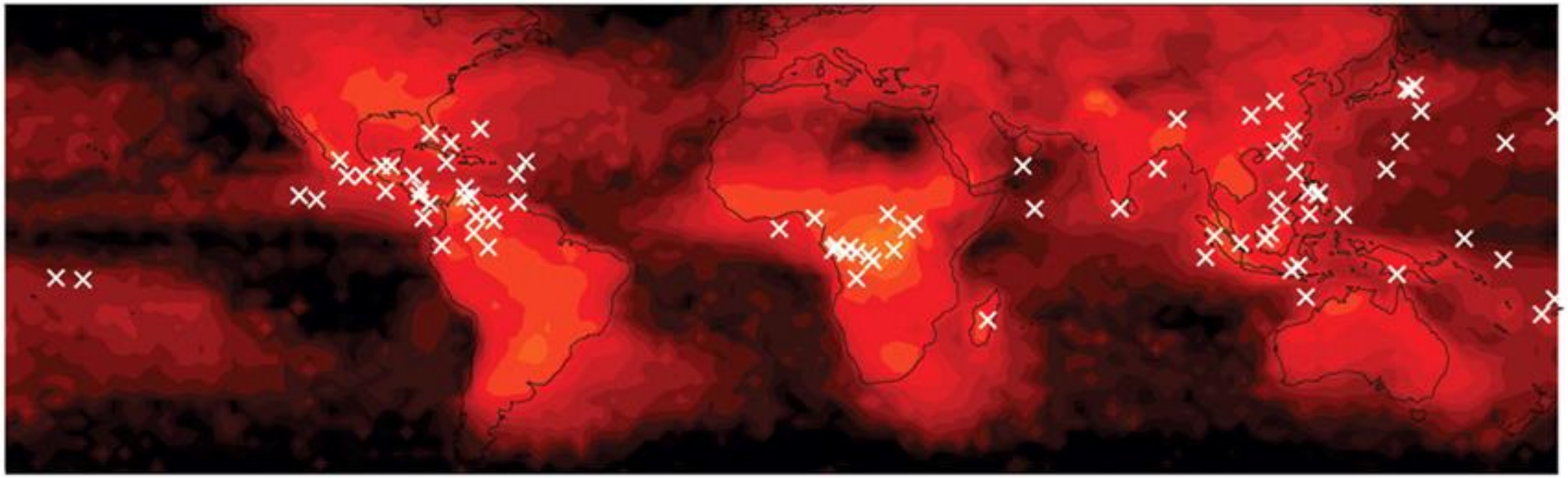


Gamma-Rays from Thunderstorms
More Powerful and More Frequent than Expected

(Smith et al., Science 2005, 307, 1085)

RHESSI invigorated the field of **Terrestrial Gamma-Ray Flashes (TGFs)**. It showed that TGFs are much more frequent than expected and that thunderstorms accelerate electrons to much higher energies than previously measured.





Location of all TGFs observed with RHESSI during the summers of 2002 and 2004, overlaid on the density map of thunderstorms seen from the surface.