Solar Physics with RHESSI at the Space Science Laboratory

The Sun is the most energetic particle accelerator in the solar system, accelerating ions up to tens of GeV and electrons to hundreds of MeV in solar flares and fast coronal mass ejections. One of the most violent forms of particle acceleration at the Sun are solar flares which release energies up to 10^32 to 10^33 ergs in a few minutes. Accelerated electrons colliding with the ambient solar atmosphere produce bremsstrahlung hard X-rays and gamma-ray continuum emission, while nuclear collisions of energetic ions result in a spectrum of gamma ray lines. The Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI, pictured at right) was launched in February 2002. RHESSI is an earth-orbiting solar observatory, part of the NASA Small Explorer Missions (SMEX). RHESSI provides high spectra resolution in the range, 3 keV to 10 MeV with an energy resolution of 1 keV up to 1 MeV. In addition, for the first time, RHESSI observed continuum emission, while nuclear collisions of energetic ions result in a spectrum of gamma ray lines. The Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI, pictured at right) was launched in February 2002. RHESSI is an earth-orbiting solar observatory, part of the NASA Small Explorer Missions (SMEX). RHESSI provides high spectra resolution in the range, 3 keV to 10 MeV with an energy resolution of 1 keV up to 1 MeV. In addition, for the first time, RHESSI provides spatial information with imaging down to ~2 arcsecond resolution. RHESSI’s primary scientific objective is to understand particle acceleration and explosive energy release at the Sun. Below are some of RHESSI’s solar research.

Coronal Hard X-ray Sources in Flares
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Flares with limb-occulted hard X-ray footpoints are used to study coronal hard X-ray sources, which generate relativistic wave emission. Specifically, we look for evidence of these hard X-ray sources in the corona as a signature of magnetic reconnection. A summary of one such study is presented.

Microflare Characteristics by RHESSI
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A database of events was created through a focused search of the smallest events (microflares). Two periods were searched May 1-5 and Jan 27-30, 2004. These periods were chosen because of their low solar activity. A total of 230 events were found.

Gamma-Ray Lines from Solar Flares
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For gamma-ray flares with sufficient statistics, the RHESSI data can be split into two time intervals and the spectra can be analyzed separately to look for any temporal variation. Such changes can then be associated with changes in the acceleration spectrum, the accumulated population, or the ambient population.

Solar Flares

Thermal Electrons in Solar Flares
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RHESSI 8-15 keV and 20-30 keV Source Centroid Positions.

1.7-5 keV Peak Rate

Gamma-Ray Lines from Solar Flares

The spectral index of the distributed hard X-ray source is harder than the 20-30 keV (possibly non-thermal) emission range show a more isotropic emission on the line scale of tens of arcseconds.

Gamma-Ray Lines from Solar Flares

Microflare Characteristics by RHESSI

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Coronal Hard X-ray Sources in Flares

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