Fermi Solar Flare Observations

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Summary

Our Fermi GI program will make GBM and LAT solar flare data and our IDL analysis software tools readily available to the International solar physics community.

We will analyze X- and gamma-ray flares, and cross-calibrate GBM with RHESSI and other solar instruments. From these measurements we will obtain spectral and temporal information *on* ***the highest energy flare-accelerated electrons and ions***.

We propose autonomous solar pointing to optimize the study of long-duration gamma-ray flares with LAT. We will encourage the international solar physics community to carry out cotemporaneous observations with Fermi and to participate in joint scientific analysis of the data.

On-line Data Products

We plan to create the following products and make them available on-line.

- IDL tools for joint spectral and time series analysis.
- Solar flare list including which detector observed the flare, as well as the usual flare parameters
- Quick look plots of GBM light curves for each orbit
- Event files containing GBM and LAT solar flare data and detector response matrices for GBM triggered and untriggered events

Software Modifications

The OSPEX spectral analysis package has been modified to -

- Read GBM data and response files
- Use new nuclear-line and pion decay gamma-ray templates

We plan to -

- Refine the GBM response matrices,
- Verify the LAT analysis tools using both simulated and real flare data, and modify OSPEX accordingly,
- Finalize plans and algorithms for autonomous solar pointing in response to GBM triggers.

GBM and Complementary Data Spectral Analysis

Spectral comparisons of GBM with RHESSI, SPHINX, and CORONAS observations will be used

- to improve GBM response matrices in the range of 1-20 keV by comparisons with coincident flare spectra from the other instruments,
- when one instrument suffers from significant pulse pile-up or particle contamination,
- to cross-calibrate the different instrument sensitivities .

Fig. 2 shows the need for cross-calibration between RHESSI and GBM, especially at the lowest energies.
This issue will be pursued by comparisons with separate spectra from each of RHESSI's nine germanium detectors.

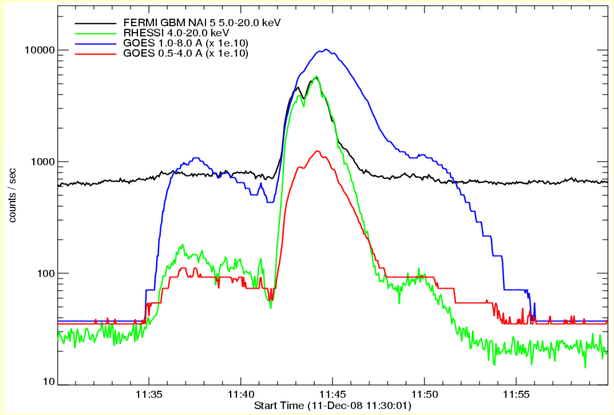

Fig. 1. GBM, RHESSI, and GOES light curves for a C-class solar flare on 11 Dec 2008.

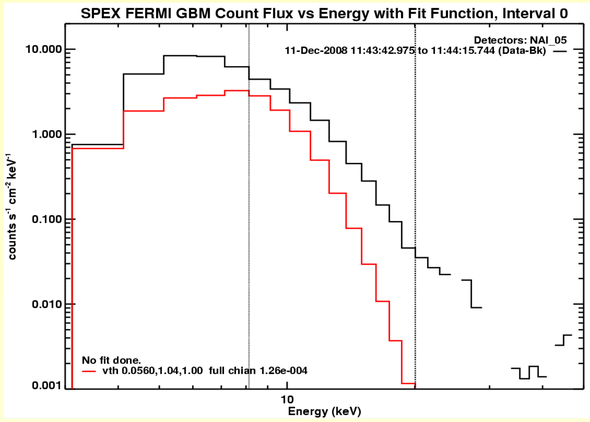

Fig. 2. GBM X-ray count-rate spectrum (black) at the peak of the flare shown in Fig. 1. Also shown for comparison is the best fit thermal spectrum to the RHESSI data (red) for one of its nine germanium detectors folded through the GBM instrument response matrix.

GBM and LAT X-ray and Gamma-ray Studies

Objectives of our analysis of GBM X-ray flare data:

- Determine the total energy in nonthermal electrons,
- Evaluate the subsecond structure of the hard X-ray time histories, and
- Study the relation between hard X-ray spectral evolution and the spectra of Solar Energetic Particles (SEPs) at the Earth.

Objectives of our analysis of gamma-ray flares seen above 300 keV with GBM and above 20 MeV with LAT:

- Gamma-ray spectroscopic studies to obtain information on the ambient medium, accelerated ions and electrons, and their relation to SEP events,
- Improved theoretical modeling of the production of pion-decay gamma rays and the determination of neutron sensitivity for use in the analysis of LAT observations up to tens of GeV.

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