Group 1
SUMMARY

Electron Acceleration and Propagation
Group Members

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- Ed Schmahl
- Richard Schwartz
- Alexander Urnov
- Loukas Vlahos
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Monday AM

Spectrum Inversion Methods: What are they and how do they work?
Mean Electron Flux & Injected Electron Flux Distributions

• Mean Electron Flux:

\[ I(\varepsilon) = \frac{nV}{4\pi R^2} \int_{\varepsilon}^{\infty} F(E) \sigma(\varepsilon, E) dE \]

\[ F(E) = \frac{1}{nV} \int_{V} n(\vec{r}) F(E, \vec{r}) dV \]

• Injected Electron Flux:

\[ I(\varepsilon) = \frac{n}{4\pi R^2} \int_{\varepsilon}^{E'} F(E') \int_{\varepsilon}^{E'} \sigma(\varepsilon, E') \frac{dE'}{dt} dE \]

\[ \frac{dE}{dt} \propto \frac{n}{v} \quad \text{(collisional losses)} \]

\( \varepsilon \): photon energy

\( E \): electron energy

\( \sigma \): bremsstrahlung cross section

\( V \): source volume

\( n \): plasma density

\( R \): 1 AU

\( I \): photon flux

\( v \): electron speed
Comparison of Spectral Inversion with Forward Fit

Johns & Lin (1992) Inversion Technique

Penalty is paid through the resulting uncertainties in the electron spectrum. These uncertainties are calculated directly from the uncertainties in the photon spectrum, but they become highly magnified. This also results in electron spectra with substantial structure which is not real. To deal with this, we are forced to bin the photon spectrum in energy, time, or both, to improve the statistics.
Spectrum Inversion Methods: How well do they work?
Input Spectra

Mean Source Electron Spectra

Photon Spectra

Electron

Photon
Mean Source Spectra

Residuals

(Green are 0.1×actual!)
Tuesday AM

Spectral Evolution
Low-Energy Cutoffs
Compton Backscattered Photons
(Albedo)
harder  

larger  

Photon spectral index ($\gamma$)  

Non-thermal flux at 35 keV ($F_{35}$)  

Paolo Grigis
Why do RHESSI results differ from that of BATSE/CGRO?

The fitted observed spectra are systematically different!
Variation of the power-law low energy cutoff $v_0$
Examples: 25-April-2002 and 20-Aug-2002 flares

Meudon, 25-28 July 2004

Eduard Kontar
Profiles of amplitudes vs roll angle in actual RHESSI data almost always show 2 “humps” (particularly for compact flares)
Tuesday PM

Albedo & Low-Energy Cutoffs
Particle Acceleration Subgroup
Effect of Albedo on Shape of Electron Distribution & Low-Energy Cutoff

Jana Kasparova
Wednesday AM

Hard X-ray Polarization
Energy contained in electrons
Imaged spectra
Location of polarization plane at the Sun 29.10.2003.
Image of the Sun was made by SPIRIT onboard CORONAS-F

Location of a polarization plane did not change strongly during a flare. Any dependence on the polarization plane location on energy was not detected.

Polarization plane location. ($\pm 30^\circ$)

I. Myagkova
Observed relations of count rates show, that X-ray emission in a flare 29.10.2003 was strongly polarized.

This may be connected with existence of collimated beams of accelerated solar electrons with energy >50 keV. In lower energy channel yield of thermal non-polarized emission is more significant, and the emission is less polarized.

In the 28.10.2003 and the first stage of 4.11.2003 flare the hard X-ray emission was not polarized. Only upper limits 25% for 28.10.03 and 40% for 4.11.03 were obtained.
Energy Content of Nonthermal Electrons and Thermal Plasma for Three Flares

![Graph showing energy content for different dates: 2002 April 15, 2002 April 21, and 2002 July 23. The graph plots energy (erg) against GOES Class (watts m\(^{-2}\)).]
Last (but not least)

- Michele Piana - DEM inversion
- Sharad Kane - Large flares
- Gordon Emslie - Imaged Spectra