Fourth RHESSI Workshop
Meudon, France
July 25-28, 2004

Group 1
SUMMARY

Electron Acceleration and Propagation

Group Members

- John Brown
- Gordon Emslie
- Ross Galloway
- Weigun Gan
- Paolo Grigis
- Iain Hannah
- Gordon Holman
- Chris Johns-Krull
- Sharad Kane
- Jana Kasparova
- Eduard Kontar
- Anna Maria Massone
- Michele Piana
- Pascal Saint-Hilaire
- Ed Schmahl
- Richard Schwartz
- Alexander Urnov
- Loukas Vlahos
- Valentina Zharkova

Monday AM

Spectrum Inversion Methods:

What are they and how do they work?

Mean Electron Flux & Injected Electron Flux Distributions

- Mean Electron Flux:

$$I(\varepsilon) = \frac{\bar{n}V}{4\pi R^2} \int_{\varepsilon}^{\infty} \bar{F}(E)\,\sigma(\varepsilon, E)\,dE$$

$$\bar{F}(E) = \frac{1}{\bar{n}V} \int_{V} n(\vec{r})\,F(E,\vec{r})\,dV$$

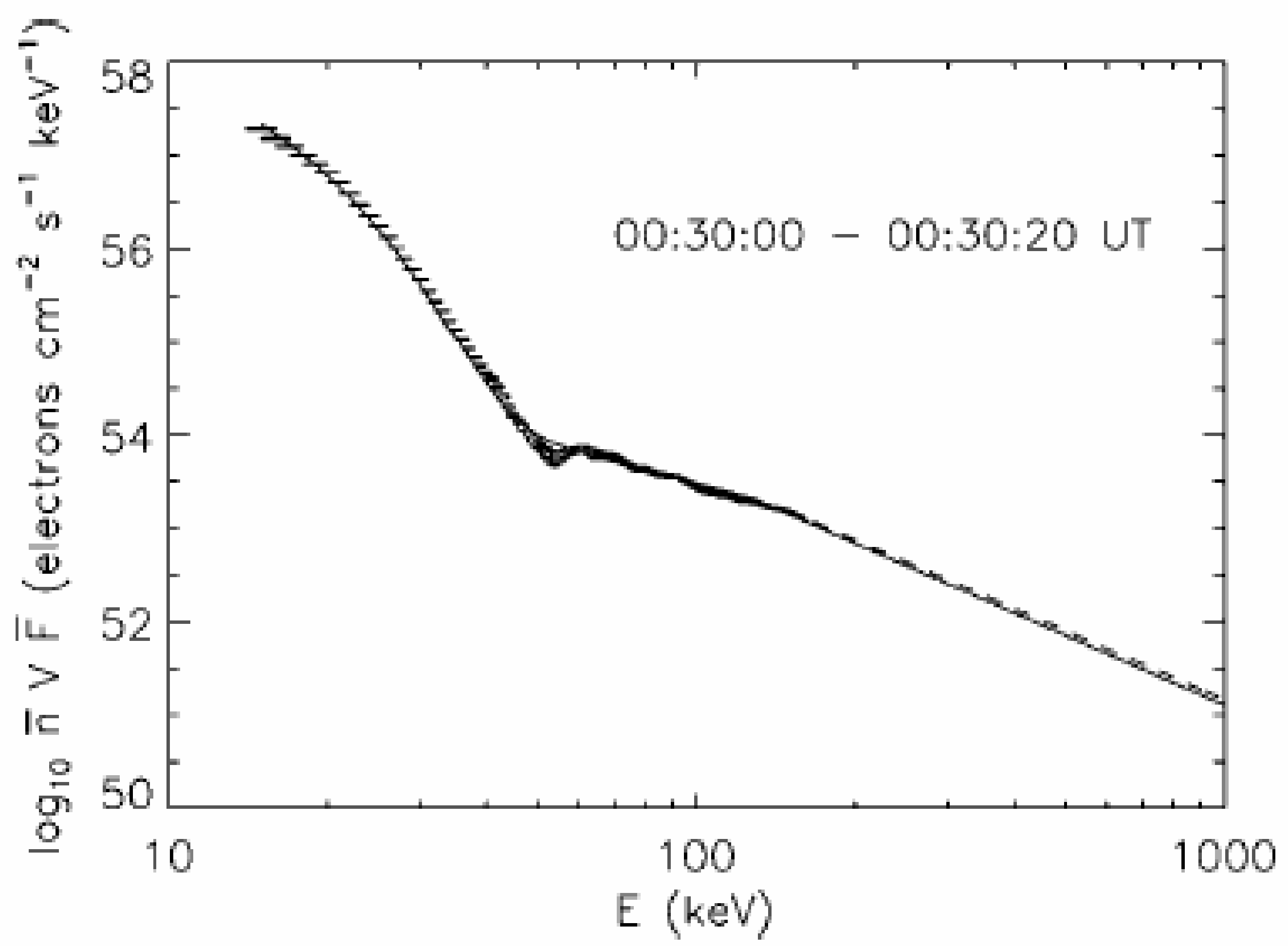
- Injected Electron Flux:

$$I(\varepsilon) = \frac{n}{4\pi R^2} \int_{\varepsilon}^{\infty} F(E') \int_{\varepsilon}^{E'} \frac{\sigma(\varepsilon, E)\mathrm{v}}{dE/dt}\,dE\,dE'$$

$$dE/dt \propto n/\mathrm{v}$$ (collisional losses)

ε	: photon energy
E	: electron energy
σ	: bremsstrahlung cross section
V	: source volume
n	: plasma density
R	: 1 AU
I	: photon flux
v	: electron speed

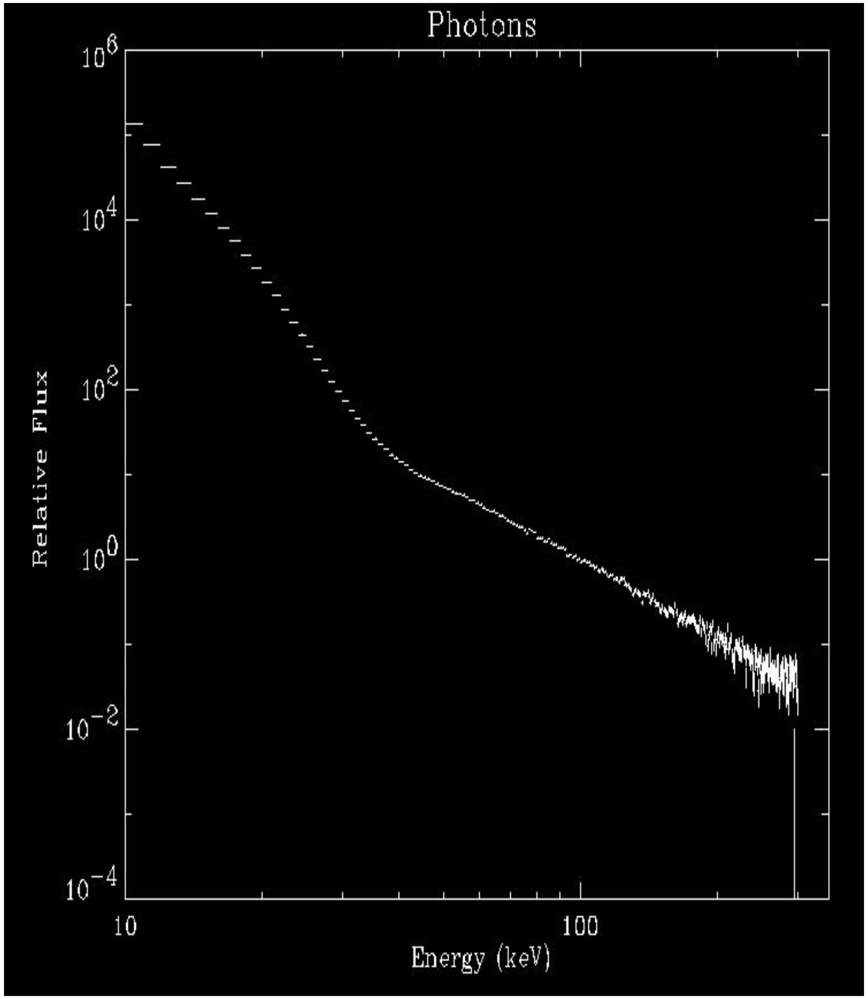
Comparison of Spectral Inversion with Forward Fit

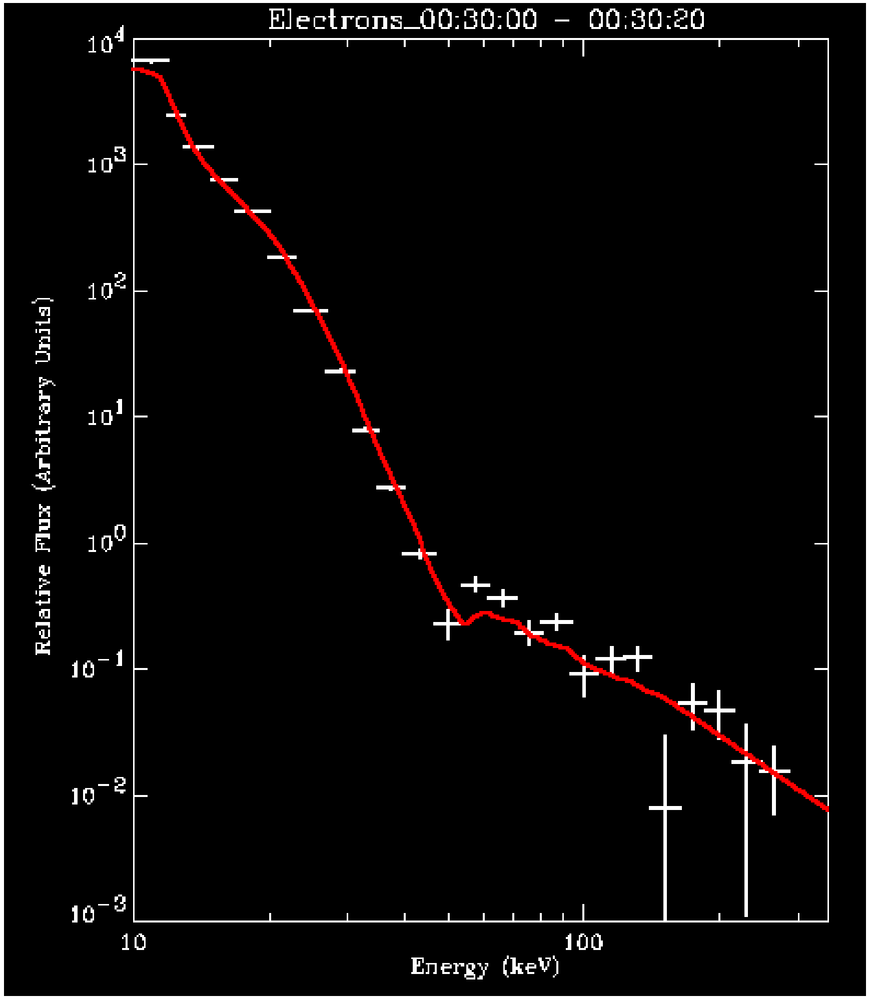


from Piana, M., Massone, A. M., Kontar, E.P., Emslie, A. G., Brown, J. C., & Schwartz, R. A. 2003, Ap. J. Letters, 595, L127

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.

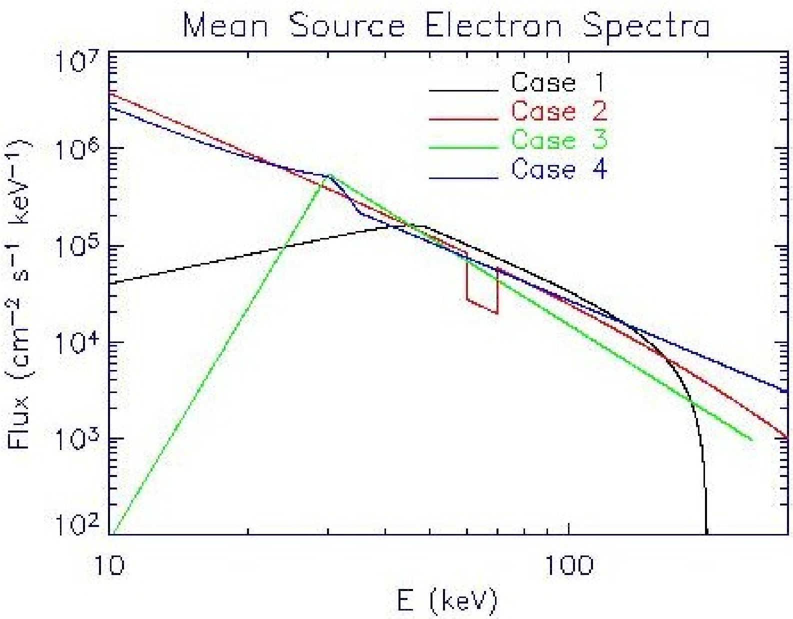


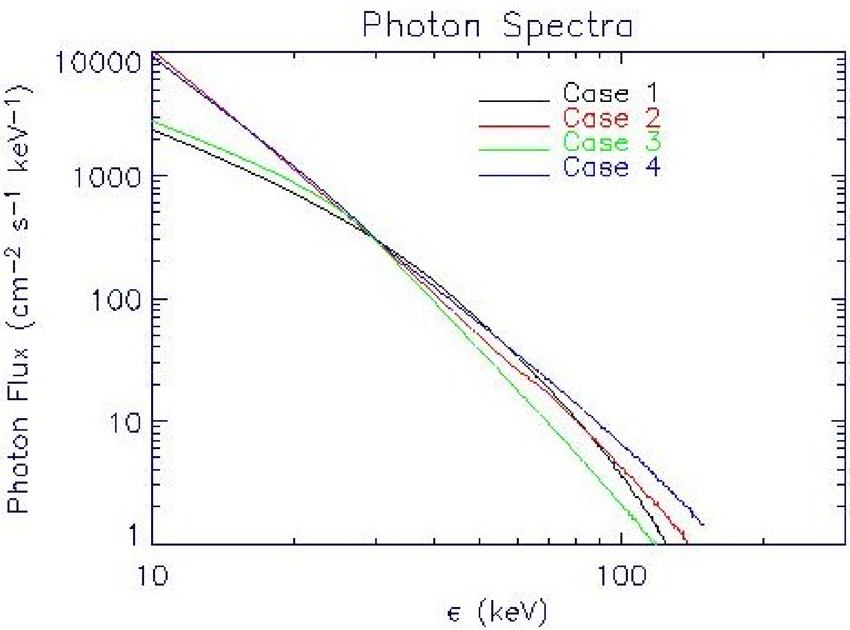


Monday PM

Spectrum Inversion Methods:
How well do they work?

Input Spectra

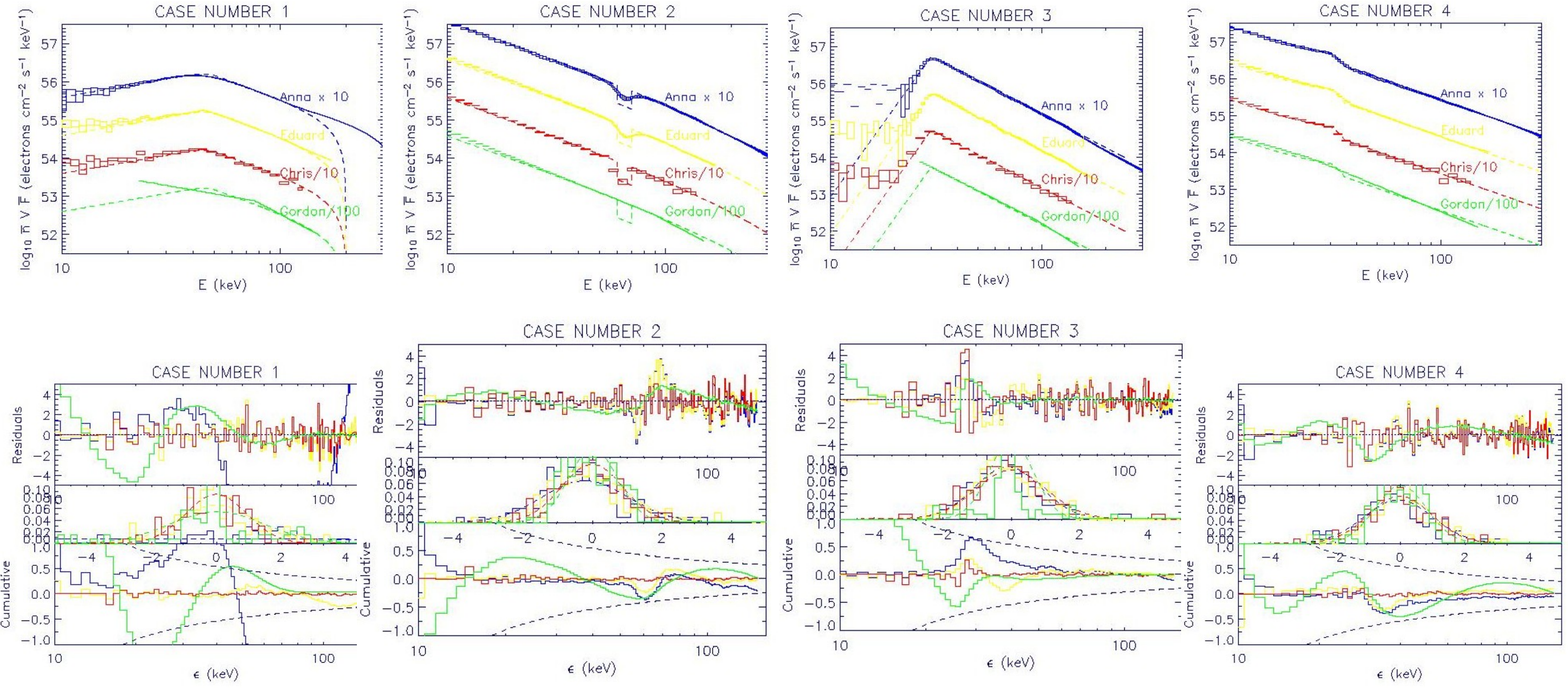




Electron

Photon

Mean Source Spectra



Residuals

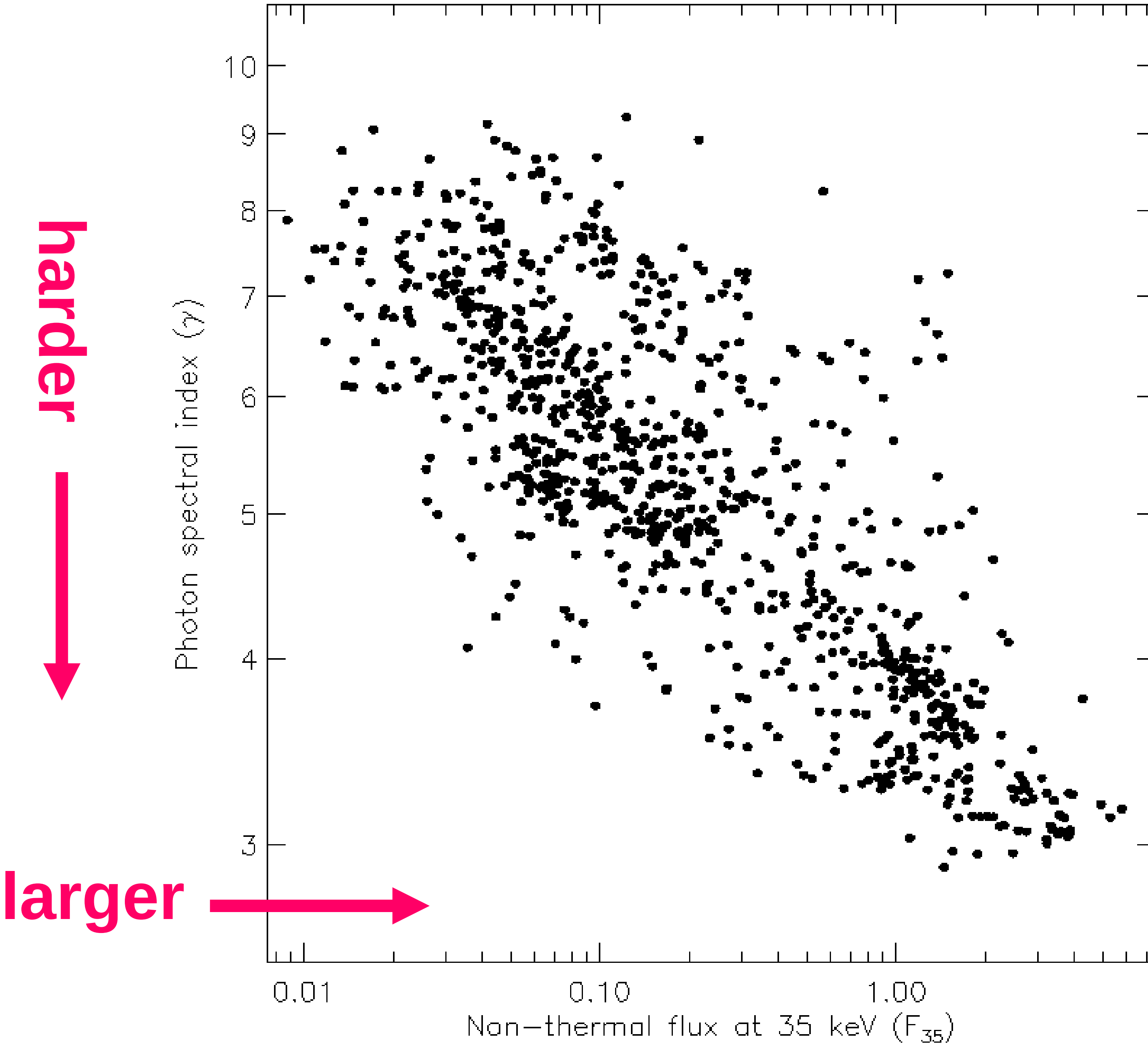
(Green are 0.1×actual!)

Tuesday AM

Spectral Evolution

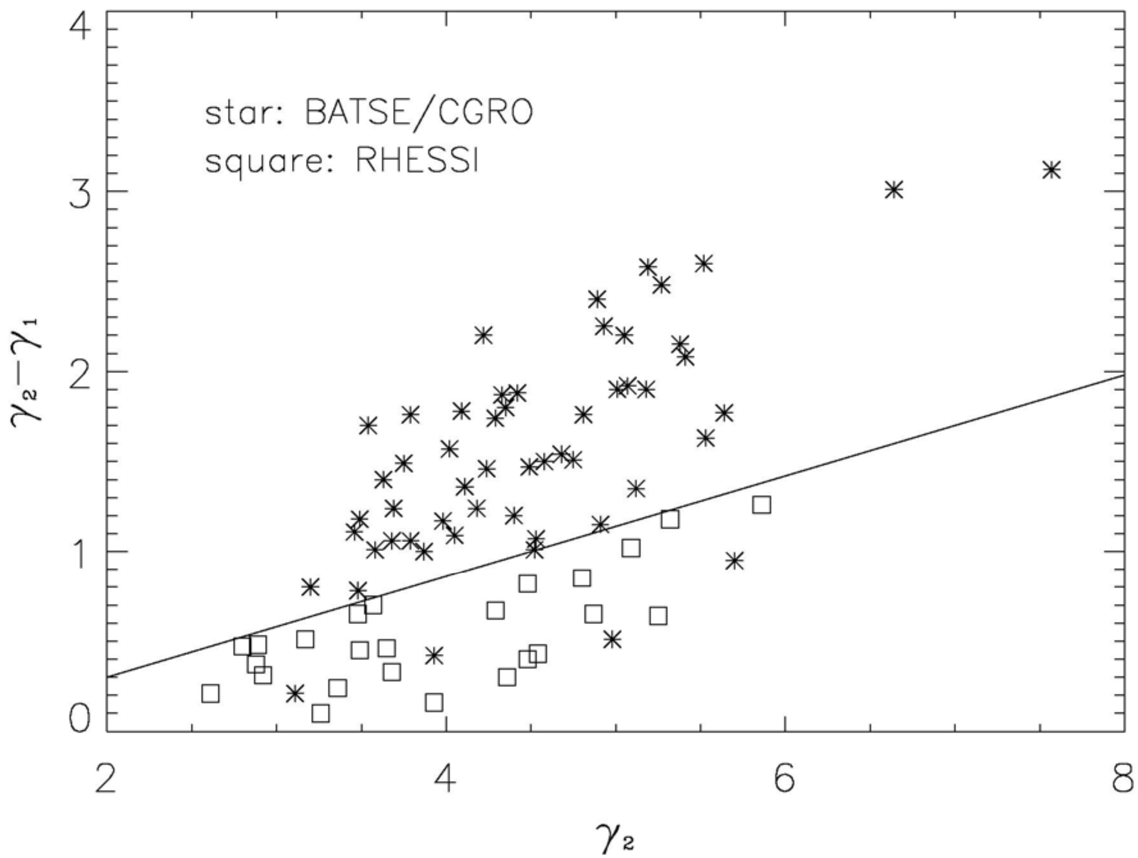
Low-Energy Cutoffs

Compton Backscattered Photons (Albedo)



Paolo Grigis

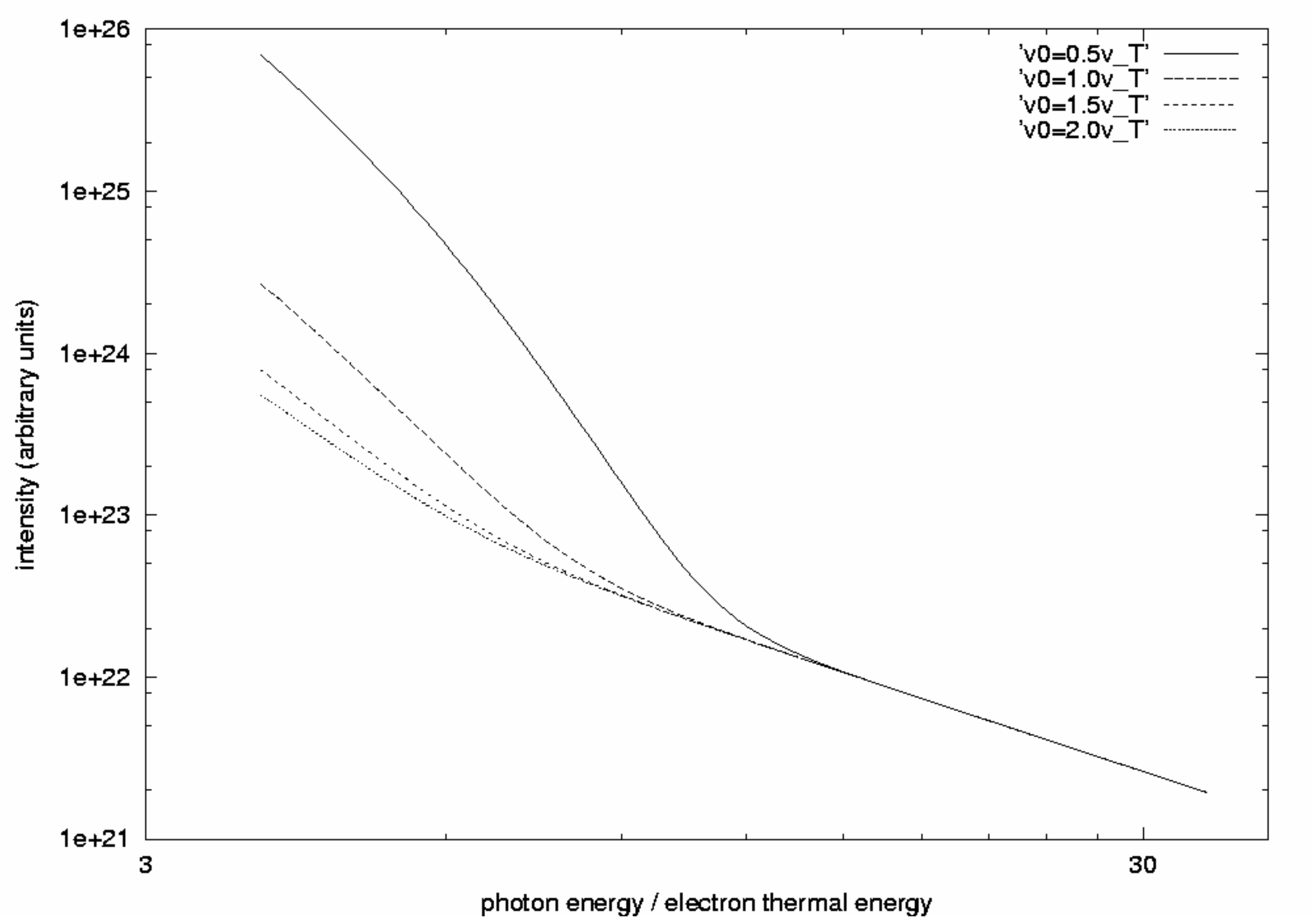
- **Why do RHESSI results differ from that of BATSE/CGRO?**



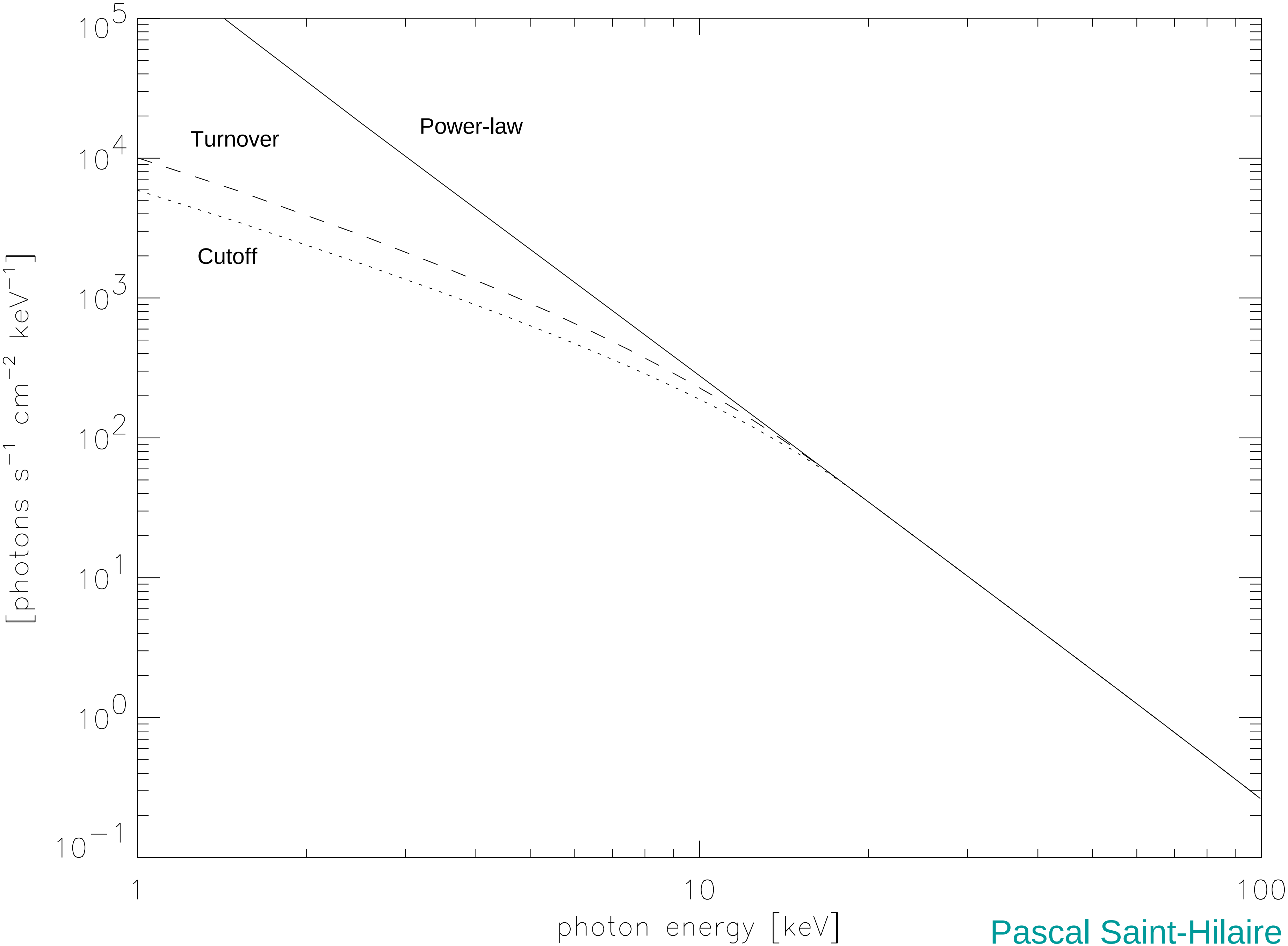
The fitted observed spectra are systematically different!

Weiqun Gan

Variation of the power-law low energy cutoff v_0

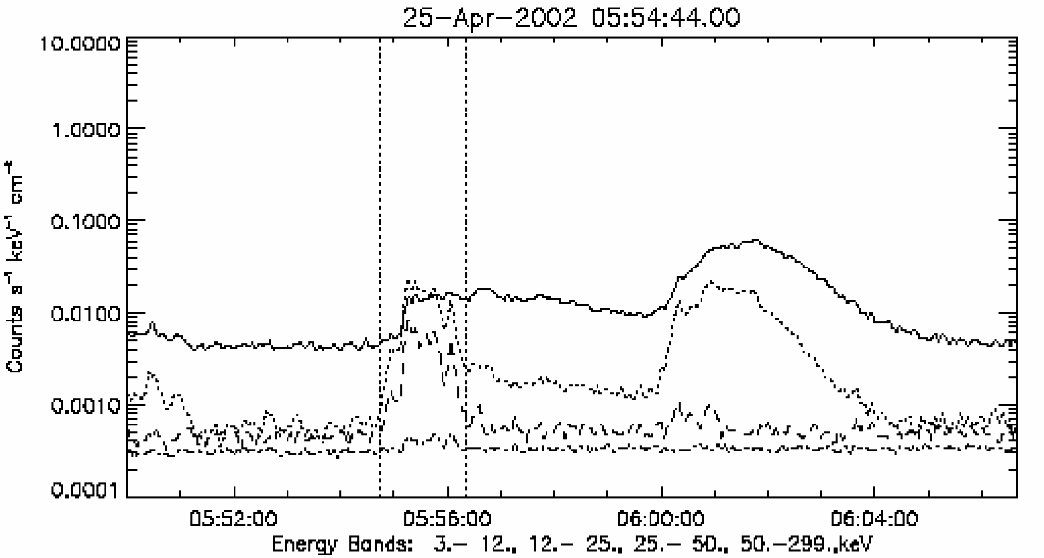


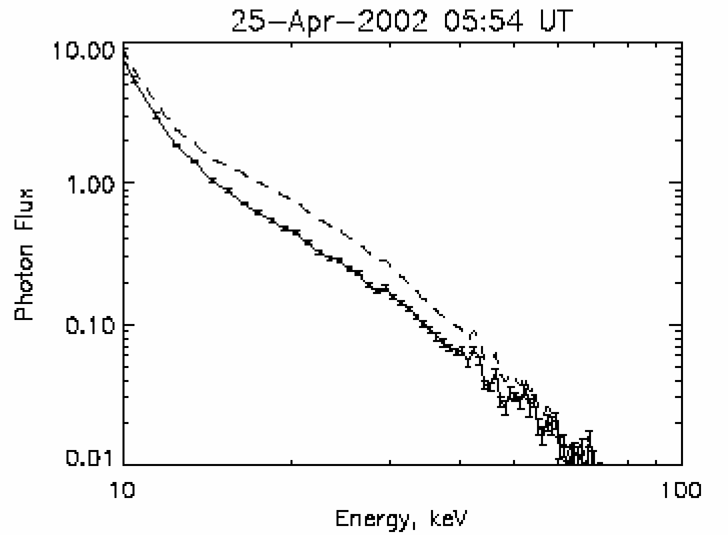
Ross Galloway

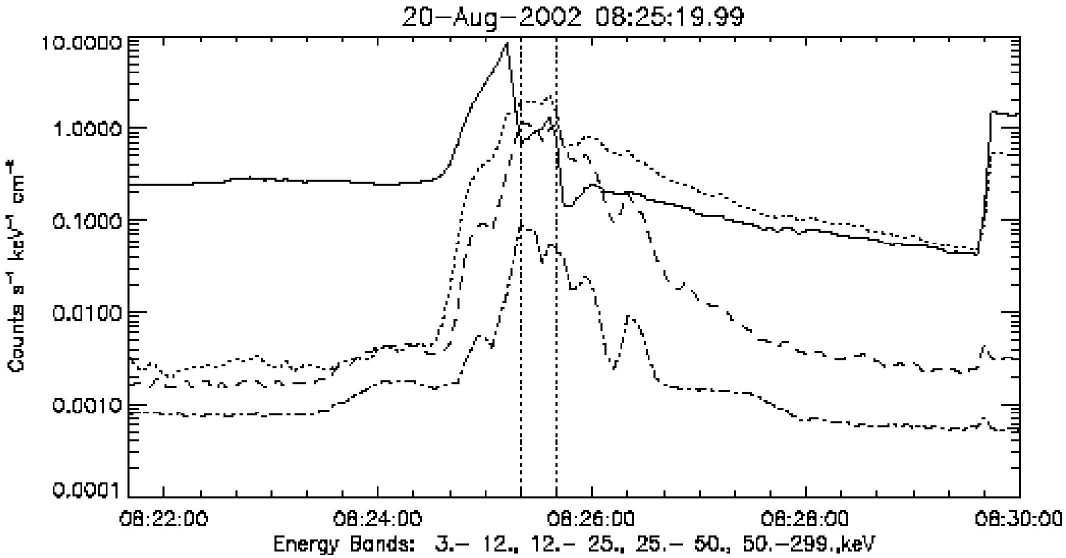


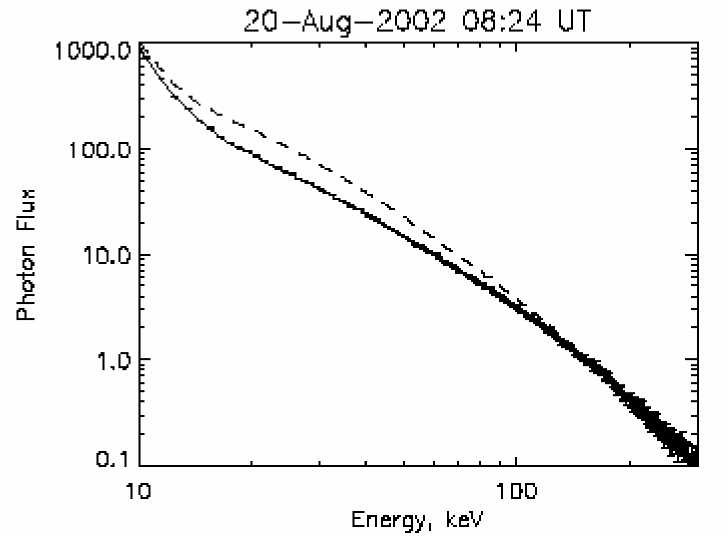
Pascal Saint-Hilaire

Examples: 25-April-2002 and 20-Aug-2002 flares









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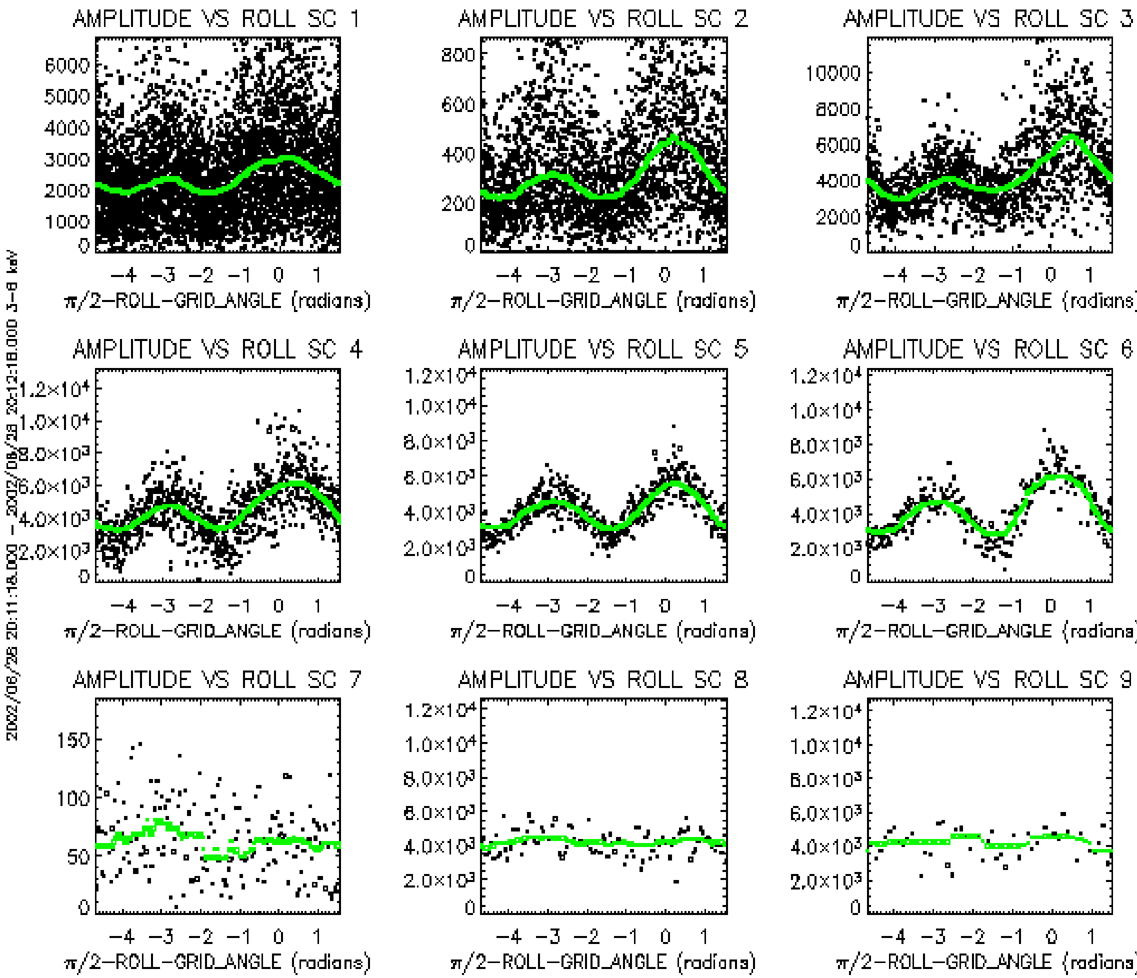
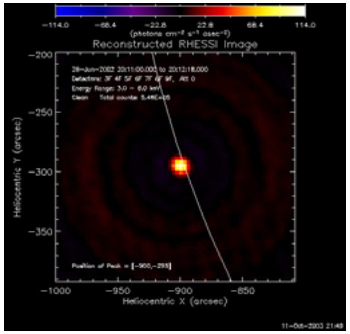
Meudon, 25-28 July 2004

Eduard Kontar

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





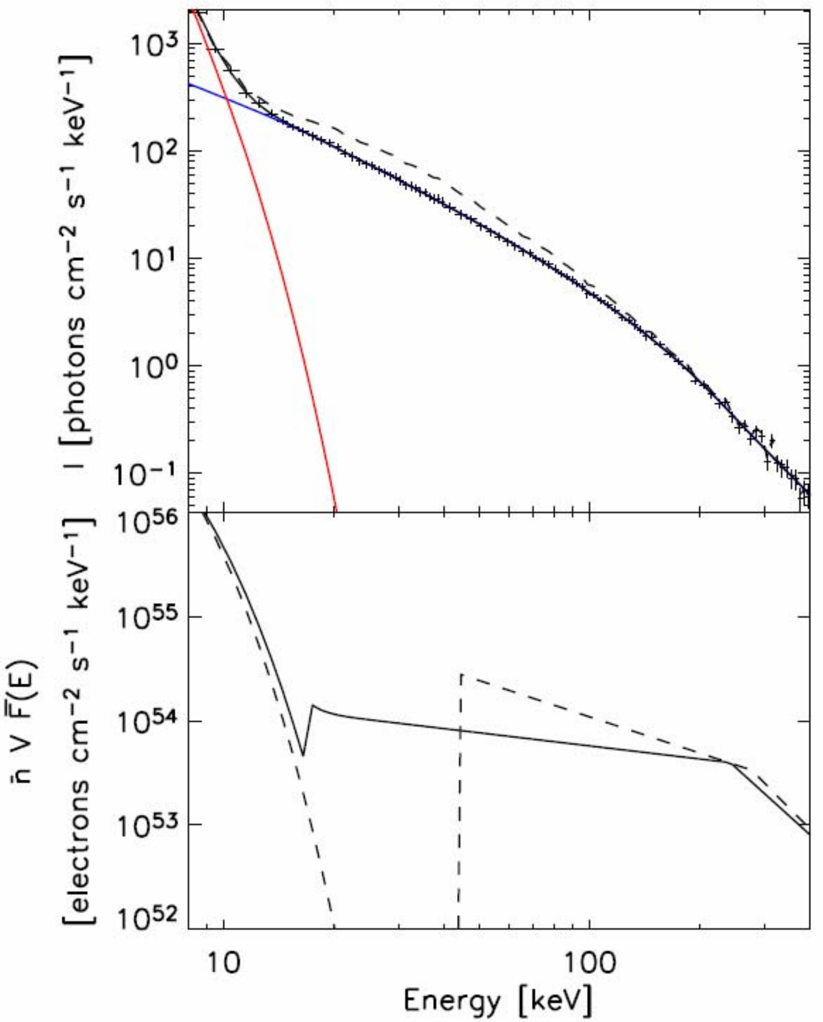
E.J. Schmahl RHESSI Workshop, Meudon, July 2004

Tuesday PM

Albedo & Low-Energy Cutoffs

Particle Acceleration Subgroup

Effect of Albedo on Shape of Electron Distribution & Low-Energy Cutoff



Jana Kasparova

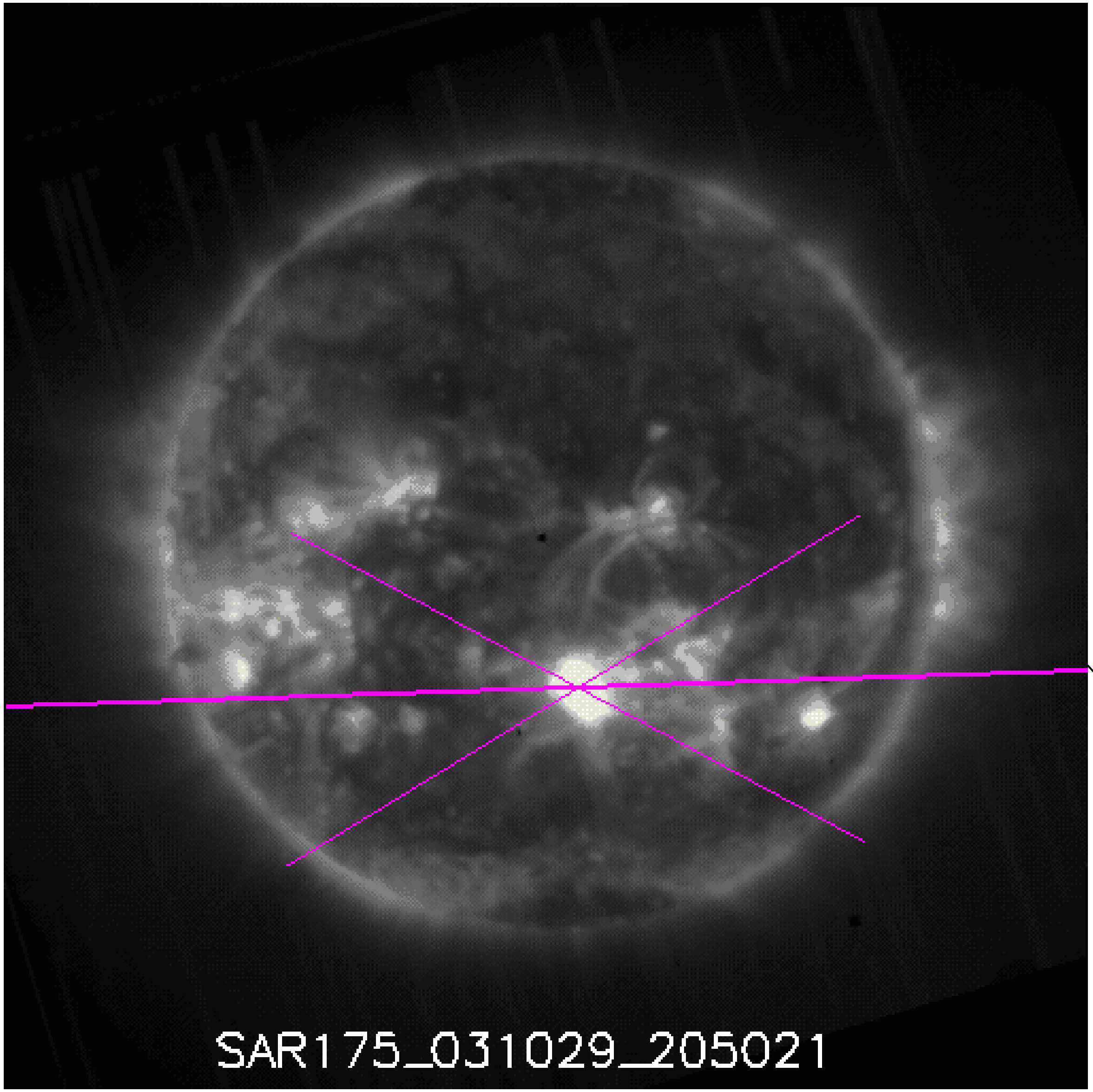
Wednesday AM

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.

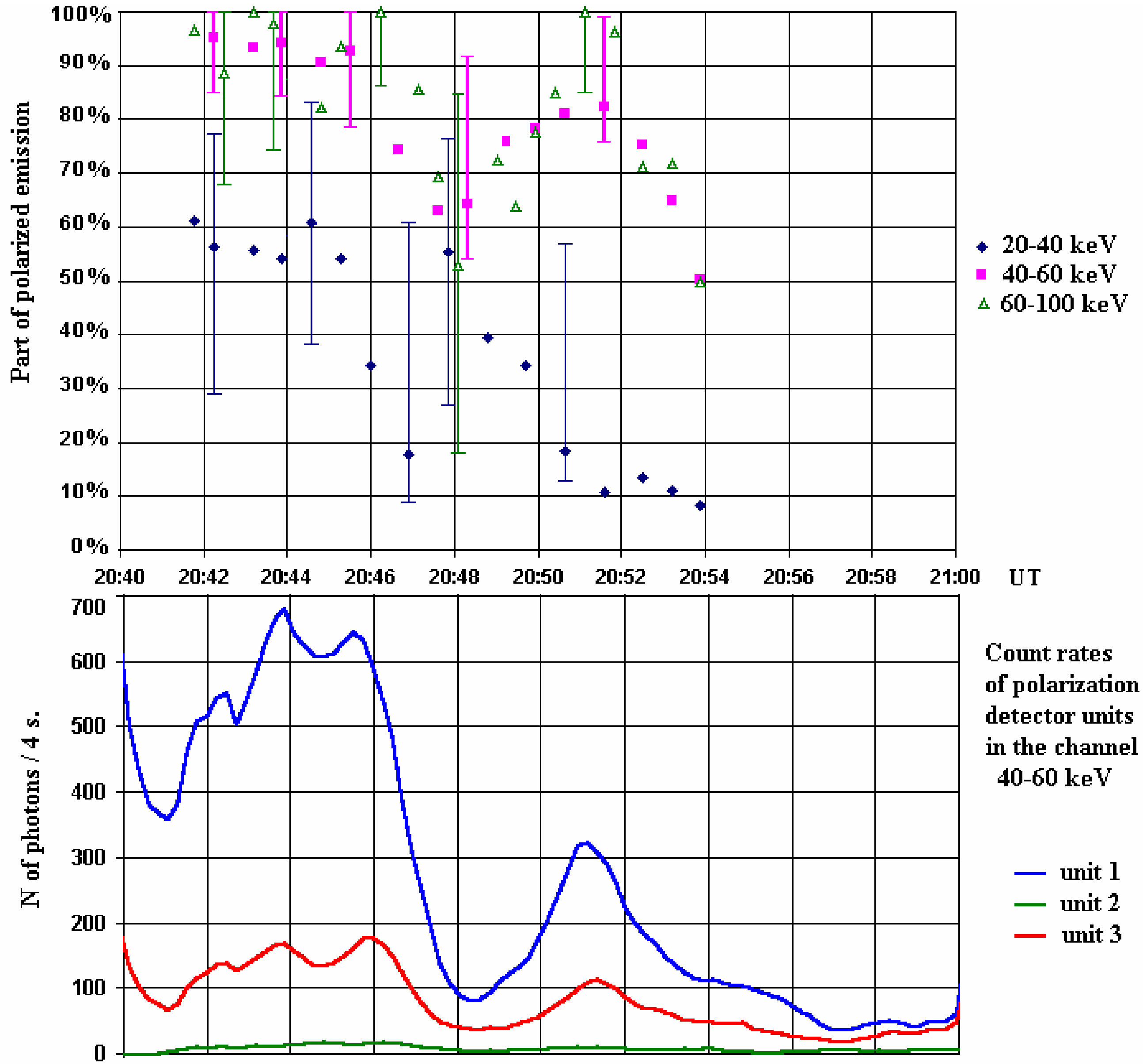
Polarization plane location. ($\pm 30^{o}$)

I. Myagkova

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

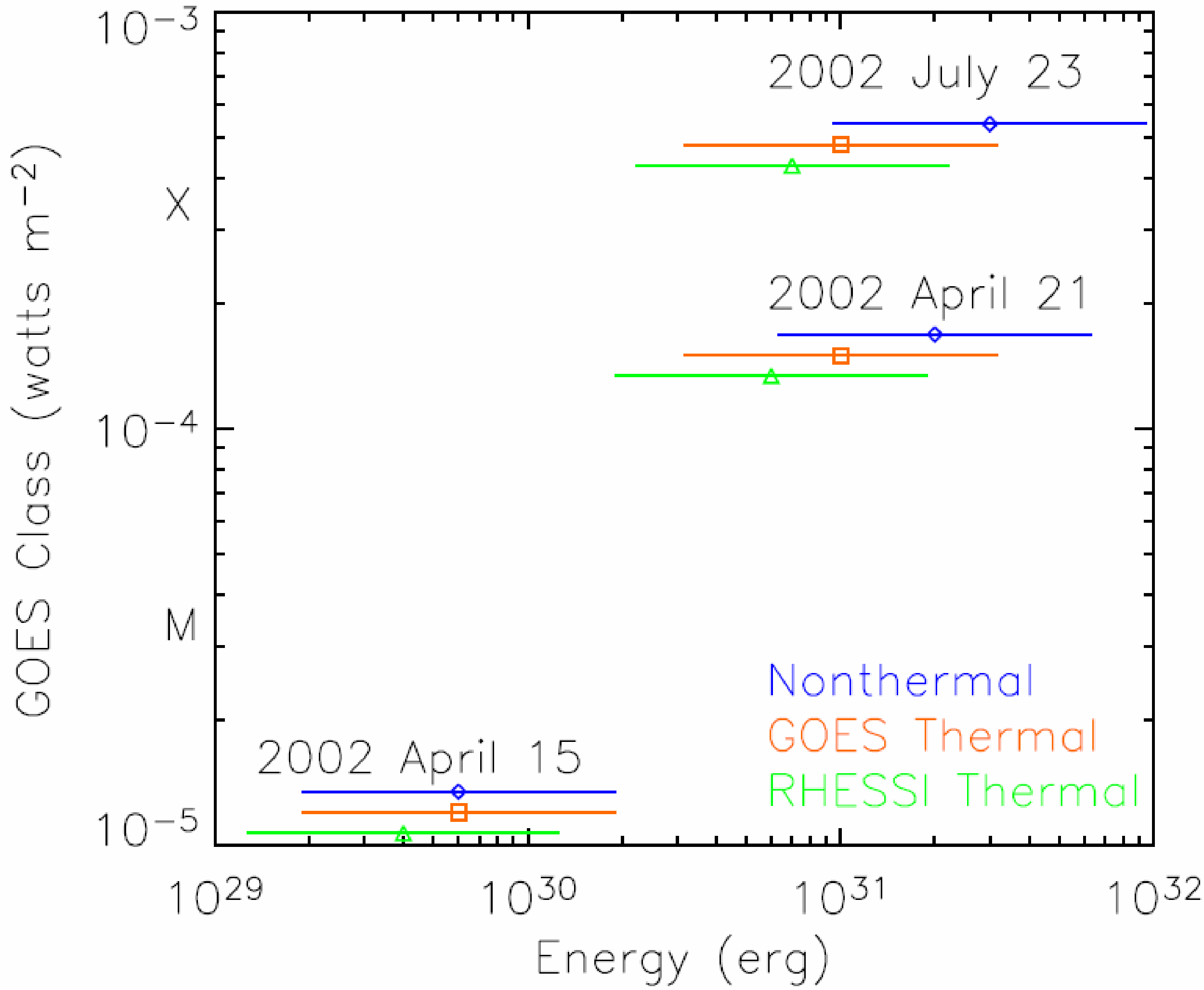
This may be connected with existence of collimated **beams of accelerated solar electrons** with energy >50 keV. In lower energy channel yield of thermal non-polarized emission is more significant,and the emission is less polarized.

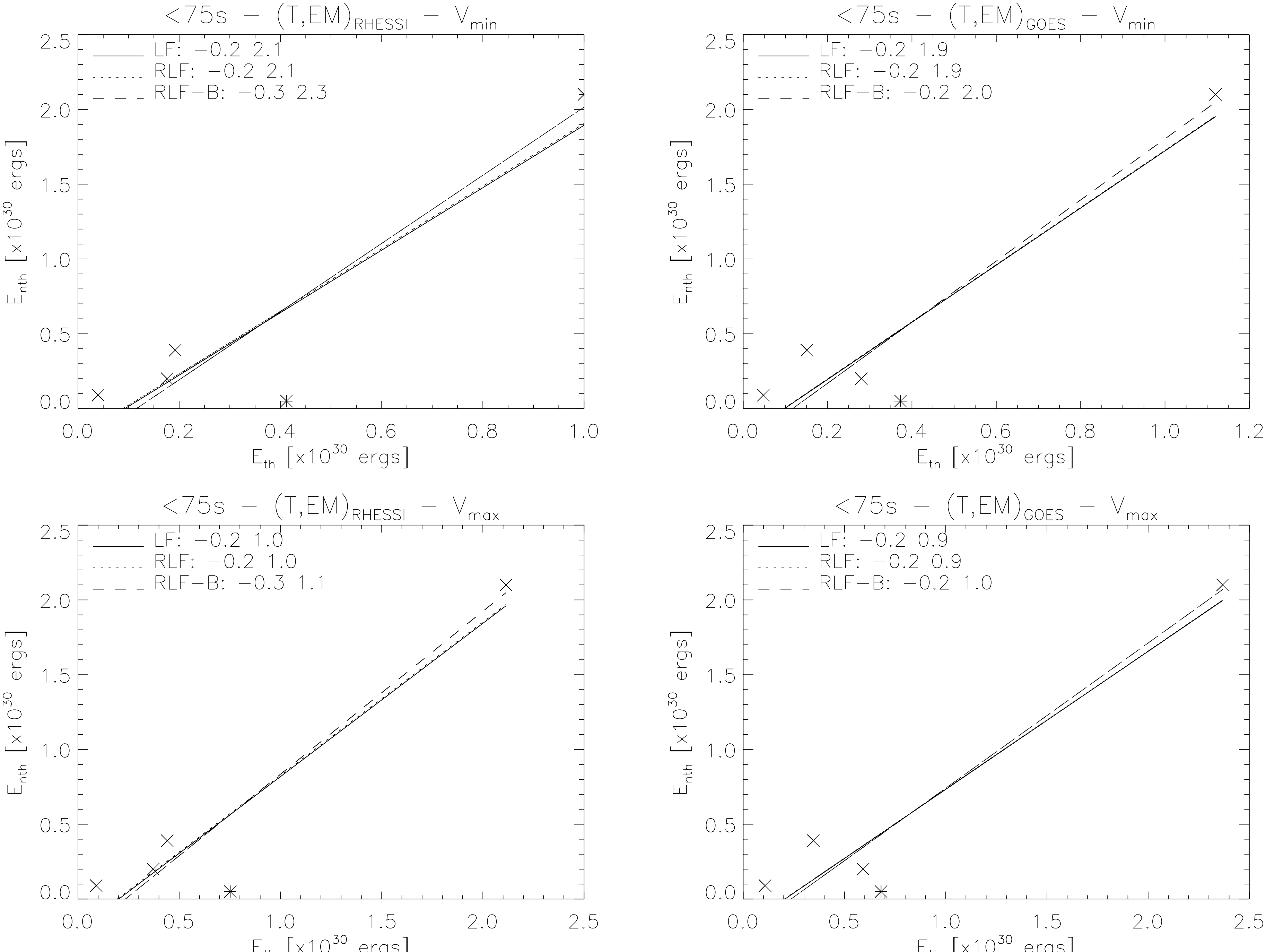
In the **28.10.2003** and the first stage of **4.11.2003** flare **the hard X-ray emission was not polarized.** Only upper limits 25% for 28.10.03 and 40% for 4.11.03 were obtained.



CORONAS-F, I. Myagkova

Energy Content of Nonthermal Electrons and Thermal Plasma for Three Flares





Pascal Saint-Hilaire

Last (but not least)

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