HIGH-ENERGY SOLAR PHYSICS WITH GLAST

THE HIGH-ENERGY SOLAR EXPERIMENT VACUUM DURING SOLAR CYCLE 24

SUMMARY OF GAMMA-RAY OBSERVATIONS >10 MeV

OUTSTANDING QUESTIONS THAT GLAST CAN ADDRESS

RHESSI OBSERVATIONS OF THE 2002 JULY 23 FLARE

STATISTICS OF HIGH-ENERGY GAMMA-RAY FLARES

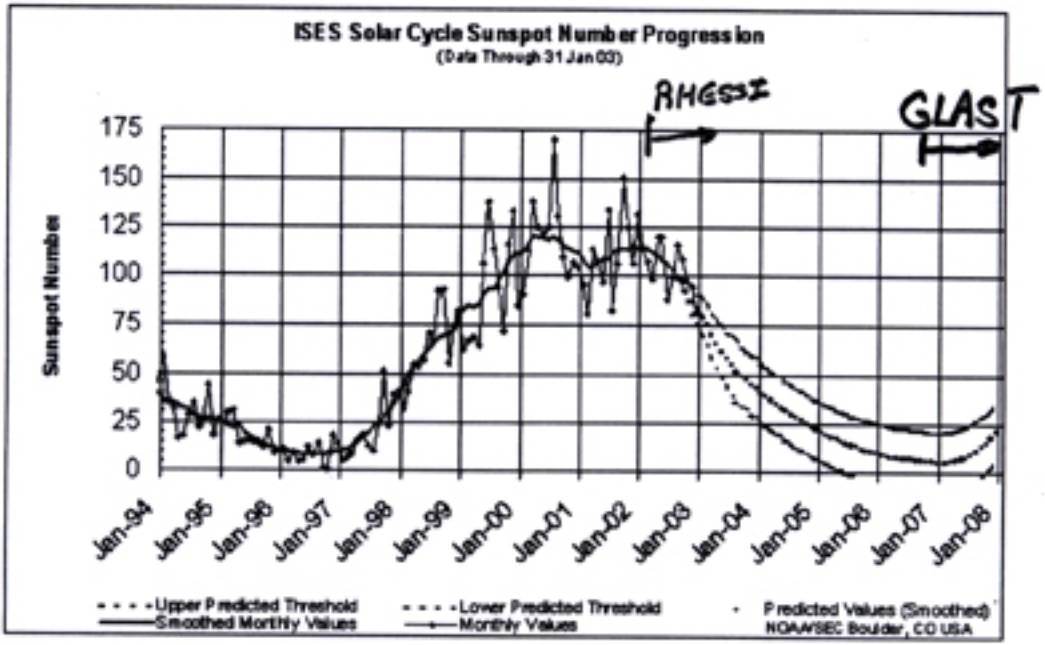
24 flares observed >10 MeV in over a solar cycle by the SMM spectrometer (~150 cm^2). 1980-1989

18 of these flares were X-class X-ray flares and 6 were M-Class (1/10 soft X-ray flux of X-class).

Evidence for beaming of high-energy radiation comes from distribution of high-energy flares on the Sun and from hardening of spectra for flares near the limb (suggests a pancake distribution of radiation).

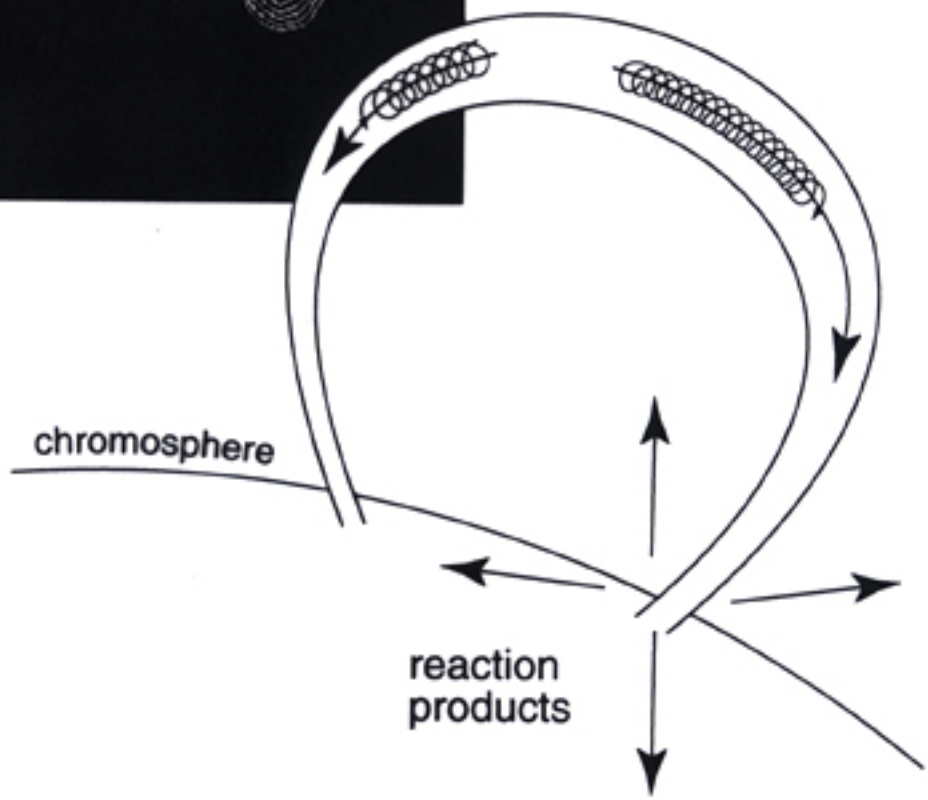
There were 88 X-class flares:

	Full sample	>10 MeV	No >10 MeV
% observed at heliocentric angles >60°	42 ± 8	71 ± 23	31 ± 8



GLAST Can Observe The Rise of Cycle 24

Neutron and γ-ray Production in Solar Flares



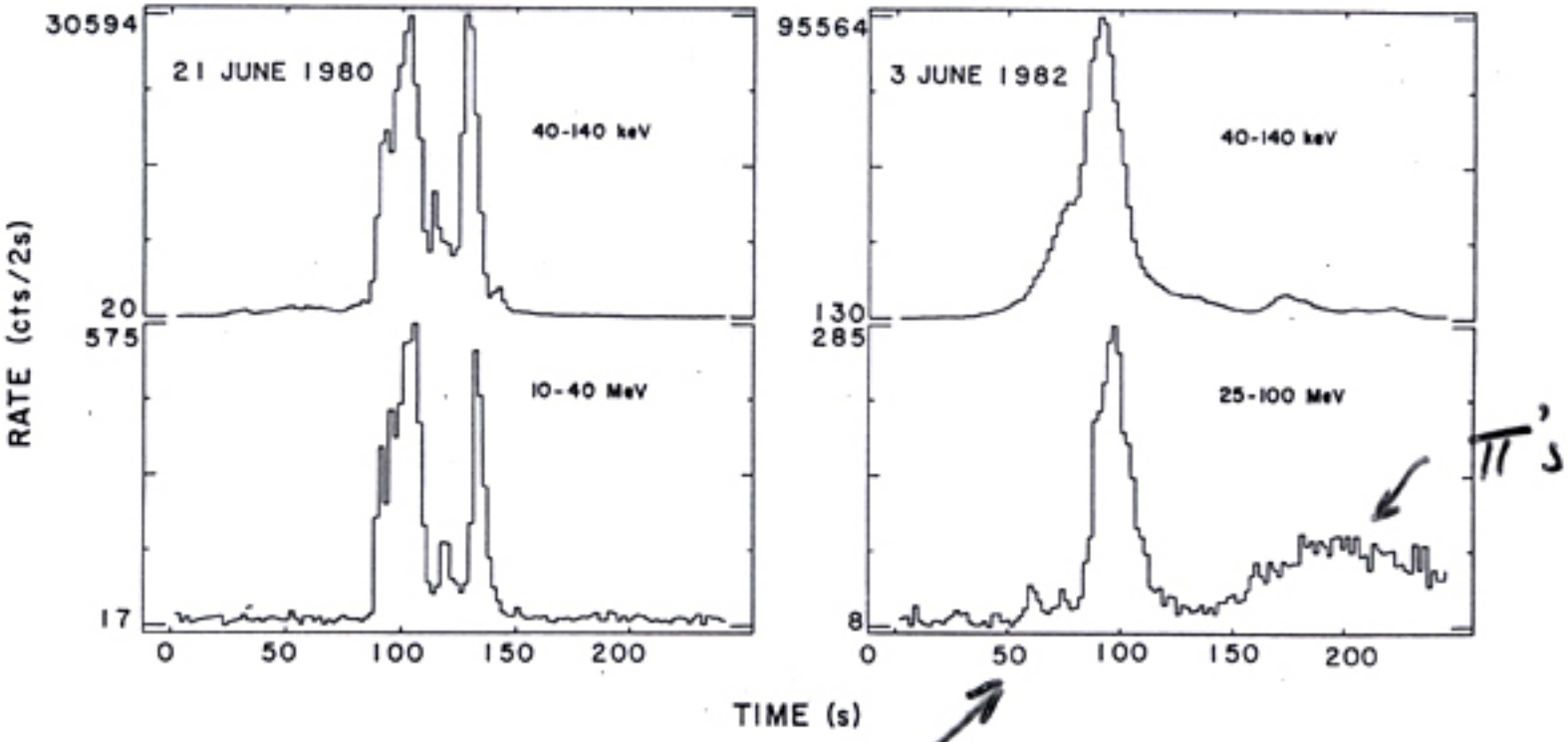
electrons: X- and γ-ray bremsstrahlung

ions: radioactive nuclei → e^+ → γ_{511}

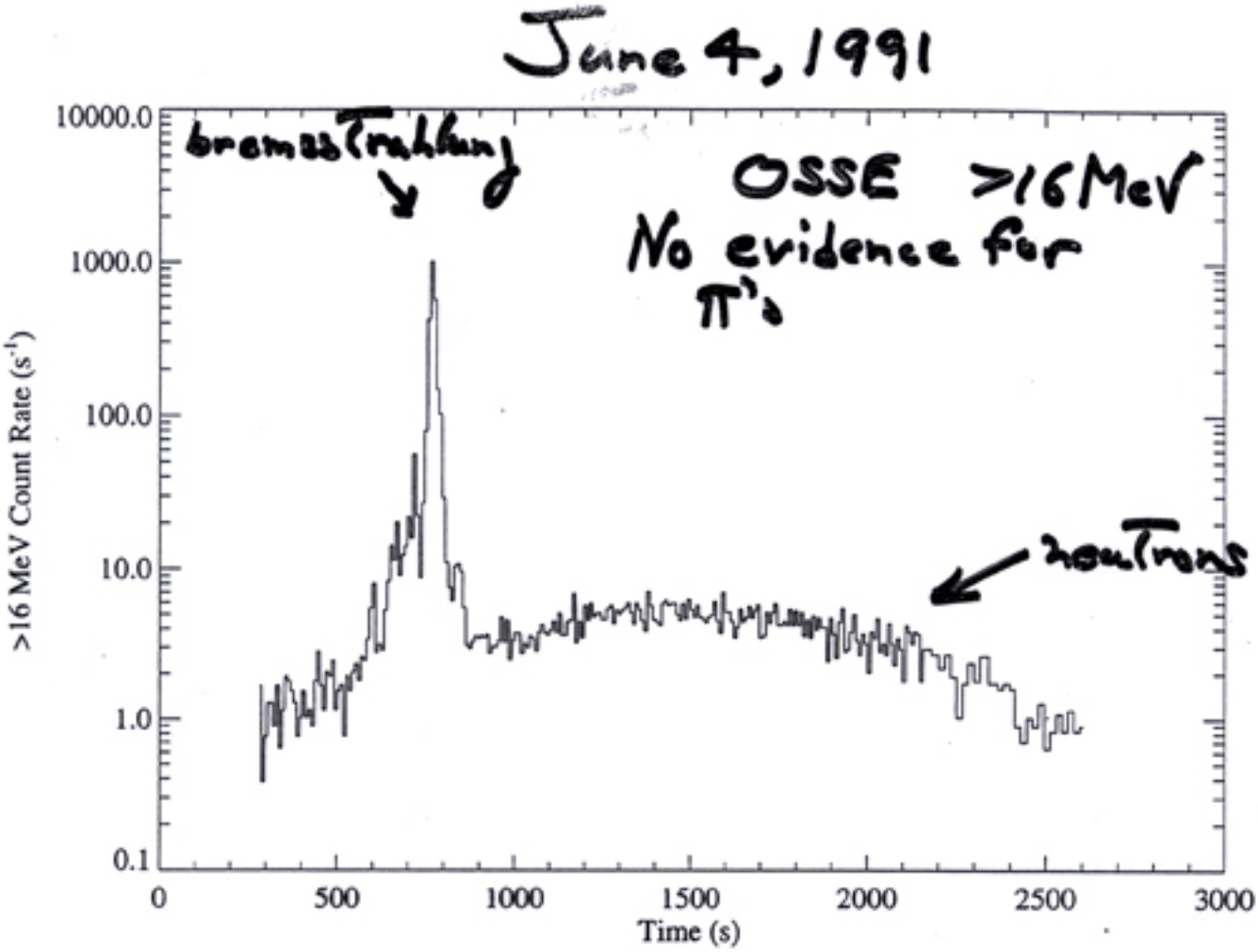
$\pi \rightarrow \gamma$ (decay, $e^{\pm}$ bremsstrahlung)

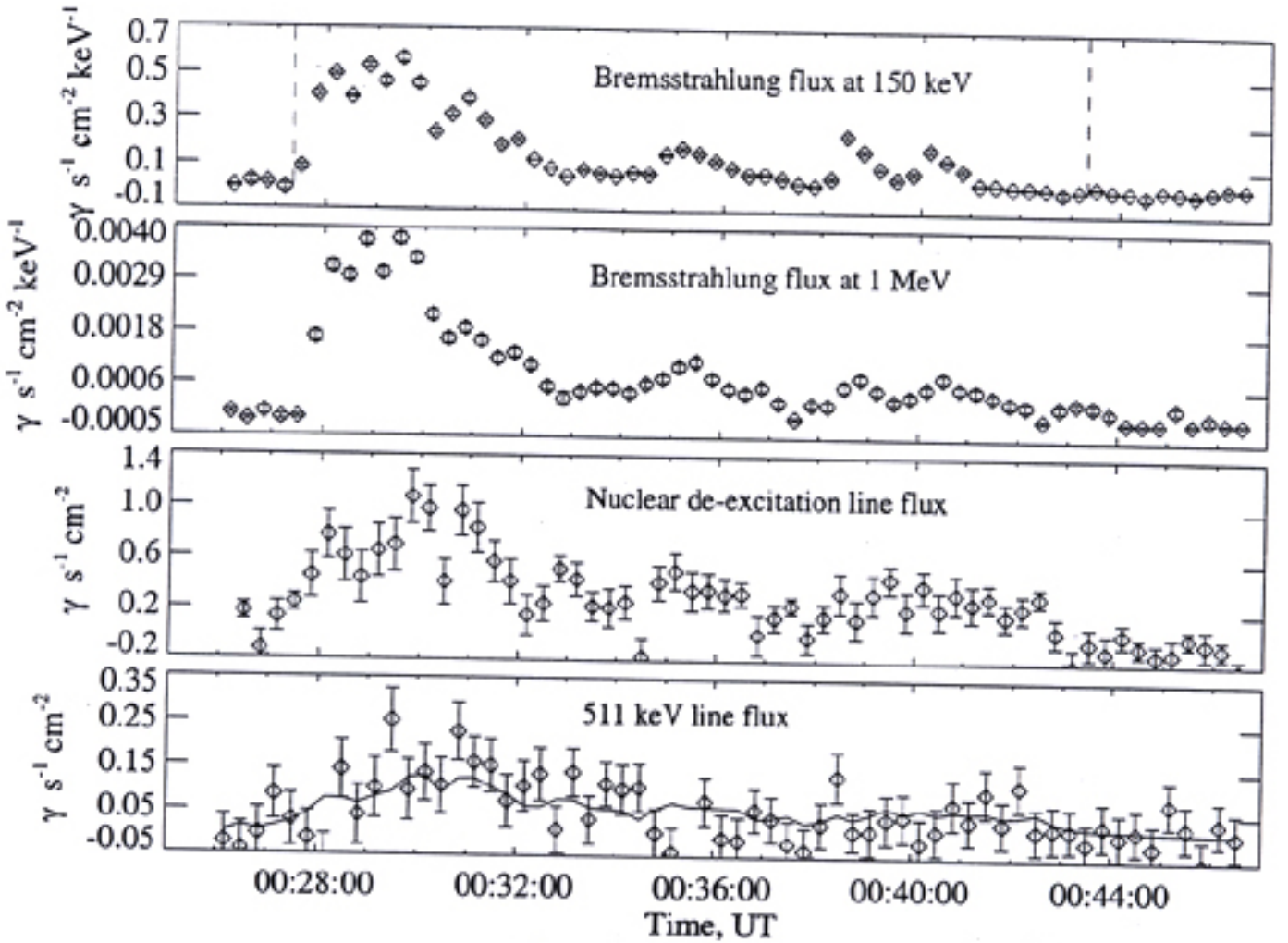
excited nuclei → γ–ray line radiation

neutrons → { escape to space / 2.223 MeV capture line



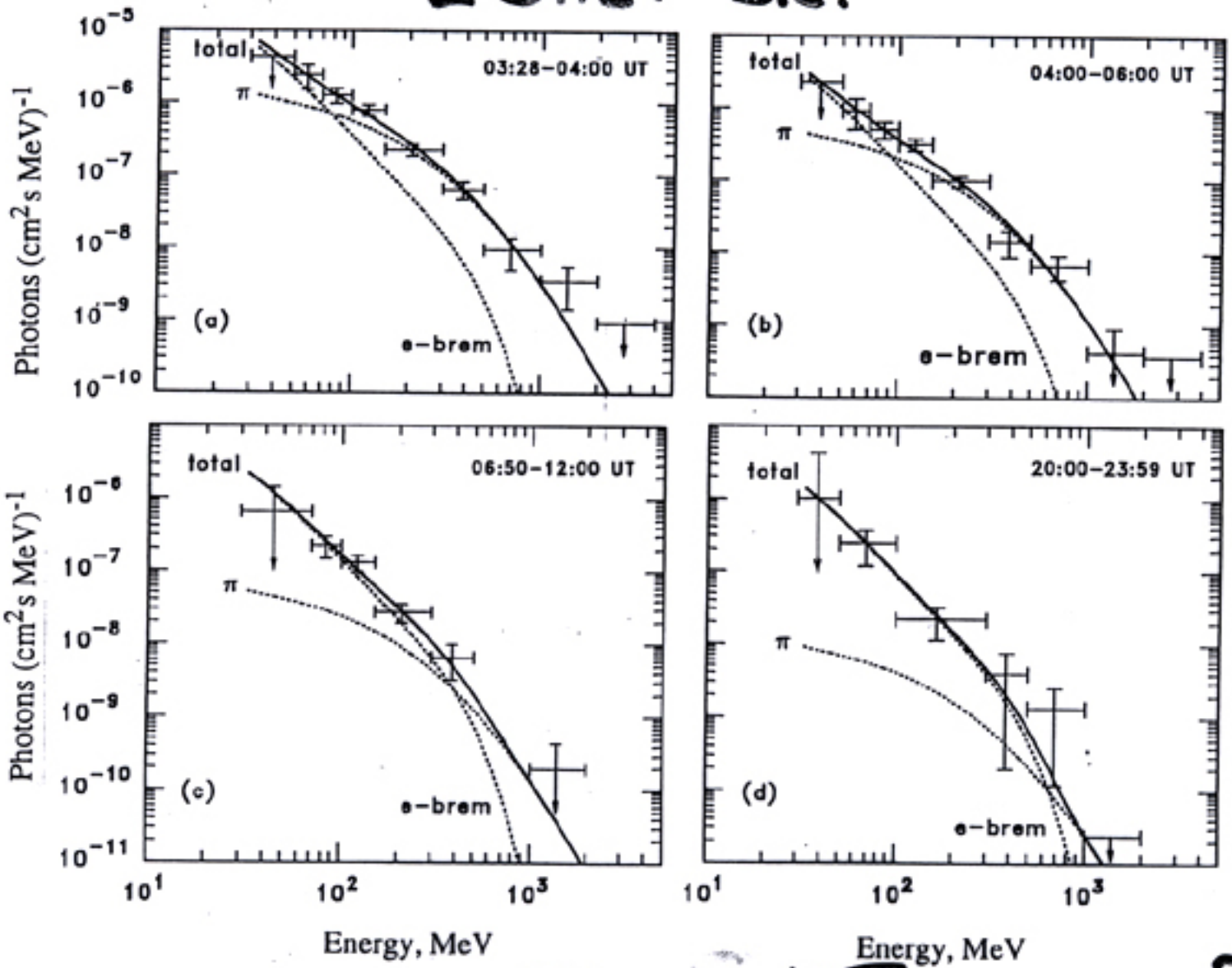
Second stage of high-energy emission


June 4, 1991
bremsstrahlung
OSSE >16 MeV
No evidence for
π's
neutrons
>16 MeV Count Rate (s⁻¹)
10000.0
1000.0
100.0
10.0
1.0
0.1
0
500
1000
1500
2000
2500
3000
Time (s)



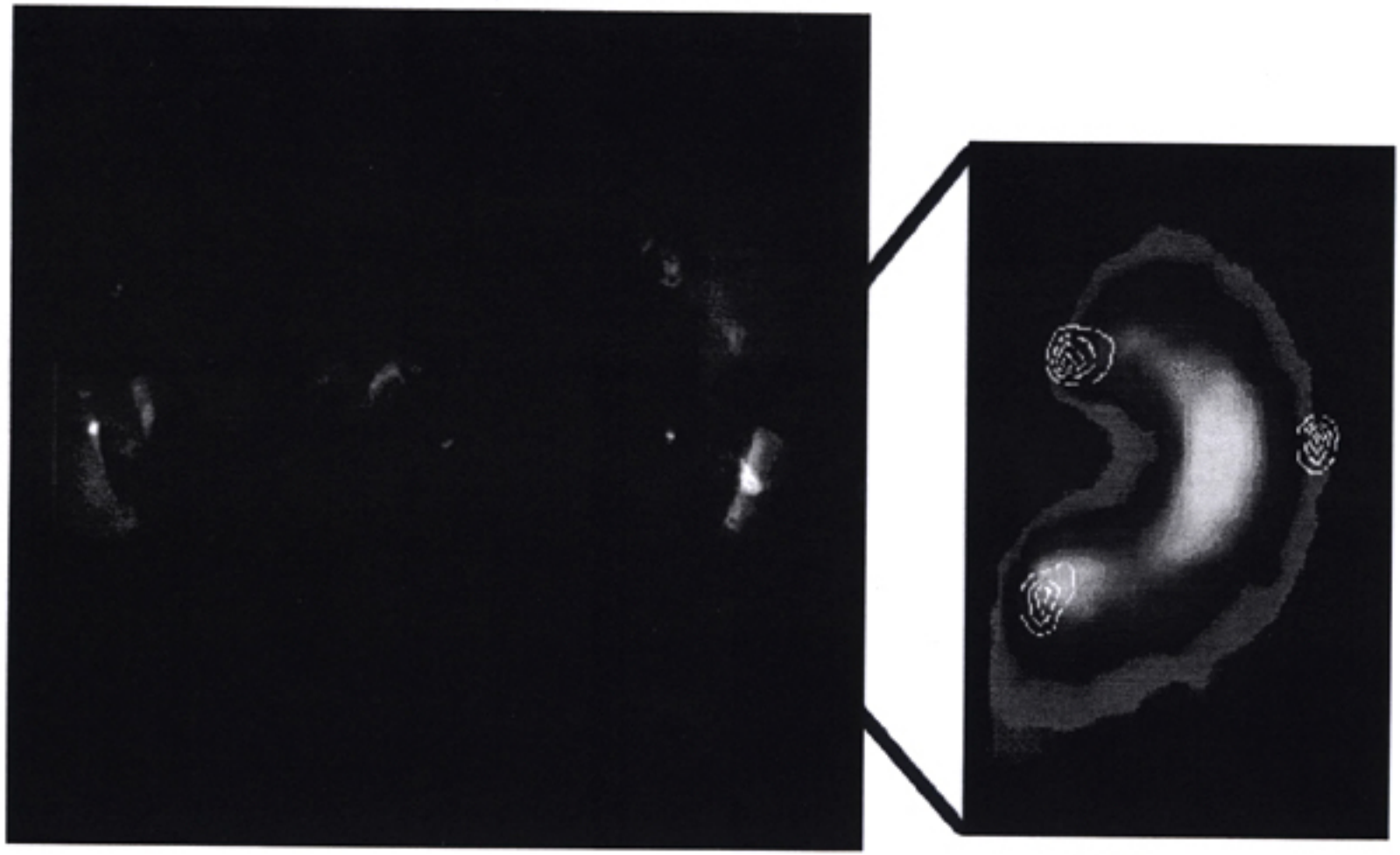
RHESSI 2002 July 23
Share et al. 2003

EGRET S.C.



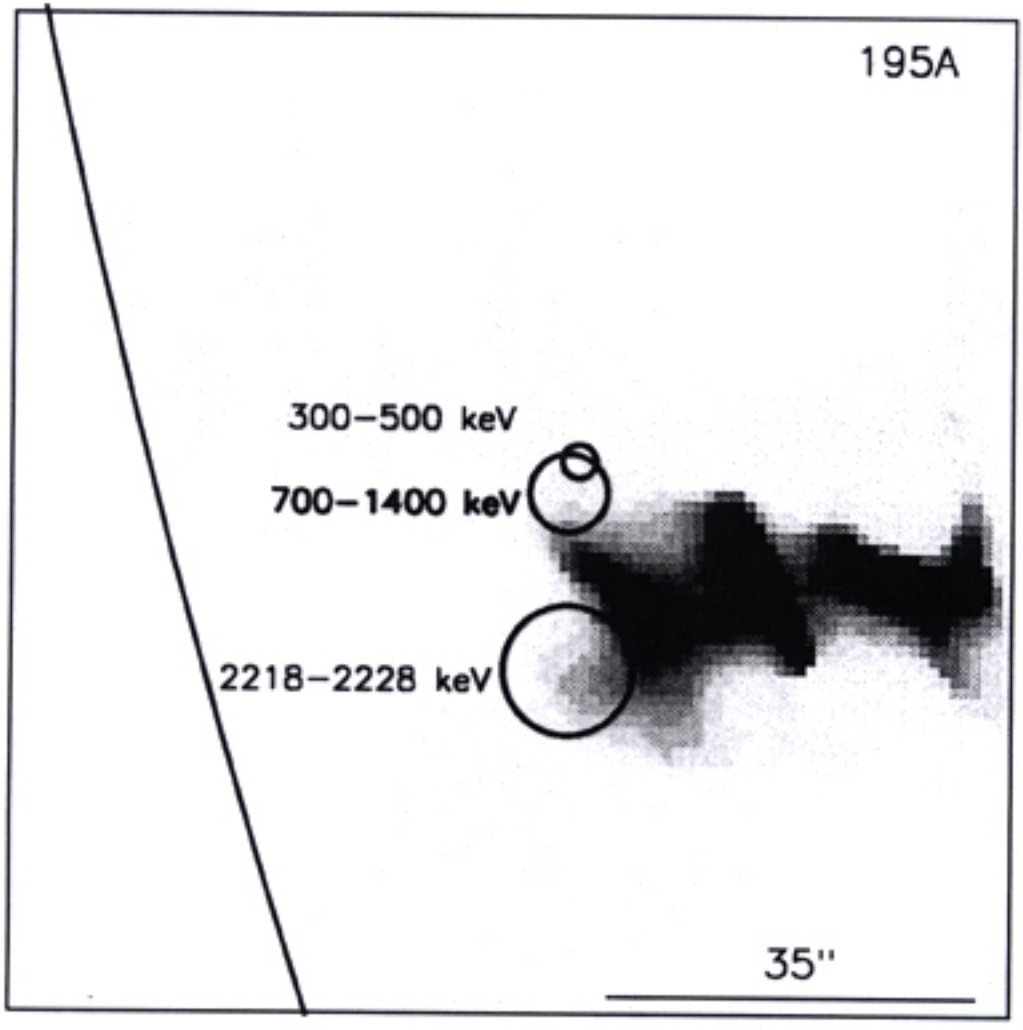
Spectral Evolution
(gradual phase only)

Ber[illegible] et al

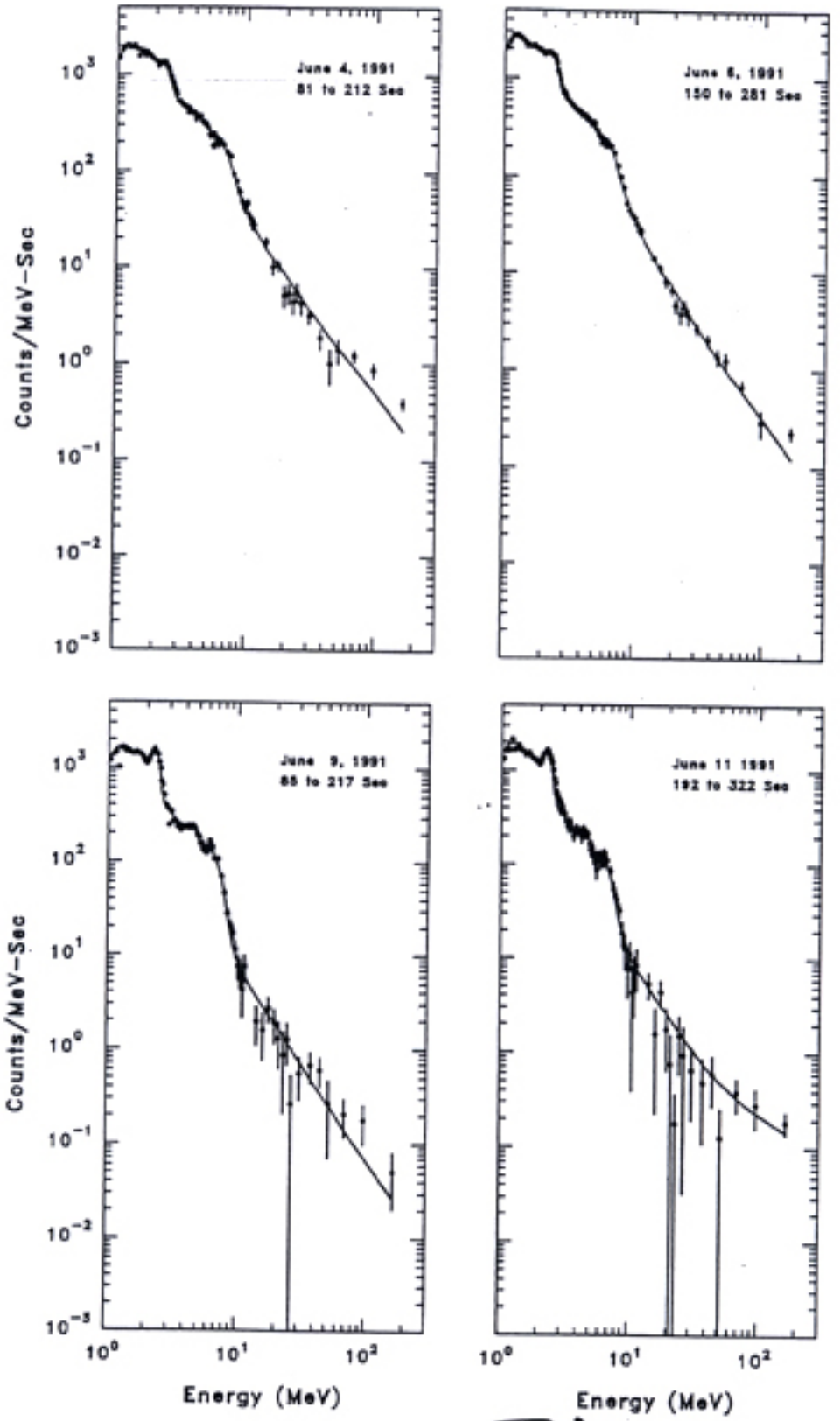


30 arcsec

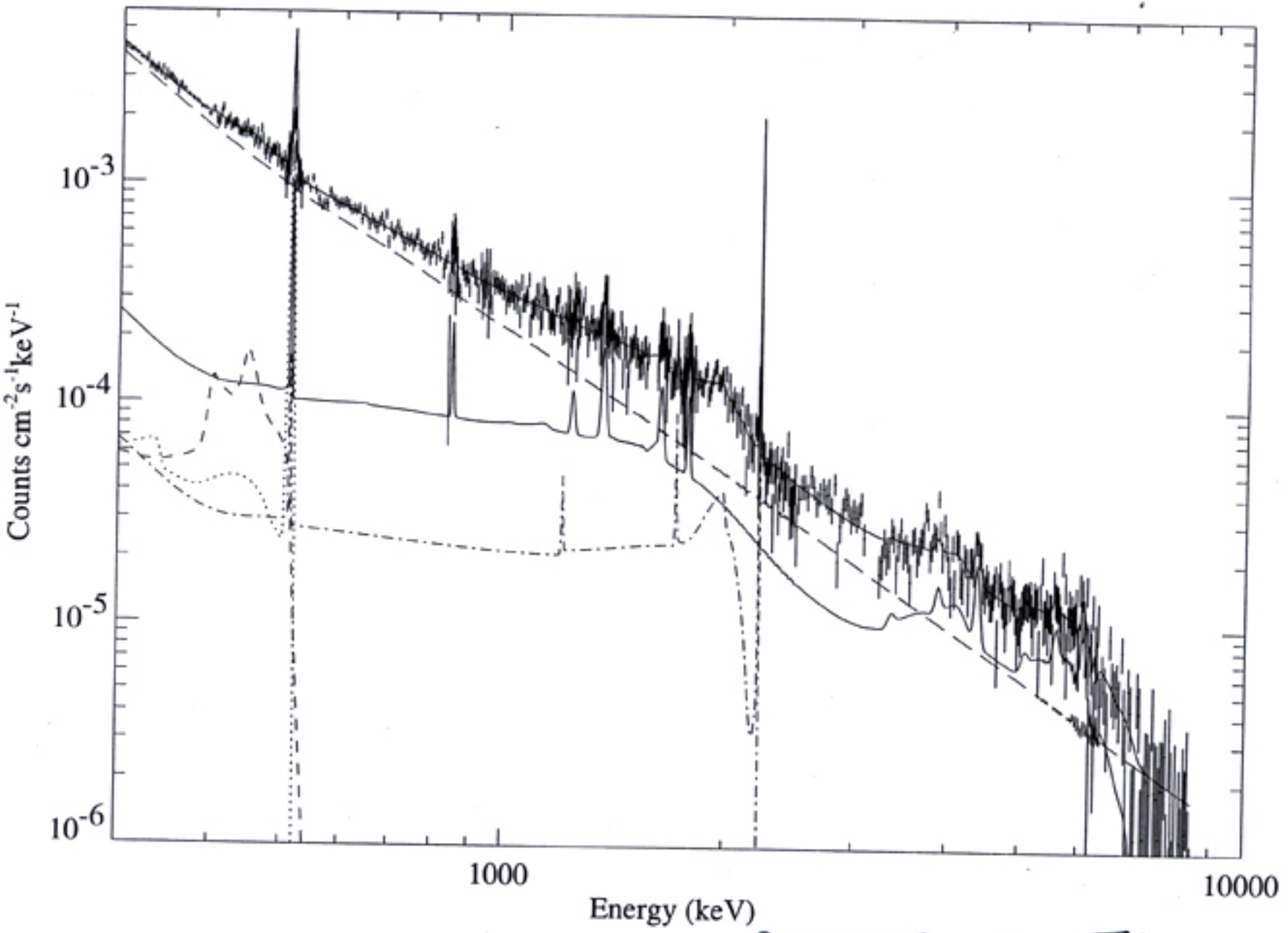
HESSI 1-10 MeV resolution 36 arcsec
GLAST location 0.5~1 arcmin



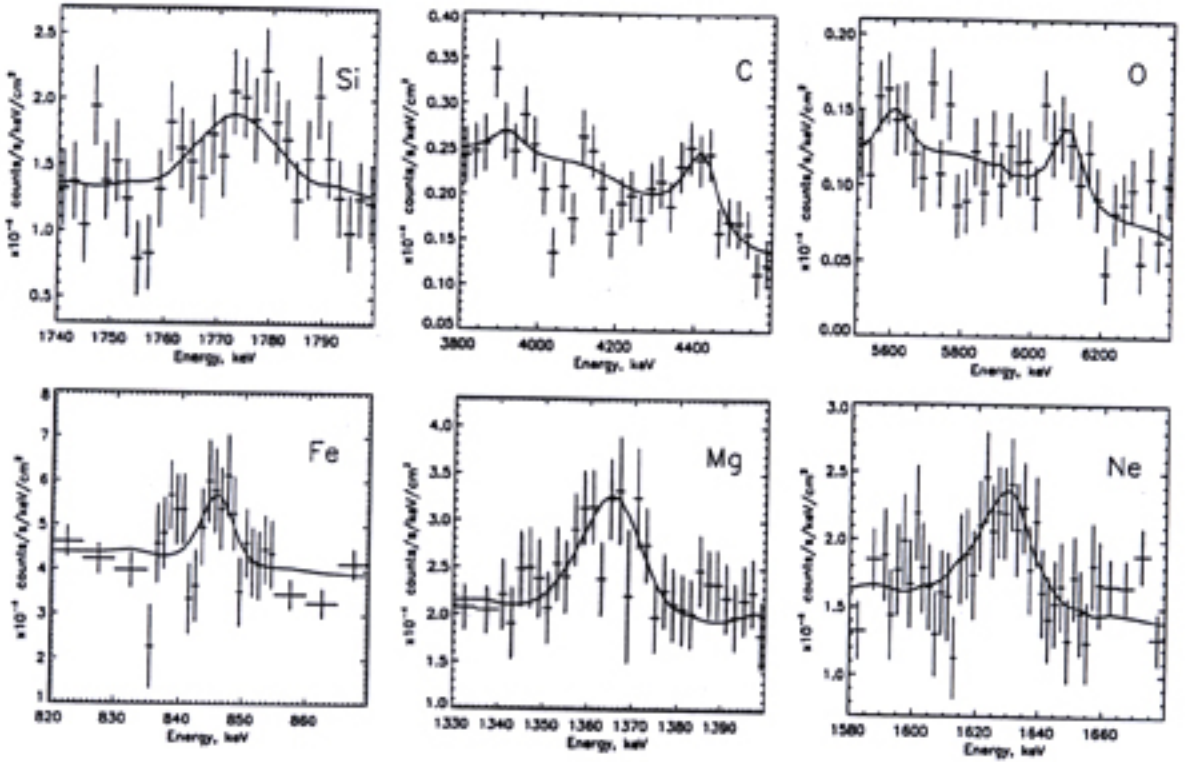
RHESSI 2002 July 23
Hurford et al. (2003)



TASC spectral measurements
Bertsch et al.
< 200 MeV - close to impulsive phase

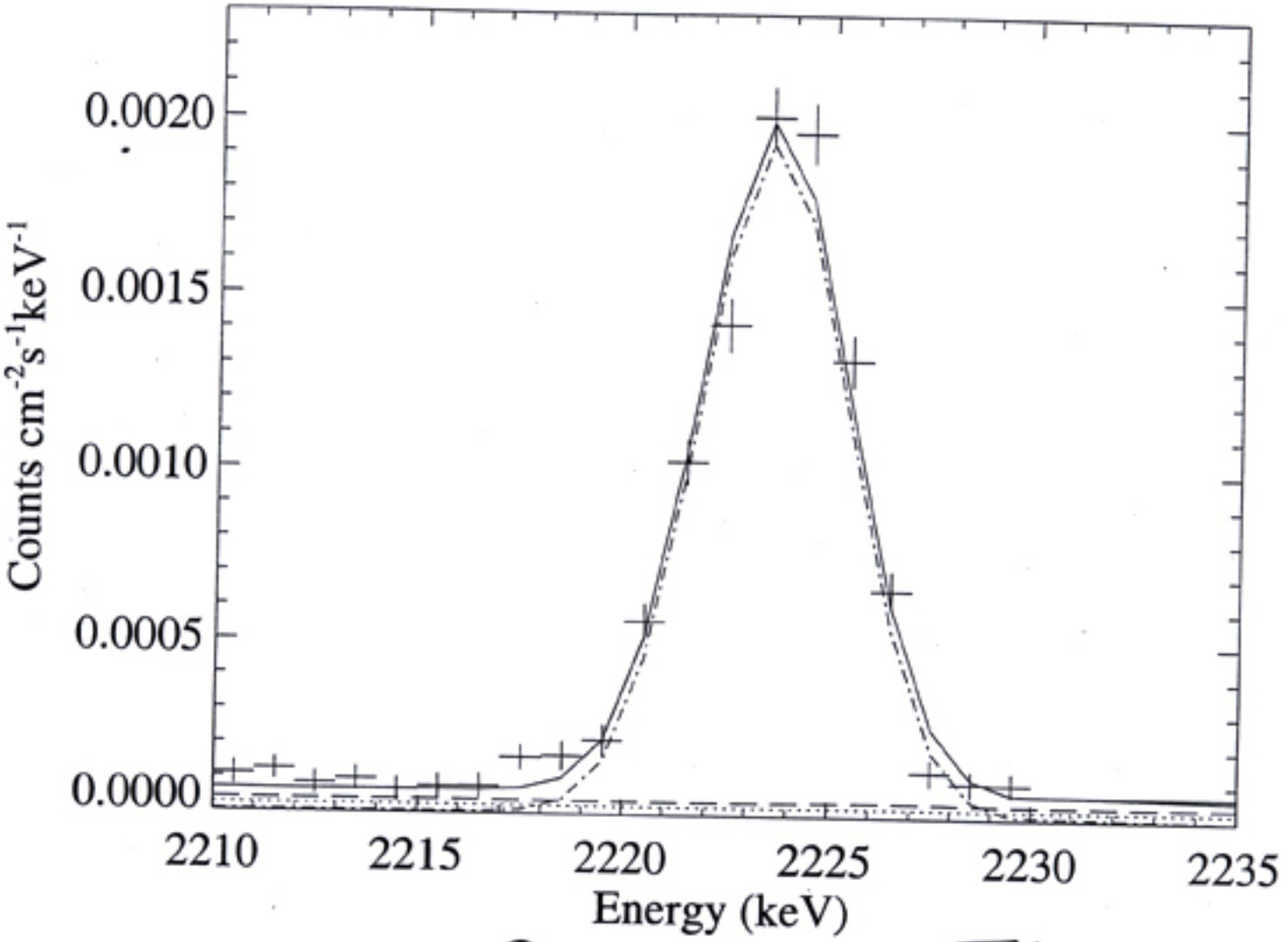


RHESSI 2002 July 23
Lin et al. 2003

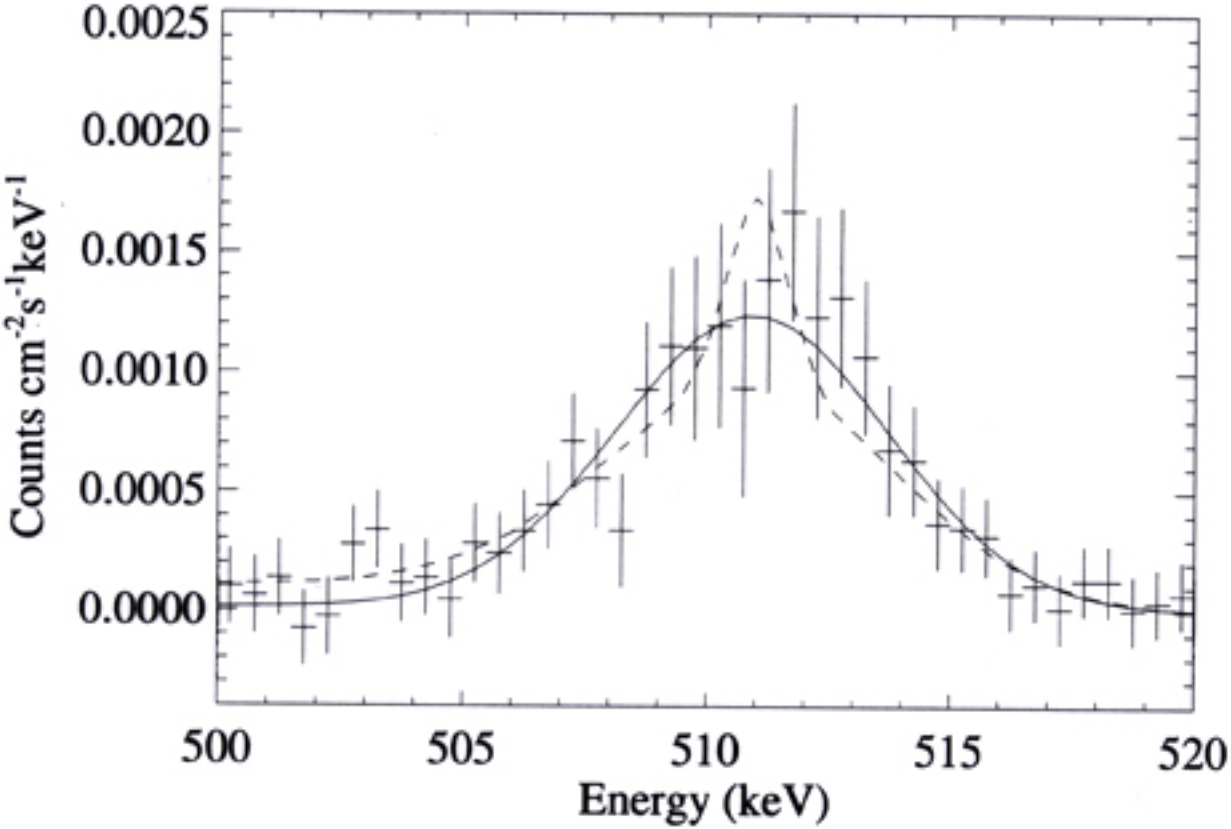


RHESSI 2002 July 23

Smith et al. 2003



RHESSI 2002 July 23
Murphy et al. 2003

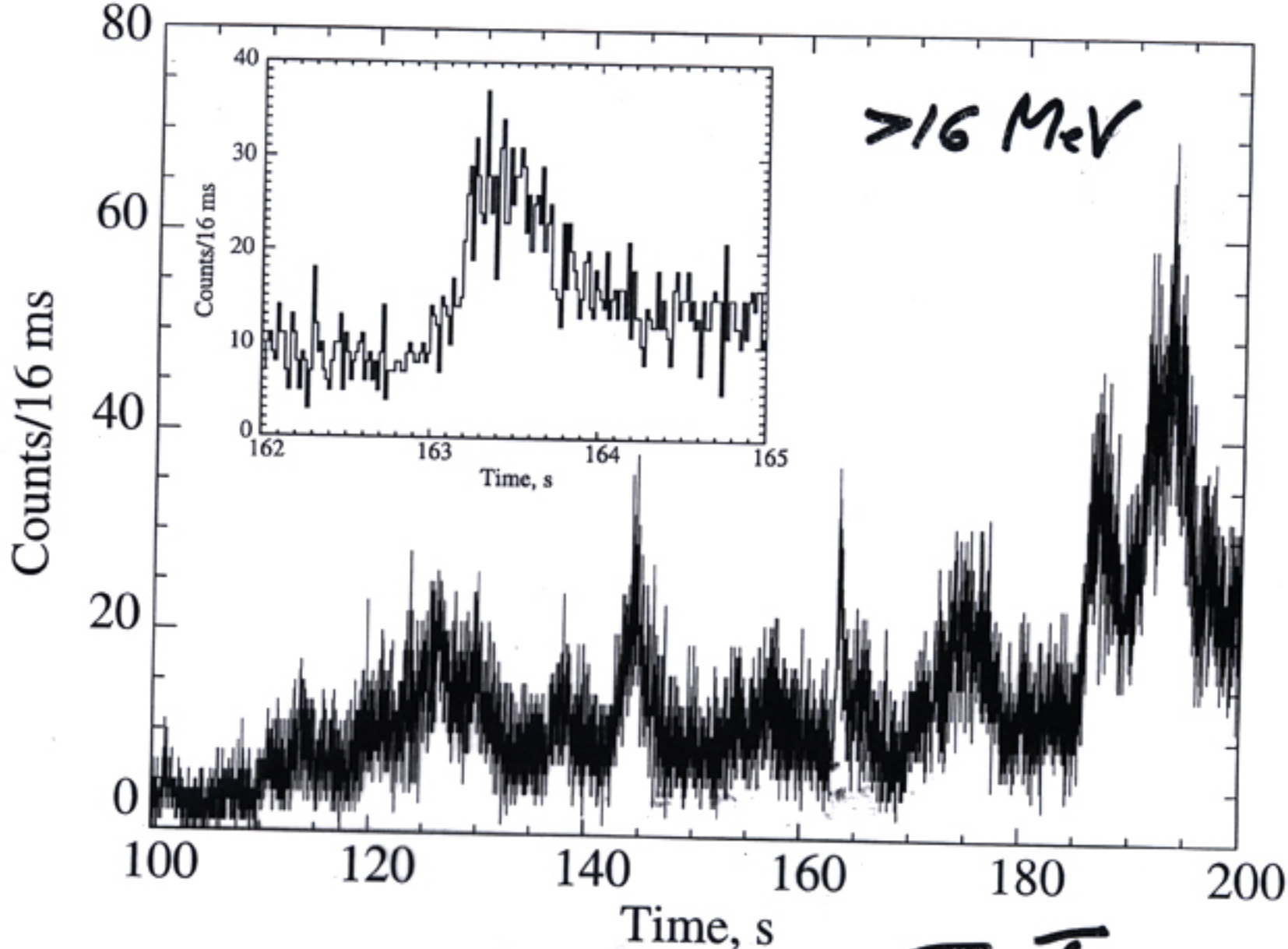


RHESSI 2002 July 23
Share et al. 2003

COMPARISON OF GLAST/GBM[+] AND SMM/GRS[*]

Energy	SMM	GBM	SMM	GBM
MeV	P.P. Area, cm^2	P.P. Area, cm^2	FWHM, keV	FWHM, keV
0.34	160	140	30	70
0.51	148	140	40	85
1.37	85	120	75	120
2.22	61	100	100	170
4.44	38	80	160	240
6.12	31	70	195	300

[+] Two 12.7 cm Dia. x 12.7 cm Bismuth Germanate (BGO) detectors
[*] Seven 7.6 cm Dia. X 7.6 cm NaI detectors within AC shield



OSSE

~ 0.1 sec temporal structure –
⇒ 'high energy acceleration time scale