

Elemental Abundances MESSENGER SAX & RHESSI

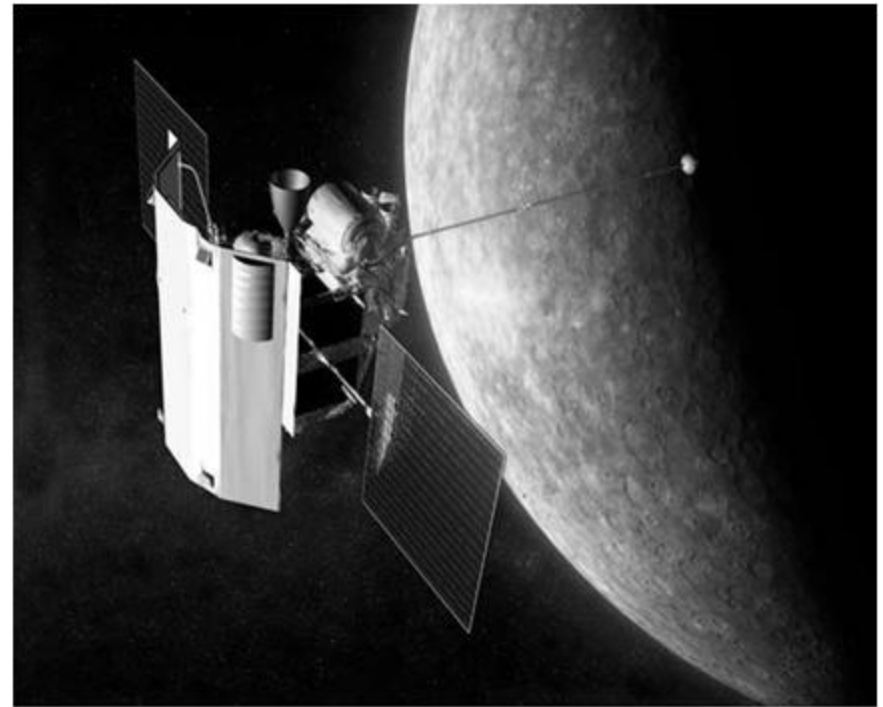
Brian Dennis

31 October 2012

Mercury MESSENGER

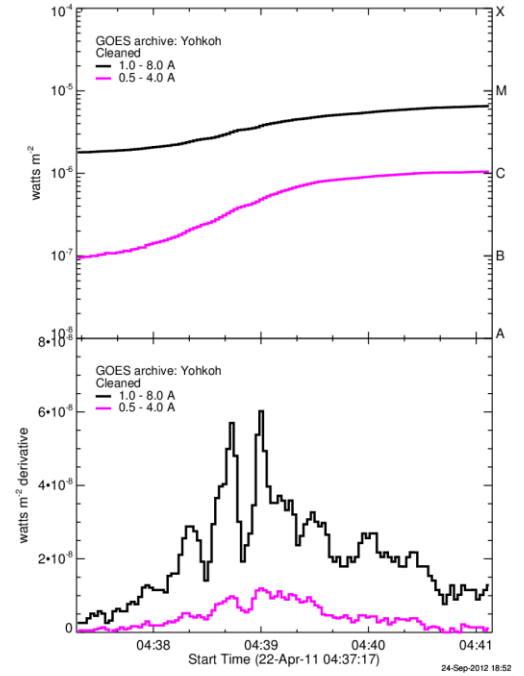
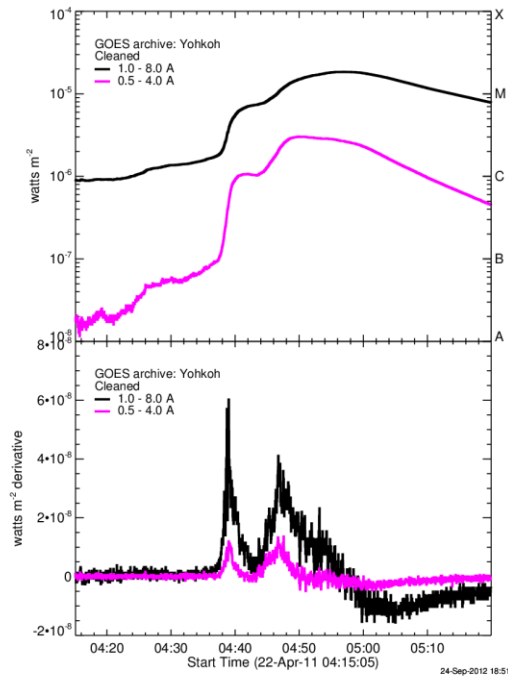
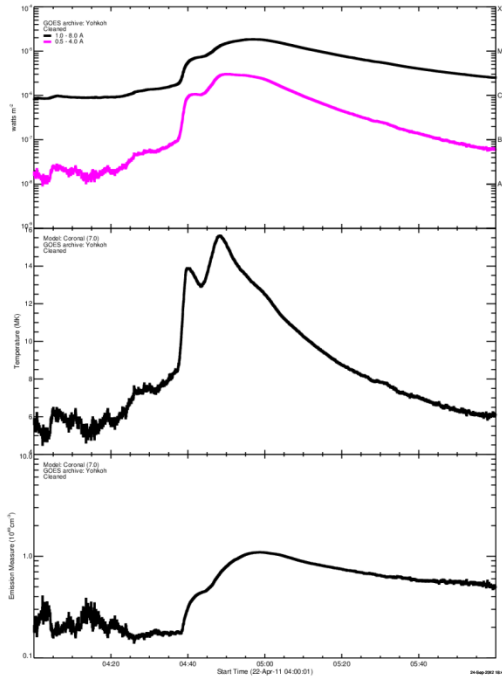
Solar Assembly for X-rays (SAX)

- Si-PIN solid-state
- 300 μm thick
- 1 to 10 keV
- ~ 300 eV resolution at 6 keV
- 0.12 mm^2
- 3 x 25 μm Be foils
- Mounted on sunshade



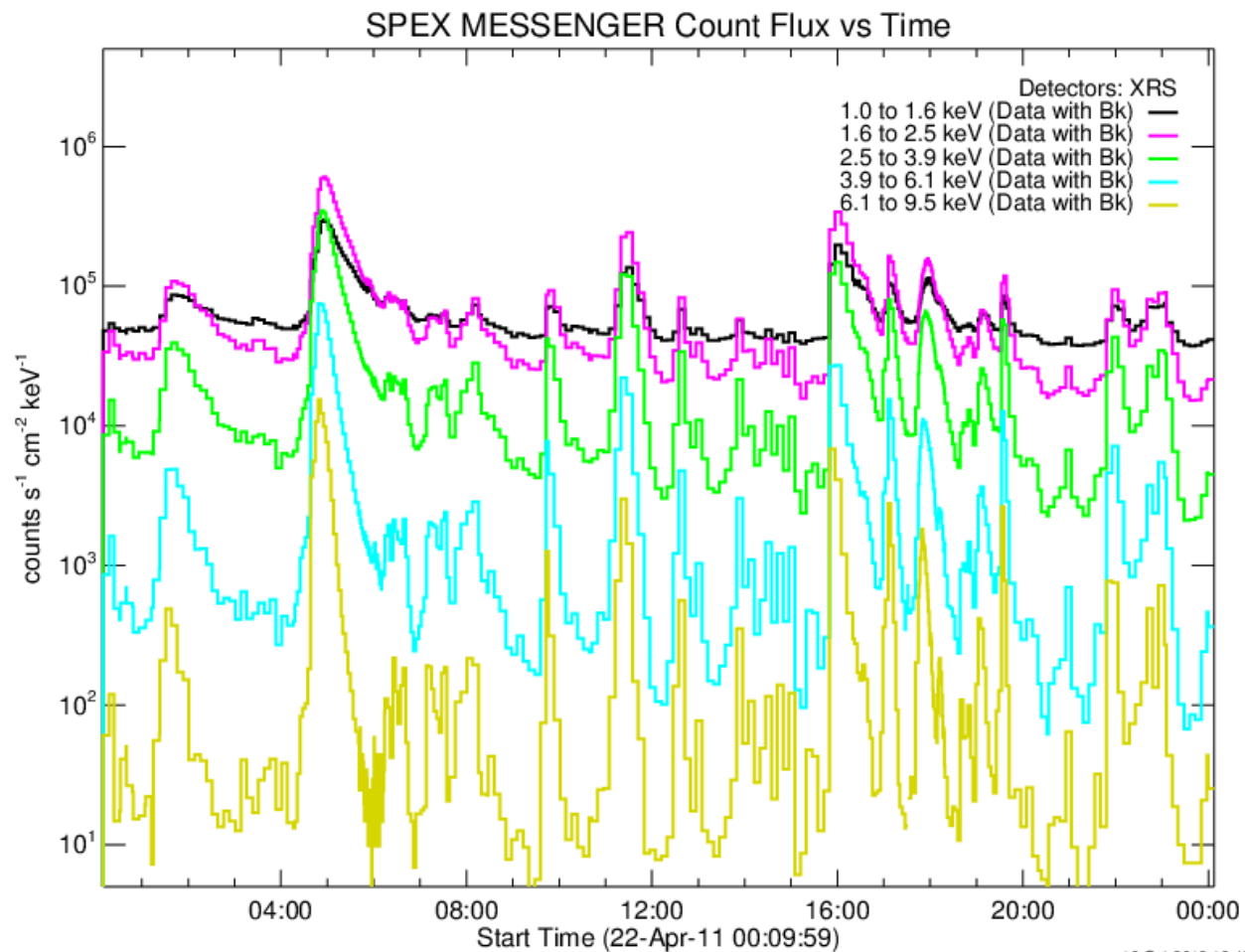
GOES Light Curves

22 April 2011



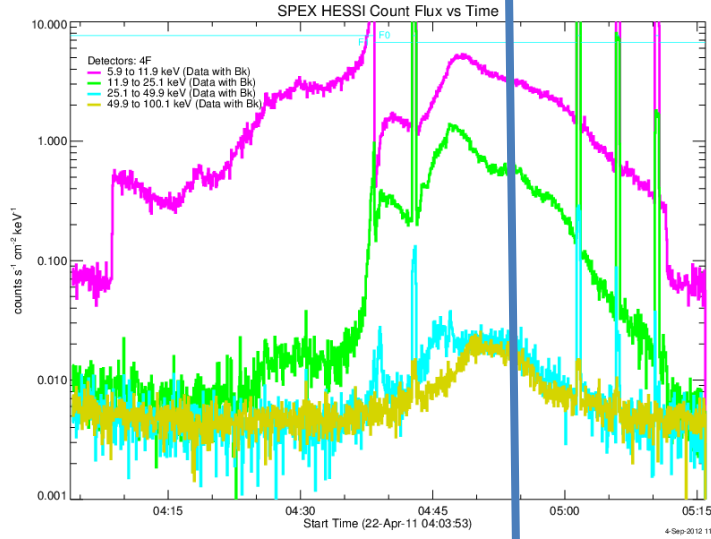
MESSENGER Light Curve

22 April 2011



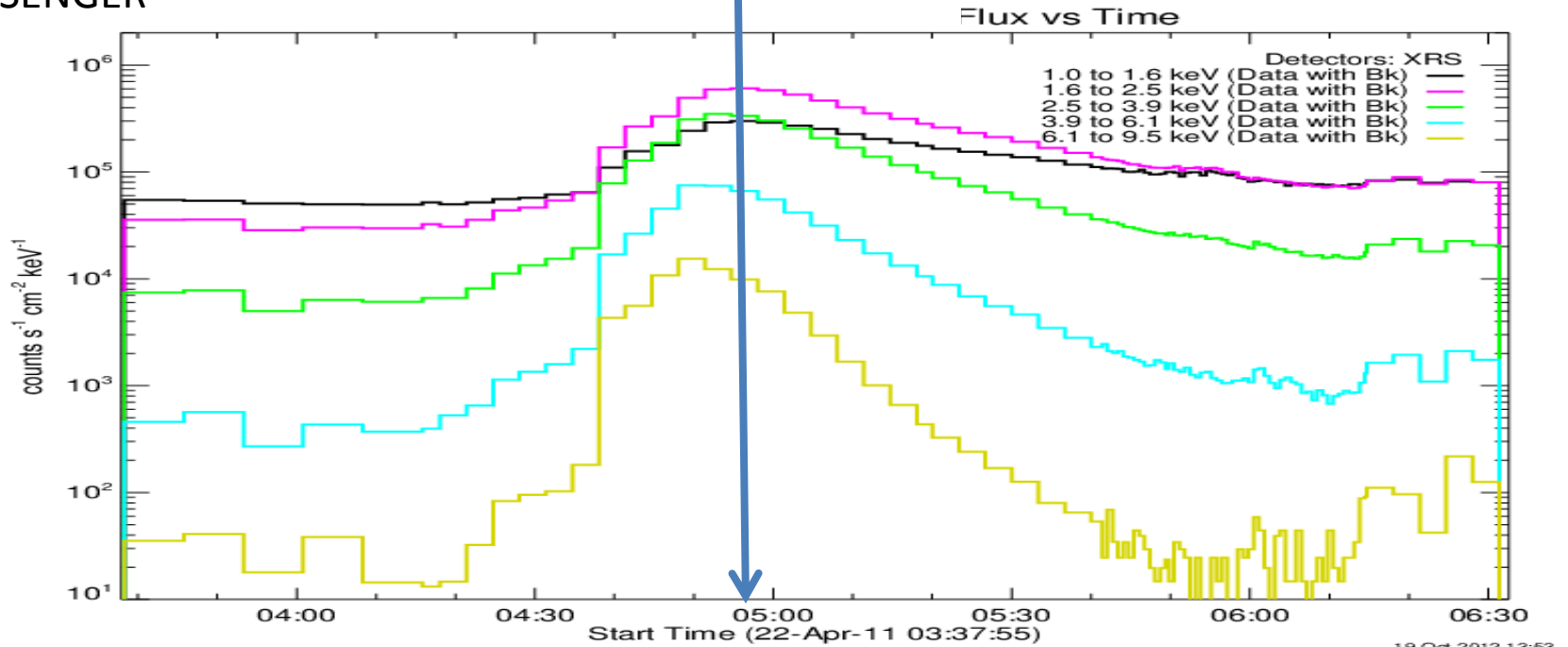
Interval of Interest

RHESSI

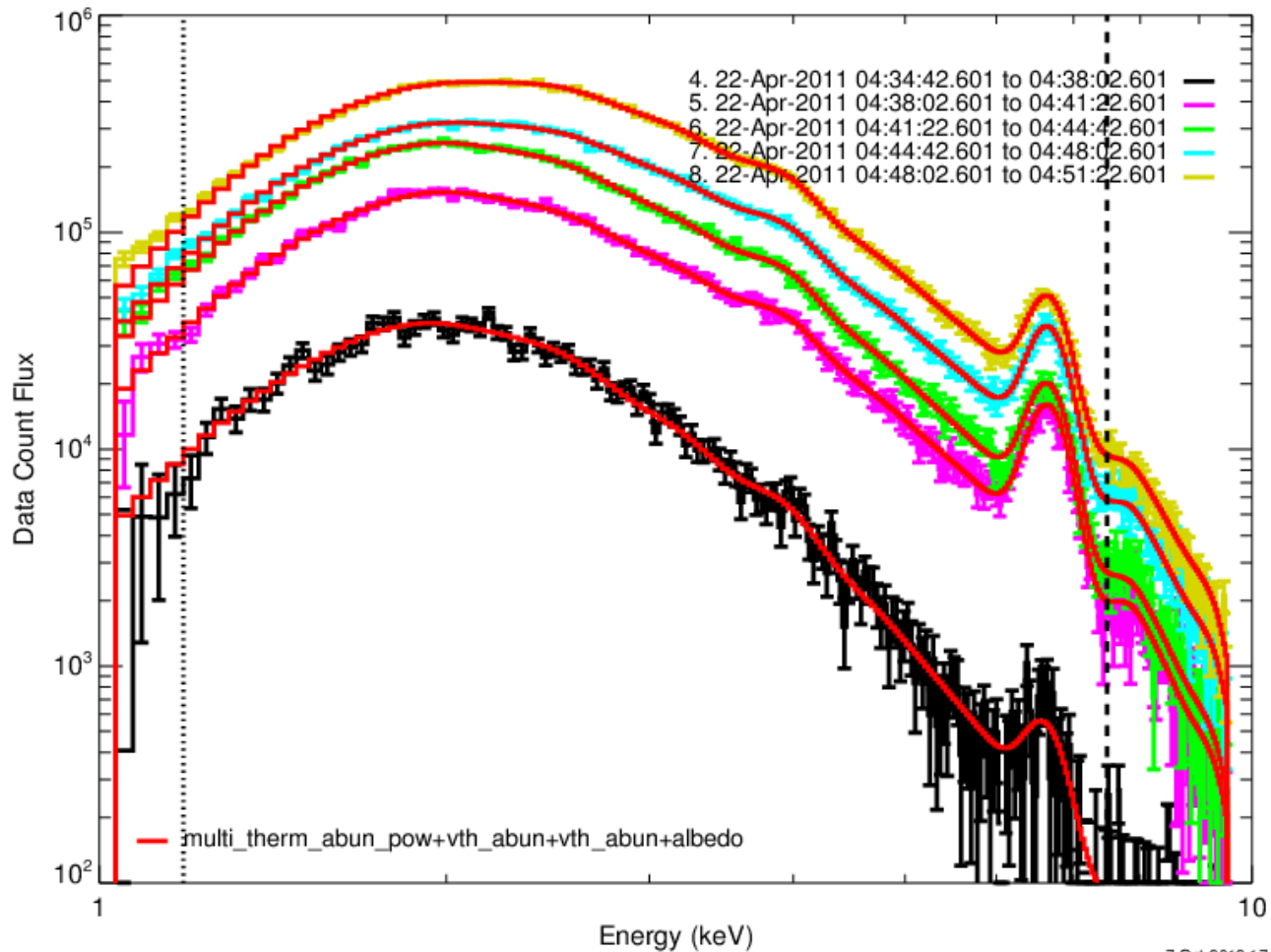


22 April 2011

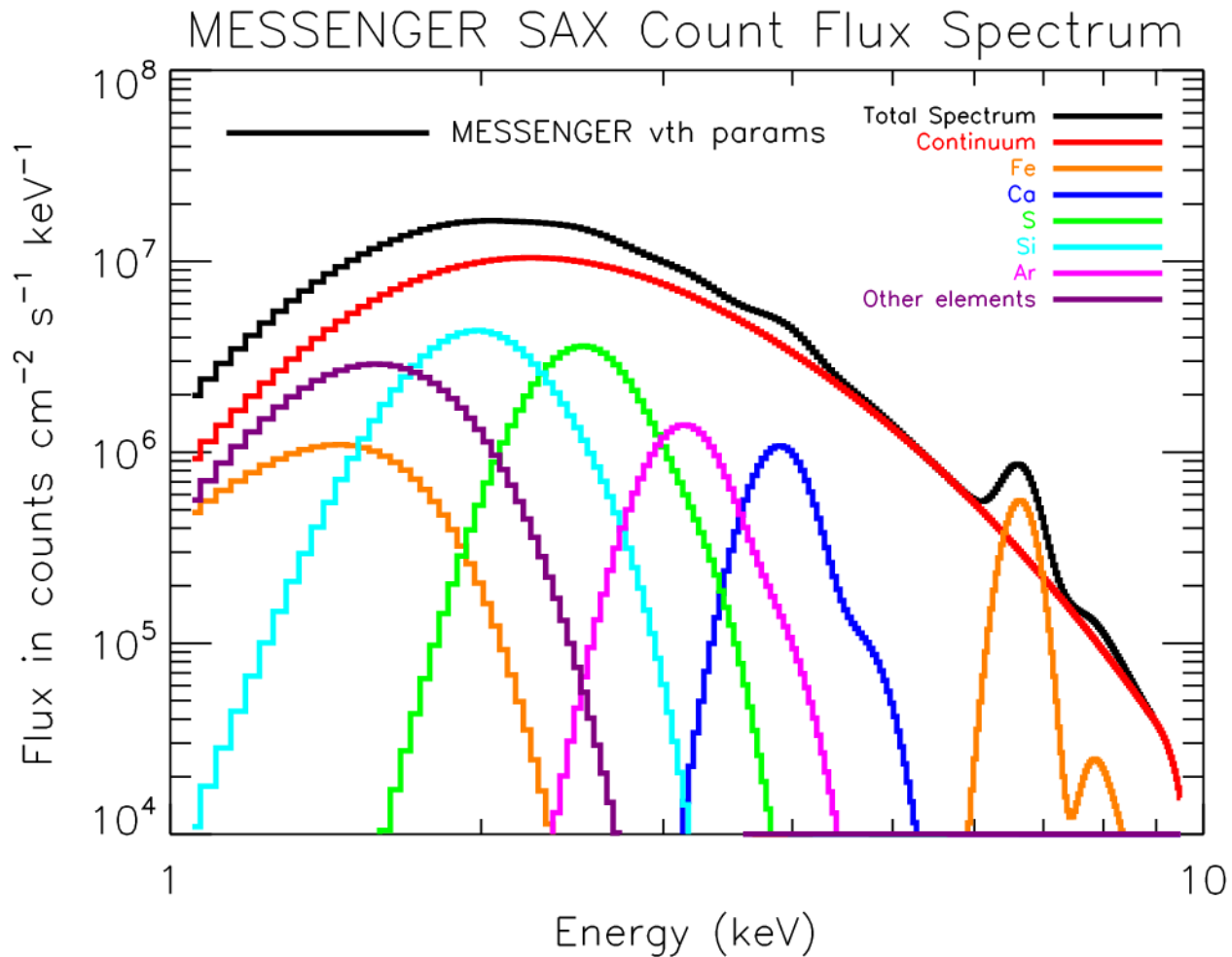
MESSENGER



MESSENGER Count-Flux Spectra

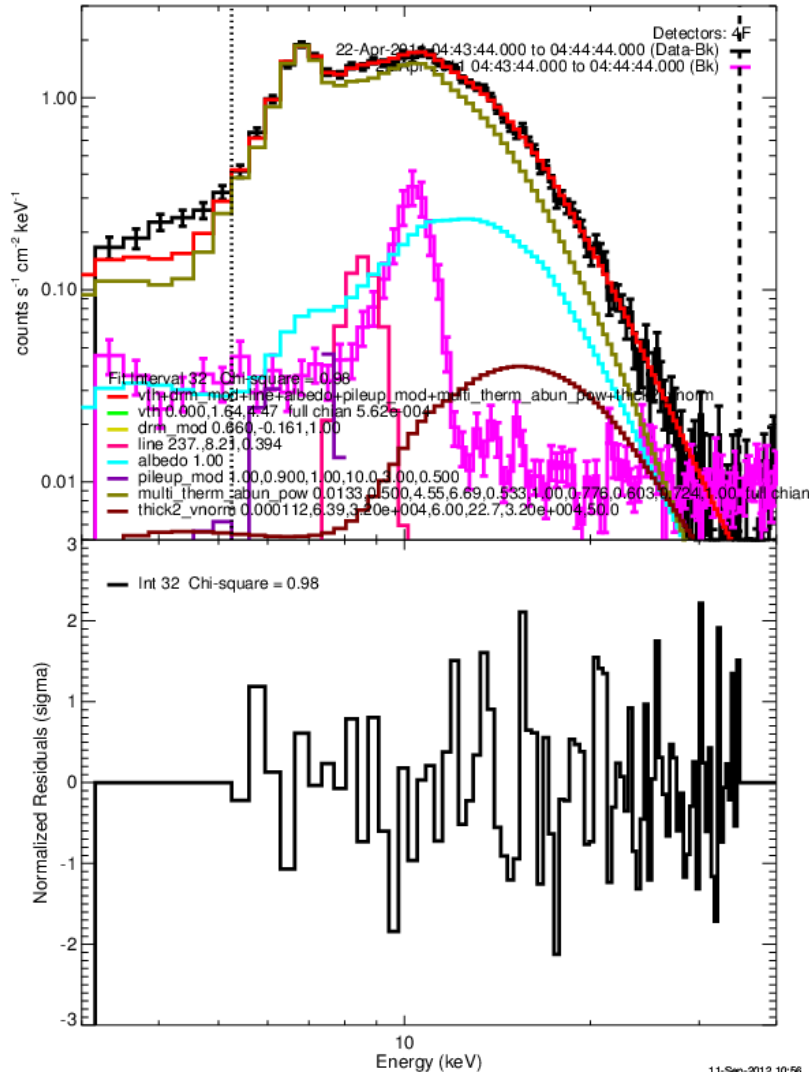


MESSENGER Spectral Components



RHESSI Count-Flux Spectrum

22 April 2011 04:54:44 to 04:58:00 UT



Detector 4

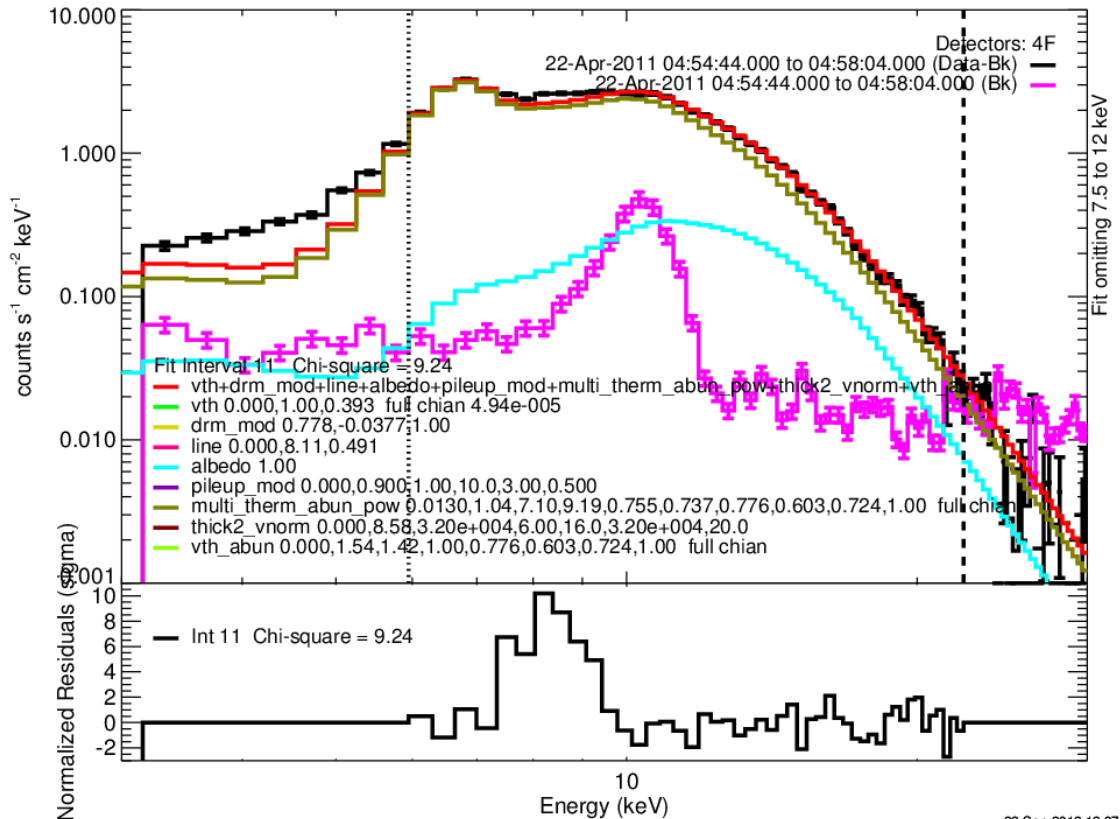
Multitherm_abun_pow + thick2

Fe abundance

= 0.53 x CHIANTI coronal

RHESSI Count-Flux Spectrum

22 April 2011 04:54:44 to 04:58:00 UT



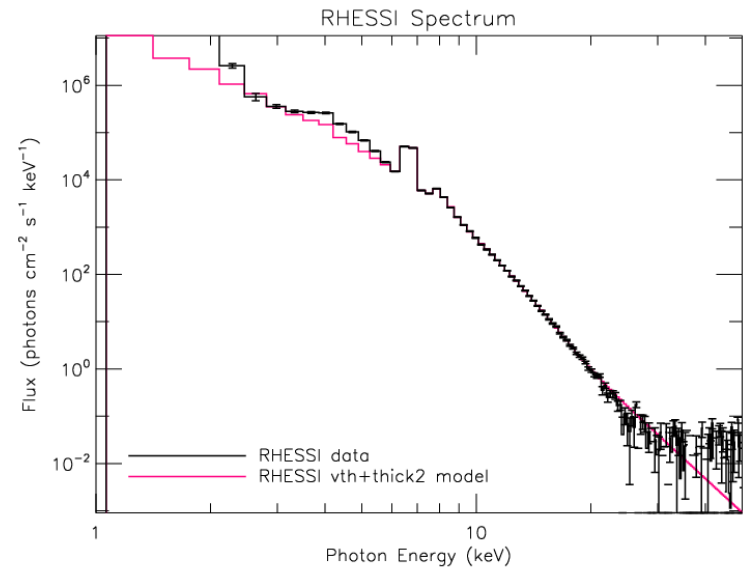
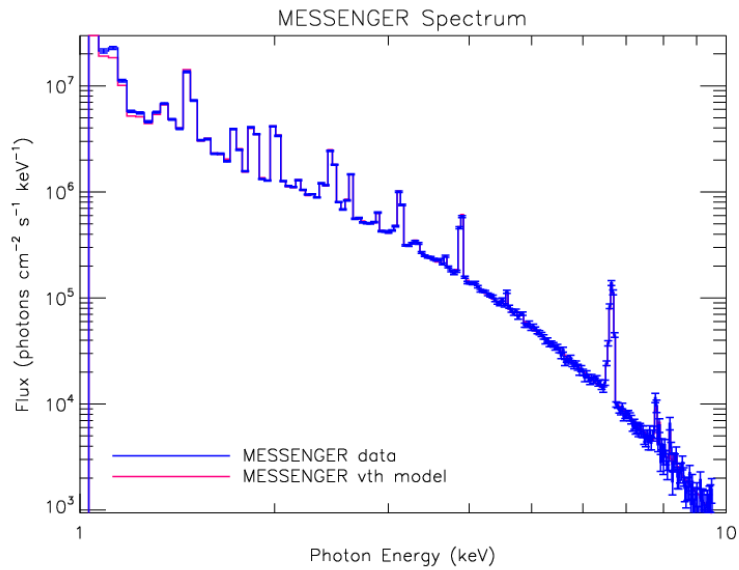
Detector 4

Multitherm_abun_pow
 + thick2

Fe abundance
 = 0.7 x CHIANTI coronal

Fitted energies: 6 to 7.5 keV and 12 to 22 keV

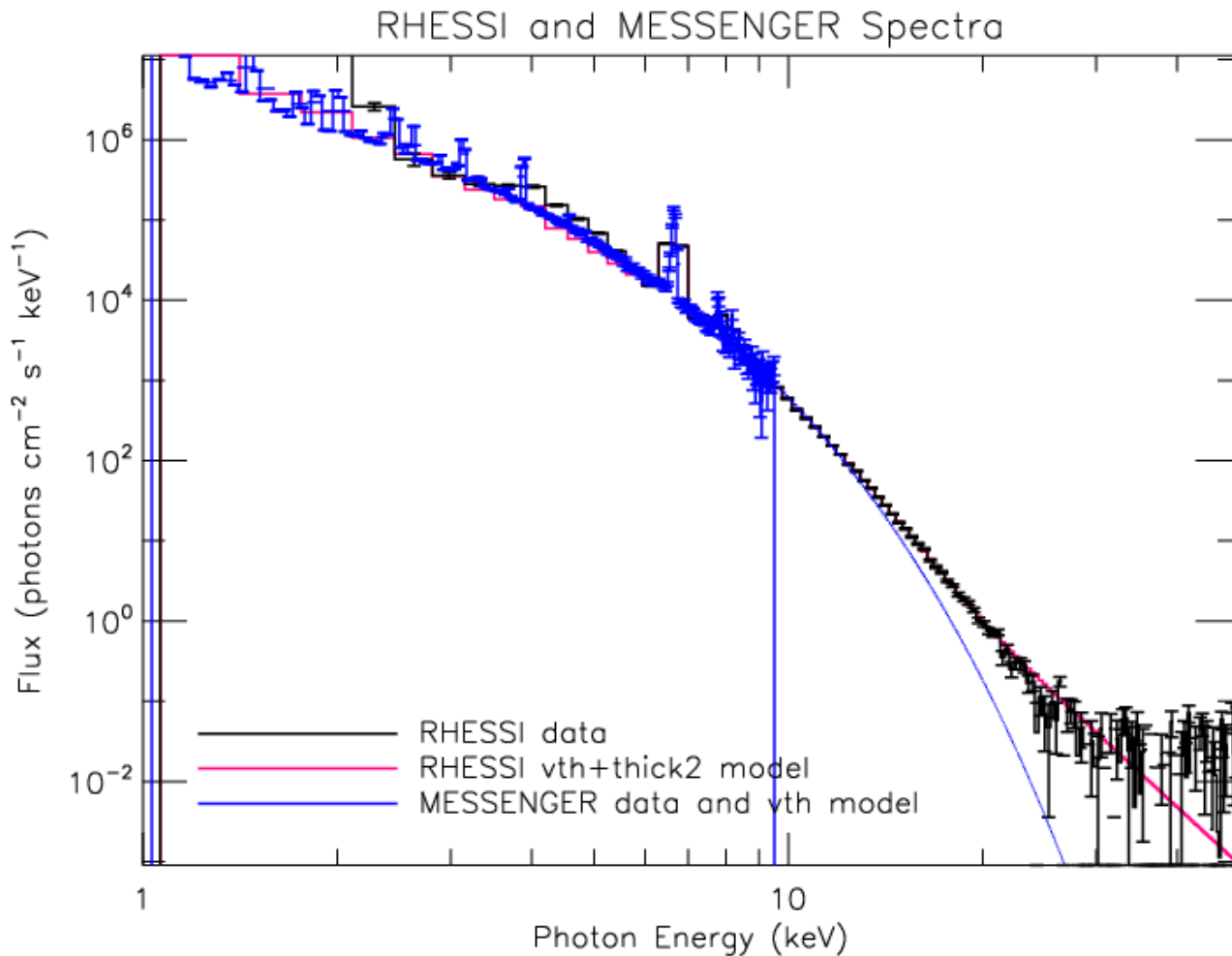
Photon Spectra



Combined Photon Spectra

22 April 2011

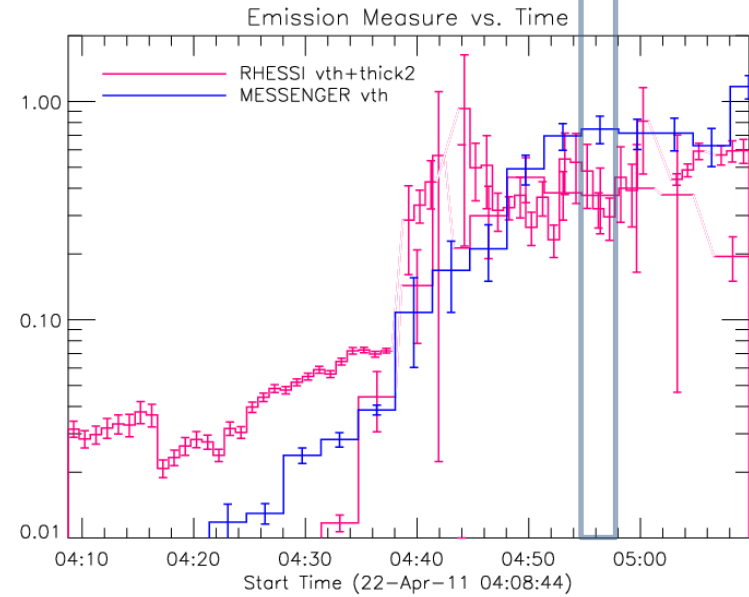
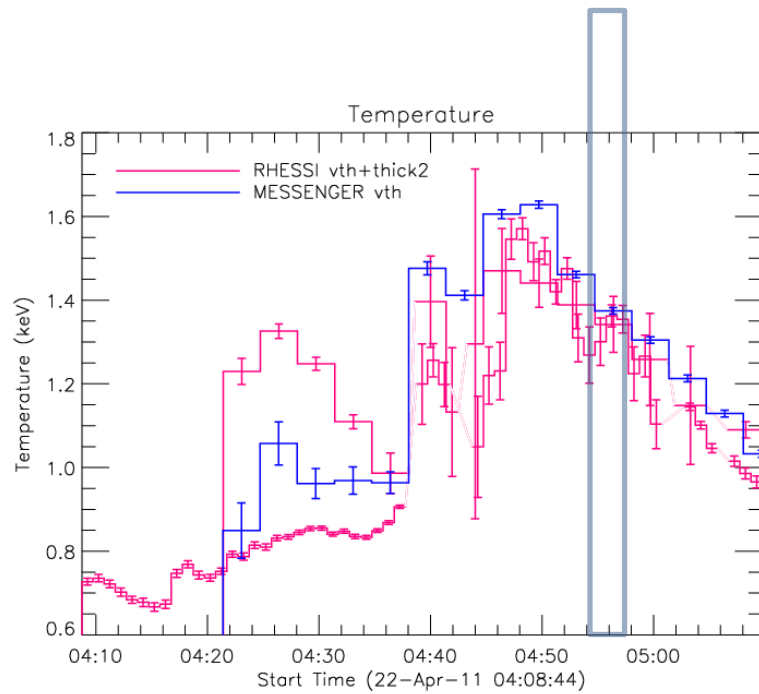
04:54:44 – 04:58:04 UT



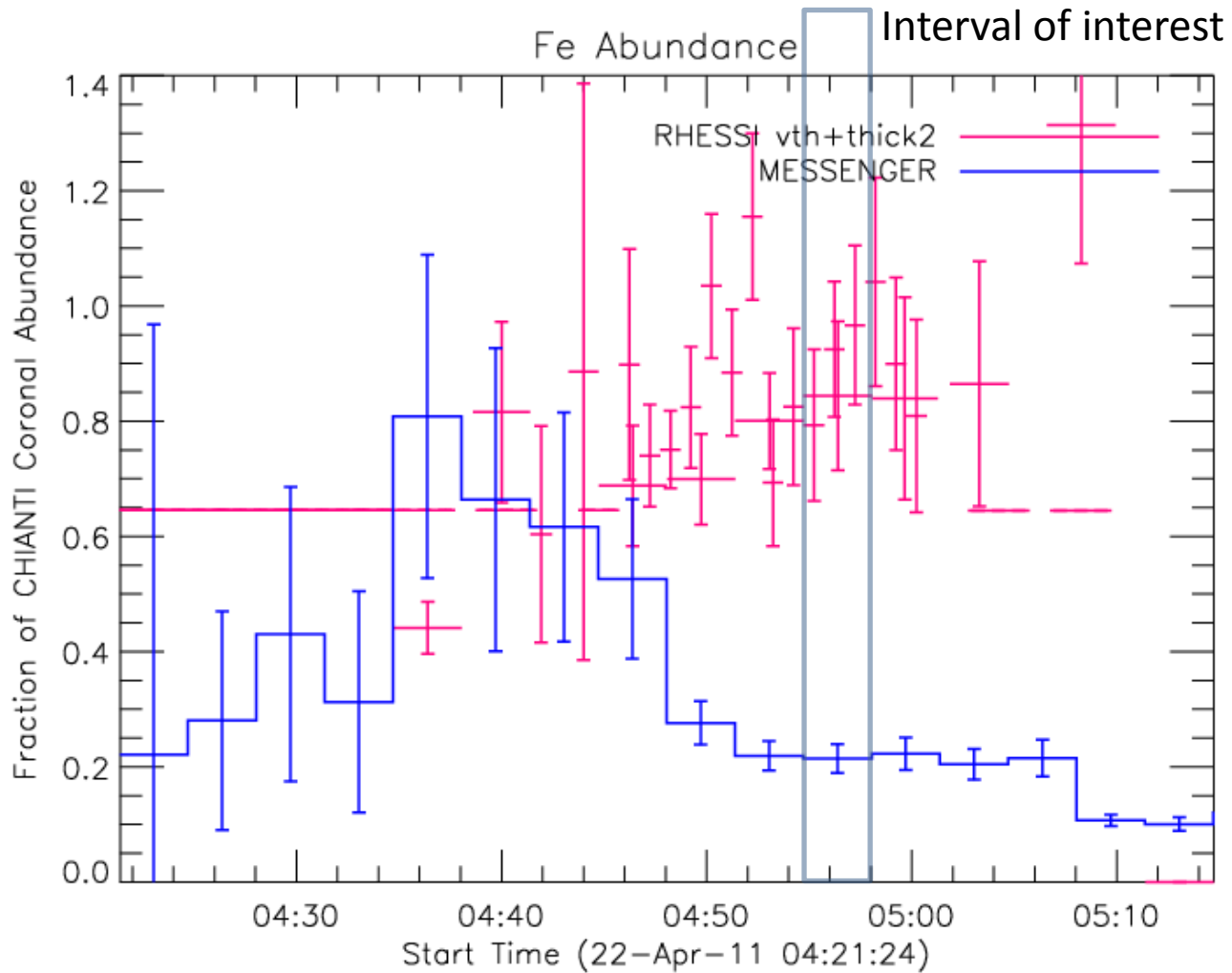
Temperature & Emission Measure

Interval of interest

Interval of interest

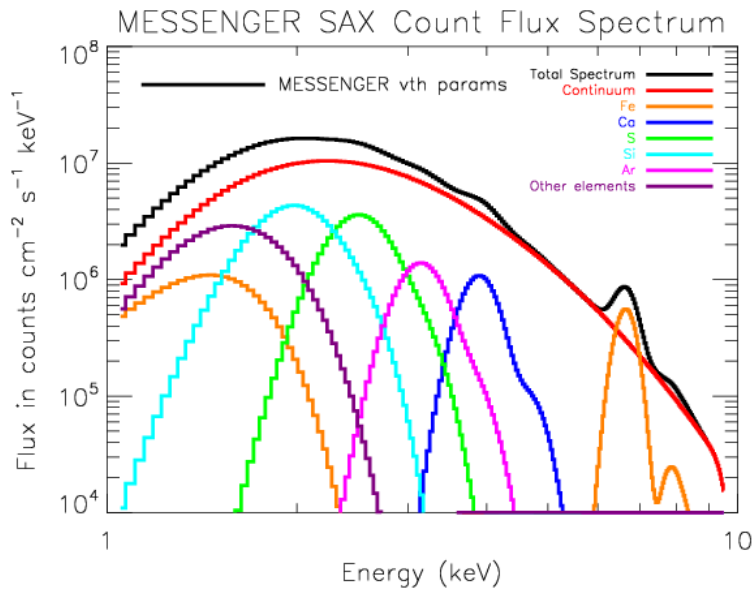


Fe Abundance



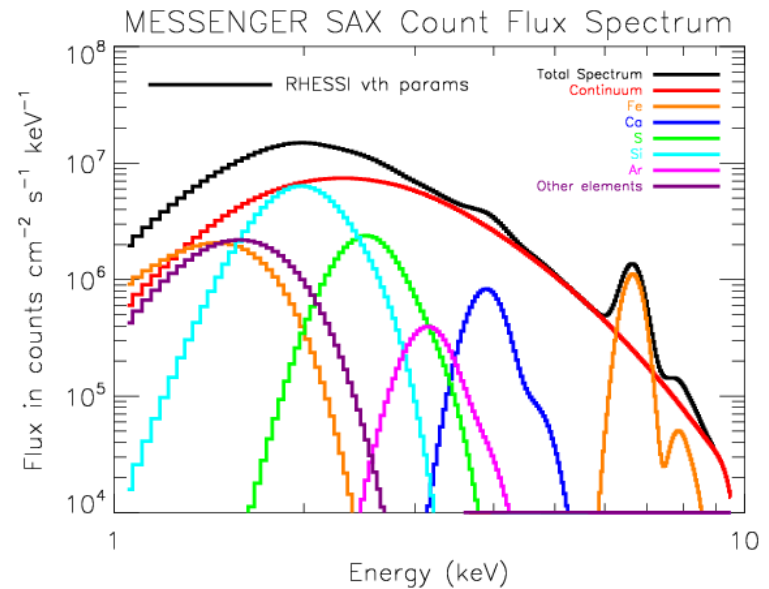
Fe-abundance Difference

22 April 04:54:44 to 04:58:00



MESENGER best-fit parameters

T, EM, element abundances



RHESSI best-fit parameters

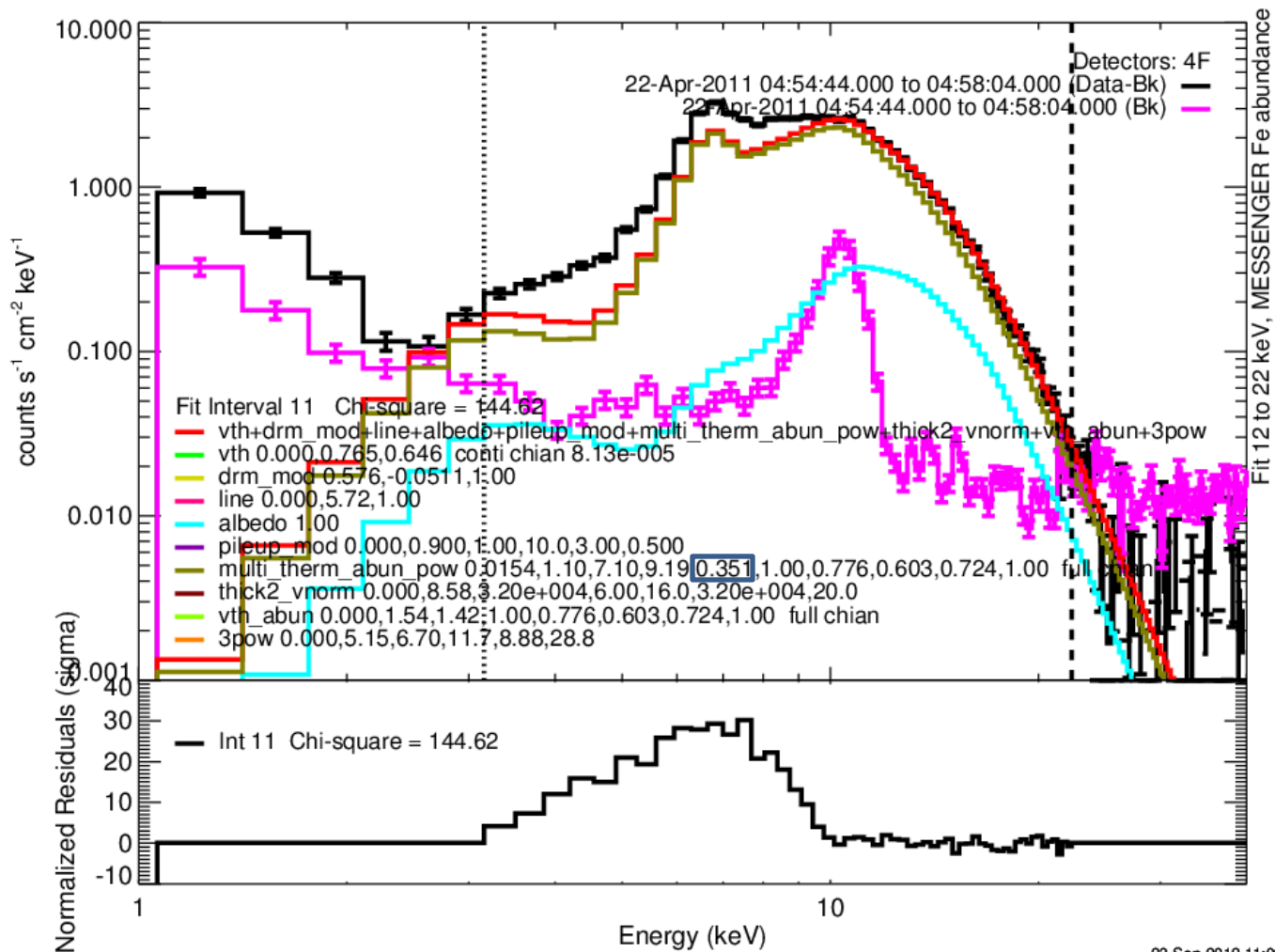
T, EM, Fe-abundance
Other elemental abundances - fixed
Coronal (Phillips' best estimates)

Why the different Fe abundances?

- MESSENGER gives 0.3 ± 0.1 x CHIANTI coronal
- RHESSI gives 0.8 ± 0.2
- Same time interval.
- MESSENGER fit from 1.5 to 9 keV
 - Similar result if fit from 5 to 9 keV
- RHESSI fit from 6 to 20 keV
 - Similar results for different spectral models:
 - vth_abun + thick2
 - multitherm_abun_pow

Assume MESSENGER is Correct

Fe abundance = 0.35

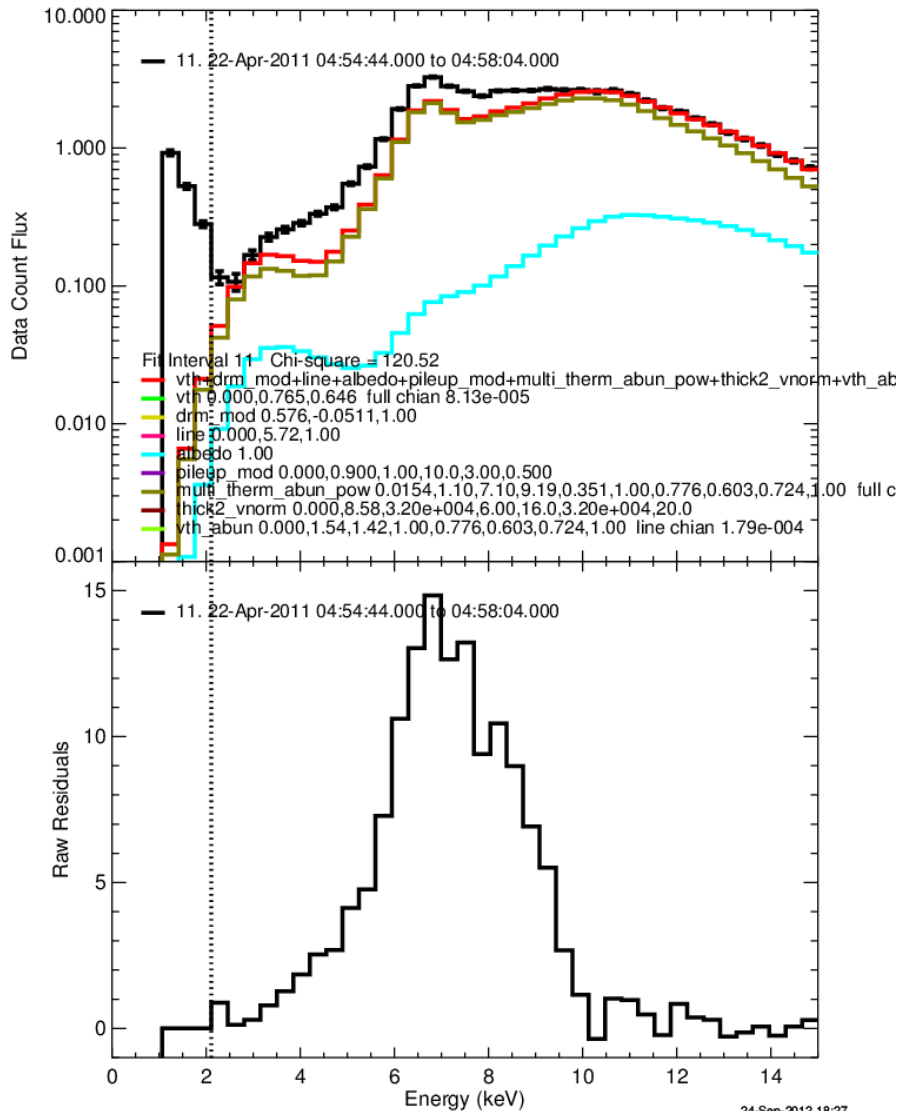


23-Sep-2012 11:09

Fit from 12 to 22 keV with Fe abundance = 0.35

Assume MESSENGER is Correct

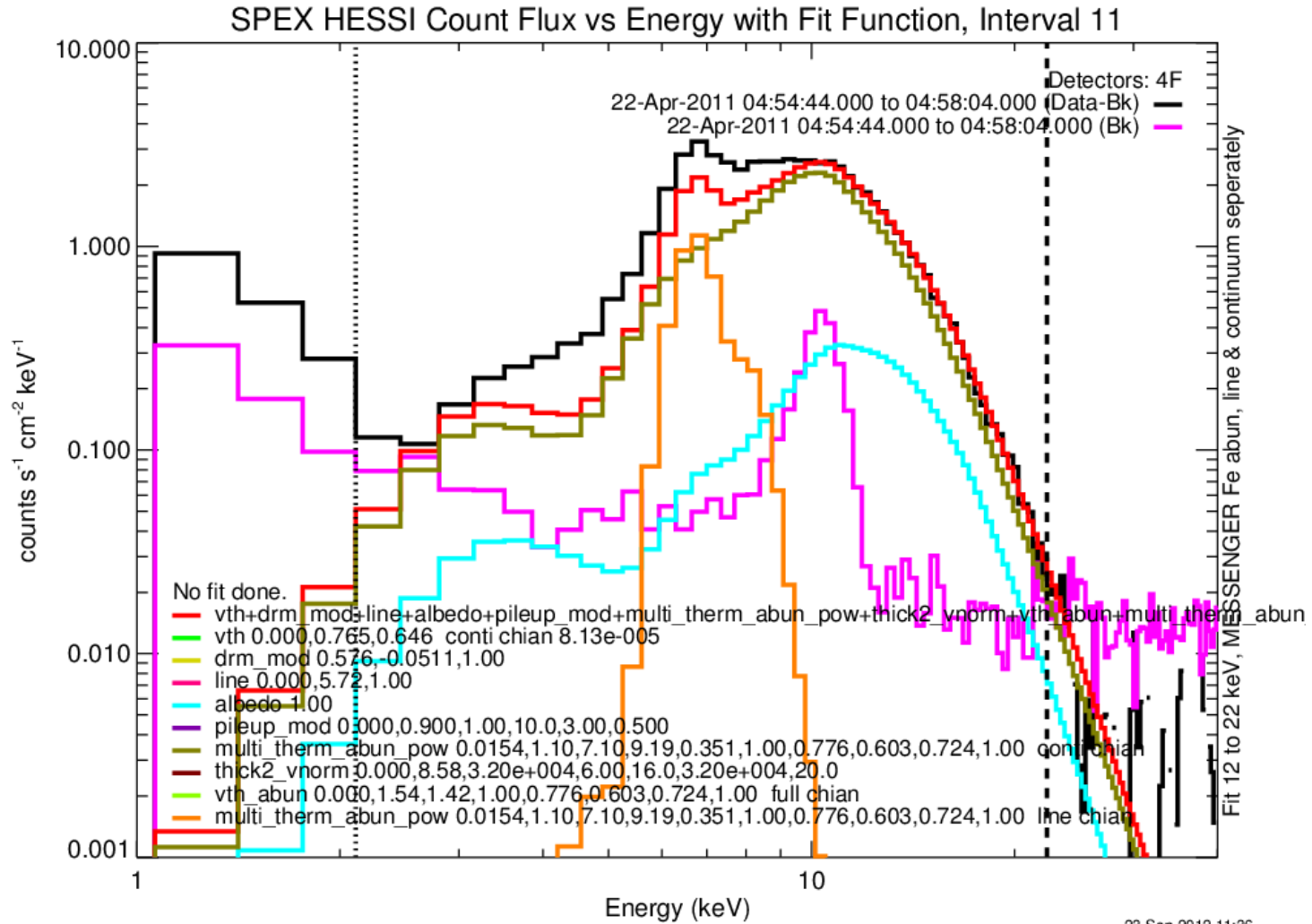
Fe abundance = 0.35



Detector #4

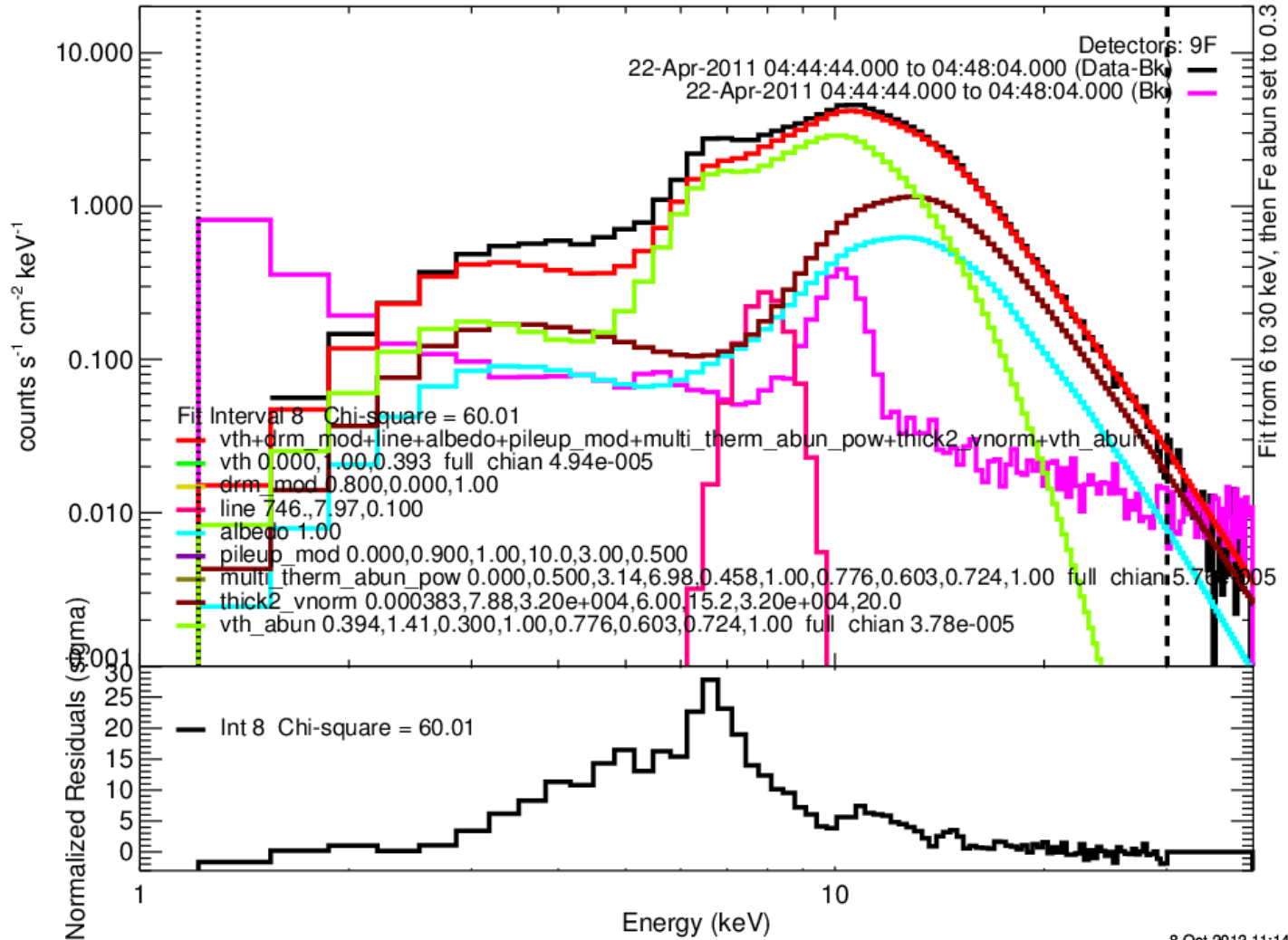
Fit from 12 to 22 keV
with Fe abundance = 0.35

Line and Continuum Spectra



RHESSI Detector 9 Spectrum

Fe abundance set to 0.3

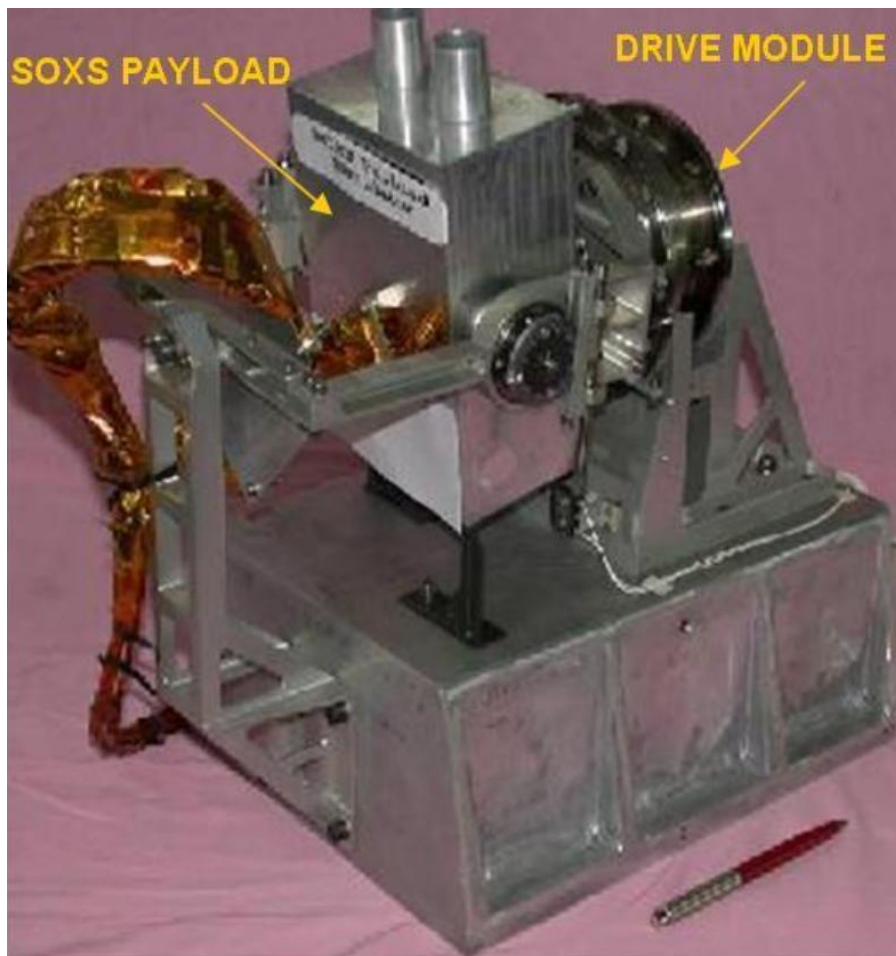


Conclusions

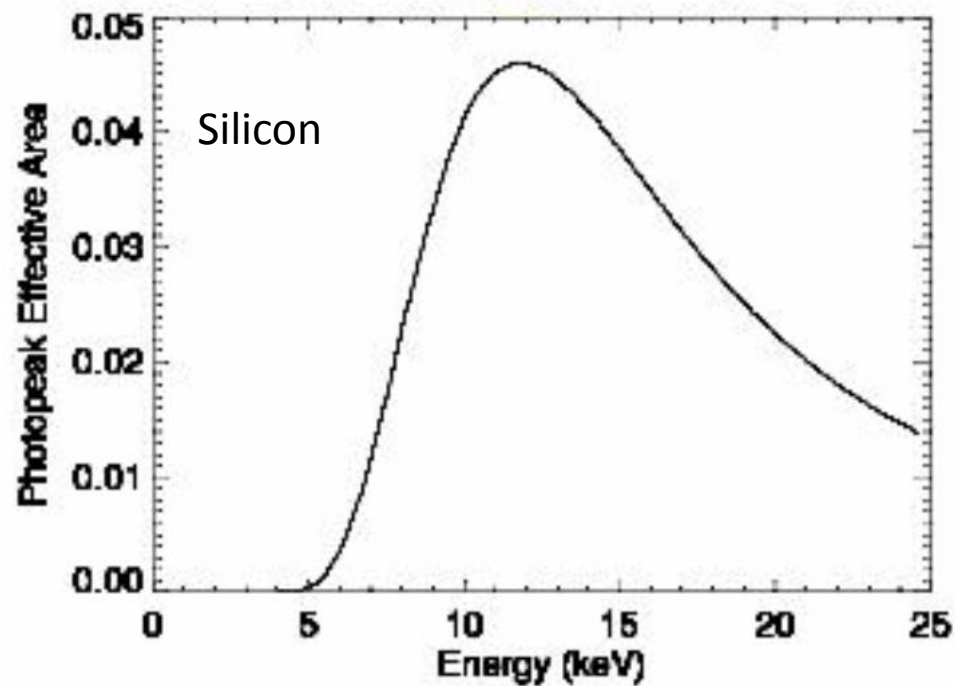
- Why do MESSENGER SAX & RHESSI Fe abundances differ by factor of ~ 2 ?
- MESSENGER
 - SAX simple Si diode
 - 1 to 9 keV
 - Ca XIX peak at 3.9 keV – Ca abundance = $\sim 1x$ coronal
- RHESSI
 - Lower end of energy range
 - Unknown spectral features at ~ 8 and 10 keV
 - Excess counts below 6 keV in A1 and A3 attenuator states (K-escape?)
 - Excess counts below 6 keV in A0 state (Hannah)
- **SOXS observed 22 April 2011 flare!!!!**

SOXS

Launched on 8 May 2003
De-orbited on 2 May 2011

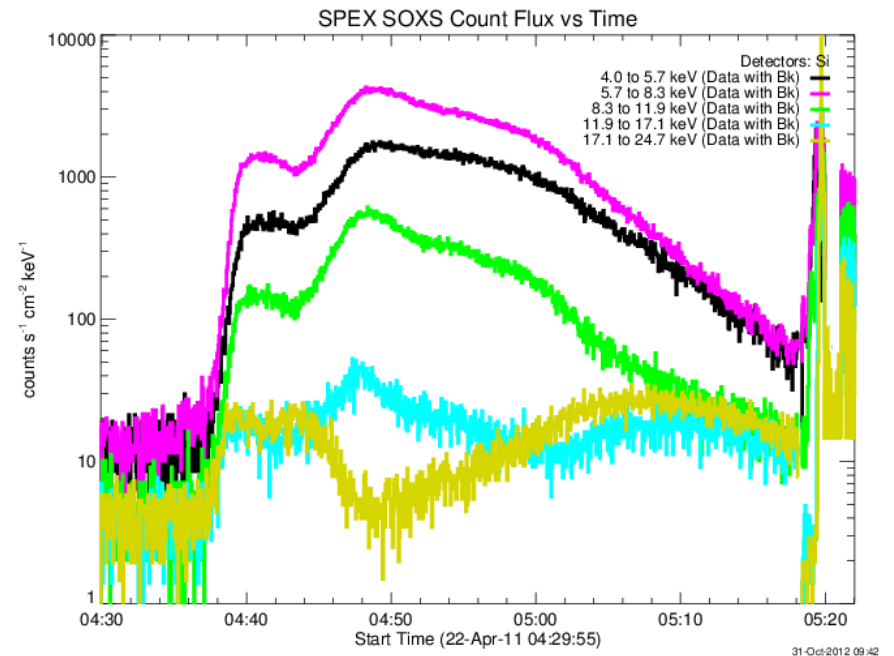
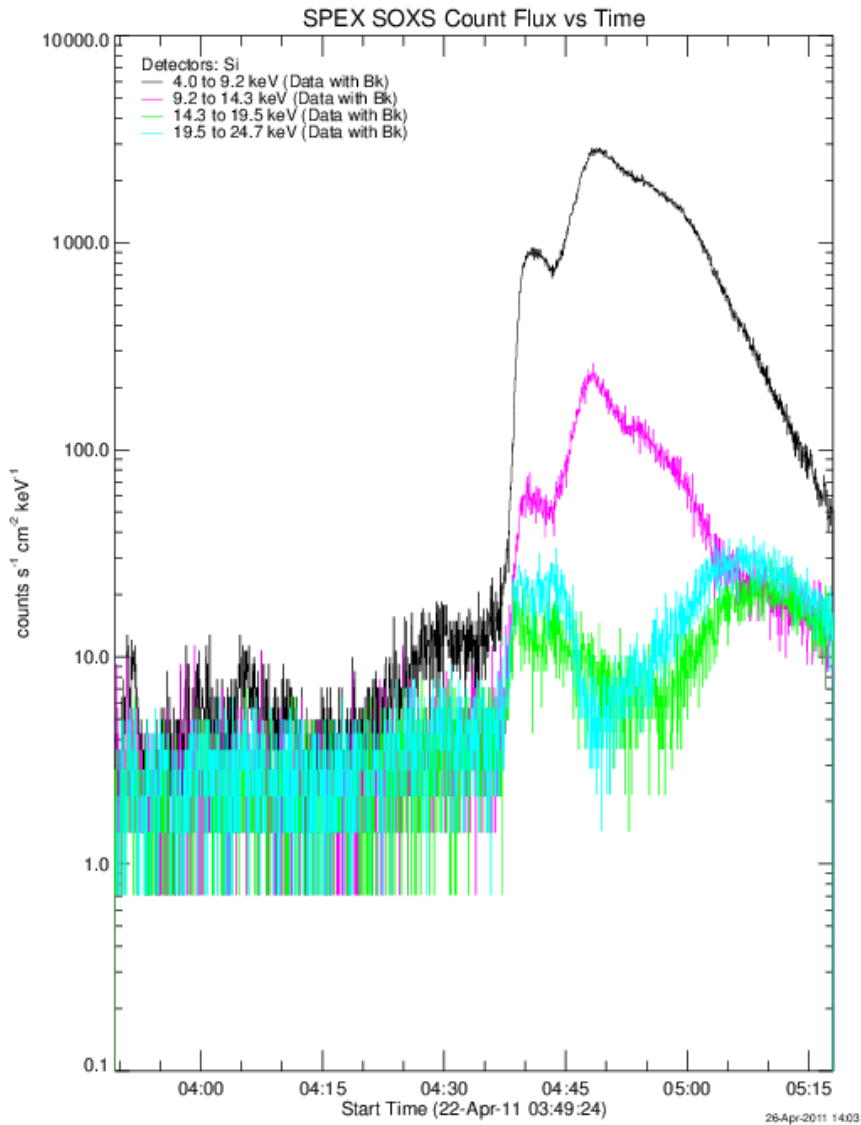


Parameter	Detector-Si	Detector-CZT
Detector Thickness (cm)	0.03	0.2
Al Thickness (micron)	50+20	100+20
Be Thickness (micron)	25.4 (1mil)	254 (10mil)
Kp Thickness (micron)	150	150
Geometric Area (cm ²)	0.091	0.18



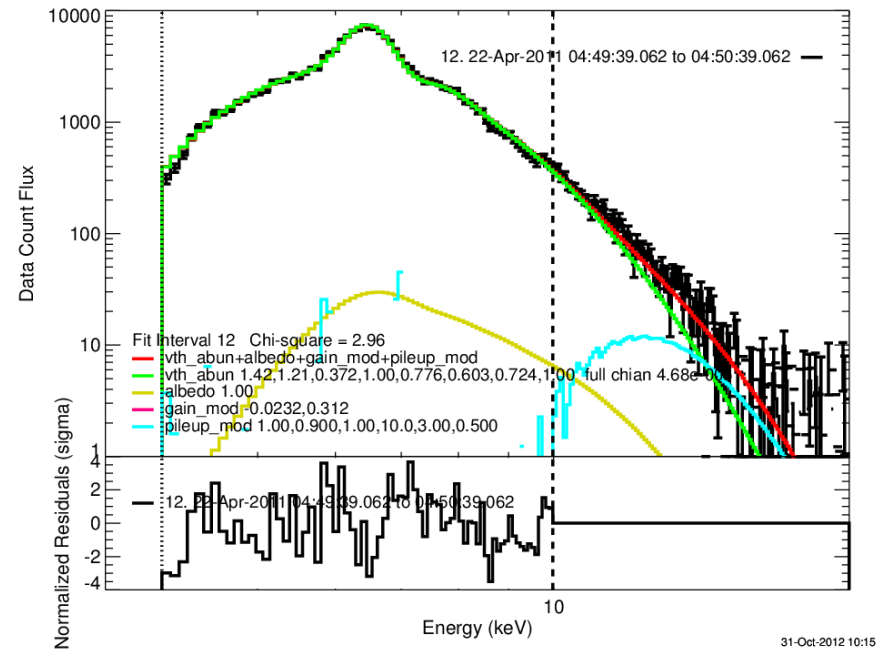
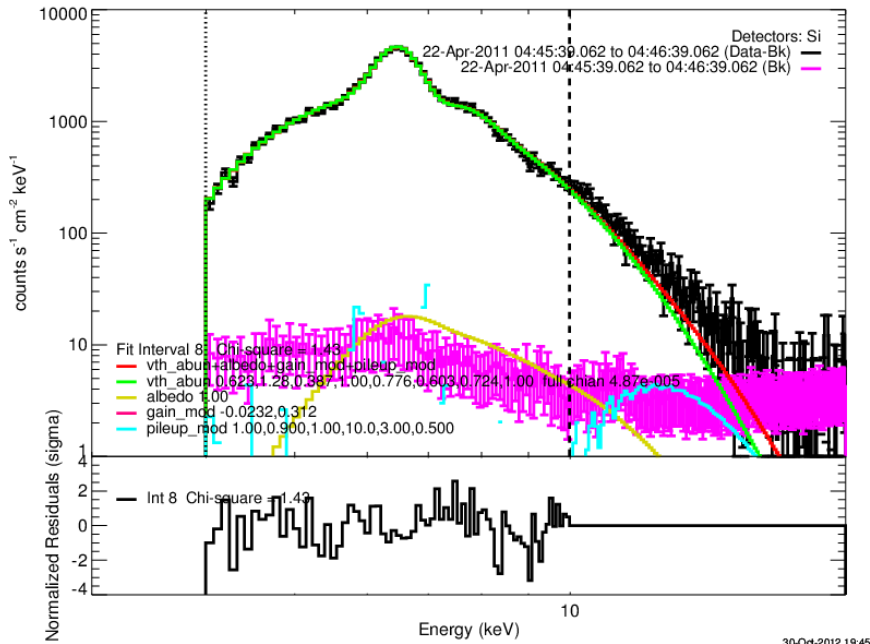
SOXS Observations

22 April 2011



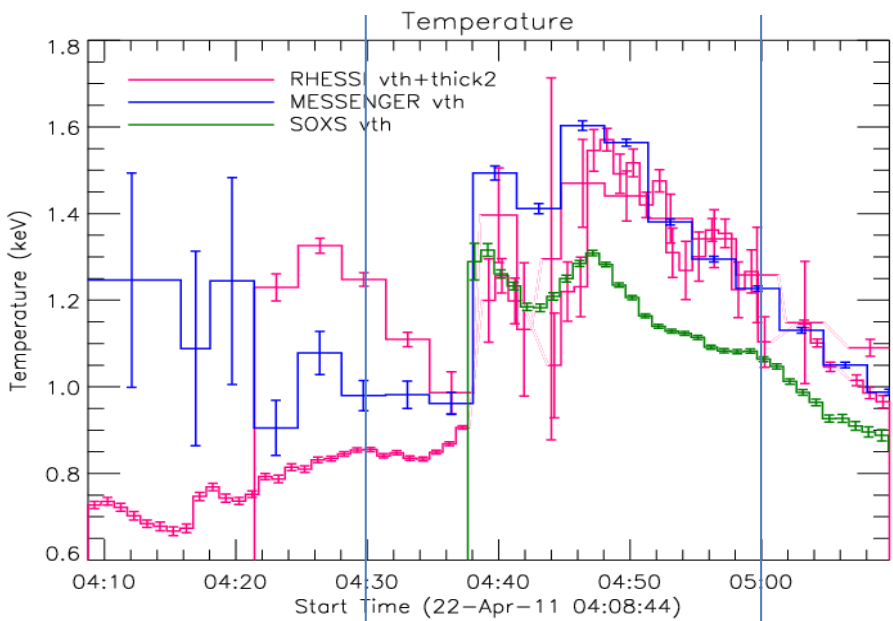
SOXS

21 April 2011

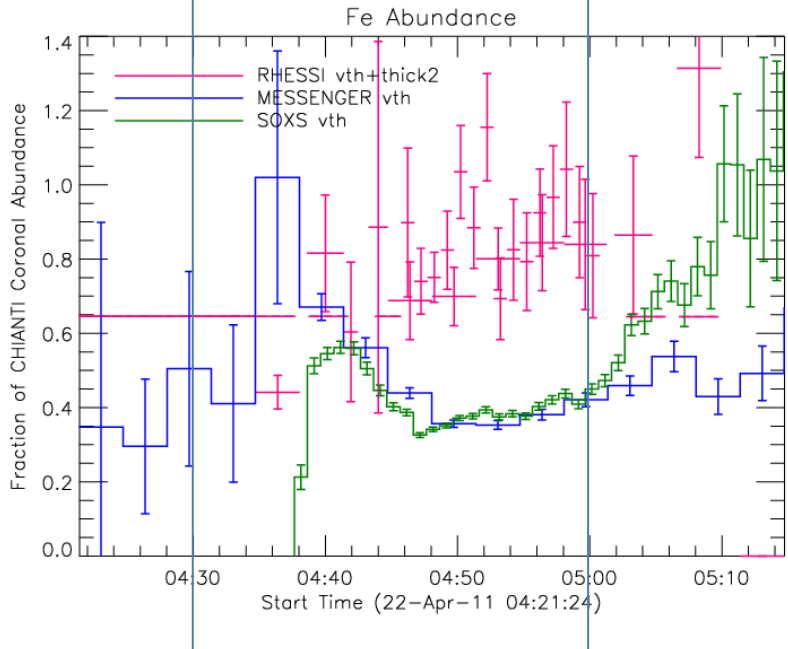


Fe abund. = 0.37

21 April 2011
Temperature

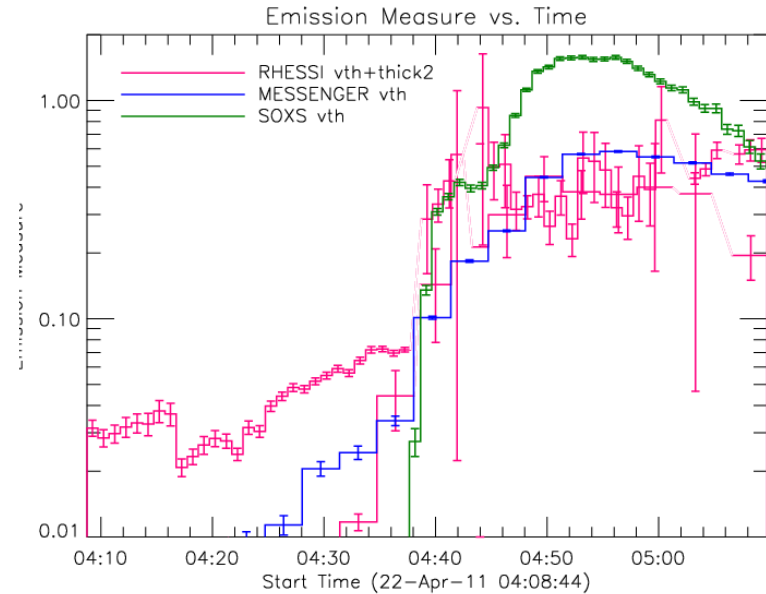
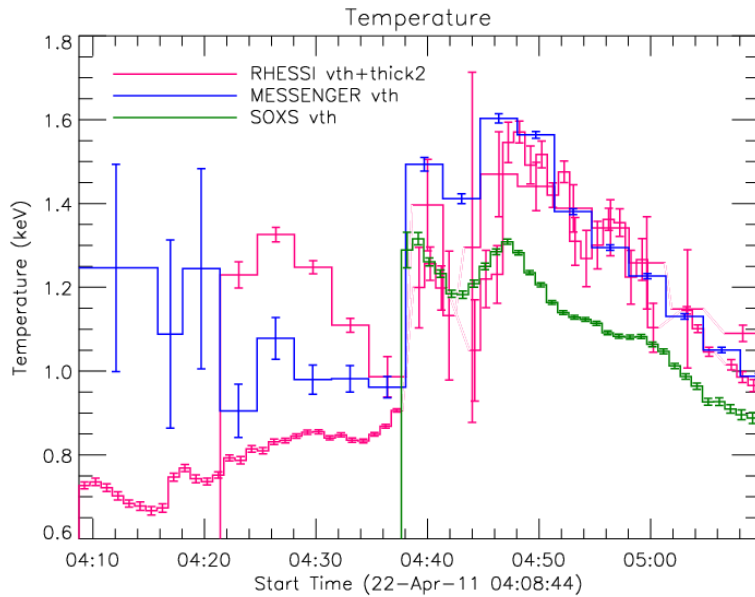


Fe Abundance



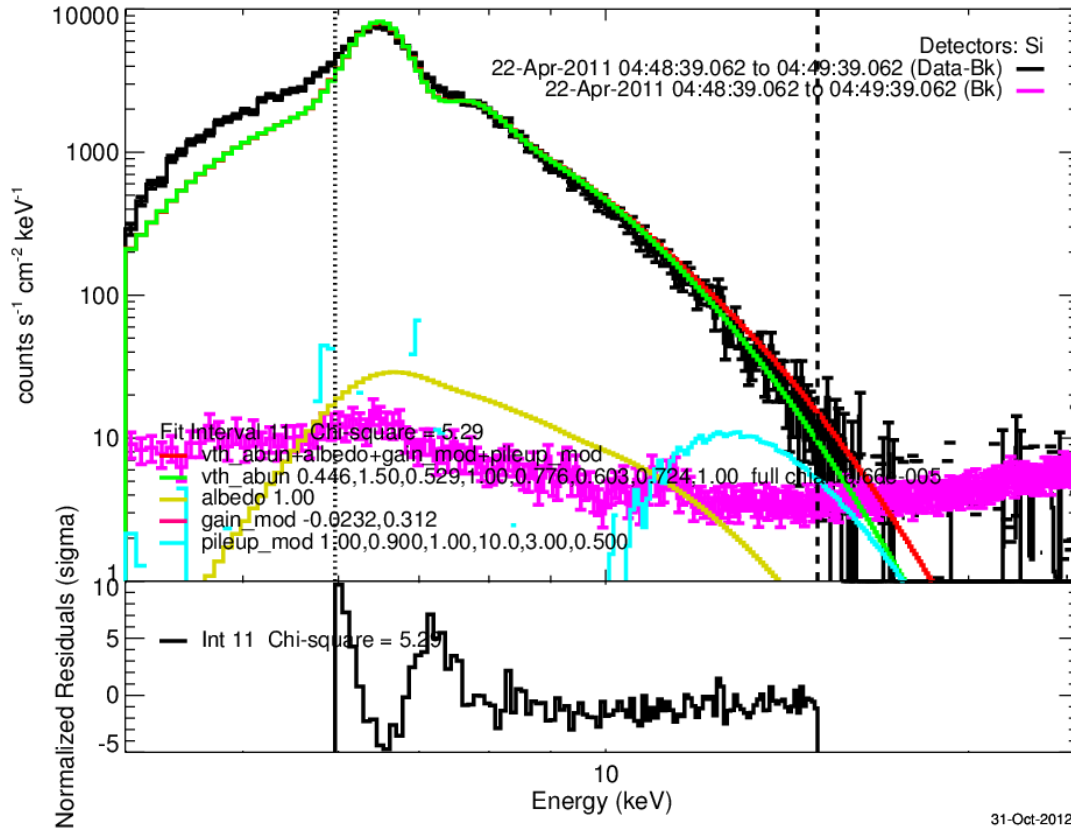
22 April 2012

Temperature & Emission Measure



SOXS

21 April 2011



Temperature: 1.5 keV (fixed)
Fe abundance: 0.53