

SPECTRA OF FLARES IN THE RANGE OF ~ 6.7 KEV Fe LINE EMISSION TO BE OBSERVED BY **STIX**



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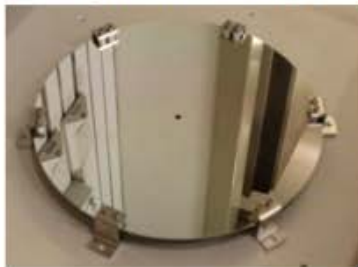
NATURAL HISTORY MUSEUM LONDON

STIX: HXR imaging spectrometer on Solar Orbiter

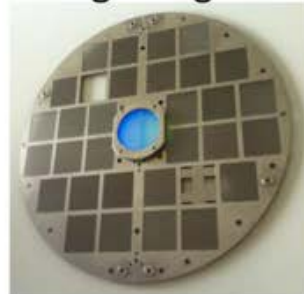
Borrowed from Sam Krücker



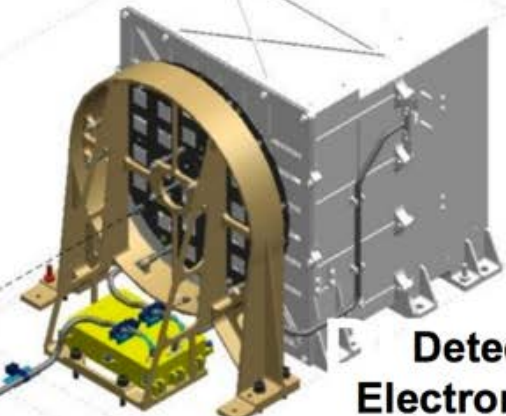
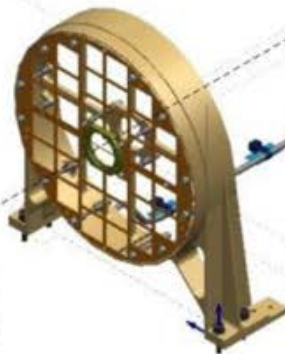
Beryllium window



Tungsten grids

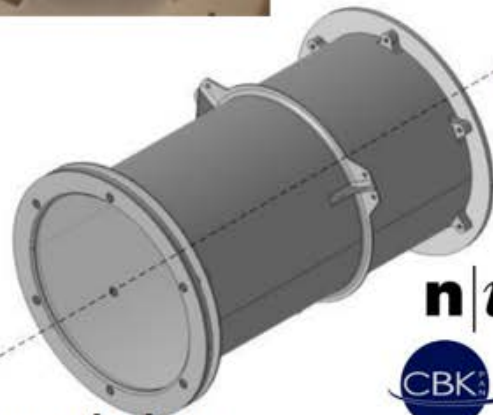


Set of tungsten grids separated by 55 cm

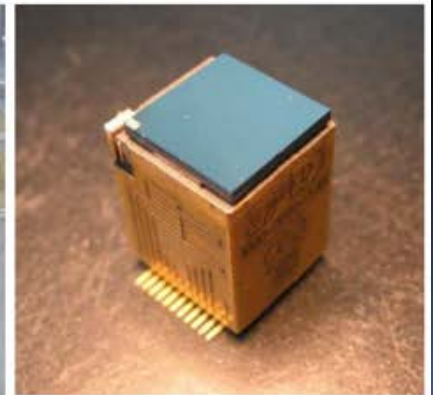
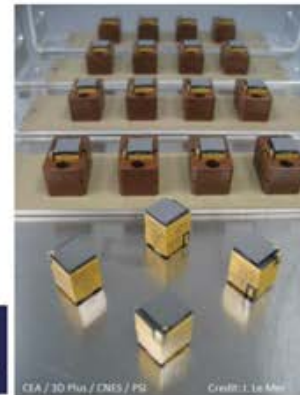


Detector Electronics Module with 32 detectors

CdTe detectors (Caliste SO)



X-ray windows and feed-through in heat shield



CEA / 3D Plus / CMS / P2 Credit: Te Mui

Aim:



Simulate spectra to be collected by STIX
in the lower-energy range $3 \div 10$ keV
where line emission contributes

The basis:

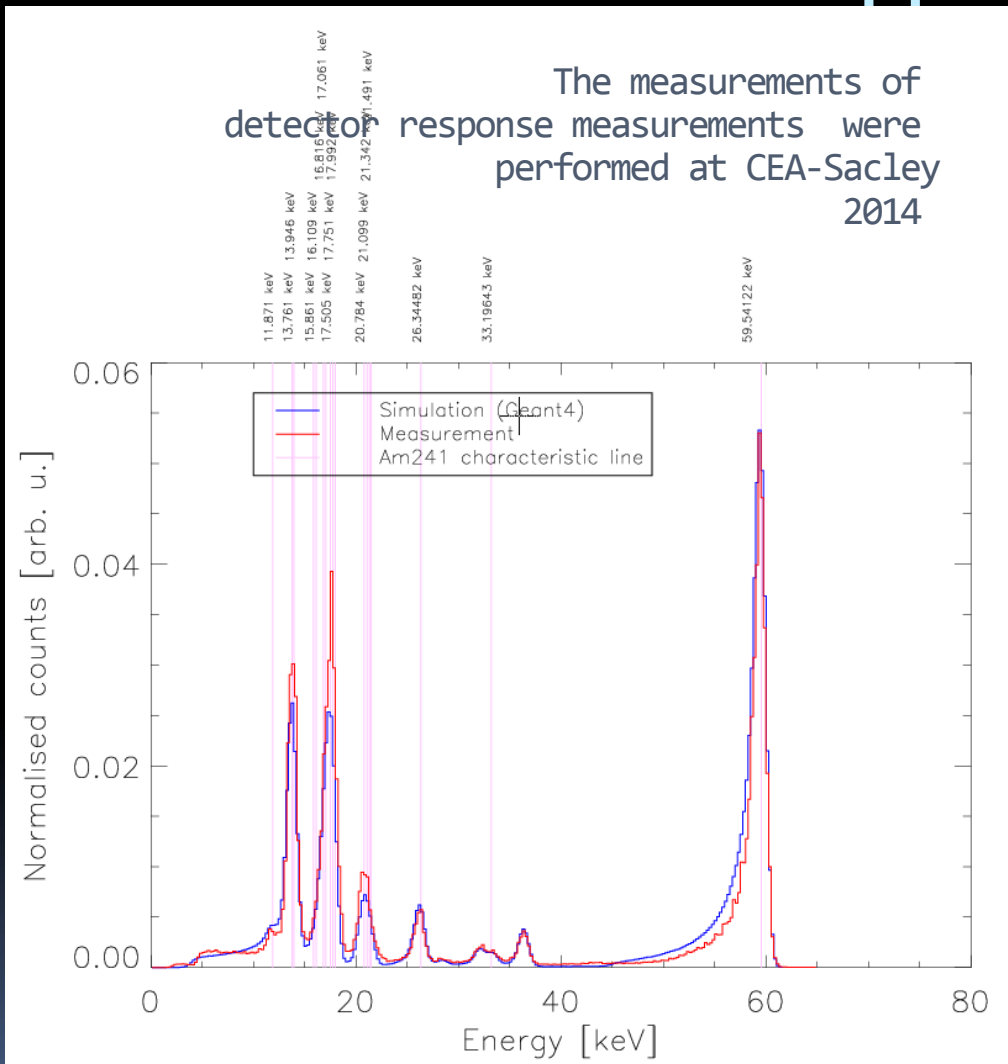
- Use of detector response matrix (DRM) calculated using Geant4 (CdTe $10 \times 10 \times 1$ mm & Calliste ASIC readout)
- Use of modern CHIANTI spectral code
- Use of RHESSI heritage
- Support from high-resolution spectra collected by BCS on SMM

Why this is important? STIX can see
Fe & Ni line groups atop the continuum

Observed intensity of these lines &
the shape of the continuum should
allow for:

- Determination of plasma temperature
(differential emission measure, DEM)
for the „thermal” plasma component
- Determination of abundance of Fe and
Ni in flaring plasmas

Geant4 DRM response model and measurements



Spectrum of detector response was Monte-Carlo generated (blue) and found to reproduce well the ^{241}Am spectra measured in France

DRM matrix: for details see poster by Jaromir

#2-11 Barylak et al.

Simulation of Caliste-SO single pixel response

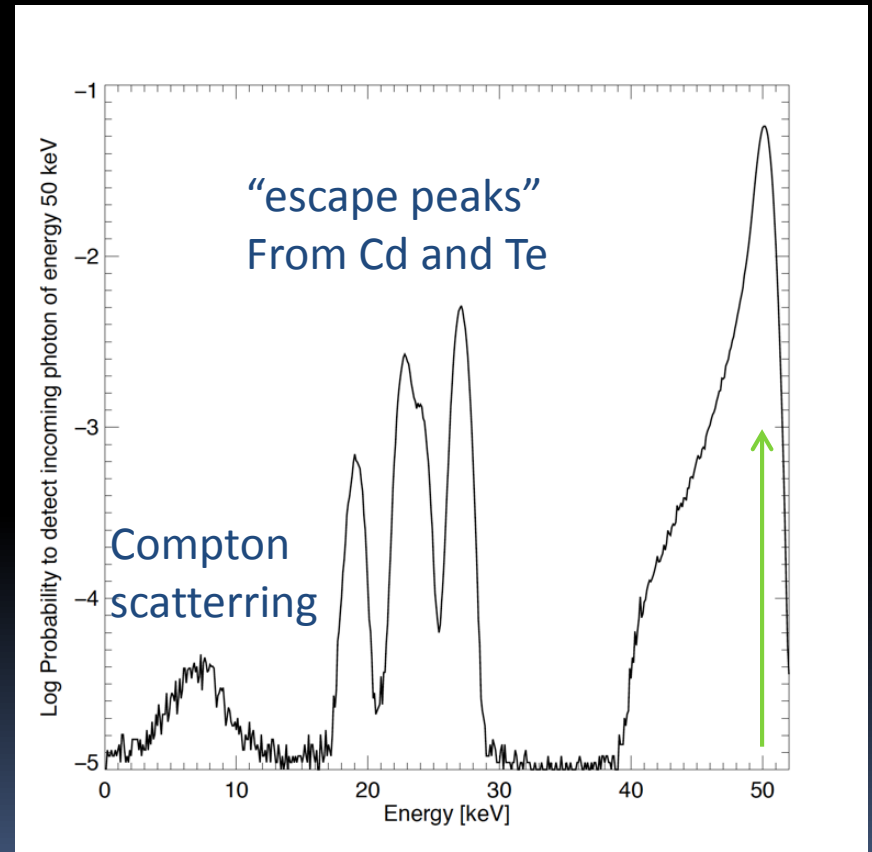
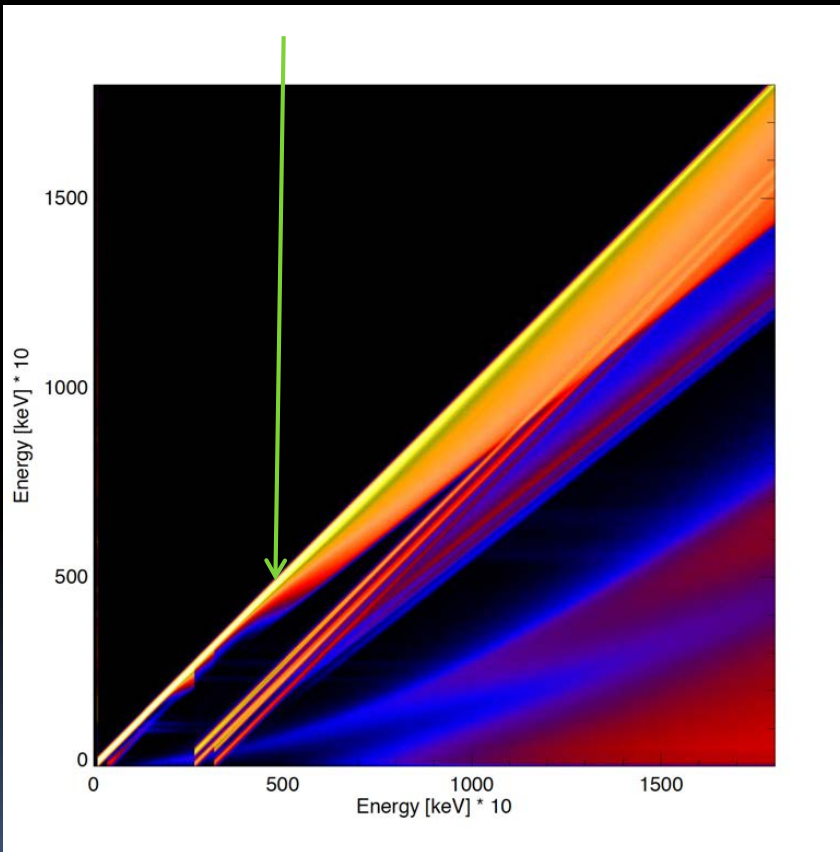
J. Barylak^a, A. Barylak^b, T. Mrozek^{a,b}, P. Podgórski^a, M. Stęślicki^a, D. Ścisłowski^a

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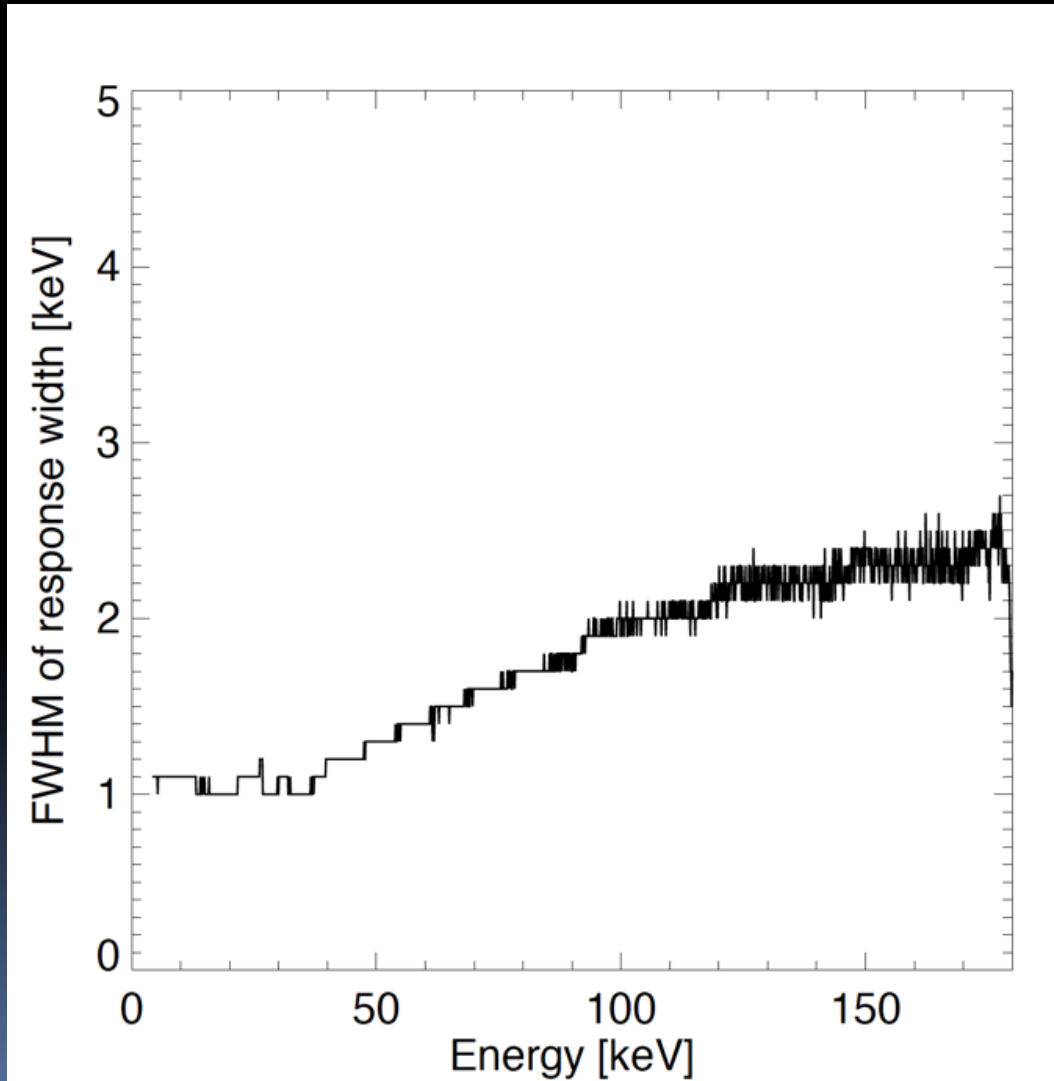
^bAstronomical Institute, University of Wrocław, Poland

2016 Proc. SPIE 10031

Simulation of Caliste-SO response

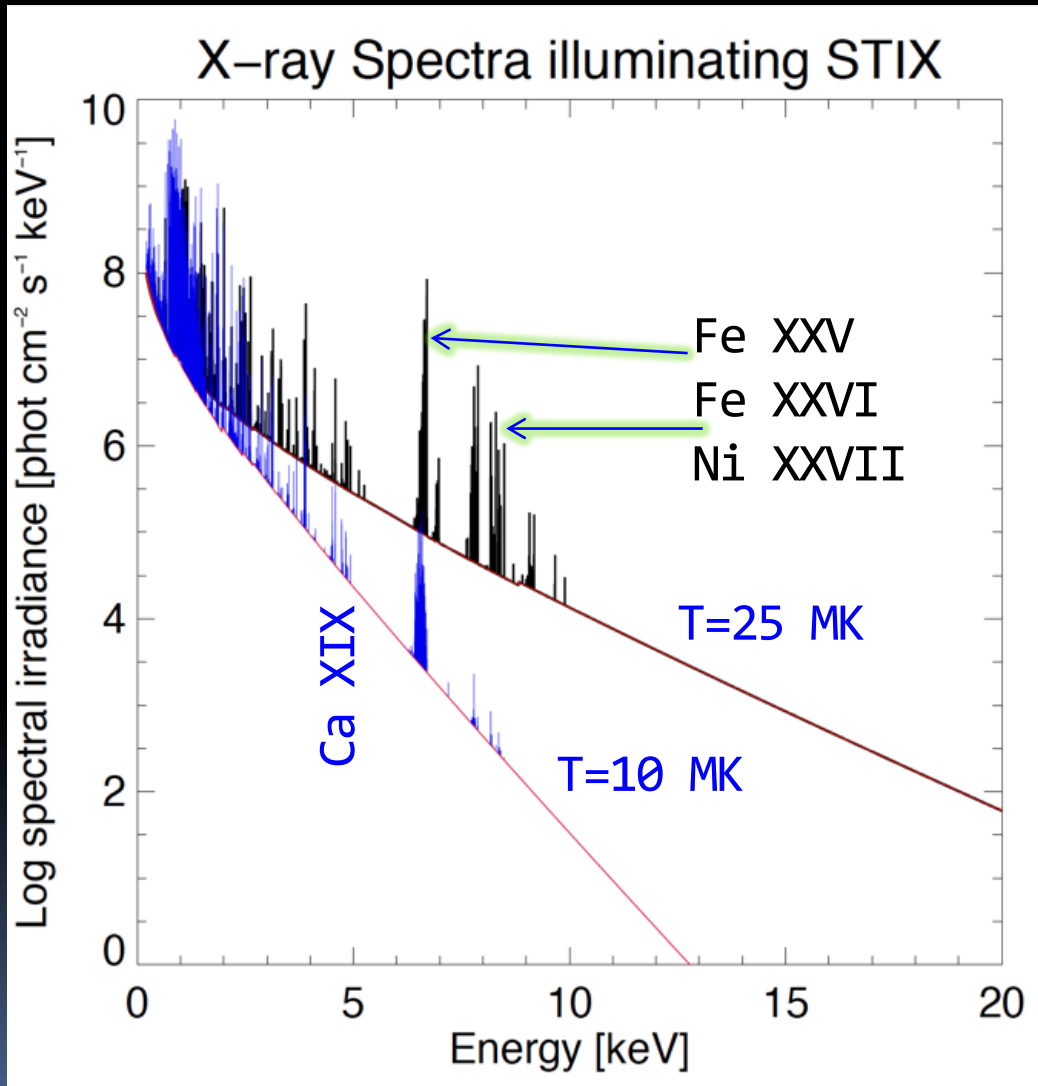


Energy resolution of STIX from Monte-Carlo DRM response calculations



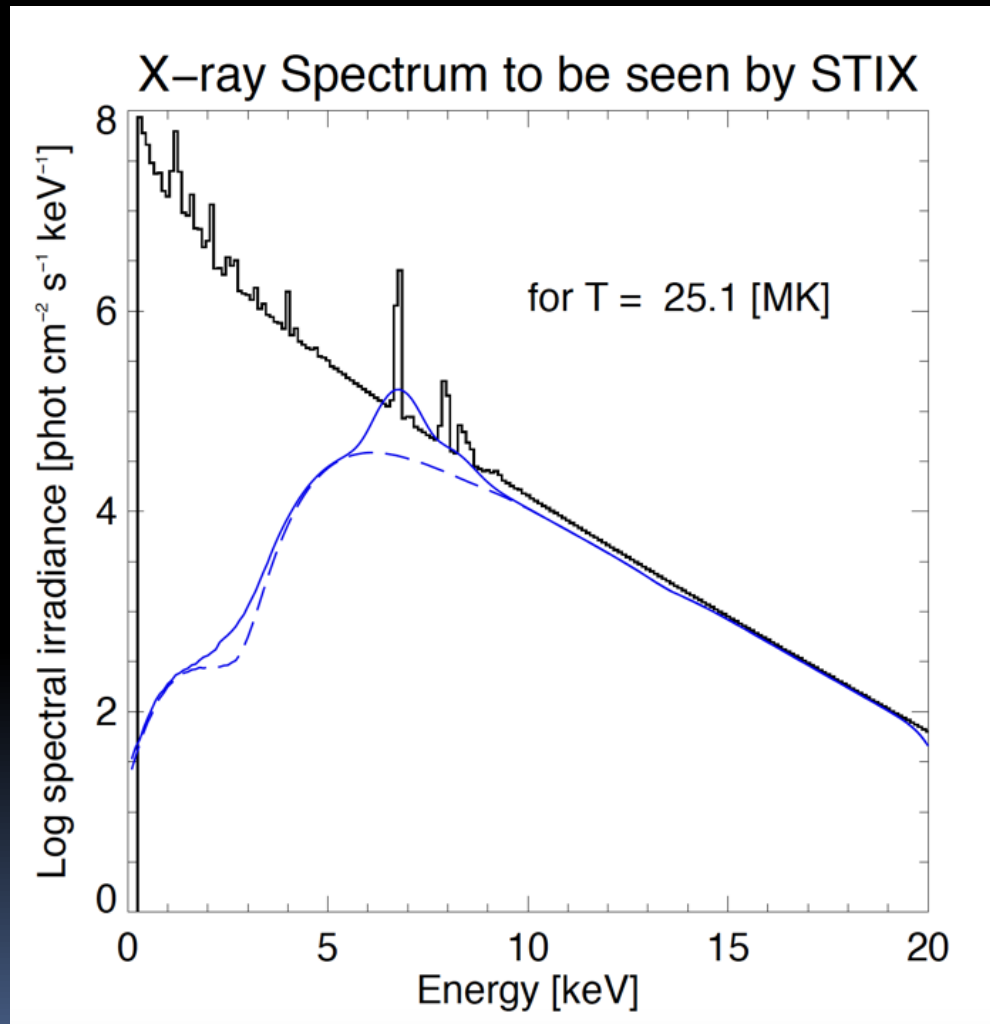
- Cut-off of instrument sensitivity for $E < 4$ keV
- Steady increase of FWHM towards higher energies

Spectra to be observed



Solar spectra
in the softer
range $E < 10$
keV contain
emission lines
due to trace
elements and
the continuum
CHIANTI
(SolarSoft)

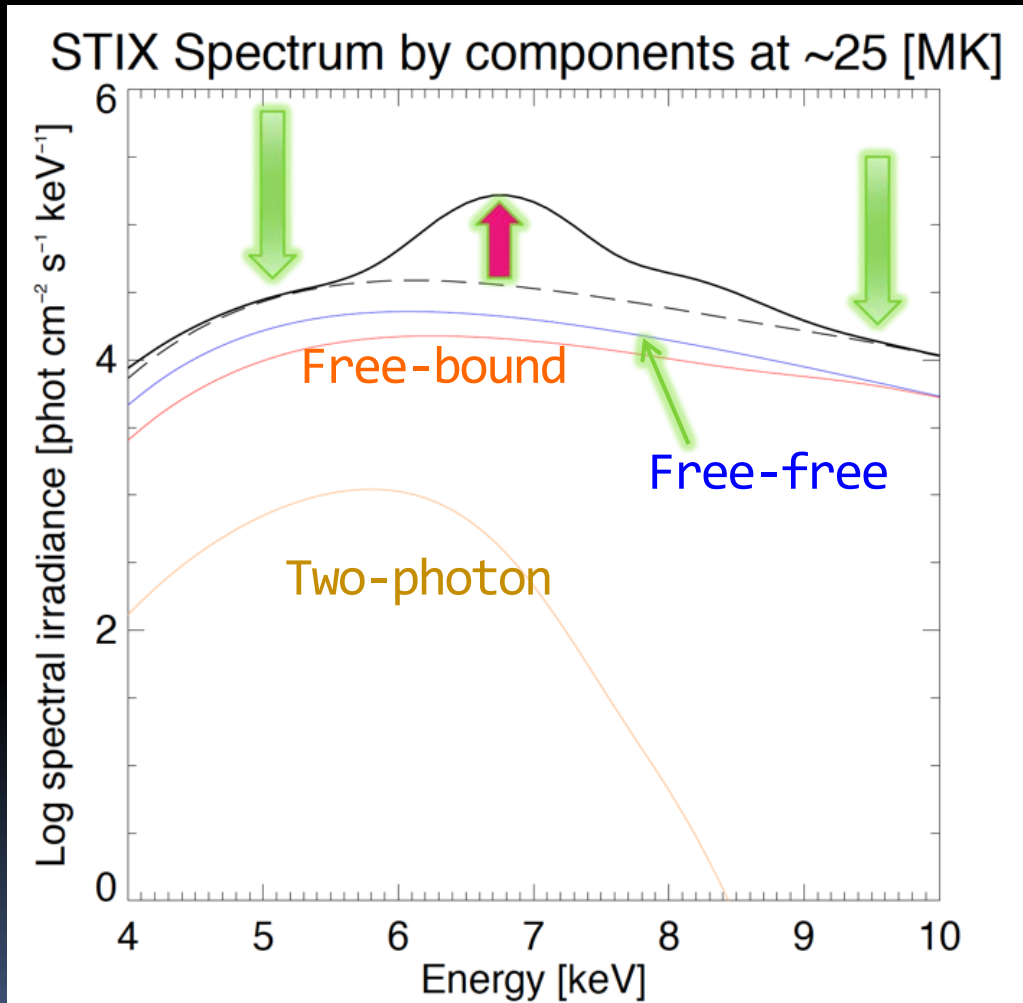
How the telescope record spectra?



Comparison of input (black) and detected spectra. Dashed-just continuum

Only Ca, Fe and Ni line groups contribute substantially

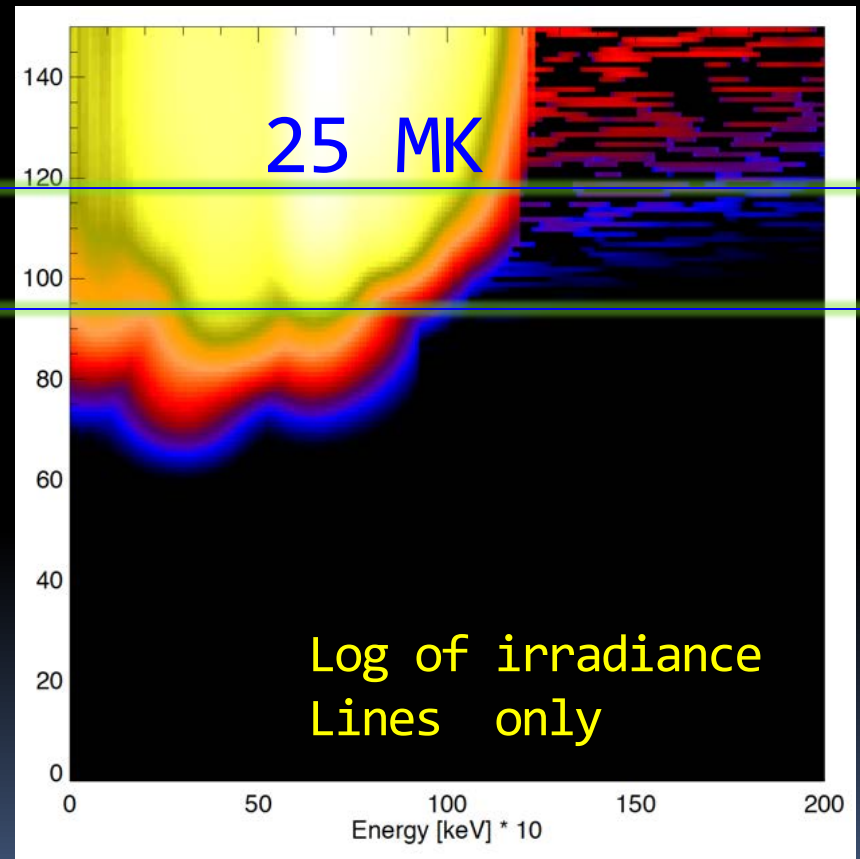
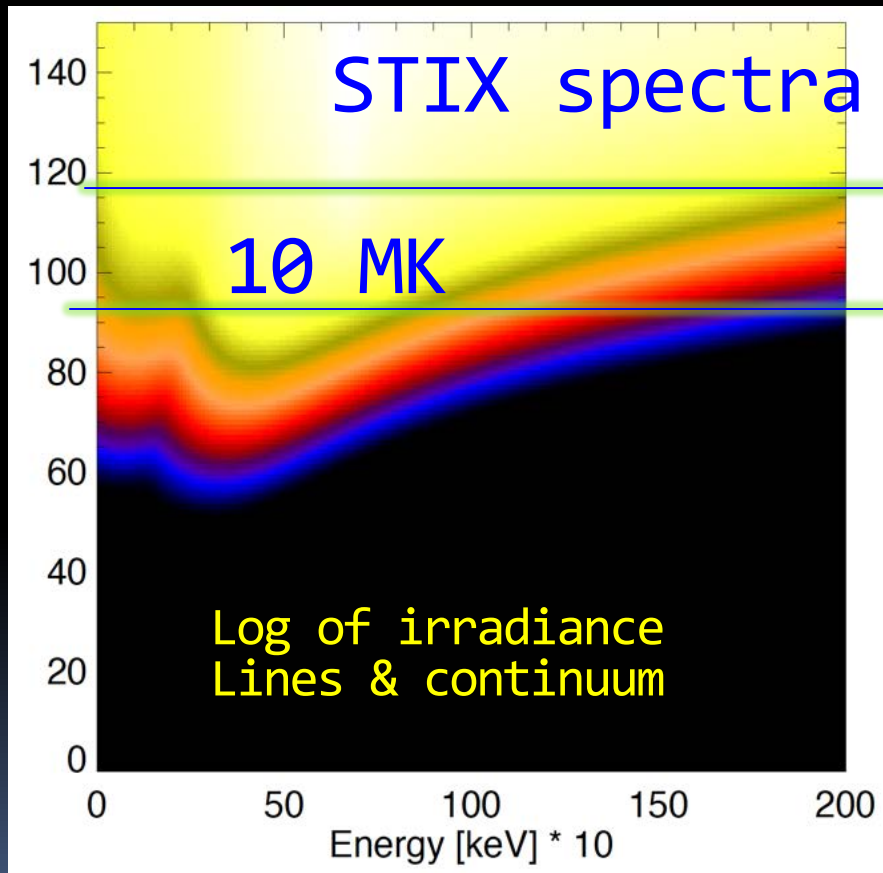
Components of low-E STIX spectra



Dashed
continuum:
Free-free
Free-bound
Two-photon

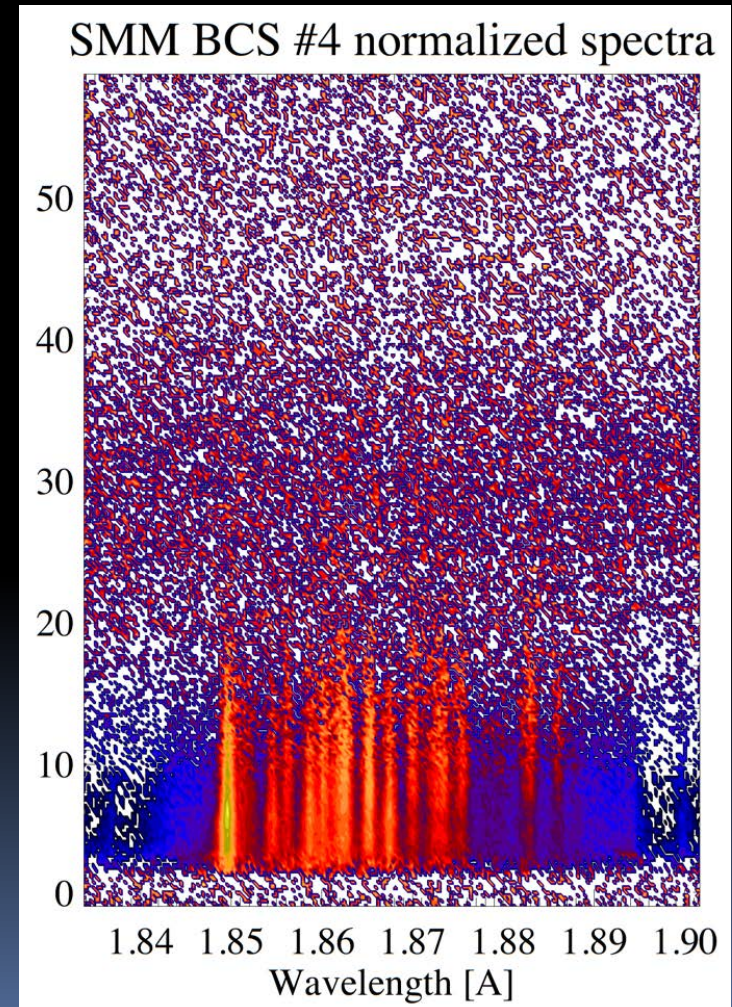
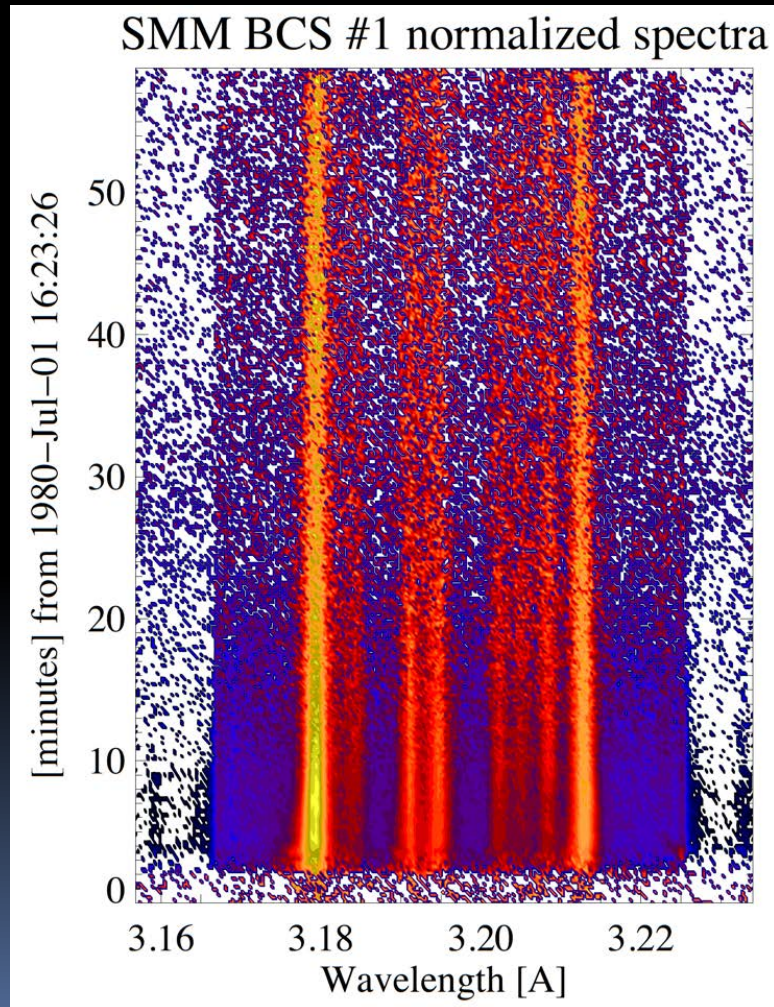
And the line
Contribution
on top

Line groups are of great interest- advanced plasma diagnostics



Spectra as they really look

SMM BCS is a good instrument to consider



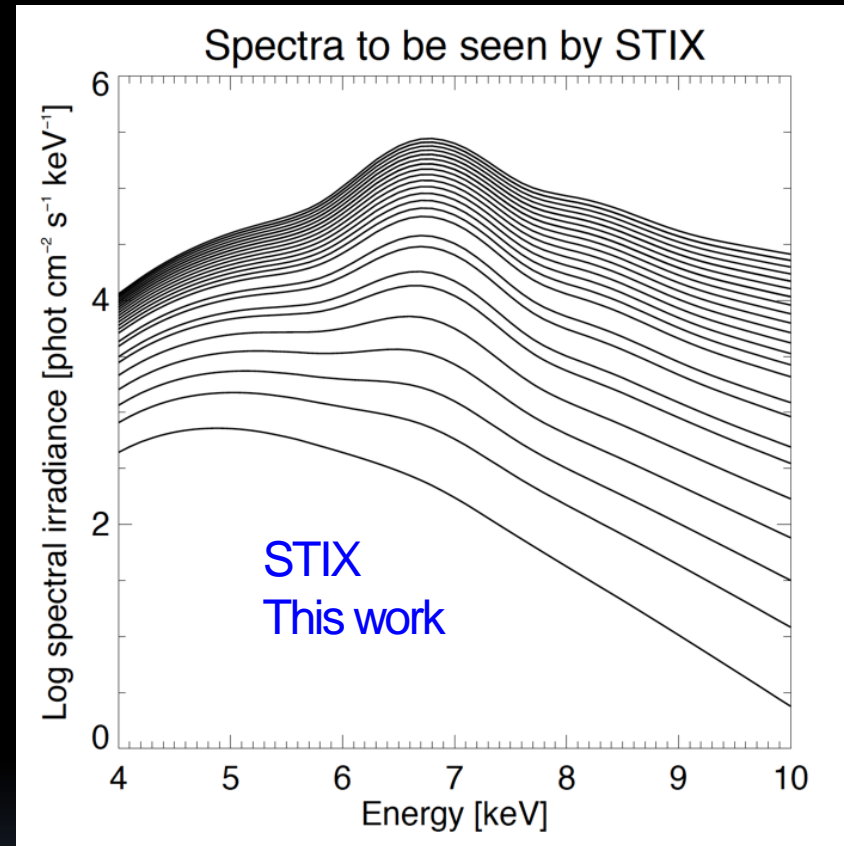
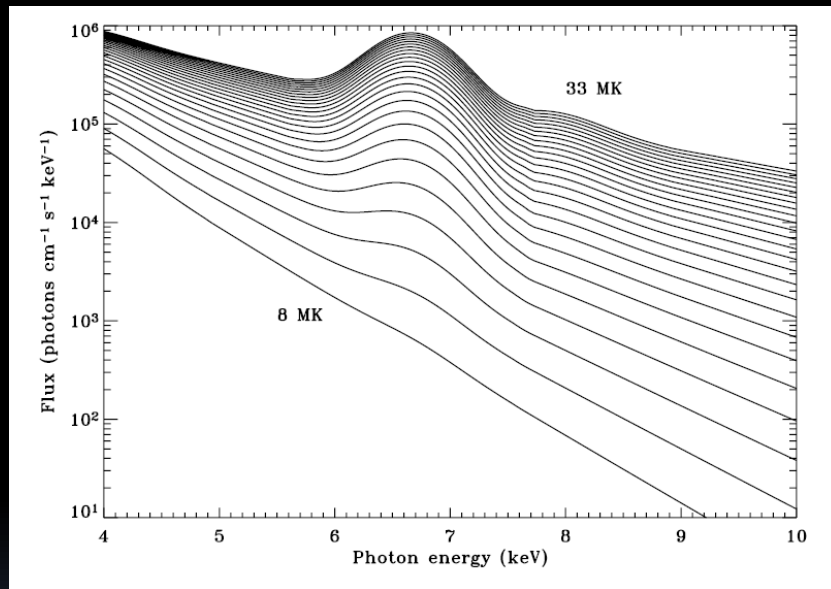
Dependence of spectral shape on plasma temperature

RHESSI

THE ASTROPHYSICAL JOURNAL, 605:921–930, 2004 April 20

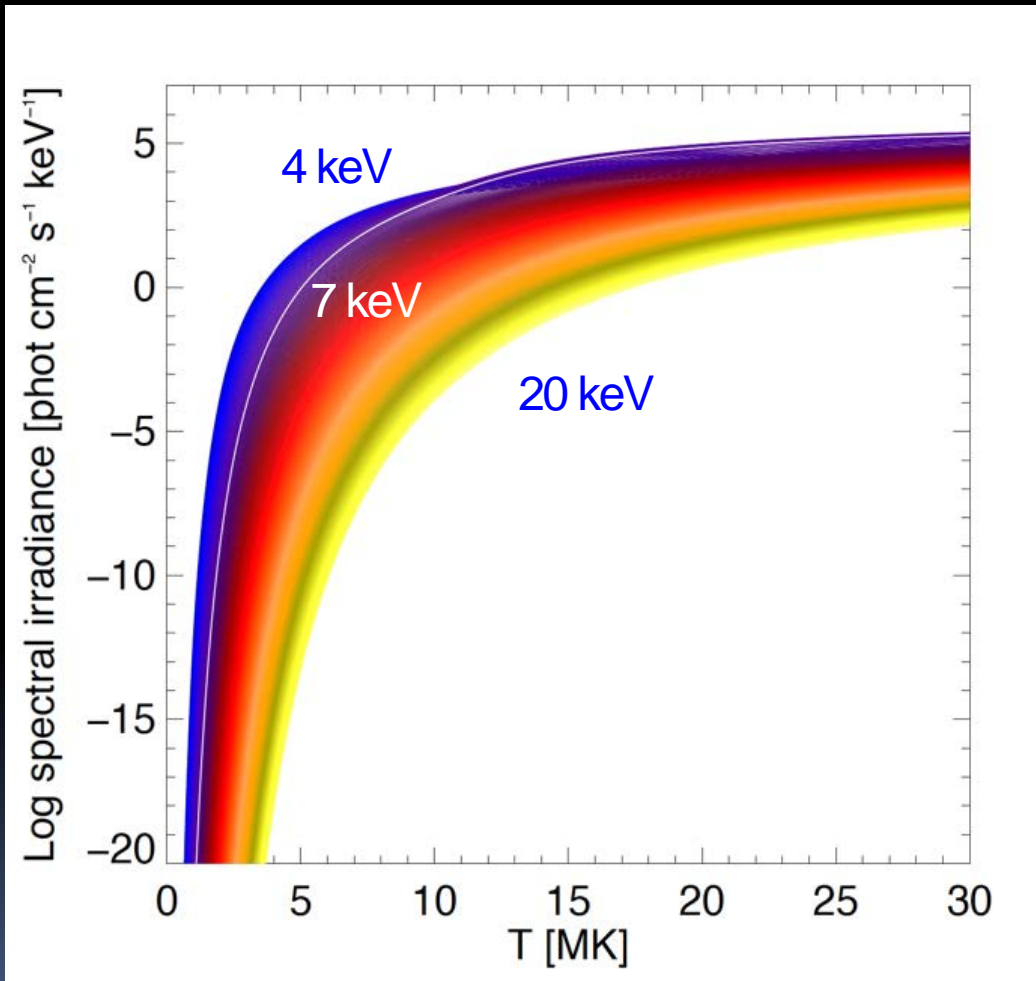
THE SOLAR FLARE 3.8–10 keV X-RAY SPECTRUM

K. J. H. PHILLIPS



Synthetic spectra between 4 and 10 keV from the CHIANTI code, with coronal abundances of Fe and Ni, convolved with respective DRM. For RHESSI a Gaussian filter having FWHM = 0.8 keV was used while for STIX the Geant4-calculated one. Spectra are given in 1 MK intervals from 8 to 33 MK. Fluxes are those at the mean solar distance and for a flare with volume emission measure $N_e^2 V = 10^{49} \text{ cm}^{-3}$.

temperature diagnostics



At the lowest energies cooler (5 MK) plasma component will dominate the flux

Conclusions

Thank you !