Can we make 鉄?

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ASTRO-H ESA Science Operation Center &
ASTRO-H JAXA Operation Office

(still at the) European Space Astronomy Centre of ESA

Outline

- Short introduction to ASTRO-H science
- The perspective of FERO with ASTRO-H

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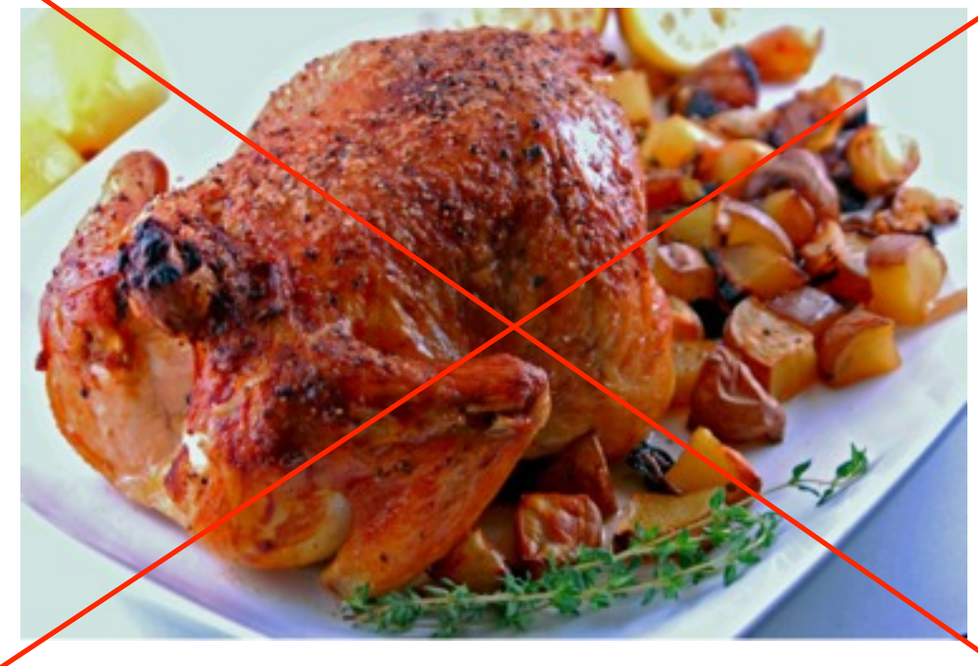

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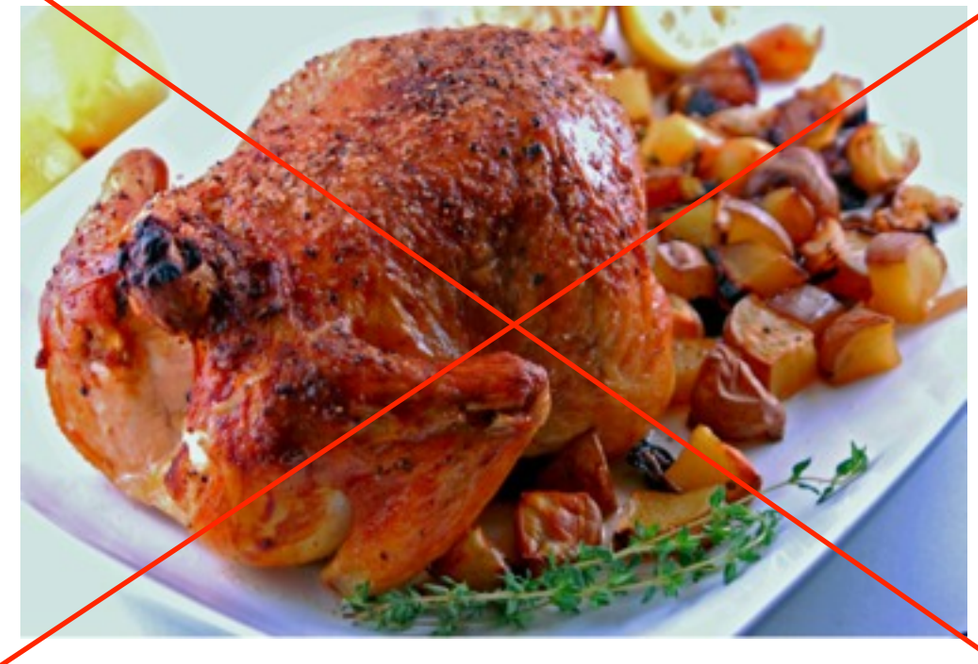

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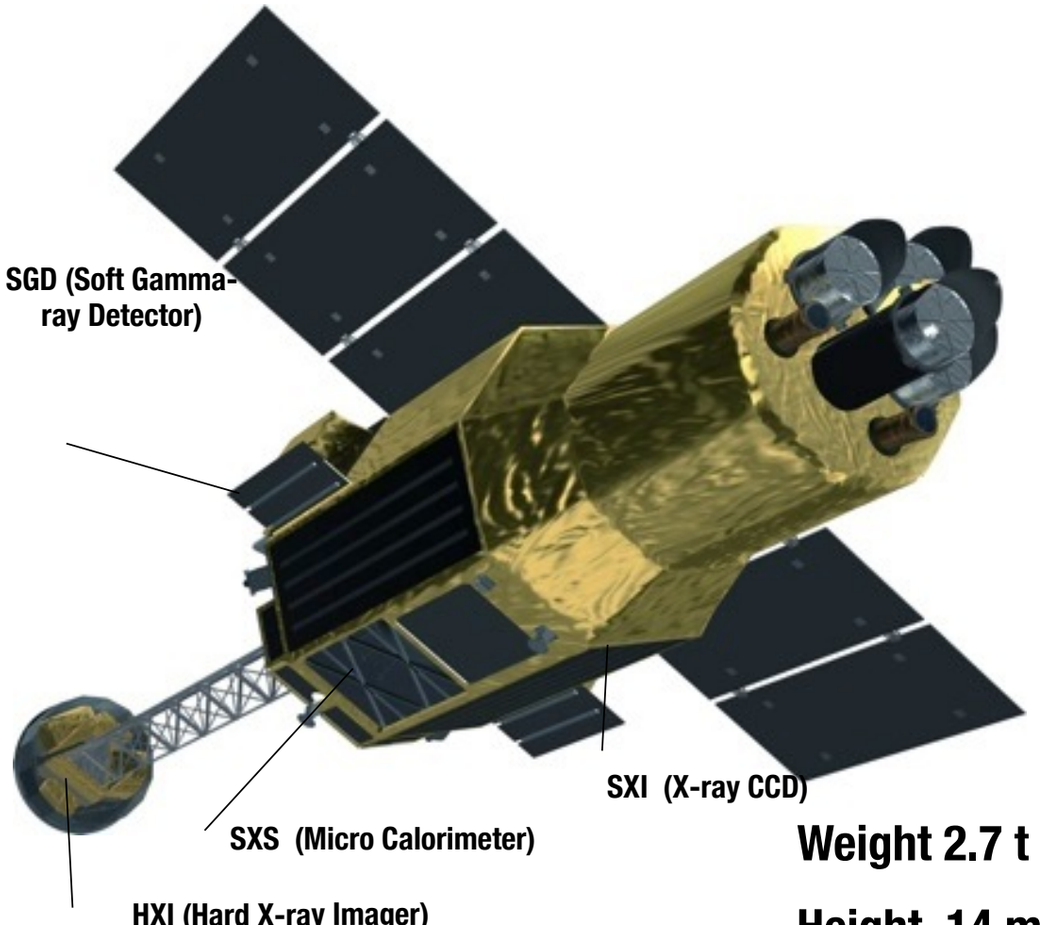
ASTRO-H in a nutshell

(Takahashi et al., 2012, SPIE, 8443, 1)

ASTRO-H is an international X-ray observatory, which is the 6th in the series of the X-ray observatories from Japan. More than 160 scientists from Japan/US/Europe/ Canada.



Weight 2.7 t

Height 14 m

- **Launch vehicle: JAXA H-IIA rocket**
- **Orbit Altitude: 550km**
- **Orbit Inclination: ~31 degrees**
- **Launch : 2015**

International Cooperations

NASA **Micro Calorimeter Array/ADR** **Two soft X-ray Telescopes** **Eight Science Advisors** **Pipeline Analysis**
SRON & U. of Geneva **Filter Wheel/MXS for SXS** **CEA/DSM/IRFU** **Contribution to BGO Shield/ASIC test** **ESA** **Three Science Advisors** **Contribution to mission instruments (SXS/HXI/SGD/HXT)** **User support in Europe**
CSA **Metrology System**

58 institutions (Japan 33)

266 scientists & leading engineers (Japan 152)

ASTRO-H science goals

- Universe large-scale structure and its evolution
    - Galaxy clusters: bulk motions and turbulence, dynamical evolution, non-thermal energy and chemistry, cosmological mass function
    - Evolution of (heavily obscured) supermassive black holes (SMBH)
- Accretion flow onto SMBH in the strong gravity regime
- Cosmic-rays acceleration in SuperNova Remnants and galaxy clusters
- Soft γ-ray polarimetry
- *Observatory science* (stars, XRBs, WDs, Galactic Centre ...)

Instruments' synopsis

(Takahashi, 2013, MmSAI, 84, 776)

Parameter	Hard X-ray Imager (HXI)	Soft X-ray Spectrometer (SXS)	Soft X-ray Imager (SXI)	Soft γ-ray Detector (SGD)
Detector technology	Si/CdTe cross-strips	micro calorimeter	X-ray CCD	Si/CdTe Compton Camera
Focal length	12 m	5.6 m	5.6 m	–
Effective area	300 cm^2@30 keV	210 cm^2@6 keV 160 cm^2 @ 1 keV	360 cm^2@6 keV	>20 cm^2@100 keV Compton Mode
Energy range	5 –80 keV	0.3 – 12 keV	0.5 – 12 keV	40 – 600 keV
Energy resolution (FWHM)	2 keV (@60 keV)	< 7 eV	150 eV (@6 keV)	4 keV (@40 keV)
Angular resolution	<1.7 arcmin	<1.3 arcmin	<1.3 arcmin	–
Effective Field of View	$\sim 9 \times 9$ $arcmin^2$	$\sim 3 \times 3$ $arcmin^2$	$\sim 35 \times 35$ $arcmin^2$	0.6×0.6 deg^2 (< 150 keV)
Time resolution	several 10 μs	several 10 μs	4 sec	several 10 μs
Operating temperature	−20°C	50 mK	−120°C	−20°C

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High-resolution spectroscopy

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High-resolution spectroscopy **Imaging up to 80 keV**

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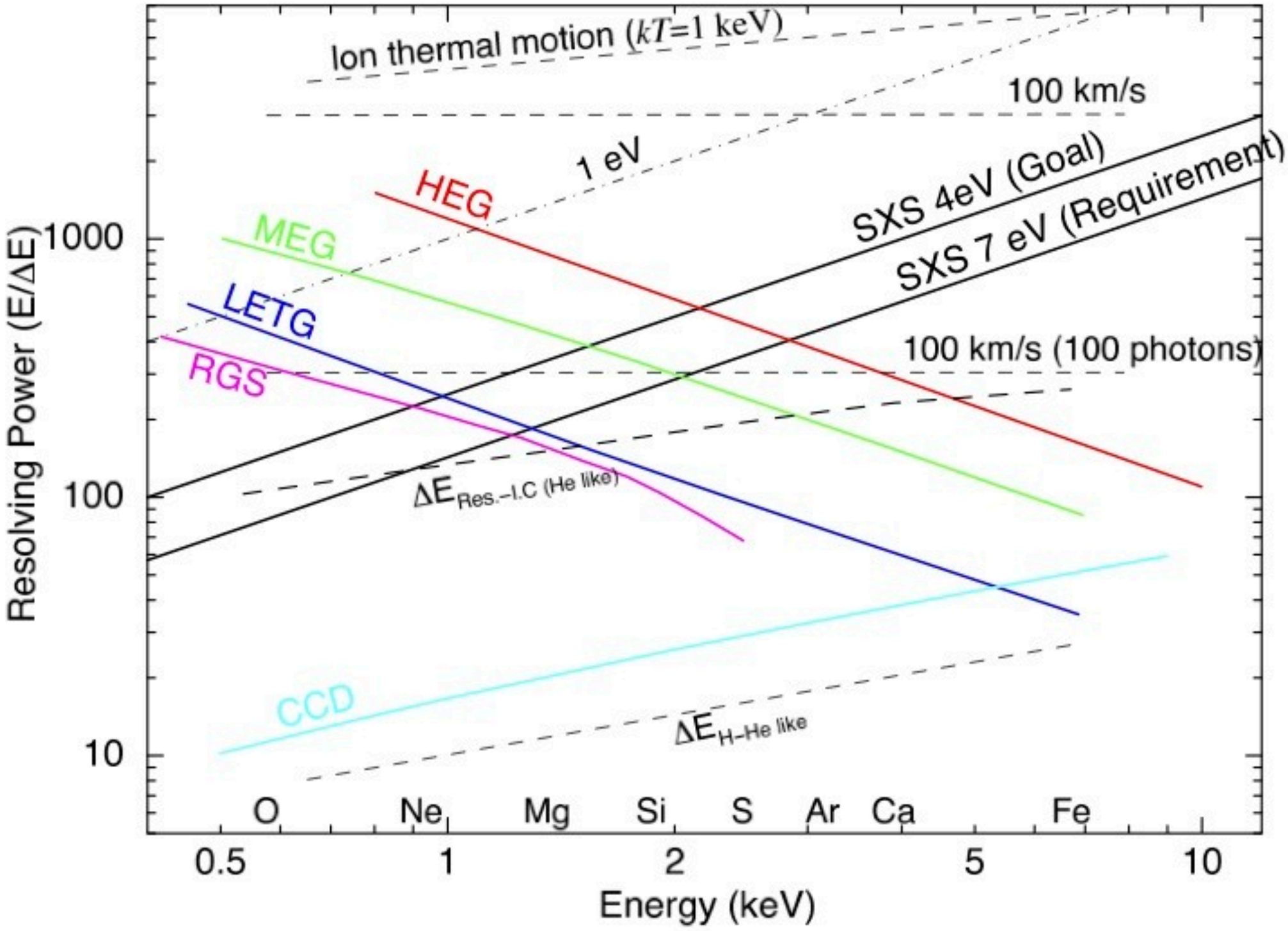
High-resolution spectroscopy **Imaging up to 80 keV** **Wide band, high sensitivity**

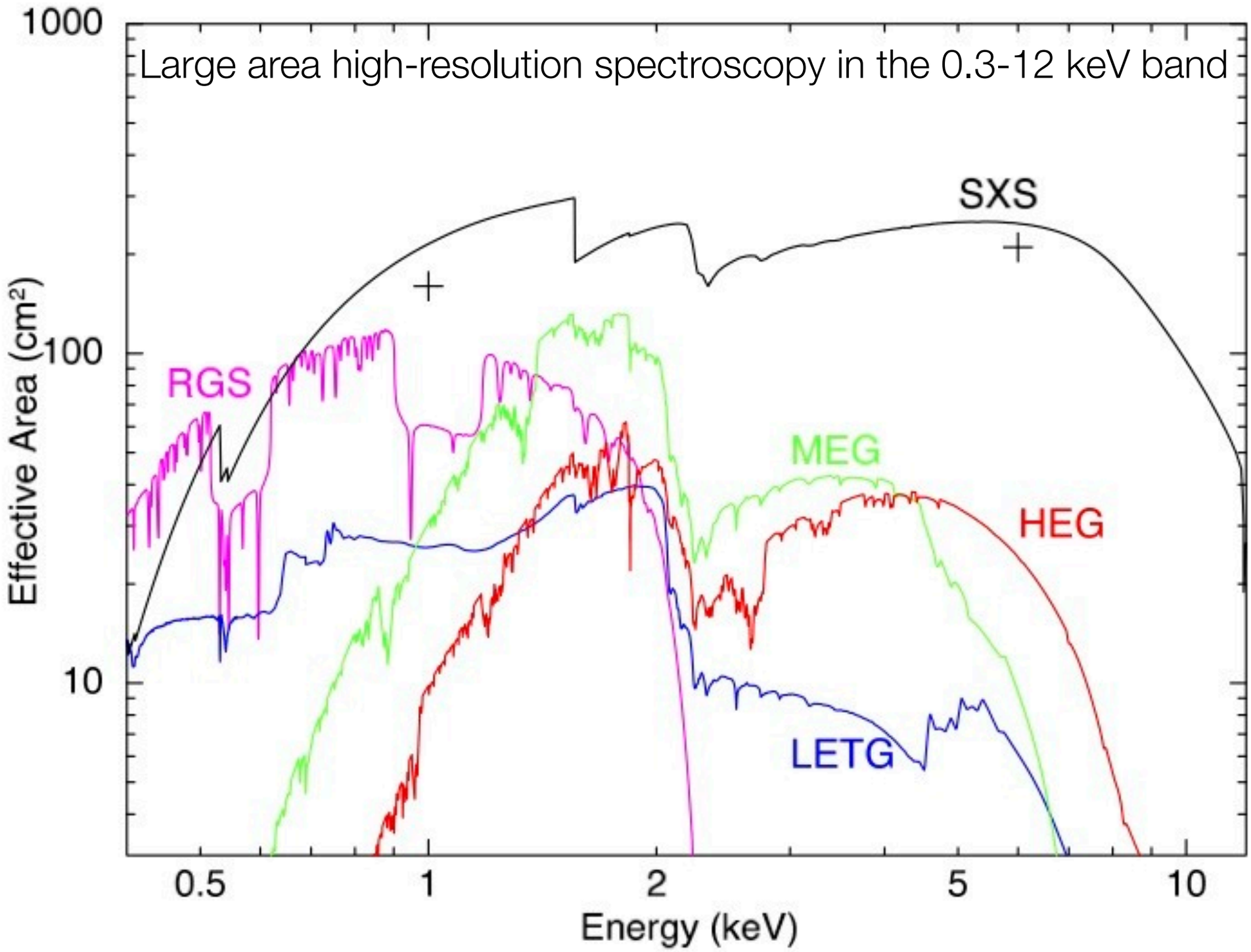
Resolving power

(Takahashi et al., 2012, SPIE, 8443, 1)



Effective area - I.

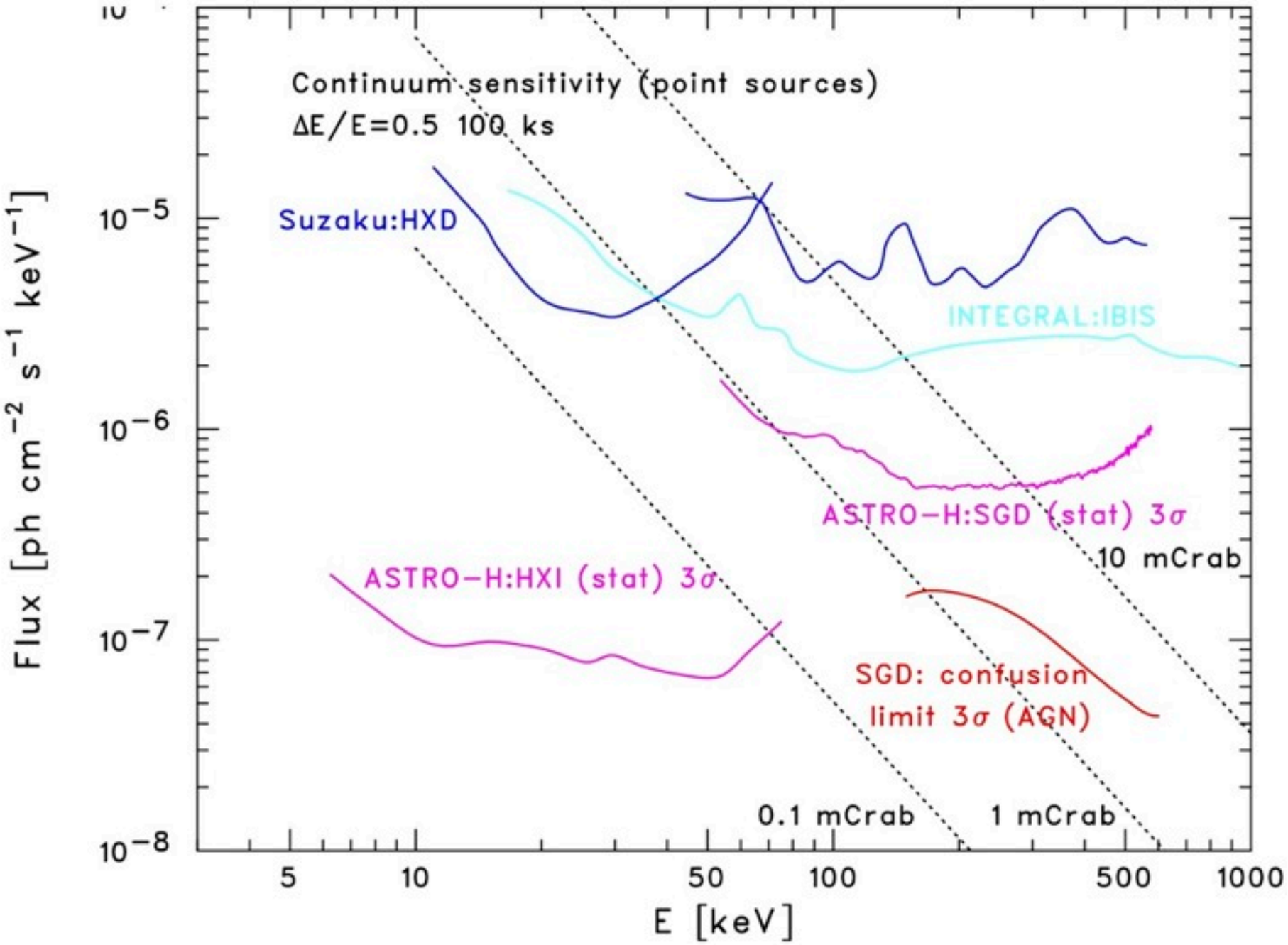
(Takahashi et al., 2012, SPIE, 8443, 1)



Effective area - III.

(Takahashi et al., 2012, SPIE, 8443, 1)

60% more (measured) area than NuSTAR

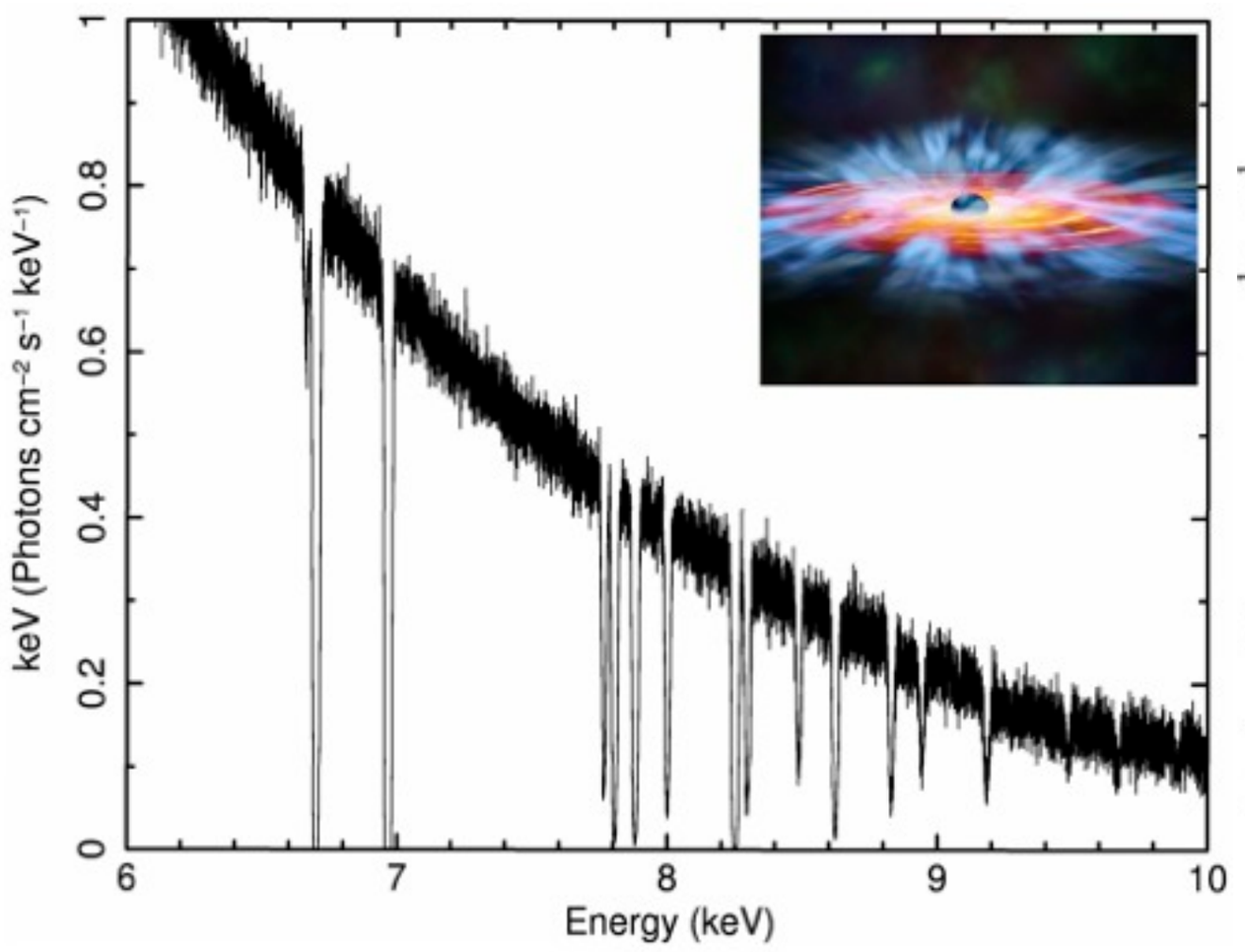


Science Goals: SMBH outflows

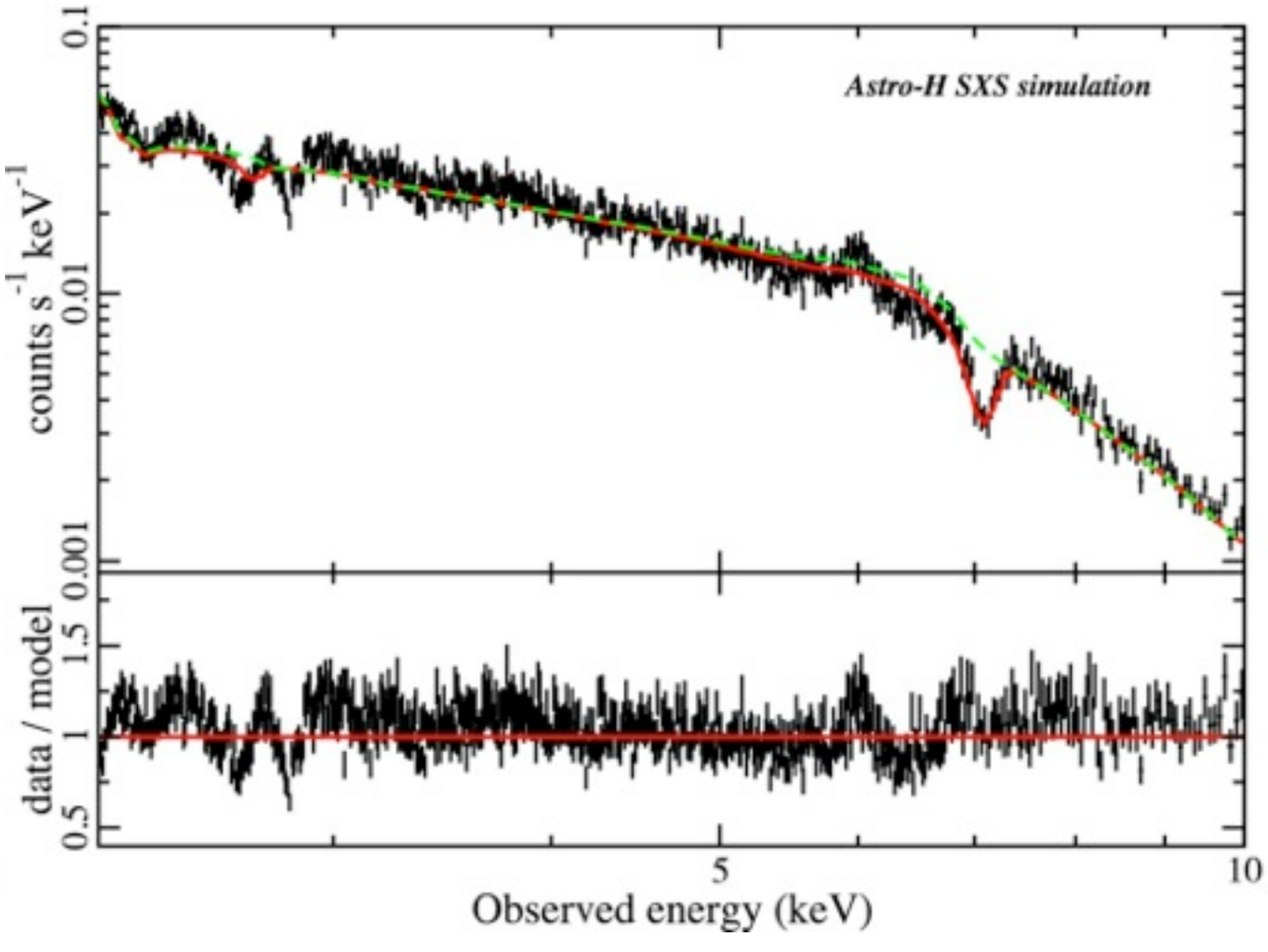
(Gallo & Fabian, 2013 MNRAS, 434, L66)

Measurement of wind velocity (outflow and circulation), density, covering fraction
AGN: host galaxy feed-back (UFOs); GBHC: disk/wind connection ⇒ driving mechanism

http://astro-h.isas.jaxa.jp/wp-content/uploads/2013/03/ahqr.pdf



100ks SXS simulation of GROJ1655-40



100ks SXS simulation of PG1211+143

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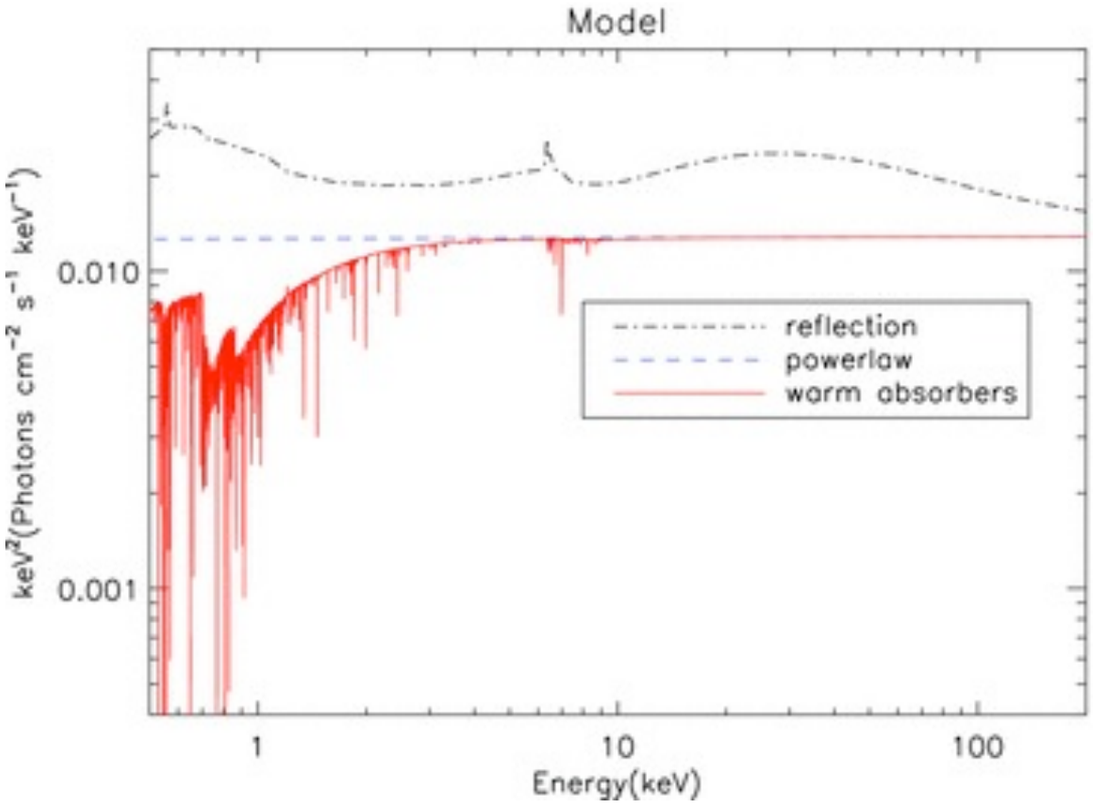
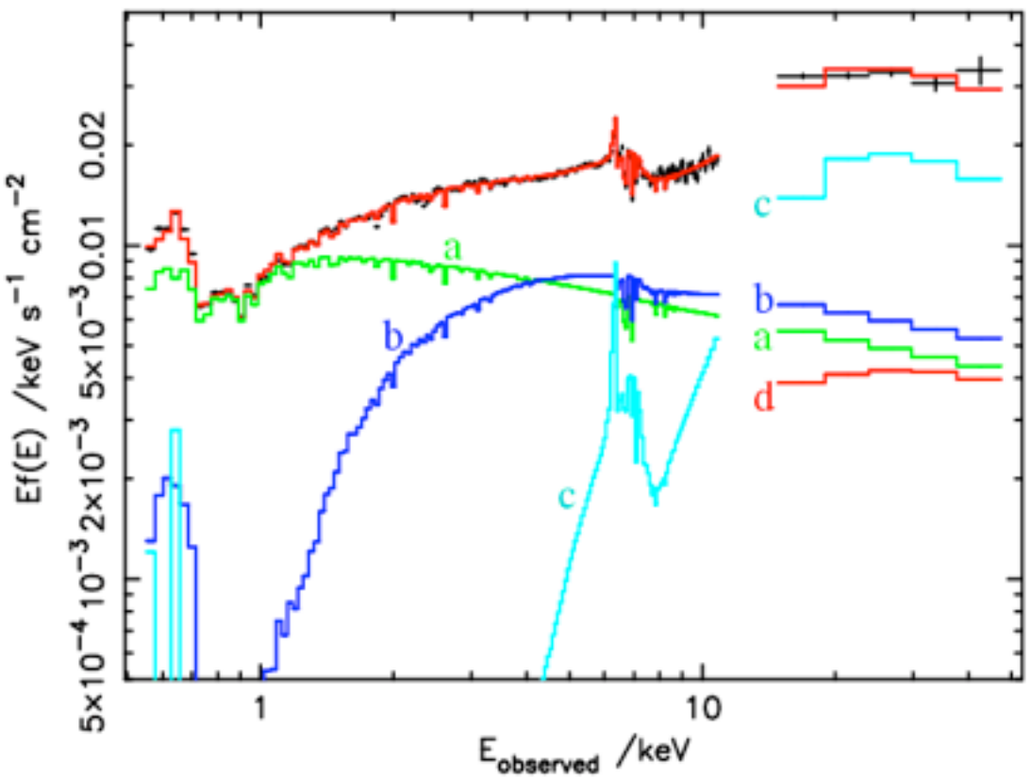
Reference source: MCG-6-30-15

Models based on multi-epoch and -instrument fits



3 layers of ionised absorbers + relativistic reflection

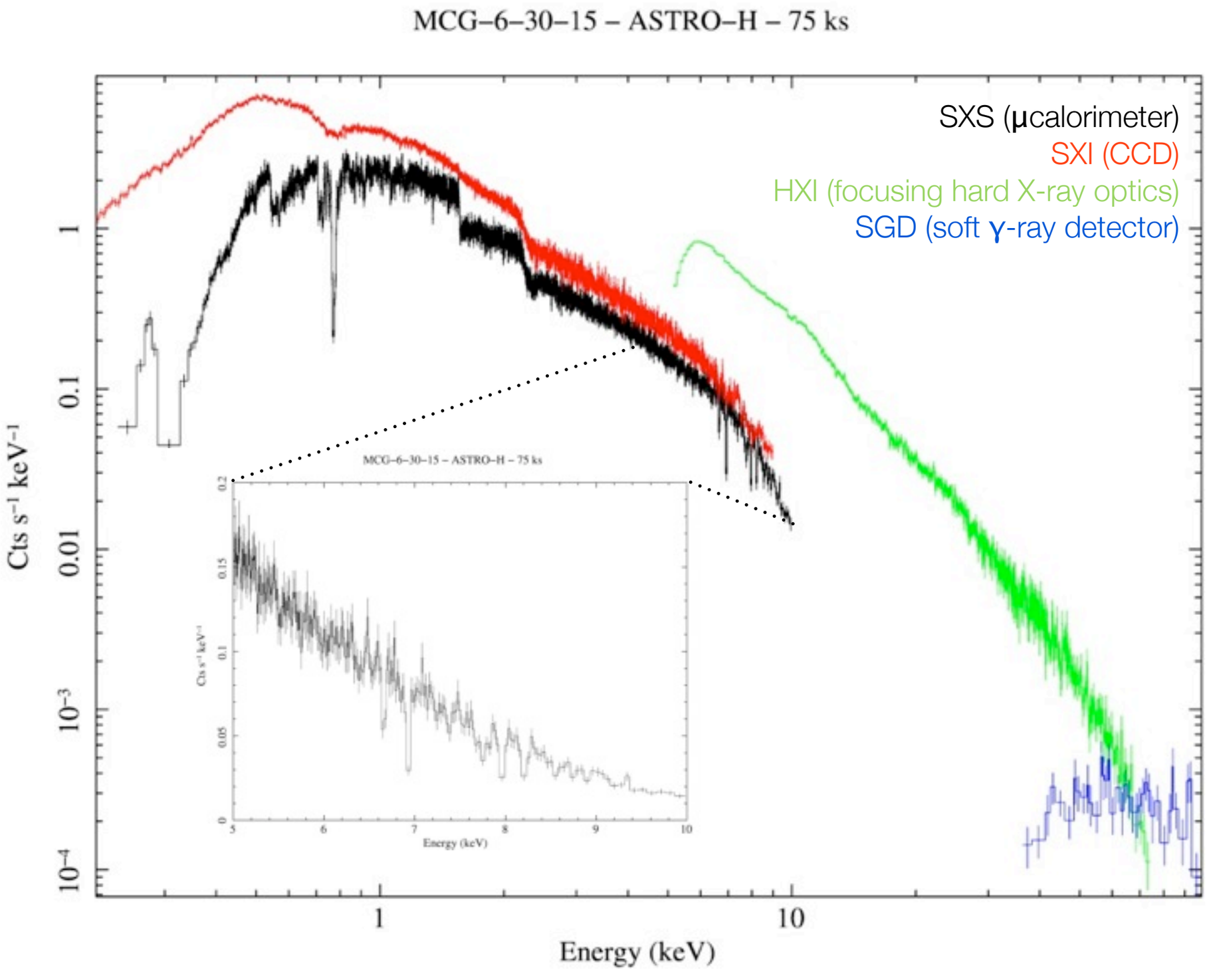
(Chiang & Fabian, 2011, MNRAS, 414, 2345)



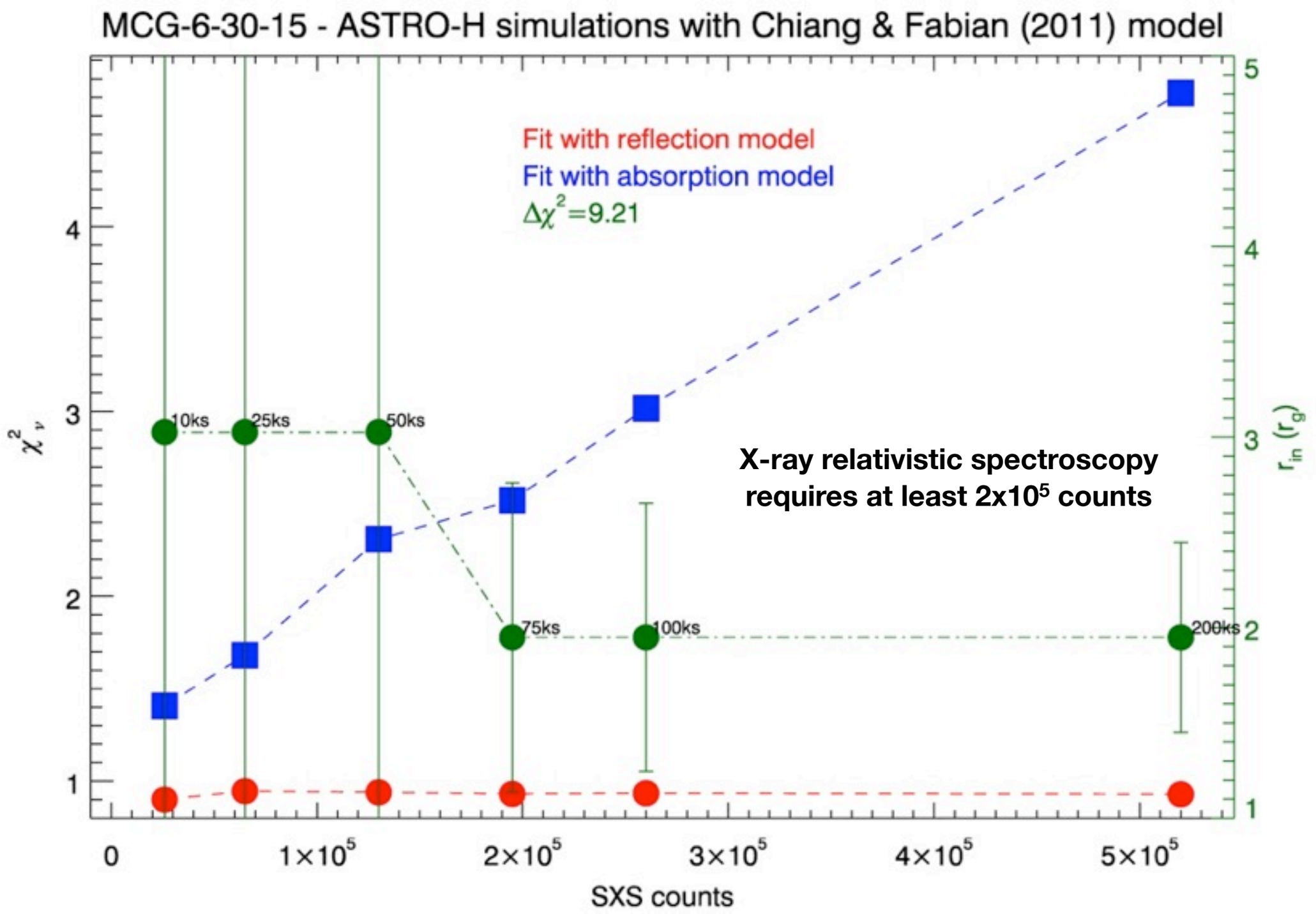
5 layers of ionised absorbers *no* relativistic reflection

(Miller et al., 2008, A&A, 483, 437)

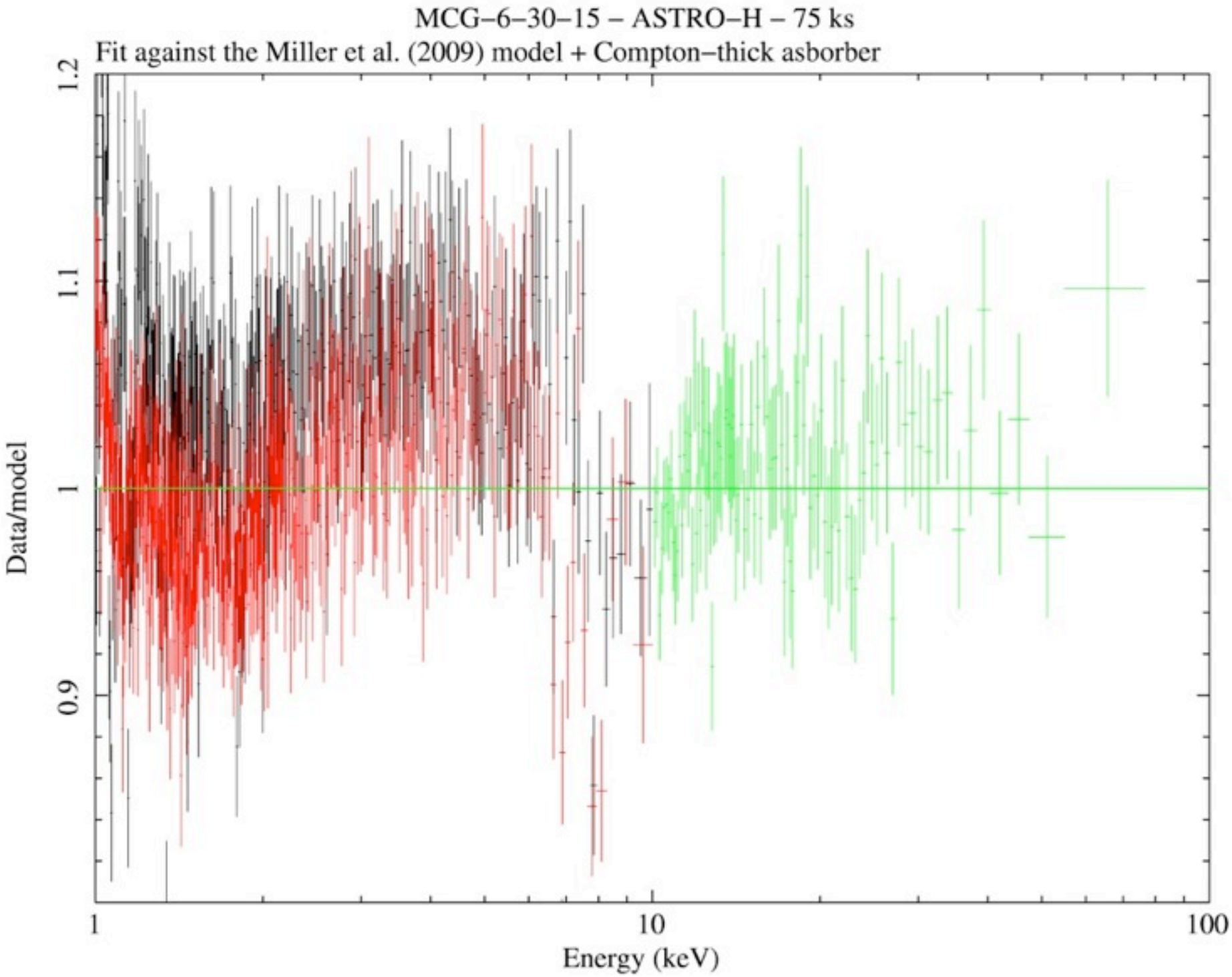
ASTRO-H expected spectrum



Expected statistical quality



It is easy to distinguish the two scenarios



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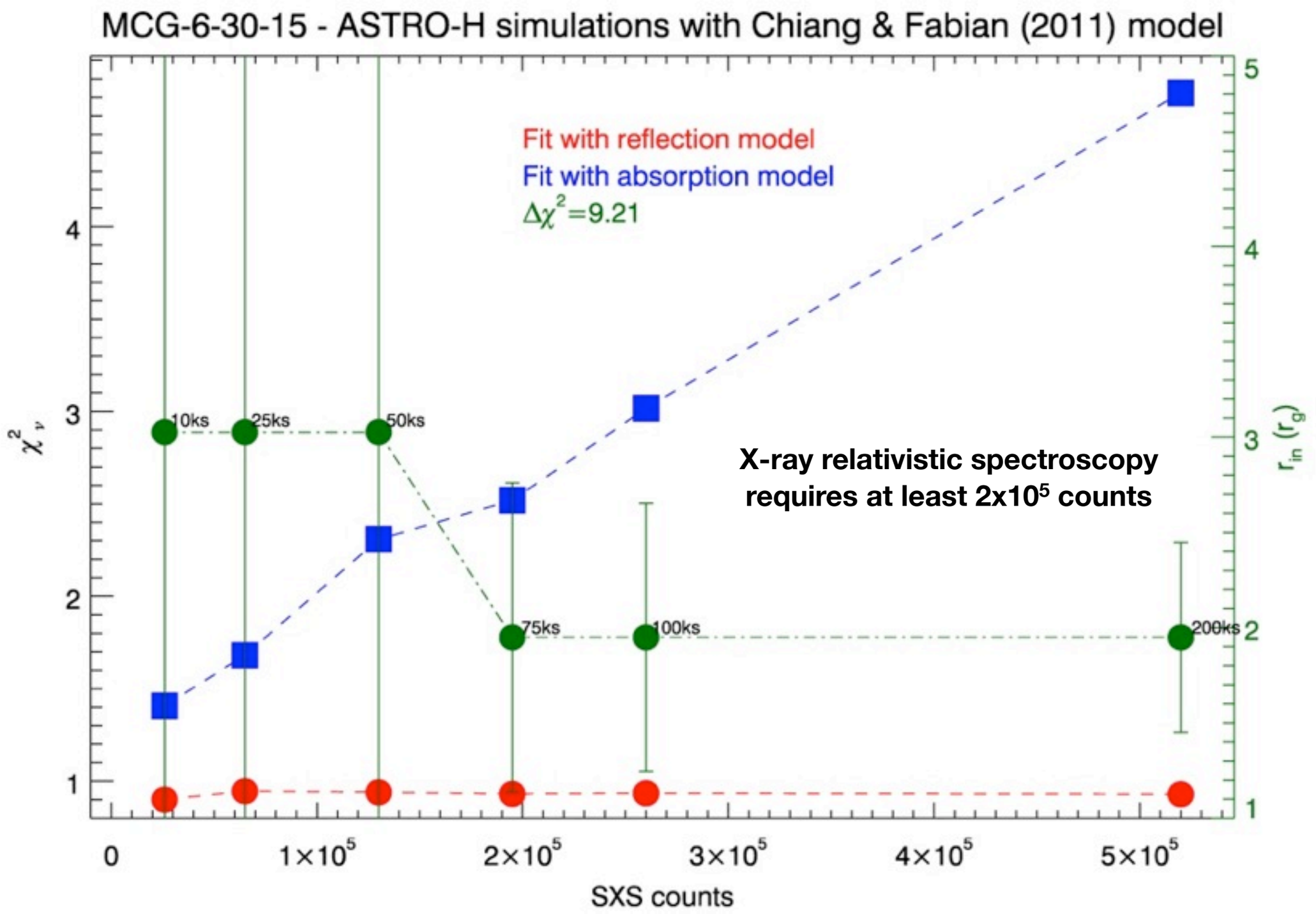
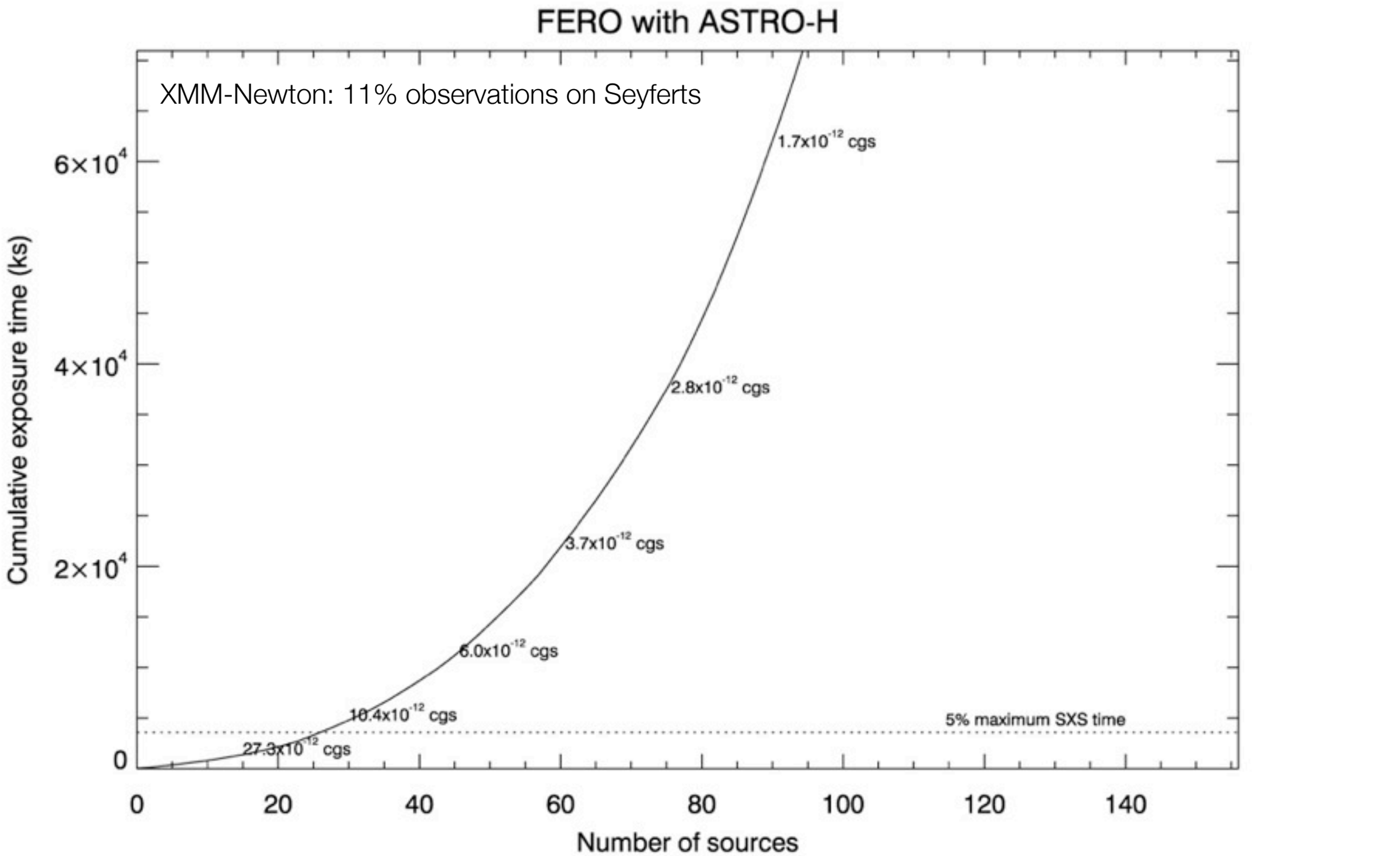


Time budget


FERO with ASTRO-H
XMM-Newton: 11% observations on Seyferts
1.7x10^-12 cgs
2.8x10^-12 cgs
3.7x10^-12 cgs
6.0x10^-12 cgs
10.4x10^-12 cgs
27.3x10^-12 cgs
5% maximum SXS time
Cumulative exposure time (ks)
6×10^4
4×10^4
2×10^4
0
0
20
40
60
80
100
120
140
Number of sources

Conclusions

- If you have a Ph.D student starting in the second half of 2016 (and the ASTRO-H launch is successful) I can offer technical expertise for an ASTRO-H based FERO thesis ...

- ... provided that by that time the FERO community has developed a fully-relativistic reflection mode with self-consistent treatment of the ionisation (and vertical?) structure ... :-).

"*Bye-bye XMM-Newton drink*"

10:00pm in the lobby. Every FERO participant welcome!