Cosmic and Particle Backgrounds

Randall Smith

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Introduction

The IXO X-ray background arises from two components:

- The Cosmic X-ray Background (CXB):
  - unresolved point sources at high energies (E>2 keV)
  - Galactic component(s) at lower energies, from the disk & halo
  - The Local Bubble and/or charge exchange in the heliosphere.
- A Non-X-ray Background (NXB) created by particle interactions in the detector itself, from:
  - relativistic particles from the Sun
  - Galactic Cosmic Rays (GCR), creating background events due to both primary and secondary interactions in the spacecraft itself.

This talk is based on a paper by Smith et al. (in prep)

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Cosmic Sources: Extragalactic

- Most of the CXB is from point sources which will be randomly distributed over the FOV
- The chance of finding a source in the central 40x40 pixel FOV is:
- Thus there is a 59% chance that one 2x2 region will have a 10^{-14} erg/cm^2/s source.

F_x (erg/cm^2/s)	Soft (1-2 keV)	Hard (2-10 keV)
$3x10^{-15}$	73%	~100%
10^{-14}	25%	59%
$3x10^{-15}$	6.1%	13%

- This source will be > 100x brighter than the 'average' background.

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Cosmic Sources: Local

- Solar Wind Charge Exchange (SWCX) will create low energy (~<1 keV) emission lines from the interaction of ions in the Solar wind with neutral H, He in the Earth's exosphere or the heliosphere.
  - At L2, the direct exospheric component will be small, but SWCX from the magnetosheath could be important, even if IXO is inside the magnetotail.
- The Local Hot Bubble also contributes…

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Cosmic Sources: Local

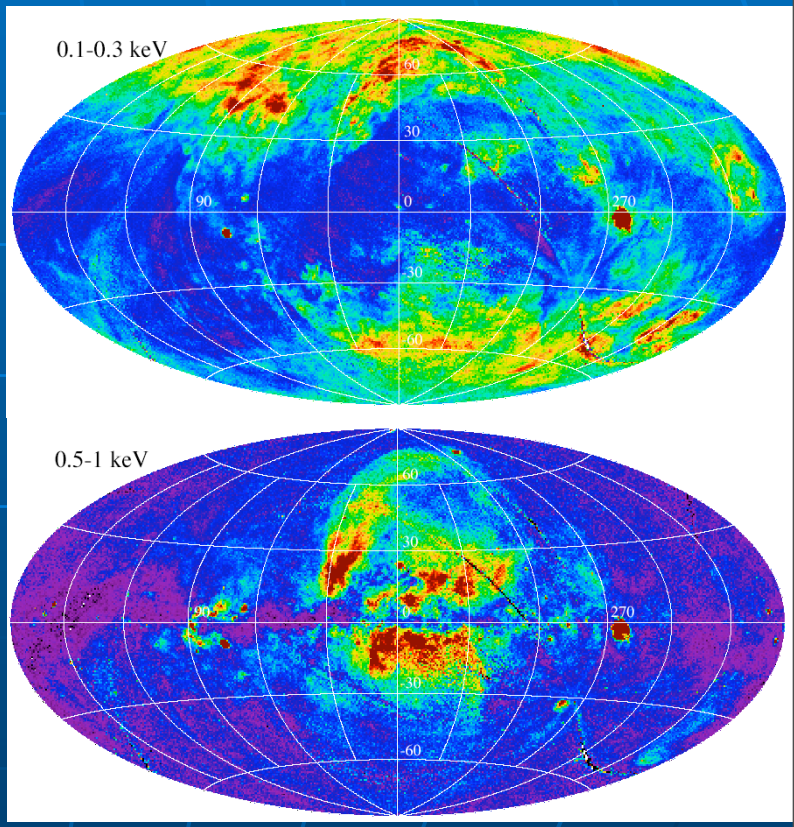
- As a typical case, the 'local' O VII surface brightness is typically 1-3 ph/cm^2/s/sr (which includes the whole triplet)
- This corresponds to 4.85 – 14.6 cts/ksec over the core 40x40 array
- Per pixel, this is 0.003 – 0.009 cts/ksec.
- Lower energy lines (<0.4 keV) may be stronger, however.

Cosmic Sources: Galactic

- The Galactic component is variable...

In particular, observations done at low ($l<5^o$) Galactic latitude will have a background due to various Galactic sources that are only 'background' when done in the context of a particular observation.

At higher latitudes the Galactic halo is known to be 'patchy' (Kuntz & Snowden 2000), with some regions at ~$3x10^6$K and others that show little hot emission. This creates a low energy (~< 1 keV) line-dominated background.



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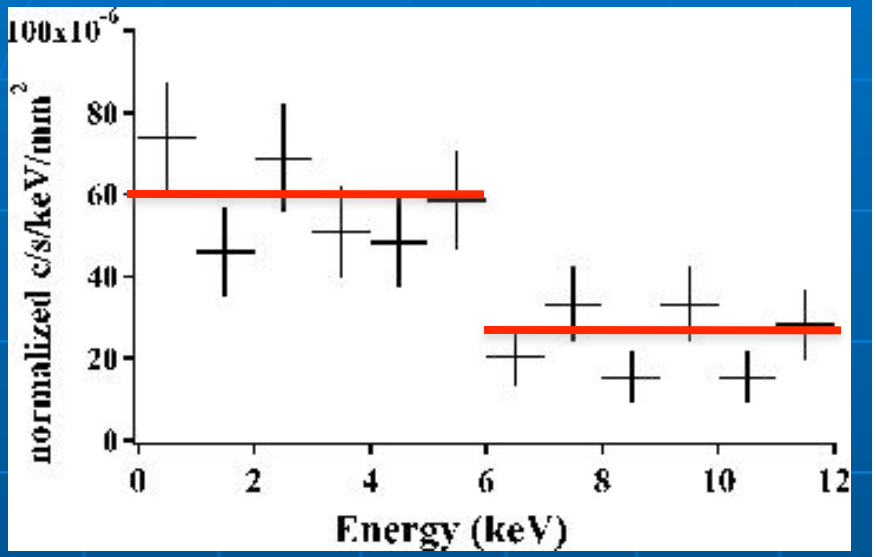
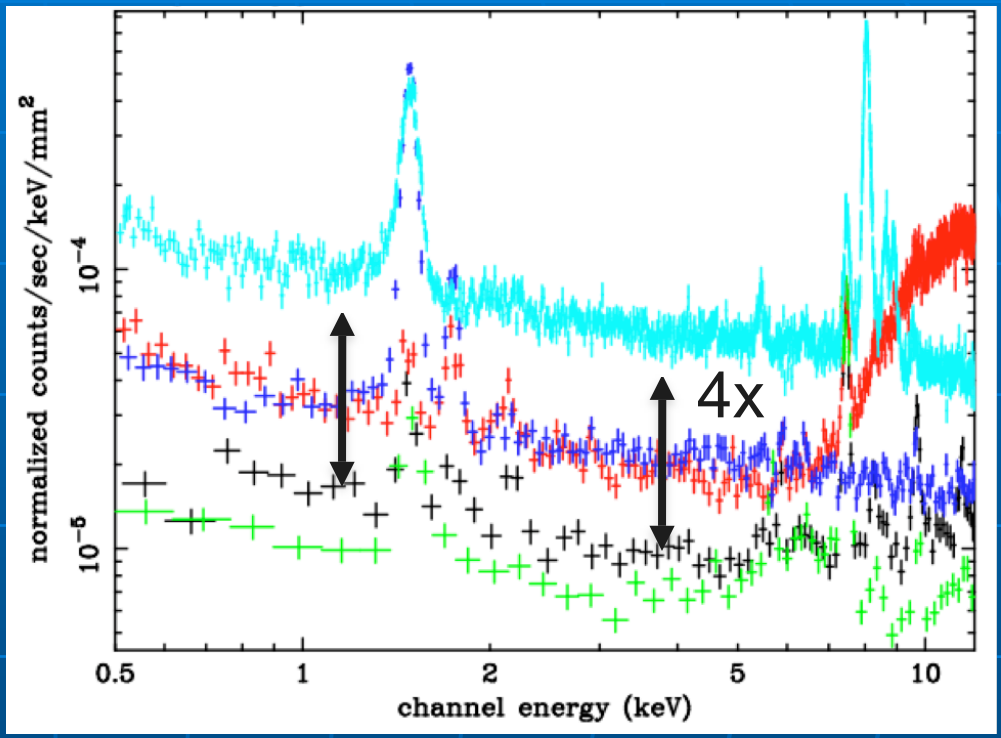
Non-X-ray Background



Internal background spectra of Suzaku XRS before gate value opening (Kelley et al. 2007, PASJ, 59S, 77)



Internal background spectra of ASCA/SIS, Suzaku/XIS-FI, Suzaku/XIS-BI, XMM-Newton/PN, XMM-Newton/MOS, normalized by CCD area.

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Estimated Background Rates

Source	Energy	Rate cts/ks/keV/pixel
NXB	< 6 keV	0.0216
NXB	> 6 keV	0.009
CXB	2-10 keV	0.0023
CXB	1-2 keV	0.011
Local	0.57 keV	3-9 x 10^{-3} in line

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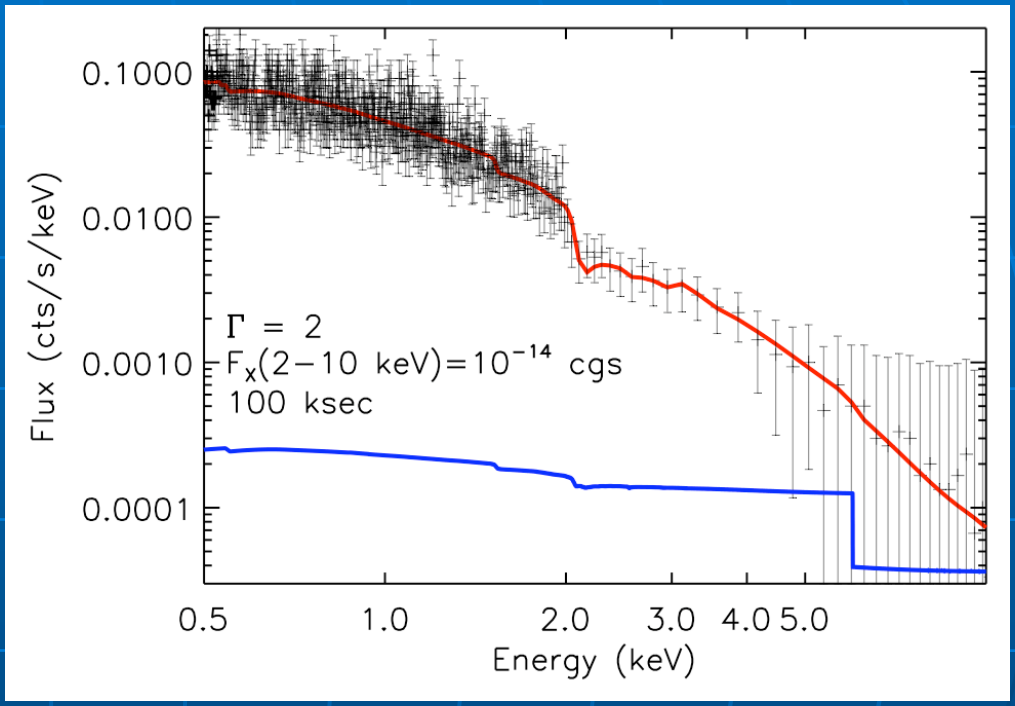
Effect of Background

	AGN (c/ks)	CXB (c/ks)	NXB (c/ks)
1-2 keV	25	0.11	0.086
2-10 keV	9.0	0.071	0.036

Counts in soft and hard bandpass for a AGN with $F_X = 10^{-14}$ erg/cm^2/s, compared to expected CXB and NXB values.



Simulated spectrum of AGN; blue line shows simulated CXB & NXB background component.

Assumes anti-coincidence vetoing at Suzaku level.

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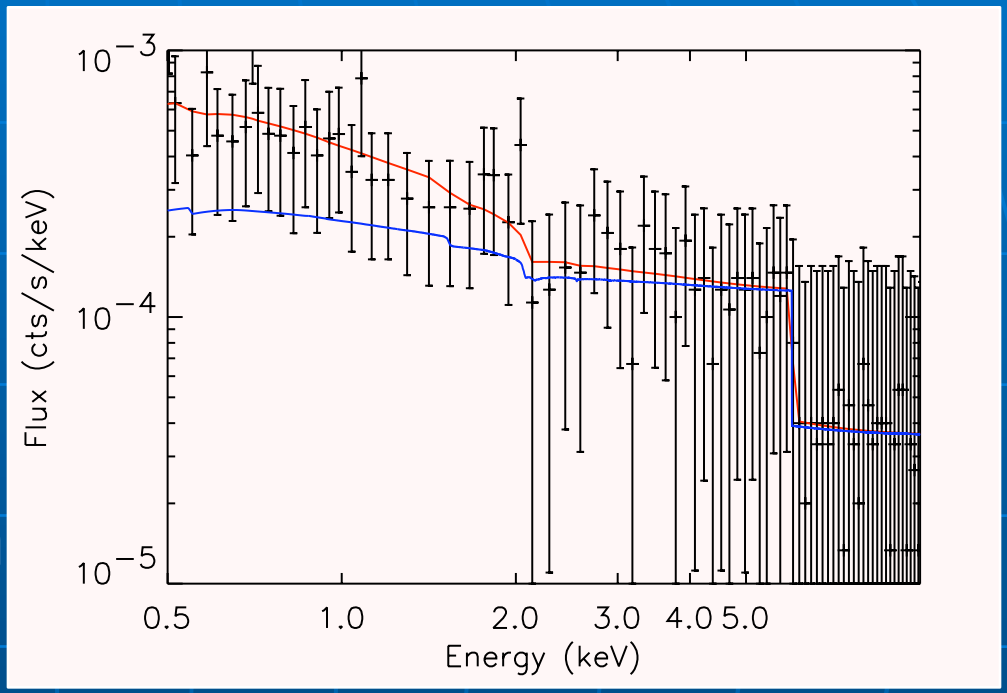
Effect of Background

	AGN (c/ks)	CXB (c/ks)	NXB (c/ks)
1-2 keV	0.17	0.11	0.086
2-10 keV	0.06	0.071	0.036

Counts in soft and hard bandpass for a AGN with $F_X(0.3\text{-}10) = 10^{-16}$ cgs, compared to expected CXB and NXB values.



Simulated spectrum of AGN; blue line shows simulated CXB & NXB background component.

Assumes anti-coincidence vetoing at Suzaku level.

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Still to do…

- What will the grating (XGS) background be? Will it affect absorption line studies?
- Will CCDs have problems from pileup? More generally, how will background affect CCDs, either in the XGS or the WFI?
- Residual stray light from nearby bright sources is not yet included; this term is neither CXB nor NXB.
- Will background events in the XMS and XGS affect requirements on the telemetry rate?
- How much can the NXB be reduced by increasing shielding?
- What error factor should be included on the overall rate to account for possible underestimation?
- Any results from planetary missions with CCDs?
- How do CCDs compare to calorimeters in general?