IXO
International X-ray Observatory

Cosmic and Particle Backgrounds

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Introduction

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The IXO X-ray background arises from two components:

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

All estimations are for the four telescope Con-X; IXO results can be rescaled as plans firm.

(This talk is based on an in-progress paper by Smith et al. on IXO background issues.)

Cosmic Sources: Extragalactic

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- Most of the CXB is due to point sources, so this emission will not be evenly distributed over the field of view but rather concentrated in specific points.
- Using the results of Moretti et al (2003, ApJ, 588, 696) the chance of finding a source in a 5 arcmin square FOV is:

F_X (erg/cm²/s)	Soft (1-2 keV)	Hard (2-10 keV)
3×10^{-15}	73%	~100%
10^{-14}	25%	59%
3×10^{-15}	6.1%	13%

- Although the average extragalactic background is 0.0038 cts/ksec/keV per XMS pixel between 2-10 keV, there is a 59% chance that some 3x3 pixel region will have a 10^{-14} erg/cm²/s source and so show a rate >5x higher (~0.02 cts/ksec/keV).

  (XMS pixels: 250 um (5 arcsec) on a side)

Cosmic Sources: Local

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- A Solar Wind Charge Exchange (SWCX) component creates low energy (E<1 keV) emission lines due to electron cascades from neutral material (either from (1) the Earth's exosphere or (2) the heliosphere) onto highly ionized solar wind ions.
  - While IXO, at L2, should have little problem with the direct exospheric neutral component, SWCX from the magnetosheath could be a larger issue, even if IXO is inside the magnetotail itself.
- The Local Hot Bubble also contributes low-energy lines.
- The local O VII line brightness will be 3.8×10^{-3} cts/ksec per pixel, or 15.34 cts/ksec summed over 32x32 pixels in four arrays.

Cosmic Sources: Galactic

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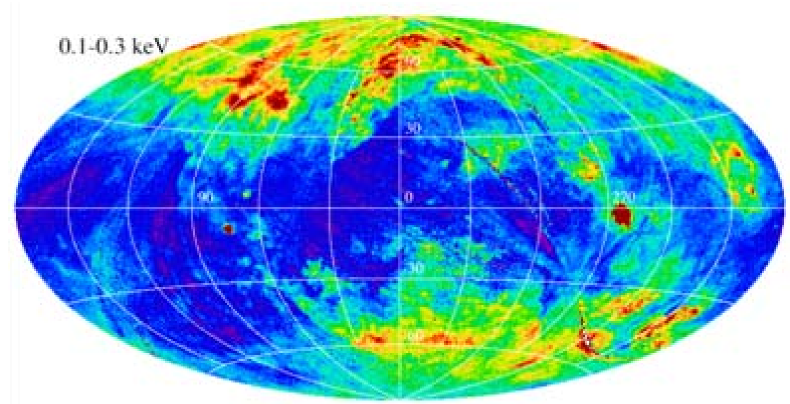
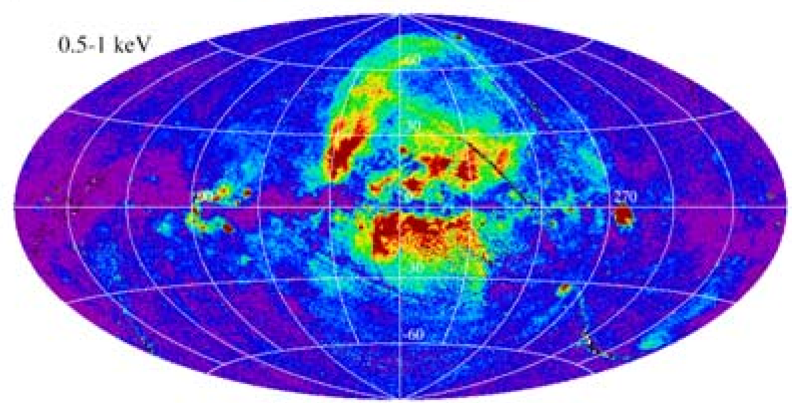
The Galactic component varies dramatically with look direction.

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.





Even at higher latitudes the Galactic halo is known to be ‘patchy’ (Kuntz & Snowden 2000, ApJ, 543, 195), with some regions that can be fit with a 3×10^6K and others that show little hot emission. This affects the low (E<1 keV) energy spectrum, and like the SWCX and LHB contributions creates a line rather than continuum background

Non-X-ray Background

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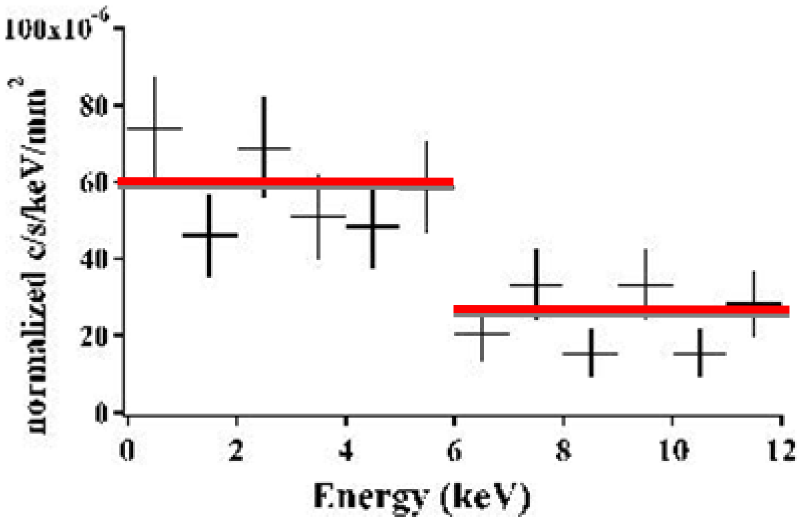
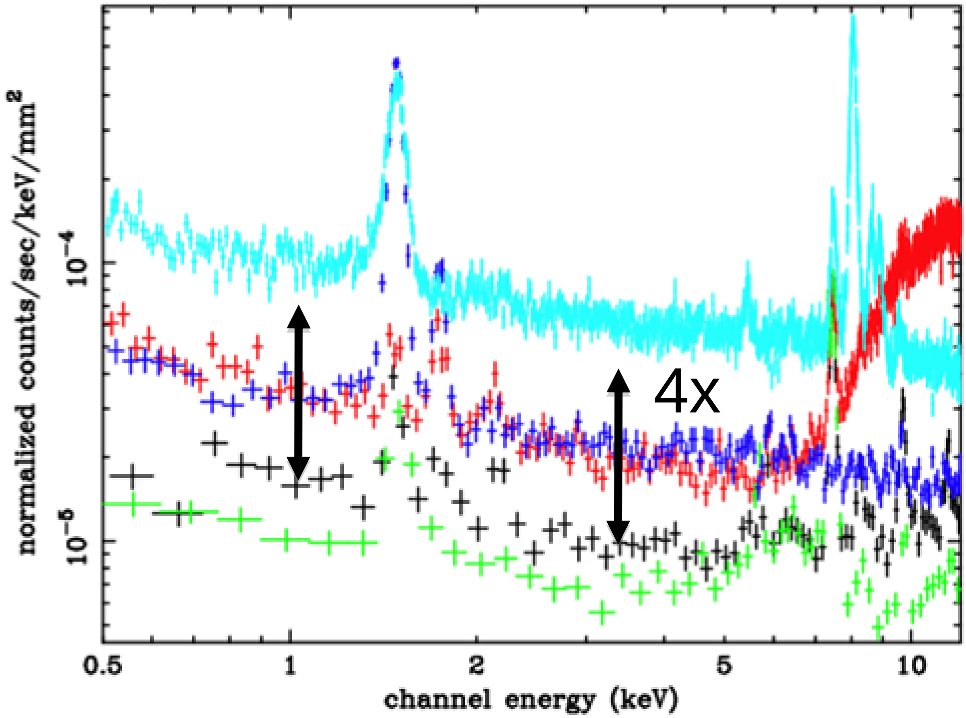


Internal background spectra of Suzaku XRS before gate value opening (Kelley et al. 2007, PASJ, 59S, 77)



Internal background spectra of ASCA/SIS (green), Suzaku/XIS-FI (black), Suzaku/XIS-BI (red), XMM-Newton/PN (light blue), XMM-Newton/MOS(blue), normalized by the CCD area.

Estimated Background Rates

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Source	Energy	Rate cts/ks/keV/pixel
NXB	< 6 keV	0.0138
NXB	> 6 keV	0.0063
CXB	2-10 keV	0.0038
CXB	1-2 keV	0.037
Local	0.56 keV	0.0038 in line

(Based on four-telescope Con-X Design; estimated IXO numbers can be scaled.)

Background Model

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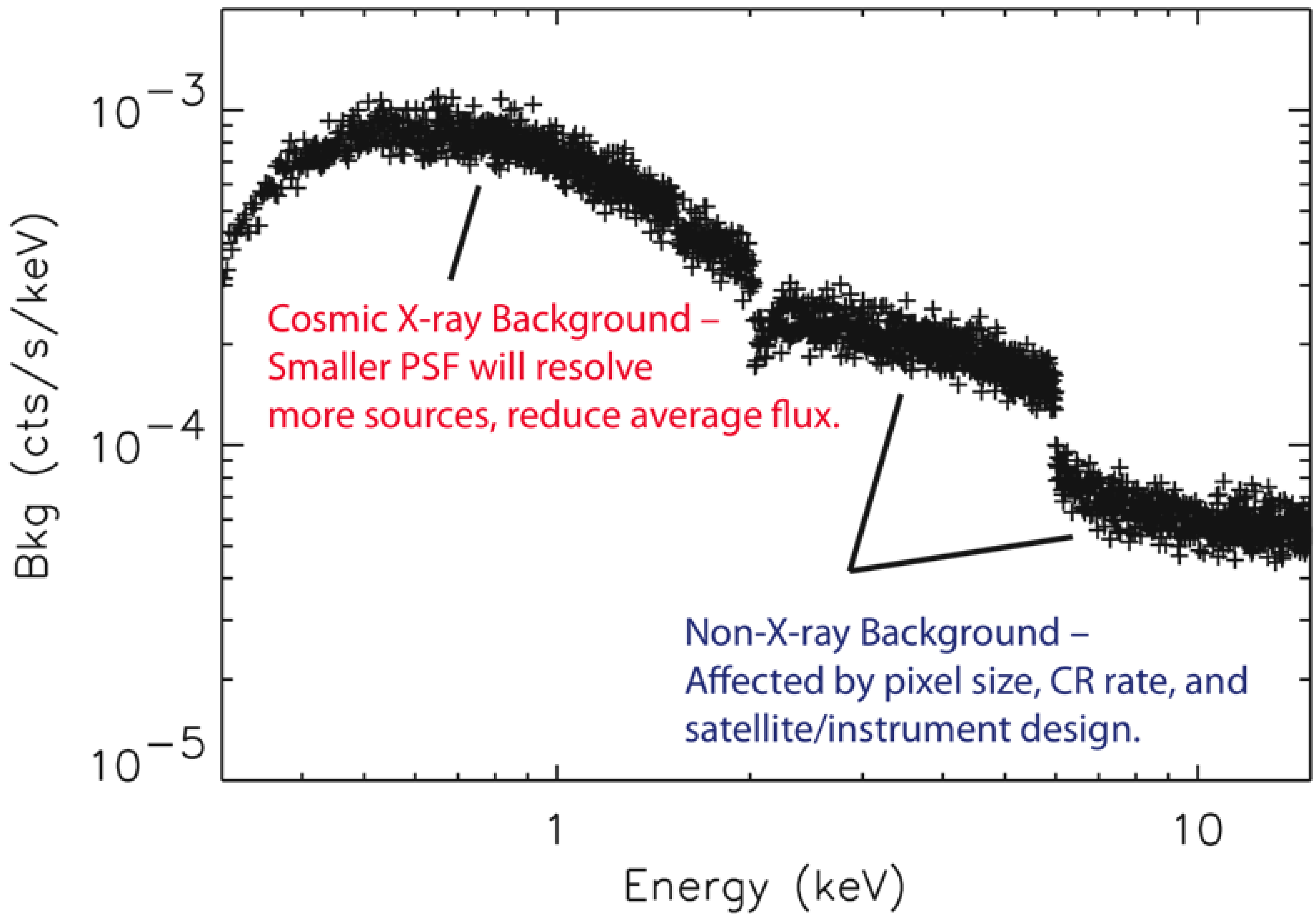

Effect of Background

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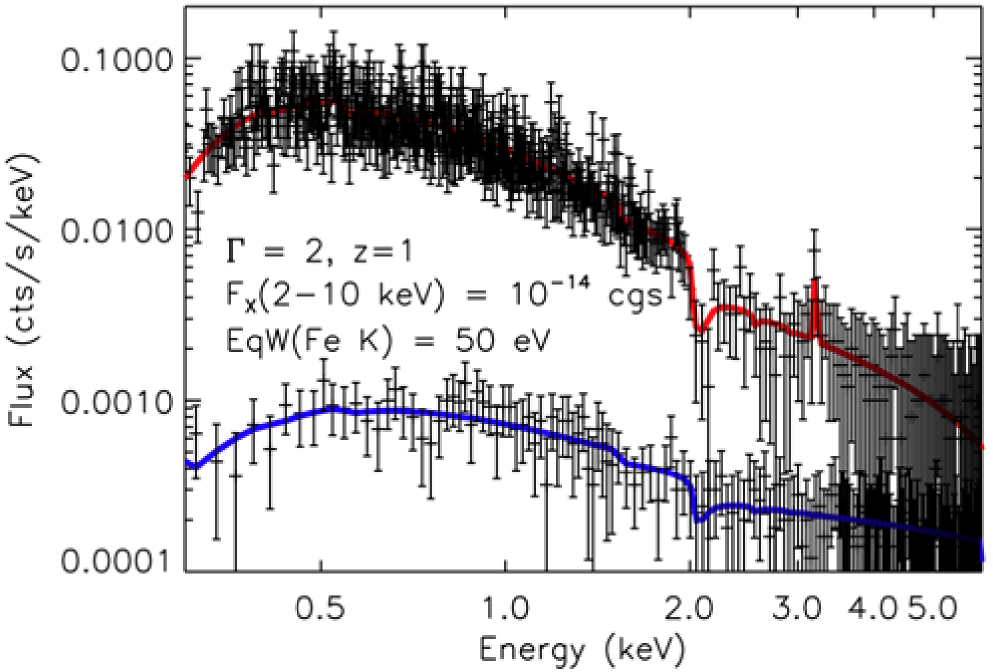
	AGN (c/ks)	CXB (c/ks)	NXB (c/ks)
1-2 keV	14.8	0.38	0.12
2-10 keV	0.68	0.32	0.72



Counts in soft and hard band pass 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.

Still to do…

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- What will the grating (XGS) background be? Will it affect absorption line studies?
- Residual stray light from nearby bright sources is not yet included; this term is neither CXB nor NXB.
- 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?
- Will CCDs have problems from pileup? More generally, how will the background affect CCDs, either in the XGS or in a WFI?
- What about planetary missions with CCDs? Any results there?
- How do CCDs compare to calorimeters in general?
- Will background events in the XMS and XGS affect requirements on the telemetry rate?