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 unvetted 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.)
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:

<table>
<thead>
<tr>
<th>$F_x$ (erg/cm$^2$/s)</th>
<th>Soft (1-2 keV)</th>
<th>Hard (2-10 keV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3 \times 10^{-15}$</td>
<td>73%</td>
<td>~100%</td>
</tr>
<tr>
<td>$10^{-14}$</td>
<td>25%</td>
<td>59%</td>
</tr>
<tr>
<td>$3 \times 10^{-15}$</td>
<td>6.1%</td>
<td>13%</td>
</tr>
</tbody>
</table>

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 $3 \times 3$ pixel region will have a $10^{-14}$ erg/cm$^2$/s source and so show a rate $>5x$ higher ($\sim 0.02$ cts/ksec/keV).

(*XMS pixels: 250 um (5 arcsec) on a side*)
• 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 $3.8 \times 10^{-3}$ cts/ksec per pixel, or 15.34 cts/ksec summed over 32x32 pixels in four arrays.
The Galactic component varies dramatically with look direction.

In particular, observations done at low (l<5°) 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 3x10^6K 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

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

<table>
<thead>
<tr>
<th>Source</th>
<th>Energy</th>
<th>Rate (cts/ks/keV/pixel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NXB</td>
<td>&lt; 6 keV</td>
<td>0.0138</td>
</tr>
<tr>
<td>NXB</td>
<td>&gt; 6 keV</td>
<td>0.0063</td>
</tr>
<tr>
<td>CXB</td>
<td>2-10 keV</td>
<td>0.0038</td>
</tr>
<tr>
<td>CXB</td>
<td>1-2 keV</td>
<td>0.037</td>
</tr>
<tr>
<td>Local</td>
<td>0.56 keV</td>
<td>0.0038 in line</td>
</tr>
</tbody>
</table>

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

Cosmic X-ray Background – Smaller PSF will resolve more sources, reduce average flux.

Non-X-ray Background – Affected by pixel size, CR rate, and satellite/instrument design.
Effect of Background

<table>
<thead>
<tr>
<th></th>
<th>AGN (c/ks)</th>
<th>CXB (c/ks)</th>
<th>NXB (c/ks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 keV</td>
<td>14.8</td>
<td>0.38</td>
<td>0.12</td>
</tr>
<tr>
<td>2-10 keV</td>
<td>0.68</td>
<td>0.32</td>
<td>0.72</td>
</tr>
</tbody>
</table>

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…

• 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?