Suzaku/XIS background report

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September 19, 2005

Abstract

We present an initial report on the background of the X-ray Imaging Spectrometers (XISs) onboard Suzaku.

1 Internal background

1.1 Fluorescent Emission lines

In the initial operation phase for which the XIS door was closed, we could take the spectrum of the internal background. Unfortunately, most of the data took in the initial operations were reached to the telemetry limit. So, we couldn't estimate the accurate count rate of the internal background using these saturated data. However, we can still examine the fluorescent lines using these spectrum because these data have a good photon statistics.

Figure 1 shows the spectrum of internal background taken while the XIS door was closed. As a calibration source is attached to the XIS door, the intensity of the calibration source is stronger than other lines. Except for emission lines from the calibration source (MnKα:5.90 keV, and MnKβ:6.49 keV), and escape lines (MnKα escape:4.05 keV, MnKβ escape:4.64 keV, and Si:1.74 keV), we can see the fluorescent lines from camera body (Al:1.49 keV, AuMα:2.12 keV, NiKα:7.48 keV, NiKβ:8.27 keV, and AuLα-1:9.71 keV).

1.2 Night earth (Dark earth) observation

After the XIS door open, we are collecting the data while Suzaku was looking at the dark side of the earth (night earth). We selected night earth event during the following condition.

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NTE_ELV<-5 && SAA.eq.0 && T_SAA > 60 && COR > 6
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The statistics of the night earth event are still poor. However, we can roughly estimate the count rate of the internal background. The count rate of the internal background in 0.5–10.0 keV are listed in Table 1.

1.3 Temporal stability of the internal background

The temporal stability of the background spectrum and the dependency on the COR are still under the investigation.

Sensor	count rate (0.5–10 keV) [10^{-8} c/s/pixel]]
XIS0	7.53±0.39
XIS1	22.47±0.67
XIS2	8.19±0.40
XIS3	8.77±0.42

Table 1: Count rate of the internal background.

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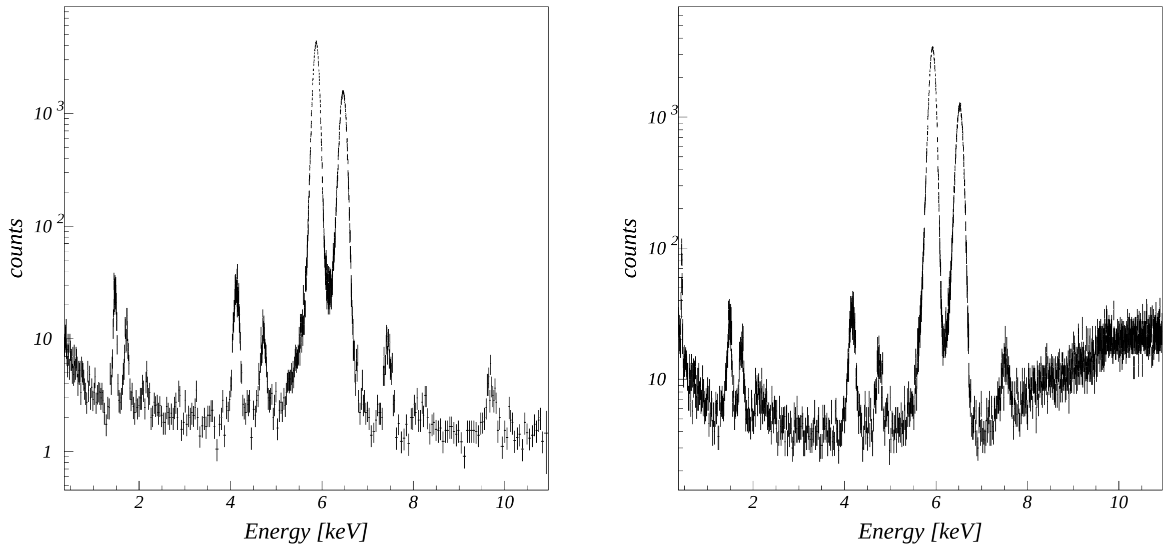

Figure 1: Internal background spectrum of the XIS taken during the initial operation phase. The spectrum of the XIS-FI (XIS0) is left and that of the XIS-BI (XIS1) is right.

1.4 Comparison of the internal background

In figure 2[1], we compare the internal background spectra of ASCA/SIS, Suzaku/XISs, and XMM-Newton/PN, XMM-Newton/MOS. The spectra of ASCA/SIS and Suzaku/XISs are the night earth observation. The spectra of XMM-Newton are "CLOSED" data which taken with the filter wheel in the closed position. Each spectrum is normalized by the physical size of the CCD.

The background level of XIS-FI is similar to ASCA/SIS though it is slightly higher above 7 keV. The background level of XIS-BI is similar to XMM/MOS though it is gradually increase above 7 keV. The oxygen line at 0.52 keV is a reflection from the night earth.

2 Sky background

In this section, we show the background spectrum which included cosmic X-ray background (CXB). The data was taken from the observation of MCG 6-30-15. We extracted the background from the annulus region of (actx, acty, r_in, r_out) = (511, 514, 275, 390) [pixel]. The total exposures are 19.4 ks.

2.1 Background of XISs

Figure 3 (left) shows the background spectrum of four XISs. The background level of 2–7 keV is almost similar. The intensity of the MnKα and MnKβ lines of XIS0 are stronger than other three sensors. These lines are considered to be scattered X-rays from the calibration source on the door or on the corner.

Figure 3 (right) shows the XIS0 image of 5.7–6.7 keV taken from the North Ecliptic Pole observation (rev0 data, 67 ks). The intensity of these lines seems to be stronger in the lower half of the image. We will continue to examine the spatial distribution of these lines scattered from calibration sources.

2.2 NXB and CXB

Figure 4 shows the comparison of the background of the source free region of the MCG 6-30-15 observation and the internal background (night earth observation). The night earth spectra below 0.5 keV were contaminated by a reflection from the night earth (see also Figure 1). The internal background is dominant above 8 keV for XIS-FI and 6 keV for XIS-BI.

2.3 Comparison of the background

In this subsection, we compare the background of Suzaku/XIS-FI, Suzaku/XIS-BI, ASCA/SIS, XMM-Newton/MOS, XMM-Newton/PN, Chandra/ACIS-S, and Chandra/ACIS-I. The data of XMM-Newton and Chandra are the

[1] This figure is still preliminary.

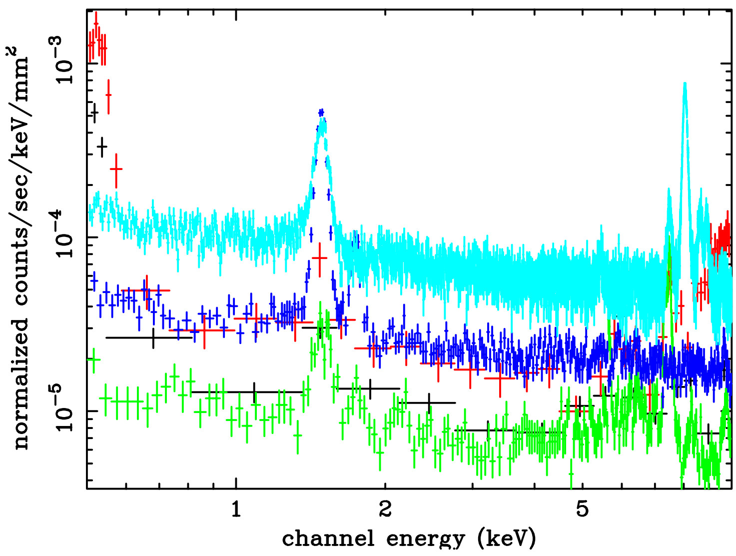

Figure 2: Internal background spectra of ASCA/SIS (green), Suzaku/XIS-FI (black), Suzaku/XIS-BI (red), XMM-Newton/PN (light blue), XMM-Newton/MOS(blue). Each spectra is normalized by the CCD area.

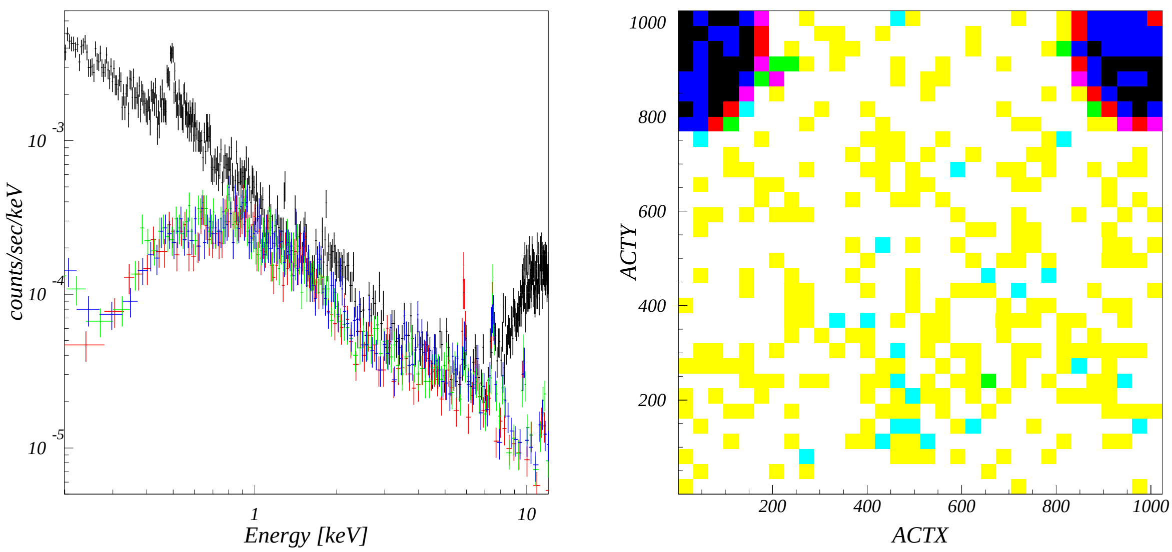

Figure 3: *Left:* Comparison of the background of four XISs. XIS0 (red), XIS1 (black), XIS2 (blue), and XIS3 (green). *Right:* XIS0 image of 5.7–6.7 keV (NEP observation 67ks).

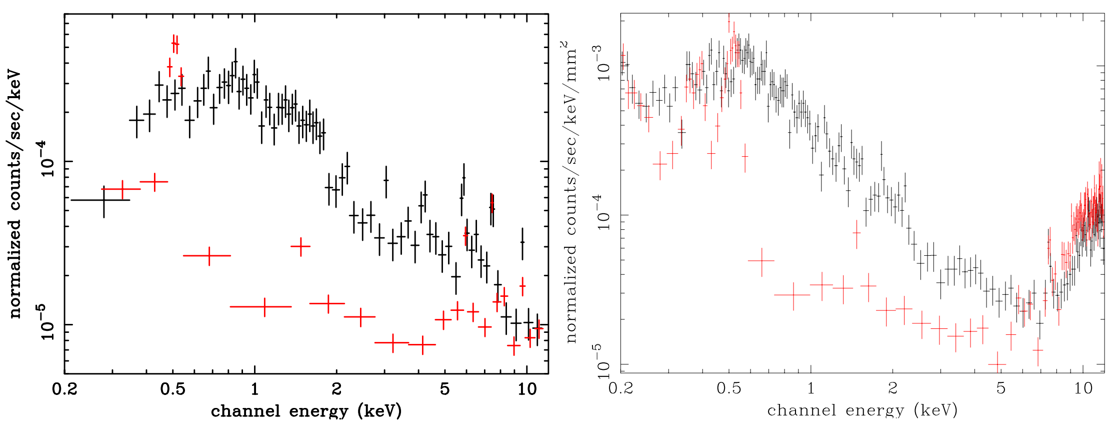

Figure 4: Comparison of the internal background (night earth) and the CXB. XIS-FI (XIS0) is left and XIS-BI (XIS1) is right. The night earth spectra below 0.5 keV were contaminated by a reflection from the night earth.

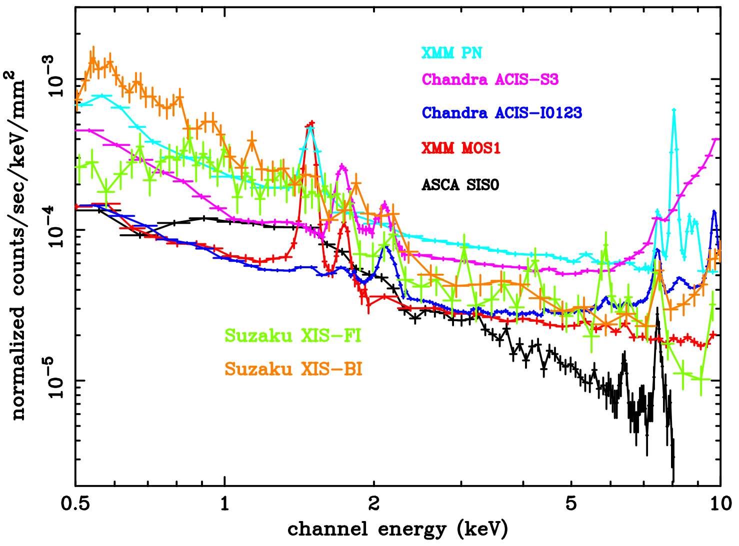

Figure 5: Comparison of the background spectra normalized by the physical size of the CCD.

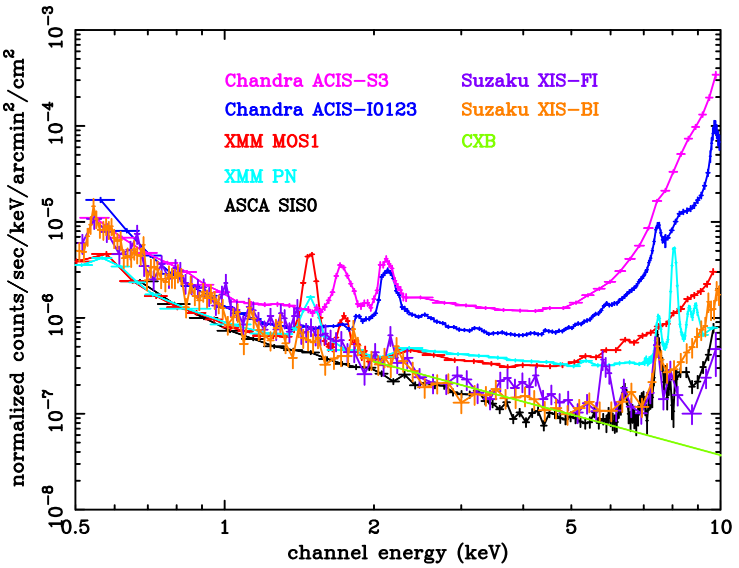

Figure 6: Comparison of the background spectra normalized by the effective area and by the FOV.

same in Katayama et al (2004).

Figure 5 shows the background spectra normalized the physical size of the CCD. As these spectra include the CXB component, a direct comparison of the background is meaningful only above 5 keV (see also Figure 2).

Figure 6 shows the background spectra normalized the effective area and by the solid angle of the FOV. Thus, it represent a surface brightness of the background, and gives a measure of sensitivity to diffuse objects. We also plotted the CXB spectrum

$$I(E) = 9.3 \times 10^{-7} E^{-1.4} \quad [\mathrm{keV/cm^2/sec/keV/arcmin^2}] \tag{1}$$

in the same figure.