DIRECT MEASUREMENT OF THE CCD WITH A SUBPIXEL RESOLUTION BY USING A NEW TECHNIQUE

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1. Introduction

The response function of the front-illuminated CCD, like SIS on ASCA, can be devided into three parts: the gate structure transmission, the absorption efficiency in the depletion region and the charge spreading after the photo-absorption. These effect depend on both the incident X-ray energy and the landing posion of the X-ray inside the CCD pixel. Then, the measurement of the X-ray efficiency within the pixel is important for the response function of the CCD. By using a new technique, we performed an experiment using the SIS CCD chip in the GSFC in order to measure how the various types of events are formed.

2. Experimental Setup

We placed a copper mesh in front of the CCD to restrict the landing position of the X-ray inside the CCD pixel. The CCD we used has 420×420 pixels of 27μm square. The mesh has 925×925 holes at 27μm intervals. The holes are circular and about 4μm in diameter. The X-ray beam line we used is a 40m long tube with an X-ray generator in the GSFC.

The alignment between the mesh and the CCD is slightly titled, which creates a moire pattern. Refering to the moire pattern, we can identify the mutual alignment between the mesh and the CCD. Then, we can determine the input position of the X-rays within the pixel.

3. Data Analysis

If we know the input position of the X-rays within the pixels, we can reconstruct the pixel image. We reconstructed the pixel image for single pixel events which are formed when the X-ray is photo-absorbed well inside the pixel. We drew the image of 3×3 pixels as shown in the Figure 1 to see the pixel boundary clearly. The dark regions in it show the regions where there are very few single pixel events. These correspond to the pixel boundaries.

We also reconstructed for vertically split events, horizontally split events, L/square events which are formed when the incident X-ray is photo-absorbed near the pixel boundary. Figure 1, 2, 3 and 4 is the reconstructed image of Y-L X-ray(1.9keV) data. We can clearly see how the various types of events are formed by the landing position inside the pixel.
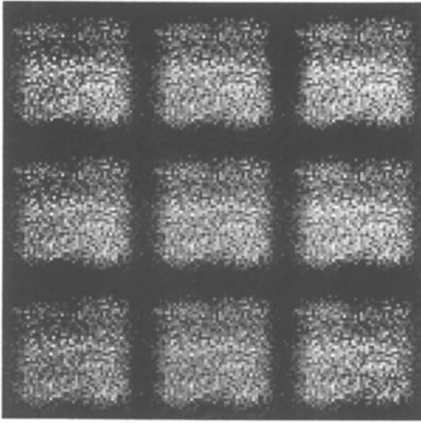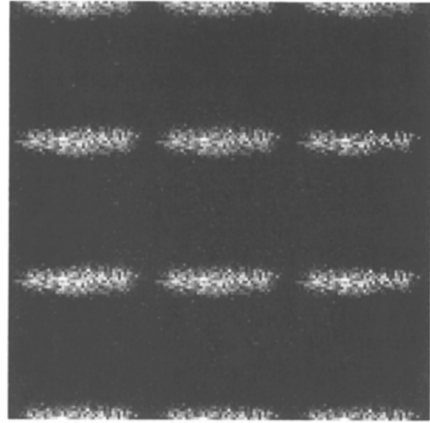

Figure 1. single pixel events
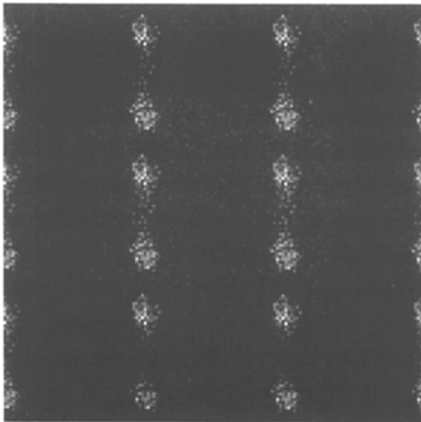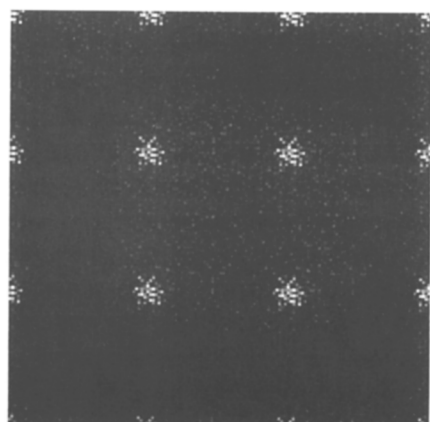

Figure 2. vertically split events

Figure 3. horizontally split events

Figure 4. L/square events