

Relative normalizations of XIS and HXD-PIN for V1.2.2.3 data

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1 Purpose of this document

Wide energy coverage of 0.2–600 keV, in combination with XIS and HXD, is one of the unique features of the *Suzaku* observatory. In order to fully utilize this unique characteristic, however, we have to know relative normalizations of the XIS and the HXD. In this document, we present the normalization of the HXD-PIN relative to the XIS on average, both at the XIS/HXD nominal positions with Crab Nebula data.

2 Data and Response Matrices

In table 1, we summarize the data and the response matrices used in the analysis. Crab Nebula

Table 1: Data and response matrices

	XIS	HXD
target name	Crab Nebula	
observation date	20050915	
processing No.	V0.7 ^a	pre-V1.2
rmf version	20060213	20060814
arf version	20060615	—
used energy range	4.0–10.0 keV	12.0– E_H
background	same f.o.v.	model a

^a<http://www.astro.isas.jaxa.jp/suzaku/doc/suzakumemo/suzakumemo-2006-21.pdf>

observations at the XIS and HXD nominal positions are carried out on 2005 September 15. Although the processing numbers of XIS and HXD data are different from that of the official pipeline processing (V1.2.2.3¹), their spectral quality is equivalent to that of V1.2.2.3. The response matrices used in this report are the latest official versions as of October 2006, which can be obtained from the CALDB. The observation date is only about ~ 1 month after the XIS door open, and hence the effect of contamination on the Optical Blocking Filter (OBF) is negligible above ~ 1 keV.

Evaluation of the relative normalizations is carried out by fitting a power-law model to the spectra of the four XIS modules and HXD-PIN contemporaneously, with the photon index Γ being constrained to be common. In order to be completely free from the absorption due to the contamination, we restrict our XIS analysis in the band above 4 keV (up to 10 keV). There still remains slight discrepancy between XIS and HXD-PIN also in Γ , as well as in the normalization. To cope with possible inconsistency in Γ , we have changed the upper boundary of the HXD-PIN energy band E_H used in the fitting. If

¹<http://www.astro.isas.jaxa.jp/suzaku/process/history/v1223.html>

E_H approaches to the lower boundary 12 keV, Γ is completely subject to the XIS spectra and the normalization of HXD-PIN at 12 keV, relative to XIS, is obtained. As E_H is increased, Γ becomes gradually governed by HXD-PIN, and one can infer systematic difference of Γ between XIS and HXD-PIN.

The results of the analysis are shown in Fig. 1. The relative normalization and the photon index

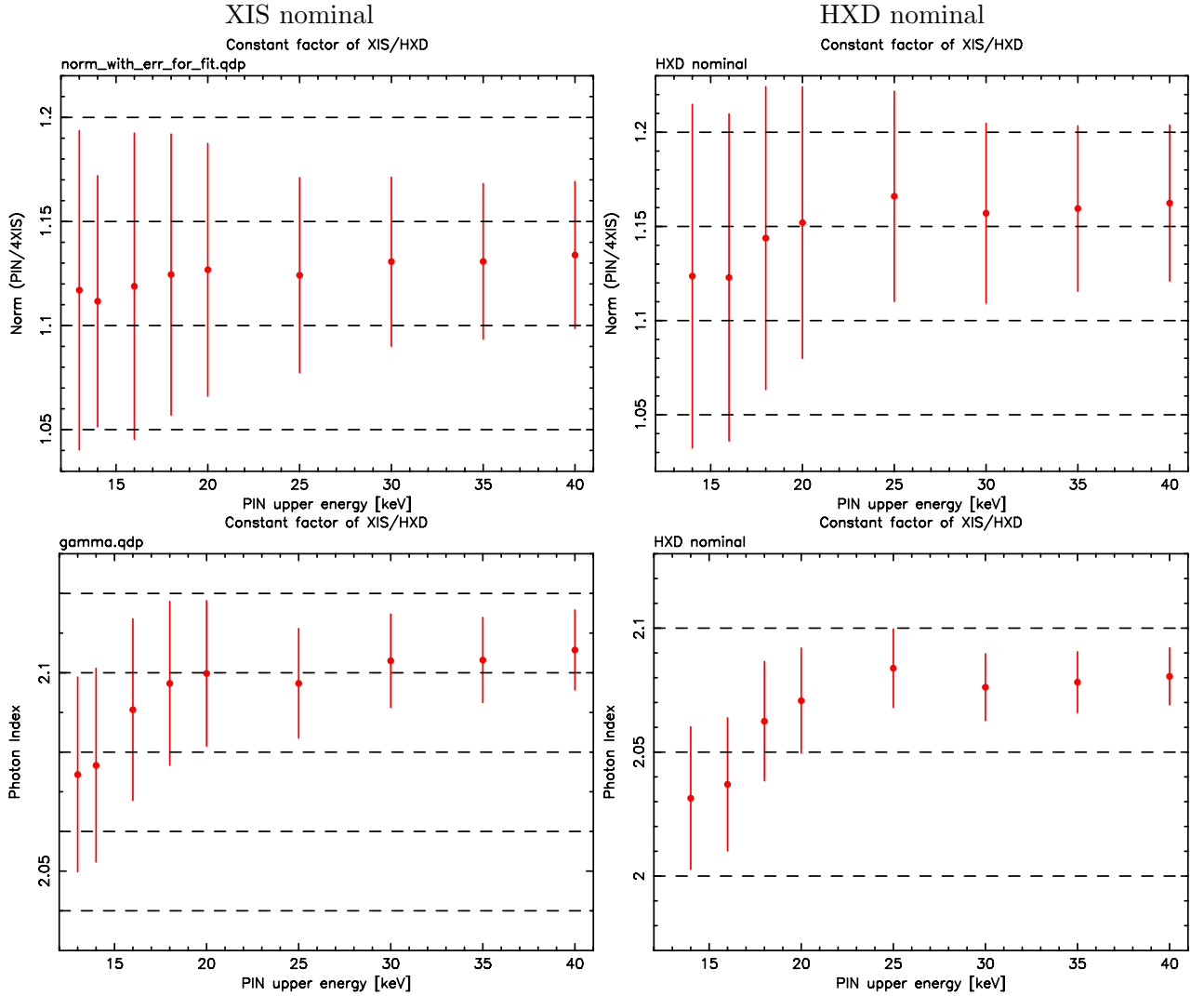


Figure 1: The normalization of HXD-PIN relative to the XIS on average (upper panels) and the photon index Γ (lower panels) of the Crab Nebula as a function of E_H at the XIS and HXD nominal positions (left and right panels, respectively).

Γ as a function of E_H are shown both at the XIS and HXD nominal positions. In short, the results can be summarized as follows:

1. Calibration at the XIS nominal position is relatively well done. The difference of Γ between XIS and HXD-PIN is only 0.03. Note that $\Gamma = 2.10 \pm 0.03$ in Toor & Seward (1974). Irrespective of E_H , the normalization of HXD relative to XIS is obtained to be 1.13 ± 0.01 .
2. Analysis of the data taken at the HXD nominal position should be made more carefully. The XIS Γ of 2.03 is smaller than that of HXD-PIN by 0.05. The relative normalization of the HXD-PIN depends on E_H more than at the XIS nominal position. If one use the full energy range of HXD-PIN, the relative normalization is 1.16.

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