

Suzaku Documentation

***Suzaku* Users' Group Meeting, 09/21/2009**

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on behalf of the

***Suzaku* GOF @ NASA's GSFC**



Documents, Procedures

- **Technical Description** .pdf, .ps, .html
`http://heasarc.gsfc.nasa.gov/docs/suzaku/
aehp_prop_tools.html#tools`
- **Suzaku Data Reduction Guide** .pdf, .ps, .html
ABC Guide
`http://heasarc.gsfc.nasa.gov/docs/suzaku/
analysis/abc/`
- **Suzaku GOF Web Pages**
`http://heasarc.gsfc.nasa.gov/docs/suzaku/
astroegof.html`

TD, ABC: maintained by Katja Pottschmidt since fall 2008
maintained by Ilana Harrus until fall 2008

WWW: maintained by Koji Mukai



TD: Chapters & General Status

Main document for proposers, **currently being updated for AO-5, input provided by instrument teams**, "polished" before AO-4:

- 1 **Introduction**: *Done*. Minor updates.
- 2 **Changes Since AO-4**: *Done*. Updated paragraph on the XIS Timing mode (usage possible in AO-5).
- 3 **Observation Policies**: *Done (Tab. 3.2?)*. Minor updates.
- 4 **Writing A Successful Suzaku Proposal**: *To Do, Katja*: Simulations with new HXD responses and backgrounds. Draft files provided (HXD team).
- 5 **XRT**: *Done*. No updates required (XRT team).
- 6 **XIS**: *Done*. Revised chapter & plots provided (XIS team).
- 7 **HXD**: *Done*. No updates, GSO in prep. (HXD team).

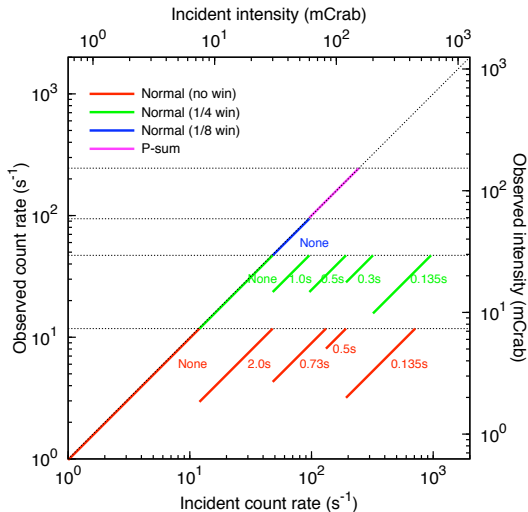


TD: XIS Changes

- **7.5.3 Editing Modes:**
"Note on the **Timing mode**" rewritten and expanded.
- **7.6.2 Supported Modes (for SCI):**
New tab. "Supported clock modes and options with SCI".
- **7.9.1 Photon Pile-Up:**
New figure "Incident vs observed count rates of a point source for the FI sensor". New statement: "ASCA grade 1 fraction correlation with pile-up fraction".
- **7.10 Clock/editing Mode Selection:**
New table "Maximum incident counting rate for avoiding pile-up, observational efficiency, and maximum observed counting rate". Replaces two old tables.
- **7.12 Anomaly in XIS0 and XIS2**
- **7.13 XIS Quick Reference:** **New figure.**



TD: XIS Changes





Suzaku X-ray Imaging Spectrometer Quick Reference

(The latest version at http://agyu.rikyo.ac.jp/~tsujimoto/jg_xis.pdf.)

2009/08/13 M. Tsujimoto (ISAS)

This leaflet is intended to assist novice users to plan a XIS observation. The Suzaku web page (<http://www.astro.isas.jaxa.jp/suzaku/index.html.en>) and the "Technical Description" document supplement the information. Consult xishelp@astro.isas.jaxa.jp for further details.

Basics

XIS is equipped with four X-ray CCDs (XIS0-3) for imaging and non-dispersive spectroscopy. The four CCDs are at the focus of four co-aligned telescopes and observe the same field. Three CCDs are front-illuminated (FI) and one is back-illuminated (BI) superior respectively in the hard- and soft-band. XIS is operated simultaneously with HXD.

Field of view	17.8' x 17.8'
Energy range	0.2-12 keV
Energy resolution	~130 eV @6keV
Effective area	340 (FI)/390 (BI) cm ² @1.5keV
Time resolution	8 s (Normal) - 7.8 ms (Psum)

Counts/s

Estimate the count rate using the PIMMS tool. Approximately, 1 mCrab flux yields 1.6 [cnt/s] (FI) and 1.9 [cnt/s] (BI). For point sources with >12 [cnt/s], choose an appropriate clocking mode to mitigate pile-up.

Modes

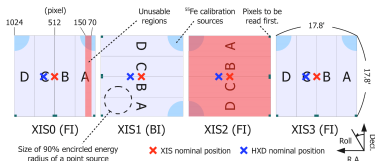
Users are responsible to choose the clocking mode. The XIS operation team chooses the editing mode. It is acceptable to use different clocking modes for different CCDs. Select the normal mode with no options for faint sources, the normal mode with the burst and/or window options for bright sources, and the Psum mode for extremely bright sources.

Archive

Accepted targets : http://heasarc.gsfc.nasa.gov/docs/suzaku/tlminfo/XIS_log : <http://darts.isas.jaxa.jp/astro/suzaku/suzakuxislog/top.do>

View

XIS0-3 has 1024x1024 pixels composed of four segments (A-D) with one readout node for each segment. A part of XIS0 and the entire XIS2 are not usable. Two ⁵⁵Fe calibration sources (Mn I K α and K β lines at 5.9 and 6.5 keV) are installed. Users can specify the roll angle. Use the Maki tool.



Aim point

Choose either XIS- or HXD-nominal position, depending on which detector you emphasize. The count rate differs by ~10%. Other positions cannot be chosen.

Position	Normalized rate	
	XIS	HXD
XIS nominal	1	0.9
HXD nominal	0.9	1

Clock mode	Normal												Psum
	Win.	1/4	1/8	no	no	no	no	1/4	1/4	1/4	1/4	no	
Opt ion	Burst	no	no	no	2.0	0.7	0.5	0.1	1.0	0.5	0.3	0.1	no
Max cnt/s to avoid pile-up		20	80	1.6 10 ²	80	2.3 10 ²	3.2 10 ²	1.6 10 ²	1.6 10 ²	3.2 10 ²	5.3 10 ²	1.6 10 ²	2.1 10 ²
Efficiency %		100	100	100	25	8.8	6.3	25	50	25	15	5	100
Support		OK	OK	*1	OK	*2	*2	*1	OK	OK	*1	*1	*1*

*1: Calibration not guaranteed. Prior consultation required. *2: Only for HXD-nominal position. *3: Only for FI.

Window option ... 1/n (n=4 or 8) option reads (1024x1024/n) pixels around the aim position in 8/n [s]. The size in the readout direction is reduced. (Pros) Photons not lost for the observed area. (Cons) The observed area reduced by 1/n. The calibration sources not observed.

Burst option ... m [s] (m=0.1, 0.3, 0.5, 0.7, 2.0) option reads photons arriving in m out of 8 [s] in each image. (Pros) The calibration sources observed. The observation area not reduced. (Cons) A fraction (1-m/8) of photons lost.

Psum mode ... 128 rows stacked along the readout direction, yielding (1024x8) pixel data. (Pros) High timing accuracy of 7.8 ms. (Cons) Spatial information lost along the readout direction. Spectral capability limited due to inefficient noise reduction, the unavailability of the sacrificed charge injection technique, etc.

Others

Simulate your observation. Things to consider include: (1) the increasing contamination materials for soft sources, (2) the non-X-ray background for low-surface brightness sources, (3) telemetry saturation for bright sources, (4) energy gain and resolution for spectroscopy, (5) calibration accuracy, ...



ABC: Chapters & General Status

Current: **Version 2**, January 2008

In prep.: **Version 3**

Updated:

- 1 Introduction
 - 2 Software
 - 3 *Suzaku* Data Specifics and Conventions
 - 4 *Suzaku* Data Analysis Overview ([add flowcharts?](#))
 - 5 The "README FIRST" of *Suzaku* data analysis
-
- 6 XIS Data Analysis — [update on-going](#)
 - 7 HXD Data Analysis — [update on-going, incorporated e-mail from Terada-san](#)



ABC: Changes Since Version 1

- Version 1 \Rightarrow 2 for the ABC Guide =
Version 1 \Rightarrow 2 for the Processing Pipeline
- Version 1 mainly described the processing **up to screening event files** (i.e., "Initial Processing", "Standard Screening")
- No "Analysis Overview" chapter, minimal "README FIRST" chapter.
- 54 \Rightarrow 77 pages

Change Log Processing (V1 \Rightarrow V2)

SCI-on to be processed, thermal wobbling correction, P-sum mode to be processed, HXD events FITS format changed, lower PI *E*-threshold revised, GSO *E*-scale calibration revised, data screening criteria updated, etc.

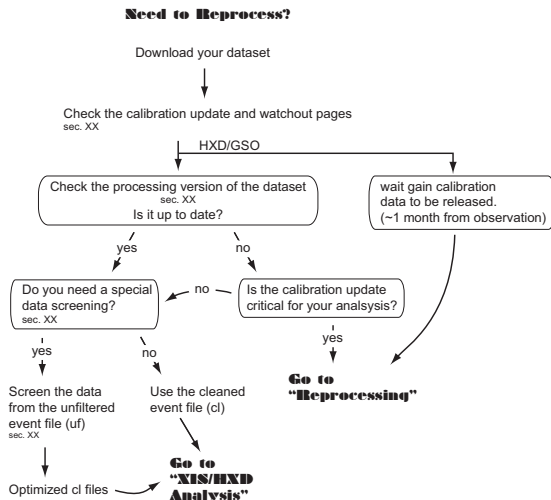


ABC: Updated Chapters

- Chapter 3: [Data Specifics and Conventions](#):
updated **XSELECT default parameters**
- Chapter 4: [Data Analysis Overview](#):
added **GSO**, discussing "**flow charts**"
- Chapter 5: [README FIRST](#):
Major update, incorporating many topics from the [GOF web pages](#):
updated: **XIS contamination, updated energy scale of SCI-on data, PIN bkg, GSO bkg, cross calibration, etc.**
new: **XIS0 anomaly, energy scale for window option data, effective area of the XRT/XIS system, XIS pile-up, XIS vignetting correction, HXD reprocessing, etc.**



ABC: Recent Work, Draft Flowchart



K. Hamaguchi



Suzaku Data Analysis Web Pages I

For most up-to-date information, check:

- **Data Analysis:** http://heasarc.gsfc.nasa.gov/docs/suzaku/aehp_data_analysis.html
 - ▶ **Things to Watch Out For**
<http://heasarc.gsfc.nasa.gov/docs/suzaku/analysis/watchout.html>
 - ▶ **Suzaku FTOOLS** **Version 12**
http://heasarc.gsfc.nasa.gov/docs/suzaku/analysis/suzaku_ftools.html
 - ▶ **Suzaku CALDB** **Monthly Update**
<http://heasarc.gsfc.nasa.gov/docs/heasarc/caldb/suzaku/>
- **What's New:** http://heasarc.gsfc.nasa.gov/docs/suzaku/aehp_whatsnew.html

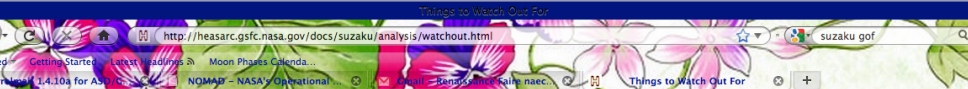


Suzaku Data Analysis Web Pages II

<http://heasarc.gsfc.nasa.gov/docs/suzaku/>

- GSO background page and reprocessing instructions:
[analysis/gsobgd.html](#), [analysis/hxd_repro.html](#)
- PIN background pages and Epoch 5 information:
[analysis/pinbgd.html](#), [analysis/pin_cxb.html](#)
- Vignetting-corrected XIS images:
[analysis/expomap.html](#)
- XRT+XIS effective area: [analysis/xrt_update.html](#)
- *E*-scale XIS window: [analysis/xis_window.html](#)
- Contamination evolution: [analysis/xis0.html](#)
- ISIS tools for pile-up correction:
<http://space.mit.edu/ASC/software/suzaku/>





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Things to Watch Out For

Last Updated Jun 4, 2009

This page contains the brief summaries of important issues that all *Suzaku* users should be aware of. It will be updated frequently to reflect our latest understanding of real and potential issues in *Suzaku* data analysis.

Most V1.x to V2.x transition issues are believed to have been solved.

- All *Suzaku* observations have been (re)processed with V2.x.
- [HXD/PIN background files](#) have been released (updated 2008 Jun 17).
- [HXD/GSO background files](#) have been released.
- XIS night earth background database and tool have been released.
- There is a new version of the ABC guide that corresponds to V2.x data analysis, although it does not yet include the description of GSO data analysis.

The remainder of this page documents the known calibration and software issues.





GSO data analysis.

The remainder of this page documents the known calibration and software issues.

1. Calibration Issues

ISAS maintains the [calibration status and caveats](#) pages.

In addition, we note the following items:

1. HXD/PIN - XIS Cross Normalization (Updated 2008 Jul 31)
 - With the 2008-07-09 release of CALDB used with Version 2 data, the normalization of PIN data relative to XIS0 data is 1.16 for observations of the Crab at the XIS nominal position, and 1.18 for those at the HXD nominal position (uncertainty is ~ 0.015). See [Suzaku Memo 2008-06](#) for details.

With older calibrations, the normalization of PIN data relative to XIS0 data is 1.06-1.09 for observations of the Crab at the XIS nominal position, and 1.11-1.13 for those at the HXD nominal position. The ranges are for use of different energy bands for the PIN data. See [Suzaku Memo 2007-11](#) for details.
2. PIN - GSO Cross Normalization (Posted on 2008 Jun 27)
 - With the current calibration, in the 2007 March 20 observation of the Crab at the HXD nominal position, there is a cross-normalization problem at the 20% level (1.0:0.80, PIN:GSO) and $\sim 10\%$ residuals in the GSO data.

The HXD team is working on resolving this issue. In the mean time, [empirical arfs](#) can be used to reduce both problems significantly.
3. XIS: Energy scale and resolution calibration as verified using the ^{55}Fe calibration source
 - SCI data processed using V2.1.6.15 and earlier versions: After 2006 September, the gain at Mn K alpha line decreased at a rate of 30 eV/year in the FI chips and 50 eV/year in the BI chip. See [notes on V2.0/2.1 processed XIS data](#) for more. Also read about [updated calibration](#).
 - Non-SCI data: The energy scale is well calibrated until July 2006 in FI units, but systematically higher by 10 eV in XIS1. After this time, gain gradually increased in XIS3, rapidly decreased in XIS0 and XIS2, and gradually decreased in XIS1.
 - 2x2 mode (non-SCI) (Updated 2008 Oct 22): There was an offset in the 2x2 mode energy scale relative to the 3x3/5x5 modes. This is believed fixed with the release of `ae_xiN_makepi_20080825.fits` files in 2008 September. Users should apply the new calibration using [the same procedure](#) as for SCI-on data processed with V2.1.6.15 or earlier.
 - 2x2 mode (SCI-on): (Added on 2008 Oct 22): The energy scale for 2x2 mode with charge injection is expected to be similar to those of the 3x3/5x5 modes. However, this expectation has not yet been verified with actual calibration. Users of 2x2 mode data with SCI should carefully check for gain discrepancies.
 - Window mode data: (Added on 2009 Jun 4): The energy scale calibration for XIS data with the 1/4 and 1/8 window mode

