MIT
Center for Space Research Chandra X-Ray Center

MEMORANDUM
June 10, 2004

To:	DS / SDS / Archive leads
From:	Bish K. Ishibashi, SDS
Subject:	Introducing New Keywords for Non-Pixel-Randomized Event files
Revision:	1.0
URL:	http://space.mit.edu/CXC/docs/memo_random_1.0.ps
File:	/nfs/cxc/h2/bish/CXC SDS/RANDOM/memo_random_1.0.tex

1 Pixel Randomization

1.1 Description

Chandra's bore-sight shifts in Lissajous pattern by default. Through aspect processing, each event is mapped into a proper place and an aspect-corrected image is reconstructed. It is, however, noted earlier that anomalous aliasing / artifacts remain in the aspect reconstructed image. In order to minimize the effect of potentially harmful artifacts, uniform pixel randomization of ± 0.5 pix is applied onto CHIP X and Y prior to calculating SKY X and Y values. A similar pixel randomization is applied in TG coordinate when processed through CIAO tg_resolve_events. In the same sense, another randomization is being added onto ACIS energy (PHA) value. This is to mitigate PI spectral aliasing (PHA ± 0.5 adu).

In CIAO 3.1 and Repro *III*, decisions have been made to alter some default options for randomization on SKY X/Y and TG R/D, while keeping the PI randomization as it is. This document describes how we propose to implement additional keywords into Level 1 Event products and higher.

1.2 Data Randomization

Table 1 shows the current schema for data randomization and proposed changes. Both spatial and grating coordinate randomizations are applied onto CHIP X/Y coordinates (± 0.5 pixels) when converting from CHIP to SKY or CHIP to TG coordinates. As for energy randomization, it is applied onto PHA value (± 0.5 adu) when converting from PHA to ENERGY and then to PI.

1.3 Required Additional Header Keywords

To define query expression for randomized or non-randomized calibration products in CALDB, we require additional header keywords to be defined and implemented into appropriate products (e.g., LSFPARM and gRMF) and processed event files at Level 1 (e.g., for SKY X/Y) or higher. To accommodate this enhancement, we propose to introduce the following three new keywords as "blessed" (i.e., primary keywords to be carried over) entities (Table 2).

Table 1. Data Randomization

Quantity	Present Default	Proposed Default	Comment
SKY X/Y (ACIS)	CHIP ±0.5 pix	±0.5 pix	Need new development of SER scheme.
SKY X/Y (HRC)	CHIP ±0.5 pix	0.0 pix	Randomization adds no merit.
TG R/D (ACIS & HRC)	CHIP ±0.5 pix	0.0 pix	No viable merit in randomization.
PI energy (ACIS)	PHA ±0.5 adu	±0.5 adu	Mitigates PI spectral aliasing

Table 2. New Keywords for Randomization

Keyword	Type	Value	Description
RAND_SKY	Float	[0.0, 0.5]	Sky X/Y randomization
RAND_TG	Float	[0.0, 0.5]	Grating Coordinate randomization
RAND_PI	Float	[0.0, 0.5]	This may not be necessary right now

2 DS / CIAO Tools

2.1 Affected CIAO tools

This enhancement will affect the following DS/CIAO items listed in Table 3.

2.2 Option for Data Randomization

In CIAO version 3.0.2 or earlier, CIAO parameter "rand_pix_size" in acis_process_events, hrc_process_events, and tg_resolve_events allows users to specify any value between 0.0 and 0.5. This scheme is to be changed such that the allowed value for the parameter is either 0.0 or 0.5, controlled through parameter library (e.g., instead of setting the value [min,max]=[0.0,0.5], the argument for the parameter will become 0.0—0.5, i.e., 0.0 or 0.5). This involves changes only in parameter files and not necessary to modify the existing subroutines for data randomization.

2.3 Tools: acis_process_events, hrc_process_events, tg_resolve_events and hdrlib

Consult Kenny G. (CXC/DS) for the detail of requirement and code changes on these tools.

Table 3. Affected Tools

Toolname	Keywords	Description
acis_process_events	RAND_SKY,RAND_PI	controlled via rand_pix_size and rand_pha
hrc_process_events	RAND_SKY	controlled via rand_pix_size
tg_resolve_events	RAND_TG	controlled via rand_pix_size
mkgrmf	RAND_TG	query keyword to locate proper CALDB/LSFPARM
ardlib	RAND_TG	set query expression for mkgrmf
hdrlib	All	acknowledge new keywords; accept new conditions
merging_rules	All	define new merging rules for dmmerge

Table 4. Merging Rules

Condition	Action
Same keywords	Merge & propagate the keyword value
Absent	Issue warning, merge, but do not propagate the keyword
Different	Issue warning, merge, but do not propagate the keyword

Table 5. Affected CALDB files

CAL type	Keyword	Comment
LSFPARM	RAND_TG	Currently only product with RAND_TG=0.5 available
GRMF	RAND_TG	Not generally queried by CALDB interface

2.4 Tools: mkgrmf / ardlib

Consult John E.D. (CXC/MIT/SDS) for the detail.
Simply taking the status of pixel randomization via RAND_TG keyword from a file specified in the parameter "obsfile" and then allowing ardlib to embed the information into CALDB query expression, the correct LSFPARM product will be loaded into mkgrmf. The keyword RAND_TG will be propagated into grating RMF products.

In case where the keyword RAND_TG does not exist in the obsfile (e.g, current archival datasets), prompt appropriate warning (e.g., "RAND_TG not found") and then assume RAND_TG = 0.5 to process.

In case where LSFPARM keywords in ardlib.par is set to CALDB and the keyword RAND_TG is not set to either 0.0 or 0.5, then exit gracefully with appropriate status code.

In case where LSFPARM keywords in ardlib.par is set to a specific file, then use the file to generate grating RMF.

2.5 Merging Rules

We propose the following merging rules for all RAND_* keywords (Table 4).

3 CALDB

3.1 Affected CALDB products

CALDB products that are affected by the introduction of new randomization keywords are listed in Table 5.