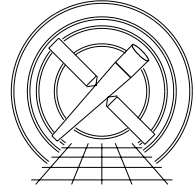




MIT
Center for Space Research



Chandra X-Ray Center

MEMORANDUM

June 4, 2003

To: Martin Elvis, SDS Group Leader
From: Glenn E. Allen, SDS
Subject: The Time-Dependent Gain ARD File
Revision: 1.0
URL: http://space.mit.edu/CXC/docs/docs.html#tgain_ard
File: /nfs/cxc/h2/gea/sds/docs/memos/memo_tgain_ard_1.0.tex

1 Time-Dependent Gain Adjustment

1.1 Description

The continuous exposure of the ACIS CCDs to particle radiation causes a steady increase in the charge-transfer inefficiency (CTI) of the detectors. As a result, the typical pulse height recorded for an X-ray of a given energy is declining with time. This kind of change in the “gain” of the detectors and a change in the electronic gain of the ACIS-II CCD is calibrated (for CTI-adjusted data) and recorded in a set of “t_gain” ARD files. This document describes the format of these files.

1.2 Some HDU 1 Keywords

1. HDUNAME = AXAF_TGAIN
2. HDUCLASS = ASC
3. HDUCLAS1 = DETCHAR
4. HDUCLAS2 = TGAIN
5. EPOCH1
6. EPOCH2

The keywords EPOCH1 and EPOCH2 are used to interpolate the gain adjustment in time. The values of these keywords correspond to the middle of each epoch used to create the ARD file. An epoch is three months long. The date encoded as part of the name of the ARD file corresponds to the beginning of EPOCH1. The values of EPOCH1 and EPOCH2 are the number of seconds in mission elapsed time (i.e. the number of seconds since 00:00:00, January 1, 1998).

1.3 HDU 1 Columns

1. CCD_ID
2. CHIPX_LO
3. CHIPX_HI
4. CHIPY_LO
5. CHIPY_HI
6. NPOINTS
7. PHA
8. DELTPHA1
9. DELTPHA2

The first five columns uniquely determine a region on one of the ACIS CCDs. For all events occurring on this region, the amount of charge (in adu) to be subtracted from the pulse height amplitude (PHA) of an event, is computed using the columns PHA, DELTPHA1 and DELTPHA2. The column PHA is a tabulation of the pulse heights at which the adjustments are calibrated. The adjustments for EPOCH1 and EPOCH2 are stored in the columns DELTPHA1 and DELTPHA2, respectively. These adjustments are roughly proportional to $\text{PHA}^{1/2}$. The adjustment for an event is linearly interpolated between the tabulated PHA values and between EPOCH1 and EPOCH2 using the values of PHA and TIME for the event.

Some of the elements in the vector columns PHA, DELTPHA1 and DELTPHA2 may be invalid. The number of valid elements is specified by the value in the column NPOINTS.

1.4 File Size

The size of a `t_gain` ARD file is dominated by the amount of data in the columns PHA, DELTPHA1 and DELTPHA2. For example, as of June 4, 2003, each row of a `t_gain` ARD file has 411 elements in each of these three columns. Since the three columns are filled with 4-byte real numbers, one row of the ARD file has about 4932 ($411 \times 3 \times 4$) bytes. The number of rows in a file is simply the total number of regions on the CCDs that have been calibrated. Each of the five calibrated front-side CCDs (ACIS-I0, -I1, -I2, -I3 and -S2) has 128 separate regions. The one calibrated back-side CCD (ACIS-S3) has 1024. Therefore, the total size of one `t_gain` ARD file is approximately 8.2 Mb ($4932 \times (5 \times 128 + 1024)$). The actual size is slightly larger due to the content in the other columns and the headers.