MIT
Center for Space Research

Chandra X-Ray Center

MEMORANDUM
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To: Martin Elvis, SDS Group Leader
From: Glenn E. Allen, SDS
Subject: acis_build_chip_gti
Revision: 1.1
URL: http://space.mit.edu/CXC/docs/docs.html#gti
File: /nfs/cxc/h2/gea/sds/docs/memos/memo_acis_build_chip_gti_1.1.tex

1 acis_build_chip_gti

1.1 Description

This document is an incomplete rough draft!

1.2 Input

1. A Level 1 exposure-statistics file (acis*stat1.fits)
2. A Level 0 parameter-block file (acis*pbk0.fits)
3. A Level 0 exposure-records file (acis*exr0.fits)

1.3 Output

One extension is appended to a Level 1 event data file for each active CCD. Each extension will have one or more rows with the following columns.

1. START
2. STOP

1.4 Parameters

1. infile,f,a,“”,,,“Name of input exposure-statistics file”
2. outfile,f,a,“”,,,“Name of event-data file to be appended”
3. pbkfile,f,a,“”,,,“Name of input parameter-block file”
4. exrfile,f,a,“”,,,“Name of input exposure-record file”
5. nominalchip,s,h,“DEFAULT”,DEFAULT|0|1|2|3|4|5|6|7|8|9,,“Aim-point CCD_ID”

6. verbose,i,h,0,0,5,"Amount of messages produced (0=none, 5=most)"
7. mode,s,h,"ql",,,

1.5 Processing

1.5.1 GTIs

For an ACIS observation, a good-time interval (GTI) is a continuous set of frames during which a detector was operated nominally. The set of GTIs for the observation span the entire useful interval of data for the observation. Some frames may be excluded from the GTIs if the pointing of the telescope was not stable or the detectors experienced some problem during the frame.

GTIs are integer multiples of the frame time for the observation because the frame time is a natural unit of time for ACIS data. Since it is not possible to determine the time an X ray interacted with a CCD within any given frame[1], there is little point in including a fractional portion of a frame in a GTI.

For a *timed-exposure* mode observation, the start and stop times of the ith GTI are given by

$$\begin{aligned}
\mathrm{START}_i &= \mathrm{TIME}_{\mathrm{exr}}(l) - (\mathrm{TIMEPIXR}_{\mathrm{exr}} \times \mathrm{TIMEDEL}_{\mathrm{exr}}) - \mathrm{FLSHTIME}_{\mathrm{exr}} \quad (1)\\
\mathrm{STOP}_i &= \mathrm{TIME}_{\mathrm{exr}}(m) + ((1 - \mathrm{TIMEPIXR}_{\mathrm{exr}}) \times \mathrm{TIMEDEL}_{\mathrm{exr}})\,, \quad (2)
\end{aligned}$$

where $\mathrm{FLSHTIME}_{\mathrm{exr}}$, $\mathrm{TIMEDEL}_{\mathrm{exr}}$ and $\mathrm{TIMEPIXR}_{\mathrm{exr}}$ are keywords in the exposure-records file for the observation. $\mathrm{TIME}_{\mathrm{exr}}(l)$ and $\mathrm{TIME}_{\mathrm{exr}}(m)$ are the times associated with frames l and m, respectively, in the exposure-records file. Frames l and m are the first and last frames, respectively, in the GTI_i.

For a *continuous-clocking* mode observation where the times are the *read-out times* instead of the times of arrival,

$$\begin{aligned}
\mathrm{START}_i &= \mathrm{TIME}_{\mathrm{exr}}(l) - (\mathrm{TIMEPIXR}_{\mathrm{exr}} \times \mathrm{TIMEDEL}_{\mathrm{exr}}) \quad (3)\\
\mathrm{STOP}_i &= \mathrm{TIME}_{\mathrm{exr}}(m) + ((1 - \mathrm{TIMEPIXR}_{\mathrm{exr}}) \times \mathrm{TIMEDEL}_{\mathrm{exr}})\,. \quad (4)
\end{aligned}$$

For a *continuous-clocking* mode observation where the times are the *times of arrival* instead of the read-out times,

$$\begin{aligned}
\mathrm{START}_i &= \mathrm{TIME}_{\mathrm{exr}}(l) - (\mathrm{TIMEPIXR}_{\mathrm{exr}} \times \mathrm{TIMEDEL}_{\mathrm{exr}}) - \\
&\quad ((\mathrm{CHIPY}_{\mathrm{TARG}} + 1028) \times \mathrm{TIMEDEL}_{\mathrm{evt}}) \quad (5)\\
\mathrm{STOP}_i &= \mathrm{TIME}_{\mathrm{exr}}(m) + ((1 - \mathrm{TIMEPIXR}_{\mathrm{exr}}) \times \mathrm{TIMEDEL}_{\mathrm{exr}}) - \\
&\quad ((\mathrm{CHIPY}_{\mathrm{TARG}} + 1028) \times \mathrm{TIMEDEL}_{\mathrm{evt}}) \quad (6)
\end{aligned}$$

where $\mathrm{TIMEDEL}_{\mathrm{evt}}$ is a keyword in the event file and $\mathrm{CHIPY}_{\mathrm{TARG}}$ is the CHIPY coordinate associated with RA_TARG and DEC_TARG at $t = \mathrm{TIME}_{\mathrm{exr}}(l) - (\mathrm{CHIPY}_{\mathrm{TARG}} + 1028)$. Note that $\mathrm{CHIPY}_{\mathrm{TARG}}$ is a function of t, which is a function of $\mathrm{CHIPY}_{\mathrm{TARG}}$. One means of handling this circularity is to iterate as follows: (i) assume that $\mathrm{CHIPY}_{\mathrm{TARG}} = 512$, (ii) compute t, (iii) compute $\mathrm{CHIPY}_{\mathrm{TARG}}$, (iv) recompute t and (v) recompute $\mathrm{CHIPY}_{\mathrm{TARG}}$. Additional iteration is not necessary.

1.5.2 ONTIME

The value of ONTIME for CCD_ID $= n$ is written to the keyword ONTIMEn. For example, the ONTIMEs for ACIS-I2 and ACIS-S2 are written to the keywords ONTIME2 and ONTIME6, respectively. The keyword ONTIME is reserved for the ONTIME of the CCD at the aim point. If the aim point is on ACIS-S3, then ONTIME = ONTIME7.

The ONTIME for an observation is defined to be the sum of the GTIs. If CCD_ID $= n$ has m GTIs, then

$$\mathrm{ONTIME}n = \sum_{i=1}^{m} \mathrm{GTI}_i(n), \quad (7)$$

where $\mathrm{GTI}_i = \mathrm{STOP}_i - \mathrm{START}_i$. For example, if there are three GTIs for ACIS-S3, then ONTIME7 = $\mathrm{GTI}_1(7) + \mathrm{GTI}_2(7) + \mathrm{GTI}_3(7)$. Note that the detector can be inactive during portions of the GTIs.

[1] The exceptions to this statement are continuous-clocking mode events and events that occur along the frame-transfer streak for a bright source observed in timed-exposure mode

1.5.3 DTCOR?

1.5.4 LIVETIME and EXPOSURE

The value of LIVETIME for CCD_ID = n is written to the keyword LIVTIMEn. For example, the LIVETIMEs for ACIS-I1 and ACIS-S4 are written to the keywords LIVTIME1 and LIVTIME8, respectively. The keyword LIVETIME is reserved for the LIVETIME of the CCD at the aim point. If the aim point is on ACIS-S3, then LIVETIME = LIVTIME7.

The LIVETIME for an observation is defined to be the total length of time during which the detector was active:

$$\text{LIVTIME}n = \text{DTCOR} \times \text{ONTIME}. \tag{8}$$

Include rows 1 and 512?
Include frame start and stop columns?
Fix the problem with EXPNO = 2.
Add the comments in the ahelp file.