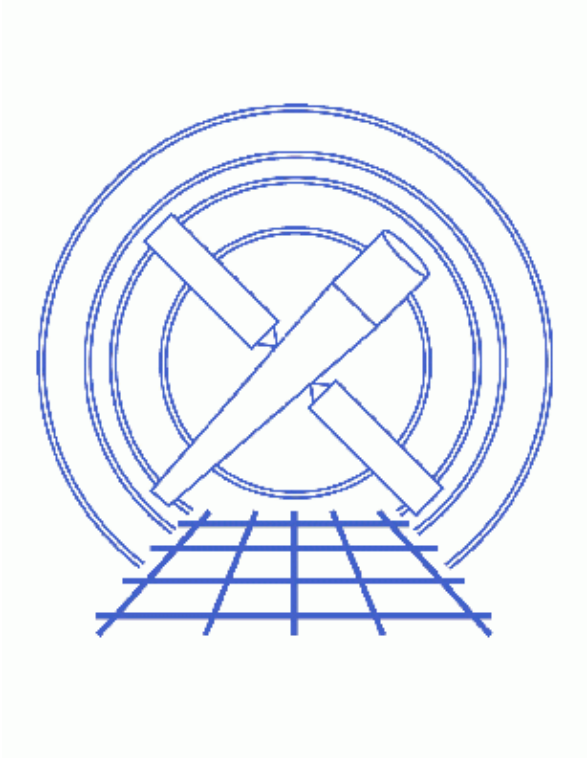
HRC-I Degap Correction



CIAO 3.4 Science Threads

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Overview

Last Update: 14 Sep 2007 - updated for CALDB 3.4.1: new HRC-I degap files

Synopsis:

The algorithm used to determine the centroid of the charge cloud exiting the rear microchannel plate of the HRC (and hence the x-ray event position) introduces systematic errors in the event positions, which are manifested by regularly spaced gaps in both x and y in HRC images. The degap correction is applied to compensate for this problem in the level=1 event file.

Purpose:

To generate a new level=2 event file with the HRC-I degap corrections applied.

Read this thread if:

you are working with an HRC-I dataset affected by the Calibration Updates.

Calibration Updates:

Get Started shows how to check the CALDBVER for your data.

- **CALDB v3.4.1 (14 Sep 2007):** A new gap lookup table, `hrciD1999-07-22gaplookupN0003.fits`, is needed to improve the off-aimpoint gap map solution for HRC-I at certain locations. The CALDB 3.4.1 section of the CIAO release notes has more information.
- **CALDB v3.4.0 (16 May 2007):** New time-dependent gain maps for the HRC-I were added to the CALDB. The CALDB 3.4.0 section of the CIAO release notes explains how the files will affect your analysis.
- **CALDB v3.3.0 (18 Dec 2006):** New time-dependent gain maps for the HRC-I were added to the CALDB. The How CIAO 3.4 and CALDB 3.3.0 Affect Your Analysis section of the CIAO release notes explains how the files will affect your analysis.
- **CALDB v3.2.3 (10 Aug 2006):** The new gap lookup table, `hrciD1999-07-22gaplookupN0002.fits`, will improve the encircled energy fraction for any on-axis point sources. As such it represents the latest and best degap correction data available for the Chandra HRC-I.

  A new gain map file for HRC-I, `hrciD1998-10-30gainN0002.fits`, has also been released. This file corrects an error in the version N0001 of this gain map, released in CALDB 3.2.0 (November 2005). Users who applied the `hrciD1998-10-30gainN0001.fits` gain map and are using PI values in their science (e.g. quantile color-color analysis) should reprocess the data; the gain file name is stored in the `GAINCORF` header keyword.

Further details on both calibration changes and information on when to reprocess are available from the How CALDB 3.2.3 Affects Your Analysis section of the release notes.

- **CALDB v3.2.0 (21 Nov 2005):** The first gain correction maps for HRC-I data are now available: `$CALDB/data/chandra/hrc/bcf/gain/hrciD1998-10-30gainN0001.fits` and `$CALDB/data/chandra/hrc/bcf/gain/hrciD1999-10-04gainN0001.fits`. For more information, refer to CALDB 3.2.0 release notes and the Gain Response of the HRC webpage.
- **CALDB v3.1.0 (23 Jun 2005):** The degap algorithm was changed in CIAO 3.2.2 to use a different calibration file format. The new HRC-S file is `$CALDB/data/chandra/hrc/bcf/gaplookup/hrciD1999-07-22gaplookupN0001.fits`. This change is transparent to users; it is not necessary to reprocess data that have had the degap correction applied.
- **CALDB v2.4 (19 Mar 2001):** A new event hyperbolic test (FPTEST) coefficients file was released.
- **CALDB v2.2 (25 Jan 2001):** The new degap correction degap calibration file (`hrciD1999-07-22gapN0002.fits`) constitutes a significant improvement over the old one.

Related Links:

- "HRC-S Degap Corrections" calibration page: technical details on the degap correction.
- Analysis Guide: HRC Data Preparation

Proceed to the HTML or hardcopy (PDF: A4 | letter) version of the thread.

Get Started

Sample ObsID used: 144 (HRC-I, G21.5-0.9)

File types needed: evt1; bpix; flt1; asol1

If you created a new bad pixel file by running the Creating a New Observation-Specific HRC Bad Pixel File thread, use that file in this analysis. Otherwise, use the `bpix1.fits` file from the Archive.

In this thread, we assume that all relevant files are in the same working directory.

Check the CALDBVER keyword in the header:

```
unix% dmkeypar hrcf00144_000N003_evt1.fits CALDBVER echo+
2.8
```

Since this data was processed with a CALDBVER lower than 3.3.0, we will complete this thread in its entirety.

The HRC AMP_SF Correction and Reducing Tap-Ringing Distortions should also be considered, since it may affect how `hrc_process_events` is run.

Generate A New Level=1 Event File

Run hrc_process_events

Running hrc_process_events with the SDP level=1 event file as the input will produce a *new* level=1 event file. Doing a "punlearn hrc_process_events" sets the degapfile to the default (CALDB); this ensures that the degap corrections will be picked up.

```
unix% punlearn hrc_process_events
unix% pset hrc_process_events infile=hrcf00144_000N003_evt1.fits
unix% pset hrc_process_events outfile=hrc_144_new_evt1.fits
unix% pset hrc_process_events badpixfile=hrcf00144_000N003_bpix1.fits
unix% pset hrc_process_events acaofffile=pcadf084154631N003_asol1.fits
unix% pset hrc_process_events badfile=NONE
unix% hrc_process_events
input level 0 event file/stack (hrcf00144_000N003_evt1.fits):
output level 1 file (hrc_144_new_evt1.fits):
bad pixel file ( NONE | none | <filename>) (hrcf00144_000N003_bpix1.fits):
aspect offset file ( NONE | none | <filename>) (pcadf084154631N003_asol1.fits):
# hrc_process_events (CIAO 3.4): The following error occurred 2104 times:
        dsHPEEVENTSEQERR -- WARNING: Out of sequence events discovered in hrcf00144_000N003_evt1
```

There are a couple things to note here:

- The warnings may be ignored. The first one is due to the fact that there is no gain file available for HRC-I. We could have set gainfile=none to avoid seeing this message. The second warning is explained in this FAQ.
- In some cases there will be more than one asol1.fits file for an observation. **All** the files must be input to the acaofffile parameter **in chronological order** (the time is in the filename, so "ls" lists them in order), either as a list or as a stack (see ahelp stack for more information.)

The contents of the parameter file may be checked using plist hrc_process_events.

If you are working with grating data, you should now proceed to the Obtain Grating Spectra from LETG/HRC-I Data thread to create a new level=2 event file (and a new PHA file). Otherwise, finish running this thread.

Generate A New Level=2 Event File

1. Filter on status

Now we apply the status filter that is specific to HRC-I observations; a value of 0 demands that the bit be flagged as "good", an "x" indicates that either status (0/1) is acceptable:

```
unix% punlearn dmcopy
unix% dmcopy "hrc_144_new_evt1.fits[status=xxxxxx00xxxx0xxx00000000x0000000]"  \
      hrc_144_flt1_evt1.fits
```

2. Apply GTI filter

Finally, the Good Time Intervals (GTIs) supplied by the pipeline need to be applied. We simultaneously eliminate unnecessary columns from the output.

```
unix% punlearn dmcopy
unix% dmcopy \
      "hrc_144_flt1_evt1.fits[EVENTS][@hrcf00144_000N003_std_flt1.fits][cols -crsu,-crsv,-amp_sf
```

```
      hrc_144_evt2.fits
```

Be sure to include the **@ symbol** in the filter expression; the command will not be executed properly if it is omitted.

Summary

The new level=2 event file, `hrc_144_evt2.fits`, is now complete.

Next, read the Computing Average HRC Dead Time Corrections thread to see if you need to recompute the deadtime statistics for your dataset.

```
Parameters for /home/username/cxcds_param/hrc_process_events.par


#
#  Parameters for the hrc_process_events task
#
        infile = hrcf00144_000N003_evt1.fits    input level 0 event file/stack
       outfile = hrc_144_new_evt1.fits output level 1 file
    badpixfile = hrcf00144_000N003_bpix1.fits bad pixel file ( NONE | none | <filename>)
    acaofffile = pcadf084154631N003_asol1.fits aspect offset file ( NONE | none | <filename>)
      (geompar = geom)            Parameter file for Pixlib Geometry files
(alignmentfile = )acaofffile -> pcadf084154631N002_asol1.fits) sim/fam alignment file ( NONE | none | <
      (obsfile = NONE)            obs.par file for output file keywords ( NONE | none | <filename>)
     (gainfile = CALDB)           gain correction image file ( NONE | none | <filename>)
      (ADCfile = NONE)            ADC correction table file ( NONE | none | <filename>)
    (degapfile = CALDB)           degap factors (NONE | none | COEFF | <filename>)
      (hypfile = CALDB)           Hyperbolic test coefficients file ( NONE | none | <filename>)
 (ampsfcorfile = CALDB)           caldb file for amp_sf_correction( NONE | none | <filename>)
      (tapfile = CALDB)           tap ring test coefficients file ( NONE | none | <filename>)
   (ampsatfile = CALDB)           ADC saturation test file ( NONE | none | <filename>)
  (evtflatfile = CALDB)           Event flatness test file ( NONE | none | <filename>)
      (badfile = NONE)            output level 1 bad event file
      (logfile = stdout)          debug log file (STDOUT | stdout | <filename>)
     (eventdef = )stdlev1 -> {d:time,s:crsv,s:crsu,s:amp_sf,s:av1,s:av2,s:av3,s:au1,s:au2,s:au3,
l:raw,s:chip,l:tdet,f:det,f:sky,s:pha,s:pi,s:sumamps,s:chip_id,x:status}) output format definition
  (badeventdef = )badlev1 -> {d:time,s:crsu,s:crsv,s:au1,s:au2,s:au3,s:av1,s:av2,s:av3,s:pha}) output fo
   (grid_ratio = 0.5)             charge ratio
    (pha_ratio = 0.5)             pha ratio
  (wire_charge = 0)               turn on center wire test (-1=off,0=on)
         (cfu1 = 1.0)             u axis 1st order cor. factor
         (cfu2 = 0)               u axis 2nd order cor. factor
         (cfv1 = 1.0)             v axis 1st order cor. factor
         (cfv2 = 0)               v axis 2nd order cor. factor
  (time_offset = 0)               Offset to add to event time field to synch w/ fam data
     (amp_gain = 75.0)            amp gain
     (instrume = hrc-i)           hrc instrument- used for parameter file
(do_amp_sf_cor = no)              perform amp_sf correction (y/n) ?
     (do_ratio = yes)             perform ratio validity checks
       (tstart = TSTART)          header key containing default time value (HSI)
        (tstop = TSTOP)           header key containing time of last event
      (clobber = no)              Overwrite output event file if it already exists?
      (verbose = 0)               level of debug detail (0=none, 5=most)
    (rand_seed = 1)               random seed (for pixlib), 0 = use time dependent seed
```

```
(rand_pix_size = 0.0)             pixel randomization width (-size..+size), 0.0 = no randomizatio
        (start = coarse)          start transformations at [coarse,chip,tdet]
         (stop = sky)             end transformations at [none,chip,tdet,det,sky]
      (badlev1 = {d:time,s:crsu,s:crsv,s:au1,s:au2,s:au3,s:av1,s:av2,s:av3,s:pha}) event format d
      (hsilev1 = {d:time,s:crsu,s:crsv,s:au1,s:au2,s:au3,s:av1,s:av2,s:av3,s:chipx,s:chipy,s:tdet
s:x,s:y,l:fpz,s:pha,s:vstat,s:estat}) event format definition string
      (stdlev1 = {d:time,s:crsv,s:crsu,s:amp_sf,s:av1,s:av2,s:av3,s:au1,s:au2,s:au3,l:raw,s:chip,
f:det,f:sky,s:pha,s:pi,s:sumamps,s:chip_id,x:status}) event format definition string
      (simlev1 = {l:tick,i:scifr,i:mjf,s:mnf,s:evtctr,s:crsu,s:crsv,s:au1,s:au2,s:au3,s:av1,s:av2
s:tdetx,s:tdety,s:pha,s:vstat,s:estat}) sim event definition string
      (fltlev1 = {d:time,s:crsv,s:crsu,s:amp_sf,s:av1,s:av2,s:av3,s:au1,s:au2,s:au3,s:chipx,s:chi
l:tdety,s:detx,s:dety,s:x,s:y,s:pha,s:sumamps,s:chip_id,l:status}) event format definition string
         (mode = ql)
```

History

14 Dec 2004	reviewed for CIAO 3.2: no changes
23 Jun 2005	CIAO 3.2.2 patch: Calibration Update that is transparent to users; it is not necessary to reprocess data that have had the degap correction applied
20 Dec 2005	updated for CIAO 3.3: new HRC-I gain map files were released in CALDB 3.2.0; the new calibration is automatically applied if you run this thread
10 Aug 2006	updated for CALDB 3.2.3: corrected HRC-I gain map file and new degap have been released; the new calibration is automatically applied if you run this thread
18 Dec 2006	updated for CIAO 3.4: new calibration files in CALDB 3.3.0; added link to Computing Average HRC Dead Time Corrections thread in Summary; CIAO version in error
21 Feb 2007	replace POG link with pointer to calibration page
01 May 2007	updated for CALDB 3.4.0: new HRC-I gain map files
14 Sep 2007	updated for CALDB 3.4.1: new HRC-I degap files

URL: http://cxc.harvard.edu/ciao/threads/hrci_degap/ Last modified: 14 Sep 2007