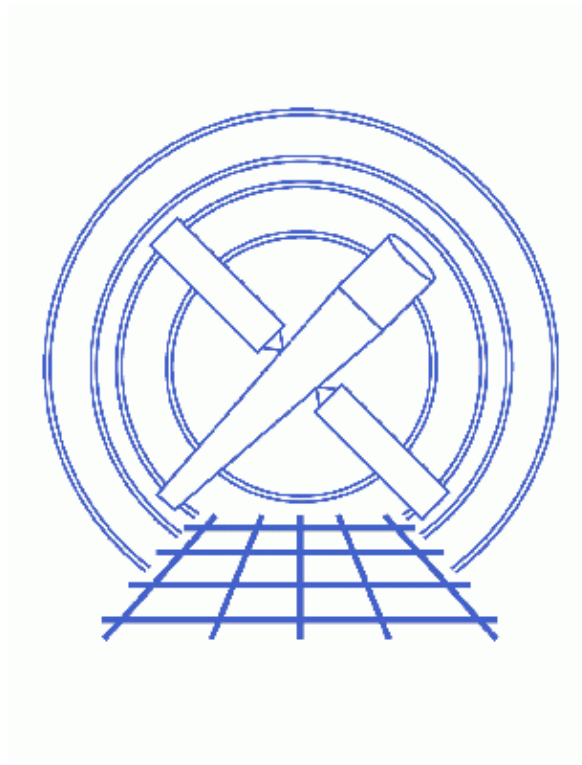


# Improving the Astrometry of your Data: Correct for a Known Processing Offset



## ***CIAO 3.4 Science Threads***

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# Improving the Astrometry of your Data: Correct for a Known Processing Offset

*CIAO 3.4 Science Threads*

## Overview

**Last Update:** 1 Dec 2006 – updated for CIAO 3.4: added CALDB and ASCDSVER information to the [Calculate Correction](#) section; thread should be run after reprocessing data with `acis_process_events` or `hrc_process_events`

### **Synopsis:**

Many ACIS and HRC datasets suffer from known aspect offsets as large as 2 arcsec. It is possible to identify and correct for this problem, if absolute astrometry is important to the analysis.

### **Purpose:**

To remove any known aspect offsets.

### **Read this thread if:**

you are working with any ACIS or HRC imaging observation and would like to improve the astrometry.

If you intend to reprocess your data with [acis\\_process\\_events](#) or [hrc\\_process\\_events](#), apply this correction *after* creating the new level 2 event file.

This aspect correction **should not** be applied to grating data. The correction will not affect the extraction or quality of the spectrum, and applying it may introduce an inconsistency between the aspect solution and data pointing later in the analysis.

### **Related Links:**

- Analysis Guide: [ACIS Data Preparation](#)
- [Notes on Chandra Astrometric Accuracy](#): the current status of Chandra astrometry
- [Correcting Absolute Astrometry with reproject\\_aspect](#) thread: how to eliminate the errors in the absolute astrometry between two files

**Proceed to the [HTML](#) or hardcopy (PDF: [A4](#) / [letter](#)) version of the thread.**

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## Get Started

*Sample ObsID used:* 461 (HRC-I, 3C 273)

**File types needed:** evt2

If you intend to reprocess your data with acis\_process\_events or hrc\_process\_events, apply this correction after creating the new level 2 event file. Those tools reapply the aspect solution, which will undo the aspect correction from this thread.

There are two main reasons why you might need to change the aspect of your observation:

1. **Correct for a known processing offset:** to remove any known aspect offsets and obtain absolute astrometry which is accurate to 1". This case is addressed by using the aspect calculator.
2. **Apply an offset for improved astrometry:** if the X-ray observation has point sources with very accurately known optical/radio/IR counterpart positions, it is possible to obtain absolute astrometry which is accurate to 0.1" – 0.2". In this case, users should follow the Correcting Absolute Astrometry with reproject\_aspect thread.

It is important to note that this thread only corrects the event file and not the other files with RA/DEC information in the header (e.g. aspect solution, source lists). Keep this in mind when continuing your analysis, as it may cause small shifts in some response products, such as exposure maps.

The reproject\_aspect thread contains the option to correct the aspect solution and use it to reprocess the event file.

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## Calculate Correction

Many Chandra data sets in the archive (for both ACIS and HRC) suffer from known aspect offsets as large as 2 arcsec. The Aspect team has created the Check for Aspect Offset and Fix page that may be used to determine whether your observation is affected by this problem and, if so, how to correct for it.

The aspect calibration files were updated in CALDB v2.25 and included in version DS7.1 of the standard data processing (SDP) software. Any observations processed with this version (or a newer one) of the calibration or software should not have any aspect offset. The versions are stored in the file header:

```
unix% dmkeypar hrcf00461N003_evt2.fits CALDBVER echo+
2.4
unix% dmkeypar hrcf00461N003_evt2.fits ASCDSVER echo+
R4CU5UPD14.6
```

This observation was also processed with an earlier version of the calibration, before it was available in SDP (the ASCDSVER is lower than DS 7.1). Note that the version naming convention changed after version R4CU5UPD14 to the "DS" system, starting with DS 6.0.0.

## Running the Aspect Calculator

Here is an example of using the offsets calculator by following the instructions posted on that page.

1. Copy your event file to what will be the new aspect-corrected version and make sure you have write permission in order to be able to edit the header later:

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```
unix% cp hrcf00461N003_evt2.fits hrcf00461_aspcorr_evt2.fits
unix% chmod +w hrcf00461_aspcorr_evt2.fits
```

2. Get the header information from the file:

```
unix% dmlist hrcf00461_aspcorr_evt2.fits header,raw,clean \
| egrep 'TCTYP|TCRVL|ASCDSVER|DATE|OBS_ID'
ASCDSVER      = R4CU5UPD14.6      / ASCDS version number
DATE          = 2001-04-02T12:51:17 / Date and time of file creation
DATE-OBS      = 2000-01-22T14:05:35 / Date and time of observation start
DATE-END      = 2000-01-22T20:22:42 / Date and time of observation stop
OBS_ID        = 461              / Observation id
TCTYP2        = CPCX              /
TCRVL2        = 0                 /
TCTYP3        = CPCY              /
TCRVL3        = 0                 /
TCTYP6        = LONG-TAN          /
TCRVL6        = 0                 /
TCTYP7        = NPOL-TAN          /
TCRVL7        = 0                 /
TCTYP8        = RA---TAN          /
TCRVL8        = 187.28142694      /
TCTYP9        = DEC--TAN          /
TCRVL9        = 2.05574860       /
```

3. Paste this information into the form on [the website](#) and click the "submit request" button. After a few minutes, the script output will be displayed:

```
Check for aspect offset and fix: Results for obsid 461
```

```
No aspect reference files in archive with version='R4CU5UPD14.6'.
This may be because you processed the event file with a CIAO tool which changed
the version header keyword (ASCDSVER), or it may be because the event file was
reprocessed without the aspect being reprocessed.
```

```
IMPORTANT:
```

```
Fix_offset will now use the most recent available aspect files:
Processing date   : 2000-12-13T16:45:15
Processing version : R4CU5UPD12.1
```

```
This assumes that the event file is the latest available version
currently in the archive, and that none of the coordinate reference
keywords in the file have been changed. If this is not the case, the
resultant dmhedit commands may be incorrect.
```

```
Observation parameters are:
```

```
Obsid      = 461
Source     = 3C 273
ASCDSVER   = R4CU5UPD12.1
RA_NOM     = 187.28142694
DEC_NOM    = 2.05574860
```

```
The aspect offset for this obsid is DY = -0.08 and DZ = 0.46 arcsec
For roll = 68.86 degrees, the offset is D_RA = -0.46 and D_Dec = 0.09 arcsec
```

```
Cut and paste the following commands to modify the event file header and remove the offset
```

```
punlearn dmhedit
dmhedit infile=aspcorr_evt2.fits filelist=none operation=add unit=degrees key=TCRVL8 value
dmhedit infile=aspcorr_evt2.fits filelist=none operation=add unit=degrees key=TCRVL9 value
dmhedit infile=aspcorr_evt2.fits filelist=none operation=add unit=degrees key=RA_NOM value
dmhedit infile=aspcorr_evt2.fits filelist=none operation=add unit=degrees key=DEC_NOM value
```

```
Alternatively, copy the following into a file for input to dmhedit using the filelist para
```

```
#add
```

```
TCRVL8=187.281299401765
TCRVL9=2.05577424284362
RA_NOM=187.281299401765
DEC_NOM=2.05577424284362
```

As the warning advises, it was confirmed that this is the newest version of the data in the Archive. You can also compare the ASCDSVER version reported by the script to the value in the aspect solution file:

```
..(from screen output, above)..
Observation parameters are:
Obsid      = 461
Source     = 3C 273
ASCDSVER   = R4CU5UPD12.1
...

unix% dmkeypar pcadf064938693N002_asol1.fits ASCDSVER echo+
R4CU5UPD12.1
```

The details of how the script works are available in the [Explanation of Plots](#) section of the [Positional Accuracy Monitor](#) page.

4. Update the header keywords with the commands listed at the end of the script output. If you are using an ACIS observation, the script will correctly tell you to update the **TCRVL11** and **TCRVL12** keywords instead of TCRVL8 and TCRVL9.

For information on how to do a batch edit with `dmhedit`, please read the description of the [filelist](#) parameter from the help file.

NB: the filename `aspcorr_evt2.fits` is hardwired into the script, but our file is named `hrcf00461_aspcorr_evt2.fits`; make sure that you use the correct filename in the `dmhedit` commands:

```
unix% punlearn dmhedit
unix% dmhedit infile=hrcf00461_aspcorr_evt2.fits filelist=none \
  operation=add unit=degrees key=TCRVL8 value=187.281299401765

unix% dmhedit infile=hrcf00461_aspcorr_evt2.fits filelist=none \
  operation=add unit=degrees key=TCRVL9 value=2.05577424284362

unix% dmhedit infile=hrcf00461_aspcorr_evt2.fits filelist=none \
  operation=add unit=degrees key=RA_NOM value=187.281299401765

unix% dmhedit infile=hrcf00461_aspcorr_evt2.fits filelist=none \
  operation=add unit=degrees key=DEC_NOM value=2.05577424284362
```

## Confirm Header Updates

Check that the changes were made:

```
unix% dmlist hrcf00461_aspcorr_evt2.fits header,raw,clean | egrep 'TCRVL(8|9)'
TCRVL8      =      187.28129940      / [degrees]
TCRVL9      =       2.05577424      / [degrees]

unix% dmkeypar hrcf00461_aspcorr_evt2.fits RA_NOM echo+
187.28129940177

unix% dmkeypar hrcf00461_aspcorr_evt2.fits DEC_NOM echo+
2.0557742428436
```

It was necessary to use `dm`list in the first command because `dmkeypar` does not search raw header keywords.

## Applying a Known Offset (for Improved Astrometry)

Improved celestial location precision is possible for some observations by cross-correlating detected X-ray sources with high-precision optical, IR, or radio catalogs. This technique can be used to remove large offsets due to processing problems or to fine-tune the astrometry to well below the typical 0.6 arcsec performance. See the [High-precision astrometry and image reconstruction with Chandra](#) document for further information.

This level of aspect correction is done with the tool [reproject\\_aspect](#), as illustrated in the [Correcting Absolute Astrometry with reproject\\_aspect](#) thread.

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## History

- 04 Jan 2005 reviewed for CIAO 3.2: no changes
  - 17 Mar 2005 minor changes to [Using the Aspect Calculator](#) section due to updates to the "Check for Aspect Offset and Fix" page
  - 19 Dec 2005 updated for CIAO 3.3: apply correction to level 1 event file if reprocessing data
  - 24 Apr 2006 renamed from "Improving the Astrometry of your Data" to "Improving the Astrometry of your Data: Correct for a Known Processing Offset"; the [Applying a Known Offset \(for Improved Astrometry\)](#) section is replaced by a link to the [Correcting Absolute Astrometry with reproject\\_aspect](#) thread
  - 01 Dec 2006 updated for CIAO 3.4: added CALDB and ASCDSVER information to the [Calculate Correction](#) section; thread should be run after reprocessing data with `acis_process_events` or `hrc_process_events`
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URL: [http://cxc.harvard.edu/ciao/threads/arcsec\\_correction/](http://cxc.harvard.edu/ciao/threads/arcsec_correction/)

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