The 2011 Chandra Alignment Shift

Presented to the Chandra Users Committee
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With thanks to Tom Aldcroft and Ping Zhao
Outline

- Discuss the alignment shift and our response
- Discuss the impact of the ACA housing temperature
- Discuss the global offset shift
- Discuss the new offset for Cycle 14 and Cycle 13 moving forward.
Fiducial Transfer System
Fiducial Light Drift

Probable cause of drift:
**Shifting ACA alignment**

Not credible
• Physical shift of the SIM relative to the OBA
• Bending of the OBA
  • Material properties inconsistent with either of these.
• Alignment drift in the FTS
  • Not credible would cause astrometry errors in ACA
  • Would not affect pointing

• Notice the width is also increasing

ACA Cool down – June 2003, Nov 2006
Aim point changed – Feb 2007

Safe Mode July 6
Fid Light Drift & ACA Housing Temperature

\[ \text{fid offset} \propto M \times \text{ACA\_housing\_temp} \]
Fid Light Drift & ACA Housing Temperature

\[
\text{fid offset} = M \times \text{ACA}_\text{housing\_temp} + B
\]

\[
\text{fid offset} = M \times \text{ACA}_\text{housing\_temp} + B + 6.5"'
\]
FID Light Drift & ACA Housing Temperature

AC HOUSING TEMP (ACH1)

dy/dx AACH1T

K/Year

UT (Day of year)

The combination of 6.5” shift + greater thermal excursions of the ACA Housing heater lead to total shifts of up to 12” from the nominal aimpoint
ACIS FLIGHT FOCAL PLANE

ACIS-I
(aimpoint on I3 = (949, 978))

ACIS-S
(aimpoint on S3 = (235, 497))

18 pixels = 8.8"

BI chip indicator
Image Region
Pixel (0,0)
Frame Store

+ΔY
Target
Offset Coordinates

+ΔZ
Pointing Coordinates

+Z
Row/Column Definition

COORDINATE ORIENTATIONS

OFFSET COORDINATES

SIM MOTION

+Y

-ΔZ

Node Definitions

Column

Row

Node zero
one
two
three

Frame Store

CCD Key
ACIS–S Aimpoint – Prior to safemode

HRMA Optical Axis and Aimpoint Positions on ACIS–S

Since 2007

Offset 2006-2007

1999-2006

1999.8

2011.0

10''

10''

Zoffset: -15''

Yoffset: +10''

Yoffset: -20''
ACIS–S Aimpoint –after safemode
ACIS–S Aimpoint – Data Range

HRMA Optical Axis and Aimpoint Positions on ACIS–S

- 1" pointing precision
- 6" ACA Thermal
- 8" Dither
- 3" background
- 2" node boundary

Point source data range

since-2007

Z offset: -15"

10"

Chip X (pixel)

Chip Y (pixel)
ACIS–S Aimpoint – final offset

HRMA Optical Axis and Aimpoint Positions on ACIS–S

Point source data range
- 1" pointing precision
- 6" ACA Thermal
- 8" Dither
- 3" background
- 2" node boundary

Yoffset: +9"

Chip Y (pixel)

Chip X (pixel)
ACIS–I Aimpoint – Prior to safemode

HRMA Optical Axis and Aimpoint Positions on ACIS–I

ACIS–I3 Edge

Offset added in 2007

Chip Y (pixel)

Chip X (pixel)
ACIS–I Aimpoint – after safemode
ACIS-I Aimpoint – with new offset

HRMA Optical Axis and Aimpoint Positions on ACIS-I

ACIS-I3 Edge

Point source data range

1" pointing precision
6" ACA Thermal
8" Dither
3" background
2" node boundary

+9" offset
ACIS–I Aimpoint – data range

HRMA Optical Axis and Aimpoint Positions on ACIS–I

ACIS–I3 Edge

Point source data range
1" pointing precision
6" ACA Thermal
8" dither
3" background
2" node boundary

+9" offset

Chip Y (pixel)

Chip X (pixel)

Scale: 10"

acsl_opaxoimp_cor_shift.ps
HRC
No data have been lost
  - Some are filtered out between Level 1 and Level 2
Astrometry is unaffected.
Mean y shift is about 6.5 sec.
Maximum shift from desired aimpoint of about 12” in cold cases
Shift in z of about 2.5 sec.
Bulletin message sent out.
Error budget information added to observer letter.
On September 1 we adopted global offset of +0.15’ (9”) in Y to ALL observations in OCAT prevent target from hitting node boundary.
  - Only ACIS-S required the change, others are being backed out
  - Default offsets as of Oct 15:
    - ACIS-S default offset:+0.15’(Y) -0.25’ (Z)
    - ACIS-I default offset:-0.20’(Y) -0.25’ (Z)
    - HRC-S and HRC-I Y and Z offset = +0.0’
Modify OCAT so that the new +9" applies only to ACIS-S.

Update to RPS to add +0.15' in Y ACIS-S.

Updated aimpoint measurements will be release by CAL this week and forwarded to the CALDB for formal approval for Cycle 14.
  - Modify default ACIS-S aimpoint in ObsVis.
  - Modify RPS DDT Help
    - Chandra_RfO_DDT/RPS.pl
  - Modify RPS AO14 Help.
  - Update proposer/new_aimpoint.html
  - Modify POG ACIS aimpoint section.

Caveat: Chandra Aimpoint Shift

DataCaveat Index

Posted: 31 August 2011

Abstract

There is a shift in the Chandra aimpoint of about 8 arcsec, caused by a change in alignment of the aspect camera with respect to the HRMA and focal plane science instruments (ACIS & HRC detectors). All aimpoints are affected, particularly ACIS-S; the direction of the shift moves targets positioned at the ACIS-S default aimpoint closer to the nod boundary, increasing the risk of apparent loss of events at that boundary.

There are no permanent science impacts from the aimpoint shift, but users with ACIS-S observations made from 11 July 2011 through 29 August 2011 may need to take special care in the data analysis, as outlined in this document.

All observations taken as of 29 August 2011 will include a Y-offset of +0.15 arcmin to return the aimpoint to its previous location. This updates the default offsets for ACIS-S observations to:
  - Y-offset = +0.15
  - Z-offset = +0.25

The following special processing concerns apply to ACIS-S observations made from 11 July 2011 through 29 August 2011: refer to the list of affected ObsIDs. The Y/X report for affected observations has also been updated to include a note about the aimpoint shift.

The observations taken in this period were done at a different point on the detector than expected. While this may have an impact on the science analysis intended by the observer, the data products produced by standard data processing are to the same accuracy as any other observation.

Spatial Analysis

There is no impact on spatial analysis. The coordinates in the aspect solution and event files are correct.

Spectral Analysis

Spectral analyses should be unaffected, except for a slightly lowered effective exposure time if the source was on the nod boundary.

Timing Analysis

The events near the nod boundary may introduce a false dip orjermission into the resulting lightcurve. Use the dither_region tool to correct a lightcurve for variable exposure induced by dithering across bad pixels, bad columns, and going off-chip.

The search for Variability in a Source thread shows an example of using dither_region and the effect with and without using it.

The file created by dither_region is used in the doextract command, renaming the "fraction" column to "dlt" on-the-fly:

```
doextract infile="ott5.fits" jsky_region=src.reg)" time="(1:2000)" \\n  outfile="ott5cor.cor" cov_out=tsfracarea.\n  where="fracarea=50000;colt=1024;off=2048"
```

Note that this is a first-order correction (not the geometric area of the aperture). A more complete method would be to simulate a PSF with the correct spectral weights for the source and run dither_region with the dither parameter set. Then run doextract, using the PSF fraction columns to apply the correction instead of the fracarea.

Checking for False Variability

If you are concerned that source variability may be due to the source crossing the node boundary, it is possible to reprocess the data and include all the events that fall on the node boundary.