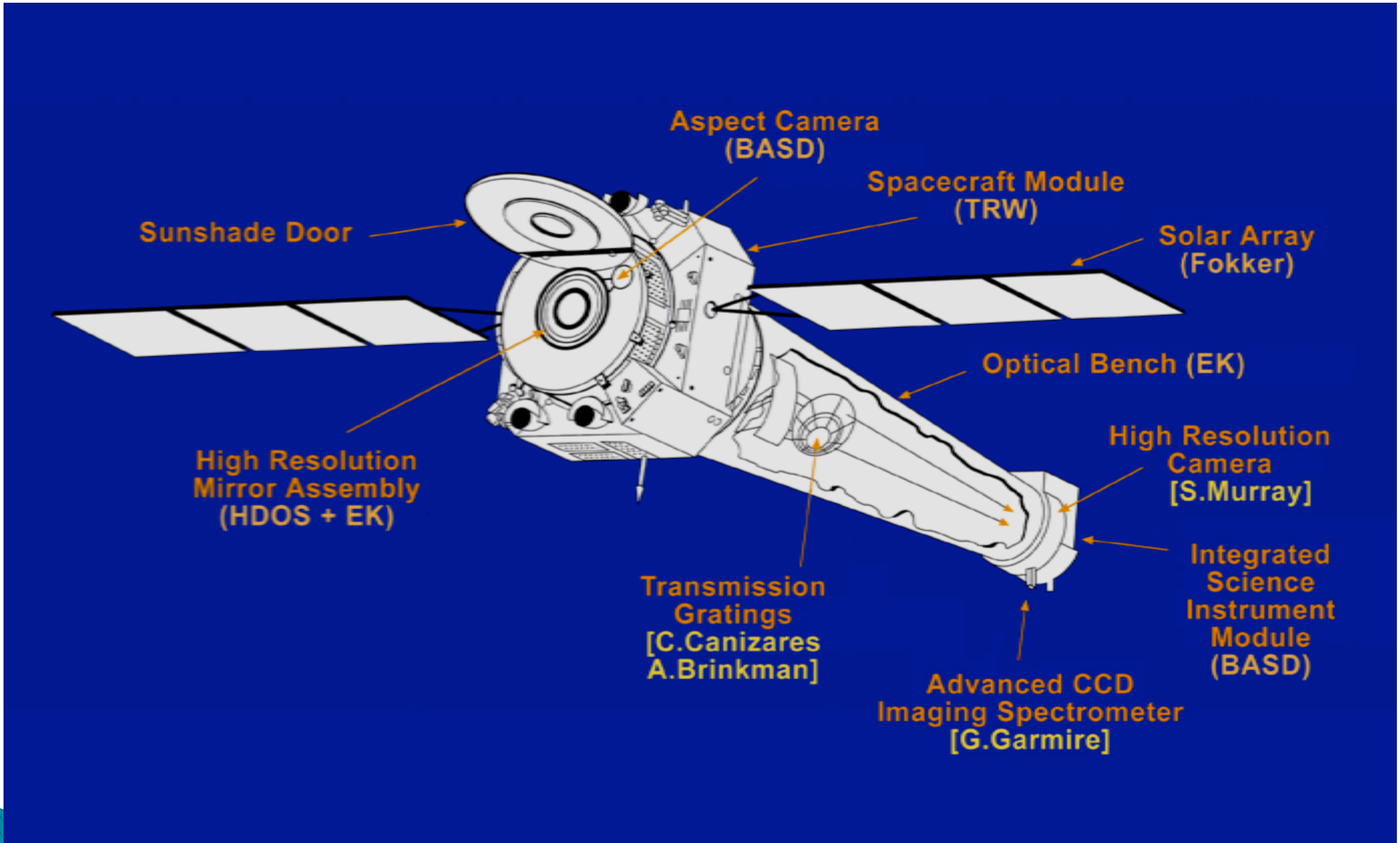
The 2011 Chandra Alignment Shift

Presented to the Chandra Users Committee
By Scott J. Wolk (SAO/CXC)

With thanks to Tom Aldcroft and Ping Zhao

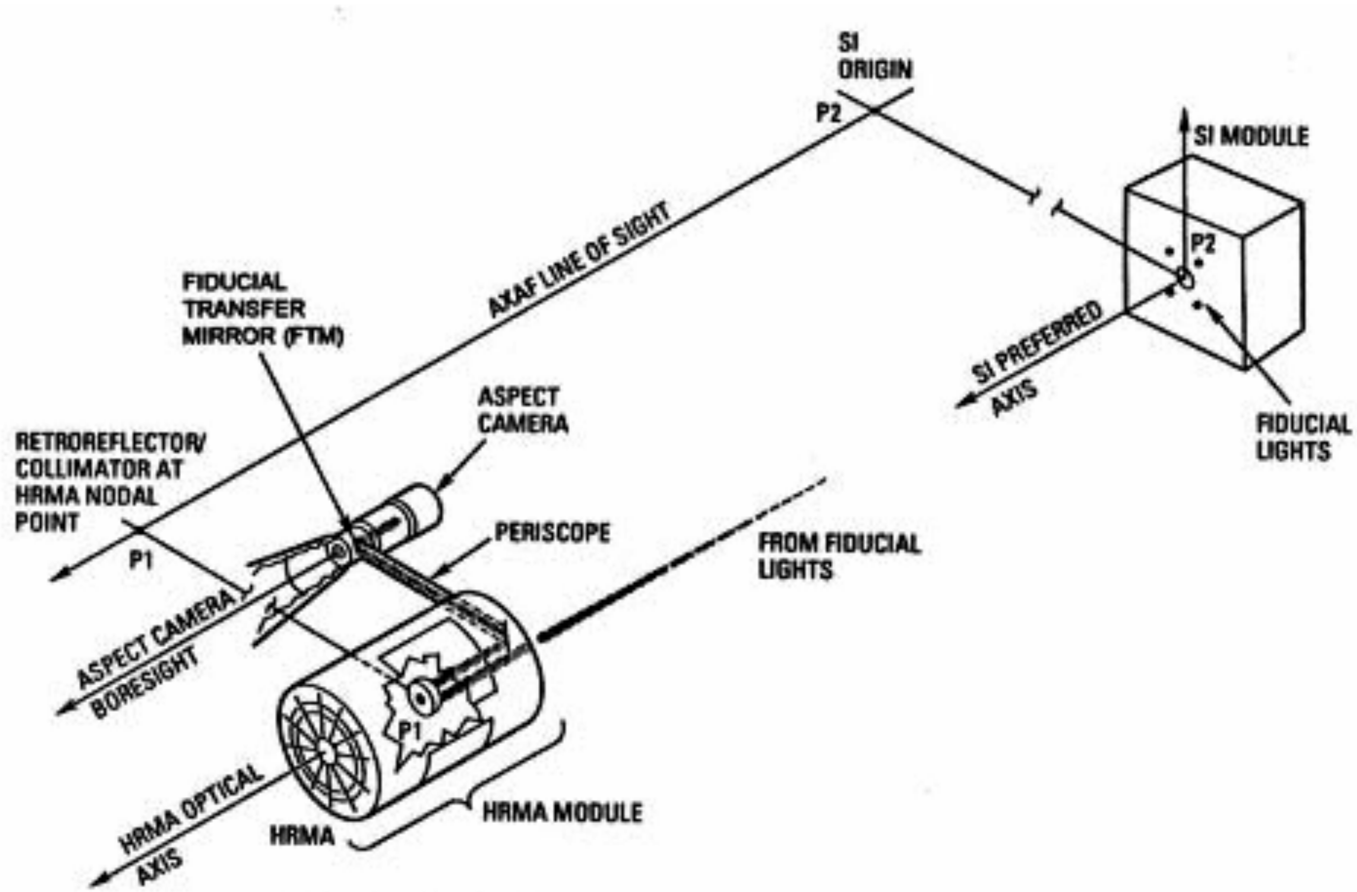
Outline

- 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.



Aspect Camera
(BASD)
Spacecraft Module
(TRW)
Sunshade Door
Solar Array
(Fokker)
Optical Bench (EK)
High Resolution
Mirror Assembly
(HDOS + EK)
High Resolution
Camera
[S.Murray]
Integrated
Science
Instrument
Module
(BASD)
Transmission
Gratings
[C.Canizares
A.Brinkman]
Advanced CCD
Imaging Spectrometer
[G.Garmire]

Fiducial Transfer System

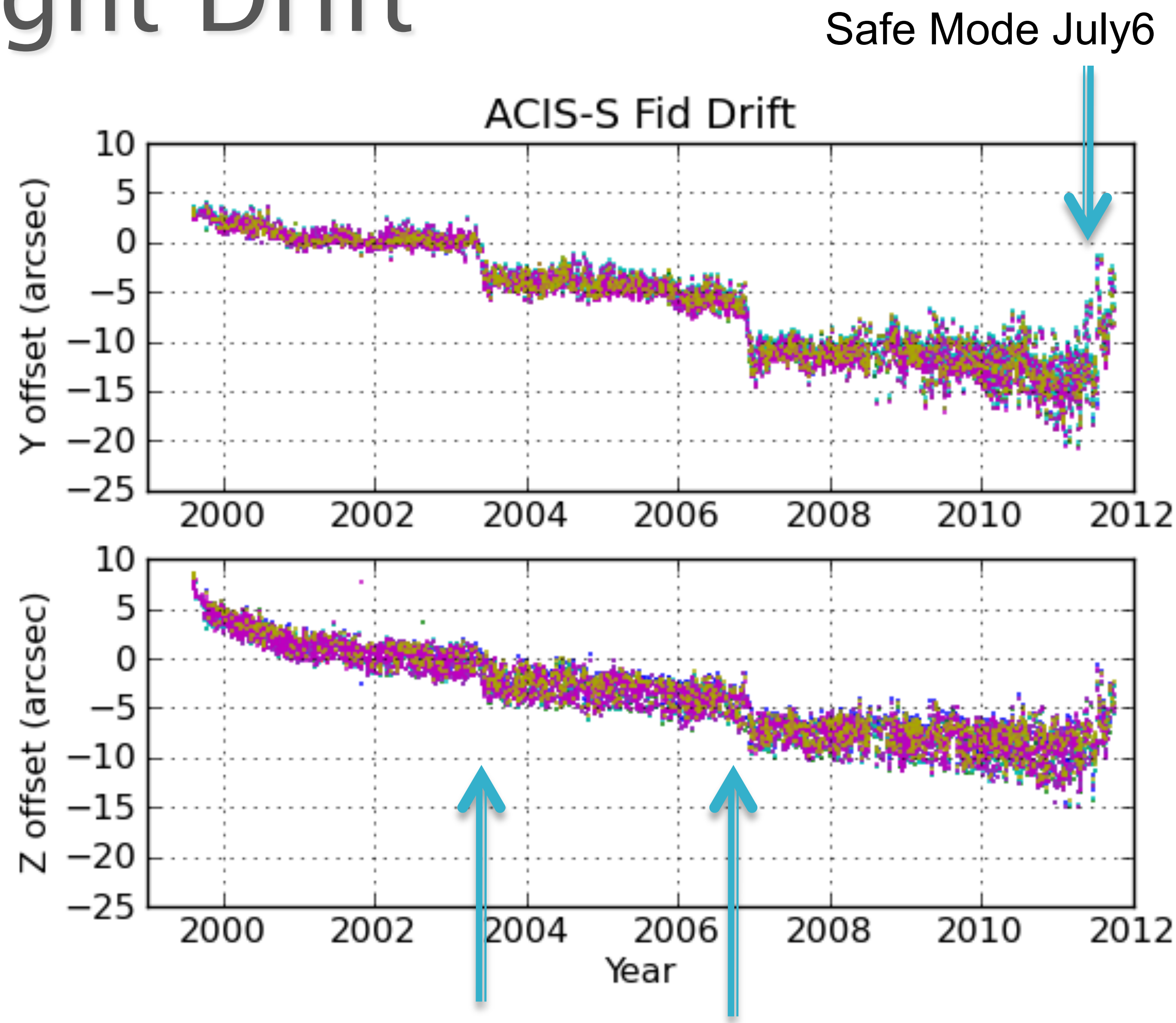


Fiducial Light Drift

Probable cause of drift:
Shifting ACA alignment

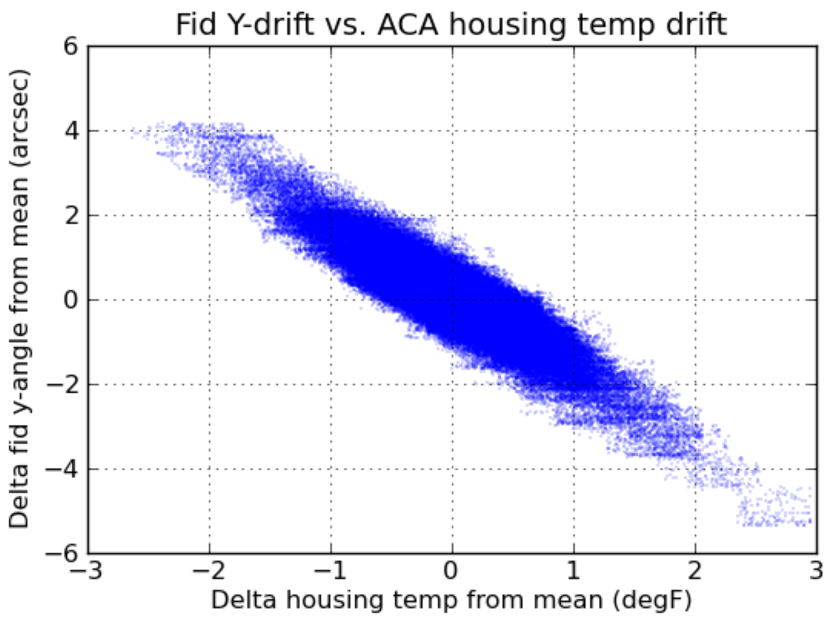
Not credible
- Physical shift of the SIM relative to the OBA
- Bending of the OBA
  - Material properties inconsistent with either of these.
- Alignment drift in the FTS
  - Not credible would cause astrometry errors in ACA
  - Would not affect pointing

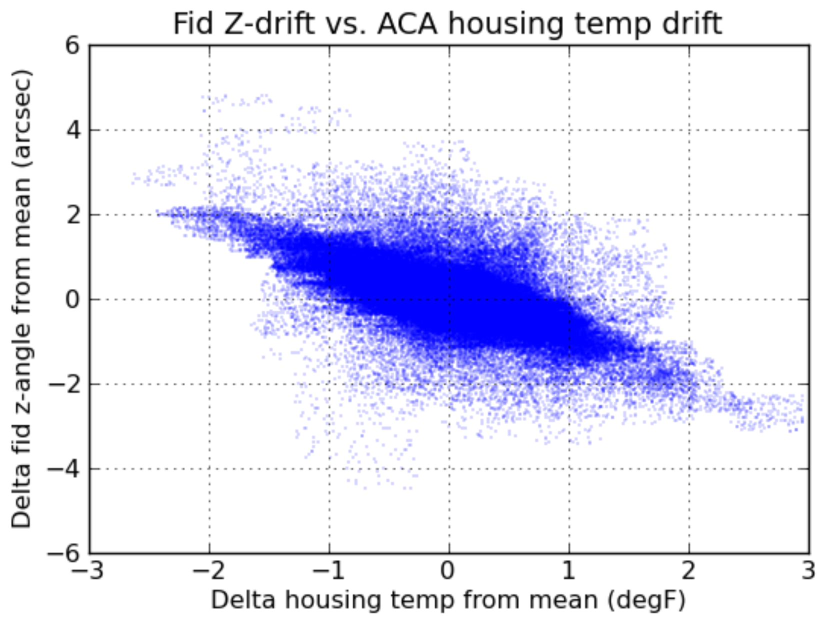
- Notice the width is also increasing



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

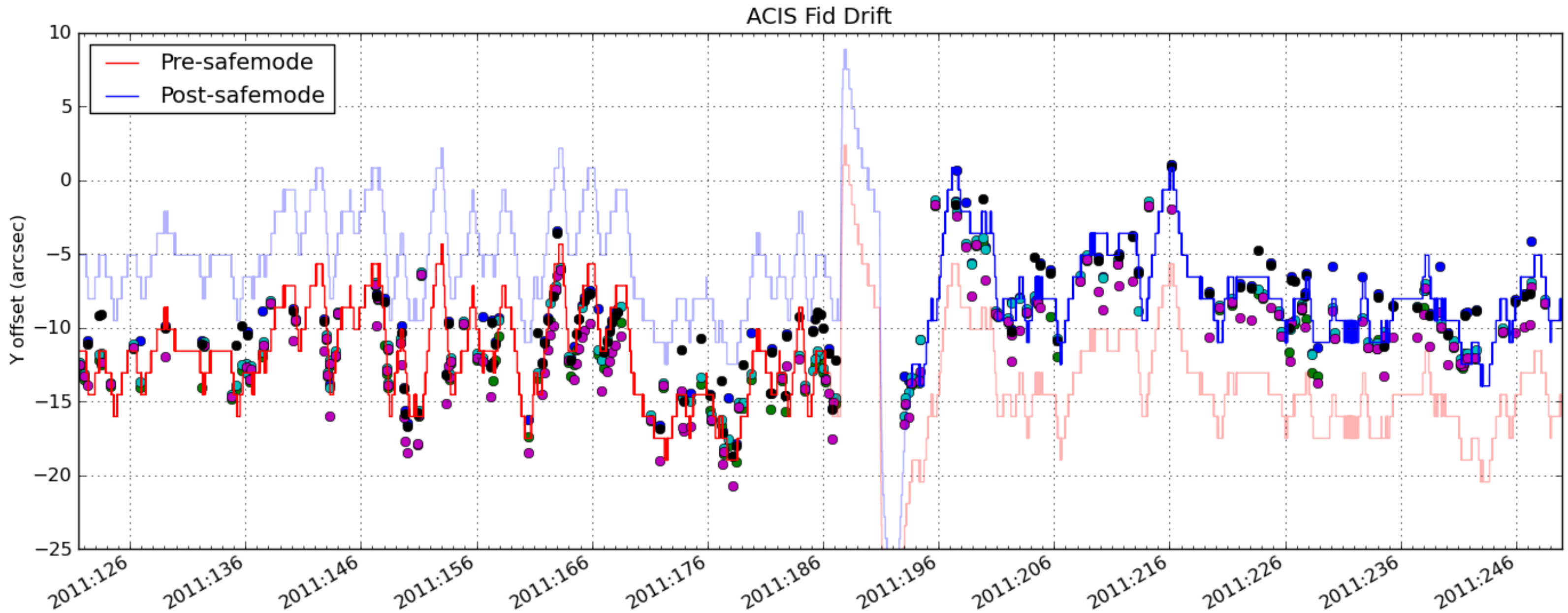
Fid Light Drift & ACA Housing Temperature





fid offset α M * ACA_housing_temp

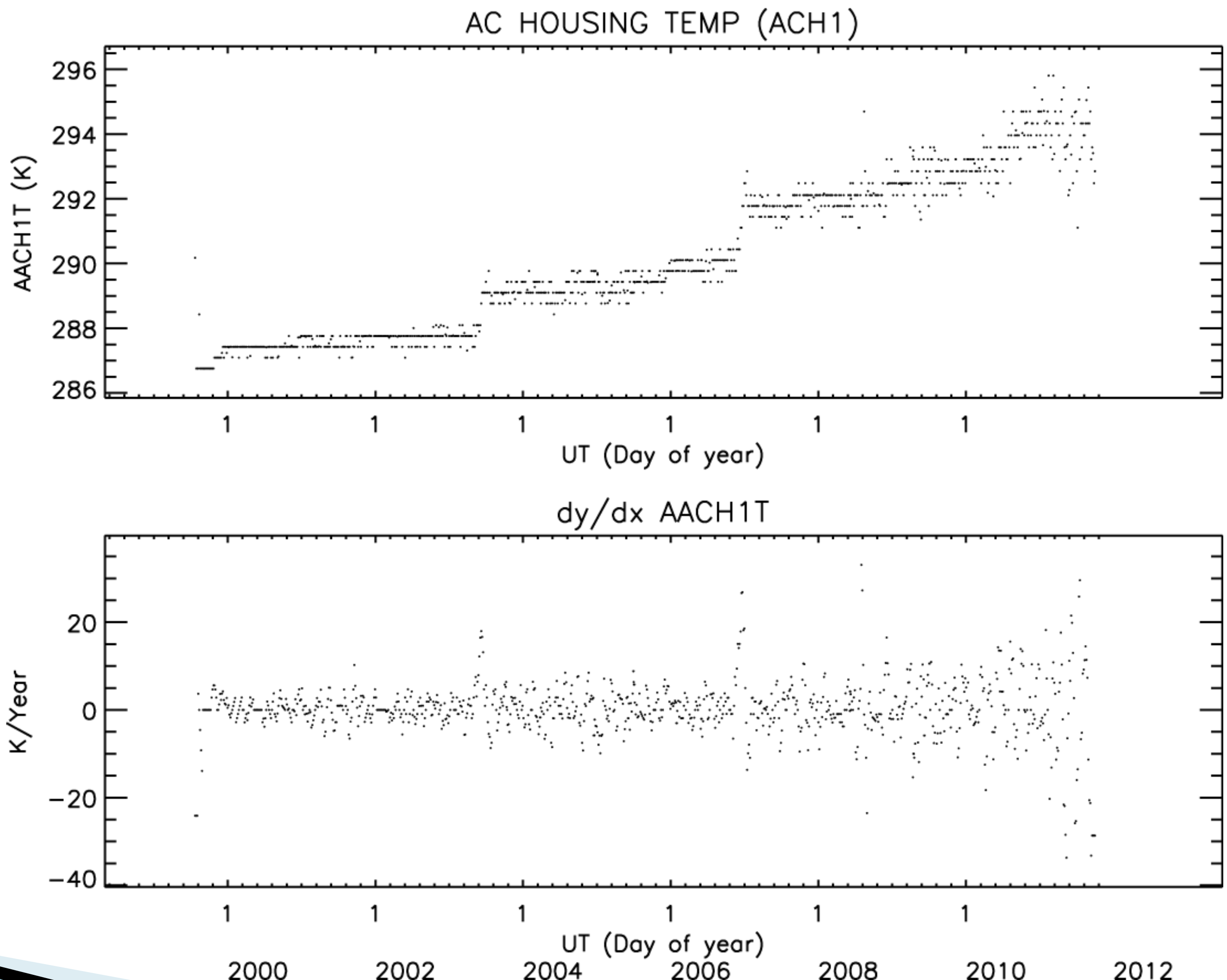
Fid Light Drift & ACA Housing Temperature



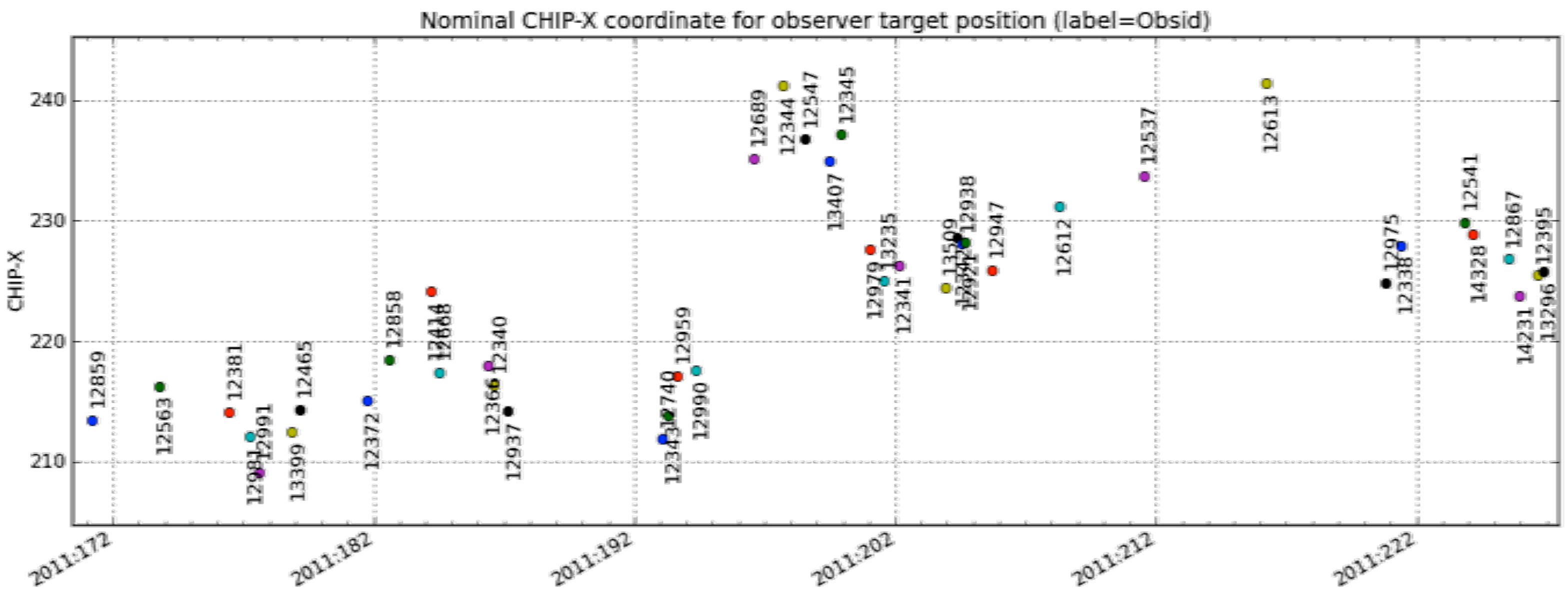
fid offset = M * ACA_housing_temp + B

fid offset = M * ACA_housing_temp + B + 6.5”

FID Light Drift & ACA Housing Temperature

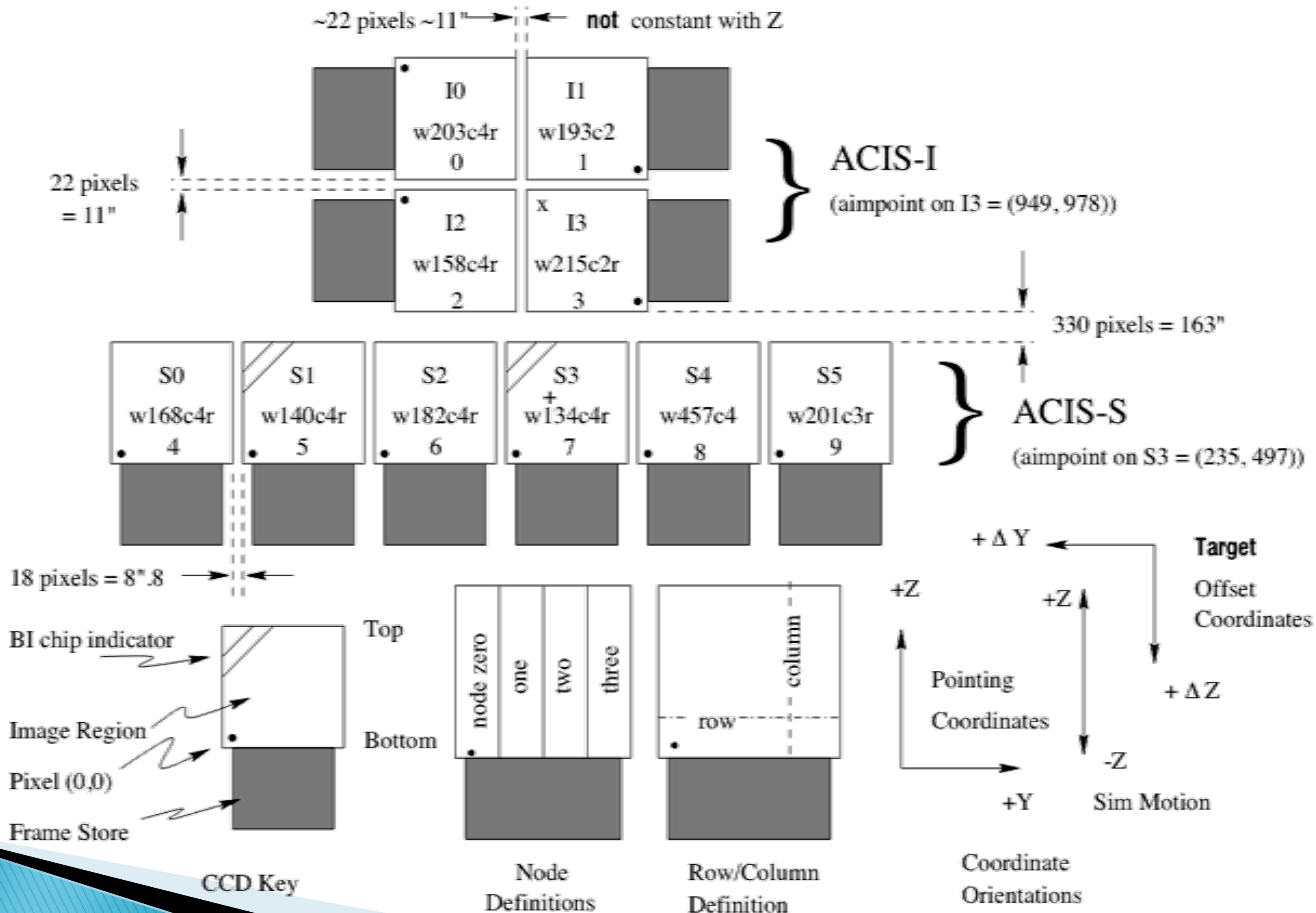


Fid Light Drift

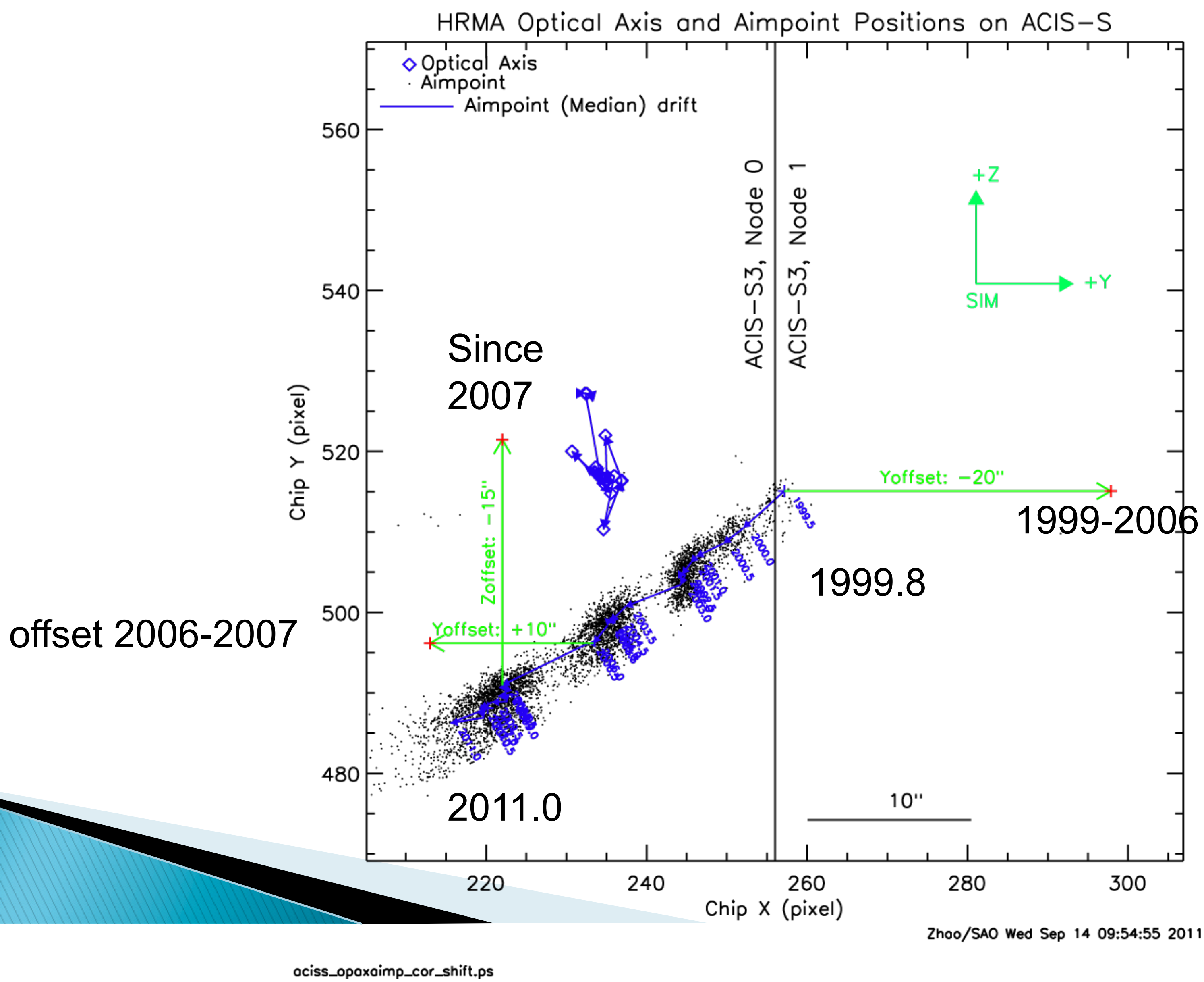


- The combination of 6.5” shift + greater thermal excursions of the ACA Housing heater lead to total shifts of up to 12” from the nominal aimpoint

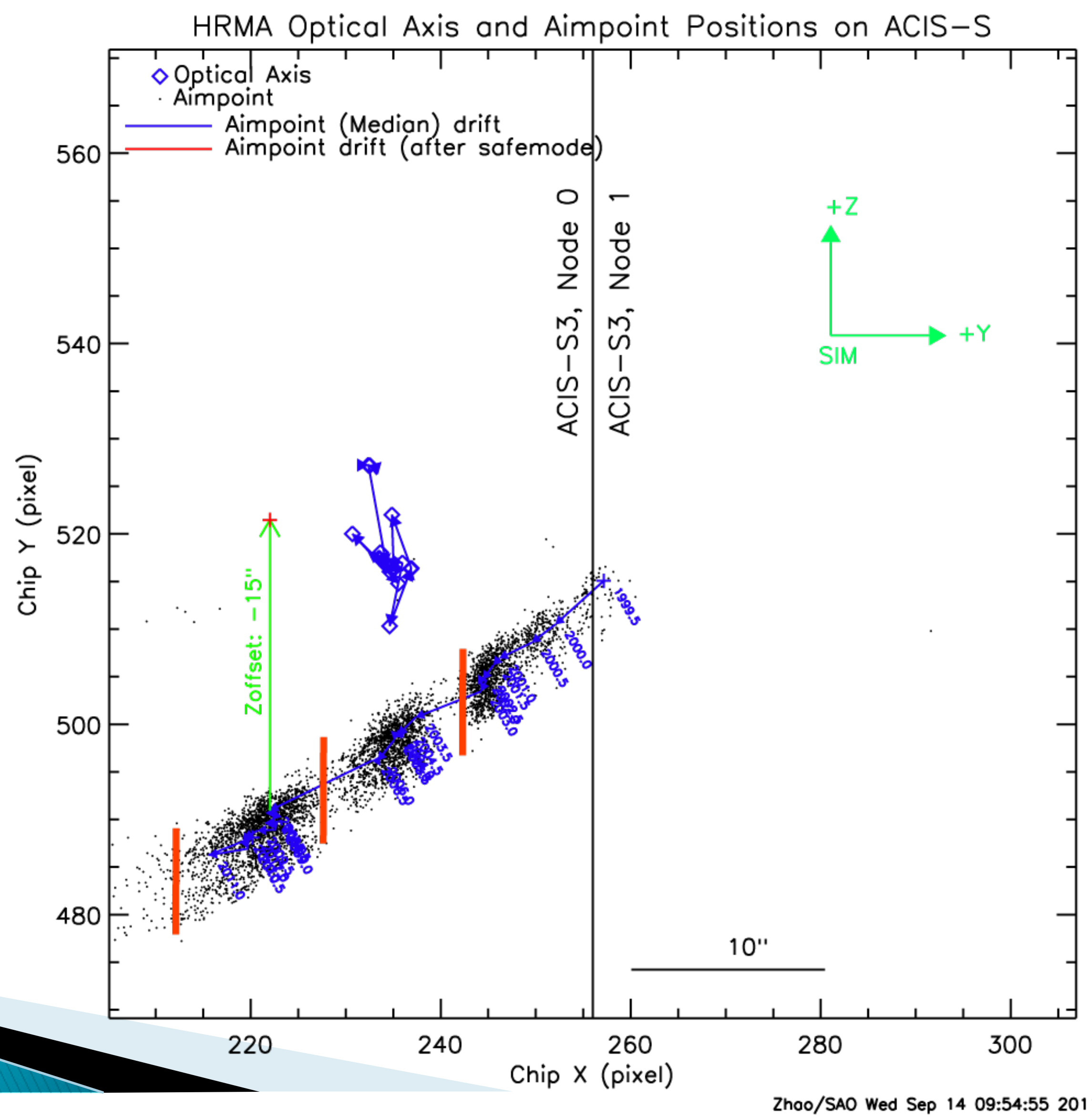
ACIS FLIGHT FOCAL PLANE



ACIS-S Aimpoint – Prior to safemode

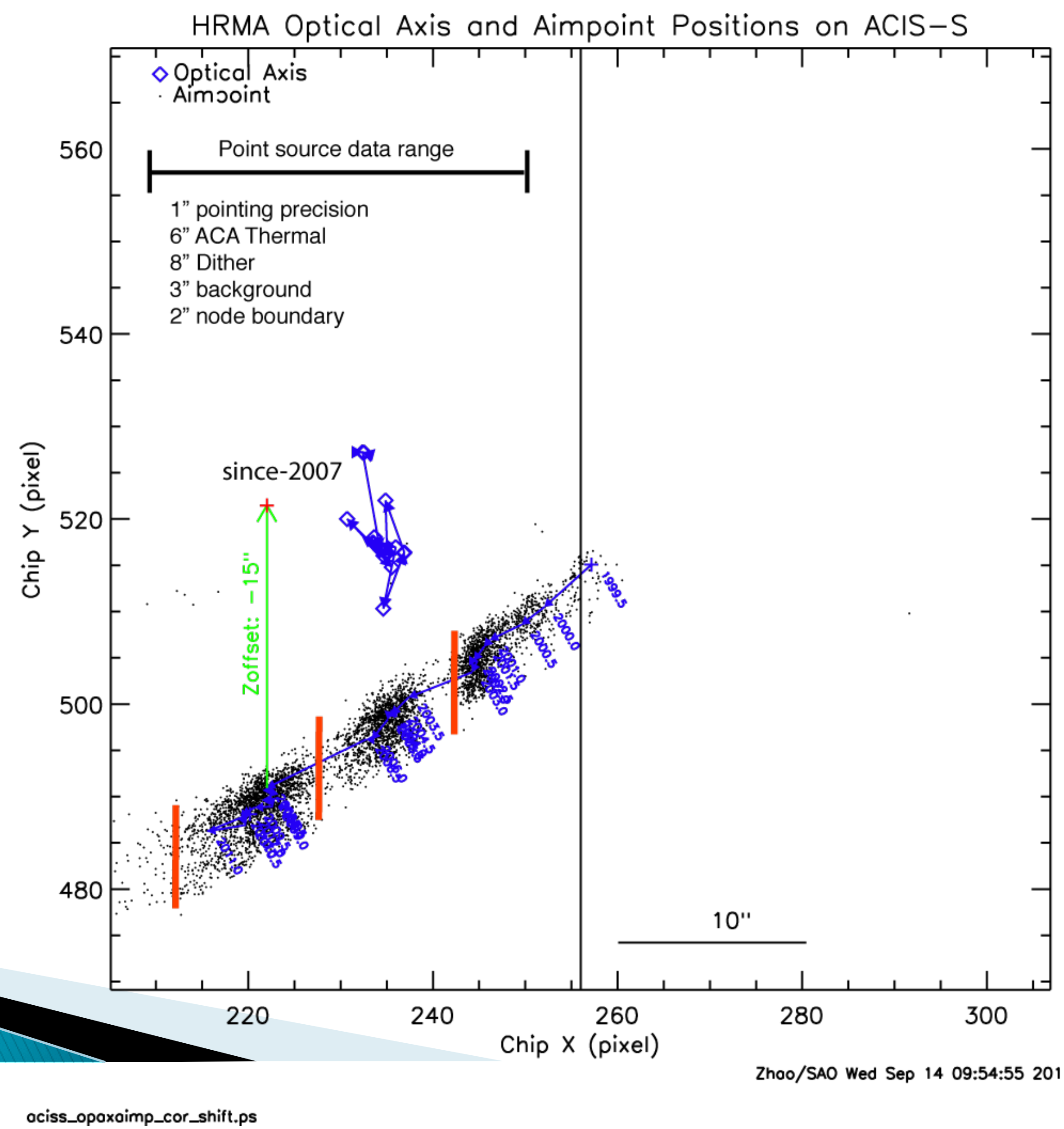


ACIS-S Aimpoint –after safemode

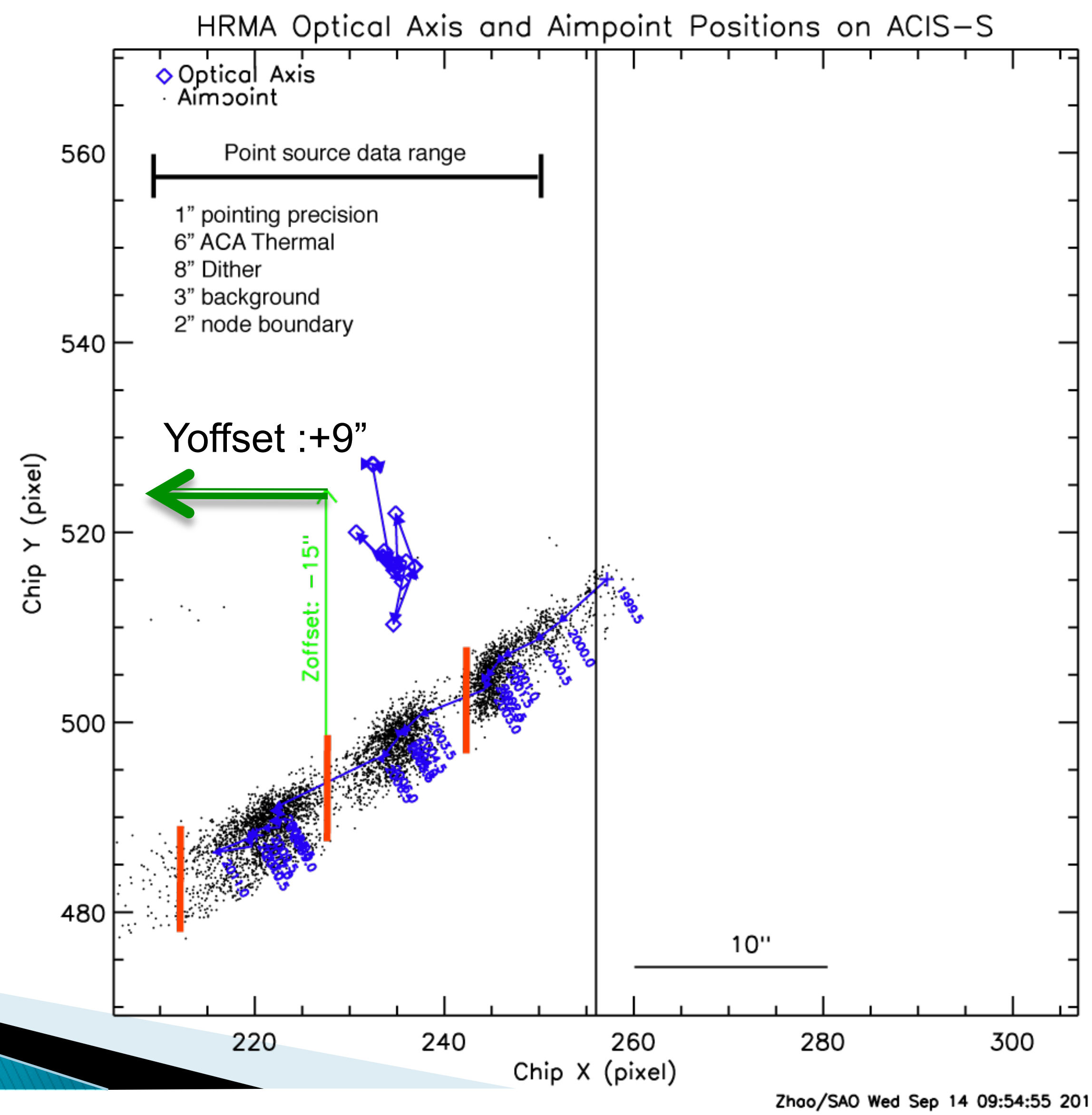


aciss_opaxaimp_cor_shift.ps

ACIS-S Aimpoint - Data Range

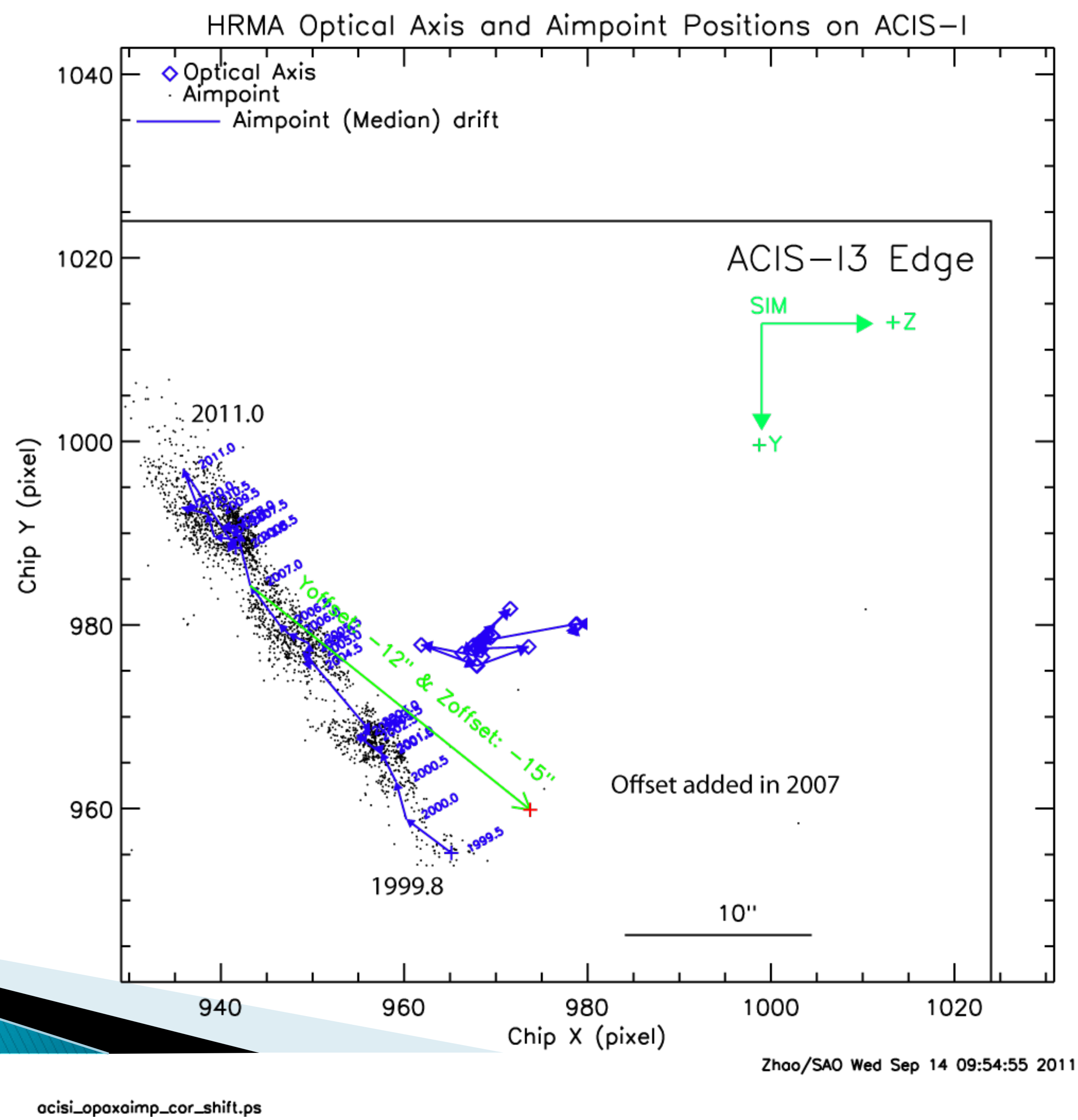


ACIS-S Aimpoint – final offset

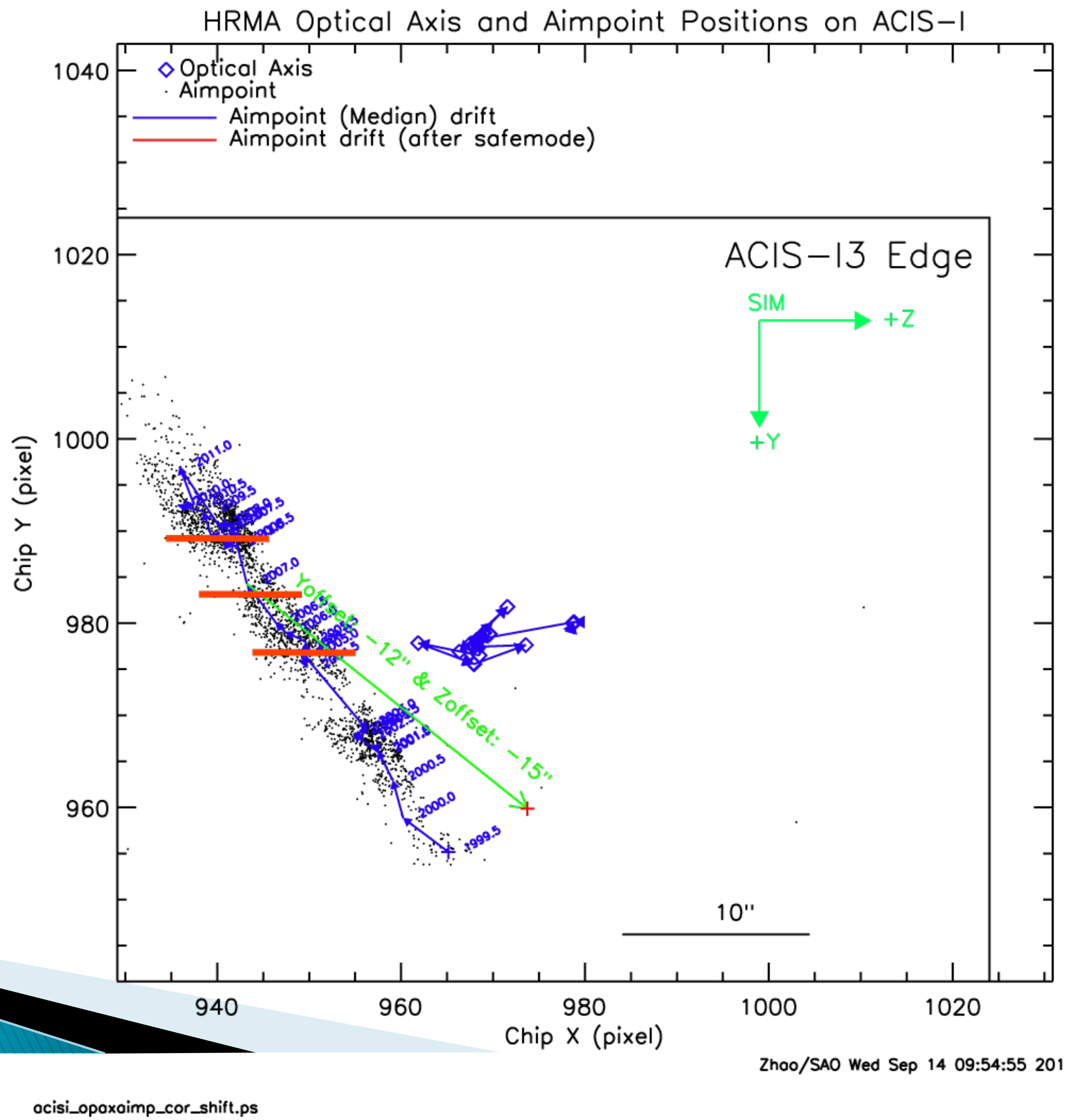


aciss_opaxaimp_cor_shift.ps

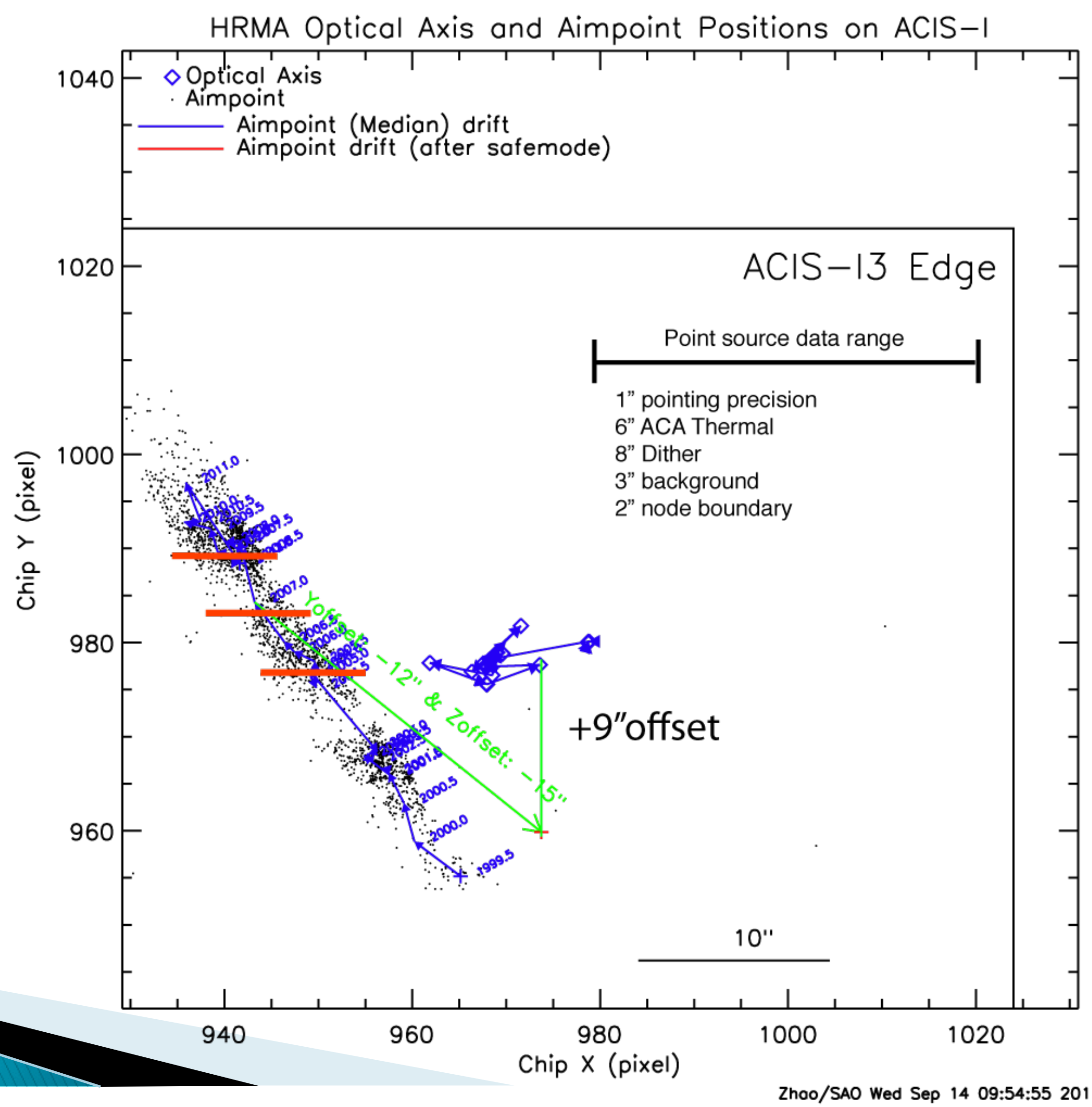
ACIS-I Aimpoint – Prior to safemode



ACIS-I Aimpoint –after safemode

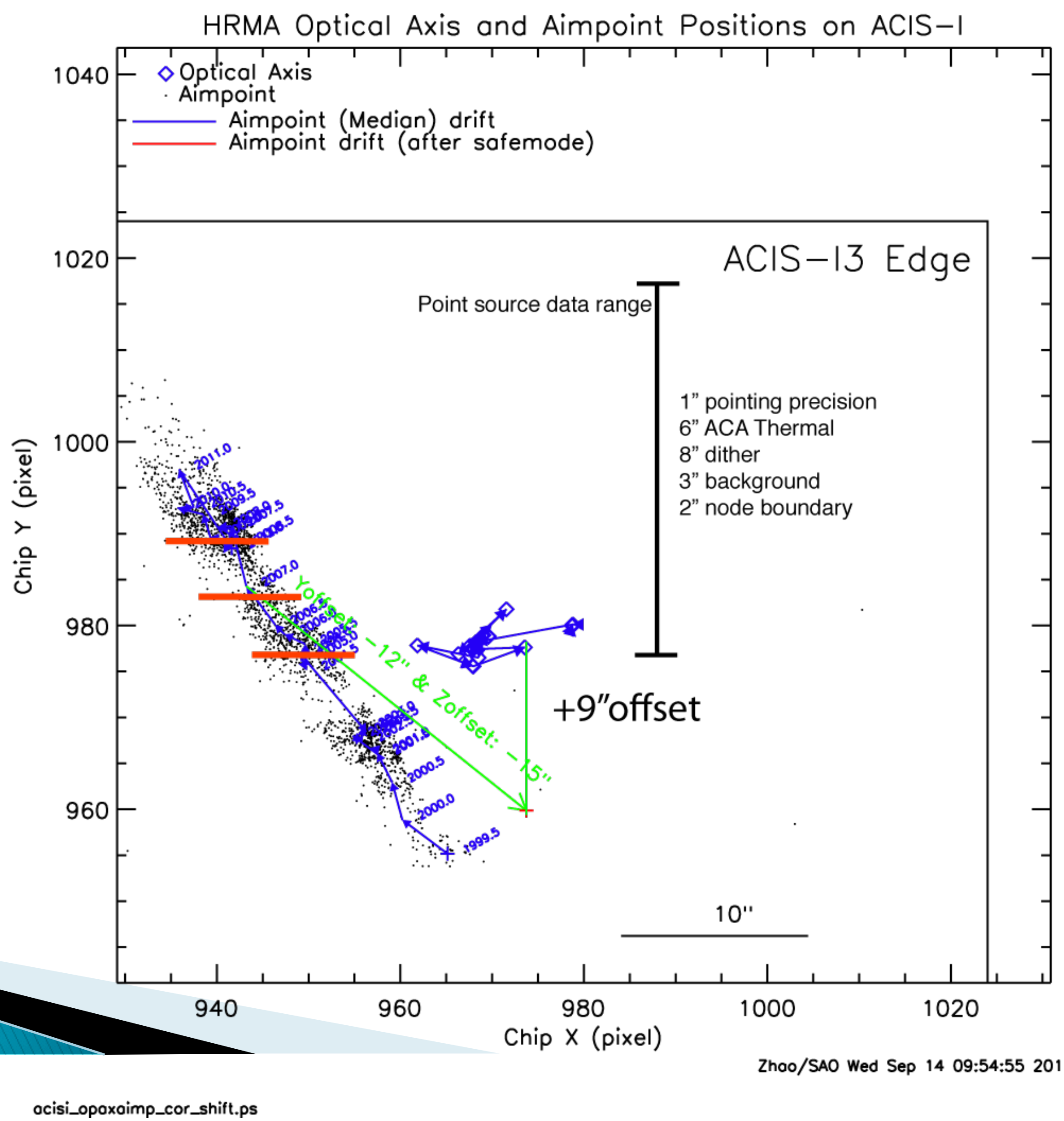


ACIS-I Aimpoint – with new offset

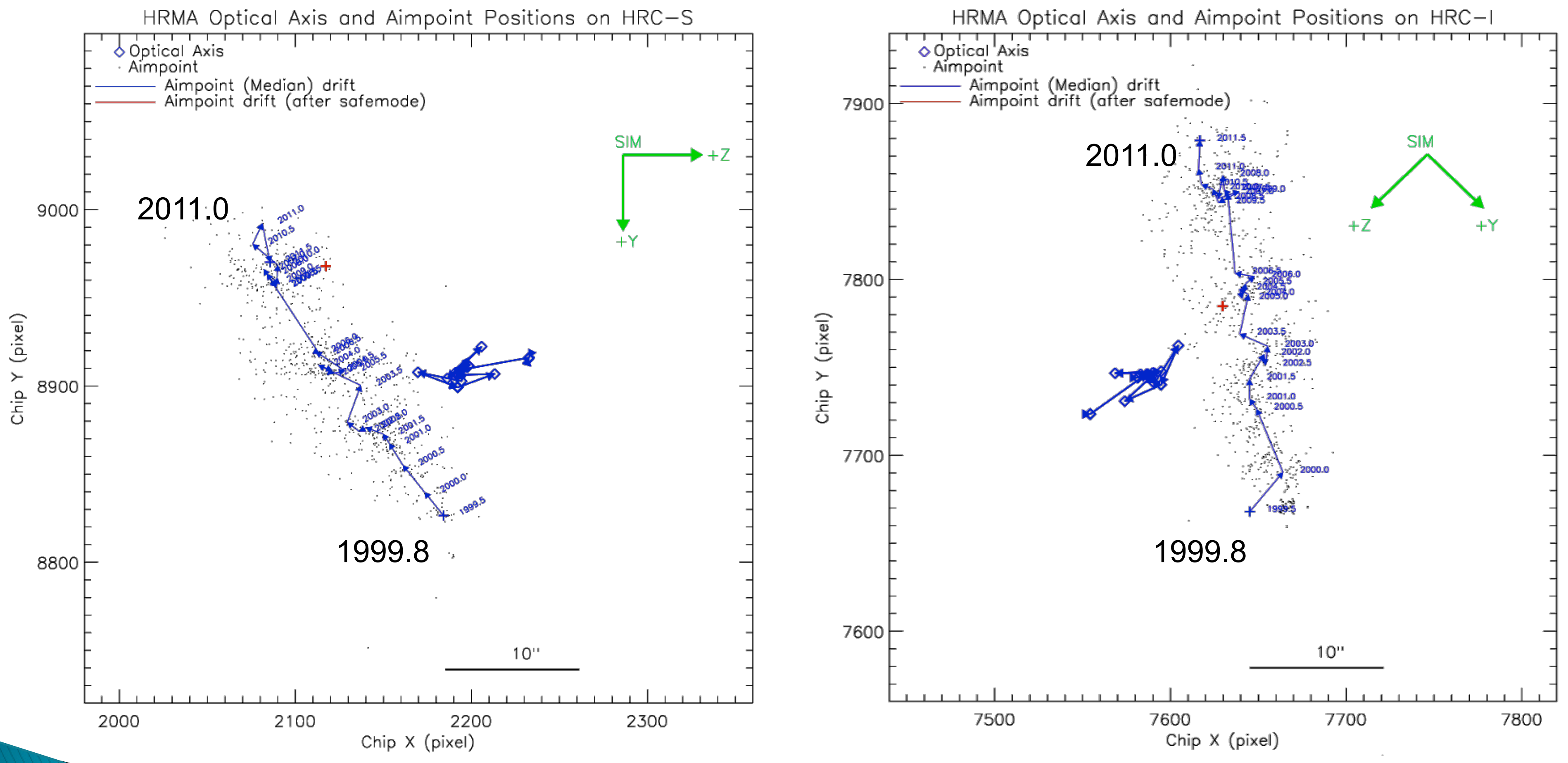


acisi_opaxaimp_cor_shift.ps

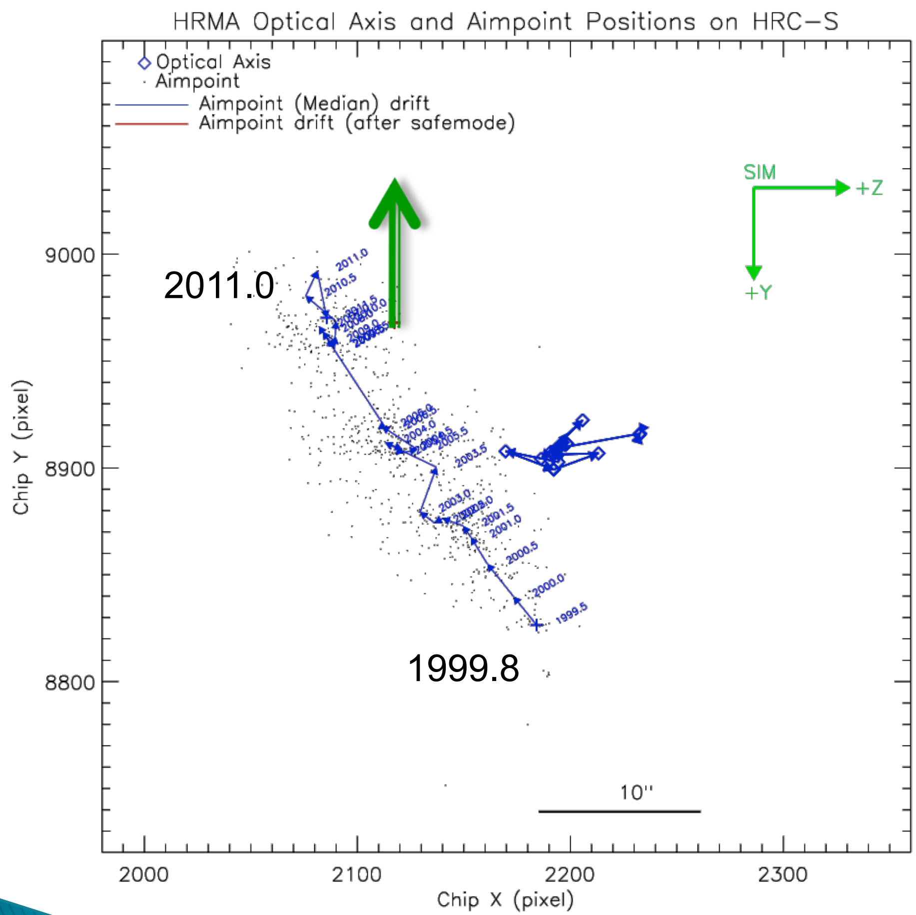
ACIS-I Aimpoint – data range



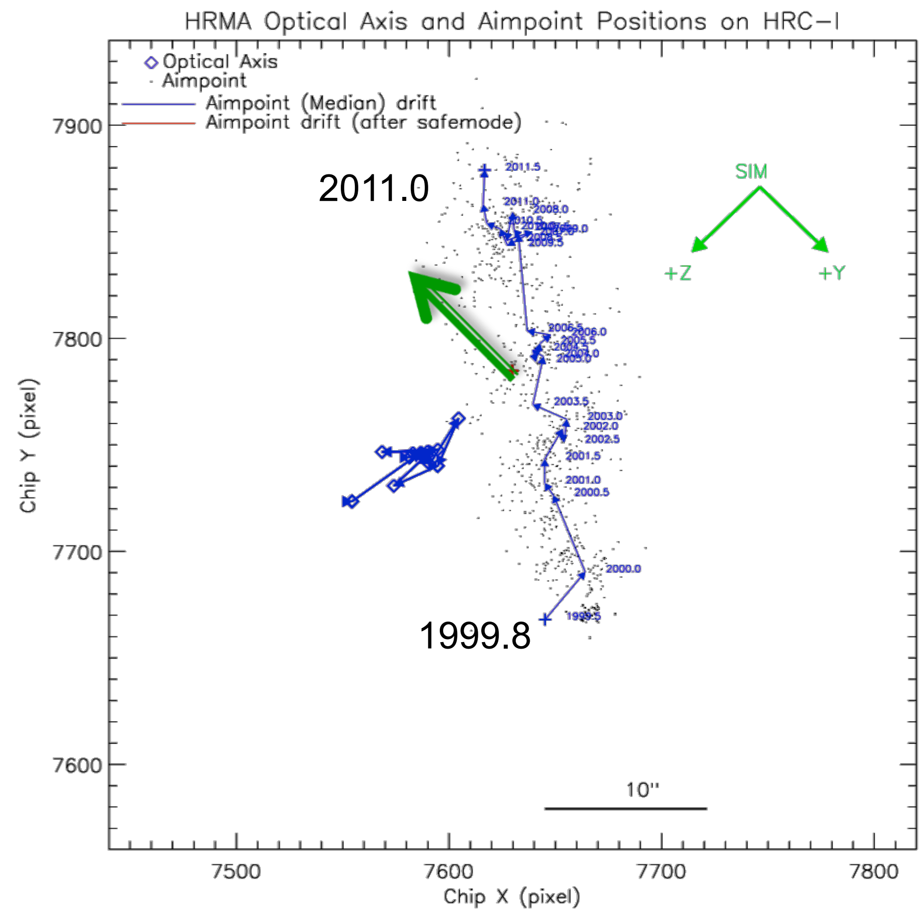
HRC


HRMA Optical Axis and Aimpoint Positions on HRC−S
Optical Axis
Aimpoint
Aimpoint (Median) drift
Aimpoint drift (after safemode)
SIM
+Z
+Y
2011.0
1999.8
10''
Chip Y (pixel)
Chip X (pixel)
9000
8900
8800
2000
2100
2200
2300
HRMA Optical Axis and Aimpoint Positions on HRC−I
Optical Axis
Aimpoint
Aimpoint (Median) drift
Aimpoint drift (after safemode)
SIM
+Z
+Y
2011.0
1999.8
10''
Chip Y (pixel)
Chip X (pixel)
7900
7800
7700
7600
7500
7600
7700
7800

HRC



HRMA Optical Axis and Aimpoint Positions on HRC−S
Optical Axis
Aimpoint
Aimpoint (Median) drift
Aimpoint drift (after safemode)
SIM
+Z
+Y
2011.0
1999.8
10''
9000
8900
8800
2000
2100
2200
2300
Chip Y (pixel)
Chip X (pixel)



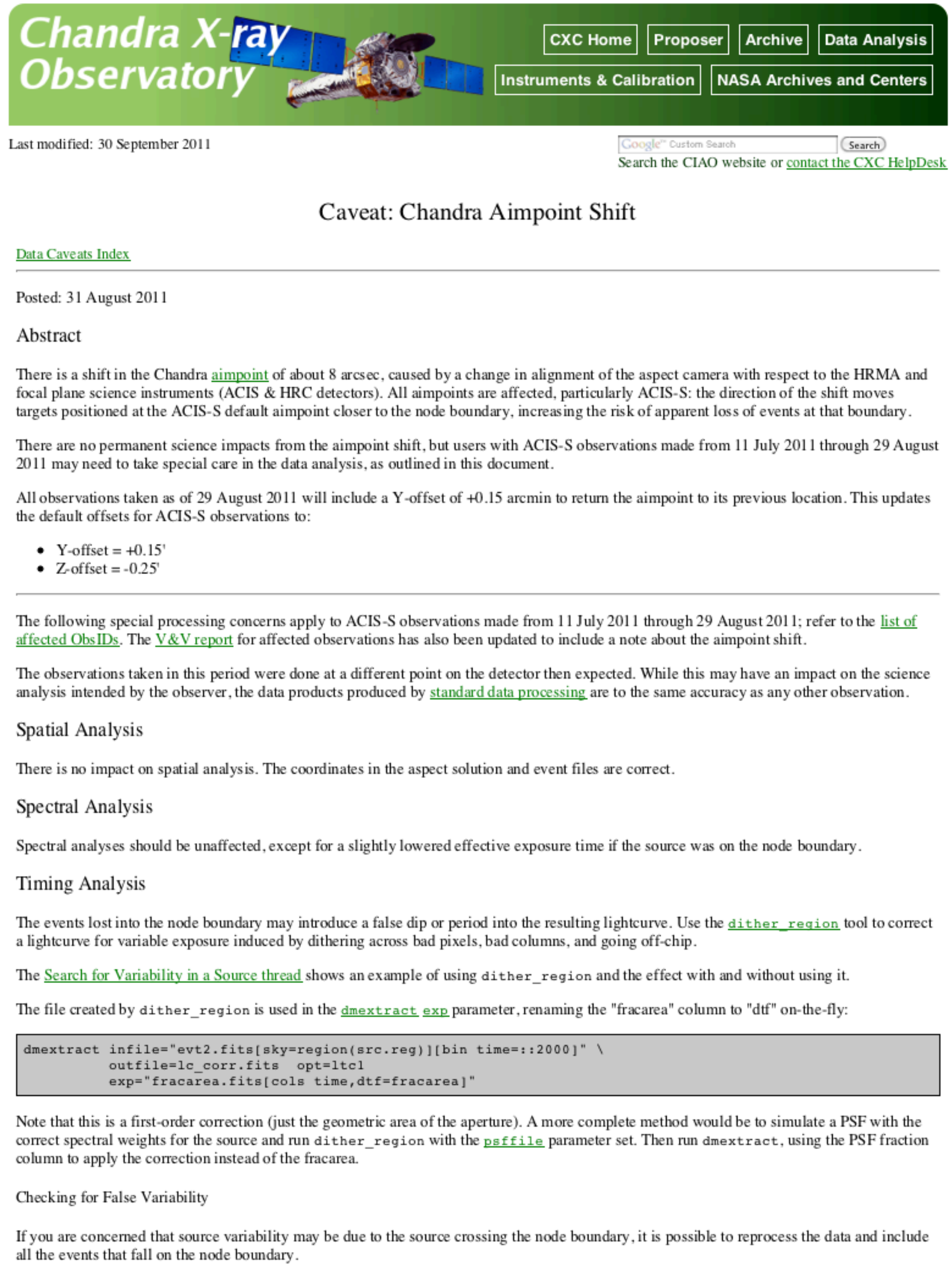
HRMA Optical Axis and Aimpoint Positions on HRC−I
Optical Axis
Aimpoint
Aimpoint (Median) drift
Aimpoint drift (after safemode)
SIM
+Z
+Y
2011.0
1999.8
10''
7900
7800
7700
7600
7500
7600
7700
7800
Chip Y (pixel)
Chip X (pixel)

Status

- 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’

Next Tasks

- 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.



Chandra X-ray Observatory

CXC Home | Proposer | Archive | Data Analysis | Instruments & Calibration | NASA Archives and Centers

Last modified: 30 September 2011

Search the CIAO website or contact the CXC HelpDesk

Caveat: Chandra Aimpoint Shift

Data Caveats 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 node 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 V&V 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 then 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 node boundary.

Timing Analysis

The events lost into the node boundary may introduce a false dip or period 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 `dmextract exp` parameter, renaming the "fracarea" column to "dtf" on-the-fly:

```
dmextract infile="evt2.fits[sky=region(src.reg)][bin time=::2000]" \
          outfile=lc_corr.fits  opt=ltc1
          exp="fracarea.fits[cols time,dtf=fracarea]"
```

Note that this is a first-order correction (just 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 `psffile` parameter set. Then run `dmextract`, using the PSF fraction column 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.