ECR: Add ACISFIDCORR HDU to PCAD CALALIGN CALDB files

Tom Aldcroft 2008-Mar-25

Table of Contents

1 Overview

In order to provide control margin for the ACIS CCD cooler and maintain the desired FP temperature of -119.7 C, the ACIS team has proposed permanently turning off the ACIS detector housing (DH) heater. This has the desired effect of reducing radiative/conductive heating of the CCD by lowering the mean DH temperature. However, an undesired consequence is that the plate on which the ACIS fid lights are mounted will vary in temperature by as much as 13 C from the nominal -60 C. The thermal contraction associated with this shift can produce an angular shift in individual fid light positions by up to 0.3 arcsec relative to the ACA. This will degrade aspect image reconstruction and celestial location if left uncorrected.

DS7.6.11.6 incorporates new aspect pipeline code that uses ACIS DH temperature telemetry and fid light magnitude data to apply a correction to fid light centroid data to compensate for the DH mount plate contraction from the nominal -60 C.

This ECR describes a new CALDB HDU, appended to the existing PCAD CALALIGN product, that contains the calibration constants required for the new code. The CALALIGN files are being updated from N0006 to N0007.

2 New HDU format and contents

Each CALALIGN file has a new HDU called "ACISFIDCORR" appended. The HDU contains 8 columns and 2 rows (for ACIS-S and ACIS-I). The columns are as follows:

Column name	Unit	Type	Description
detector		String[9]	Instrument ID
dh_temp_base	K	Real4	Baseline ACIS DH temperature degC
deg_per_count	K/count	Real4	Degrees per fid light count (integrated e-)
fid_CTE	K**(-1)	Real4	Fid light mount coeff. of thermal expansion
fid_y_center_nom	deg	Real4	Fid light Y-center of expansion
fid_z_center_nom	deg	Real4	Fid light Z-center of expansion
fid_y_ang_nom[6]	deg	Real4(6)	Fid light nominal Y angle
fid_z_ang_nom[6]	deg	Real4(6)	Fid light nominal Z angle

The HDU values are as follows:

detector	dh_temp_base	deg_per_count	fid_CTE	fid_y_center_nom	fid_z_center_nom
ACIS-I	213.15	-0.00026923	1.63E-05	-0.01805	0.3875
ACIS-S	213.15	-0.00026923	1.63E-05	-0.01805	0.3875

ROW	CELL	detector	fid_y_ang_nom[6]	fid_z_ang_nom[6]
1	1	ACIS-I	0.257777	-0.232500
1	2		-0.213611	-0.234722
1	3		0.012777	-0.269444
1	4		0.595833	0.294722
1	5		-0.505555	0.294444
1	6		0.108611	0.473055
2	1	ACIS-S	0.257777	-0.232500
2	2		-0.213611	-0.234722
2	3		0.012777	-0.269444
2	4		0.595833	0.294722
2	5		-0.505555	0.294444
2	6		0.108611	0.473055

3 Analysis

The values of the coefficients were derived using data and scripts in the directory:

```
/proj/sot/ska/analysis/fid_cooling/calib
```

Data for each of the ACIS DH cooling tests were ingested and prepared (using the *yaxx* processing thread `10_prepare_data`) in a format for fitting in Sherpa. The key step then was to simultaneously fit (using `fit_all.py`) for all of the new CALDB coefficients in order to minimize fid residuals after correcting for the DH mount contraction. The correction was done using the same formalism as was implemented in the new aspect pipeline code.

4 Verification

The new N0007 CALDB files were created by TLA and delivered to the CALDB manager. These were processed and assembled into a test CALDB which was installed for test use by DSops. Each of the 17 ACIS cooling test obsids and 2 HRC obsids were reprocessed using the pre-release DS7.6.11.6 pipeline and the test CALDB.

The processed data and verification outputs are available at:

```
/proj/sot/ska/analysis/fid_cooling/corr_fid_cent/CALDB/ds7.6.11.6
```

In each case the `vv_asp` tool was run to allow inspection of the fid light residuals. For all of the 19 reprocessed obsids the residuals indicated nominal aspect pipeline performance. No unexpected pipeline processing warnings or errors were noted.

5 References

- http://occweb.cfa.harvard.edu/twiki/Aspect/FidLightCooling
- http://occweb.cfa.harvard.edu/twiki/Aspect/DHcoolingFidCalibration
- http://cxc.harvard.edu/twiki/bin/view.cgi/AcisOps/CoolingTests