The CHANDRA X-RAY OBSERVATORY CALIBRATION DATABASE (CALDB)

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I. INTRODUCTION

The CHANDRA CALDB is a passive calibration data structure used by CIAO analysis routines.

- Basic structural design is from HEASARC CalDB, intended to contain calibration data for all space-born HEA missions. (See http://heasarc.gsfc.nasa.gov/docs/heasarc/caldb/caldb_intro.html)
- CHANDRA CALDB is a particular branch of HEASARC CALDB that is under development at CXCDS.
- More calib. data than existing CalDBs.

I.A. In general, a CALDB provides the following:

- Provides an organized predictable directory structure.
- Indexing for automated data retrieval by software.
- Time- and boundary-dependent calibration data selection.
- Configuration control and versioning.
- Separation of calib. updates from software updates.
- TBA: A set of user commands for retrieving data via the index. (FTOOLS: quzcif)

I.B. CALDB data are in FITS format.

- Indexing, directory structure, and in our case filenames, are established by CALDB header keyword values:
  - -**TELESCOP** CHANDRA always
  - -**INSTRUME** ACIS,HRC, TEL, EPHIN, SIM, PCAD
  - -**DETNAM** Nonessential, ACIS-n, HRC-S, HRC-I, GRATING, HRMA
  - -**CCLS0001** BCF or CPF
  - -**CDTP0001** DATA, FEF, or
  - -**CCNM0001** Type of calibration data.
  - -**CBDn0001** Boundary value range for a parameter
  - -**CVSD0001** Observation date after which these data should be used; yyyy-mm-dd
  - -**CVST0001** Observation hour after which these data should be used; hh:mm:ss
  - -**CDES0001** Description of data set.
  - -**GRATING** LETG or HETG, indexed through CBD
  - -**GRATTYPE** Grating part; LEG, MEG, HEG

II.A. CALDB directory structure branches by keywords INSTRUME, then by CCLS, then by CCNM.

We have six branches: acis, ephin, hrc, pcad, sim, tel.

$CALDB/data/chandra/acis/

- caldb.indx
- index/
- bcf/
  - badpix/
  - gain/
  - qe/
- cpf/
  - fefs/
  - 2dpsf/
  - osip/

Similarly for hrc/, ephin/, pcad/, and sim/...

II.A. When gratings are involved, CXC convention places them under the “tel” branch, in parallel with HRMA and coordinate system parameter values.

```
$CALDB/data/chandra/tel/
                        caldb.indx
                        index/
                        bcf/
                        hrma/
                              bcf/
                              cpf/
                        grating/
                              hetg/
                                    bcf/
                                    cpf/
                              letg/
                                    bcf/
                                    cpf/
```

II.B. Finding USER files in the CALDB

Some files are selectable by the user for specific analyses, such as RMFs, GRMFs, and PSFs.

- ACIS RESPONSES: *mkrmf* uses FEFs from the CALDB to build RMF's.

  acis_fef_lookup tstart= chipid= type= chipx= chipy=
  $CALDB/data/chandra/acis/cpf/fefs/

- Grating RMFs for *mkgarf* (and sherpa):

  $CALDB/data/chandra/tel/grating/hetg (or letg)/cpf/rmf/

- PSF library for *mkpsf*.

  $CALDB/data/chandra/acis (or hrc)/cpf/2d_psf/

III.A. INDEXING: “caldb.indx” files

- One “caldb.indx” FITS binary table file per branch.
- Columns of stored keyword values from CALDB files in the order that they were indexed.
- One and only one file and extension for each complete keyword configuration.
- Library functions (from FTOOLS) called by CIAO routines or ARDLIB select one and only one dataset for each call.

III.B. Versioning

Each time a new file is added to the CALDB, a new addition is made to the corresponding index file.

"caldb.indx" is linked to a file in ./index called caldbNnnnn.index, where nnnn is a version number, incremented with each addition of files to that branch.

Prescribed configurations of index files correspond to unique CALDB versions.

CALDBVER, in headers of processed data files, indicates this configuration. Currently: Version 2.3 for CIAO users.

IV.A. Downloading your own CALDB from CXC can be accomplished from the web page:

http://cxc.harvard.edu/caldb/download.html

The task is essentially just to download, unzip, and unpack a tar file. Takes <110MByte. See TABLE 1 on web page.

You also need to edit a caldbinit.unix file.

PSF library is huge (~6.6GByte all unpacked) and is available separately.

Set the $CALDB variable to the location you unpacked the tar file.

IV.B. Updating your CALDB.

http://cxc.harvard.edu/caldb/download.html, see TABLE 2.

This is also just downloading, unzipping and unpacking a tar file in exactly the same place you located your CALDB before.

FOLLOW INSTRUCTIONS EXACTLY. Do not use “gtar” to unpack or your index links won’t be updated.

Any corrected files will be overwritten. Outdated files will remain but will not be selected by CIAO (unless you pset them!)

V. The CHANDRA CALDB WEB PAGE is the most current resource for the information in this presentation.

- See http://cxc.harvard.edu/caldb/
- Most of this talk is condensed from "About the Chandra CALDB".
- Download page (Section IV.)
- FILES and CAL LINKS: Gives all currently active and demoted files.
  - -Relationship between "Instruments and Calibrations" web page data and the CALDB.
- Schedule of anticipated updates.
- Version and RELEASE NOTES.
- Caveats and Error Estimates.