Chandra X-ray Center

ACIS Dead Area Correction

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Introduction

The dead area affect on the ACIS FI chips has been calibrated from an I3 measurement of a cluster. This calibration accounts for the effect of cosmic rays which strike the detector and render a portion of it dead for an entire frame. The correction is dependent on CHIPY and ranges from approximately –2.2% at the readout to –4% at the top of the chip.

The calibration file was release in CALDB 3.3.0 on 15 December 2006. In CIAO 3.4, the application of the dead area correction is *turned off* by default. Note that the CIAO tool specextract cannot currently apply the dead area correction; refer to the Applying the Correction section for further instructions.

Technical Details

The cosmic ray flux incident on ACIS reduces the usable area in a probabilistic fashion dependent upon the time a pixel is exposed to cosmic rays during readout. Since that time depends on the clocking parameters and upon parallel read row, it cannot be treated as a scalar factor on the QE or on the effective exposure time. In effect, it is properly a position–dependent exposure time correction factor.

The ACIS "DEAD_AREA" file is implemented in the Chandra CalDB to store for each CCD the fractional area loss per unit time due to cosmic rays. These values are used in the response tools (mkarf, mkinstmap, mkgarf, and mkwarf) in conjunction with the observation–dependent parameter block to compute the average loss factor as a function of position to modify the resultant effective area or "FRACEXPO" (used in pileup modeling, where the exposure time cannot be absorbed into the QE).

A calibration is being introduced as a single coefficient for each chip. A non–zero value – 0.006508 – is being included for the eight FI chips in version N0001 for this file. The effect is not detectable for the BI chips, so the nominal calibration value is 0.0. The resulting chipy–dependent reduction in the EA will be approximately 2.2% at the readout, and 4.0% at the top of the chip.

For further technical details, refer to the memo "Factoring the ACIS QE".

Applying the Correction

The following CIAO response tools can take the dead area correction into account:

- mkarf

- mkinstmap
- mkgarf
- mkwarf

To do so, the value of the `dafile` parameter must be set to "CALDB".

In addition, the `pbkfile` parameter must be set to the appropriate parameter block file for the observation. The parameter block file, one of the "secondary" data products obtained from the Archive, contains ACIS clocking parameters required to scale the coefficients in the dead area correction.

For example:

```
unix% pset mkgarf dafile=CALDB
unix% pset mkgarf pbkfile=acisf063875928N002_pbk0.fits
```

By default, the correction is "off" in CIAO 3.4, i.e. both the `dafile` and `pbkfile` parameters are set to "NONE".

Note that the CIAO tool __specextract__ cannot currently apply the dead area correction. Users of `specextract` need to rerun `mkwarf` independently to include the correction, e.g. as shown in Example 3 of the mkwarf help file.

Observations before 1999–09–16

If an observation was taken on or before 1999–09–16 00:00:00, the tool will fail with a CALDB lookup error:

```
# mkwarf (CIAO 3.4): WARNING: No files found matching CALDB search:
       tel=CHANDRA
       inst=ACIS
       det=-
       filt=-
       product=DEAD_AREA
       start_date=1999-08-30T05:15:43
       start_time=05:15:43
       stop_date=1999-08-30T11:40:08
       stop_time=11:40:08
       query=CCD_ID.eq.1
```

The calibration is valid for these observations, but an indexing problem prevents the file from being selected. The workaround is to manually set the path to the calibration file:

```
unix% pset mkwarf dafile=$CALDB/data/chandra/acis/bcf/dead_area/acisD1999-09-16dead_areaN0001.fits
```

Using the CIAO Analysis Scripts

UPDATED (26 Feb 2007) The CIAO Contributed Scripts package released on 26 February 2007 includes:

- fullgarf v4.0.1 (uses `mkgarf`)
- psextract v4.0 (uses `mkarf`)
- acisspec v4.0 (uses `mkwarf`)

These scripts now have the `pbkfile` and `dafile` parameters included in their own parameter files.

For instance, to apply this correction when running `fullgarf`:

```
unix% pset fullgarf dafile=CALDB
unix% pset fullgarf pbkfile=acisf063875928N002_pbk0.fits
unix% fullgarf
```

The threads and help files for these scripts have been updated with information on the new parameters.

The following is a correction to a previous recommendation of applying the dead area calibration with `merge_all`:

- <u>merge all</u> (uses `mkinstmap`)

  Since `merge_all` runs `mkinstmap` with a merged event file, it *is not* appropriate to try to apply the ACIS dead area correction while running that script. Users who wish to apply the calibration should use the step−by−step exposure maps threads, available from the CIAO Imaging Threads page.