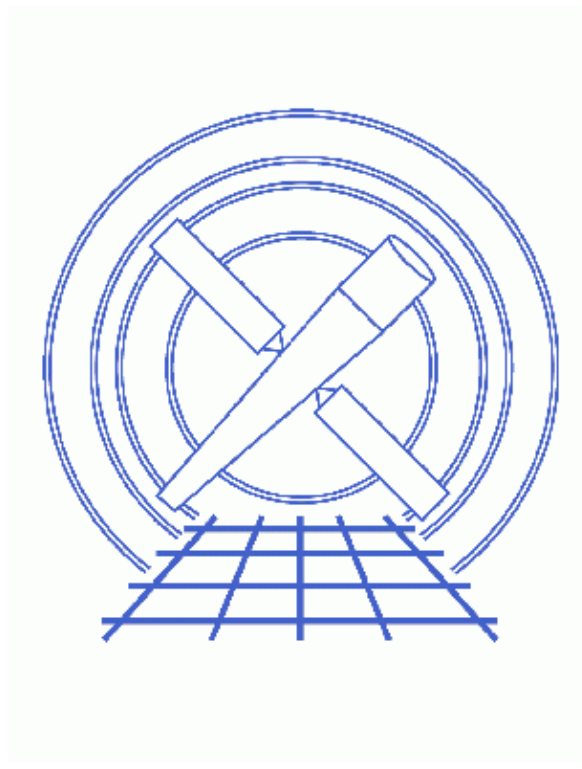


Compute HETG/ACIS-S Grating ARFs



CIAO 3.4 Science Threads

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Compute HETG/ACIS–S Grating ARFs

CIAO 3.4 Science Threads

Overview

Last Update: 26 Feb 2007 – fullgarf v4.0.1: Four new parameters have been added, all of which are used by the mkgarf tool: pbkfile, dafile, osipfile, and maskfile; see "ahelp fullgarf" for details on each new parameter. Added ACIS dead area correction section

Synopsis:

fullgarf is a script that creates a grating ARF for a particular order and grating of an observation. While the mkgarf tool will create a grating ARF for an individual chip given an aspect histogram, this script creates ARFS for each chip, creating aspect histograms as necessary. The script then combines the individual ARFS into one for the full array.

Purpose:

To create grating ARFs for an HETG/ACIS–S observation.

Read this thread if:

you are working with an HETG/ACIS–S observation and intend to model and fit the spectra in *Sherpa*.

Calibration Updates:

- **CALDB v2.26 (2 Feb 2004):** The ACIS contamination files were added to the CALDB. The Account for the ACIS QE Degradation section of this thread describes how it is taken into account in the data analysis.
- **CALDB v2.8 (13 Sep 2001):** New OSIP files make it possible to analyze –120 degrees S3 grating data with the gainmaps and FEFs that were in the previous CALDB release. If you are working with an observation taken under these conditions, run the Apply an ACIS Gain Map and Obtain Grating Spectra from HETG/ACIS Data threads before running this thread to ensure the use of the correct gainmap and OSIP files.

Related Links:

- Analysis Guide for Chandra High Resolution Spectroscopy: an in–depth discussion of grating analysis.
- Continuous Clocking Mode why topic: additional information for users working with CC–mode data.

Proceed to the HTML or hardcopy (PDF: A4 | letter) version of the thread.

Get Started

Sample ObsID used: 459 (HETG/ACIS–S, 3C 273)

File types needed: evt2; pha2; asol1; bpix1; msk1

If you created a new bad pixel file by running the [Create a New ACIS Bad Pixel File: Identify ACIS Hot Pixels and Cosmic Ray Afterglows thread](#), use that file in this analysis. Otherwise, use the `bpix1.fits` file from the Archive. Make sure that you have [set up ardlib](#) to use the same bad pixel file.

It is assumed that you have created a gRMF for your observation by running the [Create Grating RMFs for ACIS–S Observations thread](#), which is called `rmf.fits`.

Download the script

This thread uses the `fullgarf` script; for information about the script, consult the help file ("[ahelp fullgarf](#)"). The most recent version of `fullgarf` is v4.0.1 (12 February 2007):

```
unix% grep version_ `which fullgarf`
version_str="4.0.1"
version_date="12 February 2007"
```

Please check that you are using the most recent version before continuing. If you do not have the script installed or need to update to a newer version, please refer to the [Scripts page](#).

Using the mask file

To make sure that the gARF file is correct, set the `maskfile` to the [observation-specific msk1.fits file](#). ***If you are working with continuous-clocking (CC) mode data***, be sure to read the [ACIS Pipeline-Processed Mask Files caveat](#) as well.

The `maskfile` parameter was added to the `fullgarf` parameter file in v4.0.1. Prior to that version, it had to be set in `mkgarf.par` before running this script.

The ACIS Dead Area Correction

There is a fractional area loss per unit time due to cosmic ray flux incident on the ACIS detector. Calibration to account for this ACIS "dead area" was included in CALDB 3.3.0 on 15 December 2006. The correction is non-zero for the 8 front-illuminated ACIS chips; 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. Refer to the [ACIS Dead Area Correction why topic](#) for technical details.

In CIAO 3.4, the application of the dead area correction is ***turned off*** by default. However, users may opt to include it in the analysis by setting the `pbkfile` and `dafile` parameters in this script. Refer to the script help file for details on these parameters.

Account for the ACIS QE Degradation


The effective low–energy ACIS QE is lower now than it was at launch. This problem is thought to be associated with the deposition of one or more materials on the ACIS detectors or optical blocking filters. Since the depth of these contaminants is growing with time, the effective low–energy QE is becoming lower as time passes. A correction for this degradation should be incorporated when creating ACIS response files.

Refer to the [ACIS QE Degradation why topic](#) for more information.

Determine the Orders of the Observation

An ARF needs to be calculated for each order in the observation. We can use [Prism](#) to examine the pha2 file and determine how many orders there are:

```
unix% prism acisf00459N002_pha2.fits &
```

The `tg_m` column indicates the order of the observation (+/- 1, +/- 2, +/- 3) and the `tg_part` column indicates the grating (1 = HEG, 2 = MEG, 3 = LEG). In [this example](#)  there are twelve rows (all +/- orders for HEG and MEG) for the HETG observation.

Run fullgarf

We will have to run `fullgarf` twelve times, once for each row in the PHA file.

For row 1, HEG, order = -3:

```
unix% punlearn fullgarf
unix% pset fullgarf phafile=acisf00459N002_pha2.fits
unix% pset fullgarf pharow=1
unix% pset fullgarf evtfile=acisf00459N002_evt2.fits
unix% pset fullgarf asol=@pcad_asol1.lis
unix% pset fullgarf engrid="grid(rmf.fits[cols ENERG_LO,ENERG_HI])"
unix% pset fullgarf dtffile=")evtfile"
unix% pset fullgarf badpix=acis_459_new_bpix1.fits
unix% pset fullgarf maskfile=acisf00459_000N002_msk1.fits
unix% pset fullgarf rootname=acisf00459
```

In many cases there will be more than one `asol1.fits` file for an observation. **All** the files must be input to the `asol` parameter, either as a list or as a stack (see [ahelp stack](#) for more information). For example, here we used:

```
unix% more pcad_asol1.lis
pcadf063874624N002_asol1.fits
pcadf063875522N002_asol1.fits
pcadf063902942N002_asol1.fits
```

If you wish to [include the ACIS dead area correction](#) (not applied in this thread), set the `pbkfile` and `dafile` parameters as well:

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

Now run the tool:

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```
unix% fullgarf
Will use /home/username/cxcds_param/fullgarf.par for the parameter file.

/home/username/cxcds_param/fullgarf.par contains 15 parameters . . .

Input PHA file (Type I or II) (acisf00459N002_pha2.fits):
Row in Type II PHA file (ignored if Type I) (0:99) (1):
Event file (acisf00459N002_evt2.fits):
Aspect offsets file (@pcad_asol1.lis):
Energy grid spec (grid(rmf.fits[cols ENERG_LO,ENERG_HI])):
Dead time correction factor; ACIS->evt file; HRC -> dtf file)evtfile -> acisf00459N002_evt2.fits):
Bad pixel file; (filename|NONE|CALDB) (acis_459_new_bpix1.fits):
Output rootname (acisf00459):
NONE, or name of ACIS window mask file (acisf00459_000N002_msk1.fits):
Getting the pha file type . . .
Grating arm is HEG, order=-3
Source location is X=4124.9199218750, Y=4068.3400878906

Detector is ACIS
Will run asphist for ccd_id= 4 5 6 7

asphist infile=@pcad_asol1.lis outfile=acisf00459_ah4.fits evtfile=acisf00459N002_evt2.fits[ccd_id=4]
dtffile=acisf00459N002_evt2.fits

asphist infile=@pcad_asol1.lis outfile=acisf00459_ah5.fits evtfile=acisf00459N002_evt2.fits[ccd_id=5]
dtffile=acisf00459N002_evt2.fits

asphist infile=@pcad_asol1.lis outfile=acisf00459_ah6.fits evtfile=acisf00459N002_evt2.fits[ccd_id=6]
dtffile=acisf00459N002_evt2.fits

asphist infile=@pcad_asol1.lis outfile=acisf00459_ah7.fits evtfile=acisf00459N002_evt2.fits[ccd_id=7]
dtffile=acisf00459N002_evt2.fits

Finished creating aspect histograms for ccd_id= 4 5 6 7
Will run mkgarf for the same ccd_id list

mkgarf detsubsys=ACIS-S0 order=-3 grating_arm=HEG outfile=acisf00459_S0_HEG_-3.fits asphistfile=acisf00
[ASPHIST] engrid=grid(rmf.fits[cols ENERG_LO,ENERG_HI]) osipfile=CALDB dafile=NONE pbkfile=NONE
maskfile=acisf00459_000N002_msk1.fits mode=hl verb=0
*** ERROR: aspect histogram acisf00459_ah4.fits[ASPHIST] contains no rows

mkgarf detsubsys=ACIS-S1 order=-3 grating_arm=HEG outfile=acisf00459_S1_HEG_-3.fits asphistfile=acisf00
[ASPHIST] engrid=grid(rmf.fits[cols ENERG_LO,ENERG_HI]) osipfile=CALDB dafile=NONE pbkfile=NONE
maskfile=acisf00459_000N002_msk1.fits mode=hl verb=0

mkgarf detsubsys=ACIS-S2 order=-3 grating_arm=HEG outfile=acisf00459_S2_HEG_-3.fits asphistfile=acisf00
[ASPHIST] engrid=grid(rmf.fits[cols ENERG_LO,ENERG_HI]) osipfile=CALDB dafile=NONE pbkfile=NONE
maskfile=acisf00459_000N002_msk1.fits mode=hl verb=0

mkgarf detsubsys=ACIS-S3 order=-3 grating_arm=HEG outfile=acisf00459_S3_HEG_-3.fits asphistfile=acisf00
[ASPHIST] engrid=grid(rmf.fits[cols ENERG_LO,ENERG_HI]) osipfile=CALDB dafile=NONE pbkfile=NONE
maskfile=acisf00459_000N002_msk1.fits mode=hl verb=0

Finished creating grating arfs for ccd_id= 4 5 6 7

dmarfadd @thisfile.istemporary acisf00459HEG_-3_garf.fits

fullgarf finished.
```

The aspect-related error from `mkgarf` may be ignored; it is explained in [this FAQ](#). The content of the parameter file may be checked using `plist fullgarf`.

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The script is run in a similar way for the remaining rows.

Summary

The thread is now complete. The grating ARFs for this dataset are:

```
acisf00459HEG_-1_garf.fits  acisf00459MEG_-1_garf.fits
acisf00459HEG_-2_garf.fits  acisf00459MEG_-2_garf.fits
acisf00459HEG_-3_garf.fits  acisf00459MEG_-3_garf.fits
acisf00459HEG_1_garf.fits   acisf00459MEG_1_garf.fits
acisf00459HEG_2_garf.fits   acisf00459MEG_2_garf.fits
acisf00459HEG_3_garf.fits   acisf00459MEG_3_garf.fits
```

Parameters for /home/username/cxcds_param/fullgarf.par

```
phafile = acisf00459N002_pha2.fits Input PHA file (Type I or II)
pharow = 1 Row in Type II PHA file (ignored if Type I)
evtfile = acisf00459N002_evt2.fits Event file
  asol = @pcad_asol1.lis Aspect offsets file
  engrid = grid(rmf.fits[cols ENERG_LO,ENERG_HI]) Energy grid spec
dtffile = )evtfile -> acisf00459N002_evt2.fits Dead time correction factor; ACIS->evt file
badpix = acis_459_new_bpix1.fits Bad pixel file; (filename|NONE|CALDB)
rootname = acisf00459 Output rootname
maskfile = acisf00459_000N002_msk1.fits NONE, or name of ACIS window mask file
(pbkfile = NONE) NONE, or the name of the parameter block file
(dafile = NONE) NONE, CALDB, or name of ACIS dead-area calibration file
(osipfile = CALDB) NONE or Name of fits file with order sorting info
(clobber = no) Clobber existing output files? This is passed to ALL child processes
(verbose = 0) Control the level of diagnostic output. 0=>least.
(mode = hl) Mode flags. Set to 'ql' to enable querying, 'hl' to suppress.
```

History

- 23 Dec 2004 updated for CIAO 3.2: canned gRMFs are no longer available in the CALDB, removed "Choosing an RMF" section
 - 06 Dec 2005 updated for CIAO 3.3: the fullgarf script has been updated to version 3.3.1 for the new asphist tool syntax; corresponding changes to screen output
 - 01 Dec 2006 reviewed for CIAO 3.4: no changes
 - 26 Feb 2007 fullgarf v4.0.1: Four new parameters have been added, all of which are used by the mkgarf tool: pbkfile, dafile, osipfile, and maskfile; see "ahelp fullgarf" for details on each new parameter. Added ACIS dead area correction section
-

URL: http://cxc.harvard.edu/ciao/threads/mkgarf_hetgacis/

Last modified: 26 Feb 2007

Image 1: Viewing the pha2 file in prism

The screenshot shows the prism software interface with the file 'prism-1 : acisf00459N002_pha2.fits' open. The interface includes a menu bar (File, Edit, Navigate, Visualization, Session, Analysis, Help) and a status bar at the bottom.

The top-left pane displays the FITS header information:

TABLE	PRIMARY	NULL
SPECTRUM		13 cols, 12 rows
REGION		11 cols, 36 rows

The top-right pane displays the FITS header text:

```

COMMENT This FITS file may contain long string keyword values that
COMMENT continued over multiple keywords. The HEASARC convention u
COMMENT character at the end of each substring which is then contin
COMMENT on the next keyword which has the name CONTINUE.
DATE 2000-10-31T13:18:03 / Date and time of file creation
DATE-OBS 2000-01-10T06:47:15 / Date and time of observation start
DATE-END 2000-01-10T18:23:09 / Date and time of observation stop
TIMESYS TT / Time system
MJDREF 50814.0 / MJD zero point for times
TIMEZERO 0 / Clock correction
    
```

The main data table is as follows:

	SPEC_NUM	TG_M	TG_PART	TG_SRCID	X	Y	CHANNEL	COUNTS
Units					pixel	pixel		count
Types	short	short	short	short	float	float	short	short
1	1	-3	1	1	4124.92	4068.34	short[8192]	short[8192]
2	2	-2	1	1	4124.92	4068.34	short[8192]	short[8192]
3	3	-1	1	1	4124.92	4068.34	short[8192]	short[8192]
4	4	1	1	1	4124.92	4068.34	short[8192]	short[8192]
5	5	2	1	1	4124.92	4068.34	short[8192]	short[8192]
6	6	3	1	1	4124.92	4068.34	short[8192]	short[8192]
7	7	4	1	1	4124.92	4068.34	short[8192]	short[8192]

The bottom status bar shows: View Mode: Read/Write Processing : 11 of 12. Navigation buttons (Goto, Forward, Back) are visible. A message at the bottom reads: 'Fri 05 - Oct 12:40:04 Loading file acisf00459N002_pha2.fits'.