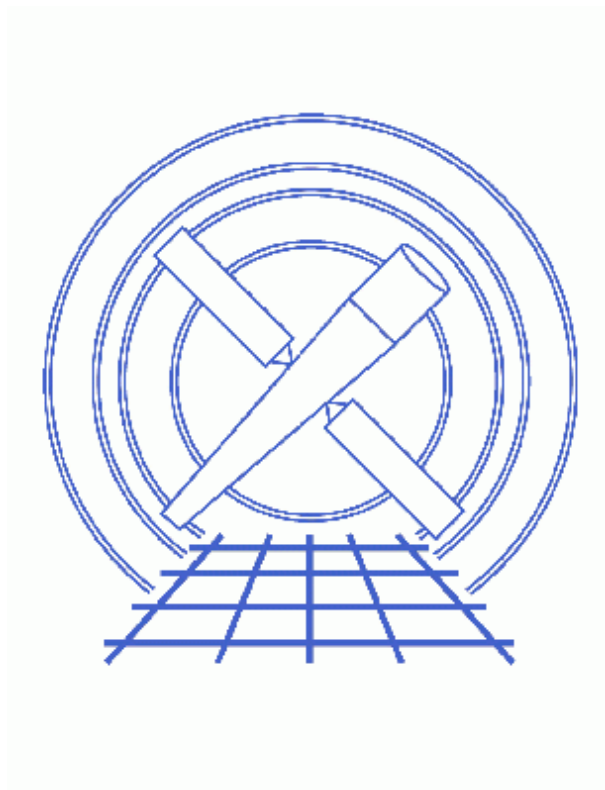


# Extract Coadded and Grouped Nth-Order Source & Background Spectra and ARFs



## ***CIAO 3.4 Science Threads***

# Table of Contents

- *Get Started*
- *Downloading add grating orders*
- *Run add grating orders*
- *Summary*
- *Parameter files:*
  - ◆ *add grating orders*
- *History*

---

# Extract Coadded and Grouped Nth–Order Source & Background Spectra and ARFs

*CIAO 3.4 Science Threads*

## Overview

*Last Update:* 1 Dec 2006 – reviewed for CIAO 3.4: no changes

### *Synopsis:*

[add\\_grating\\_orders](#) is a script which lets the user add up positive and negative diffraction orders of a given grating spectrum, and their associated ARFs. The output spectrum can be grouped if desired.

### *Purpose:*

To generate and group a coadded positive and negative order grating spectrum (for both source and background) and the associated ARF.

### *Read this thread if:*

you are working with ACIS/HETG, ACIS/LETG, or HRC/LETG observational data and would like to add the grating orders.

### *Related Links:*

- [Analysis Guide for Chandra High Resolution Spectroscopy](#): an in–depth discussion of grating analysis.

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:* pha2

This thread assumes that you have created positive and negative grating ARFs for your dataset. This process is illustrated in the threads for building [ACIS/HETG](#), [ACIS/LETG](#), [HRC–S/LETG](#), or [HRC–I/LETG](#) ARFs.

The data to be combined must have been taken with the same instrumental configuration:

- ACIS–HETG–HEG
- ACIS–HETG–MEG
- ACIS–LETG–LEG
- HRC–LETG–LEG

---

## Downloading add\_grating\_orders

The most recent version of add\_grating\_orders is 2.2 (22 May 2001):

```
unix% grep version_ `which add_grating_orders`
version_str="2.2"
version_date="22 May 2001"
```

*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](#).

---

## Run add\_grating\_orders

The script executes the following tools in order:

1. [dmtype2split](#): to split the PHA2 spectrum into two temporary positive and negative order spectra with PHA1–like format.
2. [dmtcalc](#): to rename columns in the two temporary PHA1 files, and to build two temporary single–order ARFs with renamed columns.
3. [dmpaste](#): to merge the two temporary PHA1 spectra and ARFs. gspec
4. [dmtcalc](#): to add together positive and negative spectra and ARFs.
5. [dmcoppy](#): to build a final coadded spectrum (with a PHA1–like format) and a coadded ARF.
6. [dmgroup](#): to group the coadded positive and negative order spectrum (if needed).

In this example, we build coadded 1st–order source and background MEG spectra and a 1st–order ARF. Then the source spectrum is grouped by a factor of 10 (to learn more about the several options for `gtype`, see [ahelp dmgroup](#)). Note that the “ADAPTIVE” grouping may take a long time on large PHA files):

```
unix% punlearn add_grating_orders
unix% pset add_grating_orders pha2=acisf00459N002_pha2.fits
unix% pset add_grating_orders order=1
unix% pset add_grating_orders garm=MEG
unix% pset add_grating_orders garfm=acisf00459MEG_-1_garf.fits
unix% pset add_grating_orders garfp=acisf00459MEG_1_garf.fits
unix% pset add_grating_orders gtype=BIN
unix% pset add_grating_orders gspec=10
unix% pset add_grating_orders root=459
unix% add_grating_orders
Input PHA2 spectrum (acisf00459N002_pha2.fits):
Order of the grating spectra to extract and add together (1):
Grating Arm (HEG, MEG or LEG) (MEG):
Negative order grating ARF (acisf00459MEG_-1_garf.fits):
Positive order grating ARF (acisf00459MEG_1_garf.fits):
Root name for output files (459):
```

## Coadd and Group Spectral Orders – CIAO 3.4

```
Input pha2 file is: acisf00459N002_pha2.fits
Using MEG grating ARF order 1: acisf00459MEG_-1_garf.fits
Using MEG grating ARF order 1: acisf00459MEG_1_garf.fits
The root filename for the output file is: 459

The coadded, grouped output spectrum is named 459_MEG_1_BIN10.pha
The coadded Effective Area is named 459_MEG_1.arf
```

The content of the parameter file may be checked using `plist add grating orders`.

---

## Summary

The thread is now complete. The coadded 1st-order spectra are contained in the PHA1-like file named `459_MEG_1_BIN10.pha`; the coadded +/- 1st order ARF is named `459_MEG_1.arf`.

To fit this data in *Sherpa*:

```
sherpa> data 459_MEG_1_BIN10.pha
sherpa> rsp[arfname](,459_MEG_1.arf,)
sherpa> instrument = arfname
```

See the [Fitting PHA Data with Multi-Component Source Models](#) thread for more information.

---

Parameters for `/home/username/cxcds_param/add_grating_orders.par`

```
pha2 = acisf00459N002_pha2.fits Input PHA2 spectrum
order = 1 Order of the grating spectra to extract and add together
garm = MEG Grating Arm (HEG, MEG or LEG)
garfm = acisf00459MEG_-1_garf.fits Negative order grating ARF
garfp = acisf00459MEG_1_garf.fits Positive order grating ARF
root = 459 Root name for output files
(gtype = BIN) Spectrum grouping type
(gspec = 10) Spectrum grouping specs (NONE,10,etc)
(clobber = no) Clobber existing output files?
(verbose = 0) Debug Level(0-5)
(mode = ql)
```

---

## History

14 Dec 2004 updated for CIAO 3.2: created [Downloading add\\_grating\\_orders section](#)

06 Dec 2005 reviewed for CIAO 3.3: no changes

01 Dec 2006 reviewed for CIAO 3.4: no changes

URL: [http://cxc.harvard.edu/ciao/threads/add\\_grating\\_orders/](http://cxc.harvard.edu/ciao/threads/add_grating_orders/)

Last modified: 1 Dec 2006