



PHA (Spectrum) Files

Data Products Guide

| Level | Instrum | ICD | Data product | Content | Pipeline | Filename template |
|-------|---------|----------------------|---------------------------------------|----------|----------|-------------------|
| L2 | ACIS | v1.4 | ACIS Grating Spectrum | SPECTRUM | TG2 | pha2.fits |
| L2 | HRC | v1.4 | HRC Grating Spectrum | SPECTRUM | TG2 | pha2.fits |

ACIS Grating Spectrum

| Level | Instrum | ICD | Data product | Content | Pipeline | Filename template |
|-------|---------|----------------------|---------------------------------------|----------|----------|-------------------|
| L2 | ACIS | v1.4 | ACIS Grating Spectrum | SPECTRUM | TG2 | pha2.fits |

description:

Transmission grating spectra for a Chandra observation are provided in the form of PHA files: 1–D counts histograms. (The name "**PHA**" is historical, referring to "Pulse Height Analyzer" or "Pulse Height Amplitude".) PHA are actually available in two formats, referred to as "Type I" and "Type II". Type I PHA are the traditional format of PHA, with sequential channels stored in sequential rows. Type II PHA files may contain many Type I PHA, with each Type I PHA stored as a row of the overall file. Thus, for any given row of a Type II PHA, the counts histogram is stored as an array. Since Chandra grating observations have at least two orders (for [LETGS](#); 12 orders for [HETGS](#)), the Type II PHA is the standard method of storing grating observation data.

Among other things, the pipeline processing will find the grating arms using [tgdetect](#), and assign each event to an order with [tg_resolve_events](#). Finally [tgextract](#) is used to create the final pha2 file.

Certain combinations of Chandra's gratings and instruments may give leveraged utility in an observation. One particular combination that is used with the ACIS–S array and the HETG is called the HETGS or High Energy Transmission Grating Spectrometer. The Proposers' Observatory Guide has [examples of HETGS Observations](#).

To begin analysis on the pha2 file, see the [Examining PHA2 Files](#) thread.

file name template:

```
acis*_pha2.fits
```

creator pipeline:

TG2

creator tool:

tgextract – *tgextract* is the final step of a series of tools designed to process chandra grating data. See the [Grating Spectroscopy threads page](#) for more info on reprocessing this data.

useful links:

- [Analysis Guide for Chandra High Resolution Spectroscopy](#) – with acknowledgements for some of the content presented here.
- [Grating Spectroscopy threads page](#)

SPECTRUM-specific columns:

| Column Name | Units | Description |
|-----------------------|----------|---|
| SPEC_NUM | – | Spectrum Number (each row indicates a different PHA Type I) |
| TG_M | – | Diffraction order (m) |
| TG_PART | – | Spectral component (0=zero order, 1=HEG, 2=MEG, 3=LEG, 99=background) |
| TG_SRCID | – | Source ID, output by detect |
| X | pixel | X sky coord of source |
| Y | pixel | Y sky coord of source |
| CHANNEL[8192] | – | Vector of spectral bin numbers |
| COUNTS[8192] | count | Counts array (a spectrum) |
| STAT_ERR[8192] | count | Statistical uncertainty (error) on counts column |
| BACKGROUND_UP[8192] | count | Background count vector |
| BACKGROUND_DOWN[8192] | count | Background count vector |
| BIN_LO[8192] | angstrom | Bin boundry, left edge |
| BIN_HI[8192] | angstrom | Bin boundry, right edge |

The Type II PHA files will also have a second block called "REGION" attached. This block spatially defines the regions used to extract the source and background spectra for the observation. For an HETG/ACIS observation (a.k.a "HETGS") there is a source, upper background, and lower background defined for each of the six orders of the HEG and MEG spectra. This creates a total of 36 regions.

REGION-specific columns:

| Column Name | Units | Description |
|-------------|----------------------|---|
| SPEC_NUM | – | Spectrum Number (each row indicates a different PHA Type I) |
| ROWID | – | Source or a background region? |
| SHAPE | – | Shape of region |
| TG_LAM | angstrom | Dispersion coordinate vector for SHAPE |
| TG_D | degrees | Cross-dispersion coordinate vector for SHAPE |
| R[2] | (angstrom , degrees) | Radius vector for SHAPE |
| ROTANG | degrees | Rotation angle for SHAPE |
| TG_PART | – | Grating part index (HEG=1, MEG=2, LEG=3) |
| TG_SRCID | – | Source identification number |
| TG_M | – | Diffraction order |

HRC Grating Spectrum

| Level | Instrum | ICD | Data product | Content | Pipeline | Filename template |
|-------|---------|-------------|-----------------------------|----------|----------|-------------------|
| L2 | HRC | <u>v1.4</u> | <u>HRC Grating Spectrum</u> | SPECTRUM | TG2 | pha2.fits |

The creation of a PHA file from HRC data is fairly similar to the ACIS method. The discussion of this method may be seen in the [ACIS Grating Spectrum](#) section.

The Proposers' Observatory Guide has an [example of an LETGS observation](#). The Low Energy Transmission Grating Spectrometer is the name given for the combination of the LETG with HRC-S.

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URL:
http://cxc.harvard.edu/ciao3.4/data_products_guide/pha_descrip.html
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