



## PHA (Spectrum) Files

[Data Products Guide](#)

Level	Instrum	ICD	Data product	Content	Pipeline	Filename template
L2	ACIS	<a href="#">v1.4</a>	<a href="#">ACIS Grating Spectrum</a>	SPECTRUM	TG2	pha2.fits
L2	HRC	<a href="#">v1.4</a>	<a href="#">HRC Grating Spectrum</a>	SPECTRUM	TG2	pha2.fits

### ACIS Grating Spectrum

Level	Instrum	ICD	Data product	Content	Pipeline	Filename template
L2	ACIS	<a href="#">v1.4</a>	<a href="#">ACIS Grating Spectrum</a>	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	<a href="#">v1.4</a>	<a href="#">HRC Grating Spectrum</a>	SPECTRUM	TG2	pha2.fits

The creation of a PHA file is 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](http://cxc.harvard.edu/ciao3.4/data_products_guide/pha_descrip.html)  
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