Chandra X-ray Center

Analysis Guide: HRC Imaging

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The High Resolution Camera (HRC) is made up of two detectors; HRC–I is optimized for imaging, while HRC–S mainly serves as a readout for the LETG grating. The HRC–I provides the largest field–of–view (~30' x 30') of any detector aboard Chandra. Its response extends to energies below the sensitivity of the ACIS, though without comparable spectral resolution. (The time resolution of the HRC detectors (16×10^{-6} s) is the best on the observatory, but can only be utilized under certain conditions; see the Instrument Anomalies section of the POG for details.)

This guide is designed to help the user decide how an HRC imaging dataset should be analyzed. The HRC Data Preparation Guide contains processing steps that should be done before beginning this analysis.

The following documents are referenced:

- A Note on HRC Spectra
- Timing Analysis with Lightcurves
- Estimate Source Counts in an Image
- Obtain and Fit a Radial Profile
- Create a PSF
- *Sherpa*: Using a PSF Image as the Convolution Kernel
- Compute an HRC–I Exposure Map

Thread: A Note on HRC Spectra

The energy resolution of the High Resolution Camera (HRC) is extremely limited. HRC–S resolution is good enough, however, to allow some discrimination between X–ray and background events. This note discusses to what extent HRC spectra may be trusted in data analysis.

Why Topic: Timing Analysis with Lightcurves

Lightcurves can be used to detect background flares in an observation, as well as for timing analysis. The proper method of creating an HRC lightcurve, which requires accounting for the dead time factor (DTF), is dicussed in the "HRC Lightcurves" section of this document, along with some caveats.

Thread: Estimate Source Counts in an Image

It is straightforward to calculate the source counts and pixel area for a number of defined regions. If an exposure map is provided, the background counts are normalized by the ratio of the mean exposures in the source and background regions. Note that this thread is not intended to provide accurate photometric results, but to provide a quick method for estimating source counts; this may, in turn, be useful as a first step in a more detailed analysis procedure.

Thread: Obtain and Fit a Radial Profile

The surface brightness flux is determined by finding the net counts in a stack of concentric elliptical annuli and then dividing by the respective areas. A specified analytic model may be fit to the resultant histogram in *Sherpa*. This information can be used, for instance, to provide evidence for extended emission and calculate the hardness ratio thereof.

Threads: Create a PSF

        Sherpa: Using a PSF Image as the Convolution Kernel

Using the position and energy of a source, an image of the PSF is created and normalized by the source flux. The PSF image can also be used as a convolution kernel for fitting and modelling in *Sherpa*.

Thread: Compute an HRC–I Exposure Map and Build Fluxed Image

To created a fluxed image [photons cm^{-2} s^{-1} $pixel^{-1}$], an exposure map needs to be created for the observation. This is a map of instrumental artifacts and detector response that complicate surface brightness measurements. Dividing an image by an exposure map creates a fluxed image in the desired units, so adding the pixel values around a source results in the source flux (providing the background has been subtracted out).

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