The Status of Continuous-Clocking–Mode Data Products and Analysis

The Guilty:

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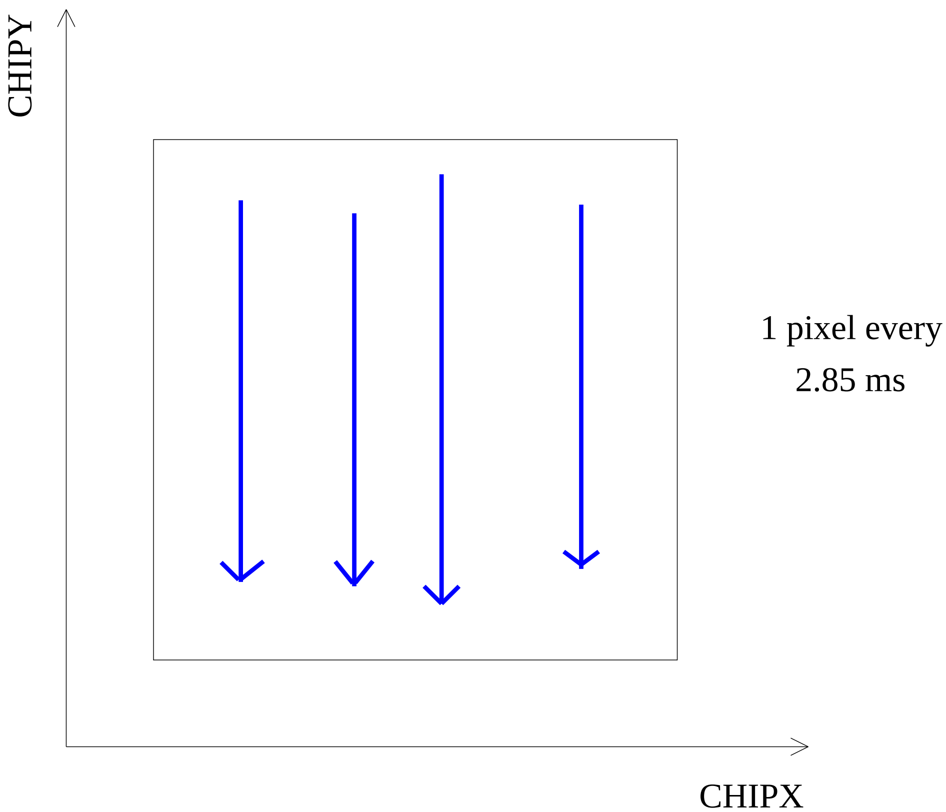
⋮

Description

Charge is “continuously clocked” to the read out at a rate of row every 2.85 ms.



Advantages

☺ 2.85 ms time resolution

☺ Pileup much less important (good for bright sources)

Disadvantages

☹ Only one-dimensional spatial information

☹ Larger effective background for a point source

☹ Event filtering is more challenging

41 of 1549 AO-1 and AO-2 observations (2.6%) employ continuous-clocking.

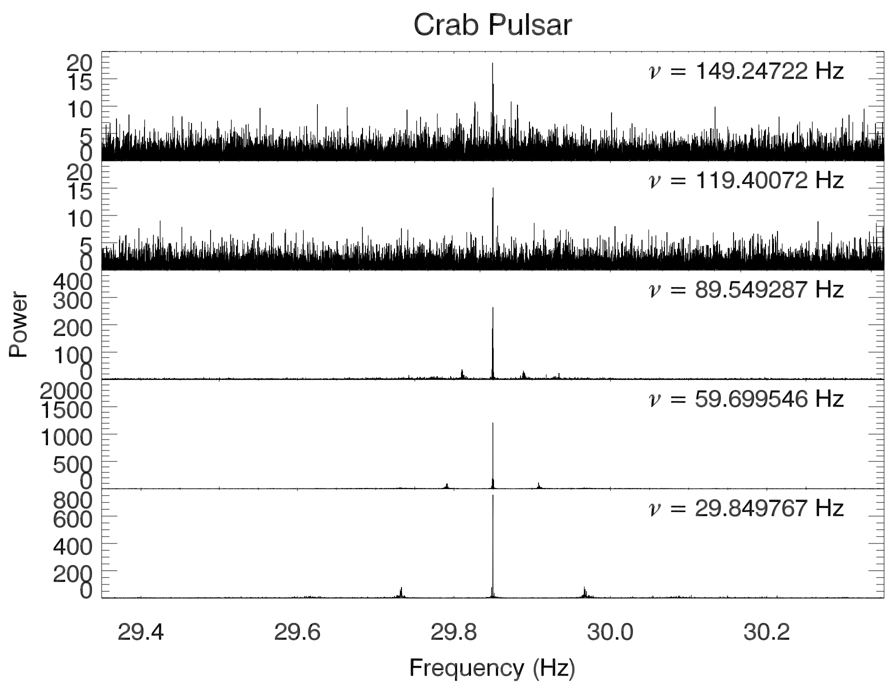
Contents of a Continuous-Clocking–Mode "FAINT" Event-Data File

TIME	Time
EXPNO	
CCD_ID	Position
NODE_ID	
CHIPX	
CHIPY	
TDETX	
TDETY	
DETX	
DETY	
X	
Y	
SKY_1D	
PHAS	Amplitude
PHA	
ENERGY	
PI	
FLTGRADE	Quality
GRADE	
STATUS	

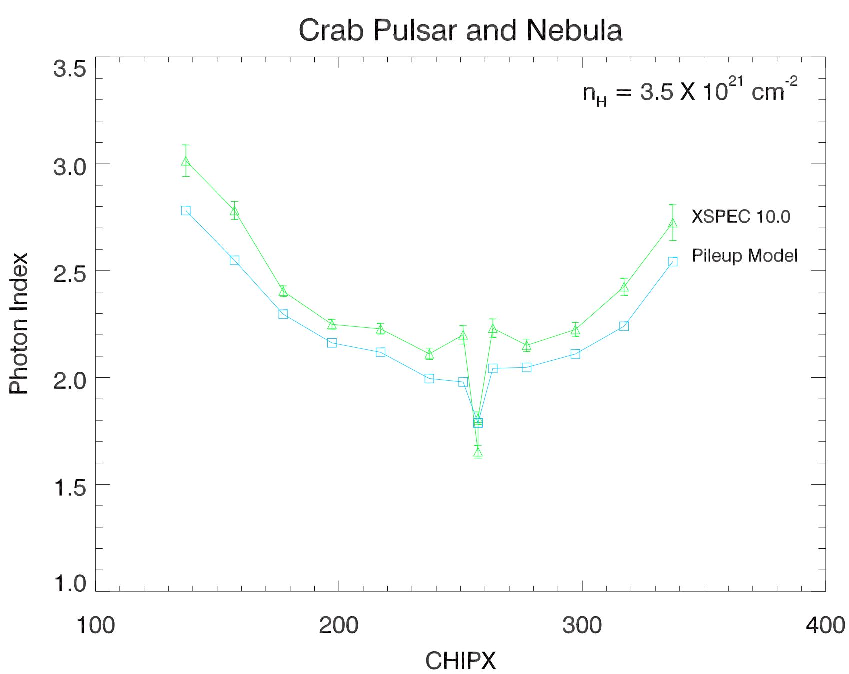
The coordinates, order, and wavelength of dispersed photons are included if a grating is used.

Types of Analyses Supported

Timing

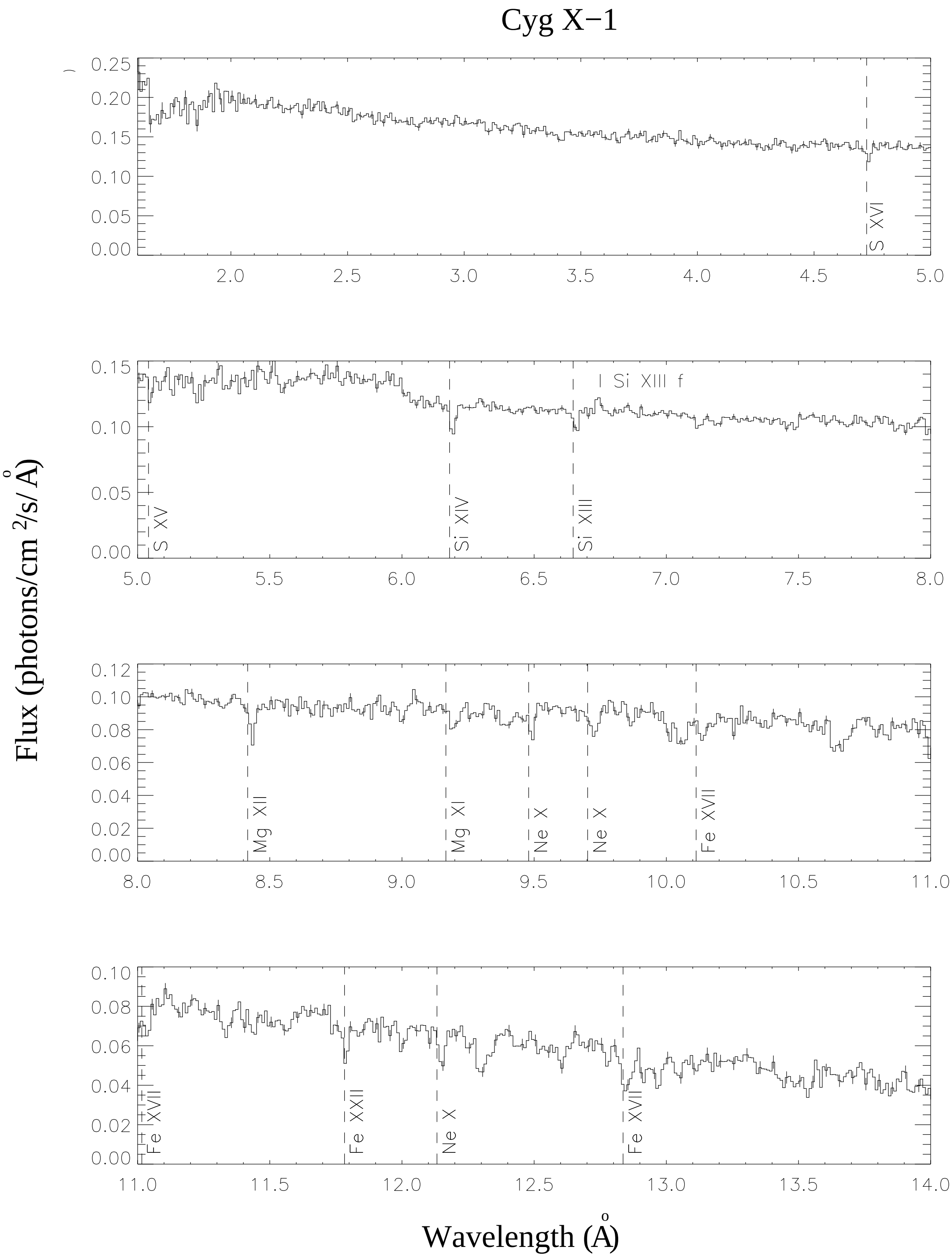


Spatially-resolved spectroscopy (1D)



High-resolution spectroscopy

Marshall et al. 2001



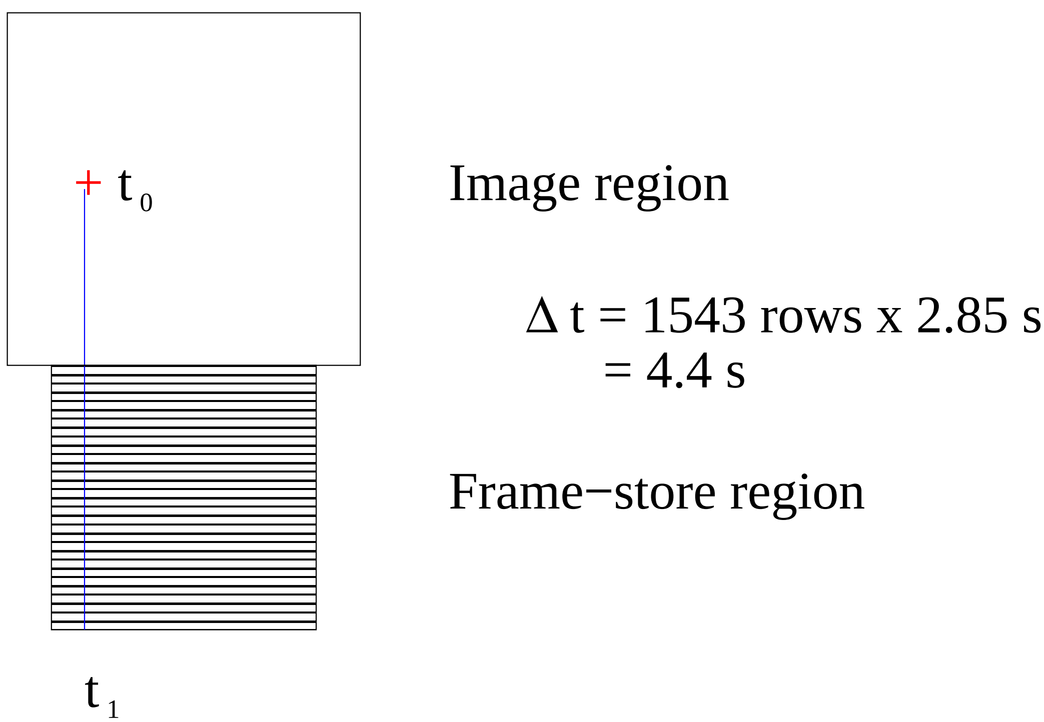
Event Time Information

Relative timing

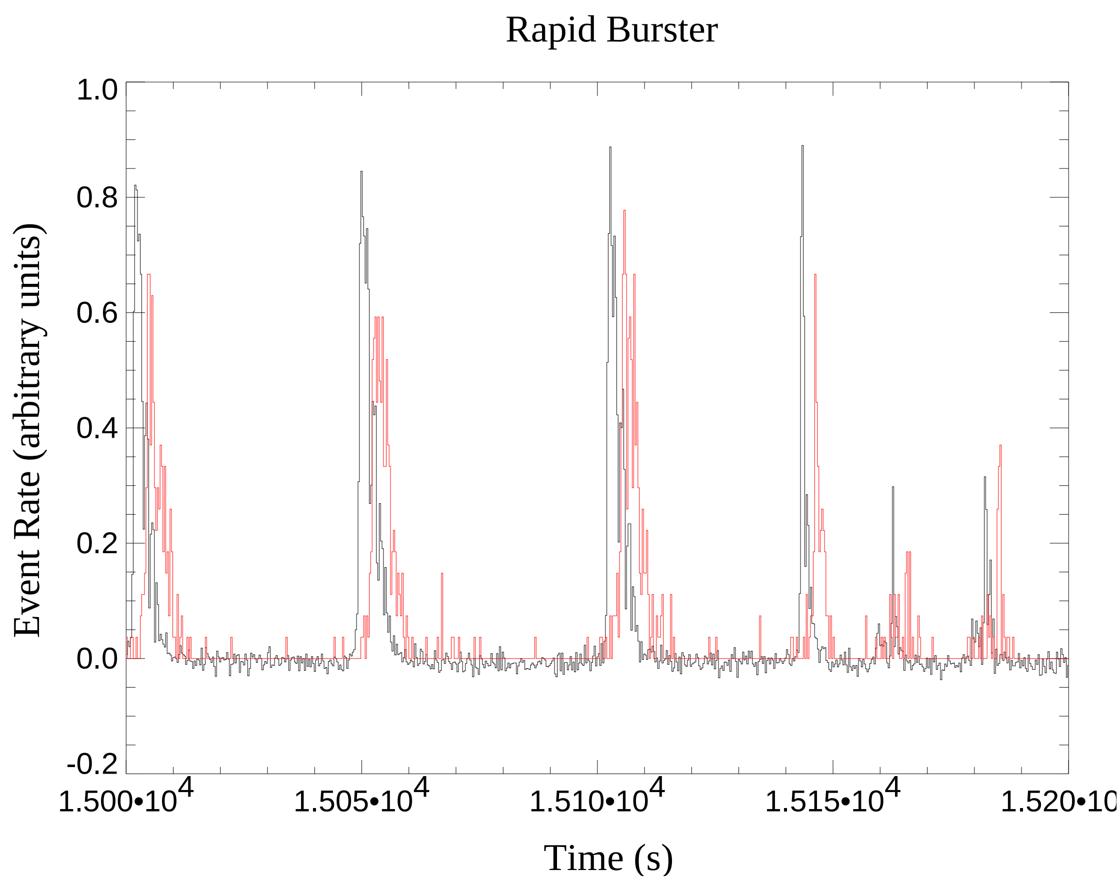
$\smile$ At least one test using the Crab pulsar suggests that the period of the Crab differs from the radio period by $\Delta P/P = 1.5 \times 10^{-5}$, which is consistent with the accuracy of the on-board clock ($\Delta t/t \sim 10^{-5}$).

Absolute timing

$\triangledown$ Beware that the times in continuous-clocking–mode event data files are the read-out times, not the times of arrival. The difference is about 4.4 s at the nominal ACIS-S3 aim point.



This effect is evident in a comparison of the times associated with simultaneous ACIS (red) and RXTE (black) data for some bursts of the Rapid Burster.

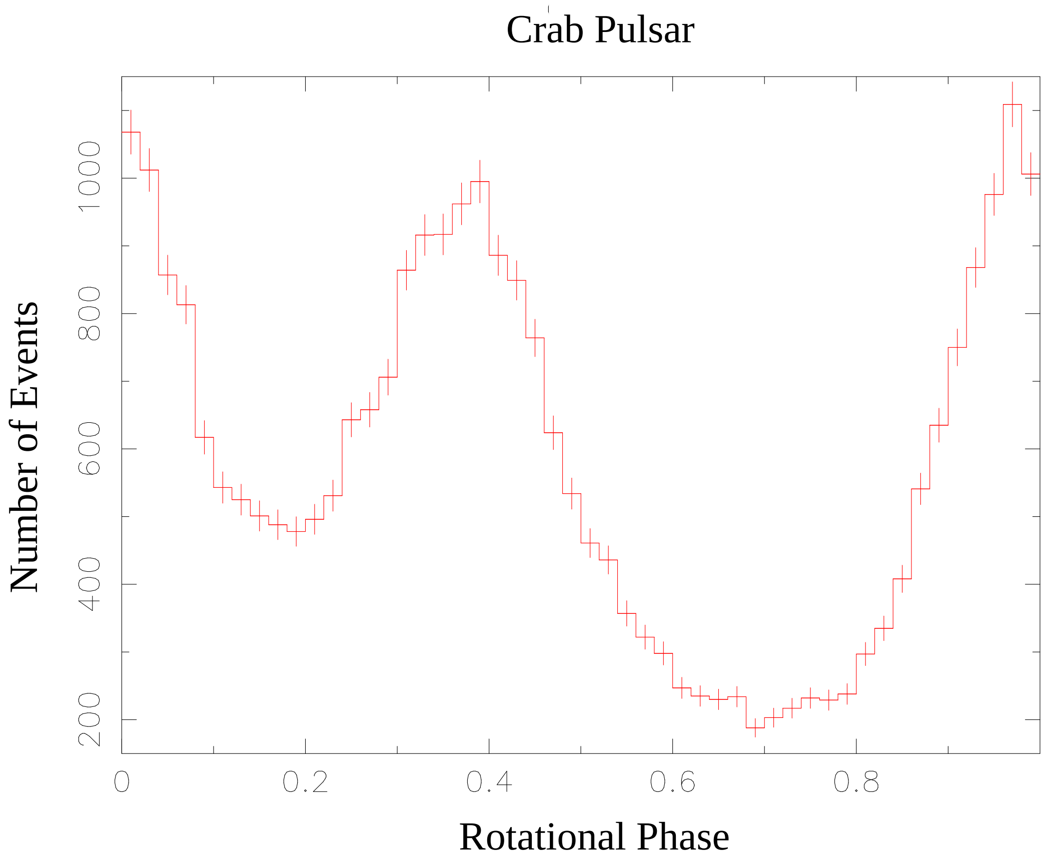


- An algorithm to compute the times of arrival of events exists. A tool that can be employed by users and in the pipeline will be available in the future.

http://wwwastro.msfc.nasa.gov/xray/ACIS/cctime/
http://space.mit.edu/ gea/docs/memo_acis_cc_calc_toa_2.0.ps

⌣̈ A test of the algorithm using the Crab pulsar suggests that the phase of the main peak ($\phi = 0.97$) is consistent with the phase from the RXTE data ($\phi_{\rm RXTE} = 0.99$), since the difference between the two ($\Delta\phi = 0.02$) is smaller than the phase uncertainties associated with the time resolution ($\sigma^t_\phi = 0.085 = 2.85$ ms $\times$ 29.85 Hz) and the absolute positional uncertainty ($\sigma^{\mathbf{r}}_\phi = 0.085$).

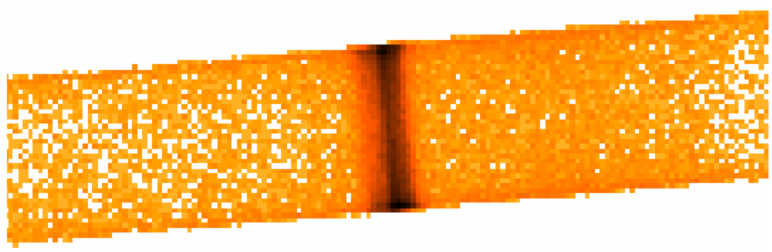
Tennant 2001



Event Position Information

Sky coordinates

- At the moment, the dither has not been removed from the sky coordinates and the coordinates may not pass through the source position.



- Code has been developed to resolve these problems.

- Yet, the positional uncertainty perpendicular to the line is the width of the observed region of the sky (e.g. one chip width or 8.4′).

Event Amplitude Information

Detector response

- $\ddot{\frown}$ The spectral response (and gain and quantum efficiency) of the standard “CC3×3” continuous-clocking mode has not been calibrated. This mode was developed after the XRCF calibration effort. The “CC1×3” mode, which was calibrated on the ground, has not been used for observations.

- $\ddot{-}$ The spectral response (i.e. FEFs) of the CC3×3 mode is assumed to be the same as the spectral response of the timed-exposure mode.

- $\ddot{-}$ Therefore, the calibration of the spectral response is no better than the calibration of the response of the CCDs for timed-exposure–mode observations.

Event Quality Information

Background subtraction and event filtering can be significantly more challenging for continuous-clocking–mode data than timed-exposure–mode data.

- The background in a continuous-clocking point-source region is much larger than the background in a timed-exposure point-source region because entire ACIS columns must be used instead of a small portion of a column.

- Removal of "cosmic-ray afterglows" is not possible.

- The effects of charge-transfer inefficiency (CTI) for continuous-clocking event data are not the same as the CTI effects for timed-exposure data because the effects of CTI are sensitive to the way the CCDs are clocked and the pixel-to-pixel transfer time for continuous-clocking–mode data is much longer (2.85 ms) than the pixel-to-pixel transfer time for timed-exposure–mode data (41 μs).

- It can be difficult to distinguish between dispersed photons associated with the MEG and HEG arms of the HETGS grating.

Event Grating Information

Event order

- $\smile$ A bug associated with assigning an order to events if a grating arm extended beyond the boundary of a CCD has been fixed.

Summary

$\ddot\smile$ Event time

> The absolute and relative times are fine. A tool to compute the absolute times of arrival is in the works.

$\ddot\smile$ Event position

> An algorithm to remove dither from the sky coordinates is being developed. A de-dithered one-dimensional profile of the source will be available (i.e. SKY_1D).

$\ddot{-}$ Event amplitude

> The spectral response is assumed to be the same as the timed-exposure response.

$\ddot\frown$ Event quality

> The background in a continuous-clocking point-source region is larger than the background in a timed-exposure point-source region. Event filtering is much more challenging.

$\ddot\smile$ Event dispersed data

> A bug in the way an order is assigned to events has been fixed.