MIT Kavli Institute **Chandra X-Ray Center**

MEMORANDUM
September 1, 2006

To:	Jonathan McDowell, SDS Group Leader
From:	Glenn E. Allen, SDS
Subject:	Identifying Potential Cosmic-Ray Background Events for VFAINT Mode Observations
Revision:	1.2
URL:	http://space.mit.edu/CXC/docs/docs.html#check_vf
File:	/nfs/cxc/h2/gea/sds/docs/memos/memo_check_vf_pha_1.2.tex

In ACIS TIMED VFAINT mode observations the pulse-height information in the outer sixteen pixels of a 5 pixel × 5 pixel event island is not used to compute the summed pulse height. However, the pulse-height information in these pixels can be helpful in trying to identify events associated with cosmic rays. This specification describes an algorithm that can be used to search for such background events. Since the algorithm has not been optimized to prevent real source events from being flagged as potentially bad, some care is required when using the algorithm.

1 Changes to acis_process_events

1.1 Additional Parameters

1. check_vf_pha,b,h,"no",,,"Search VFAINT mode data for potential background events?"
2. trail,r,h,0.027,0,1,"Fraction of charge trailed"

1.2 Additional Input

If the parameter badpixfile is used to specify an input bad-pixel file, then known bad pixels are excluded from the search.

1.3 Additional Output

If an event is identified as a potential cosmic-ray event, then STATUS bit 23 (of 0–31) is set to one in the output event-data file.

1.4 Processing

If the parameter check_vf_pha = "yes," then the algorithm described hereafter is used to identify potential background events. If the parameter check_vf_pha = "no," then set the value of STATUS bit 23 to zero for all events in the output event-data file and do not perform the following search.

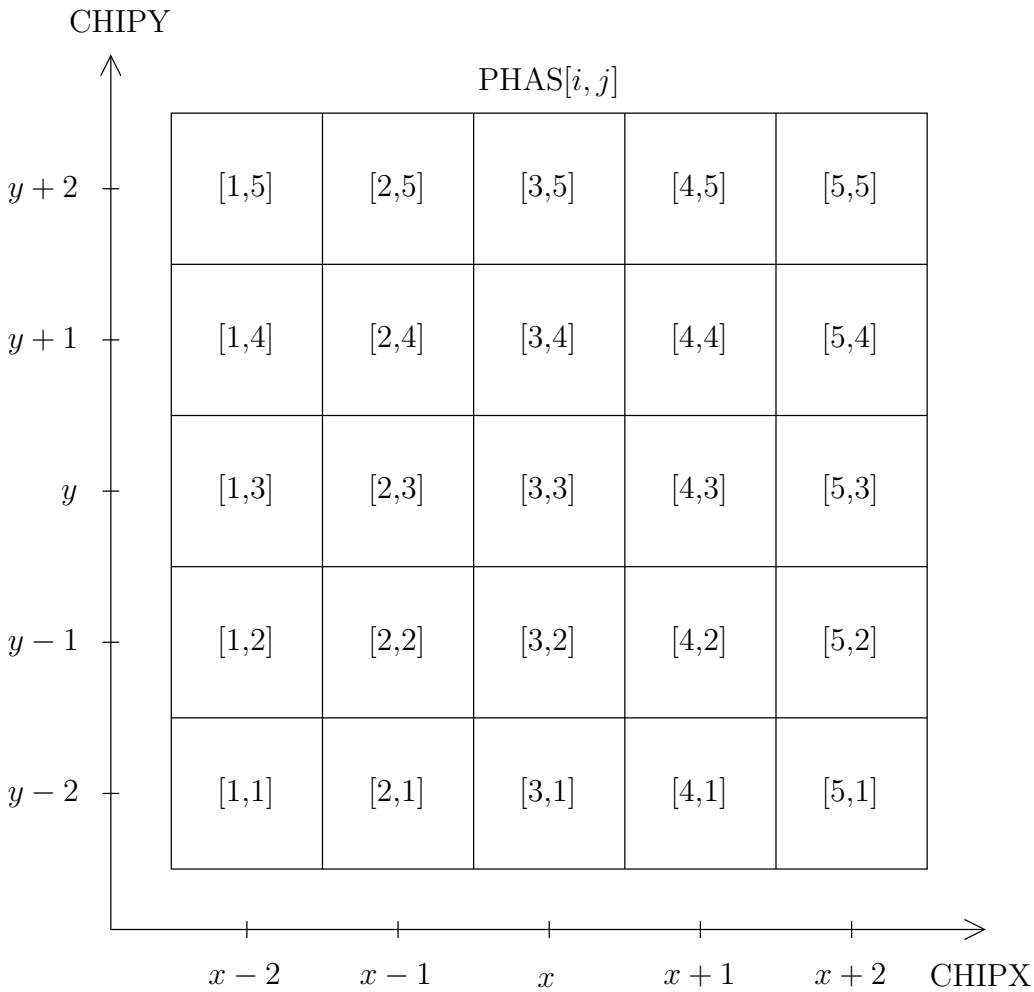

Figure 1: The relative CHIPX and CHIPY coordinates of the twenty five elements PHAS$[i, j]$[1] of a 5 pixel $\times$ 5 pixel event island with $(\mathrm{CHIPX}, \mathrm{CHIPY}) = (x, y)$.

CHIPY

$\geq s$	$\geq s + t \times \mathrm{PHAS}[2,3]^1$	$\geq s + t \times \mathrm{PHAS}[3,3]^1$	$\geq s + t \times \mathrm{PHAS}[4,3]^1$	$\geq s$
$\geq s$	N/A	N/A	N/A	$\geq s$
$\geq s$	N/A	N/A	N/A	$\geq s$
$\geq s$	N/A	N/A	N/A	$\geq s$
$\geq s$	$\geq s$	$\geq s$	$\geq s$	$\geq s$

CHIPX

Figure 2: The pulse-height conditions for each one of the outer sixteen pixels of a 5 pixel × 5 pixel event island. If one or more of the pulse heights $\mathrm{PHAS}[i,j]^1$ satisfies these conditions, then the event may have been caused by a cosmic ray instead of an X ray. Here, s is the split threshold and t is the value specified by the parameter trail.

1. Exit with an error message if
   - The output file exists and clobber = "no."
   - The input file does not exist.

   If the input data file does not have the keyword DATAMODE = 'VFAINT′, then change check_vf_pha to "no" and produce a warning message.

2. Set the value of STATUS bit 23 to zero for all of the events in the input event-data file.

3. For each event in the input event-data file, examine the pulse heights $\mathrm{PHAS}[i,j]^1$ of the outer sixteen pixels of the 5 pixel × 5 pixel event island. If
   - the coordinates of the pixel associated with $\mathrm{PHAS}[i,j]^1$ (see Fig. 1) are not the coordinates of a pixel listed as bad[2] in the input bad-pixel file (if any),
   - the coordinates of the pixel associated with $\mathrm{PHAS}[i,j]^1$ are greater than or equal to 1 and less than or equal to 1024 and
   - the pulse height $\mathrm{PHAS}[i,j]^1$ satisfies the condition shown in Figure 2,

   then set STATUS bit 23 (of 0–31) to one in the output event-data file for the event.

4. Write the output to the output event-data file.

[1] If the parameter apply_cti = "yes," then use PHAS_ADJ instead of PHAS in the following.

[2] For the purposes of the VFAINT background algorithm, a pixel is considered bad if one or more of the STATUS bits 0–4, 11–14 or 16 is set to one in the input bad-pixel file.