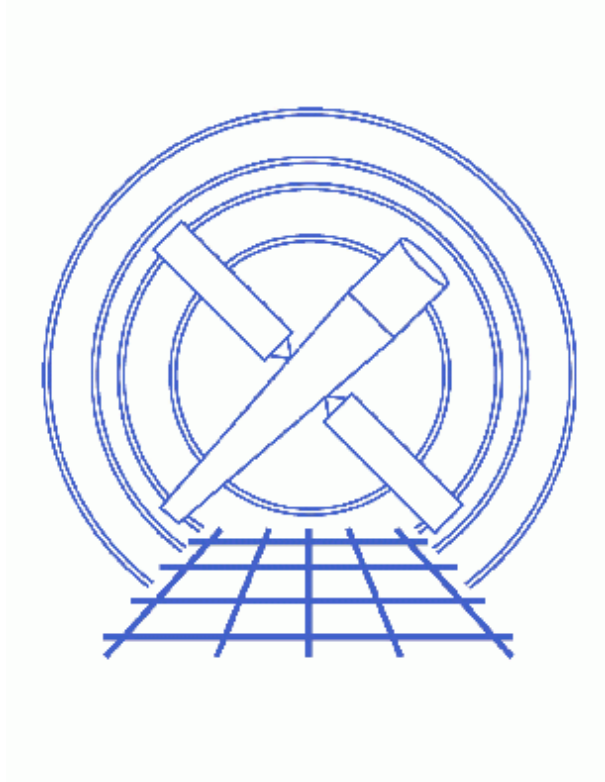


# Destreak the ACIS-S4 Chip



## ***CIAO 3.4 Science Threads***

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# Destreak the ACIS–S4 Chip

*CIAO 3.4 Science Threads*

## Overview

**Last Update:** 1 Dec 2006 – reviewed for CIAO 3.4: no changes

**Synopsis:**

There is a flaw in the serial readout of the chips, causing a significant amount of charge to be randomly deposited along pixel rows as they are read out. Chip S4 (ccd\_id=8) is most affected by this problem. These streak events are not removed by standard grade, status, or bad pixel filtering, and are therefore still present in the level=2 event file. This horizontal streak (in CHIP coordinates) should not be confused with the vertical "read-out" streaks associated with bright sources, as discussed in the [Which streak is that?](#) section.

The [destreak](#) tool became part of [standard data processing](#) at [software version DS 7.3.0](#).

**Purpose:**

To use the `destreak` to produce a new, destreaked event file.

**Read this thread if:**

you are working with any ACIS data (imaging or grating) affected by streak events.


**Related Links:**

- Analysis Guide: [ACIS Data Preparation](#)
- The [Destreaking ACIS Data](#) why topic expands on the information presented in the [Background Information](#) section.

Proceed to the [HTML](#) or [hardcopy \(PDF: \[A4\]\(#\) | \[letter\]\(#\)\)](#) version of the thread.

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## Which streak is that?

This thread only shows how to remove the serial readout streaks from the S4 chip. [Figure 1](#)  shows both the streaks on the S4 chip, as well as the prominent readout streak on the S3 chip. The latter is due to out-of-time events from the source; to remove this streak, you need to use the [acisreadcorr](#) tool, as shown in the [Remove the ACIS Readout Streak thread](#).

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## Background Information

On account of the serial readout problem, the event file shows a variable pattern of linear streaks. For the purpose of this tool, a "streak" is defined as any CHIPY row which contains more than M events in a single frame–time in a single CCD node. By default, M=1, which is to say that any row containing 2 or more events on a single node in a single frame–time is identified as a streak. This default should be fine for low count–rate data; more details are given in [destreak.ps](#).

`destreak` should always be used with caution because it removes counts from any source sufficiently bright to generate multiple events in a single row of one CCD node within a single frame–time. ***Bright point sources are certain to be affected.***

Applying `destreak` to the ACIS–S4 chip is justified when the source count rate per row is small compared to the streak event rate. It is generally most applicable to grating observations of faint point sources and imaging observations of extended, low–surface brightness objects.

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## Get Started

*Sample ObsID used:* 1712 (ACIS–S, 3C273)

*File types needed:* evt2

To avoid confusion with cosmic ray events and events generated in bad pixels and bad columns, this tool should be applied *after* all standard filtering steps. See the [ACIS Imaging Observations](#) section of the [Create a New Level=2 Events File](#) thread for more information on standard filtering.

You can check the software processing version to see if `destreak` was applied in SDP:

```
unix% dmkeypar acisf01712N002_evt2.fits ASCDSVER echo+
R4CU5UPD14.1
```

This observation was processed before the correction became part of SDP, i.e. the ASCDSVER is lower than DS 7.3.0. Note that the [version naming convention](#) changed after version R4CU5UPD14 to the "DS" system, starting with DS 6.0.0.

---

## Run destreak

The `ccd_id` parameter should always be set to 8 (the default) to ensure that the `destreak` algorithm will be applied to the ACIS–S4 chip only. The algorithm should not be applied to chips that do not show streaks like those on ACIS–S4.

```
unix% punlearn destreak
unix% pset destreak infile=acisf01712N002_evt2.fits
unix% pset destreak outfile=acis_1712_dstrk_evt2.fits
```

```
unix% pset destreak filter=no
Input dataset/block specification (acisf01712N002_evt2.fits):
Output dataset/block specification (acis_1712_dstrk_evt2.fits):
```

The `filter` parameter determines whether the streak events are eliminated from the output (`yes`) or simply flagged as bad in status bit 15 (`no`). If you intend to image the flagged events in [the final section](#) of this thread, you must use `filter=no`, as seen in the example.

The contents of the parameter file may be checked using [plist destreak](#).

## Remove the Streaks

**NOTE:** if you set `filter=yes` in the previous step, skip ahead to the [last section](#).

In the `destreak` run, we flagged all the possible streak events. Now we need to use `dmcoppy` to eliminate them from the file. The filter is defined to only keep those events with status bit 15 marked as ``good" (0); all other bits are filtered on the wildcard (x):

```
unix% dmcoppy \
  "acis_1712_dstrk_evt2.fits[EVENTS][status=xxxxxxxxxxxxxxxx0xxxxxxxxxxxxxxxx]" \
  acis_1712_clean_evt2.fits
```

The output file no longer has any of the streaks in it.

## Examine the Output

To compare the input and output files, view them both in ds9. If you set `filter=no` in the [Run destreak section](#):

```
unix% ds9 acisf01712N002_evt2.fits acis_1712_clean_evt2.fits &
```


or, if you set `filter=yes` in the [Run destreak section](#):

```
unix% ds9 acisf01712N002_evt2.fits acis_1712_dstrk_evt2.fits &
```

[Figure 2](#)  compares the original level=2 event file (left) and the "destreaked" version (right).

To determine whether significant source counts were removed, examine the spatial distribution of streak events flagged by `destreak`. Here we have defined a filter with status bit 15 marked as "bad" (1) and all other bits set as "good" (0); note that the bits are counted from the right, starting at zero. This filter retains only those events that have been flagged by `destreak`:

```
unix% dmcoppy "acis_1712_dstrk_evt2.fits[EVENTS][status=000000000000000100000000000000]" \
  streak_events.fits
```

If the events are distributed across the field when [displaying the file in ds9](#) , it is fine to filter out the events. However, if the source is visible, raise the streak event threshold (`max`) and run the tool again. Remember that the streak threshold that was used was printed to the screen in [the previous step](#). The default threshold value is appropriate for low count-rate sources, but higher threshold values may be required for brighter sources.

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## Caveat: VFAINT background cleaning

If you have run `acis_process_events` with `check_vf_pha=yes`, as shown in the [Clean ACIS Background in VFAINT Mode](#) thread, `destreak` will not be as efficient at detecting (and removing) streak events because of the large number of nonzero status bits set by the background-cleaning algorithm. While the `destreak` `mask` parameter may now be used to include the nonzero status events in the destreaking, the following is still the recommended method for combining these two processes:

1. run `destreak` on the `level=1` event file
  2. perform the VFAINT background cleaning with `acis_process_events`
- 

## Summary

If you are working with grating data, you should now look at the [Obtain Grating Spectra from HETG/ACIS-S Data](#) thread or [Obtain Grating Spectra from LETG/ACIS-S Data](#) thread to create a new PHA2 file from the destreaked event file. Make sure that you use the correct file as input to `tgextract`; depending on how you ran this thread, it may be named either `acis_1712_dstrk_evt2.fits` or `acis_1712_clean_evt2.fits`.

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Parameters for `/home/username/cxcds_param/destreak.par`

```

infile = acisf01712N002_evt2.fits  Input dataset/block specification
outfile = acis_1712_dstrk_evt2.fits Output dataset/block specification
(max = )          streak threshold syntax: m OR m:m:m:m
(max_rowloss_fraction = 5.0e-5)    Maximum fraction of avg streaks/node/frame
(num_sigma = 1.0)    Sigma value for determining streak threshold
(filter = yes)      Discard tagged events
(mask = [status=0,grade=0,2:4,6])  Filter to select candidate streak events
(ccd_id = 8)       CCD ID to filter
(ccd_col = ccd_id) CCD ID column name
(node_col = node_id) Node ID column name ('none' for single node)
(exptime = -1)    frame time (s) (reads EXPTIME if no pos. value given)
(countfile = )   filename for event row-count distribution
(fracfile = )   filename for cumulative streak contam function
(timefile = )   filename for exposure time lost per row
(verbose = 0)    Debug Level(0-5)
(clobber = no)  Clobber existing file
(mode = ql)

```

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## History

16 Dec 2004 updated for CIAO 3.2: new `max_rowloss_fraction` parameter

## Destreak the ACIS-S4 Chip – CIAO 3.4

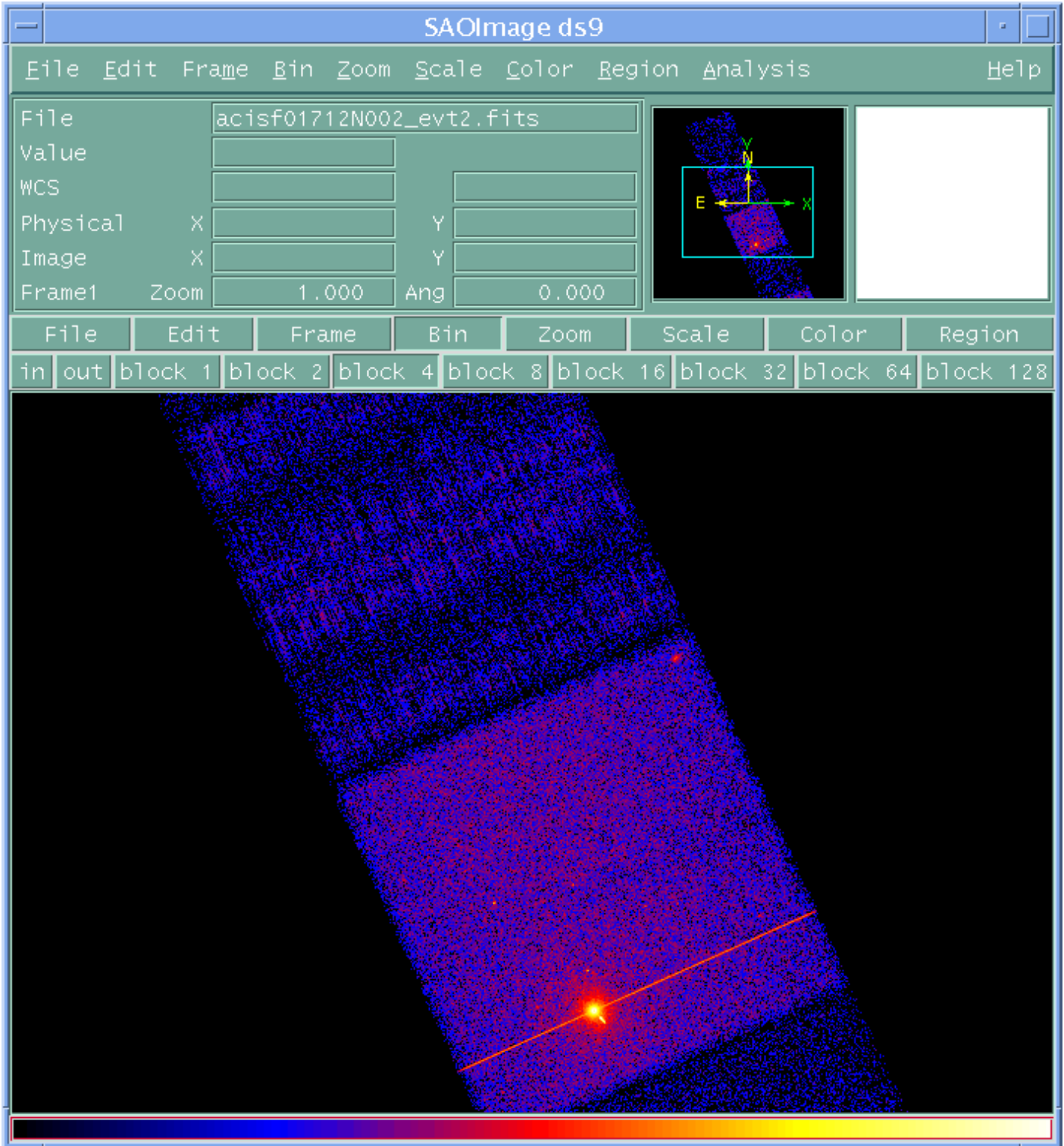
- 21 Jan 2005 updated VFAINT background cleaning caveat
- 09 Feb 2005 reinstated original version of VFAINT background cleaning caveat
- 12 Dec 2005 updated for CIAO 3.3: output filenames include ObsID; several changes to the `destreak` parameter file, including a new default value for the `mask` parameter
- 01 Dec 2006 reviewed for CIAO 3.4: no changes

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URL: <http://cxc.harvard.edu/ciao/threads/destreak/>

Last modified: 1 Dec 2006

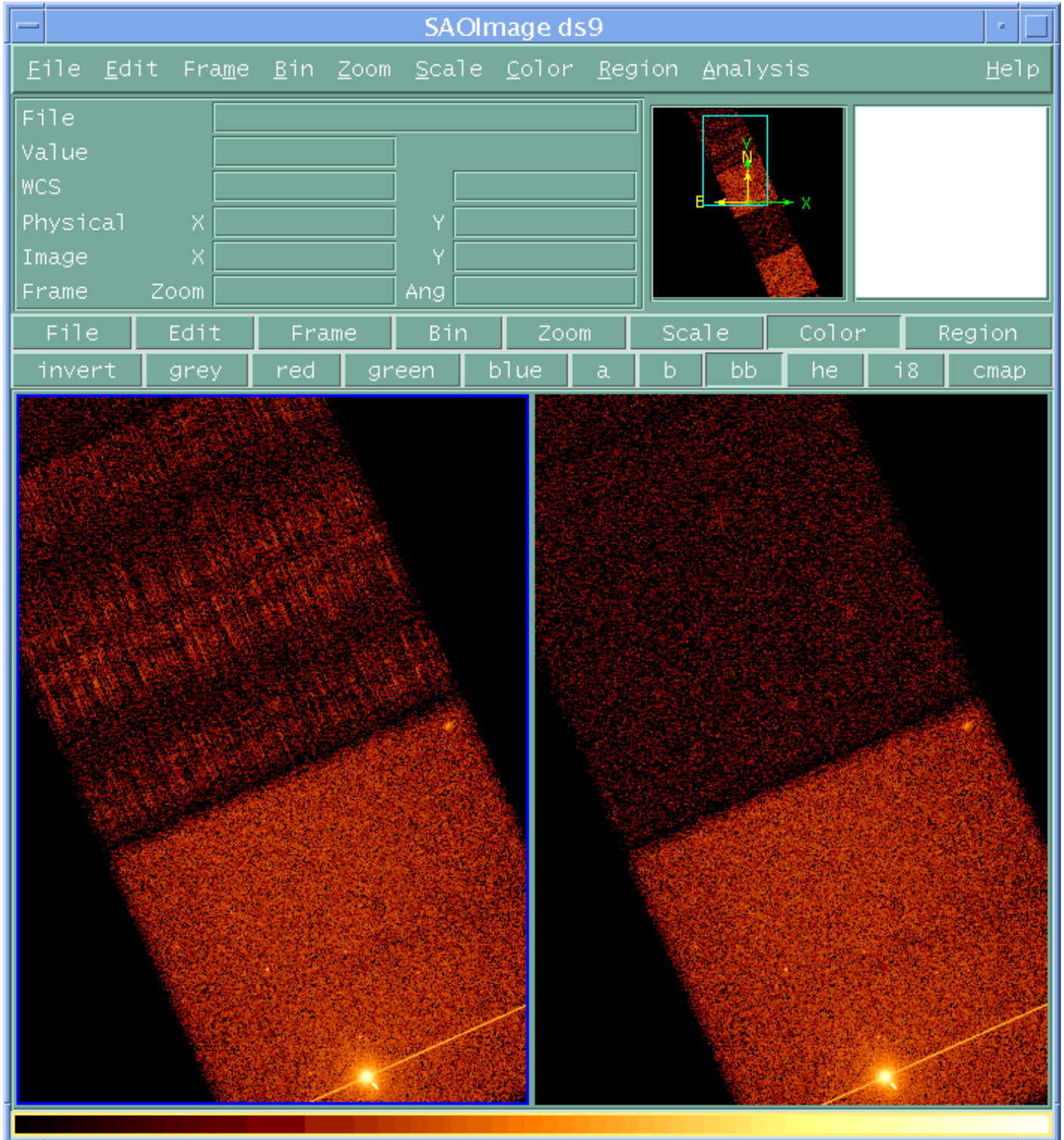
**Image 1: Chip S4 streaks vs. readout streak**





## Image 2: Original and destreaked event files

The original event file is on the left and the destreaked version is on the right.



**Image 3: Image of the streak events**

