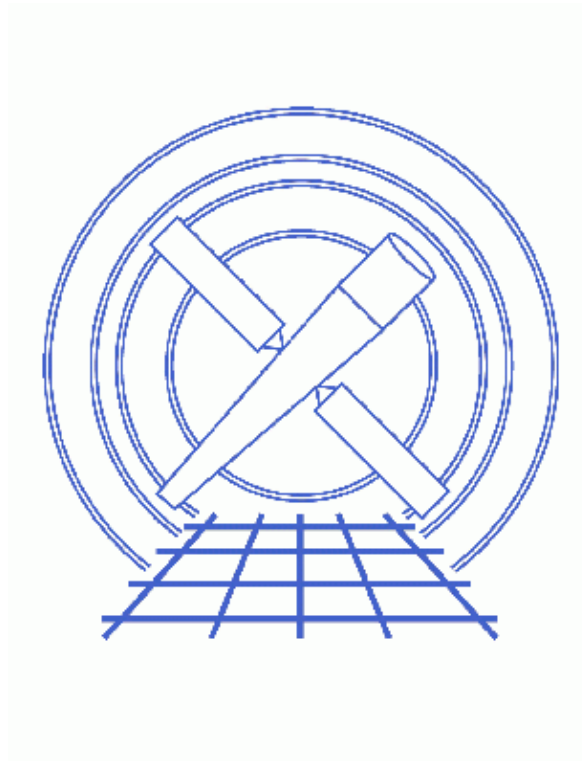


Running vtpdetect



CIAO 3.4 Science Threads

Table of Contents

- *Getting Started*
- *Running vtpdetect*
- *Parameter files:*
 - ◆ vtpdetect
 - ◆ vtpdetect
- *History*
- *Images*
 - ◆ Event list filtered on chip S3 (ObsID 578)
 - ◆ Event list with detections overlaid
 - ◆ Event list with detections from both runs overlaid

Running vtpdetect

CIAO 3.4 Science Threads

Overview

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

Synopsis:

vtpdetect uses Voronoi Tessellation and Percolation (VTP) source detection to determine individual densities, or fluxes, for every occupied pixel. The tool then analyzes the distribution of densities for significant source enhancements.

Purpose:

To illustrate several ways to use the Detect tool [vtpdetect](#).

Read this thread if:

if you want to detect sources in an ACIS or HRC observation. This tool finds faint, low surface brightness features, and extended sources found as single source in visually "correct" way, regardless of their actual shape.

Related Links:

- Analysis Guide: [Extended Sources](#)
- [Detect manual](#): other examples of using this tool are available in the "[Running vtpdetect](#)" chapter.

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

Getting Started

Sample ObsID used: 578 (ACIS-S, 3C 295)

File types needed: evt2

The filtered event file and output source lists for this thread are available in [vtpdetect.tar.gz](#) (1.2 MB tarred & gzipped; 3 MB unpacked).

If vtpdetect is given an image as input, it automatically creates a simulated event list from the data. For this reason, the tool should be run directly on an event list whenever possible.

Since the time vtpdetect takes to run increases with the number of events, first try the program on a low-density event list. Here we restrict the file to a 512x512 section of the S3 (ccd_id=7) chip:

```
unix% dmcopy "acisf00578N002_evt2.fits[EVENTS][ccd_id=7,x=3848:4360,y=3860:4372]" s3_evt2.fits
```

Don't limit the region area too much, since `vtpdetect` relies on the background information to make good source detections.

The event list may be viewed in `ds9`:

```
unix% ds9 s3_evt2.fits &
```

Figure 1  shows the filtered dataset.

Running vtpdetect

Now we are ready to run `vtpdetect`. Note that it is not required to create an ASCII version of the region file; if the `regfile` parameter is left blank, it will not be used.


```
unix% punlearn vtpdetect
unix% pset vtpdetect infile=s3_evt2.fits
unix% pset vtpdetect outfile=s3_src.fits
unix% pset vtpdetect regfile=s3_src.reg
unix% vtpdetect
Input file name (s3_evt2.fits):
Exposure map file name (none):
Source list output file name (s3_src.fits):
Threshold scale factor (0:) (1):
Max. probability of being a false source (0:1) (1e-06):
Minimum number of events per source (0:) (10):
Maximum number of iterations to allow (0:100) (10):
```

The contents of the parameter file may be checked using `plist vtpdetect`.

There are two source lists created, both containing the same sources: an ASCII file (`s3_src.reg`) and a FITS file (`s3_src.fits`). Both formats are fully described in the [Detect manual](#).

To display the data with source detections overlaid:


```
unix% ds9 s3_evt2.fits &
```

Load the source list from either file (Region → Load Regions... → `s3_src.fits[SRCLIST]` **OR** `s3_src.reg`). Figure 2  shows the resulting image.

Key parameters that you may wish to vary are `scale` and `limit`; each affects the detection of faint sources in different ways.

The `scale` affects the flux threshold used to determine whether individual events should be assigned to source photon distributions. Increasing this threshold may remove fainter sources, but will also reduce the size of detected sources. Useful values for the `scale` parameter range from 0.8 to 2.5. Values less than 1 will detect more faint sources at the expense of blending nearby sources into a single source; values greater than 1 tend to de-blend complex extended sources into multiple sources at the expense of detecting faint sources.

The `limit` parameter affects the allowed probability of false source detection based on the distribution of densities above the flux threshold. Reducing this probability may remove faint, possibly false sources, but shouldn't affect the detection of stronger sources. The default value of 10^{-6} corresponds to one spurious source in a 1000x1000 pixel map.

For the sake of comparison, the results of running `vtpdetect` on the same event file with `limit=1e-07` – a higher detection threshold/fewer possibly false sources – are shown in Figure 3  with the detection

Running vtpdetect – CIAO 3.4

results from the first run. The blue ellipses are the sources detected in the run with the higher threshold limit (`s3_limit_src.reg`); the green ellipses are the additional sources detected with the lower threshold (`s3_src.reg`). The parameter file used for this run is given [here](#).

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

```
#
# parameters for vtpdetect
#
#
# inputs -- can either be an image or table
#
#         infile = s3_evt2.fits      Input file name
#         expfile = none             Exposure map file name
#
# output
#
#         outfile = s3_src.fits      Source list output file name
#
# processing parameters
#
#         scale = 1                  Threshold scale factor
#         limit = 1e-06              Max. probability of being a false source
#         coarse = 10                Minimum number of events per source
#         maxiter = 10               Maximum number of iterations to allow
#
# SAOImage regions
#
#         (regfile = s3_src.reg)     name for ASCII output region files
#         (ellsigma = 3)             Size of output source ellipses (in sigmas)
#         (edge = 2)                How close to edge of field to reject events
#         (superdo = no)            Perform Super Voronoi Cell procedure
#
# probably use defaults for these...
#
#         (maxbkgflux = 0.8)         Maximum normalized background flux to fit
#         (mintotflux = 0.8)         Minimum total flux fit range
#         (maxtotflux = 2.6)         Maximum total flux fit range
#         (mincutoff = 1.2)          Minimum total flux cutoff value
#         (maxcutoff = 3)            Maximum total flux cutoff value
#         (fittol = 1e-06)           Tolerance on Poission fit
#         (fitstart = 1.5)           Initial background fit starting scale factor
#
# user settable parameters
#
#         (clobber = no)             Overwrite if file exists
#         (verbose = 0)              Debug level
#         (logfile = stderr)         Debug file name
#         (kernel = default)        Output format
#
# mode
#
#         (mode = ql)
```

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

Running vtpdetect – CIAO 3.4

```
#
# parameters for vtpdetect
#
#
# inputs -- can either be an image or table
#
    infile = s3_evt2.fits      Input file name
    expfile = none            Exposure map file name
#
# output
#
    outfile = s3_limit_src.fits Source list output file name
#
# processing parameters
#
    scale = 1                 Threshold scale factor
    limit = 1e-07             Max. probability of being a false source
    coarse = 10               Minimum number of events per source
    maxiter = 10              Maximum number of iterations to allow
#
# SAOImage regions
#
    (regfile = s3_limit_src.reg) name for ASCII output region files
    (ellsigma = 3)            Size of output source ellipses (in sigmas)
    (edge = 2)                How close to edge of field to reject events
    (superdo = no)           Perform Super Voronoi Cell procedure
#
# probably use defaults for these...
#
    (maxbkgflux = 0.8)        Maximum normalized background flux to fit
    (mintotflux = 0.8)        Minimum total flux fit range
    (maxtotflux = 2.6)        Maximum total flux fit range
    (mincutoff = 1.2)         Minimum total flux cutoff value
    (maxcutoff = 3)           Maximum total flux cutoff value
    (fittol = 1e-06)          Tolerance on Poission fit
    (fitstart = 1.5)          Initial background fit starting scale factor
#
# user setable parameters
#
    (clobber = no)            Overwrite if file exists
    (verbose = 0)             Debug level
    (logfile = stderr)        Debug file name
    (kernel = default)        Output format
#
# mode
#
    (mode = ql)
```

History

- 03 Jan 2005 reviewed for CIAO 3.2: no changes
- 03 Jun 2005 updated links for CIAO 3.2 version of Detect manual
- 12 Dec 2005 updated for CIAO 3.3: updated files in detect data tarfile
- 01 Dec 2006 reviewed for CIAO 3.4: no changes

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

Last modified: 1 Dec 2006

Image 1: Event list filtered on chip S3 (ObsID 578)

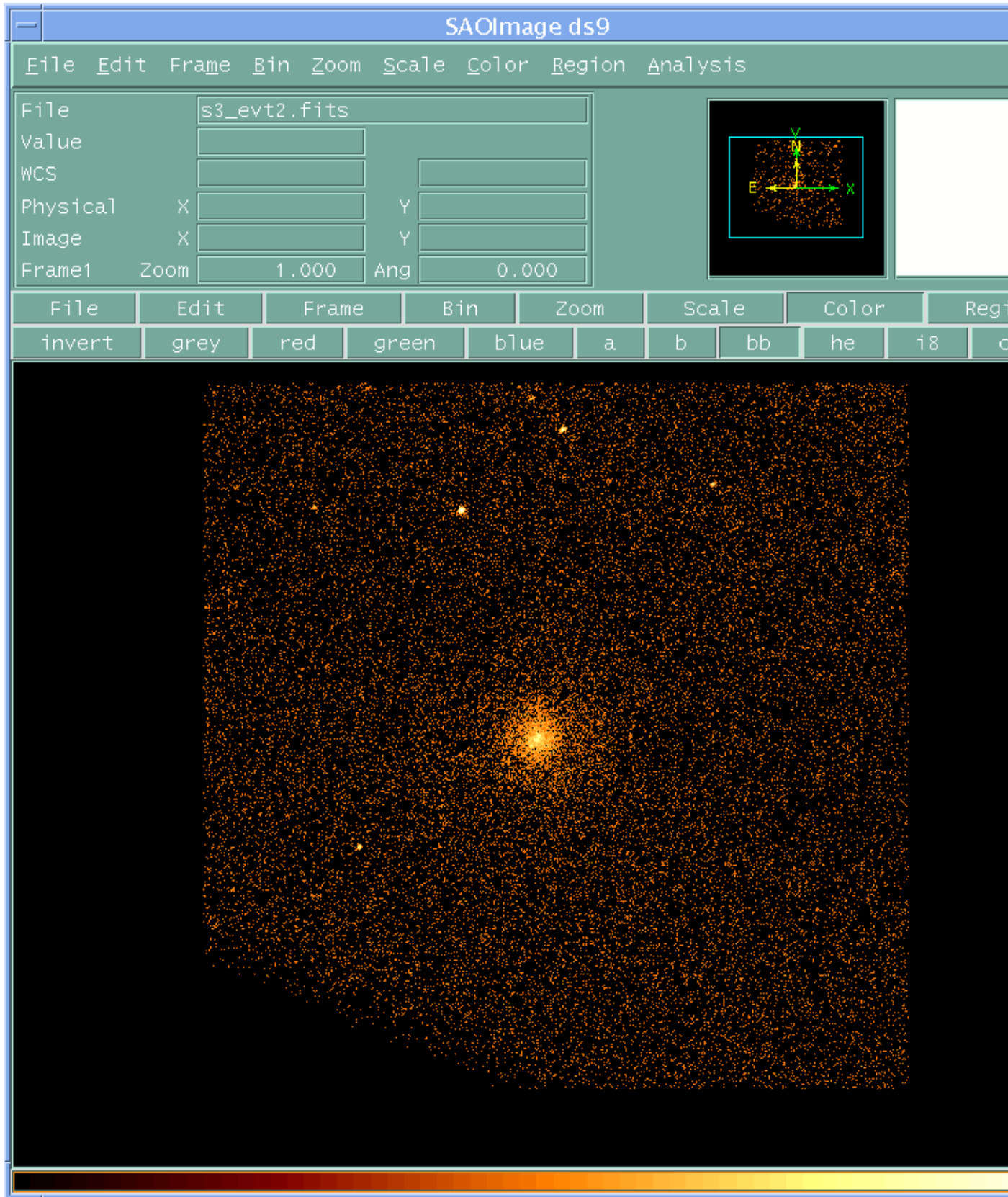


Image 2: Event list with detections overlaid

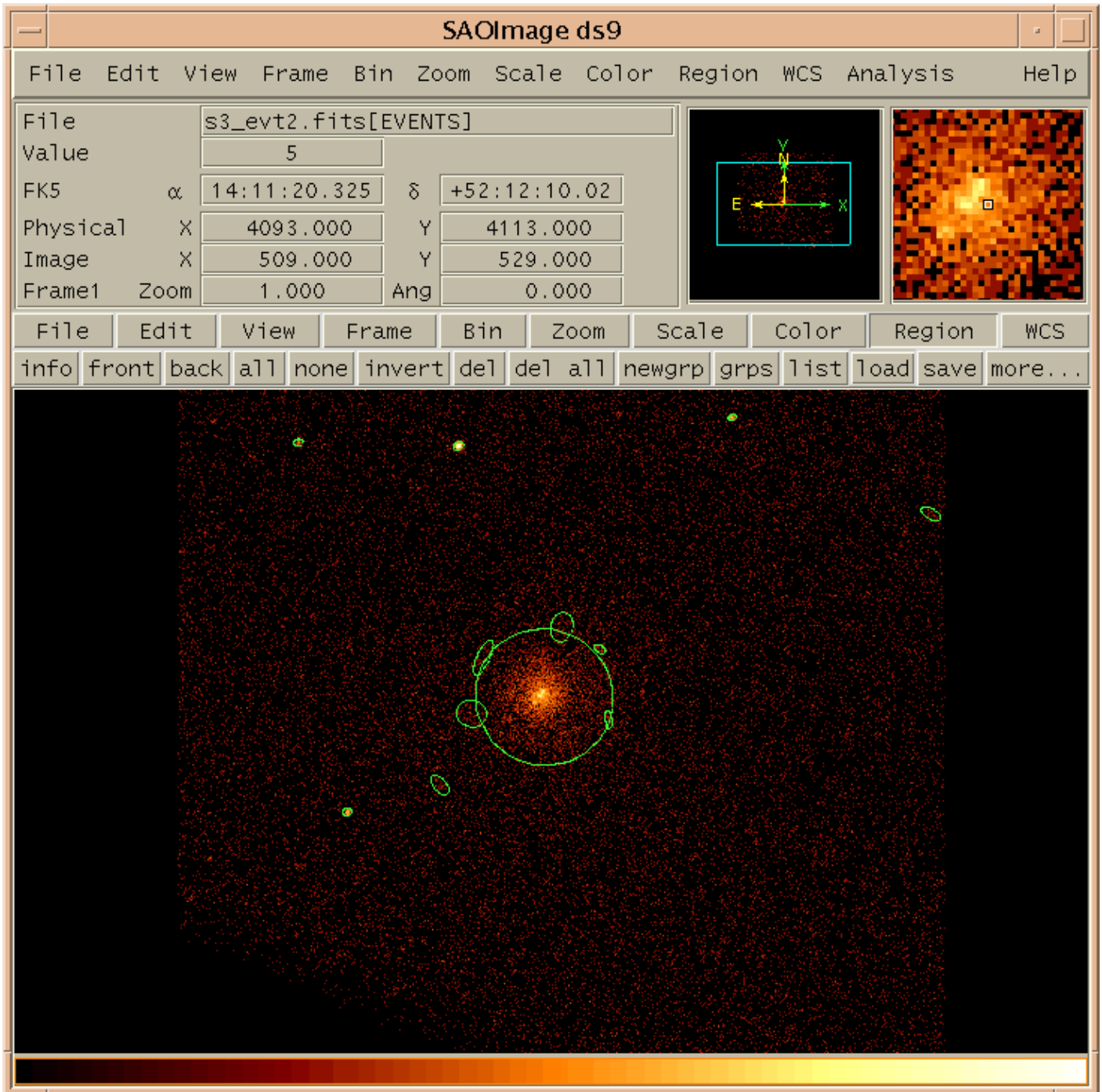
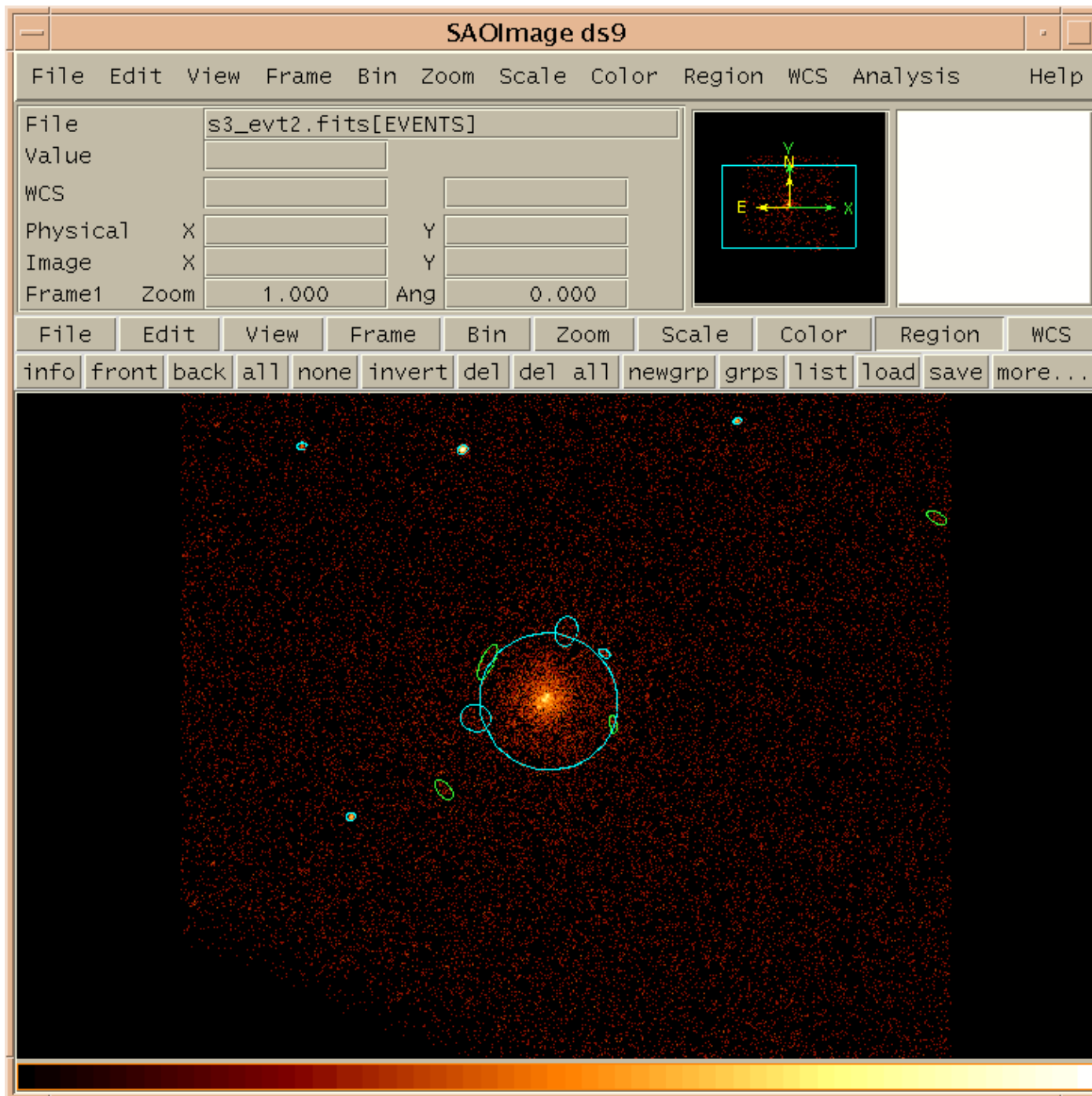


Image 3: Event list with detections from both runs overlaid

The blue ellipses are the sources detected in the run with the higher threshold limit (`s3_limit_src.reg`); the green ellipses are the additional sources detected with the lower threshold (`s3_src.reg`).



Running vtpdetect – CIAO 3.4