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## Welcome to CIAO

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The remarkable science capabilities of the Chandra X-ray Observatory demanded new, flexible, multi-dimensional software to analyze the data it returned. The result is CIAO, a system that has proven itself useful for the analysis of data from other, non-X-ray missions, because of the mission independence that is the basis of the CIAO design.

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The [Introduction to Tools and Applications](#) page describes the classes of tools and gives links to the tool help files. The [Release Notes](#) have detailed information regarding the most recent version of CIAO and any patches, including new tool descriptions and bug fixes. The [Data Caveats](#) page gives warnings for specific data sets.

There are [CIAO Software downloads](#) available for [several platforms](#).

For information regarding calibration and how CIAO uses cal information, try visiting the [CALDB page](#). You may also find the [Chandra Instruments and Calibration page](#) useful.

High resolution spectroscopy using the Chandra gratings requires a greater amount of atomic physics knowledge than previous X-ray astronomy has done. The CXC has therefore supported the creation of a new atomic physics database, [APED](#).

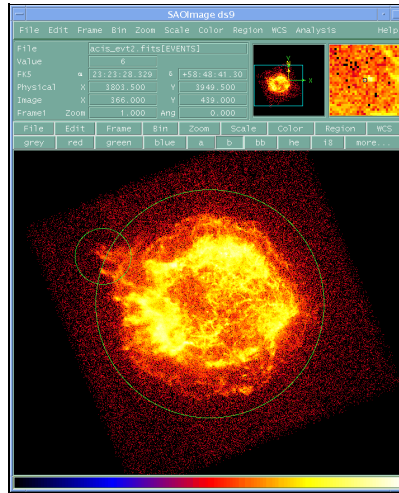
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The following is a simple example of how CIAO works. This set of commands creates an energy spectrum for a region of an [event file](#). The data is from the ObsID 214 dataset (an ACIS-S observation of supernova remnant Cassiopeia A), which was downloaded from the [Archive](#).

We begin by loading the event file into the image viewer, ds9. The event file will appear something like the one below.

```
unix% ds9 acis_evt2.fits &
```

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Now we select a region to contain most of the source emission (the green circles displayed on the ds9 image). The resulting file (`obj.reg`) will look similar to the following:

```
unix% more obj.reg
# Region file format: CIAO version 1.0
circle(3818,3980,408)
circle(3436,4150,100)
```

The `dmextract` tool can be used to create a spectrum for the source by binning the events which fall within this region:

```
unix% punlearn dmextract
unix% dmextract "acis_evt2.fits[(x,y)=region(obj.reg)][bin pi]" spectrum.fits
```

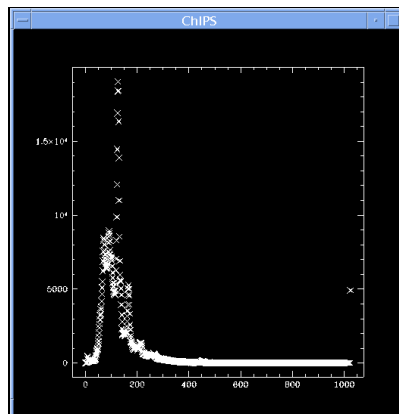
The `PI` spectrum can now be plotted and examined using `ChIPS`, the CIAO plotting tool:

```
unix% chips

Welcome to ChIPS, version CIAO 3.4
Copyright (C) 1999-2003, Smithsonian Astrophysical Observatory

chips> curve "spectrum.fits[cols channel,counts]"
```

Which produces the plot below. The `prism` file browser can also be used to select data to plot using ChIPS.



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This spectrum may also be used as input to *Sherpa*, the CIAO modeling and fitting tool, and analyzed further:

```
unix% sherpa
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Welcome to Sherpa: CXC's Modeling and Fitting Program
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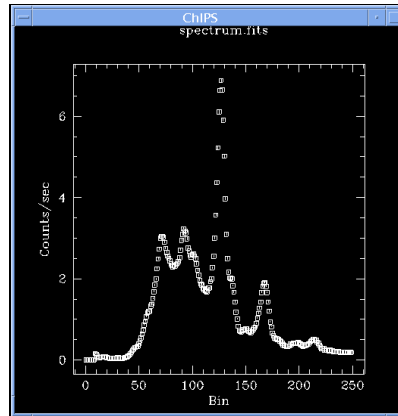
Type HELP for help options.
Type EXIT, QUIT, or BYE to leave the program.

Notes:
  Temporary files for visualization will be written to the directory:
  /tmp
  To change this so that these files are not deleted when you exit Sherpa,
  edit $ASCDS_WORK_PATH in your 'ciao' setup script.

  Solar abundances set to Anders & Grevesse

sherpa> data spectrum.fits
The inferred file type is PHA.  If this is not what you want, please
specify the type explicitly in the data command.
sherpa> lplot data
sherpa> ignore bin 250:
sherpa> lplot data
```

This filtering shows the detail of the spectrum in the plot below. Analysis of greater depth, such as fitting a source model, may be done in *Sherpa* once the necessary response files have been created.



The [CIAO Threads page](#) contains more examples of frequently used data analysis procedures.

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