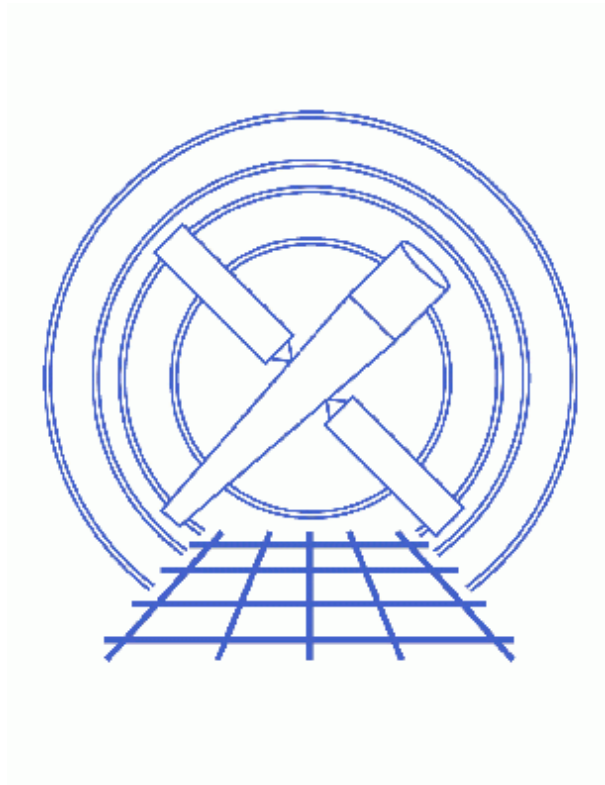


# Introduction to CIAO



## CIAO 4.1 Science Threads

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# Introduction to CIAO

## CIAO 4.1 Science Threads

### Overview

**Last Update:** 12 Mar 2009 - changed CIAO installation directory to /soft/ciao-4.1/ to match [the Installing CIAO thread](#)

#### Synopsis:

A basic introduction to using CIAO, the Chandra Interactive Analysis of Observations software package.

For information on ChIPS, the CIAO plotting application, refer to the [ChIPS website](#). Sherpa, the CIAO modeling and fitting application, is described in the [Sherpa website](#).

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

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### Get Started

The CIAO software is installed in /soft/ciao-4.1/ in this thread. Your installation of CIAO may be located in a different directory.

For illustration, this thread utilizes the ObsID 1843 (ACIS-I, G21.5-0.9) data that was downloaded in the [How to Download Chandra Data from the Archive](#) thread.

If this is your first time using CIAO, please read the [Starting CIAO](#) thread to ensure that your environment is configured properly. That thread also contains details on running [multiple versions of CIAO](#) and avoiding [conflicts with FTOOLS](#).

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### Dictionary of terms

CIAO uses a number of specialized terms some of which are common in X-ray astronomy data analysis, but not used elsewhere, and some of which are new to CIAO. We have provided a [dictionary](#) for some of these terms.

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## Command-line Completion

From the `unix%` prompt it is not necessary to type the full name of a tool, application, or filename. `<ESC><ESC>` or `<TAB>` will complete the name as long as sufficient letters/numbers are given for it to be unique:

```
unix% dml<TAB>  dmlist
```

and

```
unix% cel<ESC><ESC>  celldetect
```

Note that command-line completion is a function of the shell, not CIAO. This will not work in Bourne shell (and perhaps others).

---

## Special Characters

As in most systems, there are restrictions on the use of special characters. Special characters are symbols that are reserved for use by the system or have special meaning to the application. The standard set (defined as special by most operating systems) of "special" characters is:

```
& ( ) [ ] ; | * ? ' " ` $ < > ; { } ^ # / \ (space character)
```

In general, files and directories should not contain these characters.

---

## Header Keywords

There are many header keywords in the Chandra FITS files. The most important ones for data analysis are described here:

- **Identification**

- ◆ SEQ\_NUM (sequence number): the primary number used for identification, unique to each observation
- ◆ OBS\_ID (observation identification number): a unique identifier used by the processing system
- ◆ OBJECT: name of the target
- ◆ OBSERVER: name of the Principal Investigator

- **Pointing information**

- ◆ RA\_NOM: nominal right ascension in J2000 coordinates, decimal degrees
- ◆ DEC\_NOM: nominal declination in J2000 coordinates, decimal degrees

- **Timing information**

- ◆ DATE-OBS: time and date of start of observation
- ◆ DATE-END: time and date of end of observation
- ◆ TSTART: time of start of observation in seconds since 1998 Jan 1 00:00:00

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- ◆ TSTOP: time of end of observation in seconds since 1998 Jan 1 00:00:00
- ◆ MJDREF: modified Julian Date of the time zero point (1998 Jan 1 00:00:00)
- ◆ DTCOR: deadtime correction
- ◆ ONTIME: sum of time in GTIs in seconds
- ◆ LIVETIME: ONTIME multiplied by DTCOR
- ◆ EXPOSURE: final exposure time, including all corrections

### • Instrument Information

- ◆ MISSION: AXAF
- ◆ TELESCOP: Chandra
- ◆ INSTRUME: the instrument used for the observation
- ◆ DETNAM: the chip number(s) of the observation, if relevant. The ACIS chip numbering scheme is provided in [Table 1](#).
- ◆ DATAMODE: mode in which the instrument was used
- ◆ GRATING: grating used (or NONE)

**Table 1.** ACIS chip numbering scheme

Number (DETNAM)	0	1	2	3	4	5	6	7	8	9
Name	I0	I1	I2	I3	S0	S1	S2	S3	S4	S5

Also see [Figure 6.1](#) of the [POG](#) for an illustration of the ACIS focal plane.

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## Parameter Files

Most CIAO tools make use of [parameters](#), which are stored in parameter files. Parameters may be set by editing the parameter file or by specifying parameter settings on the command line; see the [Using Parameter Files](#) thread for details and examples.

A few things to know about using CIAO parameter files:

- If you wish to use FTOOLS as well as CIAO, then start FTOOLS *before* you start CIAO; this is discussed in detail in the [CIAO startup](#) thread.
- To check the current setting for parameter-file storage in your environment

```
unix% echo $PFILES
/home/username/cxcds_param4;/soft/ciao-4.1/contrib/param:/soft/ciao-4.1/param
```

The default parameter files for each tool are stored in \$ASCDS\_INSTALL/param; in the example above, this is the /soft/ciao-4.1/param directory.

- The filename of a tool's parameter file is the tool name with a .par extension. When you edit a parameter file or run a tool, the tool's parameter file is placed and/or updated in \$HOME/cxcds\_param4 by the software.
- One way to view the contents of a parameter file is to use [plist](#):

```
unix% plist dmlist
Parameters for /soft/ciao-4.1/param/dmlist.par
```

```

infile =          Input dataset/block specification
  opt = data      Option
(outfile = )      Output file (optional)
  (rows = )       Range of table rows to print (min:max)
  (cells = )      Range of array indices to print (min:max)
(verbose = 0)     Debug Level(0-5)
(mode = ql)

```

Those parameters not within parentheses are called "positional parameters;" those parameters that are within parentheses are called "hidden parameters."

- Parameters are set with the `pset` command:

```

unix% pset dmlist infile=acisf01843N002_evt2.fits
unix% plist dmlist

Parameters for /home/username/cxcds_param4/dmlist.par

  infile = acisf01843N002_evt2.fits Input dataset/block specification
    opt = data          Option
(outfile = )           Output file (optional)
  (rows = )            Range of table rows to print (min:max)
  (cells = )          Range of array indices to print (min:max)
(verbose = 0)         Debug Level(0-5)
(mode = ql)

```

Further information and examples are available in the [Using Parameter Files](#) thread.

## Running a Tool

- All the CIAO tools that make use of parameter files are directly executed from the command line:

```

unix% dmlist
Input dataset/block specification (acisf01843N002_evt2.fits):
Option (data): block

-----
Dataset: acisf01843N002_evt2.fits
-----

  Block Name          Type          Dimensions
-----
Block   1: PRIMARY    Null
Block   2: EVENTS     Table          15 cols x 490795  rows
Block   3: GTI7       Table           2 cols x 1        rows
Block   4: GTI6       Table           2 cols x 1        rows
Block   5: GTI3       Table           2 cols x 2        rows
Block   6: GTI2       Table           2 cols x 1        rows
Block   7: GTI1       Table           2 cols x 1        rows
Block   8: GTI0       Table           2 cols x 1        rows

```

- The `prism` and `peg` tools possess their own graphical user interface (GUI) environments. For example, the following command launches the *Prism* GUI:

```
unix% prism
```

Choose "Exit" from the GUI's "File" menu to quit.

---

## Accessing CIAO Help

CIAO Help is available from the command line or from the "Help" button on the graphical interfaces. The command to access CIAO Help is `ahelp` and takes several optional arguments:

- `ahelp dmlist`  
returns the full `dmlist` help file
- `ahelp -s dmlist`  
returns a synopsis and the tool's syntax
- `ahelp -m dmlist`  
returns a synopsis, the syntax, and examples
- `ahelp -l dmlist`  
returns the maximum amount of text-based help, describes all parameters in detail
- `ahelp -k list`  
returns a list of subjects that are cross-referenced to the help string (akin to unix's `apropos` command).

The "about" command is an alias for "`ahelp -k`", a keyword search:

- `about tools` - all CXC tools (such as `dmcopy`, `csmooth`, or `lightcurve`)
- `about detect` - tools related to source detection

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## Further Assistance and Reporting Bugs

Further assistance is available from the [Helpdesk](#), the [Chandra Users email list](#), or the [CIAO FAQ](#). Bug reports and suggestions should be submitted to the Help Desk, but please check the [Bug List](#) first to see if the problem is already known.

When reporting bugs, please include the version of CIAO you are using. This can be found using the `ciao` alias used to [start CIAO](#):

```
unix% ciao -v
This script sets the user's CIAO environment to utilize:
CIAO version      : CIAO 4.1 Friday, December 5, 2008
Proposal Toolkit version : Cycle 11 Friday, December 5, 2008
bin dir           : /soft/ciao-4.1/bin
```

If CIAO is already running in the window, you will see:

```
unix% ciao -v
The current environment is configured for:
CIAO version      : CIAO 4.1 Friday, December 5, 2008
Proposal Toolkit version : Cycle 11 Friday, December 5, 2008
bin dir           : /soft/ciao-4.1/bin
```

## Additional Software

The CXC provides two additional software resources:

1. A number of command-line scripts, which are designed to simplify repetitive tasks, or work around bugs in the system.
2. Other Software for Chandra Data Analysis, which contains user-contributed code.

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## History

- 04 Jan 2005 updated for CIAO 3.2: version numbers
- 01 Dec 2005 updated for CIAO 3.3: version numbers
- 01 Dec 2006 updated for CIAO 3.4: CIAO, ChIPS, and Sherpa versions
- 14 Dec 2007 updated for CIAO 4.0: added links to ChIPS and Sherpa websites; updated CIAO version and parameter directory name; filename and screen output updated for reprocessed data (version N002 event file)
- 15 Sep 2008 the Chandra Contributed Software page is now called Other Software for Chandra Data Analysis and has a new URL
- 30 Dec 2008 updated for CIAO 4.1: the GUIs no longer use sessions or ciao.par (removed "Session Management & GUIs" section)
- 12 Mar 2009 changed CIAO installation directory to /soft/ciao-4.1/ to match the Installing CIAO thread

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URL: [http://cxc.harvard.edu/ciao/threads/ciao\\_intro/](http://cxc.harvard.edu/ciao/threads/ciao_intro/)

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