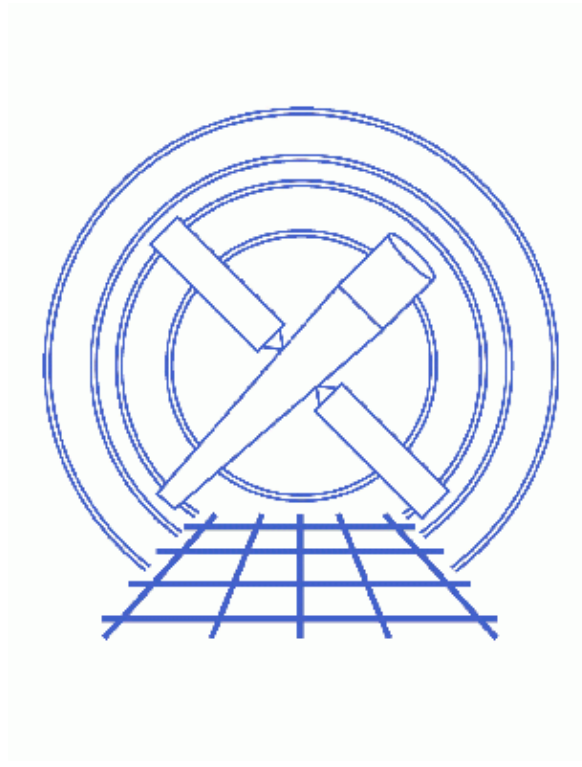


Introduction to CIAO



CIAO 3.4 Science Threads

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Introduction to CIAO

CIAO 3.4 Science Threads

Overview

Last Update: 1 Dec 2006 – updated for CIAO 3.4: CIAO, ChIPS, and Sherpa versions

Synopsis:

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

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

Get Started

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](#).

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.

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
```

This will work when calling tools from within *Sherpa* and *ChIPS*, but does not work on plotting commands; i.e. `curv<TAB>` in *ChIPS* won't finish the word `curve` for you.

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)
```

Sherpa and *ChIPS* have additional restrictions on the use of the following:

```
: +
```

In general, files and directories should not contain these characters. *Sherpa* and *ChIPS* specifically have trouble operating in directories which have the ":" or "(" characters in them (see the *Sherpa* or *ChIPS* bugs pages for more info).

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
- ◆ 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.

Parameter Files

Most CIAO tools make use of [parameters](#), which are stored in parameter files; some of the tools that *do not* make use of parameter files are *firstlook*, *ChIPS*, and *Sherpa*. 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.
- The default directory in which CIAO stores parameter files is `$HOME/cxcds_param`. To check the current setting for parameter-file storage in your environment

```
unix% echo $PFILES
/home/username/cxcds_param:/soft/ciao/param
```

The default parameter files for each tool are stored in `$ASCDS_INSTALL/param`; in the example above, this is the `/soft/ciao/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_param` by the software.
- One way to view the contents of a parameter file is to use [plist](#):

```
unix% plist dmlist

Parameters for /soft/ciao/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=acisf01843N001_evt2.fits
unix% plist dmlist

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

    infile = acisf01843N001_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 (acisf01843N001_evt2.fits):
Option (data): block

-----
Dataset: acisf01843N001_evt2.fits
-----

```

Block Name	Type	Dimensions
Block 1: PRIMARY	Null	
Block 2: EVENTS	Table	14 cols x 475869 rows
Block 3: GTI7	Table	2 cols x 1 rows
Block 4: GTI0	Table	2 cols x 1 rows
Block 5: GTI1	Table	2 cols x 1 rows
Block 6: GTI2	Table	2 cols x 1 rows
Block 7: GTI3	Table	2 cols x 2 rows
Block 8: GTI6	Table	2 cols x 1 rows

- The *Sherpa* and *ChIPS* tools possess their own command-line interfaces. Issuing the command `sherpa` or `chips` will place the user in the tool's environment:

```

unix% sherpa

-----
Welcome to Sherpa: CXC's Modeling and Fitting Program
-----

Version: CIAO 3.4

Type AHELP SHERPA for overview.
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.

  Abundances set to Anders & Grevesse

sherpa> exit
Goodbye.

```

and

```
unix% chips

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

chips> exit
```

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

```
unix% firstlook
Initializing firstlook CIAO3.0 ...
Looking for resources ...
Initializing toolbar ...
Scanning environment for observation index files ...
```

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

Session Management & GUIs

A "session" is a conceptual notion of the integrated data-analysis environment formed by the interaction of CIAO applications. Most of this interaction is "under-the-hood" and not seen by the user, such as when *filtwin* reads a region drawn on an image displayed in *ds9*. Presently, only *ChIPS*, *filtwin*, and *prism* provide the ability to save and restore the current state of the session.

The user-configurable preferences for session support are stored in [ciao.par](#); documentation on this parameter file, the CIAO guis, and the session concept can be accessed using

```
unix% ahelp ciao.par
unix% ahelp qui
unix% ahelp session
```

The appearance of the GUI applications can be controlled by the `.CXCdefaults` file in your home directory. Start by copying the version from the CIAO installation into your home directory with:

```
unix% cp $ASCDS_INSTALL/config/system/CXCdefaults ~/.CXCdefaults
```

and then make your changes. While it contains many configuration options, it is most useful for defining the colors used by the GUI applications; see [the colormap FAQ](#) for an example.

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 one of the following arguments may be added to it:

- `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 -i dmlist`
directs the user's browser to the full help stored at <http://cxc.harvard.edu/ciao/ahelp/>.
- `ahelp -w dmlist`
as with "-i" but use the version contained in the local CIAO installation (it may not be as up-to-date as the "-i" version).
- `ahelp -k list`
returns a list of subjects that are cross-referenced to the help string (akin to unix's `apropos` command).

The user may find the following special help commands useful:

- `ahelp dmintr` – an introduction to the Data Model
- `ahelp dmsyntax` – an overview of the Data Model syntax
- `ahelp chips` – *ChIPS* commands
- `ahelp sherpa` – *Sherpa* commands
- `ahelp tools` – all CXC tools (such as `dmcopy`, `csmooth`, or `lightcurve`)
- `ahelp acis` – ACIS tools
- `ahelp hrc` – HRC tools
- `ahelp detect` – Detect tools
- `ahelp grating` – grating tools
- `ahelp convolution` – convolution tools
- `ahelp timing` – timing tools

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 3.3.0.1 Wednesday, January 4, 2006
Proposal Toolkit version : Cycle 8 Wednesday, November 16, 2005
bin dir           : /soft/ciao/bin
```

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

```
unix% ciao -v
The current environment is configured for:
CIAO version      : CIAO 3.3.0.1 Wednesday, January 4, 2006
Proposal Toolkit version : Cycle 8 Wednesday, November 16, 2005
bin dir           : /soft/ciao/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. A Software Exchange Page, which contains user-contributed code.

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

URL: http://cxc.harvard.edu/ciao/threads/ciao_intro/

Last modified: 1 Dec 2006

