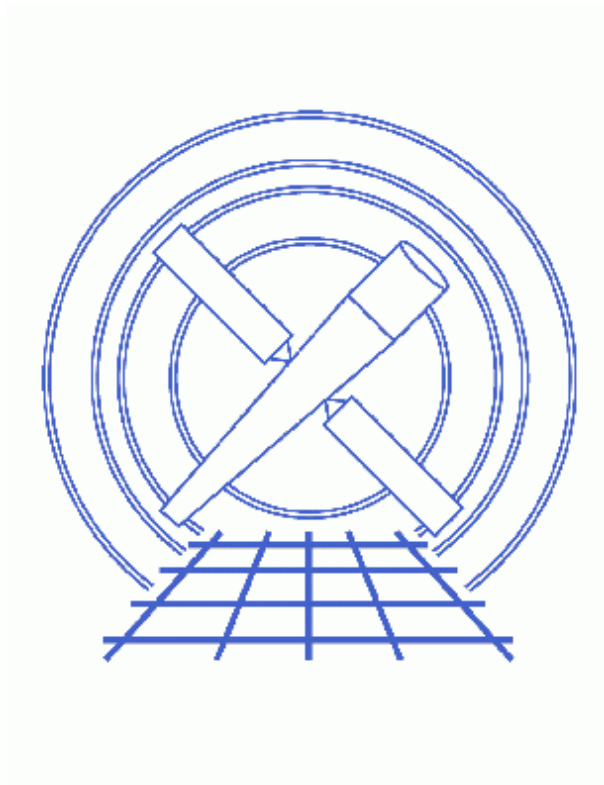


Introduction to Prism



CIAO 3.4 Science Threads

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Introduction to Prism

CIAO 3.4 Science Threads

Overview

Last Update: 1 Dec 2006 – updated for CIAO 3.4: ChIPS version

Synopsis:

Prism is a graphical user interface (GUI) application for file browsing. It offers many analysis features: [interactive plots of column data](#), [table editing](#), [column-filtered viewing](#), and [image display](#).

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

Getting 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.


Like many other CIAO tools, *prism* has a parameter file that allows the user to set several preferences which are then used as the default value each time the tool is invoked. The file may be viewed with [plist prism](#) and the options are described in the [ahelp](#) file.

Launching prism

There are several options for starting up *prism*:

- From a directory where you have a FITS file:

```
unix% prism &
```

The *prism* GUI  should then appear on your screen. Open the desired datafile from within *prism* using the "Open" dialog box from the "File" menu.

A list of recently accessed files is maintained by *prism* and can be found in the "File → Open List" submenu. This displays a list of (up to) the last 10 files viewed; selecting any of the files reloads it. Note that filter specifications and path names are considered part of the file name.


- Alternatively, *prism* may be told to open a file when it is launched:

```
unix% prism acisf01843N001_evt2.fits &
```


Once a file is loaded, the GUI will look like [Figure 2](#) .

The Basic Display

The file browser contains four main information windows. The upper left window shows the extensions, also called blocks, contained in the FITS file; the "interesting" block (e.g. EVENTS for an event file, SPECTRUM for a PHA file) is automatically chosen by *prism* to be displayed. The upper right window shows the header information of the block that's currently selected; the lower window shows the data contents of the current block. A status window across the bottom of the application provides various feedback messages.

Note that some columns are vectors (e.g. `chip` and `sky`). To further examine the contents of a vector column, left-click in the lower window to highlight it, then right-click to display a pop-up menu. From this menu, you may expand the column to show the actual data values. [Expanding the `sky` column](#) , shows the X and Y sky pixel positions for every photon detection recorded in the event file. To close the expanded vector window, click on the the "OK" button.

Column-filtered Viewing

It is also possible to view a table extension that has been column-filtered to your preference. This feature may be used to fit all the columns of interest in the *prism* data window, making it unnecessary to use the horizontal scroll bar. Left-click to highlight the desired columns in the order in which you would like them displayed. Then reload the file using the "Reopen w/ Selected" option from the "File" menu. [Figure 4](#)  displays the `time`, `ccd_id`, `sky`, and `energy` columns of the file.

Viewing ASCII Data

Prism is able to display simple ASCII files, including those in RDB format. If an ASCII file is selected, the `ascii2fits` script is run automatically to convert it to FITS format. The results are then displayed in the file browser. The format for ASCII files must therefore match that supported by `ascii2fits`, as described in the [ahelp file](#).


The Visualization Menu

The follow sections all cover tasks that are run from *prism*'s "Visualization" menu. This menu is available from the top bar of the GUI. It may also be invoked by right-clicking on any column in the main window; in this case, a pop-up menu is created.

Plotting Data

Any two columns of data may be plotted within *prism*:

1. Highlight the desired two columns for plotting by clicking on them; the first column selected will be plotted along the x-axis, the second along the y-axis. If using a vector column, only a single column needs to be selected.
2. Select the "Interactive plot" task from the "Visualization" menu. This will result in the plot of the data, as well as an xterm window running a *ChIPS* session. This window may be used to customize the plot; see the [Introduction to *ChIPS*](#) thread for more information.

For example, open the `acisf01843_000N001_aoff1.fits` file (it's in the secondary directory); the ASPOFF block will automatically be loaded. Highlight the `TIME` and `Y_OFFSETS` columns in the lower window and select "Visualization -> Interactive plot". [Figure 5](#) , which illustrates the temporal variation of the y-component of the spacecraft dither pattern, is created.

The equivalent *ChIPS* command used to plot these columns is:

```
unix% chips
Welcome to ChIPS, version CIAO 3.4
Copyright (C) 1999-2003, Smithsonian Astrophysical Observatory
chips> curve "acisf01843_000N001_aoff1.fits[cols time,y_offsets]"
```


If *three* columns have been selected, then the third column will be used as the symmetric error values for the "y" column. This column may either be a third scalar column or the third element in a vector column.

To create a hardcopy, use the "Visualization -> Print plot..." menu after plotting the data.

Creating Images

Any two columns of data may be binned into an image and then displayed within *prism*:

1. Highlight the desired two columns for binning by left-clicking on them. Again, if using a vector column, only one needs to be selected for binning.
2. Select the "Interactive image" task from the "Visualization" menu.

For example, load `acisf01843N001_evt2.fits` and select the `sky` column for binning. After choosing "Interactive image", *ds9* is launched with [the image loaded](#) . The binning factor used by *prism* (default of 8) can be changed in the "Edit -> Preferences" dialog box or with the [binfactor parameter](#).

This task works by running the CIAO tool `dmcopy` to bin the sky pixel data and then displaying the resultant image:


```
unix% dmcopy "acisf01843N001_evt2.fits[bin x=8,y=8]" image.fits
unix% chips
Welcome to ChIPS, version CIAO 3.4
Copyright (C) 1999-2003, Smithsonian Astrophysical Observatory
chips> display image.fits
```

To create a hardcopy, use the "Visualization → Print image..." menu after imaging the data.


Histograms

Any single column may be viewed as a histogram.

1. Highlight the desired column by left-clicking on it. In this case, it *is not* possible to use a vector column.
2. Select the "Histogram" task from the "Visualization" menu. This will result in the histogram, as well as an xterm window running a *ChIPS* session. This window may be used to customize the plot; see the [Introduction to *ChIPS*](#) thread for more information.

For example, load `acisf01843N001_evt2.fits` into *prism* again. Highlight the `ccd_id` column in the lower window and select "Visualization → Histogram". The "Histogram Preferences" dialog box is launched, which is used to specify the binning for the histogram. In [Figure 7](#) , we keep the "Data Min" and "Data Max" values, and set the number of bins to 8 (one for each CCD – numbered 0 to 7 – in the ACIS array that may have been on for this observation).

There is also the option to supply a "Bin File" instead; this is an ASCII or FITS file which lists the lower and upper bounds of the bins to use for the binning. More information on this option is available from the [ahelp file](#).

Click "OK" or "Apply" to generate the histogram; this may take a minute or two. The resulting plot looks like [Figure 8](#) . Clearly the majority of the events occurred on CCD 7 (Chip S3).


To create a hardcopy, use the *ChIPS* `print` command:


```
chips> print
```

Table Editing


Note: to edit a table, you must have write permission for the file.

Cell Editing

To enter editing mode, <CTRL>-left-click on the desired cell. Once it is displayed in reverse video , type in the new value. To edit cell values of arrays or vector columns, expand the column and enter cell editing mode in the data matrix that is displayed.

While in editing mode, the up and down arrow keys may be used to cycle through rows to select different cells. Cycling through columns may be done by using the <TAB> key to move right or <SHIFT><TAB> to move left. Limited range, overflow, and type checking are provided; incorrect values will display an error dialog  and a message in the status box. In addition, *prism* will automatically reset the entry back to its previous value.


Undo Last Cell Edit:


An undo option for cell edits can be accessed via the "Edit" menu's "Undo Last Cell Edit" option. The undo option treats cell edits as a stack; that is, they are undone in reverse order (edits 1, 2, 3 will be undone as 3, 2, 1). When the "Undo Last Cell Edit" option is used, the most recently edited cell is changed back to its prior value and the status message box identifies the change. For example, [this status box](#)  shows that two edits were done



successfully and then undone in reverse order.

Note that cell edits may only be undone while the window displaying the data is still open. If edits are made to a vector column in an expanded window and the window is closed, the edits will be removed from the undo stack. Appending rows or columns flushes edits to the output file and deletes the entries in the cell editing undo stack. In both these cases, the undo option will no longer be available for the changes.

Append a Column/Row

- A. To append new columns to the open table extension, select the "Append Table Column..." option from the "Edit" menu and a dialog window  will appear. There are fields for the column name, data type, units, and description fields; if "Array" is selected, an additional field for the number of elements is provided.



Click "OK" or "Apply" to add the column ; a HISTORY keyword that column "colname" was added by *prism* is written to the block's header. Note that the values are not initialized to any specific value, so they may contain garbage.

- B. To append one or more rows to the open table extension, select the "Append Table Row(s)..." option from the "Edit" menu and a dialog box  will appear. Enter the number of rows to append and click on "OK" or "Apply". Note that the values are initialized to zero . A HISTORY keyword stating that N rows were added by *prism* is written to the block's header.

The keywords are added to the raw header. To view them in *prism*, use "Edit -> Preferences" and select "Show raw header keys". Alternatively, you can use `dmlist` on the command line:

```
unix% dmlist acisf01843N001_evt2.fits header,raw
.
. (output omitted)
.
Key 545: CMT          *HISTORY      = Column NEW_COLUMN added in PRISM by egalle on Oct  1 16:02:
Key 546: CMT          *HISTORY      = 3 rows appended in PRISM by egalle on Oct  1 16:03:32 2001 /
```

Editing Header Keywords

From the "Edit" menu, select the "Edit header..." option and a dialog box  will appear on the screen. There are 3 text fields – keyword name, value, and comment string – that can be used to change an existing keyword or to add a new one. After typing in the desired values, click on the appropriate button, e.g. "Insert New Keyword". This will result in the keyword being added  to the open header block.

The Analysis Menu

The "Analysis" menu allows you to launch other CIAO tools from within *prism*; see the [Introduction to the Analysis Menu](#) thread for more information.

Image 2: Prism GUI after loading an event file

The screenshot shows the Prism GUI interface for the file `prism-1 : acisf01843N001_evt2.fits`. The menu bar includes File, Edit, Navigate, Visualization, Session, Analysis, and Help. The left pane displays the FITS structure:

IMAGE	PRIMARY	NULL
TABLE	EVENTS	14 cols, 475869 rows
TABLE	GTI7	2 cols, 1 rows
TABLE	GTI0	2 cols, 1 rows
TABLE	GTI1	2 cols, 1 rows
TABLE	GTI2	2 cols, 1 rows
TABLE	GTI3	2 cols, 2 rows
TABLE	GTI6	2 cols, 1 rows

The right pane shows the FITS header information:

```

COMMENT This FITS file may contain long string keyword values that
COMMENT continued over multiple keywords. The HEASARC convention
COMMENT character at the end of each substring which is then cont
COMMENT on the next keyword which has the name CONTINUE.
HDUCLASS OGIP /
HDUCLASS1 EVENTS /
HDUCLASS2 ALL /
ORIGIN ASC / Source of FITS file
CREATOR cxc - Version CIAO 2.0b / tool that created this output
REVISION 1 /

```

The main data table displays event information with the following columns: time, ccd_id, node_id, expno, chip, tdet, and det. The units and types are also indicated.

	time	ccd_id	node_id	expno	chip	tdet	det
Units	s				pixel	pixel	pixel
Types	double	short	short	long	short	short	float
1	84272488.55042922	6	3	3	(short,short)	(short,short)	(float,fla
2	84272488.55042922	6	3	3	(short,short)	(short,short)	(float,fla
3	84272488.59146923	7	2	3	(short,short)	(short,short)	(float,fla
4	84272488.59146923	7	3	3	(short,short)	(short,short)	(float,fla
5	84272488.59146923	7	1	3	(short,short)	(short,short)	(float,fla
6	84272488.59146923	7	3	3	(short,short)	(short,short)	(float,fla

At the bottom, the status bar shows "View Mode: Read/Write" and "Processing : 11 of 20". Navigation buttons for "Goto", "Forward", and "Back" are available. A message box at the bottom indicates: "Mon 01 - Oct 15:23:27 Loading file /home/egalle/export/OI/OIF/primary/acisf01843N001_evt2.fits".

Image 3: Viewing a vector column

Expanded float vector column: sky

	(x	y)
1	1439.863159	3556.311279
2	1894.883911	3682.796143
3	1263.752441	4255.012695
4	1289.864014	4540.078125
5	1392.268555	4186.462891
6	1457.145996	4526.554199
7	1551.137573	4269.765137
8	1541.843506	4501.403320
9	1601.352661	4181.573730
10	1601.160889	4371.977051
11	1627.596069	4129.056152
12	1626.836304	4160.988281
13	1638.410889	4135.563477
14	1647.092163	4105.388184
15	1673.394409	4008.164551
16	1673.854248	4068.965088

Processing : 11 of 20

Goto Forward Back

OK Help

Image 4: Filtering on selected columns in a table file

The screenshot shows the CIAO Prism software interface. The title bar indicates the file path: `prism-1 : acisf01843N001_evt2.fits[2][cols time,ccd_id,sky,energy]`. The menu bar includes File, Edit, Navigate, Visualization, Session, Analysis, and Help.

On the left, a table lists the contents of the FITS file:

IMAGE	PRIMARY	NULL
TABLE	EVENTS	4 cols, 475869 rows
TABLE	GTI7	2 cols, 1 rows
TABLE	GTI0	2 cols, 1 rows
TABLE	GTI1	2 cols, 1 rows
TABLE	GTI2	2 cols, 1 rows
TABLE	GTI3	2 cols, 2 rows
TABLE	GTI6	2 cols, 1 rows

On the right, the FITS header is displayed:

```

COMMENT This FITS file may contain long string keyword values that
COMMENT continued over multiple keywords. The HEASARC convention
COMMENT character at the end of each substring which is then conti
COMMENT on the next keyword which has the name CONTINUE.
HDUCLASS 0GIP /
HDUCLASS1 EVENTS /
HDUCLASS2 ALL /
ORIGIN ASC / Source of FITS file
CREATOR cxc - Version CIAO 2.0b / tool that created this output
REVISION 1 /
    
```

The main window displays a table of filtered data with the following columns: `time`, `ccd_id`, `sky`, and `energy`. The units and types for each column are shown in the top row of the table:

	time	ccd_id	sky	energy
Units	s		pixel	eV
Types	double	short	float	float
1	84272488.55042922	6	(float,float)	14079.6
2	84272488.55042922	6	(float,float)	15603.1
3	84272488.59146923	7	(float,float)	12244.9
4	84272488.59146923	7	(float,float)	15991.6
5	84272488.59146923	7	(float,float)	8132.1
6	84272488.59146923	7	(float,float)	14570.9
7	84272488.59146923	7	(float,float)	12251.5

At the bottom, the status bar shows "View Mode: Read Only" and "Processing : 11 of 20". There are buttons for "Goto", "Forward", and "Back". A log window at the bottom displays the following messages:

```

Mon 01 - Oct 15:26:04 Loading file /home/egalle/export/OIFOIF/primary/acisf01843N001_evt2.fits[2][cols time,ccd_id,sky,energy]
Mon 01 - Oct 15:23:27 Loading file /home/egalle/export/OIFOIF/primary/acisf01843N001_evt2.fits
    
```

Image 5: Plotting from Prism: Y_OFFSETS against TIME

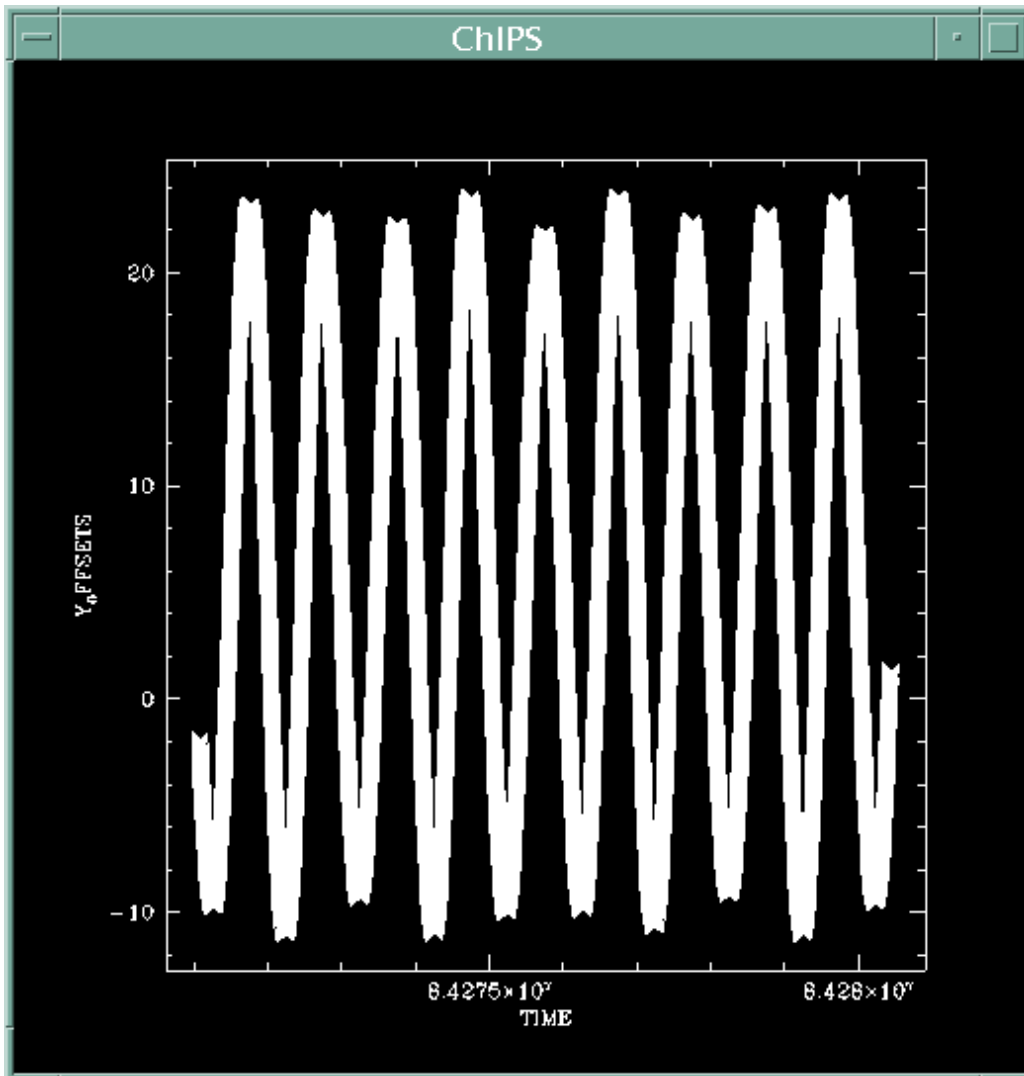


Image 6: Binning the SKY to form an image

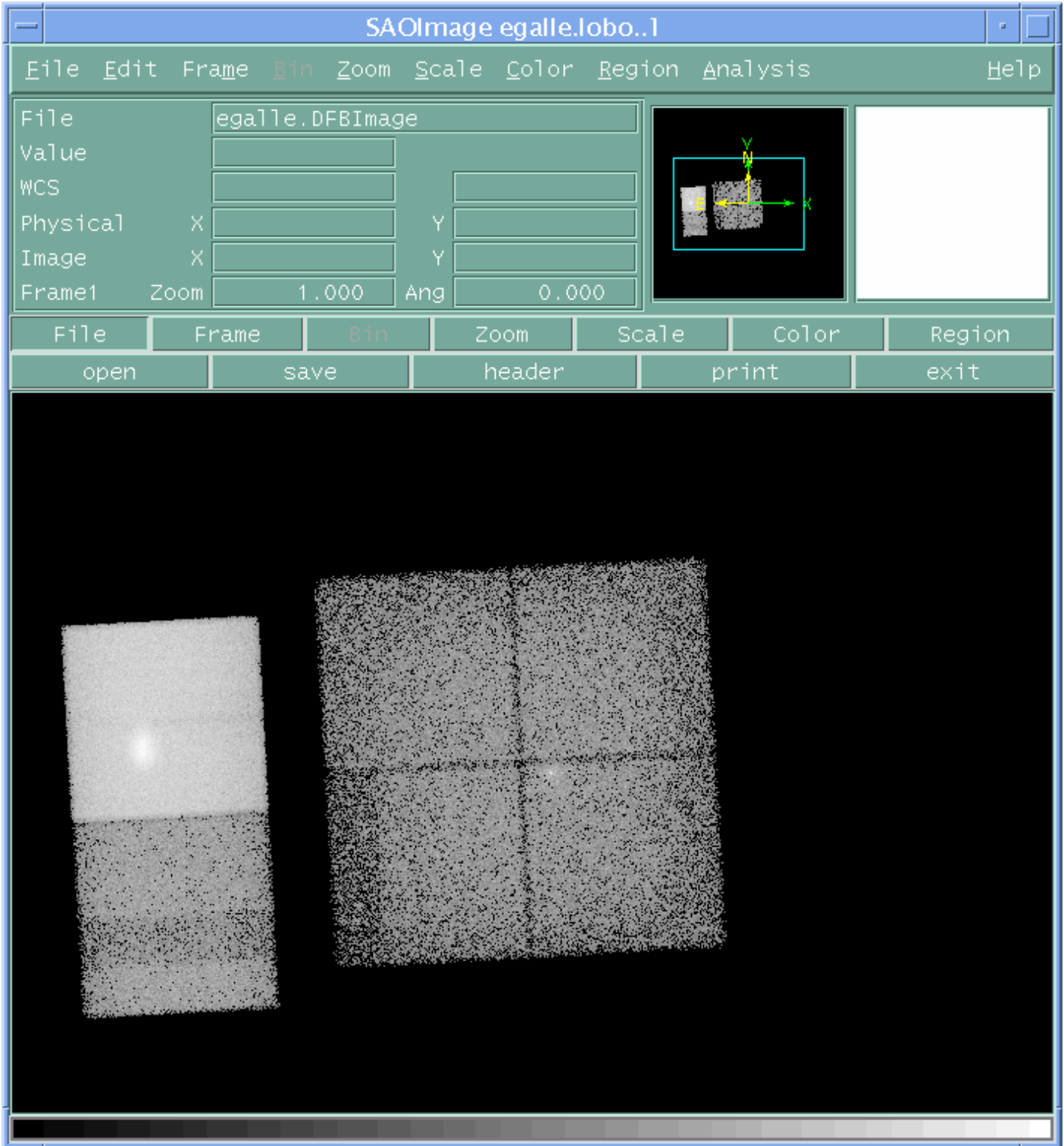


Image 7: "Histogram Preferences" dialog box

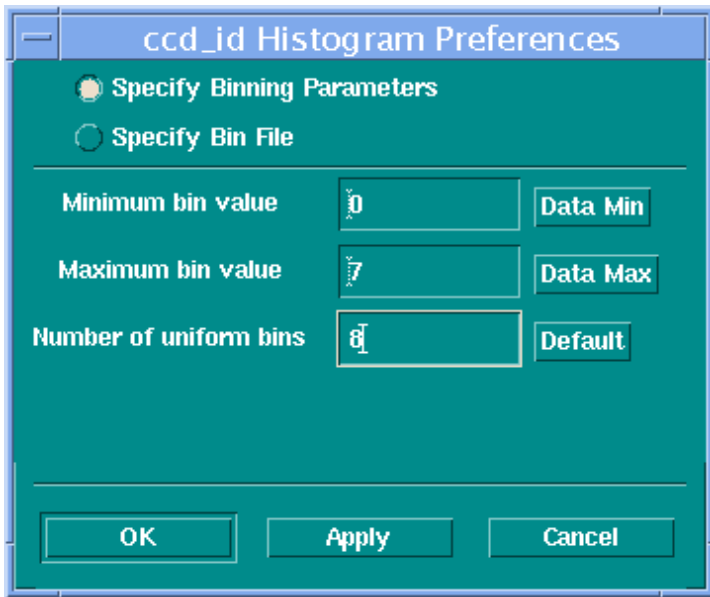


Image 8: Histogram of ccd_id column

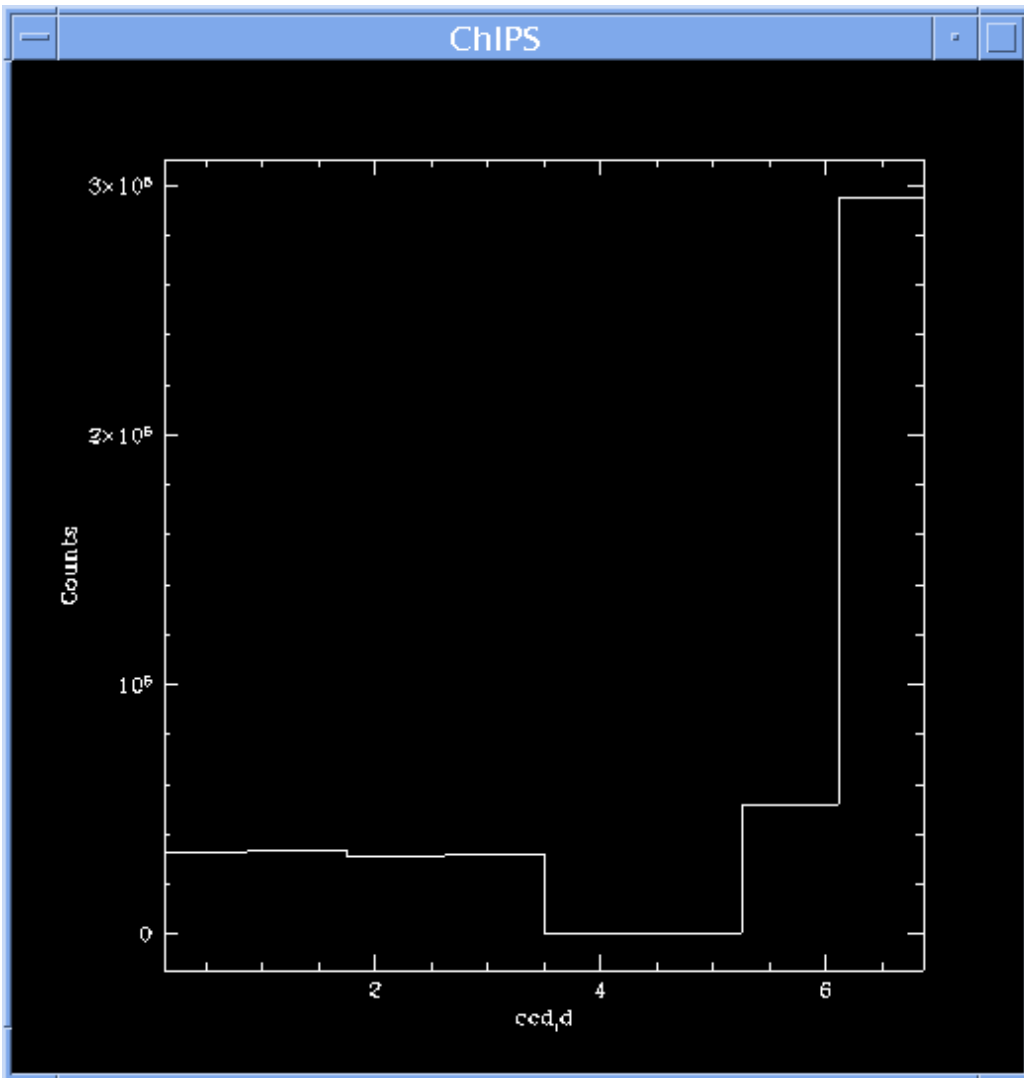


Image 9: Selecting a table entry for editing

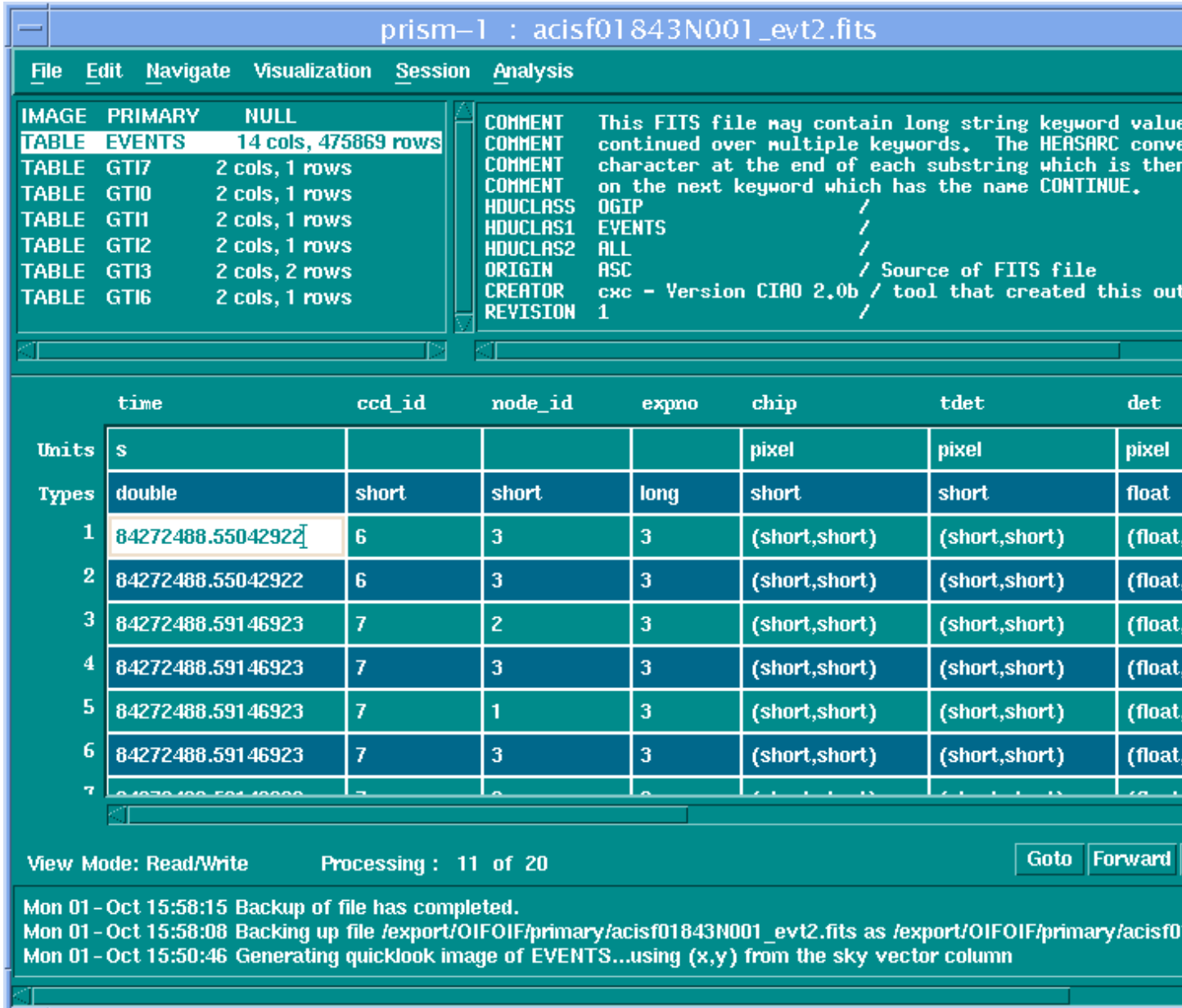


Image 9: Selecting a table entry for editing

Image 10: Entering an incorrect value into a cell



Prism performs limited error checking on any value you enter; here you see the error window that appears after trying to enter the string "this_is_bad_input" into the TIME column.

Image 11: Viewing previous edits in the status window

The screenshot shows the Prism software interface. The top window displays the file name 'prism-1 : acisf01843N001_evt2.fits' and a menu bar with 'File', 'Edit', 'Navigate', 'Visualization', 'Session', and 'Analysis'. Below the menu is a table listing FITS tables:

IMAGE	PRIMARY	NULL
TABLE	EVENTS	14 cols, 475869 rows
TABLE	GTI7	2 cols, 1 rows
TABLE	GTI0	2 cols, 1 rows
TABLE	GTI1	2 cols, 1 rows
TABLE	GTI2	2 cols, 1 rows
TABLE	GTI3	2 cols, 2 rows
TABLE	GTI6	2 cols, 1 rows

To the right of this table is a 'COMMENT' section with the following text:

```

COMMENT This FITS file may contain long string keyword value
COMMENT continued over multiple keywords. The HEASARC conv
COMMENT character at the end of each substring which is then
COMMENT on the next keyword which has the name CONTINUE.
HDUCLASS OGIP /
HDUCLASS1 EVENTS /
HDUCLASS2 ALL /
ORIGIN ASC / Source of FITS file
CREATOR cxc - Version CIAO 2.0b / tool that created this out
REVISION 1 /

```

Below these windows is a large data table with the following columns: 'time', 'ccd_id', 'node_id', 'expno', 'chip', 'tdet', and 'det'. The table contains 6 rows of data. The first row is highlighted:

	time	ccd_id	node_id	expno	chip	tdet	det
Units	s				pixel	pixel	pixel
Types	double	short	short	long	short	short	float
1	84272488.55042922	6	3	3	(short,short)	(short,short)	(float)
2	84272488.55042922	6	3	3	(short,short)	(short,short)	(float)
3	84272488.59146923	7	2	3	(short,short)	(short,short)	(float)
4	84272488.59146923	7	3	3	(short,short)	(short,short)	(float)
5	84272488.59146923	7	1	3	(short,short)	(short,short)	(float)
6	84272488.59146923	7	3	3	(short,short)	(short,short)	(float)

At the bottom of the interface, there is a status window with the following text:

```

View Mode: Read/Write      Processing : 11 of 20      Goto Forward
Mon 01 - Oct 16:00:36 Cell Edit Undo- Changing cell (1,1) from 345.678 back to 84272488.55042922
Mon 01 - Oct 16:00:34 Cell Edit Undo- Changing cell (2,1) from 876.543 back to 84272488.55042922
Mon 01 - Oct 16:00:31 Cell Edit- Changing cell (2,1) from 84272488.55042922 to 876.543
Mon 01 - Oct 16:00:24 Cell Edit- Changing cell (1,1) from 84272488.55042922 to 345.678

```

The status window of prism (below the main data window) details the edits (and removal of edits) that you have made to the current file.

Image 12: Appending a column to a table

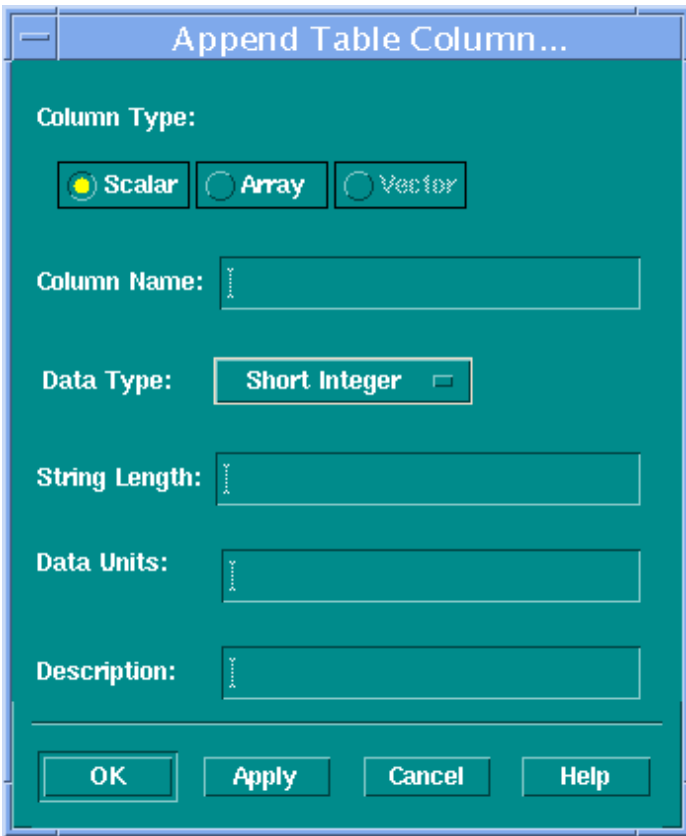


Image 13: Viewing the new column

The screenshot shows the CIAO Prism software interface. The title bar indicates the file is 'prism-1 : acisf01843N001_evt2.fits'. The menu bar includes File, Edit, Navigate, Visualization, Session, and Analysis. A table of contents on the left lists several tables: EVENTS (15 cols, 475869 rows), GTI7 (2 cols, 1 rows), GTI0 (2 cols, 1 rows), GTI1 (2 cols, 1 rows), GTI2 (2 cols, 1 rows), GTI3 (2 cols, 2 rows), and GTI6 (2 cols, 1 rows). The main window displays the header of the EVENTS table, including columns for 'z', 'pha', 'energy', 'pi', 'fltgrade', 'grade', 'status', and a newly added 'NEW_COLUMN'. The 'NEW_COLUMN' column is currently empty. Below the header, the first six rows of data are visible. At the bottom, the status bar shows 'View Mode: Read/Write' and 'Processing : 11 of 20'. A log window at the very bottom records several 'Cell Edit' actions.

	z	pha	energy	pi	fltgrade	grade	status	NEW_COLUMN
Units	el	adu	eV	chan				cm
Types	at	long	float	long	short	short	bit	short
1	float,float)	3601	14079.6	965	0	0	bit[32]	0
2	float,float)	3737	15603.1	1024	208	6	bit[32]	0
3	float,float)	2625	12244.9	839	10	6	bit[32]	0
4	float,float)	3509	15991.6	1024	16	4	bit[32]	0
5	float,float)	1712	8132.1	557	64	2	bit[32]	0
6	float,float)	3185	14570.9	999	104	6	bit[32]	0

View Mode: Read/Write Processing : 11 of 20 [Goto](#) [Forward](#)

Mon 01 - Oct 16:00:36 Cell Edit Undo- Changing cell (1,1) from 345.678 back to 84272488.55042922
 Mon 01 - Oct 16:00:34 Cell Edit Undo- Changing cell (2,1) from 876.543 back to 84272488.55042922
 Mon 01 - Oct 16:00:31 Cell Edit- Changing cell (2,1) from 84272488.55042922 to 876.543
 Mon 01 - Oct 16:00:24 Cell Edit- Changing cell (1,1) from 84272488.55042922 to 345.678

Image 14: Appending new rows to a table

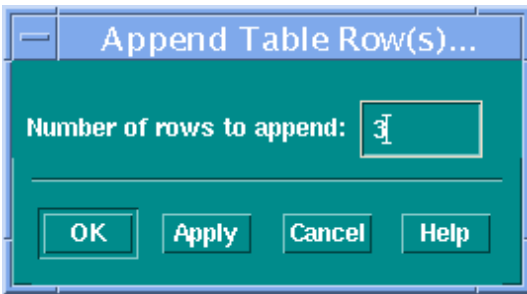


Image 15: Viewing the new rows

prism-1 : acisf01843N001_evt2.fits

File Edit Navigate Visualization Session Analysis

IMAGE	PRIMARY	NULL
TABLE	EVENTS	15 cols, 475872 rows
TABLE	GTI7	2 cols, 1 rows
TABLE	GTI0	2 cols, 1 rows
TABLE	GTI1	2 cols, 1 rows
TABLE	GTI2	2 cols, 1 rows
TABLE	GTI3	2 cols, 2 rows
TABLE	GTI6	2 cols, 1 rows

```

COMMENT This FITS file may contain long string keyword value
COMMENT continued over multiple keywords. The HEASARC convention
COMMENT character at the end of each substring which is then
COMMENT on the next keyword which has the name CONTINUE.
HDUCLASS OGIP /
HDUCLASS1 EVENTS /
HDUCLASS2 ALL /
ORIGIN ASC / Source of FITS file
CREATOR cxc - Version CIAO 2.0b / tool that created this output
REVISION 1 /

```

	time	ccd_id	node_id	expno	chip	tdet	det
Units	s				pixel	pixel	pixel
Types	double	short	short	long	short	short	float
475868	84280442.16567804	0	3	2457	(short,short)	(short,short)	(float)
475869	84280442.16567804	0	1	2457	(short,short)	(short,short)	(float)
475870	0	0	0	0	(short,short)	(short,short)	(float)
475871	0	0	0	0	(short,short)	(short,short)	(float)
475872	0	0	0	0	(short,short)	(short,short)	(float)

View Mode: Read/Write Processing : 475871 of 475872 Goto Forward

Mon 01 - Oct 16:03:45 Appended 3 new rows to end of selected block.
 Mon 01 - Oct 16:00:36 Cell Edit Undo- Changing cell (1,1) from 345.678 back to 84272488.55042922
 Mon 01 - Oct 16:00:34 Cell Edit Undo- Changing cell (2,1) from 876.543 back to 84272488.55042922
 Mon 01 - Oct 16:00:31 Cell Edit- Changing cell (2,1) from 84272488.55042922 to 876.543

The cells in the new rows have been set to 0.

Image 16: Editing header keywords

The image shows a dialog box titled "Edit header ...". It features three input fields: "Keyword", "Value", and "Comment". Below the "Comment" field, there are three buttons: "Change This Keyword", "Delete This Keyword", and "Insert New Keyword". At the bottom of the dialog is a "Cancel" button.

Image 17: Viewing the new header

The screenshot shows the Prism software interface with the following components:

- Header Window:** A list of keywords and their values. The keyword **NEWKEY** is highlighted in red. Other keywords include HISTORY, CONTENT, HDUCLASS3, and HISTORY.
- Table:** A table with 7 columns: time, ccd_id, node_id, expno, chip, tdet, and det. The rows show event data for various times and IDs.
- Status Bar:** Shows 'View Mode: Read/Write' and 'Processing: 475871 of 475872'. There are 'Goto' and 'Forward' buttons.
- Log Window:** Shows a list of messages, including 'Mon 01 - Oct 16:03:45 Appended 3 new rows to end of selected block.' and 'Mon 01 - Oct 16:00:36 Cell Edit Undo - Changing cell (1,1) from 345.678 back to 84272488.55042922'.

The new keyword (NEWKEY) is highlighted in the header window.

