Publ. Astron. Inst. ASCR 99, 9–21 (2002)

Data acquisition at the 700mm CCD camera of the Ondřejov telescope coudé spectrograph

Miroslav Šlechta, Petr Škoda

Astronomical Institute, 251 65 Ondřejov, Czech Republic;
slechta@sunstel.asu.cas.cz; skoda@sunstel.asu.cas.cz

We present a short tutorial on driving the 2-meter telescope coudé spectrograph and on acquisition of scientific data. We hope that visitors collaborating with stellar department will appreciate this tutorial as an useful cookbook. Although the user interface driving the spectrograph and CCD controller is quite comfortable, it is not possible to find or understand all keywords and commands intuitively. Therefore we present this manual containing all necessary commands with descriptions and examples.

Keywords: Astrophysical Data – Observations – Spectrographs – CCD

1 Introduction

This is a short manual for the acquisition of spectra with the 700mm CCD camera installed in coudé spectrograph of the Ondřejov 2-meter telescope.

We divide this report in two parts: in part one we give a short recipe for the spectra acquisition (i.e. start and using user-interface); in the second part we give a list of the most frequent commands, their explanation and some examples, if needed.

We hope the manual will be useful, for example, for students or visitors of the stellar department. Therefore we have written down the report with the main accent given to the intelligibility and accuracy.

2 Spectra exposure

2.1 Start of observation

The user-interface for driving the CCD and coudé spectrograph controllers are installed on the `alhena` PC in the coudé room. The package driving the CCD controller is installed just on the `alhena` while the package driving the coudé spectrograph controller is installed at the `mizar` PC; the user interface communicates with the `mizar` automatically through ethernet connection.

Steps necessary to be done before the first exposure are as follows:

1. One should check (and eventually adjust) the grey filter for the comparison light: the control knob is denoted `HK` and it is situated at the slit head. There are 6 possible positions: `HK 1÷5` denote the grey filters while `HK 6` is the open hole (none weakening). The correct position for the 700mm camera CCD is `HK 6`.

2. Switch on the CCD chip controller. It is situated in the coudé spectrograph, just below the Dewar bottle.

3. Switch on the controller of the spectrograph. It is a small button near to the spectrograph slit head.
Remark: *The previous items should be done by experienced person (i.e. the night assistant) On the contrary, all followings items are led by the astronomer:*

4. *One should login to the* `alhena`*; login name is* `tcsuser` *while password is written on the monitor.*

5. *Start XWindow graphics through the command* `startx`

6. *The interface driving the spectrograph and the CCD controllers are started via the command* `observe` *which opens 5 windows:*

- `BIAS CCD CONTROL`
- `BIAS CCD STATUS`
- `Coude Spectrograph`
- `SAOImage for BIAS`
- *The window of the guiding camera (camera in the slit head).*

We have depicted cited applications in the appendix of this tutorial
Remark: *In the case that the application* `Coude Spectrograph` *or* `BIAS CCD CONTROL` *hangs up, then it is necessary to kill and restart them. One can finish the* `Coude Spectrograph` *via the key* $\boxed{q}$ *and restart via the command* `startc` *or* `startb`*, respectively, in the* `xterm` *window.*

7. *One should check the type of the dichroic mirror and the color filter (do not confuse it with the grey filters* `HK`*) for the star and flat beams – see Tab. I.*

Fig. 1: The application `Dichroic mirror`.

Fig. 2: The application `Filter`.

The default combination is $\boxed{1}$/$\boxed{1}$
Remark: *It is easy to change any parameter: one should click two times the left key of the mouse in the field of the selected parameter and the editable subwindow will be opened.*
Example: *We need to change the type of the dichroic mirror. Therefore we click two times in the field* `Dichroic mirror` *(see the window* `Coude Spectrograph`*). The editable item will open. We write number in the range 1÷4 and save the configuration through* `OK`*.*

It is important to notice that the position of the parameter itself is inactive! One should click to the grey field of parameter but not at the proper value of the parameter.

8. Slit height is asked to be near to maximal value but, on the other hand, not equal to it, since the code is unstable at that boundary limit due to the hysteresis of the end sensors and may hang up. Therefore we recommend to set slit height at 16.5÷17 mm (limited value is 17.5 mm).

9. We click at `ON` in the window of the guiding camera and switch the camera on. The camera is installed in the slit head.
   Remark: *The guiding camera is highly sensitive to the overexposure and therefore a carousel is installed with grey filters to reduce shining of stellar light, if necessary. There are 5 positions of the carousel: from 1 (full target – camera closed) to 5 (none filter). The carousel closes the camera automatically in the case of extremely intensive light (e.g. flat field). Then it is necessary to re-adjust carousel position again after the end of exposure. Recommended filters are, typically, 2 for the α CMa and 5 for weak stars.*

10. Grating angle for the H_α region is 30^o $15'$[1], therefore we set `30:15`.
    Example: *In the angle* 30^o $08'$ *we write* `30:8`*, not* `30:08`*.*

2.2 Exposing the calibration spectra

The main terminal window application is `BIAS CCD CONTROL`; it is possible to write commands on the command line:

1. On the command line of the application `BIAS CCD CONTROL` we write down `observer` and after the `Enter` write down names of observers; these names will be copied to the FITS header of exposed files.
   Remark: *The text string is limited to the 20 characters (including spaces). Any longer string will be cut off from the beginning.*

   The identification is transmitted to all following files and thus it is sufficient to write the identification once per the observational session. Nevertheless, if the user-interface hangs up and is restarted, then it is, of course, necessary to identify again.
   Remark: *The* `BIAS` *allows writing remarks into the header of the exposed files via commands* `comm` *or* `xcomm`*; the command* `comm` *will write the remark to the first following file while the command* `xcomm` *will write the remark to the all*

[1]In this angle we get H_α, He 6678 and also Si 6346 and Si 6370.

Table I: *Recommended dichroic mirrors and color filters for spectra acquisition*

Spectral area	Wavelength range	Dichr. mirror	Filter
Blue	*3800÷6000 A*	*4*	*5*
Red	*6000÷7200 A*	*1*	*1*
Infrared	*7200÷8300 A*	*1*	*3*

following files. The string is limited by 40 characters (including spaces).

2. The offset is exposed via command `zero` – it is recommended to expose 10÷15 offsets per night.

3. The command `flat` exposes flat field. The default exposure time is 3s (optimised for H_α region), nevertheless the exposure time may be put as a parameter:
   Example: *The command* `flat␣3` *will expose for 3s.*

   It is recommended to expose at least 10 flats per night for each grating angle.
   Warning: *If one needs expose even only stellar spectrum for different grating angle (for example in region H_β), we recommend you expose minimally 5 flats. The reduction procedure (prepared for IRAF) excludes automatically the strongest and the weakest flat and average remaining flats. Therefore the minimal number of flats is 3!*
   Warning: *Commands of the graphical user interface do not check slit position. The astronomer should not forget to open the slit or the* `flat` *command will expose wrong flat and any following exposures will be wrong.*

4. The command `comp` enables taking of a comparison spectrum of the Th-Ar lamp. Default exposure time is 5s, optimised for H_α region. Of course, it is possible to put another exposure time as a parameter of the command.
   Example: `comp␣5` *will expose comp for 5s.*

   The command `comp` runs for a long time as it closes the slit to the slit height 0.5mm and after the exposure it opens to the original height again. The reason for this unexpected behaviour is the construction of the slit head (the retracting prism joined with the slit arm).

   It is recommended to expose one comp before and one comp after any stellar spectrum. The recommended sequence of files is suggested in the table Tab. II.

2.2.1 Preview of the last exposed spectrum

Of course, it is allowed to preview the exposed spectrum in a graphic mode. The application `SAOImage for BIAS` with a spectrum is shown on the Figure 9.
Warning: We do not recommend preview of the exposed spectrum while another exposure is being run as the graphical code is unstable and it may hang up. Therefore one should preview the spectrum while no exposure is in process.

The `BIAS`-command `imexamine` (or unambiguous abbreviation `imexam`) opens new graphical window with the last spectrum depicted. It is possible to place the cursor at any position in that window and press the key $\boxed{\text{l}}$ (as “**l**ine”); the profile along a selected line of pixels (i.e. along the dispersion) will be shown; by the same way one can press the key $\boxed{\text{c}}$ (as “**c**olumn”) and watch the perpendicular profile (perpendicular cut) of the chip.

Press the key $\boxed{\text{q}}$ to stop the preview. The graphical window `imexamine` will close.
Warning: It is necessary to hold the cursor inside the main field of the application `SAO Image for BIAS` (otherwise the application may hang up and the user interface must be restarted).

2.2.2 Preview of an old spectrum

The command `display␣` <*filename*> is designed for the preview of an old spectrum. Selected file is opened in the window `SAOImage for BIAS`. The following treatment is similar to the previous paragraph: write

Table II: Recommended sequence of calibration spectra exposures

5× zero
5× flat
comp
star
comp
5× flat
5× zero

command `imexamine`, or abbreviated `imexam`, and open the window with selected spectrum.

2.3 Exposing of the stellar spectra

Once we have exposed some offsets, flats and at least one comparison spectrum ThAr; then we can expose the first spectrum of a star.

1. We write the command `object` and write the name of asked star. The string is limited to 20 letters (including spaces).
   Remark: *The user-interface communicates with the telescope and reads the telescope position (needed for the reduction process to find heliocentric correction) but it does not read the name of the object from the catalogue of the telescope and thus it is necessary to write it in order to be able identify the star later.*
   Example: `HD 206773`

2. The exposure is started via the command `exp` with a parameter defining exposure time in seconds.
   Example: `exp␣180` *denotes 180s exposure.*
   Remark: *It is necessary to expose the stellar spectrum at the same region of the CCD chip like comps and flats are, due to demands of the reduction procedures. See figure Fig. 3.*

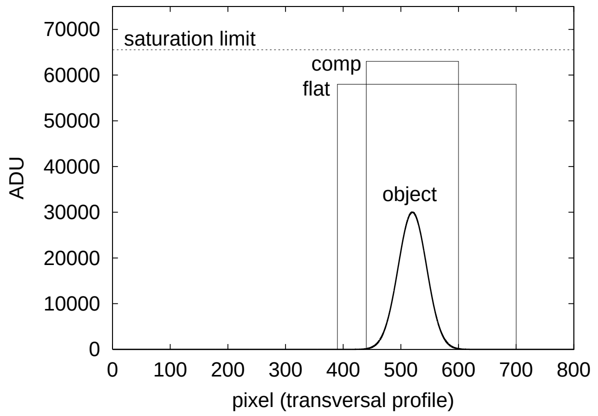

Fig. 3: The expected position of exposed spectra: transversal profile. Some ThAr lines may exceed the saturation limit.

2.4 Finishing observation

1. We should expose at least one or more comparison lights, flats and offsets (i.e. use commands `comp`, `flat`, `zero`).

2. The `exit` in `BIAS CCD CONTROL` will close the `BIAS`.

3. The application `Coude Spectrograph` remains active; we press the key $\boxed{\text{q}}$ and kill it.

4. We can exit out of `alhena` PC. It should be said that all exposed files are automatically saved to the data server disk array in the service building.

5. The observer should check, whether the collimator was closed, all lamps (FF, ThAr) are switched off, and finally he should switch off both controllers (spectrograph and CCD controller).

3 Comments to the CCD controller driver

HELP: we put the cursor anywhere inside the application `Coude Spectrograph` and press the key $\boxed{\text{F1}}$. The HELP will open in the new window. Nevertheless we present the fundamental remarks in this tutorial.
Remark: *The HELP pretends, that it may be edited, but that is not true. In reality the* `tcsuser` *is not allowed to save the HELP. Therefore the user cannot damage it.*

Closing the HELP: by the same way we press the key $\boxed{\text{F1}}$ again and the HELP will close.

Choice of parameters for some process (i.e. selection of one of several possibilities): double-clicking the left button of the mouse inside the selected field will open a menu.
Example: *The double-click inside the* `Dichr. zrc.` *(Dichroic Mirror) will open the menu (see Fig. 1, see also Fig. 8)*[2].

Restart of the `BIAS`: It is necessary to put `observer`, `comm`, `xcomm` etc. commands after the restart of `BIAS`.

Names of exposed spectra: The format of the filename is quite specific: the information WHEN the spectrum was exposed is encrypted into the filename. As an explanation we "decode" the file `hk230011.fit` where `h` denotes the year (a=1991, b=1992 etc.), `k` is a month in the year (a=January, a=February...) following two numbers denote the day in the month and the other numbers denote the sequence number of the file. For example the file

$$\underbrace{\text{year}}_{\text{h}}\ \underbrace{\text{month}}_{\text{k}}\ \underbrace{\text{day}}_{23}\ \underbrace{\text{No.}}_{0011} = \text{Nov 23 1998}$$

[2]All graphical applications are described in Czech language because some of night assistants do not speak English

and it was 11th file that day.

A problem could arise with the restart (if necessary) after the midnight of Universal Time: the sequence could be broken, file `hk230011.fit` could be followed by `hk240001.fit`. Therefore the numbering of files changes at noon.

Error, limit or unusual states of `Coude Spectrograph` The red warning text indicates error, limit or unusual states of the application `Coude Spectrograph`.
Example: *The limit of the slit height is indicated by the red warning text* `-limit`

4 List of the most important or frequently asked commands

4.1 `UNIX`-commands of the `shell`

1 – `observe` The command starts the user-control package for the spectrograph and CCD driving. It opens 5 windows (see the appendix of this tutorial). The command line for writing the commands is in `BIAS CCD CONTROL`. It is recommended to write ampersand `observe&` to be able to use `startb/startc`, if necessary (see the following text).

2 – `startb` starts `BIAS` only. It is an useful command if the `BIAS` hangs up while remaining application run correctly.

3 – `startc` starts the application `Coude Spectrograph` only. It is similar to the previous item.

4.2 Commands of the `BIAS`

Warning: Some of following commands can lead to instabilities of the user-interface. They are marked and should be used carefully.

4 – `HELP` The `HELP` (see the upper text) is opened through the key F1 and close by the same key.

The control of the `HELP` is possible via commands:

`ENTER` moves a cursor one line ahead;

`SPACE` moves a cursor one page ahead;

`b` moves a cursor one page back;

`F1` stops the `HELP`

5 – `observer` The command for the identification of observers. It opens a new active line; the string is limited to 20 letters (including spaces)
Example: `Skoda␣+␣Slechta`
(Of course, it is not necessary to use `+`)

6 – `object` identifies the name of the object; the string is limited to 20 characters (including spaces).
Example: `HD␣206773`

7 – `comm` A remark or commentary to the following file. The string is limited to 40 characters and it may contain a space; a longer string will be cut off from the beginning.

8 – `xcomm` The command similar to the previous one; it remarks all following files (i.e. not one file only).

9 – `header`+< *filename* > (or `head` since it is unambiguous) will open a new window with the FITS header < *filename* >`.fit`
The astronomer can check whether all statements are correct.

10 – `zero` exposes the offset; it is usually recommended to expose 10÷20 offsets per night.

11 – `mzero␣0␣`<*n*> exposes selected number of offsets. The obligatory parameter *0* defines the exposure time (which is 0s in the case of the offset) and the second obligatory parameter defines how many offsets will be exposed. Both of parameters must be `INTEGER`
Example: *mzero␣0␣5*

12 – `slitwidth` <*p*> adjusts the slitwidth to the selected value. Default is 0.2mm. We do not recommend to change this value.

13 – `slitheight` <*p*> adjusts the slit height to the selected value. Default is 17mm. It should not reach the maximal limit value in 17.5mm or the user-interface becomes unstable.

14 – `flat` exposes a flat. The exposure time (in seconds) may be determined by a parameter (it must be an `INTEGER`). Default exposure time is 3s (i.e. time will be exposed without any parameter)
Remark: *The default exposure time can be redefined by the command* `fint␣` <*n*>.
Example: `flat␣4` *will expose the flat for 4s.*
We recommend to expose 10÷15 flats per night. They may be exposed in one or two groups in each grating position.

15 – `fint␣` < *n* > The command re-defines the exposure time of the flat (if the observer set the command `flat` without a parameter).
Example: *The command* `fint␣3` *will pre-define the default exposure time of flats to 3s. Then the command* `flat` *will be equal to the command* `flat␣3`.

16 – `comp` The command will expose the comparison spectrum of the ThAr-lamp for the default time (which is recommended to be 5s - optimized for the Hα region). It is possible to expose the ThAr for a different time which is defined by the `INTEGER` parameter (in seconds).
Example: `comp␣5`

17 – `cint␣` $< n >$ The command, similarly to the `fint`, will re-define the exposure time for the comparison spectrum. The parameter is the exposure time in seconds and it must be an `INTEGER`.
Example: *The command* `cint␣5` *will pre-define the default exposure time of comps to 5s. Then the command* `comp` *will be equal to the command* `comp␣`*5.*

18 – `exp␣` $< n >$ will expose an object for $< n >$ seconds where n must be an `INTEGER`.

19 – `pexp␣` $< p >$ The command allows to select number of Megacycles (detected in the exposuremeter) to be exposed. The parameter p may be a `REAL`.
Example: `pexp␣2.1`

20 – `exp␣-e` The command will expose the object with respect to the value of the exposuremeter (see the next command `pexp`).
Remark: *It is possible to obtain the premature readout the CCD chip (for example when the sky becomes overclouded) via the command* `readout`*; similarly one can use the command* `abort` *which will not read out the CCD chip — the file will not be saved!*

21 – `autosave±` The command defines if the file is saved automatically or not.
Example 1: `autosave+` – *all following files will be saved*
Example 2: `autosave-` – *no following file will be saved to disk.* It is convenient during some experiments. Nevertheless, we recommend you to put (or check) `autosave+`

22 – `save` will save the last exposed file. It is convenient if we have put the command `autosave-` and then we have exposed a file which we need to save.

23 – `readout` The command for the premature readout of the chip. It is comfortable if the sky becomes overclouded. The command will read out the chip and save the file.

24 – `abort` It is a command similar to the previous one but it will not read out the chip. The exposed file is thus lost.

25 – `imexamine` (or unambiguously `imexam`). The command will open a new window graphical application with the last spectrum being depicted.
Warning: *We do not recommend you to put this command if we are exposing any spectrum because the user-interface becomes unstable and may hang up!*
Warning: *It is necessary to keep the cursor inside the window* `SAOImage for BIAS` *or the user-interface hangs up! In case of commands* $\boxed{l}$, $\boxed{c}$ *etc. (see bellow) we have to return the cursor to the* `SAOImage for BIAS` *again when we finish them!*

There are some keys useful for the detailed inspection of the exposed file:

$\boxed{\mathbf{l}}$ depicts the profile of the spectrum along the dispersion.

$\boxed{\mathbf{c}}$ depicts a transversal profile of the exposed spectrum (i.e. cross the chip).

$\boxed{\mathbf{z}}$ will mark (but will not depict) 10x10 pixels field in the topical position of the cursor. This field cannot be shifted: it is necessary to put the cursor at some another position and click the key $\boxed{\mathrm{z}}$ again – it depicts upgraded field.

$\boxed{\mathbf{a}}$ writes out aperture photometry in the selected field (see the command $\boxed{\mathrm{z}}$)

$\boxed{\mathbf{m}}$ computes statistics in `imexbox`

$\boxed{\mathbf{s}}$ depicts an array near to the topical position of the cursor as a 3-dim graph.
Warning: *It is necessary to have* $\boxed{z}$ *before the command* $\boxed{s}$

$\boxed{\mathbf{e}}$ depicts a isofots round the modern position of the cursor.
Warning: *It is necessary to have* $\boxed{z}$ *before the command* $\boxed{s}$

$\boxed{\mathbf{h}}$ depicts a histogram round the cursor
Warning: *It is necessary to have* $\boxed{z}$ *before the command* $\boxed{s}$

$\boxed{\mathbf{q}}$ will finish the `imexamine` and close the window.

26 – `display␣` $< filename >$ reads an older file
Example: `display␣hk230011.fit`
Remark: *One may put* `imexamine` *after the* `display␣` $< filename >$ *and inspect selected file.*

27 – `z±` zoom in/out the picture to be able watch details of the spectra. Click at any point in the image of the full spectrum (just bellow the upper border of the `SAOImage for BIAS` – see Fig. 7) and the neighbourhood of the cursor will be zoomed.

Nevertheless, the command `imexam` (and its "sub-commands" $\boxed{\mathrm{l}}$ or $\boxed{\mathrm{c}}$) will show full profile of the spectra, without zooming.

28 – `exit`/$\boxed{\mathbf{q}}$ close the user-interface; be careful and inspect whether the collimator was closed.

`exit` stops the `BIAS` and other applications except for `SAOImage for BIAS`.

$\boxed{\mathbf{q}}$ Put the cursor to the `SAOImage for BIAS` and press $\boxed{\mathrm{q}}$. The window will be closed.

Some of following commands can be unstable or can work incorrectly. Please, be so kind and inspect them before observation...

29 – `dark`$_\sqcup$ $< n >$ exposes a dark for a n-seconds.

30 – `addtime`$_\sqcup$ $< n >$ adds n-seconds to the running exposure. The n must be an `INTEGER`
Example: *You have set exposure time to 1hour:* `exp 3600` *and have started the exposure. The weather condition has changed and you need to add some time to the exposure. Therefore you put the command* `addtime 1800` *and thus add 1800s to the running exposure. Then the chip is read out after 5400s*
Remark: *You can set a negative time* $n < 0$ *to get the exposure shorter. If the final time is negative, then the exposure breaks down immediately and the chip is read out.*
Example: *You have started 1hour exposure:* `exp 3600` *and now you have 1000s to finish. You put the command* `addtime -1200`*. The final time is -200s. Therefore the chip is read out immediately.*

31 – `hold` breaks down running exposure. The CCD camera shutter will be closed.

32 – `resume` will continue the exposure (see the previous command). The camera shutter is opened.

33 – `preclear`$\pm$ This command either clears or does not clear the chip before next exposure.

34 – `tint` pre-defines the exposure time. It is possible to put the command `exp` without any parameter and the exposure time will set the default value.

35 – `impath`$_\sqcup$ $<$ *path* $>$ re-direct the path to the directory where exposed files are saved. The user `tcsuser` is allowed to write to `/data/ccd/` or `/home/tcsuser` and thus the path must be one of these or files will be lost!

36 – `filename`$_\sqcup$ $<$ *filename* $>$ selects the name of the exposed file. It is limited to 8 letters. See also the section 3.

37 – `autoshow`$\pm$ The exposed spectrum is or is not shown after the chip is read out.

38 – `ls` It is similar to `UNIX`-command `ls`. It works in that directory where files are defaultly saved, i.e. `/data/ccd` for example (see also command `impath`).

39 – `ll` It is similar to `UNIX`-command `ls -l`. It works in that directory where files are defaultly saved, i.e. `/data/ccd` for example (see also command `impath`).

40 – `sleep`$_\sqcup$ $< n >$ waits for n-seconds. Here n must be a positive `INTEGER`.

41 – `wait` waits until the key $\boxed{\text{ENTER}}$ is pressed.

42 – `stat` writes the state of the CCD. It puts `B` (i.e. Busy) or `R` (i.e. Ready).

5 Important or frequently asked commands of the `SAOImage for BIAS`

Another "click-able" submenu is in the application `SAOImage for BIAS`. It allows inspection of the exposed spectra. A spectrum in `SAOImage for BIAS` is presented, as an example, on the Figure 9.

The default (after the opening the application) is `Scale`. The user may click at any item of the submenu and work with it.

43 – `Scale` is divided into subitems `linear`, `wrap`, `log`, `sqrt` and `histeq` for the selection how depends the *"signal in a pixel"* on *"pixel shown on monitor"*. The default is `linear`.

44 – `Cursor` Put the cursor at any point inside the `SAOImage for BIAS` and click on the left mouse button. It shows the relative coordinate of the point. The middle button shows the same but in the red color.

It is possible to mark more positions.

To erase coordinates, mark the item $\boxdot$ and press the key $\boxed{\text{Delete}}$ on the keyboard. Erasing is realised in the opposite order than the writing (the last market position is erased as the first one).

Clicking on some graphical symbol in submenu enables drawing into the spectrum via the middle mouse; it is possible to draw one symbol only (if one draws another symbol then it automatically erases the previous one).

Clicking on the symbol `abc` enable to write some text into the spectrum.

To erase the symbol one should click on the symbol ⊡ just on the left-hand side.

Drawing the vector into the spectrum, the middle mouse marks the initial point of the vector and the left mouse marks the final point.

45 – `Color` selects the intensity/contrast of the shown spectrum. Keeping the left mouse button down and moving cursor on spectrum, one can change intensity/contrast: the horizontal motion changes the intensity and the vertical motion changes the contrast of the depicted spectrum.

Another subitems in `Color`:

mono – switching from monochromatic to grey scale and/or back again; density in monochromatic mode can be selected in dith1, dith2 and diffuse. Press the invert to invert the picture white↔black.

cmap – opens a new submenu for drawing the spectrum in false colors (items `I8`, `A` and `B`); the intensity and contrast can be changed by the same way as the `Color`

Click the color border on the bottom of the `SAOImage for BIAS` to open a new color border-submenu on the right-hand side of the application `SAOImage for BIAS`. It allows you to change intensity of colors in the RGB-scale (via the left mouse again). Click the Grey to return to the greyscale.

The escape from cmap to the upper level `Color` is possible via clicking the cmap again.

etc. we do not recommend this item. The command opens a new submenu. Items Quit and New kill the application `SAOImage for BIAS` but the `BIAS` will hang up and it is necessary to restart the user-interface! (Commands `startb`, `startc` or `observe`).

46 – `Pan` shifts the depicted spectrum. Clicking on any point of the spectrum defines a vector (starting point is in the center of the `SAOImage for BIAS` and final one is marked by the `Pan`) and the image will shift along the defined vector.

Clicking on the item center in submenu will re-center the image.

It is possible to zoom in/out the image with scale-factor 2, i.e. 2^m, where $m = \pm 1, \pm 2$ via items:

- $\boxed{\text{x2}}$ zoom 2^1
- $\boxed{\text{x4}}$ zoom 2^2
- $\boxed{\text{x1/2}}$ zoom 2^{-1}
- $\boxed{\text{x1/4}}$ zoom 2^{-2}

6 Alphabetical list of commands

Here we present in alphabetical order all commands presented in the previous sections 4 and 5. The first column presents the name of the command, the second column presents its logical order, as they are marked in sections 4 and 5.

abort	24	ls	38
addtime	30	mzero	11
autosave±	21	object	6
autoshow±	37	observe	1
cint	17	observer	5
Color	45	Pan	46
comm	7	pexp	19
comp	16	preclear	33
Cursor	44	readout	23
dark	29	resume	32
display	26	save	22
exit/$\boxed{\text{q}}$	28	Scale	43
exp	18	sleep	40
exp␣-e	20	slitheight	13
filename	36	slitwidth	12
fint	15	startb	2
flat	14	startc	3
header	9	stat	42
HELP	4	tint	34
hold	31	wait	41
imexamine	25	xcomm	8
impath	35	z±	27
ll	39	zero	10

Acknowledgement

This work was supported by projects AV0 Z1003909 and K2043105 and by grants GA AVČR A3003805 and GAČR 205/02/0445.

Fig. 4: The application for the driving of the guiding camera.

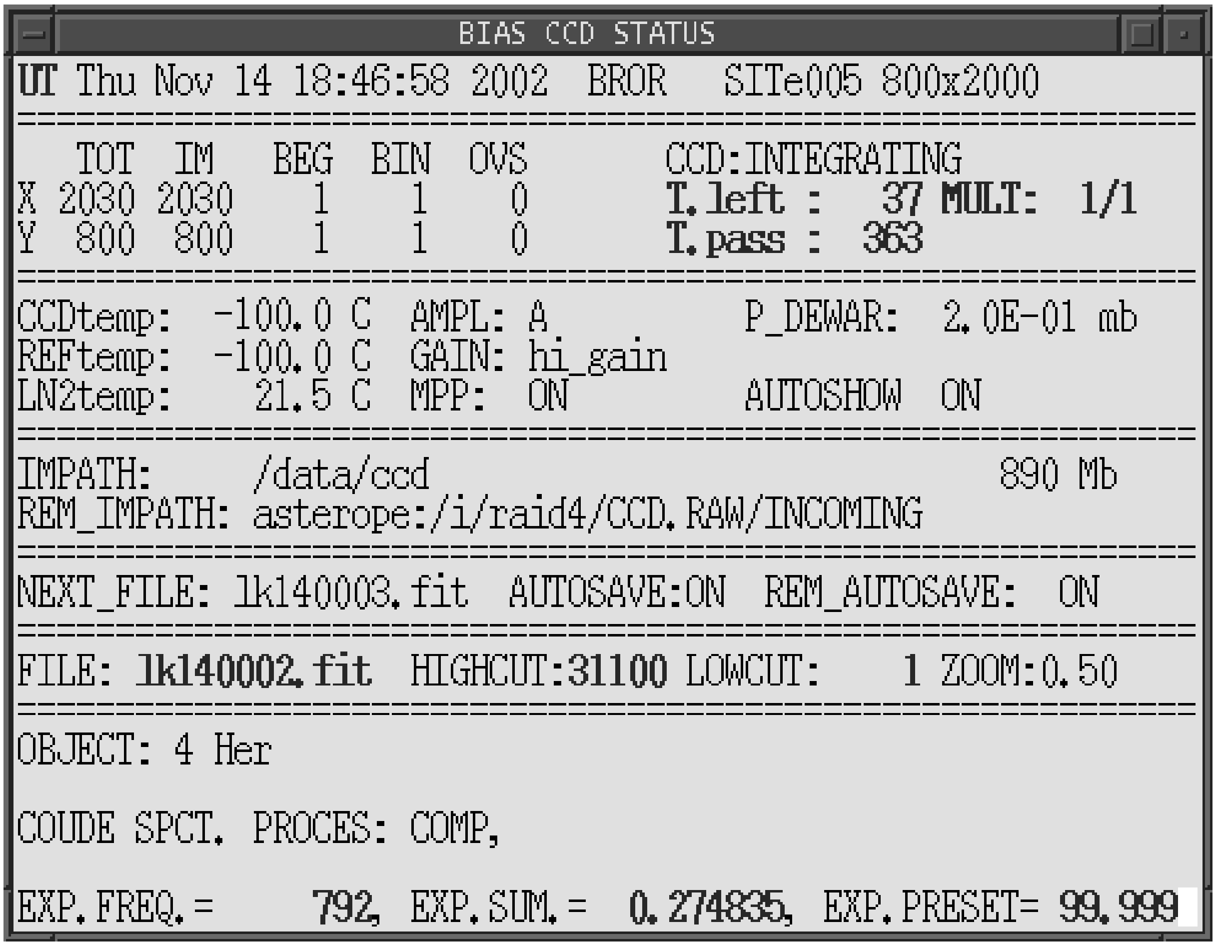

Fig. 5: The application "BIAS CCD STATUS".

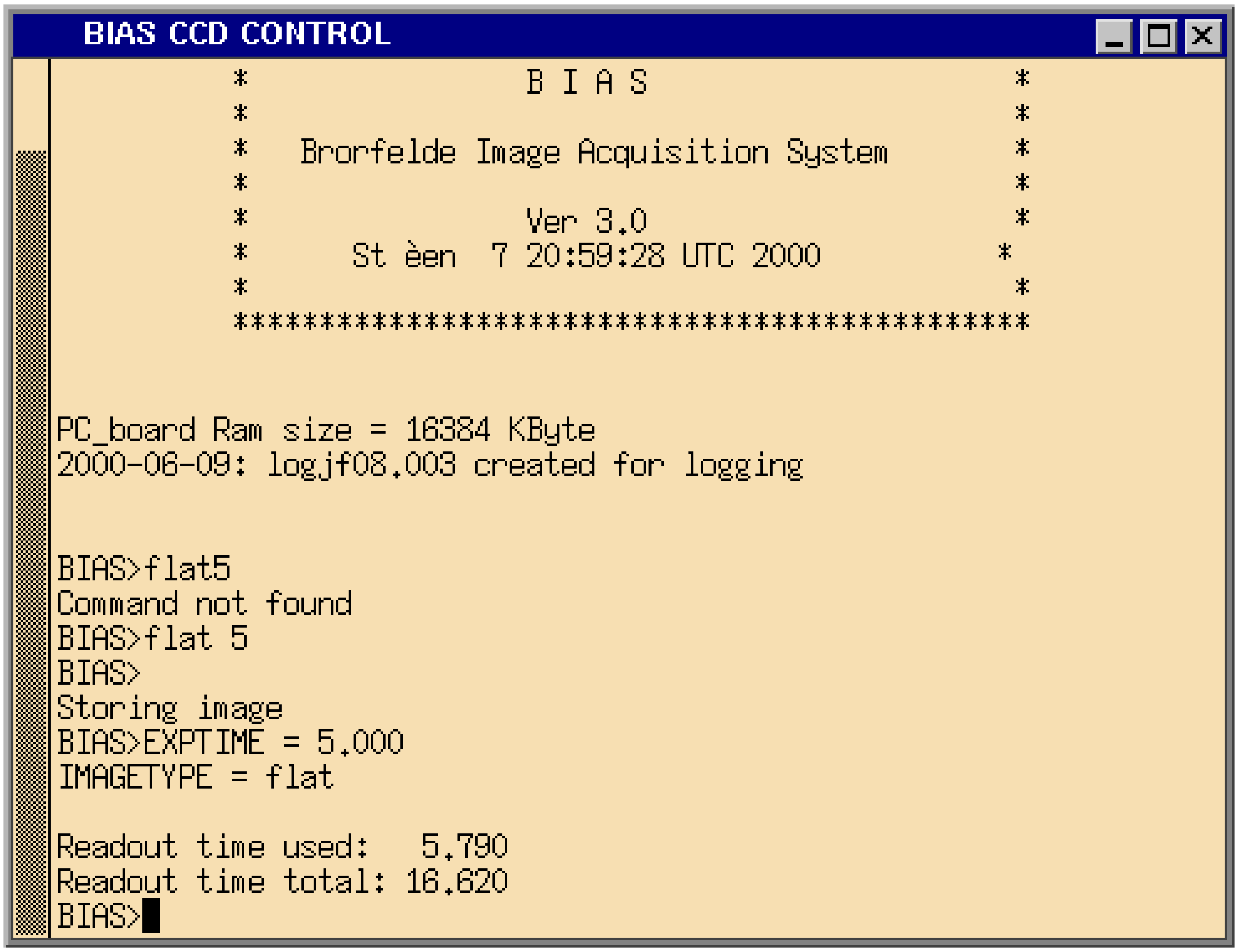

Fig. 6: The application "BIAS CCD CONTROL".

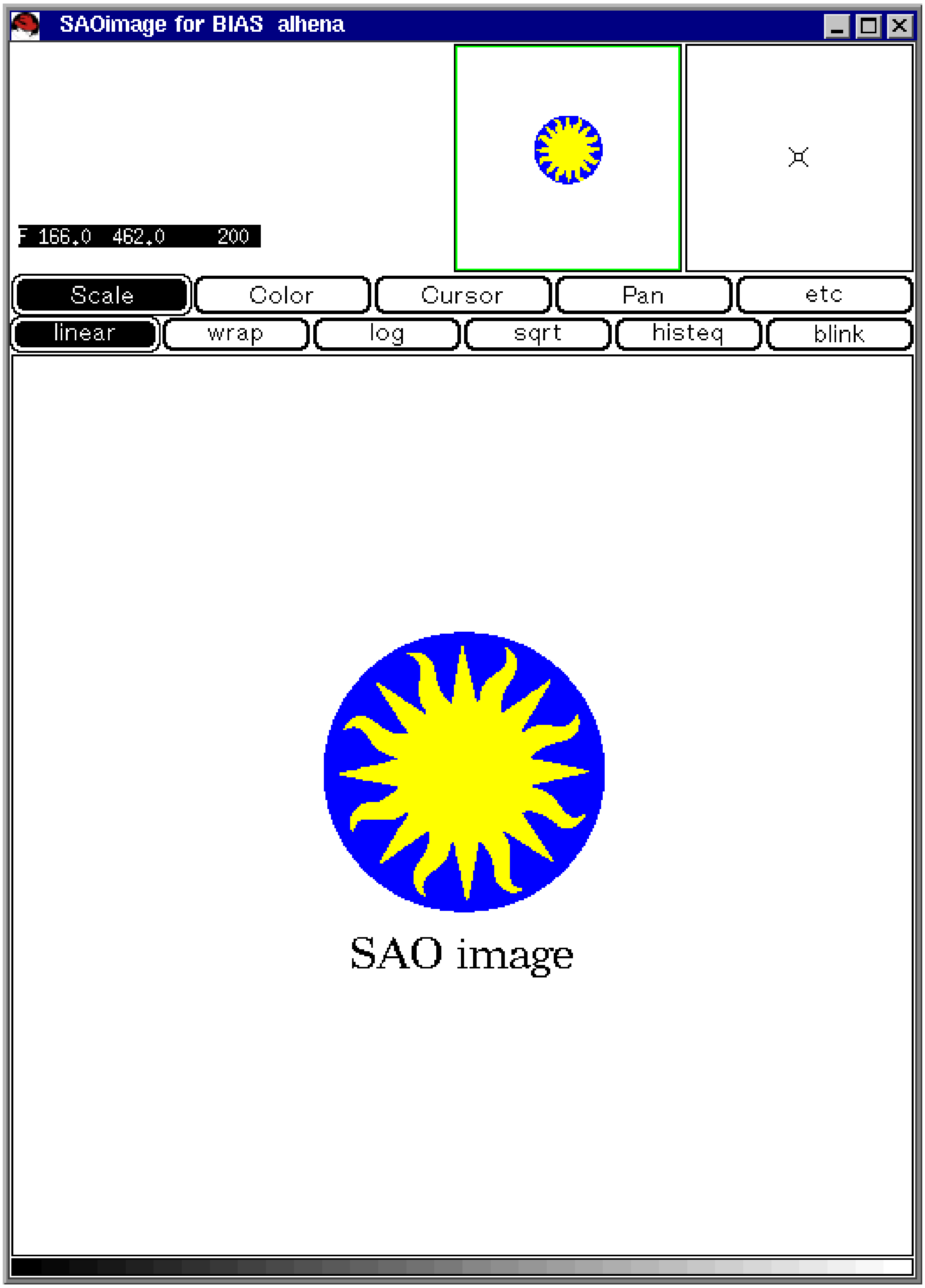

Fig. 7: The application "SAOImage for BIAS".

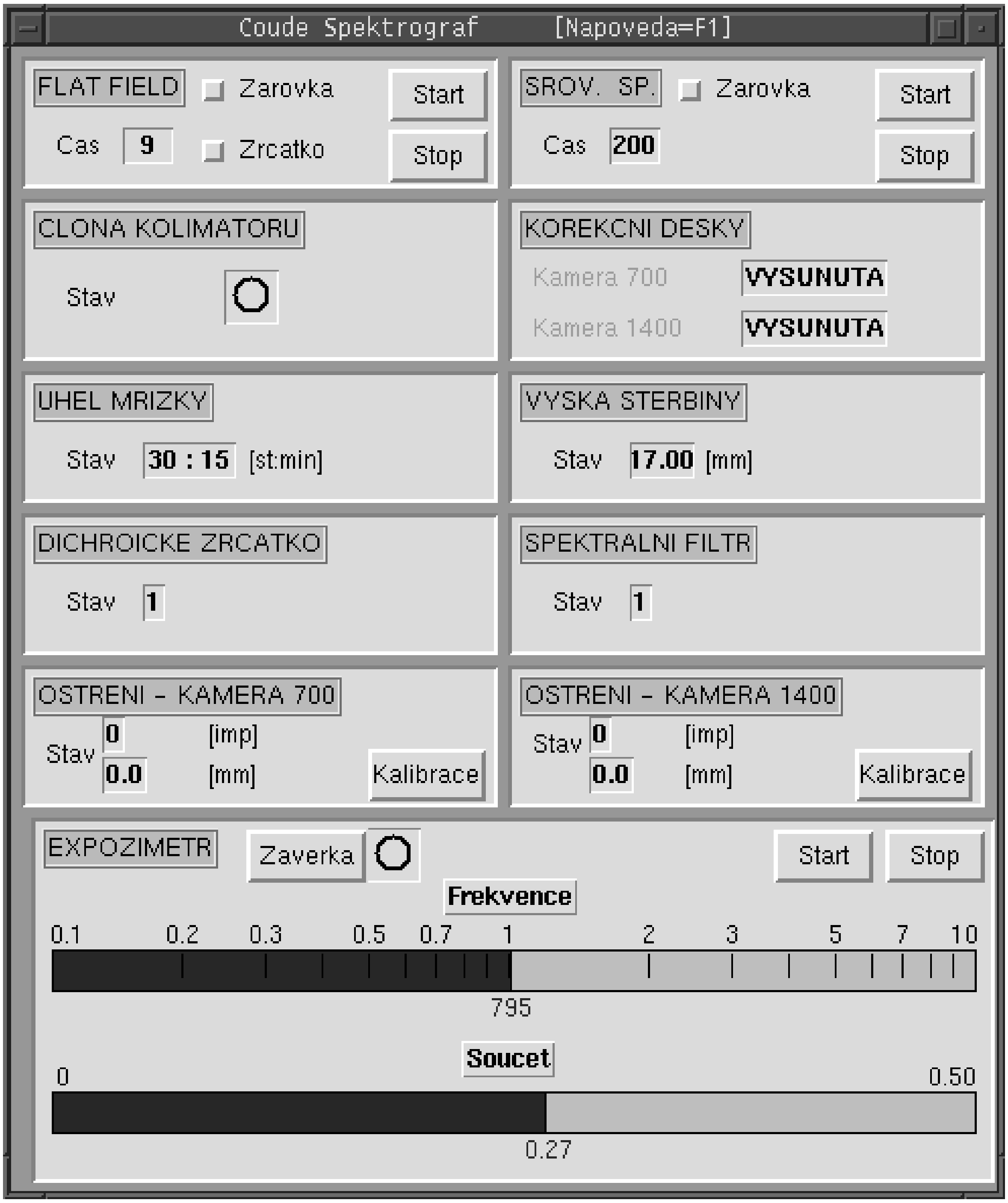

Fig. 8: The application "Coude Spectrograph".

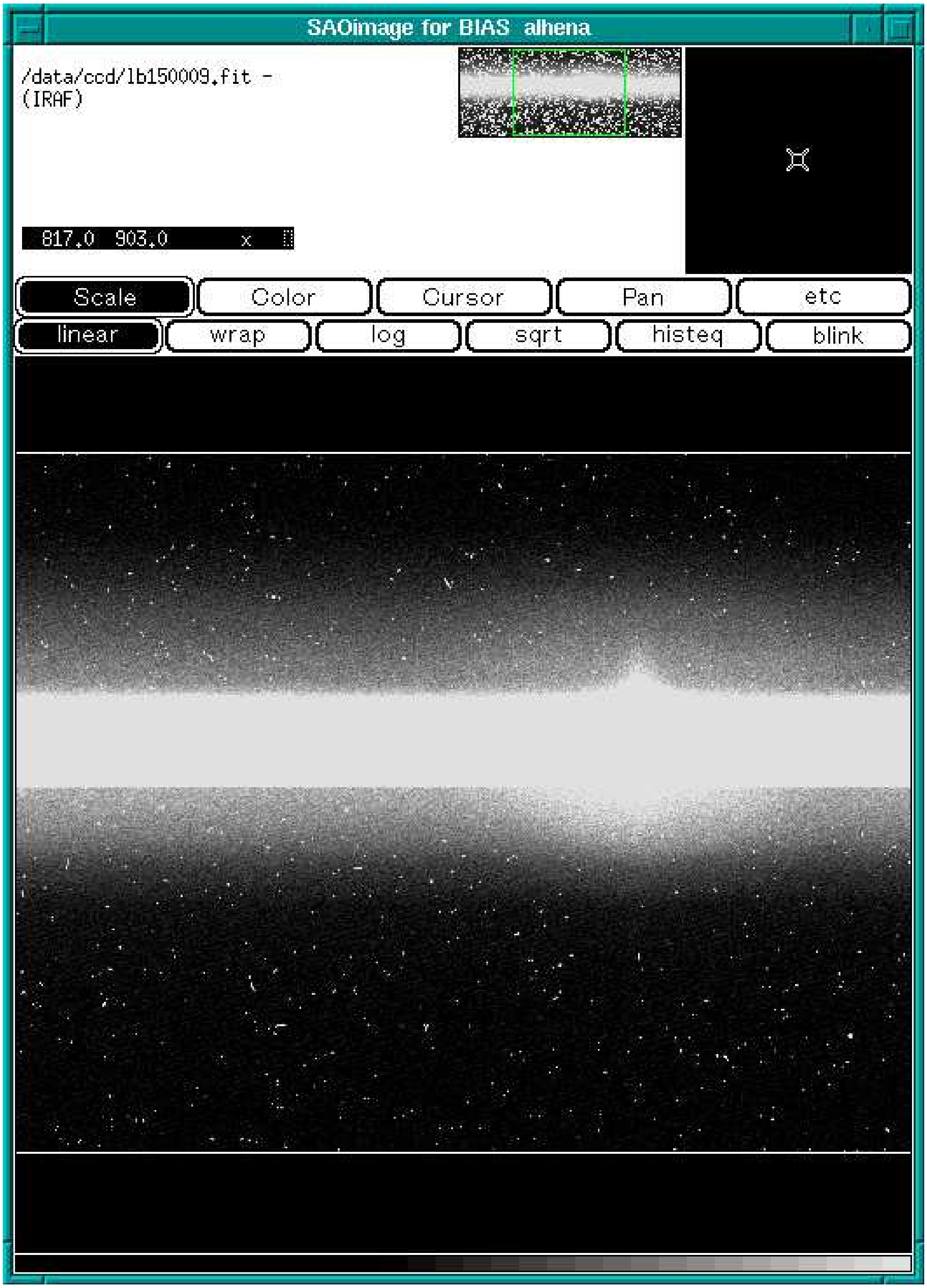

Fig. 9: The application "SAOImage for BIAS" with a spectrum.