The Graphical User Interface of MIA

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Chapter 1

The Graphical User Interface of MIA

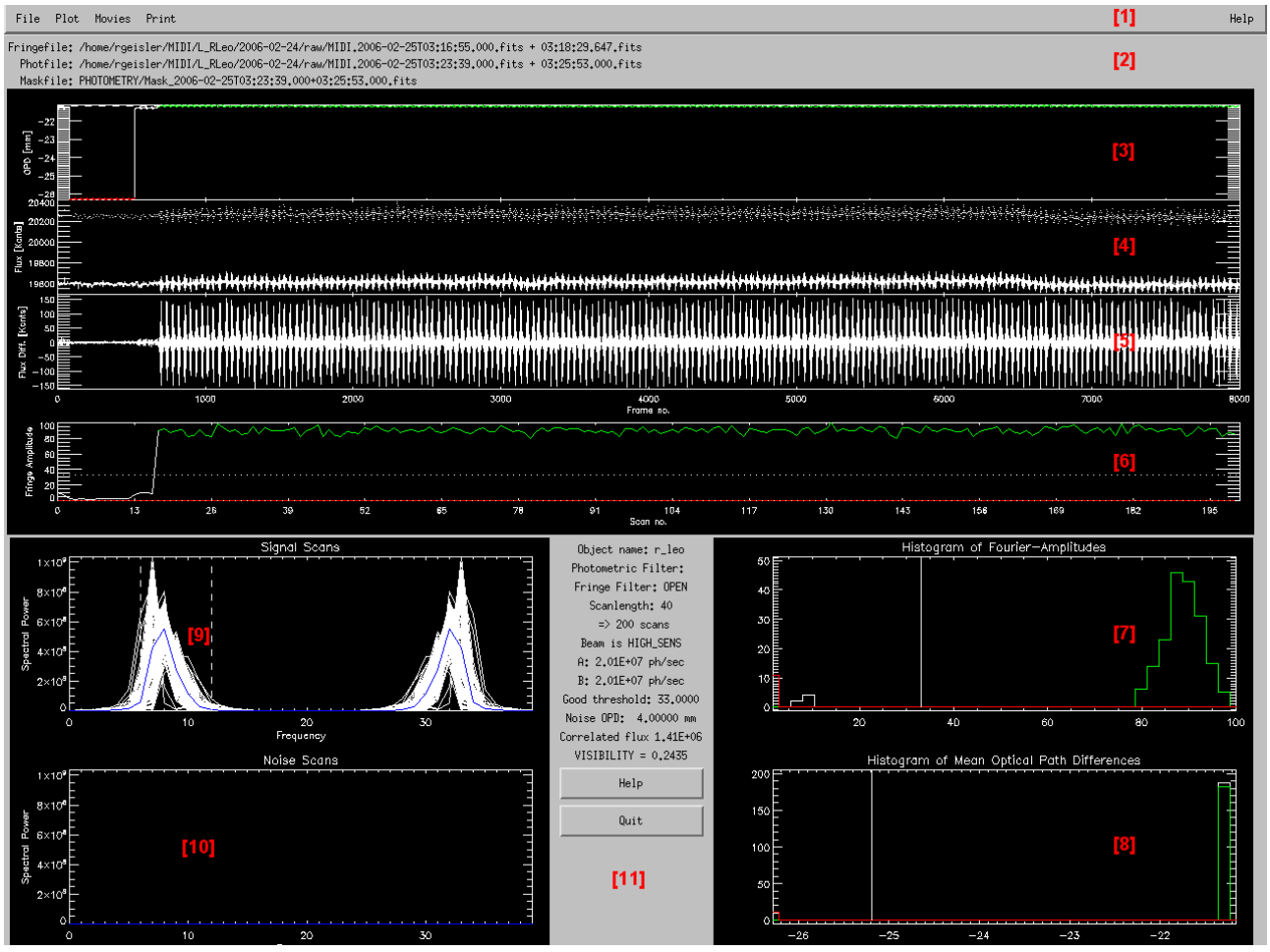

Figure 1.1: Graphical User Interface (GUI) of MIA.

The most complete way to visualize the results is to bring up the main graphical user interface. Therefore, please type

```
cal->gui
```

The window drawn in Figure 1.1 should appear. On some computers IDL has some difficulty to figure out which color model should be used. If you do not see colours (the red colour only appears after the threshold has been adjusted) please try

```
cal->gui,/tru
```

This will use 24bit colors and might help. In some cases it was useful to close the gui and restart it again. All the modifications are recorded and thus available afterwards. The graphical user interface is divided into various areas and subpanels. Some of them are interactive.

[1] Menu bar

All features accessible via the menu bar are explained here, except all important features also accessible via buttons/areas within the panel itself. It is recommended to read the rest of the manual first.

Overview over all items in the Menu bar:

- "File ⇒"
  - "Lambda GUI", see [5] and Figure 1.5
  - "Mask GUI" opens the Mask GUI, for details see the Mask GUI manual on the web
  - "White Fringe Method" opens a dialog to specify the method to compute white fringe amplitude, see Figure 1.3
  - "Save Visibility" saves the (raw) visibility data (as FITS) in the file '<path>/*filename*' where *filename* is the name of the FITS-file to print to. The name is created from your specified name or the name of the fringe data. See [9]+[10] and Figure 1.10
  - "Hardcopy" saves the current view of the GUI (as PS). This can also be done on the IDL command line with the command `cal->hardcopy, filename`, `/NCOLOR` prints in black and white, `/TRACES` prints the traces, too, and `/DONTCLOSE` doesn't close the file afterwards, so you can append more plots
  - "Write to log" writes a brief log in the file '<path>/visibilities'
  - "Save xmdv-Object" saves the xmdv-Object (as SAV) in the file '<path>/*filename*'
  - "Quit", see [11]
- "Plot ⇒"
  - "Dispersed Power", see [9]+[10] and Figure 1.9
  - "Visibility" shows the (raw) visibility plot, see [9]+[10] and Figure 1.10
  - "Correlated Flux" shows the correlated flux plot
  - "Photometric Flux" shows the photometric flux plot

  - "Photometry A" shows the photometric flux plot of channel A
  - "Photometry B" shows the photometric flux plot of channel B
  - "Almost Everything" shows the (raw) visibility plot as well as the photometric and correlated flux plot

- "Movies ⇒"
  - "Fringes" Movie displays for each scan the fringe signal vs. the OPD (in ADS vs. meter, conversion factor for MIDI: 145 photons/ADU, Figure 1.2, left)
  - "Power Spectra" Movie displays for each scan the spectral power (in ADS^2/sec^2) vs. the spatial frequency (Figure 1.2, right)

- "Print ⇒"
  - "Results" prints the raw photometry, correlated and visibility plots as well as the dispersed power plot (as PS) in the file '<path>/*filename*'
  - "Visibility" prints the (raw) visibility plot (as PS) in the file '<path>/*filename*', see [9]+[10] and Figure 1.10

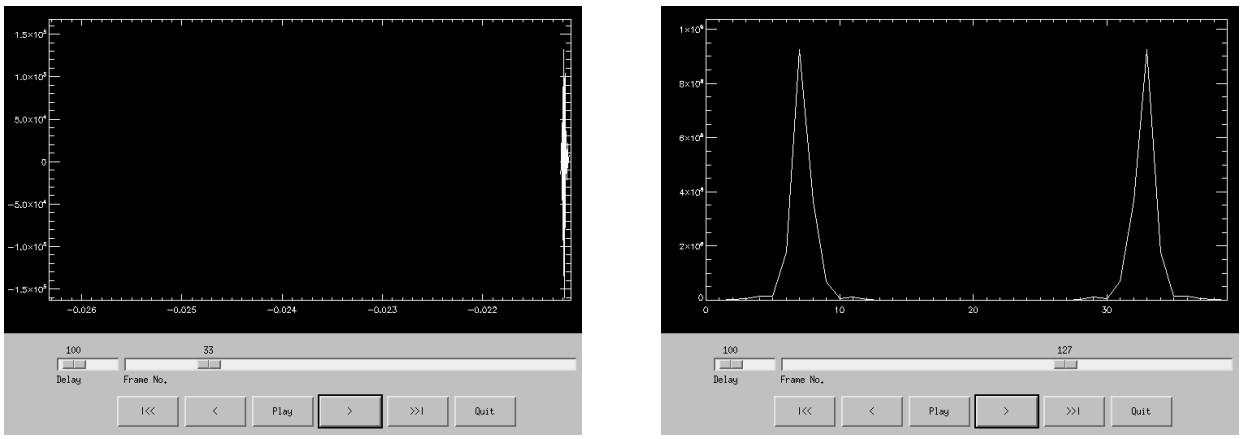

Figure 1.2: Left: Fringe Movie (fringe signal vs. OPD). Right: Power Spectra Movie (spectral power vs. spatial frequency).

[2] File Listining

Below the menu bar all used files are listed. These informations can be obtained with the commands

```
fringefile = cal->get_filename()
photfiles = cal->get_filename(/PHOT)
maskfile = cal->get_filename(/MASK)
```

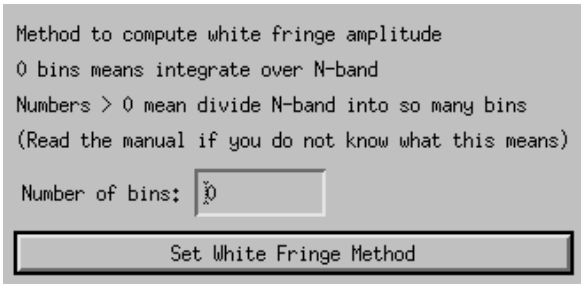

Figure 1.3: White Fringe Method dialog.

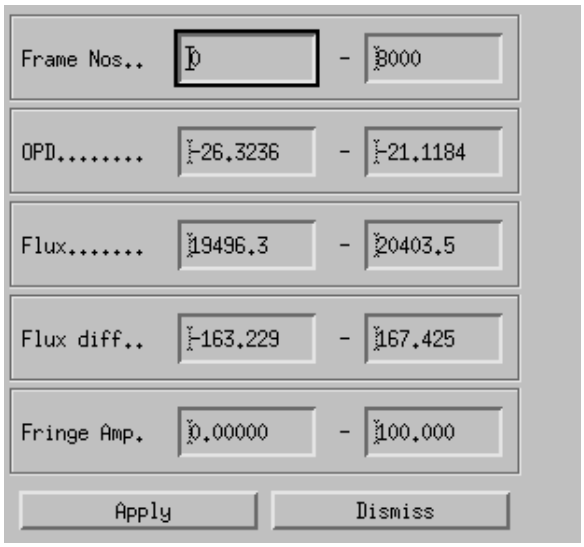

Figure 1.4: Parameter dialog.

where `photfiles` is an array. The name of the object can be stored in the variable `object` with the command

```
object = cal->get_objectname()
```

[3] to [6]

By clicking on the plots one can change the ranges interactively for panel [3], [4], [5] and [6], see Figure 1.4.

[3] OPD panel

This panel diplays the optical path difference (OPD) vs. the frame number. Clearly visible are the 80 μm scans. During each of the 200 scans 40 exposures have been taken leading to a total amount of 8000 frames. After 680 frames = 17 scans zero OPD has been found at -21.19 mm and MIDI tracked on it between frame number 680 and frame number 8000.

[4] Photometry Panel

This panel displays the measured flux vs. the frame number. To get the photometry type

```
spec = cal->photometry()    print,spec
```

One gets a 3 by N array, where N is the number of bins in lambda. The first row (`spec[0,*]`) is the wavelength in the center of the bins in μm, the second row (`spec[1,*]`) is the width of the wavelength bins in μm, and the third row (`spec[2,*]`) is the photometry of all 4 spectra divided by the bin-size (3 pixels) in ADU/sec (conversion factor for MIDI: 145 photons/ADU).

The Keywords `/Atotal` and `/Btotal` return the sum of the two (I1 & I2) A- or B-spectra, respectively. The command

```
lambda = cal->lambda()
```

returns an array that gives wavelength in μm as function of the pixel number (0...170). With

```
cal->set_lambda,lambda
```

the user can set a wavelength calibration.

[5] Fringe Panel

This panel displays the flux difference (I1-I2) vs. the frame number, i.e. the modulation in the correlated flux. Before MIDI reached zero OPD no fringes are visible. Afterwards, a strong signal could be detected. By typing

```
cf = cal->correlflux()
```

one gets the correlated flux as function of wavelength. This command is similar to `photometry()`. Again N is in the 3 by N array the number of bins in lambda. The first row (`cf[0,*]`) is the wavelength in the center of the bins in μm, the second row (`cf[1,*]`) is the width of the wavelength bins in μm, and the third row (`cf[2,*]`) is the correlated flux divided by the bin-size (3 pixels) in ADU/sec (conversion factor for MIDI: 145 photons/ADU).

Keyword `/PLOT` will plot the good and bad fringes in the lambda bins, and the correlated flux. Keyword `/CFPLOT` will plot only the correlated flux.

To set the binning in wavelength one can use the command

```
cal->set_lambda_bins, start, end, step, width
```

where `start` is the number of the first column used, `end` the number of the last column used, `step` the spacing between columns, and `width` the number of columns added for one bin. For example

```
cal->set_lambda_bins, 0, 100, 25, 50
```

will set the bins 0...49, 25...74, 50...99, 75...124, and 100...149 pixels. Note that the last bin can extend beyond the given end column. An interactive tool to define the bins is the "Lambda GUI" (Figure 1.5). It can be started from the menu or with

```
cal->lambda_gui
```

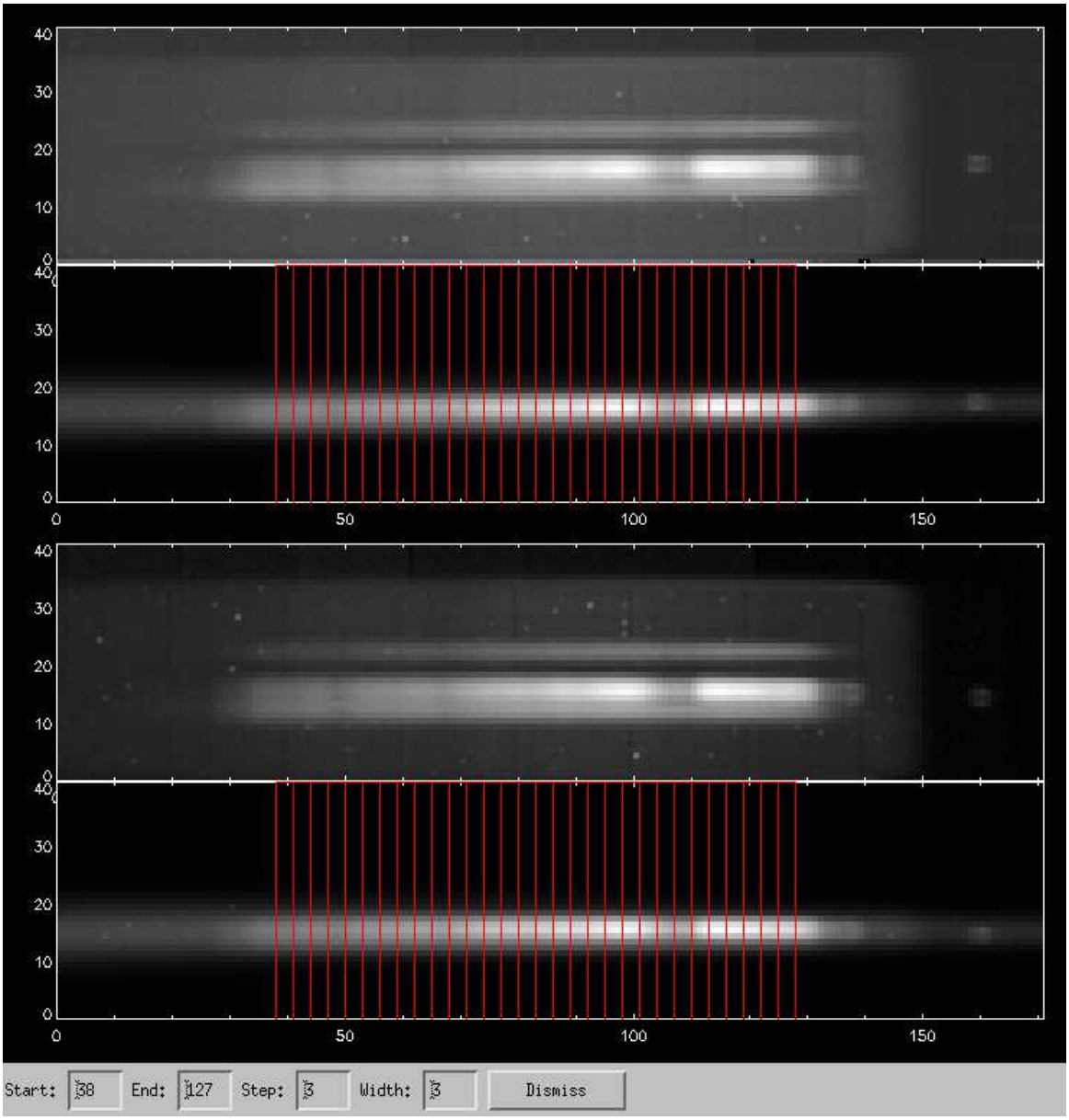

Figure 1.5: Lambda GUI: raw and masked Fringe signal with binning for Detector Window A and B (in Detector pixels).

The command

```
fringes = cal->fringes()
```

returns a 3D-array: `fringes[0,*,*]` is the OPD in meter and `fringes[1,*,*]` the fringe amplitude in ADU/sec. The second index counts the frame-number within a scan and the third counts the scan.

[6] Fourier Fringe Amplitude Panel

This panel displays the maximum amplitude of the fringes in the white light (normalized to 100), i.e. integrated over wavelength vs. the scan number. To get the amplitude, we integrate over wavelength, Fourier-transform each scan, add up the power spectrum at the frequencies where we expect fringes, and calculate the square root. To get the maximum amplitude of the white light fringe use

```
whitelight = cal->whitefringeampl()
```

[7]+[8] Histogram of Fourier-Amplitudes & Mean Optical Path Length

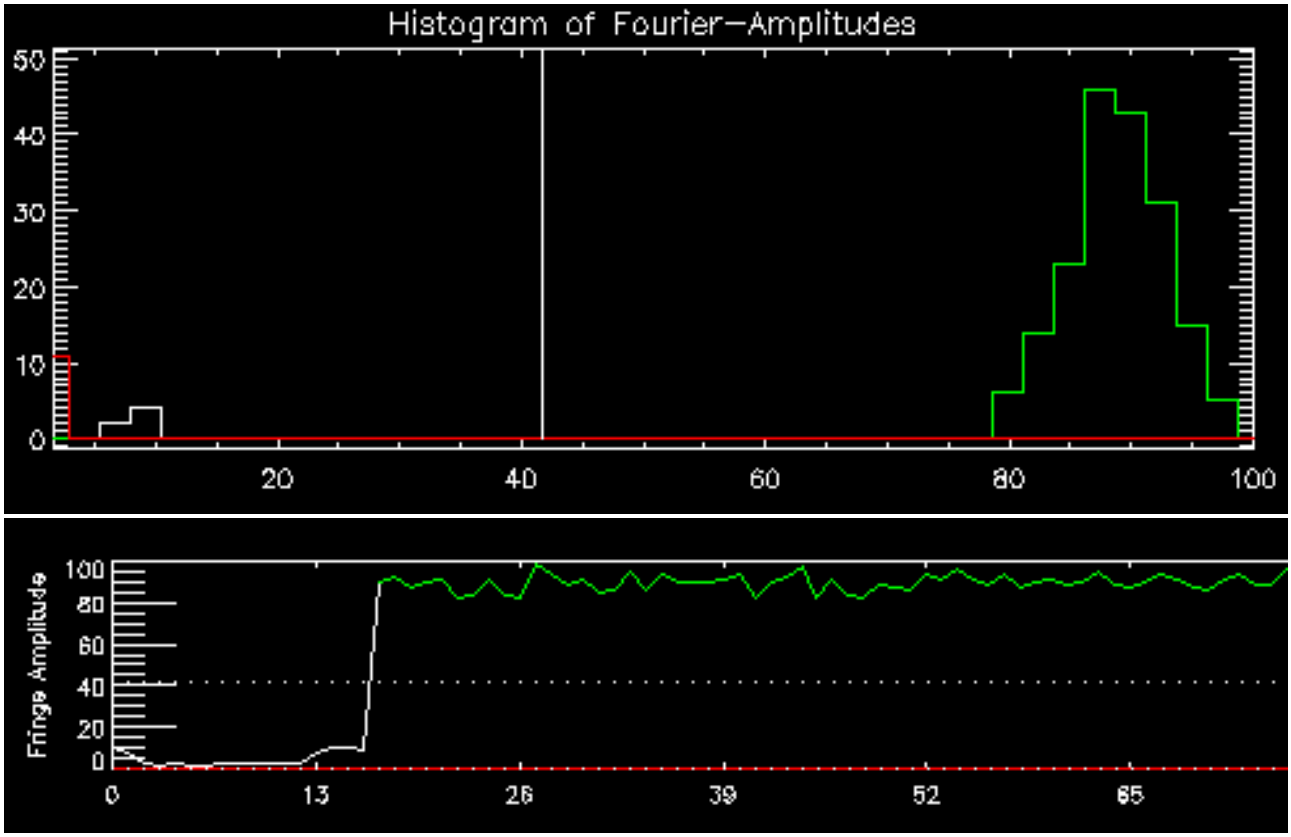

Figure 1.6: Upper Figure [7]: Histogram of Fourier Amplitudes. Lower Figure [6]: Fringe Amplitudes vs. Scan number in the Fourier Fringe Amplitude Panel.

On the lower right panel two histograms are drawn. One displays the distribution of the scans with respect to the fourier amplitude (Figure 1.6) and the other with respect to the mean optical path difference (Figure 1.7). Two thresholds can be set:

1. Threshold for "good" scans (= signal), i.e. scans that contain fringe signal (Figure 1.6: solid vertical line in the fourier amplitude histogram, dotted upper horizontal line in the Fourier Fringe Amplitude Panel)

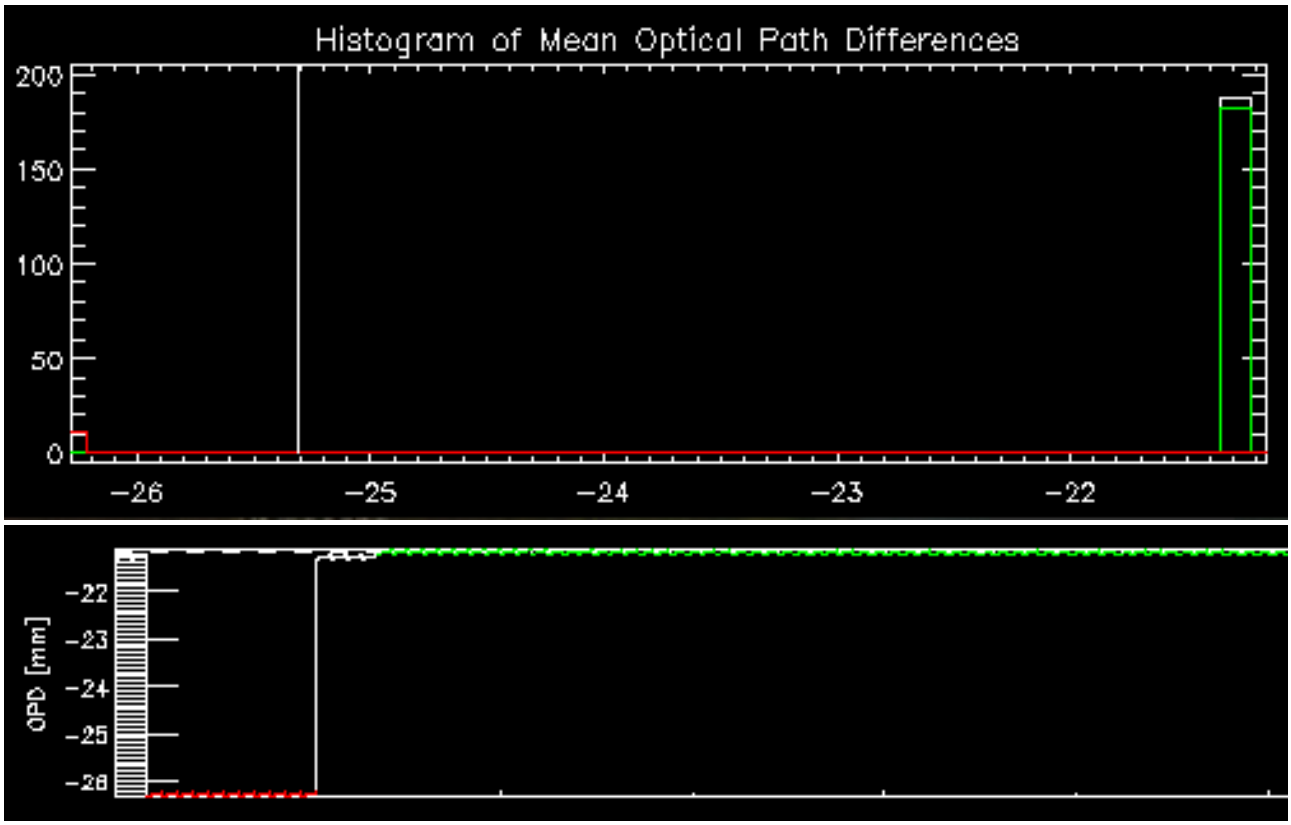

Figure 1.7: Upper Figure [8]: Histogram of Mean Optical Path Differences. Lower Figure [3]: Mean Optical Path Difference in the OPD panel.

2. Minimum distance of "bad" scans (= noise) from the median OPD in meter (Figure 1.7: solid vertical lines in the OPD-histogram, here in mm). Scans with a mean OPD that is more than this distance away from the median OPD of all scans are used to estimate the noise in the power spectrum.

These tresholds can be set either interactively by dragging the lines in the histograms with the mouse pointer, or on the IDL prompt by the command

```
cal->set_thresholds, good, bad, noiseopd
```

where `good` is a normalized value between 0 and 100, for example 42 (1. Item), `bad` is not any longer available and have always to be 0 and `noiseopd` is optional with a default value of 0.004 (2. Item). To read out the current values type

```
th = cal->get_thresholds()
```

The percentage of good and bad scans with the current thresholds is returned by

```
gb = cal->get_percent_goodbad()
```

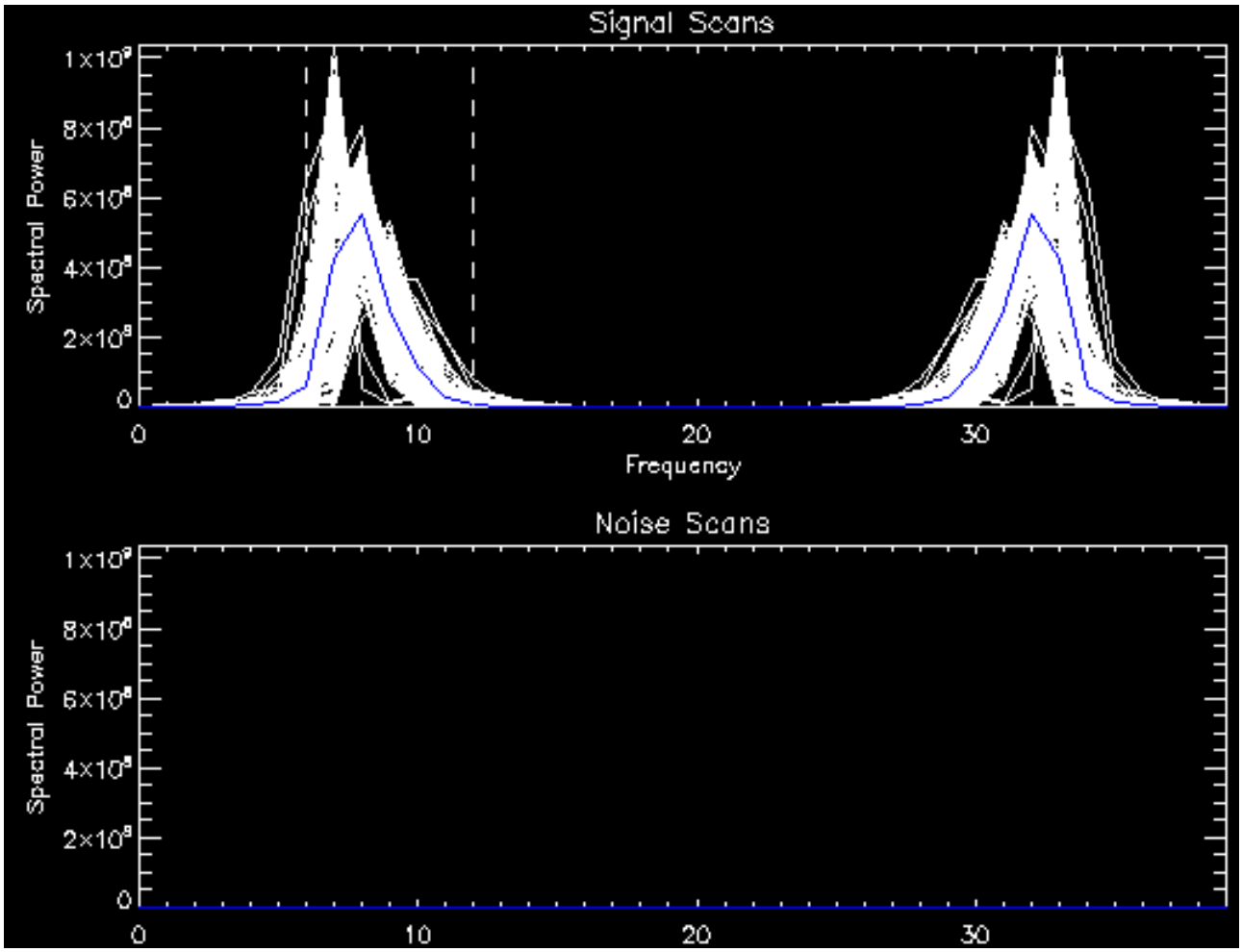

Figure 1.8: Signal and Noise Scans (spectral power vs. spatial frequency).

[9]+[10] Signal and Noise Scans

The spectral power (in ADS^2/sec^2) of the signal (good fringes) and the noise (bad fringes) vs. the spatial frequency is plotted on the lower left panel of the GUI (Figure 1.8). The vertical dashed lines mark the frequency range where fringes are expected, i.e.

$$\nu_{\min} = \text{floor}(\frac{\delta}{\lambda_{\max}} + 0.5) \qquad \nu_{\max} = \text{floor}(\frac{\delta}{\lambda_{\min}} + 0.5)$$

δ is the length of a scan. The symmetry of the plots, i.e. the right side is a mirrored left side, is an artifact of the fourier transformation. The blue curve is the mean of all the white curves.

By clicking on the plots a new window opens (Figure 1.9). It displays the spectral power plots for the different wavelength bins set with the "Lambda GUI" or the corresponding command `set_lambda_bins` (see above). The signal are plotted on the left side, the noise on the right side. The frequency range, where the fringes are expected moves from lower to higher frequencies, because the binned wavelengths are decreasing. Another window opens simultaneously,

showing the (raw) visibility of the object (Figure 1.10).

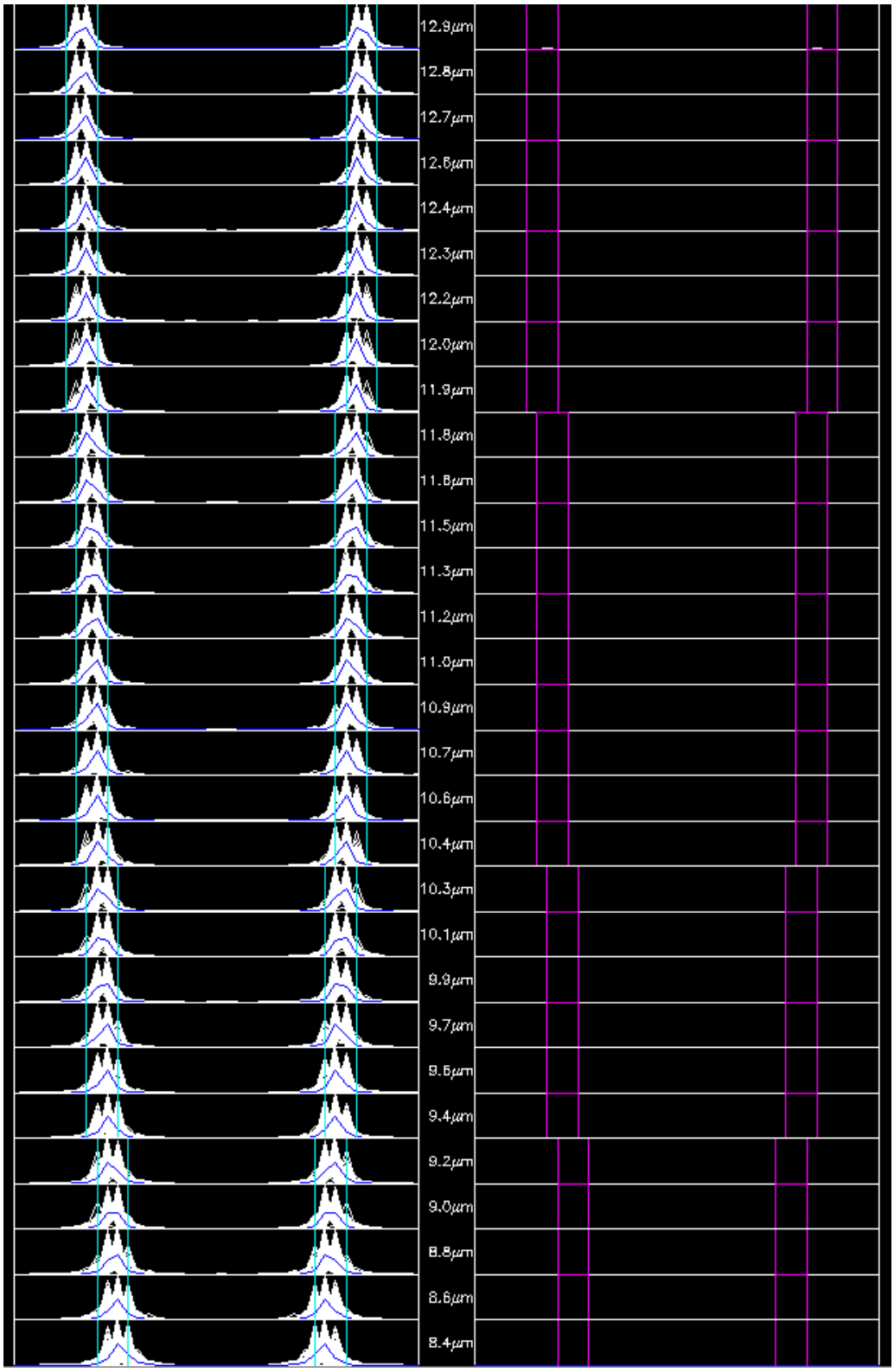

Figure 1.9: Dispersed Power (spectral power vs. spatial frequency).

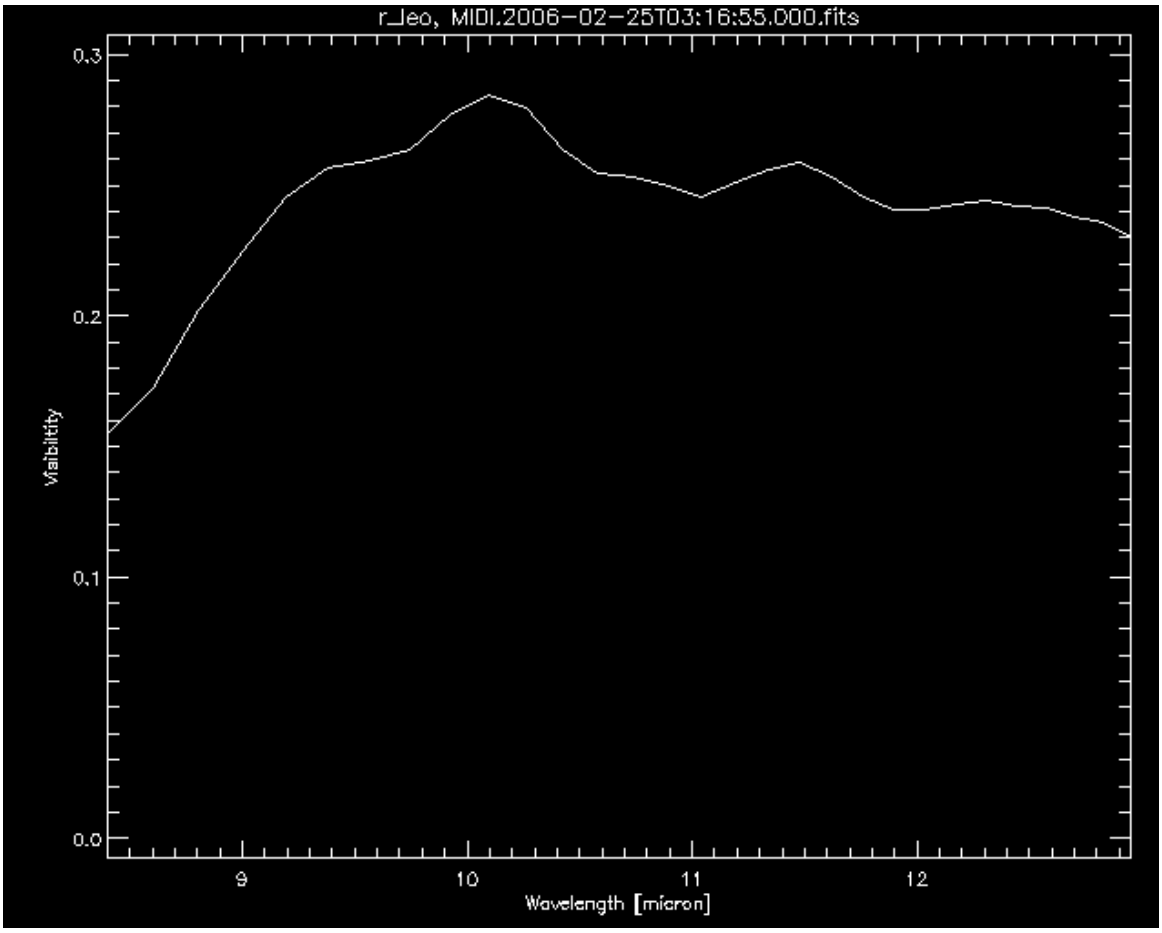

Figure 1.10: Visibility.

The corresponding command that delivers the same information is

```
visi = cal->visibility()
```

This command is again similar to `photometry()`, except that `visi[2,*]` contains the visibility and not the photometry and an additional fourth row (`visi[3,*]`) with the photometry not divided by the bin-size (3 pixels) in ADU/sec (conversion factor for MIDI: 145 photons/ADU). The first row (`visi[0,*]`) is the wavelength in the center of the bins in μm and the second row (`visi[1,*]`) is the width of the wavelength bins in μm.

The optional keyword `/PLOT` plots the shown lambda-binned spectral power (1.9) and `/VISPLOT` the visibility graph (1.10).

[11] Info Panel

The panel in the center summarizes the most important quantities given in various subpanels and offers a few buttons.

- "Help" opens the Online Help webpage
- "Quit" quits the GUI. To destroy the object and free all its memory use `obj_destroy, cal`.

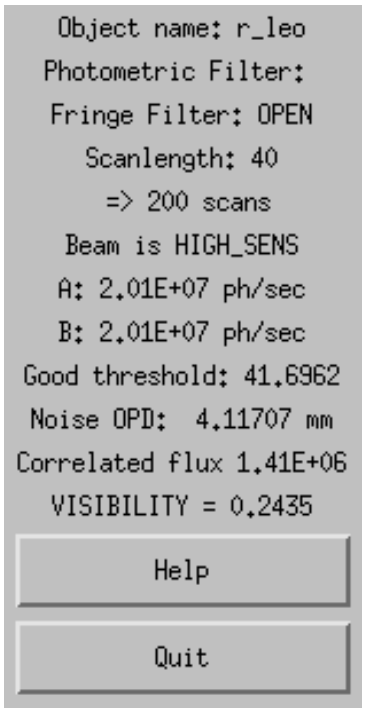

Figure 1.11: Info Panel.