

# OAG Tools for General Users

*A Contribution to the “Getting Started with  
EPICS” Lecture Series*

Michael Borland  
Operations Analysis Group  
APS Operations Division  
Argonne National Laboratory  
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# Brief Introduction to OAG

- Group of accelerator physicists and programmers formed in 1995 to “apply the lessons of commissioning to accelerator operation.”
- We write high-level applications for physicists, engineers, and operators, e.g.,
  - Automated startup and shutdown
  - Orbit correction and steering
  - Accelerator experiments
- We manage the accelerator data logging systems and configuration control systems.
- Much of the software we write is generic and can be used in any EPICS context.

# Outline

- Brief introduction to Operations Analysis Group
- Intended audience
- What you'll learn
- How to access the software
- General features of OAG applications
- Accessing the accelerator data logs
- Performing data analysis
- Controlling things through EPICS
- Summary

# Intended Audience

- We cater to a range of users
  - Programmers in a variety of languages
  - Those who want commandline tools
  - Those who want an easy-to-use graphical user interface (GUI)
- Today, we'll concentrate the last type.
- Underlying software is the same.
- Two later talks will concentrate on the details.

# A Few Details

- We build our applications out of two components
  - Tcl/Tk: a scripting language that allows easily making graphical user interfaces (GUIs).
  - SDDS: a type of general data file and a toolkit of C programs that work with such files.
- Almost all the screen-shots in this presentation are Tcl/Tk GUIs.
- The data processing is done by SDDS tools hidden under the Tcl/Tk layer
  - SDDS Toolkit for data processing and display
  - SDDS/EPICS Toolkit for EPICS-specific functions

# What You Can Learn from this Talk

- Types of applications that are available from OAG
- Features and usage of specific applications
  - Detailed click-by-click guidance,
  - Review of the interface, or
  - Listing of major features.
- Important concepts for using OAG applications
  - SDDS files and “meta-applications”
  - Reusing data and programs
- How you can do even more with SDDS Toolkits
- How OAG software differs from similar EPICS clients

# Accessing the Software

- For AOD, ASD, and XFD staff with access to a Sun workstation, access is via your workspace menu

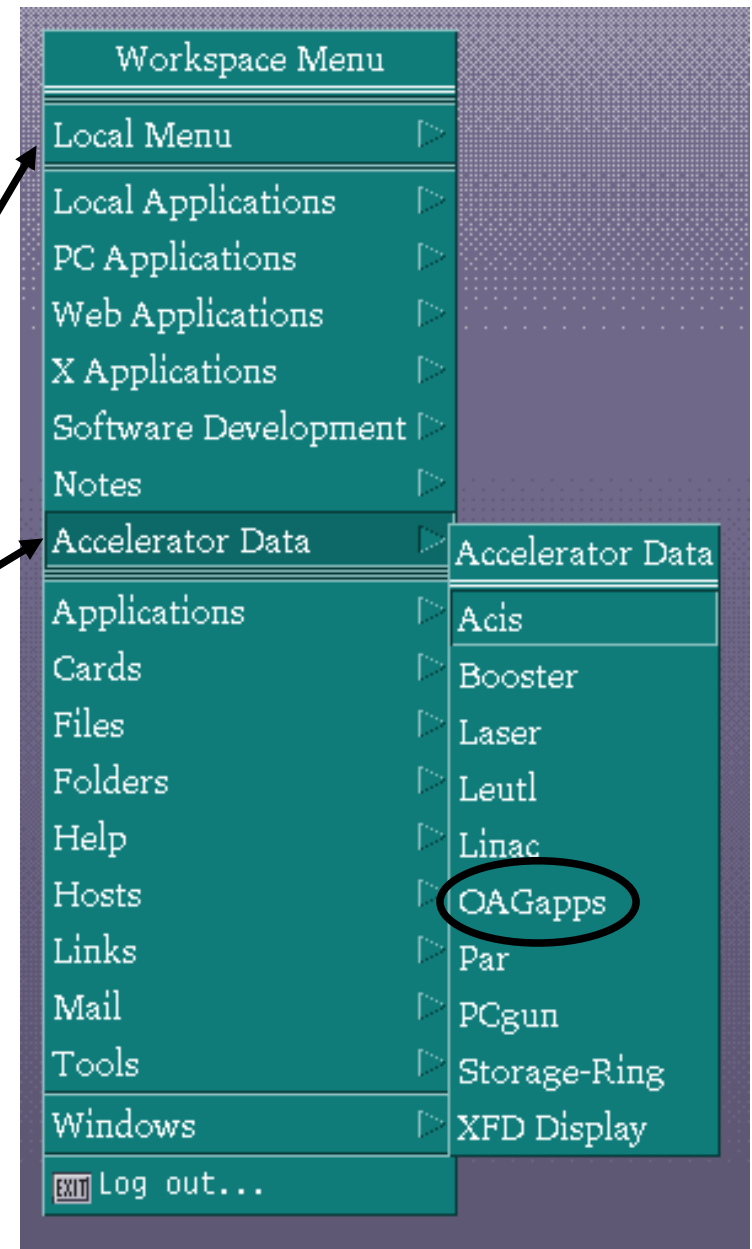
Right-click on the background to bring up the workspace menu

Click on “Accelerator Data”

Click on “OAGapps”

- Others can download from our website:

<http://www.aps.anl.gov/asd/oag/oaghome.shtml>

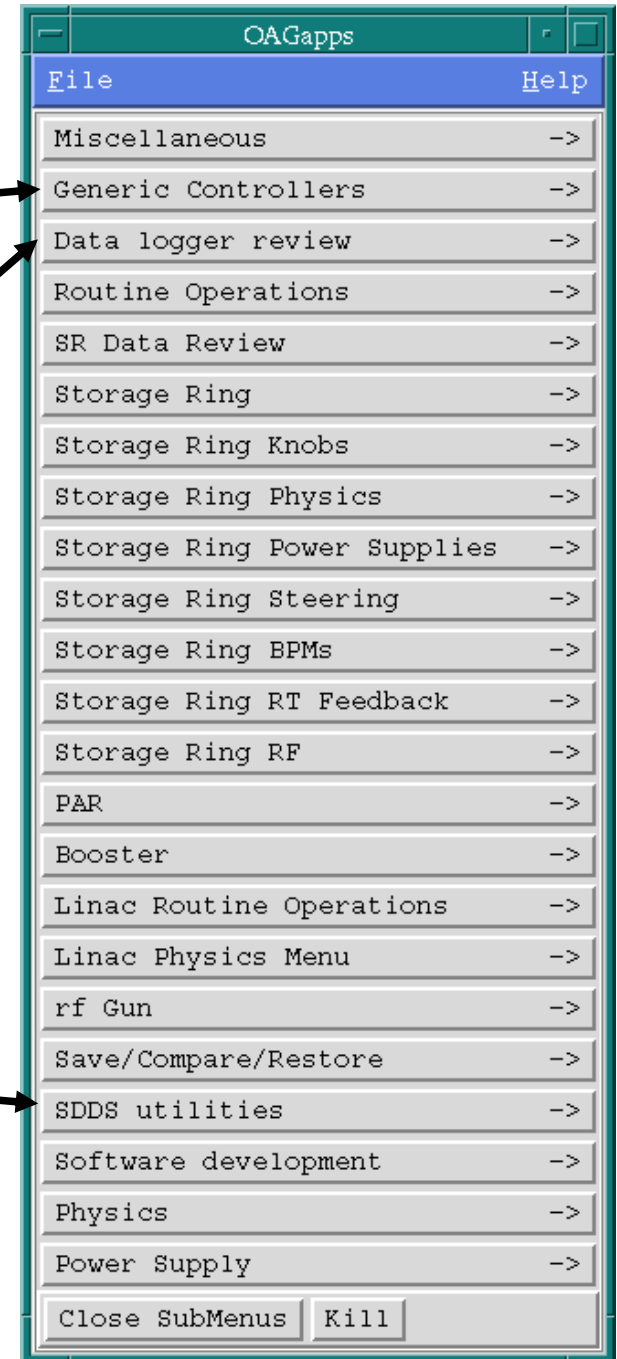


# OAGapps Main Menu

Generic applications for controlling things in EPICS

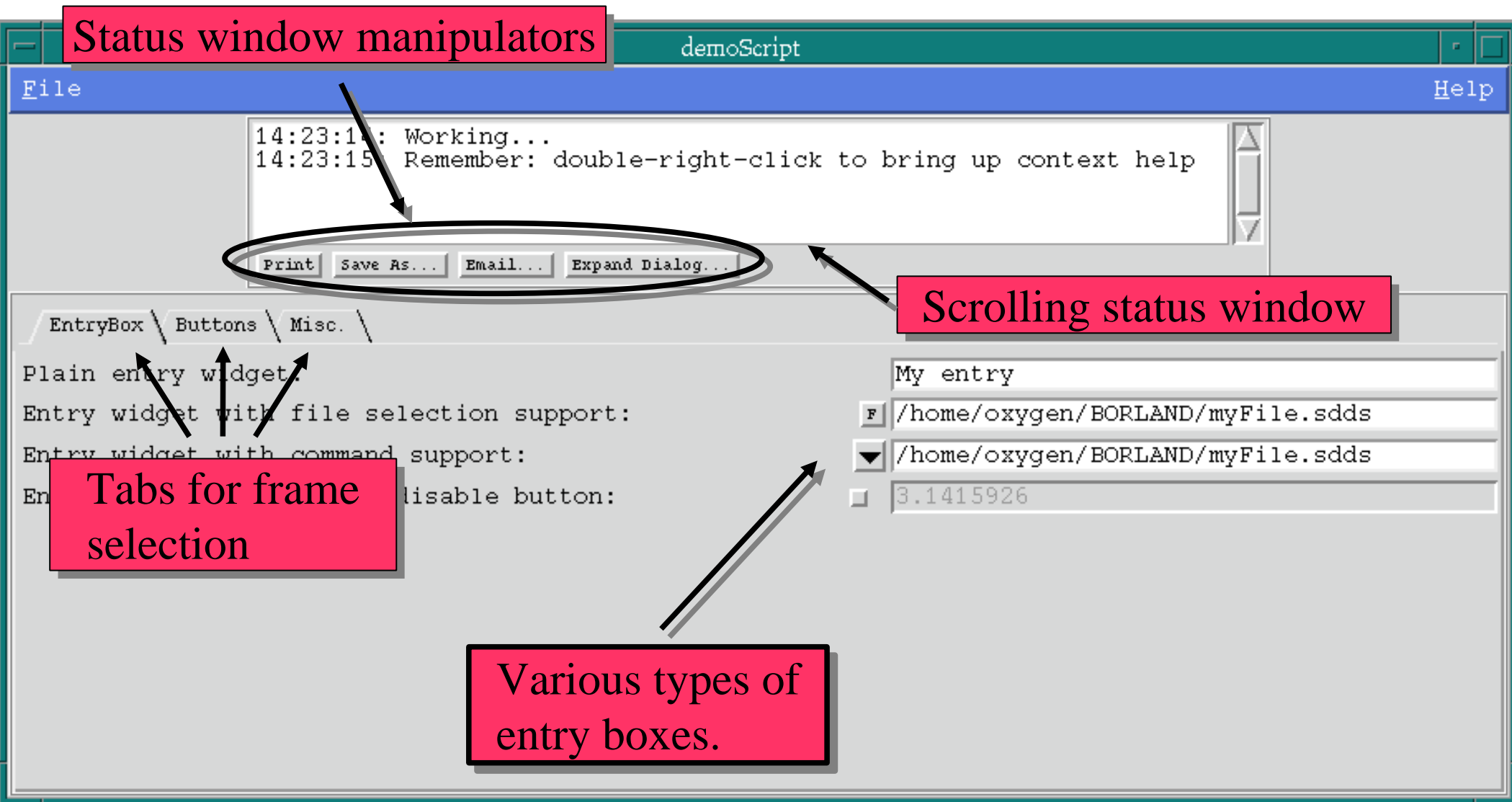
Applications for accessing the accelerator data logs

Data collection, review, and analysis utilities





# A Typical OAG-Style Application



# Context-Help Feature

The screenshot shows a window titled "demoScript" with a menu bar containing "File" and "Help". A text area at the top contains the following text:

```
14:48:35: Working...
14:48:36: Remember: double-right-click to bring up context help
```

Below the text area are buttons for "Print", "Save As...", "Email...", and "Expand Dialog...". The main area of the window is divided into tabs: "EntryBox", "Buttons", and "Misc.". Under the "EntryBox" tab, there are four text labels and corresponding input widgets:

- Plain entry widget: A text box containing "My entry".
- Entry widget with file selection support: A text box with a file icon and the path "/home/oxygen/BORLAND/myFile.sdds".
- Entry widget with command support: A text box with a dropdown arrow and the path "/home/oxygen/BORLAND/myFile.sdds".
- Entry widget with enable/disable button: A text box with a checkbox and the value "3.141592".

Two arrows point from the "Entry widget with command support" and the "Entry widget with enable/disable button" to a "Context Help" dialog box. The dialog box contains the following text:

This is a entry box with command support. You can click on the combo-box button to bring up a selection of commands and to select files.

An "OK" button is located at the bottom of the dialog box.

**Double right-clicking on most widgets will bring up help for that widget.**

```
14:23:14: Working...
14:23:15: Remember: double-right-click to b
```

Print Save As... Email... Expand Dialog...

EntryBox \ Buttons \ Misc. \

Plain entry widget:

Entry widget with file selection support:

Entry widget with command support:

Entry widget with enable/disable button:

F

The "F" button brings up a file selection dialog.

/home/oxygen/BORLAND/myFile.sdds

/home/oxygen/BORLAND/myFile.sdds

3.1415926

Select File:

Filter: /home/helios5/BORLAND/oag/apps/src/tcltkapp/oagapp/\*

Directories

Files

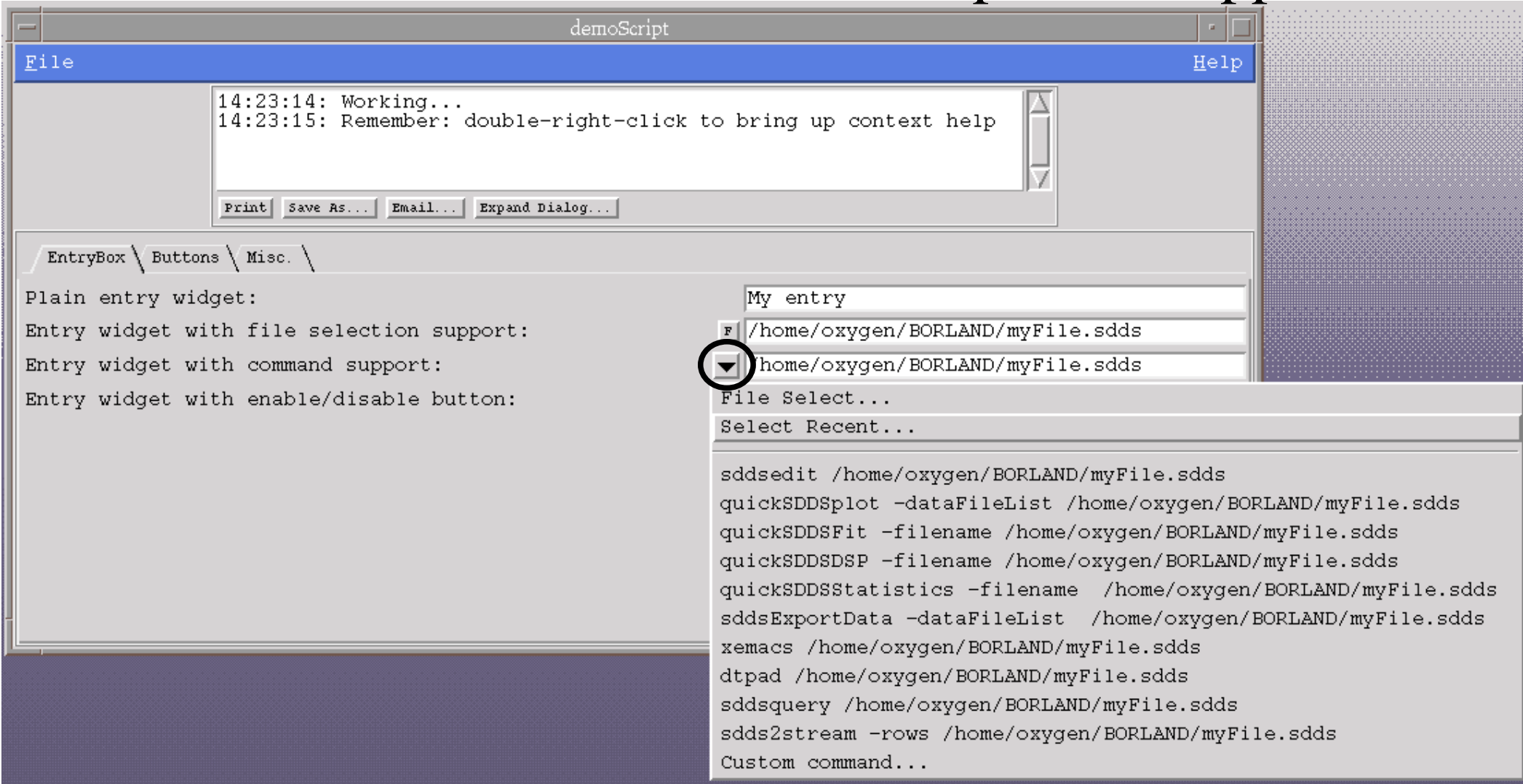
./  
../  
3ScreenData/  
CVS/  
O.Common/  
O.solaris/  
O.solaris-sparc/

2DSlider  
ADTFilter  
APSCalibrateDCPS  
APSCalibratePSTS  
APSLinacDiagConfig  
APSMWST  
APSMMeasureTunes  
AbsorberWaterReview  
AlarmProbabilityAnalysis  
AttendanceChecklist  
AttendanceNotification  
BBPMHistWaveformSetup  
BCorrControl  
BMagFFTMonitor  
BRampControl

Selection: /home/helios5/BORLAND/oag/apps/src/tcltkapp/oagapp

OK Filter Cancel

# The Command-Selection Feature Helps Link Applications

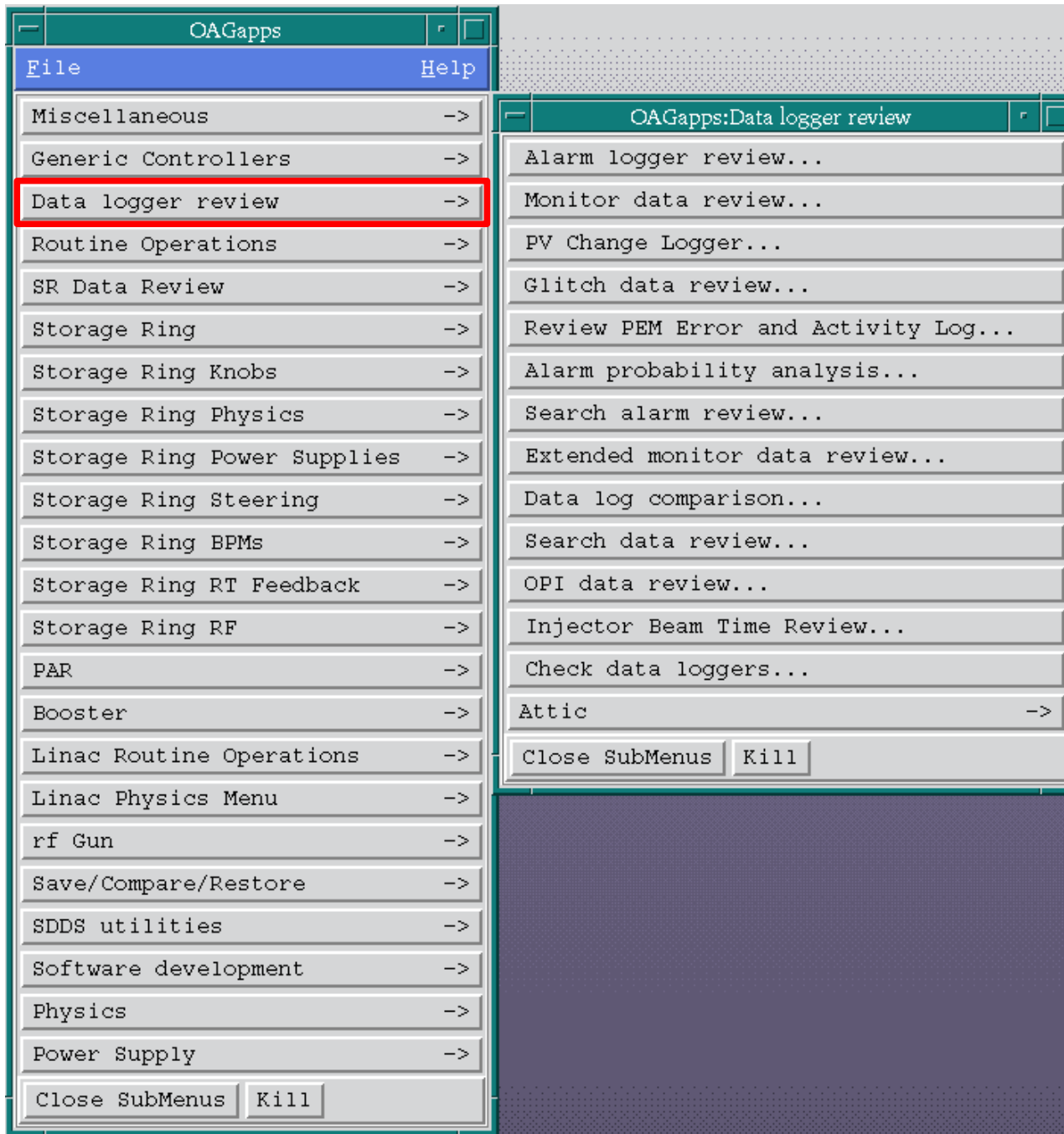


- Select file
- Select recently-used file
- Launch another application using given file

# Why All the Files?

- OAG applications require input and output filenames as part of data processing
- Some feel this is inconvenient or even bad software design
- However, using files
  - Lets user name and identify data and results
  - Creates open-ended “meta-applications” out of many small, simple applications
  - Lets anyone add to the application suite
  - Avoids getting trapped by software that doesn't do what you want

# Data Logger Review SubMenu



Access archives of  
accelerator-related data

- Review alarm history
- Review signal values
- Review history of  
setpoint changes
- Review glitches
- Find process variables in  
the data loggers

# Alarm Logger Review

- The alarm logger review utility allows
  - Reviewing alarms by subsystem and time period
  - Finding alarm times, severity, and status
  - Viewing related information (e.g., status bits)
  - Histogramming alarm density
  - Look for overlapping alarms
- We monitor alarms on 14k process variables
- Private alarm logs also supported

# Alarm Logging or ALH?

- ALH (ALarm Handler) is a GUI for alerting operators to alarms
- ALH logs data, but
  - Must have GUI open
  - Not space efficient
  - No analysis tools
- `sddsalarmlog` provides
  - Background logging
  - Space-efficient format
  - Sophisticated analysis and review tools

You need both!

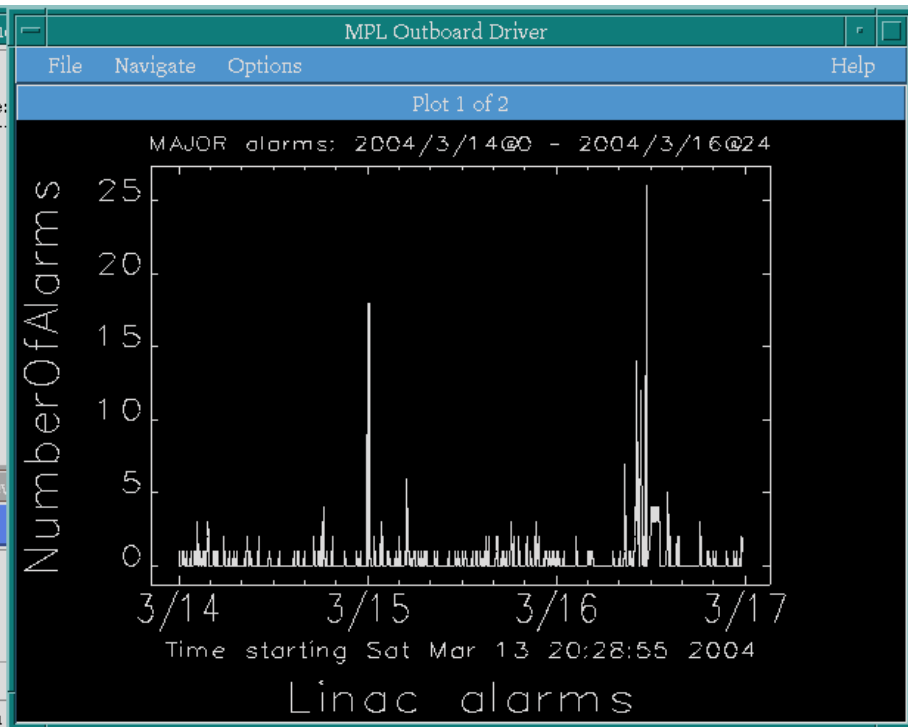


# Alarm Log Review Application

Display File: (/tmp/040317-140813-3685borlan)

Linac alarms: minor  
2004/3/14@0 - 2004/3/16@24

ControlName	Count	De:
L1:RG2:LFA>StatusCC	3	
L1:RG2:QM1>StatusCC	2	
L1:RG2:QM4>StatusCC	2	
L1:RG2:SC2:HZ>StatusCC	2	
L1:RG2:SC3:HZ>StatusCC	2	
L1:SC2:HZ>StatusCC	2	
L1:SC3:HZ>StatusCC	2	
L1:SC3:VL>StatusCC	1	
L2:TW:VP:CO1:controllerDG	2	
L4:TW:VP:CO6:controllerDG	2	
L4:TW:VP:CO7:controllerDG	104	
L5:TW:VP:CO4:controllerDG	2	



Indexing... 14:08:13  
Processing done. 14:08:13  
Counting alarms... 14:08:13  
Plotting... 14:08:13

Print Save As... Email... Expand Dialog...

System:

- Booster  Linac  MPS  PAR  SR  SR-BPM  SR-RTFB  SRF  Timing
- TopUp  ACIS  runControl  SRDCPS-100Hz  CA Beacon Monitor  Custom

Start Year/Month/Day/Hour:Minutes :

TODAY -DAY +DAY -WEEK +WEEK -MONTH +MONTH -YEAR +YEAR

End Year/Month/Day/Hour:Minutes :

TODAY -DAY +DAY -WEEK +WEEK -MONTH +MONTH -YEAR +YEAR

Directory:

Filename:

Filter:

PICK FILE...

Data filtering

PV name match:

PV name exclude:

Severity:  MAJOR  MINOR  INVALID  NO\_ALARM  All  None

Histogram control

Bin size:

unit:  seconds  hours  days  weeks

Count control

Threshold (counts):

Sort by:  Name  Counts

Fixed scale:  Yes  No

Printout control

Sort by:  Name  Time

# “Monitor Data Review” Application

The screenshot shows the MonitorDataReview application window. The title bar reads "MonitorDataReview". The menu bar includes "File" and "Help". The status bar at the top says "Ready.". Below the status bar is a toolbar with buttons for "Print", "Save As...", "Email...", and "Expand Dialog...". The main area is titled "Data group" and contains a tabbed interface with tabs for "SR", "Booster", "Par", "Linac", and "Misc". A list of data groups is displayed, including "BTS Power Supplies", "Beam Charge (Gun to PTB)", "Beam Charge (LTP to SR)", "CA Diagnostics", "Frontend Beamline", "Liquid Nitrogen Distribution System", "Mobile MV200", "Mobile MV200 Vid3", "PS/Mag H2O Flow/Pres.", "Power System", "Process Water/Air Temps", "RF Gun", "RF Test Stand", "Radiation Monitors", "Run Control", "Weather", and "injector IOCs". The "Process Water/Air Temps" group is selected. Below the list is a "Date/Time Range of Interest" section with input fields for "Starting date/time" and "Ending date/time", both set to 2004 8 9 and 2004 8 9 24 respectively. There are also buttons for "TODAY", "-DAY", "+DAY", "-WEEK", "+WEEK", "-MONTH", "+MONTH", "-YEAR", and "+YEAR". At the bottom, there are buttons for "PRESET PLOTS...", "CUSTOM PLOTS...", "quickSDDSplot...", "EXPORT...", and "Search for PVs...".

System tabs

Provides access to 37k logged quantities.

Data group selection

Create custom plots

Export data

Time-span selection

Select pre-defined plots

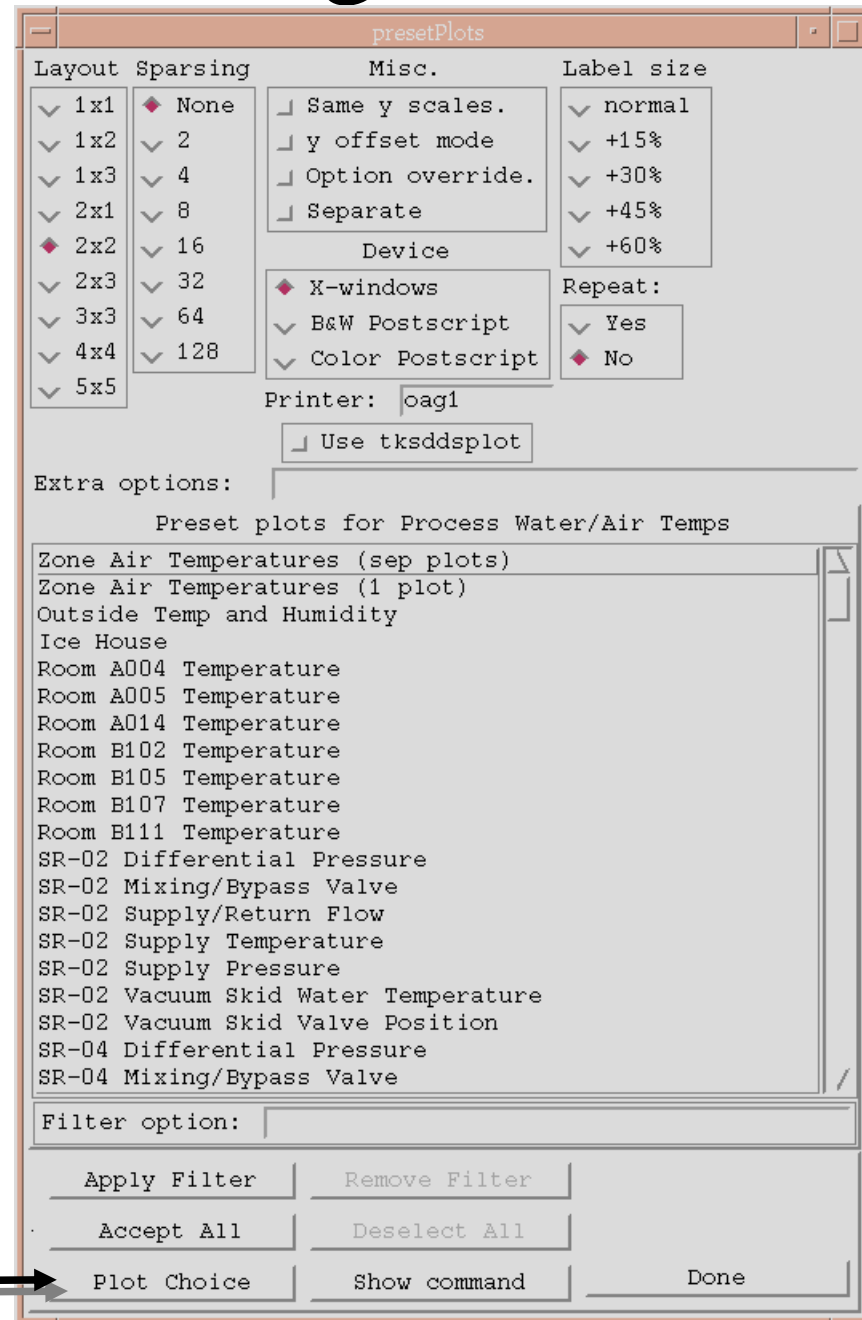
# Preset Plots Dialog

Plot modifiers →

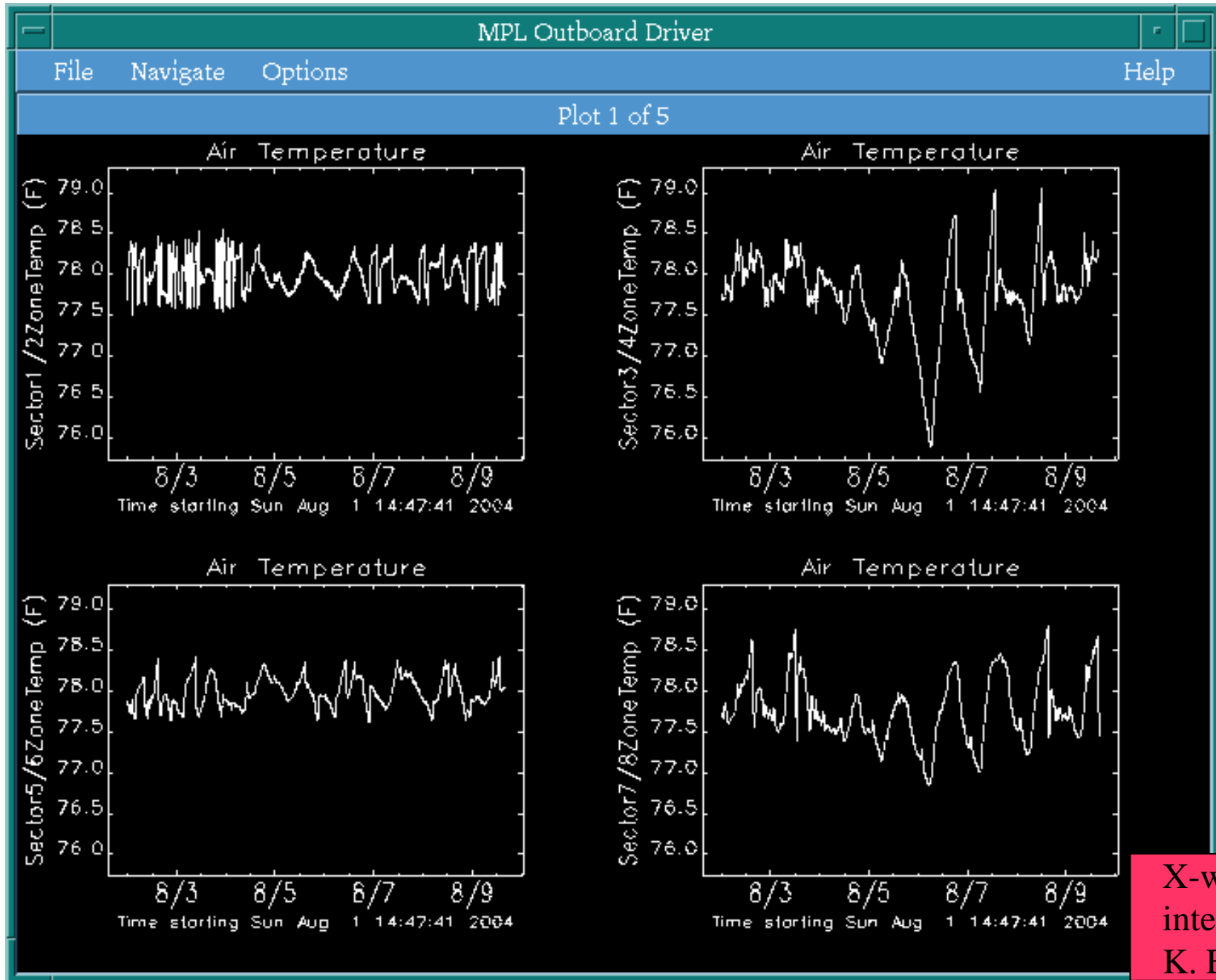
Preset plot choices  
(select one or more) →

For example, select  
“Zone Air Temperatures  
(sep plots)”

Button to actually make plot →



# A Typical "SDDS Plot"



# Web Access to Accelerator Data Logs

## Operations Analysis

Home News Operations Research Reports Software Docs

Home  
Mission Statement  
What We Do\*  
**Data Review**  
Full History  
AOD  
ASD  
XFD  
APS  
Argonne

## Operations Analysis Group

Accelerator Operations Division---Argonne National Laboratory

### Mission Statement

The mission of OAG is to apply integrated capabilities and experience in accelerator physics, accelerator operation, accelerator simulation, and high-level software to the operation, understanding, and enhancement of the Advanced Photon Source.

1. Development, maintenance, and application of software for highly-automated, highly-reliable accelerator operation, data collection, diagnosis, and experimentation.
2. Development, maintenance, and application of software for accurate, timely simulation of APS accelerator systems.
3. Development and exploration through simulation and experiment of innovative ideas for accelerator enhancements to improve the quality and reliability of beam delivered to users.
4. Integration of knowledge and understanding of the interplay of accelerator subsystems to provide reliable advice and decisions on accelerator operations and modifications.

### Graphics Gallery

[Photos of the APS bunch compressor.](#)

[First 6-day top-up run.](#)

**Current APS SDDS plots.** (Link moved to Operations tab.)

**Storage ring current and lifetime.** (Link moved to Operations tab.)

[APS RF Gun Beam and Electromagnetic Field Simulation](#)



## Data Review

Data groups available on the OAG web site:

<a href="#">SR RF</a>	<a href="#">Run Control</a>	<a href="#">Beam Charge (Gun to PTB)</a>	<a href="#">Linac RF Top Up</a>
<a href="#">SR Absorber H2O</a>	<a href="#">SR BPMs</a>	<a href="#">BTS Power Supplies</a>	<a href="#">Linac Modulators</a>
<a href="#">SR Vacuum</a>	<a href="#">SR Ave. BPMs</a>	<a href="#">Booster Pulsed Power Supplies</a>	<a href="#">Linac Modulators Top Up</a>
<a href="#">SR chamber temps</a>	<a href="#">SR BPLD</a>	<a href="#">Booster Vacuum</a>	<a href="#">Linac Diag</a>
<a href="#">SR DCPS: correctors/dipole</a>	<a href="#">SR Synch. Light Mon.</a>	<a href="#">Booster RF</a>	<a href="#">Linac Diag Top Up</a>
<a href="#">SR DCPS: correctors/dipole (extensive)</a>	<a href="#">SR Hydrostatic Level</a>	<a href="#">Booster Ramp Param</a>	<a href="#">Linac Switch Gear</a>
<a href="#">SR DCPS: correctors/dipole (100 Hz stats)</a>	<a href="#">SR Switchgear</a>	<a href="#">Booster Injection</a>	<a href="#">Linac Test Stand</a>
<a href="#">SR DCPS: quads/dipole</a>	<a href="#">SR Injection</a>	<a href="#">PAR/LET Vacuum</a>	<a href="#">Linac Water</a>
<a href="#">SR DCPS: quads/dipole (extensive)</a>	<a href="#">SR Feedback Status</a>	<a href="#">PAR/LET DC Power Supplies</a>	<a href="#">RF Gun</a>
<a href="#">SR DCPS: quads/dipole (100 Hz stats)</a>	<a href="#">SR Feedback Corrector Errors</a>	<a href="#">PAR Pulsed Power Supplies</a>	<a href="#">RF Test Stand</a>
<a href="#">SR Pulsed Power Supplies</a>	<a href="#">SR Thermocouples</a>	<a href="#">PAR RF 1</a>	<a href="#">Injector IOCs</a>
<a href="#">Radiation Monitors</a>	<a href="#">SR Source Parameters</a>	<a href="#">PAR RF 12</a>	<a href="#">SR IOCs</a>
<a href="#">Process Water / Air Temps</a>	<a href="#">ID data</a>	<a href="#">Linac Vacuum</a>	<a href="#">Mobile MY200</a>
<a href="#">Power System</a>	<a href="#">BM data</a>	<a href="#">Linac Power Supplies</a>	<a href="#">Mobile MY200 Vid3</a>
<a href="#">PS/Mag H2O Flow/Pres.</a>	<a href="#">Frontend &amp; PSS</a>	<a href="#">Linac Power Supplies Top Up</a>	<a href="#">CA Diagnostics</a>
	<a href="#">Beam Charge (LTP to SR)</a>	<a href="#">Linac RF</a>	<a href="#">Weather</a>

PV name:

Workstation data loggers:

<a href="#">Ariel</a>	<a href="#">Charis</a>	<a href="#">Demeter</a>	<a href="#">Iris</a>
<a href="#">Artemus</a>	<a href="#">Chiron</a>	<a href="#">Echo</a>	<a href="#">Medusa</a>
<a href="#">Brahms</a>	<a href="#">Chopin</a>	<a href="#">Helios</a>	<a href="#">Phoenix</a>
			<a href="#">Ravel</a>

Listing of data groups same as in the Tcl/Tk application

Data Group	Preset Plot	Control Name / Readback Name
Process Water / Air Temps	Zone Air Temperatures (sep plots)	G: AHU: A004ZoneTempAi / G: AHU: RoomA004Temp
	Zone Air Temperatures (1 plot)	G: AHU: A005ZoneTempAi / G: AHU: RoomA005Temp
	Outside Temp and Humidity	G: AHU: A014ZoneTempAi / G: AHU: RoomA014Temp
	Ice House	G: AHU: B102ZoneTempAi / G: AHU: RoomB102Temp
	Room A004 Temperature	G: AHU: B105ZoneTempAi / G: AHU: RoomB105Temp
	Room A005 Temperature	G: AHU: B107ZoneTempAi / G: AHU: RoomB107Temp
	Room A014 Temperature	G: AHU: B111ZoneTempAi / G: AHU: RoomB111Temp
	Room B102 Temperature	G: AHU: FP5057Ai / G: AHU505Column89ID8FP5057Temp
	Room B105 Temperature	G: AHU: FP5058Ai / G: AHU505Column89ID8FP5058Temp
	Room B107 Temperature	G: AHU: FP5059Ai / G: AHU505Column92ID9FP5059Temp
	Room B111 Temperature	G: AHU: FP5060Ai / G: AHU505Column92ID9FP5060Temp
	SR-02 Differential Pressure	G: AHU: FP5061Ai / G: AHU505Column92BM10FP5061Temp
	SR-02 Mixing/Bypass Valve	G: AHU: FP5062Ai / G: AHU505Column92BM10FP5062Temp
	SR-02 Supply/Return Flow	G: AHU: FP5063Ai / G: AHU505Column90ID9FP5063Temp
	SR-02 Supply Temperature	G: AHU: FP5064Ai / G: AHU505Column90ID9FP5064Temp
	SR-02 Supply Pressure	G: AHU: FP5065Ai / G: AHU505Column90ID9FP5065Temp
	SR-02 Vacuum Skid Water Temperature	G: AHU: FP5066Ai / G: AHU505Column88BM9FP5066Temp
	SR-02 Vacuum Skid Valve Position	G: AHU: FP5067Ai / G: AHU505Column90ID8FP5067Temp
	SR-04 Differential Pressure	G: AHU: FP5068Ai / G: AHU505Column93ID9FP5068Temp
	SR-04 Mixing/Bypass Valve	G: AHU: FP5069Ai / G: AHU505Column91ID9FP5069Temp

Plot

Date/Time Range of Interest				
	Year	Month	Day	Hour
Starting date/time:	2004	8	1	0
Ending date/time:	2004	8	7	24

Plot

Plot Options	
Size:	Normal
Background Color:	White
Layout:	1x1
Label size:	Normal
Sparsing:	None
Miscellaneous:	<input type="checkbox"/> Same Y scales <input type="checkbox"/> Y offset mode <input type="checkbox"/> Separate <input type="checkbox"/> Option override
Extra Options:	

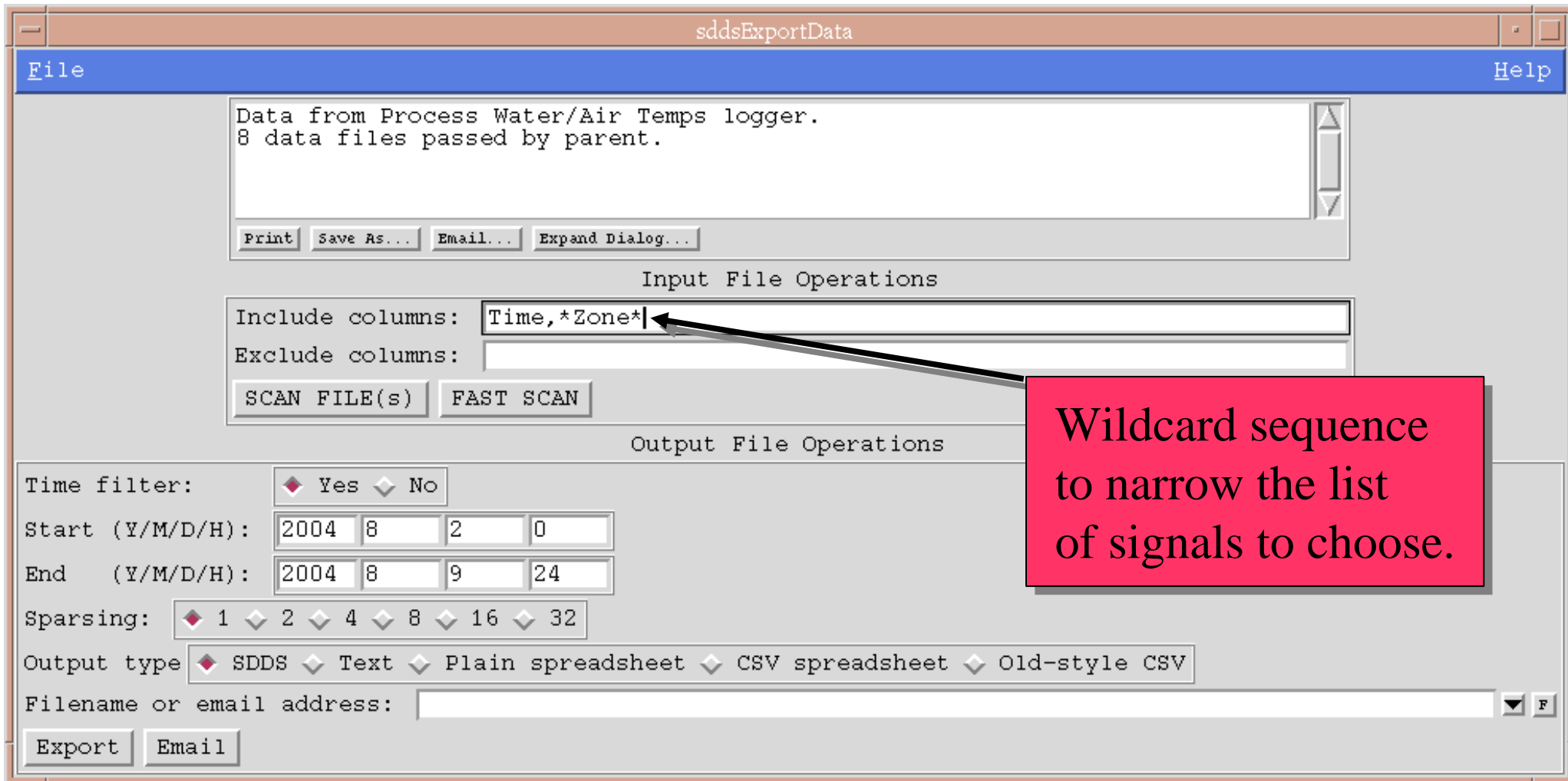
In this example, we select some process variables explicitly.





# Exporting Data

In this case, “sddsExportData” is launched from the data review application to allow exporting the selected data.



# Exporting Data

The screenshot shows the 'sddsExportData' application window. The main window has a menu bar with 'File' and 'Help'. Below the menu bar is a text area containing the message: 'Data from Process Water/Air Temps logger. 8 data files passed by parent.' Below this are buttons for 'Print', 'Save As...', 'Email...', and 'Expand Dialog...'. The 'Input File Operations' section includes 'Include columns:' with the text 'Time,\*Zone\*' and an empty 'Exclude columns:' field. Below these are 'SCAN FILE(s)' and 'FAST SCAN' buttons. The 'Output File Operations' section includes a 'Time filter:' dropdown set to 'Yes', 'Start (Y/M/D/H):' (2004/8/2/0) and 'End (Y/M/D/H):' (2004/8/9/24) fields, a 'Sparsing:' dropdown set to '1', an 'Output type' dropdown set to 'SDDS', and a 'Filename or email address:' field. 'Export' and 'Email' buttons are at the bottom. An 'Export Selection List' dialog box is open, showing a list of 16 zone temperature entries, all of which are selected. An arrow points from the 'FAST SCAN' button to the list. The dialog has 'Close', 'Clear', 'Accept', and 'Select all' buttons at the bottom.

Data from Process Water/Air Temps logger.  
8 data files passed by parent.

Print Save As... Email... Expand Dialog...

Input File Operations

Include columns: Time,\*Zone\*  
Exclude columns:

SCAN FILE(s) FAST SCAN

Output File Operations

Time filter: Yes No  
Start (Y/M/D/H): 2004 8 2 0  
End (Y/M/D/H): 2004 8 9 24  
Sparsing: 1 2 4 8 16 32  
Output type: SDDS Text Plain spreadsheet CSV spreadsheet  
Filename or email address:

Export Email

Export Selection List

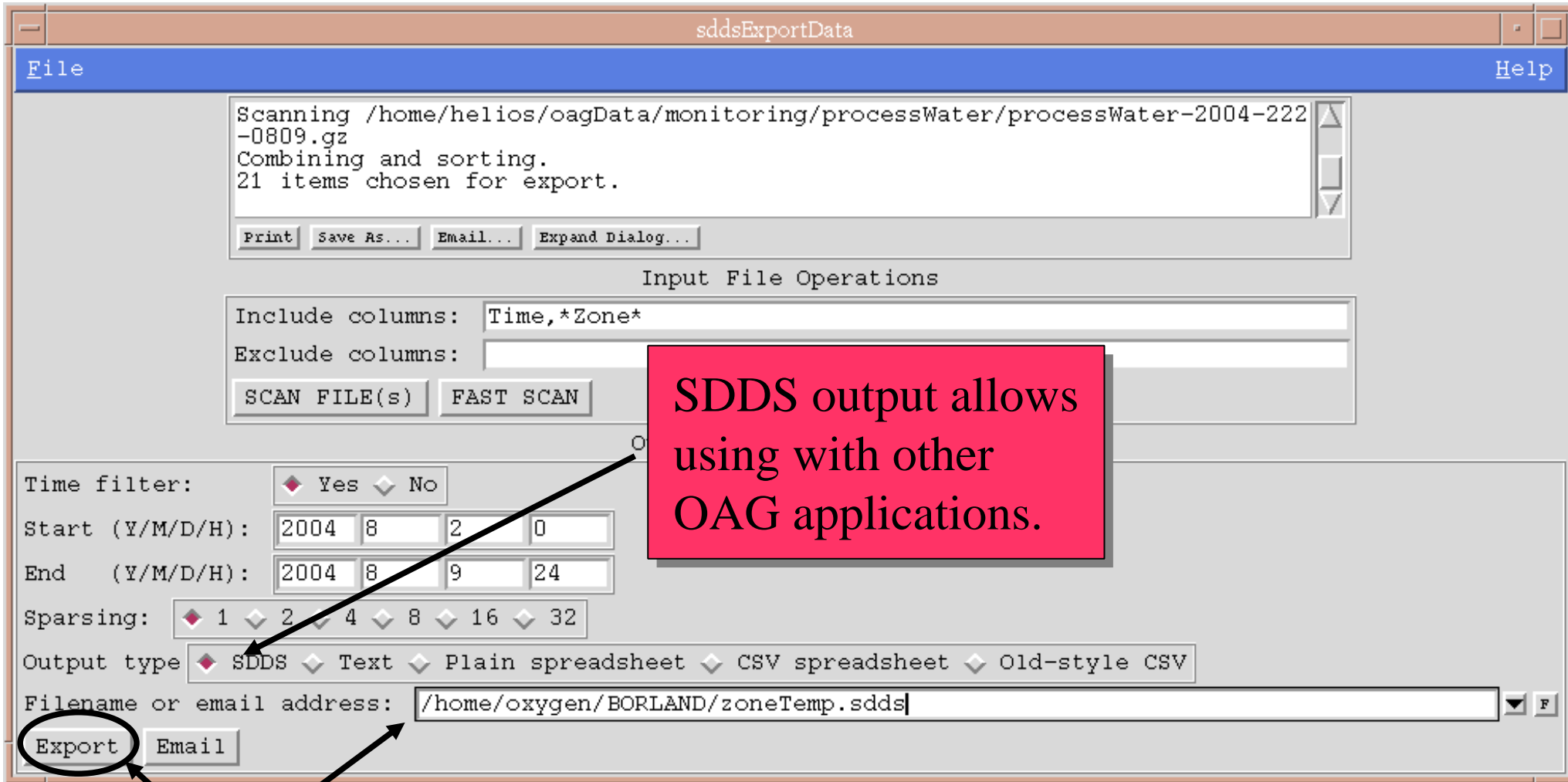
Export Selection List

- G:PW:Sector1/2ZoneTemp
- G:PW:Sector11/12ZoneTemp
- G:PW:Sector13/14ZoneTemp
- G:PW:Sector15/16ZoneTemp
- G:PW:Sector17/18ZoneTemp
- G:PW:Sector19/20ZoneTemp
- G:PW:Sector21/22ZoneTemp
- G:PW:Sector23/24ZoneTemp
- G:PW:Sector25/26ZoneTemp
- G:PW:Sector27/28ZoneTemp
- G:PW:Sector29/30ZoneTemp
- G:PW:Sector3/4ZoneTemp
- G:PW:Sector31/32ZoneTemp
- G:PW:Sector33/34ZoneTemp
- G:PW:Sector35/36ZoneTemp

Close Clear Accept Select all

The air temperatures for all zones were selected.

# Exporting Data



SDDS output allows using with other OAG applications.

Export to private file

# Working with Exported Data

The screenshot shows the `sddsExportData` application window. The title bar reads `sddsExportData`. The menu bar includes `File` and `Help`. A status window at the top displays the message: `-0809.0001`, `Combining and sorting.`, `21 items chosen for export.`, and `Data exported.` Below this are buttons for `Print`, `Save As...`, `Email...`, and `Expand Dialog...`.

The `Input File Operations` section contains `Include columns:` (set to `Time,*Zone*`) and `Exclude columns:` (empty). Buttons for `SCAN FILE(s)` and `FAST SCAN` are present.

The `Output File Operations` section includes a `Time filter:` (set to `Yes`), `Start (Y/M/D/H):` (2004 8 2 0), `End (Y/M/D/H):` (2004 8 9 24), `Sparsing:` (set to 1), and `Output type` (set to `SDDS`). The `Filename or email address:` field contains `/home/oxygen/BORLAND/zoneTemp.sdds`. Buttons for `Export` and `Email` are at the bottom left.

A red callout box with a black border contains the text: `Use command dialog to launch next application`. An arrow points from this box to a small downward-pointing arrow icon in the bottom right corner of the application window.

The `File Select...` menu is open, showing a list of commands. The command `quicksDDSDSP -filename /home/oxygen/BORLAND/zoneTemp.sdds` is circled in black.

```
File Select...
Select Recent...

sddsedit /home/oxygen/BORLAND/zoneTemp.sdds
quicksDDSP -dataFileList /home/oxygen/BORLAND/zoneTemp.sdds
quicksDDSEit -filename /home/oxygen/BORLAND/zoneTemp.sdds
quicksDDSDSP -filename /home/oxygen/BORLAND/zoneTemp.sdds
quicksDDSSStatistics -filename /home/oxygen/BORLAND/zoneTemp.sdds
sddsExportData -dataFileList /home/oxygen/BORLAND/zoneTemp.sdds
xemacs /home/oxygen/BORLAND/zoneTemp.sdds
dtpad /home/oxygen/BORLAND/zoneTemp.sdds
sddsquery /home/oxygen/BORLAND/zoneTemp.sdds
sdds2stream -rows /home/oxygen/BORLAND/zoneTemp.sdds
Custom command...
```

# SDDS Utilities SubMenu

“Quick” interfaces to  
basic SDDS capabilities

•Graphics

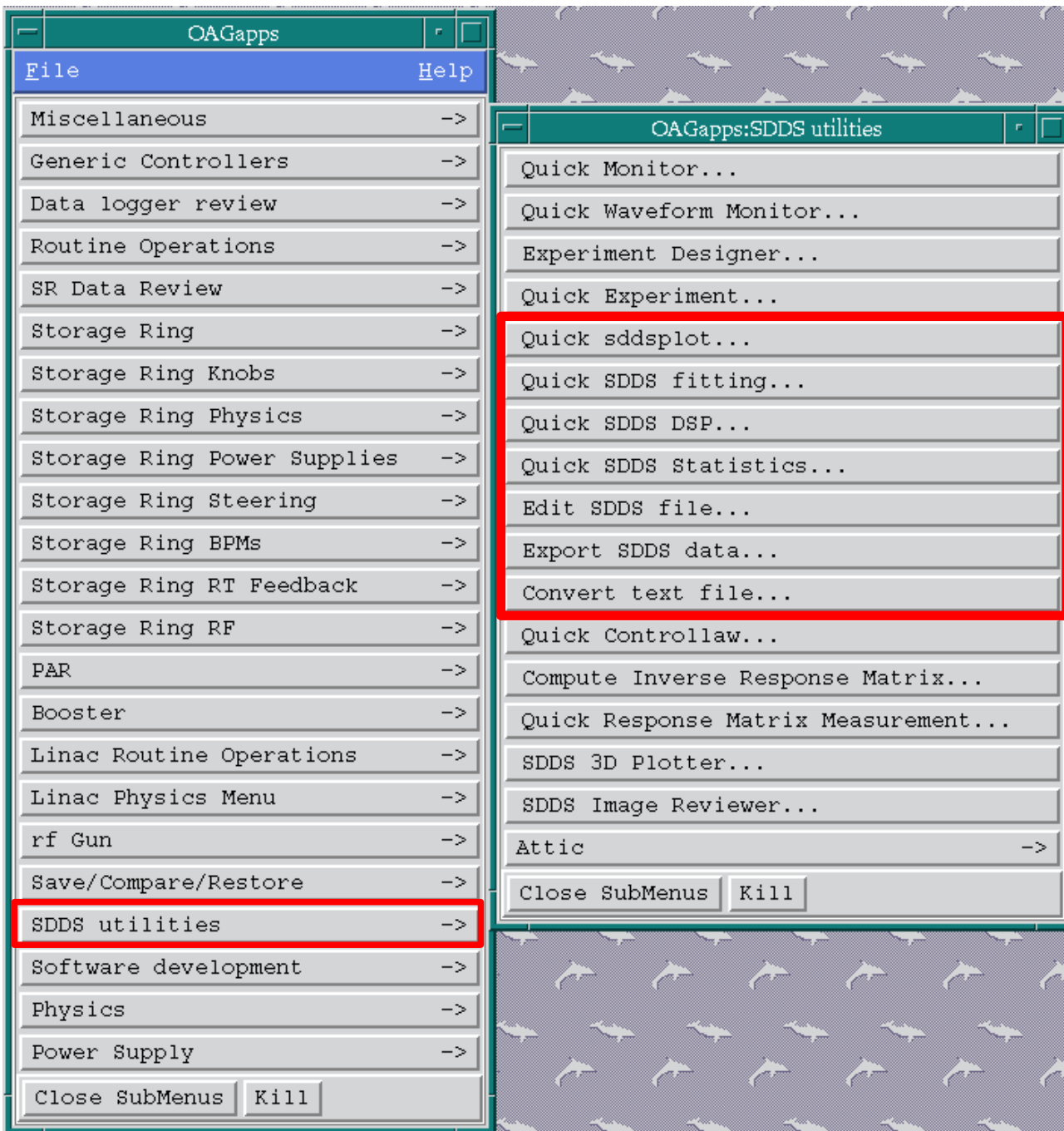
•Fitting

•Digital signal  
processing

•Statistical analyses

•Edit

•Export/import



# “quick SDDS DSP”: Digital Signal Processing

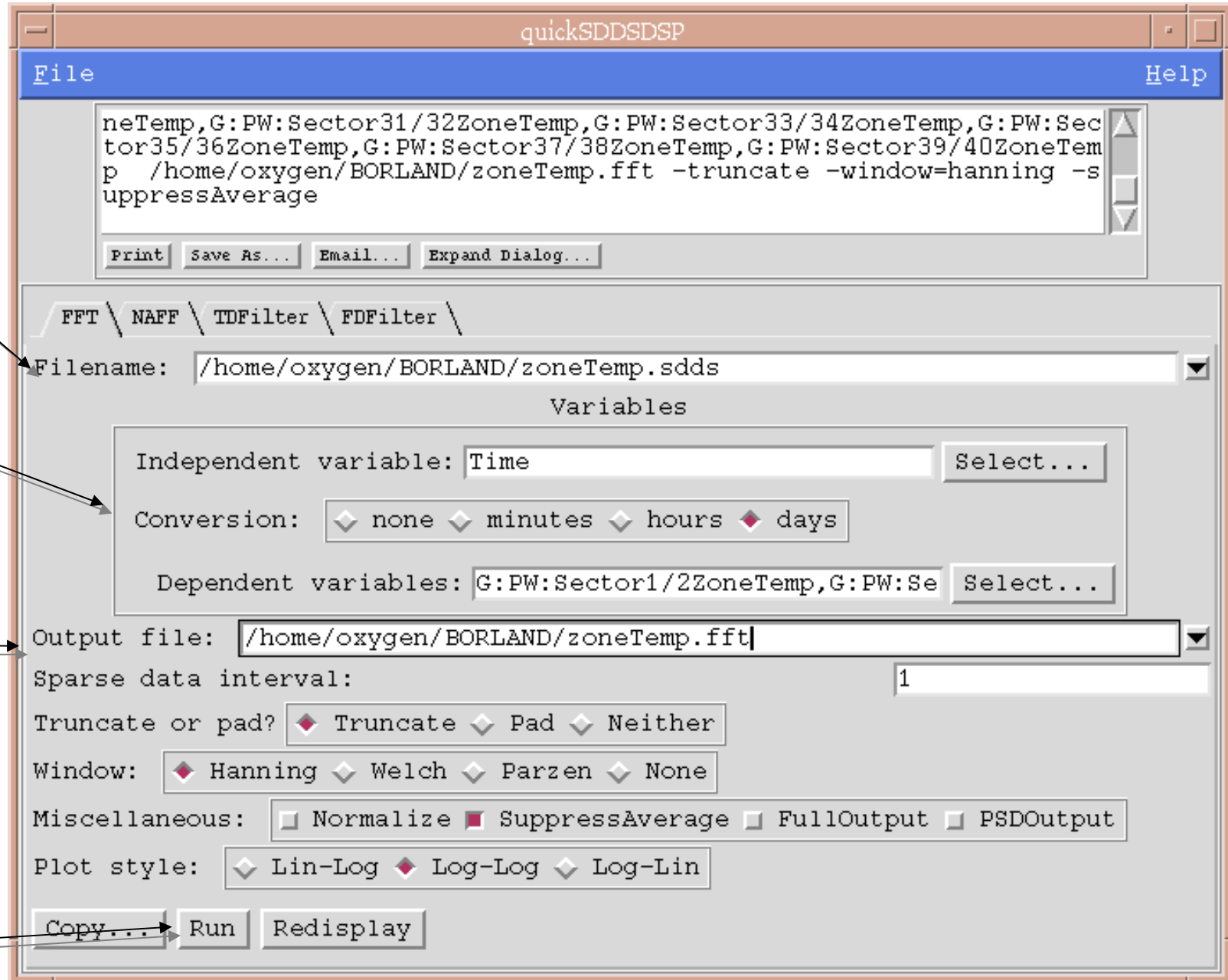
Fast  
Fourier  
Transforms

Input file preset by  
export application

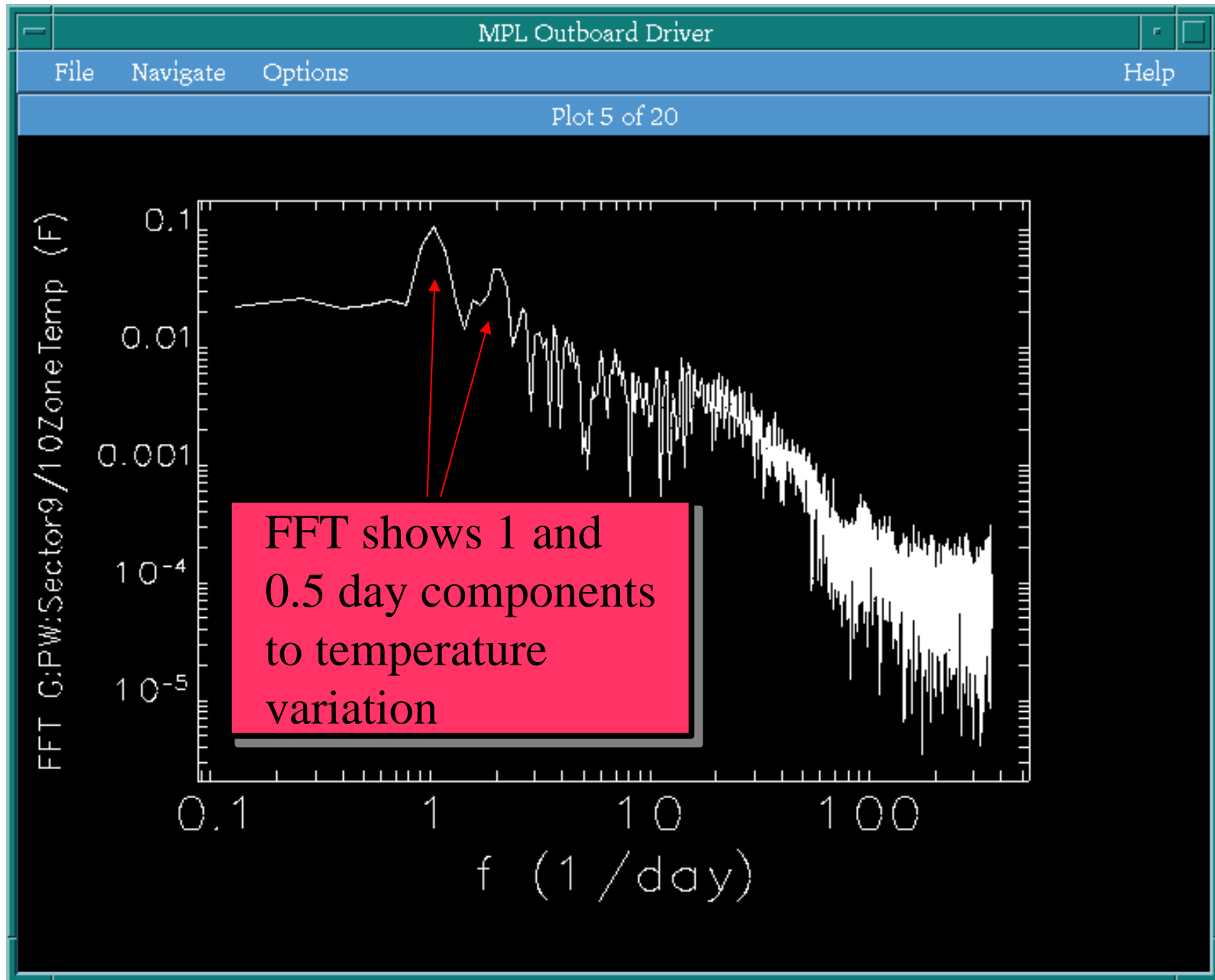
Select independent  
and dependent  
variables

Specify output  
file and  
processing  
parameters

Do the analysis  
and display results



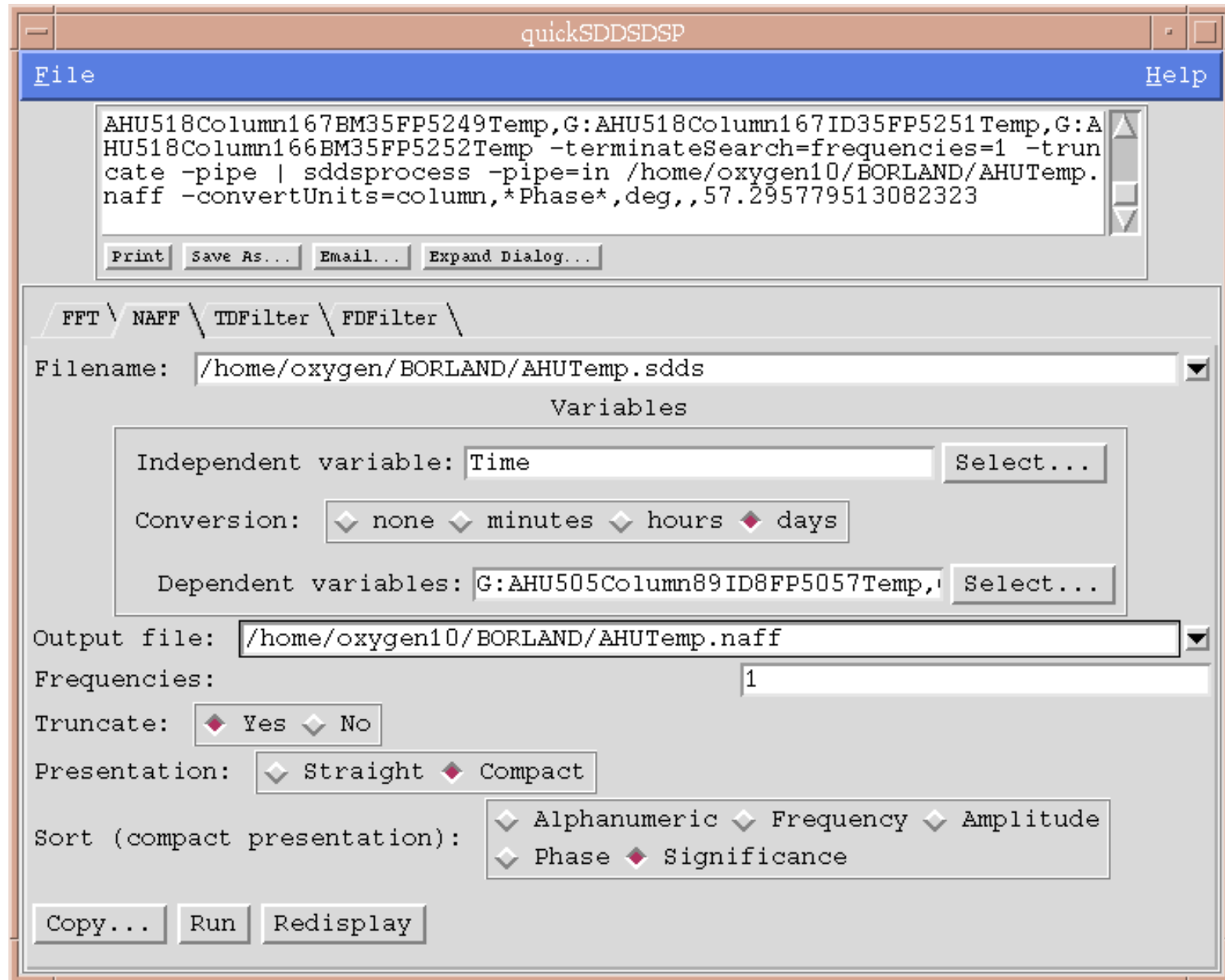
# Example of FFT Results



# More DSP: NAFF

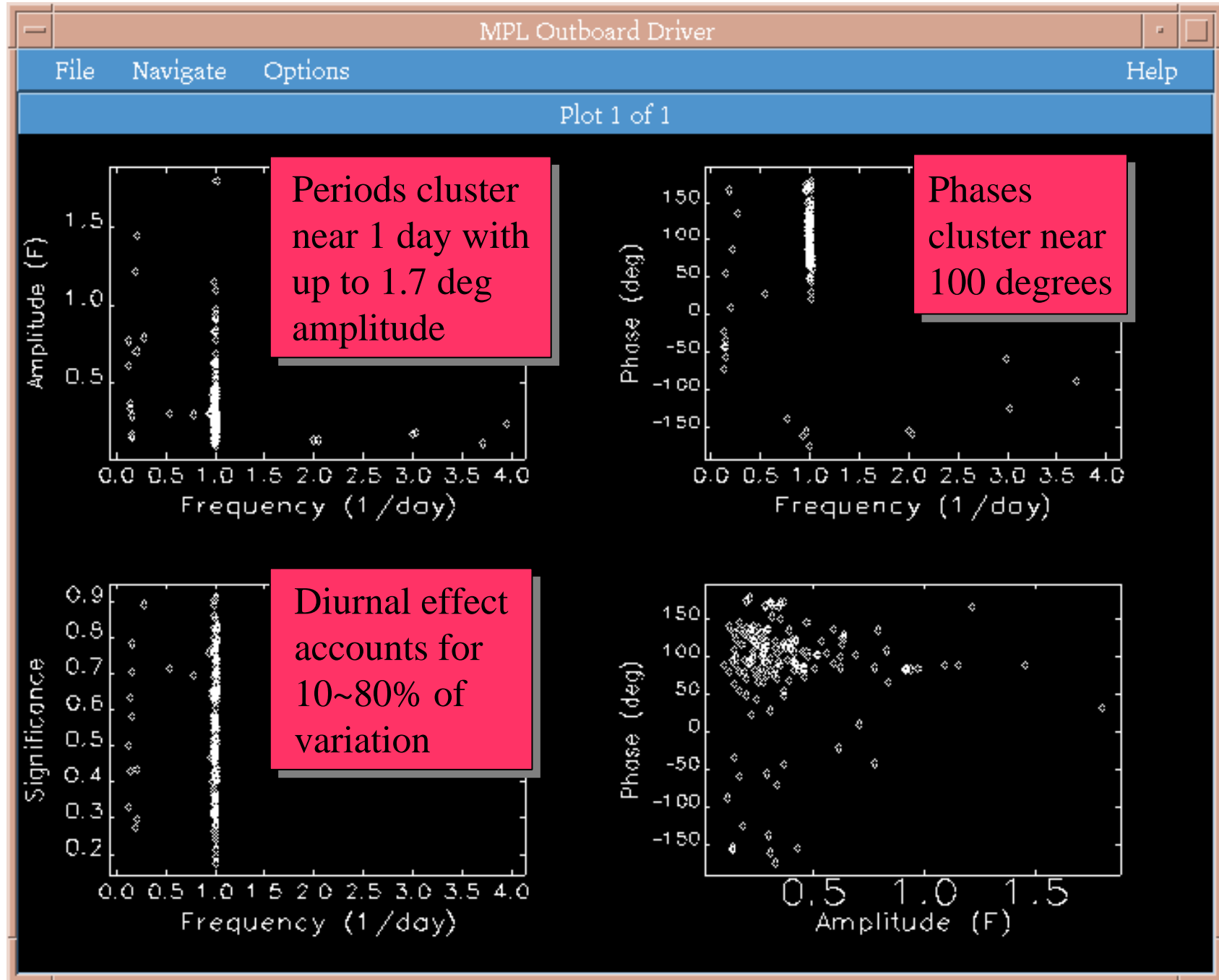
## Numerical Analysis of Fundamental Frequencies

To make it more interesting, look at all 172 AHU temperatures for the experimental hall.





# NAFF Reveals a Wealth of Information

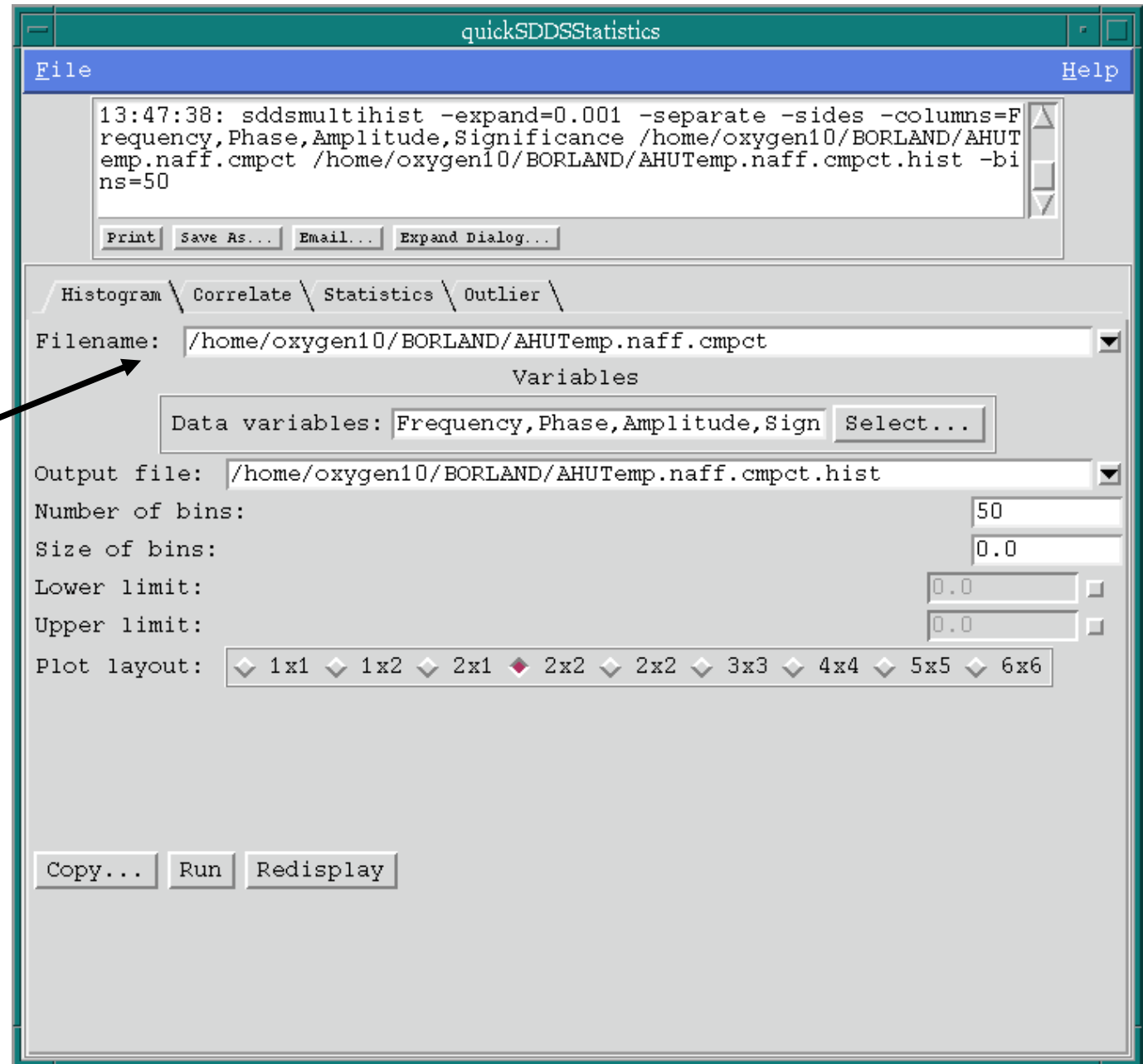


# “quick SDDS Statistics”

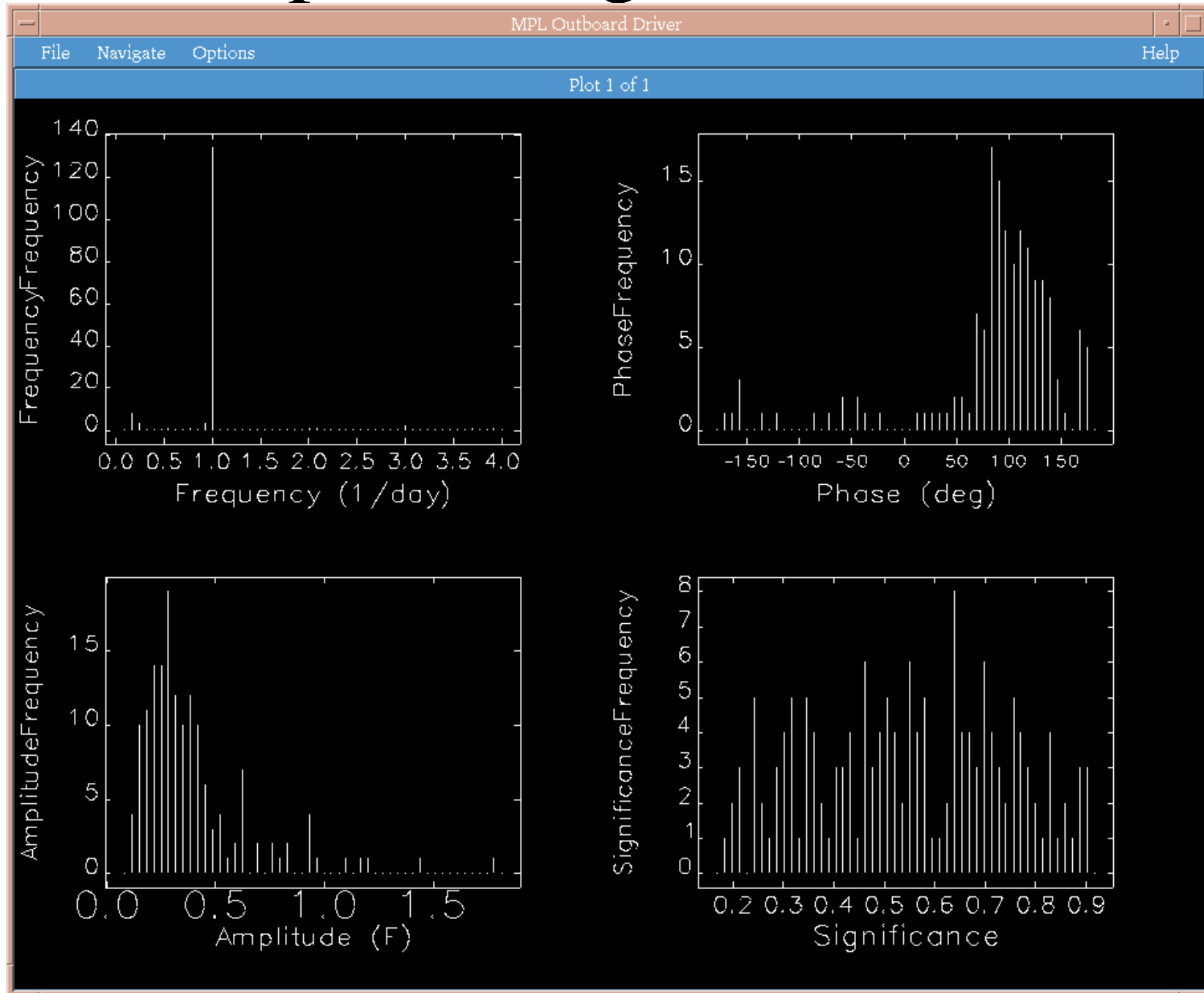
- Histograms
- Statistics computation
- Outlier analysis
- Correlation analysis

Input for histogram is the output from NAFF analysis.

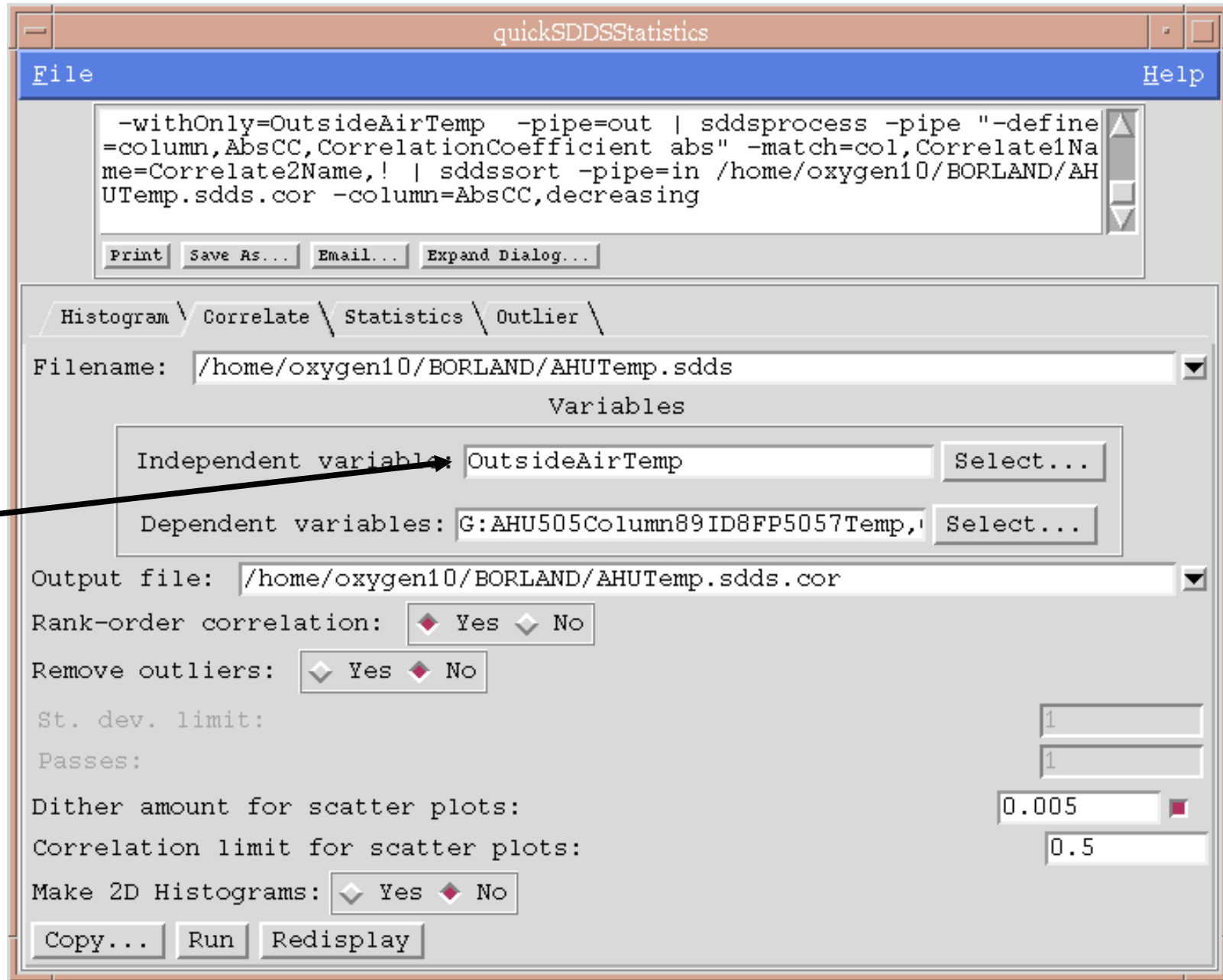
The idea of using one program's output as another program's input is central to SDDS.



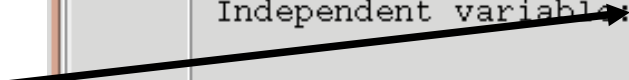
# Sample Histogram Results



# Searching for Correlations



Search for correlations with outside air temperature



# Correlation Analysis: Experimental Hall Temps. with Outside Air Temp.

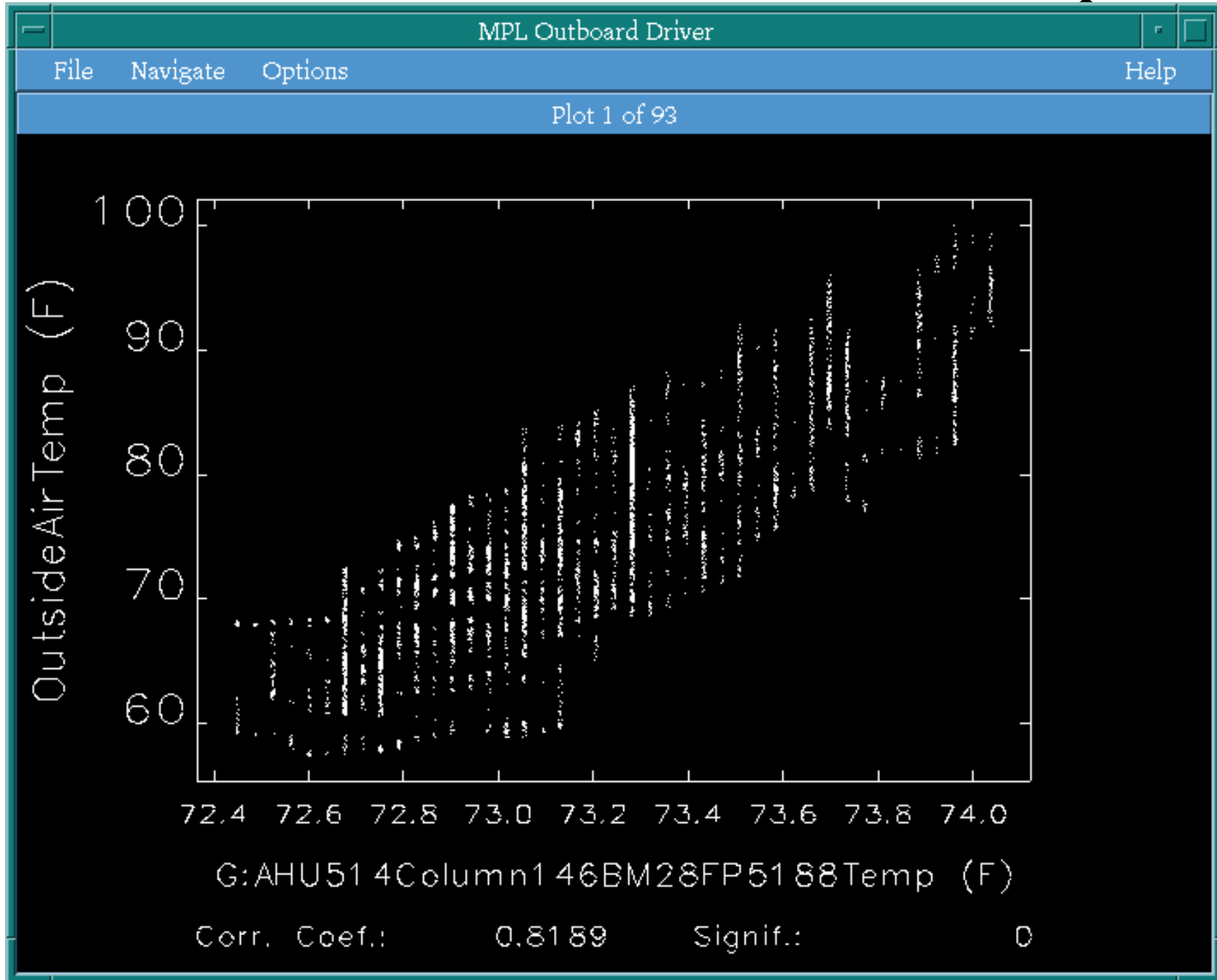
Display File: (/tmp/040811-115348-29914borland5)

Printout for SDDS file /home/oxygen10/BORLAND/AHUTemp.sdds.cor

Corr.Coeff.	Corr.Signif.	CorrelatePair
0.819	0.000	G:AHU514Column146BM28FP5188Temp.OutsideAirTemp
0.805	0.000	G:AHU517Column160ID32FP5234Temp.OutsideAirTemp
0.805	0.000	G:AHU513Column139BM26FP5174Temp.OutsideAirTemp
0.795	0.000	G:AHU507Column102ID13FP5092Temp.OutsideAirTemp
0.791	0.000	G:AHU514Column142ID26FP5192Temp.OutsideAirTemp
0.777	0.000	G:AHU509Column116ID18FP5117Temp.OutsideAirTemp
0.761	0.000	G:AHU508Column110BM16FP5104Temp.OutsideAirTemp
0.761	0.000	G:AHU513Column141ID25FP5180Temp.OutsideAirTemp
0.754	0.000	G:AHU511Column128ID22FP5146Temp.OutsideAirTemp
0.752	0.000	G:AHU508Column110BM16FP5103Temp.OutsideAirTemp
0.750	0.000	G:AHU515Column152BM30FP5202Temp.OutsideAirTemp
0.745	0.000	G:AHU516Column156ID31FP5218Temp.OutsideAirTemp
0.737	0.000	G:AHU513Column140ID25FP5172Temp.OutsideAirTemp
0.735	0.000	G:AHU513Column139ID25FP5175Temp.OutsideAirTemp
0.719	0.000	G:AHU513Column140ID25FP5171Temp.OutsideAirTemp
0.717	0.000	G:AHU513Column138ID25FP5176Temp.OutsideAirTemp
0.716	0.000	G:AHU515Column152BM30FP5201Temp.OutsideAirTemp
0.714	0.000	G:AHU514Column143BM27FP5196Temp.OutsideAirTemp
0.709	0.000	G:AHU517Column160BM33FP5233Temp.OutsideAirTemp
0.705	0.000	G:AHU513Column140ID26FP5173Temp.OutsideAirTemp
0.702	0.000	G:AHU510Column119BM19FP5135Temp.OutsideAirTemp
0.702	0.000	G:AHU511Column125BM21FP5154Temp.OutsideAirTemp
0.701	0.000	G:AHU508Column106ID14FP5108Temp.OutsideAirTemp
0.693	0.000	G:AHU514Column144ID27FP5190Temp.OutsideAirTemp
0.693	0.000	G:AHU509Column113BM17FP5121Temp.OutsideAirTemp
0.691	0.000	G:AHU514Column143ID26FP5184Temp.OutsideAirTemp
0.691	0.000	G:AHU514Column144ID26FP5193Temp.OutsideAirTemp
0.687	0.000	G:AHU513Column139ID25FP5181Temp.OutsideAirTemp
0.684	0.000	G:AHU506Column98BM12FP5076Temp.OutsideAirTemp
0.682	0.000	G:AHU509Column113BM17FP5126Temp.OutsideAirTemp
0.680	0.000	G:AHU515Column150ID29FP5203Temp.OutsideAirTemp
0.676	0.000	G:AHU514Column145ID27FP5195Temp.OutsideAirTemp
0.673	0.000	G:AHU511Column128ID21FP5143Temp.OutsideAirTemp
0.658	0.000	G:AHU516Column156ID31FP5217Temp.OutsideAirTemp
0.657	0.000	G:AHU506Column96ID11FP5077Temp.OutsideAirTemp

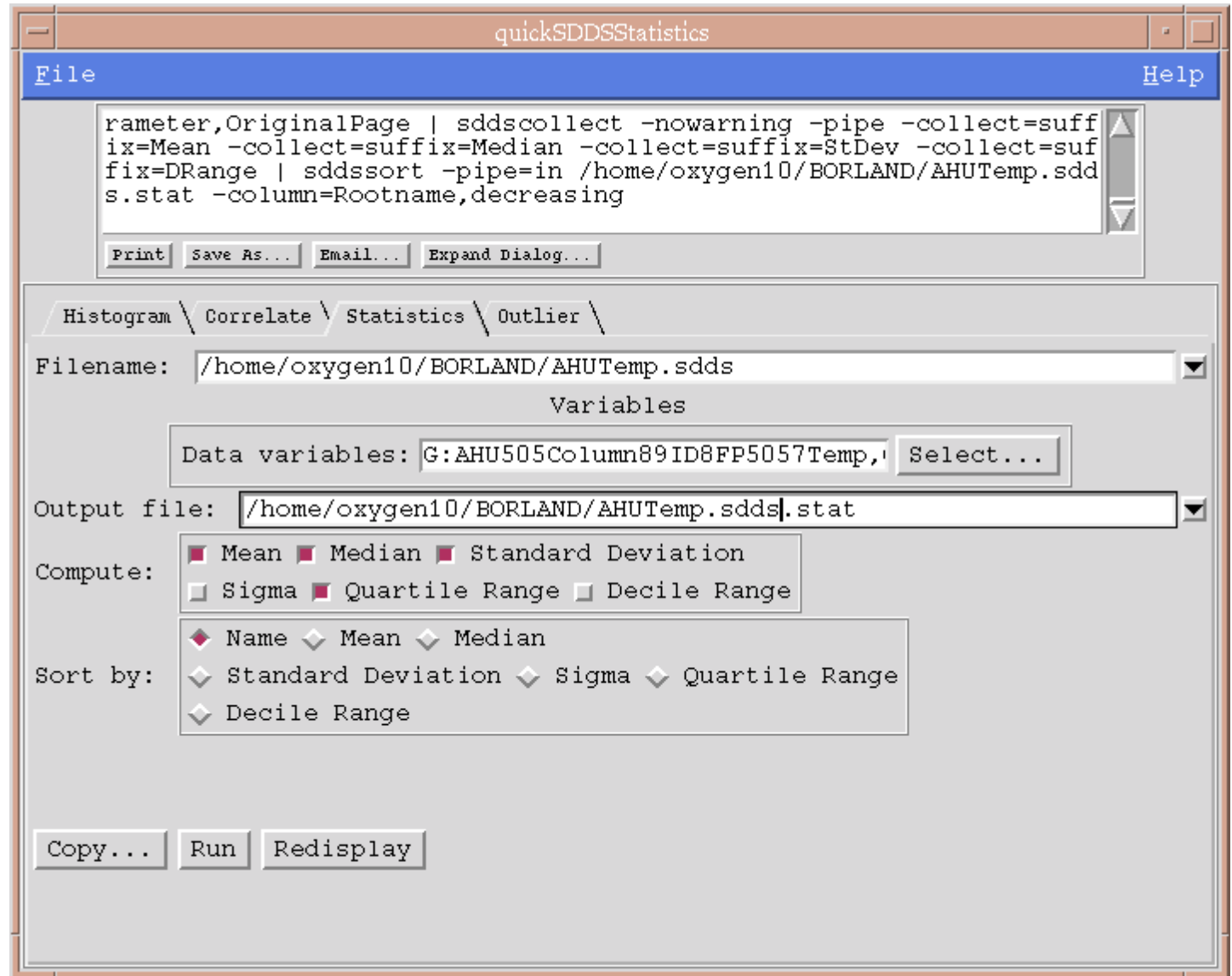
Close Print Print... Export text... Email... Export SDDS...

# Correlation Scatter Plot Example



# Statistics Computation

Example of computing a variety of statistics for AHU temperatures



# Statistics Results

Display File: Statistics for /home/oxygen10/BORLAND/AHUTemp.sdds (/tmp/040811-122550-409borland1)

Printout for SDDS file /home/oxygen10/BORLAND/AHUTemp.sdds.stat

Data	Mean F	Median F	StDev F	QRange F	Units
OutsideAirTemp	74.6002	73.6877	8.66182	12.3464	F
G: AHU513Column138ID24FP5170Temp	149.361	149.083	3.15517	2.45618	F
G: AHU513Column138ID24FP5169Temp	136.968	137.142	1.87958	1.92712	F
G: AHU511Column129ID21FP5152Temp	81.1791	80.9899	1.12983	1.62488	F
G: AHU513Column140ID25FP5171Temp	71.18	71.0896	1.10392	0.642395	F
G: AHU510Column119BM19FP5140Temp	76.0424	76.3799	0.994822	1.66266	F
G: AHU510Column122ID19FP5130Temp	77.2784	77.3624	0.956028	0.869141	F
G: AHU506Column94BM11FP5080Temp	72.8692	72.6389	0.843321	1.20923	F
G: AHU506Column99ID12FP5075Temp	71.3853	71.5431	0.837735	0.982483	F
G: AHU506Column96ID10FP5081Temp	72.9772	72.7523	0.799526	1.54932	F
G: AHU505Column90ID9FP5064Temp	72.7389	72.5255	0.766343	1.05798	F
G: AHU506Column95BM11FP5079Temp	72.7368	72.6011	0.760342	1.20911	F
G: AHU505Column90ID9FP5065Temp	73.4221	73.2057	0.760193	1.09583	F
G: AHU505Column92BM10FP5061Temp	72.6179	72.4878	0.755631	1.17133	F
G: AHU505Column88BM9FP5066Temp	72.5121	72.2988	0.724488	1.02026	F
G: AHU513Column139BM26FP5174Temp	73.3495	73.3569	0.720899	1.05804	F
G: AHU507Column104BM14FP5089Temp	72.8949	72.8279	0.720211	1.02032	F
G: AHU508Column110ID15FP5102Temp	73.4295	73.2812	0.709764	1.05804	F
G: AHU505Column92BM10FP5062Temp	73.719	73.5458	0.70514	1.05811	F
G: AHU513Column140ID26FP5173Temp	72.3504	72.3744	0.704499	0.755737	F
G: AHU511Column125ID20FP5141Temp	71.4532	71.203	0.702095	0.944702	F
G: AHU511Column126ID20FP5142Temp	73.2692	73.2057	0.693935	1.20923	F
G: AHU511Column125BM21FP5149Temp	72.6193	72.5255	0.673863	0.944641	F
G: AHU514Column142ID26FP5192Temp	72.7267	72.6767	0.615539	1.13361	F
G: AHU506Column96ID11FP5078Temp	73.7232	73.5836	0.613883	0.982544	F
G: AHU509Column115BM18FP5118Temp	73.5204	73.4325	0.601155	0.982544	F
G: AHU505Column90ID9FP5063Temp	72.3857	72.2988	0.580747	0.982544	F
G: AHU518Column168ID35FP5244Temp	73.7625	73.5836	0.575005	0.982544	F
G: AHU513Column138ID25FP5176Temp	72.2851	72.2988	0.56553	0.982544	F
G: AHU513Column139ID25FP5175Temp	73.0856	73.1301	0.563497	0.982544	F
G: AHU511Column124BM21FP5150Temp	71.9982	71.8454	0.559164	0.982544	F
G: AHU506Column98BM12FP5076Temp	72.7235	72.6389	0.558715	0.982544	F
G: AHU513Column140ID25FP5172Temp	71.8758	71.8076	0.55239	0.982544	F
G: AHU513Column137BM25FP5177Temp	72.8068	72.79	0.534591	0.982544	F
G: AHU505Column89ID8FP5057Temp	73.2572	73.1679	0.534436	0.982544	F
G: AHU508Column108ID15FP5106Temp	72.4288	72.2988	0.52788	0.982544	F
G: AHU513Column139ID24FP5179Temp	71.7383	71.6943	0.526587	0.982544	F
G: AHU507Column102ID13FP5091Temp	72.9825	73.0546	0.526466	0.982544	F
G: AHU509Column114ID17FP5119Temp	72.4345	72.3744	0.523983	0.982544	F
G: AHU507Column102ID13FP5092Temp	71.803	71.7698	0.521031	0.982544	F
G: AHU508Column110BM16FP5104Temp	72.9612	72.979	0.510259	0.793457	F

Context Help

Shows statistical analysis for /home/oxygen10/BORLAND/AHUTemp.sdds. The "sigma" value is the error bar for the mean. The "QRange" and "DRange" are, respectively, the quartile and decile ranges, which contain, respectively, the middle 50% and 80% of the data.

OK

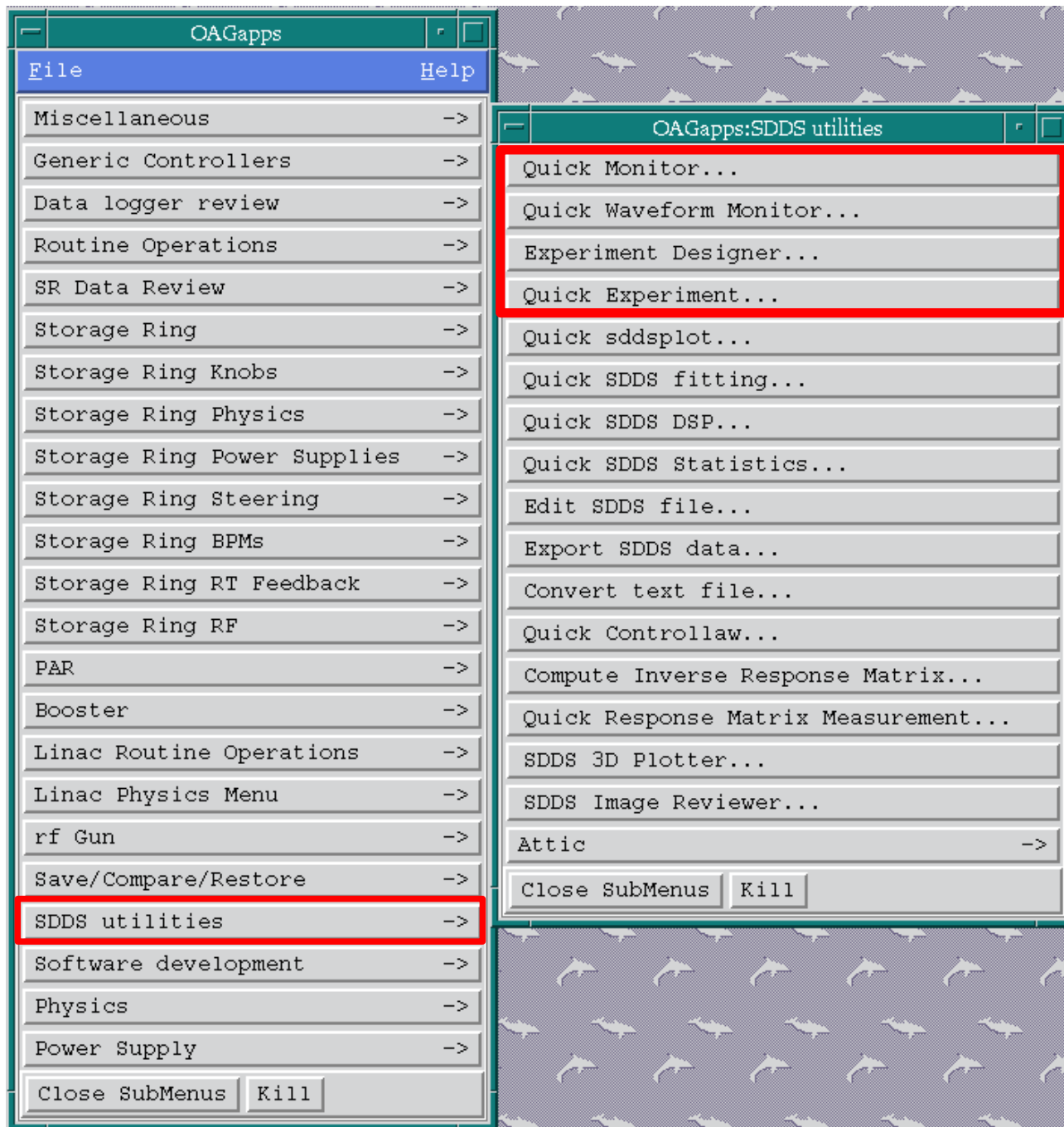
Close Print Print... Export text... Email... Export SDDS...



# SDDS Utilities SubMenu (again)

“Quick” interfaces to  
basic SDDS capabilities

- Data collection
- Experiment execution



# Data Collection

- quickMonitor
  - Interface to basic features of the program `sddsmonitor`
  - Time-interval-based data collection
- quickWaveformMonitor
  - Interface to basic features of the program `sddswmonitor`
  - Time-interval-based collection of waveforms and scalar values
- For more sophisticated applications, one can use commandline SDDS tools...

# SDDS Data Collection Capabilities

- Capabilities include
  - Time series logging of values and statistics
  - Glitch-, alarm-, or trigger-initiated logging with pre- and post-event samples
  - Synchronous and quasi-synchronous logging
  - Logging of changes to values
  - Alarm logging with related data capture
- Input files for these programs are largely identical
- All APS accelerator data logging uses these tools
- See our web site or later talks for more...

# quickMonitor

PV names loaded  
“by hand” or from  
SDDS file.

Provide optional alias  
for output column name

The screenshot shows the quickMonitor application window. At the top, a status bar displays: "Press ADD to enter... Loaded configuration... Searching... Running.... (started Mon Aug 23 12:02:25 CDT 2004)." Below this is a menu bar with "File" and "Help". The main area contains a table of PV names and readback names. Each row has "DELETE" and "CLEAR" buttons to the left of the "PV name" field. The "PV readback" field is to the right of the "PV name" field. Below the table is an "ADD" button. At the bottom, there are fields for "Interval (s)", "Steps", and "Output file". The "Output file" field contains the path "/home/oxygen/BORLAND/vlinac/monitorData01.sdds". At the very bottom is a row of buttons: "RUN", "NEW...", "CLEAR ALL", "SAVE CONFIG...", "LOAD CONFIG...", and "NAME CAPTURE...".

DELETE	CLEAR	PV name:	PV readback:
DELETE	CLEAR	mdb:BM1:setCurrentC	mdb:BM1:setCurrentC
DELETE	CLEAR	mdb:CM1:intensityM	mdb:CM1:intensityM
DELETE	CLEAR	mdb:FC1:intensityM	mdb:FC1:intensityM
DELETE	CLEAR	mdb:FC2:intensityM	mdb:FC2:intensityM
DELETE	CLEAR	mdb:GV1:positionM	mdb:GV1:positionM
DELETE	CLEAR	mdb:H1:setCurrentC	mdb:H1:setCurrentC
DELETE	CLEAR	mdb:H2:setCurrentC	mdb:H2:setCurrentC
DELETE	CLEAR	mdb:H3:setCurrentC	mdb:H3:setCurrentC
DELETE	CLEAR	mdb:H4:setCurrentC	mdb:H4:setCurrentC
DELETE	CLEAR	mdb:H5:setCurrentC	mdb:H5:setCurrentC

Interval (s): 0.5  
Steps: 1200  
Output file: /home/oxygen/BORLAND/vlinac/monitorData01.sdds

RUN NEW... CLEAR ALL SAVE CONFIG... LOAD CONFIG... NAME CAPTURE...

Pressing run begins  
data collection

# MEDM Allows Dragging and Dropping PV names

The screenshot displays the MEDM interface for 'Virtual\_Linac.adl'. At the top, it shows 'Electron LINAC Beam Position' with 'X-Position (mm)' and 'Y-Position (mm)' fields and a 'RESET' button. Below this is a 'quickMonitor' window with a menu bar (File, Help) and a text area containing 'Press ADD to enter more PV names for monitoring'. A 'PV name' entry box contains 'mdb:FC1:intensityM' and a 'PV readback' box is empty. To the right, a 'Trend Display' shows a value of '8.34' circled in red. Below the 'quickMonitor' is an 'ADD' button and a section for 'Interval (s): 1', 'Steps: 100', and 'Output file:'. At the bottom, there are buttons for 'RUN', 'NEW...', 'CLEAR ALL', 'SAVE CONFIG...', 'LOAD CONFIG...', and 'NAME CAPTURE...'. Three red callout boxes provide instructions: one points to the 'RESET' button, another points to the 'PV name' entry box, and a third points to the 'NAME CAPTURE...' button.

Click on PV widget with middle mouse button

Click in entry box with middle mouse button

K. Evans' NameCapture application makes SDDS file directly

# quickMonitor Run Dialog

sddsmonitor command is visible (educational!)



Basic plot features (use command dialog for more)

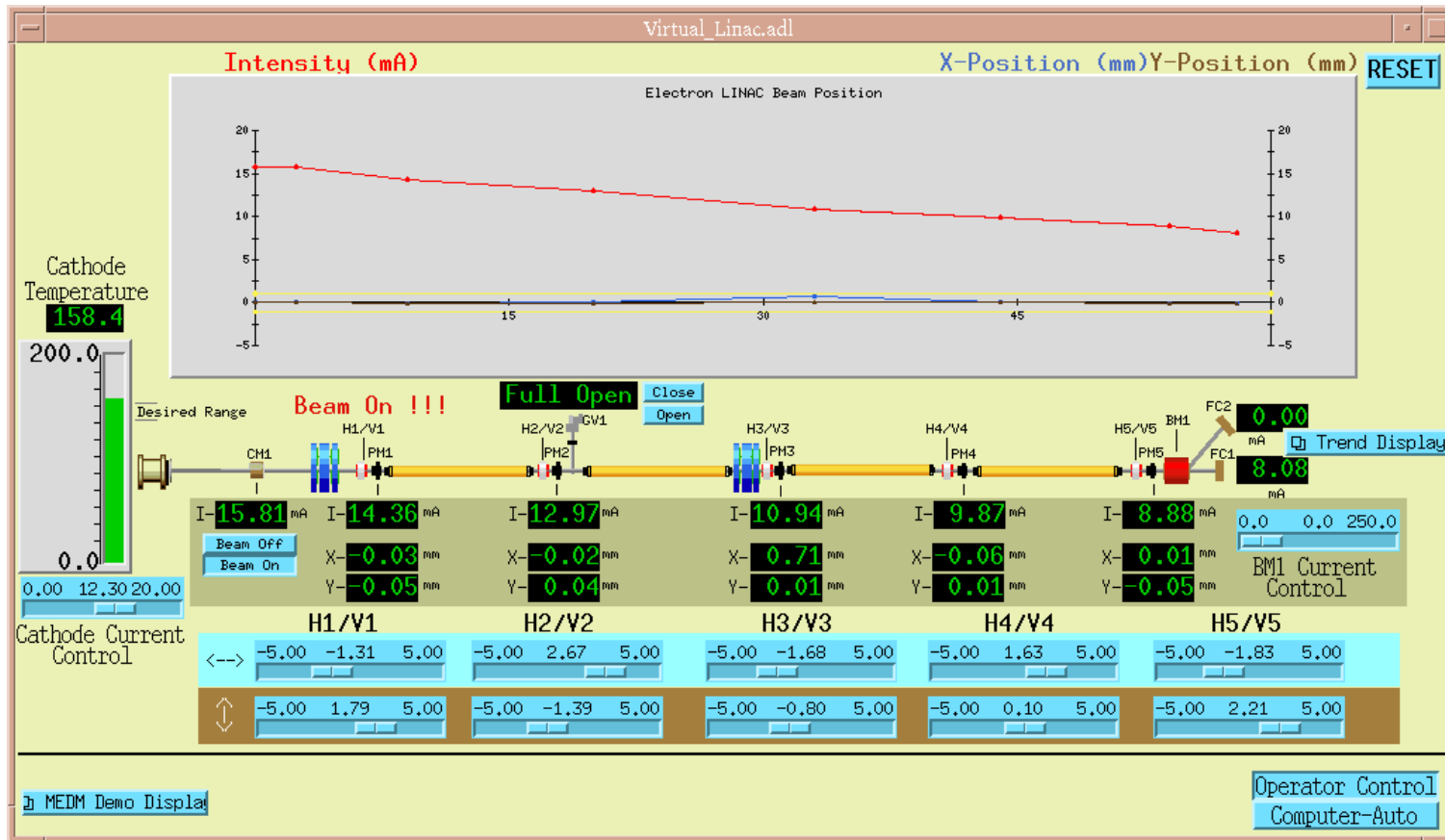
Stop sddsmonitor but keep window open

Stop sddsmonitor and close window

# quickMonitor or StripTool?

- **StripTool is a popular EPICS client for time-series sampling**
  - **Convenient interface**
  - **Scrolling plots of the data**
- **Use StripTool when**
  - **~5 channels or less**
  - **Primary interest is *seeing* the data**
  - **Note: StripTool can dump SDDS data**
- **Use quickMonitor when**
  - **More than ~5 channels**
  - **Primary interest is *analyzing* the data**
  - **quickSDDSplot can perform “movie” plots of updating**

# Homework: Analyse the Vlinac\* Simulation



- Use quickMonitor to collect data on all PVs.
- Use quickSDDSplot to review signals: *Final current (FC1) varies with time.*
- Use quickSDDSStatistics to look for correlations with FC1: *Cathode temperature is highly correlated.*
- Use quickSDDS DSP to look for frequencies: *Clear 60s oscillations!*

\*N. Arnold, ASD



# Experiment Execution: quickExperiment

- Limited interface to `sddsexperiment`
- Perform 1-D experiments with several (ganged) variables
- Measure any number of readbacks, with averaging and statistics
- `sddsexperiment` offers more
  - N-dimensional experiments
  - Verification of response of variables
  - Test limits to ensure data quality
  - Script execution

# Example with Vlinac

The screenshot shows the 'quickExperiment' window. At the top, there is a menu bar with 'File' and 'Help'. Below the menu bar is a text area containing the following text: 'Press ADD to enter more PV names for measurements and variables', 'Press ADD to enter measurement or variable PV names for sddsexperiment', 'Measurement data loaded from /home/oxygen/BORLAND/vlinac/quickExperiment.mon.', and 'Running.... (started Sun Aug 22 16:10:37 CDT 2004)'. Below the text area are buttons for 'Print', 'Save As...', 'Email...', and 'Expand Dialog...'. The main area has tabs for 'Measurements', 'Variables', and 'Parameters'. Under the 'Measurements' tab, there is a text field for 'Intermeasurement interval (s):' with the value '0.5'. Below this is a list of five measurement entries, each with a 'DELETE' button, a 'CLEAR' button, a text field for the PV name, a text field for the number of averages, and two checkboxes for 'stddev' and 'sigma'. The entries are: 'mdb:CM1:intensityM', 'mdb:FC1:intensityM', 'mdb:FC2:intensityM', 'mdb:PM1:X:positionM', and 'mdb:PM1:Y:positionM'. At the bottom left, there are buttons for 'Add Line', 'Copy Line', 'Load...', and 'Save...'. A red box at the bottom right contains the text: 'PV names loaded by hand or from SDDS file (compatible with quickMonitor)'.

quickExperiment

File Help

Press ADD to enter more PV names for measurements and variables  
Press ADD to enter measurement or variable PV names for sddsexperiment  
Measurement data loaded from /home/oxygen/BORLAND/vlinac/quickExperiment.mon.  
Running.... (started Sun Aug 22 16:10:37 CDT 2004).

Print Save As... Email... Expand Dialog...

Measurements Variables Parameters

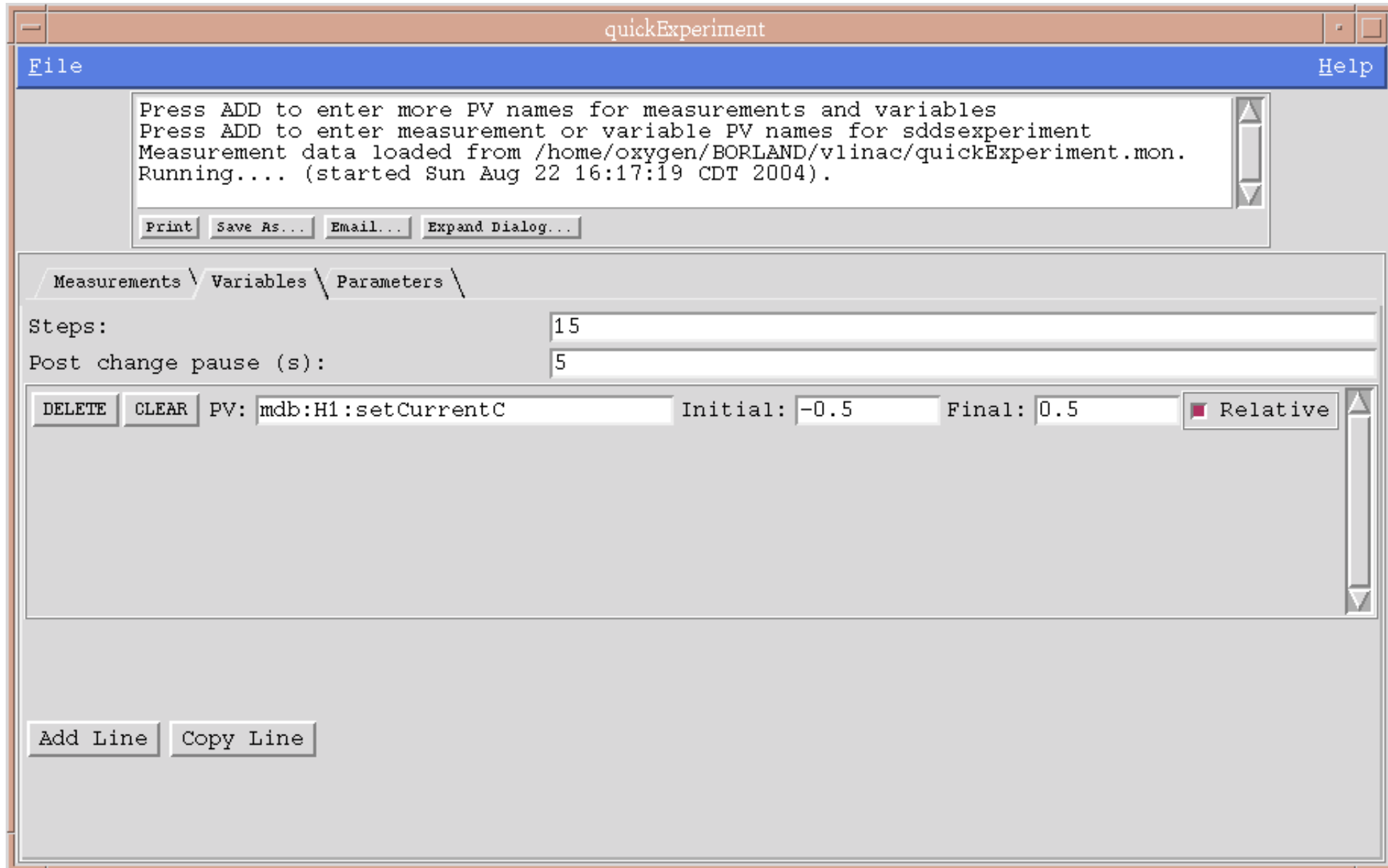
Intermeasurement interval (s): 0.5

DELETE	CLEAR	PV: mdb:CM1:intensityM	no. to average	30	<input checked="" type="checkbox"/> stddev	<input checked="" type="checkbox"/> sigma
DELETE	CLEAR	PV: mdb:FC1:intensityM	no. to average	30	<input checked="" type="checkbox"/> stddev	<input checked="" type="checkbox"/> sigma
DELETE	CLEAR	PV: mdb:FC2:intensityM	no. to average	30	<input checked="" type="checkbox"/> stddev	<input checked="" type="checkbox"/> sigma
DELETE	CLEAR	PV: mdb:PM1:X:positionM	no. to average	30	<input checked="" type="checkbox"/> stddev	<input checked="" type="checkbox"/> sigma
DELETE	CLEAR	PV: mdb:PM1:Y:positionM	no. to average	30	<input checked="" type="checkbox"/> stddev	<input checked="" type="checkbox"/> sigma

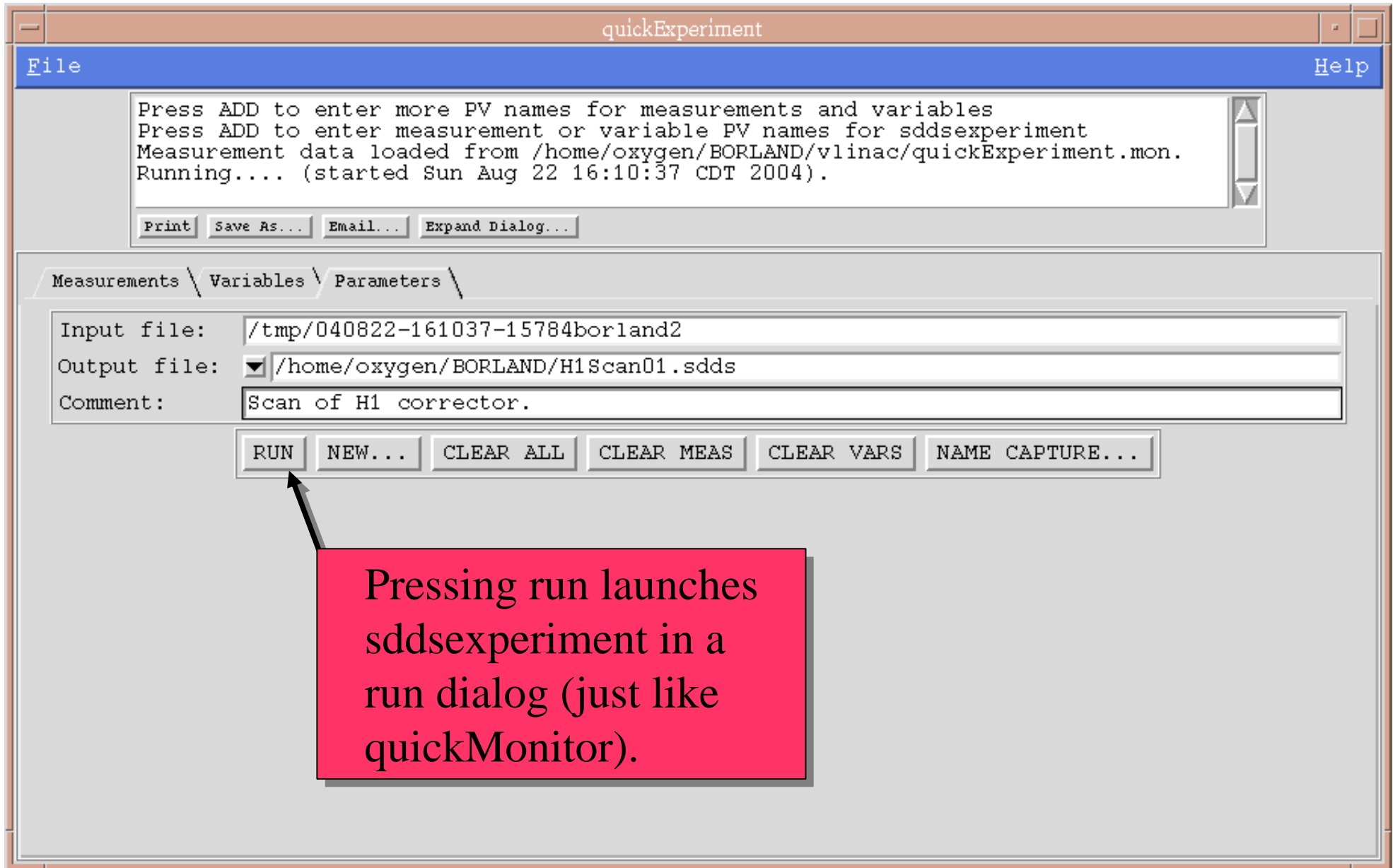
Add Line Copy Line Load... Save...

PV names loaded by hand or from SDDS file (compatible with quickMonitor)

# Variables Tab

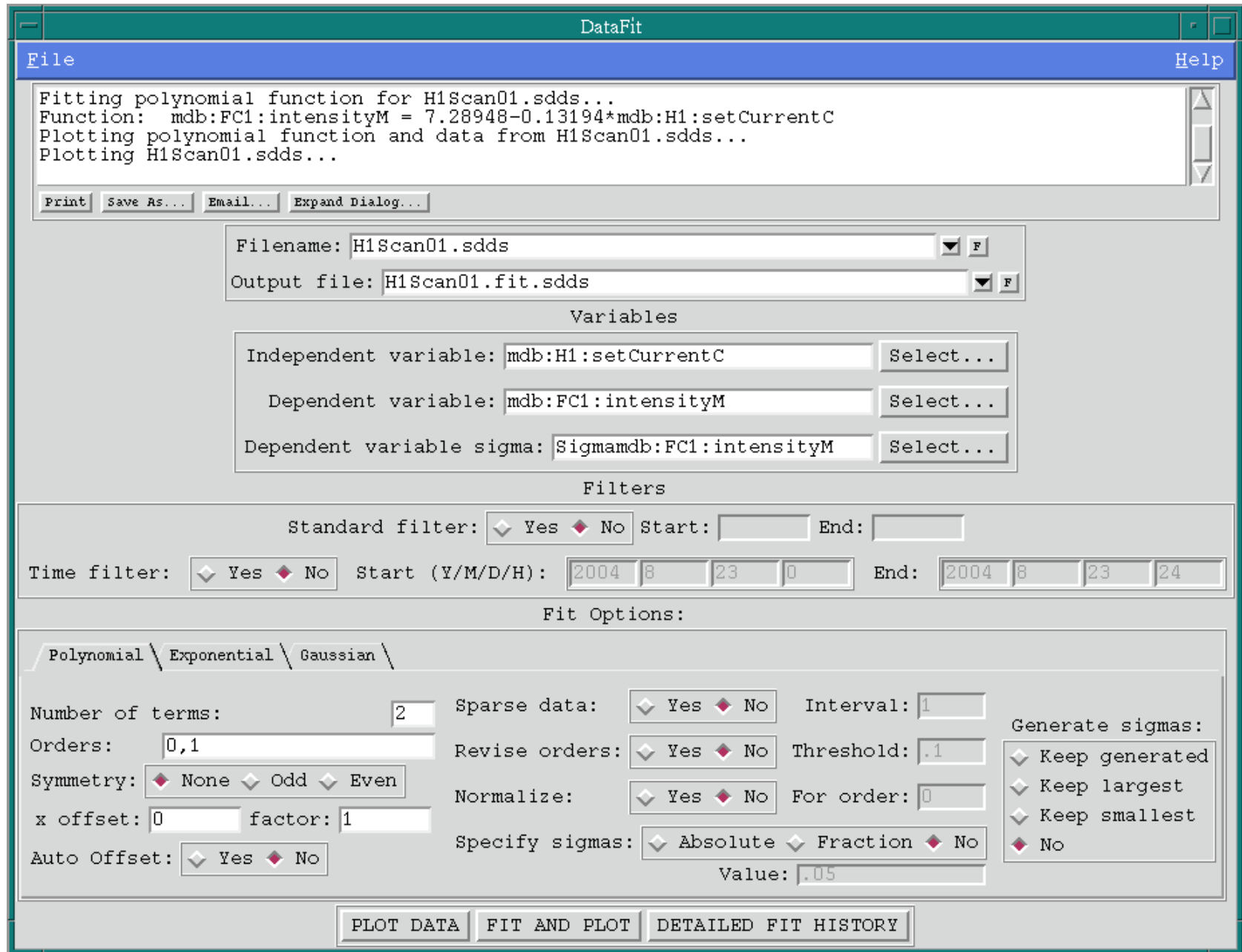


# Parameters Tab

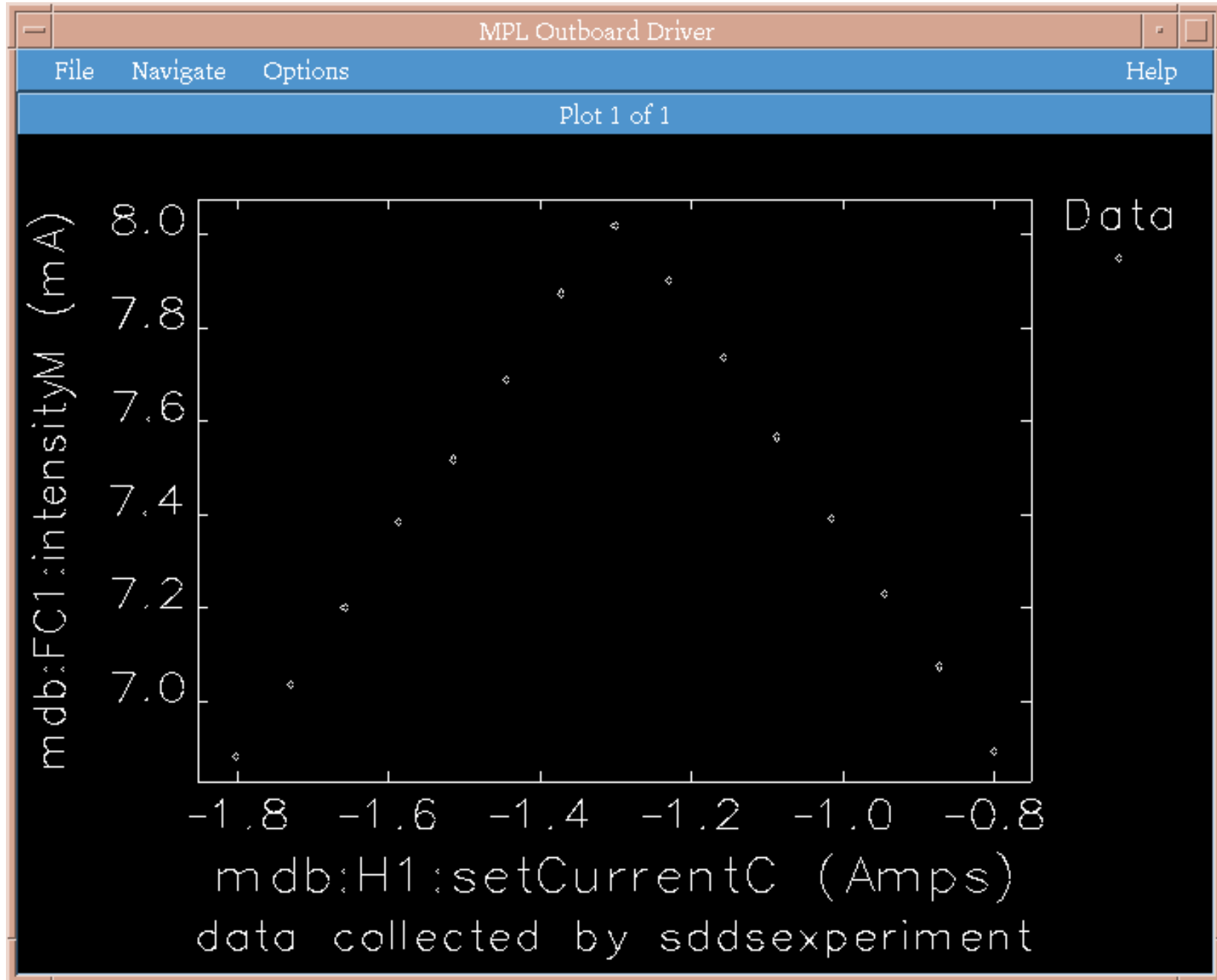


# Use quickSDDSFit to Look at Results

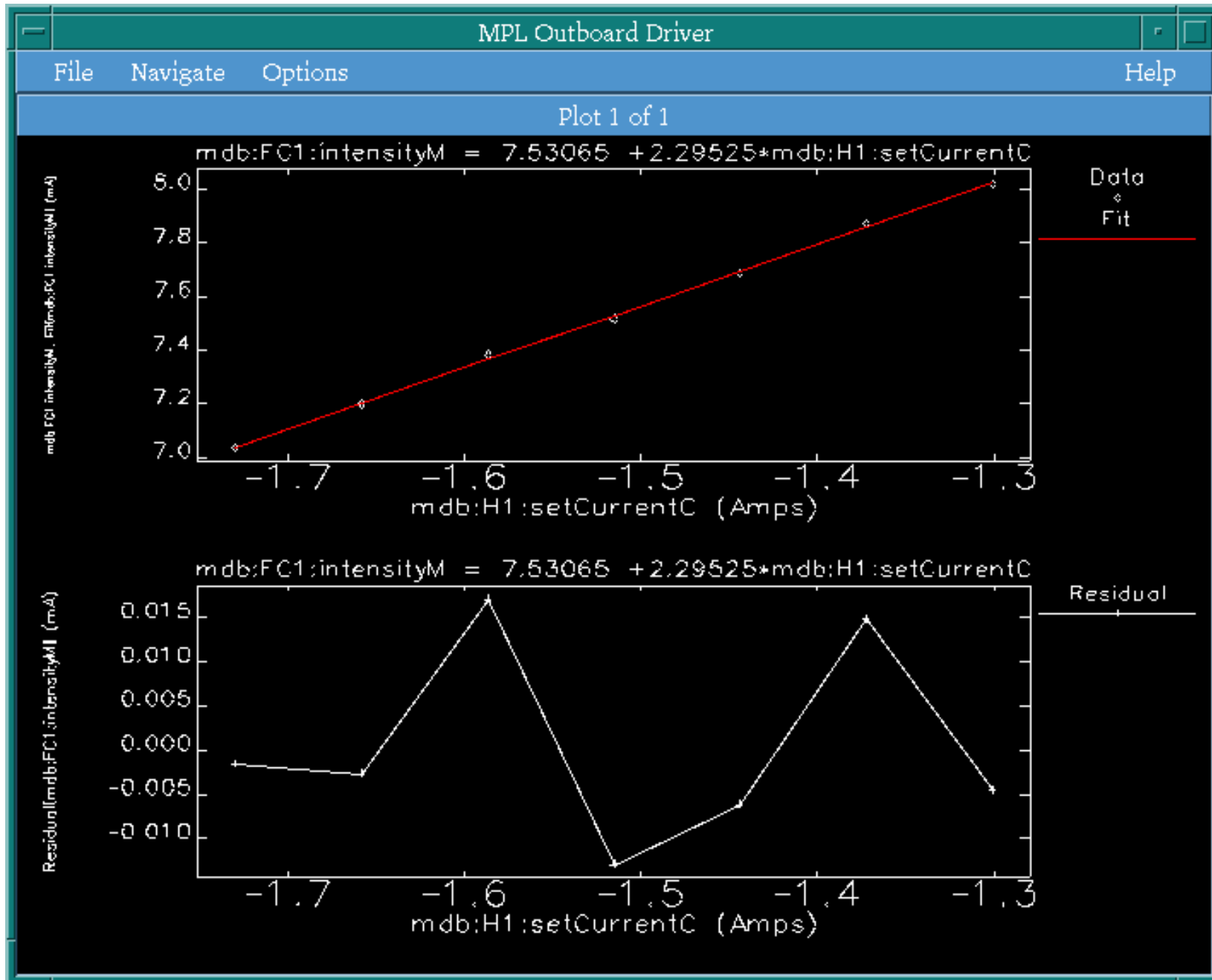
Provides polynomial, exponential, and gaussian fitting and display.



# Intensity Data Is Bi-Linear



# Linear Fit to One Side



# Experiment Execution: ExperimentDesigner

- Allows designing complex experiments that involve
  - Initialization
  - Execution sequence
    - User interaction
    - Coordination of external programs and scripts
  - Finalization
  - Postprocessing
- Configurations can be saved and executed as a script with no interface
  - Allows N-dimensional experiments



# ExperimentDesigner: PV Panel

The screenshot shows the 'ExperimentDesigner' application window. The 'File' menu is open, showing options like 'Load Config...', 'Save Config...', 'Restart', and 'Quit'. A red callout box points to the 'Load Config...' option with the text 'Loaded configuration from file menu.' Below the menu, a text area displays configuration logs. The main panel is titled 'PV / Equation' and contains a table of process variables. A red callout box points to the table with the text 'Declared PVs directly visible to the script: controls and readbacks'. Below the table, there are buttons for 'Add Process Variable ...', 'Add Equation ...', and 'Add Parameter ...'. A red callout box points to the 'Add Equation ...' button with the text 'Defined equation to compute a new quantity from PVs.' At the bottom of the window, there is a row of control buttons: 'INITIALIZE', 'RUN', 'INITIALIZE+RUN', 'PAUSE', 'RESUME', 'TERMINATE', 'CLEAR ALL', and 'NAME CAPTURE...'. The table in the PV section is as follows:

				Minimum	Maximum	PVtype	
mdb:H1:setCurrentC	mdb:H1:setCurre	2.50000000000000	Amps	-5.00000000	5.00000000	Control	DELETE
mdb:cathodeTempM	mdb:cathodeTemp	159.82661216176	degF	0.00000000	1.00000000	Readback	DELETE
Equation	CathodeTemperat	60.2955718	degC				DELETE

Loaded configuration from file menu.

Declared PVs directly visible to the script: controls and readbacks

Defined equation to compute a new quantity from PVs.

# Experiment Designer: Initialization Design

ExperimentDesigner

File Help

```
17:33:17 Done.
17:33:18 Configuration loaded from file /home/oxygen/BORLAND/vlinac/ED01/monitorLines
17:33:18 Completely loaded from /home/oxygen/BORLAND/vlinac/ED01/execution
17:33:18 Completely loaded from /home/oxygen/BORLAND/vlinac/ED01/ChangeControl. |
```

Print Save As... Email... Expand Dialog...

ProcessVariables \ Initialization \ ExecutionDesign \ Finalization \ OutputFiles \ Postprocess \

Press "Add Init Entry" to add the initialization steps.

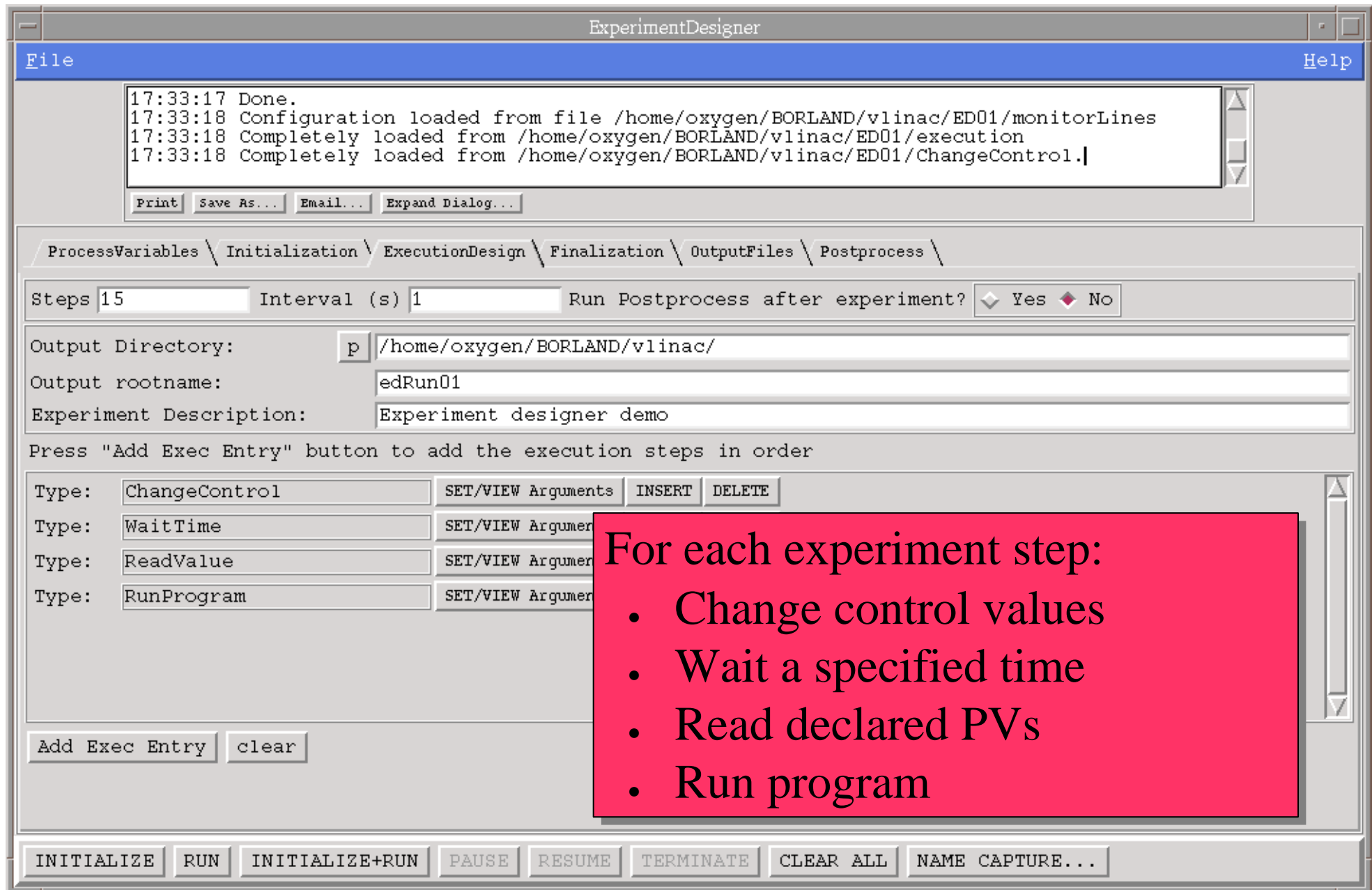
PV name	Readback name	set_value	orig_value	tolerance			
mdb:cathodeCurrentC	mdb:cathodeCurrentC	12	12	1.0	INSERT	DELETE	Get Orig
mdb:gunOnC	mdb:gunOnC	1	1	0.0	INSERT	DELETE	Get Orig
mdb:GV1:positionC	mdb:GV1:positionM	1	1	0.0	INSERT	DELETE	Get Orig
Script:	exec sddscasr -restore /home/oxygen/BORLAND/vlinac/config.snap				INSERT	DELETE	
Script:	exec maintainReadback -configFile /home/oxygen/BORLAND/vlinac/maintain				INSERT	DELETE	
Script:	exec sleep 5					DELETE	

Add Init Entry clear

INITIALIZE RUN INITIALIZE+RUN

- Set cathode current, check response
- Turn gun on, check response
- Open valve, check response
- Restore setpoints from SDDS file
- Launch cathode temperature regulator (more later)

# Experiment Designer: Execution Design



ExperimentDesigner

File Help

```
17:33:17 Done.  
17:33:18 Configuration loaded from file /home/oxygen/BORLAND/vlinac/ED01/monitorLines  
17:33:18 Completely loaded from /home/oxygen/BORLAND/vlinac/ED01/execution  
17:33:18 Completely loaded from /home/oxygen/BORLAND/vlinac/ED01/ChangeControl. |
```

Print Save As... Email... Expand Dialog...

ProcessVariables \ Initialization \ ExecutionDesign \ Finalization \ OutputFiles \ Postprocess \

Steps 15 Interval (s) 1 Run Postprocess after experiment? Yes No

Output Directory: p /home/oxygen/BORLAND/vlinac/  
Output rootname: edRun01  
Experiment Description: Experiment designer demo

Press "Add Exec Entry" button to add the execution steps in order

Type: ChangeControl	SET/VIEW Arguments	INSERT	DELETE
Type: WaitTime	SET/VIEW Argumer		
Type: ReadValue	SET/VIEW Argumer		
Type: RunProgram	SET/VIEW Argumer		

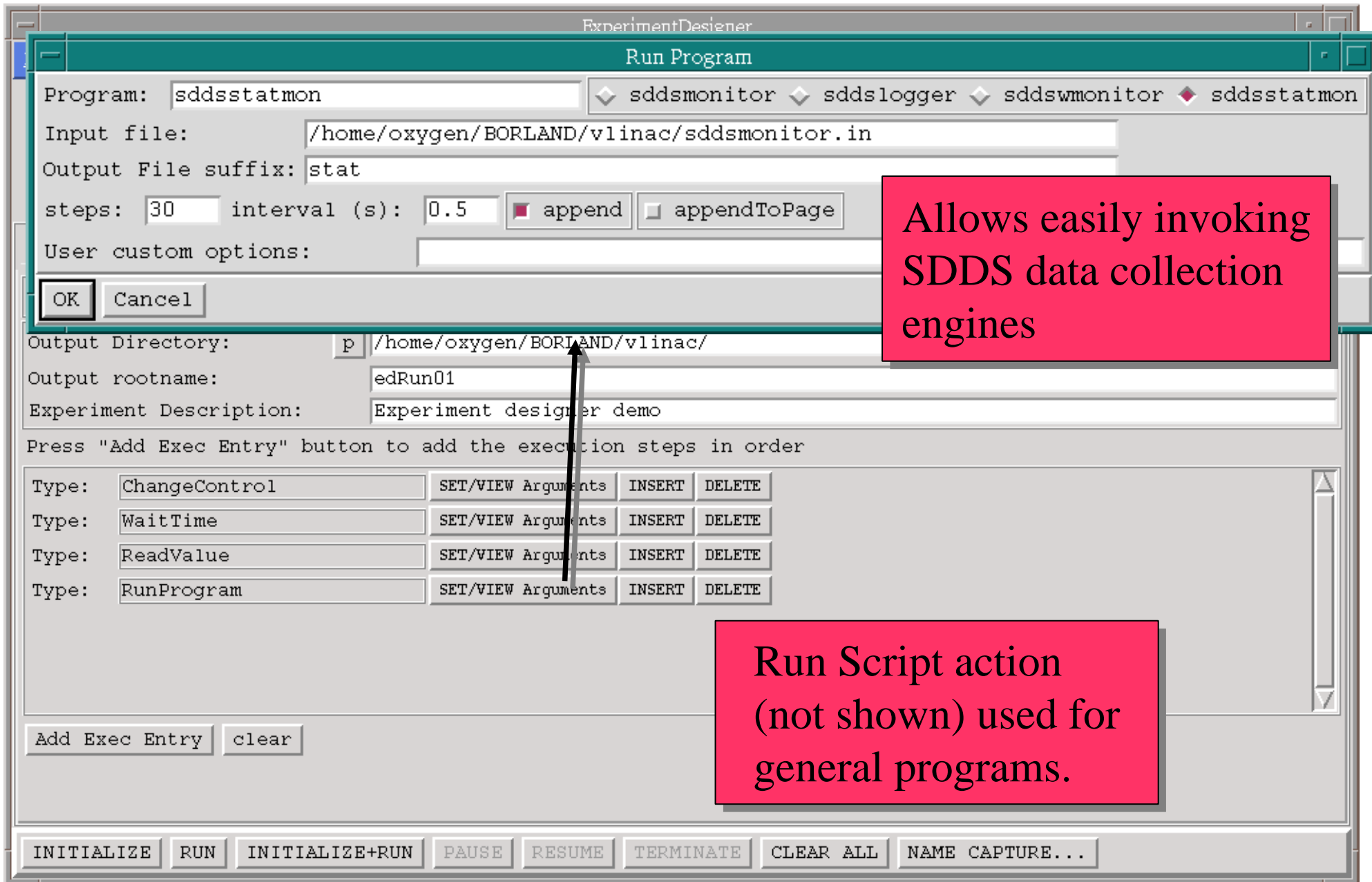
Add Exec Entry clear

INITIALIZE RUN INITIALIZE+RUN PAUSE RESUME TERMINATE CLEAR ALL NAME CAPTURE...

For each experiment step:

- Change control values
- Wait a specified time
- Read declared PVs
- Run program

# Experiment Designer: Run Program Dialog



# Experiment Designer: Output Files Tab

ExperimentDesigner

File Help

```
17:44:58 Test passes, reading values ...
17:44:59 Step 14, Line 3: RunProgram ....
17:45:16 Step 14 done.
17:47:49 Experiment Done.
```

Print Save As... Email... Expand Dialog...

ProcessVariables \ Initialization \ ExecutionDesign \ Finalization \ OutputFiles \ Postprocess \

ReadValue Output File: /home/oxygen/BORLAND/vlinac//edRun01-value

RunProgram(sddsstatmon) Output File: /home/oxygen/BORLAND/vlinac//edRun01-stat

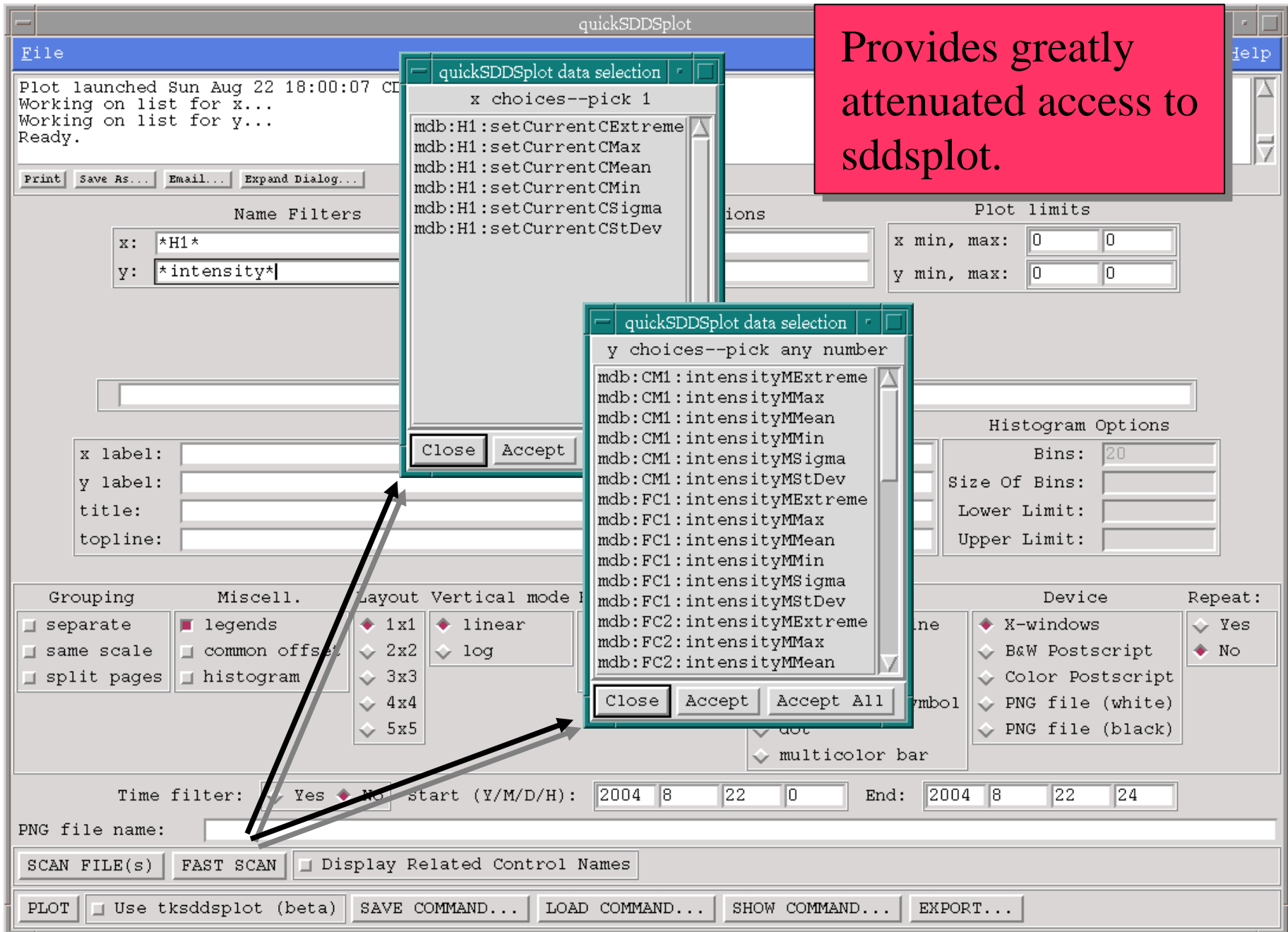
File Select...  
Select Recent...

sddsedit /home/oxygen/BORLAND/vlinac//edRun01-stat  
**quickSDDSplot -dataFileList /home/oxygen/BORLAND/vlinac//edRun01-stat**  
quickSDDSFit -filename /home/oxygen/BORLAND/vlinac//edRun01-stat  
quickSDDS DSP -filename /home/oxygen/BORLAND/vlinac//edRun01-stat  
quickSDDSStatistics -filename /home/oxygen/BORLAND/vlinac//edRun01-stat  
sddsExportData -dataFileList /home/oxygen/BORLAND/vlinac//edRun01-stat  
xemacs /home/oxygen/BORLAND/vlinac//edRun01-stat  
dtpad /home/oxygen/BORLAND/vlinac//edRun01-stat  
sddsquery /home/oxygen/BORLAND/vlinac//edRun01-stat  
sdds2stream -rows /home/oxygen/BORLAND/vlinac//edRun01-stat  
Custom command...

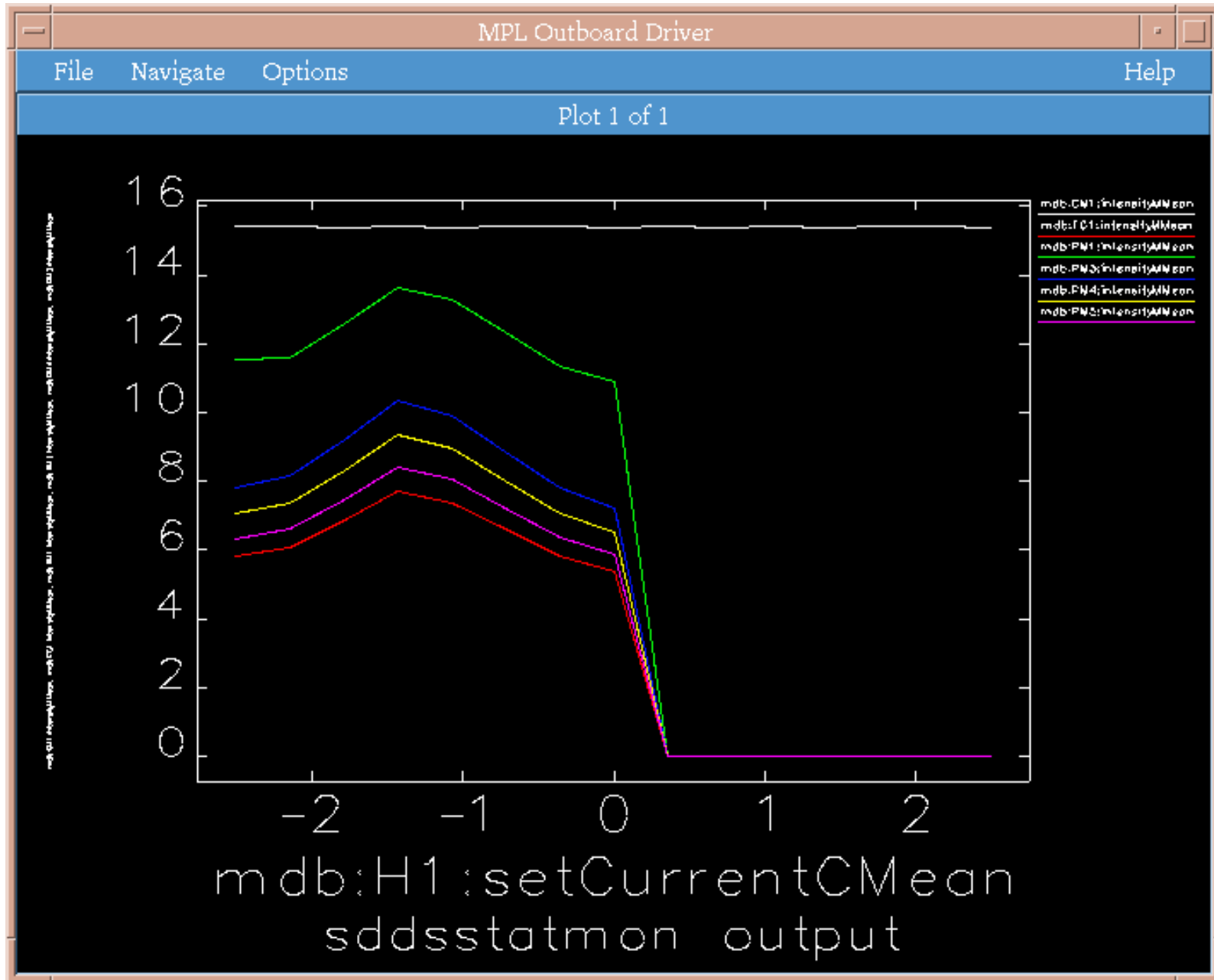
**In this example, we select quickSDDSplot to review the statistical results.**

INITIALIZE RUN INITIALIZE+RUN PAUSE RESUME TERMINATE CLEAR ALL NAME CAPTURE...

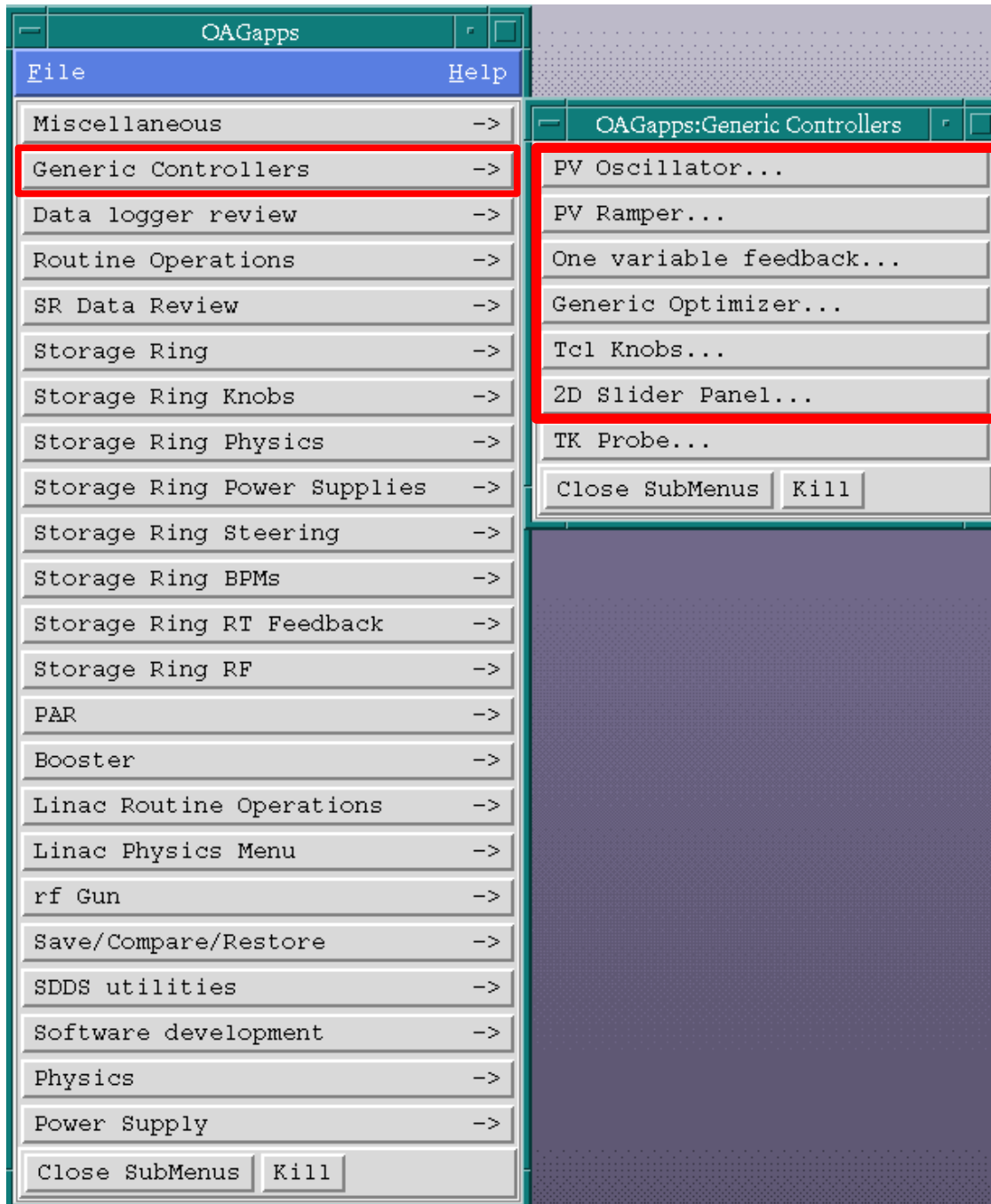
# quickSDDSplot Interface



# quickSDDSplot Output Example



# Generic Controllers SubMenu



- Set up a one-readback, one-actuator feedback loop
- Set up and perform optimizations
- Change PVs in oscillatory or ramped fashion
- Set up knobs and 2D sliders

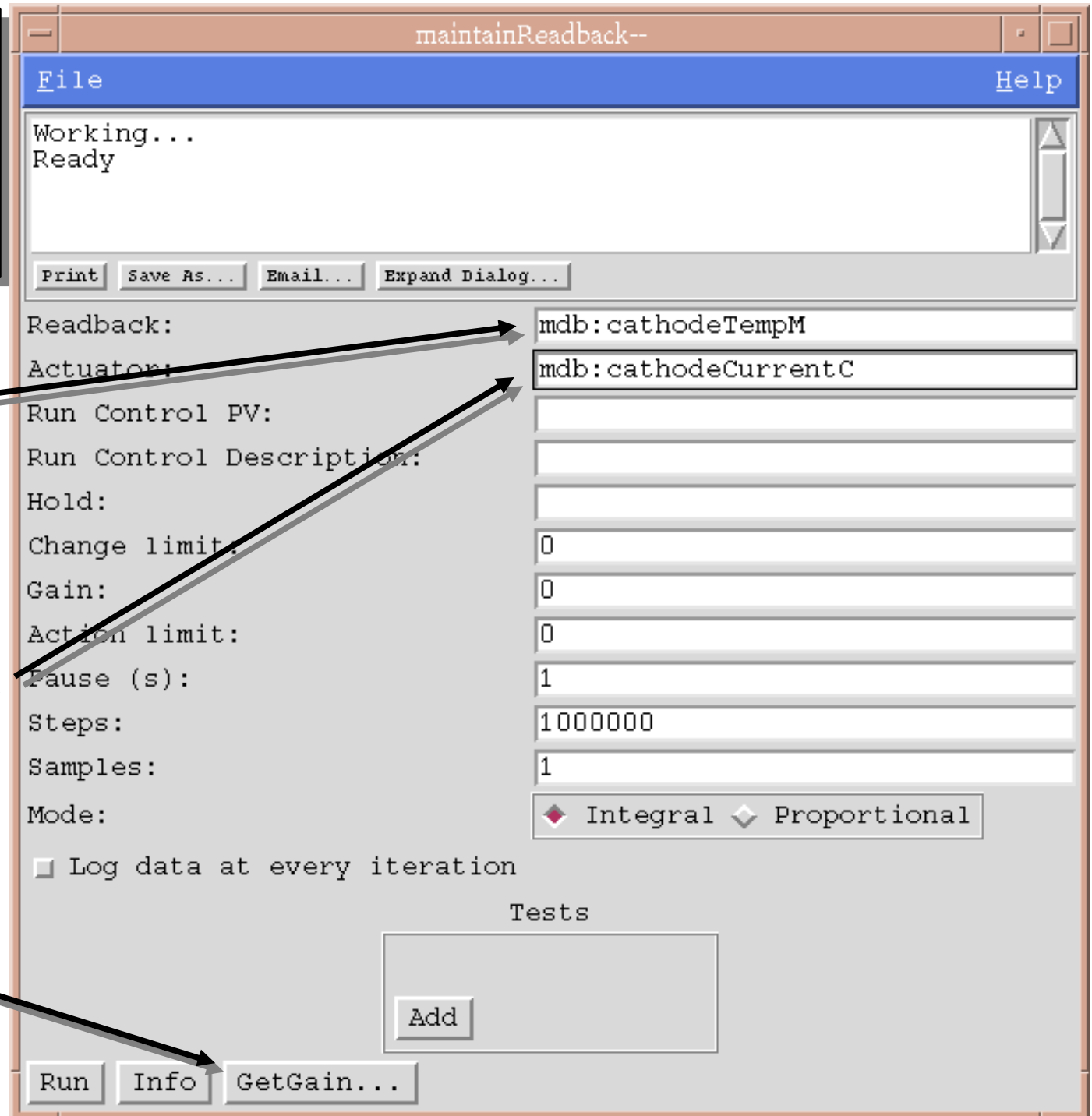


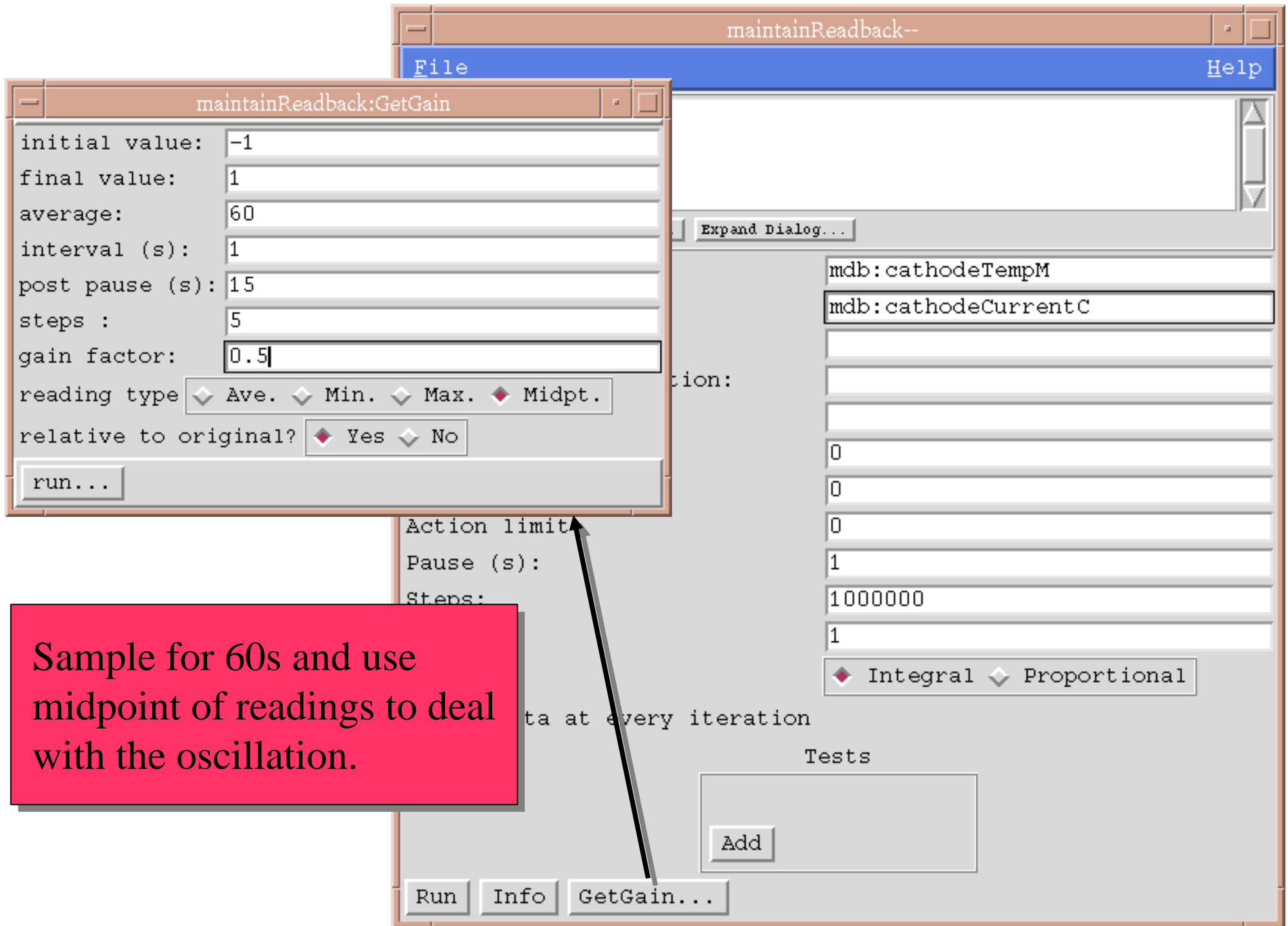
Can use the script  
“maintainReadback”  
to regulate Vlinac  
cathode temperature

The “readback” is the  
thing to be stabilized  
(cathode temperature)

The “actuator” is the  
control used to stabilize  
the readback

Use “GetGain” button  
to measure response  
coefficient





Sample for 60s and use midpoint of readings to deal with the oscillation.

```
Unix Command Execution
1.130000e+01
Done ramping.
Setting mdb:cathodeCurrentC to
Waiting 15.000000 seconds after
Taking measurements...
* Experiment is 20.00% done.
File updated
Setting mdb:cathodeCurrentC to
Waiting 15.000000 seconds after
Taking measurements...
* Experiment is 40.00% done.
File updated
Setting mdb:cathodeCurrentC to 1.230000e+01
Waiting 15.000000 seconds after changing values
Taking measurements...
* Experiment is 60.00% done.
File updated
Setting mdb:cathodeCurrentC to 1.280000e+01
Waiting 15.000000 seconds after changing values
Taking measurements...
* Experiment is 80.00% done.
File updated
Setting mdb:cathodeCurrentC to 1.330000e+01
Waiting 15.000000 seconds after changing values
Taking measurements...
```

**sddsexperiment  
run dialog**

maintainReadback--

File Help

GetGain done.  
The fit slope is 6.772139209791320e+00.  
Maximum "gain" is 0.14766382807875186  
Using 0.073831914039375932

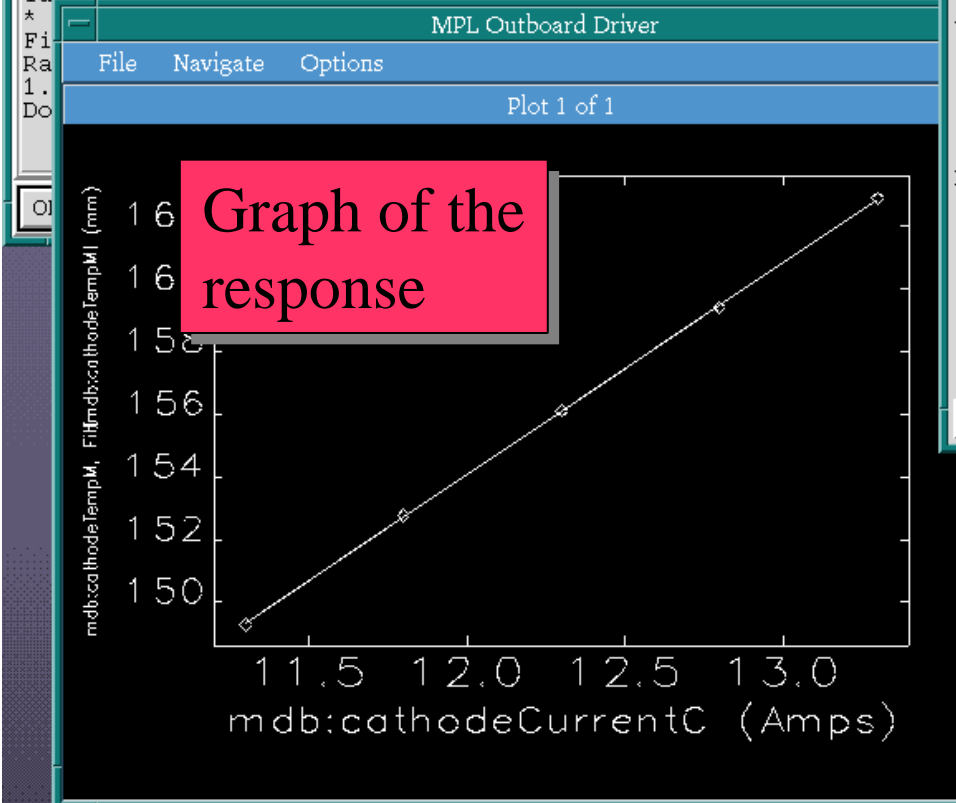
Print Save As... Email... Expand Dialog...

Readback:	mdb:cathodeTempM
Actuator:	mdb:cathodeCurrentC
Run Control PV:	
Run Control Description:	
Hold:	
Change limit:	0
Gain:	0.073831914039375932
Action limit:	0
Pause (s):	1
Steps:	1000000
Samples:	
Mode:	<input checked="" type="checkbox"/> Integral <input type="checkbox"/> Proportional

Log data

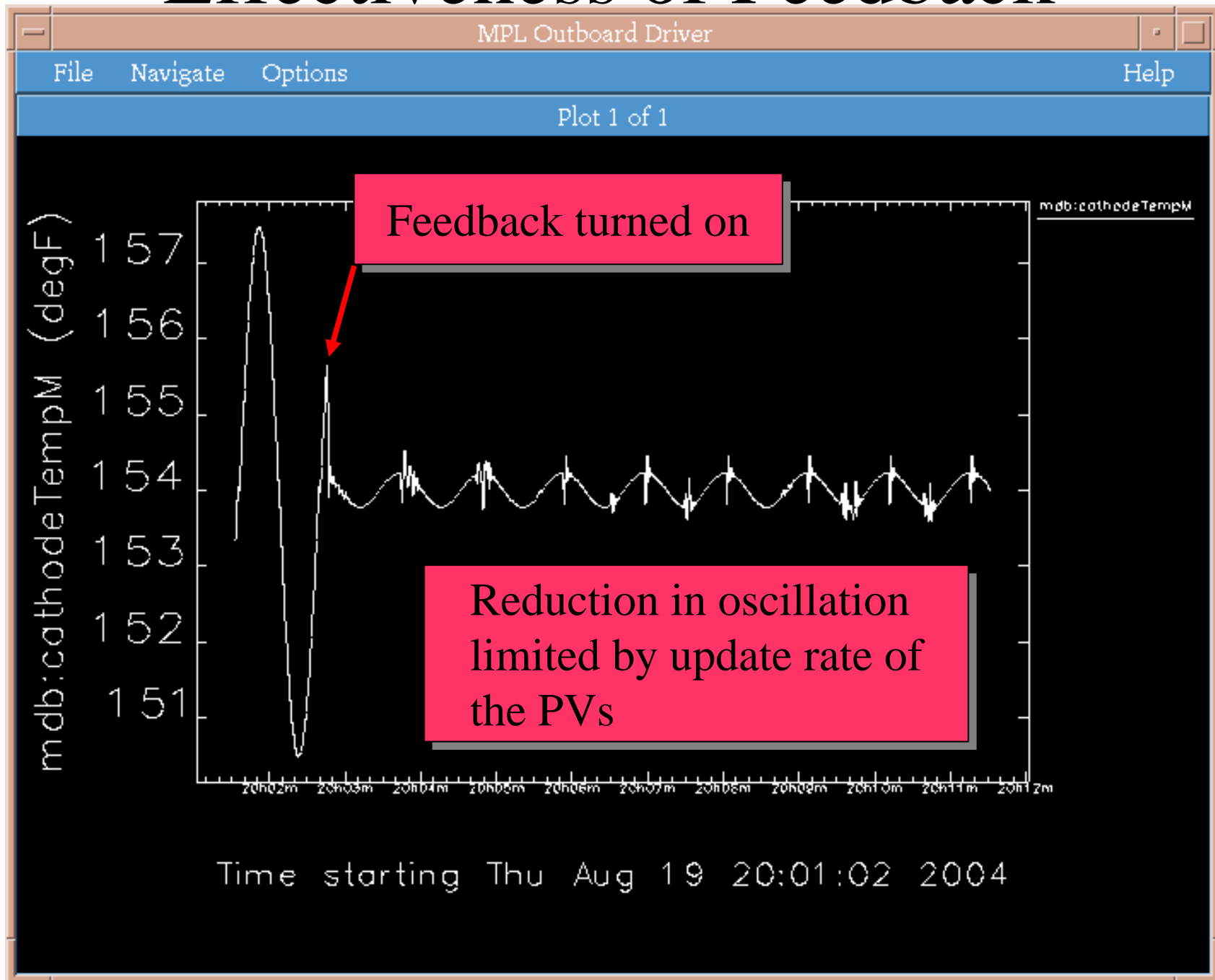
Run Info

**"Gain" value  
automatically  
entered in dialog**



**Graph of the  
response**

# Effectiveness of Feedback



# Generic Optimizer\*

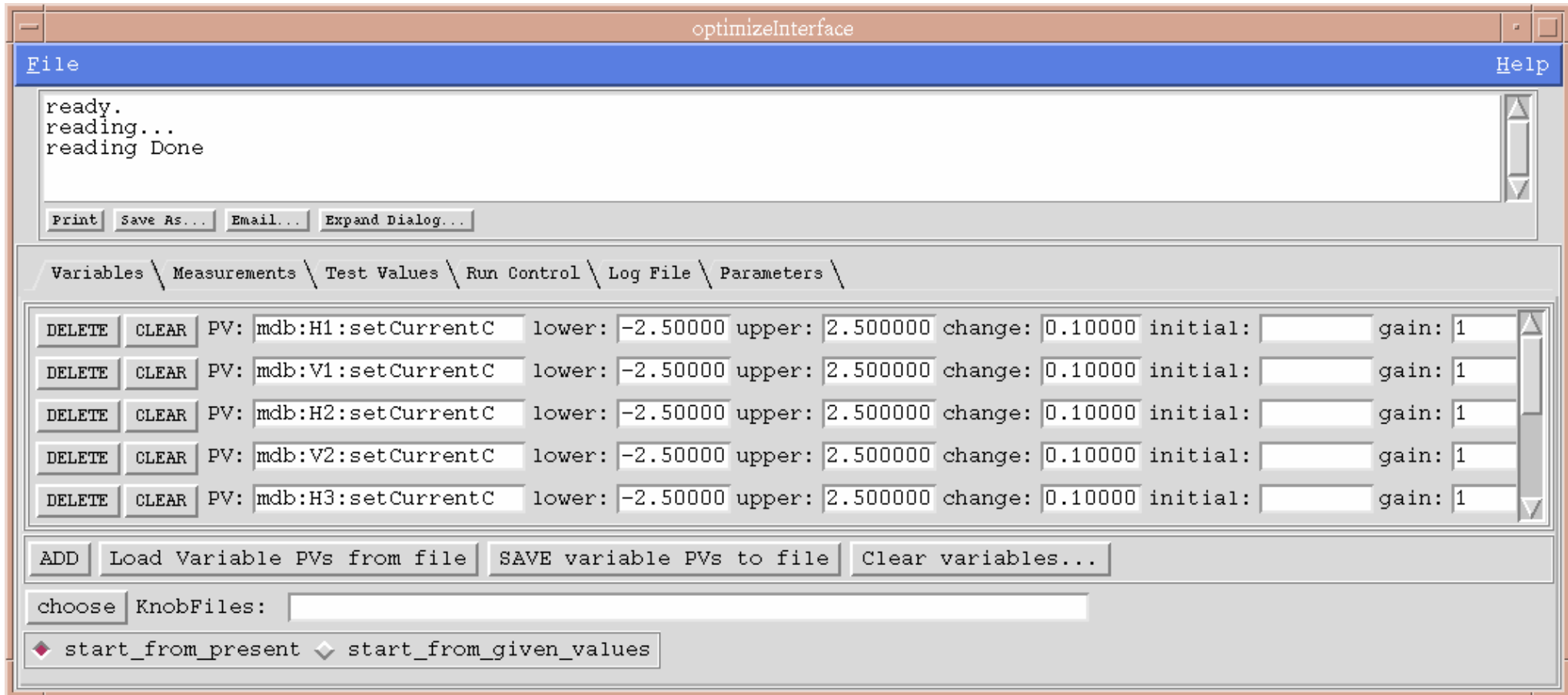
- A common requirement in control systems is optimization of some quantity
- Feedback requires quasi-linear responses measured around the desired point
- Automated optimization is useful when none of these conditions apply
  - Explores new territory
  - Has advantages over manual tweaking
  - It is relatively slow

\*Inspired by J. Lewellen's "amoeba" script.

# Example: Optimization of the Vlinac

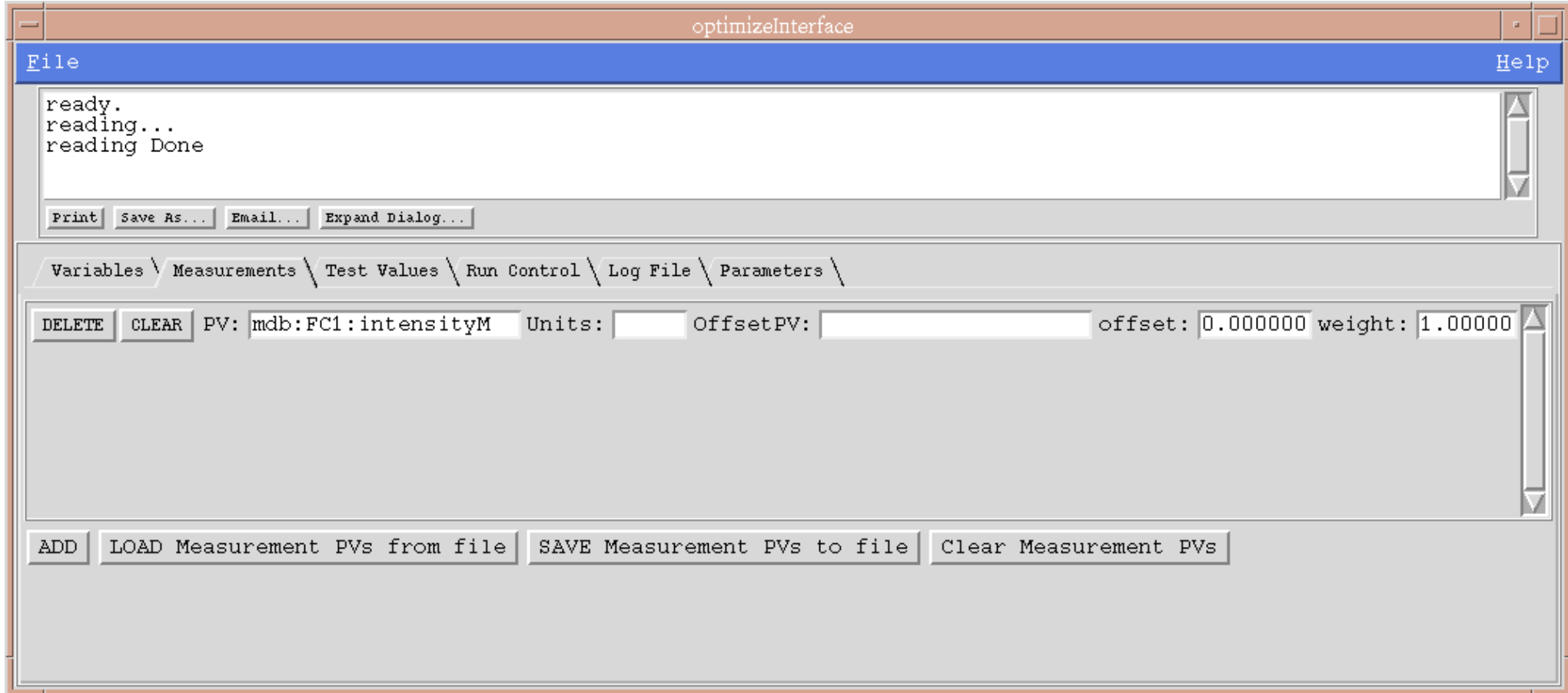
- Deliberately mis-set all the correctors in the Vlinac simulation
- Set up optimizer with
  - 10 variables: the setpoints for all the correctors
  - 1 readback: the final beam current
- Use Simplex method without initial 1D scans
- To reduce current ripple and noise effects:
  - Use maintainReadback to regulate cathode temperature
  - Average for 60 seconds

# Optimizer Interface: Variables Tab



- Any number of actuators (“variables”)
- Enter limits and initial step sizes
- Provide composite knob definition files

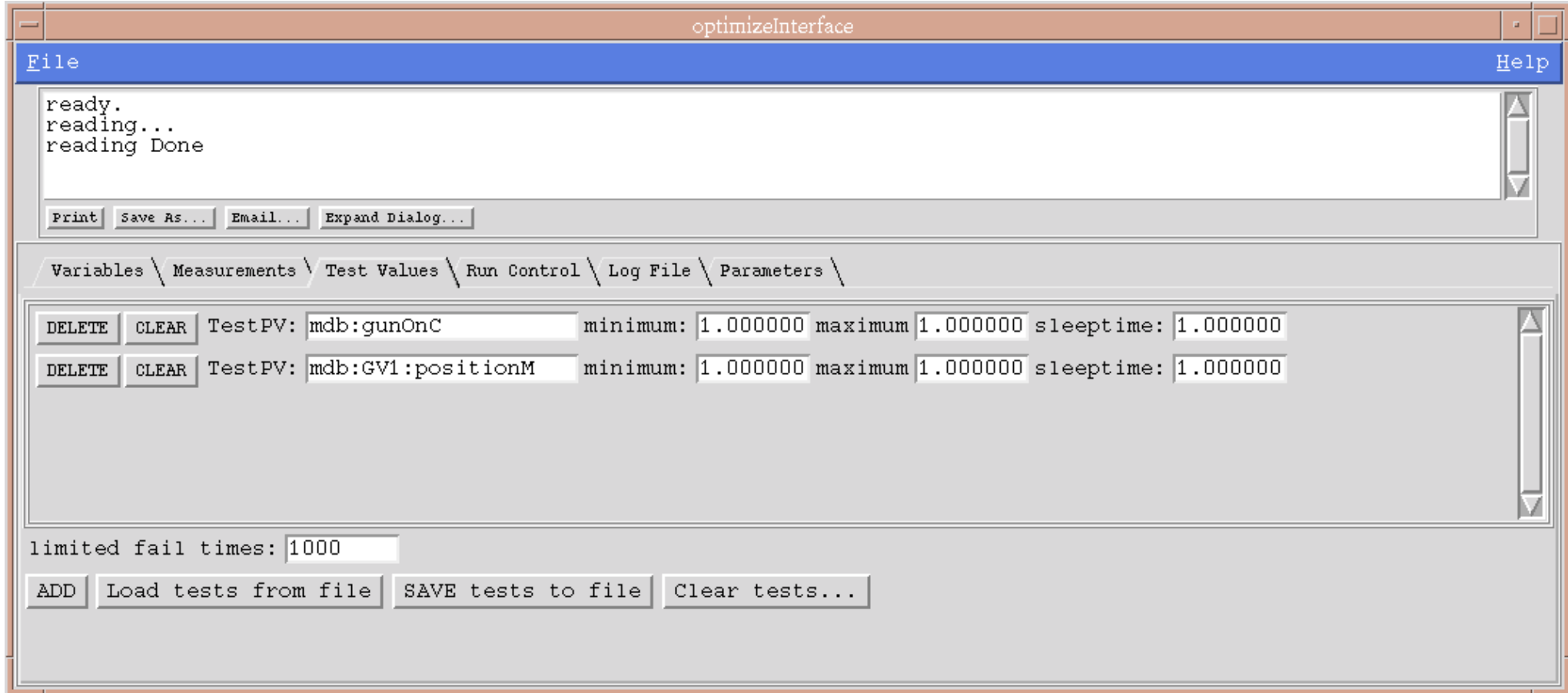
# Optimizer Interface: Measurement Tab



- Optimizes the mean-absolute-value (MAV) or RMS of any number of readbacks with optional offsets and weighting

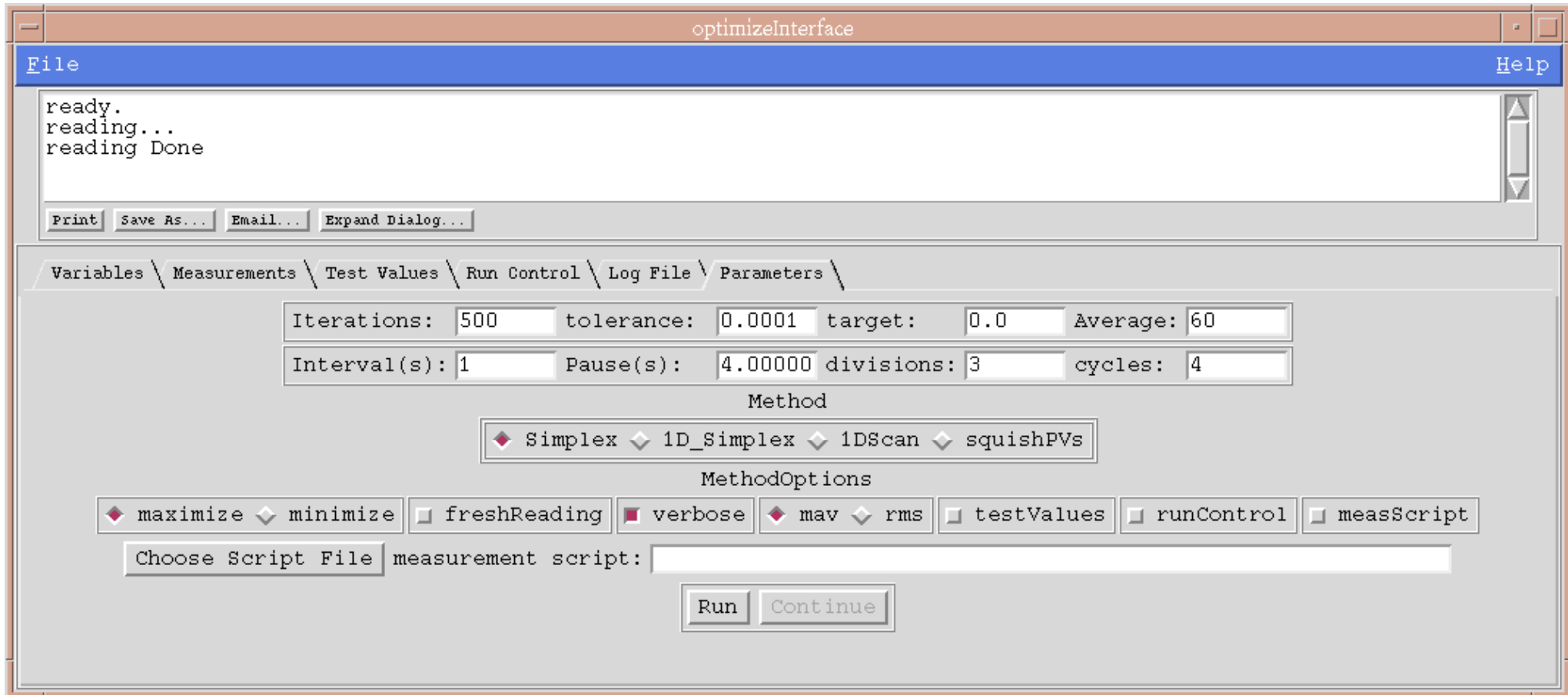


# Optimizer Interface: Tests Tab



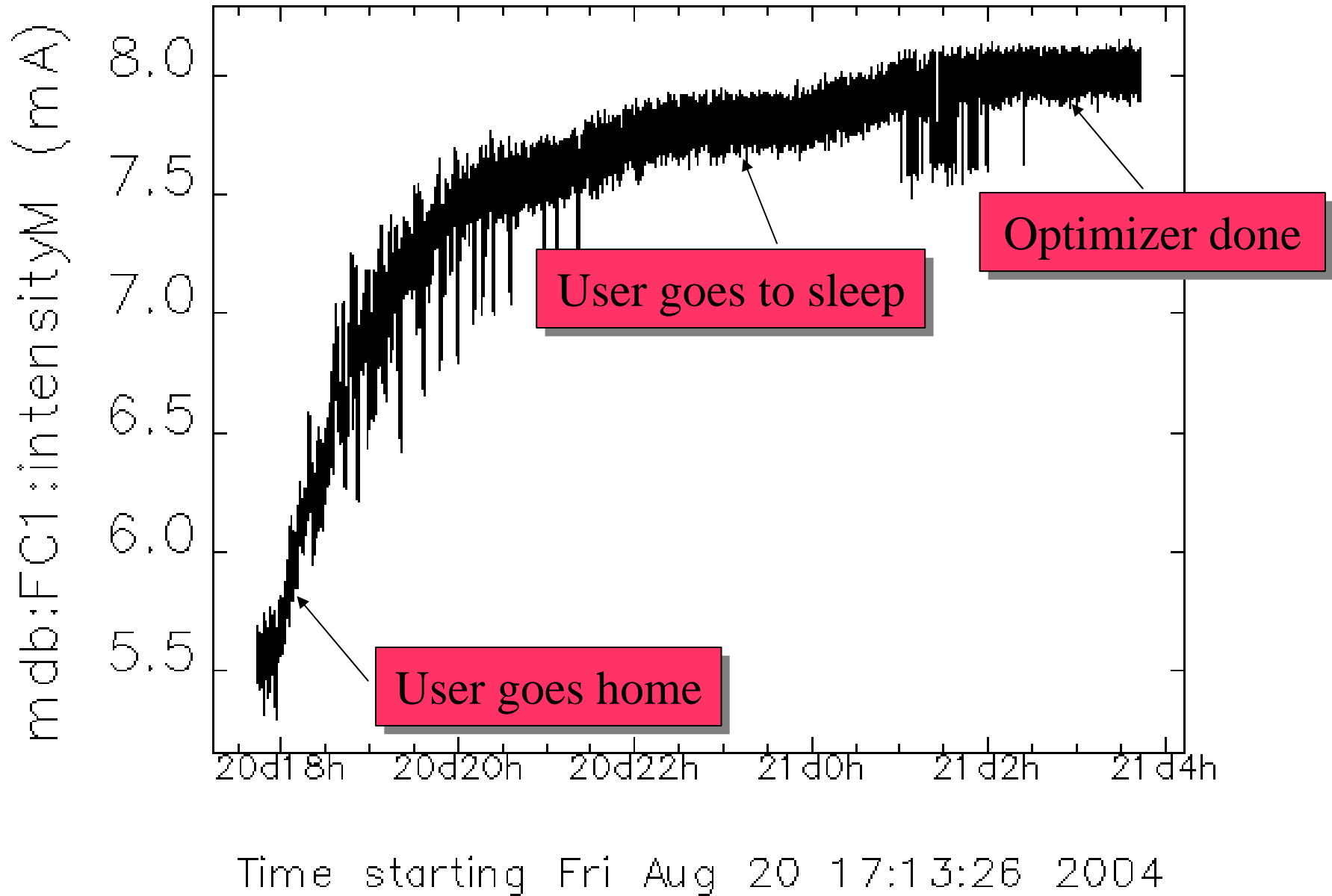
- Optional “test values” to prevent optimizer from running when conditions are not right (e.g., no beam)

# Optimizer Interface: Parameters Tab



- Simplex or successive 1-D scan methods
- User-specified averaging and post-change pause
- Can optimize with user script to compute penalty function

# Optimizer Result



# Summary

- OAG provides a number of tools for the general EPICS user
  - Access to accelerator data logs
  - Perform data collection
  - Plot and analyze data
  - Design and execute experiments
  - Feedback and optimization
- These tools are interlinked by SDDS files
- Don't miss follow-up lectures
  - OAG Tcl/Tk (R. Soliday)
  - SDDS (M. Borland)

# OAG Group Members

- Present:  
M. Borland, L. Emery, N. Sereno,  
H. Shang, R. Soliday
- Emeritus:  
D. Blachowicz, B. Dolin, K. Evans, C. Saunders