On-line Tools

NSF Review, April 30, 2001

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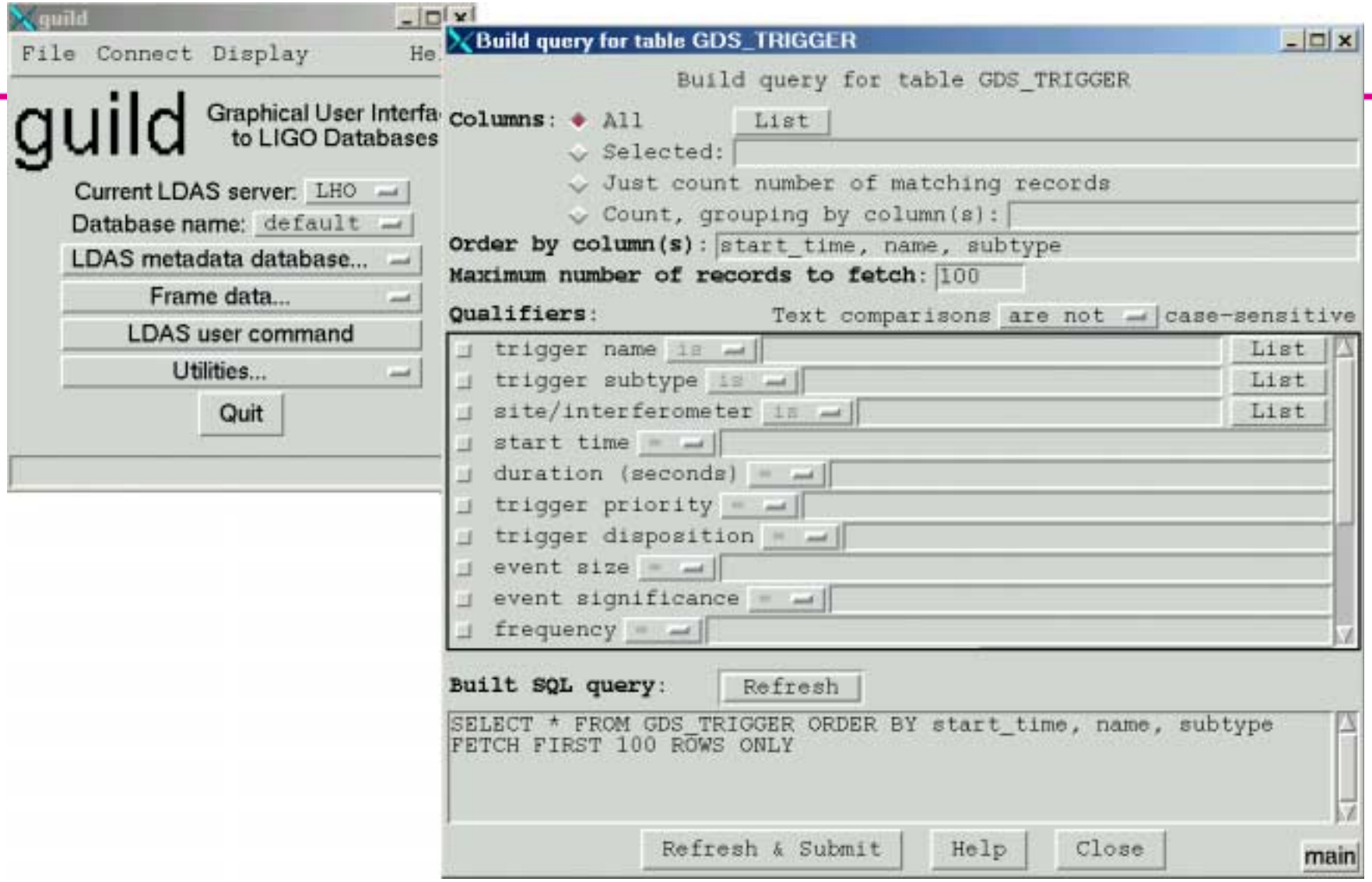
LIGO Tools

- Easy data access
  - ***Guild, Lidax, LARS***
- Interactive data viewing and quick diagnostics
  - ***Data viewer***, ***Diagnostics test tool,*** *Time frequency plotting*
- Continuous monitoring
  - ***Data monitor tool***
    - Environmental vetoes
    - Performance monitoring (detector sensitivity, system ID, etc.)
- Event-analysis and histograms
- Set of useful utilities
  - ***Xlook, frame file utilities, Matlab/Mathematica interfaces, ROOT, grasp library, …***

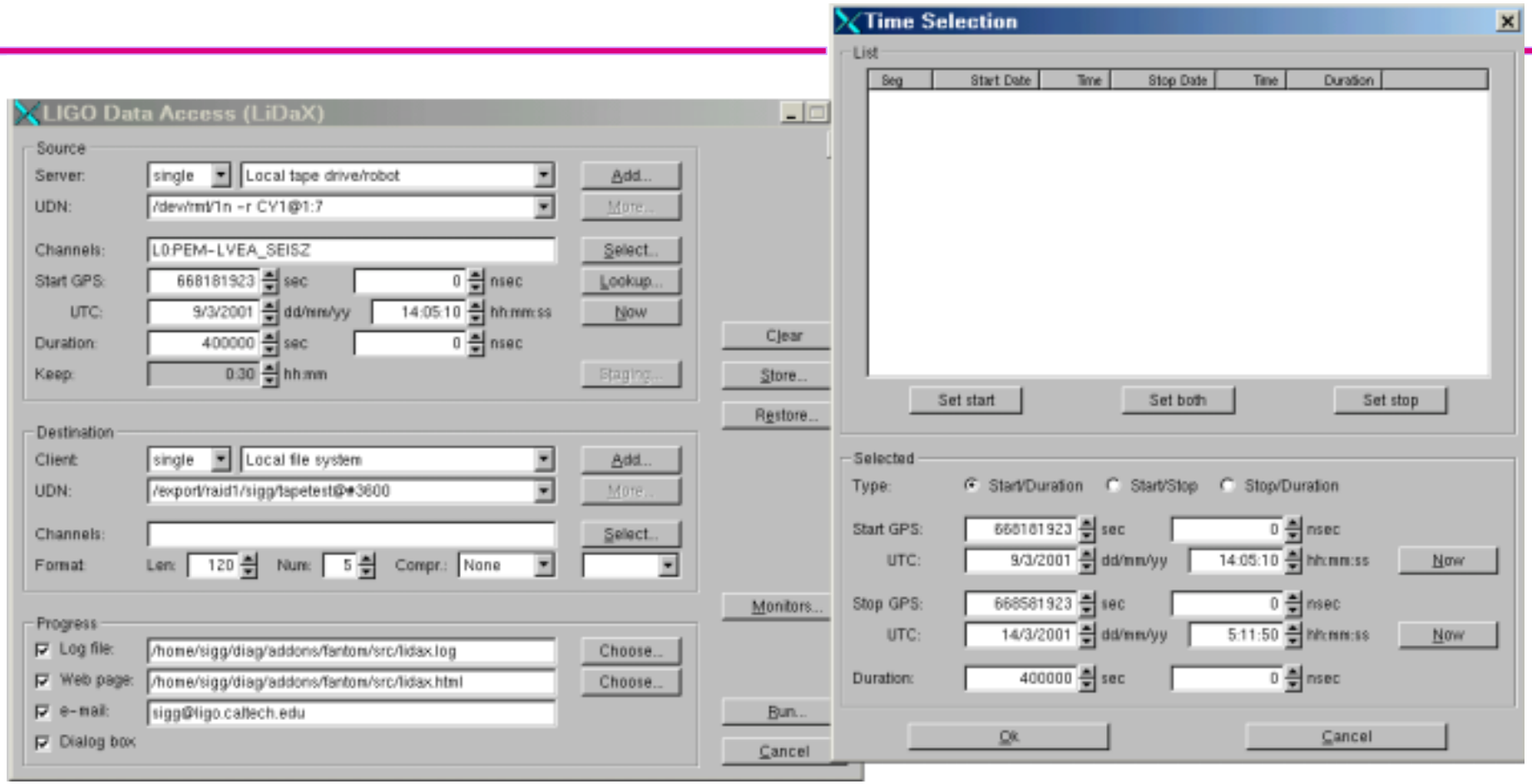
LIGO Tools (2)

- LIGOtools home page:
  - http://www.ldas-sw.ligo.caltech.edu/ligotools/index.html
- Multi-platform support
  - Sparc/Solaris, Intel/Linux, Intel/Windows
  - Available from every machine at LIGO
- Source and binary distributions
- Installation tools
- Documentation

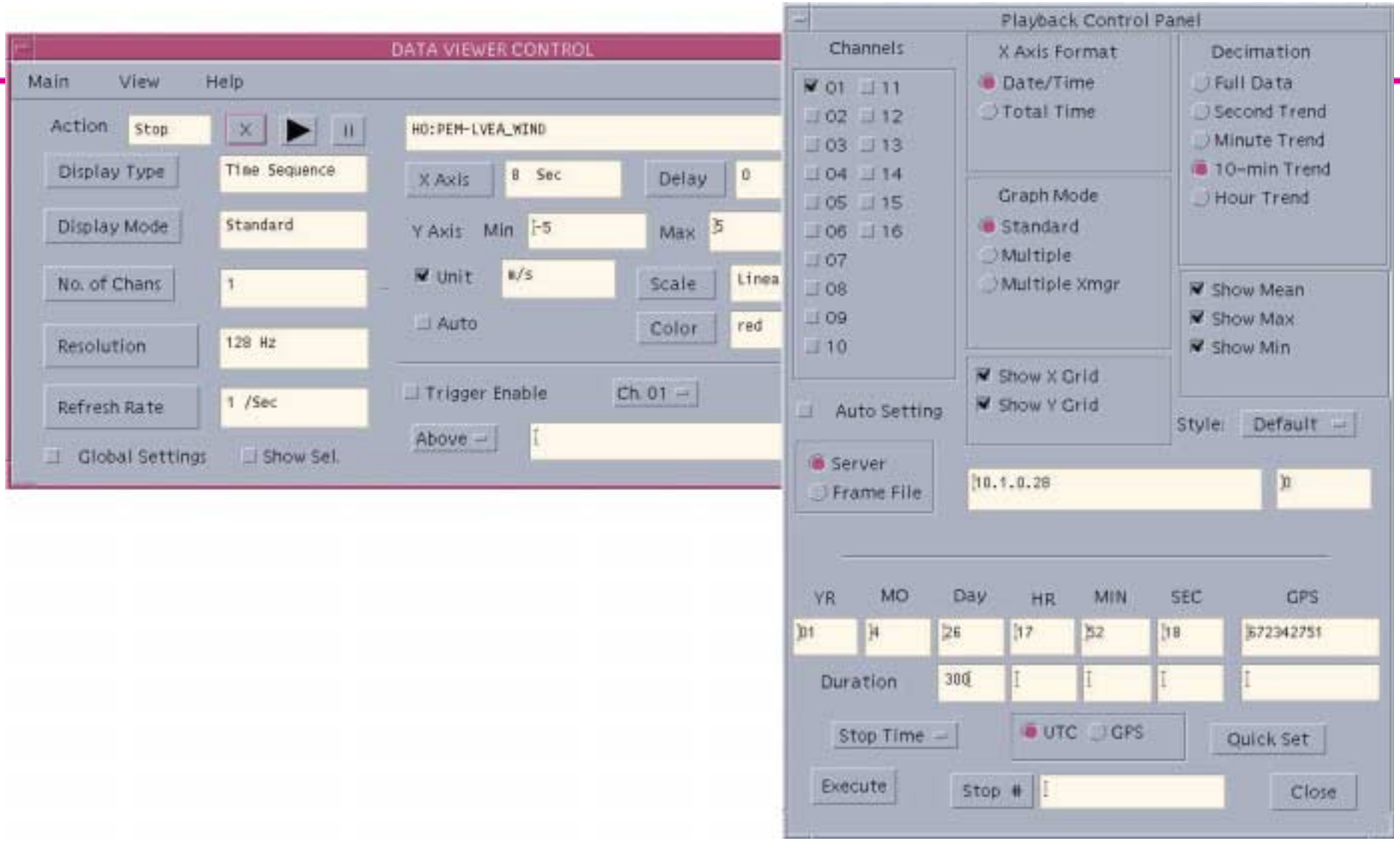
Easy Data Access: Guild

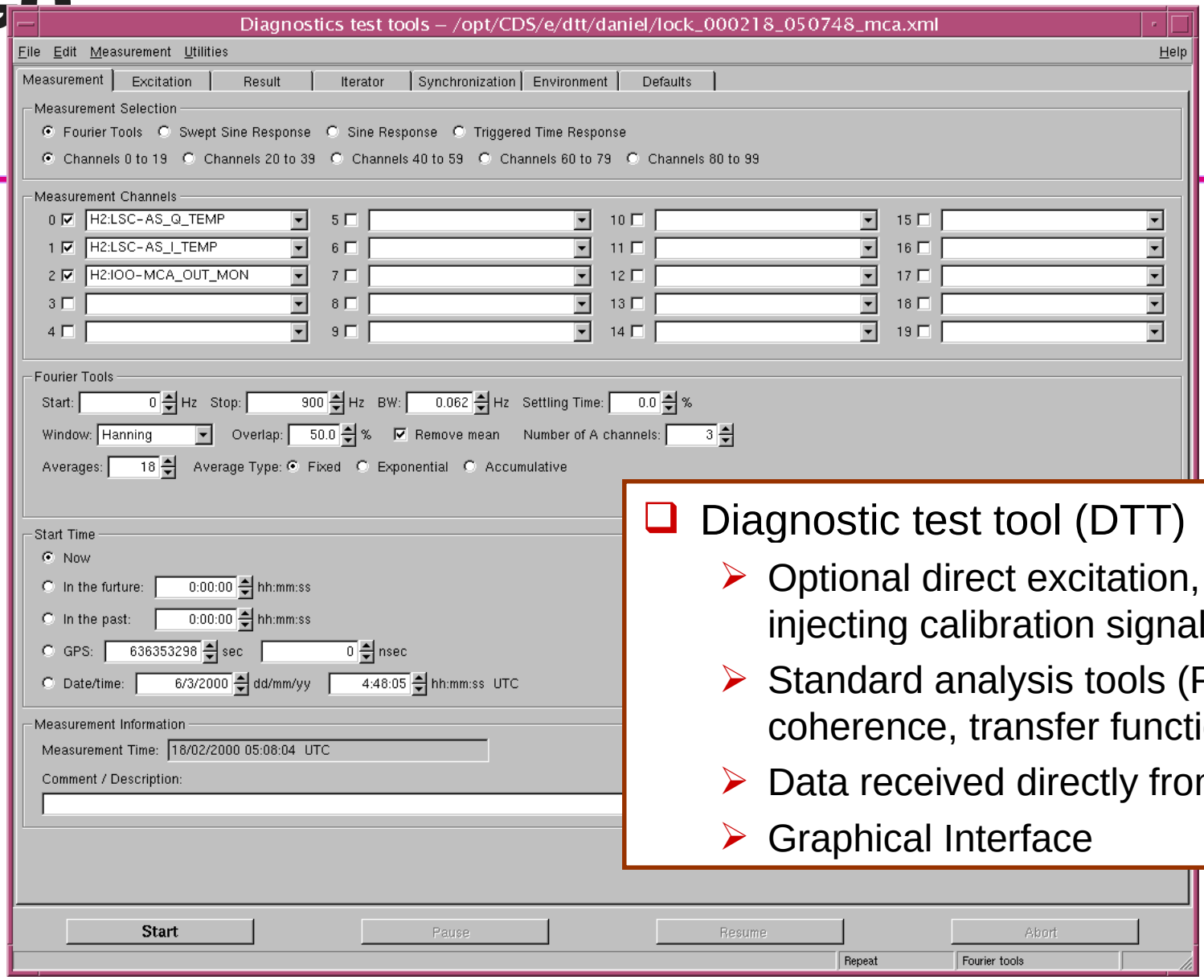


Easy Data Access: Lidax



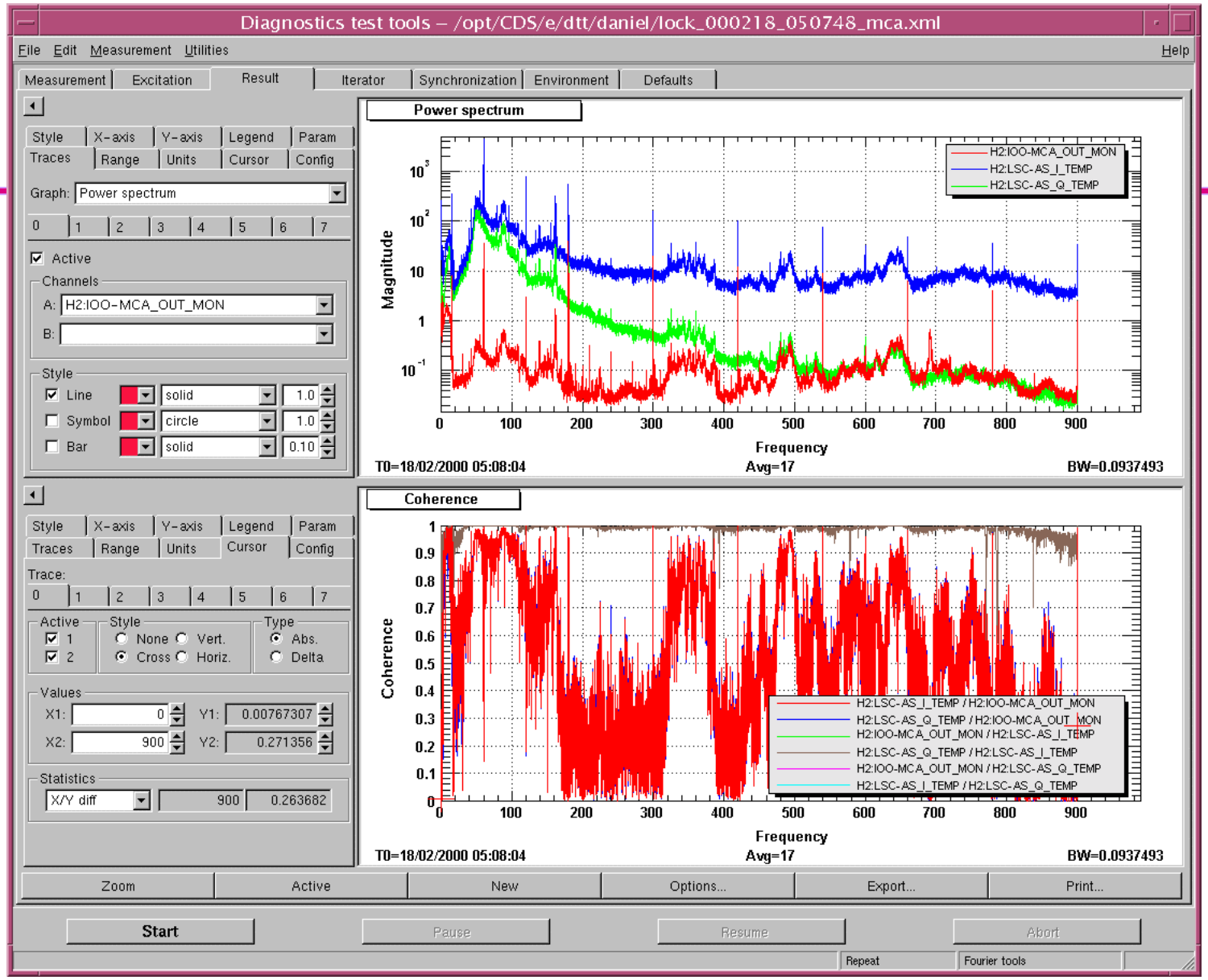
Data Viewer


DATA VIEWER CONTROL
Main
View
Help
Action
Stop
H0:PEM-LVEA_WIND
Display Type
Time Sequence
X Axis
8 Sec
Delay
0
Display Mode
Standard
Y Axis
Min
-5
Max
5
No. of Chans
1
Unit
m/s
Scale
Linea
Auto
Color
red
Resolution
128 Hz
Trigger Enable
Ch 01
Refresh Rate
1 /Sec
Above
Global Settings
Show Sel.
Playback Control Panel
Channels
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
X Axis Format
Date/Time
Total Time
Graph Mode
Standard
Multiple
Multiple Xmgr
Decimation
Full Data
Second Trend
Minute Trend
10-min Trend
Hour Trend
Show Mean
Show Max
Show Min
Show X Grid
Show Y Grid
Auto Setting
Style:
Default
Server
Frame File
10.1.0.28
YR
MO
Day
HR
MIN
SEC
GPS
01
4
26
17
52
18
672342751
Duration
300
Stop Time
UTC
GPS
Quick Set
Execute
Stop #
Close



- Diagnostic test tool (DTT)
  - Optional direct excitation, injecting calibration signals
  - Standard analysis tools (PSD, coherence, transfer function)
  - Data received directly from DAD
  - Graphical Interface

Plot


Diagnostics test tools – /opt/CDS/e/dtt/daniel/lock_000218_050748_mca.xml
File Edit Measurement Utilities Help
Measurement Excitation Result Iterator Synchronization Environment Defaults
Style X-axis Y-axis Legend Param
Traces Range Units Cursor Config
Graph: Power spectrum
0 1 2 3 4 5 6 7
Active
Channels
A: H2:IOO-MCA_OUT_MON
B:
Style
Line solid 1.0
Symbol circle 1.0
Bar solid 0.10
Power spectrum
H2:IOO-MCA_OUT_MON
H2:LSC-AS_I_TEMP
H2:LSC-AS_Q_TEMP
Magnitude
Frequency
T0=18/02/2000 05:08:04
Avg=17
BW=0.0937493
Coherence
Trace:
Active 1 2
Style None Vert. Cross Horiz.
Type Abs. Delta
Values
X1: 0
Y1: 0.00767307
X2: 900
Y2: 0.271356
Statistics
X/Y diff 900 0.263682
H2:LSC-AS_I_TEMP / H2:IOO-MCA_OUT_MON
H2:LSC-AS_Q_TEMP / H2:IOO-MCA_OUT_MON
H2:IOO-MCA_OUT_MON / H2:LSC-AS_I_TEMP
H2:LSC-AS_Q_TEMP / H2:LSC-AS_I_TEMP
H2:IOO-MCA_OUT_MON / H2:LSC-AS_Q_TEMP
H2:LSC-AS_I_TEMP / H2:LSC-AS_Q_TEMP
Zoom Active New Options... Export... Print...
Start Pause Resume Abort
Repeat Fourier tools

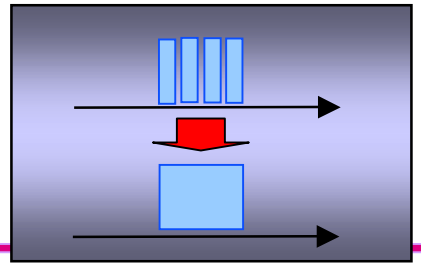
Data Monitor Tool

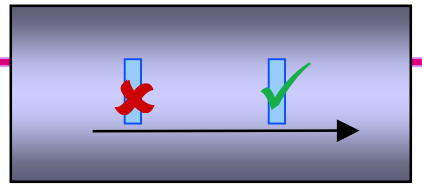
- Detect and tag known signals and disturbances
  - Find and record transients
  - Correlate external effects to operational parameters
- Measure and summarize the running state
  - Noise spectra, average power, other operational parameters
  - Rate and magnitude of known transient signals
- Notify operators of faults or abnormal conditions
  - Increases in all or part of noise spectrum
  - Other device specific problems
- Support interactive testing and diagnosis

Monitor Development

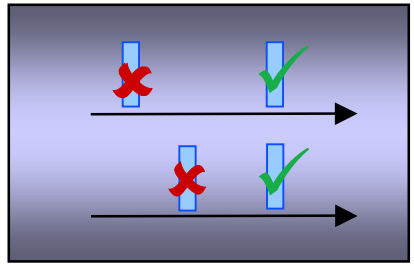
- Detector characterization group
  - Line tracking, transient detection, correlations, reduced data sets, noise characterization, time-frequency thresholds, etc.
- Engineering run investigation teams
  - Data integrity, loss-of-lock, calibration, environmental cross-correlation, identification of disturbances, etc.

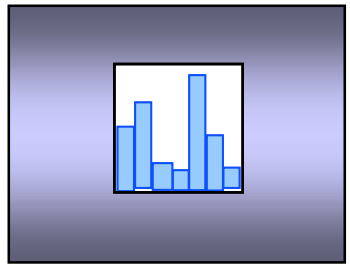
Event Analysis



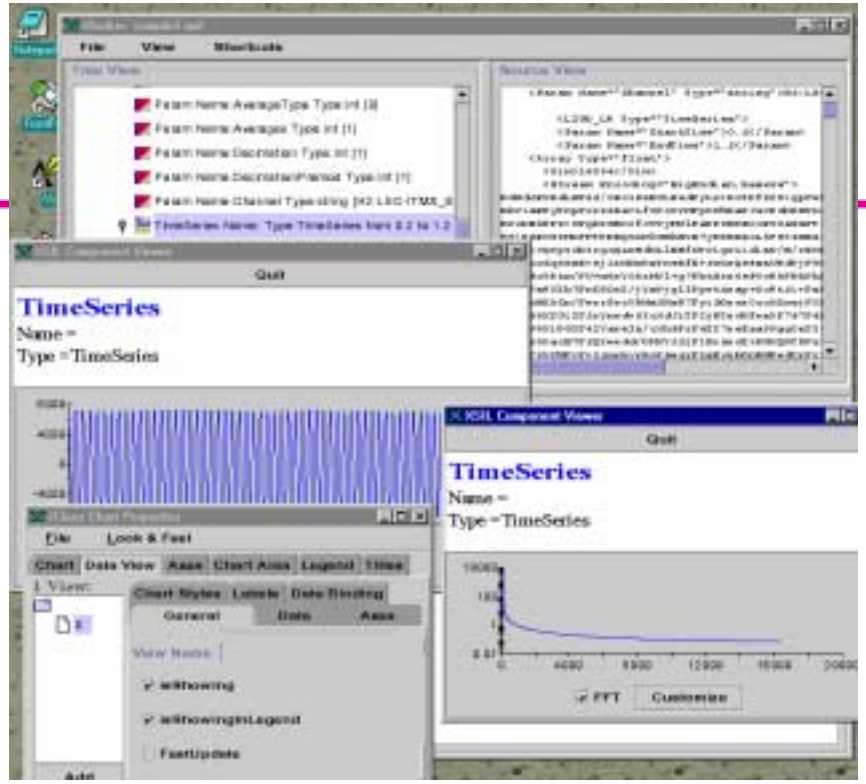


- Fine selection/rejection of events
  - Selection of event types & cuts on event parameters
  - Adjust parameter values (normalization, calibration, derived quantities)
- Cluster analysis
  - Time window and multiplicity
  - Remove duplicate (closely space) triggers
  - Reclassification of clusters into a single event or veto
- Correlation (Trigger logic)
  - True and false (time shifted) coincidences
    - Detector/detector & between different sensors or event types
  - Veto one event type by another
  - Keep track of trigger uptime!
- Event data lookup
- Histogram generation
- Simple parallel processing paradigm: split in time



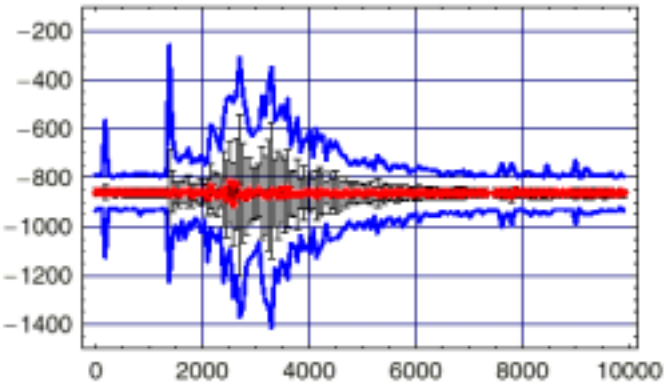


Xlook



Matlab/Mathematica

```
trace = 1;
MultipleListPlot[
  {{#[1], #[3]}, ErrorBar[#[4]]} & /@ (trend[trace]),
  (#[1], #[5]) & /@ (trend[trace]),
  (#[1], #[6]) & /@ (trend[trace]),
  PlotRange → {-1500, -100}, plotopt];
```



Command line utilities

FrDump, FrSplit, FrMerge, fdir, finfo, fsettime, etc.

Conclusions

Combination of

- High performance data acquisition system
- 24 hour disk cache
- New software and analysis tools

has enabled

- Fast learning curve
- Emphasis on analysis rather than data gathering
- Greatly enhanced remote diagnostics