

Control System Studio

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ORNL is managed by UT-Battelle, LLC for the US Department of Energy

Control System (CS) Studio

User Interface tools

- Display editor & runtime
- Strip Chart
- Channel Access utilities

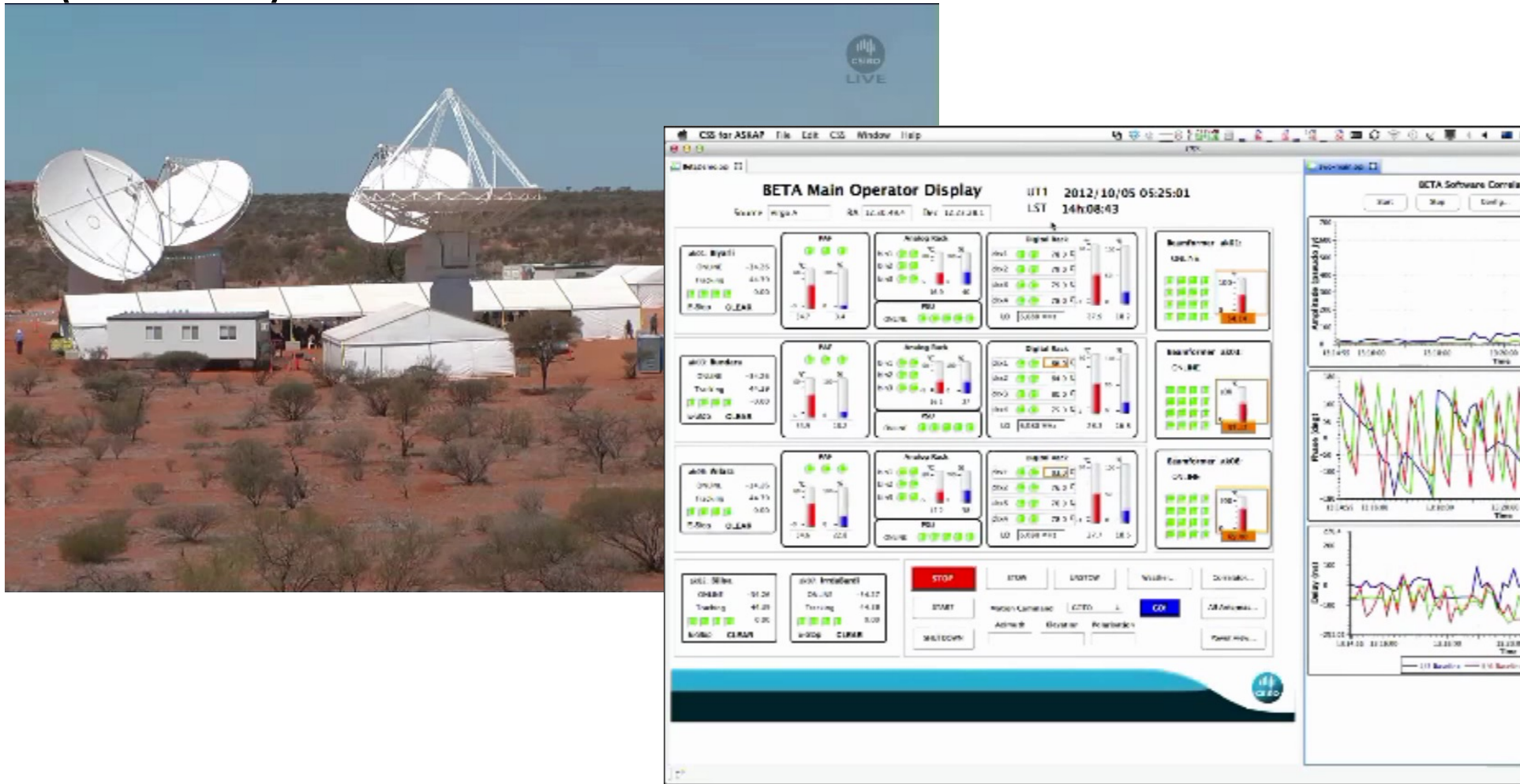
Also

- Archive system
- Alarm Handler
- Site-Specific support for logbook, PV names, ..

.. integrated user-interface tool for
Windows, Linux, OS X

What does CS-Studio look like?

Australian Square-Kilometer Array Pathfinder (ASKAP)



Oct. 2012, Juan Guzman, <http://www.aps.anl.gov/epics/tech-talk/2012/msg02113.php>

ITER

ITER-FPSC-
vBetaVersionPanels
OPI-
UserManual.doc,
Nadine Utzel, 2011

Hardware Monitor and Control Module

Date and Time: 2011/11/03 15:19:13 Set Fans Level (0<value<110): 100

Username: Unknown system PV 'user' Submit

Hostname: fpcpsh.local

Used Memory: 143.230 MB

Free Memory: 79.922 MB

Available Memory: 227.562 MB

CENTELLIS TEMPERATURE MEASUREMENTS

FTM TEMP #1: 27.16 °C

FTM TEMP #2: 31.68 °C

FTM TEMP #3: 24.2 °C

CENTELLIS FANTRAY SPEED

Fan#1 Speed (RPM): 2145

Fan#2 Speed (RPM): 2.178E3

Fan#3 Speed (RPM): 2211

CODAC SysSTATUS

- Not ready
- Ready
- Start of pulse sequence
- Wait for systems initialised
- Pre-pulse checks
- Final preparation
- Pulse
- After pulse checks

Stop

Exclude

MARTE SysSTATUS

Execute

- Off
- Not ready
- Ready
- Initialising
- Initialised
- Executing
- Post pulse

Stop

Plasma Operational SysStateMachine STATUS

Pulse N.: 13689 Authorisation: YES

Countdown: 0.0 PulseTime: 24.0

OPREQ: Pulse

Plasma Operational SysStateMachine STATUS (continued)

ORNL 'CG-1D' Beam Line

The screenshot displays the EPICS/CSS control interface for the ORNL 'CG-1D' beam line. The interface is divided into several sections:

- File Browser (Left):** Shows a directory tree with files like 'Turbine_4_CT' and various FITS files.
- Camera Control (Top Left):** Includes fields for Exposure Time (180.000), Blinning (1), ADC Speed (1.00 MHz), Shutter Mode (Auto), and Camera State (Idle). There are Start and Stop buttons.
- Cooling (Middle Left):** Shows Cooler (On), Temperature (-60.000), and Status (Stabilized at set pt).
- Advanced (Bottom Left):** Contains buttons for Full Control (Simulated), Full Control (Andor), File I/O Configure, and General Camera.
- Camera View (Center):** A grayscale image of a turbine component with X and Y axes ranging from 0 to 2048.
- Motors (Top Right):** A table listing motor parameters and status.
- Configuration (Bottom Right):** Fields for Start, End, Step, Device, Exposure, Delay, and Directory.
- Console (Bottom):** A log window showing scan activities.

Motor	Readback	Position	Left/Move/Right	Limits
Lift Table	83.1 mm	83.1 mm	STOP	
Short Axis	80.0 mm	80.0 mm	STOP	
Long Axis	132.5 mm	132.5 mm	STOP	
Large Rotation T.	90.0 deg	90.0 deg	STOP	
Detector Table	225.0 mm	225.0 mm	STOP	Enabled
Small Rotation T.	181.4 deg	181.4 deg	STOP	
Camera Vert.	70.0 mm	70.0 mm	STOP	

ID	Created	Name	State	%	Runtime	Finish	Command	Error
153	2013-01-08 17:54:24	Rotation Scan: Turbine_CT	Finished - OK		14:35:06	08:29:31	- end -	
152	2013-01-08 17:38:07	Rotation Scan: Turbine_CT_test	Finished - OK		00:15:35	17:53:42	- end -	

Neutron Tomography, EPICS/CSS since Jan. 2013

ORNL SNS 'VULCAN' Beam Line

Alignment Scan

Device: BL7:Mot:Parker Start: -0.5 End: 0.5 Step: 0.05
 Step condition: bm2 increment by: 10000.0 Active Scan: ●
 Log: east_neutrons east_neutrons

Fit Method: Gauss+const Position: -0.096 Width: 0.164

VULCAN Neutron Stats

East Detector

ROI Left: 55 Top: 0 Width: 39 Height: 25 Default
 DSpace ROI Start: 0.000 Ang End: 4.500 Ang Default
 Detector ROI: 79477 counts DSpace: 79477 counts

West Detector

ROI Left: 0 Top: 0 Width: 155 Height: 25 Default
 DSpace ROI Start: 0.000 Ang End: 4.500 Ang Default
 Detector ROI: 212202 counts DSpace: 212202 counts

VULCAN User Start Page

Proposal

IPTS: 10076 Run: 42594 Run Detail

Neutrons

Detectors: 291679 counts 68.5 cts/sec Detail
 BM1, 2: 827141 counts 4430023 counts Shutter: ●
 Frame Rate: 30 Hz Wavelength: 2.80 Ang

Equipment

All OK: ● Status... Detail

Experiment Control

Scan: /tmp/10076-mapping_Mg-4-1mm.csv
 Progress: ●
 Finish: 17:01:09
Table Scan Range Scan
Alignment Scan

Table Scan

Table: /tmp/Calibration/Si Ca
 Comment: BL7:CS:IF BL7:CS

30Hz HI Si	30 Hz HI V	30Hz HRS	30 Hz HR					
		1.693	66.1	-10.5	-178	bm2	15040000	14400
		0.33	61.1	-86.5		bm2	30040000	

Scan Monitor

ID	Created	Name	State	%	Runtime	Fin
989	2014-03-31 15:45:56	/tmp/Calibration/Si Calibration 30 HZ.csv	Running		17:25:43	11
988	2014-03-31 13:45:53	/tmp/Calibration/Si Calibration for Al cover.csv	Finished - OK		01:45:21	15
987	2014-03-30 15:29:55	/tmp/Calibration/Si Calibration for Doug.csv	Finished - OK		11:54:59	03:24:54 - end -
986	2014-03-30 15:15:44	Gauss+slope Scan west_neutrons	Finished - OK		00:04:43	15:20:27 - end -
985	2014-03-30 15:09:28	Gauss+slope Scan west_neutrons	Finished - OK		00:04:43	15:14:11 - end -

Engineering Diffractometer, EPICS/CSS since March 2014

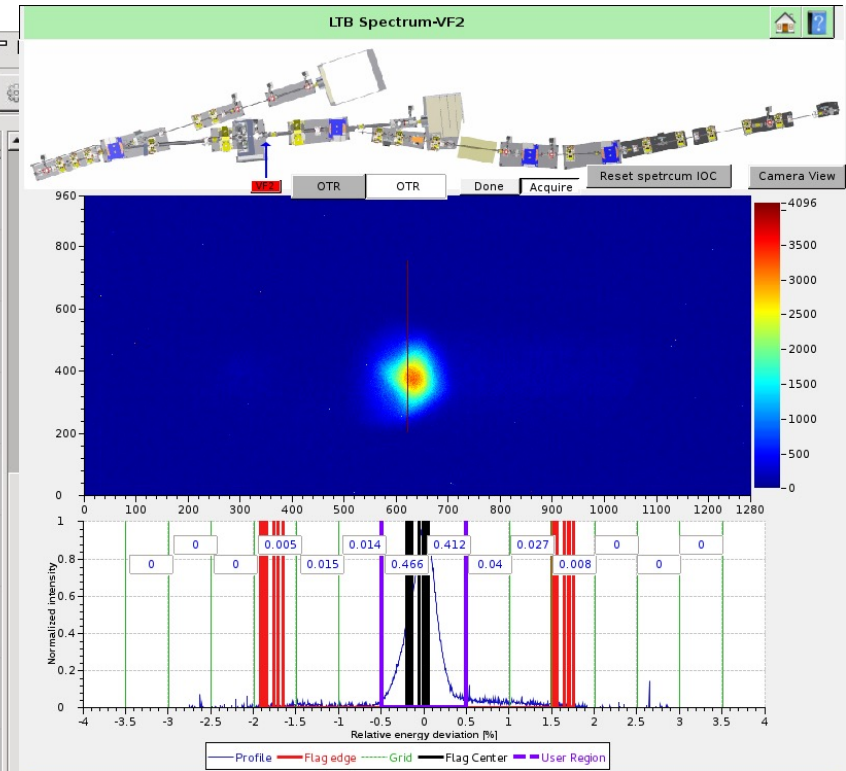
BNL NSLS2

Log Table Log Tree

Log Query: Adv Search

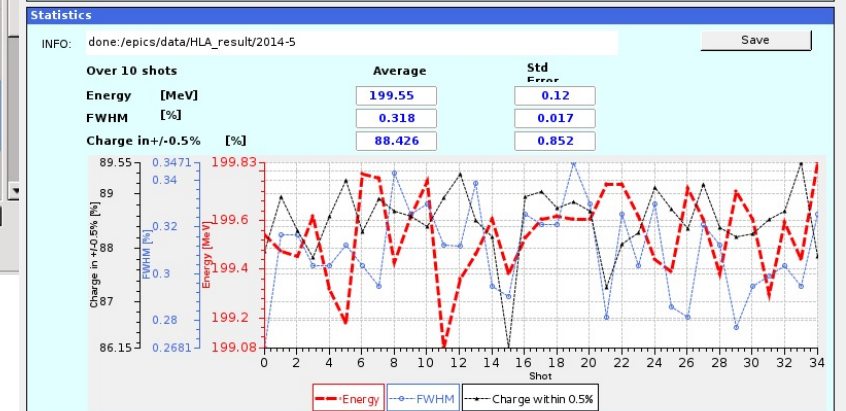
Date	Description	Owner	Logbooks	Tags	A.
5/12/14 7:40 AM modified at: 5/13/14 11:32 AM	Systems are now shut down for SR, BTS, Booster, LBT, and Linac. Klystrons 1 and 3 were left on and in standby.	zeitler modified by: zitvogel	Operations		0
5/12/14 7:32 AM modified at: 5/13/14 11:32 AM	Pentant 3 would not open using normal access request, RCT had to hit emergency access button. At the time the SR RF was set to AUX state, the main dipole was off, BTS B2 was off, and BTS shutter was closed.	zeitler modified by: zitvogel	Operations		0
5/12/14 7:21 AM modified at: 5/13/14 11:32 AM	Linac is Off. Cathode is off. klystrons in standby.	rfiller modified by: zitvogel	Operations		1
5/12/14 7:19 AM modified at: 5/13/14 11:32 AM	Vertical Emittance Measurement epsy: 85.6 +/-3.8 nm betay=14.2 +/-0.63 m alphay=-1.67 +/-0.07	rfiller modified by: zitvogel	Operations		1
5/12/14 7:09 AM modified at: 5/13/14 11:32 AM	Horizontal Emittance Scan: epsx: 81 +/-5nm betax: 14.3 +/-0.6m alphax: -1.81 +/-0.08	rfiller modified by: zitvogel	Operations		1
5/12/14 7:00 AM modified at: 5/13/14 11:32 AM	Linac Status Page.	rfiller modified by: zitvogel	Operations		1
5/12/14 7:00 AM modified at: 5/13/14 11:32 AM	Starting to shut down the Storage ring and booster while Ray finishes some measurements on the Linac.	zeitler modified by: zitvogel	Operations		0
5/12/14 7:00 AM modified at: 5/13/14 11:32 AM	There are the 72 bunches in all their glory. Saved the waveform to a text file.	rfiller modified by: zitvogel	Operations		1
5/12/14 6:55 AM modified at: 5/13/14 11:32 AM	72 bunches in the booster! That is what the linac is making. GREAT! We have established that the linac can inject its bunch train into the booster.	rfiller modified by: zitvogel	Operations		1
5/12/14 6:52 AM	successfully restore machine with the snapshot #1164 and Conifg LTB_BR_BTS_20140421	rfiller	Machine Physics Operations	MASAR	0
5/12/14 6:52 AM	Succeed to save a snapshot #1165 to MASAR database using Conifg LN-LTB-All-20131219 with description: 200 MeV, 9.0nC at ICT1, 150 ns 0.3% energy spread. Comment: Saving best Beam Loading Compensation with 9nC at ICT1, 150 ns	rfiller	Machine Physics Operations	MASAR	0
5/12/14 6:50 AM modified at: 5/13/14 11:32 AM	This is the best beam loading compensation to date with a 150 ns pulse. 9nC at ICT1. 7.4 nC at FCT1.	rfiller modified by: zitvogel	Operations		1
5/12/14 6:23 AM modified at: 5/13/14 11:32 AM	Booster extraction kicker 1 pulse is still erratic.	zeitler modified by: zitvogel	Operations		1

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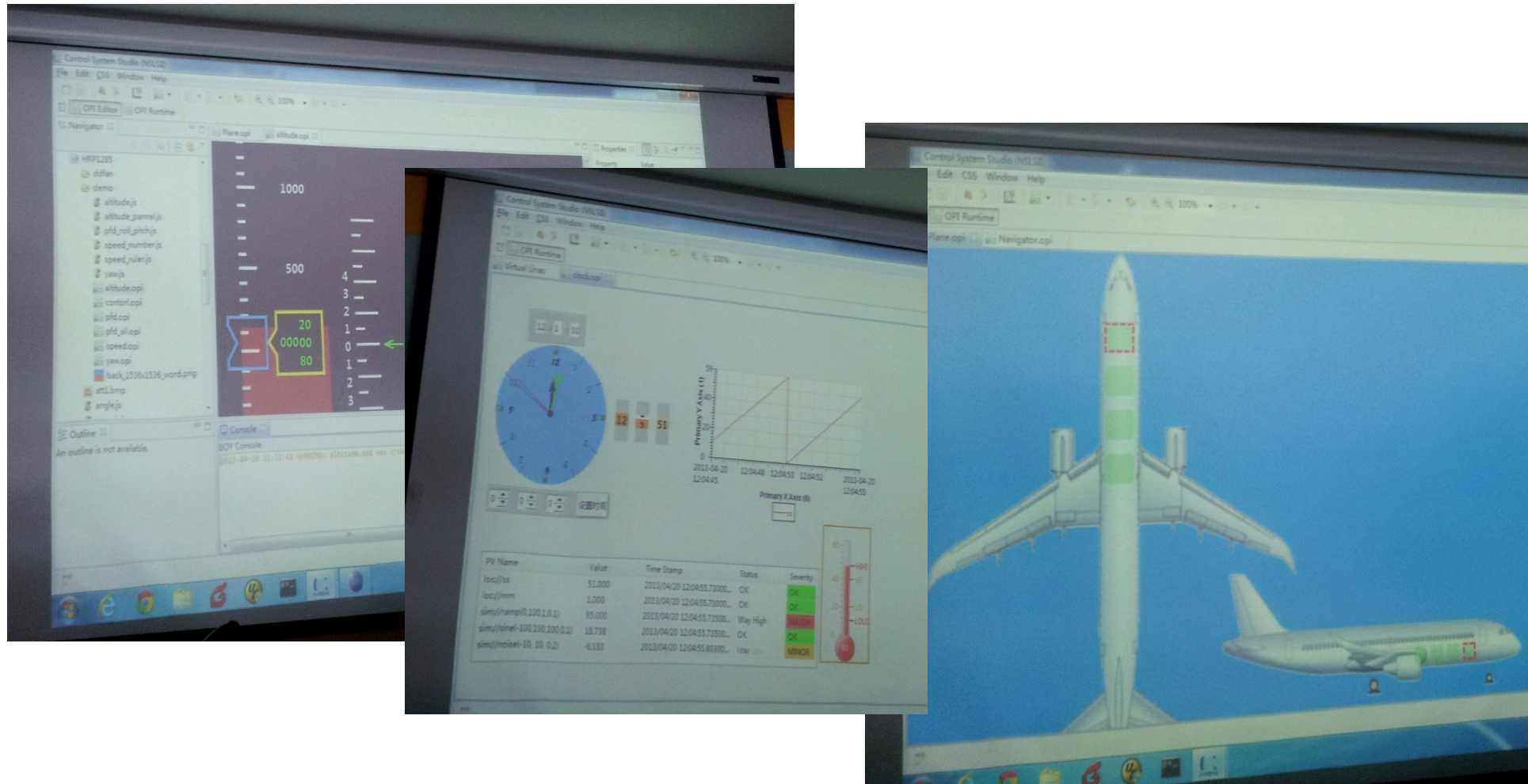


Each shot

Energy	199.83 MeV	FWHM	0.325 %	Charge within +/-0.5%	87.838 %
UserLeftRegion	-0.5 %	UserCharge within +/-0.5%	88.861		



Airplane Simulator/Test



Somewhere ...

What is CS-Studio?

CS-Studio Components

Common Use

- Display Builder
- Data Browser
- Probe
- PV Table
- PV Tree
- Channel Access
- PV Autocomplete from History

Selected Use

- Alarm System
- Archive Appliance, RDB Archiver, Channel Archiver
- ChannelFinder
- Olog, SNS Elog
- PV Access, MQTT
- Autocomplete from Channel Finder, SNS PV database, Archive

Integration: Alarm...

The image shows a software interface for alarm management. It consists of three main panels:

- Alarm Area Panel:** A grid of colored buttons representing different alarm areas. One button, 'BL-1B NOMAD', is highlighted in red. A context menu is open over this button, listing actions: 'Show in Alarm Tree', 'NOMAD Overview', 'Trigger automated email', and 'Alarm Perspective' (which is highlighted).
- Alarm Tree:** A hierarchical tree view showing the structure of alarm areas. The 'Area: BL-1B NOMAD (major-ack' entry is expanded, showing its sub-components.
- Alarm Table:** A table displaying current and acknowledged alarms. The 'Current Alarms (0)' section is empty. The 'Acknowledged Alarms (1)' section contains one entry:

PV	Description	Alarm Time	Current Sev	Current Sta	Alarm Sev	Alarm Statu	Alarm Value
BL1B:Vac:VacOK	major-ack'ed alarm: Beam Line 1 B Vacuum	2014/03/06 07:40:376	MAJOR	LOLO_ALAR	major-ack'ed	LOLO_ALAR	0.0

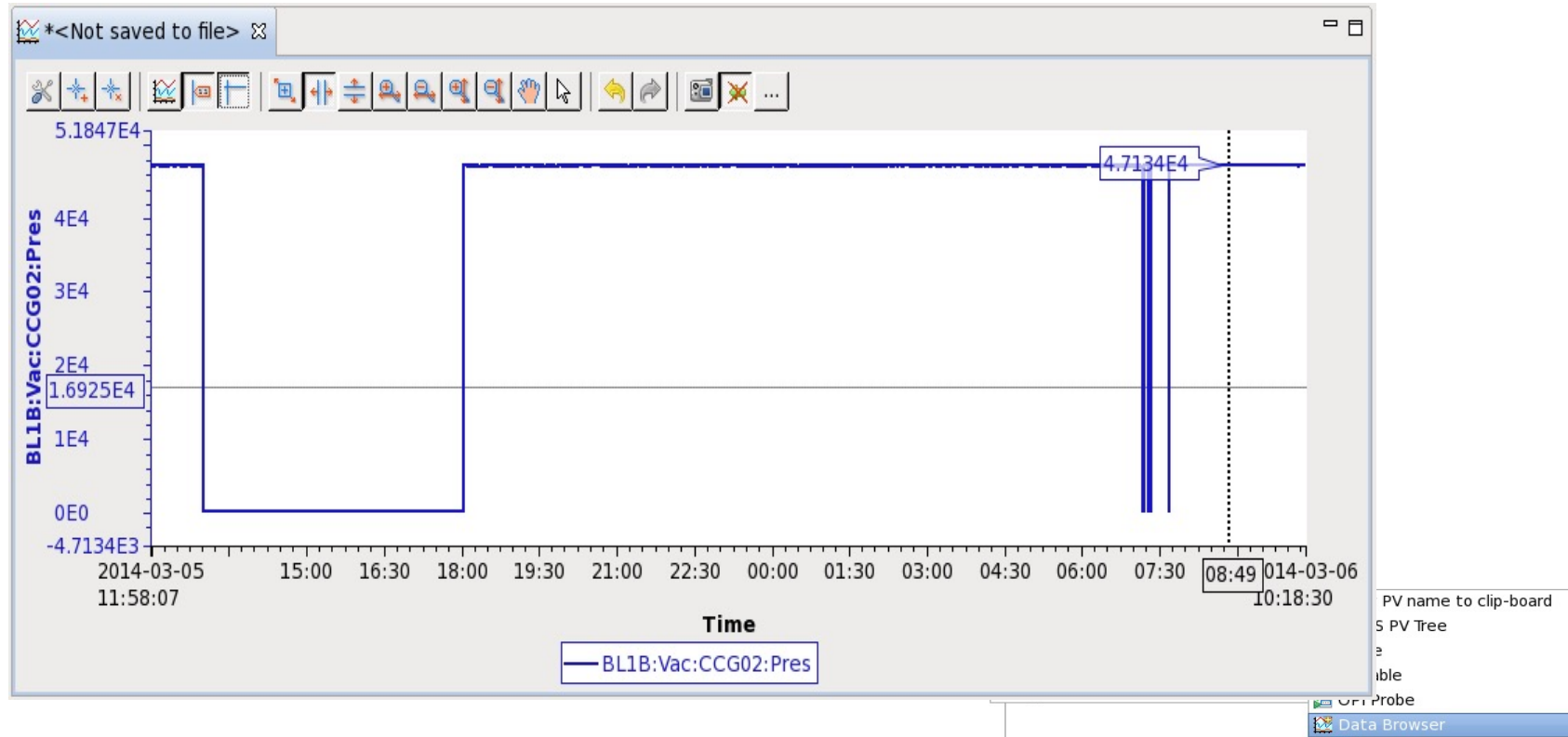
Context-Menu

Complete Alarm Perspective:
Tree view, Table of current alarms

Integration: Alarm...

The interface displays a vacuum system diagram with various components and their status. A red 'Not OK' indicator is present at the top. The diagram includes a Collimator, three Guides (Guide 1, Guide 2, Guide 3), a Secondary Shutter, a Sample Isolation Chamber, and a Nomad Detector Tank. Various pressure points (TCG 01-07) and valves (RV01-RV06) are shown. The Alarm Tree on the left lists several areas, with 'Area: BL-1B NOMAD (major-ack' being the active one. The Alarm Table at the bottom shows a table with columns for PV, Description, Alarm Time, Current Sev, Current Sta, Alarm Sev, Alarm Statu, and Alarm Value. A tooltip window is open over the table, showing a list of actions: 'What to do', 'NOMAD Overview', and 'Vacuum Display'.

Integration: Alarm...



Integration: Alarm...

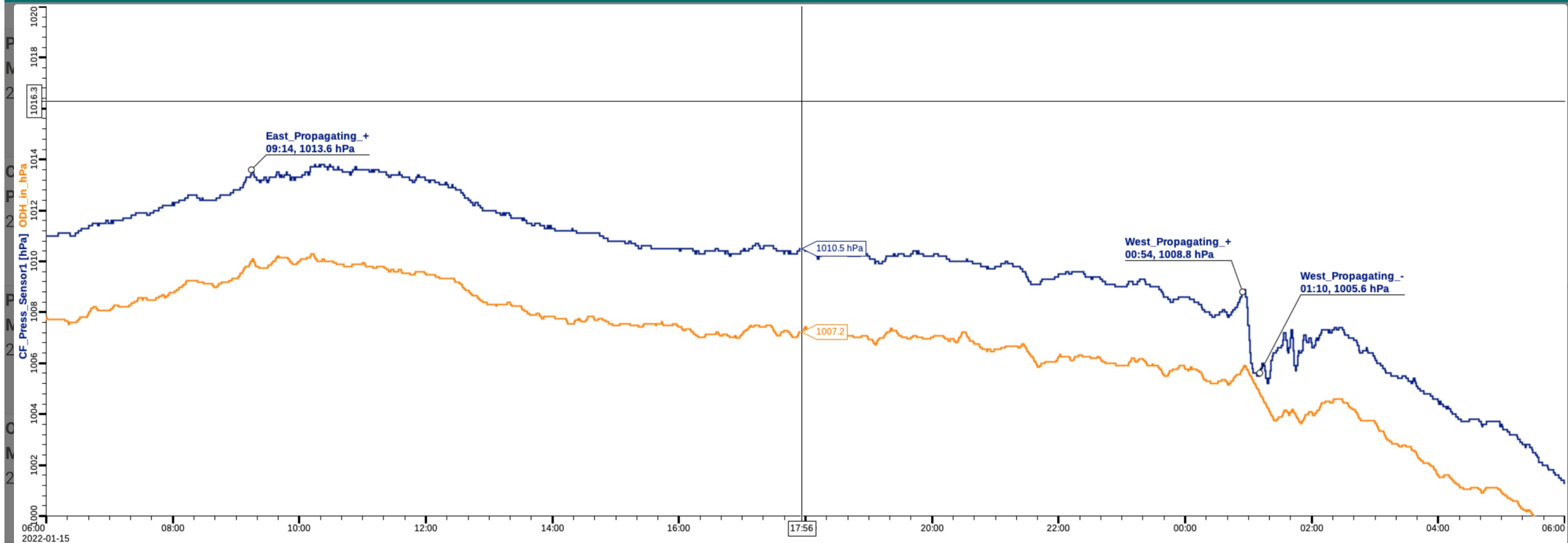
The image shows a software interface with two main components: a data plot and a 'Create Log Entry' dialog box.

Data Plot: The plot shows a signal labeled 'BL1B:Vac:CCG02:Pres' on the y-axis (ranging from -4.7134E3 to 5.1847E4) against 'Time' on the x-axis (ranging from 21:00 to 00:00). A blue line shows a sharp drop from approximately 4.5E4 to near zero at 21:58:07 on 2014-03-05. A context menu is open over the plot, listing various actions such as 'Hide Toolbar', 'Add PV', 'Add Formula', 'Import CSV Data File', 'Remove Empty Axes', 'Refresh', 'Open Data Export Panel', 'Open Properties Panel', 'Open Archive Search Panel', 'Inspect Samples', 'Data Browser Perspective', 'Inspect Waveforms', 'Send E-Mail...', 'Print...', and 'Create Log Entry'.

Create Log Entry Dialog: This dialog box is titled 'Create Log Entry' and contains the following fields and controls:

- User Name:** Fred
- Password:** [masked]
- Date:** Apr 4, 2014
- Level:** [dropdown menu]
- Text Area:** Received vacuum alarm on beam line. Looks like the reading dropped to zero. The same happened a few times before. We assumed that just as before the sensor was disconnected, so we checked the XY123 controller box. Upon inspection, we noticed that ...
- Logbooks:** Operations
- Tags:** [empty field]
- Buttons:** Add Image, Screenshot, CSS Window, Cancel, Submit

Integration: From Archive to Logbook



Pressure Transients from Tonga Volcano?
Comments: 37:55.png:
2022-01-18 15:37

Pressure Transients from Tonga Volcano? - Kelly Mahoney
We are actually able to see the global air pressure wave generated by the Tonga-Hunga Ha'apai eruption on some of our atmospheric pressure sensors! Like official NOAA data, a small pressure wave propagates west to east hitting us a little after 9 am on the 15th and a much larger east to west wave around 1am on the 16th.
- 2022-01-18 15 -



CS-Studio

is a collection of components.

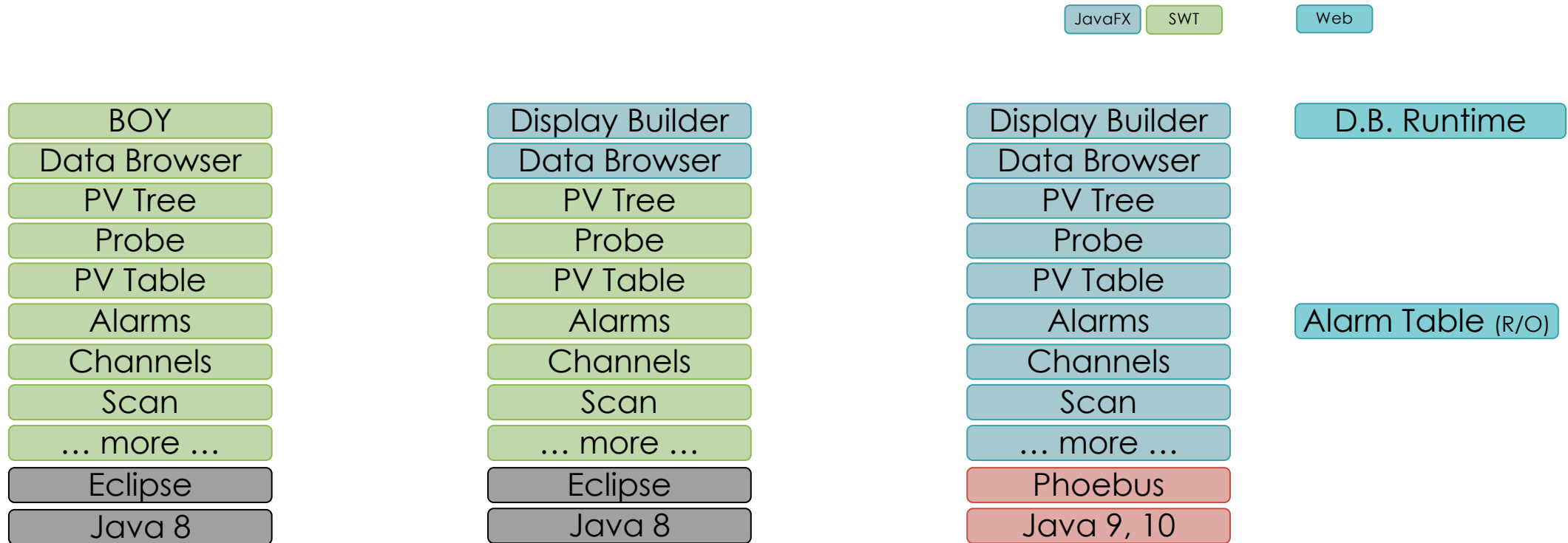
Integrated Workflow:

- Alarm display
- Display Builder (Channel Access)
- Data Browser (with RDB Archive)
- Logbook (SNS Elog)

Result:

Operations	RFQ Recovery from SCL 19a Trip
2014-04-03 10:40	During the 30-second beam recovery from SCL 19a, the RFQ resonance error decreased quickly. In order to save the RFQ from opening loop, I dropped the field down by one click. After the resonance error became stable, I restored the field back to .340. Note: The BEAST alarm for RFQ resonance error came in and this is what alerted us that there was a problem. The alarm annunciated in time for us to do something instead of it being too late. - 2014_04_03_103941.jpg -

Evolution of CS-Studio



Since ~2010:
Operational at several sites

Since ~2016:
SNS beam lines,
planned for ESS

2019:
SNS beam lines
2021:
ESS, ALS, FHI,
partially: FRIB, NSLS2

2020:
SNS beam lines

From 2014 to 2018

Phoebus (on ih-dassrv1.sns.gov)

File Applications Window Help

File Browser Alarm Area Panel X

Instruments VULCAN Neutron Stats MANDI X

* Data Browser X

Beam Power 0.3 Watts

Shutters

Vacuum & Choppers

Detectors

Instrument Floor

Temperature 78.6 F

Software Status

Sample Environment

Alarm Tree X

- ▶ BL-11A POWGEN
- ▶ **BL-11B MANDI**
- ▶ BL-12 TOPAZ
- ▶ BL-13B FNPB
- ▶ BL-14B HYSPEC
- ▶ BL-15 NSE
- ▶ BL-17 SEQUOIA
- ▶ BL-18 ARCS
- ▶ BL-1A USANS
- ▶ BL-1B NOMAD
- ▶ BL-2 BASIS
- ▶ **BL-3 SNAP**
- ▶ BL-4A MR
- ▶ BL-4B LR
- ▶ BL-5 CNCS
- ▶ BL-6 EQSANS
- ▶ BL-7 VULCAN
- ▶ BL-9 CORELLI
- ▶ BL16B VISION
- ▶ HFIR
- ▶ TGT

CF_TA:MaNDi_TIT01:F [F]

Alarm Table X

Active Alarms: 1

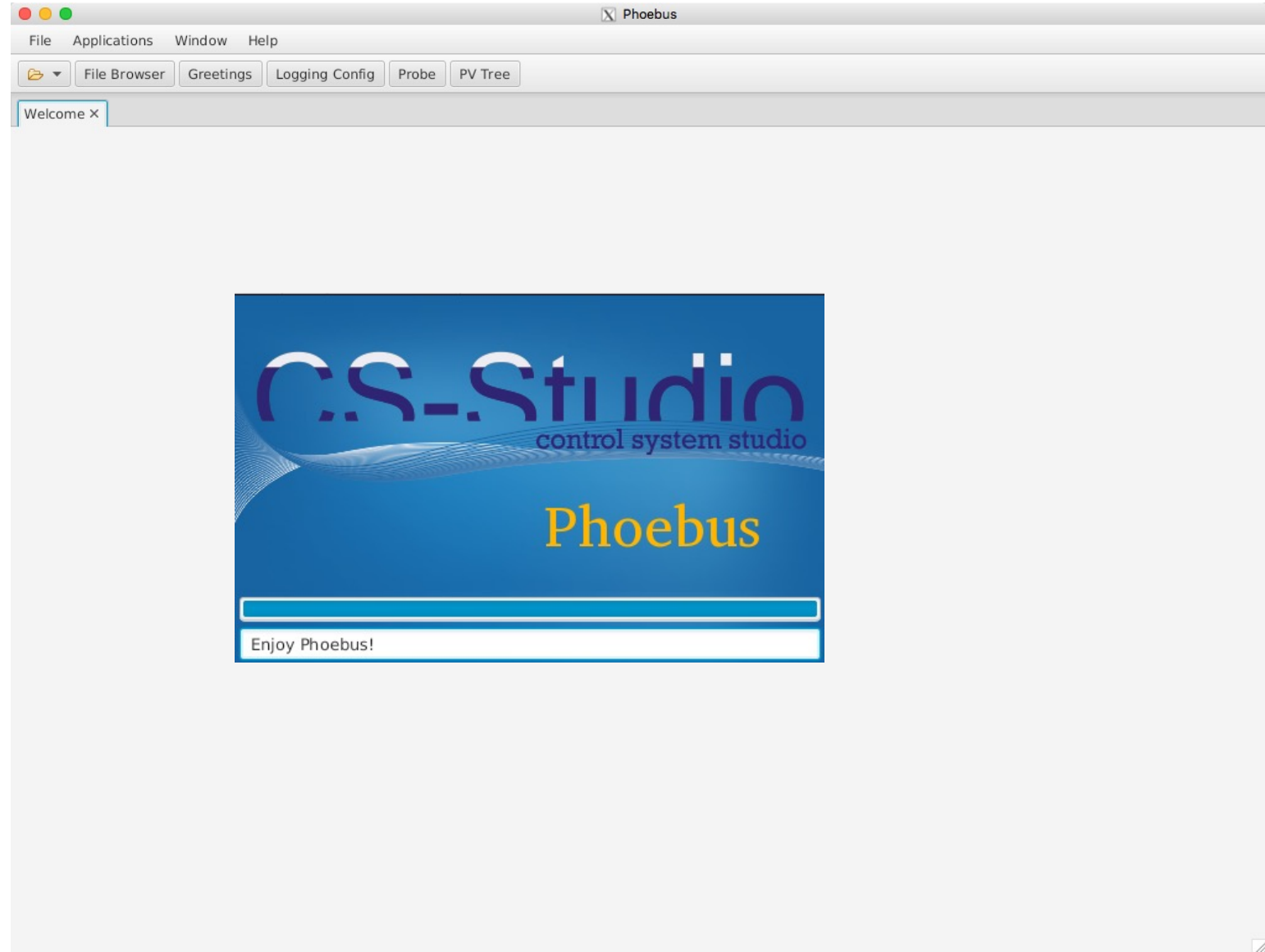
PV	Description	Alarm Severity	Alarm Status	Alarm Time	Alarm Value	PV Severity	PV Status
CF_TA:MaNDi_TIT01:F	Mandi cave temperature alarm	MINOR	HIGH_ALARM	2018-07-24 13:18:12.405	78.518798...	MINOR	HIGH_ALARM

Acknowledged Alarms: 3

PV	Description	Alarm Severity	Alarm Status	Alarm Time	Alarm Value	PV Severity	PV Status
BL11B:Det:nED:Status	Beam line 11b detector nED status	MAJOR_ACK	LOW_ALARM	2018-07-24 10:50:51.852	0.0	MAJOR	LOW_ALARM
BL3:SE:Lakeshore:ALARM_SUMMARY	Beam line 3 sample environment Lakeshore alarm	MAJOR_ACK	STATE_ALARM	2018-07-19 17:35:10.201	Alarm	MAJOR	STATE_ALARM
BL11B:Det:CaenHV:All:Alarm	Beam line 11b detector high voltage alarm	MAJOR_ACK	STATE_ALARM	2018-07-24 10:49:59.060	Alarm	MAJOR	STATE_ALARM

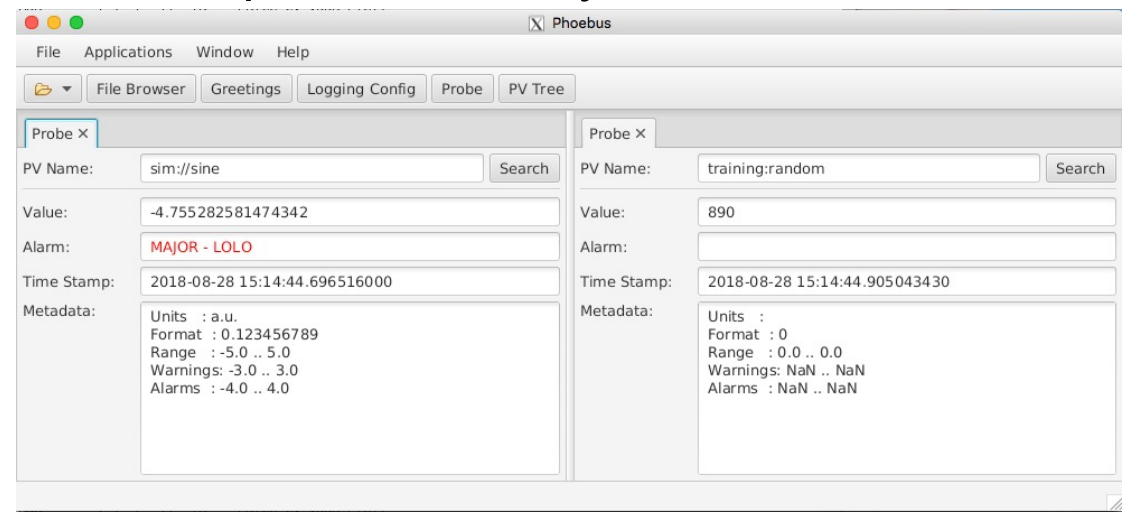
Getting Started with CSS

- Start
`css`



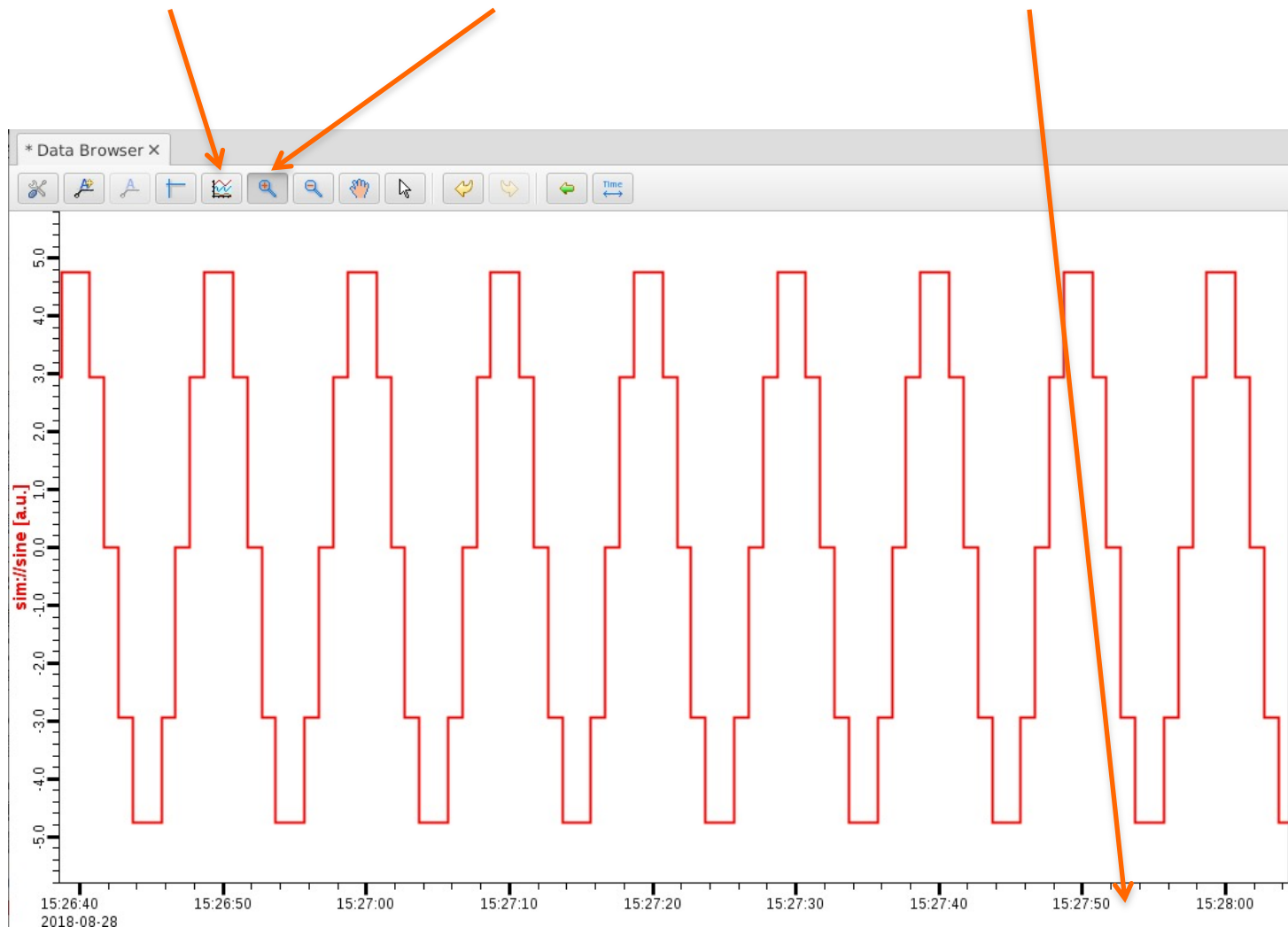
Exercise: Probe

- Use “Probe” in toolbar or Menu *Applications, Display, Probe*
- Enter PV name “sim://sine”
- Open another Probe for “training:random” (or some other PV from your IOC)
- Close Probe
- Open it again
- Note previously used PVs in history as you enter new PV
- Right-click on the “Probe” tab, Select “Split Horizontally”, and move one of the probes to new panel.



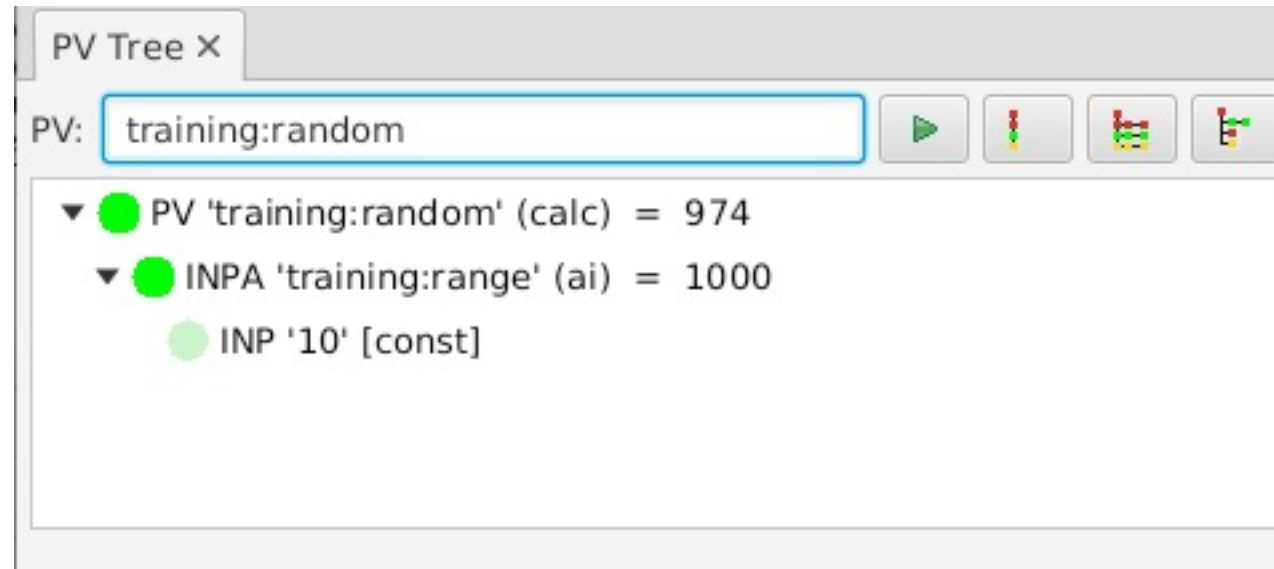
Exercise: Data Browser

- Menu *Applications, Display, Data Browser*
- Right-click on plot, *Add PV*, “sim://sine”
- Wait a little, press *Stagger* button, then *zoom* and select a region on the time axis



Exercise: PV Tree

- Menu *Applications, Display, PV Tree*
- Enter a PV from an IOC, like “training:random”

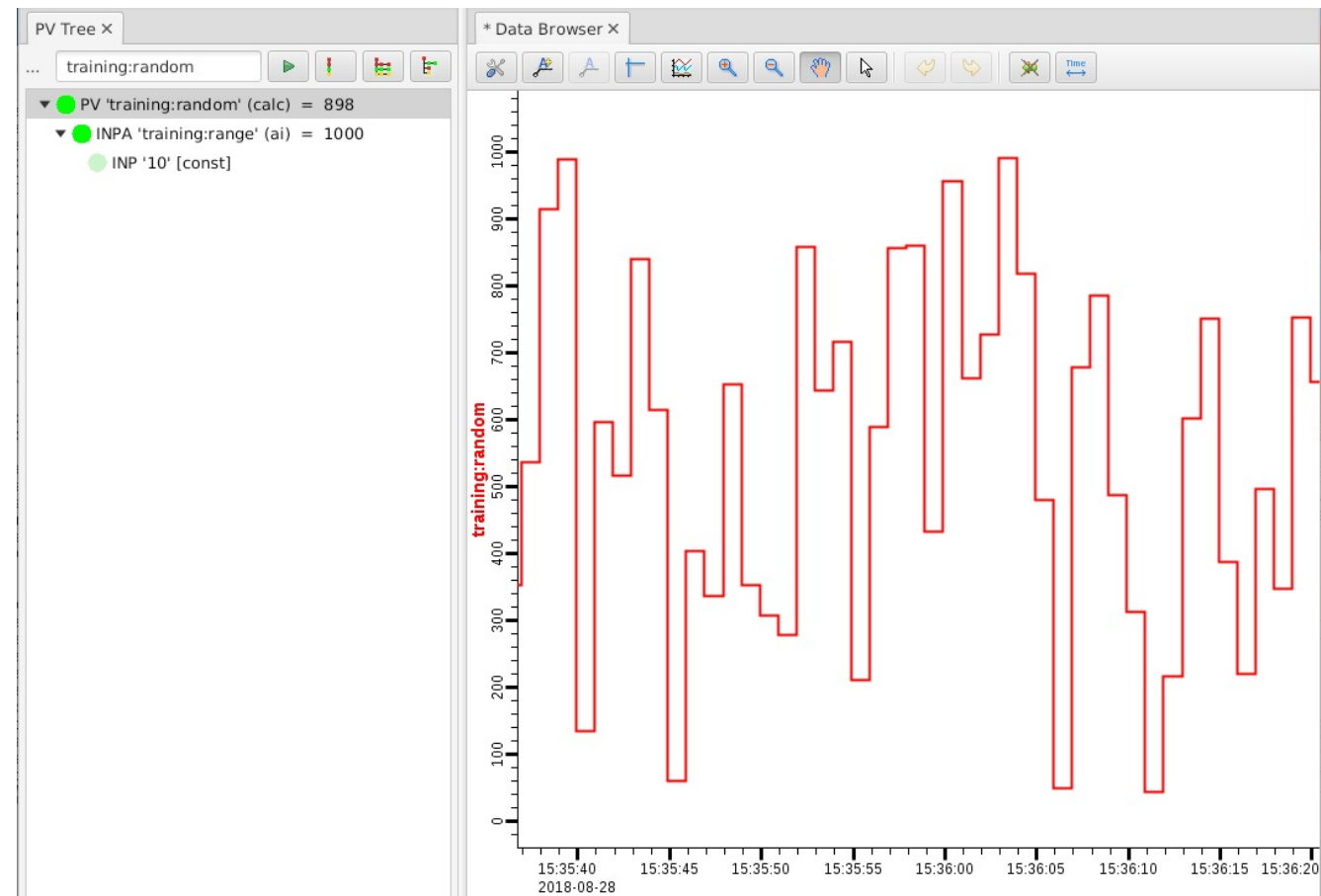


CSS PV Exchange

- PV in any CSS Tool
→ Context Menu → Select other PV Tool

Try:

Right-click on
item in PV Tree,
select
Data Browser



More Display Arrangements

- Tab Context Menu:
 - Split Horizontally/Vertically
 - Detach
 - Lock Pane
- Window Menu:
 - Show/Hide Toolbar
 - Always show tabs?
 - Save Layout As .. / Load Layout

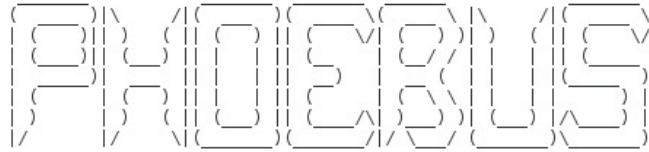
Saved Layout Example

- Hide the toolbar
- Open File Browser
- Split Pane Horizontally, leave file browser at left
- Lock the left pane
- Window, Save Layout As.., “Demo 1”

- Create another one as “Demo 1”
- Switch between them

Settings

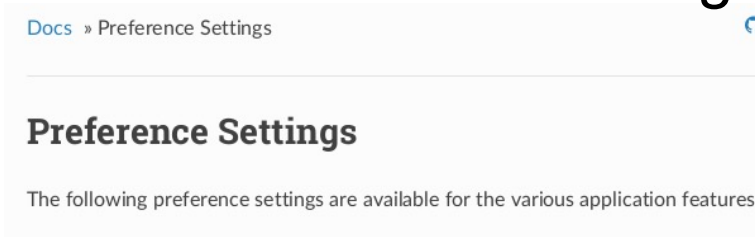
- CSS saves its settings in `~/.phoebus`
 - Change that via `-Dphoebus.user=/path/to/other/dir` on startup
 - Your 'start' script could copy certain saved layouts into that dir to share a set of layouts
- For command line settings, run with `-help`:



Command-line arguments:

```
-help                - This text
-splash             - Show splash screen
-nosplash           - Suppress the splash screen
-settings settings.xml - Import settings from file, either exported XML or property file format
-export_settings settings.xml - Export settings to file
-logging logging.properties - Load log settings
-list               - List available application features
-server port        - Create instance server on given TCP port
-app probe          - Launch an application with input arguments
-resource /tmp/example.plt - Open an application configuration file with the default application
```

- For details on the `"-settings"` file, see online help



```
# -----
# Package org.phoebus.pv.ca
# -----

# Channel Access address list
addr_list=

auto_addr_list=true

max_array_bytes=100000000

server_port=5064

repeater_port=5065
```