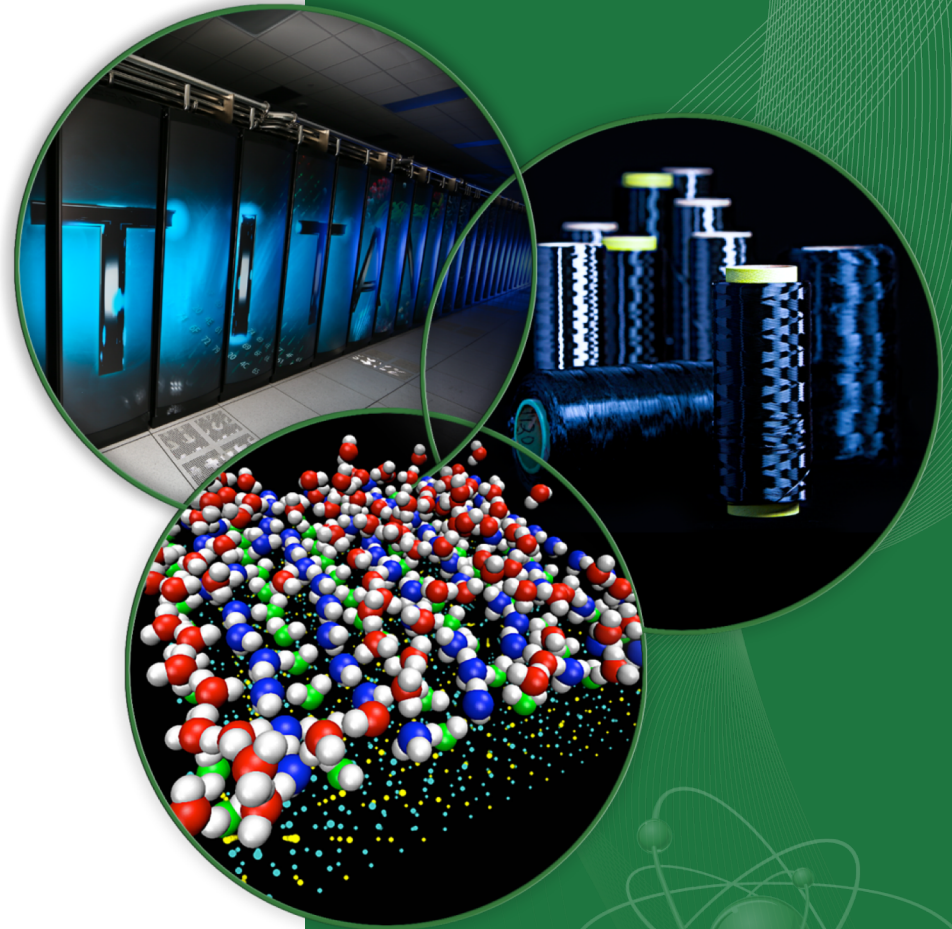


Control System Studio



Kay Kasemir

ORNL/SNS

kasemirk@ornl.gov

Jan. 2019

Control System (CS) Studio

User Interface tools

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

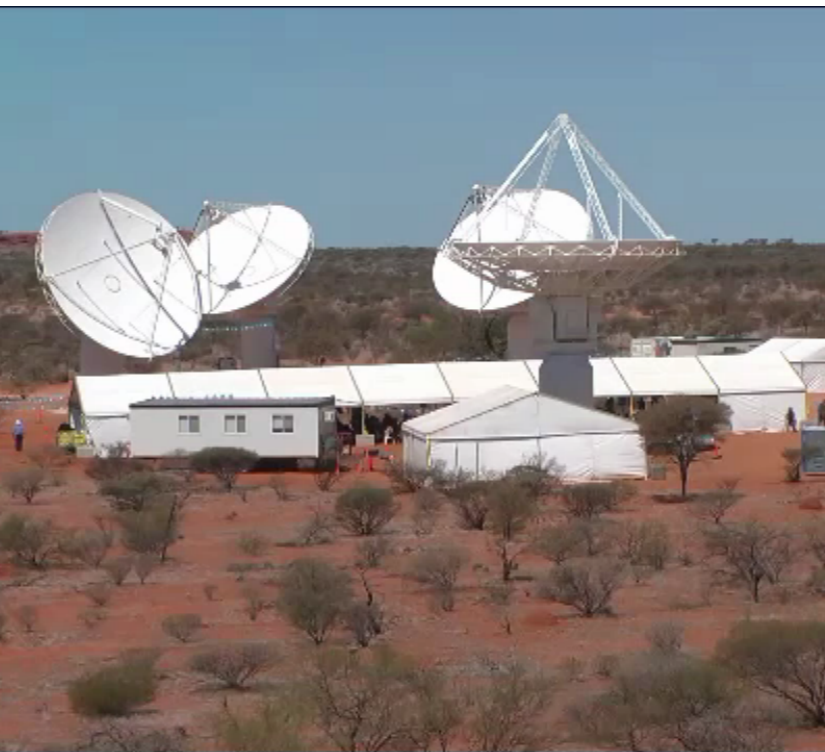
Also

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

.. integrated, site-specific 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>

Hardware Monitor and Control Module

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

Username: Unknown system PV'user/

Hostname: fpcpsh.local

Used Memory: 143.230 MB

Free Memory: 79.922 MB

Available Memory: 227.592 MB

CENTELLIS TEMPERATURE MEASUREMENTS

Alarm Indicator LED

CENTELLIS FANTRAY SPEED

CODAC SysSTATUS

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

MARTE SysSTATUS

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

Plasma Operational SysStateMachine STATUS

Pulse N.: 13689 Authorisation: YES

Countdown: 0.0 PulseTime: 24.0

ORNL 'CG-1D' Beam Line

The screenshot displays the CSS (Control System Software) interface for the ORNL 'CG-1D' beam line. The interface is divided into several sections:

- Navigator:** A tree view on the left showing the file structure, including folders like 'data', 'Tuesday', and 'Turbine_4_CT' with numerous FITS files.
- Camera Control:** A panel with settings for Exposure Time (180.000), Blinning (1, 1), ADC Speed (1.00 MHz), Shutter Mode (Auto), and Camera State (Idle). It includes Start and Stop buttons and a Cooling section with Cooler (On), Temperature (-60.000), and Status (Stabilized at set pt).
- Advanced:** Buttons for Full Control (Simulated), Full Control (Andor), and File I/O Configure.
- Camera View:** A central window showing a grayscale image of a turbine component with X and Y axes ranging from 0 to 2048.
- Motors:** A table listing motor parameters and status:

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

Below the motor table is a diagram of the motor guide with arrows indicating movement directions: Lift Table (up/down), Short Axis (smaller/larger), and Long Axis (left/right).

- Configuration:** Start (0), End (182), Step (0.650), Device (Large .., Small Rot. Table), Exposure (180.000), Delay (0 sec), Simulate? (checked), Directory (/home/controls/cg1d/data), File name (Turbine_CT).
- Status:** Angle (90.0 deg), Camera (Idle), Last file (/130109_Turbine_CT_0180_181.350_0279.f).

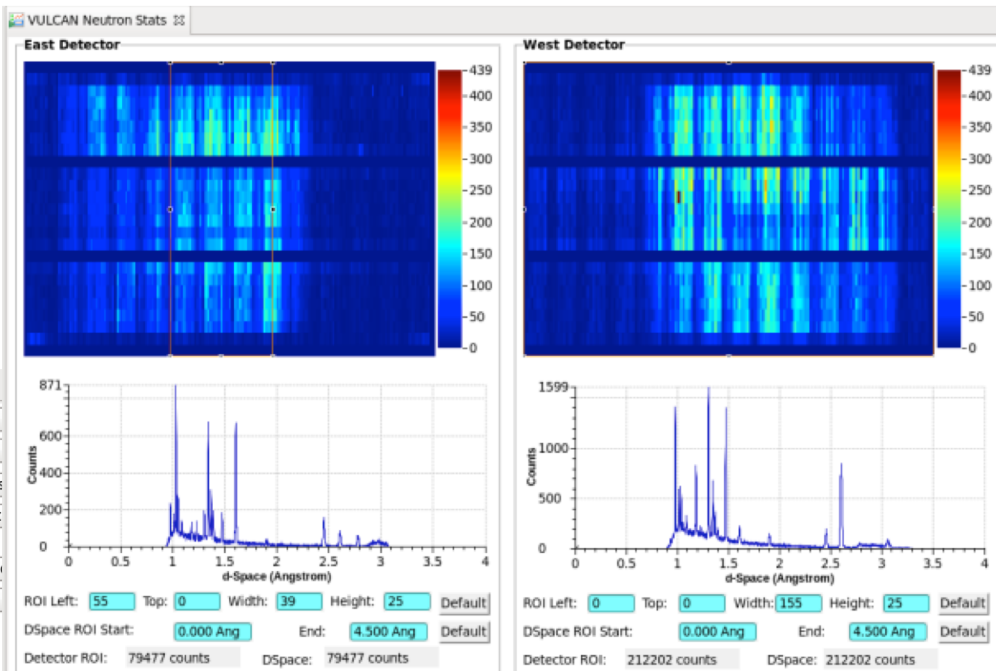
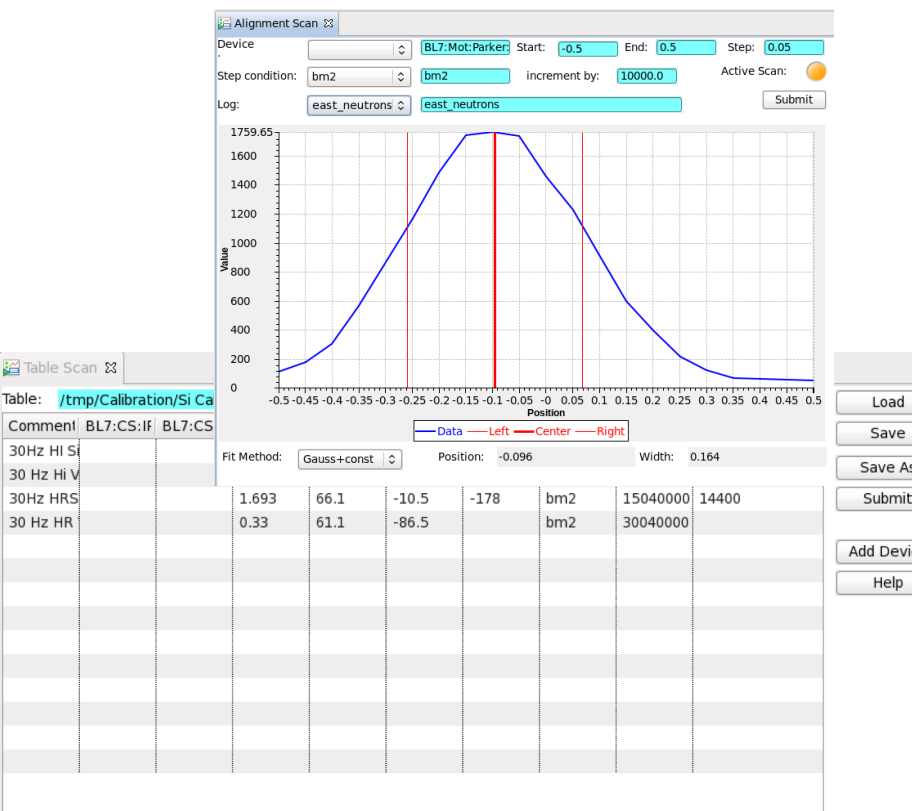
Console / Scan Monitor: A table showing scan history:

ID	Created	Name	State	%	Runtime	Finish	Command	Error
153	2013-01-08 17:54:24	Rotation Scan: Turbine_CT	Finished - OK	100%	14:35:06	08:29:31	- end -	
152	2013-01-08 17:38:07	Rotation Scan: Turbine_CT_test	Finished - OK	100%	00:15:35	17:53:42	- end -	

Scan Server Memory: 25.1 MB / 1744.0 MB (1.4 %)

Neutron Tomography, EPICS/CSS since Jan. 2013

ORNL SNS 'VULCAN' Beam Line



Scan Monitor

ID	Created	Name	State	%	Runtime	Fi
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 -

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

Engineering Diffractometer, EPICS/CSS since March 2014

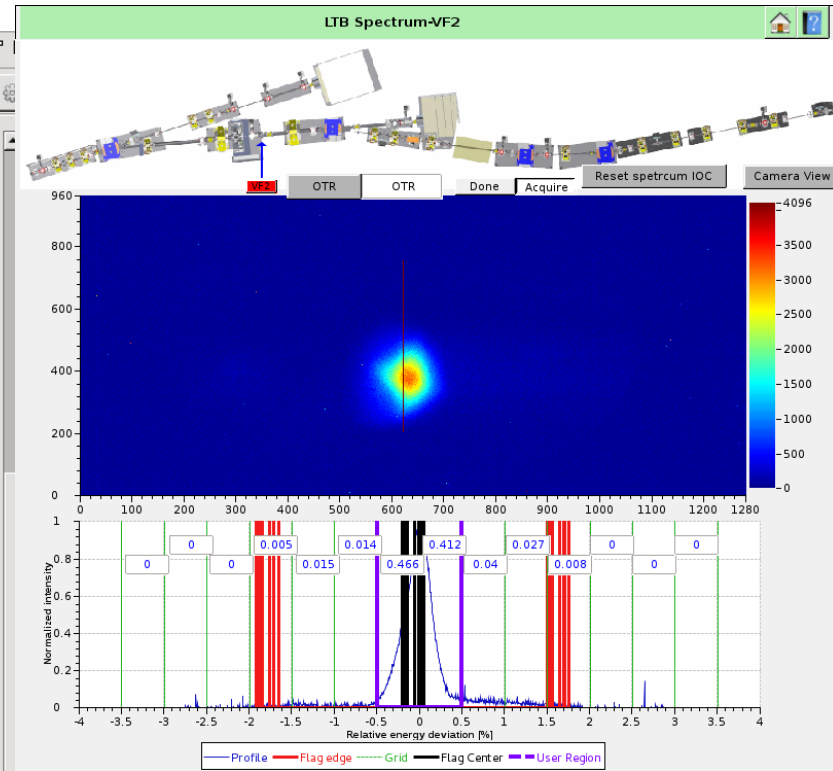
BNL NSLS2

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	Pendant 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

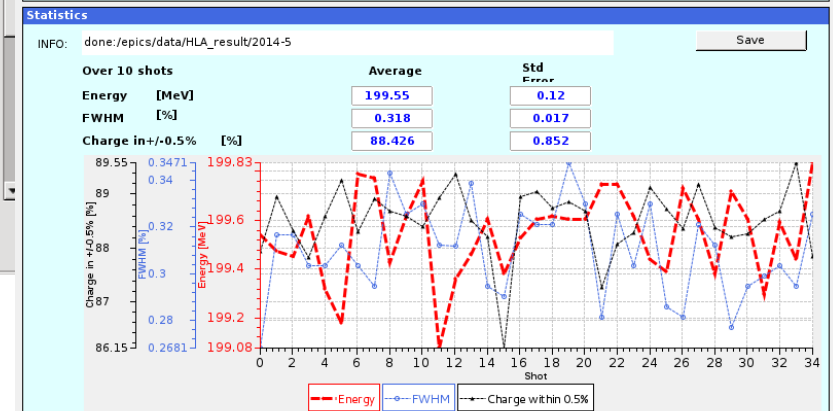
Previous page 1 Next page



Each shot

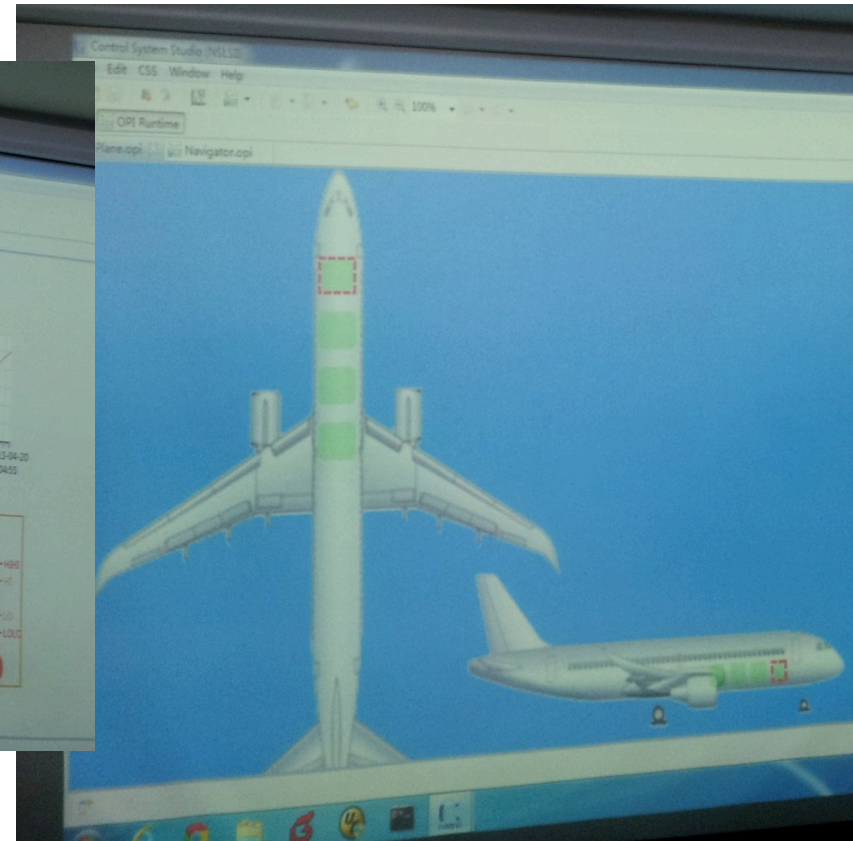
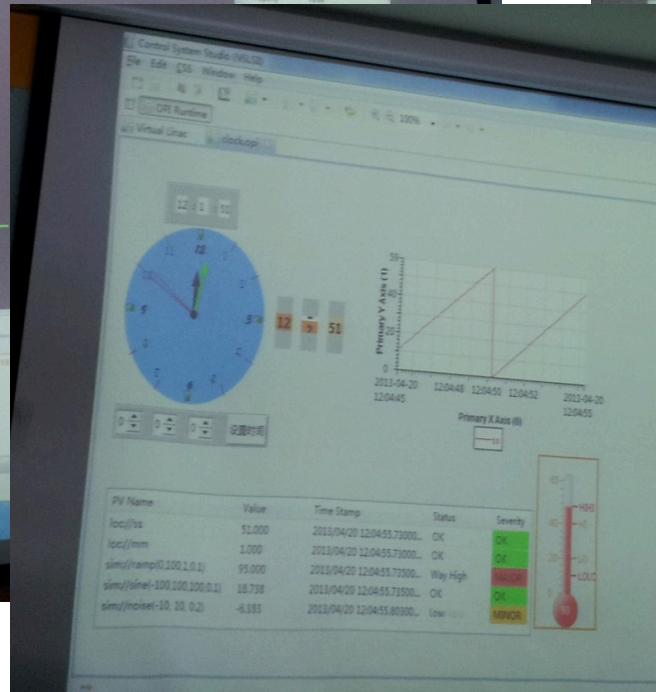
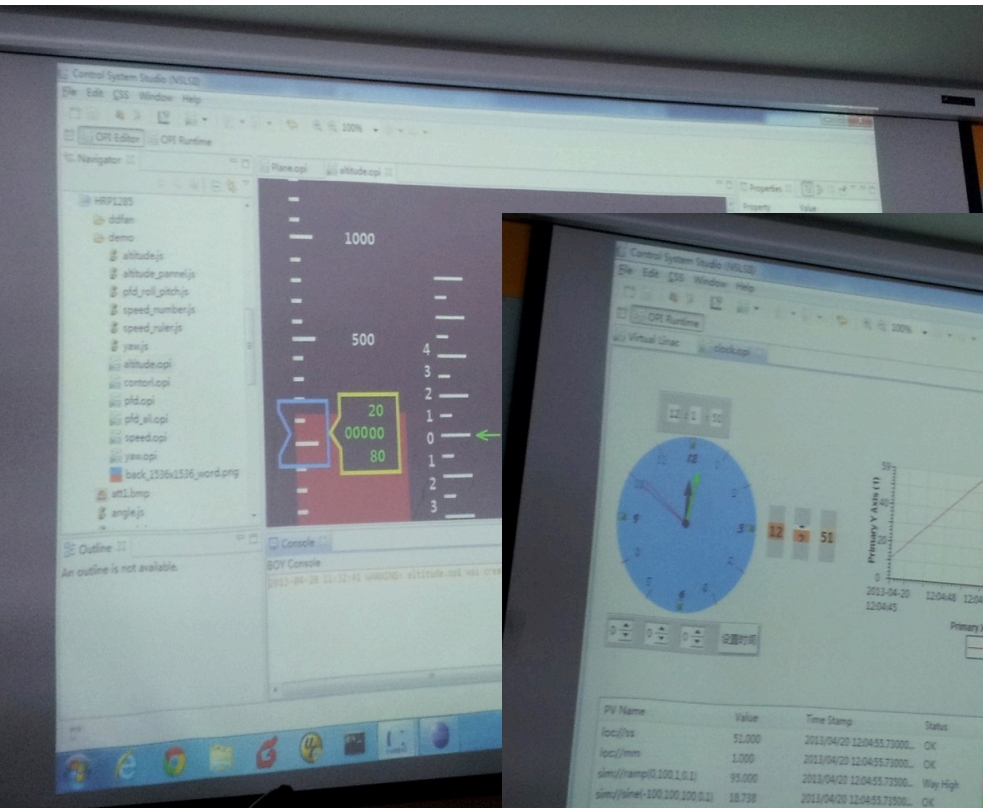
Energy MeV FWHM % Charge within +/-0.5% %

UserLeftRegion % UserCharge within +/-0.5%



Kunal Shroff, May 2014

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...

Context-Menu

The interface consists of several panels:

- Alarm Area Panel:** A grid of colored boxes representing different alarm areas. One box, 'BL-1B NOMAD', is highlighted in red. A context menu is open over it, listing options: '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'ed)' 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

Complete Alarm Perspective:
Tree view, Table of current alarms

Integration: Alarm...

Alarm Area Panel

- IH
- BL-1B NOMAD
- BL-3 SNAP
- BL-7 VULCAN
- BL-11A POWGEN
- BL-14B HYSPEC
- BL16B VISION
- IPPS

Alarm Tree

- Area: IH
- Area: BL-1B NOMAD (major-ack)
- Area: BL-3 SNAP
- Area: BL-7 VULCAN
- PV: BL7:Det:All:Stat
- PV: BL7:CS:Stat:SkfChoppers
- Area: BL-11A POWGEN
- Area: BL-14B HYSPEC
- Area: BL16B VISION
- Area: IPPS

Alarm Table

Current Alarms (0)

PV	Description	Alarm Time	Current Sev	Current Sta	Alarm Sev	Alarm Statu	Alarm Value

Acknowledged Alarms (1)

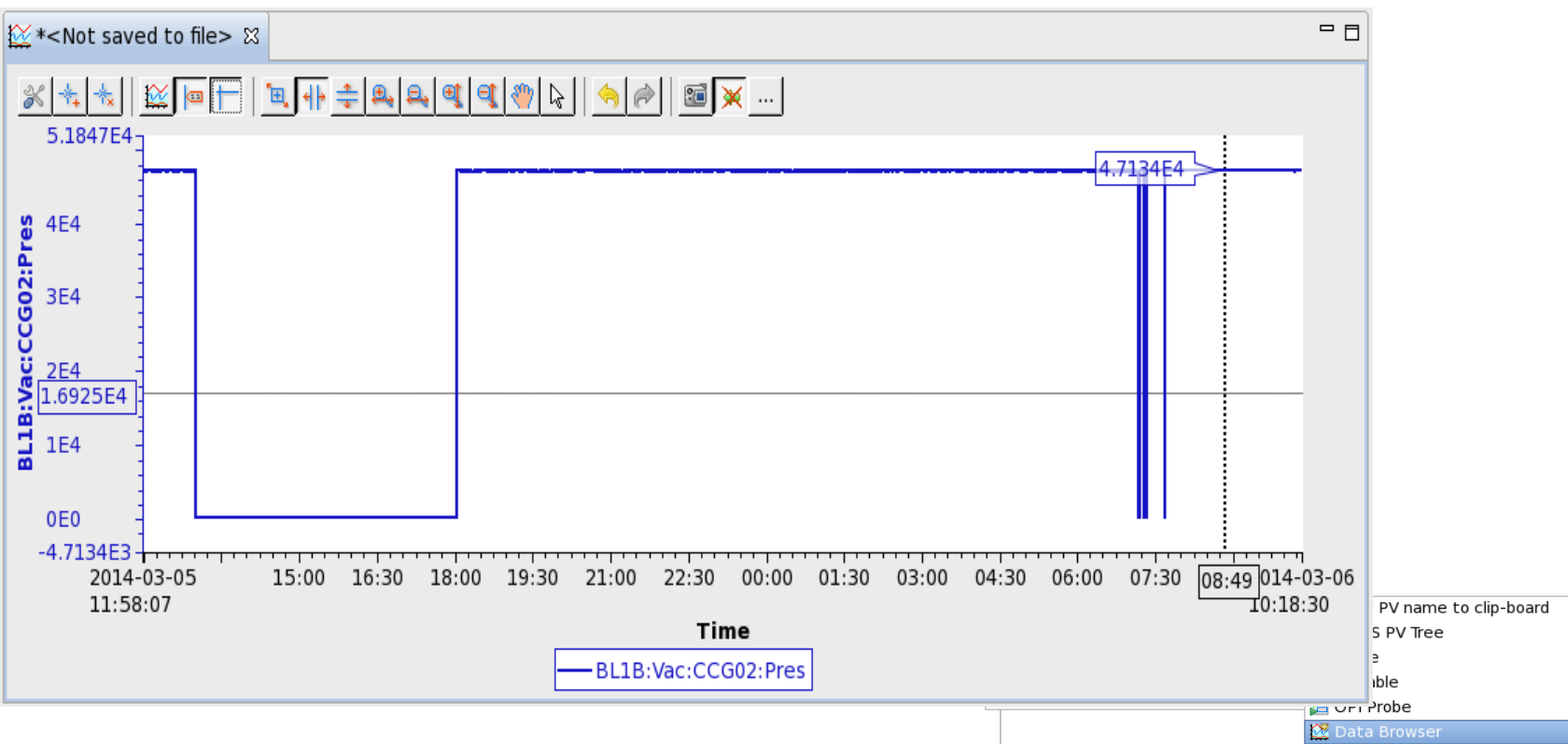
PV	Description	Alarm Time	Current Sev	Current Sta	Alarm Sev	Alarm Statu	Alarm Value
BL1B:Vac:VacOK	major-ack'd alarm: Beam Line 1 B Vacuum	2014/03/0					

What to do

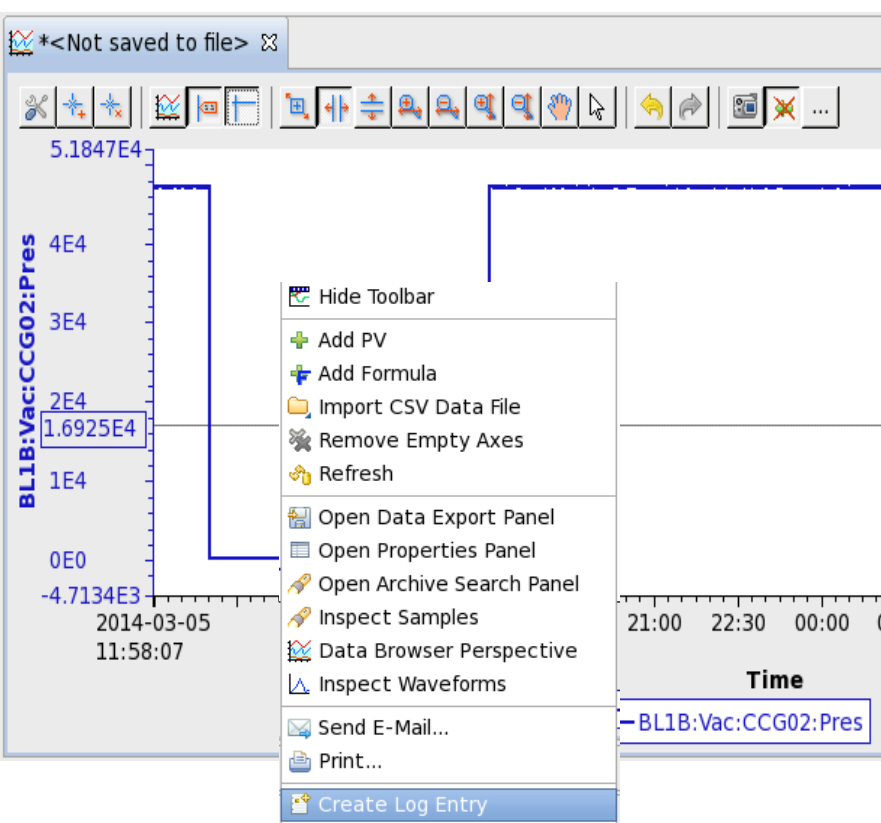
- NOMAD Overview
- VACUUM DISPLAY

OAK RIDGE National Laboratory

Integration: Alarm...



Integration: Alarm...



Create Log Entry

User Name: Password:

Date: Level:

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:

Tags:

Hide details

Images Files Properties

CS-Studio

is a collection of components.

Integrated Workflow:

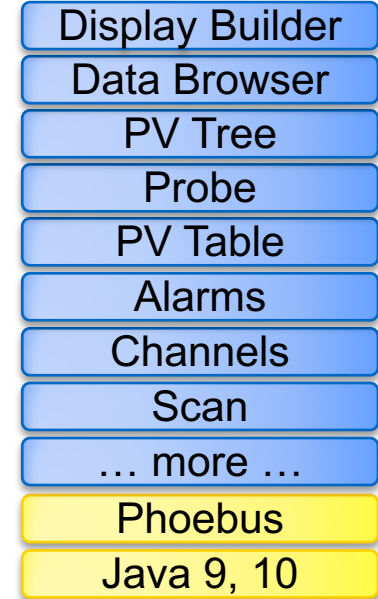
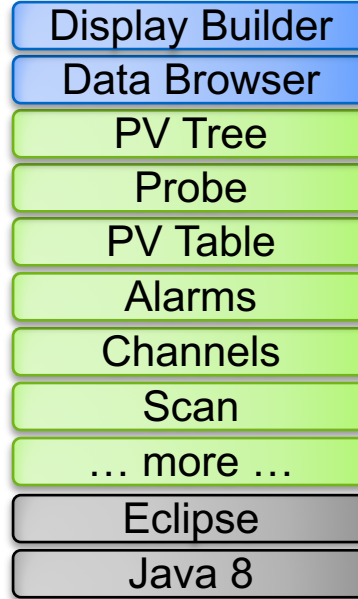
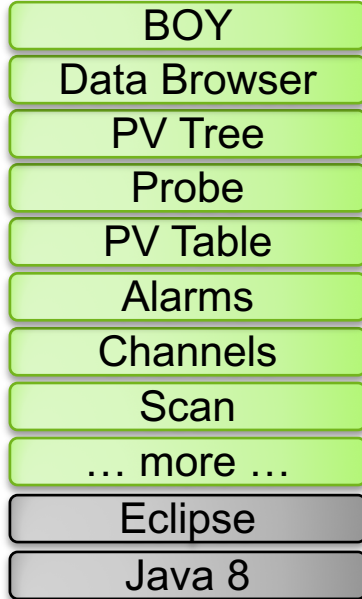
- Alarm display
- Display Builder (Channel Access)
- Data Browser (with RDB Archive)
- Logbook (SNS Elog)

Result:

Operations 2014-04-03 10:40	<p>The instrument returned to normal automatic operation as of 10:39.</p> <p>RFQ Recovery from SCL 19a Trip</p> <p>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.</p> <p>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.</p> <p>- 2014_04_03_103941.jpg -</p>
Operations	<p>LEPT changes channel C dropping out Charles Peterson</p>

Evolution of CS-Studio

JavaFX SWT



Since ~2010:
Operational at several
sites

Since ~2016:
SNS beam lines,
planned for ESS

2019:
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

100 %

Beam Power 0.3 Watts

Shutters

MANDI

Vacuum & Choppers

Detectors

Instrument Floor

Software Status

Sample Environment

Alarm Tree X

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

BL-11A POW... BL-11B MA... BL-12 TO...
 BL-13B FNPB BL-14B HYS... BL-15 NSE
 BL-17 SEQU... BL-18 ARCS BL-1A US...
 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 COR...
 BL16B VISION HFIR TGT

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]

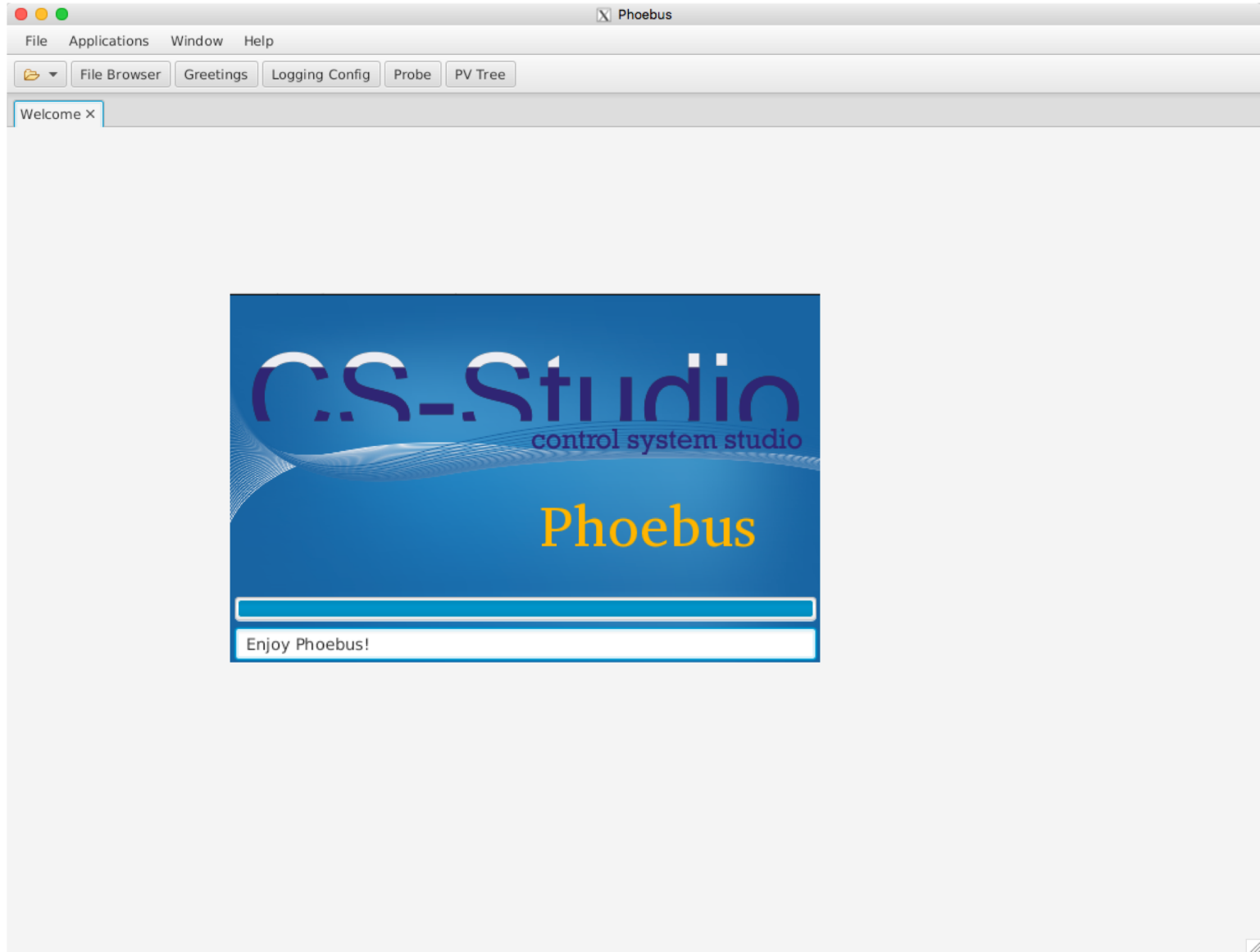
70.0 71.0 72.0 73.0 74.0 75.0 76.0 77.0 78.0 79.0

00:00 12:00 00:00 12:00 00:00 12:00 00:00 12:00 00:00 12:00 00:00 12:00 00:00 12:00 00:00 12:00

2018-07-19 2018-07-19 07:19 07:20 07:20 07:21 07:21 07:22 07:22 07:23 07:23 07:24 07:24

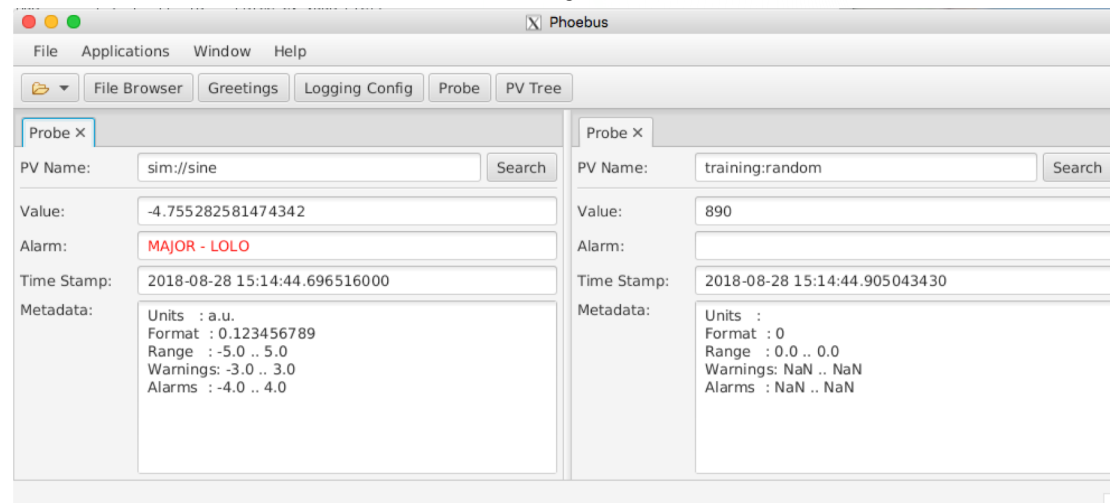
Getting Started with CSS

- Start `css`



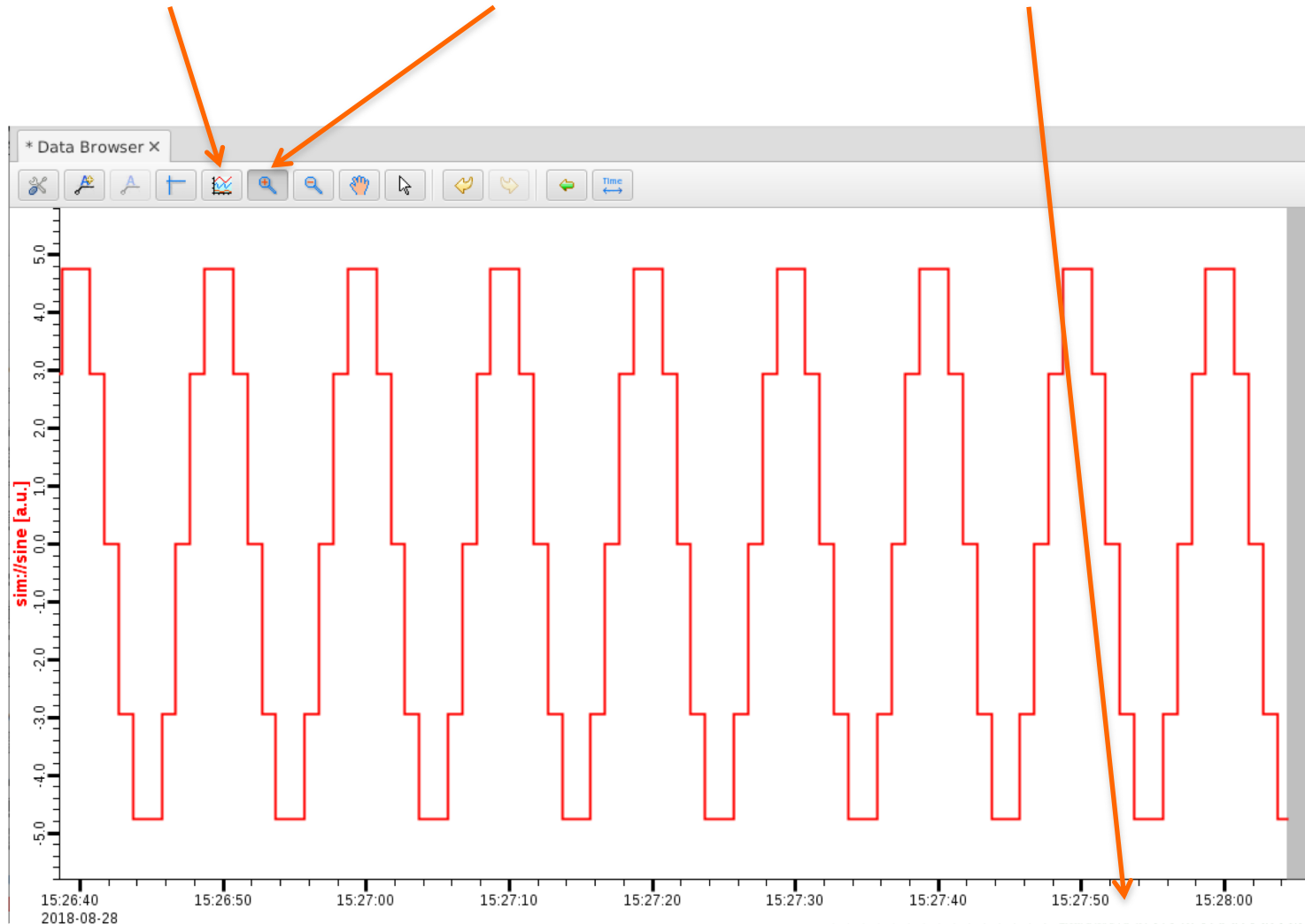
Exercise: Probe

- 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.



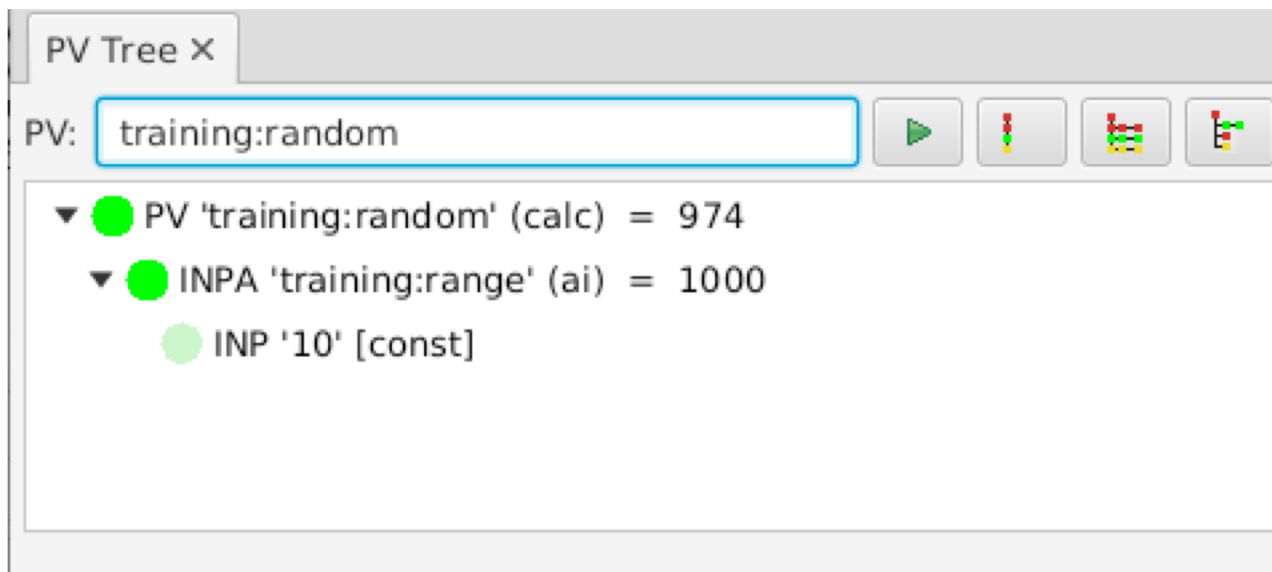
Exercise: Data Browser

- 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”



The screenshot shows a window titled "PV Tree X". Inside the window, there is a text input field labeled "PV:" containing the text "training:random". To the right of the input field are four icons: a play button, a vertical bar chart, a horizontal bar chart, and a tree diagram icon. Below the input field, a tree structure is displayed:

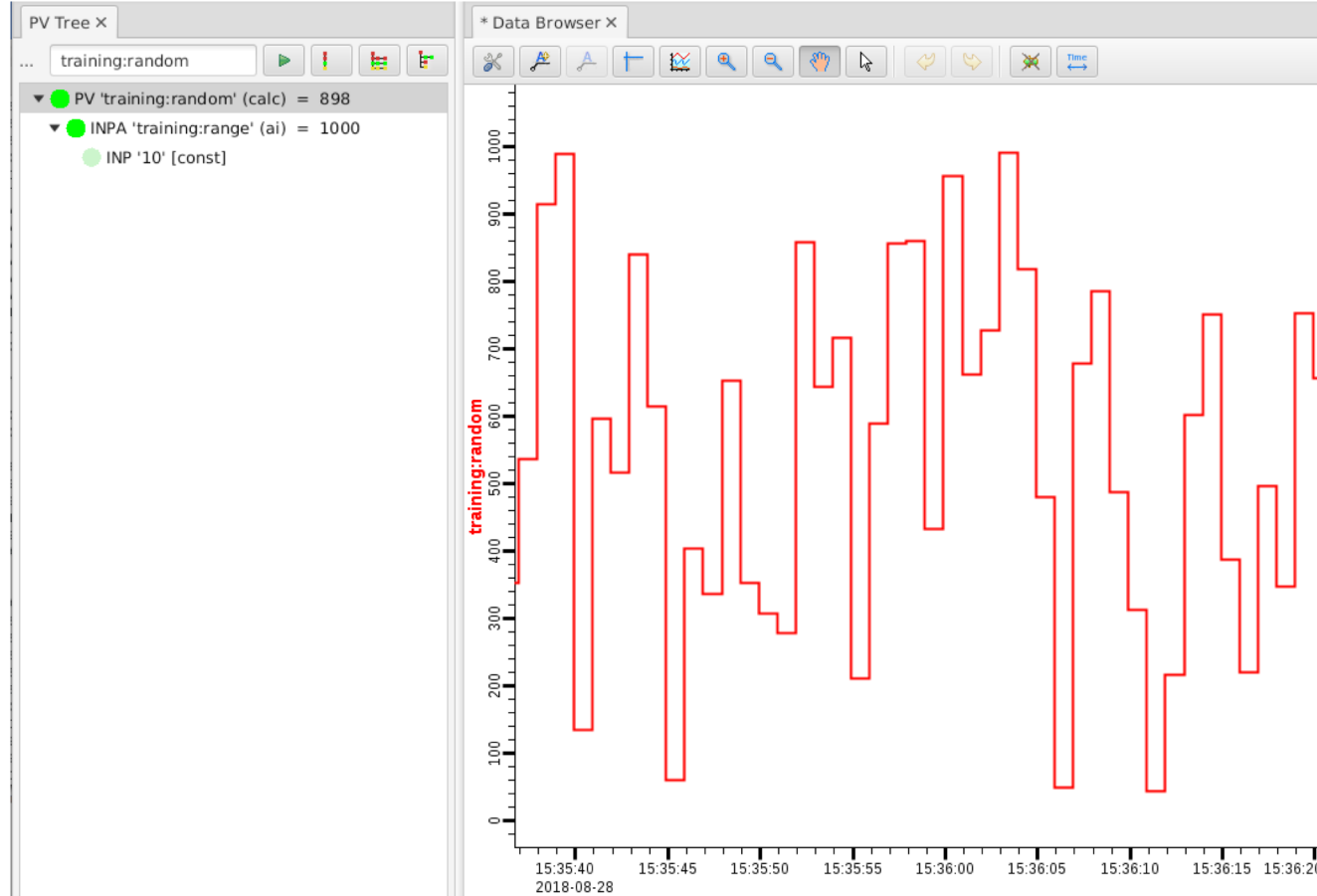
- ▼ ● PV 'training:random' (calc) = 974
 - ▼ ● INPA 'training:range' (ai) = 1000
 - INP '10' [const]

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

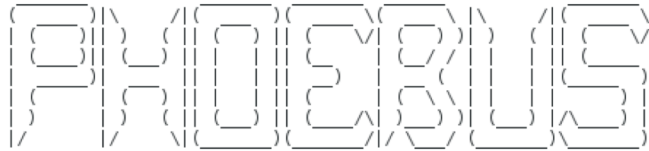
- Hide the toolbar
- Open File Browser
- Split Pane Horizontally, leave file browser at left
- Lock the left pane
- Window, Save Layout As..., “Demo 1”

- 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

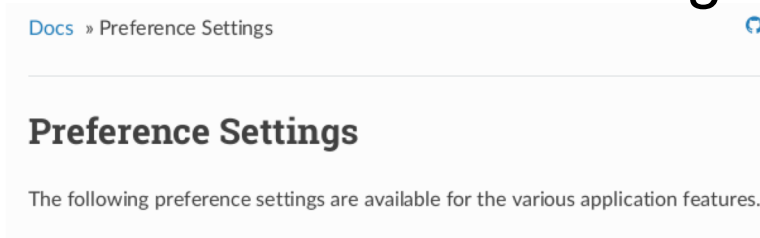
- For command line settings, run with `-help`:



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
```