

Control System Studio: An Integrated Toolset

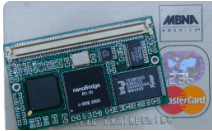
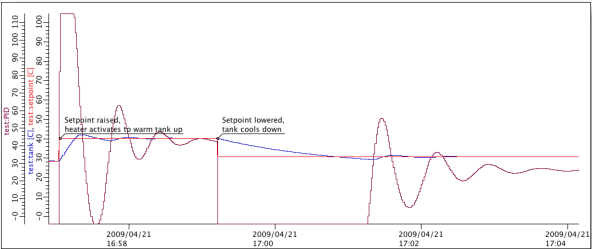
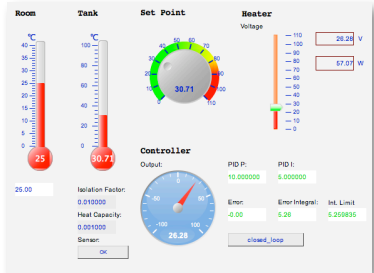
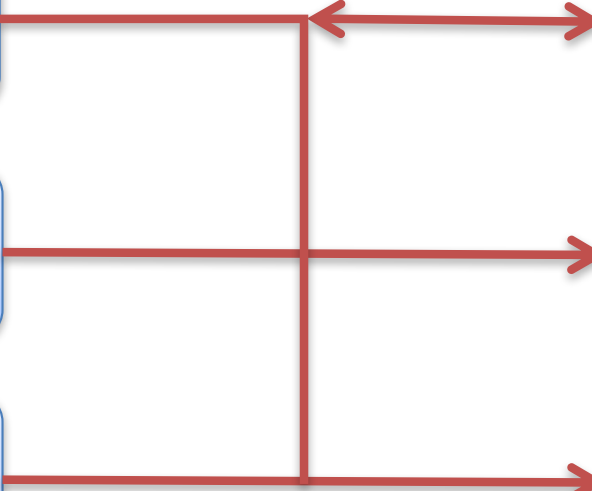
Kay Kasemir,
ORNL/SNS

EPICS: Distributed System

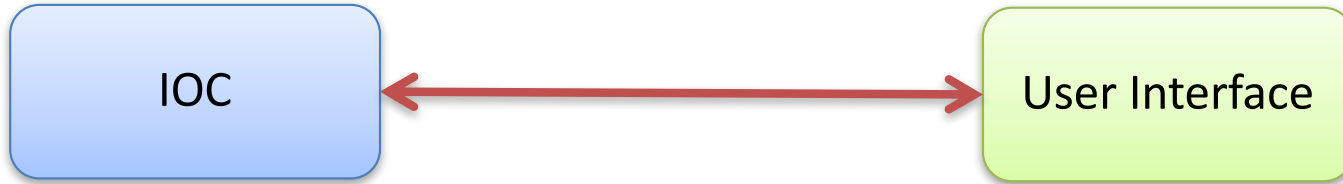
Servers



Clients



Over the years



Since ~1990:

```
record(ai, "my_record")
{
    field(DTYP, "MyDevice")
    field(INP , "@channel2")
    field(SCAN, "1 second")
    ...
}
```

More supported platforms:
vxWorks, RTEMS, Linux, OS X, Windows, ..
68000, Intel, PPC, Arm, ..

1. edd/dm 198x
2. medm 199x
3. edm 200x
4. CS-Studio 201x
2009: BOY
2017: Display Builder

Also:
tcl/tk/ca, python/qt/ca, ..

Limited upward-compatibility.

Control System (CS) Studio

User Interface tools

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

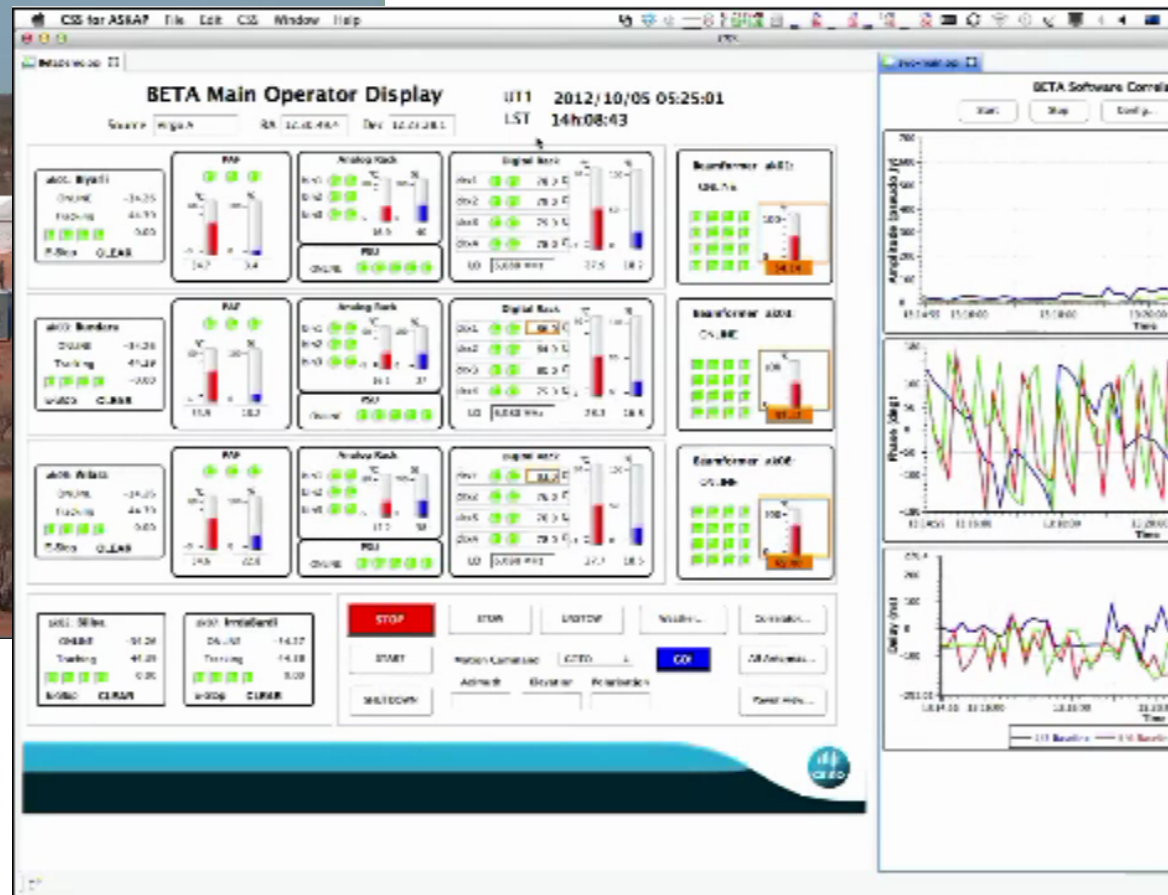
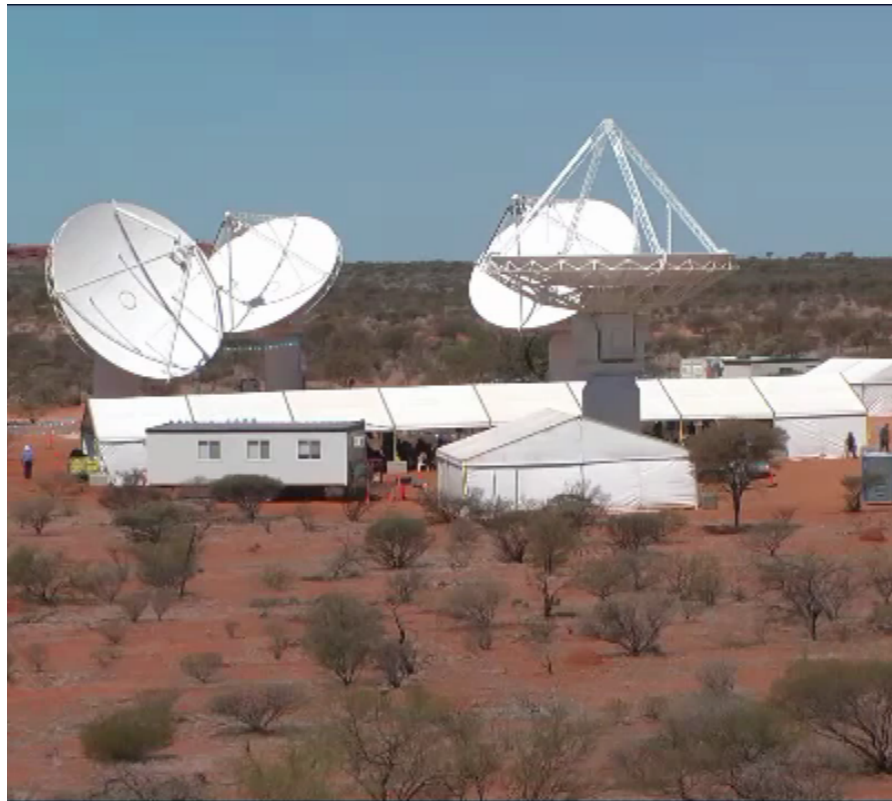
Also

- Archive system
- Alarm Handler
- Site-Specific support for logbook, IOC and channel information, ..

.. combined into an integrated, site-specific user-interface tool for Windows, Linux, OS X

What does CS-Studio look like?

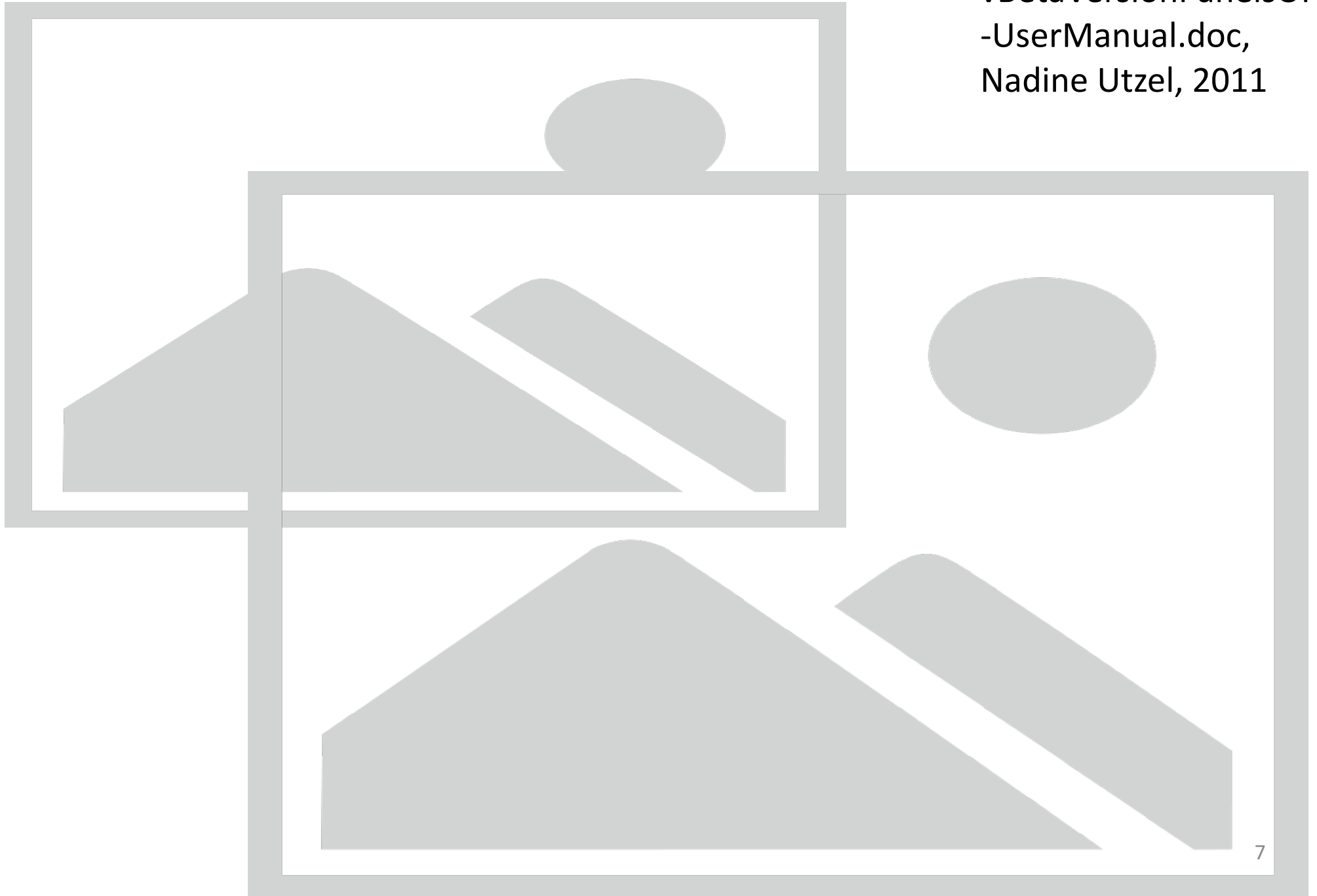
Australian Square-Kilometer Array Pathfinder (ASKAP)



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

ITER

ITER-FPSC-
vBetaVersionPanelsOPI
-UserManual.doc,
Nadine Utzel, 2011



ORNL 'CG-1D' Beam Line

The screenshot displays the CSS control interface for the ORNL 'CG-1D' beam line. The interface is organized into several functional areas:

- Navigator:** A file tree on the left side showing the directory structure, including folders like 'GIT_cg1d', 'T_share', 'data', and 'Tuesday', and a list of FITS files.
- Camera Control:** A panel with various settings for the camera, including Exposure Time (180.000), Binning (1x1), ADC Speed (1.00 MHz), Shutter Mode (Auto), and Camera State (Idle). It also includes a Cooling section with a Cooler (On) and Temperature (-60.000) and an Advanced section with buttons for Full Control (Simulated), Full Control (Andor), File I/O Configure, and General Camera.
- Display:** A central grayscale image of a turbine component, with X and Y axes ranging from 0 to 2048.
- Motors:** A panel with a table of motor parameters and a diagram of the motor arrangement. The table includes columns for Motor, Readback, Position, Left/Move/Right, and Limits. The diagram shows the relative positions of the Lift Table, Short Axis, Long Axis, Large Rotation T., Detector Table, Small Rotation T., Camera Vert., and Robofocus.
- Configuration:** A panel with fields for Start, End, Step, Device, Exposure, Delay, Directory, and File name. It also includes a Go button and a Status section with Angle (90.0 deg), Camera (Idle), and Last file.
- Console/Scan Monitor:** A panel at the bottom showing a table of scan logs with columns for ID, Created, Name, State, %, Runtime, Finish, Command, and Error. The table shows two completed scans for 'Turbine_CT' and 'Turbine_CT_test'.

Neutron Tomography, EPICS/CSS since Jan. 2013

ORNL SNS 'VULCAN' Beam Line

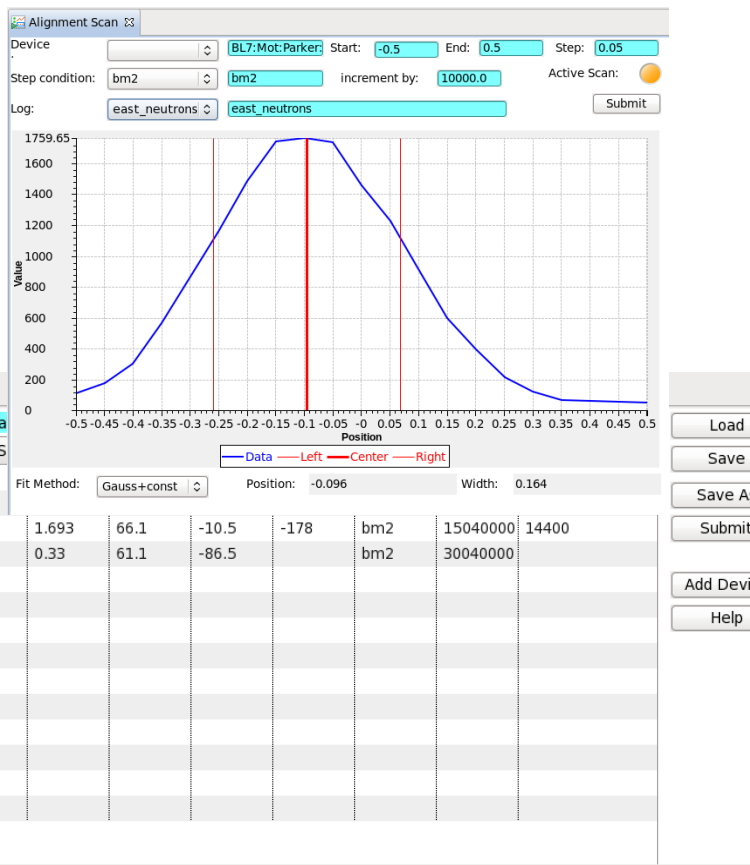


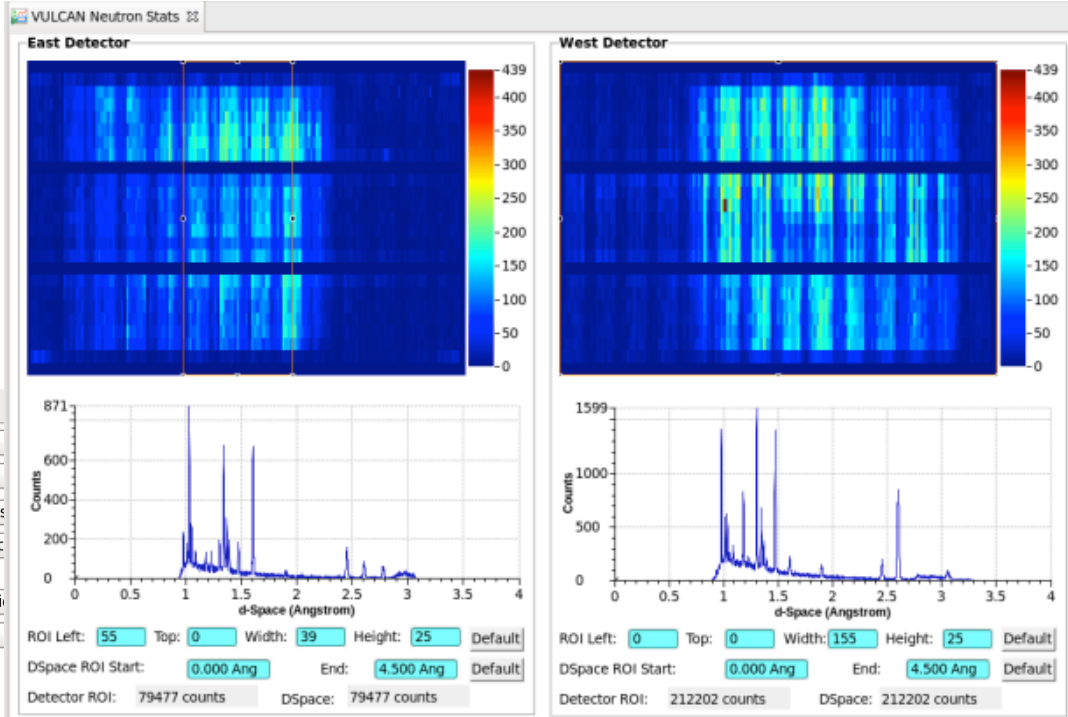
Table Scan

Table: /tmp/Calibration/Si Ca

Comment	BL7:CS:IF	BL7:CS
30Hz HI Si		
30 Hz Hi V		
30Hz HRS	1.693	66.1
30 Hz HR	0.33	61.1
	-10.5	-178
		bm2
		15040000
		14400
		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	11:15:11
988	2014-03-31 13:45:53	/tmp/Calibration/Si Calibration for Al cover.csv	Finished - OK		01:45:21	15:15:11
987	2014-03-30 15:29:55	/tmp/Calibration/Si Calibration for Doug.csv	Finished - OK		11:54:56	03:24:54
986	2014-03-30 15:15:44	Gauss+slope Scan west_neutrons	Finished - OK		00:04:43	15:20:27
985	2014-03-30 15:09:28	Gauss+slope Scan west_neutrons	Finished - OK		00:04:43	15:14:11



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

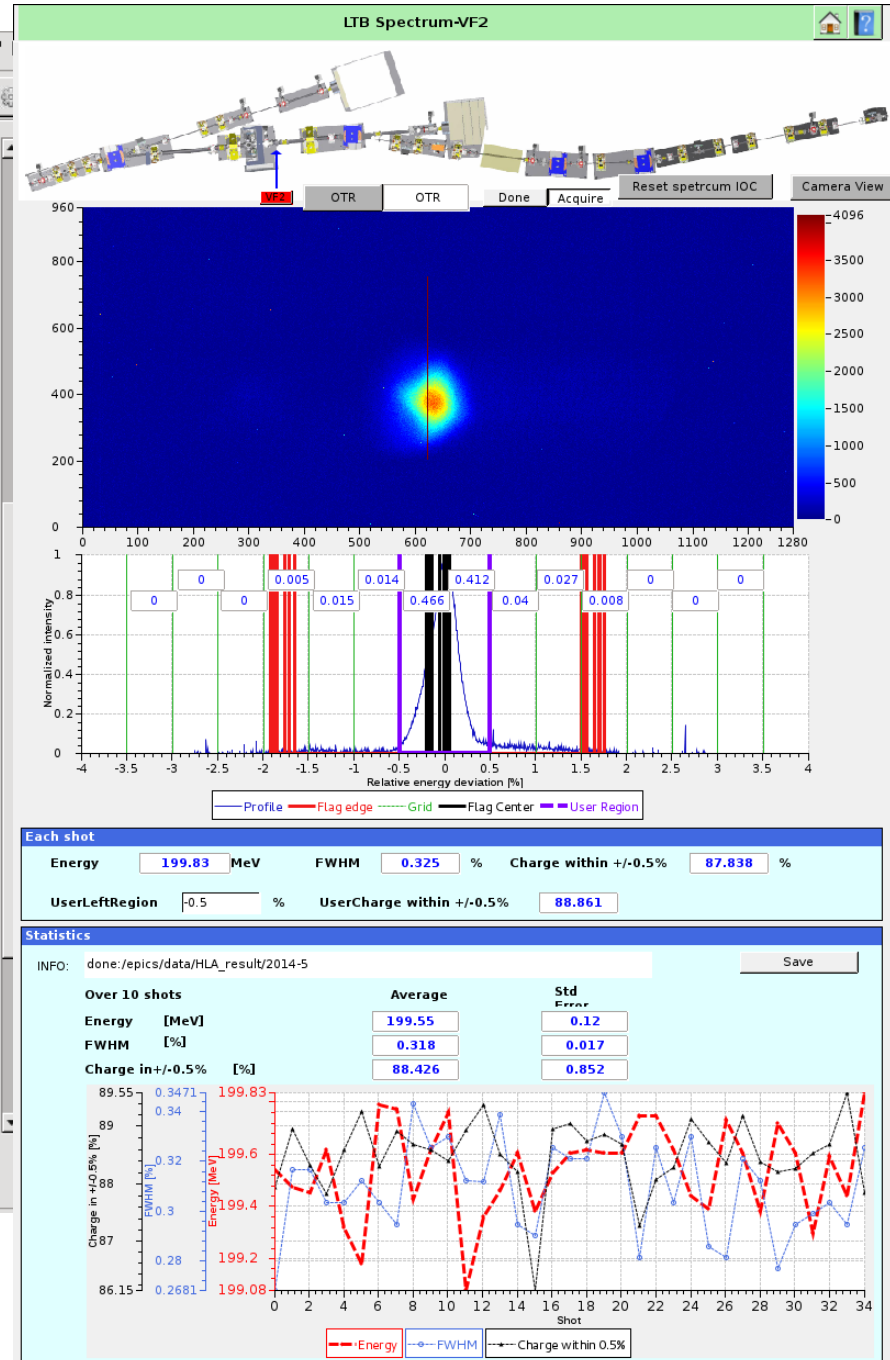
BNL NSLS2

Log Table Log Tree

Log Query: Adv Search

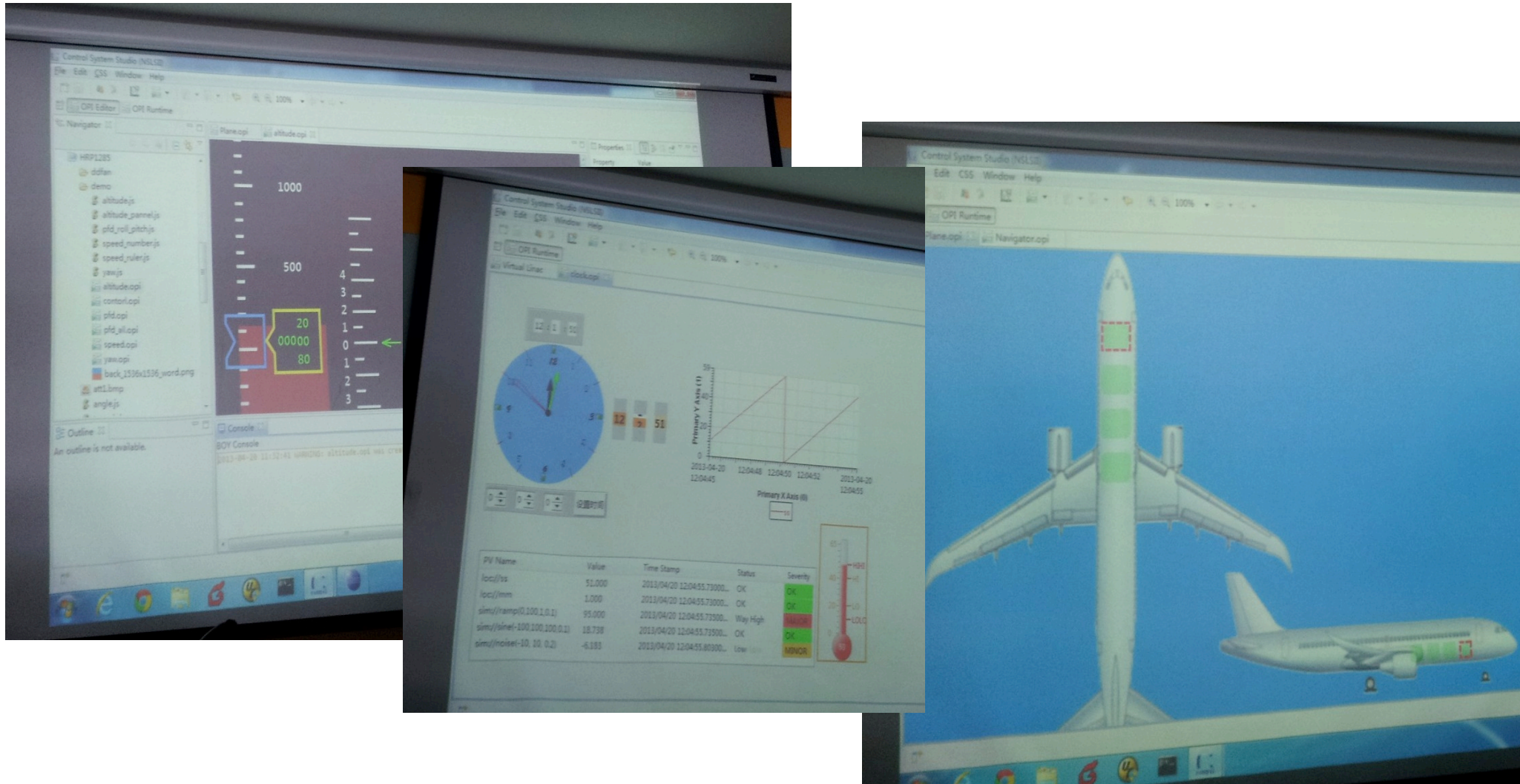
Date	Description	Owner	Logbooks	Tags	A.
5/12/14 7:40 AM modified at: 5/13/14 11:32 AM	Systems are now shut down for SR, BTS, Booster, LBT, and Linac. Klystrons 1 and 3 were left on and in standby.	zeitler modified by: zitvogel	Operations		0
5/12/14 7:32 AM modified at: 5/13/14 11:32 AM	Pentant 3 would 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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Kunal Shroff, May 2014

Airplane Simulator/Test



Somewhere ...

What is CS-Studio?

CS-Studio Components

Common Use

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

Selected Use

- Alarm System
- Channel Archiver, RDB Archiver, Archive Appliance
- ChannelFinder
- Olog, SNS ELog
- DDS, EPICS V4 PVA
- Autocomplete from Channel Finder, SNS PV database, Archive
- SNS MPS Bypass Table
- Therapist

Integration: Alarm...

Context-Menu

The interface consists of several panels:

- Alarm Area Panel:** A grid of colored boxes representing different alarm areas. Most are green, but 'BL-1B NOMAD' is red. A context menu is open over this area, listing options: 'Show in Alarm Tree', 'NOMAD Overview', 'Trigger automated email', and 'Alarm Perspective' (which is highlighted).
- Alarm Tree:** A hierarchical tree view on the left side, showing the structure of alarm areas and their associated Process Variables (PVs). The 'BL-1B NOMAD' area is expanded, showing its PVs.
- Alarm Table:** A table on the right side showing current and acknowledged alarms. The 'Current Alarms' section is empty, while the 'Acknowledged Alarms' section contains one entry for 'BL1B:Vac:VacOK'.

Complete Alarm Perspective:
Tree view, Table of current alarms

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

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

- IHC
- 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

BL1B_Nomad Vacuum

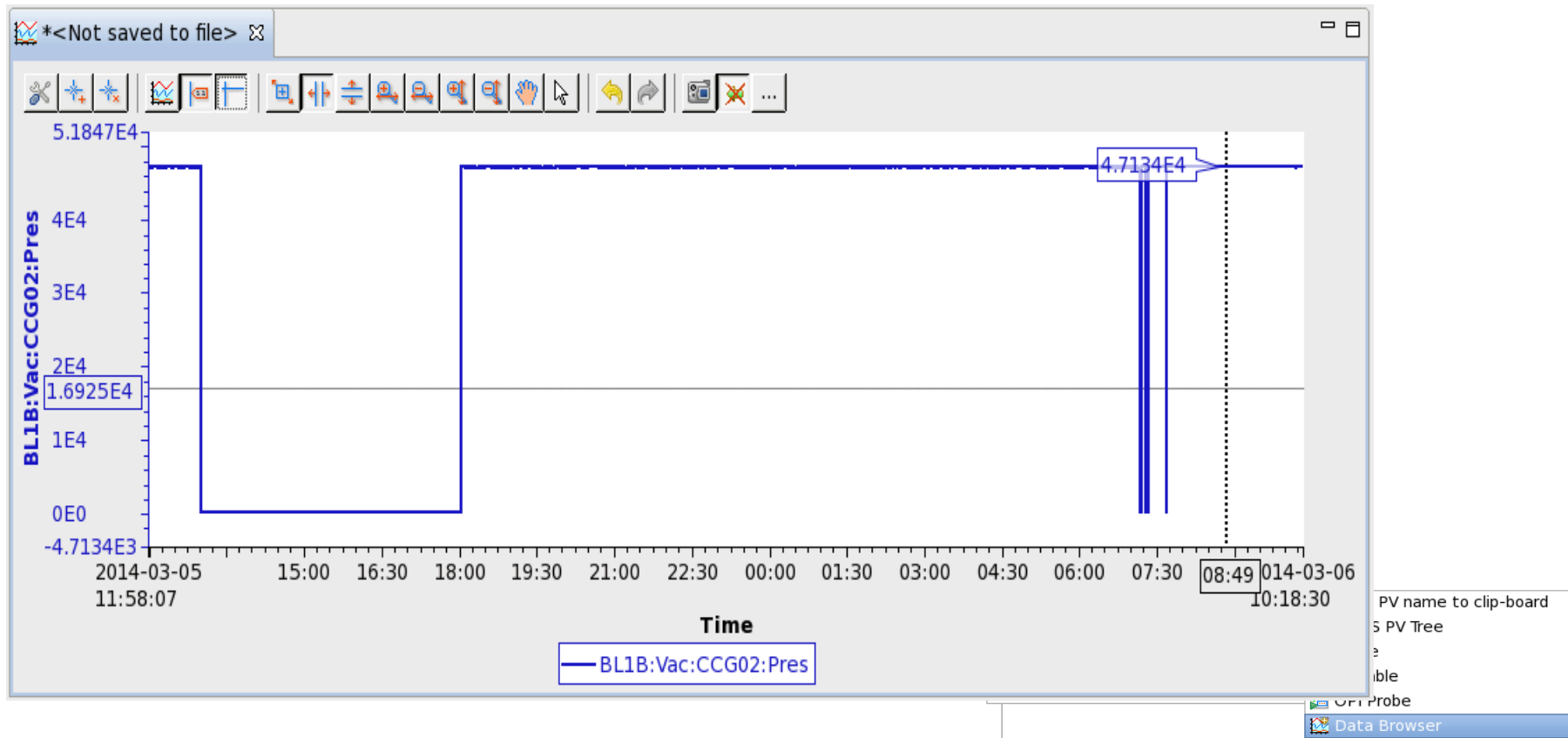
Alarm Table

Current Alarms (0)						
PV	Description	Alarm Time	Current Sev	Current Sta	Alarm Sev	Alarm Statu
Acknowledged Alarms (1)						
BL1B:Vac:VacOK	major-ack'ed alarm - Beam Line 1 B Vacuum	2014/03/0				LOLO_ALAR 0.0

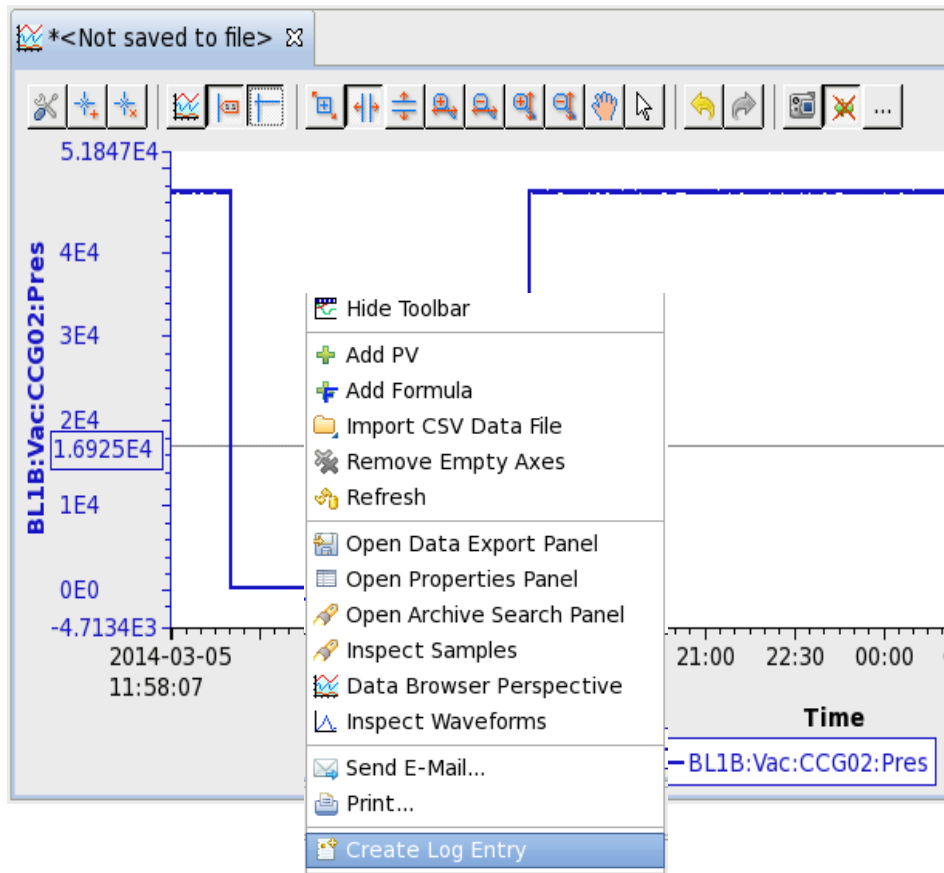
What to do

- NOMAD Overview
- Vacuum Display

Integration: Alarm...



Integration: Alarm...



The 'Create Log Entry' dialog box contains the following information:

- 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

CS-Studio

is a collection of components.

Many of them. Confusing to get started as a developer/integrator.

To end user:

One tool, integrated Workflow

- Alarm display
- BOY Displays (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 09:50.</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>LEBT channel C dropping out Charles Peters</p>