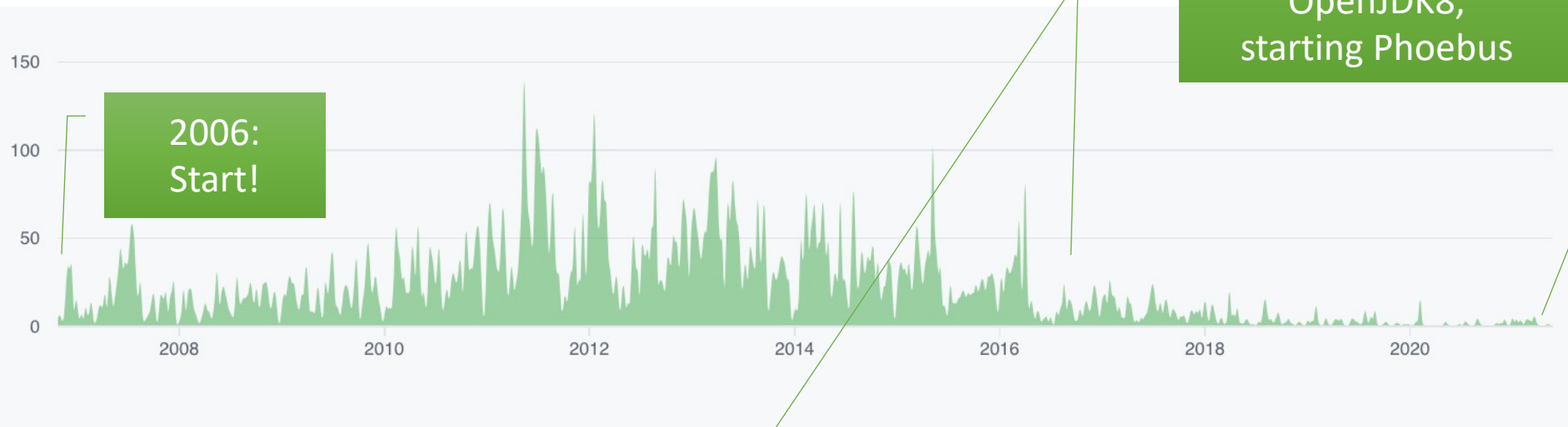


# Phoebus & CS-Studio

Kunal Shroff – NSLS2  
Kay Kasemir – SNS  
Georg Weiss, Anders Harrisson, Fredrik Soderberg – ESS  
Will Rodger, Rebecca Williams – DLS  
Tynan Ford – ALS  
Genie Jhang, Tanvi Ashwarya – FRIB  
Jacqueline Garrahan – SLAC  
Ralph Lange – ITER  
Imran Usmani – ALS

# Collaboration in Action

Github contributions to Eclipse/RCP version ...



2006:  
Start!

2017:  
RCP becomes  
burdensome vs  
OpenJDK8,  
starting Phoebus

Basic support,  
JDK upgrades,  
bug fixes

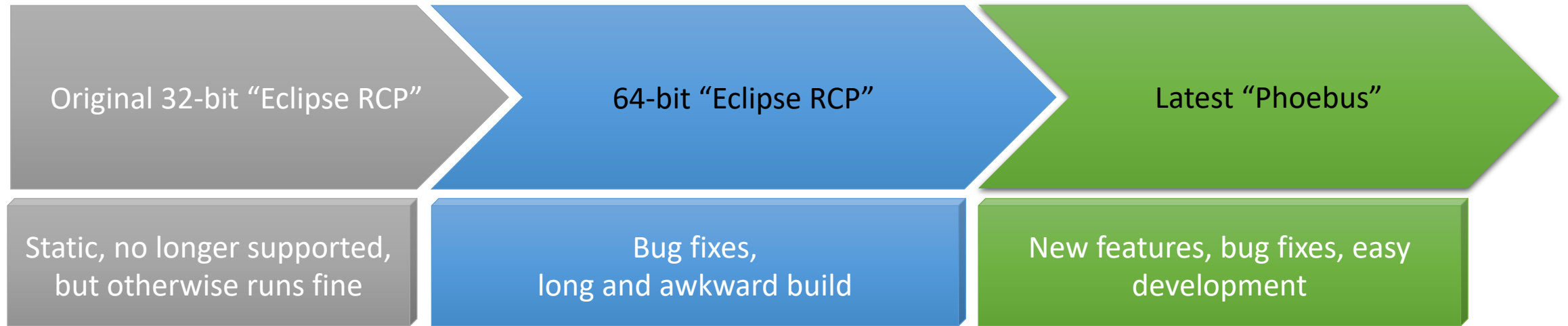
... and current Phoebus version

Implementation  
of key features



Continuing  
development

# Status of individual sites



- SNS Accelerator

- DLS
- ITER
- ISIS
- FRIB (partially)
- NSLS-II (accelerator)
- ...

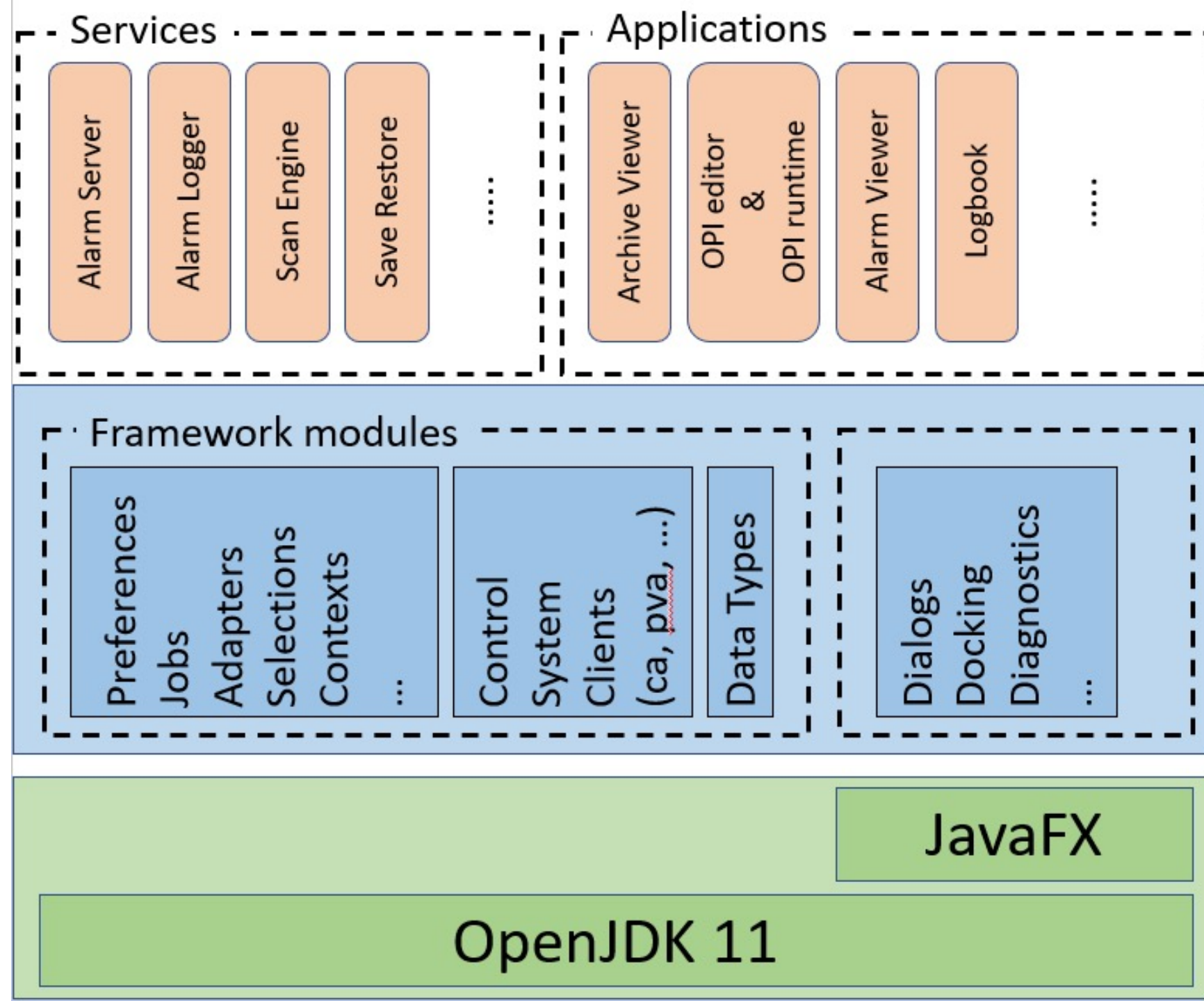
- SNS Beam Lines
- ESS
- ALS
- FHI
- FRIB (partially)
- NSLS2 (some beamlines)
- ...

CS-Studio:

Migration from eclipse to Phoebebus

# Eclipse to Phoebus

All Major CS-Studio applications  
and services have been ported to  
Phoebus

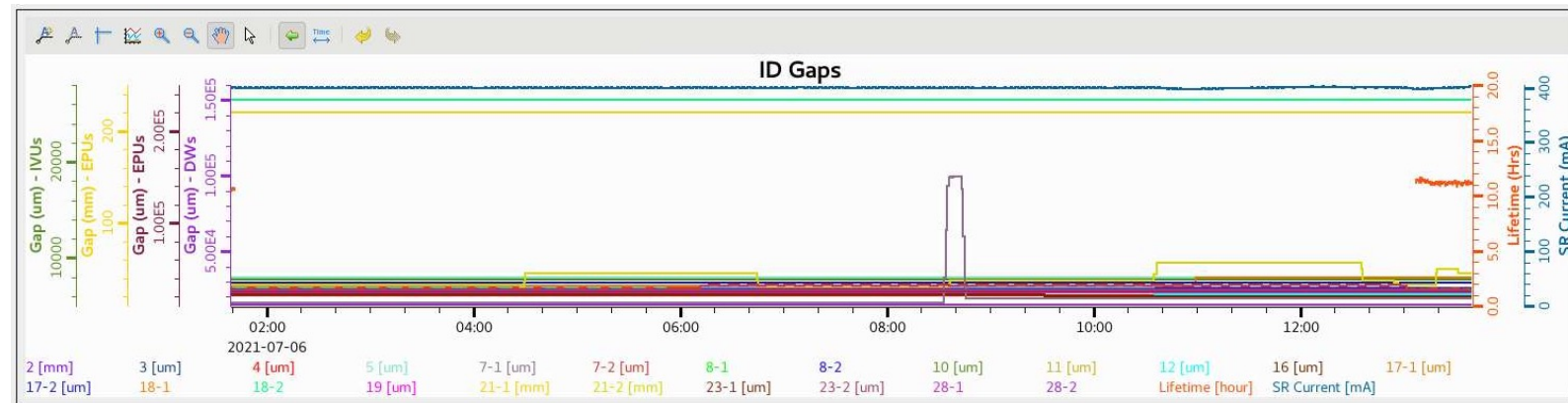


# Databrowser

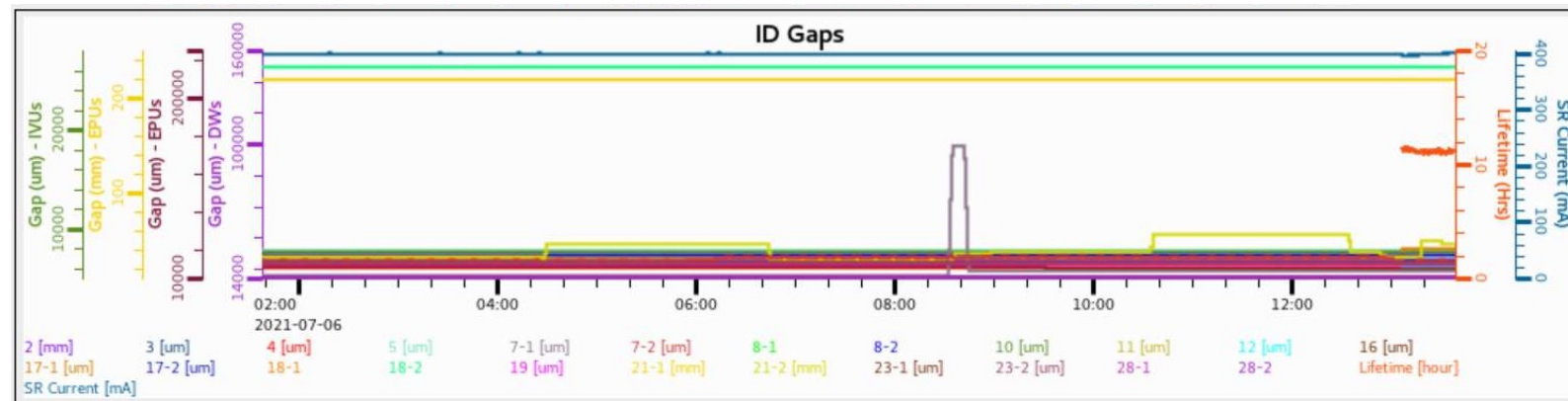
- .plt files can be opened in Phoebus
- Merging features and bug fixes across both the code bases
- Improvements to the Archiver Appliance data retrieval and optimization

<https://github.com/ControlSystemStudio/phoebus/discussions/1796>

[EPICS code-a-thon 2021](#)



Eclipse Databrowser



Phoebus Databrowser



# Logbook

Log Tree

Log Query:  Adv Search

Description	Owner	Log...ks	Tags	A...
12ID gap change caused lifetime	santana	Operatio		1
CSS Olog was not working since 9am	santana	Operatio	RF	0
BRF tripped to STBY from global arc	santana	Operatio	MASAR	0
4539 # LTB BR BTS 20140421	santana	Operatio	MASAR	0
Succeed to save a snapshot #4539	santana	Operatio	MASAR	0
4538 # LN-LTB-All-20131219	santana	Operatio	MASAR	0
Succeed to save a snapshot #4538	santana	Operatio	MASAR	0
I, Mike Santana, have assumed	santana	Operatio	Start	0
Shift Summary: 7/5/2021 - 2000 to	asantiaq	Operatio	Summar	0
I Anthony Santiago have assumed	asantiaq	Operatio	Start	0
Shift Summary: 7/5/2021 - 0800 to	weiner1	Operatio	Summar	0
10-ID X angle adjusted to -0.006	weiner1	Operatio	Beamlin	0
Current Alarms	weiner1	Operatio	Cryo	0
2-ID rack power cycled as per D.	weiner1	Operatio	Insertion	0
23-ID-2 rack power cycled by Flocos	weiner1	Operatio	Insertion	0
2-ID Sample chamber was vented	millert	Operatio	Beamlin	0
I, Gary Weiner, have assumed	weiner1	Operatio	Start	0
Shift Summary: 20:00 7/4/21 - 08:00	zeitler	Operatio	Summar	0
nt email to ID group regarding stuck	zeitler	Operatio	Insertion	0
C23-2-ID stuck. shows error on Ax:BU	zeitler	Operatio	Controls	1
C02 EPU stuck. Shows tilt error.	zeitler	Operatio		1
Setting up for operations. Already	zeitler	Operatio		0
FloCo (Billy) entry for BNL Fire	zeitler	Operatio		0
Study Shift Summary for Unified	yhidaka	Machine		0
A long-term testing of UOFB (Unified	yhidaka	Machine		4
successfully restore machine with	zeitler	Operatio	MASAR	0
successfully restore machine with	zeitler	Operatio	MASAR	0
I, Edward Zeitler, have assumed	zeitler	Operatio	Start	0
Shift Summary: 7/4/2021 - 0800 to	weiner1	Operatio	Summar	0
successfully restore machine with	weiner1	Operatio	MASAR	0
successfully restore machine with	gwang	Operatio	MASAR	0
R. Rainer notes:	weiner1	Operatio	Controls	0

Date: Jul 6, 2021 Level: Info

12ID gap change caused lifetime drop until 17ID-AMX gap change recovered lifetime back. Topoff was unable to keep up during the lower lifetime episode.

Logbooks: Operations

Tags:

Hide details

Images Files Properties Shift

Images:



Log Entry Table X

Query: start=70 days&end=now search

Reply Show/Hide Group

georgweiss  
Markup demo  
Operations  
2021-06-29 15:06:26  
168  
Shift Start

georgweiss  
Markup demo  
Operations  
2021-06-29 14:51:11  
167  
Shift Start

georgweiss  
Markup demo  
Operations  
2021-06-29 14:21:22  
166  
Shift Start

georgweiss  
Markup demo  
Operations  
2021-06-29 14:11:47  
165  
Shift Start

georgweiss  
Test log group  
Operations  
2021-06-16 08:28:19  
155

Contrary to popular belief, Lorem Ipsum is not simply random text. It...

georgweiss  
Test log group  
Operations  
2021-06-16 08:09:16  
154

(attachment/fdbe9a07-cb69-4bf3-96f0-9b4d7694addb)

susanneregnell  
Testing 508  
Operations  
2021-06-02 12:38:34  
153  
Shift Start

susanneregnell  
Testing again  
Operations  
2021-06-01 16:43:15  
152  
Shift Start

New test entry

georgweiss  
Markup demo  
Operations  
2021-06-29 15:06:26  
168  
Shift Start

Markup Demo

Body rendered as HTML

Attachments

Properties

LCR Shift Info

Shift ID	Operator	Shift Lead	Operator Phone	Shift Lead Phone	Shift Lead Email
1234567					
	James Bond				

Supported for multiple logbook services

- Olog
- Phoebus Olog
- SNS logbook
- elog

# Alarm

BEAST → Phoebus Alarm Services

- Alarm Tree
- Alarm Table
- Alarm Panel

Alarm History

Alarm Tree

NSLS2\_OPR

- Area: Common environment (MAJOR/STA)
- Area: Linac
- Area: Booster (MAJOR/STATE\_ALARM)
- Area: Storage ring (MINOR/LINK\_ALARM)
- Area: Experimental Floor (undefined-ack)

Console

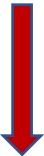
Alarm Table [NSLS2\_OPR]

Current Alarms (4)

	PV	Description	Alarm Time	Curre	Curre	Alarm	Alarm	Alarm
	SR:C3-ID:G1	I.D. 3 IVU Temperature	2021/07/05 01:08:	MINOR	LINK_AI	MINOR	LINK_AI	35.0
	SR-Cry{Cmp:	Compressor A fault.	2021/06/21 09:03:	MAJOR	STATE	MAJOR	STATE	1
	SR-Cry{Cav:f	Cavity D nitrogen exhaust t	2021/07/06 15:30:	MAJOR	LOLO_	MAJOR	LOLO_	10.0
	BR:XS-PS{PS	Booster Extraction Septum	2021/07/05 15:33:	MAJOR	STATE	MAJOR	STATE	Trip

Acknowledged Alarms (19)

	PV	Description	Alarm Time	Curre	Curre	Alarm	Alarm	Alarm
	XF:17IDC-EP	17-ID Rack Group C smoke	2021/06/22 18:02:	UNDEFI	Discon	undefir	Discon	OK
	XF:17IDB-EP	17-ID Rack Group B smoke	2021/06/22 18:03:	UNDEFI	Discon	undefir	Discon	OK
	XF:17IDA-UT	17-ID Rack Water Leak Dete	2021/06/22 18:02:	UNDEFI	Discon	undefir	Discon	OK
	XF:17IDA-UT	A Hutch Water Leak Detecte	2021/06/22 18:02:	UNDEFI	Discon	undefir	Discon	OK
	XF:17IDA-PP	17 I.D. PPS Aperture Pressur	2021/06/22 18:02:	UNDEFI	Discon	undefir	Discon	32.826
	XF:17IDA-PP	17 I.D. PPS Aperture Pressur	2021/06/22 18:02:	UNDEFI	Discon	undefir	Discon	32.964



NSLS2\_OPR Alarm Tree X

NSLS2\_OPR

- Booster
- Common environment
- Experimental Floor
- Linac
- Storage ring

NSLS2\_OPR Alarm Table X

Active Alarms: 46

NSLS2\_OPR

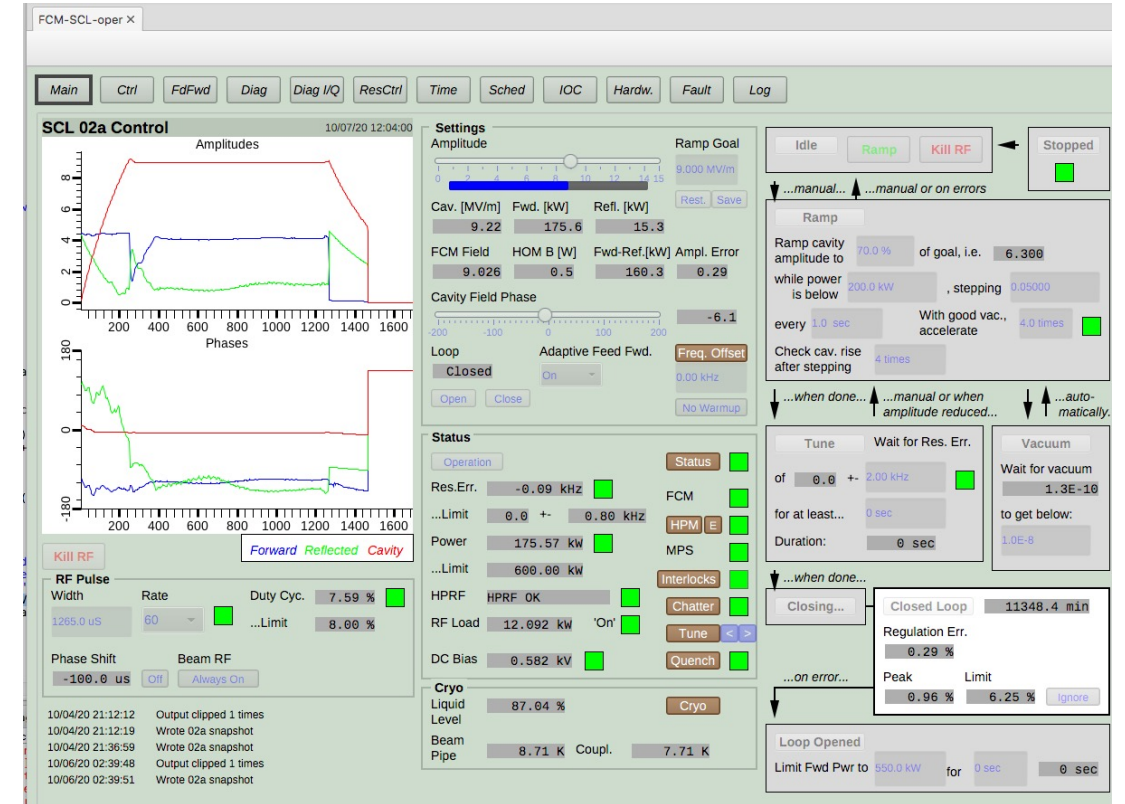
	PV	Description	Alarm Severity	Alarm Status	Alarm Time	Ala
	BR-RF{Xmtr-Load}Flt:Arc1-Sts	Booster transmitter: Arc at load, detector 1!	MAJOR	STATE_ALARM	2021-07-06 13:02:12.738	
	BR-RF{Xmtr-Load}Flt:Arc2-Sts	Booster transmitter: Arc at load, detector 2!	MAJOR	STATE_ALARM	2021-07-06 13:02:12.738	
	BR-RF{Xmtr-PLC}ICS:Down-Sts	Booster transmitter switched back to lower state.	MAJOR	STATE_ALARM	2021-07-06 13:02:12.749	
	BR-RF{Xmtr}Flt:Arc-Sts	Booster transmitter is arcing.	MAJOR	STATE_ALARM	2021-07-06 13:02:13.034	
	BR:A2-BI{BPM:5}Alarm-Sts	Booster Arc2 BPM 5	MAJOR	LINK_ALARM	2021-07-06 13:43:49.104	

Acknowledged Alarms: 1

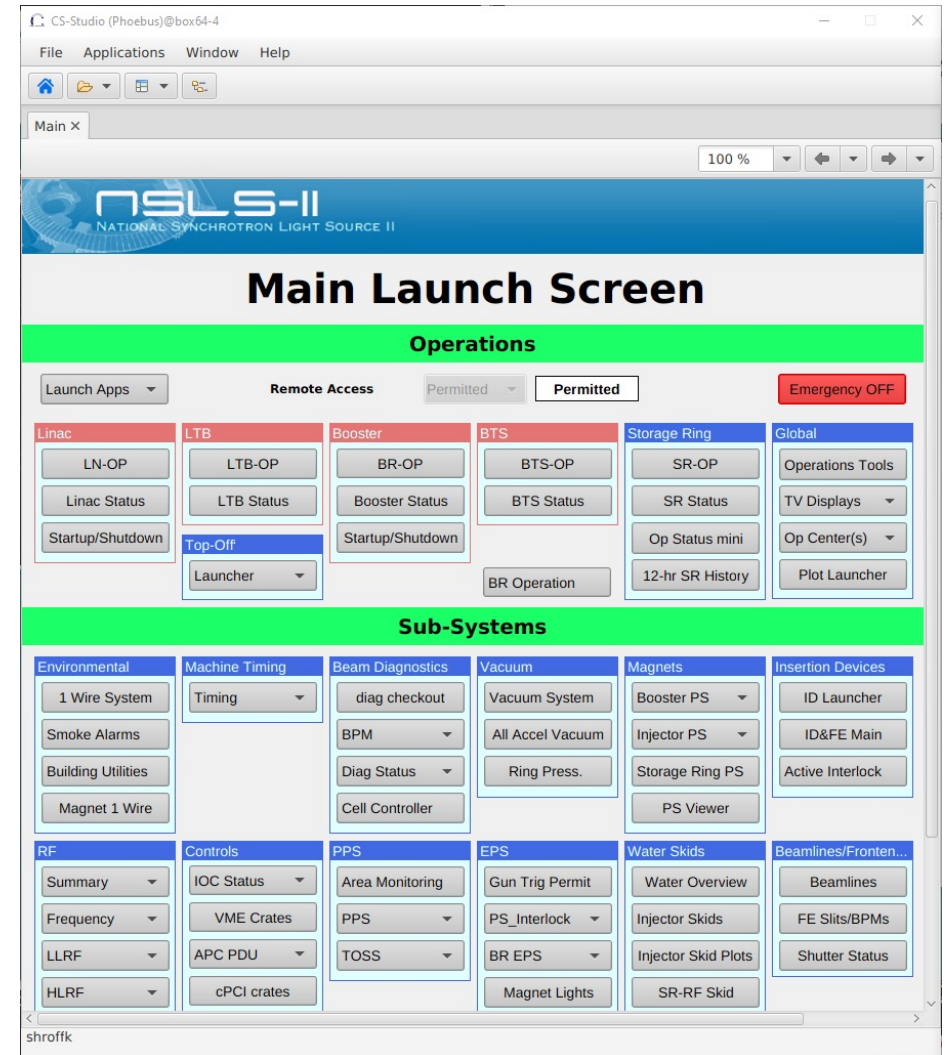
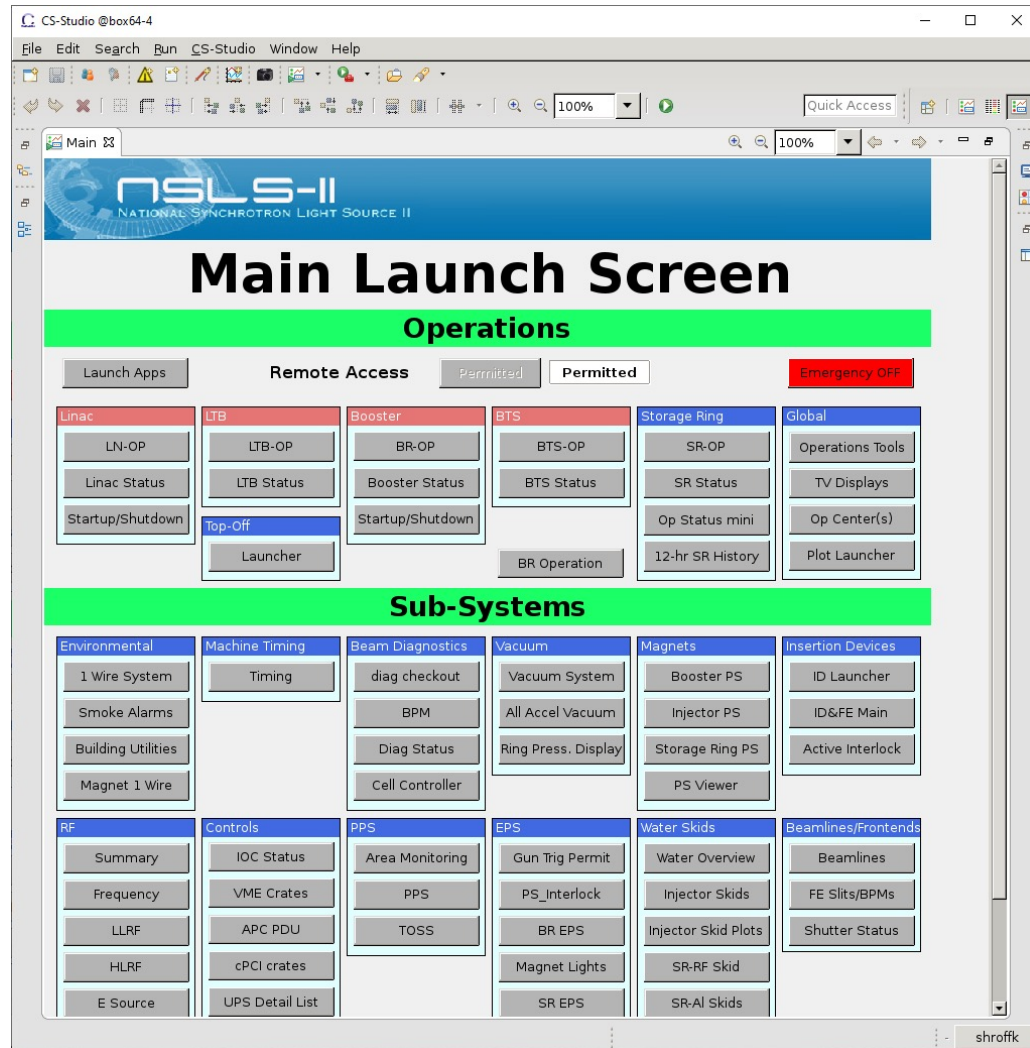
	PV	Description	Alarm Severity	Alarm Status	Alarm Time	Ala
	SR-Cry{Cmprs:A}Trip:02-Sts	Compressor A fault.	MAJOR_ACK	STATE_ALARM	2021-06-21 09:03:30.456	1



# EDM screens converted on runtime



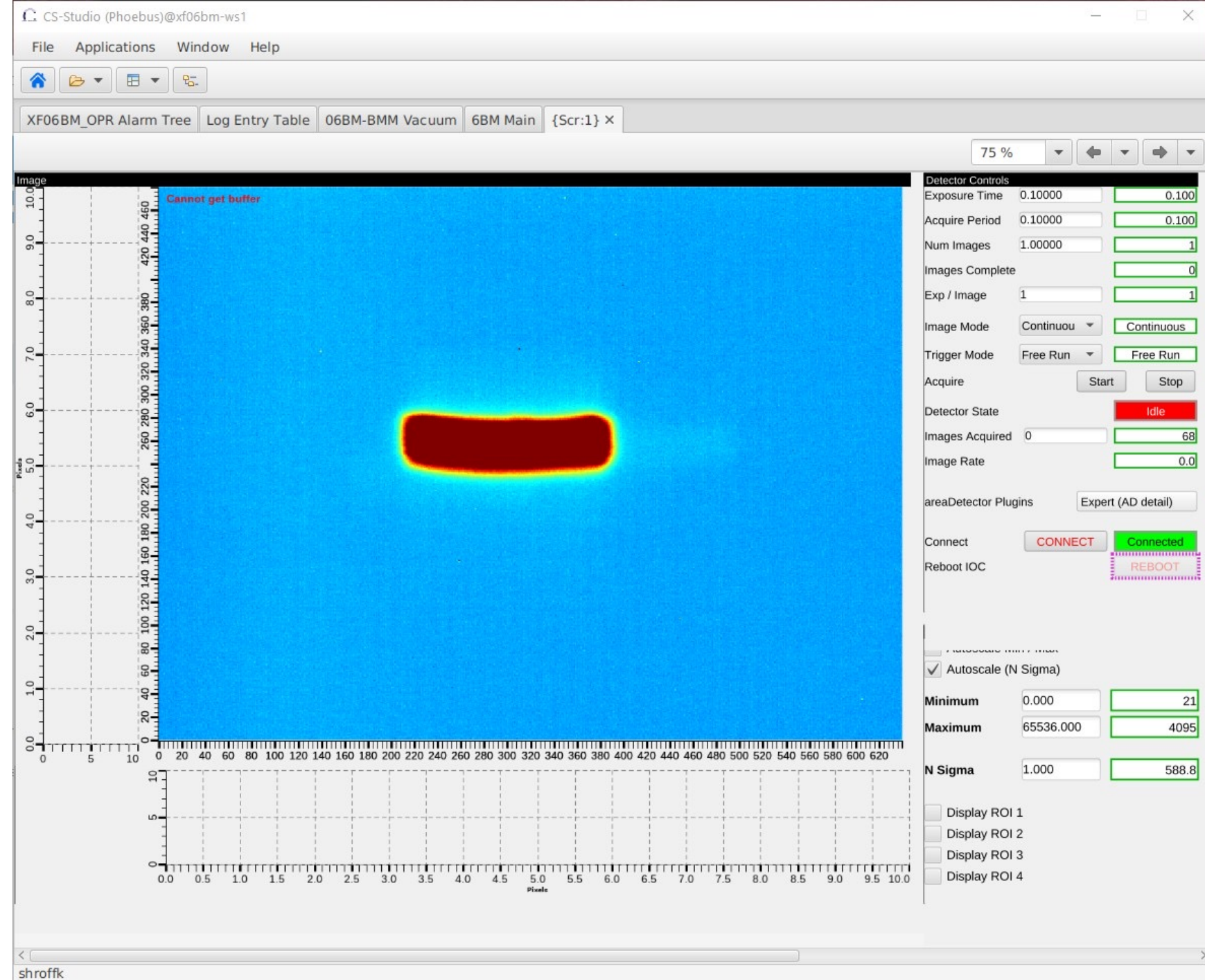
# BOY screens converted on runtime





# Converted BOY screens

Monochrome Camera using Channel Access Image



# BOY to Display Builder

- .edl, .adl, .opi screens are auto converted at runtime
- If the auto converted result isn't perfect
  - **Case 1:** This is a common requirement

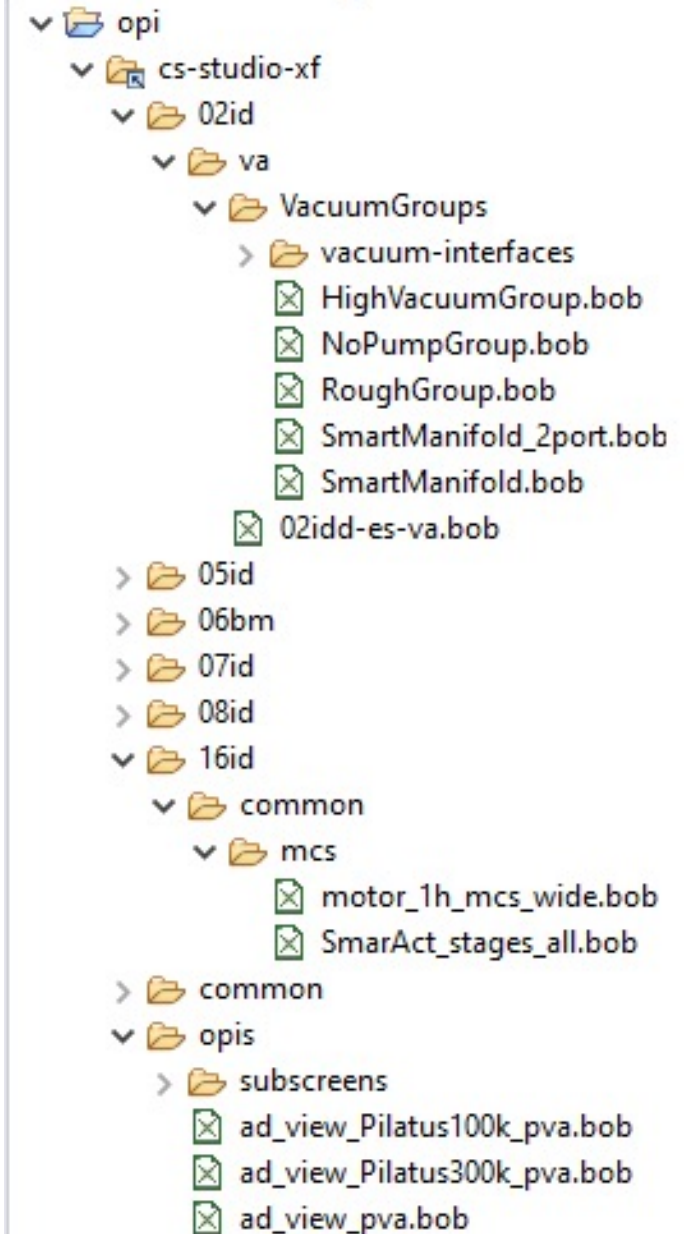
The auto converter in Phoebus is updated  
e.g. [Issue 1564](#) The borders from BOY were not mapping correctly to DB

- **Case 2:** The screen consists of many rules and scripts, complex widgets

These can be opened in editor with a best effort conversion (PV names, macros, widgets, layouts,...)

Once modified the file is stored as a .bob file, future “**open**” requests will launch .bob files if they are present

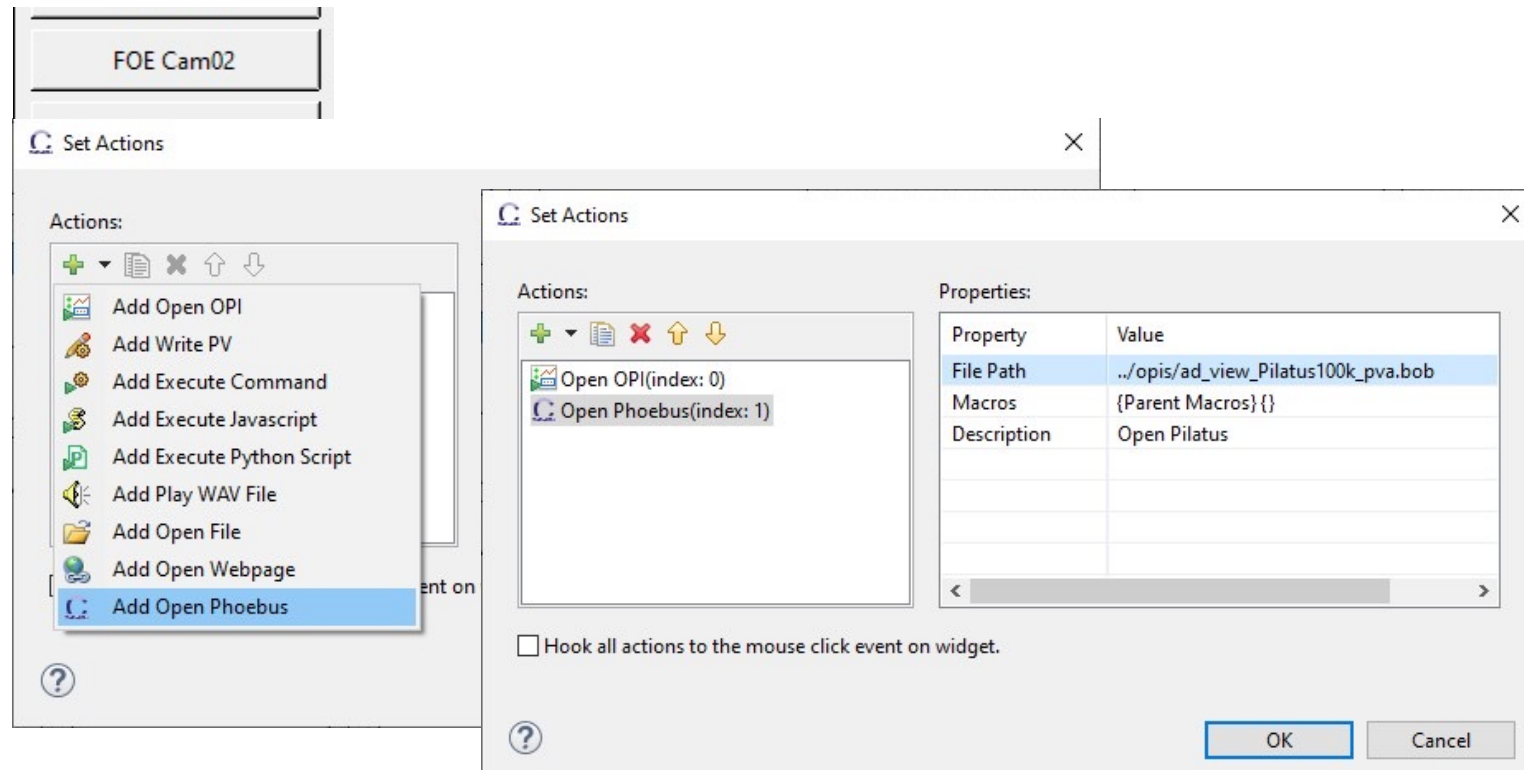
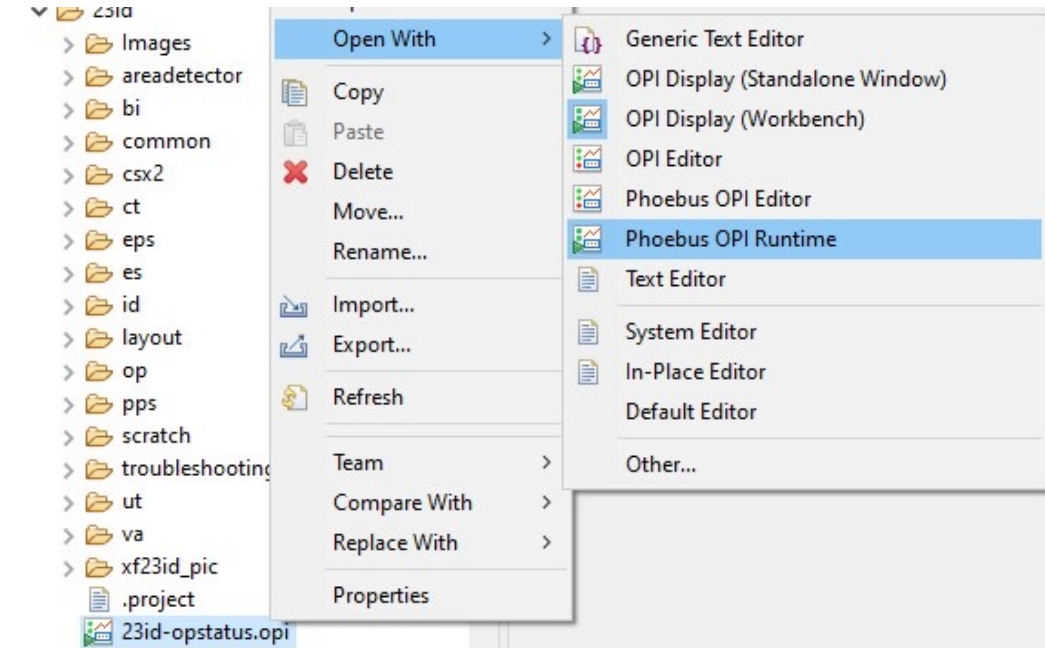
410 file names matching '\*.bob' in 'cs-studio-xf'





# BOY to Display Builder

- Individual files can be opened with Phoebus applications (editor/ runtime)
- Action Buttons & Menu Buttons can be configured to open .opi/.bob files in Phoebus



Beyond Migration

# Improvements to Display Builder

- Display editor improvements
  - Undo support across 'save'
  - Crosshair support in OPI editor
  - Open scripts in external editor

<https://github.com/ControlSystemStudio/phoebus/issues>

# Phoebus

## Formula Functions

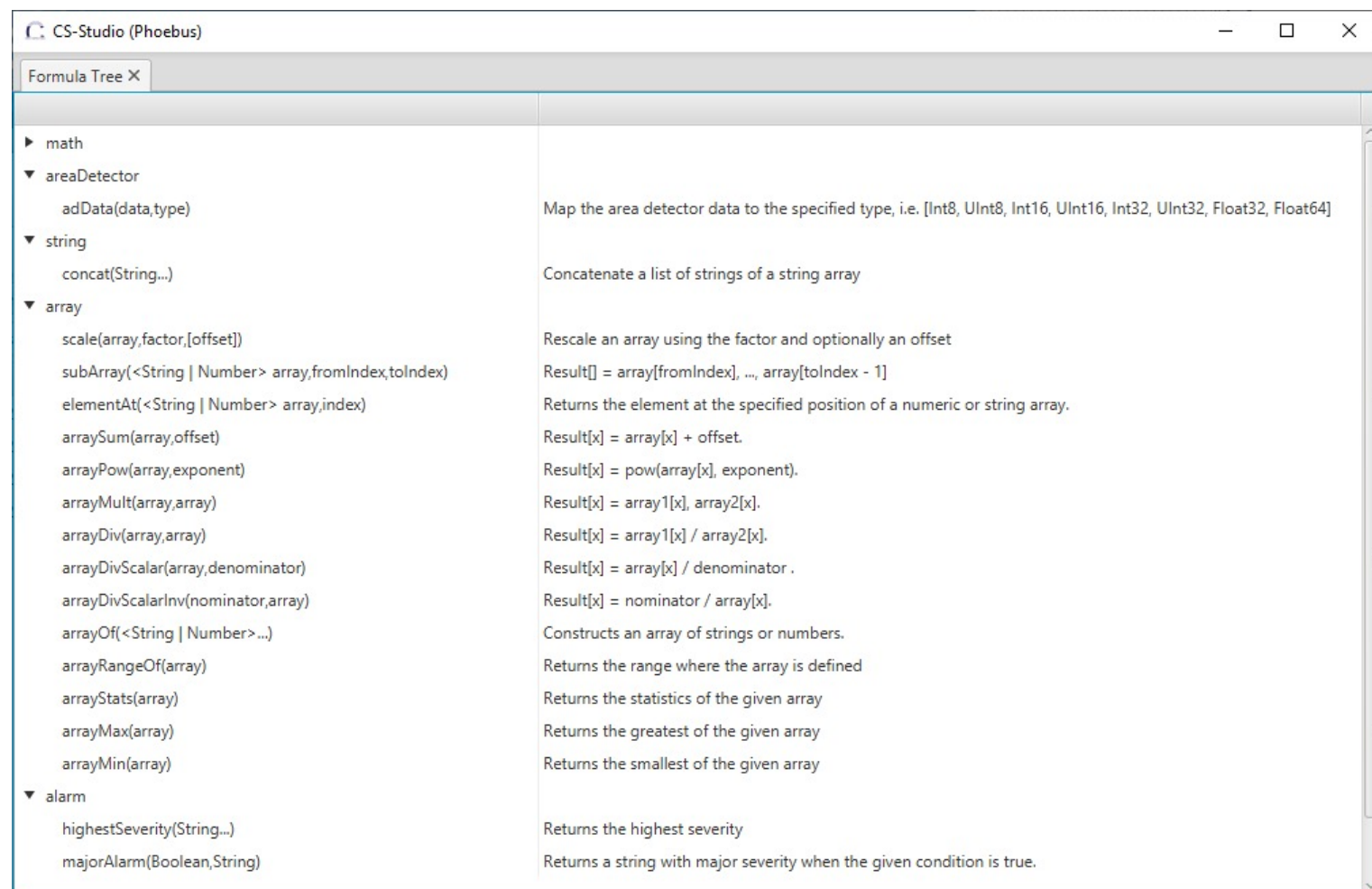
An efficient way to avoid Scripts & Rules

- Data processing happening off the UI thread
- Thread safe access to data
- Connection management

Easier to use

`=(pv1>pv2?pv1:pv2)`

`=adData(`ca://test_image_data`, UInt16)`





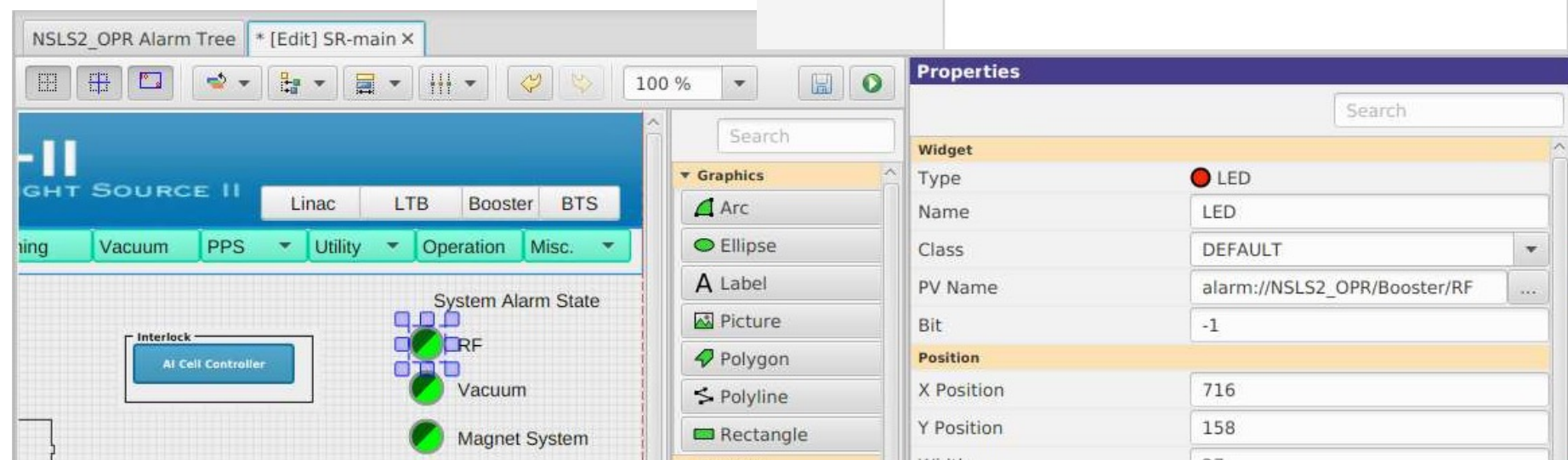
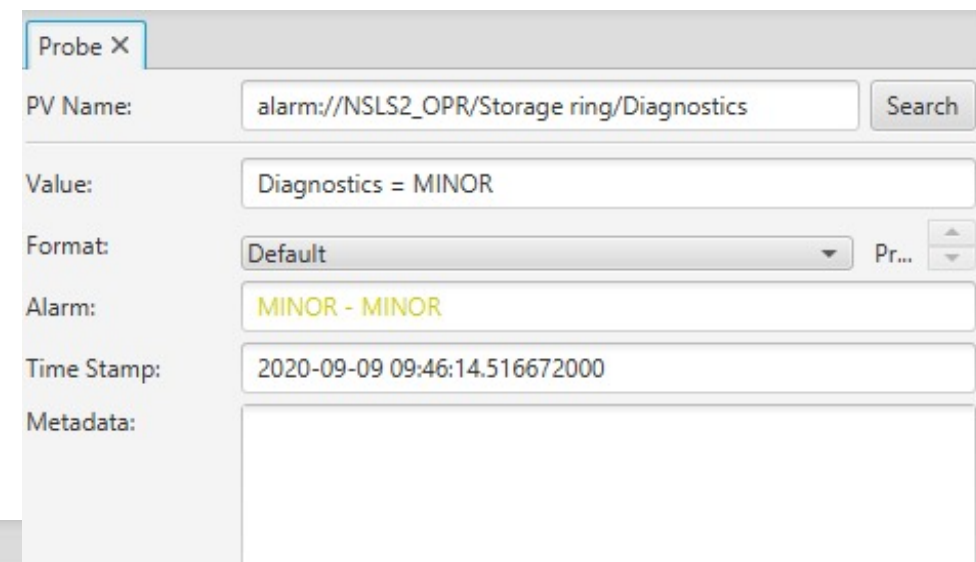


# Alarms Datasource

Nodes of the alarm tree can be accessed as channels

alarm://NSLS2\_OPR/Booster/RF

Alarm Server info can be embedded into .bob screens.



# Auto generated BOB files

- Simplified .bob file structure allows for programmatic creation of BOB screens

<https://github.com/tynanford/phoebusgen>

```
import phoebusgen.screen  
import phoebusgen.widget
```

```
screen = phoebusgen.screen.Screen("Auto generated Screen")  
screen.add_widget(phoebusgen.widget.TextUpdate("test", "test:PV", 10, 10 ,10 ,10))
```

# Core Modules

- Refactor core services

- Selection Services

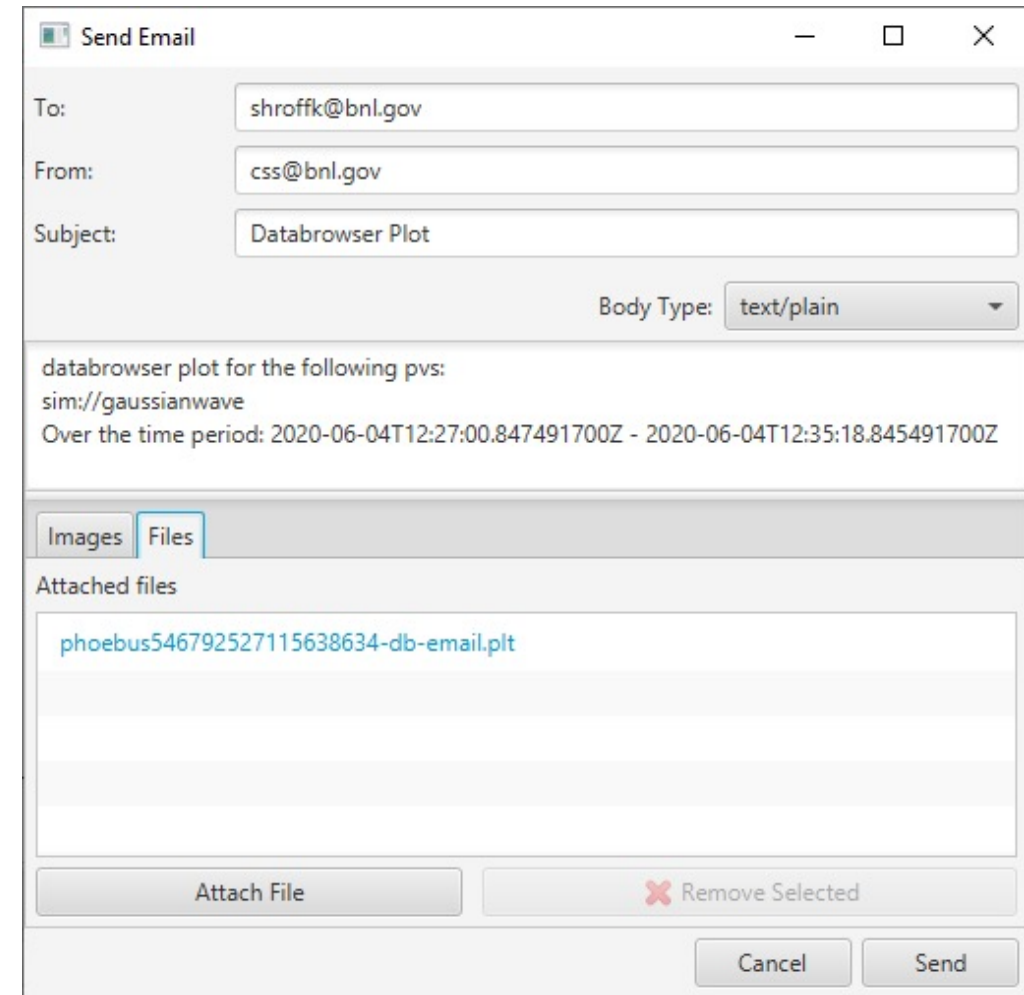
The Selection Service provides a clean and powerful mechanism for allowing Phoebus applications to share the user selected data.

- Adapter Service

The Adapter services provided by the framework is a means for Phoebus applications to provide runtime integration between loosely coupled applications.

- Jobs

CancellableJob A helper class which provides the framework for running tasks in the background while still monitoring for cancel requests



A screenshot of a 'Send Email' dialog box. It has fields for 'To:' (shroffk@bnl.gov), 'From:' (css@bnl.gov), and 'Subject:' (Databrowser Plot). The 'Body Type' is set to 'text/plain'. The email body contains the text: 'databrowser plot for the following pvs: sim://gaussianwave Over the time period: 2020-06-04T12:27:00.847491700Z - 2020-06-04T12:35:18.845491700Z'. Below the body, there are tabs for 'Images' and 'Files'. Under the 'Files' tab, an attached file 'phoebus546792527115638634-db-email.plt' is listed. At the bottom, there are buttons for 'Attach File', 'Remove Selected' (with a red X icon), 'Cancel', and 'Send'.



A screenshot of an 'Active Jobs' window. It has a title bar 'Active Jobs X' and a table with two columns: 'Name' and 'Status'. The table contains one row with the text 'searching Channelfinder for pattern : SR\*C023\*' in the 'Name' column and 'searching Channelfinder for pattern : SR\*C023\* running for : 1 seconds' in the 'Status' column. To the right of the table is a 'Cancel' button with a red square icon.

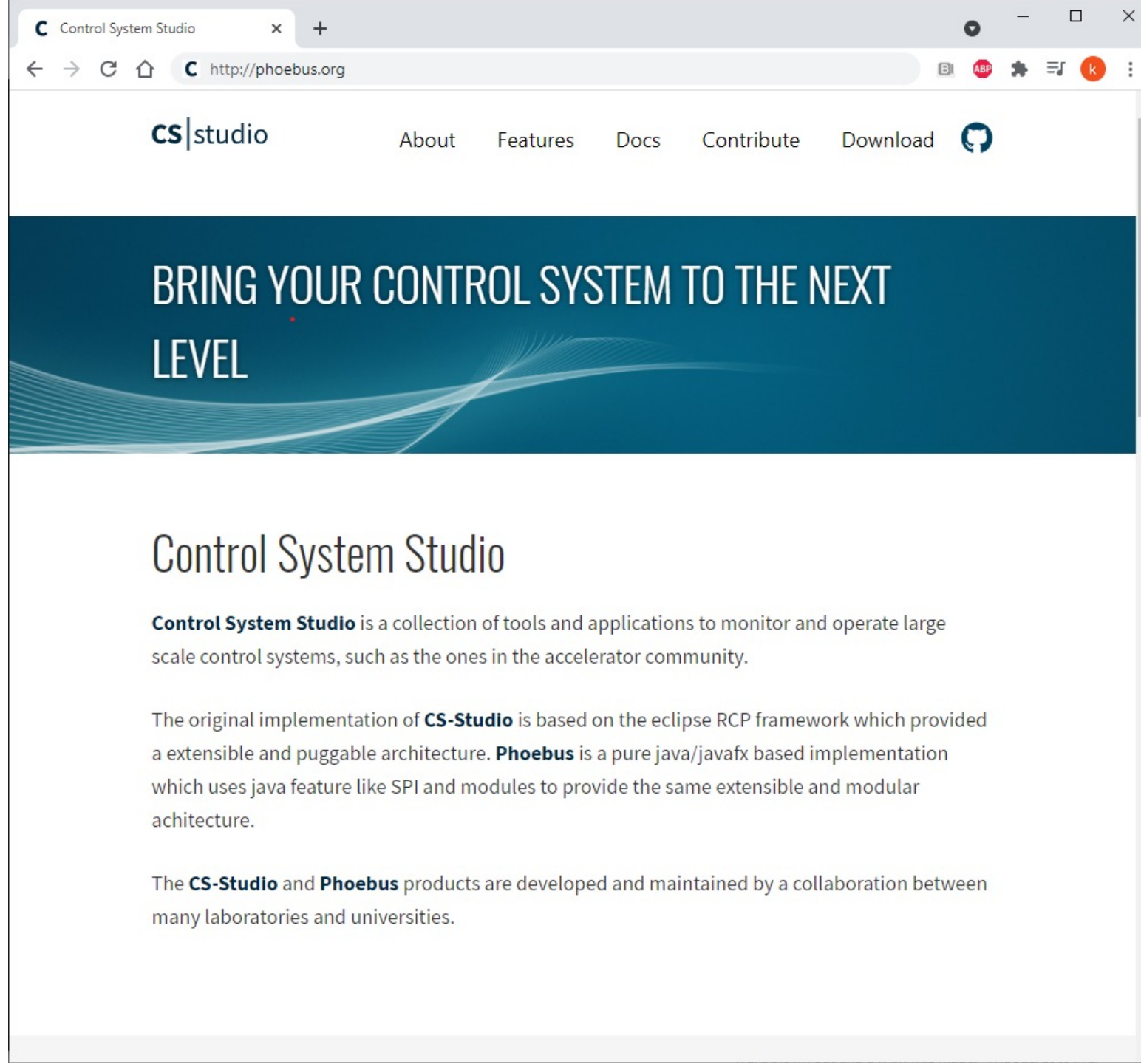
Name	Status
searching Channelfinder for pattern : SR*C023*	searching Channelfinder for pattern : SR*C023* running for : 1 seconds

# org.phoebus

Redesign of the website for Control System Studio (CS-Studio). Made using GatsbyJS and hosted on netlify.

<https://github.com/ControlSystemStudio/controlsystemstudio.org>

[EPICS code-a-thon 2021](#)





# Publishing to maven central

All Phoebus modules will be published to maven central

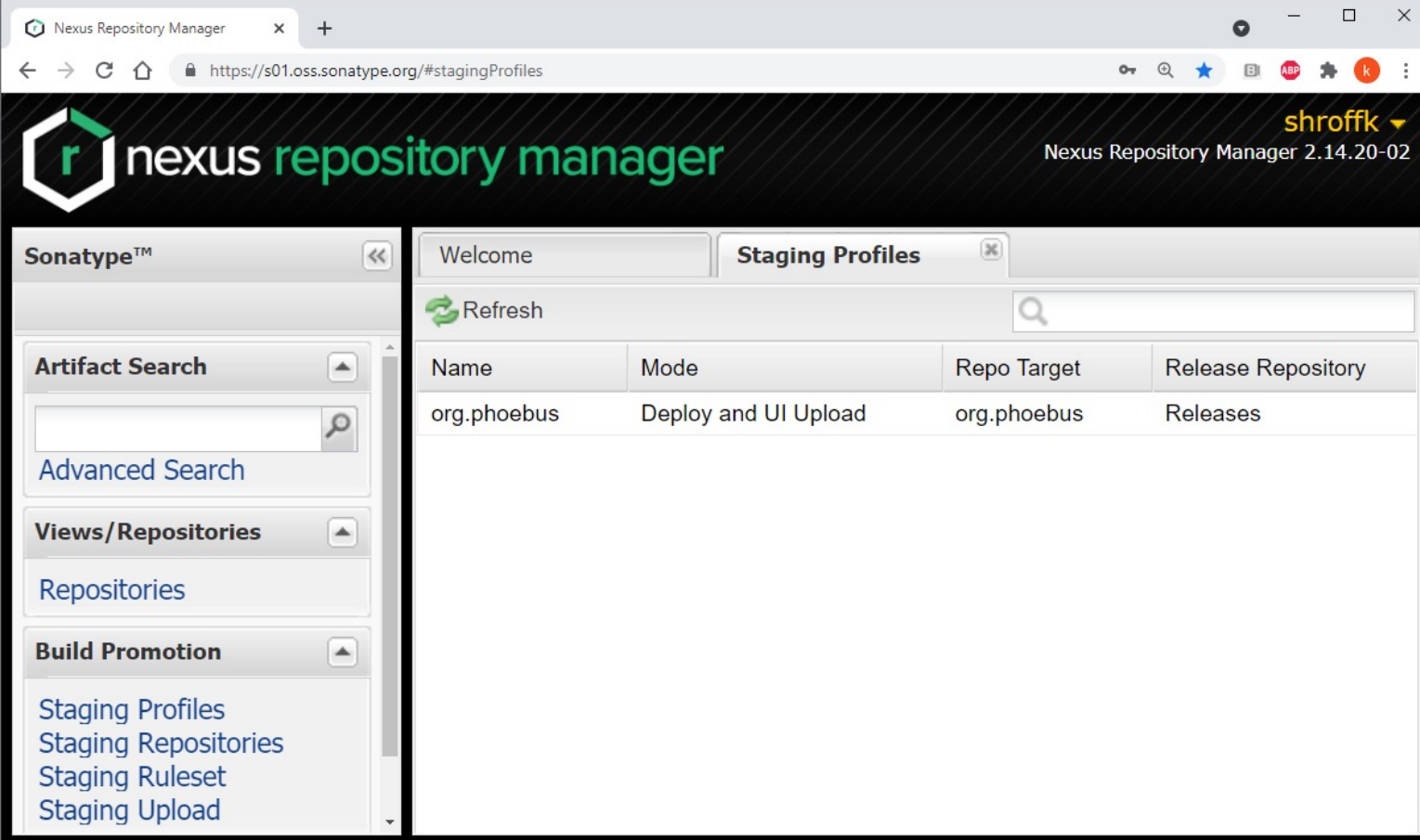
## Releases Repository

- tagged releases

## Snapshots Repository

- latest successfully built artifacts

Working on migration of existing CI/CD pipeline



The screenshot shows the Nexus Repository Manager web interface. The browser address bar displays `https://s01.oss.sonatype.org/#stagingProfiles`. The page header includes the Nexus logo and the text "nexus repository manager". The user "shroffk" is logged in, and the version "Nexus Repository Manager 2.14.20-02" is shown in the top right.

The left sidebar contains the Sonatype™ logo and a navigation menu with the following items:

- Artifact Search
- Advanced Search
- Views/Repositories
- Repositories
- Build Promotion
- Staging Profiles
- Staging Repositories
- Staging Ruleset
- Staging Upload

The main content area has two tabs: "Welcome" and "Staging Profiles". The "Staging Profiles" tab is active, showing a "Refresh" button and a search bar. Below these is a table with the following data:

Name	Mode	Repo Target	Release Repository
org.phoebus	Deploy and UI Upload	org.phoebus	Releases

# Site Specific products

Creating a site specific Phoebus product is simplified to a 2 files

*/site\_specific\_product/*

*pom.xml*  
*settings.ini*

a pom.xml file which lists all the applications, based on your requirements, to be included in your product

a settings.ini with the url's and preferences to match your environment

build and run your product






```
>> mvn verify
```

```
>> java -jar site-specific-product-*.jar
```

Phoebus MicroServices

# Phoebus Microservices

- EPICS middle layer services
  - Reactive Services
  - Adoption of modern solutions and technologies ( e.g. springboot, kafka, elastic, mongoDB, ...)
- Services which have been redesigned/refactored
  - ChannelFinder
  - Olog
  - Alarm Services
  - Save Restore
  - Scan Engine

 alarm-config-logger alarm-logger alarm-server archive-engine save-and-restore scan-server



# Save Restore

- Based on the MASAR Epics middle layer service
- These can be used to
  - manage save sets (aka configurations) and snapshots
  - retrieve and compare snapshots
  - restore settings from snapshots
- REST services using the SpringBoot framework

`java [options] -jar service-save-and-restore-.jar`

# Save Restore

Save And Restore ×

http://jmasar.tn.esss.lu.se

CM-TS2

DTL-010

LLRF-RFQ

LLRF-TS2-1

LLRF-TS2-2

LLRF\_TS2\_2\_1

StableOperation

2021Jan25

2021Fev10

2021Mar02

2021jun09

test1

MEBT-BPM

Migration 2019-11-07 15:35:25

RFLPS-RFQ

RFLPS-TS2

RFQ\_Cond

SRF-TS2

Test

2021Jan25 ×

Snapshot name: 2021Jan25

Snapshot date: Mon Jan 25 19:13:37 CET 2021

Created by: gabrielfedel

Comment: 2021Jan25-2

Restore

Take Snapshot

Save Snapshot

Preserve selection after Filter: \* for all matching and , as or separator, & as and separator. Start with / for regex. All if empty. (%F)

Δ Threshold (%) 0.0

Restore with scale 1.0

	#	PV Name	Timestamp	Status	Severity	Stored Setpoint		Live Setpoint
						Stored Setpoint	Δ Live Setpoint	
<input checked="" type="checkbox"/>	1	TS2-020:RFS-DIG-1...	13:05:54.236 Jan 19 2021	NONE	NONE	[47, 104, 111, 109, 10...	---	[47, 104, 111, 109, 10...
<input checked="" type="checkbox"/>	2	TS2-020:RFS-DIG-1...	13:05:54.231 Jan 19 2021	NONE	NONE	Non-Linear	Non-Linear	Non-Linear
<input checked="" type="checkbox"/>	3	TS2-020:RFS-DIG-1...	13:05:54.237 Jan 19 2021	NONE	NONE	[47, 104, 111, 109, 10...	! NOT EQUAL	[47, 111, 112, 116, 47, ...
<input checked="" type="checkbox"/>	4	TS2-020:RFS-DIG-1...	13:05:54.231 Jan 19 2021	NONE	NONE	Non-Linear	Non-Linear	Non-Linear
<input checked="" type="checkbox"/>	5	TS2-020:RFS-DIG-1...	13:05:54.237 Jan 19 2021	NONE	NONE	[47, 104, 111, 109, 10...	! NOT EQUAL	[47, 111, 112, 116, 47, ...
<input checked="" type="checkbox"/>	6	TS2-020:RFS-DIG-1...	13:05:54.232 Jan 19 2021	NONE	NONE	Non-Linear	Non-Linear	Non-Linear
<input checked="" type="checkbox"/>	7	TS2-020:RFS-DIG-1...	13:05:54.238 Jan 19 2021	NONE	NONE	[47, 104, 111, 109, 10...	! NOT EQUAL	[47, 111, 112, 116, 47, ...
<input checked="" type="checkbox"/>	8	TS2-020:RFS-DIG-1...	13:05:54.233 Jan 19 2021	NONE	NONE	Non-Linear	Non-Linear	Non-Linear
<input checked="" type="checkbox"/>	9	TS2-020:RFS-DIG-1...	13:05:54.239 Jan 19 2021	NONE	NONE	[47, 104, 111, 109, 10...	! NOT EQUAL	[47, 111, 112, 116, 47, ...
<input checked="" type="checkbox"/>	10	TS2-020:RFS-DIG-1...	13:05:54.234 Jan 19 2021	NONE	NONE	Non-Linear	Non-Linear	Non-Linear
<input checked="" type="checkbox"/>	11	TS2-020:RFS-DIG-1...	12:45:01.347 Jan 25 2021	NONE	NONE	Disabled	! Disabled	Enabled
<input checked="" type="checkbox"/>	12	TS2-020:RFS-DIG-1...	13:05:54.248 Jan 19 2021	NONE	NONE	0.03	! +0.03	0.0
<input checked="" type="checkbox"/>	13	TS2-020:RFS-DIG-1...	13:05:54.247 Jan 19 2021	NONE	NONE	0.18	! -0.8200000000...	1.0
<input checked="" type="checkbox"/>	14	TS2-020:RFS-DIG-1...	13:22:09.367 Jan 25 2021	NONE	NONE	[0.0, 2.5896259141...	! NOT EQUAL	[0.0, 1.5334205419...
<input checked="" type="checkbox"/>	15	TS2-020:RFS-DIG-1...	11:23:26.451 Jan 18 2021	NONE	NONE	Enabled	Enabled	Enabled
<input checked="" type="checkbox"/>	16	TS2-020:RFS-DIG-1...	17:26:51.948 Jan 15 2021	NONE	NONE	Disabled	Disabled	Disabled
<input checked="" type="checkbox"/>	17	TS2-020:RFS-DIG-1...	13:22:09.368 Jan 25 2021	NONE	NONE	[0.0, 0.0403747558...	! NOT EQUAL	[0.0, 0.0304565429...

# Containerization

- Alarm Services (Kafka, elastic)
- Phoebus Olog service (elastic, mongo)
- ChannelFinder service (elastic)

Docker compose recipes provided with the services  
`/src/test/resources/docker/docker-compose.yml`

Great for:

- Development
- Integration testing
- Demos and Training

# Useful links

<https://controlsystemstudio.org/>

<http://phoebus.org>

- Fork us on github  
<https://github.com/ControlSystemStudio>
- Documentation and Help  
<https://control-system-studio.readthedocs.io/en/latest/>
  - List of preferences  
[https://control-system-studio.readthedocs.io/en/latest/preference\\_properties.html#preference-settings](https://control-system-studio.readthedocs.io/en/latest/preference_properties.html#preference-settings)
  - Service  
<https://control-system-studio.readthedocs.io/en/latest/services.html>