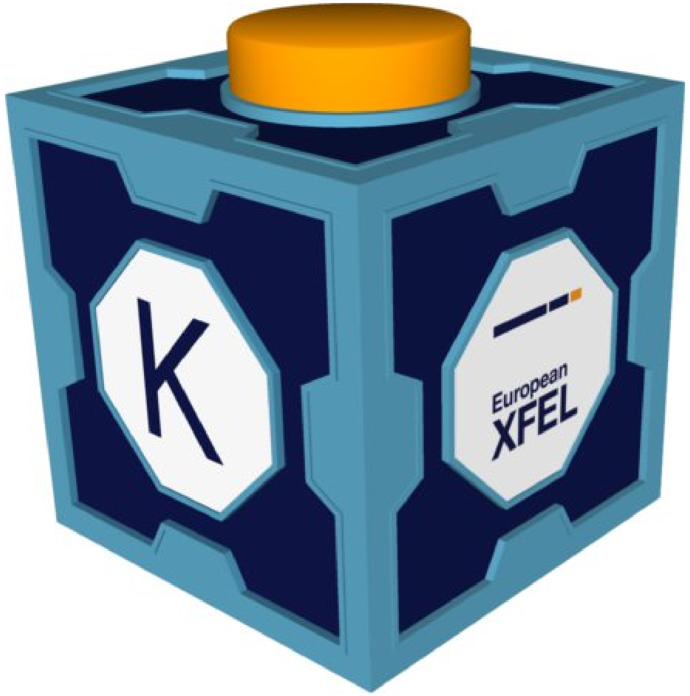
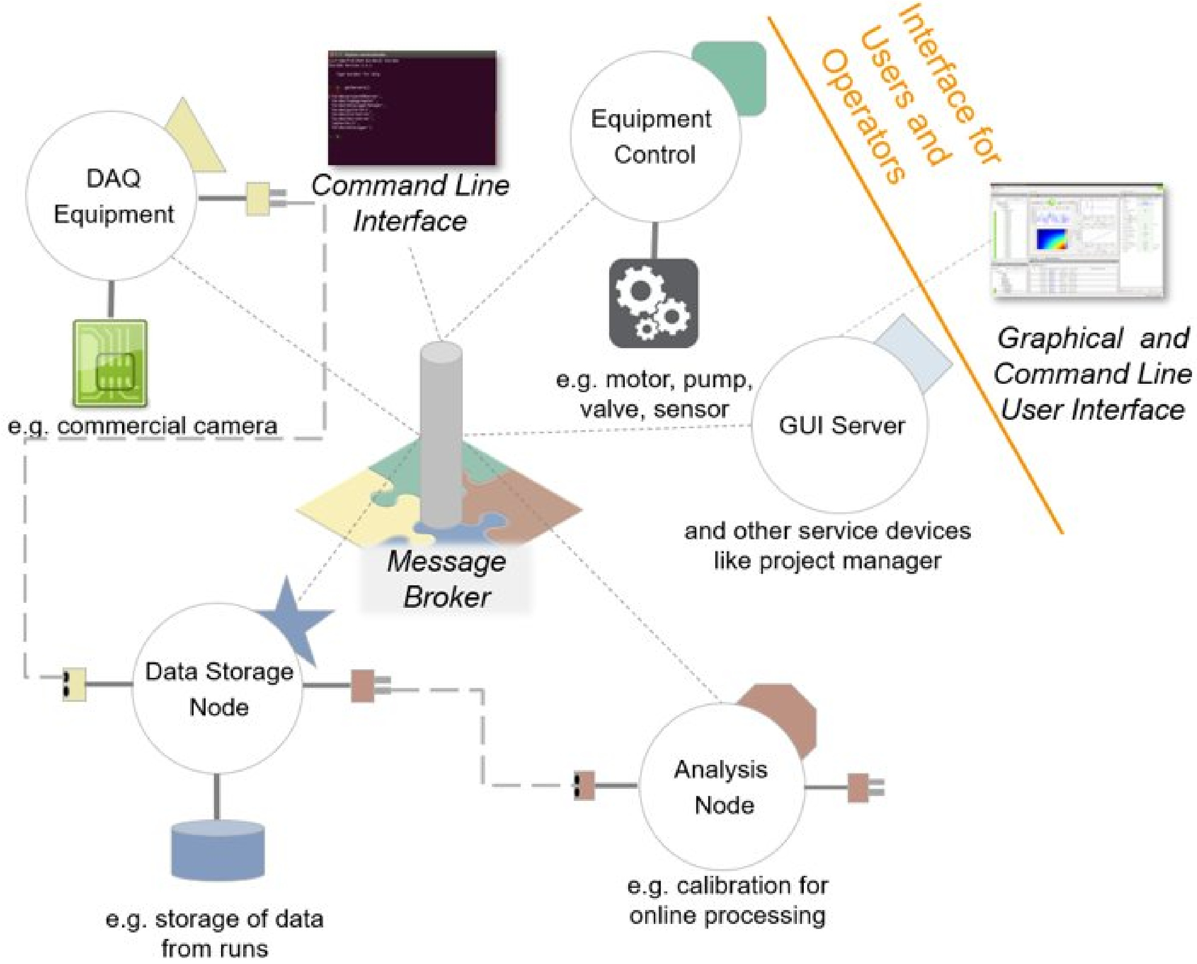
European XFEL GUI Strategy & Karabo GUI Platform

D. Göries for the Controls Group



Karabo in a nut shell: Architecture

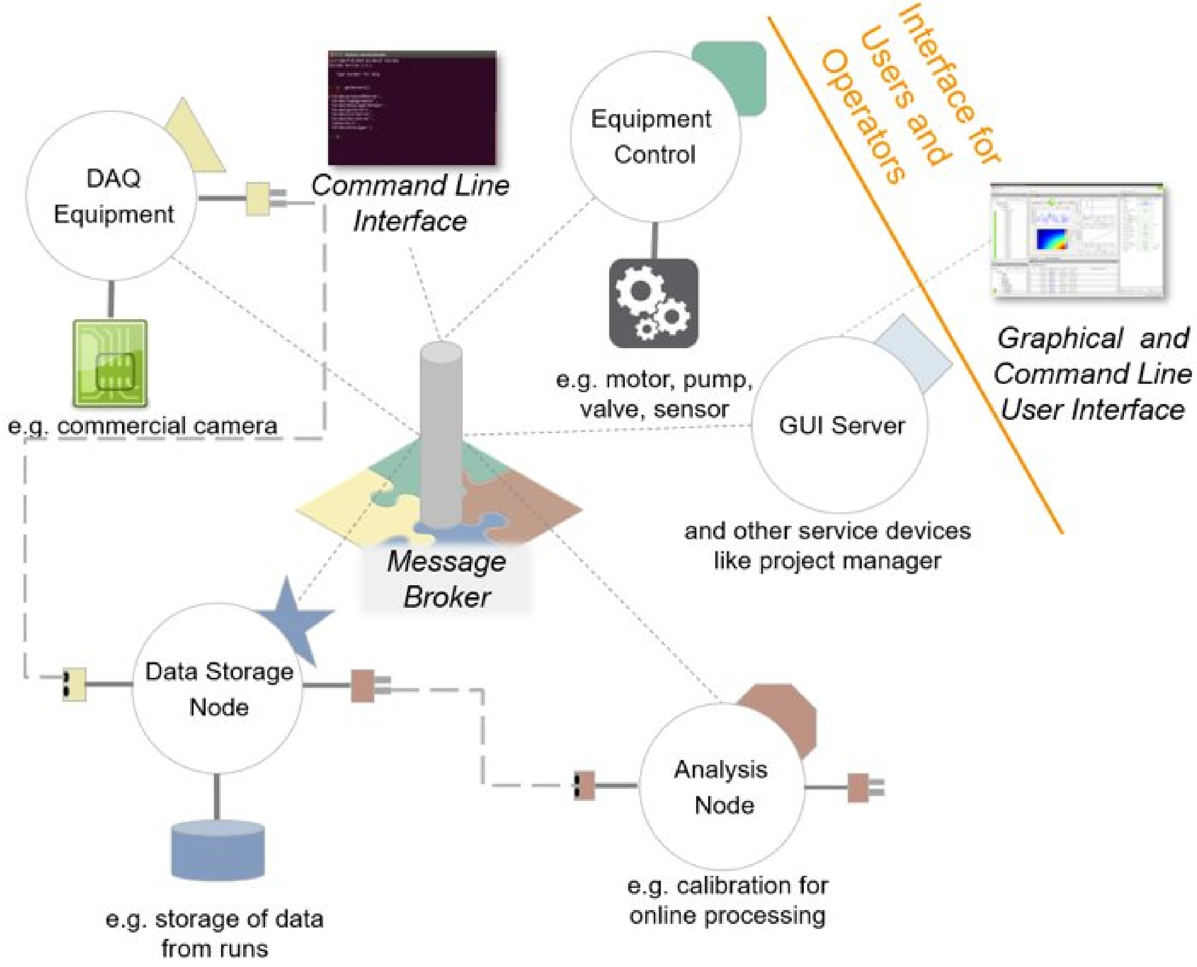
- Central Message Broker (Control and slow data)
  - Currently: OpenMQ
  - Soon interchangeable: RabbitMQ, MQTT, Redis
- Event driven:
  - Data propagates through the system when values change – push not polling
  - **Data logging backend**
- Message driven:
  - Signal – Slot paradigm
  - Asynchronous core, synchronous convenience in middleware


DAQ Equipment
e.g. commercial camera
Command Line Interface
Equipment Control
e.g. motor, pump, valve, sensor
Interface for Users and Operators
Graphical and Command Line User Interface
GUI Server
and other service devices like project manager
Message Broker
Data Storage Node
e.g. storage of data from runs
Analysis Node
e.g. calibration for online processing

Karabo in a nut shell: Architecture

- Peer-2-peer connections (scientific/large) data
  - Scatter / Gather / Copy / Distribute
  - Block / Drop on congestion
  - TCP
  - Capable of saturating a 10G line
    Comparable performance with ZeroMQ

- **GUI Server:**
  - **Gateway to the Control system**
  - **TCP Connection to Clients**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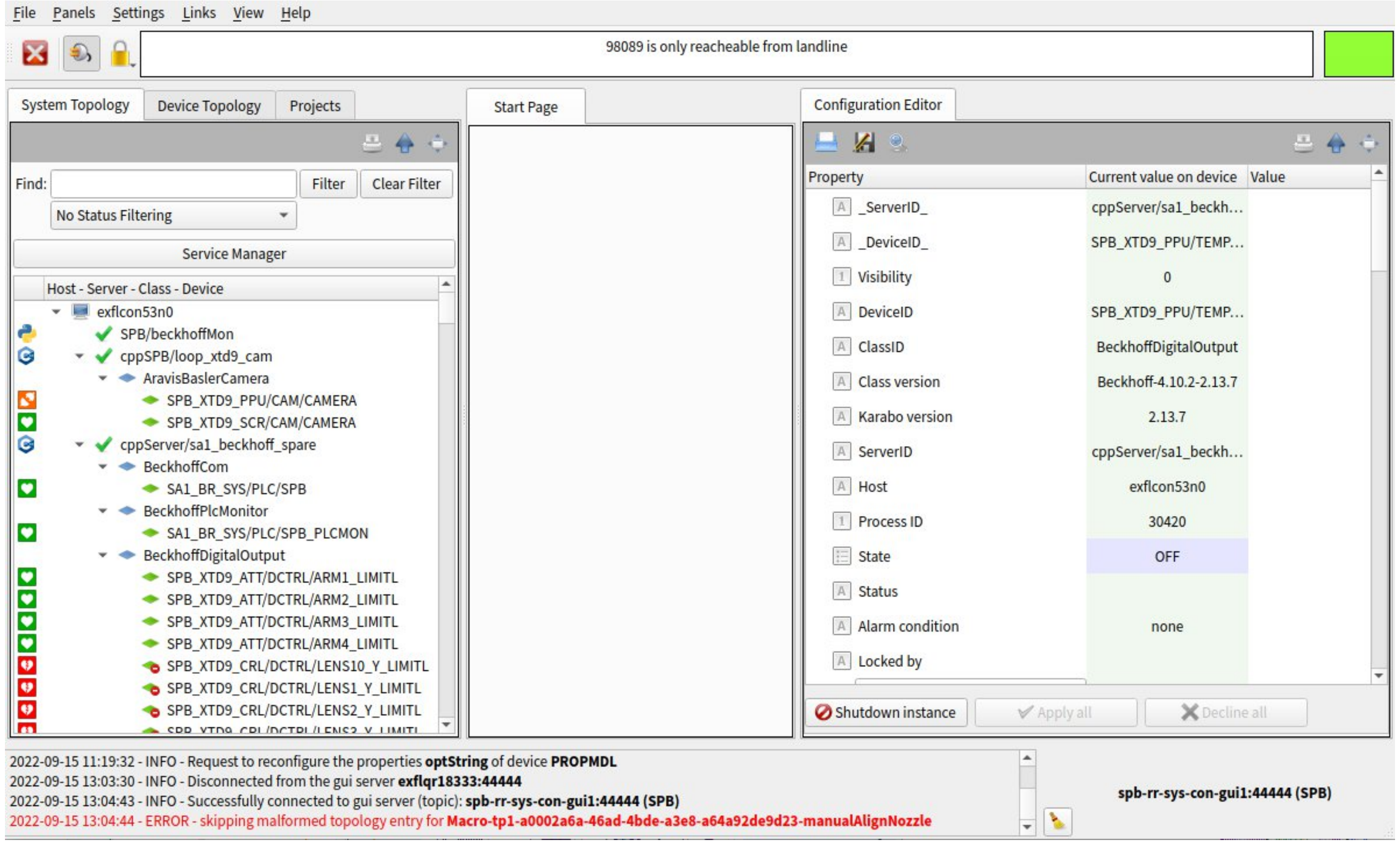
KaraboGui – The Cockpit

- **Python** software contained in karabo framework
  - Separate package installation
- Based on **Qt** Library and **Traits**
- Nowadays standard asynchronous server - client approach
- Extensible via „gui-extensions“, a plugin updater for more widgets and controllers
- **Core feature: Scene Designer / Scene Model Interpreter**



98089 is only reacheable from landline

No Status Filtering

```
Host - Server - Class - Device
exflcon53n0
  SPB/beckhoffMon
  cppSPB/loop_xtd9_cam
    AravisBaslerCamera
      SPB_XTD9_PPU/CAM/CAMERA
      SPB_XTD9_SCR/CAM/CAMERA
  cppServer/sa1_beckhoff_spare
    BeckhoffCom
      SA1_BR_SYS/PLC/SPB
    BeckhoffPlcMonitor
      SA1_BR_SYS/PLC/SPB_PLCMON
    BeckhoffDigitalOutput
      SPB_XTD9_ATT/DCTRL/ARM1_LIMITL
      SPB_XTD9_ATT/DCTRL/ARM2_LIMITL
      SPB_XTD9_ATT/DCTRL/ARM3_LIMITL
      SPB_XTD9_ATT/DCTRL/ARM4_LIMITL
      SPB_XTD9_CRL/DCTRL/LENS10_Y_LIMITL
      SPB_XTD9_CRL/DCTRL/LENS1_Y_LIMITL
      SPB_XTD9_CRL/DCTRL/LENS2_Y_LIMITL
```

Property	Current value on device	Value
ServerID	cppServer/sa1_beckh...	
DeviceID	SPB_XTD9_PPU/TEMP...	
Visibility	0	
DeviceID	SPB_XTD9_PPU/TEMP...	
ClassID	BeckhoffDigitalOutput	
Class version	Beckhoff-4.10.2-2.13.7	
Karabo version	2.13.7	
ServerID	cppServer/sa1_beckh...	
Host	exflcon53n0	
Process ID	30420	
State	OFF	
Status		
Alarm condition	none	
Locked by		

```
2022-09-15 11:19:32 - INFO - Request to reconfigure the properties optString of device PROPMDL
2022-09-15 13:03:30 - INFO - Disconnected from the gui server exflqr18333:44444
2022-09-15 13:04:43 - INFO - Successfully connected to gui server (topic): spb-rr-sys-con-gui1:44444 (SPB)
2022-09-15 13:04:44 - ERROR - skipping malformed topology entry for Macro-tp1-a0002a6a-46ad-4bde-a3e8-a64a92de9d23-manualAlignNozzle
```

spb-rr-sys-con-gui1:44444 (SPB)

Development: Principles of the KaraboGui

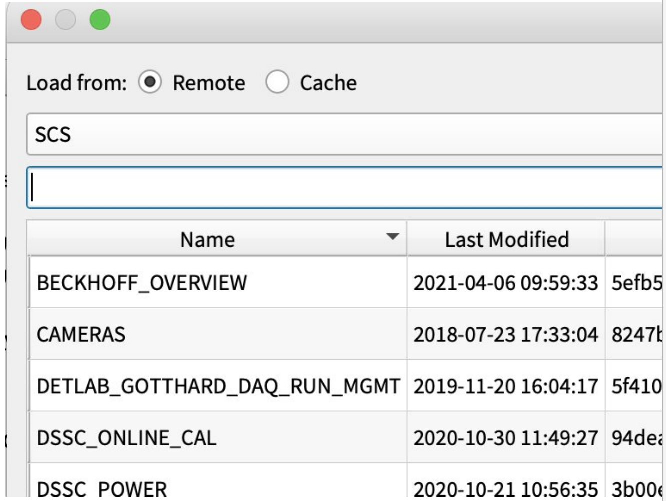
- Dependencies leaned towards community efforts (Spyder / PyQtGraph)
  - **Conda** feedstocks for **Qt / QtPy / PyQtGraph**
- Strict typing and events with **traits** package (enthought)
  - As much code as possible is **factored out** to trait models and controllers
- Tests are provided with **gitlab** ci (unit) and **squish** test suite and **robot** framework (integration). Very high test coverage
- **Processing** is limited to a **single thread** - ordering of messages
  - Critical: The application is entirely event driven -> pressure on code development
- Only a few major releases a year (Coupled to karabo kernel release)

User: Principles of the KaraboGui

- Graphical User Interface for **Controls**
  - Limited data analysis inside application
  - Move analysis algorithms outside to karabo devices or other frameworks and view the results
- **One** application with large toolset serving the Operator needs
  - Configuration Management (Karabo Projects / Comparison Features / Generic Configurator Panel)
  - **Panel (Scene) building (generic panels, linking of scenes, synoptic views)**
  - Tight integration with controls system archival features (however, should not be main application for this purpose)
  - IPython Console Panel
  - ......

Distribution (Cloud Structure) - Karabo Projects

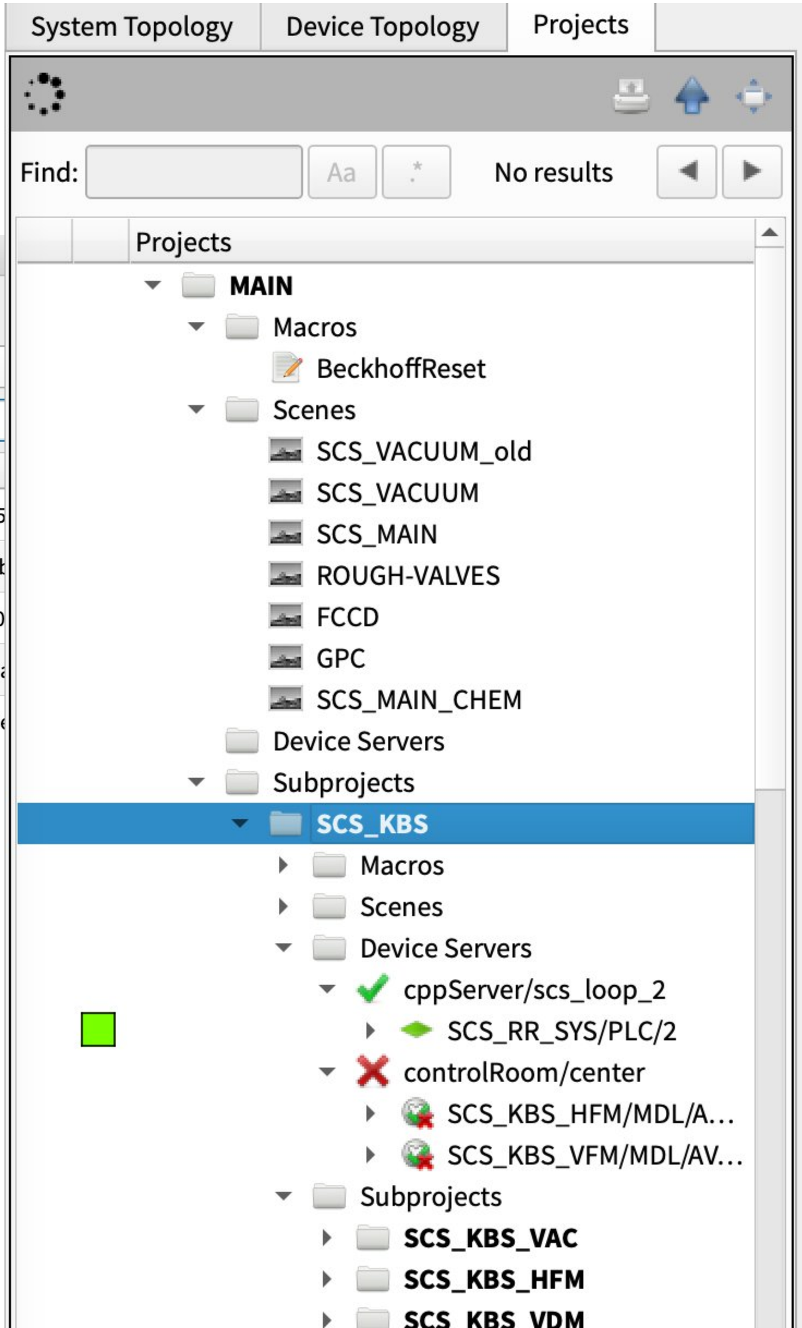
- Stored in database domains
- Further Elements
  - Scenes (Panels)
  - Macros
  - Servers / Devices
  - Configurations
  - Linked Projects (SubProjects)
- **Technical: NoSQL eXistDB**
- Currently, in operation we have **~1200** projects with **~6000** scenes



Load from: ● Remote ○ Cache

SCS

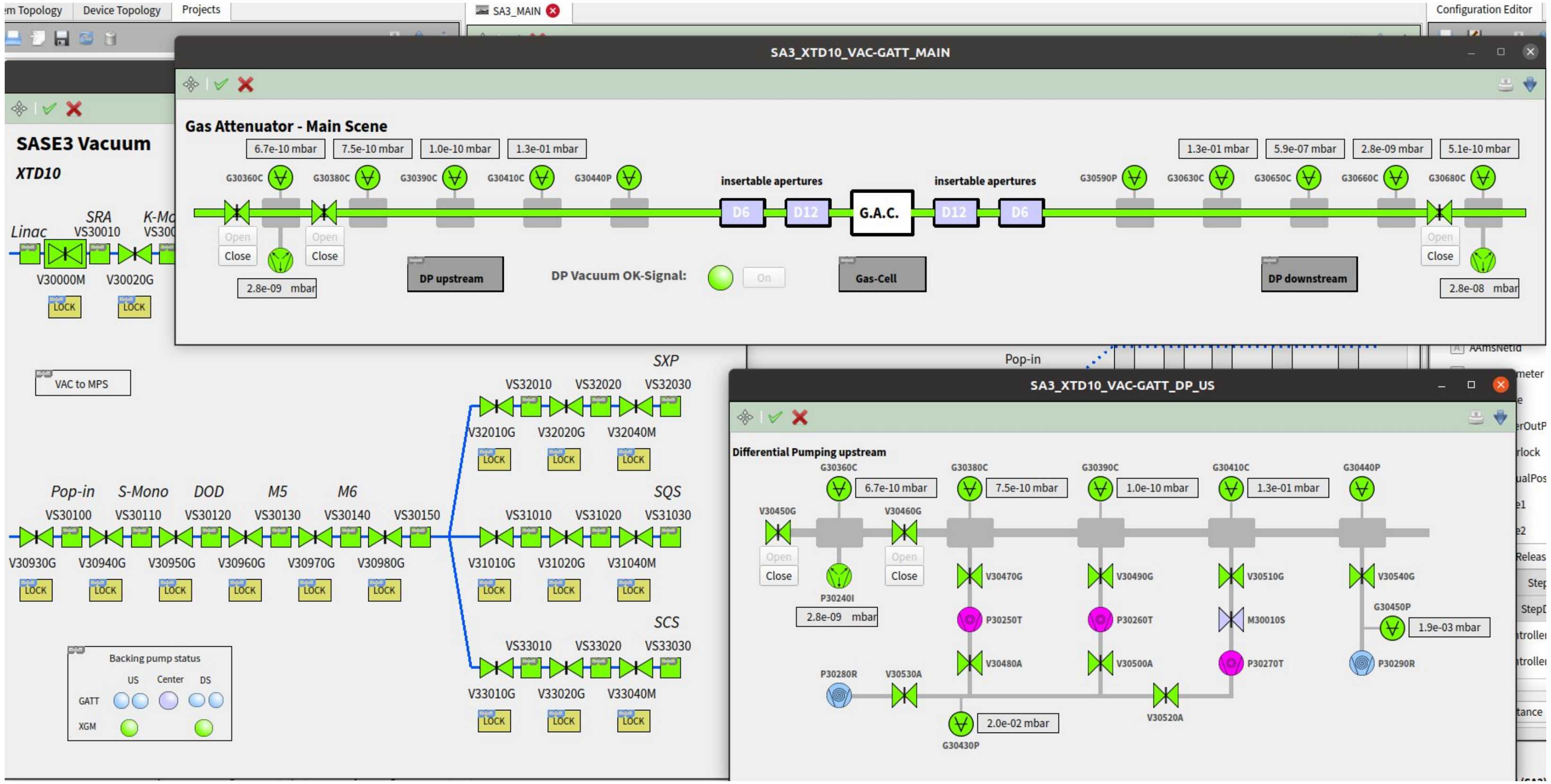
Name	Last Modified	
BECKHOFF_OVERVIEW	2021-04-06 09:59:33	5efb5
CAMERAS	2018-07-23 17:33:04	8247t
DETLAB_GOTTHARD_DAQ_RUN_MGMT	2019-11-20 16:04:17	5f410
DSSC_ONLINE_CAL	2020-10-30 11:49:27	94dea
DSSC_POWER	2020-10-21 10:56:35	3b00e



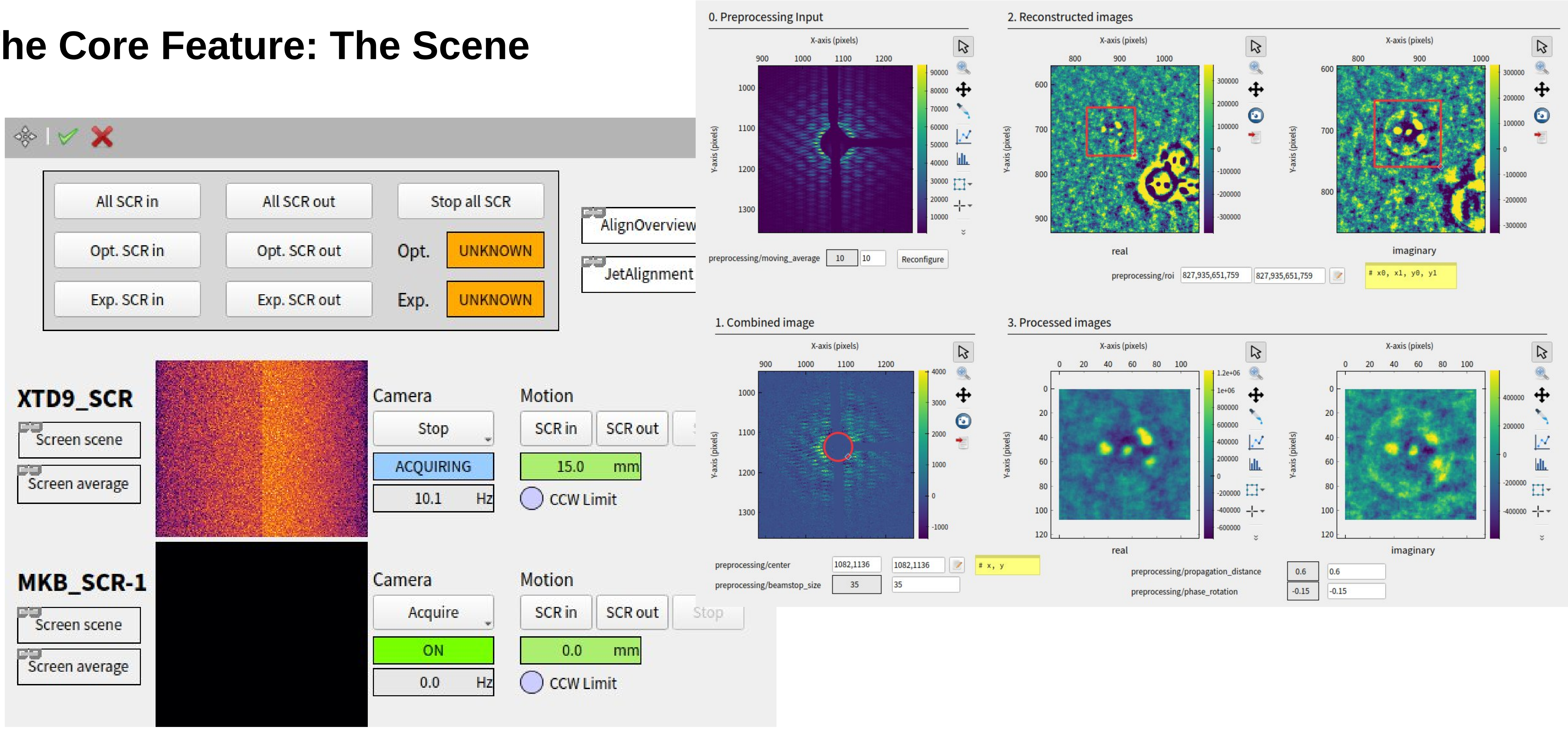
Projects
- MAIN
  - Macros
    - BeckhoffReset
  - Scenes
    - SCS_VACUUM_old
    - SCS_VACUUM
    - SCS_MAIN
    - ROUGH-VALVES
    - FCCD
    - GPC
    - SCS_MAIN_CHEM
  - Device Servers
  - Subprojects
    - SCS_KBS
      - Macros
      - Scenes
      - Device Servers
        - cppServer/scs_loop_2
          - SCS_RR_SYS/PLC/2
        - controlRoom/center
          - SCS_KBS_HFM/MDL/A...
          - SCS_KBS_VFM/MDL/AV...
      - Subprojects
        - SCS_KBS_VAC
        - SCS_KBS_HFM
        - SCS_KBS_VDM

The Core Feature: The Scene

- Scenes are composed of so-called controllers that contain a widget.
- Scenes have two modes: **Control** and **Edit** (toggle)
- **Edit**: Elements can be dragged from various sources onto the scene
- **Control**: Interact with elements on scene to execute and reconfigure device slots and properties



The Core Feature: The Scene



XTD9_SCR Camera: ACQUIRING, 10.1 Hz; Motion: 15.0 mm

MKB_SCR-1 Camera: ON, 0.0 Hz; Motion: 0.0 mm

0. Preprocessing Input

preprocessing/moving_average 10 10

2. Reconstructed images

preprocessing/roi 827,935,651,759 827,935,651,759 # x0, x1, y0, y1

1. Combined image

preprocessing/center 1082,1136 1082,1136 # x, y

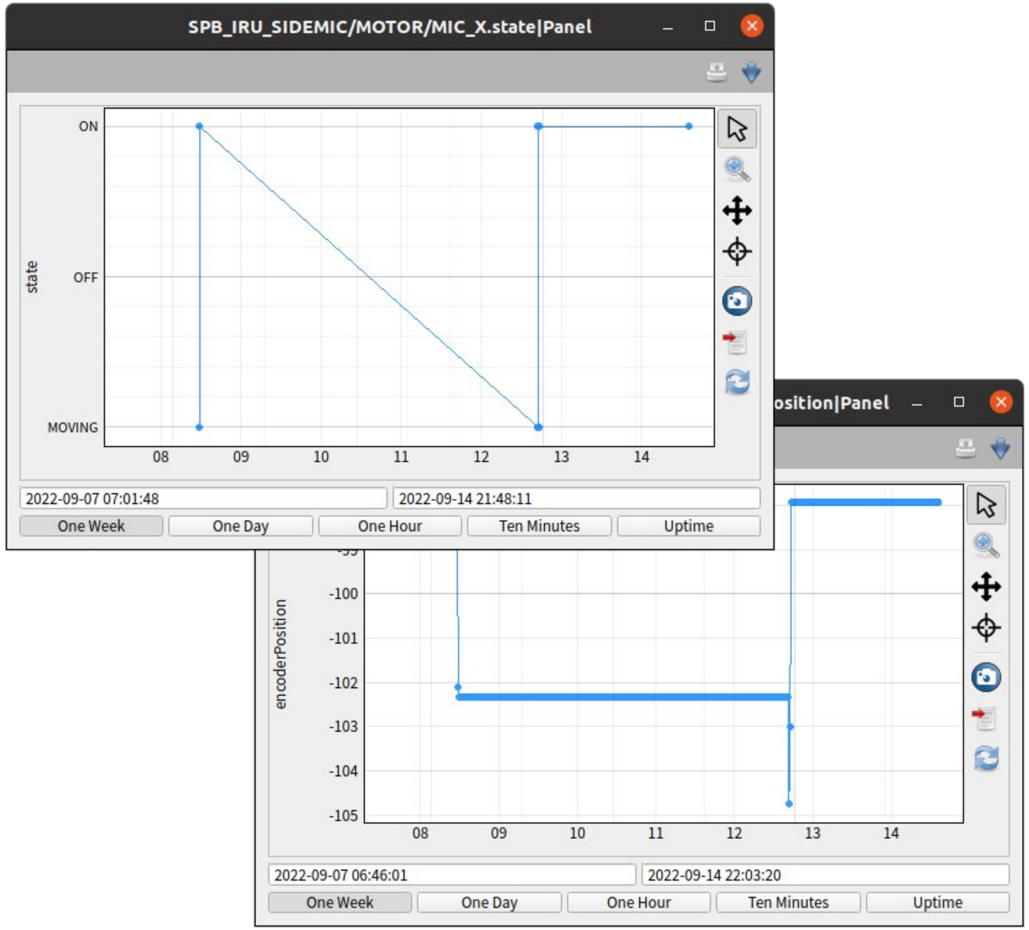
preprocessing/beamstop_size 35 35

3. Processed images

preprocessing/propagation_distance 0.6 0.6

preprocessing/phase_rotation -0.15 -0.15

The Core Feature: The Scene

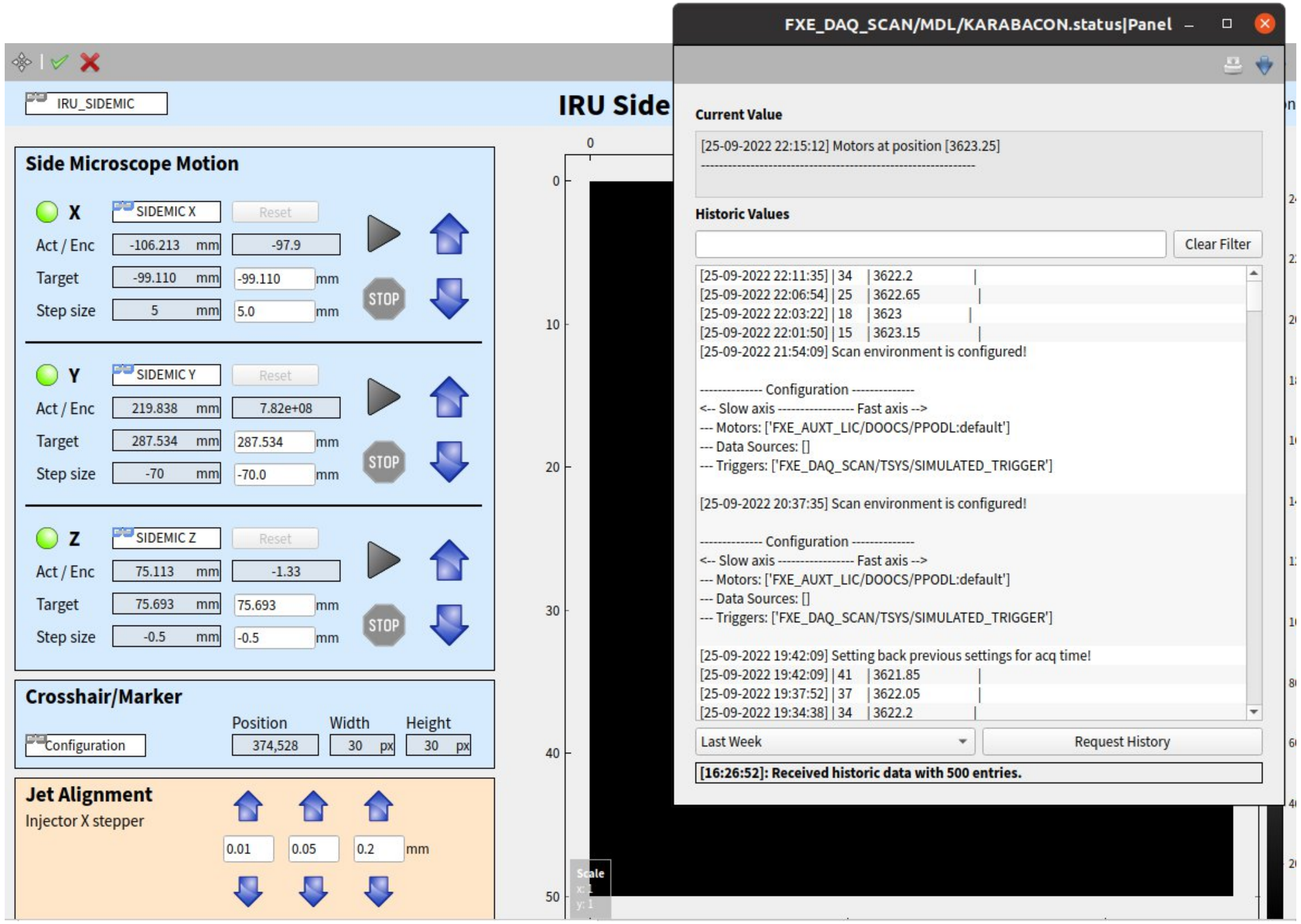


SPB_IRU_SIDEMIC/MOTOR/MIC_X.state|Panel

2022-09-07 07:01:48
2022-09-14 21:48:11

osition|Panel

2022-09-07 06:46:01
2022-09-14 22:03:20



IRU_SIDEMIC

IRU Side

Side Microscope Motion

X SIDEMIC X
Act / Enc -106.213 mm -97.9
Target -99.110 mm -99.110 mm
Step size 5 mm 5.0 mm

Y SIDEMIC Y
Act / Enc 219.838 mm 7.82e+08
Target 287.534 mm 287.534 mm
Step size -70 mm -70.0 mm

Z SIDEMIC Z
Act / Enc 75.113 mm -1.33
Target 75.693 mm 75.693 mm
Step size -0.5 mm -0.5 mm

Crosshair/Marker

Configuration
Position 374,528
Width 30 px
Height 30 px

Jet Alignment

Injector X stepper

0.01 0.05 0.2 mm

FXE_DAQ_SCAN/MDL/KARABACON.status|Panel

Current Value

```
[25-09-2022 22:15:12] Motors at position [3623.25]
-----------------------------------------------------------
```

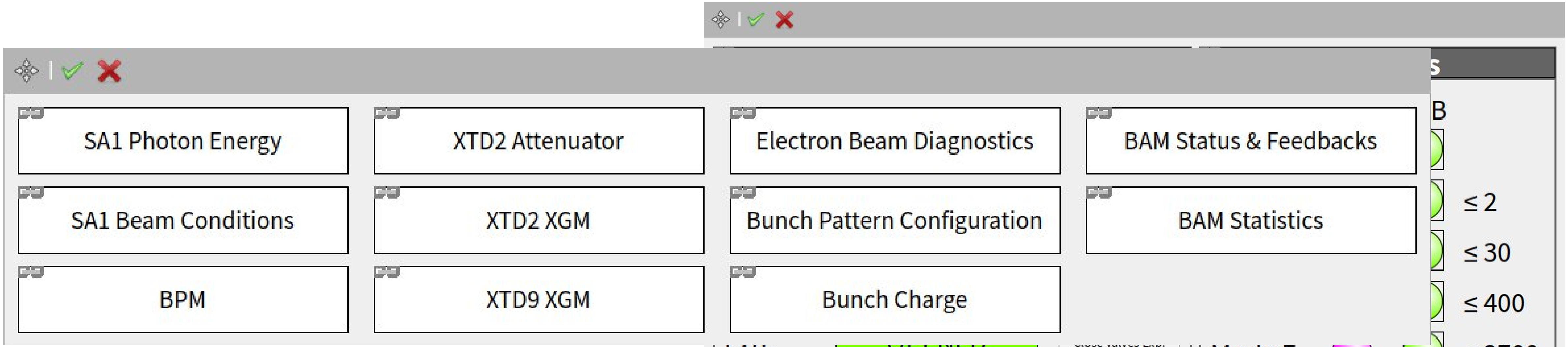
Historic Values

```
[25-09-2022 22:11:35] | 34   | 3622.2          |
[25-09-2022 22:06:54] | 25   | 3622.65          |
[25-09-2022 22:03:22] | 18   | 3623           |
[25-09-2022 22:01:50] | 15   | 3623.15          |
[25-09-2022 21:54:09] Scan environment is configured!

-------------- Configuration --------------
<-- Slow axis ----------------- Fast axis -->
--- Motors: ['FXE_AUXT_LIC/DOOCS/PPODL:default']
--- Data Sources: []
--- Triggers: ['FXE_DAQ_SCAN/TSYS/SIMULATED_TRIGGER']

[25-09-2022 20:37:35] Scan environment is configured!

-------------- Configuration --------------
<-- Slow axis ----------------- Fast axis -->
--- Motors: ['FXE_AUXT_LIC/DOOCS/PPODL:default']
--- Data Sources: []
--- Triggers: ['FXE_DAQ_SCAN/TSYS/SIMULATED_TRIGGER']

[25-09-2022 19:42:09] Setting back previous settings for acq time!
[25-09-2022 19:42:09] | 41   | 3621.85          |
[25-09-2022 19:37:52] | 37   | 3622.05          |
[25-09-2022 19:34:38] | 34   | 3622.2          |
```

Last Week

[16:26:52]: Received historic data with 500 entries.

- * Double – clicking properties can provide quick archival features such as trendlines (state, alarm, plain old data). For string data we provide a scrolling panel.



SA1 Photon Energy | XTD2 Attenuator | Electron Beam Diagnostics | BAM Status & Feedbacks

SA1 Beam Conditions | XTD2 XGM | Bunch Pattern Configuration | BAM Statistics

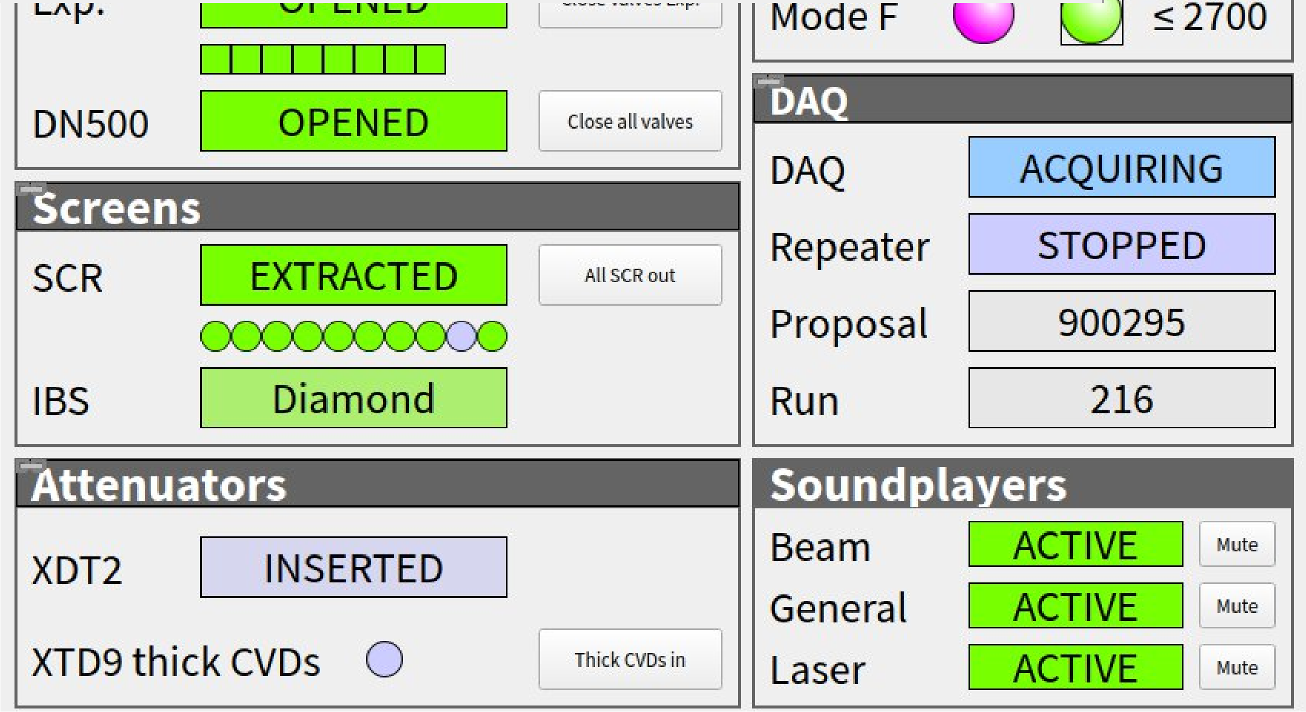
BPM | XTD9 XGM | Bunch Charge

B

≤ 2

≤ 30

≤ 400



Exp. OPENED Close valves Exp.

Mode F ≤ 2700

DN500 OPENED Close all valves

Screens

SCR EXTRACTED All SCR out

IBS Diamond

Attenuators

XDT2 INSERTED

XTD9 thick CVDs Thick CVDs in

DAQ

DAQ ACQUIRING

Repeater STOPPED

Proposal 900295

Run 216

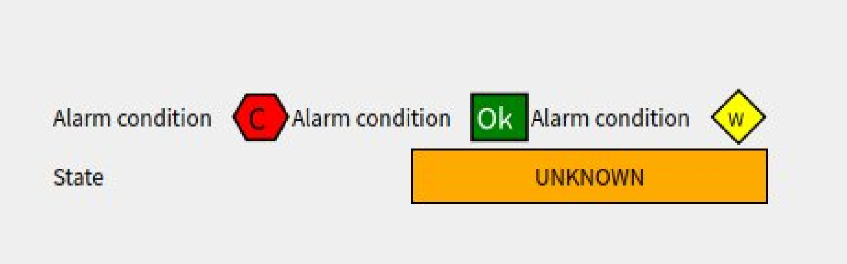
Soundplayers

Beam ACTIVE Mute

General ACTIVE Mute

Laser ACTIVE Mute

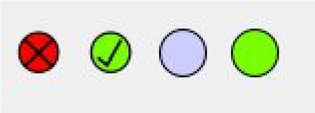
- Standardized coloring of State and Alarm Information



Alarm condition C Alarm condition Ok Alarm condition W

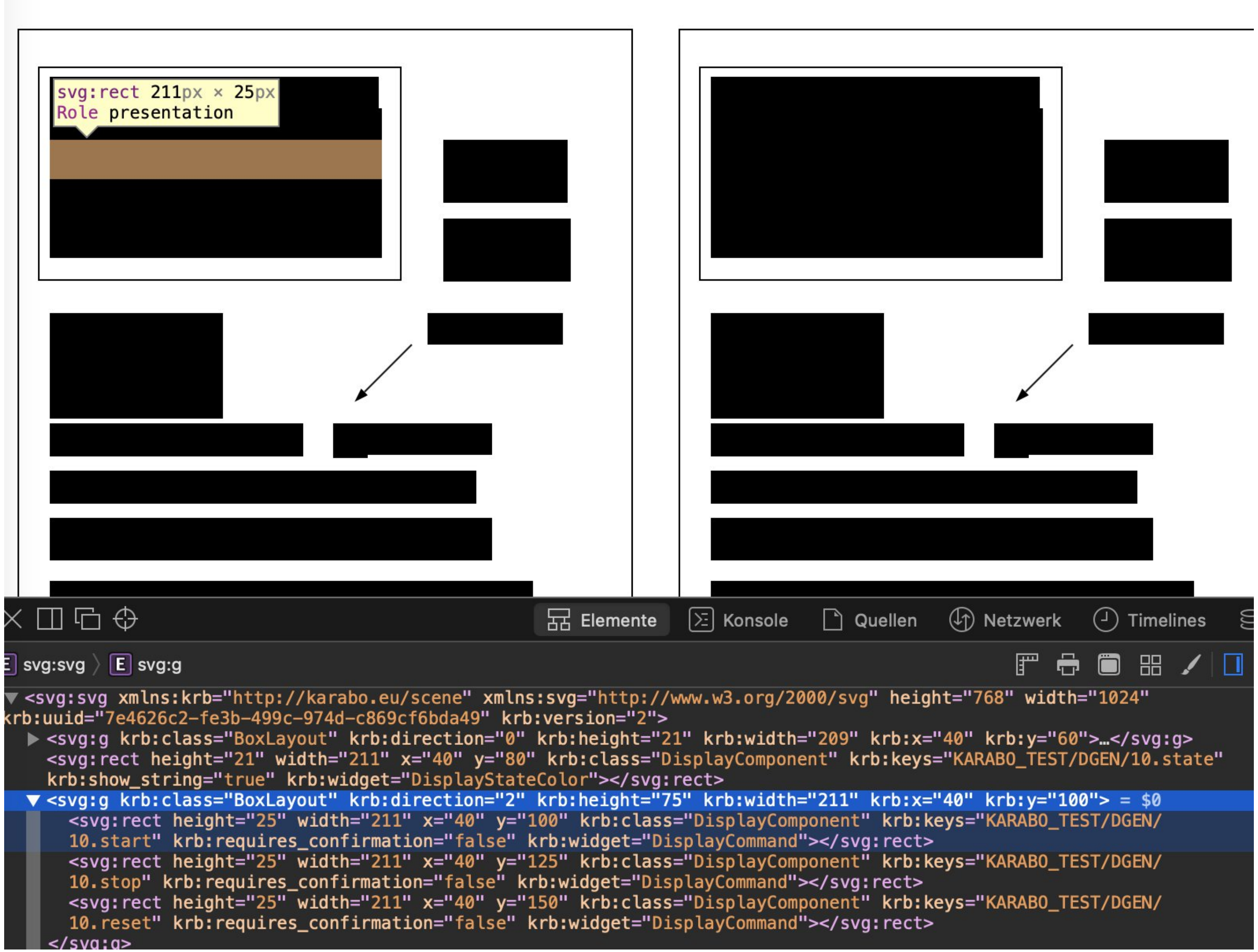
State UNKNOWN

- Booleans can be configured!



The Core Feature: The Scene

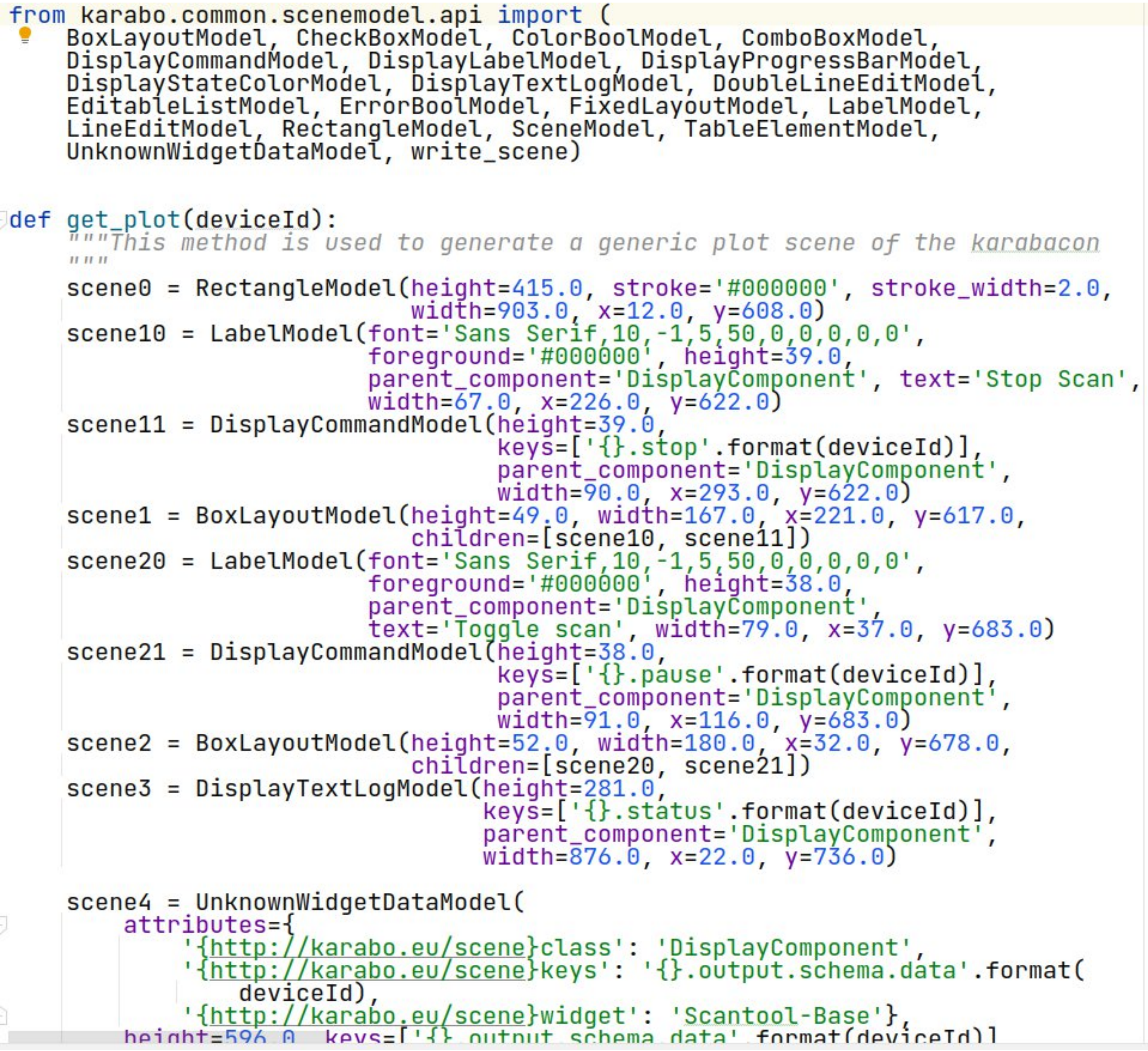
- Linked to every widget controller is a widget model.
  - Seperation of model and ui code fascilitates external tools and applications
  - Scenes are stored as *.svg
- **Can be edited outside Karabo**
  - **Include images, artwork, ...**
  - **Inkscape**



```
▼ <svg:svg xmlns:krb="http://karabo.eu/scene" xmlns:svg="http://www.w3.org/2000/svg" height="768" width="1024"
krb:uuid="7e4626c2-fe3b-499c-974d-c869cf6bda49" krb:version="2">
  ▶ <svg:g krb:class="BoxLayout" krb:direction="0" krb:height="21" krb:width="209" krb:x="40" krb:y="60">…</svg:g>
    <svg:rect height="21" width="211" x="40" y="80" krb:class="DisplayComponent" krb:keys="KARABO_TEST/DGEN/10.state"
    krb:show_string="true" krb:widget="DisplayStateColor"></svg:rect>
  ▼ <svg:g krb:class="BoxLayout" krb:direction="2" krb:height="75" krb:width="211" krb:x="40" krb:y="100"> = $0
      <svg:rect height="25" width="211" x="40" y="100" krb:class="DisplayComponent" krb:keys="KARABO_TEST/DGEN/
      10.start" krb:requires_confirmation="false" krb:widget="DisplayCommand"></svg:rect>
      <svg:rect height="25" width="211" x="40" y="125" krb:class="DisplayComponent" krb:keys="KARABO_TEST/DGEN/
      10.stop" krb:requires_confirmation="false" krb:widget="DisplayCommand"></svg:rect>
      <svg:rect height="25" width="211" x="40" y="150" krb:class="DisplayComponent" krb:keys="KARABO_TEST/DGEN/
      10.reset" krb:requires_confirmation="false" krb:widget="DisplayCommand"></svg:rect>
    </svg:g>
```

The Core Feature: The Scene

- Scenes can be translated to device code with **scene2py [deviceId]**
- Scenes can be embedded into devices and retrieved via protocol
  - **Panels shipped with devices**
  - Developer can steer the operator
- Device provided scenes retrieved by double click on device in any navigation or project panel (first name)



```python
from karabo.common.scenemodel.api import (
    BoxLayoutModel, CheckBoxModel, ColorBoolModel, ComboBoxModel,
    DisplayCommandModel, DisplayLabelModel, DisplayProgressBarModel,
    DisplayStateColorModel, DisplayTextLogModel, DoubleLineEditModel,
    EditableListModel, ErrorBoolModel, FixedLayoutModel, LabelModel,
    LineEditModel, RectangleModel, SceneModel, TableElementModel,
    UnknownWidgetDataModel, write_scene)


def get_plot(deviceId):
    """This method is used to generate a generic plot scene of the karabacon
    """
    scene0 = RectangleModel(height=415.0, stroke='#000000', stroke_width=2.0,
                            width=903.0, x=12.0, y=608.0)
    scene10 = LabelModel(font='Sans Serif,10,-1,5,50,0,0,0,0,0',
                         foreground='#000000', height=39.0,
                         parent_component='DisplayComponent', text='Stop Scan',
                         width=67.0, x=226.0, y=622.0)
    scene11 = DisplayCommandModel(height=39.0,
                                  keys=['{}.stop'.format(deviceId)],
                                  parent_component='DisplayComponent',
                                  width=90.0, x=293.0, y=622.0)
    scene1 = BoxLayoutModel(height=49.0, width=167.0, x=221.0, y=617.0,
                            children=[scene10, scene11])
    scene20 = LabelModel(font='Sans Serif,10,-1,5,50,0,0,0,0,0',
                         foreground='#000000', height=38.0,
                         parent_component='DisplayComponent',
                         text='Toggle scan', width=79.0, x=37.0, y=683.0)
    scene21 = DisplayCommandModel(height=38.0,
                                  keys=['{}.pause'.format(deviceId)],
                                  parent_component='DisplayComponent',
                                  width=91.0, x=116.0, y=683.0)
    scene2 = BoxLayoutModel(height=52.0, width=180.0, x=32.0, y=678.0,
                            children=[scene20, scene21])
    scene3 = DisplayTextLogModel(height=281.0,
                                 keys=['{}.status'.format(deviceId)],
                                 parent_component='DisplayComponent',
                                 width=876.0, x=22.0, y=736.0)

    scene4 = UnknownWidgetDataModel(
        attributes={
            '{http://karabo.eu/scene}class': 'DisplayComponent',
            '{http://karabo.eu/scene}keys': '{}.output.schema.data'.format(
                deviceId),
            '{http://karabo.eu/scene}widget': 'Scantool-Base'},
        height=596.0, keys=['{}.output.schema.data'.format(deviceId)]
```

The Scene - Challenge: Performance

- At European XFEL we typically have to deal with very large data sizes
  - Detectors can provide large image data
  - Fast digitizers provide arrays with a **million** data points
- Development of an own image controller that is significantly faster than the upstream software on github
  - Only **render what is required** (widget size and zoom consideration) increases performance by several magnitudes
- Translation of the well-known **Largest – Triangle - Three - Buckets** algorithm to C-Extension code to be able to downsample and view large datasets in a PyQt application.
  - Used by other applications as well: **https://pypi.org/project/lttbc/**
  - E.g. by a plotly resampler nowadays

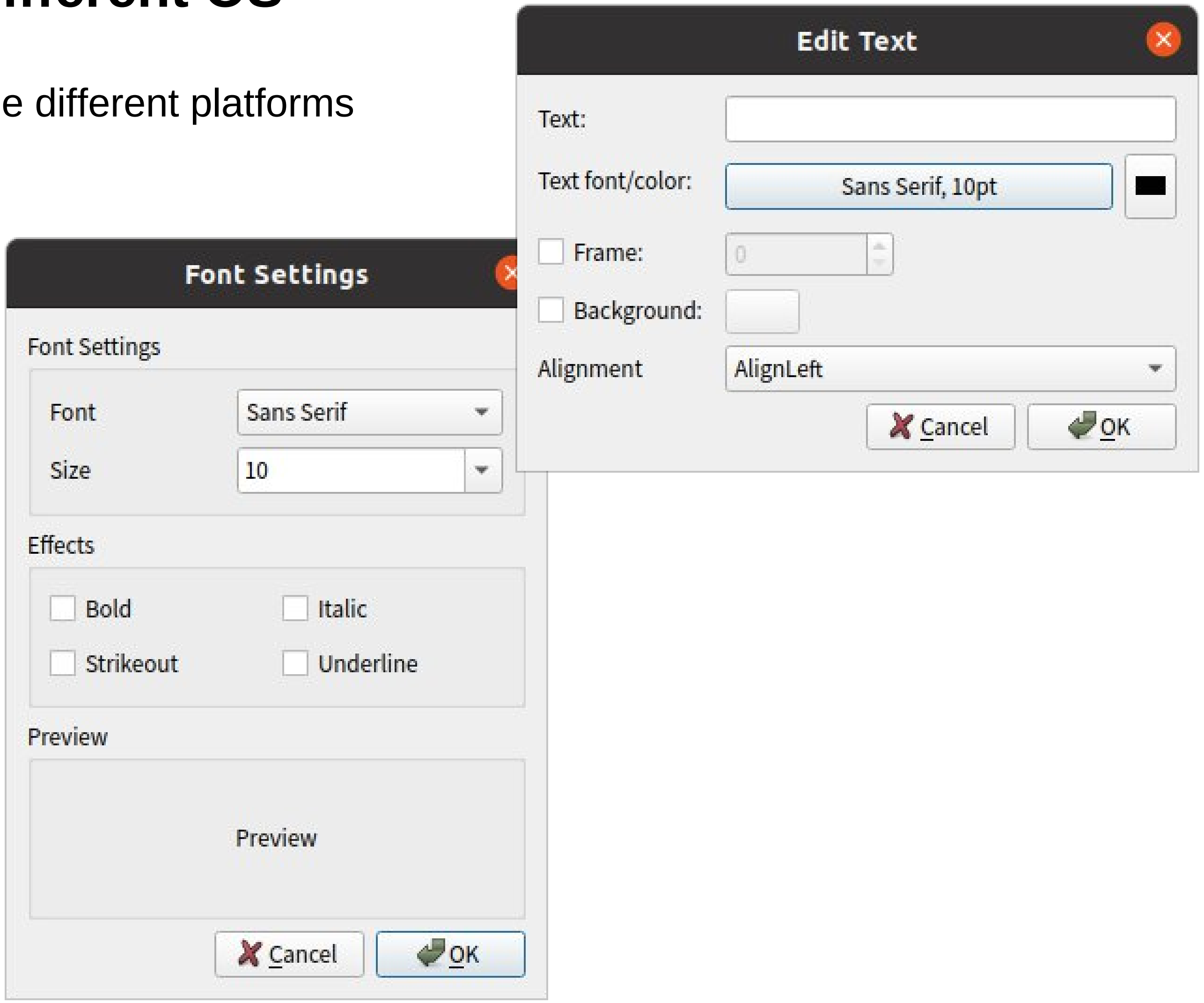
The Scene - Challenge: Compatibility Different OS

* karaboGui is now supported and tested (**Squish**) on three different platforms

  - **Linux**
  - **Windows**
  - **<u>MacOS (May 2020)</u>**

- Shipment of fonts (open source) with limited selection:

  Monospaced, Serif, Sans Serif



Font Settings

Font Settings

Font: Sans Serif

Size: 10

Effects

□ Bold □ Italic

□ Strikeout □ Underline

Preview

Preview

Edit Text

Text:

Text font/color: Sans Serif, 10pt ■

□ Frame: 0

□ Background:

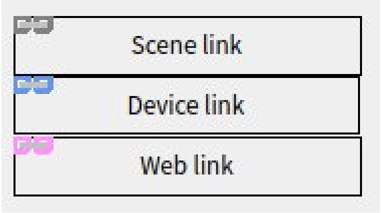
Alignment: AlignLeft

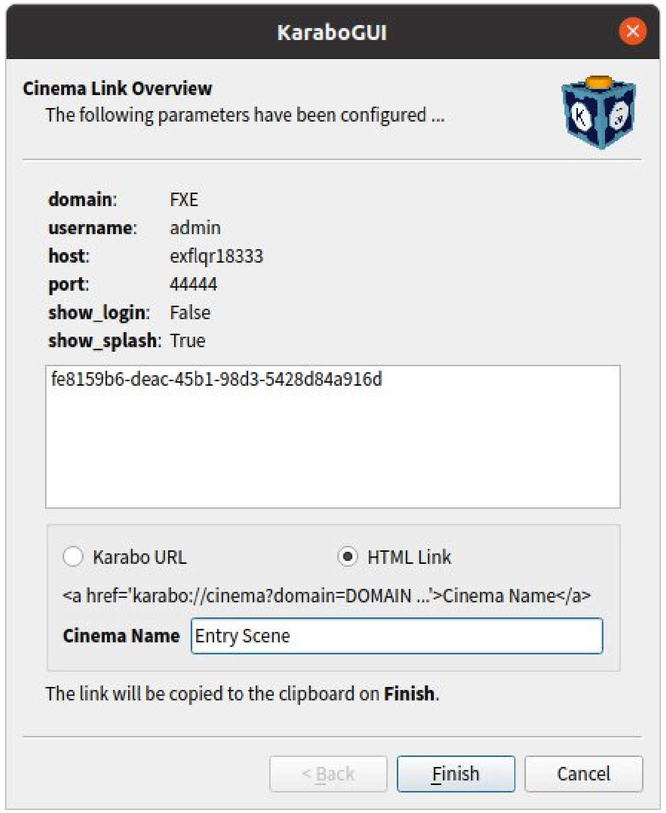
The Scene - Challenge: Compatibility between applications

- Limited but very well tested layouts and grouping of widgets
  - Fixed Layout, Vertical Layout, Horizontal Layout
  - Grid layout at the moment not available (but planned to make its comeback)
- Flat hierarchy on the scene with scene or web links (Web browser feeling)

➢ **Children positions inside layouts must be always synchronized and calculated**

- KaraboGui can be started via **URI scheme handler** from web applications in **karabo-cinema** or **karabo-theatre** mode
  - Open single scenes (panels standalone) in control mode
  - Links can be integrated into any web form





Cinema Link Overview

The following parameters have been configured ...

domain: FXE
username: admin
host: exflqr18333
port: 44444
show_login: False
show_splash: True

fe8159b6-deac-45b1-98d3-5428d84a916d

○ Karabo URL ● HTML Link

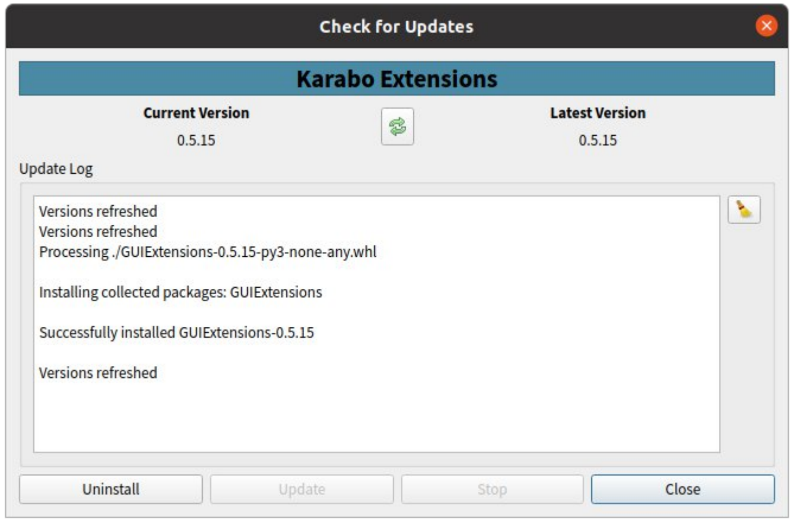
<a href='karabo://cinema?domain=DOMAIN ...'>Cinema Name</a>

Cinema Name Entry Scene

The link will be copied to the clipboard on **Finish**.

New UI features - Deployment

- The karaboGui is coupled to the framework (gui server and core devices protocol) and has around **2 releases** a year.
  - Treated as a basic **interpreter** that should provide most basic and generic features
- **Ansible** is used for deployment on client machines in the control hutches
  - Provide own **CONDA** Mirror for Gui dependencies in the company network
- No control about user laptops: handshake of minimum client version on gui server device
- **GUI Extensions updater**
  - Another gitlab repository with additional controllers and applications that can be used by the karaboGui, to provide features on short lead time.



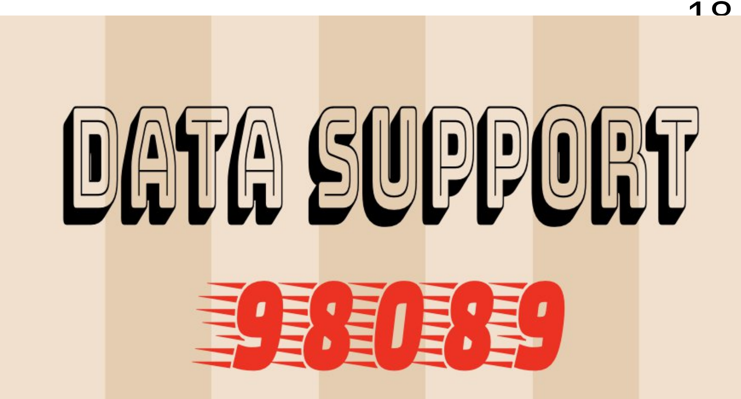
Current Version: 0.5.15

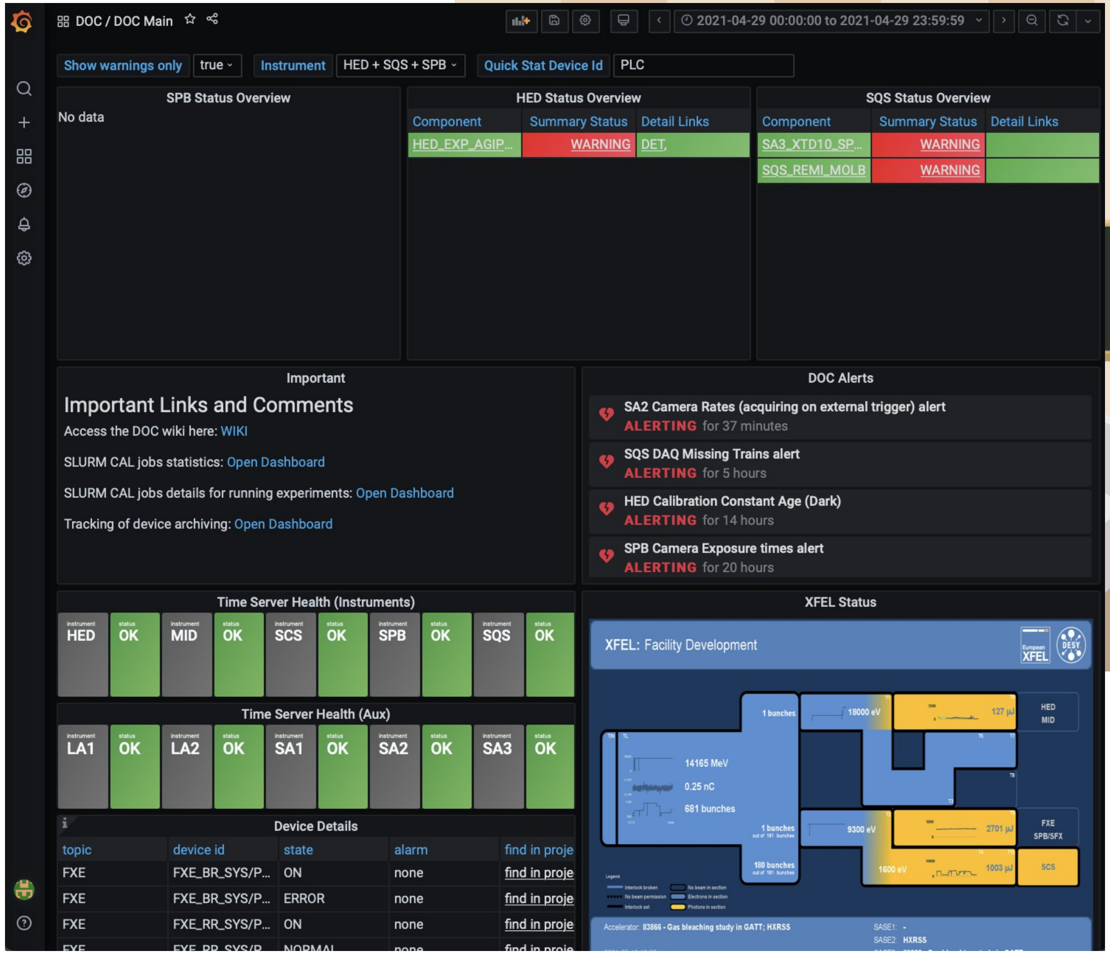
Latest Version: 0.5.15

```
Versions refreshed
Versions refreshed
Processing ./GUIExtensions-0.5.15-py3-none-any.whl

Installing collected packages: GUIExtensions

Successfully installed GUIExtensions-0.5.15

Versions refreshed
```

Alternative Monitoring Route: Integration with Grafana

- All slow control data (send via broker) is stored via data logger devices into a time series database
  - **InfluxDB**
- Have **Grafana** as additional front-end to monitor control system status (**Data Operation Center**)
- Embed KaraboGui links into Grafana Dashboards
- Future: Add **Kapacitor** to the stack for automated notifications from **InfluxDB** data





Show warnings only: true
Instrument: HED + SQS + SPB
Quick Stat Device Id: PLC

SPB Status Overview

No data

HED Status Overview

Component	Summary Status	Detail Links
HED_EXP_AGIP...	WARNING	DET,

SQS Status Overview

Component	Summary Status	Detail Links
SA3_XTD10_SP...	WARNING	
SQS_REMI_MOLB	WARNING	

Important

Important Links and Comments

Access the DOC wiki here: WIKI

SLURM CAL jobs statistics: Open Dashboard

SLURM CAL jobs details for running experiments: Open Dashboard

Tracking of device archiving: Open Dashboard

DOC Alerts

SA2 Camera Rates (acquiring on external trigger) alert
ALERTING for 37 minutes

SQS DAQ Missing Trains alert
ALERTING for 5 hours

HED Calibration Constant Age (Dark)
ALERTING for 14 hours

SPB Camera Exposure times alert
ALERTING for 20 hours

Time Server Health (Instruments)

instrument	status	instrument	status	instrument	status	instrument	status	instrument	status
HED	OK	MID	OK	SCS	OK	SPB	OK	SQS	OK

Time Server Health (Aux)

instrument	status	instrument	status	instrument	status	instrument	status	instrument	status
LA1	OK	LA2	OK	SA1	OK	SA2	OK	SA3	OK

Device Details

topic	device id	state	alarm	find in proje
FXE	FXE_BR_SYS/P...	ON	none	find in proje
FXE	FXE_BR_SYS/P...	ERROR	none	find in proje
FXE	FXE_RR_SYS/P...	ON	none	find in proje
FXE	FXE_RR_SYS/P	NORMAL	none	find in proje

XFEL Status

XFEL: Facility Development

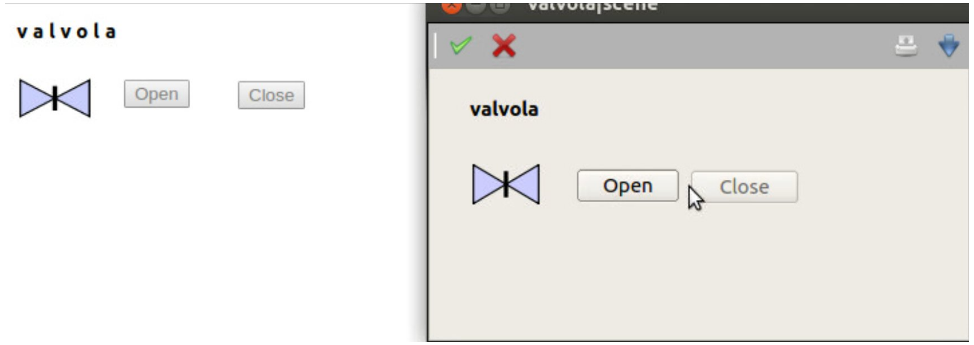
Accelerator: 83866 - Gas bleaching study in GATT; HXRSS

SASE1: -

SASE2: HXRSS

Future – Hybrid between Qt and Web

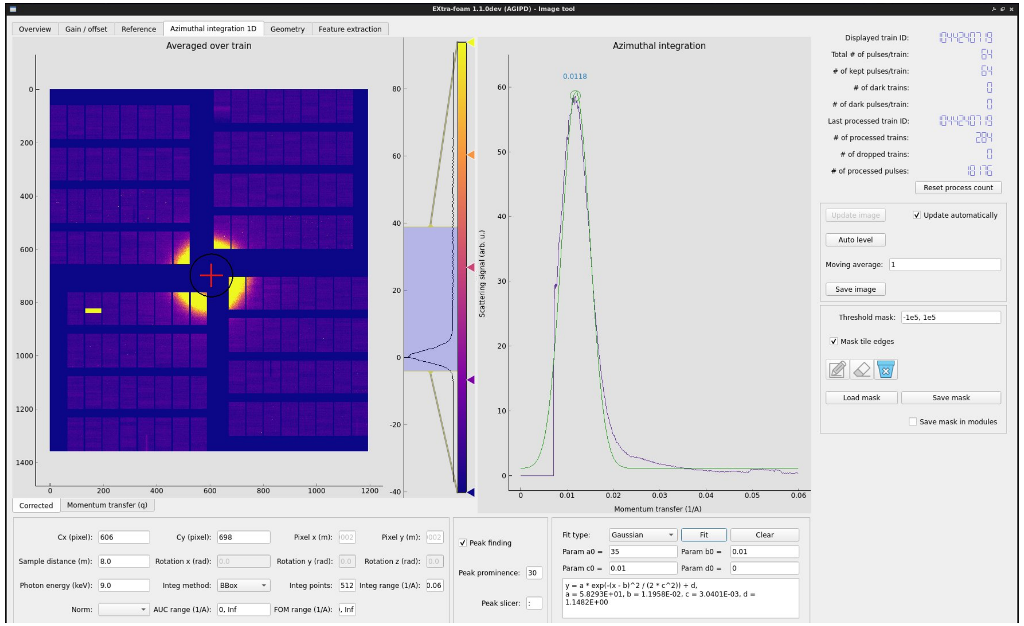
- The scene model is ui technology independent
- **Provide WebGui that can translate the scene model and provide user interface**
  - Use Gui Server device as entry to the control system
- Prototyping possible candidates started using **Angular** and **React**
  - **Build karabo scene in editor -> Direct Web form**
  - Example: Simple valve scene



- Considering various back-end designs: Open for discussion, among others: GRPC, binary data on web sockets, ...
- **Motivation: Encapsulate scene in web form to preserve integrity and combine with other web services and control systems**

Data Analysis – Other Rich Client Applications

EXTRA-foam



Displayed train ID: 1044240719
Total # of pulses/train: 64
# of kept pulses/train: 64
# of dark trains: 0
# of dark pulses/train: 0
Last processed train ID: 1044240719
# of processed trains: 284
# of dropped trains: 0
# of processed pulses: 18176

☑ Update automatically
Moving average: 1
Threshold mask: -1e5, 1e5
☑ Mask tile edges
□ Save mask in modules

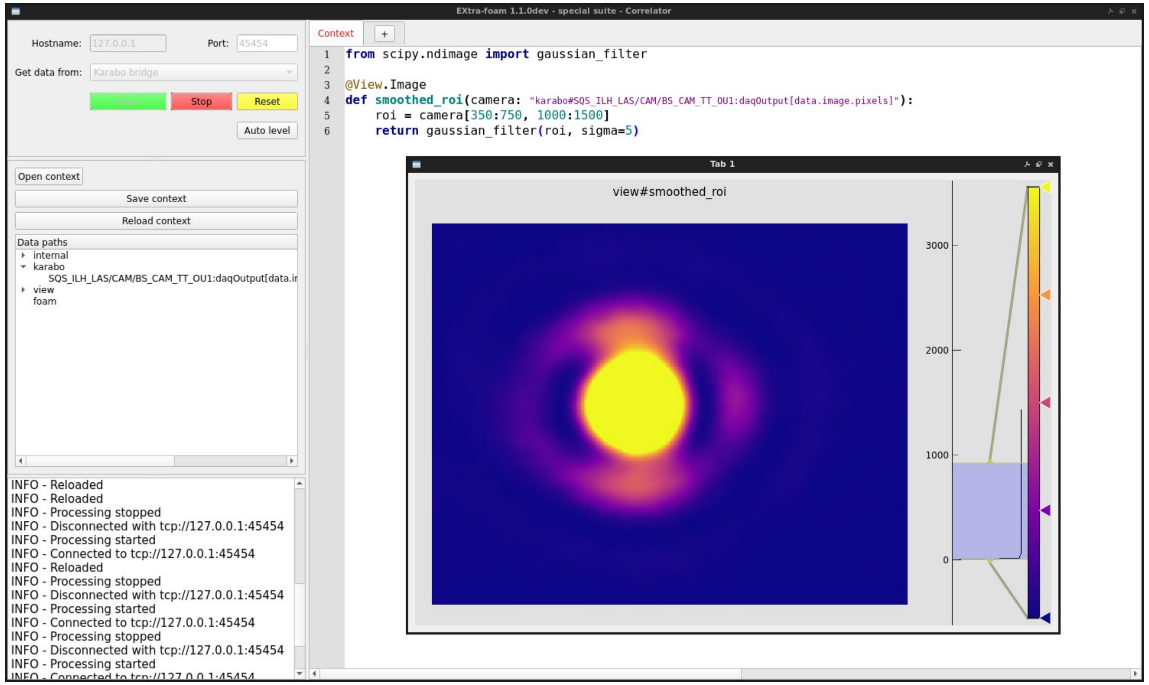
Cx (pixel): 606
Cy (pixel): 698
Pixel x (m): 002
Pixel y (m): 002
Sample distance (m): 8.0
Rotation x (rad): 0.0
Rotation y (rad): 0.0
Rotation z (rad): 0.0
Photon energy (keV): 9.0
Integ method: BBox
Integ points: 512
Integ range (1/A): 0.06
Norm:
AUC range (1/A): 0, Inf
FOM range (1/A): , Inf

☑ Peak finding
Peak prominence: 30
Peak slicer: :

Fit type: Gaussian
Param a0 = 35
Param b0 = 0.01
Param c0 = 0.01
Param d0 = 0

```
y = a * exp(-(x - b)^2 / (2 * c^2)) + d,
a = 5.8293E+01, b = 1.1958E-02, c = 3.0401E-03, d =
1.1482E+00
```

EXTRA-metro



Hostname: 127.0.0.1
Port: 45454
Get data from: Karabo bridge

Data paths
- internal
- karabo
  - SQS_ILH_LAS/CAM/BS_CAM_TT_OU1:daqOutput[data.ir
- view
  - foam

```python
from scipy.ndimage import gaussian_filter

@View.Image
def smoothed_roi(camera: "karabo#SQS_ILH_LAS/CAM/BS_CAM_TT_OU1:daqOutput[data.image.pixels]"):
    roi = camera[350:750, 1000:1500]
    return gaussian_filter(roi, sigma=5)
```

```
INFO - Reloaded
INFO - Reloaded
INFO - Processing stopped
INFO - Disconnected with tcp://127.0.0.1:45454
INFO - Processing started
INFO - Connected to tcp://127.0.0.1:45454
INFO - Reloaded
INFO - Processing stopped
INFO - Disconnected with tcp://127.0.0.1:45454
INFO - Processing started
INFO - Connected to tcp://127.0.0.1:45454
INFO - Processing stopped
INFO - Disconnected with tcp://127.0.0.1:45454
INFO - Processing started
INFO - Connected to tcp://127.0.0.1:45454
```

- Similar technology stack as the karaboGui
  - Qt, traitlets, IPython with jupyter notebooks etc...
  - Not part of this presentation, but there are more ..

Overview – Who does what?

- **Controls Group** at European XFEL maintains Karabo Framework and has two teams
- **Development team** responsible for maintaining and developing the **karaboGui** (both in Qt and Web form)
  - Dedicated test engineer in the development team
  - Includes infrastructure of extensions (Gitlab CI)
- **Instrument Control Integration team**
  - Does not develop karaboGui, they develop karabo devices, scenes provided directly by devices
  - Advanced integration team members develop controllers for GUI Extensions
- **Beamline scientists and operators**
  - Do not develop GUI, they develop macros and scenes.

Thank you!