

From Desktop to Web: The Evolution of Our GUIs from PyQt to React



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European XFEL currently uses PyQt for several of our critical applications



Controls and Data Analysis groups are now transitioning to web technologies

Advantages:

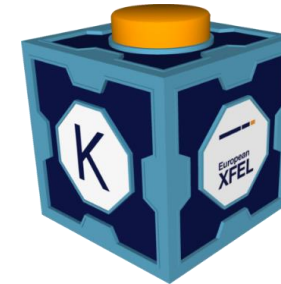
- Cross-platform accessibility
- Modern and responsive interfaces
- Centralized deployment

Frontend: Consistent across applications

- React (JavaScript library)
- Redux (state management)

Backend: Implementation varies by application

- FastAPI (Python web framework)
- Tailored solutions to meet specific requirements



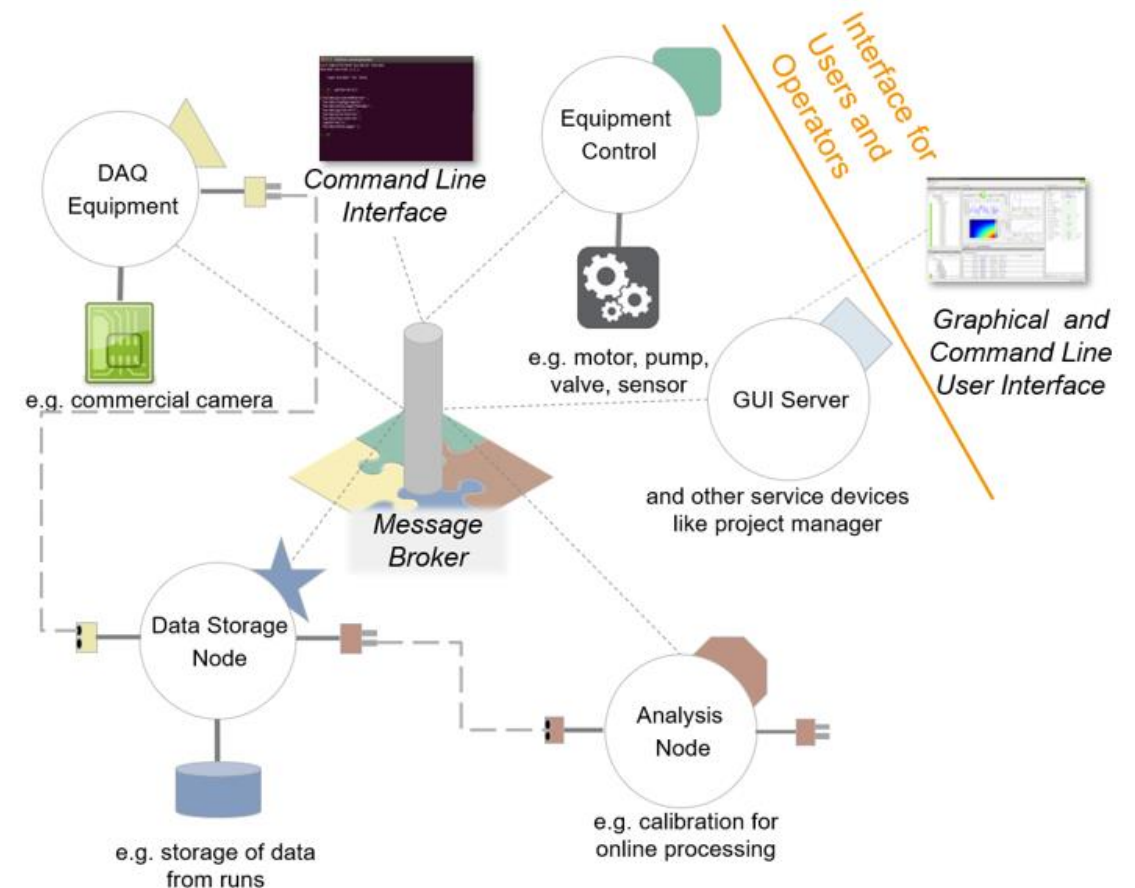
Karabo
(distributed controls system)
<http://karabo.eu/>



DAMNIT
(experiment data and metadata management)
<https://damnit.rfd.io/>

Karabo in a nut shell: Architecture

- Central Message Broker: RabbitMQ (Control data)
- Event and message driven:
 - Data propagates through the system on value change
 - Signal – Slot paradigm: publish and subscribe
- Peer-to-peer TCP connections for fast data
- GuiServer Device:
 - **Gateway** to the control system
 - TCP connection to application clients



Karabo GUI – The Cockpit

- **Python** software contained in Karabo framework
 - Separate package installation
- Technology: **Qt** Library and **Traits**
- **Core feature:**
 - Scene (Panel) Designer
 - Scene Model Interpreter
 - Extensible via guiextensions:
 - a plugin updater for more widgets and controllers

The screenshot displays the Karabo GUI interface with the following components:

- System Topology:** A tree view showing the hierarchy of devices under 'Host - Server - Class - Device'. The tree includes 'exflcon53n0' and several sub-devices like 'SPB/beckhoffMon', 'cppSPB/loop_xtd9_cam', and 'BeckhoffDigitalOutput'.
- Configuration Editor:** A table showing properties for a selected device. The 'State' property is highlighted in blue and set to 'OFF'.
- Logs:** A log window at the bottom showing system messages, including a successful connection to the GUI server and an error message about a malformed topology entry.

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-4.10.2-13.7	
Karabo version	2.13.7	
ServerID	cppServer/sa1_beckh...	
Host	exflcon53n0	
Process ID	30420	
State	OFF	
Status		
Alarm condition	none	
Locked by		

Log messages:

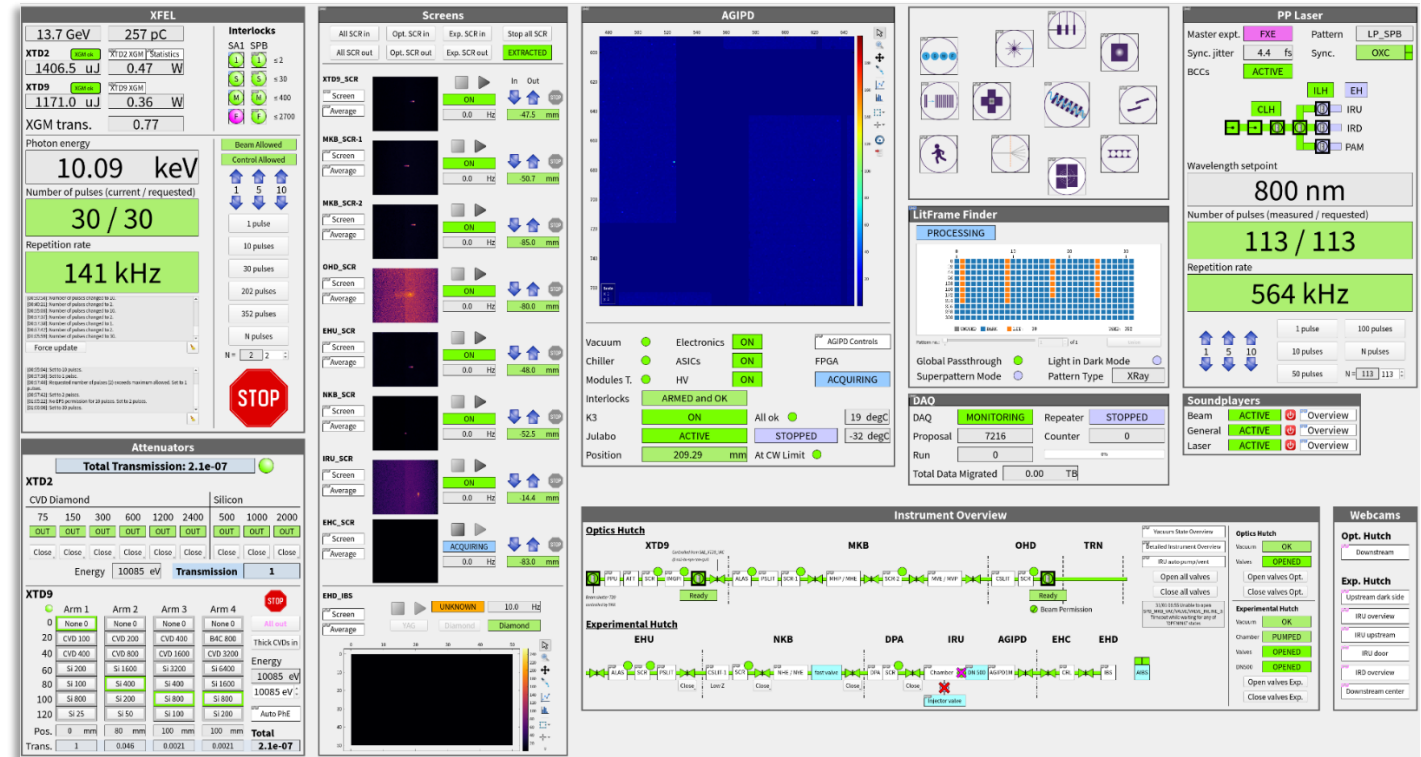
```

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
  
```



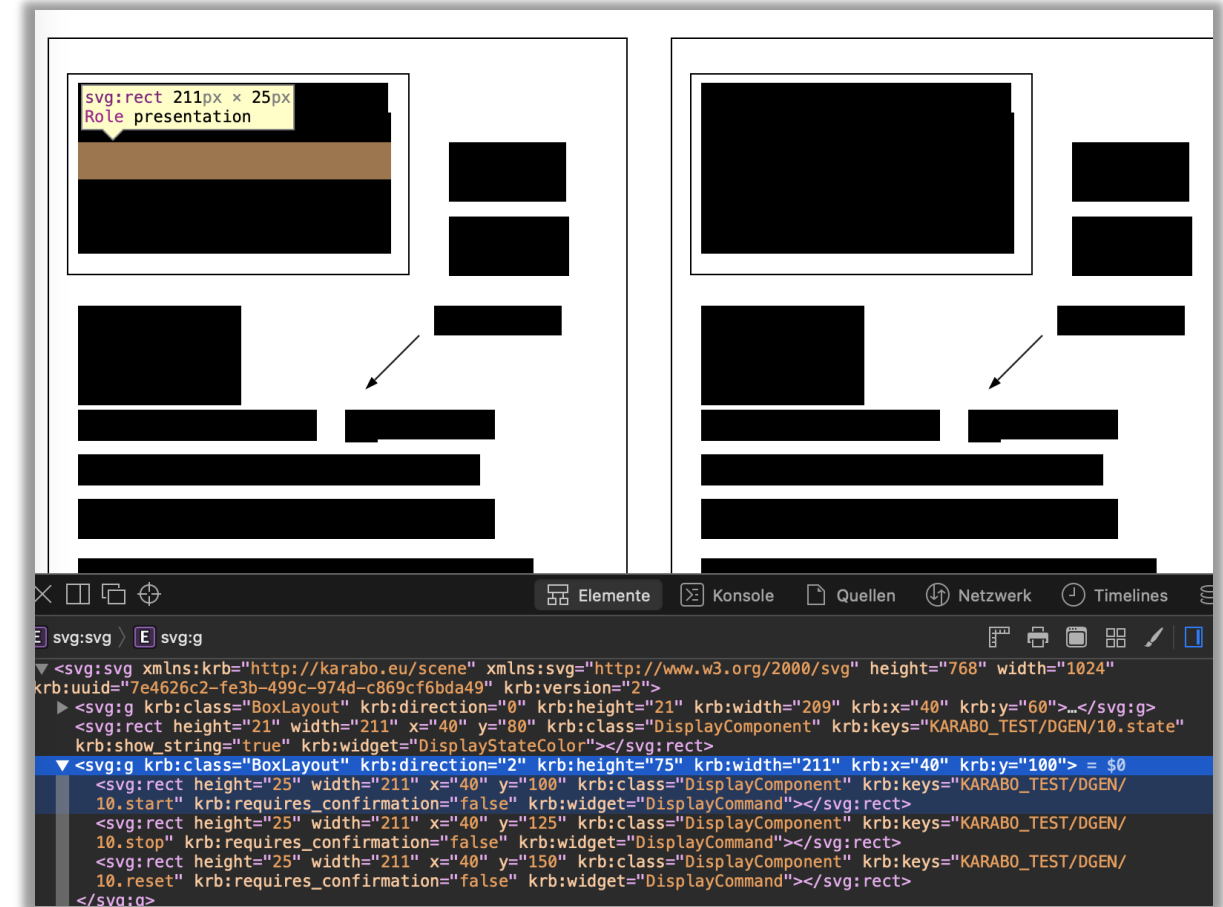
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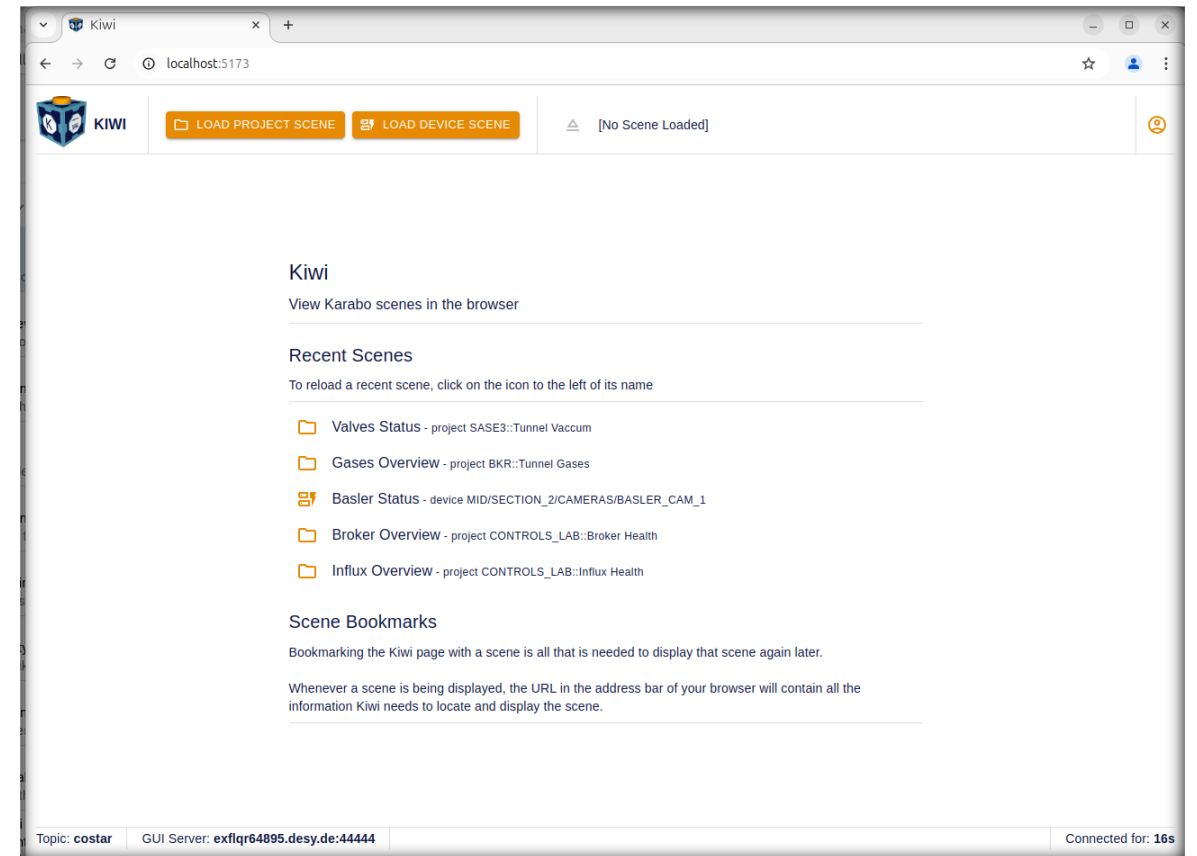
The Core Feature: The Scene

- Linked to every widget controller is a widget model
 - Separation of model and UI code facilitates external tools and applications
 - Scenes are stored as *.svg
 - The scene model is UI technology independent
- Scenes are stored in central database (ExistDB)



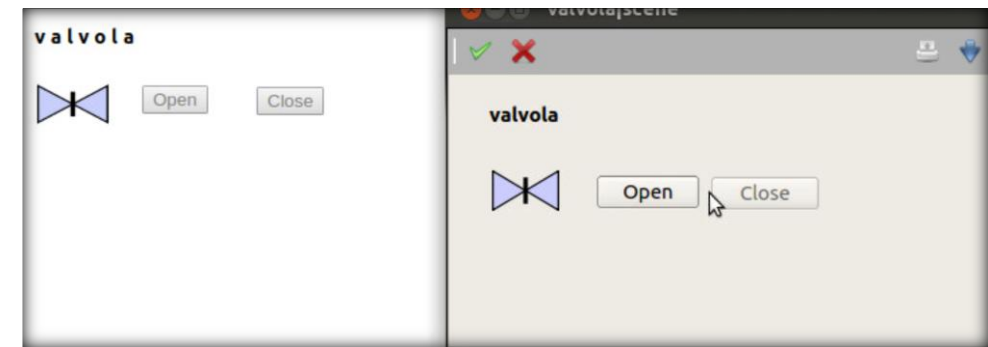
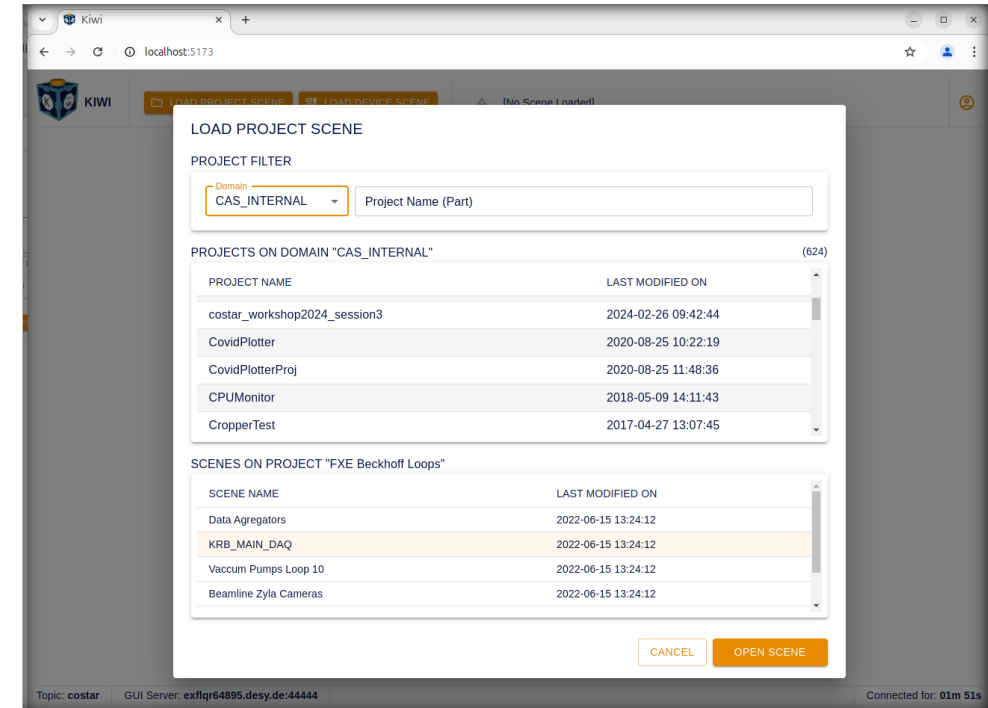
Motivation

- Encapsulate scenes in web form
 - To preserve integrity
 - To combine with other web services and control systems (**Synoptic View**)
- Hybrid between Qt and Web
 - Build Karabo scenes in Qt GUI Editor
 - Direct Web display
- Use of strong authentication features on the web (LDAP, KeyCloak)
- Server-side deployment instead of application deployment



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Karabo GUI - Strategy

- Backend: GuiServer device used for both Web and Qt Application (share same protocol)
 - WebSocket to TcpSocket mediator
- Technology Stack:
 - Frontend: React, Redux
 - Backend: FastAPI
- Translation of Karabo scene model to web is ongoing
 - Derive synoptic web view (read only) and concept of fast image streaming by beginning of **2026**
 - Provide plugin for widget extensions for other applications (Scantool Karabacon) by **2026**



Concept: Synoptic web view

Full user-facing experiment in a web view

2025

Work Group (~3 personel)

2026

DAMNIT in a nutshell

- Advanced alternative to traditional spreadsheets, specifically designed for **run tables**
- Interactive **PyQt**-based desktop application for data visualization and exploration
- Tabular format allows intuitive management of experimental data and metadata
- Automation through Python scripts for backend data processing and storage, integrated within the interface

DAMNIT talk on the *data reduction session* (Thomas M.)
 Wednesday, 24. September 2024, 5:10 PM

	Date	Time	Sample	Photon Energy	Detector distance	Detector Gain	Pulses per Train	Injection type	Num. frames	Num. hits	Hit rate (%)	Extended Comments
1	23-06-2024	19:04:43	Dark									
2	23-06-2024	19:48:42	Test DAQ	1 keV								
3	23-06-2024	20:00:25	Test DAQ	1 keV					1020			
4	23-06-2024	20:02:23	Dark			4			600			
5	24-06-2024	8:25:18	Dark									
6	24-06-2024	12:16:33	Dark		85 mm	1						
7	24-06-2024	12:41:37	Test run	1.0 keV	85 mm	1						
8	24-06-2024	12:43:05	Test run	1.0 keV	85 mm	1	10	ITV1	4500			
9	24-06-2024	13:25:48	Test run	1.2 keV	85 mm	1	1	ITV1	3200			
10	24-06-2024	15:15:23	Sample A	1.2 keV	85 mm	1	1	ITV1	5750			
11	24-06-2024	15:25:52	Sample A	1.2 keV	85 mm	1	1	ITV1	1900			
12	24-06-2024	16:01:20	Sample B	1.2 keV	120 mm	1	1	ITV1	5555	230	4.14%	
13	24-06-2024	16:11:44	Sample B	1.2 keV	120 mm	1	1	ITV1	5800	243	4.19%	
14	24-06-2024	16:22:59	Sample B	1.2 keV	120 mm	1	1	ITV1	5750	253	4.40%	
15	24-06-2024	16:33:08	Sample B	1.2 keV	120 mm	1	1	ITV1	6150	255	4.15%	
16	24-06-2024	16:44:29	Sample B	1.2 keV	120 mm	1	1	ITV1	6000	298	4.97%	
17	24-06-2024	16:54:40	Sample B	1.2 keV	120 mm	1	1	ITV1	4800	140	2.92%	
18	24-06-2024	17:04:46	Sample B	1.2 keV	120 mm	1	1	ITV1	6100	212	3.48%	
19	24-06-2024	17:29:36	Sample B	1.2 keV	120 mm	1	1	ITV1	5900	182	3.08%	

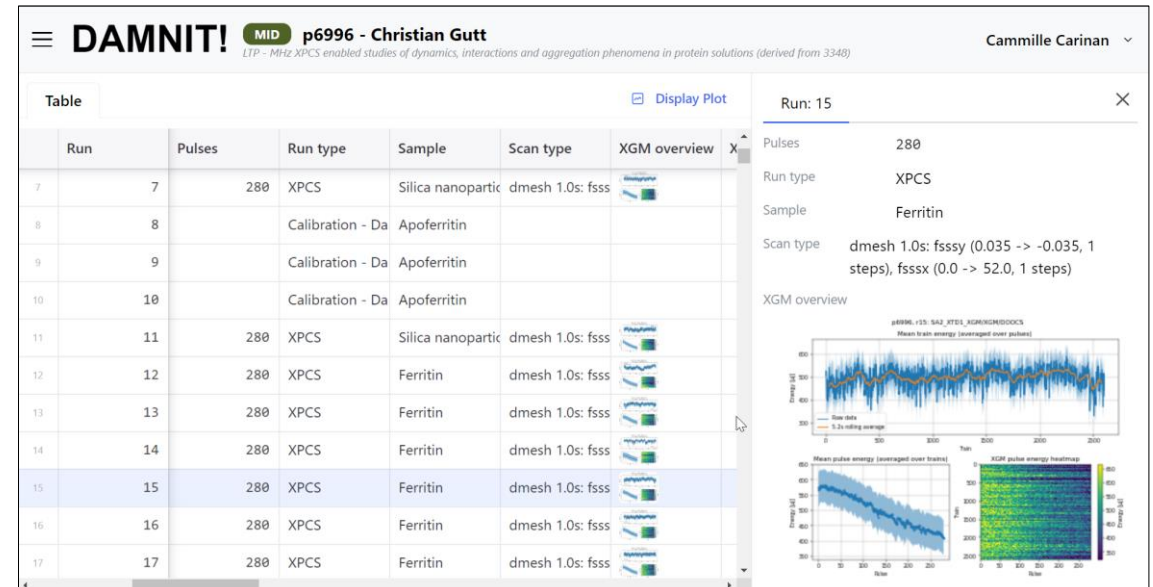


DAMNIT-web: First Prototype

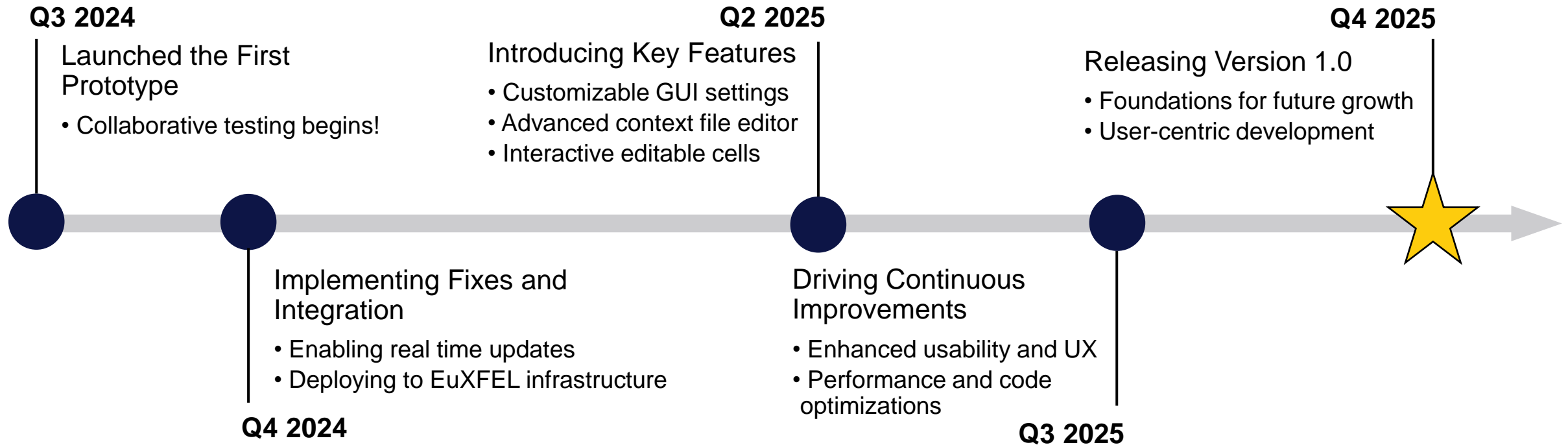
- Frontend: React, Redux, Apollo GraphQL
- Backend: FastAPI, Strawberry GraphQL
 - OAUTH authentication
 - LDAP authorization
- Benefits of transitioning to web:
 - Enhanced usability with improved interface
 - ▶ Table pagination with infinite scrolling
 - ▶ Faster overview and interaction
 - Accessibility outside of the compute cluster
 - ▶ Web-based access
 - ▶ Secure external access
 - Real time updates via GraphQL subscriptions (in development)

DAMNIT! Cammille Carinan

Proposal	Beamtime date
2024 - II	
+ FXE 6640 Serena DeBeer	August 16, 2024
+ HED 6656 Thomas Preston	August 16, 2024
+ SPB 8316 Romain Letrun	August 10, 2024
+ SPB 6844 Dominik Oberthuer	August 09, 2024
+ SQS 8256 Marziyeh Sadat Tavakkoly	August 07, 2024
+ FXE 7296 Sonja Herres-Pawlis	August 01, 2024
+ HED 8237 Srijati Venkata Rahul	July 31, 2024
+ MID 900466 Anders Madsen	July 01, 2024
+ SCS 900464 Andreas Scherz	July 01, 2024
+ SXP 900460 Manuel Izquierdo	July 01, 2024



Roadmap: From Prototype to Release



Questions for the Community

■ Transition Experiences

- Have you undertaken a similar transition from desktop to web-based applications?
If so, what were the key challenges you faced?

■ Maintaining Consistency

- What best practices have you implemented to maintain consistency across applications during a technology transition?

■ Enhancing User Experience

- What strategies have you found effective in improving user experience when redesigning application interfaces?

■ Utilizing Metrics and Insights

- Do you use metrics and other methods to gather insights that inform your design and development decisions? If so, which metrics and techniques have been most beneficial?