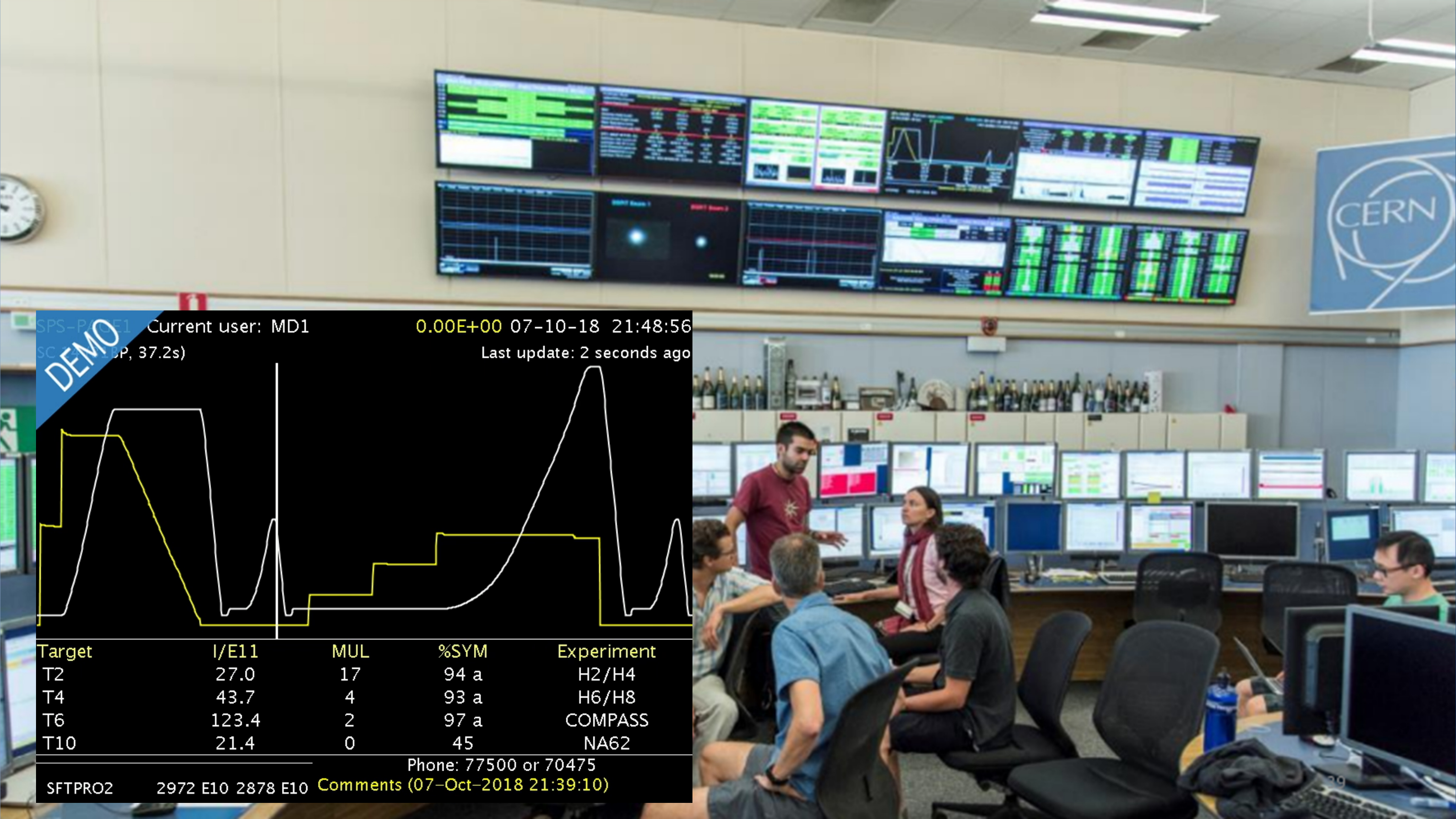


Our Journey from Java to PyQt for CERN Accelerator Control GUIs

Ivan Sinkarenko, Sara Zanzottera, Vito Baggiolini

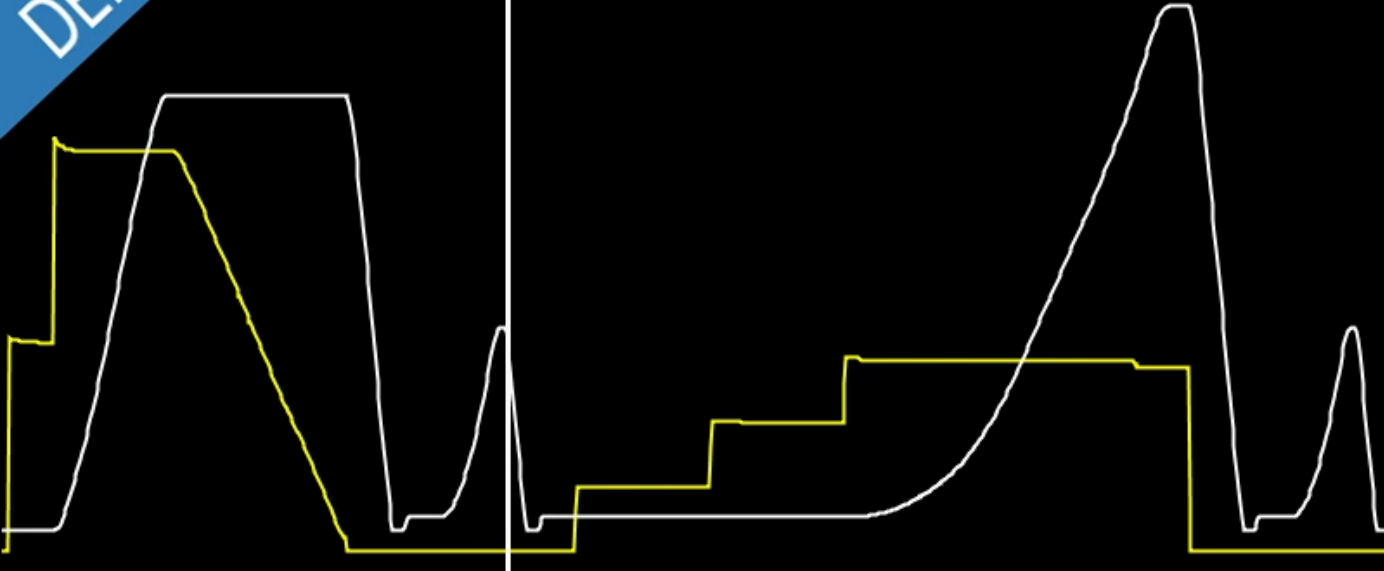






DEMO

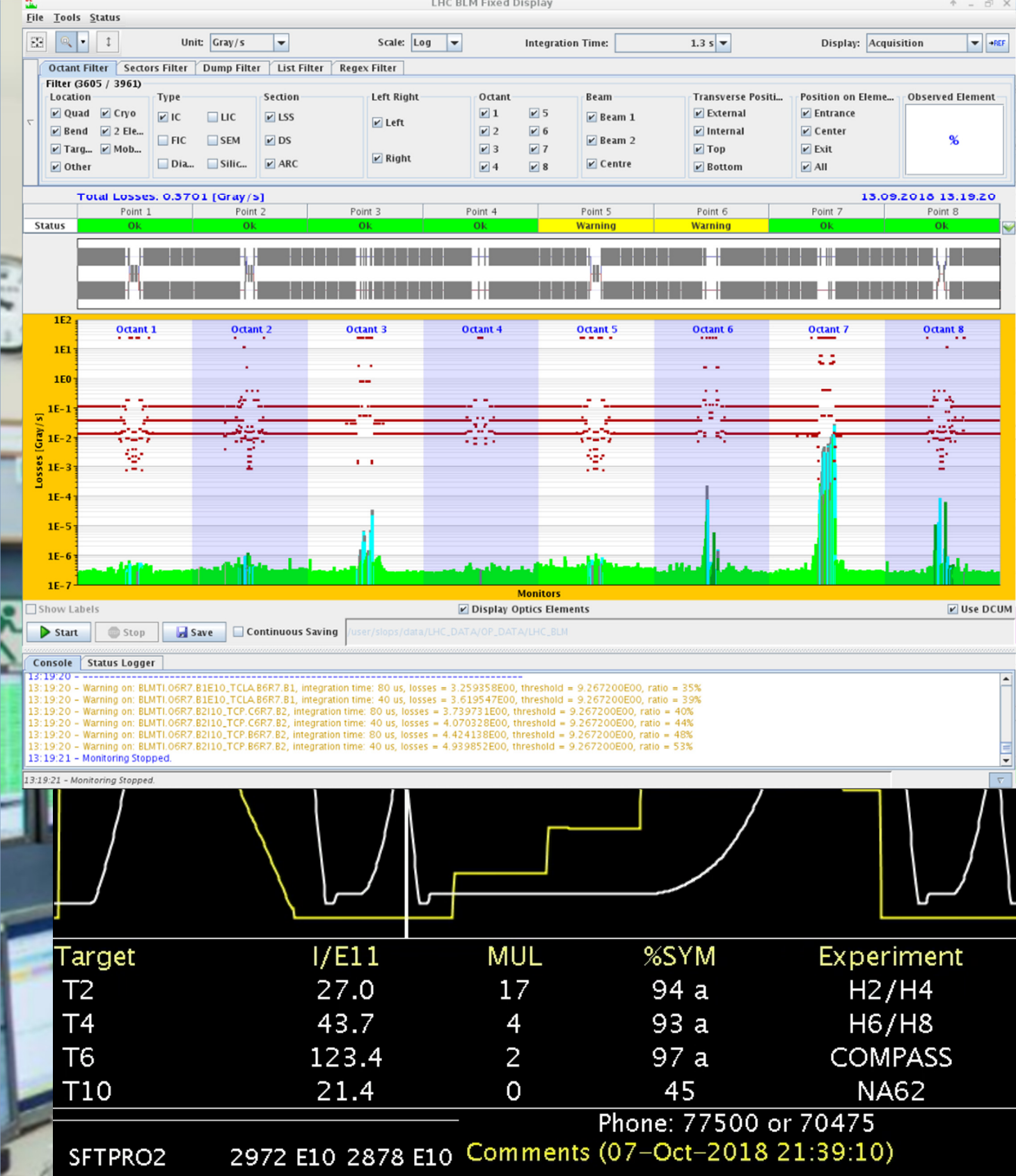
SPS-PAVE1 Current user: MD1 0.00E+00 07-10-18 21:48:56
SC 2 (P, 37.2s) Last update: 2 seconds ago

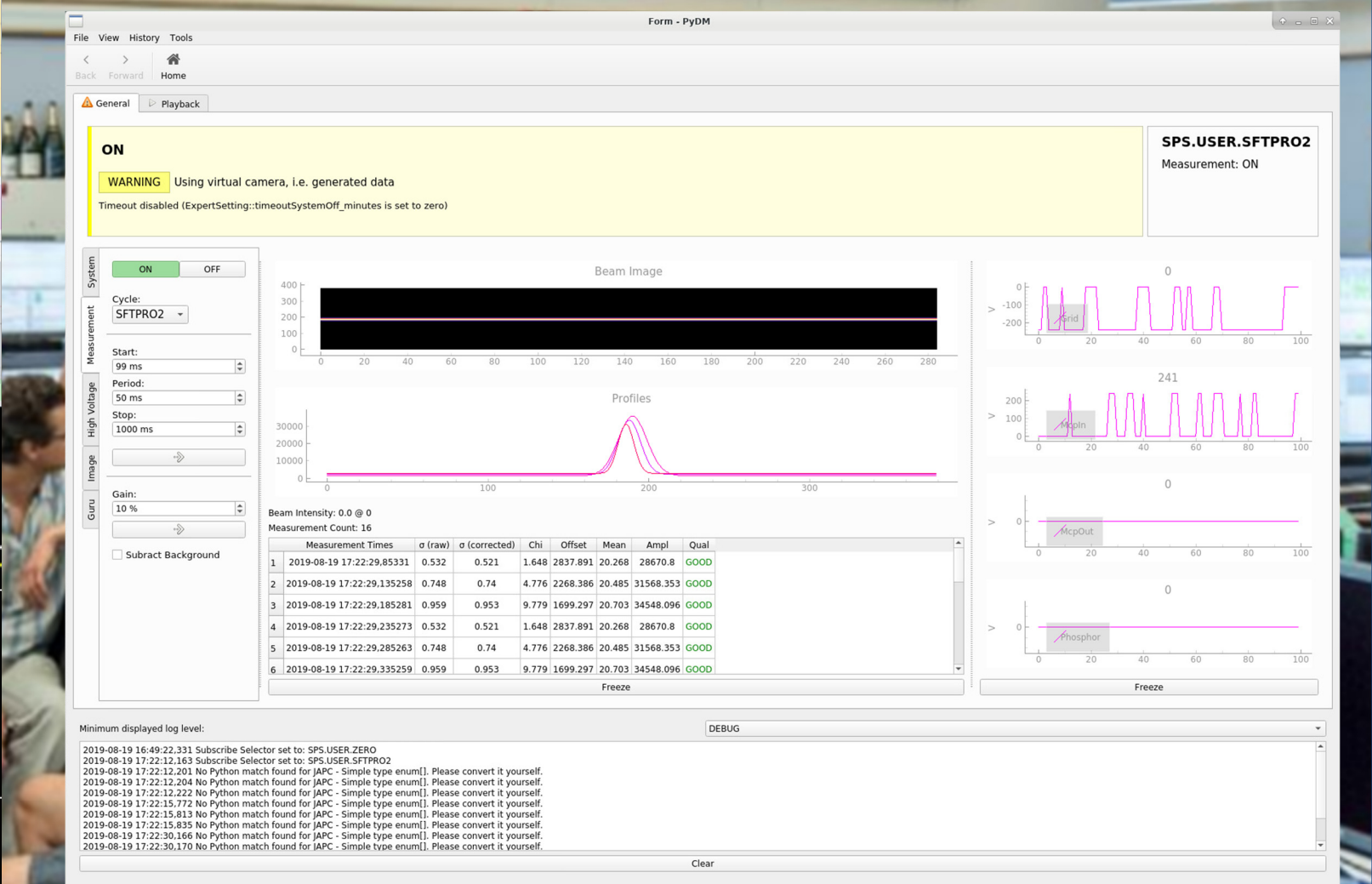
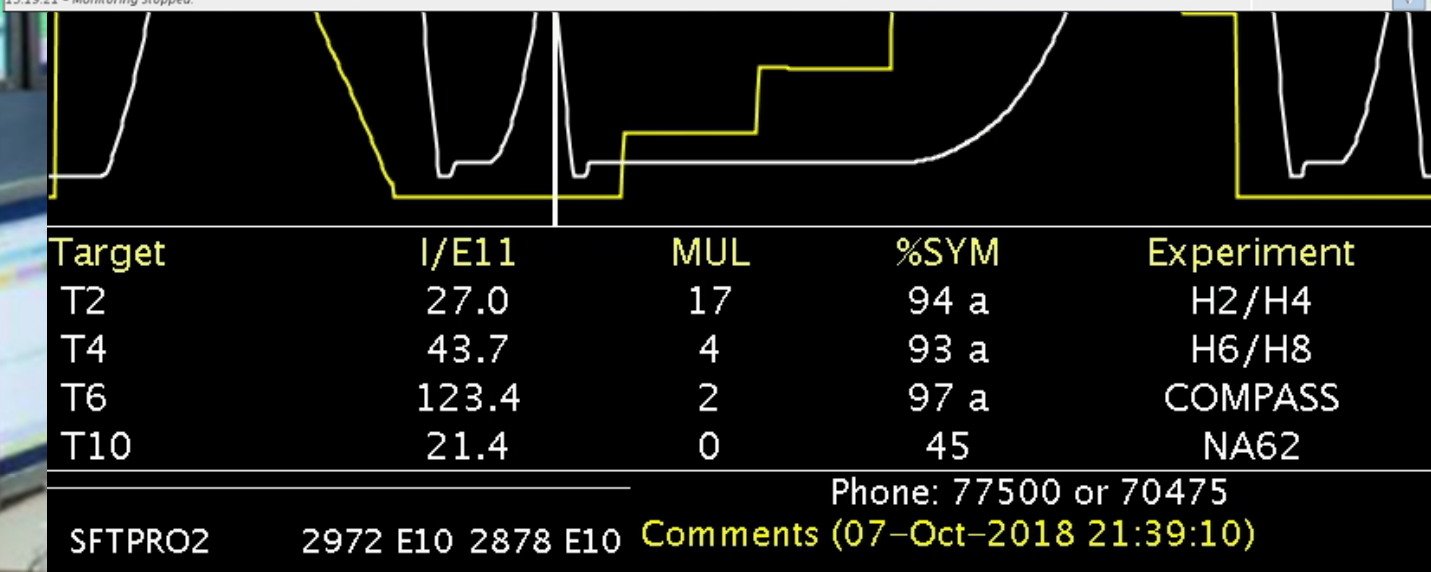
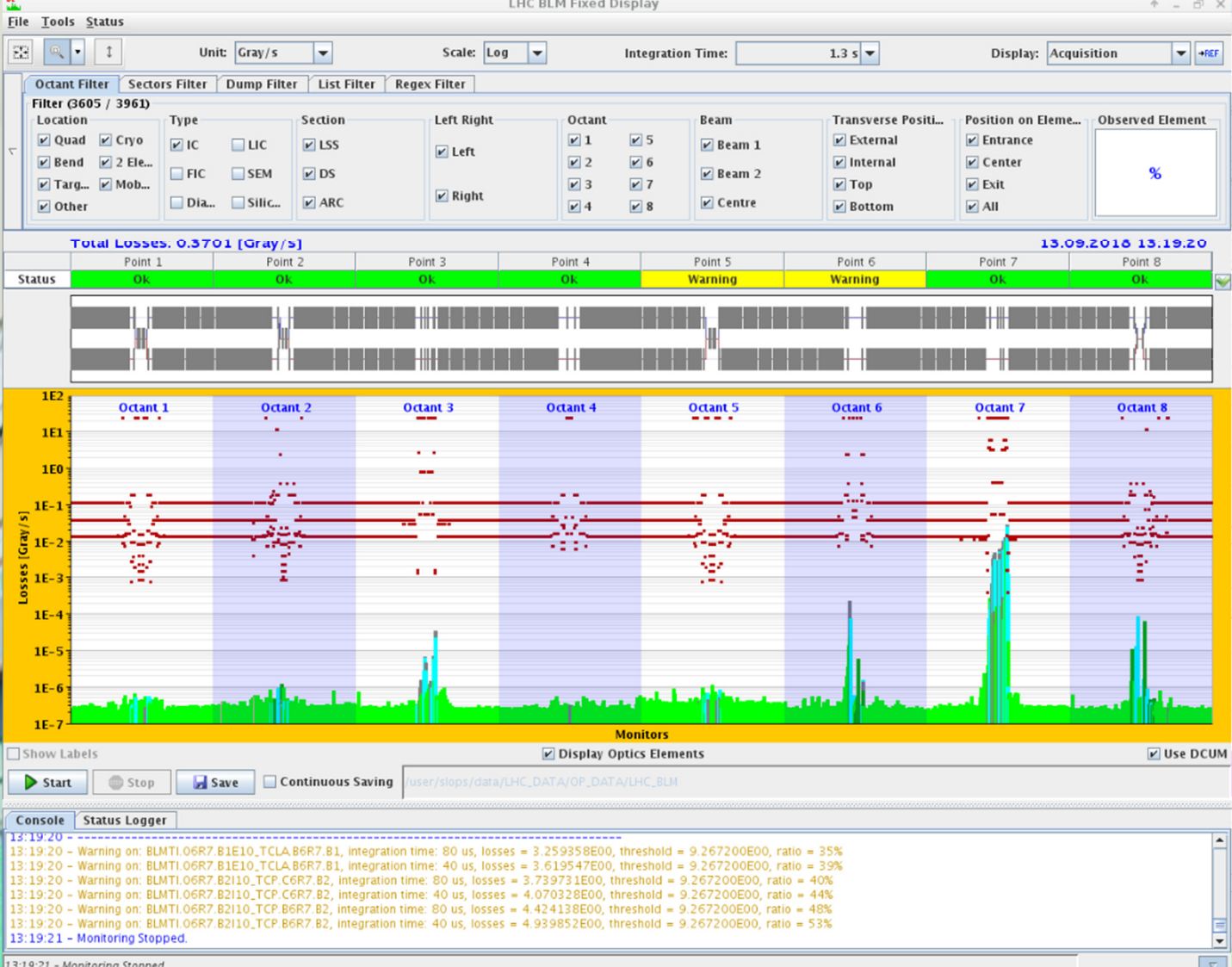


Target	I/E11	MUL	%SYM	Experiment
T2	27.0	17	94 a	H2/H4
T4	43.7	4	93 a	H6/H8
T6	123.4	2	97 a	COMPASS
T10	21.4	0	45	NA62

Phone: 77500 or 70475

SFTPRO2 2972 E10 2878 E10 Comments (07-Oct-2018 21:39:10)





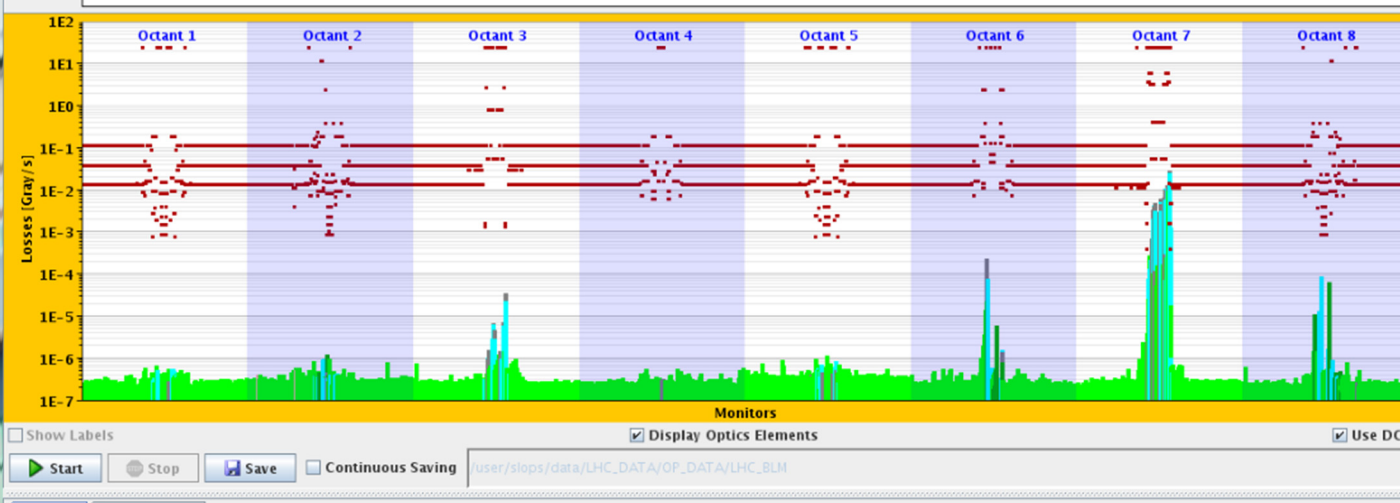
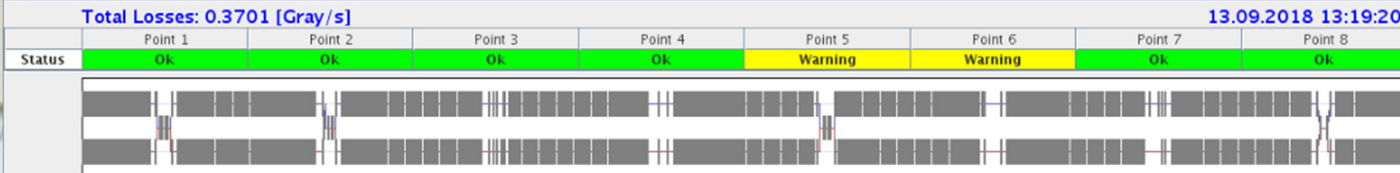
File Tools Status

Unit: Gray/s Scale: Log Integration Time: 1.3 s Display: Acquisition

Octant Filter Sectors Filter Dump Filter List Filter Regex Filter

Filter (3605 / 3961)

Location	Type	Section	Left Right	Octant	Beam	Transverse Posi...	Position on Eleme...	Observed Element
<input checked="" type="checkbox"/> Quad	<input checked="" type="checkbox"/> Cryo	<input checked="" type="checkbox"/> IC	<input type="checkbox"/> LIC	<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> Beam 1	<input checked="" type="checkbox"/> External	<input checked="" type="checkbox"/> Entrance	%
<input checked="" type="checkbox"/> Bend	<input checked="" type="checkbox"/> 2 Ele...	<input type="checkbox"/> FIC	<input type="checkbox"/> SEM	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> Beam 2	<input checked="" type="checkbox"/> Internal	<input checked="" type="checkbox"/> Center	
<input checked="" type="checkbox"/> Targ...	<input checked="" type="checkbox"/> Mob...	<input type="checkbox"/> Dia...	<input type="checkbox"/> SIIC...	<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> Centre	<input checked="" type="checkbox"/> Top	<input checked="" type="checkbox"/> Exit	
<input checked="" type="checkbox"/> Other	<input type="checkbox"/> Dia...	<input type="checkbox"/> SIIC...	<input checked="" type="checkbox"/> ARC	<input checked="" type="checkbox"/> 4		<input checked="" type="checkbox"/> Bottom	<input checked="" type="checkbox"/> All	
				<input checked="" type="checkbox"/> 5				
				<input checked="" type="checkbox"/> 6				
				<input checked="" type="checkbox"/> 7				
				<input checked="" type="checkbox"/> 8				



Console Status Logger

13:19:20 - Warning on: BLMTI.06R7.B1E10.TCLA.B6R7.B1, integration time: 80 us, losses = 3.259358E00, threshold = 9.267200E00, ratio = 35%

13:19:20 - Warning on: BLMTI.06R7.B1E10.TCLA.B6R7.B1, integration time: 40 us, losses = 3.619547E00, threshold = 9.267200E00, ratio = 39%

13:19:20 - Warning on: BLMTI.06R7.B2I10.TCP.C6R7.B2, integration time: 80 us, losses = 3.739731E00, threshold = 9.267200E00, ratio = 40%

13:19:20 - Warning on: BLMTI.06R7.B2I10.TCP.C6R7.B2, integration time: 40 us, losses = 4.070328E00, threshold = 9.267200E00, ratio = 44%

13:19:20 - Warning on: BLMTI.06R7.B2I10.TCP.B6R7.B2, integration time: 80 us, losses = 4.424138E00, threshold = 9.267200E00, ratio = 48%

13:19:20 - Warning on: BLMTI.06R7.B2I10.TCP.B6R7.B2, integration time: 40 us, losses = 4.939852E00, threshold = 9.267200E00, ratio = 53%

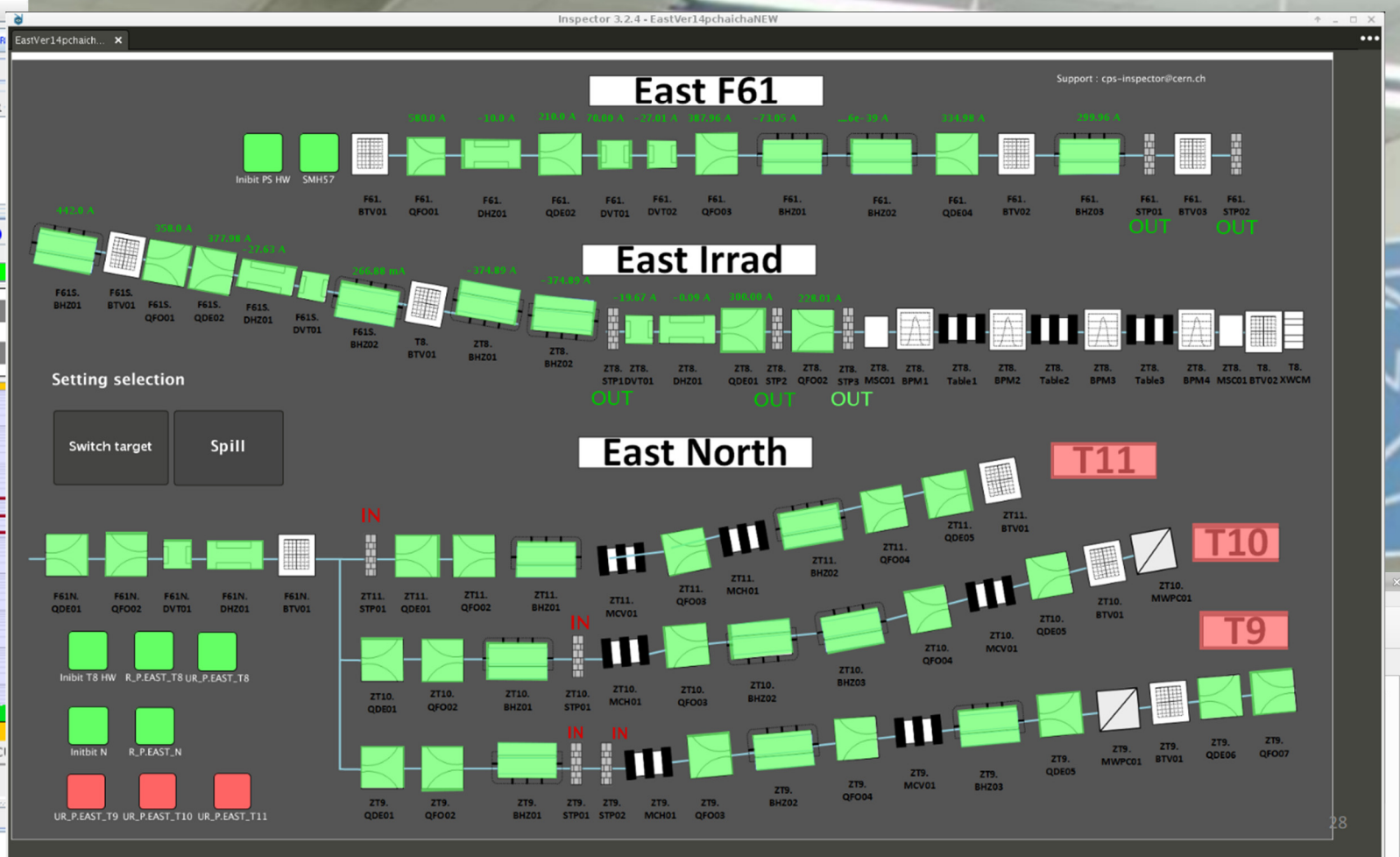
13:19:21 - Monitoring Stopped.



Target	I/E11	MUL	%SYM	Experiment
T2	27.0	17	94 a	H2/H4
T4	43.7	4	93 a	H6/H8
T6	123.4	2	97 a	COMPASS
T10	21.4	0	45	NA62

Phone: 77500 or 70475

SFTPRO2 2972 E10 2878 E10 Comments (07-Oct-2018 21:39:10)



Minimum displayed log level: DEBUG

2019-08-19 16:49:22.331 Subscribe Selector set to: SPS.USER.ZERO

2019-08-19 17:22:12.163 Subscribe Selector set to: SPS.USER.SFTPRO2

2019-08-19 17:22:12.201 No Python match found for [JAPC - Simple type enum]. Please convert it yourself.

2019-08-19 17:22:12.204 No Python match found for [JAPC - Simple type enum]. Please convert it yourself.

2019-08-19 17:22:12.222 No Python match found for [JAPC - Simple type enum]. Please convert it yourself.

2019-08-19 17:22:15.772 No Python match found for [JAPC - Simple type enum]. Please convert it yourself.

2019-08-19 17:22:15.813 No Python match found for [JAPC - Simple type enum]. Please convert it yourself.

2019-08-19 17:22:15.835 No Python match found for [JAPC - Simple type enum]. Please convert it yourself.

2019-08-19 17:22:30.166 No Python match found for [JAPC - Simple type enum]. Please convert it yourself.

2019-08-19 17:22:30.170 No Python match found for [JAPC - Simple type enum]. Please convert it yourself.

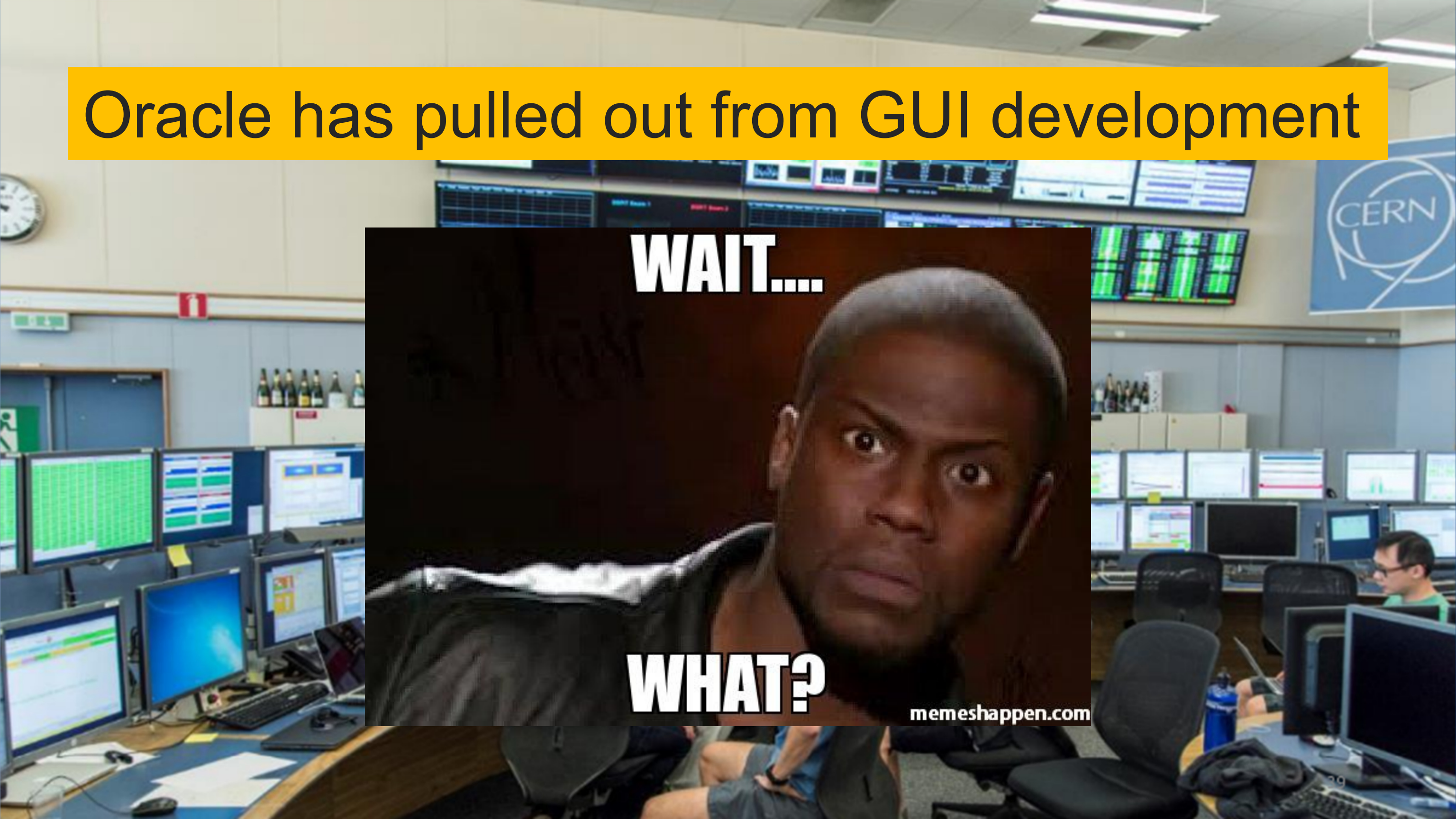
Clear

A photograph of a control room with several rows of computer workstations. Each workstation has multiple monitors displaying data. In the background, a large wall-mounted display shows various data visualizations. A CERN logo is visible on the right wall. Two large overlapping circles, one green and one yellow, are overlaid on the image. The green circle contains the text 'Software developers' and the yellow circle contains the text 'Physicists, operators, hardware experts'.

Software
developers

Physicists, operators,
hardware experts

Oracle has pulled out from GUI development



Evaluation

We did a lot of reading...



- Extremely popular nowadays
- Goes beyond browser:
 - Desktop (Electron)
 - Server-side (Node.js)



- Became popular through desktop GUIs
- Is familiar to our user community

Jobs on indeed.com (as of Nov 2018):

- JavaFX (tens) < Java Swing << Qt (hundreds) << Angular (thousands)

Web

- ✓ Easy to find new people
- ✓ Successfully used by software teams in Controls group
- ✓ Deployment and upgrades are smooth
- ! Hard to integrate with existing control system libraries
- ! Learning curve for existing community
- ! Rapidly changing technology



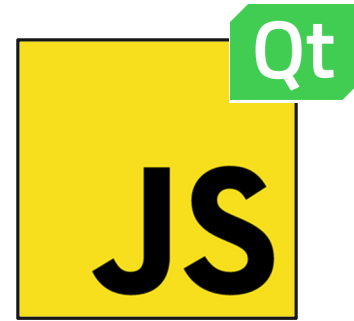
It just did not feel a right option for our user community

Qt



Java/Qt

- First idea to rescue all existing investment



QML+JavaScript (QtQuick)

- Use new promising technology
- Be closer to web



Python/Qt

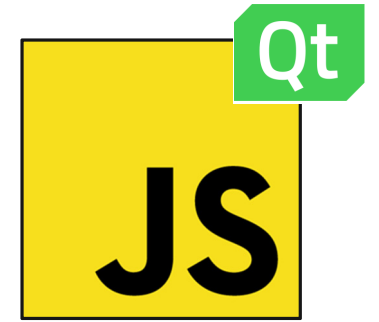
- Stay with stable and familiar technology

Java + Qt



- Looked like an ideal scenario
 - Reuse existing client libraries, dev tools, processes
- Qt Jambi
 - Java bindings for Qt framework
 - Very obsolete (discontinued 10 years ago)
 - We did not manage to run it
- Own bindings?
 - No QML Java bindings existed
 - We could create our own QML bindings (with DOtherSide)
 - Much smaller API than Qt Jambi
 - We did a proof of concept
 - But, it would be too exotic

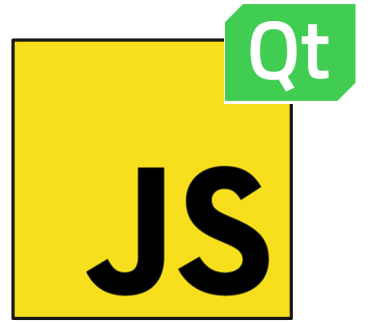
QtQuick



- QML + JavaScript
 - QML – user interface markup language
 - Logic implemented in JavaScript
 - Typical app has a C++ entrypoint that launches QML engine
- Can JavaScript (or better TypeScript) be our main GUI language?
- Control libraries would be connected via Qt plugin mechanism

- We made some proofs of concept
 - Charting
 - Complex tables
 - Copy of UI of existing Java applications

QtQuick



We faced a number of problems

- No bindings existed for 3rd-party libraries (e.g. charts)
- Not all desktop widgets well supported (e.g. trees and tables)
- How to split code between QML documents and external JavaScript?
- Debugging was supported only in Qt Creator
- Declarative style felt awkward for our users
- We wanted a typed language but TypeScript was not supported



We felt that QtQuick was not ready for us

Python + QtWidgets



- ✓ PyQt is very popular and familiar to our community
- ✓ We are confident that QtWidgets will not go away in the future
- ~ We can integrate with our Java libraries (using JPytype temporarily)
- ! Dependency management can get tricky
- ~ Python is a dynamic language



At this point we made the decision, and never reconsidered it since

Conclusion

- We will phase out JavaFX within the next 5 years
- Web is not our first choice, though can be attractive in certain cases
- We choose QtWidgets, as QtQuick experience was bumpy
- We have settled with PyQt



Since then we're...

- Creating CERN-specific widgets & charts
- Bringing PyQt-based Rapid Application Development (RAD) framework
- Organizing PyQt training for our users
- Integrating PyQt with control system services
- Contributing to the open-source community

Thank you!