

Software for the new BPM systems in LEIR

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BI-SW



LEIR

The Orbit System

Ring Orbit

Challenge

Solution

Results

MXBPM Expert GUI

Injection Line

Challenge

Solution

Bpmli Expert GUI



▷ LEIR

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MXBPM Expert GUI

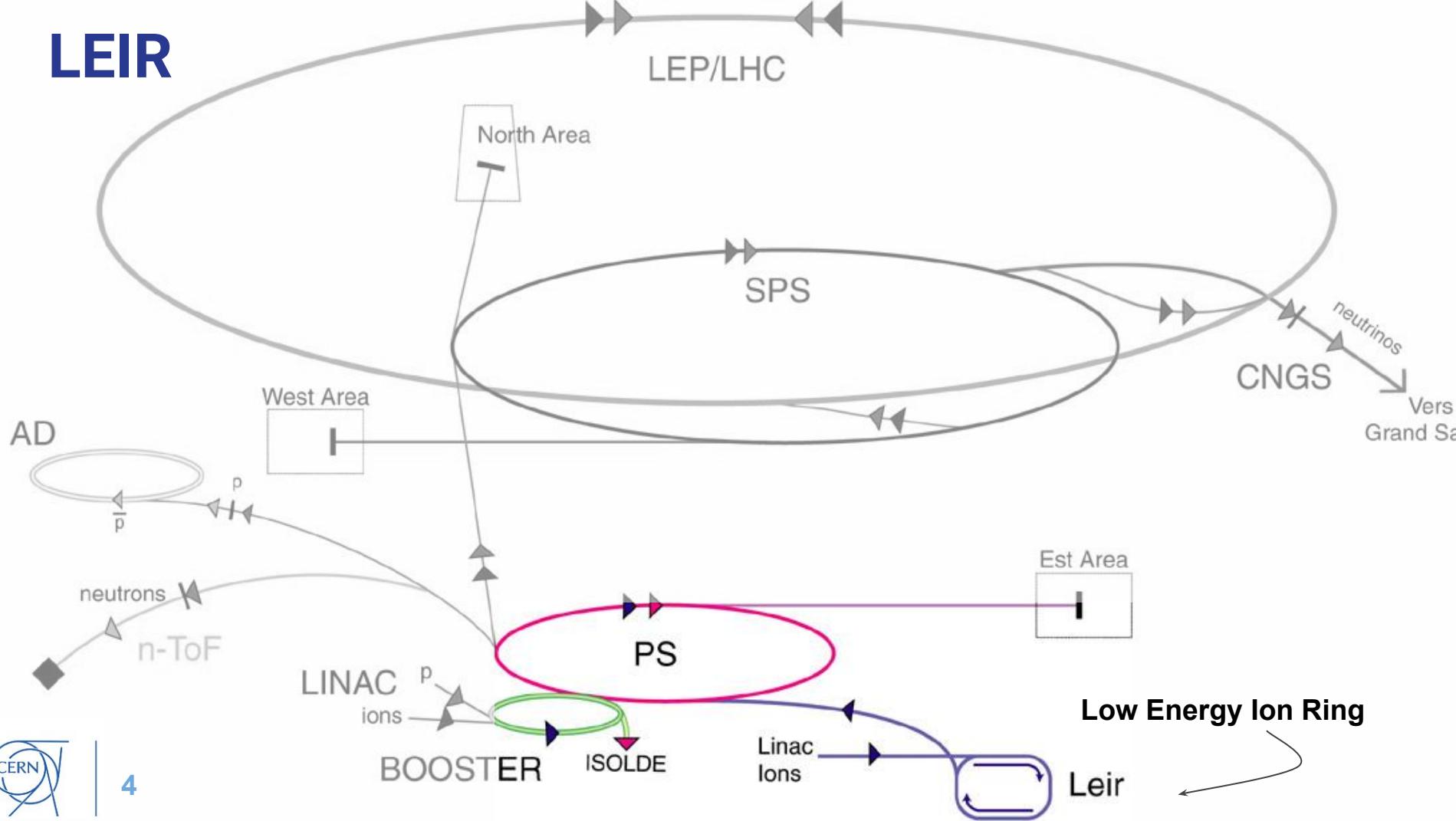
Injection Line

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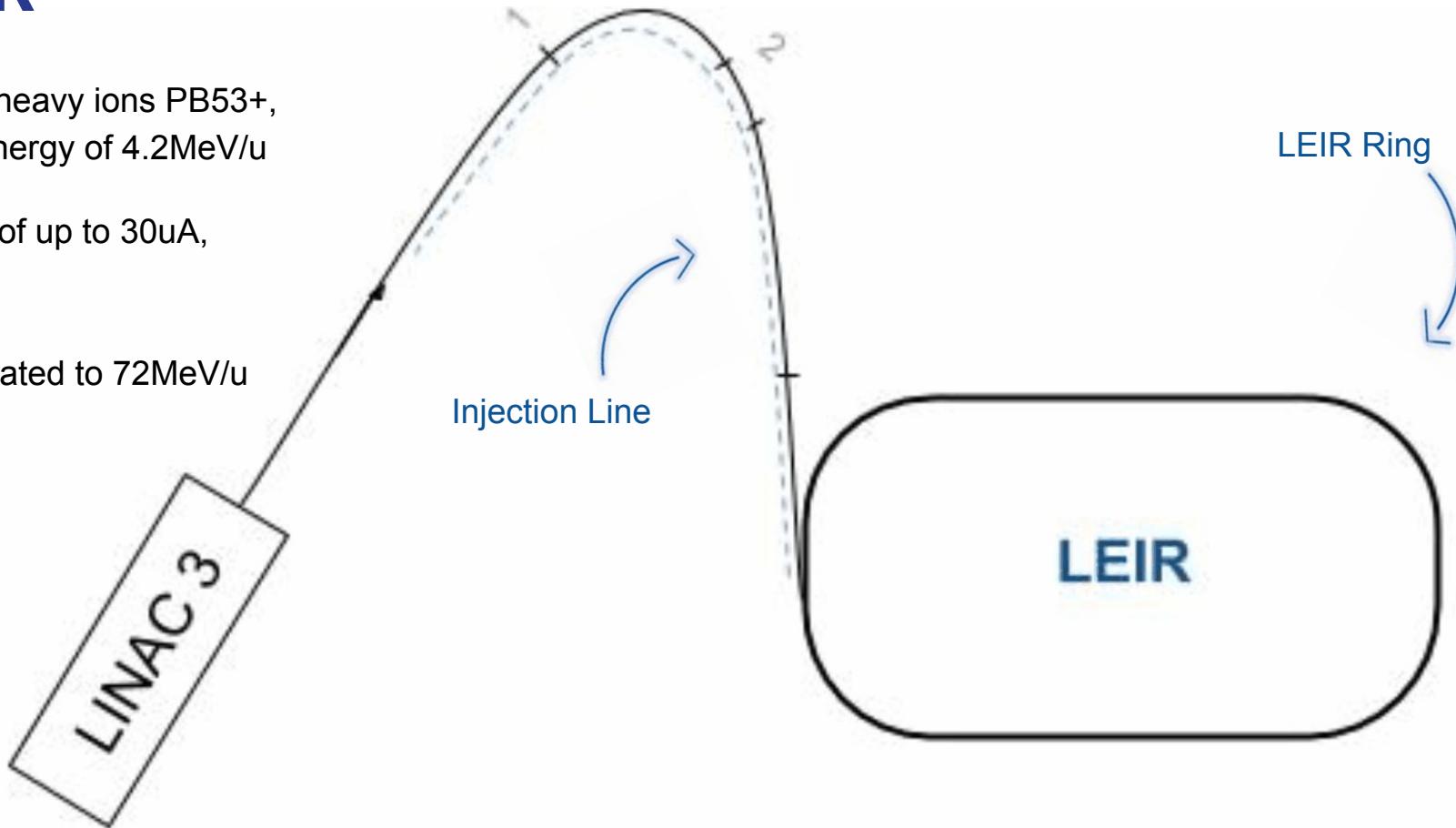
Bpmli Expert GUI





LEIR

- Mainly heavy ions PB⁵³⁺, at an energy of 4.2MeV/u
- Pulses of up to 30uA, 200us
- Accelerated to 72MeV/u



LEIR

▷ **The Orbit System**

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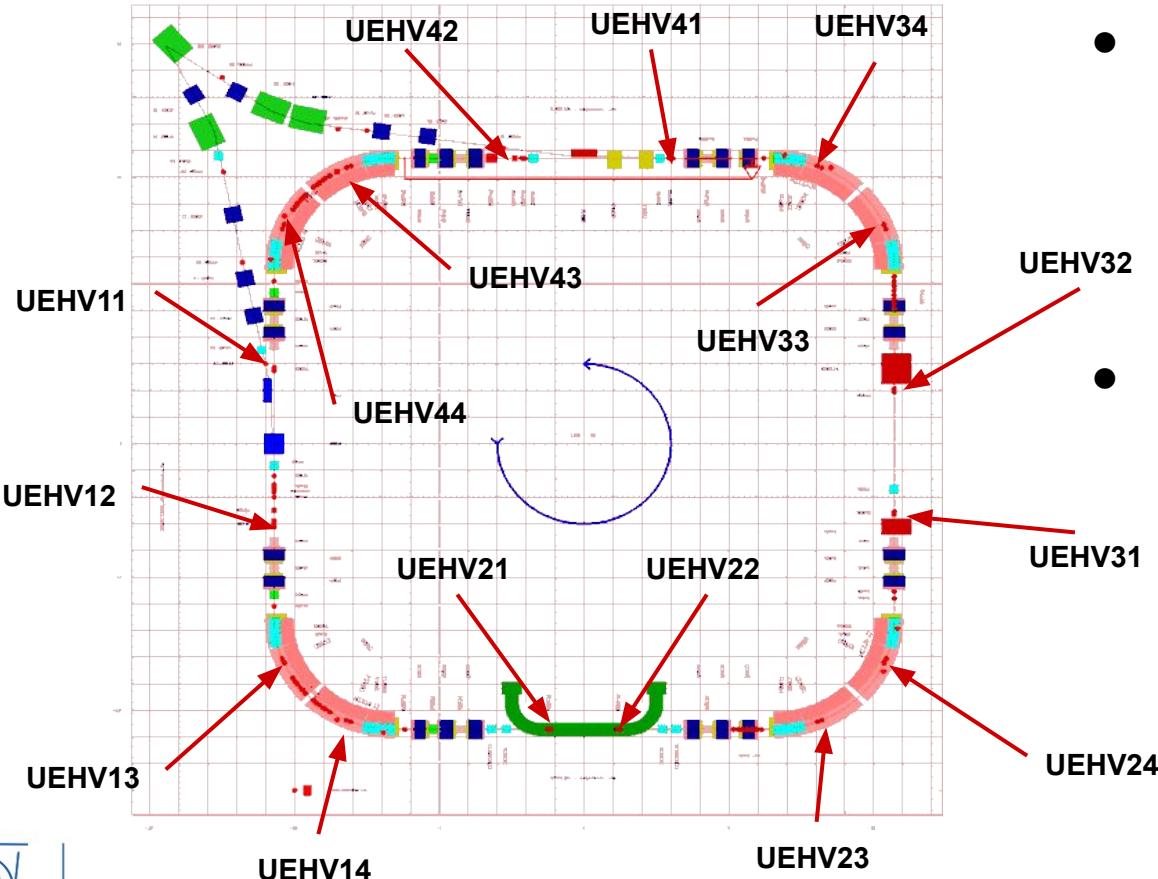
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The Orbit System



- System installed for ion accelerations at LEIR's
- Allows position measurement of the bunched beam

LEIR

The Orbit System

- ▷ **Ring Orbit**

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Ring Orbit *What was the challenge?*

LEIR orbit upgrade due to a change of electronics

1. Old System

It was not precise enough (OP requested precision of 0.1mm)

2. Add trajectory feature

The current software and calibration programs were **obsolete** and had to be **replaced**

Ring Orbit *What did we do?*

- New digital acquisition system DSP-based was installed by Ole Marqversen and other staff from BE-BI-PI
- **BPMADLNA** class development
 - *The existing common class for AD and ELENA was reused and adapted*
 - *Driver upgrade was needed for trajectory feature*
 - *Re-Commissioning of orbit feature after the driver upgrade*

LEIR

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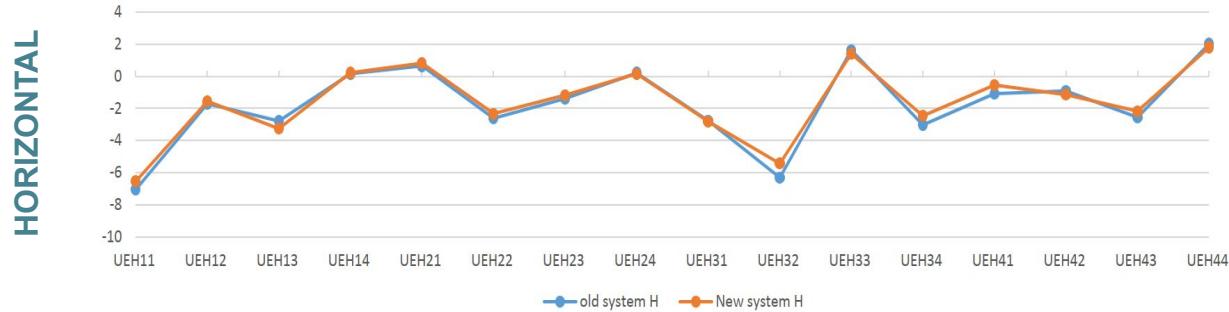
Solution

Bpmli Expert GUI



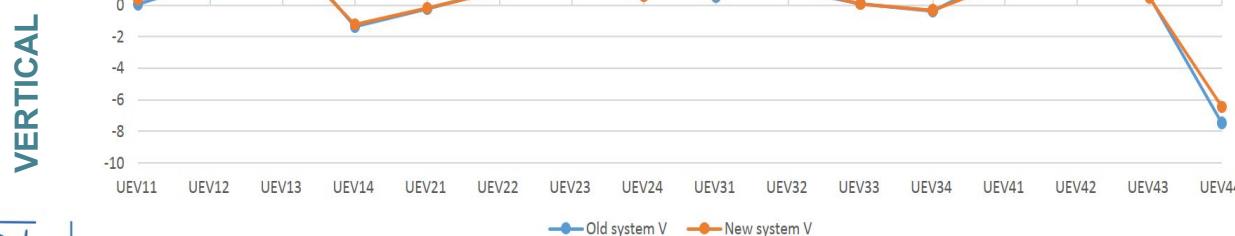
Results *Orbit comparison*

Comparison of average orbits (mm) - New system vs Old



How was the data taken?
Statistics for 40 different cycles
with both system in parallel

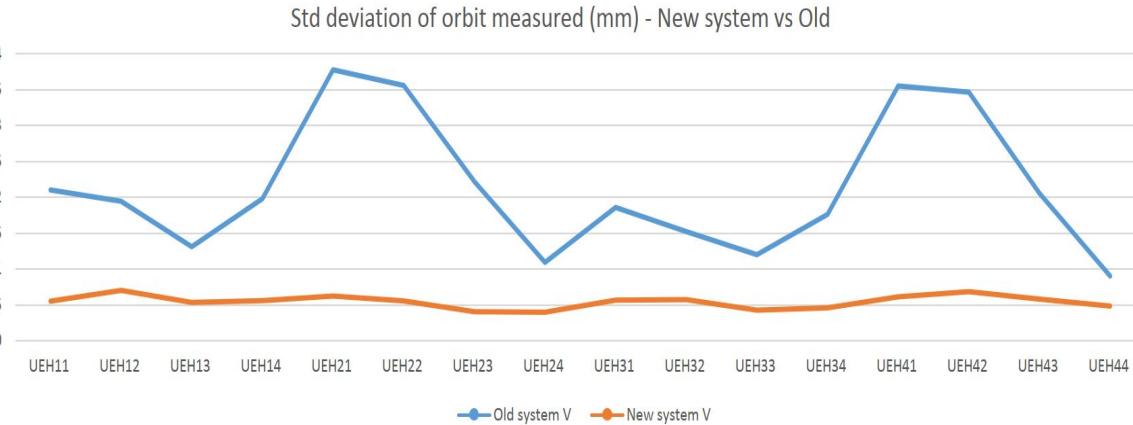
Comparison of average orbits (mm) - New system vs Old



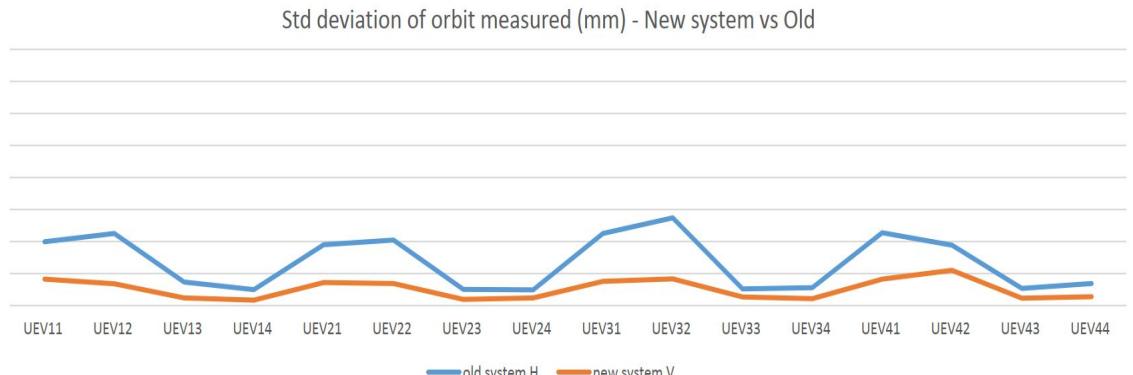
What are we showing?
The accuracy is the same as the
old system

Results Standard Deviation comparison

HORIZONTAL



VERTICAL



How was the data taken?

Statistics for 40 different cycles
with both system in parallel

What are we showing?

The precision is better, **within the specifications** (0.1mm RMS)



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Motivation

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▷ **MXBPM GUI Expert**

Injection Line

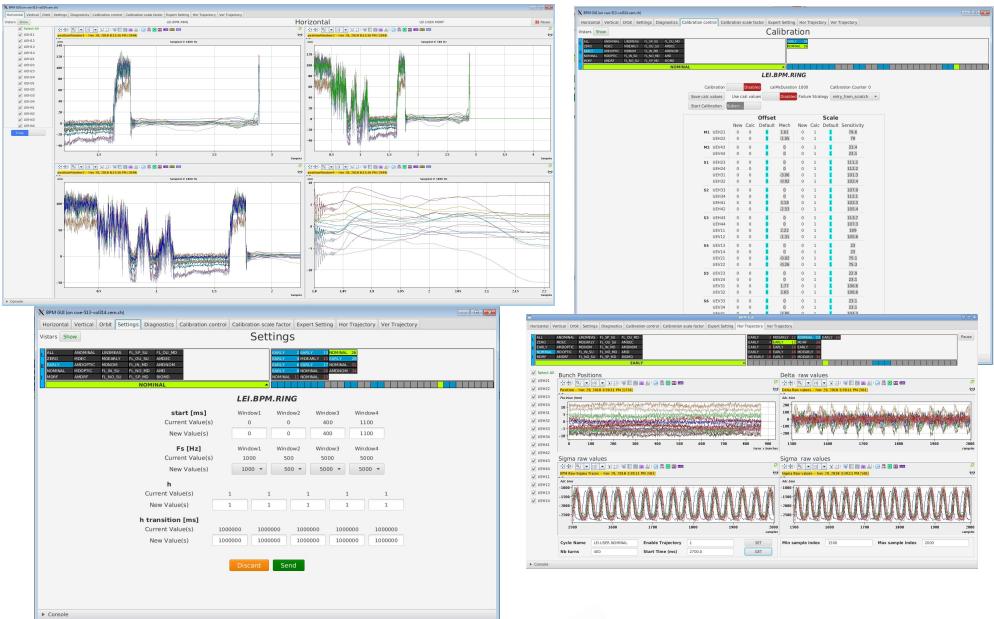
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Bpmli Expert GUI

MXBPM Expert GUI Overview

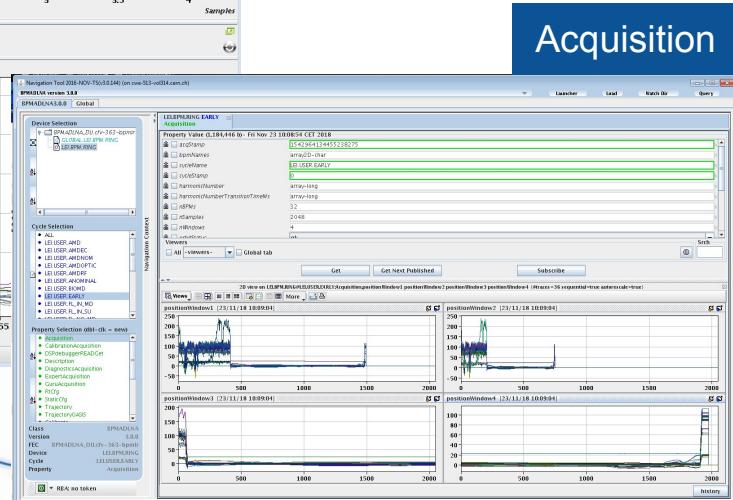
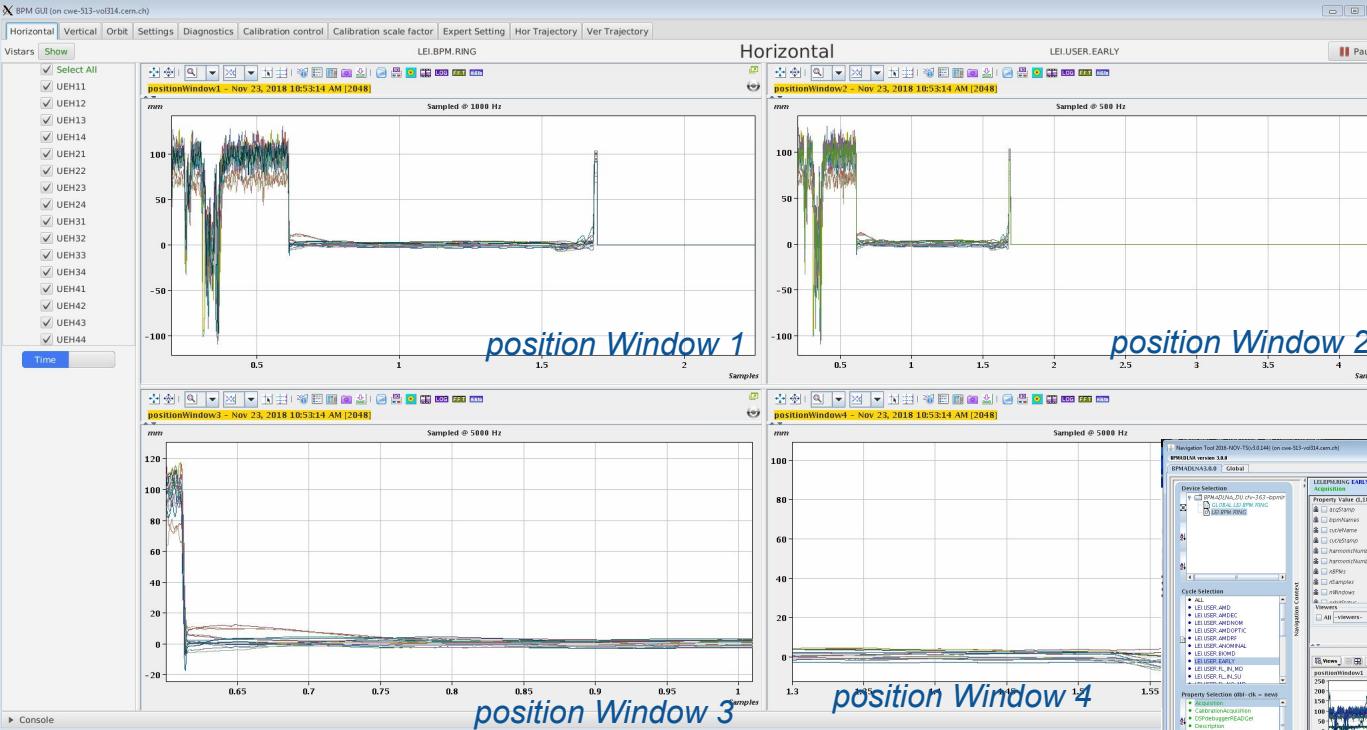
- Position traces for all the BPMs.
- Orbit for Vertical and Horizontal planes at once.
- Calibration and Expert Settings.
- Trajectory measurement.



Common class for AD and ELENA accelerators adapted to LEIR

MXBPM Expert GUI Acquisition

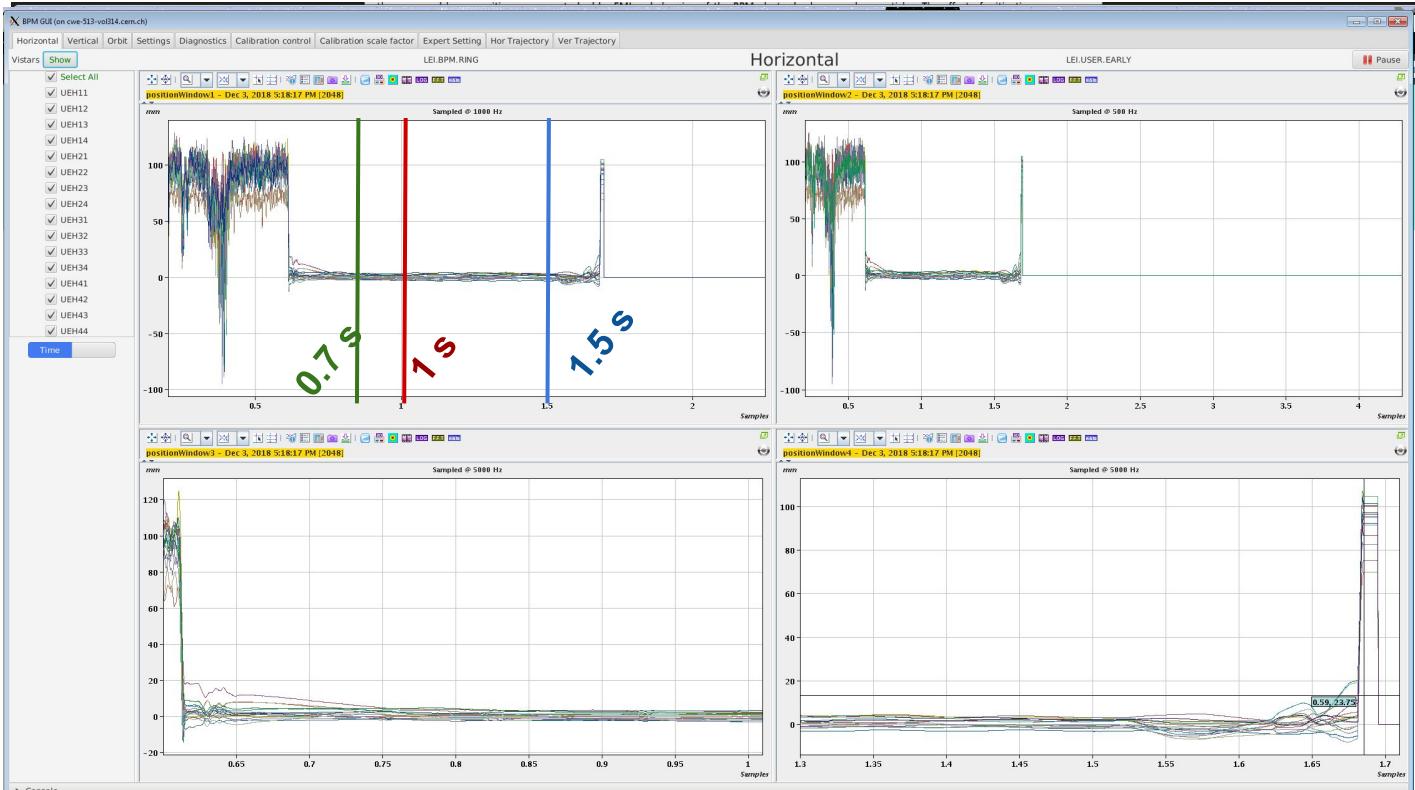
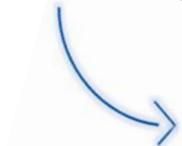
- Measures the beam positions for the 4 different timestamps
- User can easily select which BPMs traces to display



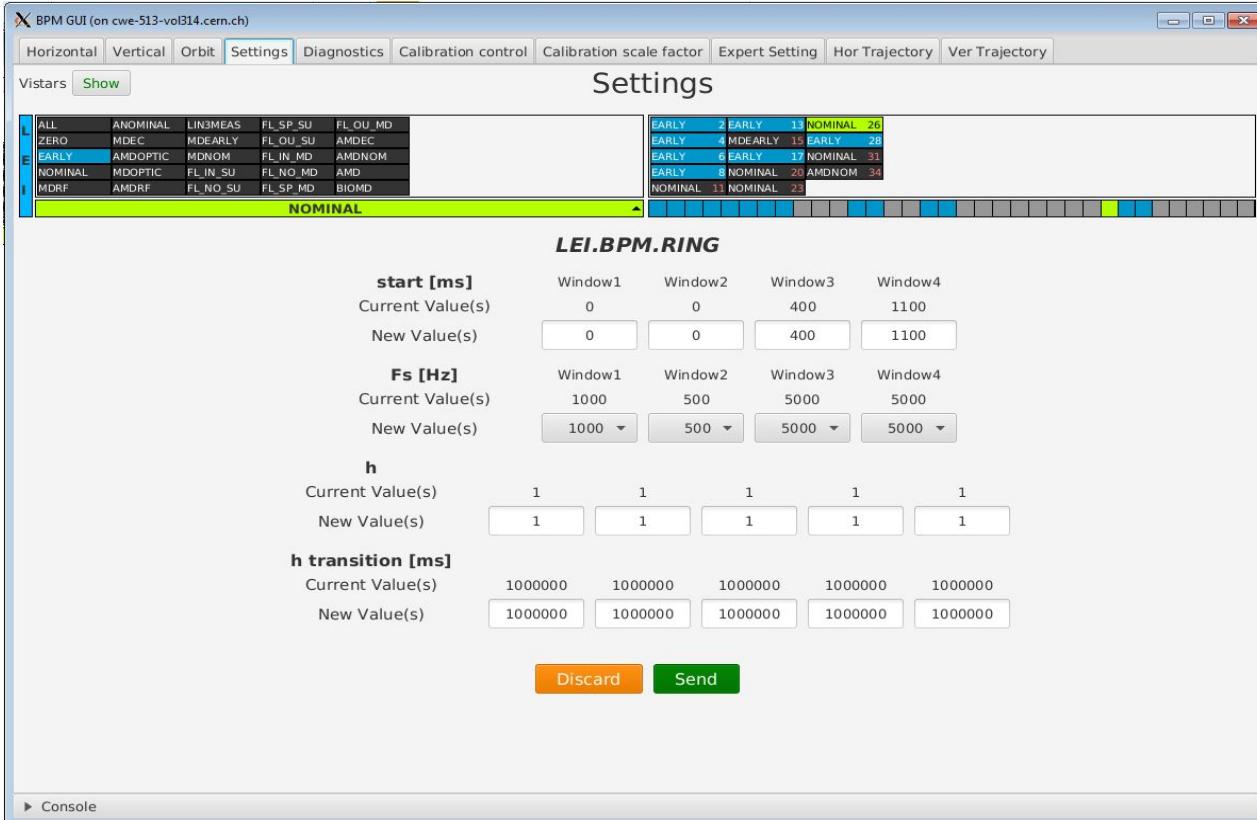
MXBPM Expert GUI *Orbit*

Orbit

- One point per timestamp and per BPM as the evolution of the orbit can be seen easily



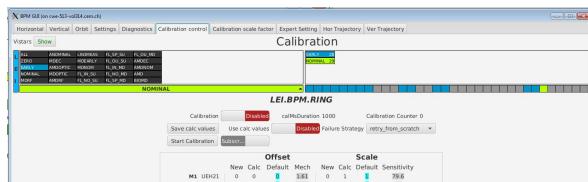
MXBPM Expert GUI *Calibration and Expert Settings*



Settings

- Defines the timestamp and the sampling rate
- Sets the harmonic (number of circulating bunches)

MXBPM Expert GUI Calibration and Expert Settings



Scale Factor

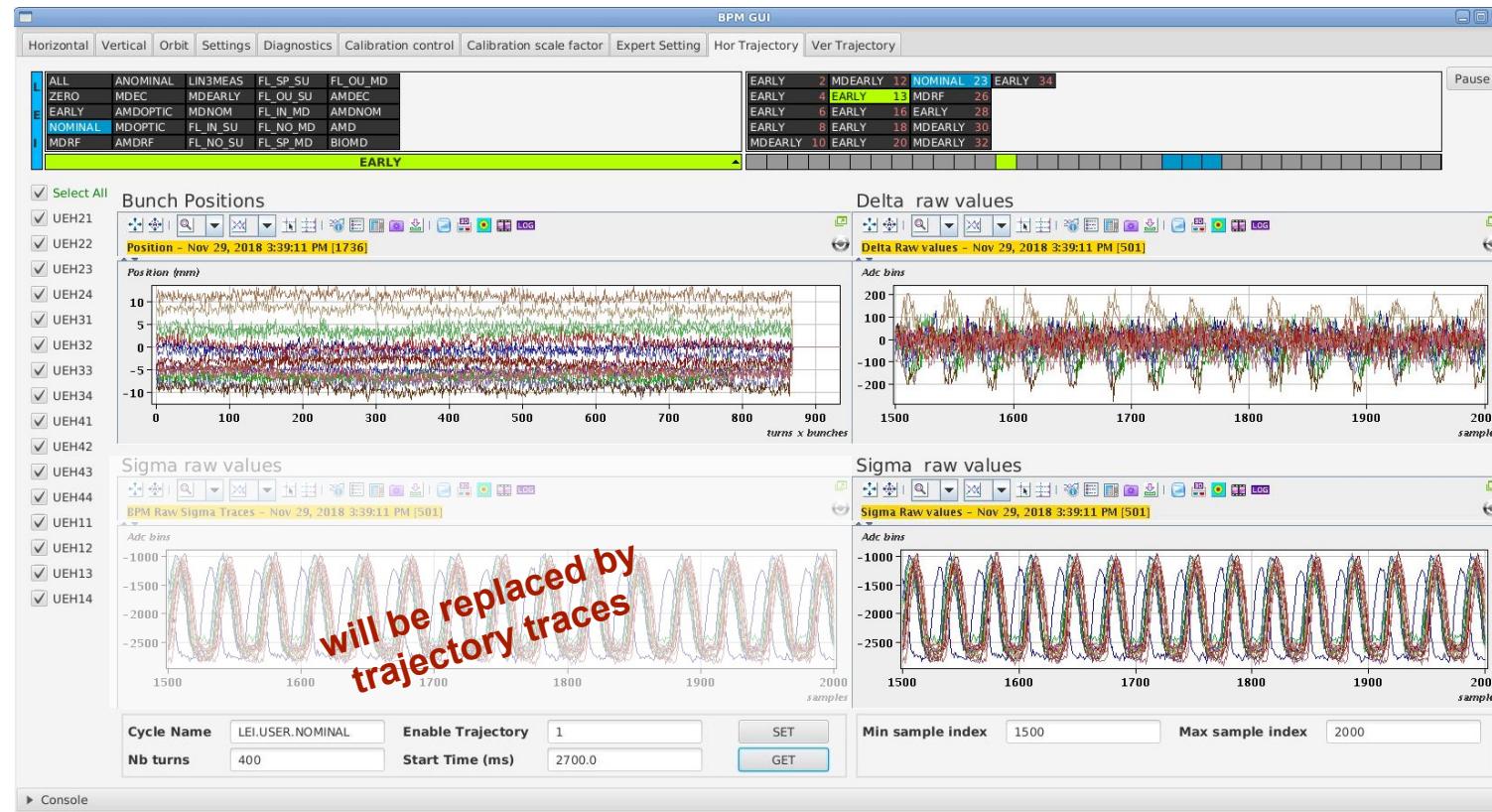
Scale factor LEI.BPM.RING					
	Device Name	Field Name	Current Value(s)	New Value(s)	Information
51	UEH1	C+ SF calc	= 79.6	= 79.6	M1: (bit 0) -> Not received or not valid: Freq received from RF: ERROR
52	UEH2	C0 SF calc	= 79	= 79	M1 (bit 0) -> FMC FPGA: FMC F2 Power surveillance: OK
53	UEH3	C0 SF calc	= 29.4	= 29.4	M1 (bit 0) -> MDD5: Double tag requested but not detected: OK
54	UEH4	C0 SF calc	= 29.4	= 29.4	M1 (bit 1) -> FMC-C-DDC (F2): Local oscillator frequency error interlock ch1: OK
55	UEH5	C0 SF calc	= 29.4	= 29.4	M1 (bit 1) -> FMC-C-DDC (F2): FMC F2 Power surveillance: OK
56	UEH6	C0 SF calc	= 29.4	= 29.4	M1 (bit 1) -> FMC-C-DDC (F2): Illegal CIC differential delay ch2: OK
57	UEH7	C0 SF calc	= 29.4	= 29.4	M1 (bit 11) -> FMC-C-DDC (F2): Illegal CIC differential delay ch3: OK
58	UEH8	C0 SF calc	= 29.4	= 29.4	M1 (bit 12) -> FMC-C-DDC (F2): Illegal CIC differential delay ch4: OK
59	UEH9	C0 SF calc	= 29.4	= 29.4	M1 (bit 12) -> MDD5: Temperature fault: OK
60	UEH10	C0 SF calc	= 29.4	= 29.4	M1 (bit 12) -> Sush Train not initialized: ERROR
61	UEH11	C0 SF calc	= 29.4	= 29.4	M1 (bit 13) -> FMC-C-DDC (F2): Illegal CIC decimation ratio ch1: OK
62	UEH12	C0 SF calc	= 29.4	= 29.4	
63	UEH13	C0 SF calc	= 29.4	= 29.4	
64	UEH14	C0 SF calc	= 29.4	= 29.4	
65	UEH15	C0 SF calc	= 29.4	= 29.4	
66	UEH16	C0 SF calc	= 29.4	= 29.4	
67	UEH17	C0 SF calc	= 29.4	= 29.4	
68	UEH18	C0 SF calc	= 29.4	= 29.4	
69	UEH19	C0 SF calc	= 29.4	= 29.4	
70	UEH20	C0 SF calc	= 29.4	= 29.4	
71	UEH21	C0 SF calc	= 29.4	= 29.4	
72	UEH22	C0 SF calc	= 29.4	= 29.4	
73	UEH23	C0 SF calc	= 29.4	= 29.4	
74	UEH24	C0 SF calc	= 29.4	= 29.4	

Calibration

Diagnostics					
	Visitors	Show	Time of check [ms]	Current Value(s)	New Value(s)
51	UEH1	AMDNOM	Time: 11:00:37	Insert Table Filter	Number of Checks: 869 Number of Successful Checks: 823 Number of Failed Checks: 46
52	UEH2	AMDNOM			
53	UEH3	AMDNOM			
54	UEH4	AMDNOM			
55	UEH5	AMDNOM			
56	UEH6	AMDNOM			
57	UEH7	AMDNOM			
58	UEH8	AMDNOM			
59	UEH9	AMDNOM			
60	UEH10	AMDNOM			
61	UEH11	AMDNOM			
62	UEH12	AMDNOM			
63	UEH13	AMDNOM			
64	UEH14	AMDNOM			
65	UEH15	AMDNOM			
66	UEH16	AMDNOM			
67	UEH17	AMDNOM			
68	UEH18	AMDNOM			
69	UEH19	AMDNOM			
70	UEH20	AMDNOM			
71	UEH21	AMDNOM			
72	UEH22	AMDNOM			
73	UEH23	AMDNOM			
74	UEH24	AMDNOM			

Diagnostic

MXBPM Expert GUI Trajectory



Trajectory

- BPMs names
- Bunch turn by turn positions

Trajectory OASIS

- Delta traces
- Sigma traces

MXBPM Expert GUI

Future improvements

- Showing the trajectory traces, reorganizing data to follow the BPM order

Conclusions

- New orbit system is used operationally by BI and OP for orbit and trajectory
- The old system will be removed during LS2
- That software is useful for debugging new features for the first turn positions
- Common FESA class and Expert GUI for the LEIR, AD and ELENA



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▷ **Injection Line**

Challenges

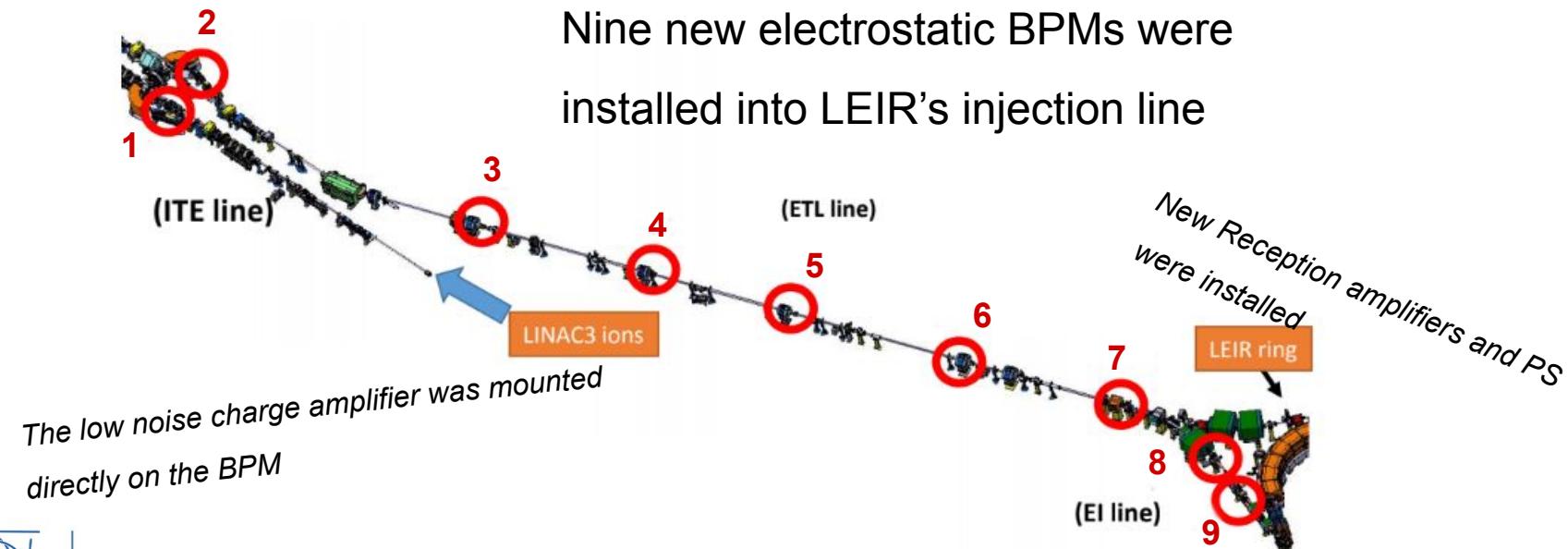
Solution

Bpmli Expert GUI

Injection Line What was the challenge?

Optimization the injection efficiency

Need to optimize and measure the trajectory of the low intensity ion beams coming from LINAC3



Injection Line What did we do?

- **BPMLI** new FESA class

A new acquisition system was installed in the injection line which required the development of a new FESA class



Beam Position
Monitor



SIS 3300
card



FESA



Expert GUI

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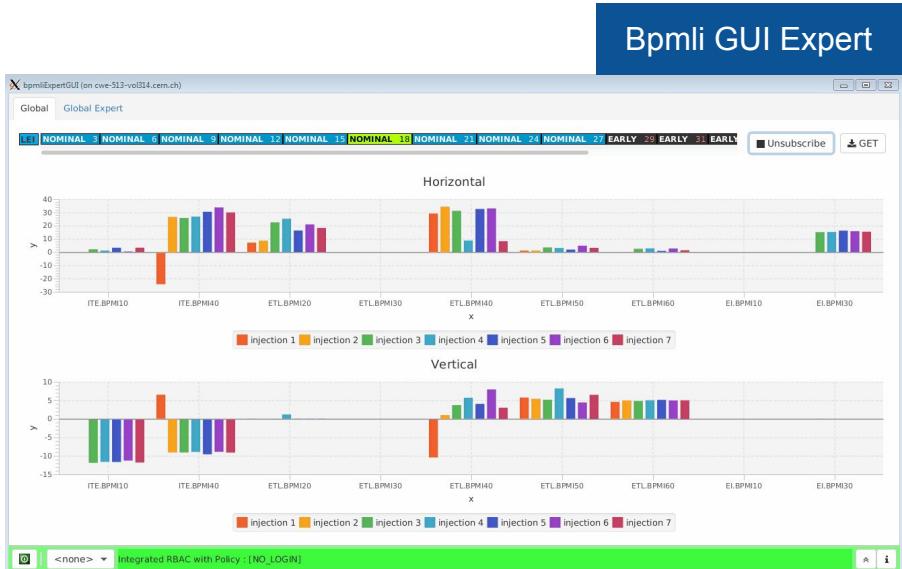
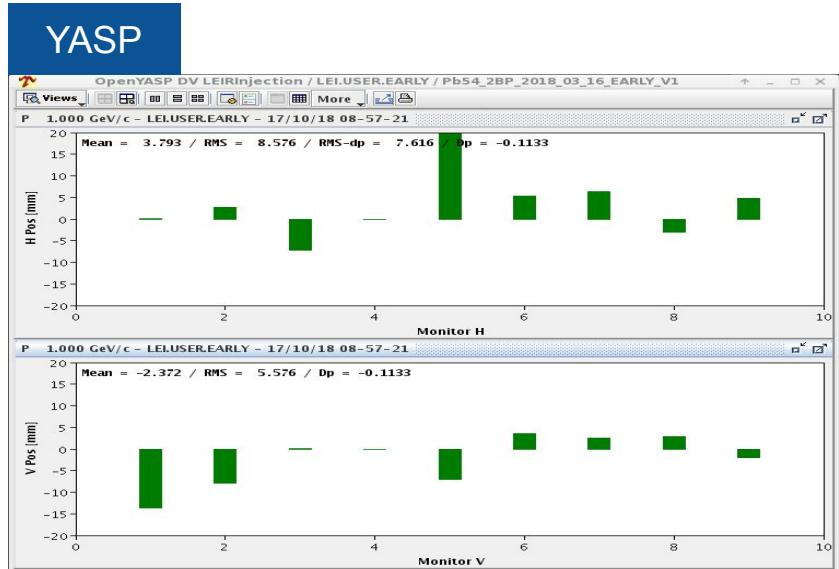
Bpmli Expert GUI



Bpmli Expert GUI Global Overview



Bpmli Expert GUI Global Overview

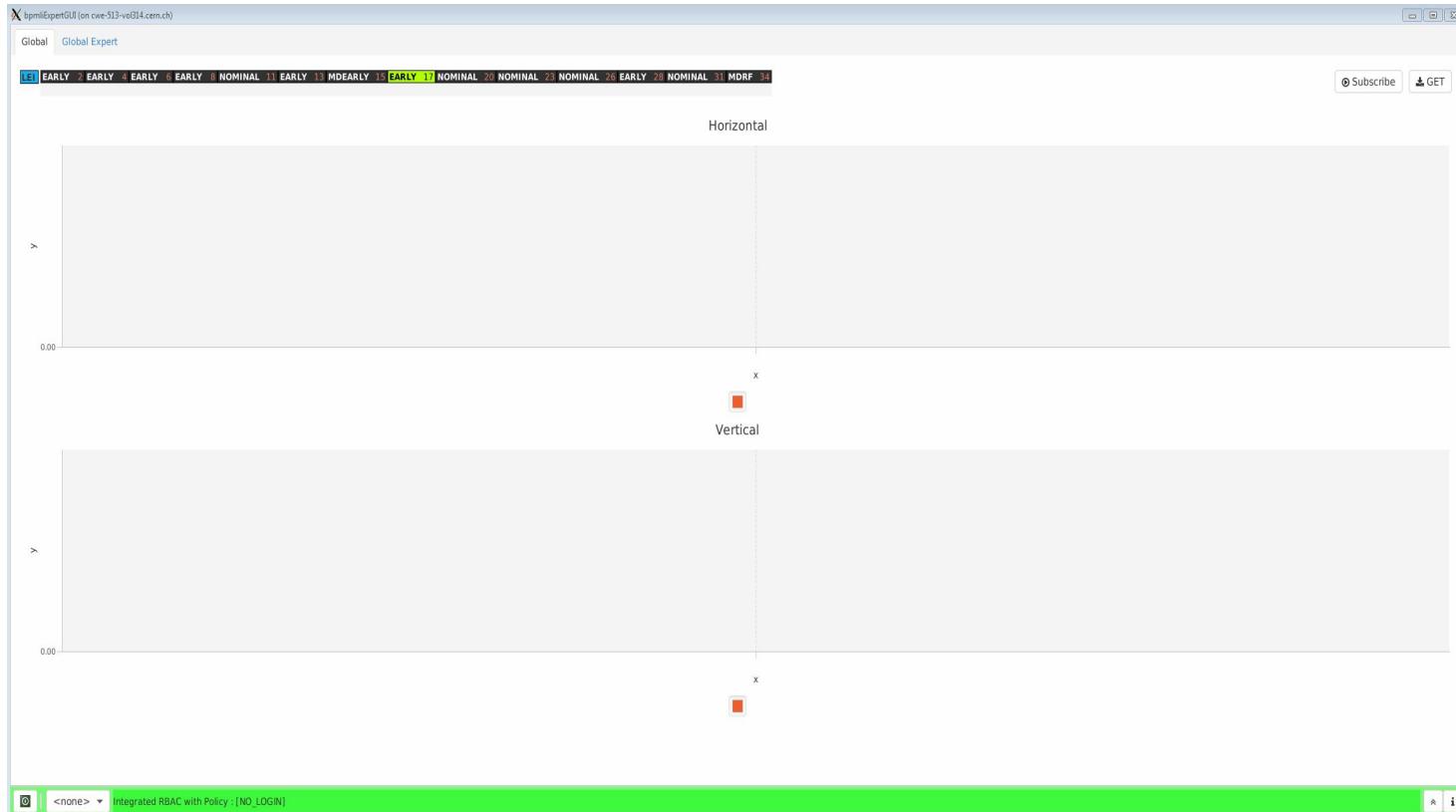


- Displays one injection for each BPM
- Displays all 7 injections per BPM
- It allows operators to monitor all injections at once

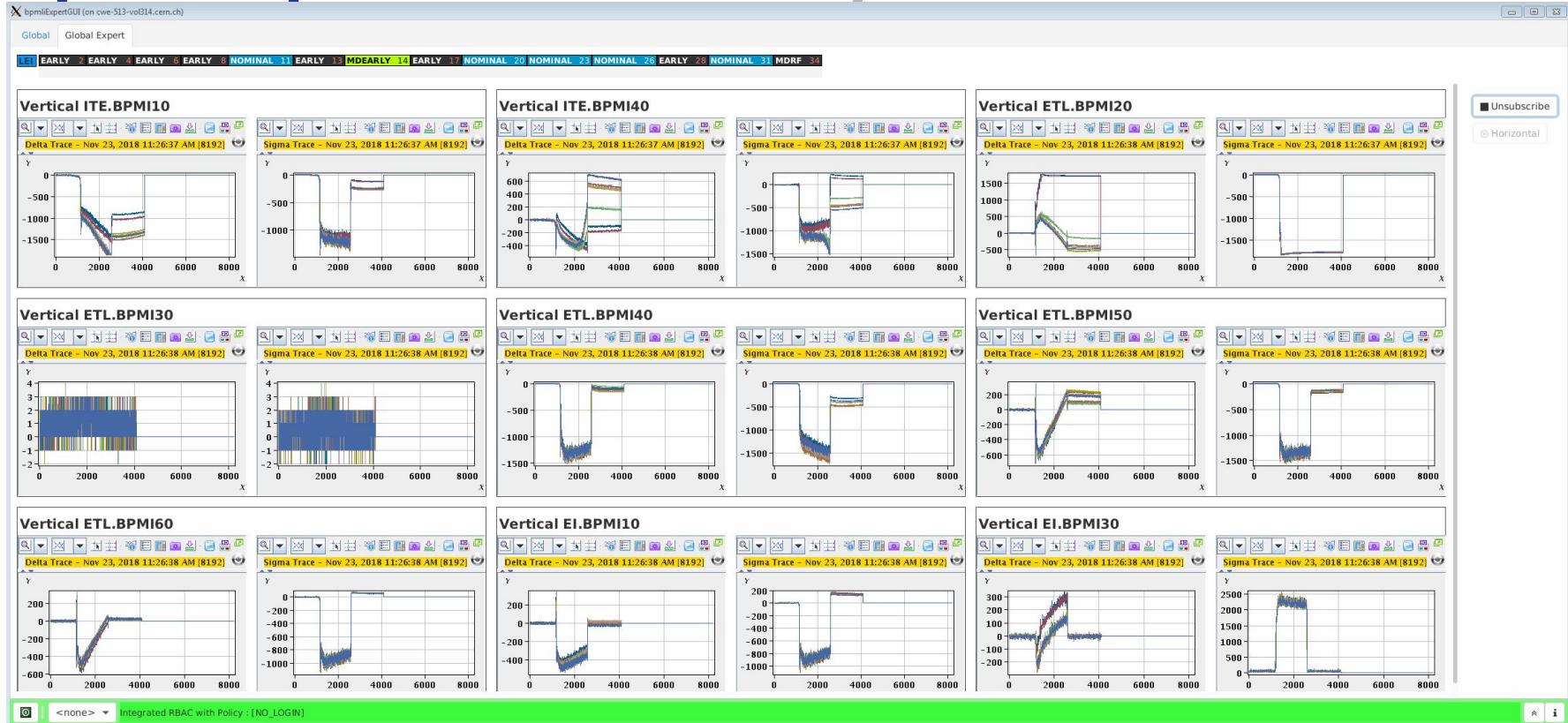
Bpmli Expert GUI Global Overview

Sigma and delta traces for ETL.BPMI.40 (Horizontal), NOMINAL cycle

*Sigma and Delta traces are useful to **detect problems** in the measurements*



Bpmli Expert GUI Global Expert Overview



Sigma and delta traces for all BPMs along the injection line for Vertical, in NOMINAL

Bpmli Expert GUI

Future and improvements

- Switch between the raw traces and the position traces for a global overview of all BPMs (Global Expert tab)

Conclusions

- This Expert GUI is helping to debug the new system
- It is used operationally by BI and OP
- Easy to maintain and take over by others (code is using the standard software pattern)



Questions



Thank you