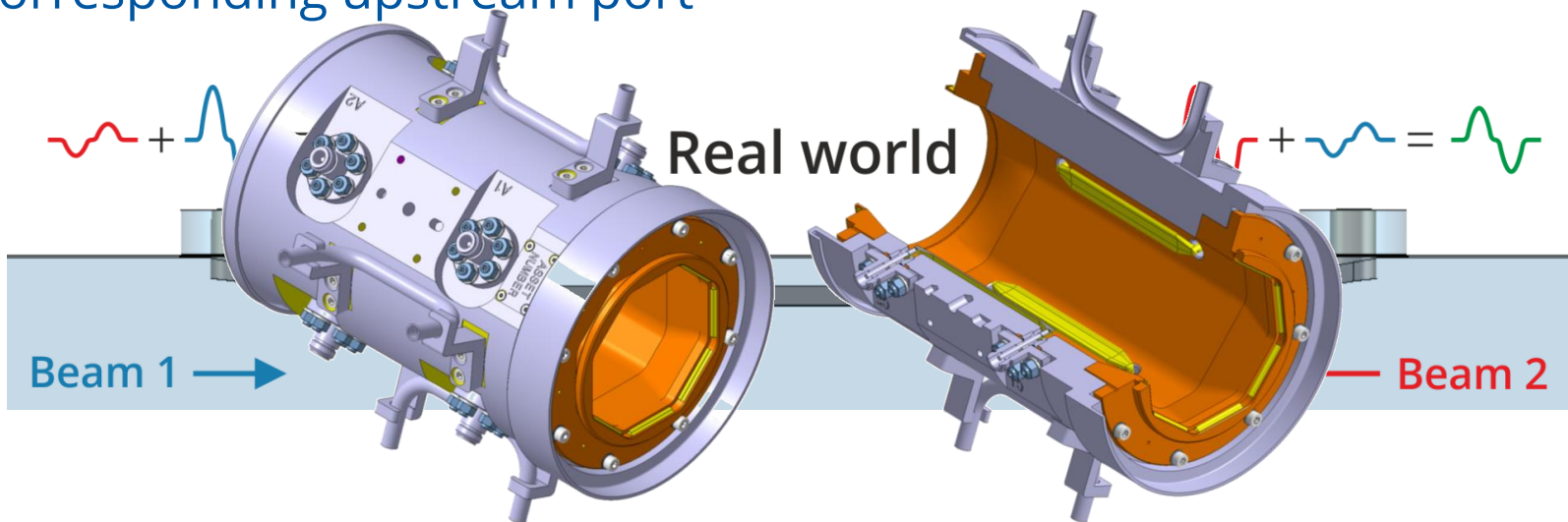


MD6948: RF cogging and orbit bumps in IR5 for HL-LHC BPM electronics development

M. Krupa for the HL-LHC BPM team

MD motivation

- In HL-LHC, each Inner Triplet in IR1/5 will feature 6 new directive BPMs installed on a common vacuum chamber for both beams
- BPMs are “directive”, i.e. they couple the beam mostly on the corresponding upstream port



MD motivation

- To aid beam disentanglement, the BPMs will be installed in locations where the beams are separated in time
- Brand new acquisition electronics is under development to apply DSP to reduce the residual measurement error from 100's μm to $< 5 \mu\text{m}$ (very demanding HL-LHC specification)
 - Validated with numerical simulations and data synthesised from 2021 single beam measurements
 - This MD goal: acquire data in conditions as realistic as feasible: RF coggling and orbit bumps

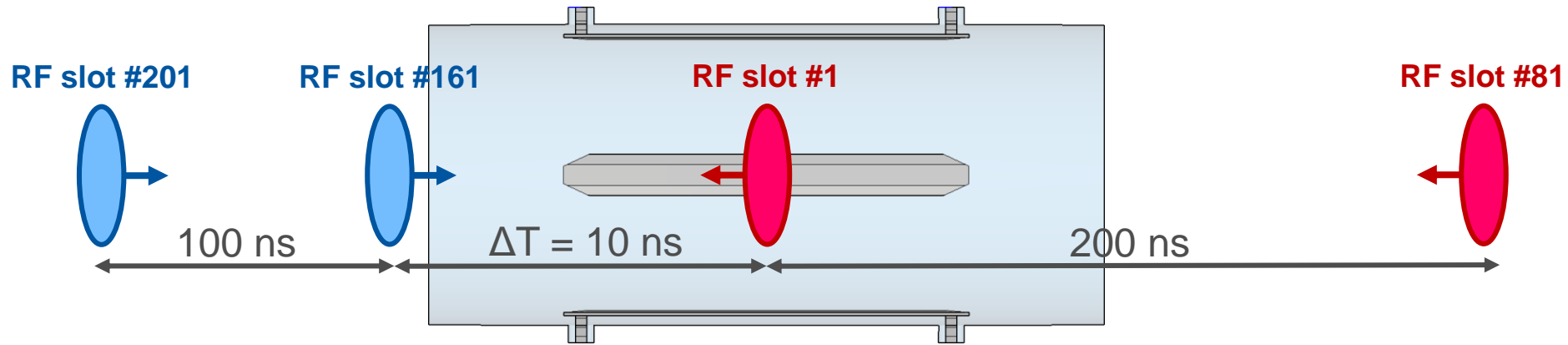
HL-LHC BPM location	Bunch crossing timing [ns]
Q1	3.92
Q2A	3.92
Q2B	6.82
Q3	9.72
CP	10.52
D1	7.36

MD procedure

- BPM selected for the tests: BPMSY.4L5
 - Directive BPM similar to those designed for HL-LHC
 - Acquisition electronics installed in USC55 which is accessible during beam operation
- Before the MD:
 - BI team #1 disconnects BPMSY.4L5.B1 and BPMSY.4L5.B2 from their acquisition electronics and connects them to the new test electronics (~ 2 hours)
 - BI team #1 will remain in USC55 for the duration of the MD for data taking and troubleshooting any issues
 - BI team #2 will be in CCC to coordinate the MD

MD procedure

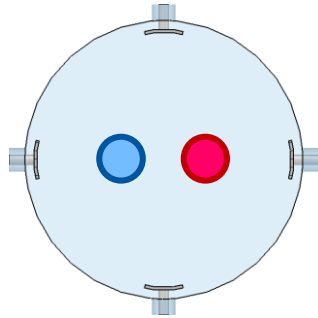
- Injection of 2 nominal bunches per beam



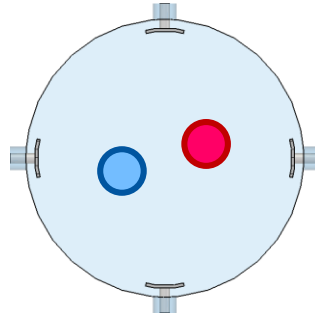
- RF cogging by an RF expert: adjust ΔT from 10 ns to -10 ns in steps of ~ 1 ns, ~ 3 min / step (~ 1.5 hour)

MD procedure

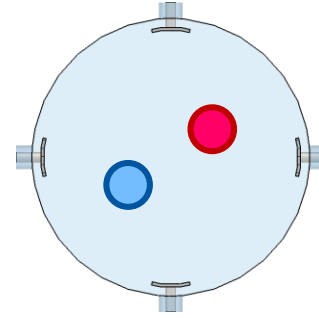
- Repeat cogging for 3 different orbits (total of ~ 5.5 hours)



$$\Delta H = \sim 10 \text{ mm}$$
$$\Delta V = 0 \text{ mm}$$



$$\Delta H = \sim 10 \text{ mm}$$
$$\Delta V = \sim 5 \text{ mm}$$



$$\Delta H = \sim 10 \text{ mm}$$
$$\Delta V = \sim 10 \text{ mm}$$

- If time permits, a bunch length scan at the end of the MD:
~ ±200 ps in ~ 100 ps steps

MD recovery

- BI team #1 reconnects BPMSY.4L5.B1 and BPMSY.4L5.B2 to their regular acquisition electronics (~ 20 mins) and removes the new test electronics from USC55 (~ 1 hour, can be done during the following MD / beam operation)
- RF experts revert the RF system to the nominal settings

Summary

- The MD is fundamental to gather realistic beam data to validate our algorithms developed over the last few years for correcting the residual beam-beam crosstalk in the HL-LHC IR1/5 Inner Triplet BPMs to meet the very demanding specification
- The MD requires help from the RF team (contact already established)
- Strong preference for either the 2nd (24-25/06) or 3rd (01-02/07) floating MD slot

Thank you for your attention