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LHC-OP MD requests for MD#4 and MD#5

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Overview

OP request for 3 MDs:

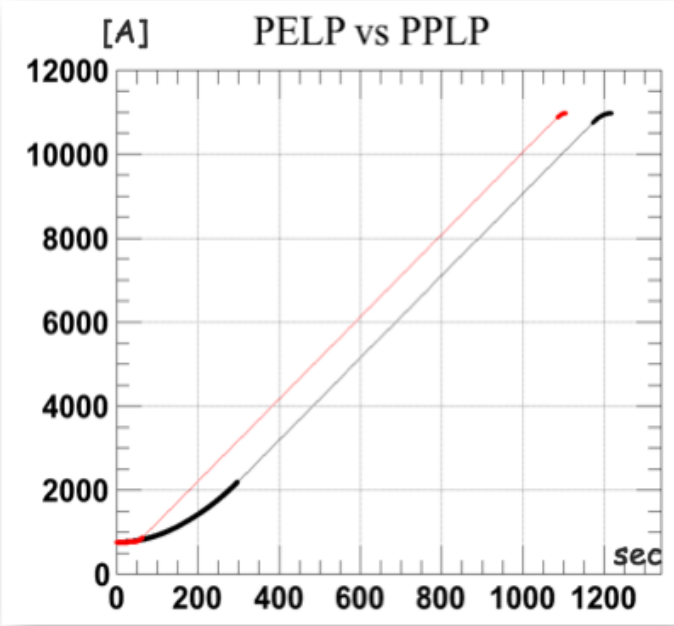
- **#11789**: PPLP ramp – operational development
- **#13403**: Smooth ramp for 2025

Possibility to combine them

- **#13523**: Improving LHC intensity dependent corrections

#11789: PPLP ramp – operational development

The Motivation



- The PPLP ramp to 6.8 TeV is **~10% shorter** than the PELP ramp (1152 sec vs 1275 sec)
- Potential gain = **10 hours/year** (~350 ramps/year)
- The PPLP ramp allows to reach lower energies

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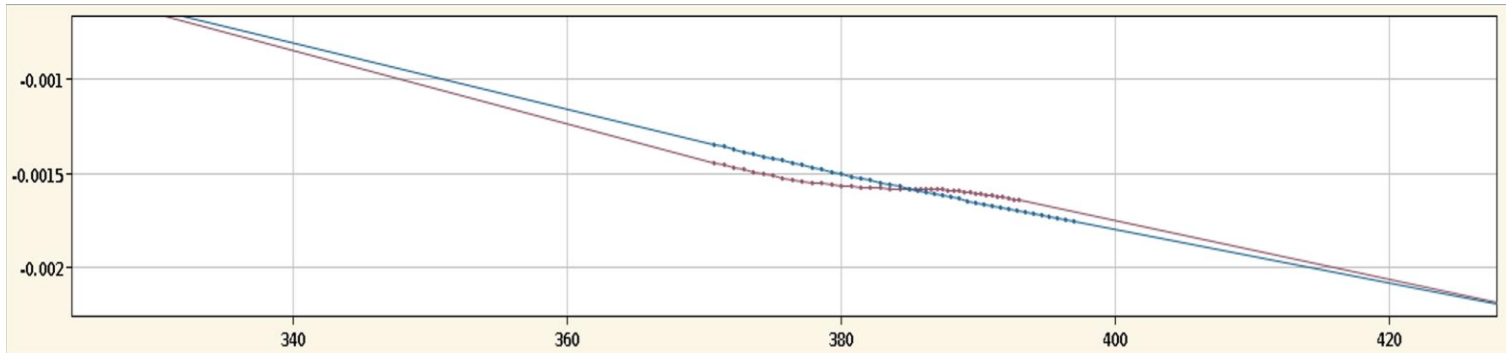
Already presented at LSWG on July 9th: https://indico.cern.ch/event/1434556/contributions/6036361/attachments/2892987/5072116/MD11789.pdf

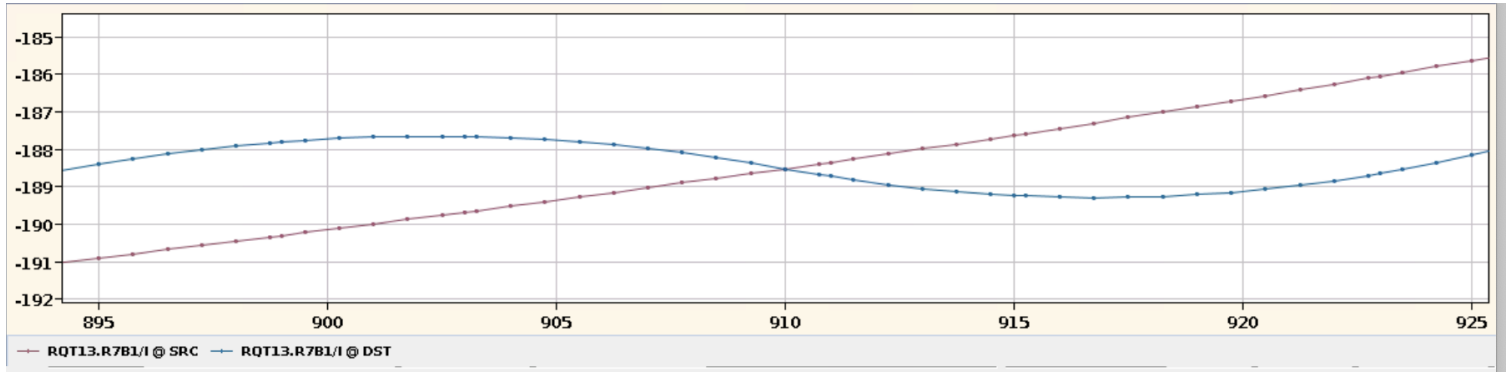
Instead of combining with MD10343, we propose to **combine with MD13403** (next slide)

#13403: Smooth ramp for 2025

HL ramp - RQT13.R7B1 example:
- K_SMOOTH
- I_REF

- **Operational development for 2025**
- The quadrupole rounding feature was designed for the squeeze, in order to allow the possibility to **stop at matched points**
- Stopping the CRS was **never** an **option** and it's not requested
- **Removing this feature** will allow a smoother current transition from the quadrupoles:
  - Reduced current stress
  - Improves corrections
  - Reduced time
- Feasibility test already done during HL-LHC MD



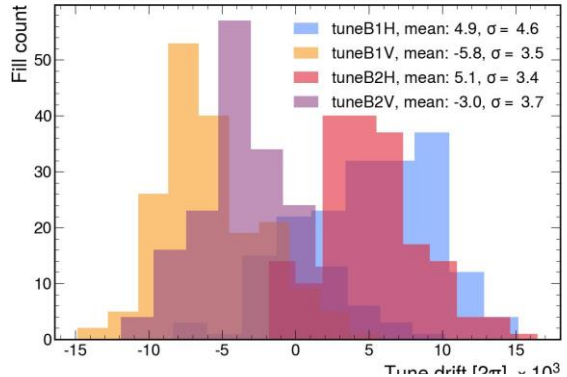


#11789&#13403 - requirements

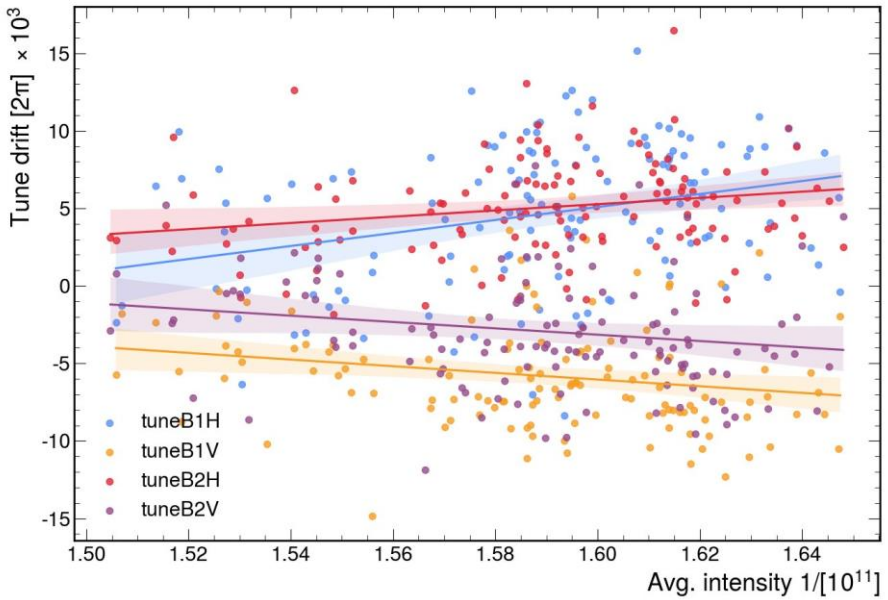
- We want to:
  - check **longitudinal blow-up control across the PPLP ramp, with particular attention at the very first part of the momentum change** - aim to deploy it in operation
  - Check the quality and reproducibility of the correction in the smoothed ramp
- **About 4 ramps** with **INDIVs** up to 1.6e11 p/b and **nominal COLL settings**
  - Ramp will be designed with same optics distribution (only difference is momentum function)
  - Modifying longitudinal blow-up settings (as done in standard operation)
  - Corrections feed-forward
- Nothing different from what done in a **standard commissioning**

#13523: Improving LHC intensity dependent corrections

- 2024 data: a **notable tune error** (~ 5e-3) is detected post corrections at injection of high intensity beams
- Much **smaller drifts** observed in the beginning of the year before the intensity ramp-up
- **Not corrected** tune drifts correlate with avg. bunch intensity
- FiDeL tune decay and Laslett are not easy to **decouple**
- Observed **tune shift differences** within the full beam, bunch-by-bunch
- Enhanced corrections would allow to **reduce the overhead** on the feedback
- **Investigate** the intensity and bunch-by-bunch differences
- Significant MD important for **operational efficiency**



*Obtained from comparing tunes corrected with the pilot and difference from the setpoint after injection is finished



#13523: Improving LHC intensity dependent corrections

- Profit from the **8b4e** variant to minimize the e-cloud tune shifts
- Injecting batches individually into a single beam to **remove BBLR contributions**
- Maximize tune shifts with high intensity and as full orbit as possible
- Measuring **tune shifts with ADT** single-turn kicks at each stage of injection
- **Gated tune measurements** for each bunch, aiming to assess Laslett coefficient accuracy and tune shift variations within the full train
- Repeat for both beams and **varied intensity levels**, starting from the highest

Specie	Protons
Beam Phase	Injection
Number of Bunches in LHC	as many as possible given the intensity
Beam Parameters	Bunch Train
Non-Standard Parameters	Multiple injections at different intensities: 1.6e11, 2e11, 2.3e11 (almost 400b)
Filling Scheme	Nominal filling scheme 2x72 + 3x36 25ns_2352b_2340_2004_2133_108bpi_24 inj

- Additionally measure single bunch intensity dependence (if possible – on the verge of sensitivity 1e-5)
- Repeat measurements at various stages of FiDeL decay correction