
CERN

OP MD requests

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MD request #10386 - residual orbit excursion in the ramp

Residual horizontal orbit excursions are present in the ramp while the **vertical plane is stable** at 10-20 microns.

- **Spikes are visible at matched points in all ramps**. They are due to the **parabolic rounding applied to feed-forward corrections**.

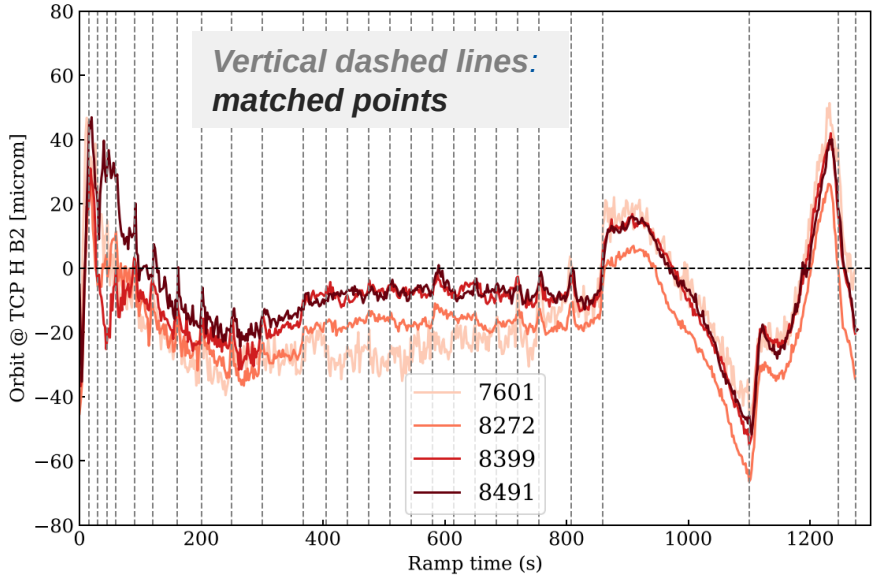
Eliminating such orbit spikes will remove some of **the lifetime dips in the ramp**. This effect contributes to ion downtime (ramp losses).

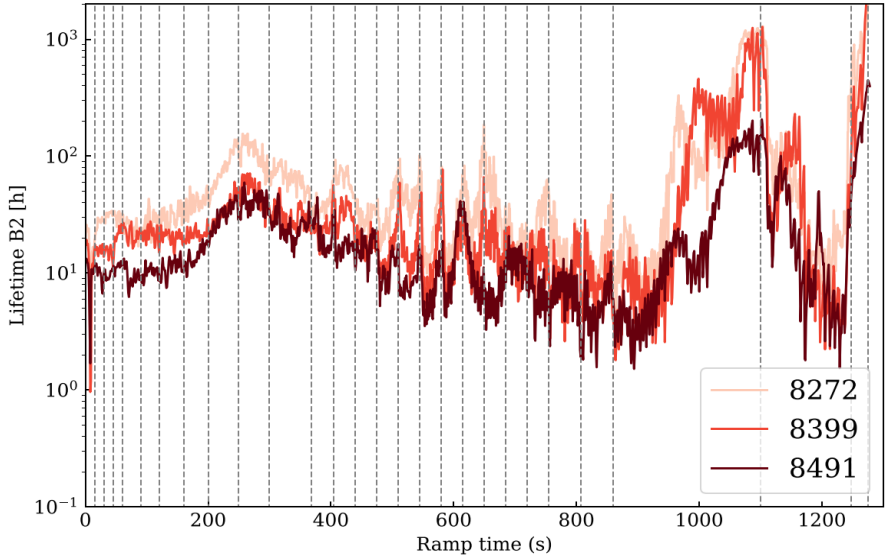
- Life structures due to beta-beating introduced by optics interpolations require other measures.

This MD is **left over from 2023**, maybe. Some pre-work may be done during beam commissioning.

Requirements:

- 2-3 consecutive ramps to be able to feed-forward corrections.
- One nominal bunch per beam.
- **8h** are required for ~3 ramps.





PPLP ramp revisited

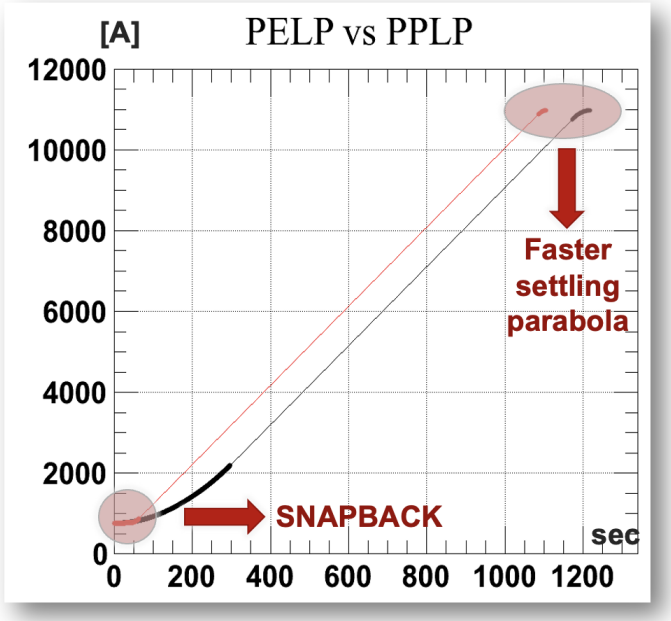
The **PPLP ramp tested successfully in 2017** (MD), it was implemented for 2018 operation.

- During commissioning **problems with controlling the bunch length** at the start of the ramp appeared (not observed during MD probably due to slightly lower bunch intensity) → switch back to PELP ramp.
- New inputs will come from the optimization of bunch length required by the vacuum module preservation.

Requirements:

- **1-3 indivs** (setup beam intensity).
- **Coarse collimator settings**.
- **8h** to be able to perform ~3 ramps.

Motivation – PPLP ramp (vs PELP)



- The PPLP ramp is **~10% shorter** than the PELP ramp (1100 sec vs 1210 sec)
- Potential gain = **10 hours/year** (~350 ramps in 2016)
- The PPLP ramp has to be **tested** with beam

From LSWG on May 23rd

Ramp in steps

The idea to reach 6.8 TeV performing **multiple ramp segments**, stopping at different energy level was discussed several times in the past.

Motivation for different studies:

- Emittance preservation studies
- More precise BSRT calibration
- Measurement of channelling efficiency as function of energy for new TWOCRYST (PBC) in IR3.
- …

Some operational / control aspects issues need to be tackled. This MD aims to perform a first test of the feasibility and of the control of the magnetic errors.

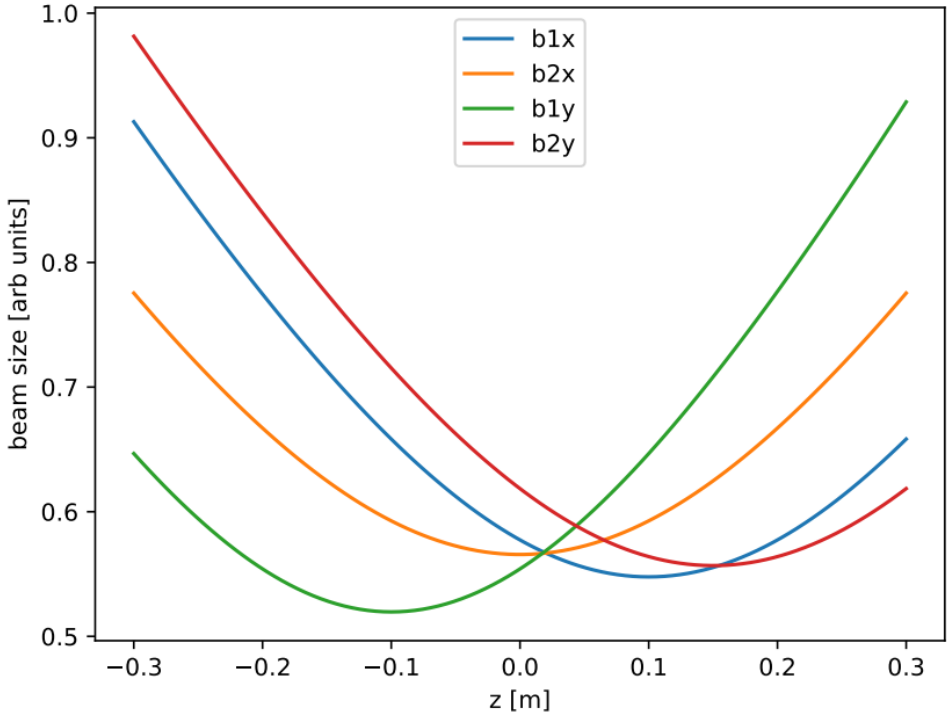
Requirements:

- Up to **3 probe bunches**, possibly one indiv if time permits.
- **Coarse collimator settings**.
- **8h** are necessary for a first series of tests (~2 attempts with correction feed-forward).

Betatron waist determination using cogging

Motivation:

- To determine the **beta-waist** has proven difficult with K-modulation, even more difficult for HL.
- Essential to equalize the luminosity of ATLAS-CMS (we are still almost half of the time NOT in lumi levelling)
- An additional benefit is that a better knowledge of beta* and waist reduces the **error** on the **emittance determination from luminosity**.



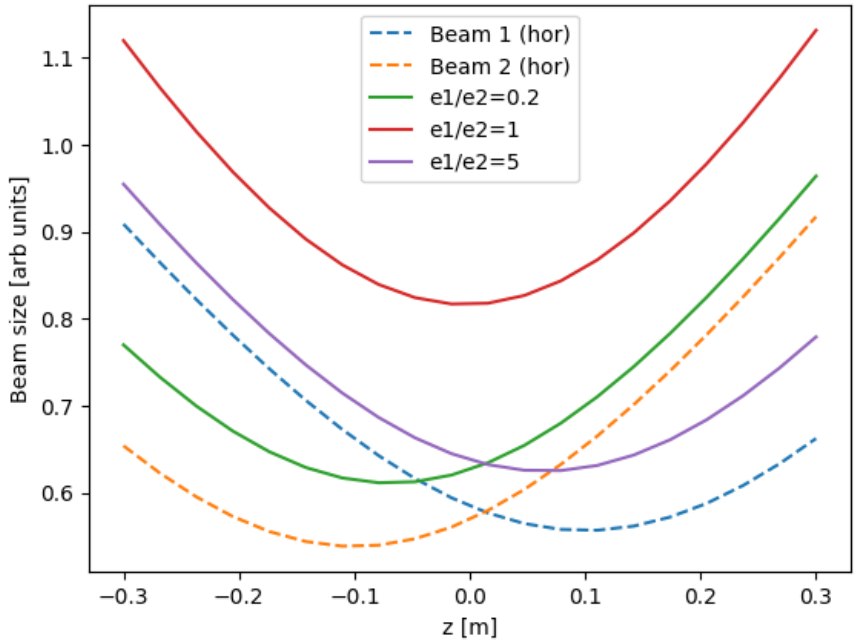
Betatron waist determination using cogging (2)

Principle:

- The MD requires bunches with very different emittances.
- Emittance scans provide the convoluted beam sizes (B1+B2).
- The waist position can be obtained from emittance scans performed at different z-positions using cogging.

Requirements:

- Many indiv-like bunches with **large differences in emittance**.
- **Total time 8-10h**, 3-4h needed for the emittance scans at different cogging values.
- There is synergy with the BSRT calibration fills, but the **pattern of emittances between B1 and B2 are different**.
  - Collide large with small emittance !



In this example the waist is shifted by 0.1 m for beam 1 and by -0.1 m for beam 2.
For scans with equal emittances in the two beams the minimum is in the centre, but not when the emittances are different.

Injection-standby-injection magnetic history

Background:

- To **enter LHC service areas**, the **two adjacent sectors** must be put to **standby**.
  - This often happens when the machine is **already at injection current**.
- **A pre-cycle** is performed when the intervention is finished to reset the magnet history.

Motivation:

- If one could **skip the pre-cycle**, **~30 min would be saved** every time this situation occurs.
- It is complicated to estimate the impact on the optics, a measurement of the static effect would give insight if this is worth investigating further. If OK more studies would be needed.
- The MD is also interesting to understand the hysteresis of the magnet.

Requirements:

- 1 measurement after 2 sectors on standby, 1 measurement after all sectors on standby.
- **3 pilots and coarse collimator settings** for optics, tune and chroma decay measurements.
- **4-6h** would be necessary for a first exploration.

Beta* levelling to 30/20cm moving TCS

Background:

- **Squeezing** further **beyond beta* = 30cm** could **gain ~5-6% of integrated luminosity**
- This requires a **tightening of the collimator hierarchy**
  - Either during the ramp or in collisions

Motivation:

- Once in Stable Beams and beta* levelling, **moving collimators with sequencer is not ideal**
  - Problems with continuity and possible resident BP
  - Need to stop levelling for experiments – not smooth in lumi / pile-up
- **Moving TCS with lumi server as part of beta* levelling** would allow for a smooth tightening
  - Presently lumi server is only moving TCTs/TCLs

Requirements:

- 2 nominal bunches colliding in all IPs (setup beam)
- Commissioned beta* levelling to 30cm, optics to go to 30/20cm
- Collimation set up for the nominal cycle, including angular alignment
- **Total 6h** for a cycle to 30/20cm