2023 Configuration MD (MD7003) with unsafe beams

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- Main results from MD1 & MD2
- Main objectives for FMD4 & Beams required
- MD steps

Main results from MD1+MD2 (1/2)

- **Demonstration of the mechanics down to 30 cm**

  → At 60 cm the settings are the same as for 2022, incl. OMC knobs, except
    - (i) TCT settings in IR1/5/8
    - (ii) X-plane in IR8
    - (iii) X-angle in IR1/5 [145 µrad @ 60 cm ->160 µrad @ 30 cm]

  → At 30 cm the settings are strictly the same

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|---|
| **New combined ramp and anti-telescopic squeeze (as of 4.5 TeV)** |
| **LHCb rotation @ FT (2 m at IP1/2/8)** |
| **Mini-squeeze down to 1.2 m** |
| **Q-change & ADJUST** |
| **1^{rst} β^*-levelling segment down to 60 cm** |
| **2nd β^*-levelling segment down to 30 cm** |

- **Optics measurement all along the cycle, with one additional OMC knob @1.2 m**
  (trimmed in in the mini-squeeze, and out in the first β^* levelling segment)

  → Very good optics:

  (i) 10-15% in the ramp, 5-10% in beta* levelling,

  (ii) outstanding case of B1H @ 2 m reaching 20%
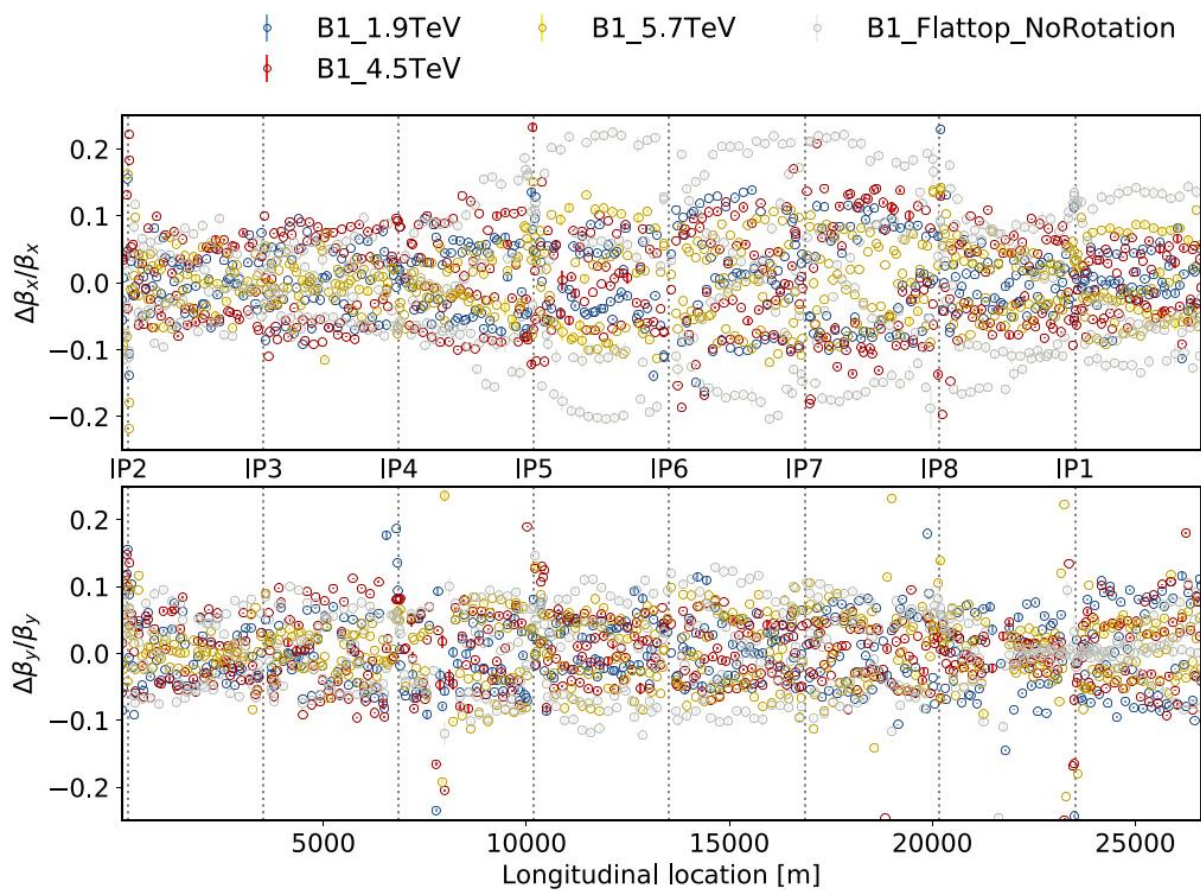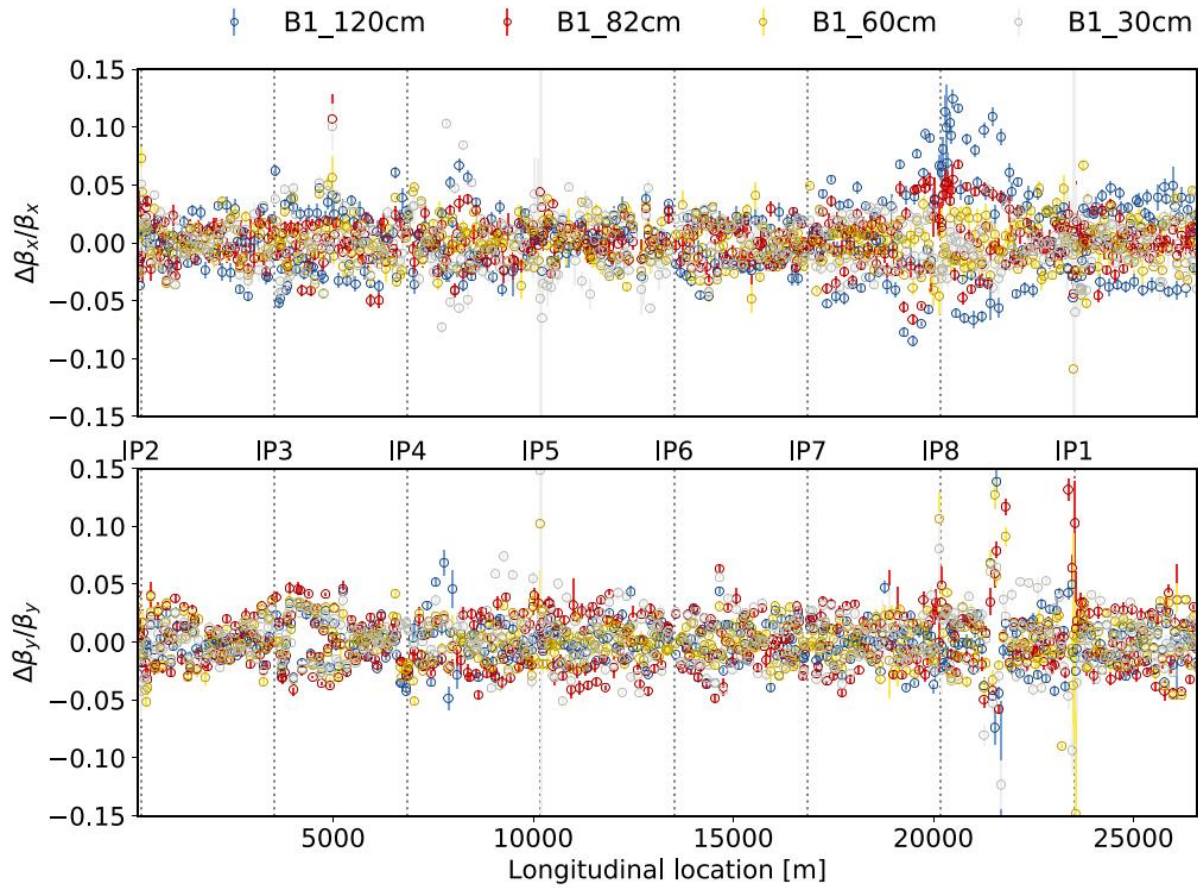
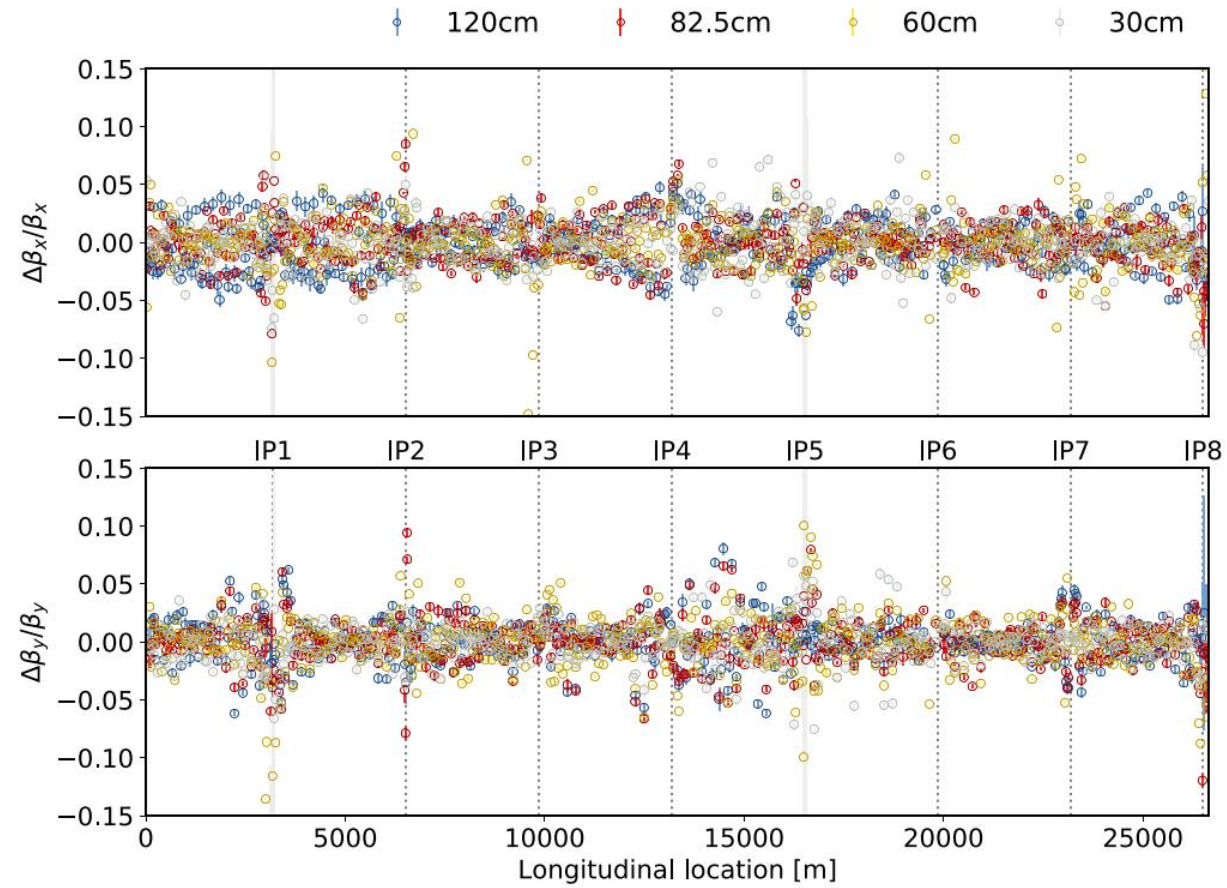**Beam 1 in the ramp**

Beam 2 in the ramp
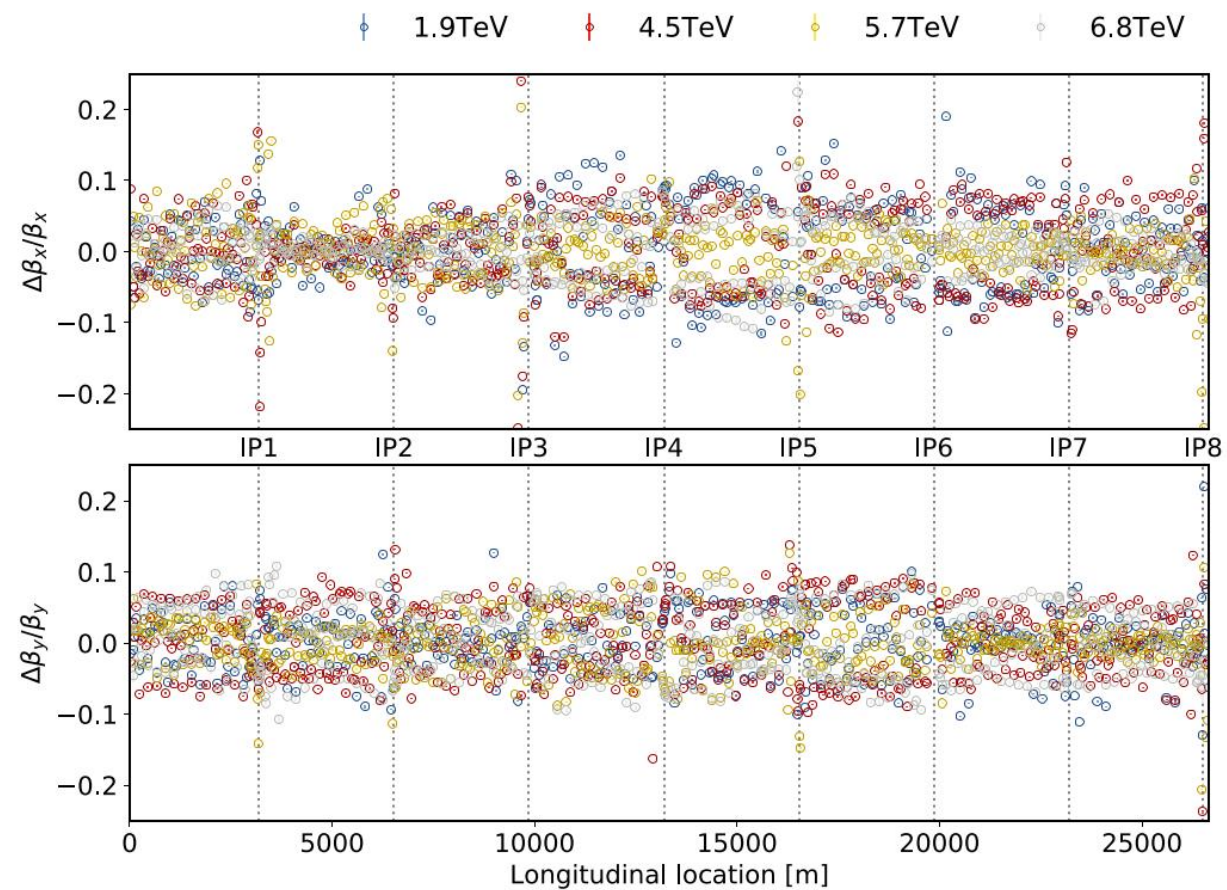
OMC team

Beam 1 in β*-levelling

Beam 2 in β*-levelling

*OMC team*

Main results from MD1+MD2 (2/2)

- **Partial validation of the cycle (with 2 nom. + 10 probes per beam)**

→ Successful ASD @ 1.2 m (worst case for MKD/TCDQ phase)

→ No off-momentum LMs yet, but most of on-momentum LMs till 60 cm

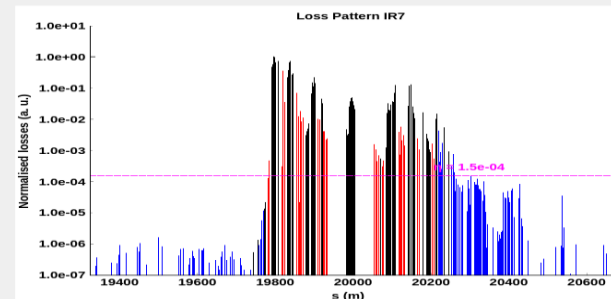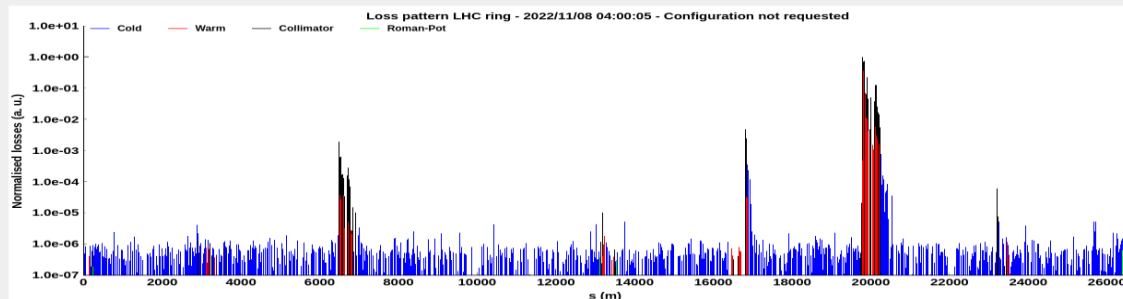|	FT @ 2m before rot.	FT @ 2m after rot.	1.2 m before coll.	1.2 m in coll.	60 cm In coll.	30 cm In col.
On-momentum	√	√	√	√	× (B1) √ (B2)	×
Off-momentum $\delta>0$	×	×	×	×	×	×
Off-momentum $\delta<0$	×	×	×	×	×	×

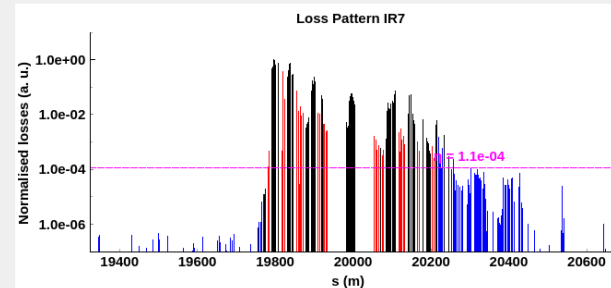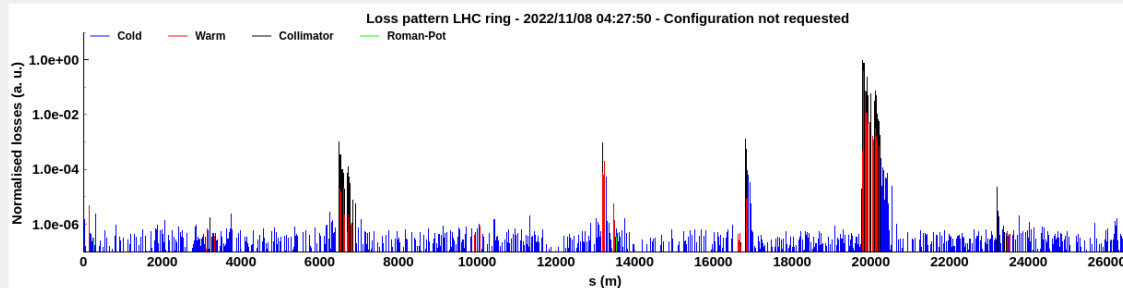## The cycle will be limited to 60 cm in FMD4

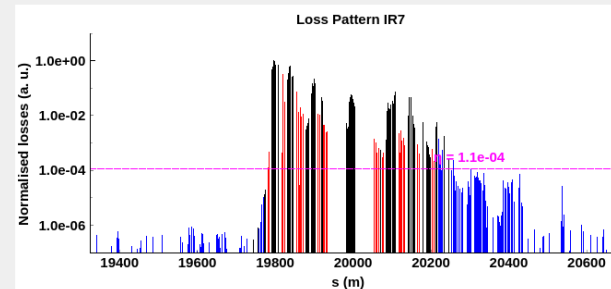# Example of B1H

Before LHCb rotation @ 2 m
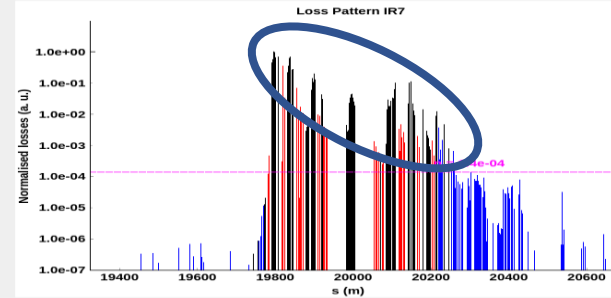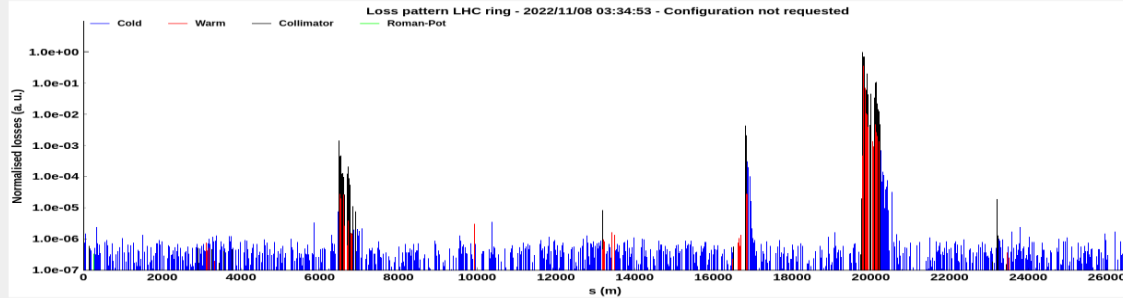
After LHCb rotation @ 2 m

Before collision @ 1.2 m

After collision @ 1.2 m
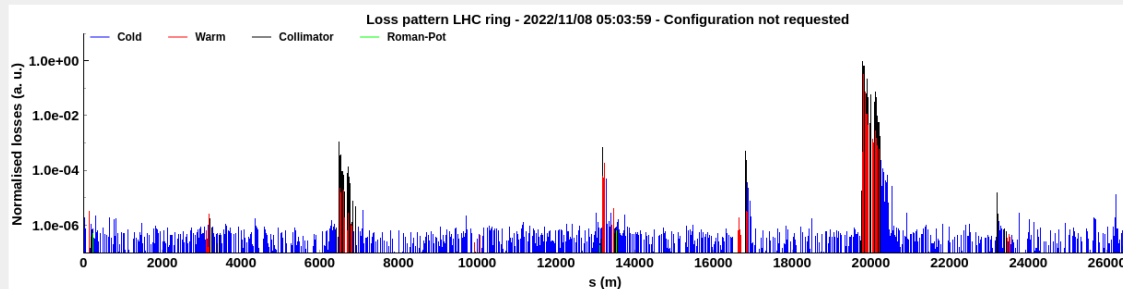
Collimation team

Objectives for MD4

- **Beam-beam studies @ 1.8e11 p/b,** collisions at the 4 IPs, and external V-crossing in IR8

  → 25ns_**156b**_144_90_96_48bpi_4inj_MD7003

  → The 48b trains are widely separated (3 SPS injection)

- **LHCb rotation in the presence of e-cloud @ 1.4e11 p/b**

  → 25ns_**732b**_31_12_720_180bpi_5inj_MD7003

  →The number of beam-beam interactions (BBLR+HO) is maximised in IR8

MD steps (1/2)

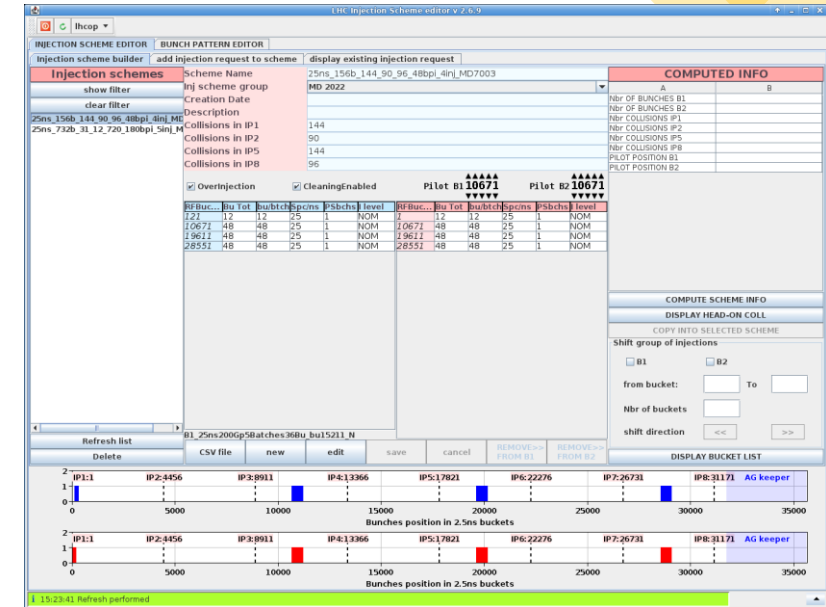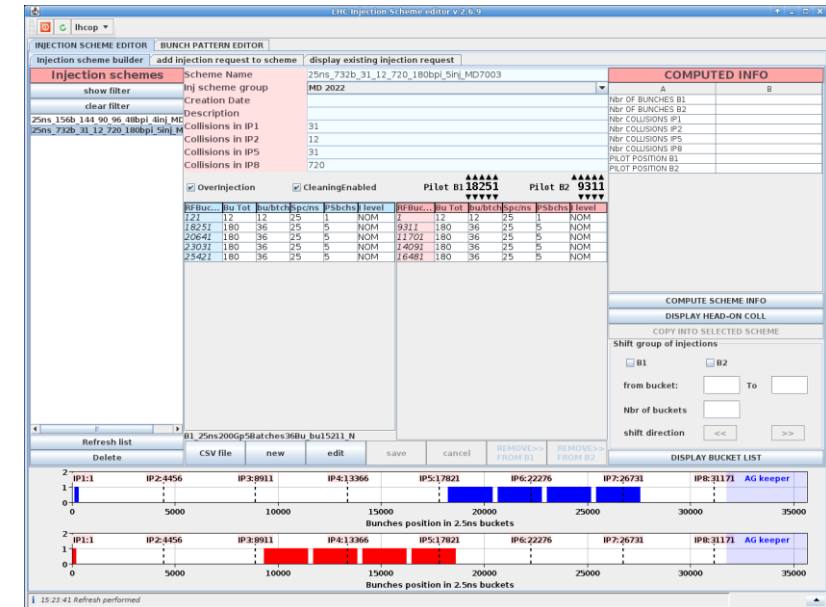- **Fill # 1: validation fill with 2 nominal + 12 probes (<3e11 p/b)**
  - Selection of off-momentum LMs down to 60 cm + B1H/V @ 60 cm
  - → **12 LMs for Beam1 and 10 LMs for Beam2**

	FT @ 2m before rot.	FT @ 2m after rot.	1.2 m before coll.	1.2 m in coll.	60 cm In coll.	30 cm In col.
On-momentum	√	√	√	√	√ (B1) √ (B2)	×
Off-momentum δ>0	×	√	×	√	√	×
Off-momentum δ<0	×	√	×	√	×	×

- De-squeeze from 60 cm up to 1.2 m
- Scrape the two nominal (is it needed ?)
- IR8 V-aperture measurement (expected to be 12.5-13 σ vs. 20σ ++ in IR1/5)
- Dump

MD steps (2/2)

- **Fill # 2:** 1rst intensity ramp-up step with 12b + **48b @ 1.4e11 p/b**
  - Run the cycle with no stop till 1.2 m
  - Establish and optimize the collisions IP1/5 (no collisions at IP2/8)
  - Tune optimization based on lifetime
  - Beta* levelling down to 60 cm
  - Lumi and tune optimization @ 60 cm
  - Dump @ 60 cm

- **Fill # 3:** 2nd step with 12b + **3×48b @ 1.8e11 p/b**
  - Run the cycle with no stop till 1.2 m
  - Establish and optimize the collisions at all Ips
    (IP2 &IP8 separated)
  - Tune optimization based on lifetime
  - Beta* levelling __in steps__ down to 60 cm
    (with lumi and tune optimization whenever needed)
  - Dump @ 60 cm

- **Fill # 4:** 3rd step with **~700 b @ 1.4e11 p/b**
  - Run the cycle with no stop till FT
  - Run the LHCb rotation and monitor lifetime and losses
  - Dump @ 2 m

Intermediate step requested by rMPP

Expected Head-on Lumi [10^{32}]

	β^*=1.2 m	β^*=60 cm
ATLAS & CMS	11.9	20.0
Alice	1.0	
LHCb	4.3	

Very likely 3h00 will be missing !
Tiny risk that it does not work, .. but sizeable impact (1 week) for the 2023 commissioning if actually it does not !