



PS2SPS Losses and Collimation Studies

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on behalf of the collimation, OP, and RF teams

IPP 03/02/2024

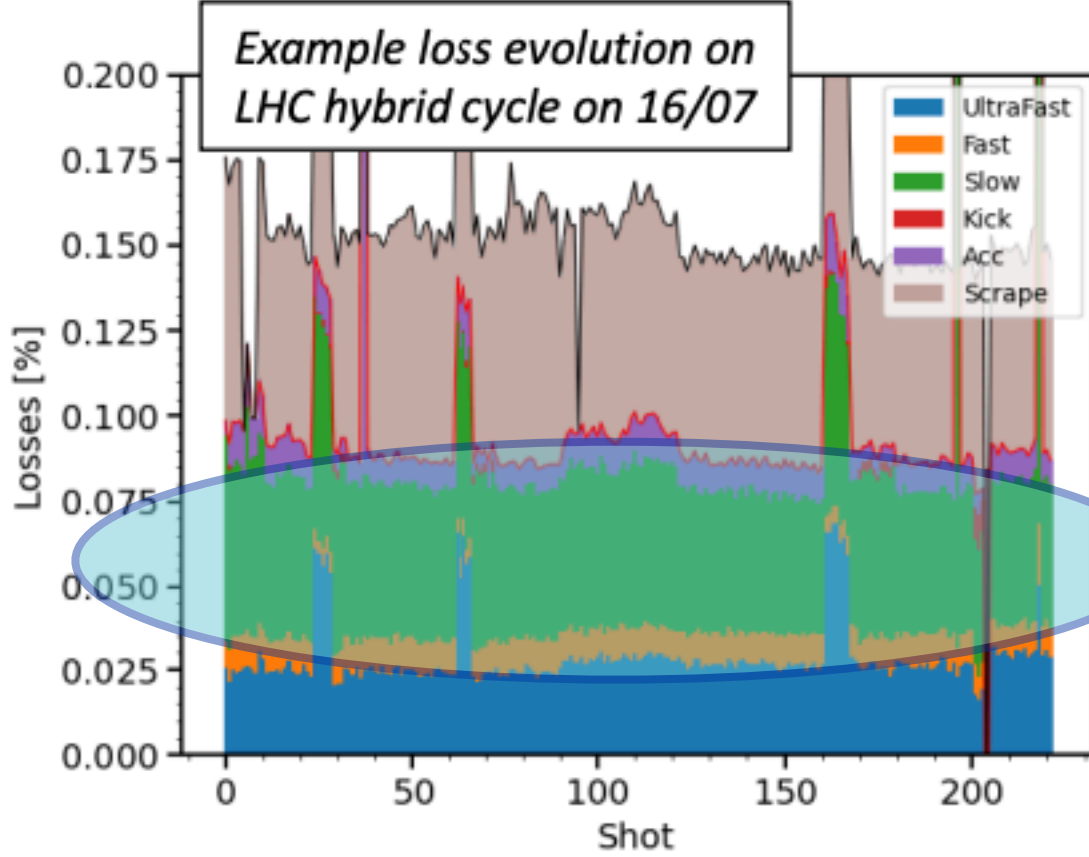
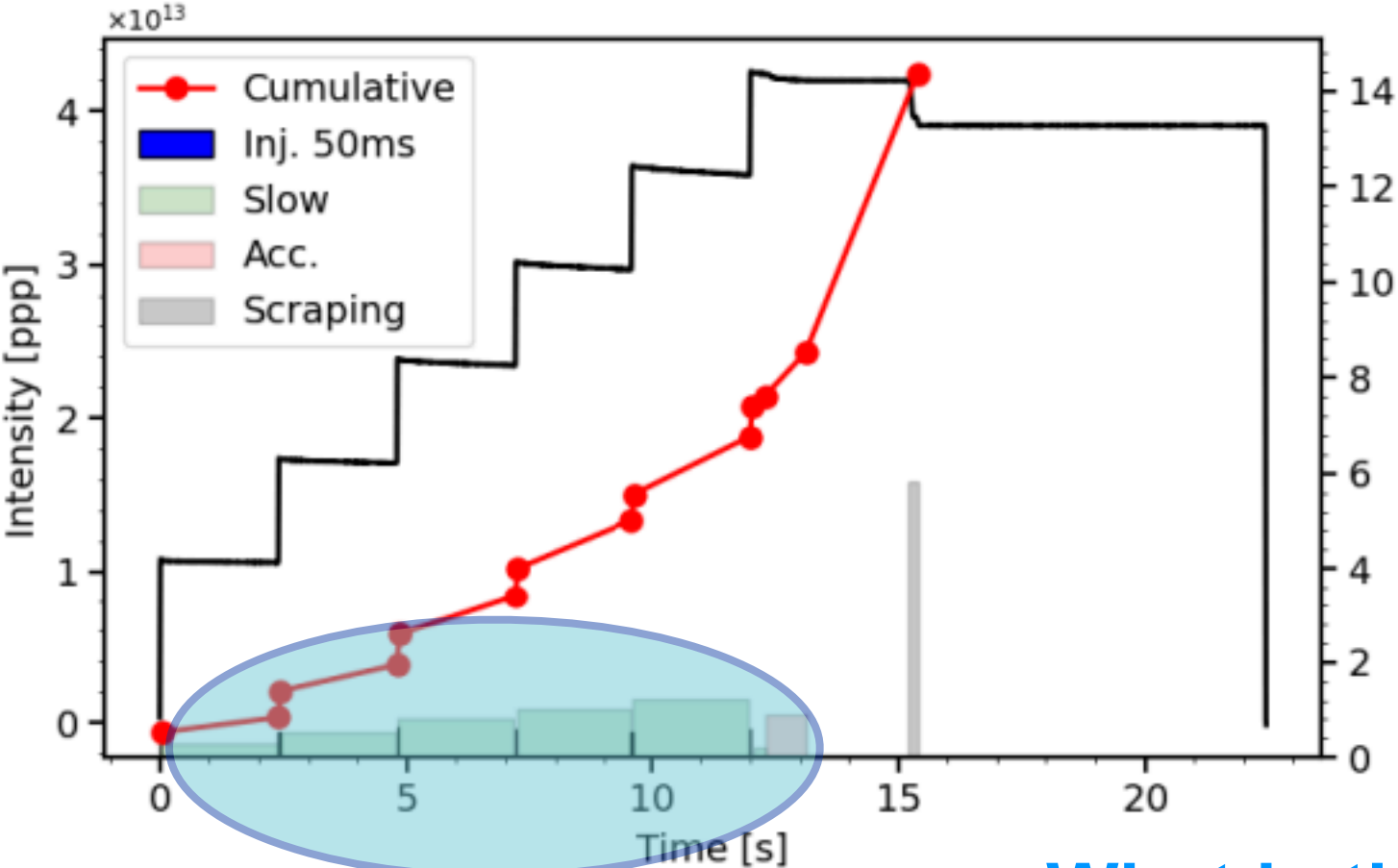
Introduction

- Priority for PS2SPS losses studies set at [IPP 17/05/2023](#)
- Reiterated and progress reviewed by A. Lasheen at [IPP 03/11/2023](#))
- Focus on:
 - Development of online tools for MDs
 - **Dedicated collimation/scraping MD** to study slow losses

Conclusions

- With the new format of the IPP, the PS2SPS WG will now organize only ad-hoc meetings to address specific technical aspects (e.g. simulations, data analysis routine, MD preparation...), while reporting will be done at the IPP.
- Priorities for 2023 *JAPW Action ID#*
 - Until ITS1 (and repair of the SPS WS)
 - Continuation of development of analysis routines and tools for longitudinal beam observation, analysis, logging (ID#48).
 - Optimization of RF parameters at PS-SPS transfer (bunch rotation, SPS injection parameters) in short parallel MDs and path for automation.
 - Provide input for the development of an OP PS-SPS vistar (ID#50).
 - Q3
 - PS-SPS transfer studies with long flat bottom
 - Study of tail distribution with scraping/collimation and contribution to slow losses (joint effort)
 - Q4
 - Continuation of studies for LHC beams from Q3
 - Start of short parallel MDs for (high intensity) SFTPRO beams (ID#64)

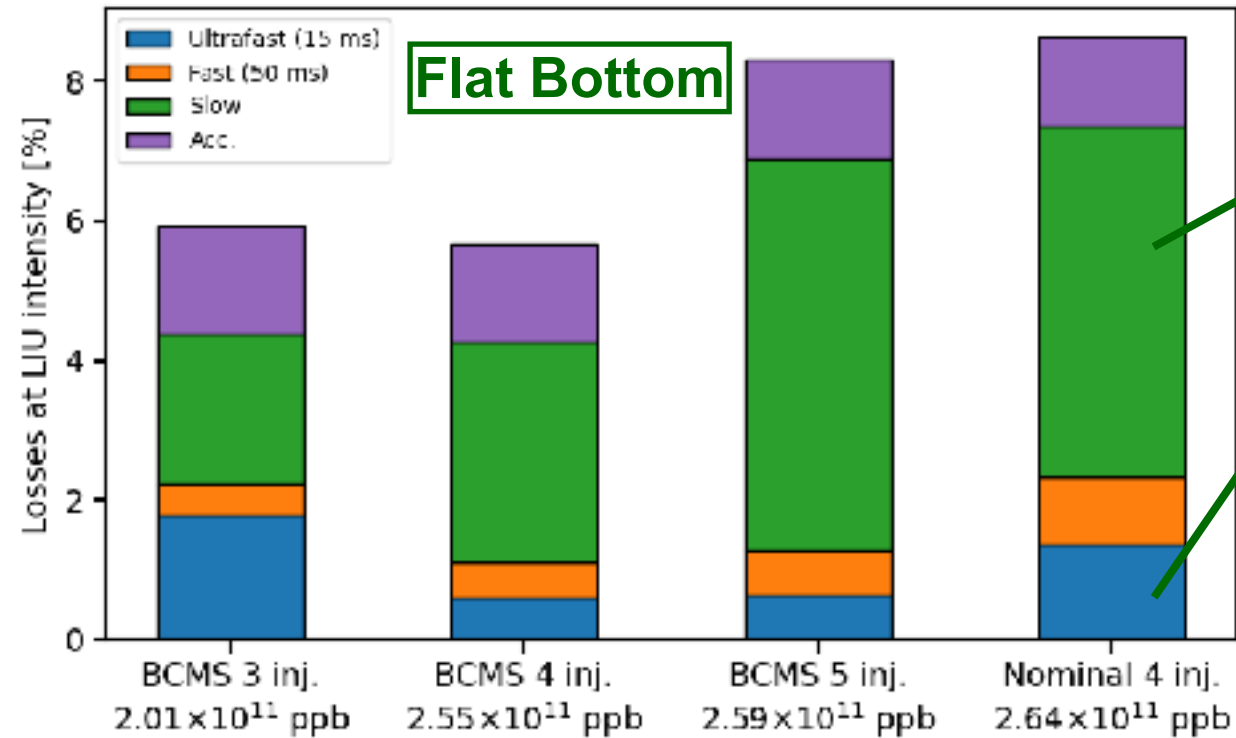
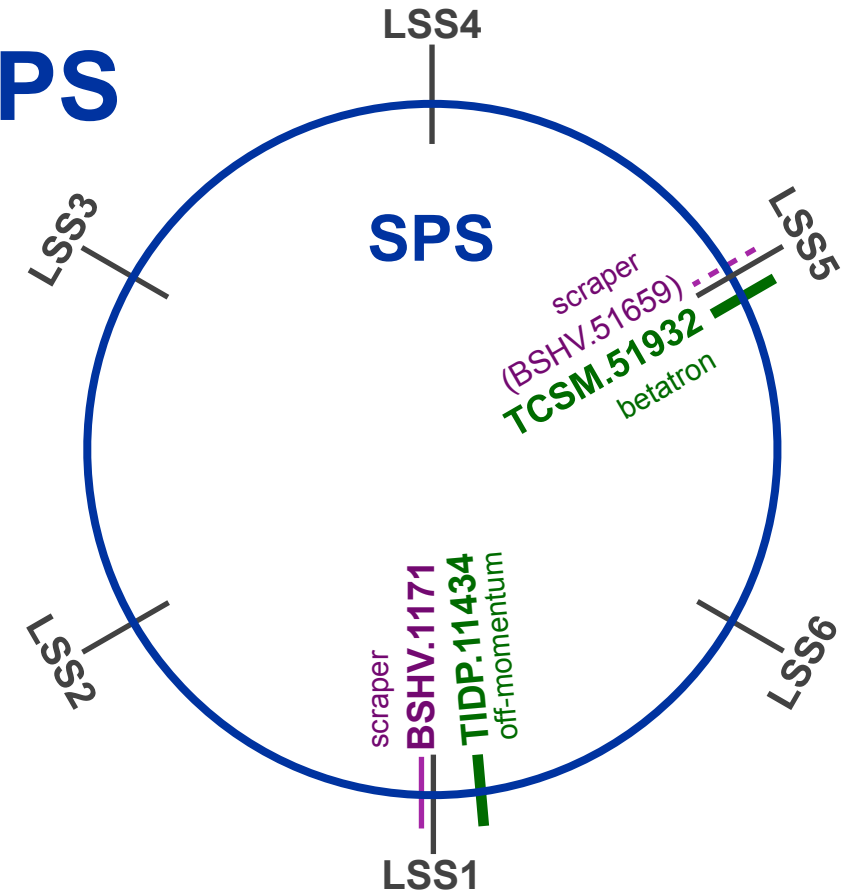
Different Types of Losses - Slow Losses



What is the main mechanism?

Beam Losses Characterisation in SPS

- Understanding losses in SPS is **crucial** for high-quality beams to LHC
- Focus on **slow losses**: origin and nature (betatronic vs off-momentum)
- Need **loss map** with orbit bumps to observe main losses locations
- Good understanding to be able to decide on **need for new hardware**



not understood
in transfer line
or at injection

- One prototype betatron collimator (H): **TCSM.51932**
 - Need **COAST** to have time to fully move
- One block in dispersion region: **TIDP.11434**
 - Need **orbit bumps** to reach
- Scrapers not (yet) used for MD

courtesy of J. Flowerdew

Previous MDs: 17/04/2024

- **Close to no measurements performed** (and the few taken were not reproducible...)
- No measurements in the **morning**:
 - Started with a LINAC MD
 - Poor beam quality from PS (took a while to stabilise)
 - Unforeseen COAST issues (even though this was tested several weeks earlier)
- **Afternoon**:
 - Calibrated TIDP and aligned TCSM (only reliable measurement)
 - Plagued by instabilities
 - Also a few quick measurements, but completely unreliable

Previous MDs: 19/06/2024

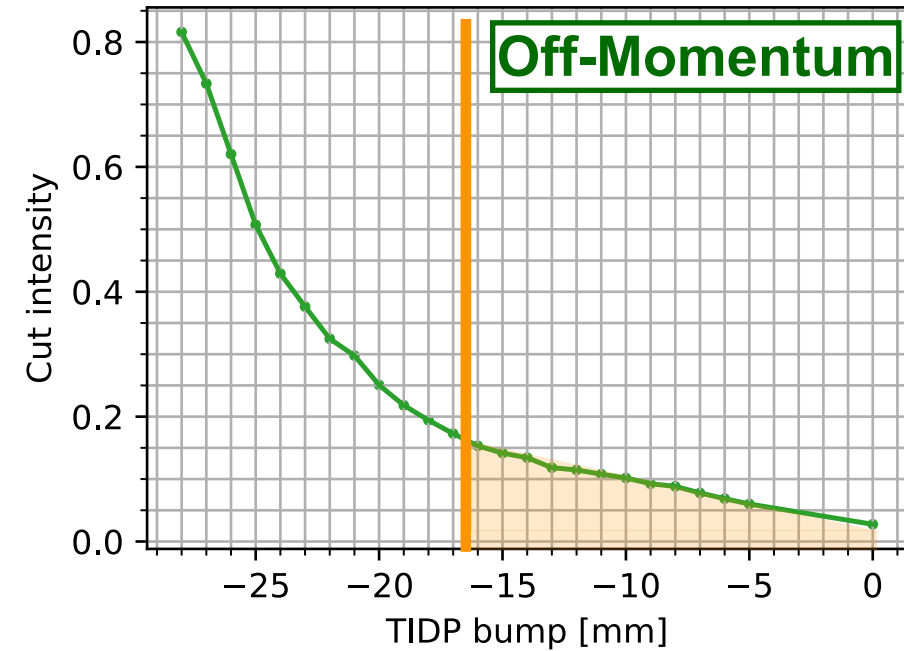
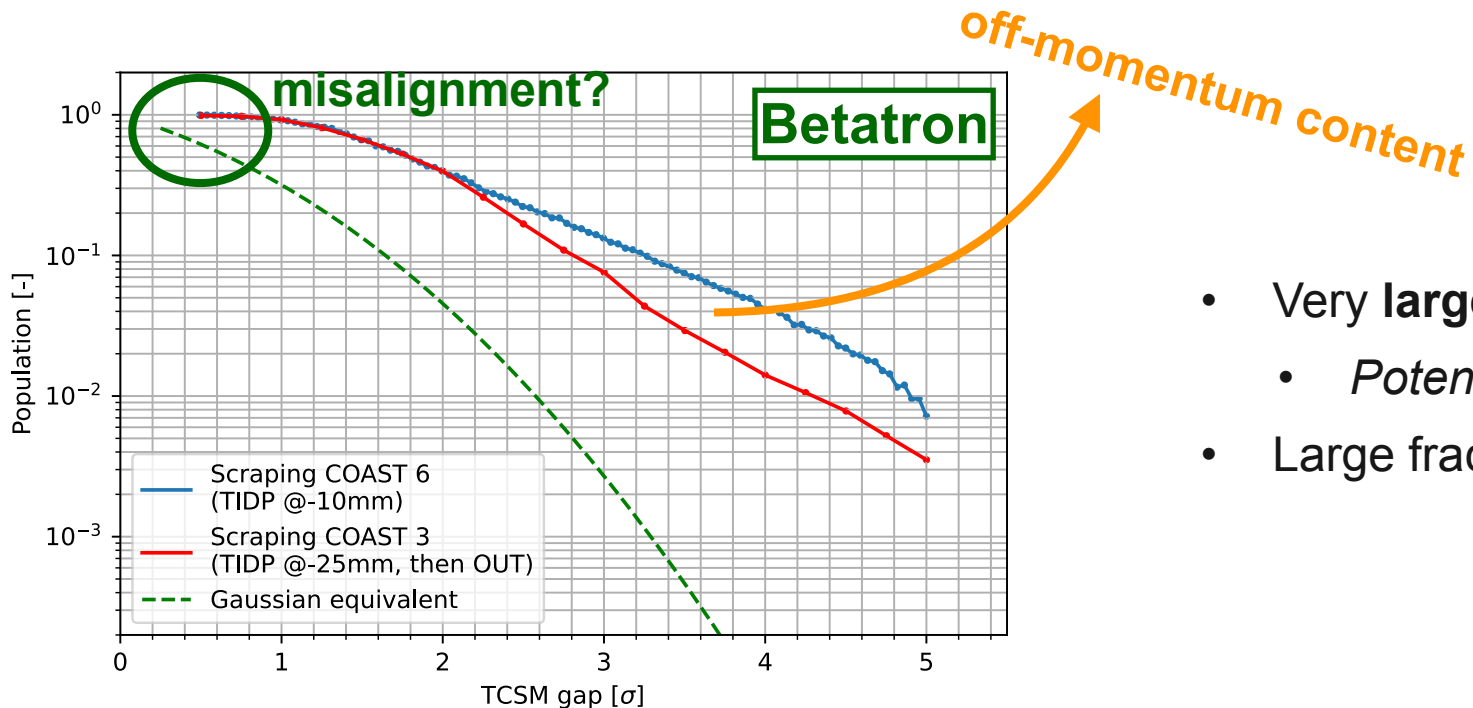
- No measurements in the **morning**:
 - Scrubbing (needed as beam quality was degraded)
 - LHC filling (loss maps)
 - Taming instabilities => huge thanks to the team (Kevin, Kostas, and Ingrid)
- **Afternoon**:
 - **Multiple useful measurements** during **7 COASTs** and a few CYCLEs
 - BLMs not always logged correctly, and could not read collimator BPMs
 - No logging of orbit bumps (screenshots taken but some missing information)
 - BLM gain not adapted
 - Few interruptions to availability due to:
 - Linac4 source change
 - LHC filling (ramp up)

Previous MDs: 19/06/2024

COAST 1	12:36:49	13:08:07	<i>alignment</i>	TCSM (close to core)
COAST 2	13:12:42	13:33:25	<i>alignment</i>	TCSM (further out in the halo) - result confirmed
			<i>scraping (end)</i>	TIDP -5mm to -28mm (in steps of 1mm)
<i>CYCLES</i>	15:20:05	15:48:23	<i>calibration</i>	TIDP bumps -30mm to -20mm (in steps of 1mm, 3 times each)
COAST 3	15:53:50	16:18:14	<i>repopulation</i>	TIDP IN/OUT -20mm and -25mm (TCSM @ 5σ)
			<i>scraping (end)</i>	TCSM 5σ to 0.5σ (in steps of 0.25σ)
COAST 4	16:22:21	16:41:14	<i>repopulation</i>	TCSM IN/OUT 3σ (TIDP OUT)
COAST 5	17:14:35	17:44:02	<i>repopulation</i>	TCSM IN/OUT 3σ (TIDP @ -20mm)
			<i>scraping (end)</i>	TIDP bumps -20mm to -30mm (in steps of 0.25mm)
COAST 6	17:47:14	17:56:00	<i>scraping</i>	TCSM 5σ to 0.5σ (in steps of $100\mu\text{m}$) TIDP @ -10mm
COAST 7	17:57:49	18:15:47	<i>scraping</i>	TIDP -7mm to -30mm (in steps of 0.25mm)

Scraping Measurements

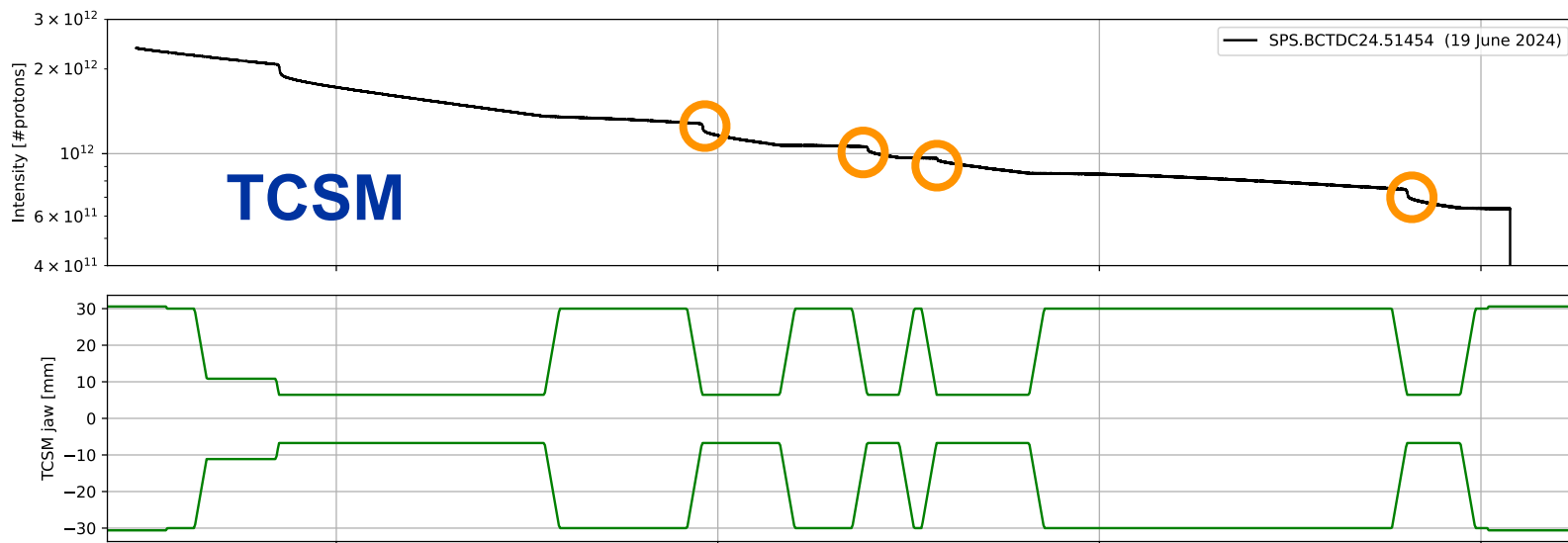
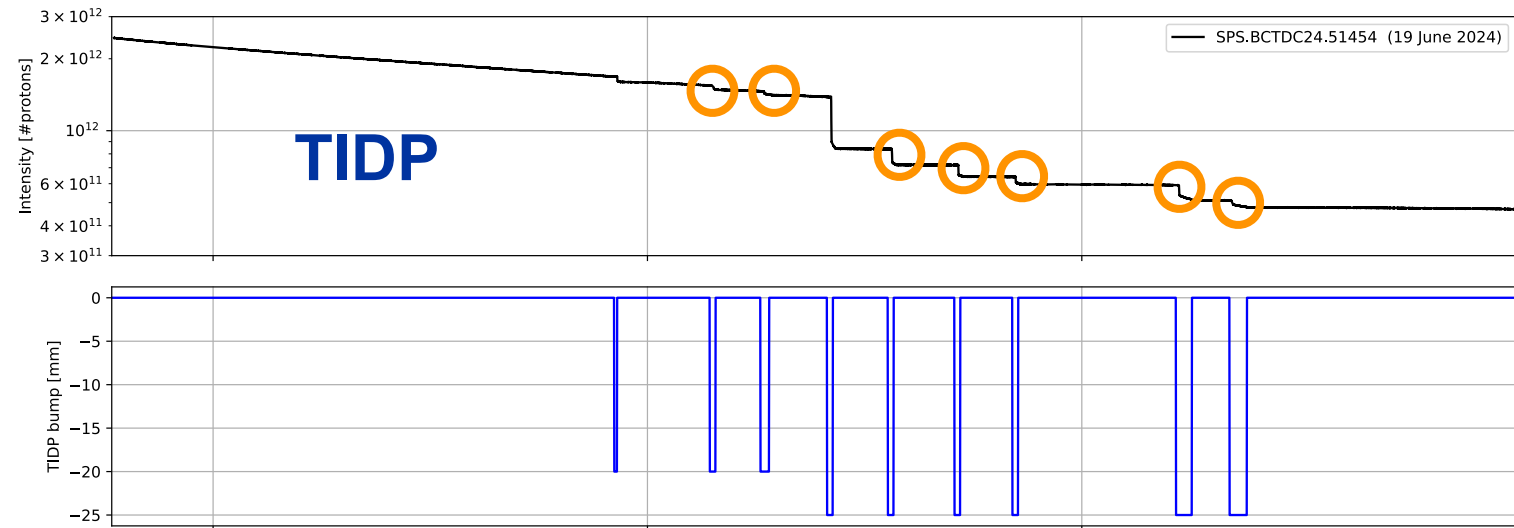
- Very large population out of RF bucket
 - *But large uncertainty on TIDP position...*
- Probably not uncaptured beam (not enough losses at start of ramp)
- Orange region also contains **steady losses** pushed on TCSM
- **Correlation** between betatronic and dispersive contributions



- Very large betatron tails $\sim 15\%$ at 3σ
 - *Potential misalignment of TCSM*
- Large fraction of tails is **correlated** to longitudinal

Tail Repopulation

- Clear hints of repopulation!
 - Both betatronic and off-momentum
- Continuous losses clearly visible
- Repopulation rate scales with time
 - 0.14 to 0.54 % per second



- Results not conclusive:
 - Settings were too tight (might have cut in core)
 - Need more statistics

Open Questions

- How certain are we about the collimator **alignment** (TCSM) / block position (TIDP)?
 - Double-check controls, collimator BPM & BLMs, adapted test with bumps for TIDP
- Losses characterisation:
 - Can we **disentangle** off-momentum from betatronic losses?
 - Are particles pushed out of the bucket during COAST?
 - Need more data on the **repopulation**
- How feasible are orbit bumps? Investigate with **loss map!**

Collimation MD Requests for 2025-2026

- In order to better understand nature of losses, we need various measurements:
 - Alternative configurations for COAST (30GeV, 200GeV, no RF)
 - Loss map around the ring (need to adapt BLM gain)
 - PS beam with lower momentum spread (reduce long. emitt. and go down in intensity)
- Requests:
 - Test readiness (BLM gain, various COAST configs, collimator controls & BPM) during commissioning / scrubbing
 - Three dedicated MD slots (2 in 2025, 1 in 2026) to be able to perform all tests, and have a backup in case of issues



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