



# PERFORMANCE OF THE ION CHAIN AT THE CERN INJECTOR COMPLEX AND TRANSMISSION STUDIES DURING THE 2023 SLIP STACKING COMMISSIONING

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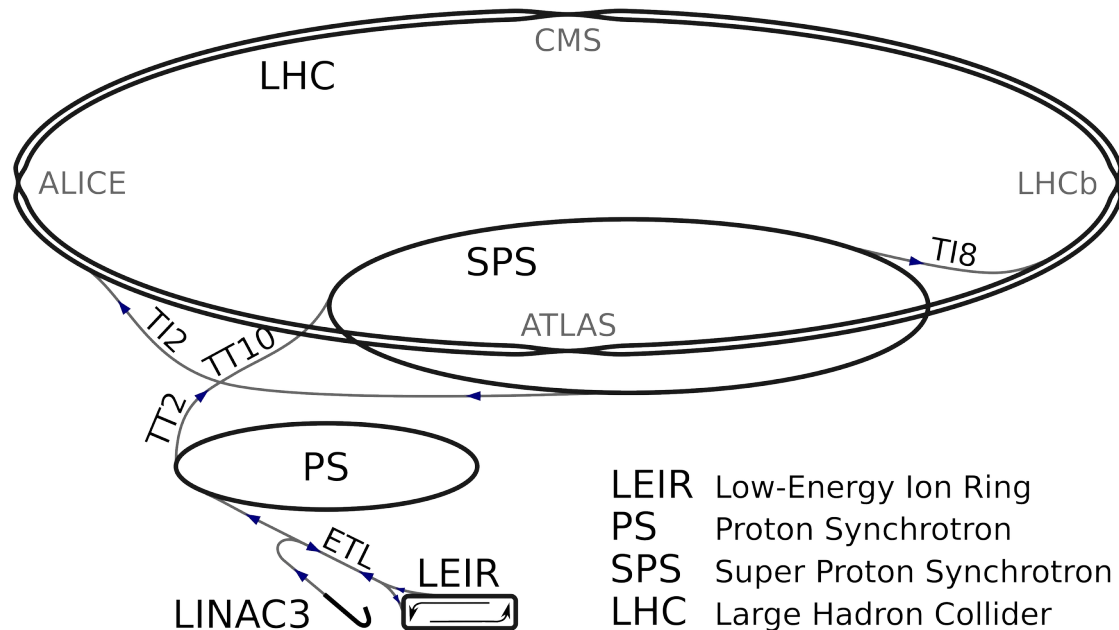
# CERN ion injector complex

## Linac3

- Source: Pb29+
- Stripping to Pb54+
- 4.2 MeV/n

## LEIR

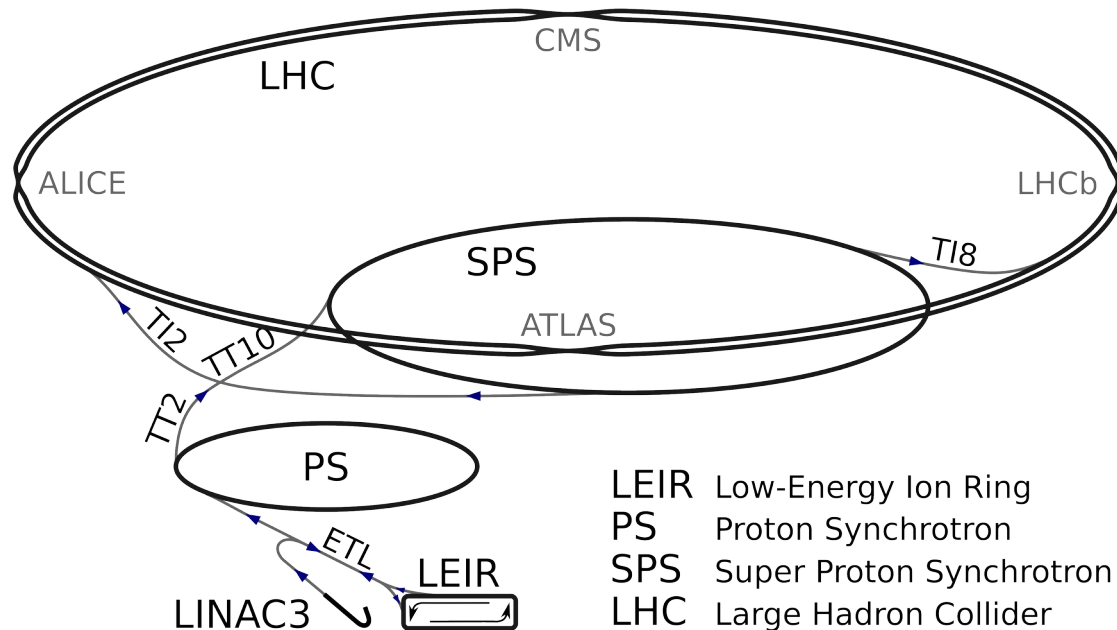
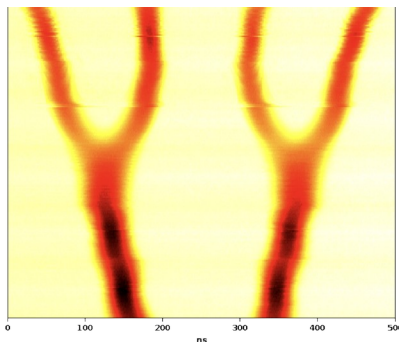
- Accumulation of seven 200  $\mu$ s-long pulses from Linac3
  - Electron-cooling
  - Multiturn injection
- RF capture: 2b
- Acceleration to 72 MeV/n



# CERN ion injector complex

## PS

- Bunch splitting ( $2b \rightarrow 4b$ )
- Bunch separation at extraction: 100 ns
- 6 GeV/n

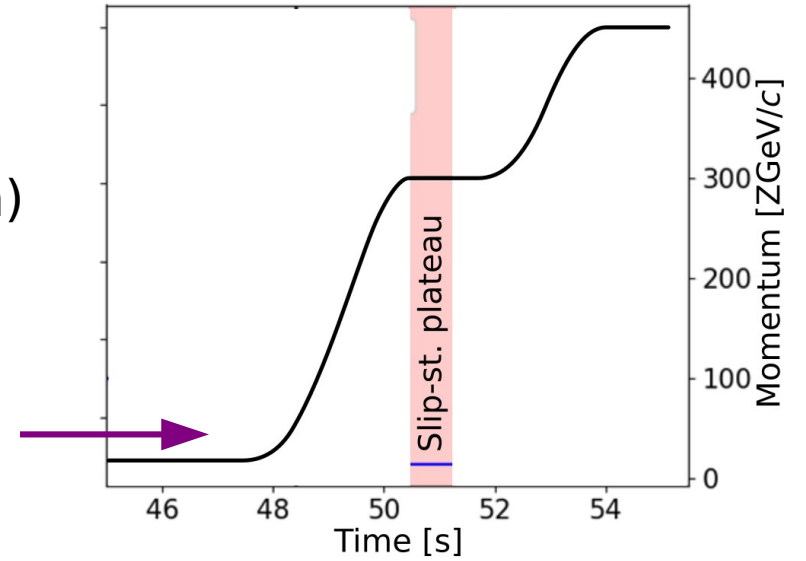


## SPS

- Long injection plateau: 48 s
- 14 injections from PS
- Slip-stacking
- Bunch separation at extraction: 50 ns

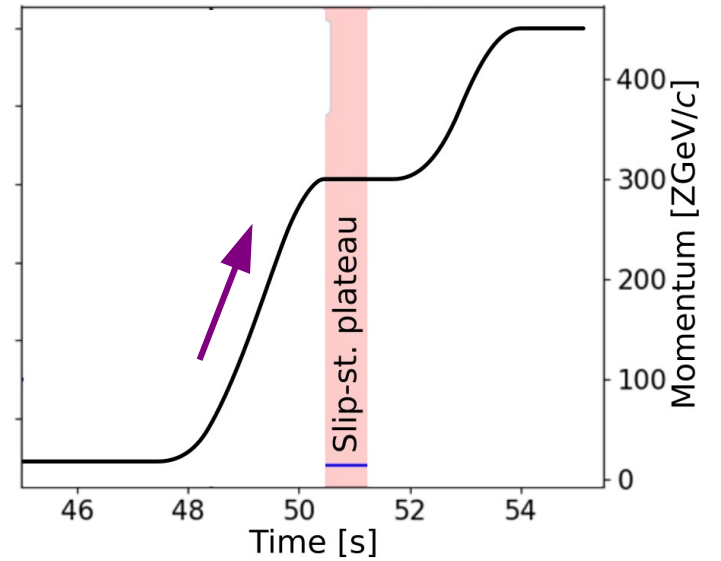
# SPS Slip-stacking

- Injection of 14 PS batches (4 bunches each)



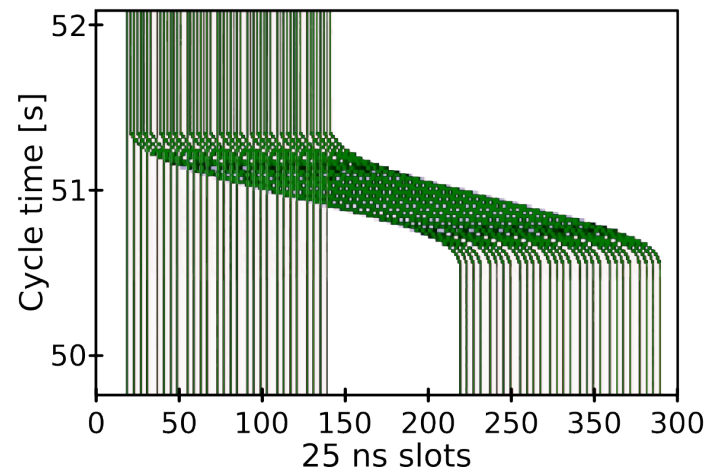
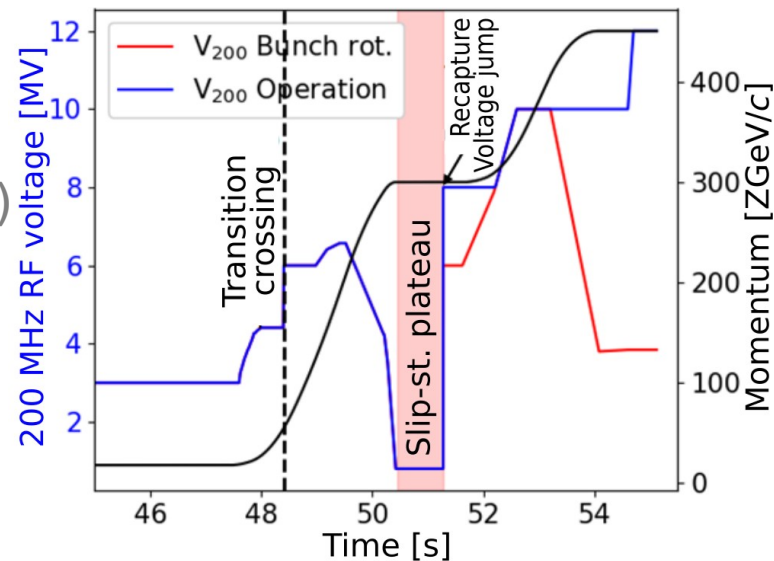
# SPS Slip-stacking

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- Ramp up to intermediate slip-stacking plateau



# SPS Slip-stacking

- Injection of 14 PS batches (4 bunches each)
- Ramp up to intermediate slip-stacking plateau
- Two particle beams of different momenta and different RF frequencies slip longitudinally relative to each other in the same beam pipe
- When the two beams are in the correct longitudinal position, the full beam is recaptured with a non-adiabatic voltage jump at the average RF frequency
  - Extracted bunch spacing is 50 ns



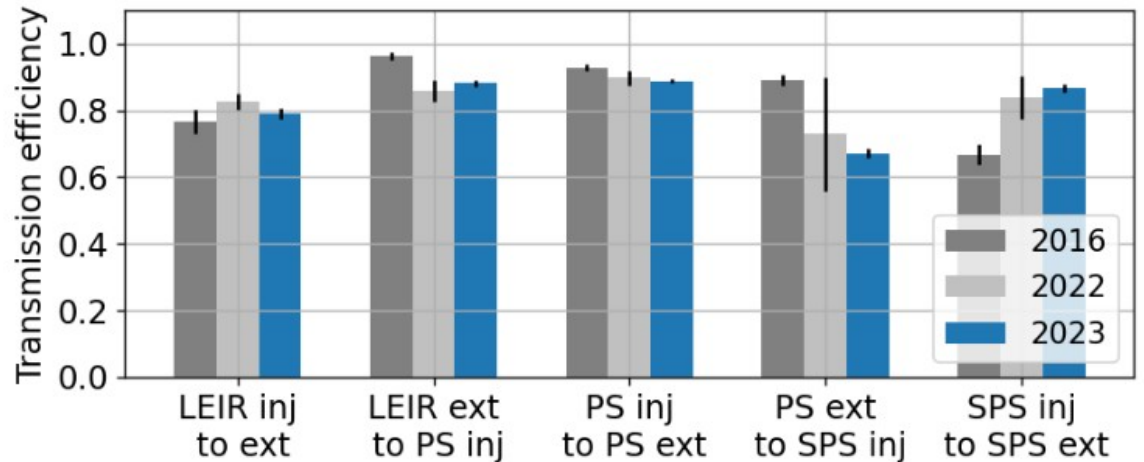
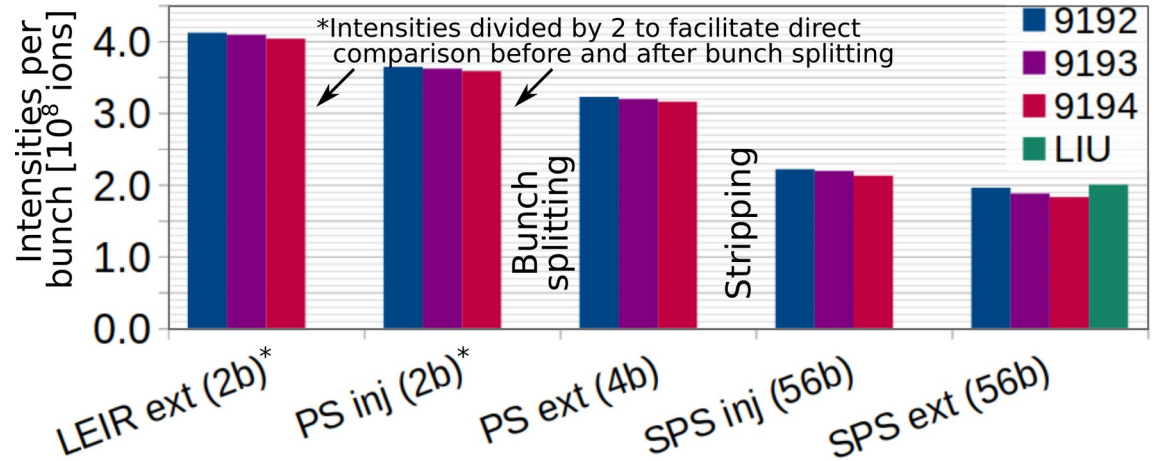
# Performance

## Intensity per SPS-equivalent bunch in the first three LHC fills of 2023 ion run

- Beam scraping at SPS due to limitation of the LHC injection system
  - Extracted intensity slightly below LIU
- Most losses between PS ext and SPS inj
  - stripping and long injection plateau

## Transmission

- Consistent across the years: 2016, 2022 and 2023
- 2023: average of the first 3 LHC fills
- PS extraction to SPS injection data from 2016 used DC BCT (incl. unbunched beam); following years used Fast BCT



# Let's meet at the poster session!

## Follow-up topics

- LEIR performance issues
- SPS slip-stacking details
- Emittance across the complex





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