



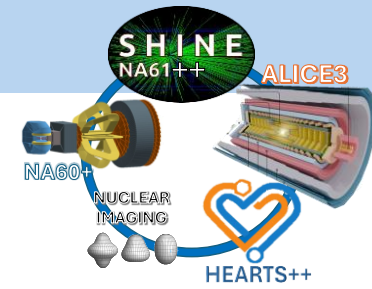
Exploring future ion operation: 25 ns ion bunch spacing MD & summary of ions MD 2025/2026

IPP MD days 2025

On behalf of the FUTURE IONS Working Group
(created in 2023)

In collaboration with PBC

Motivation: post-LS3 Diversity Programme



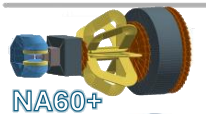
Proposals, not approved yet (except LHC ions in Run 4&5*)

| | | | | | | | | | |
|----------------------------------|------------------------------------|------------------------------------|--|------------------------------------|--------------------------------------|-------------------------------------|--------------------------------------|------------------------------------|----------------------------------|
| 5 B Boron 10.811 | 8 O Oxygen 15.9994 | 10 Ne Neon 20.1797 | 12 Mg Magnesium 24.305 | 18 Ar Argon 39.948 | 20 Ca Calcium 40.078 | 36 Kr Krypton 83.80 | 49 In Indium 114.818 | 54 Xe Xenon 131.29 | 82 Pb Lead 207.2 |
|----------------------------------|------------------------------------|------------------------------------|--|------------------------------------|--------------------------------------|-------------------------------------|--------------------------------------|------------------------------------|----------------------------------|

SHINE
NA61++



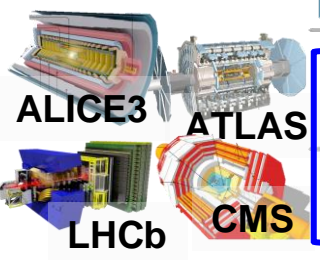
SPS NA
Run 4



Run 5 LHC



A >> Lnn >> Run 5



NUCLEAR
IMAGING



Pilot runs



PS fixed target
15' switch 4 species

**GAMMA
FACTORY**



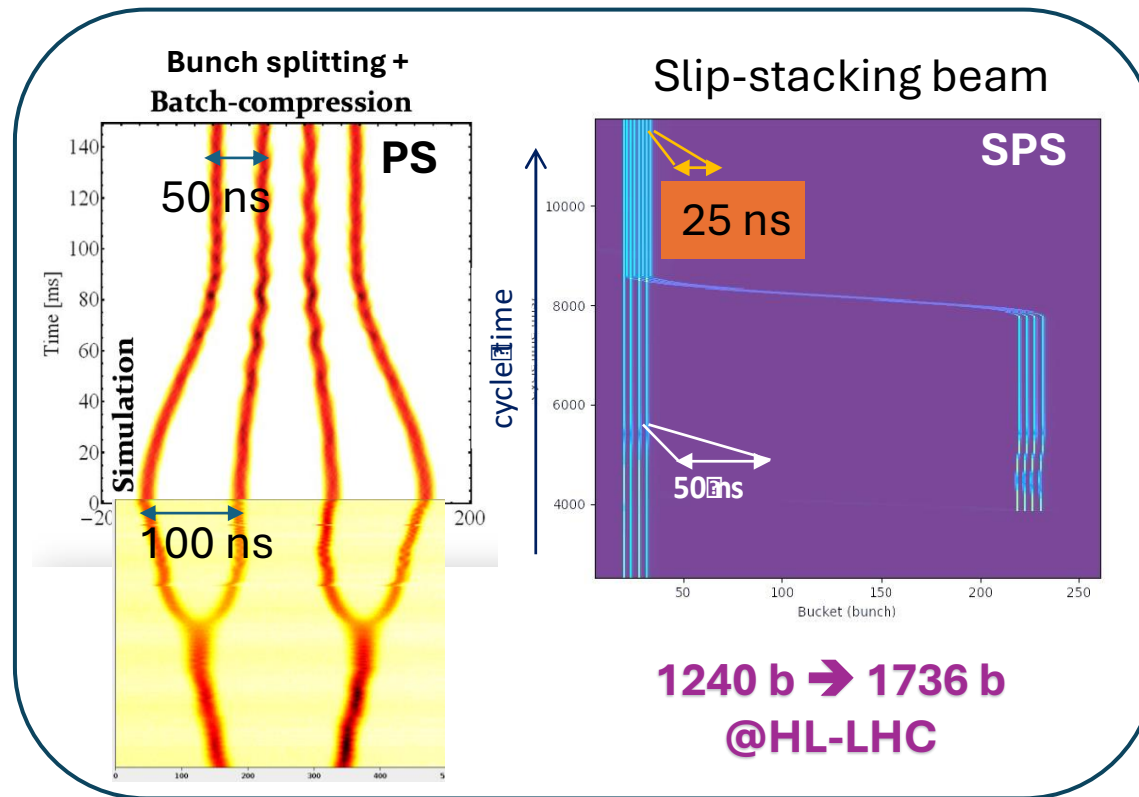
SPS PoP

★ Tested and validated
 ★ Tested, need another test
 ★ Untested

Ion Complex Upgrade (ICU) Proposal



- **DELIVERABLE 4: 25 ns bunch spacing at LHC**
 - Increase LHC luminosity → 1240 to 1700 bunches



PS Baseline: 2 x 2b 50 ns

PS Optimized: 2 x 3b 50 ns

Upgrade of **PS RF system** with two new RF cavities for 50 ns batch compression

25 ns ion bunch spacing MD



- 2025 we propose to test this schema with 2 bunches separated 50 ns out of PS, followed by slip-stacking in SPS to get down to 25 ns bunch separation

- Beam production:

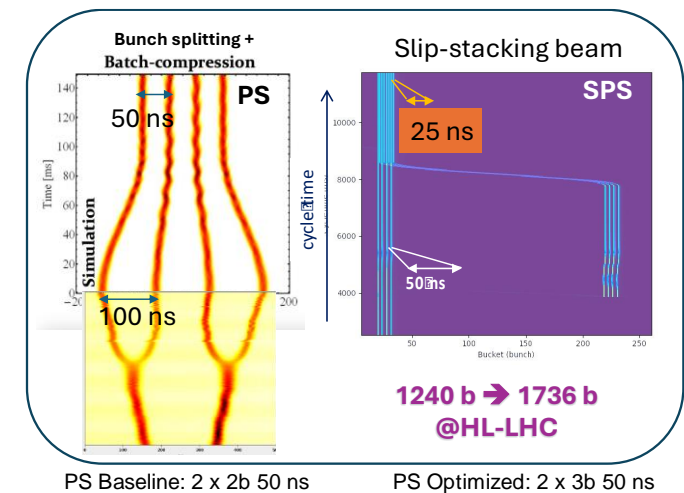
- LEIR NOMINAL beam 2b separated 200 ns
- PS batch compression to 50 ns with $h=21 \rightarrow 21+7 \rightarrow 42$
- SPS slip stacking from 50 ns to 25 ns

- Objectives:

1. PS & SPS MD

2. LHC MD with 2b 25 ns

- Beam life-time
- Transverse and longitudinal emittance
- Transmission efficiency along the cycle



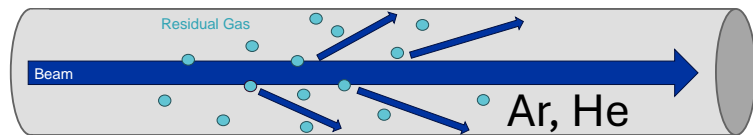
- Obtain data to compare with **4 b 25 ns (baseline)** & **6 b 25 ns (optimize)** in the future
- Ultimately address LHC experiments capability to take data with 25 ns in case upgrade is needed during LS4 to cope with
 - H. Damerou & A. Lasheen (SY/RF)
 - E. Waagaard, H. Bartosik, R. Bruce, R. Alemany (BE/ABP)
 - T. Argyropoulos, LEIR, PS, SPS, LHC OP teams

2025-2026 ions MD wish proposal



Elias Waagaard 03.02.2025 covered Lead & Oxygen MDs

PS beam-gas interaction cross section measurements



$^{208}\text{Pb}^{54+}$ (2022-2024)

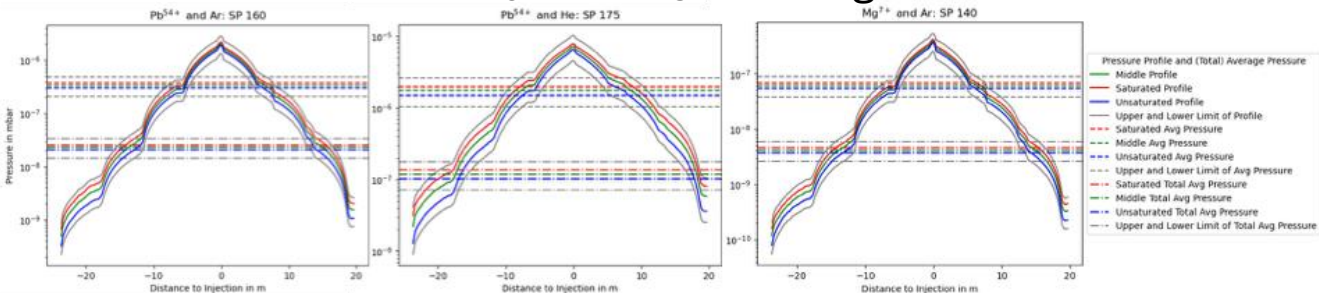
$^{24}\text{Mg}^{7+}$ (2024)

$^{16}\text{O}^{4+}$ (2025)

$^{208}\text{Pb}^{54+} \rightarrow \text{Ar}$

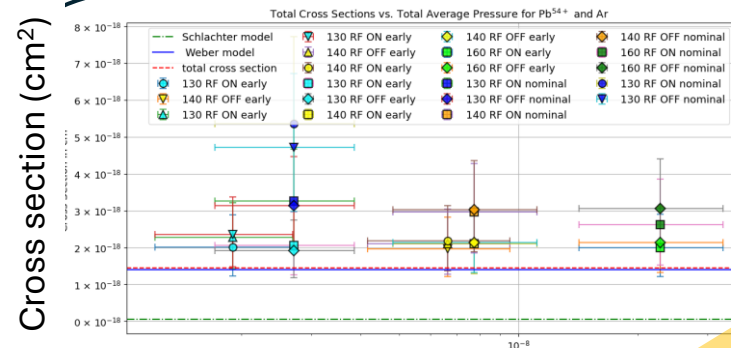
$^{208}\text{Pb}^{54+} \rightarrow \text{He}$

$^{24}\text{Mg}^{7+} \rightarrow \text{Ar}$

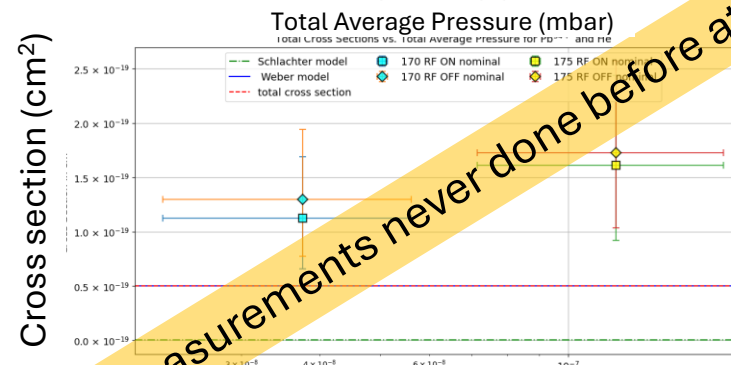


Very detailed simulations of the pressure bump done by TE/VSC

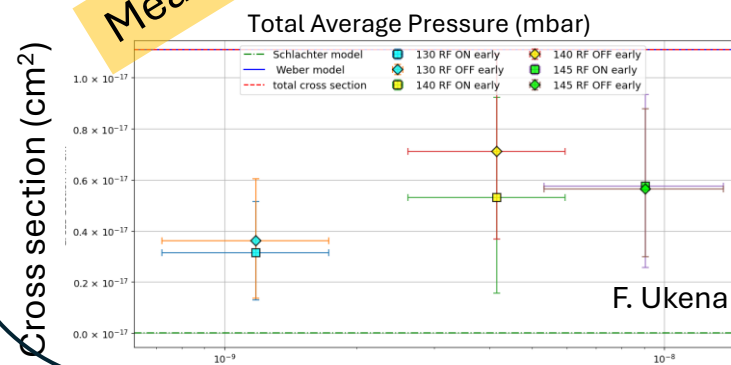
- J. Ferreira Somoza & F. Ukena (TE/VSC)
- G. Weber (GSI)
- E. Waagaard & H. Bartosik & R. Alemany (ABP)
- PSOP team



$^{208}\text{Pb}^{54+} \rightarrow \text{Ar}$



$^{208}\text{Pb}^{54+} \rightarrow \text{He}$



$^{24}\text{Mg}^{7+} \rightarrow \text{Ar}$

F. Ukena

Measurements never done before at this energies