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Achievement of LIU longitudinal parameters at the CERN SPS

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To prepare the Super Proton Synchrotron (SPS) as an injector for the High Luminosity Large Hadron Collider (HL-LHC), its Radiofrequency (RF) system was majorly upgraded. The 200 MHz travelling wave structures were rearranged, adding two solid-state power amplifiers and a new Low-Level RF (LLRF) system. The increase in RF power and reduction of the beam coupling impedance at the fundamental frequency were designed for capture and acceleration of four trains of 72 bunches spaced by 25 ns at an intensity of 2.3×10^{11} protons per bunch with bunch lengths of $1.65 \text{ ns} \pm 10\%$ at SPS extraction. These beam parameters have first been demonstrated in 2024 after careful optimisation of all the main longitudinal settings: voltage program at fundamental and higher harmonics, interplay of one turn-delay feedback, feedforward and longitudinal damper, as well as controlled emittance blow-up. This contribution details the achieved beam parameters and the conditions that allowed them, along with the encountered limitations.

Footnotes

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