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Investigating ion beam loss mechanisms at the SPS flat bottom

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The long injection segment (flat bottom) of the cycle in the Super Proton Synchrotron (SPS) used for filling the Large Hadron Collider (LHC) with Pb ion beams, exhibits strong beam losses and transverse emittance growth. During the 2024 run, large improvements of the beam transmission could be made such that record intensities could be delivered to the LHC. In particular, these improvements were enabled by operational measures such as working point optimization and a numerical compensation scheme for the 50 Hz ripple from the main quadrupole power converters. This paper provides a summary of these improvements, and presents recent advancements in particle tracking simulations of the SPS flat bottom, including effects such as intra-beam scattering and space charge in the presence of tune modulation induced by power converter noise. These simulations are compared with transverse and longitudinal beam measurements. The relative importance of each effect and their estimated impact on the future ion programmes at CERN are discussed.

Footnotes

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