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Predicting losses in the SPS using longitudinal tomography during bunch shortening in the PS

Wednesday 4 June 2025 16:00 (2 hours)

The efficient transfer of protons from the Proton Synchrotron (PS) to the Super Proton Synchrotron (SPS) is crucial for beams in the Large Hadron Collider (LHC). A particular challenge at the intensities required for the High-Luminosity LHC is the handover from a 40 MHz to a 200 MHz RF system. This requires a non-adiabatic bunch shortening in the PS triggered by a fast RF voltage jump. However, nonlinearity of the synchrotron frequency distribution causes tails to emerge during rotation, resulting in uncaptured beam in the SPS. The uncaptured particles lost at the start of acceleration in the SPS, and the additional flat bottom losses, can currently only be evaluated with the beam intensity and loss monitors. In this work, detailed studies of the bunch rotation in the PS were carried out both in simulations and in measurements. A tomography-based tool was developed to predict uncaptured losses in the SPS from bunch profile measurements in the PS during bunch shortening. This tool enables detailed monitoring of the PS-to-SPS transfer of LHC-type beams by identifying potential losses due to uncaptured beam, before injection into the SPS.

Footnotes

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