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Effects of dipole power converter ripple during empty-bucket channelling

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In 2023, an RF technique known as empty-bucket channelling was implemented operationally at the CERN Super Proton Synchrotron (SPS) to improve the quality of the spill provided to the North Area experiments. Empty-bucket channelling suppresses particle-flux variations during resonant slow extraction by accelerating particles between empty RF buckets and rapidly displacing particles into the tune resonance via chromatic coupling. The flux variations are often caused by the power converter ripple present in the synchrotron's magnets, which modulates the beam dynamics during the extraction process. In a chromatic extraction, the quadrupole ripple is the main contribution to the modulation as it directly perturbs the transverse tune. When empty-bucket channelling is applied, however, dipole ripple additionally modulates the size of the empty RF bucket. In this contribution, the phenomenon is explored and the consequences for empty bucket channelling in the SPS are outlined.

Footnotes

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