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Thresholds of longitudinal multi-bunch instabilities in double harmonic RF systems

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Multi-bunch instabilities, often driven by narrowband impedance sources such as higher-order modes, present significant intensity limitations in synchrotrons. One approach to mitigate these instabilities is applying a double harmonic radio frequency (RF) system, which can increase the intensity threshold by enlarging the synchrotron frequency spread. In this study, intensity thresholds are calculated for different RF parameters using stability diagrams derived from the Lebedev equation. We analysed configurations and beam characteristics relevant to the synchrotrons at CERN, particularly focusing on the Super Proton Synchrotron (SPS). The semi-analytical results were then compared to macroparticle simulations and measurements. The findings reveal an unexpected beam stabilisation even if a non-monotonic amplitude dependency of the synchrotron frequency is present. Further, techniques for deducing the driving impedance parameters are discussed.

Footnotes

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