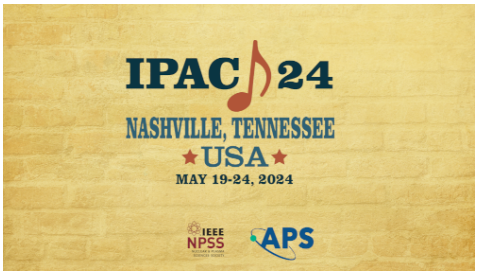

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Bunch-by-bunch simulations of beam-beam driven particle losses in the LHC

Sunday, 19 May 2024 16:00 (2 hours)

Recent experimental measurements in the Large Hadron Collider (LHC) have shown a clear correlation between beam-beam resonance driving terms and beam losses, with a characteristic bunch-by-bunch signature. Due to the encounter schedule of the different bunches as they cross the interaction points, it is known that different bunches experience different long-range interactions with bunches of the other beam. This creates interesting conditions to study particle stability. Over the past few decades, early chaos indicators, frequency map analysis and dynamic aperture studies have been commonly used to study particle stability in circular machines. However, the underlying mechanisms driving particles to large amplitudes in the presence of high order resonances is still an open question. In preparation for the High-Luminosity upgrade of the LHC and other future circular colliders, a better understanding of slow particle losses is needed, alongside possible compensation schemes to reduce strong nonlinearities. Leveraging on years of development on particle tracking tools, this paper presents full-fledged bunch-by-bunch beam loss simulations in the LHC and shows the evolution of macroscopic observables for the beam over a time scale of 30 minutes (2e+7 turns). The experimental observations from LHC Run 3 are reproduced and compensation schemes are proposed.

Footnotes

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