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Interplay of local linear coupling and beam-beam effects on luminosity

Monday 2 June 2025 16:00 (2 hours)

With the LHC achieving luminosity precision at the percent level, accounting for linear coupling becomes crucial. This effect is caused by skew quadrupoles and can be studied during van der Meer (vdM) scans performed for absolute luminosity measurements and detector calibration. A bias is induced as the nonlinear beam-beam force and the linear coupling makes the charge distribution of the beam non-factorisable, impacting the luminosity overlap integral calculation. Simulations utilising the Xsuite beam dynamics code implements an artificial local coupling using two skew quadrupoles of opposite strengths, adopting a realistic beta factor scaling around the IP. The results suggest that linear coupling impacts the beam profiles and introduces changes to the phase spaces. Additionally, studying this effect could help understand the beam shapes and the generation of non-factorisation in the luminous region observed in beam imaging studies done at the CMS and LHCb experiments at CERN.

Footnotes

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