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Benchmarking the LHC impedance model through loss of Landau damping measurements and simulations

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Refining the present longitudinal impedance model is essential for an accurate prediction of beam stability thresholds. Longitudinal loss of Landau damping (LLD) for single bunches has been observed in the Large Hadron Collider (LHC). For High Luminosity (HL-) LHC beams, the present stability margin is aimed to be maintained. While coupled-bunched instability has not been detected in the LHC so far, it may become an issue under HL-LHC parameters. Recent studies have shown that broad-band impedance contributions and their cut-off frequencies affect the LLD threshold, whereas the narrow-band high order modes can give rise to coupled-bunched instabilities. In this contribution, results from the analysis of the machine development studies of 2024 are presented and compared to macroparticle tracking simulations, as well as LLD threshold predictions using semi-analytical solvers. Their discrepancies are discussed, and potential sources are investigated.

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