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Study of the Transverse Mode Coupling Instability in the CERN LHC

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A fast single bunch instability can occur when two transverse oscillation modes couple at high bunch intensity. In the Large Hadron Collider (LHC), simulations using the impedance model predict an instability threshold at $3e11$ protons per bunch. In the framework of the High-Luminosity upgrade of the accelerator (HL-LHC), the individual bunch intensity would be close to this threshold, and therefore, to prevent coherent beam instabilities, an impedance reduction is foreseen.

In order to quantify the present LHC TMCI threshold and the beneficial effect of the impedance reduction, the current machine TMCI threshold was inferred from beam based measurement and compared to simulations. The HL-LHC reduced impedance was also emulated relaxing the LHC machine collimators settings and the increase in TMCI threshold was confirmed.

These measurements, associated with others using various methods during the 2015-2018 period, allowed assessing the accuracy of the present LHC impedance and stability model.

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