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Beam impedance investigation of the elliptical interconnecting vacuum modules of the LHC and prospect for HL-LHC

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In view of ensuring the successful completion of the third operational run of the Large Hadron Collider (LHC) and preparing for the High-Luminosity LHC era, a systematic assessment of the risk of failure of all the vacuum interconnection modules installed in the accelerator is being carried out. This was prompted by a significant pressure rise in 2023, localized near an interconnection module (212 mm inner diameter) caused by a localized impedance-induced heating on the tension spring. This led to degradation and loss of electrical contact of the Radiofrequency (RF) sliding fingers. The studies include the evaluation of the various modules currently present in the LHC, alongside the description of a mitigation strategy. In this paper, we focus on the study of elliptical vacuum modules both from the point of view of electromagnetic simulations and of experimental validation. We report also on the general strategy where the most critical vacuum modules with sliding contact RF fingers, featuring tension springs, will be replaced with upgraded designs to avoid issues and therefore ensure improved reliability under future operational conditions with higher bunch intensities.

Footnotes

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