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Analysis of losses and emittance growth in the 2024 LHC run and correlation with Dynamic Aperture

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This paper presents observations collected during the LHC operation with proton beams in 2024. In particular, a systematic analysis of the beam and machine parameters along the run reveals that the emittance evolution at the LHC injection plateau and during collisions cannot be fully explained by Intra-Beam scattering, synchrotron radiation and electron cloud effects, thus indicating that some beam dynamics effects are missing in the models. During the collapse of the separation bumps, a significant drop in beam lifetime is observed due to the reduction of Dynamic Aperture as the separation reduces and the machine enters into a beam-beam dominated regime. The correlation of beam lifetime in operation and Dynamic Aperture in simulations is demonstrated. Furthermore, a strong correlation is identified between this lifetime reduction and the population of non-Gaussian tails in the transverse beam profiles. The paper also includes the observation of high-frequency power supply ripple in the beam spectrum.

Footnotes

Paper preparation format

Region represented

Europe

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