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Impact of Crab Cavity RF noise on the transverse beam profiles in the HL-LHC

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Crab Cavities (CCs) are a key component for the HL-LHC luminosity upgrade. To significantly reduce the Long-Range Beam-Beam (LRBB) effects a large crossing angle scheme is needed. The installation of 4 CCs per beam in each of the two main interaction points aims to restore the luminosity loss caused by the crossing angle. Noise injected through the Low-Level RF (LLRF) system in these cavities is known to be affecting the growth of the transverse bunch emittance. In this paper a new numerical study has been developed thanks to the new tracking tool Xsuite to study in depth this detrimental effect of both phase and amplitude LLRF noise. Both Long Range and Head On Beam Beam effects are included in the simulation together with the CC noise to evaluate the effects of the interplay between these strong non-linearities and the external noise. Furthermore, transverse bunch measurements show that the transverse distribution can be modeled as an heavy tailed q-Gaussian. To take this into account a particular focus is given to the linear matching and subsequent tracking of a multivariate q-Gaussian distribution in the lattice. The Emittance Growth Rate induced on both a Gaussian and a q-Gaussian bunch is computed. This study could serve as a basis to evaluate the cross-talk between the two beams introduced by their head-on interaction in this heavy tailed scenario.

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Footnotes

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Yes

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