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Comprehensive study of Robinson instability in active and passive higher harmonic cavities for bunch lengthening

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Higher harmonic cavities (HHCs) play a critical role in storage rings by extending the bunch length, thus mitigating beam instability and increasing the beam lifetime. This study investigates the influence of Robinson instability on the bunch lengthening performance for both active and passive HHCs. A detailed comparison is conducted to analyze the Robinson instability thresholds*and the parameters of the HHCs** that govern the onset of instability. Simulation results and theoretical analysis are combined to provide guidelines for optimizing HHCs configurations to balance effective bunch lengthening with stability requirements. As illustrative examples, we consider an active normal-conducting HHC for Korea-4GSR , and a passive superconduting HHCs for PLS-II.

Footnotes

*T.He et al., Mode-zero Robinson Instability in the presence of passive superconducting harmonic cavities.**A. Gamelin et al., Beam dynamics with a superconducting harmonic cavity for the soleil upgrade.

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