



Contribution ID: 409 Contribution code: MOPS39

Type: **Poster Presentation**

Formulas of coherent synchrotron radiation induced microbunching instability in an arbitrary four-dipole chicane bunch compressor

Monday, 20 May 2024 16:00 (2 hours)

Almost all linac-based free-electron laser (FEL) facilities have employed a symmetric three- or four-dipole chicane to compress the electron beam in order to achieve a kA-level bunch current. The achromatic C-type chicane has been widely used in present linac-FEL facilities. Coherent synchrotron radiation (CSR) induced microbunching instability (MBI) can be an issue in the chicane design. Recently a novel design of non-symmetric four-dipole chicane has been proposed to effectively mitigate the CSR-induced emittance growth. In this work we derive an analytical formula of the CSR-induced microbunching gain in a generic four-dipole chicane based on the iterative approach. The formulas have been benchmarked against semi-analytical Vlasov calculation, applied for a quick estimate of CSR-induced MBI for a generic four-dipole achromatic chicane beamline, and can be used to verify the effectiveness of suppressing MBI in a non-symmetric S-type four-dipole bunch compressor chicane.

Footnotes

Funding Agency

This work is supported by the Fundamental Research Funds for the Central Universities (HUST) under Project No. 2021GCRC006 and National Natural Science Foundation of China under project No. 12275094.

Paper preparation format

LaTeX

Region represented

Asia

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Session Classification: Monday Poster Session

Track Classification: MC5: Beam Dynamics and EM Fields: MC5.D05 Coherent and Incoherent Instabilities Theory, Simulations, Code Development