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Computational analysis of shielding on the coherent synchrotron radiation generated by a 3D bunch

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The analysis and mitigation of collective beam effects, such as coherent synchrotron radiation (CSR), is a significant challenge in the generation of high-brightness beams. To this end, considerable effort has been invested in the development of simulation tools to accurately characterize the CSR generated by a bunch following a curved trajectory. In particular, with codes like LW3D and CoSyR, it is possible to model the CSR wake due to an evolving 3D bunch distribution in free space with minimal approximation. Recently, we have developed a simulation tool that self-consistently characterizes CSR through direct computation of the Liénard–Wiechert fields while accounting for the presence of shielding walls. In this work, we use this method to study the CSR shielding effect on a complex bunch moving through both a single dipole and a bunch compressor, with particular emphasis on the boundaries of validity of 1D theory in predicting the phase space evolution. This work is part of a broad effort to investigate the impact of shielding both theoretically and through a series of planned experiments at the Argonne Wakefield Accelerator (AWA).

Footnotes

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