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Quantum Diffusion Due to Coherent Radiation

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Quantum diffusion is caused by the recoil effect that a particle experiences when it emits a photon [1]. Quantum diffusion due to the synchrotron radiation in high-energy electron and positron circular accelerators defines the main parameters of the beam: its energy spread and hence the bunch length, as well as the horizontal emittance. It is calculated as a single particle effect assuming incoherent radiation. This assumption is not valid in FELs where the radiation is coherent. In this work, we develop theory of the quantum diffusion in coherent radiation and show that it leads to the energy diffusion of the particles that is correlated between the different positions in the bunch.

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