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Active Control of the Energy Chirp of a Relativistic Electron Beam

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Many applications in modern accelerators require short electron bunches with high peak current. To achieve this high current, a large energy chirp must be imposed on the bunch so that the electrons are compressed when they pass through a chicane. In existing linear accelerators, this energy chirp is imposed by accelerating the beam off-crest from the peak fields of the RF cavities, thereby reducing the average accelerating gradient. It is a cost-inefficient solution that results in an increase in the facility footprint and reduced beam quality A promising solution, known as the Transverse Deflecting Cavity Based Chirper (TCBC) [1], presents an alternative method for actively imposing a substantial energy chirp onto an electron beam in an accelerator, without the need for off-crest acceleration. The TCBC consists of 3 transverse deflecting cavities, which together impose an energy chirp while canceling out the transverse deflection. An experiment is being developed to validate this concept at the Argonne Wakefield Accelerator (AWA) facility. Here, we explain the concept, show preliminary simulations, and report on progress related to the implementation of the experiment at AWA.

Footnotes

[1] N. Yampolsky, E. I. Simakov, and A. Malyzhenkov, "Imposing strong correlated energy spread on relativistic bunches with transverse deflecting cavities,"Phys. Rev. Accel. Beams 23, 054403 (2020).

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