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Active control of the energy chirp of a relativistic electron beam at the Argonne Wakefield Accelerator

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A very high electron peak current is needed in many applications of modern electron accelerators. To achieve this high current, a large energy chirp must be imposed on the bunch so that the electrons will compress when they pass through a chicane. In existing linear accelerators (LINACs), this energy chirp is imposed by accelerating the beam off-crest from the peak fields of the RF cavities, which increases the total length and power requirements of the LINAC. A novel concept known as the Transverse Deflecting Cavity Based Chirper (TCBC) [1] can be used to actively impose a large 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 cancelling out the transverse deflection. An experiment is being developed to demonstrate this concept at the Argonne Wakefield Accelerator (AWA) facility. Here we explain the concept, show preliminary simulations of the experiment, and report on progress related to 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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