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Modeling of standing wave RF cavities for tracking through multi-pass energy recovery linac

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Short bunches, high current and multiple linac pass are all characteristics of Energy Recovery Linacs (ERLs), which may result in collective effects. They in turn, may affect the beam, degrading its quality, or even yield to instabilities causing a beam loss. To study and mitigate these effects one needs a numerical simulation code, that can take into account both the collective effects, as well as, particular ERL features, such as a multi-turn design that does not reach a steady state or the multiple passages of the beam through Radio-Frequency (RF) cavities at different energies. CODAL [1], a code developed by SOLEIL in collaboration with IJCLab, enables such studies. It is a 6 dimensional (6D) tracking code applying 'kicks' based on the integration of the local Hamiltonian for each element of the lattice. It is also capable of simulating space charge, wakefields and coherent synchrotron radiation.
However, to correctly take into account the ERL dynamics, an upgrade had to be made to include the effect of a standing wave RF cavity in 6D. In this paper, we will concentrate on the implementation and benchmarking (with DESY's tracking code ASTRA [2]) of both the longitudinal and the transverse models (by J.B. Rosenzweig and L. Serafini [3]), which we use to carry out tracking of fully analytical 6D RF cavity.

Funding Agency

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Footnotes

[1] Alexis Gamelin. Collective effects in a transient microbunching regime and ion cloud mitigation in ThomX. *Theses, Université Paris-Saclay*, September 2018.

[2] Klaus Floettmann. Astra space charge tracking algorithm version 3.2 march 2017, 2017.

[3] J.B. Rosenzweig and L. Serafini. Transverse particle motion in radio-frequency linear accelerators. *Physical review. E, Statistical physics, plasmas, fluids, and related interdisciplinary topics*, 49:1599–1602, 03 1994.

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