

The Study of Stability of Compensated Colliding Beams

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The luminosity of a collider is proportional to the particle density in a beam. The focusing electric field of a colliding beam restricts the particle density, so the particle density of a beam degrades, so the luminosity does.

Non-linear focusing compensation in a storage ring done by the opposite-charge beam circulating in another storage ring was proposed and tested many years ago. [1]. Ya. S. Derbenev has shown that such a scheme does not allow the significant improvement of luminosity [2]. However, the state of the art accelerator technology has made great progress, and a new type of accelerator has appeared –the energy recovery linac.

In this work, the stability of coherent betatron oscillations is considered in a simple model of rigid bunches. In particular, the “figure-8” collider with electron-positron beams of equal currents, but different energies, colliding at zero angles, is considered. Another scheme to be considered is the collider based on electron energy recovery linac (ERL) and “figure-8” positron storage ring with beams of equal currents. Positrons are circulating in a two-loop storage ring (positron-positron collider), and the electron-electron collider uses ERL, as in original Tigner’s proposal [3]. Thus, a collision of four bunches and space-charge compensation in a multi-bunch mode can be ensured. The mathematical and numerical analysis of these configurations is presented.

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2. Derbenev Ya. S. Collective instability of compensated colliding beams / Ya. S. Derbenev // Proc. of the 3rd All-union Conf. on Charge Particle Accel., Moscow, 1972, pp. 382-385. SLAC TRANS-151, 1973.
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