Estimations of Maximal Yield and Polarization in Positron Sources

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Sources of polarized positrons for ILC should produce intensive positron bunches with high degree of polarization. The cross section of Compton scattering is sufficiently low, therefore with the most powerful lasers available now expected intensity of the beams of gammas (back-scattered laser photons) is lower than from undulator-based sources.
From the other hand, the beams of gammas produced in Compton rings with energy of electrons of a few GeV allow one to control the energy spectra by collimating these beams.
In the first section of the report, there are considered the dynamics of electrons circulating in a storage ring and interacting with a powerful laser pulse. Aiming at maximal yield of gammas, requirements on the ring lattice formulated. The most suitable for positron source is the ring with low linear compaction factor, nil second order, and sufficiently high third order momentum compaction factors. The proposed phase manipulation scheme can enhance yield of gammas but requires large energy acceptance of the ring. As shown in simulations, the Compton rings are able to produce about 0.6 gammas per electron-turn in short trains (50 to 100 turns).
In the second section, there are considered an idealized model of positron production in the convertors exposed to the gamma-beams. As is shown, proper collimated beams of gammas can produce desirable amount of positrons with high degree of polarization. Also collimated gammas reduce energy load in the converter target. Several schemes of enhancement of the positron beam qualities such as energy spectrum and angular spread are listed.
A conclusion follows from the estimations that Compton ring based positron sources is able to produce required amount of positrons with a high degree of polarization.