Lattice design for Compton ring

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Abstract

In ILC, for physical motivations, polarized positrons and electrons are requested. A method to obtain polarized positrons is to use a Compton ring (CR). In the CR, Compton interaction between unpolarized electrons beam and polarized laser, produces polarized photons, that impacting on a target, produce polarized positrons.

A lattice for the CR has been calculated in order to perform beam dynamics calculations. To achieve low emittance it has been adopted the TME (Theoretical Minimum Emittance) lattice style, which also allows enough flexibility in the choice of the momentum compaction, a critical parameter for the interaction of the electron beam with the laser cavity. The lattice parameters have been designed in order to satisfy the requirements given in the Snowmass proposal [1]. To decide the optimal number of cells for the lattice we have calculated emittance and momentum compaction in different cases. After these preliminary studies it has been chosen a lattice with 60 cells.

We have considered different kinds of lattice with or without wigglers and at different ring energies (1.3 or 1.6 GeV). The Touschek lifetime has been calculated for the various cases and the result, due to the rather low beam energy and the high bunch density, is of the order of few minutes. In order to achieve a reasonable Touschek beam lifetime it is recommended to increase the beam energy above 1.3 GeV and to insert wigglers in the ring. Due to the high current and high bunch density required for this ring all the collective effects should be evaluated: in particular the possible emittance growth due to intrabeam scattering, bunch lengthening and fast ion instability.

To study the Compton interaction (scattering beam-laser) it has been written a simulation code for the longitudinal dynamics of the single bunch, taking in account the synchrotron radiation effects and the linear Compton cross section. In the code it has been used a macro-particles model.