Positron Spin Rotation

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Spin Rotation Schemes at the ILC for Two Interaction Regions and Positron Polarization with both Helicities

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Helicity Selection for Positron Polarization between Pulse Train

- A promising method for generating polarized positrons at the ILC is to use a helical undulator to produce circularly polarized photons. The longitudinally polarized positrons are generated in a target. The direction of the longitudinally polarized positrons will not easily be changed from right- to left-handed longitudinally polarized positrons at the source.

- Randomly selecting the direction of the polarization vector of the positrons at the e+e- IR is important to minimizing systematic errors in the measurement of polarization asymmetries.

Positron Spin Rotation at Damping Ring

- A 5 GeV longitudinal polarized positrons is deflected in a bend system before they enter the solenoid system.

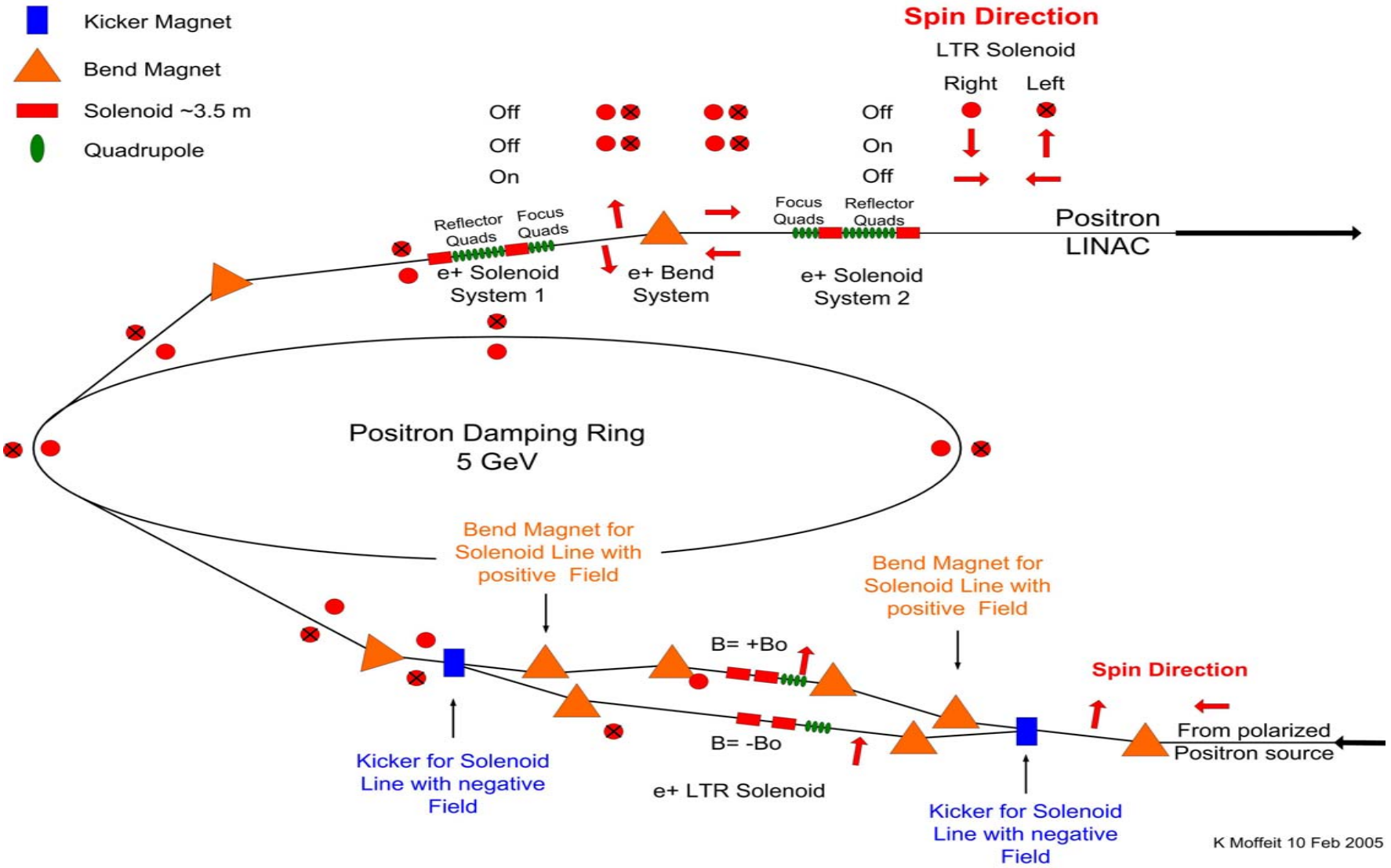
$$\theta_{spin} = \gamma \frac{g-2}{2} \cdot \theta_{bend} = \frac{E(GeV)}{0.44065} \cdot \theta_{bend}$$

•We find the electron spin component in the plane normal to the applied magnetic field will precess 90^o in that plane for every 7.9317^o of rotation of the momentum vector at 5GeV.

•An axial solenoid field integral of 26.2 Tesla-meters will rotate the spin direction parallel to the field of the DR, i.e., by 90^o.

$$\varphi^{spin} = \left[1 - \left(\frac{g-2}{2}\right)\right] \frac{\int B_z \cdot dl}{B_0 \rho} \approx \frac{\int B_z \cdot dl}{B_0 \rho} = 2\varphi^{orbit}$$

•Two half solenoids 3.5 meters in length with maximum field strength of 38.5 kilogauss will be used; each will rotate the spin by 45^o at a beam energy of 5 GeV. In the linac-to-ring (LTR) transfer line, the paired solenoids will be located after a bend of n*7.9317^o , where *n* is an odd integer.



Layout of positron damping ring system showing the parallel spin rotation beam lines for randomly selecting positron polarization direction. A pair of kicker magnets is turned on between pulse-trains to deflect the beam to the spin rotation solenoids with negative B-field.

- Some considerations for the parallel beam lines are:

- The chicanes for the parallel beam lines are in the horizontal plane, so there are no bends in the vertical plane, since the beam emittance is critical in that dimension.

- Path lengths for the parallel beams need to be almost equal, with any difference small compared to the bunch length. Path length correction chicanes can be added to the parallel beam lines, if necessary.

- The pair of kicker magnet can be powered in series from the same current source to minimize beam jitter entering the linac.