Coordinate System for the 20 mrad Crossing Angle Case of the ILC

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Abstract

Studies of the Very Forward Instrumentation of an International Linear Collider Detector should all be based on the same coordinate system. When these studies were started considering head-on or a 2 mrad crossing angle the detector system was axially symmetric. In the case of a 20 mrad crossing angle of the beamlines this does not hold true any more. The aim of this document is to define a global coordinate system to be used by all members of the FCAL collaboration. The use of this common coordinate system will facilitate the comparison of our results in the future.

1 Definition of the Coordinate System

During the FCAL workshop at TAU it was agreed, that the coordinate system obeys the rules:

- it is a righthanded one,
- it is centered at the nominal point of interaction (IP),
- with the y–axis pointing upward,
- with the z–axis pointing in the same direction as the e^-–beam (guineapig compatible),
- and with the x–axis being in the horizontal plane and thus pointing to the left.

Figure 1 summarizes the definitions so far.

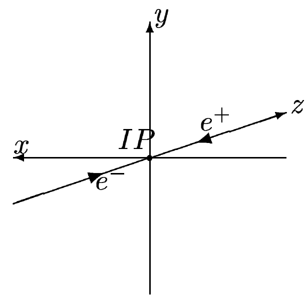

Figure 1: Overall definition of the righthanded coordinate system for ILC studies. The general direction of the incoming beams is drawn, which defines the orientation of the z–axis.

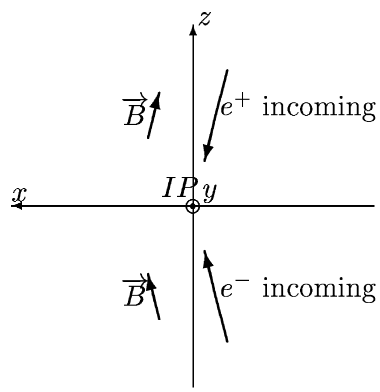

Figure 2: Top view of the suggested beamline orientation with positive x–component of the incoming particles' momenta in the case of a crossing angle α_x. The angle between the z–axis and the incoming beams is $\alpha_x/2$. The DID configuration of the magnetic field is indicated.

2 Beamline Orientation and Kink in the B Field

A similar discussion has now been started in the LDC collaboration, the successor of the TESLA detector. A similar coordinate system as mentioned above will be most probably also used by them. The beamline orientation is defined by the sign of the incoming particles x–component of the momentum. The choice is $p_x > 0$, so that the incoming particles will approach from the -x side of the coordinate system. The LDC B–field map for the DID field configuration is therefore directly usable, as the B_x component has the correct negative sign. This is shown in Figure 2. I propose to use this coordinate system in all future studies. This ensures comparability to LDC studies and Mokka based simulations.

3 (x–y) Distribution of Pairs from Beamstrahlung

The energy distribution of the pairs from beamstrahlung in the (x–y) plane at the nominal front face position of the BeamCal, z =365 cm, is dominated by the magnetic field configuration. We have agreed on centering our detectors BeamCal and LumiCal around the *outgoing* beam, to keep the error of the luminosity measurement small. Figure 3 shows an example of the (x–y) energy distribution at the position of the BeamCal front face at +z. The magnetic field configuration is a simplifed DID field by using $B_x = -0.04\,\mathrm{T}$. A blind area of 30° is used to cut out the region of the incoming beam.

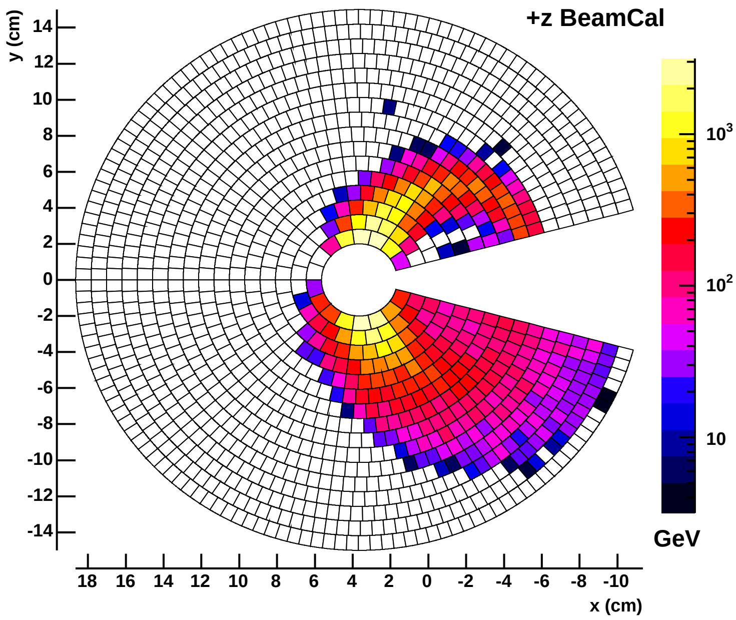

Figure 3: Energy deposition from pairs at $z = +365\,\mathrm{cm}$. The configuration shown here is for a 20 mrad crossing angle using the coordinate system and beamline orientation as described above. The magnetic field is here simplified to $\overrightarrow{B} = (B_x/B_y/B_z) = (-0.04/0/4)\,\mathrm{T}$. The deflected electrons are in the upper part of the picture, recognizable by the focussing introduced by the incoming positron beam.

It is clear, that we should always show the **physically correct** distribution. Without stating otherwise a standard plot would be the energy distribution at the +z position as viewed from the IP. Just plotting the (x–y) distribution would result in a mirrored and thus physically incorrect picture. Note that in Fig. 3 I decided to invert the x–axis to accomodate for this issue at the same time keeping the (x–y) denotion correct.