BeamCal Simulations with Mokka

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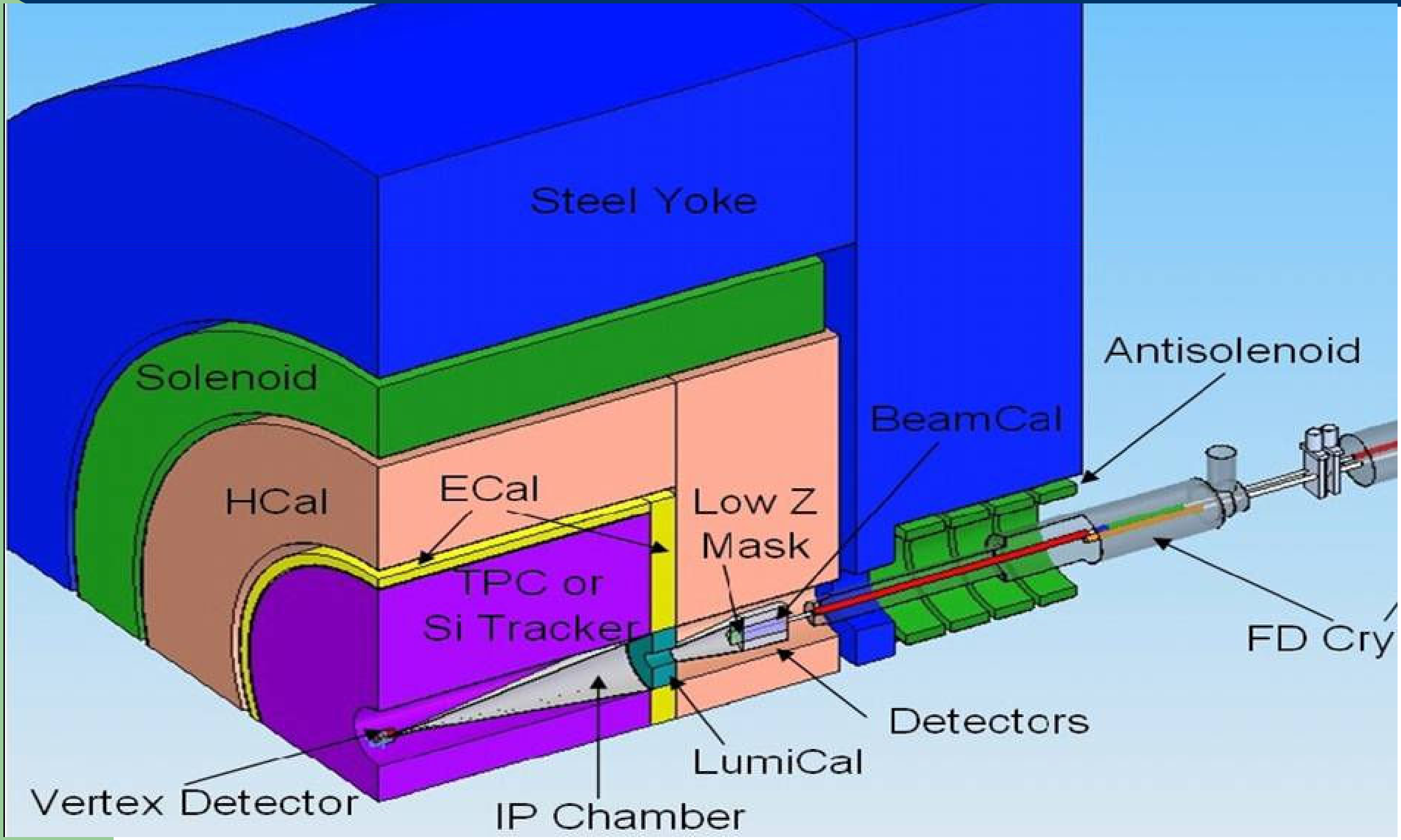
Detector Concept at the ILC



Detector Concepts:

1) Silicon Detector

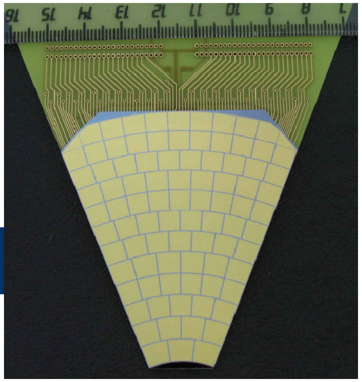
2) Large Detector Concept (LDC)

3) GLD

4) The 4th Concept

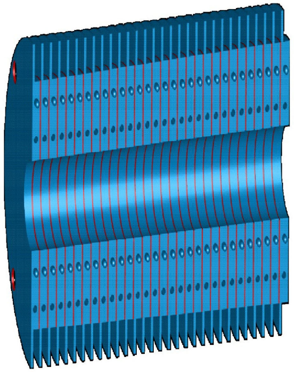
Height 14m *Length 20m*

BeamCal

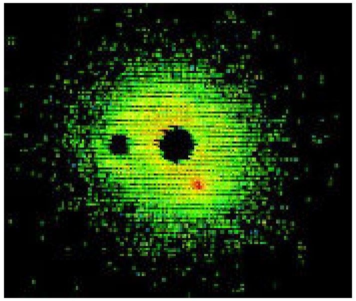


One sensor segment (19 rings divided into pads)

Reduces backscattering *from pairs into the inner ILC detector and protects the magnet from the beam delivery system*



EM longitudinal sandwich calorimeter; 30layers(Sensors alternate with Absorbers)
Absorber=Tungsten.
Sensors must be radiation hard (Diamond, GaAs, Si)



Beamstrahlung pairs ; beam pipes; reconstructed high energy electron

Analysis of vast amount of deposited energy from e+e- beamstrahlung pairs → fast estimation of the luminosity *and* ***measurement of colliding beams parameters***

Guinea Pig Beam-Beam interaction simulation

When linear e+ e- bunches collide

- Bunches are deformed by electromagnetic attraction → LUMINOSITY ENHANCEMENT
- Needed high luminosity (since each pair of bunches has only one chance to cross and interact) →
- These high EM Fields bend the particles (DISRUPTION) →
- Transverse acceleration →
- Energy loss in the form of synchrotron radiation: BEAMSTRAHLUNG →
- BACKGROUNDS:
  - Electromagnetic (Pairs) : e+e- → gamma-gamma → e+e- ...
  - Hadronic : e+e- → gamma-gamma → hadrons

Guinea Pig Beam-Beam interaction simulation – Version GP++0.7.0-b

MONTE CARLO BACKGROUND Simulation from collision of two beams (e+e- or e-e-).

ACCELERATOR:: TESLA

energy = 250 ;
particles = 2.0 ;
sigma_x = 553 ;
sigma_y = 5.0 ;
sigma_z = 300 ;
emitt_x = 10.0 ;
emitt_y = 0.03 ;
charge_sign = -1.0 ;

PARAMETERS:: PAIRS

n_x=32 ;
n_y=64 ;
n_z=32 ;
n_t=3 ;
n_m=200000 ;
electron_ratio=0.05 ;
photon_ratio=0.05 ;

OUTPUT: Secondaries.dat – 130.000 Beamstrahlung e+e in ASCII, 9 parameters:

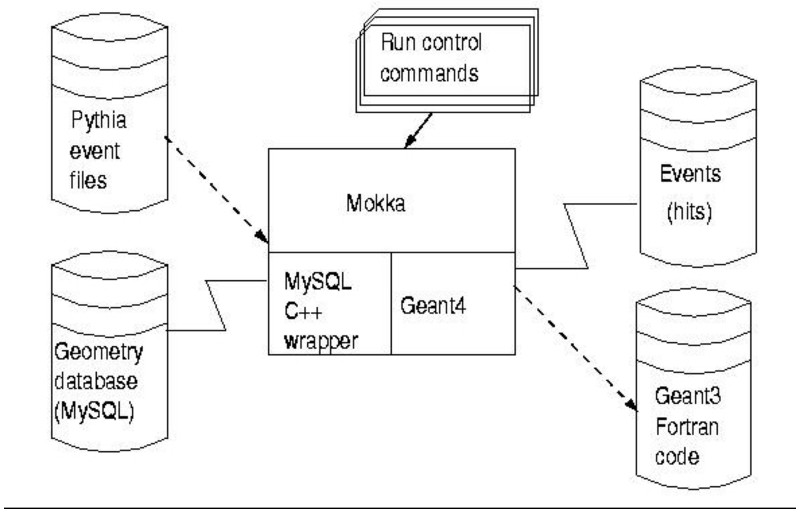
Energy in GeV/c (positive for e-, negative for e+);
Velocity (v/c): vx,vy,vz
Position (nm): x,y,z
Process (Breit-Wheeler, Bethe-Heitler, Landau-Lifshitz), Label

Mokka - general software schema

→ C++ simulation using GEANT4 (simulates passage of matter through detector).

→ GEOMETRY DATA DRIVEN, several detector models in MySQL geometry database.

→ Importance for BeamCal simulations: NEARBY DETECTORS INCLUDED IN SIMULATIONS



Mokka- Parameters and files

6BX in Version 06-06-p03
1BX in Version 06-07-p2 … STILL RUNNING :)

INPUT: 1 different GP-Secondary (each with 130.000 events) for each BX

PARAMETERS:

DetectorModel ILD_00fw

Subdetectors: SEcal03, SLcal02, LHcal01, tubeX04, maskX03, BEAMCAL01

ILC_Main_Crossing_angle 14.

LorentzTransformationAngle 7.

Field:

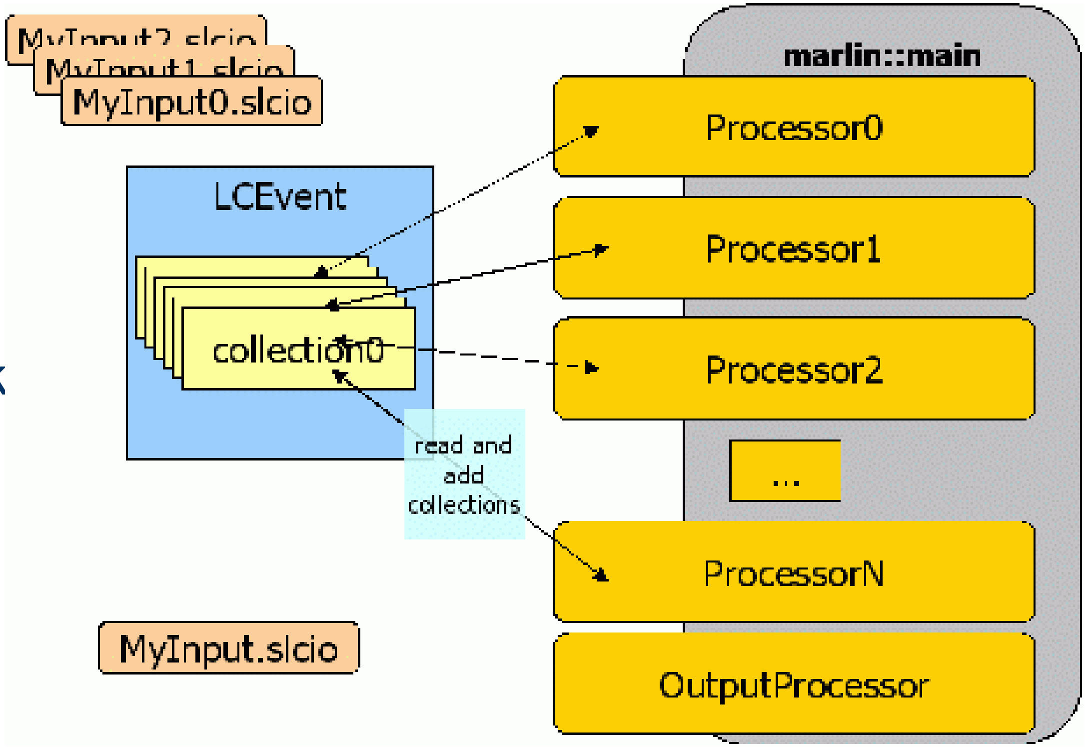
constant in older version (SField01)
field map in last version (fieldX02)

OUTPUT: Files in LCIO Format (1 for each BX), with ~ 125.000-130.000 events

Marlin

Modular Analysis and Reconstruction for the LINear collider

Simple modular application framework for analysis and reconstruction code based on LCIO.



Marlin-input files

I. XML steering file:

- **order of processors to be executed:**

  <!—processor name="MyTestProc"/>

- **global parameters:**
  - *LCIO input files generated by Mokka*

- **processor parameters:**
  - *Collections analyzed (BeamCalCollection)*

My Test Processor: gets events and tracks from BEAMCAL and sums up background energy depositions per layers

II. XML geometry file (generated by Mokka)

Results after Marlin

1BX (ILD_00FW, no Field map, 130.000 events).

Geometry from Mokka : BeamCal 30 layers, coordinates on Z Axis 3615.61 → 3735.63

RESULTS:

129786 events in 1 runs
ZNMIN= -3672.99 ZNMAX= -3496.55 ZPMIN= 3502.85 ZPMAX= 3767.32

Total Deposited Beamstrahlung energy per layers(GeV):

Layers 0→14: 0
Layer 15: 0.000445139
Layer 16: 34.431
Layer 17: 45.5031
Layer 18: 96.9574
Layer 19: 19 46.5834
Layer 20: 38.1586
Layer 21: 55.6539
Layer 22: 21.1079
Layer 23: 15.9522
Layer 24: 22.0388
Layer 25: 8.2

Future steps

- Higher statistics & Graphics (ROOT).
- Study of background distribution & fluctuations in calorimeter cells, for 1 BX, integrate for several BXs.
- Algorithm for high energy electron signal reconstruction.
- Electron detection efficiency under several background conditions, for different regions of the calorimeter.
- Optimization of the calorimeter segmentation.

THANK YOU VERY MUCH FOR LISTENING !!