BeamCal Simulations with Mokka

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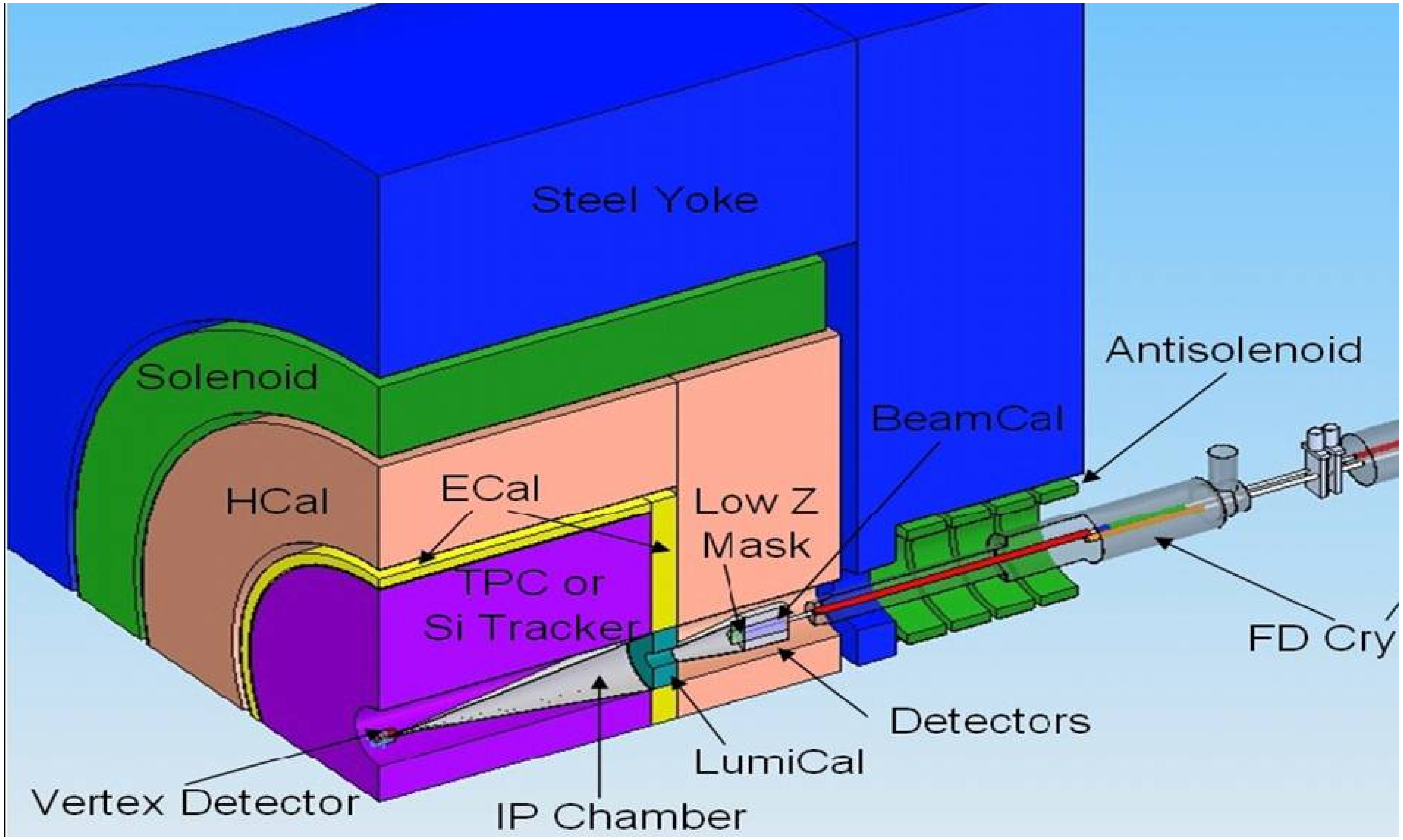
Forward region of the ILC



Forward region of the ILC

Beam calorimeter (BeamCal) - monitor the beam parameters at the interaction point; adjacent to the beampipe.

Luminosity detector (LumiCal) – covers larger polar angles; luminometer of the detector.

The gamma detector (GamCal) – together with BeamCal, measures beamstrahlung photons, which are very collinear to the beam.

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

GP simulates collision of two bunches (e-e+ or e-e-) for a given set of input parameters in *ACC.DAT*:

Energy =250.0 GeV
Particles=2 (per BX)
Charge_sign=-1 (this is the relative sign of charges → e+e-)
Beam sizes, Angles

Store_beam=1 → **produce beam1.dat + beam2.dat with the particles of the first and second beam respectively, after the beam-beam collision.**

Do_photons=1 Store_photons=1 → **produce photon.dat with the Beamstrahlung photons after interaction**

Do_compt=0 → **no Compton Background**
Do_hadrons=0 → **no Hadronic Background**

Do_pairs=1 Track_secondaries=1 Store_secondaries=1 → **produce secondaries.dat with the e+e- incoherent pairs generated by Beamstrahlung photons**

SECONDARIES.DAT **(in Ascii):**
Energy in GeV/c (positive for e-, negative for e+); x,y,z Velocity (v/c); x,y,z position (nm), process labels (Breit-Wheeler, Bethe-Heitler, Landau-Lifshitz)

Mokka

→ Full C++ simulation using Geant4 and a realistic description of a detector for the future linear collider.

→ Geometry data driven, able to simulate several detector models from its geometry database (via MySQL C++ wrapper) .

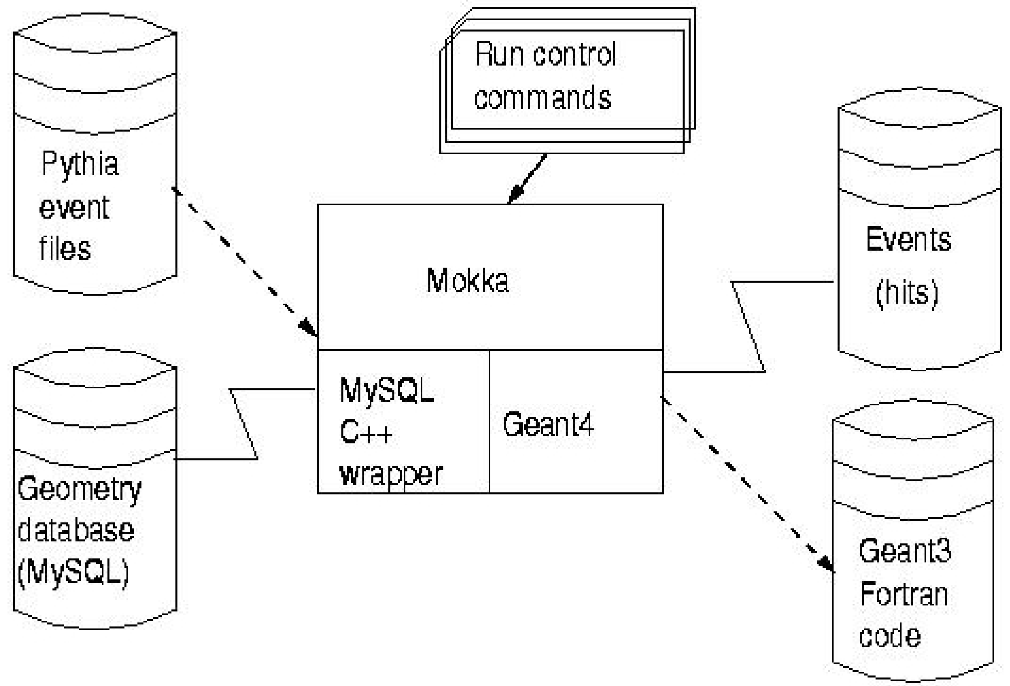
→ Using Geant4, builds the detector geometry and simulate events in this geometry.

→ Data driven at run time via steering files, interactive command dialogues, macro files.

→ Can read Pythia event files.

→ Event output files can be written on disk in ASCII or LCIO file formats.

Mokka general software schema



Mokka-input files

MACRO.MAC
/generator/generator secondaries.dat
/run/beamOn 10 → *Number of events (1BX)*

MOKKA_BCAL.STEER
/Mokka/init/detectorModel ILD_00 → *detector model*
/Mokka/init/dbHost pollin1.in2p3.fr → *host machine*
→ *MySql username and password*
/Mokka/init/EditGeometry/rmSubDetector all → *removes all detectors*
/Mokka/init/EditGeometry/addSubDetector SLcal02 600 →*adds LumiCal*
/Mokka/init/EditGeometry/addSubDetector BeamCal01 800 → *adds BeamCal*
→ *global geometry parameters that may change at runtime*
/Mokka/init/initialMacroFile ./macro.mac →*macro file to be executed after startup*
/Mokka/init/lcioFilename mokka.slcio →*LCIO output file*

Mokka-output files

I. LOG FILE:

1) Reading and executing steering lines
2) Connecting to the database "models03"
3) Asking for the model ILD_00: found.
4) Connecting to detectors, subdetectors, drivers,subdrivers
5) Running 10 events of BeamCal and LumiCal

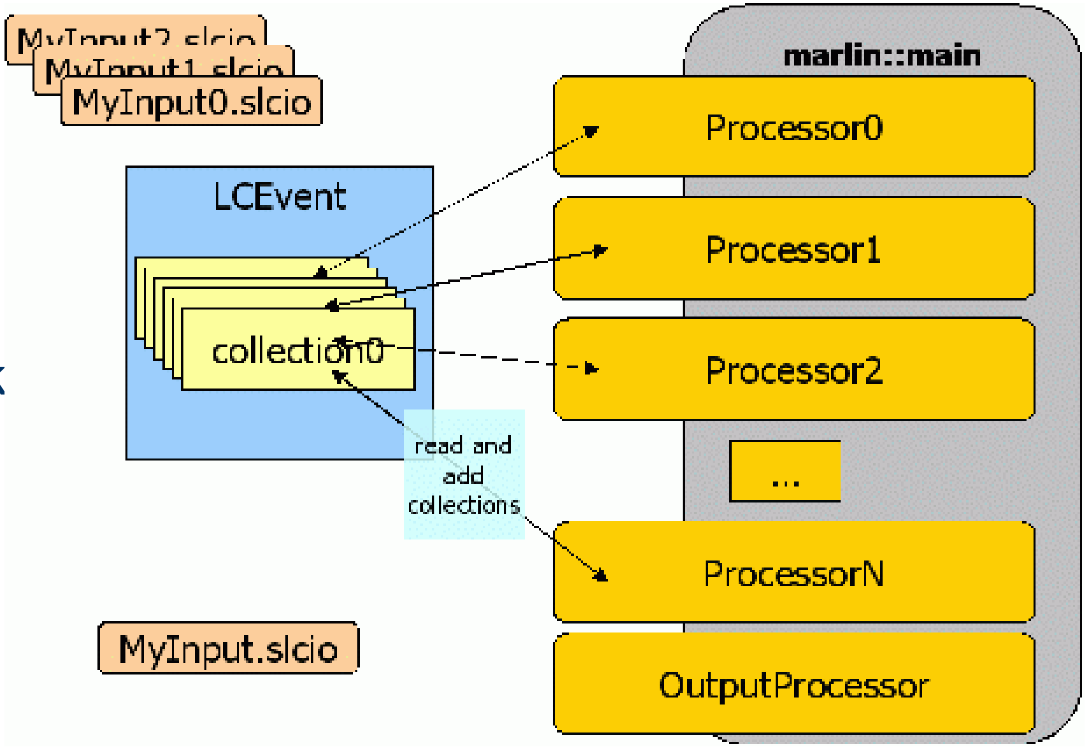
Event 7, scanning sub-detectors
LumiCalCollection from the LumiCal sensitive detector has 0 hits.
BeamCalCollection from the BeamCal sensitive detector has 31 hits.

II. MOKKA.SLCIO with events data → Analyzed by Marlin

Marlin

Modular Analysis and Reconstruction for the LINear collider

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



Marlin

I. XML steering file:

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

  <!—processor name="MyTestProc"/>

- **global parameters:**
  - *LCIO input files (mokka.slcio)*

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

II. Predefined and User Defined Processors:

The heart of the reconstruction package are the Marlin processors which hold the different modules of algorithms to ***get runs, events, racks and clusters from the simulated data.***

My Test Processor: gets events and tracks from BeamCal and MonteCarlo Collections

Marlin

Event number: 1 has 0 pads hits – BeamCal

Event number: 2 has 0 pads hits – BeamCal

Event number: 3 has 0 pads hits – BeamCal

Event number: 4 has 3 pads hits and 1 MC particles - BeamCal

x: 128.884   y:-81.1788   z: 3744.88   E[GeV]: 0.000129556
cell ID0 : 30445582 cell ID1 : 0
x:-25.8615   y: 111.691   z: 3745.96   E[GeV]: 0.000303077
cell ID0 : 30492685 cell ID1 : 0
x: 37.6266   y: 130.386   z: 3745.51   E[GeV]: 0.000337587
cell ID0 : 30483470 cell ID1 : 0
Total Energy Deposition [GeV] : 0.000770219
E[GeV]:   1.38255
PDG ID : 11
Total Monte Carlo Energy Deposition [GeV] : 1.38255

Event number: 5 has 0 pads hits – BeamCal

Event number: 6 has 0 pads hits - BeamCal

Event number: 7 has 31 pads hits and 20 MC particles - BeamCal

Event number: 8 has 0 pads hits – BeamCal

Event number: 9 has 0 pads hits – BeamCal

Event number: 10 has 7 pads hits and 4 MC particles - BeamCal

MyTestProc processed 10 events in 1 runs

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 !!