Construction of the Vertex Detector in Mokka

Xun Chen



- Introduction
- General Layout
- Geometry of ladders
- Offset of ladders
- Test Mode and so on

Introduction

- We want to do…
 full simulation of ILC detector
- Geant4

A toolkit for the simulation of the passage of particles through matter.

Mokka

Mokka is a detailed simulation program of ILC detectors based on Geant4.

My task:

To write a driver of the DEPFET vertex detector for Mokka

We need: The full description of Geant4 provide the necessary libraries to construct a simulation nrogram It include. Is able to simulate several other detector pieces (TPC, •The modules used to Write c++ codes, add them to Mokka source

tree. Add parameters to MySQL database.

General Layout of DEPFET Vertex Detector

- Follow the layout of the CCD based detector
- 5 layers.
- Inner radius is about 15mm.
- Distances between adjoint layers are about 11mm





Layout of Ladders



Layout of the inner ladder

Difference between the ladders in the 1st layer and other layers is the length of width of the ladder.

Build a Ladder



sensor_size_half_thickness)

ChipMotherSolid = G4Box("chipsolid", sensor_size_half_x, chip_size_half_y, chip_size_half_thickness)

UpperWaferSolid = G4Box("upperwafersolid", frame_size_half_x, frame_size_half_y, sensor_size_half_thickness) - SensorSolid

LowerWaferSolid = G4Box("lowerwafersolid", frame_size_half_x, frame_size_half_y, sensor_size_half_thickness) – EtchingSensorHoleSolid – EtchingChipHoleSolid

FrameSolid = UpperWaferSolid + LowerWaferSolid

Placement of Ladders

The function G4PVPlacement() is used to generate the physical volume.

G4LogicalVolumes will be rotated by a rotation matrix and shifted along a vector.





We do not consider the thickness and the width of the ladder, we just place the center of sensor at a distance of R to z axis. - overlap! We should shift the ladders along the tangential of the circle. The value is marked as tangential offset. And the new positions of the centers of the sensors are given by

$$x = R\cos\frac{2\pi i}{n} + d\sin\frac{2\pi i}{n} \quad y = R\sin\frac{2\pi i}{n} - d\cos\frac{2\pi i}{n}$$
And the offset is given by
$$d = y_{\frac{1}{2}s} + 2(y_{\frac{1}{2}f} - y_{\frac{1}{2}s} - y_{\frac{1}{2}}) + \frac{t_2 - R + \Delta + (R + t_1)\cos\frac{2\pi}{n}}{\sin\frac{2\pi}{n}}$$



An standard DEPFET Vertex pixel Detector. With 5 layers at r=15.5, 27, 38, 49, 60mm. Ladder gap is 0.04mm. Layers contain 8, 8, 12, 16, 20 ladders separately. Parameters are stored in table of "ladder", "layer", and "ladder_common_parameters".

Support Shells





Output: Position



Data are taken from the Collection **SimTrackerHit**. Compared with the output of VXD01.

Output: Time and Energy



Data are taken from the Collection **SimTrackerHit**. Compared with the output of VXD01.

---Test Mode---

To study the influence of additional sensors to the impact parameters:

>Test Mode is introduced. A variable in database is used to decide if the mode is activated.

>When this mode is activated, an additional sensitive layer is added between the 1st and 2nd layers.

>The addition sensitive layer has the same number of ladders to that of the 1st layer.

>The distance between the additional layer and the 1st layer is adjustable by a variable in MySQL database.

>The offset of the layer is calculated automatically in program to avoid overlap.

>To be careful: layer_radius, n_ladders_phi, additional_offset should be examined carefully before you use the test mode.



Inner layer and the additional layer. Inner layer is at r=12cm. The distance between the 2 layers is 2cm. 7 ladders in those layer.

Output of Test Mode



inner radius=12mm, n_ladders_phi=7 for layer 1. Distance between the inner layer and the additional layer is 2mm.

Summary and Outlook

- The DEPFET VTX detector are constructed within the framework of Mokka.
- The geometry can be easily adjusted by changing the parameters in database.
- The output of the DEPFET module was compared with the output of the CCD based module.
- Outlook: Study the resolution of impact parameter of the DEPFET detector and More realistic simulation--the support construction and self-scaling...