Planar Strip Detector Geometry Description

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This document describes the geometry class used to describe a planer strip detector immersed in a magnetic field used to measures charged particle helical trajectories three dimensions.

I. INTRODUCTION

The detector consists of a ten layer strip detector immersed in a 1 Tesla magnetic field. The sensors are planes in the x,z plane with the normals vectors along the y axis, though an arbitrary orientation is supported. The sensors are grouped in 5 pairs with each pair closely spaced in y. One sensor of each pair measures in the x direction (X sensors) while the other sensor measures in either the z direction (Z sensors) or at a +,-10 degree angle small angle (small angle sensors SAS)relative to the x direction. The SAS allow matching between Hits in the X view and the Z view. The sensors closest to the iteration region are smaller in x and z and have finer segmentation. The magnetic field is oriented in the z direction to give bending in the x,y plane.

The interaction vertex is at located 0,0,0 and particles generally move in the positive y direction.

The sensors are described by:

- unsigned int type, types 0: X, 1, SAS, 2, Z
- unsigned int nStrips
- double stripPitch, nStrips times stripPitch gives the size in the measurement direction measurementSize
- double intrinsicHitResolution
- double hitResolution
- double badHitResolution
- double threshold
- TVector3 center
- TVector3 normal
- TVector3 measurementDirection, the cross produce of the normal and the measurementDirection give the strip or perpendicular direction.
- double _perpSize;

This detector could represent a set of rectangular planes used in a fix target experiment or a single wedge in phi of the cylindrical collider experiment, where additional identical wedges could populate the cylinder to complete the cylindrical design. Further the detector could represent silicon or other tracking strip detectors, calorimeter strip chambers, or muon chambers given appropriate size and resolutions.

II. UNITS

The detector and magnetic field and calculation of trajectories and particle properties are set up such that the units are distance (m), Energy (GeV), magnetic field (Tesla).

III. DETECTOR LAYOUT AND PERFORMANCE

In the default configuration the X strip sensors are oriented perpendicular to the y axis in the x-z plane in 20 cm intervals. Strips in the X sensors run in the z direction. The two inner, lowest y, sensors have strips spaced 50 and 100 micron intervals in x, while the 3 outer sensors have strips spaced in 200 micron intervals in x. Each sensor has 4096 strips symmetrically positioned around x = 0. The magnetic filed is oriented in the z direction such that each sensor makes measurements of the x-y position allowing the curvature or pT to be measured in the magnetic field.

In the default configuration the Z strip sensors are oriented perpendicular to the y axis in the x-z plane in 20 cm intervals. Strips in the Z sensors run in the x direction. The two inner, lowest y, sensors have strips spaced 50 and 100 micron intervals in x. While the next outer sensor has strips spaced in 200 micron intervals in x. Each sensor has 2048 strips symmetrically positioned around z = 0. Each sensor makes measurements of the x-z position allowing the z component of the momentum to be measured.

In the default configuration the SAS strip sensors are oriented perpendicular to the y axis in the x-z plane in 20 cm intervals. Strips in the SAS sensors run +10 and -10 degree in angles from the x direction. The SAS sensors are at higher y than the Z sensors. The sensors have strips spaced 200 micron intervals. The sensors are placed 200 microns from the associated X sensor to allow measurement in X and SAS to be used to find an intersections which determines the z coordinate and match the information from the X sensors with the information from the Z sensors . Without partially rotated SAS sensors the X an Z views would be independent making it impossible to match X and Z views.

Figure 1 shows a view of the detector with one track and associated hits superimposed.

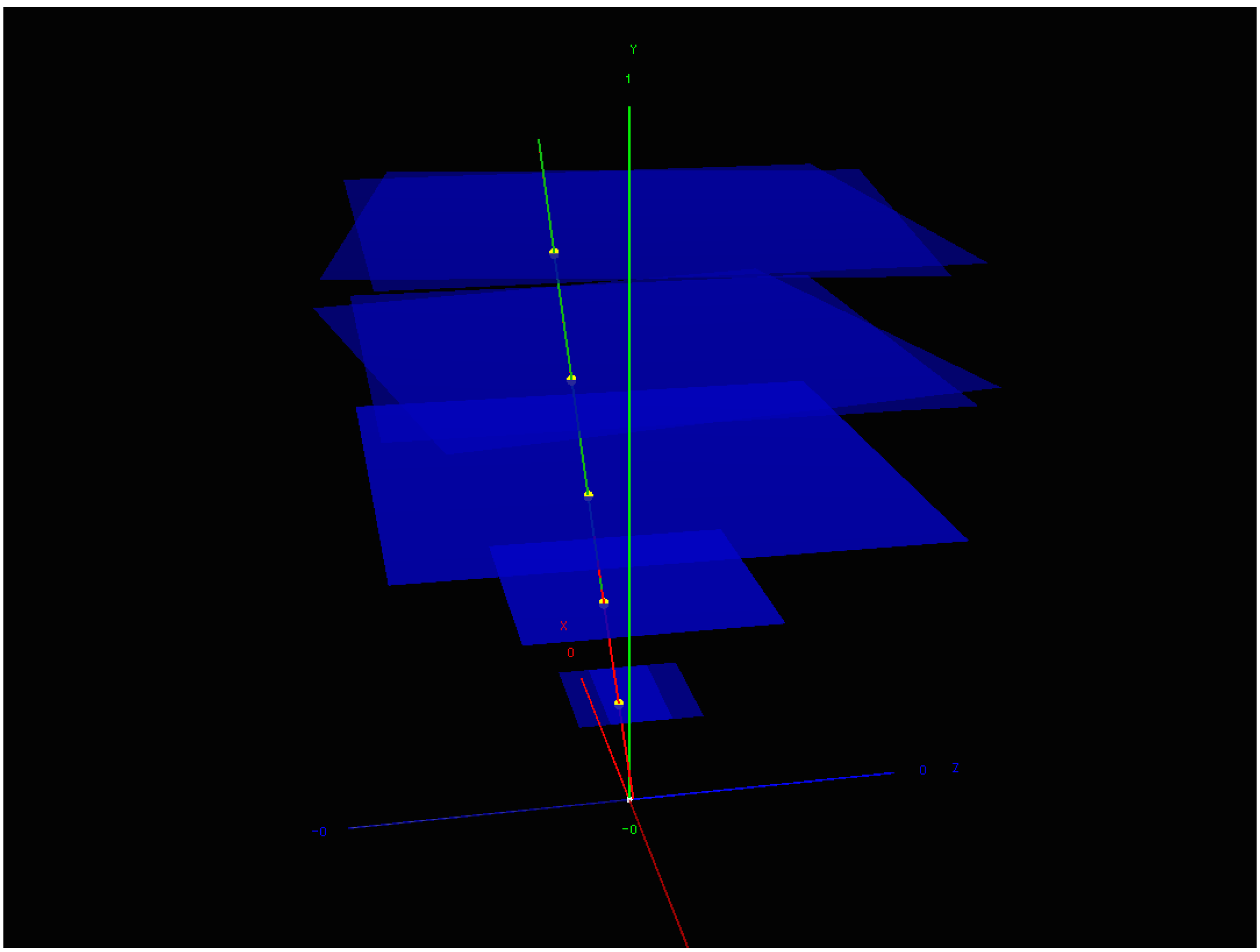

FIG. 1: Toy detector geometry with a track and associated hits superimposed

The sensors digitize approximately 64 ADC counts of charge per charged particle hit and have a hit resolution given in microns which is due to digitization and intrinsic resolution uncertainties. Charge deposition is taken as minimum ionizing and set to 32 ADC counts. The combined resolution due to intrinsic resolution and digitization uncertainty

TABLE I: Sensor properties.

Layer	type	Number Strips	Strip Pitch (um)	Y Pos (m)	Res (um)
0	X	2048	50	0.2	12
1	X	2048	100	0.4	25
2	X	2048	200	0.6	50
3	X	2048	200	0.8	50
4	X	2048	200	1.0	50
5	Z	2048	50	0.2002	12
6	Z	2048	100	0.4002	25
7	Z	2048	200	0.6002	50
8	SAS	2048	200	0.8002	50
9	SAS	2048	200	1.0002	50

can be measured using the simulation by comparing true generated and reconstructed hit positions. In addition when only one strip is hit or when two hits from different tracks overlap resolution can be degraded. However, these cases can be identified by the number of strips or the amount of charge in a hit and separate resolutions for "bad" hits can be assigned.

A subset of the sensor characteristics is given in table I

In addition the primaryVertex is also described as a 0.01(m) resolution "sensor" in X and Z to allow for performing a primaryVertex constraint to determine a track trajectory from 2X and one SAS hit. With the primary vertex and 2 hits a circle can be determined in the XY plane and the primary vertex and one Z or SAS hit can be used to determine the trajectory in z.

Detector geometry class variables:

- int, _nXSensors, _nZSensors, _nSASSensors
- int _MIP:
- TVector3 _bField: magnetic field strength, oriented along z-axis
- _curvatureC: allows conversion between pT and curvature using units of Tesla, meters, and GeV
- _sensors, vector of Sensors classes: describing the sensors

Detector geometry class functions:

- vector of Sensor type sensors(), get vector of all sensors
- Sensor sensor(int layer) get one sensor, -2 and -1 are for the X and Z primary vertex information and layers 0 - N-1 for the N physical sensors
- int nSensors() total sensor vector size
- double curvatureCInField(TVector3 bField) curvature constant in arbitrary field
- int nXSensors()
- all other accessors are named according to their class variables as is nXSensors() is named for _nXSensors