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 place 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 1 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:

- int _type;// types 0: X, 1, SAS, 2, Z
- int _nStrips;
- double _stripPitch; _nStrips times _stripPitch gives the measurementDirSize
- double _intrinsicHitResolution;
- double _hitResolution;
- double _badHitResolution;
- double _threshold;
- TVector3 _center;
- TVector3 _normal;
- TVector3 _measurementDirection;
- 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.

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).

TABLE I: Sensor properties.

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

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 micron intervals in x. While the 3 outer sensors have strips spaced in 200 micron intervals in x. Each sensor has 2048 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 micron intervals in x. While the 1 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 1 degree in angle from the x direction. The sensors at higher y than the Z sensors. The sensors have strips spaced 200 micron intervals in x. While the 1 outer sensor has strips spaced in 200 micron interval. Each sensor has 2048 strips. 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 rotated sensors the X an Z views would be independent making it impossible to match X and Z views.

The sensors digitize approximately 32 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. The combined resolution 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 assigned.

A subset of the sensor characteristics is given in table I

Class variables:

- int, _nXSensors, Z, SAS
- int _MIP:
- TVector3 _bField: magnetic field strength, oriented along z-axis
- _curvatureC: allows conversion between pT and curvature
- _sensors, vector of sensorDecriptor structs: describing the sensors

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 Z or 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.