sidaug05

This is the version of the Silicon Detector modelled as of July 23, 2005, to be used for detector studies at Snowmass.
The compact description of this detector in xml format can be found at http://www.lcsim.org/detectors/sidaug05.zip . What follows is a plain text description of the file compact.xml found in this zip file.

The tracking region is defined to be a cylinder with radius 125.5cm and z extent +/- 167.9cm.

Beampipe:

The beampipe is composed of three sections: a cylindrical central tube and forward and backward conical sections.
The central tube has an inner radius of 1.2cm and a z extent of +/- 6.251cm and is made of .040cm thick Beryllium.
The conical sections are 1mm thick Beryllium and flare from 1.2cm inner radius at 6.25cm to 6.97cm at the edge of the tracking region.
The beam pipe has a titanium inner liner .0025cm thick for the central barrel section and 0.0075cm thick for the conical sections.

Vertex Detector:

The vertex detector is composed of a central barrel system with five layers and forward systems composed of four disks.

The barrels are all 12.5cm long and are composed of .01cm Silicon, of which the outer .002 is sensitive.
The inner radii of the layers are:

1.4, 2.5, 3.6, 4.8, 6.0

There are four forward disks on either end, composed of a total of .022cm of silicon, of which the inner .002 is sensitive. All of the disks extend to a maximum radius of 7.5cm. The z positions and inner radii for the four disks are:

z	inner radius
7.6cm	1.6cm
9.5cm	1.6cm
12.5 cm	2.0cm
18.0 cm	2.0cm

The barrel vertex detector is supported by a Beryllium cage and the whole vertex detector is surrounded by a foam cryostat.

The barrel support is a cylinder of 0.1cm Beryllium with inner radius 7.0cm and z extent +/- 6.5cm. The barrel support endplate composed of a mixture of ladder blocks, annuli, plate and cable/fiber is represented by 0.58cm thick G10, with inner radius 1.5cm, outer radius 7.3cm and inner z of 6.5cm.

The mechanical supports for the endcap disks are modelled as a pair of Beryllium rings behind each disk at the inner and outer rims, with a thickness of 0.1 cm and radial span of 0.7cm each.

The VXD utility mixture of cooling channels, cables and fibers etc. is represented by a layer of 0.99cm thick G10 around the conical section of the beampipe at each end.

The barrel cryostat is a cylinder of 1.5cm PolystyreneFoam with inner radius 11.2cm and z extent +/- 24.0cm.
The endplate cryostats are disks of 3.0cm PolystyreneFoam with inner radius 2.3cm, outer radius 11.2cm and inner z of 21.0cm.
The cryostat coatings and Faraday cage are represented by 0.02cm Aluminum placed at the inner surfaces of the cryostat.

Tracker:

For a more detailed description of the tracker material, please see the attached document.

The tracker is composed of five cylindrical barrels with five disk-shaped endplanes. The z extent of the barrels increases with radius and the endplane for each extends beyond its cylinder in radius to provide overlap. The sensitive medium is silicon, assembled into carbon-fiber/Rohacell/PEEK modules and read out via a bump-bonded chip and Kapton/Copper cables. These modules are supported by carbon-fiber/Rohacell/carbon-fiber barrels or disks. Each barrel cylinder is supported from the next barrel out by an annular carbon fiber-ring. Outside each of these support rings in z, G10/Copper printed circuit boards are mounted for power and readout distribution to all silicon modules in a layer.

Barrels:

The radii and z extent of the barrel silicon are:

layer	z	inner radius
1	26.7	20.0
2	61.7	46.3

3	96.7	72.5
4	131.7	98.8
5	161.7	121.3

For the barrels, the support tubes are composed of .025cm CarbonFiber, 1.3cm of Rohacell31 and 0.25cm CarbonFiber. The sensor modules for the barrel are single-sided and have 0.03cm of silicon mounted on CarbonFiber/Rohacell31 frames that clip into PEEK (Polyetheretherketone) mounts. The average thickness of the CarbonFiber, Rohacell31 and PEEK in the modules of each barrel layer are 0.016cm, 0.14cm and 0.02cm repectively. The average thicknesses of the readout materials are 0.00048cm of Silicon, 0.0064cm of Kapton and 0.00065cm of Copper, however, the thickness of the cable material varies by layer.

Endcap:

The z positions and radial extents of the endcap silicon are:

layer	z	inner radius	outer radius
1 inner	30.0	4.0	25.0
1 outer	30.4	4.0	25.0
2 inner	65.0	7.9	51.3
2 outer	65.4	7.9	51.3
3 inner	100.0	11.8	77.5
3 outer	100.4	11.8	77.5
4 inner	135.0	15.6	103.8
4 outer	135.4	15.6	103.8
5 inner	165.0	18.9	126.3
5 outer	165.4	18.9	126.3

where each layer is composed of double-sided sensor modules to measure coordinates in two views. The forward disk supports are composed of .039cm CarbonFiber, 2.5cm Rohacell31 and 0.039cm of CarbonFiber. The sensor modules mounted outside of the disks are double-sided and have 0.03cm of silicon mounted on either side of CarbonFiber/Rohacell31 frames that clip into PEEK (Polyetheretherketone) mounts. The average thickness of the CarbonFiber, Rohacell31 and PEEK in the modules of each disk double-layer is assumed to be the same as that for the barrel modules. The average thicknesses of the readout material are also assumed to be the same, but are repeated on both sides of the modules for double-sided readout.

The the z-positions and radial extents of the annular support rings that complete the structure of the tracker are:

layer	z	inner radius	outer radius
1	26.7	18.0	44.3
2	61.7	44.3	70.5
3	96.7	70.5	96.8
4	131.7	96.9	119.3
5	161.7	119.3	127.0

These rings are composed of 0.15cm thick CarbonFiber. The readout and power distribution boards are mounted on the outside surfaces of these support rings. The regions occupied by these boards and the average thickness of the material they represent are given by:

layer	z	inner radius	outer radius	G10 thickness (cm)	Copper thickness (cm)
1	27.0	25.5	44.3	0.057	0.0038
2	62.0	51.8	70.5	0.102	0.0068
3	97.0	78.0	96.8	0.108	0.0072
4	132.0	104.3	119.3	0.186	0.0124
5	162.0	104.3	119.3	0.246	0.0164

Note that in layer five, due to the constraints of the calorimeter, the readout boards are not mounted on this annular ring, but rather at smaller radius.

Calorimeters:

Electromagnetic Calorimeter:

This element sets the basic size and aspect ratio for the rest of the detector. The inner radius for the barrel is 127cm. The aspect ratio is set to cos(theta) =0.8, meaning the inner z of the endcap EM calorimeter is at z of 168cm.

The EM calorimeter is a sampling calorimeter composed of 30 layers of

material	thickness
Tungsten	.250cm
G10	.068cm
Silicon	.032cm
Air	.025cm

The endcap plug sits inside the barrel cylinder, so the barrel z extent is +/- 179.5cm.
The endcap starts at an inner radius of 26cm and extends out to 125cm.

Hadron calorimeter:

The hadron calorimeter is a sampling calorimeter composed of 34 layers of

material	thickness
Steel	2.0cm
G10	0.3cm
PyrexGlass	0.11cm
RPCGas	0.12cm
PyrexGlass	0.11cm
Air	0.16cm

It begins immediately outside of the EM calorimeters, with the endcap plug sitting inside the barrel.

The barrel inner radius is 138.5 with a z extent of +/- 277cm.
The endcap extends from an inner radius of 26.0 cm to an outer radius of 138.25, inner z of 179.5

Solenoid:

The solenoid is modelled as a cylinder with an inner radius of 250cm. This is larger than the outer radius of the hadron calorimeter since we will not be building a cylindrical detector, but a polygonal one (current thinking is octagonal). The barrel composition is as follows:

material	thickness	z
Steel	6.0cm	271.0cm
Air	8.5cm	271.0cm
Aluminum	39.3cm	262.5cm
Steel	6.0cm	262.5cm
Air	20.0cm	271.0cm
Steel	3.0cm	271.0cm

This is capped with disk endplates of 6cm steel from r=250cm to 332.8cm

Muon System:

The muon system is implemented as a sampling calorimeter composed of 48 layers of:

material	thickness
Iron	5.0cm
G10	0.3cm
PyrexGlass	0.11cm
RPCGas	0.12cm
PyrexGlass	0.11cm
Air	0.86cm

The barrel inner radius is 333.0cm with z extent of +/- 277cm.
The endcap sits outside the barrel at an inner z of 277.5cm and radius from 26.0cm to 645.0cm

The field is solenoidal, constant 5 Tesla along z up to half the coil thickness and -0.6 outside.

Masks and Far Forward Detectors

This detector is designed for the 2mr beam crossing solution. The far forward plug extends out to a radius of 25cm. It starts with an electromagnetic calorimeter with the same composition as the endcap calorimeter, extending from 8.69cm out to 25cm.

The calorimeter is backed up by a conically tapered tungsten mask, inner radius 8.69 at z of 179.5, tapering to 16cm at z of 330cm. The outer radius is constant at 25cm.

There is a far forward low-Z shield (10cm thick Beryllium) at z of 285cm, with a 1.5 cm central aperture.

This is followed by a 50 layer silicon-tungsten calorimeter at z of 295cm, with a single aperture for both the incoming and outgoing beams, radius 2cm.