## SiD01 Plus Additional Disks

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Brown / SLAC
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# • Si D

## Tracker Simulation of SiD01

- SiD01 is the version of SiD that is currently being simulated
- Considerable effort associated with getting us to our present situation
  - Reasonably detailed conceptual design was developed for the SiD tracker
  - Effort made to account for all sources of dead material
  - Dead material translated into cylinders/disks that represent average amount of material traversed
  - Locations of sensors and supports extracted from AutoCad layout generated by Bill Cooper
  - A detailed text description of the simulation model was generated
  - The simulation model was implemented in the SiD01 compact.xml file
  - Lots of simulated events were generated
  - Much effort devoted to simulation code
    - Virtual segmentation developed for versatile segmention of disks, cylinders
    - Planar tracker digitization provides realistic modeling of planar strip detectors
    - Pixel digitization provides realistic modeling of pixel detectors
    - SeedTracker provides pattern recognition code for track finding using either virtual or physical segmentation
    - HelicalTrackFitter performs simple helix fitting from any combination of 3 or more strip/pixel/stereo hits
  - SeedTracker strategies were tuned to produce track seeds over the full solid angle
  - We are working hard to understand how SiD01 + Hit Making + SeedTracker works
    - Efficiency, purity, hit resolutions, helix resolutions, etc.



# SiD01 is Extensively Documented

## Linear Collider: sid01

## DRAFT Version, under construction.

This is the version of the Olicon Cetector modelled as of November, 2000, post Yalendia. The compact description of this descript in sum format can be found at Metal/Janus. Manage/platestacks (2007 ab., 1986 follows is a plan into description of the file compact...ml

Where a material is listed as xxf6 coverage, the density of the material has been reduced to xxf6 of its nominal value to missio the effect of cursuss in the material.

The tracking region is defined to be a cylinder with radius 126.5cm and z extent +/+ 167.9cm.

The beamping consists of a cylindrical control table and forward blackward control sections. The CAPOUN table the vision control face has an inner radius of 1.00m and exceeds to 11 if 6.050m. The control section have a cost self-radius (in the vision of 1.00m.) The control section have a cost self-radius (in 1.00m.) The control sections are 0.0075cm bits of the 1.00m. The control sections are 0.0075cm bits of the 1.00m. The control sections are 0.0075cm bits of the 1.0075cm bits of 1.00m. The control sections are 0.0075cm bits of the 1.0075cm bits of 1.00m. The 1.00

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

The barrels are composed of .0113cm thick Silcon, of which the outer .002cm is sensitive, with the following inner radii and |z| extarts:

Layer	Inner Radius	z  Extant
1	1.46cm	6.25cm
2	2.25cm	6.25cm
3	3.54cm	6-25cm
4	4.80cm	6.25cm
	6 Odem	6.75cm

## The barrels are supported by 0.05cm thick carbon fiber (15% coverage) rings:

Layer	Inner Radius	Outer Radius	Inner  z
ı	21.5cm	45.6cm	57.0em
2	46.5cm	70.6cm	83.6cm
3	71.5cm	95.6cm	109.5cm
4	96.5cm	120.6cm	135.9cm
5	121.5cm	126.5cm	161.7cm

Layer	Inner Radius	Outer Radius	z  for A Plane	z  for B Plane
1	20.7cm	49.4cm	85.5cm	85.9cm
2	20.7cm	74.7cm	111.4cm	111.8cm
3	20.7cm	99.9cm	137.6cm	138-2cm
4	20.7cm	125.0cm	163.6cm	164.0cm

## Each A plane has the following material thicknesses

Material	Layer 1	Layer 2	Layer 3	Layer 4
Silicon (active)	0.03cm	0.03cm	0.03cm	0.03cm
Silicon (dead)	0.00048cm	0.00048cm	0.00048cm	0.00048cm
Kapton	0.0051cm	0.0064cm	0.0078cm	0.0091cm
Copper	0.00052cm	0.00065cm	0.00079cm	0.00093cm
PEEK	0.02cm	0.02cm	0.02cm	0.02cm
Rohaceli31 (50% coverage)	0.3cm	0.3cm	0.3cm	0.3cm
Epory	0.0175cm	0.0175cm	0.0175cm	9.9175cm
Carbon Fiber	0.016cm	0.016cm	0.016cm	0.016cm

## Each B plane has the following material thicknesses:

Material	Layer 1	Layer 2	Layer 3	Layer 4
Silicon (active)	0.03cm	0:03em	0.03cm	0.03cm
Silicon (dead)	0.00048cm	0.00048cm	0.00048cm	0.00048cm
Kapton	0.0051cm	0.0064cm	0.0078cm	0.0091cm
Copper	0.00052cm	0.00065cm	0.00079cm	0.00093cm

Layer	Inner Radius	z  Extant
1	1.43cm	6.27cm
2	2.23cm	6.27cm
3	3.51cm	6.27cm
4	4.77cm	6.27cm
5	6.C1cm	6.27cm

The splinders attact to 0.626cm thick carbon fiber (25% coverage) builtheads that span 1.44cm <=7.14cm and have an inner (i) of 6.27cm. The verse, detects in a statched to the support tube by 0.626cm thick carbon fiber (25% coverage) support disks that span 1.44cm <=16.47cm and have an inner (a) of 6.25cm.

There are four forward disks on either end, composed of a total of .0113cm of silicon, of which the inner .002cm is sensitive. The ricital extent and inner izi for the disks are:

Layer	Inner Radius	Outer Radius	Inner  z
i	Lifen	7.iom	7.18en
2	1.6on	7.1cm	9.02cm
3	1.8on	7.1cm	12.16om
4	2.0cm	7.1cm	17.00cm

## The forward disk supports are 0.375cm thick carbon fiber (20% coverage) disks located as follows:

Layer	Inner Radius	Outer Radius	Inner   2
1	1.395cm	16.87um	7.21cm
2	1.595cm	16.87pm	9.05cm
3	1.795cm	16.87pm	12.19cm
4	1.995cm	16.87um	17.03um

For the barrel, reacout electronics are modeled as G30 rings that are currently located outside the

Layer	Inner Fadius	Outer Radius	Inner  z	Thickness
	1.46cm	1.66cm	6.4cm	0.5cm
	2.24cm	2.46cm	6.4cm	0.5cm
	3.54cm	3.74cm	6.4cm	0.5cm

Layer	Inner Radius	Outer Radius	Inner  z
1	20.3um	31.0cm	84.3cm
2	20.5cm	76.3cm	110.3cm
3	20.5em	101.3cm	136.7cm
4	20.5cm	126.3cm	162.6cm

The readout and power distribution locards are mounted on the outside surfaces of the barrel support rings. The replace occupied by these boards and the average shidmess of the material they represent are given by:

Layer	Inner Radius	Outer Radius	Inner  z	G10 Thickness	Copper Thickness
1	21.7cm	45.6cm	57.1cm	0.657cm	0.0038cm
2	51.0cm	70.6em	83.7sm	0.102cm	0.0068um
3	76-3cm	95.6cm	109.5cm	0.108cm	0.0072cm
4	101-3cm	120.6cm	136.3cm	0.186cm	0.0124cm
5	101-3cm	120.6cm	167.3cm	0.246cm	0.0164cm

Note that in layer five, due to the constraints of the calorimeter, the readout boards are not mounted on

Layer	Inner Radius	Outer Radius	z  for A Plane	2  for B Plane
1	2./8cm	16.6/cm	29.40	20-sucm
2	7.51cm	16.67cm	53.85cm	54.25cm
3	11.65cm	16.67cm	82.95cm	83.35cm

Material	Layer 1	Layer 2	Layer 3
Silicon (active)	6.63cm	0.03cm	0.03cm
Silicon (dead)	6.60648cm	0.00048cm	6.60048cm

Layer	Inner Radius	Outer Radius	Inner  z	Thickness
1-in	1-3em	1.4em	6.93cm	9-2cm
2-in	1.5cm	1.6am	8.82cm	0.2cm
3-in	1.7rm	1.firm	11.96rm	0.2rm
4-in	1.9cm	2.0am	16.30cm	0.2cm
1-met	7.1cm	7.6cm	6.90rm	0.2cm
2-out	7.1cm	7.6cm	8.62cm	0.2cm

7.6am Barrel sables first are brought radally down to the beam pipe. These radial cables are modeled as Cu

16.30cm

Jonnes Radius	Outer Redius	Inner  4	Thickness
1.32cm	2.26cm	6.90cm	6.6057cm
2-26cm	3.54cn	6/90cm	6.0031cm
3.54cm	4.80cm	6.90cm	0.0016cm
1.00cm	6.01cm	6.90em	6,0007em

The remaining cable and service meta-risk are occased along the beam pipe. Inner cables are 0.012 on thoic scope and rar conscile from an inner radius of 1.35 on at 1.14 \$5.00 to a solute of 1.455 on at 1.145 o

The entire vertex desector is ancicaed within a double-valled carbon fiber support table valle are 0.00cm thick carbon fiber with near moli of 16.07cm and 18.47cm and a [z] estant of [z] disAdom. The exist of the support table double-valled disis of 0.00cm thick carbon fiber distin broads a filter fiber.

Wall	Inner Radius	Outer Radius	Inner  z
Inner	4.00cm	16-97cm	66.60cm
Outer	4.91cm	16.87cm	89.43cm

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Kapten	0.0038cm	0.0038cm	0.0035cm
Copper	0.00038cm	0.00038cm	0.00038cm
PEEK	0.02cm	0.03cm	0.02cm
Rohacel 31 (50% coverage)	0.3om	0.3cm	0.3cm
Epony	0.0175cm	0.0175cm	0.0175cm
Carbon Fiber	0.016cm	0.016cm	0.016am

## Each B Plane has the following material thicknesses:

Material	Layer 1	Layer 2	Layer 2
Silicen (setive)	0.03em	0.03em	0.036%
Silicon (dead)	6.00048cm	0.09048cm	0.00048cm
Kapten	0.0038cm	0.0038cm	0.0035cm
Copper	0.00038cm	0.00038cm	0.00038cm

The ferward disk supports are disks made of two C-95cm thick Carbon Fiber places separated by a 0.35cm thick layer of Rohacel31 (19% coverage). The radial span and inner a coordinate are:

Layer	Inner Radius	Outer Radius	Inner  z	
l .	2.68cm	16-37cm	21.18cm	
ì	7.41cm	16.87cm	54.37em	
1	:1.55cm	16.87cm	83.48cm	

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## The radii and |z| extents of the barnel silicon layers are:

Layer	Inver Radius	z  Extent		
1	21.6cm	33.6cm		
2	46.8cm	82.5cm		
2	74-9en	100.3um		
4	96-8cm	134.7om		
5	121.8cm	160.6cm		

The estimated material thickness for modules, silcon, readout, and cables are averaged over the barrel and are given by:

Material	Layer 1	Liyer 2	Layer 3	Liyer 4	Layer :
reek	0.02cm	0.02cm	0/82cm	0.02cm	0.62cm
Rohacell 31 (504 coverage)	0.3cm	0.3om	0.3em	0.3cm	0.3em
Ераку	0.0175cm	0.0175cm	0.4175cm	0.0175cm	0.0175cm
Carbon Fiber	0.016cm	0.016cm	0.016cm	0.016om	0.816cm
Silicon (active)	0.03cm	0.03cm	0.63cm	0.03cm	0.03cm
Silicon (dead)	0.40040cm	0.00040cm	0/80040cm	0.00040cm	0.00046cm
Kapton	U.8U.650%	0.00stem	0.0064cm	0.00/sem	0.00910T
Conner	0.00035cm	0.00052cm	0.60065cm	0.00079cm	0.00093rm

The barrel support cylinders are composed of .05 cm CarbonFiber, 0.00 cm of Fohacel31 (15% coverage) and 0.05 cm CarbonFiber. The inner radii and |z| extent are given by:

Layer	Inrer Radius	z  Extent
1	20.6cm	57.7cm
2	45-6cm	84.3cm
3	70.6cm	110.2cm
4	95-6cm	136.6om
5	120.6cm	162.4cm

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Kichard Partridge



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## Detailed XML Tracker Description

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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      c'lirget > staye d="Y" innor_y="4.80"cm" innor_y="86.88"cm" outr_y="16.87"inn"; side naterial="CarbonFiber" thickness="YVD_CF_support"/y
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         ="10.07" om">
nuteriol="CarbonFiber" thicknom="VXD_GF_support" /
                                                      https://de.ar.inner_r="4.77"cm" outor_t="6.27"cm">
citios muon tot= Cartocnfibor_25 percent
thickness="VXD_CF_senser" />
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          historid="6" name="VertexBeadout" type="DiskBracker" reflect="true">
doyer d="1" inner =="1.40"em" cuter =="1.60"em" inner z="0.4"em">
site = raterid="610" teichense"0.5"em"/>
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        tayer d="2" inner_r="2.26" cm" cuter_r="2.46" cm" inner_r="6.4" cm" ;
cuter_raterial="6.10" thekness="0.5" cm" />
                                                                   syria
yerida "G' ineer_ra"16.87 'em' cuter_ta 199.48 'em'>
'Soo motorela "Carocrasbor" (beckness "VIII) (3. support' />
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      (Tager)

dayer da"4" inner f="4.80"em cuter f="5.00"em 'mer_t="6.4"em">

-dayer da"4" inner f="4.80"em cuter f="5.00"em 'mer_t="6.4"em">

-dayer natorial="610" thishess="0.5"em"/>
                                        orbitors
director of the control of 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      cligate
days: d. %" inner_c. % filt town outer_c. % 94 town inner_c. % 4 town outer material. "610" thickness. "0.5" em" />
                                             "Schens-VXQ C5 senser" / "V4 cm" rine_Ls*4.30" cm" obsr_se"16.87" cm' seller 6.7" it mort_se"1.48 cm" rine_Ls*4.30" cm" obsr_se"16.87" cm' seller metral="Carboner-Wag C5 senser" / "Vag C5 senser / "Vag 
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      -/layer delib liner pell.32*cm* curr pell.226*cm* inter_zel6.50*cm*;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 c/layers
-layer d="7" inner_="Z.281" cm" outer_="3.54" cm" inner_a="6.90" cm" /
-sites material="Copper" 0x0zons="0.0031" cm" /s
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      clayer d="8" imms_s="3.541" cm" outs_s="4.89" cm" imms_d="6.99" cm" >

-size myseries="Copper" thickness="0.0016" cm" />
                                                      byer id="4" inner r="1.595" cm" inner z="9.05" cm" 
a.tor_r="16.87" cm" >
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      -layer d="9" innor r="4.801" cm" outer r="6.04" cm" innor z="6.90" cm")
-des estecida "Copper" Nicknoss "0.0007" cm" />
                                                          Allgory
Alayer de "10" inner pe "1.3" can' cuter pe "1.399 "can' inner pe "6.98" can' a
Alayer ante in the "0.10" With traces "0.2" and "can'
                                                                   oyer id="5" inser_="1.795"em" inser_z="12.15"em" in
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 -/layer s -layer d="11" inner_r="1.5"cm" cuter_r="1.599"cm" inner_r="8.92"cm" site material="610" thickness="0.2"cm" />
                                                 byer id="6" inner_r="1.995"em" inner_z="17.03"em"
sater_r="16.97"em"=
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               -disc material "Biscen" thickness "0.00" cm" tembre "yes", 
sider material "Biscen" thickness "0.00046" cm" /s 
-disc material "Biscen" thickness "0.00046" cm" /s 
-disc material "Depter" thickness "0.00046" cm" /s 
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-disc material "0.0156" cm" /s 
-disc materi
                               Toper -

"These y-"11.55" cm' inner y-"11.55" cm' inner y-"11.48" cm'
ober y-"44.87" cm"
offer material "Carbood Ben" thickneys "0.85" cm' /-
offer material "Rehase101", TSpercent "thickness "0.55" cm' /-
offer material "Carbood Ben" thickness "0.55" cm' /-
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          chapter 4. "O' invert ye." 11.05" cm" invest ye. "83.35" cm" older ye." 16.47" cm". "Sich cm "000" ye." 16.47" cm". "Sich cm "000" cm" investigate ye." ye." ye. "Sich cm adarea". Sicken "teck vest." 0.0034" cm" / sicken madarea". "Applied" "Sicken "C.0038" cm" / sicken madarea". "Copper" "Richessa" (C.0038" cm" / sicken madarea".
"Gladeline Charles Transaction of the Charles 
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director for '0' name "TrackerSupportRings" type="DiskTracker' tellicon" track
tellicon" track | J="21.5" cm; 'm/m' _2="52.0" cm; 'outor _1="45.6" cm;
size material="Cattors ber_15-percent" trackors= 0.05" cm; /=
size material="Cattors ber_15-percent" trackors= 0.05" cm; /=
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      -/limit > days id "2" inner r="46.5" cm" inner z="83.6" cm" outer r="70.6" cm" - days id="2" inner r="46.5" cm" inner z="83.6" cm" outer r="70.6" cm" /= day material="Carthers the Tigercent" thicknow="0.05" cm" /=
             or laptor - despite (a. 2) from y = 2. 29 from inner y= 120.80 from inner y= 120.80 from inner y= 120.80 from inner y= 120.80 from inner inne
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- dayer is "4" inner _r="94.5" cm" inner _z="135.9" cm"
- oter r="120.6" cm" >
- size material="Carbor#iber | 15percent" thickness="0.95" cm" /
                                        per la Company Company
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   (layer),
layer id: "5" inner_r="121.5" cm" inner_t="161.7" cm"
outr_r="126.5" cm"
- sike material="Carbonf iber_15percent" (historial="0.05" cm"
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      detector ic = '0' name = "TrackerReadout" type = "DiskTracker" reflect="true" 
-layer id = "1" inner y = "25.7" om" inner y = "55.6" em" - 
-size material = ("51" this reserve = "0.45" ("m") ; ; ;
                                                          10+14" mor_y="2.51"em" mor_y="54.25"em"
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        loyer -
oyer Al-"2" inner y="51,0" cest" inner _c="83,7" cest" outor _r="70,6" cest"
-sitte material="6.10" talecross="0.102" cest" />
-sitte material="Copper" 2x/bress="0.0068" cest" />
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      elayer id="2" inner_r="76.3" em" inner_z="109.6" em" outer_r="95.6" em";
                      larger st. "5" store g. "18.65" and loreer g. "82.65" and
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Richard Partridge

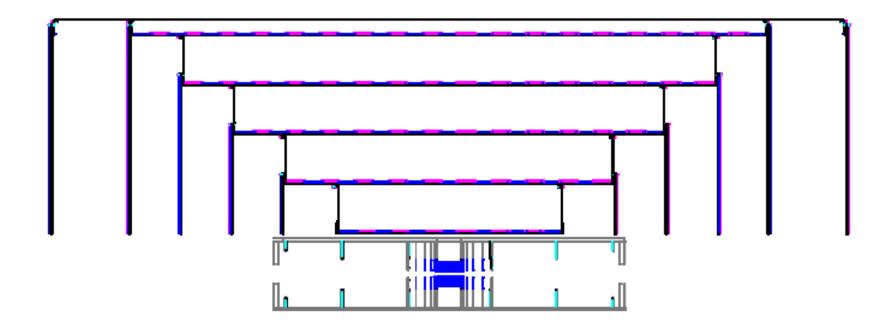
# · SiD

## What Level of Effort for SiD02?

- For purposes of discussion, consider 3 options
- Minimal effort
  - Continue to use SiD01 tracker geometry as is
  - Tracking volume will then end ~40 cm in front of ECAL
- Modest effort
  - Keep SiD01 tracker geometry for |Z| < 1.7 m
  - Add additional disks in front of ECAL so there are now 5 forward disks
    - Original SiD concept had 5 disks one disk was dropped in the final SiD01 mechanical design
    - Improves forward coverage, where we start to lose hits and have tracks crossing numerous detector boundaries
    - Easy comparison between stretched and unstretched designs
  - Simulation and Mechanical design allowed to evolve semi-independently
- Major effort
  - Need to:
    - Bring mechanical and simulation designs into conformance in a new simulation model
    - Adjust dead material in simulation to account for stretched mechanical design
    - Develop simulation tools to support new layouts (such as conical supports)
  - Potentially long delay in getting out simulation results,
    - Mechanical design must converge, xml and documentation must be updated, simulation tools must be adapted as necessary, time needed to understand "features" that are introduced, and finally, produce LOI results
    - Who will do this work??



# SiD01 With Added Disk Layers



Richard Partridge 6



# Hit Multiplicity vs Polar Angle

- Look at how many hits are assigned to tracks found in single muon events uniformly distributed in the polar angle
  - Currently, tracker strategies require 7 or more hits on a track
  - Preliminary indications that "purity" degrades as the number of hits decreases

