



LOI: VTX

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Places where VTX is Mentioned

1.2 Detector Overview

Brief description of VTX
 Impact parameter resolution
 Field strength of the solenoid
 Deferred choice of sensor technology
 Ability to install VTX relatively late and/or replace
 Looks fine

My apologies for mentioning material
 in sections others provided.

1.5.2 Vertex Detector

Machine parameters
 Spatial distribution and magnitudes of backgrounds
 Pattern recognition studies
 Hit densities in forward VTX disks
 EMI related to beam RF
 Figure 1.6 (at right) appears to
 correspond to the text describing
 Figure 1.3.
 Otherwise, looks fine

Figures and paragraph numbering
 are taken from v0.94.

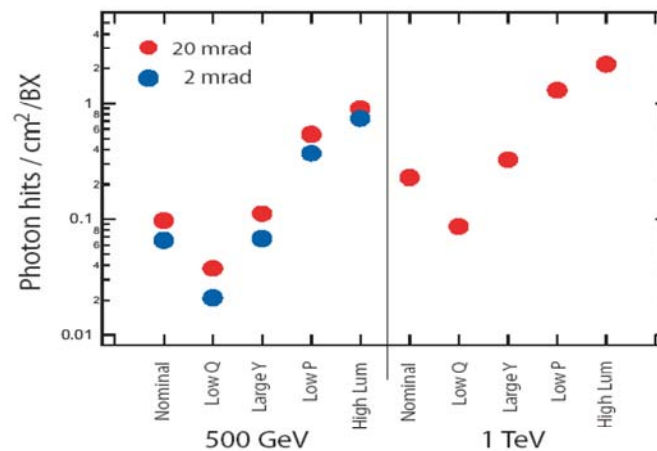


Figure 1.6: The density of electron and positron tracks / cm² / BX in Layer #1 of the forward tracker, as a function of the radius of the hit.

Places where VTX is Mentioned

1.5.3 Forward Tracker

This section describes disks with inner radii = 4, 5, 6, and 7 cm.

That's fine for background studies, but it does not correspond to the present SiD design.

Main text descriptions of Figures 1.4 and 1.5 seem to be interchanged with respect to the figures themselves.

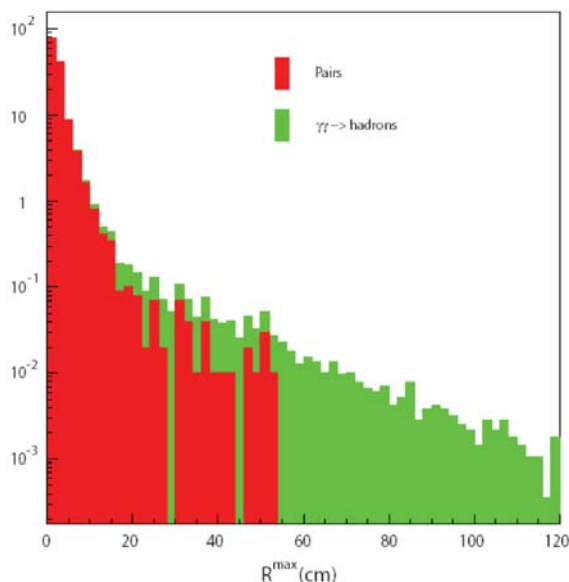


Figure 1.4: VXD Hits/mm²/train for Barrel Layer 1 for the various ILC beam parameter sets.

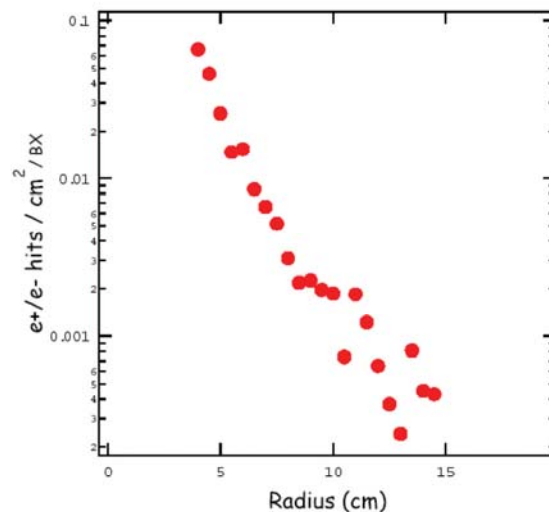


Figure 1.5: The number of charged particles / BX which reach a maximum radius between R and $R + 2$ cm, as a function of radius R , for nominal 500 GeV beam parameters. The e^+e^- pairs are shown in red; hadrons and muon pairs in green.

Places where VTX is Mentioned

2.1 Vertex and Tracking System

2.1.1 Introduction

Integration of vertex detector and outer tracker

Looks fine

2.1.2 Beam Environment

Bunch structure

Backgrounds from the interaction point

Machine backgrounds

Description of beam pipe geometry

Looks fine

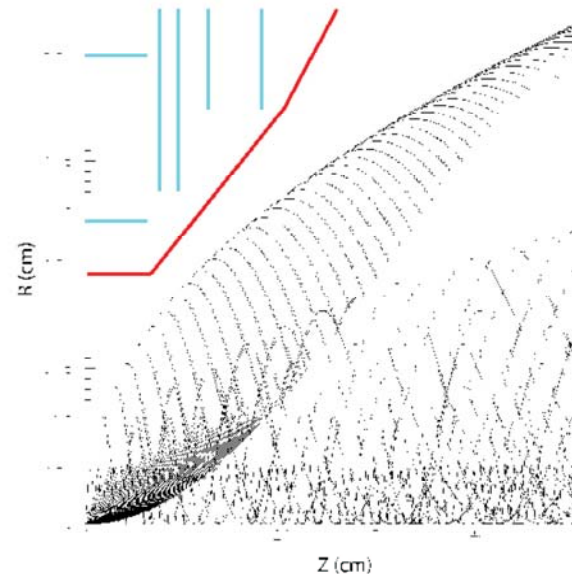


Figure 2.1: Maximum envelope of the e^+e^- -pair backgrounds in a 5 Tesla field. Indicated is the 12 mm radius beampipe.

Contributions & their Locations

2.1.3 Vertex Detector Design

Integration with the outer tracker

R-Z view of the vertex detector

Paragraph 1, sentence 2: Change “experiment” to “experiments”.

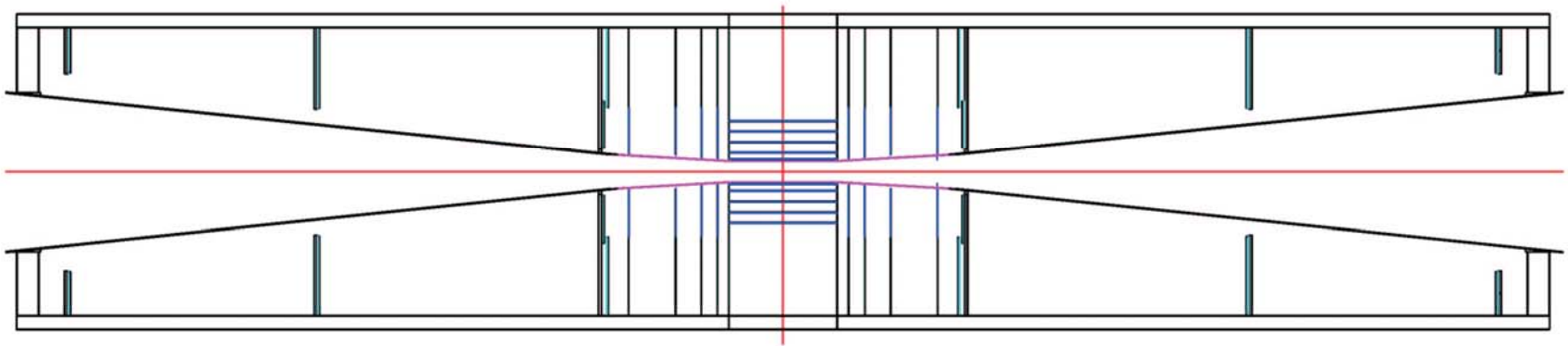


Figure 2.2: R-z view of the vertex detector and its support structure.

Paragraph 3, sentence 3: Change “occurs” to “occur”.

Contributions & their Locations

2.1.3 Vertex Detector Design (continued)

CTE mismatch considerations and “all-silicon” design

Sensor assumptions

Operating temperature $> -10^{\circ}\text{C}$

Thickness = $75\ \mu\text{m}$

Geometry

Split construction to allow assembly around the beam pipe

Radii of barrel layers

Radii and Z-positions of the innermost pixel disks

Radii and Z-positions of the outermost pixel disks

Looks fine, except for Fig. 2.3

Contributions & their Locations

2.1.3 Vertex Detector Design (continued)

Geometry (continued)

Barrel Region	R (mm)	Length (cm)	Number of sensors in φ
Layer 1	14	125	12
Layer 2	21	125	12
Layer 3	34	125	20
Layer 4	47	125	28
Layer 5	60	125	36
Disk	R_{inner}	R_{outer}	z_{center}
Disk 1	15	75	76
Disk 2	16	75	95
Disk 3	18	75	125
Disk 4	21	75	180
Forward Disk	R_{inner}	R_{outer}	z_{center}
Disk 1	28	166	211
Disk 2	76	166	543
Disk 3	118	166	834

Table 2.2: Parameters of the vertex detector. Units are mm.

Contributions & their Locations

2.1.3 Vertex Detector Design (continued) Geometry (continued)

Figure 2.3 is too wide to fit the page.

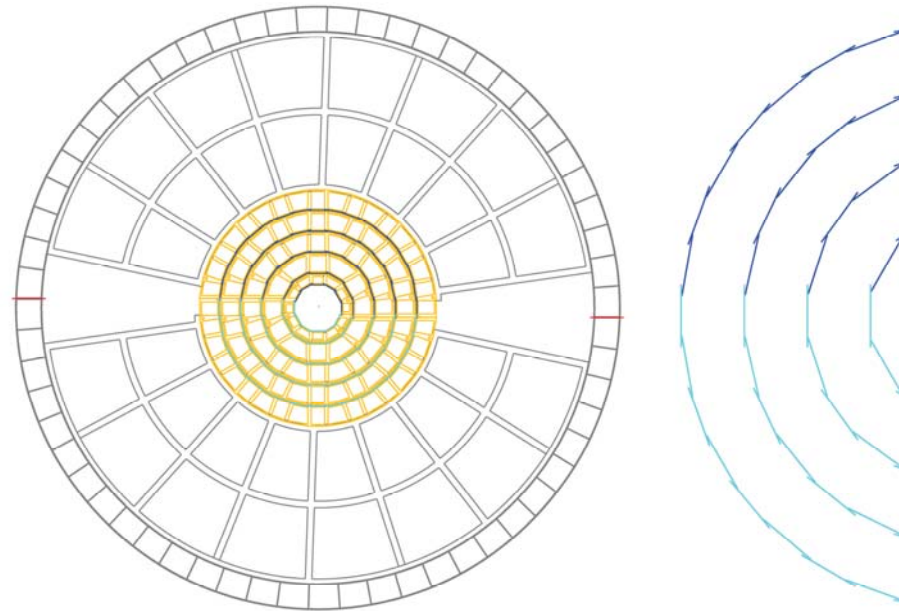


Figure 2.3: Barrel end view of the vertex detector (left) and layer arrangement of the silicon sensors only (right).

Contributions & their Locations

2.1.3 Vertex Detector Design (continued)

Cooling

Barrel: 20 W

Central 8 disks: 17 W

Outermost 6 disks: 13 W

For the latest layout, barrel power with the assumptions given would be 21.3 W (not too different from 20 W).

I haven't checked whether there are similar small changes in disk power, but disk designs are still being developed.

There is probably more text on cooling than necessary.

Otherwise these paragraphs look fine.

Contributions & their Locations

2.1.3 Vertex Detector Design (continued)

Readout and sensor technologies

Rolling shutter

CPCCD, DEPFET, many MAPS

In-pixel storage

ISIS, some MAPS, Chronopix, 3D-VIP

Chronopix was spelled Chronopixel (I'm not sure which is preferred)

These paragraphs look OK to me.

Layer	Number of ladders	hits/crossing	hits/train	bits/train	Readout time (ms)
Layer 1	12	2000	$5.6 \cdot 10^6$	$1.8 \cdot 10^8$	75
Layer 2	12	1200	$3.4 \cdot 10^6$	$1.1 \cdot 10^8$	45
Layer 3	20	800	$2.3 \cdot 10^6$	$7.2 \cdot 10^7$	18
Layer 4	28	450	$1.3 \cdot 10^6$	$4.1 \cdot 10^7$	7.3
Layer 5	36	400	$1.1 \cdot 10^6$	$3.6 \cdot 10^7$	5.0

Table 2.1: Readout rates for the vertex detector assuming 3D-VIP readout scheme.

Contributions & their Locations

2.1.3 Vertex Detector Design (continued)

Power delivery

DC-DC conversion

Series power is not mentioned (?)

Copper wires with diameter ~ 0.3 mm are mentioned, but not flat lines

Possibility of optical transmission of signals

Would be OK as is.

Paragraph 15, sentence 7: Change “The material from the thin fibers are...” to “The material from the thin fibers is ...”.

Paragraph 17, sentence 5: Change “for considerable portion of the endcap” to “for a considerable portion of the endcap”.

Connections

At the end of each sensor

Simulations assumed a block 2 mm high x 5 mm long x full sensor width with the same radiation length as G-10

That may be conservative, but it should be OK.

Looks OK to me, but see next slide.

2.1.3 Vertex Detector Design (continued)

Connections (continued)

There is a statement “The number of radiation lengths represented by vertex detector structures, averaged over ϕ in most cases, is given in Fig. 2.10”.

Should that say Fig. 2.5?

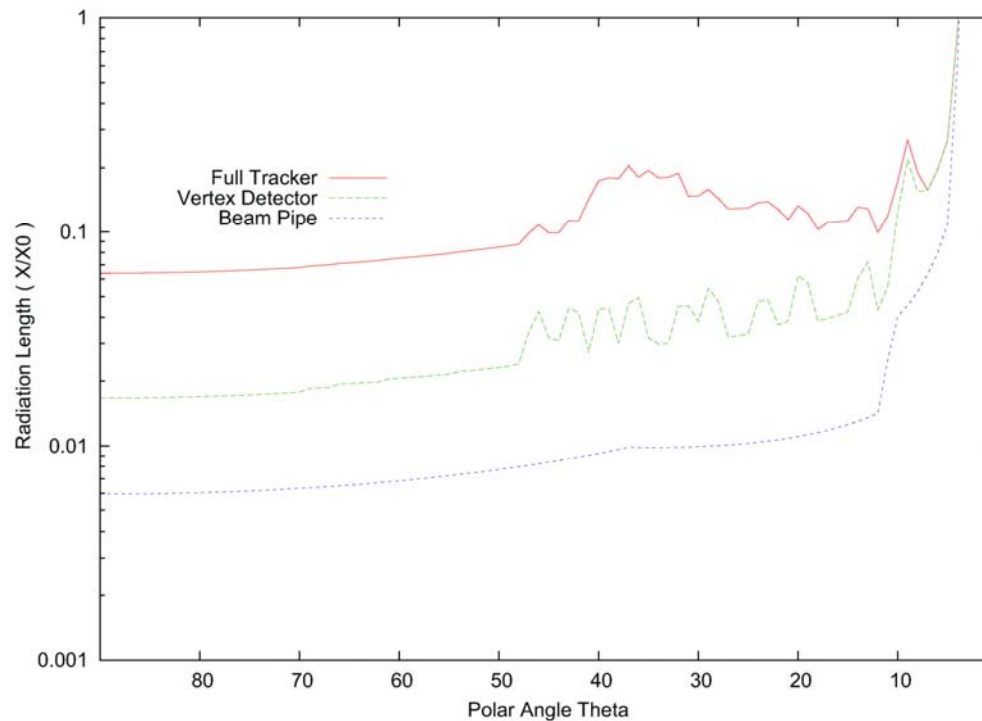


Figure 2.10: Material budget of the tracking system.

Contributions & their Locations

2.1.3 Vertex Detector Design (continued)

Servicing

VTX and beam pipe remain at the same Z

Outer radius of VTX and its structures limited to 18.5 cm

Looks fine.

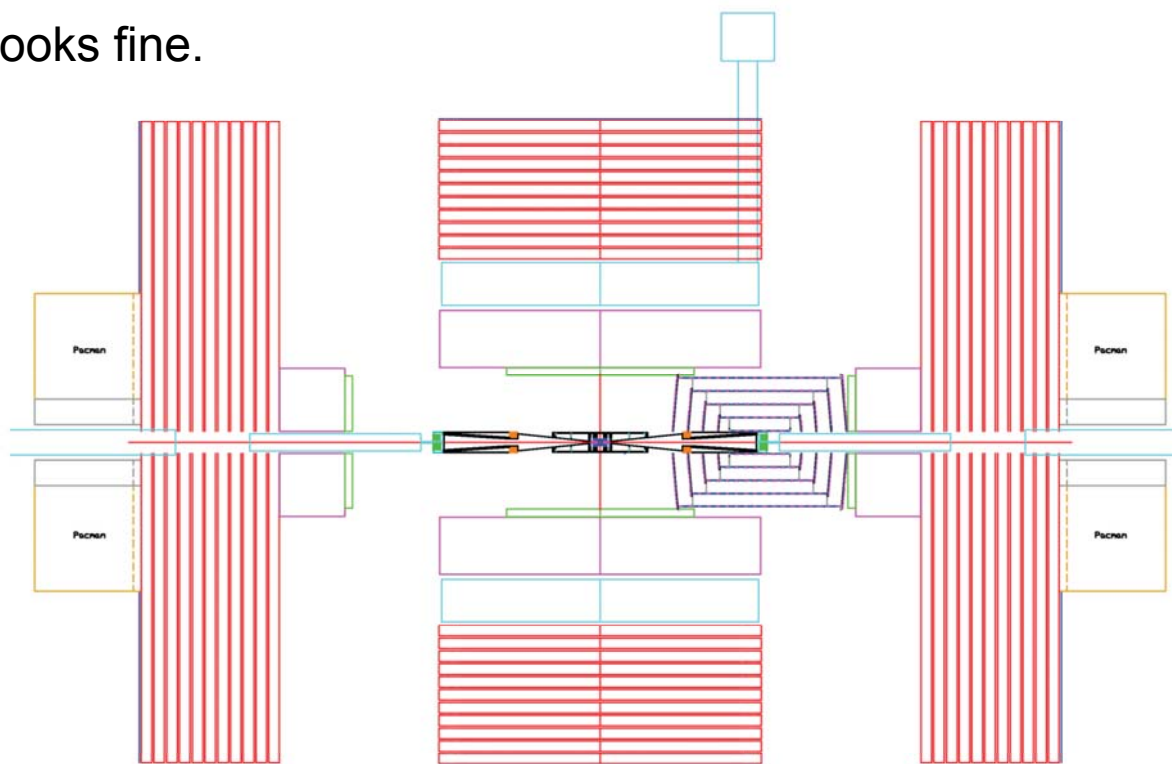


Figure 2.4: Tracker in the open position for servicing of the vertex detector.

Contributions & their Locations

2.1.3 Vertex Detector Design (continued)

VTX hit pattern and material sum

Figure 2.5 is missing

Recent questions related to
VTX design and this plot

Comparison of barrels plus disks
with a long barrel

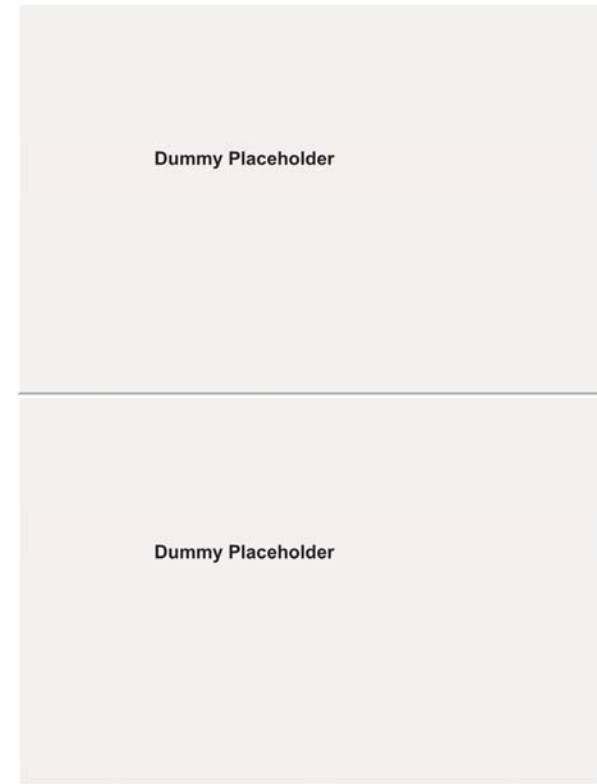


Figure 2.5: Hit pattern and material summary of the vertex detector as function of polar angle.

Places where VTX is Mentioned

2.1.6 Simulation Infrastructure

Compact xml detector description of the vertex detector and tracker for simulations

Figure 2.15 is extracted from the description of the VTX barrel.

Looks fine to me.

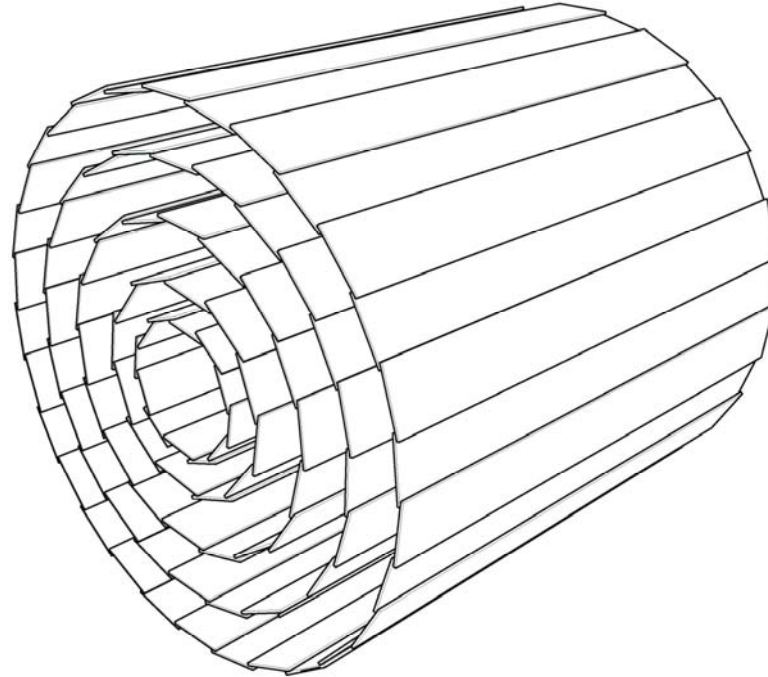


Figure 2.15: The central vertex detector showing the layout of the silicon pixel sensor modules.

Places where VTX is Mentioned

2.1.7 Vertex Detector Hit Digitization

Two VTX sensor simulation algorithms

CCD simulation from SLD

Charge diffusion

δ -electrons from ionizing radiation

Low energy electrons from Compton scattering

Noise contributions

Involves approximations of the Landau distribution

A more detailed package in which the parameterization of the diffusion and the Landau distribution have been eliminated

Computing resources

Look-up tables

Generation of fake hits and electronics noise

All of this looks fine to me.

In Summary

- VTX contributions are generally in good shape.
- A few typos remain to be fixed.
- One figure with two plots is missing.
- A few figures should be renumbered and/or matched with the main text.