Incoherent pair background studies for the ILD vertex detector

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LC-note in preparation Draft available on http://www.iphc.cnrs.fr/IMG/BKGStudies.ps

Characteristics of the study

- GuineaPig 0.7.4-b

5□□0 files of e^+e^- pairs

- Mokka-06-06

detector model LDCPrime_02Sc_p01

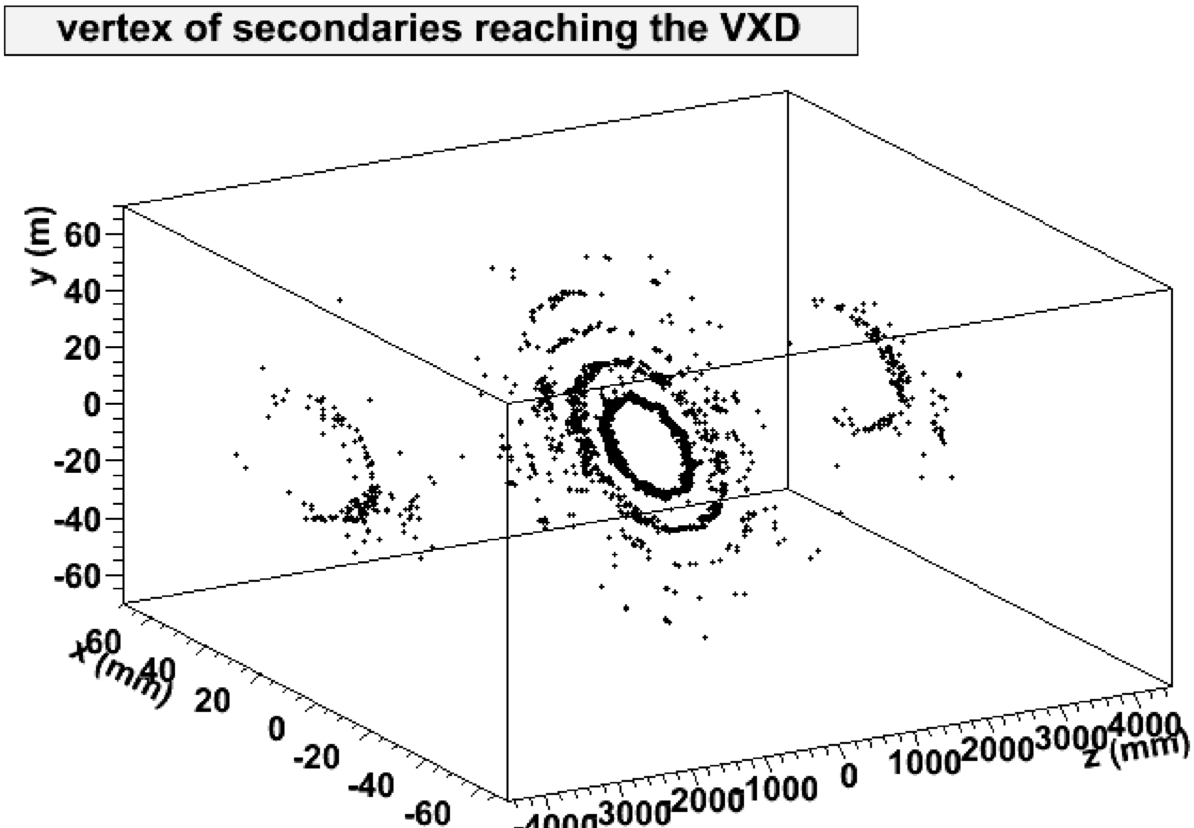
radii of VXD: 15, 26, 37, 48, 60 mm

solenoid magnetic field 3.5 T + anti-DID field

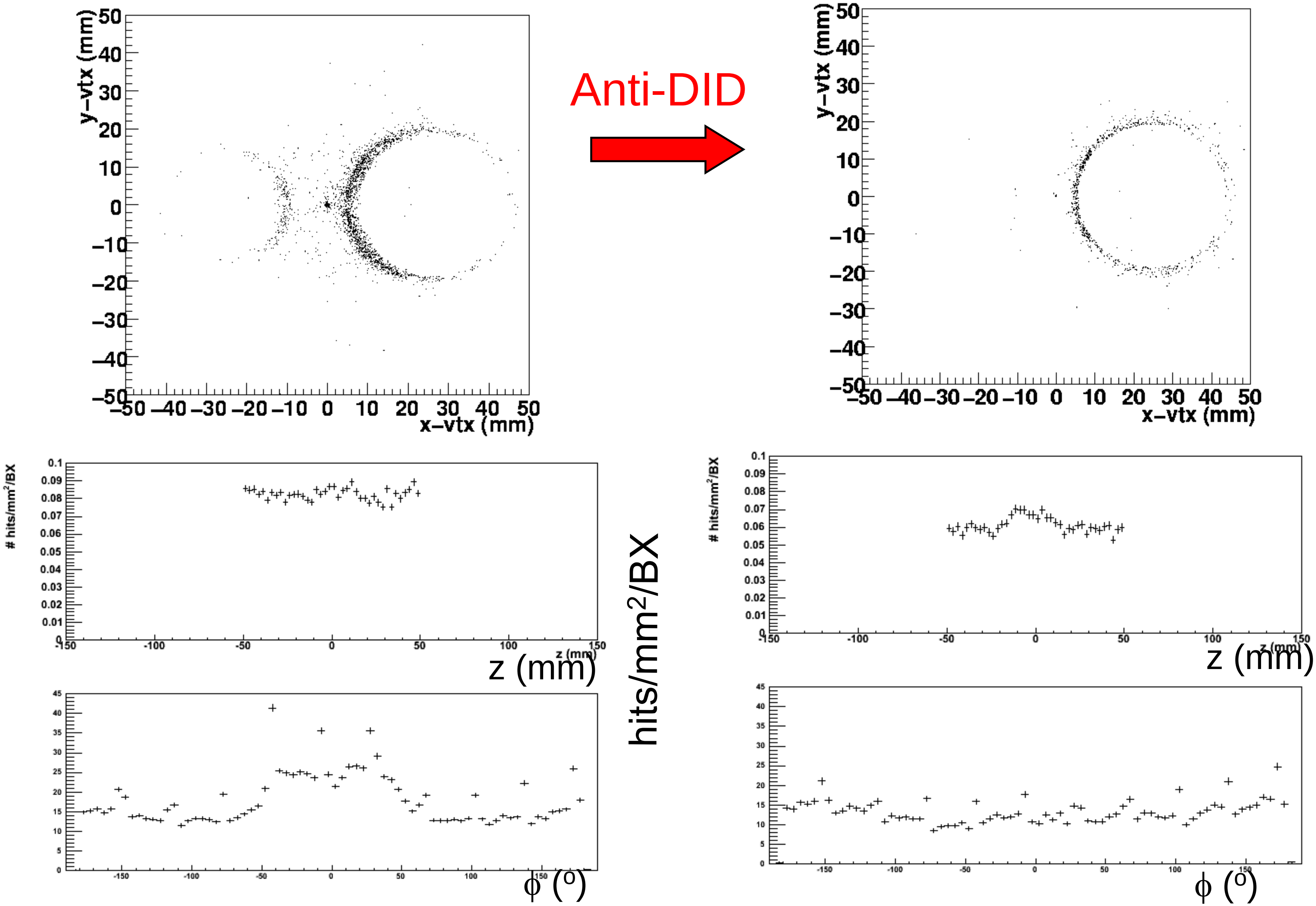
LorentzTransformationAngle 7 mrad

Secondary particles

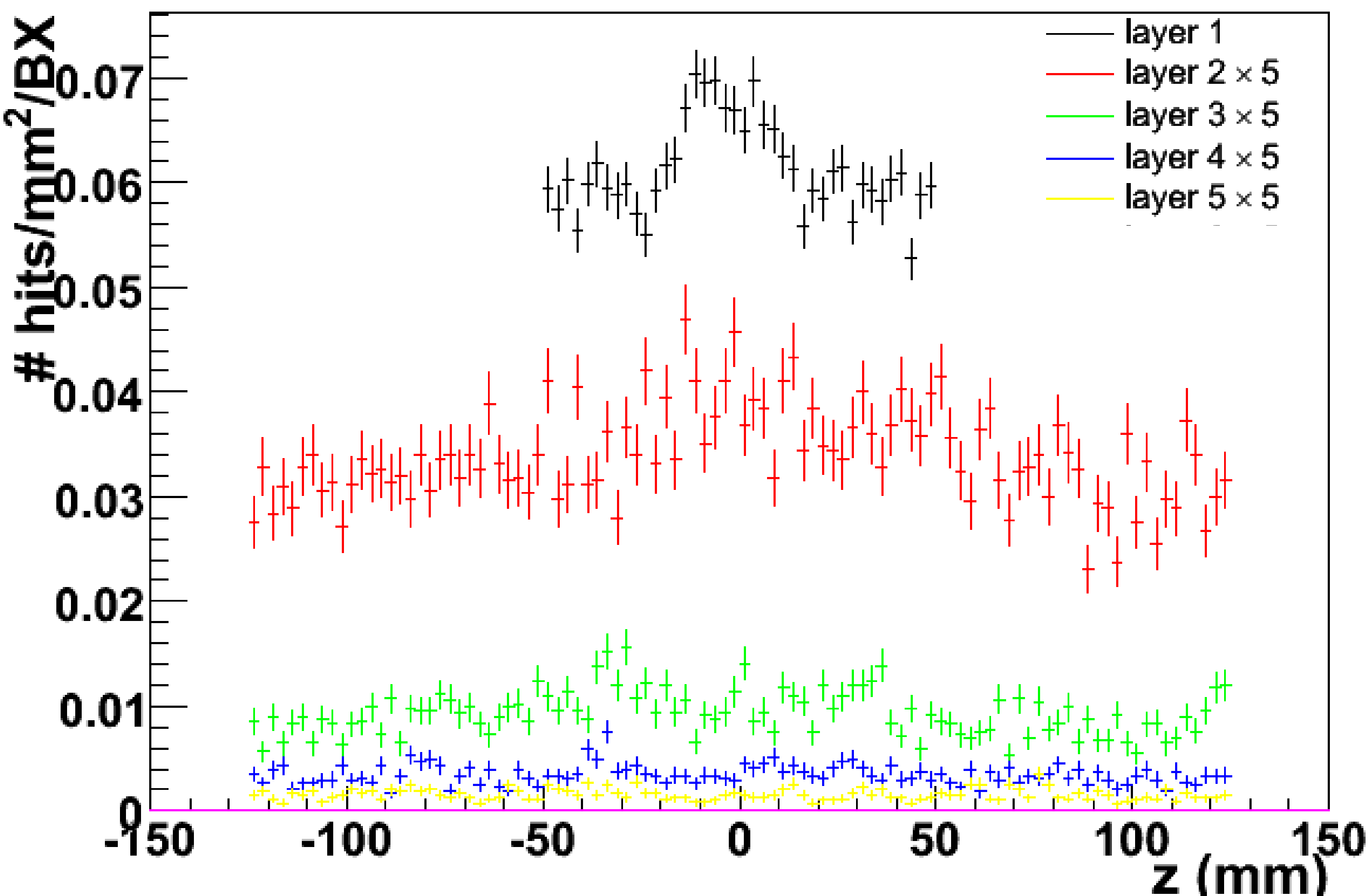
Secondary particles reaching the VXD are originated mostly by the interaction of beamstrahlung $e^{\pm}$ with the BeamCal, the beam tube or the VXD itself.



Effect of anti-DID on innermost layer

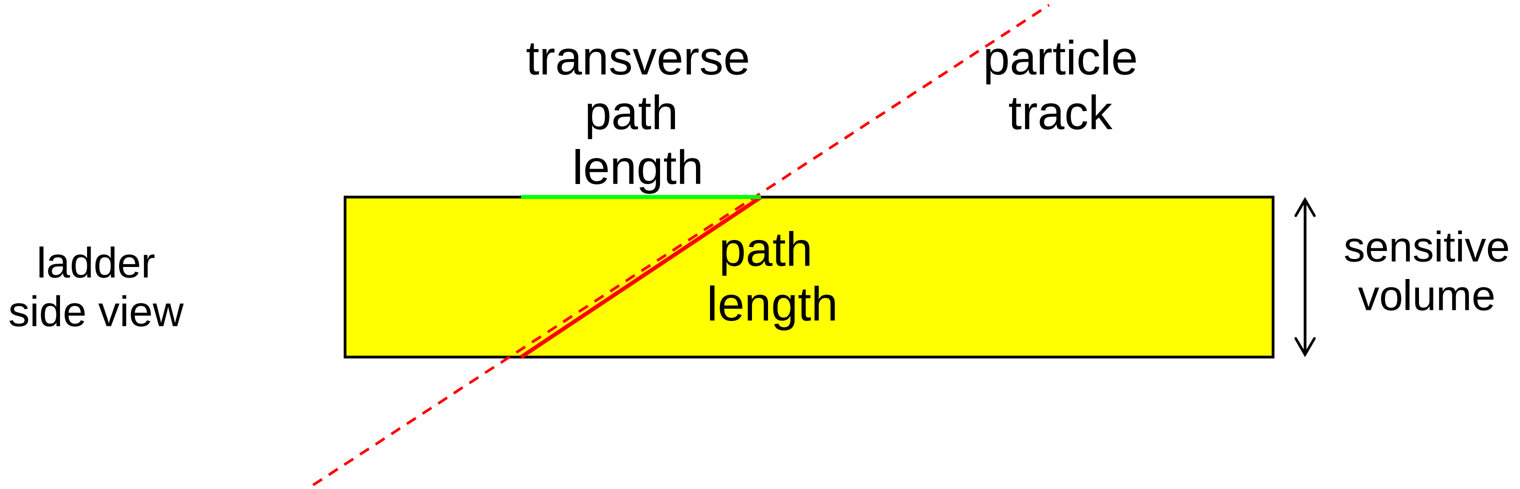


Hit rates

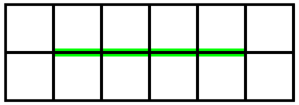


hits/mm^2/BX
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-150
-100
-50
0
50
100
150
z (mm)
layer 1
layer 2 × 5
layer 3 × 5
layer 4 × 5
layer 5 × 5

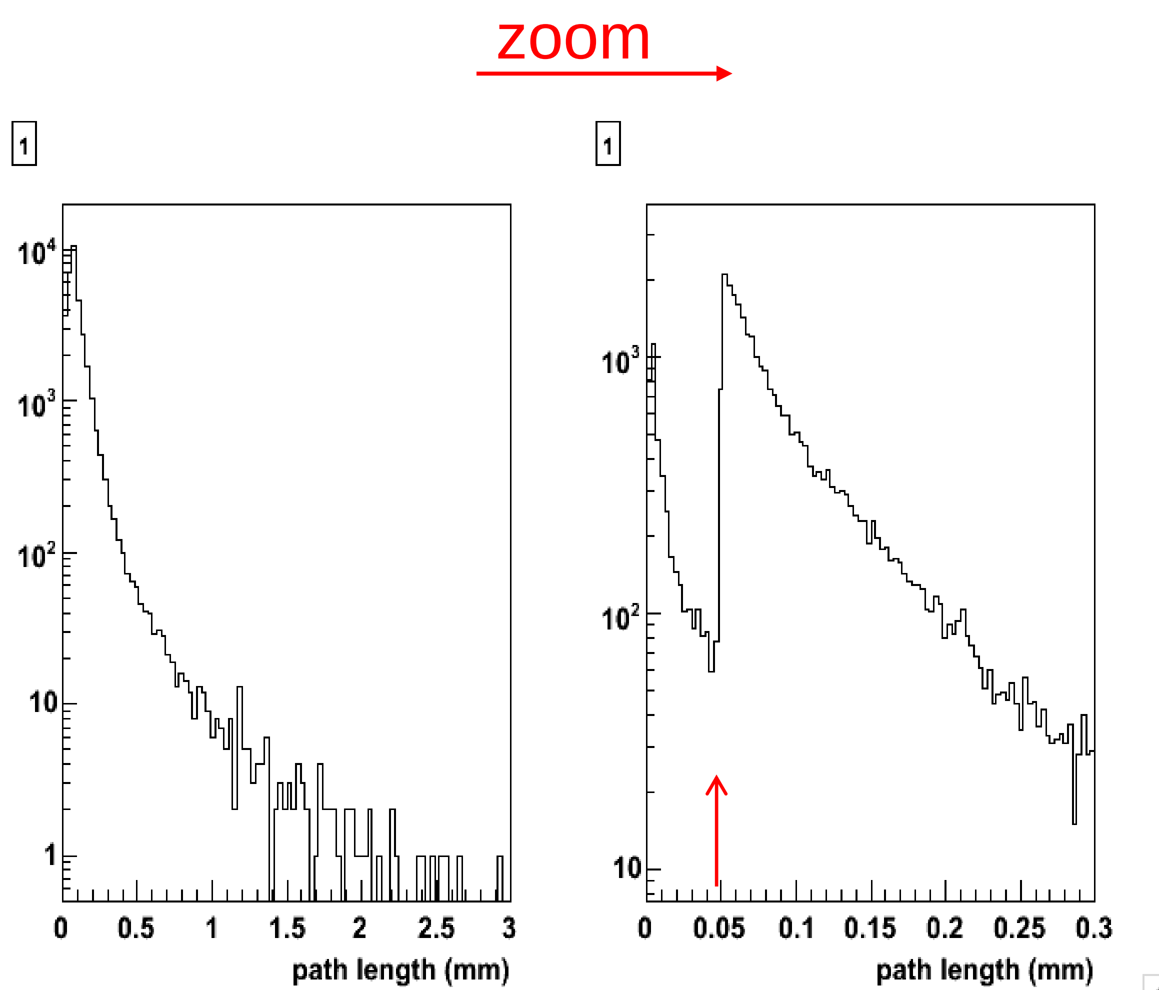
How to get to the occupancy…



seed pixels = pl_T / pitch size
pixels in cluster = 2 x #seed pixels + 4



Path length (from GEANT) on the innermost layer



Evaluated with the option *lcioDetailedTRKHitMode* in Mokka.

Path length smaller than the detector thickness belong to secondaries created in the VXD.

Estimate of the occupancy

50 μm thick sensitive volume

Layer	pitch (μm)	integration time(μs)
1	25	50
2	25	200
3	25	200 □□
4	25	200
5	25	200

Layer	occupancy
1	0.059
2	0.027
3	0.007
4	0.003
5	0.001

Alleviating the occup□ancy

15 μm thick sensitive volume
(and larger clusters due to thermal diffusion)

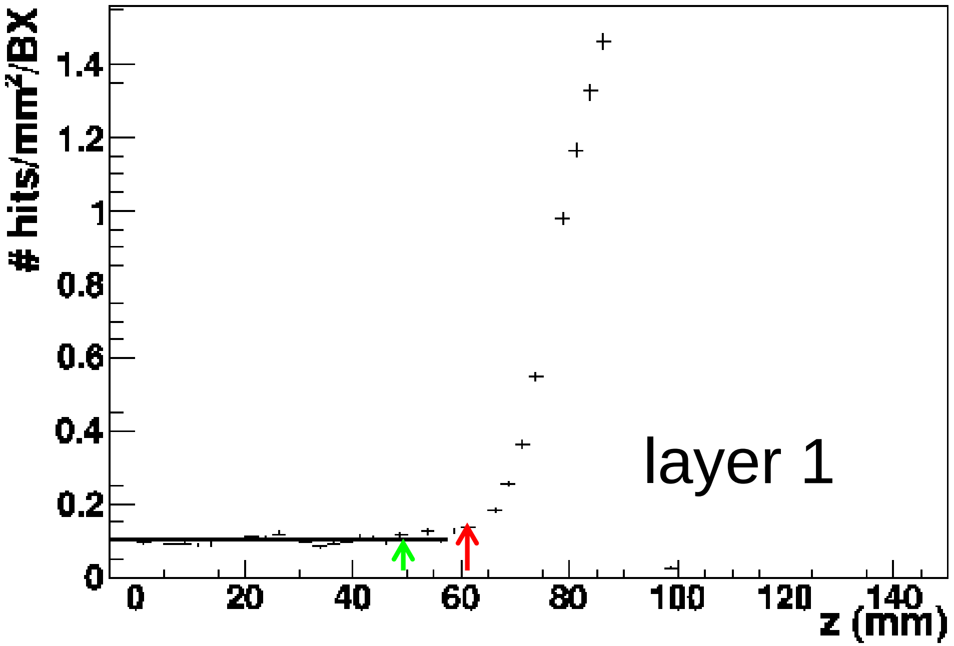
Layer	pitch (μm)	integration time(μs)
1	20	25
2	25	50
3	33	100 □□
4	33	100
5	33	100

See M. Winter's talk
in the same session

Layer	occupancy
1	0.015
2	0.005
3	0.004
4	0.002
5	0.001

Low P configuration

(double layer geometry)



~X2 increase

Layer	hit rate (/cm²/BX)
1	8.1 ± 0.5
2	5.1 ± 0.4
3	4.4 ± 0.2 x 10^{-1}
4	3.3 ± 0.1 x 10^{-1}
5	7.0 ± 0.7 x 10^{-2}
6	6.0 ± 0.5 x 10^{-2}

nominal

1	3.61 ± 0.14
2	2.24 ± 0.11
3	1.54 ± 0.14 x 10^{-1}
4	1.34 ± 0.11 x 10^{-1}
5	3.2 ± 0.7 x 10^{-2}
6	2.7 ± 0.5 x 10^{-2}

Depending on the technology maybe necessary to increase the inner radius

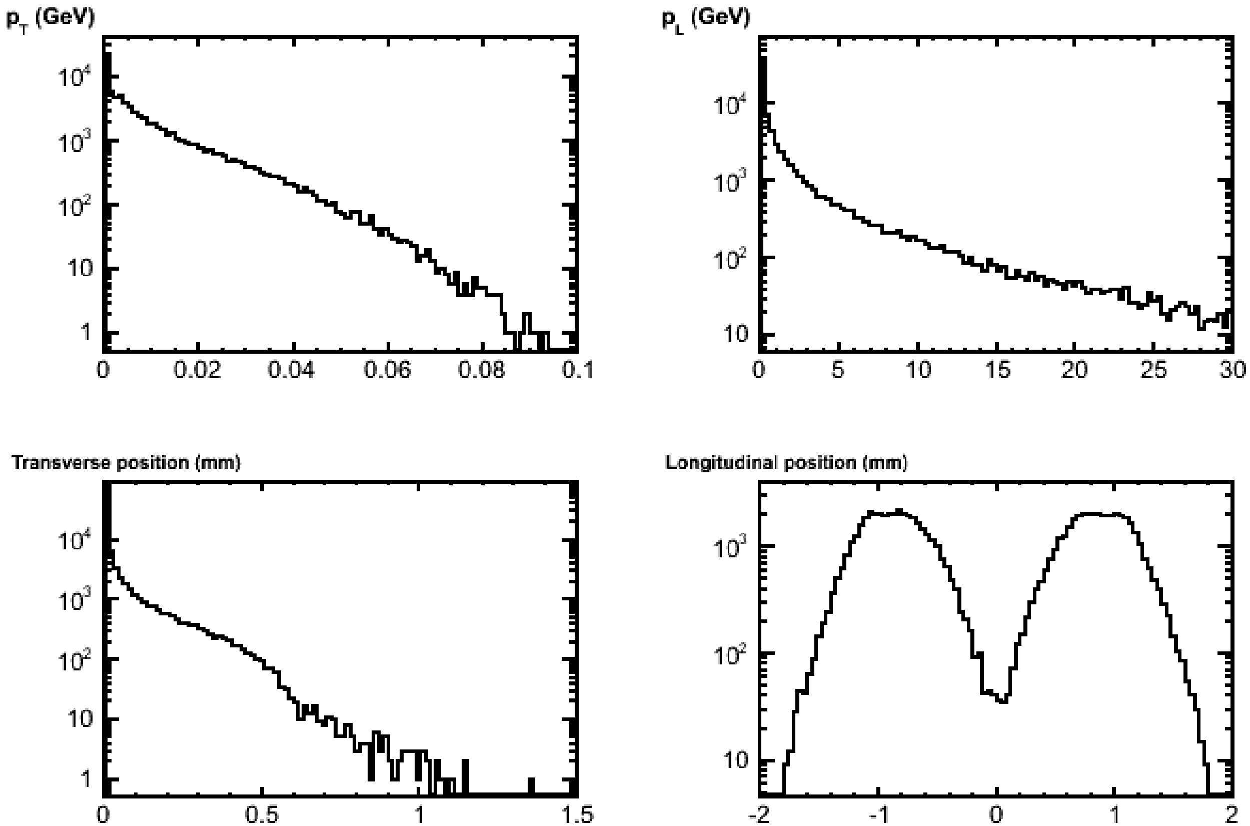
Conclusions

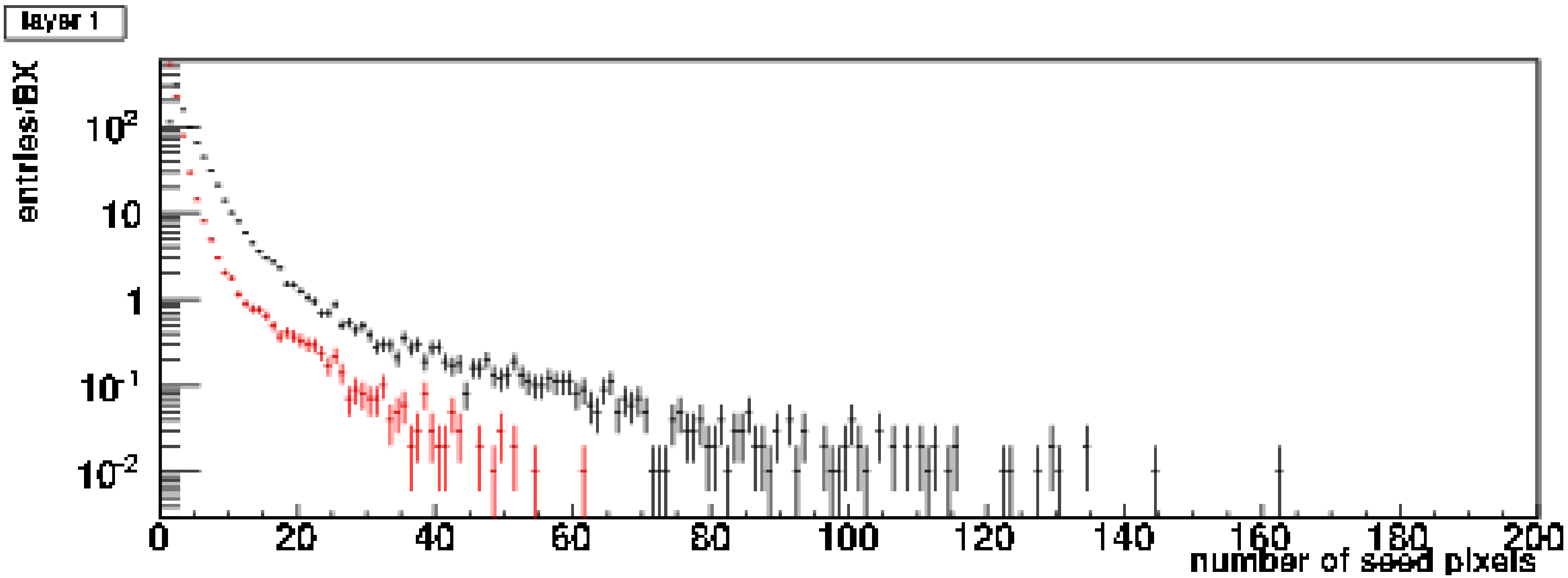
- The occupancy in the two innermost layers is several % (anti-DID included, no safety factor).
- The occupancy grows by a factor >2 for the low-P option.
- A reduction by a factor 4 to 5 follows from different sensor parameters: thinner sensitive volume, faster readout, … .

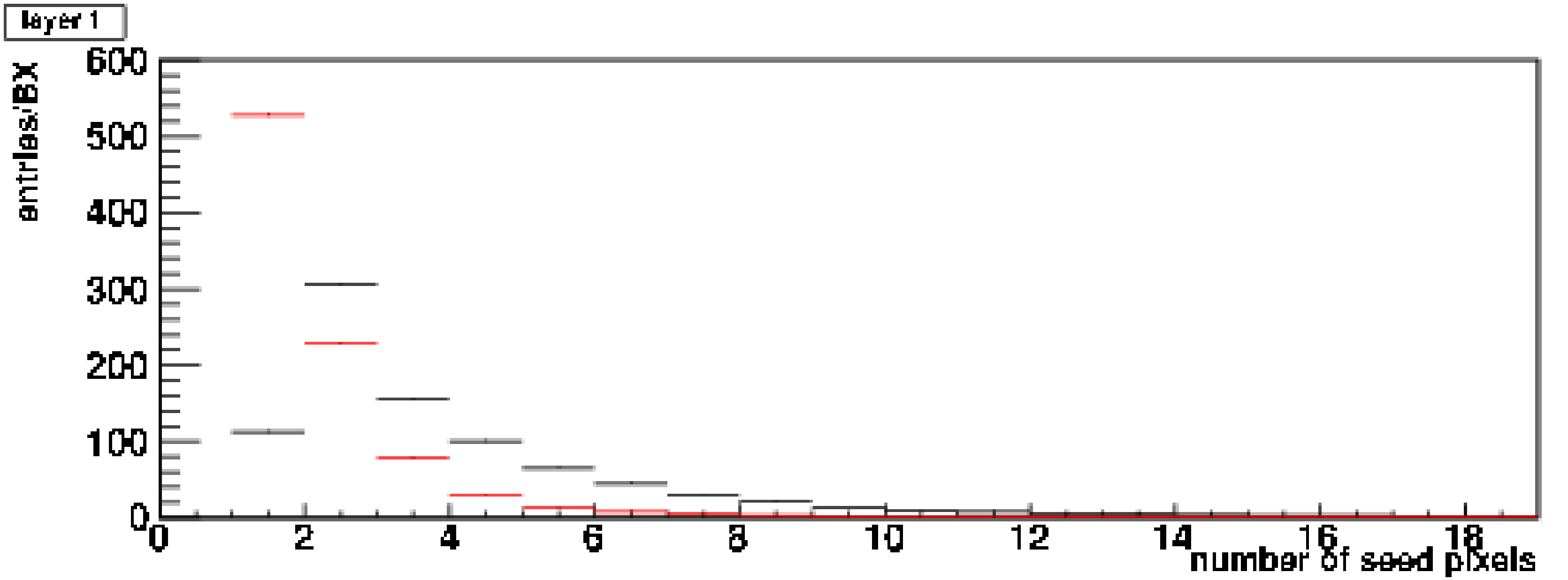
Backup slides

Primary particles (from GuineaPig)

position and momentum spectra




layer 1
entries/BX
10^2
10
1
10^{-1}
10^{-2}
0
20
40
60
80
100
120
140
160
180
200
number of seed pixels


layer 1
entries/BX
600
500
400
300
200
100
0
0
2
4
6
8
10
12
14
16
18
number of seed pixels