

# A brief report on pair backgrounds studies

updates since KILC12

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KEK

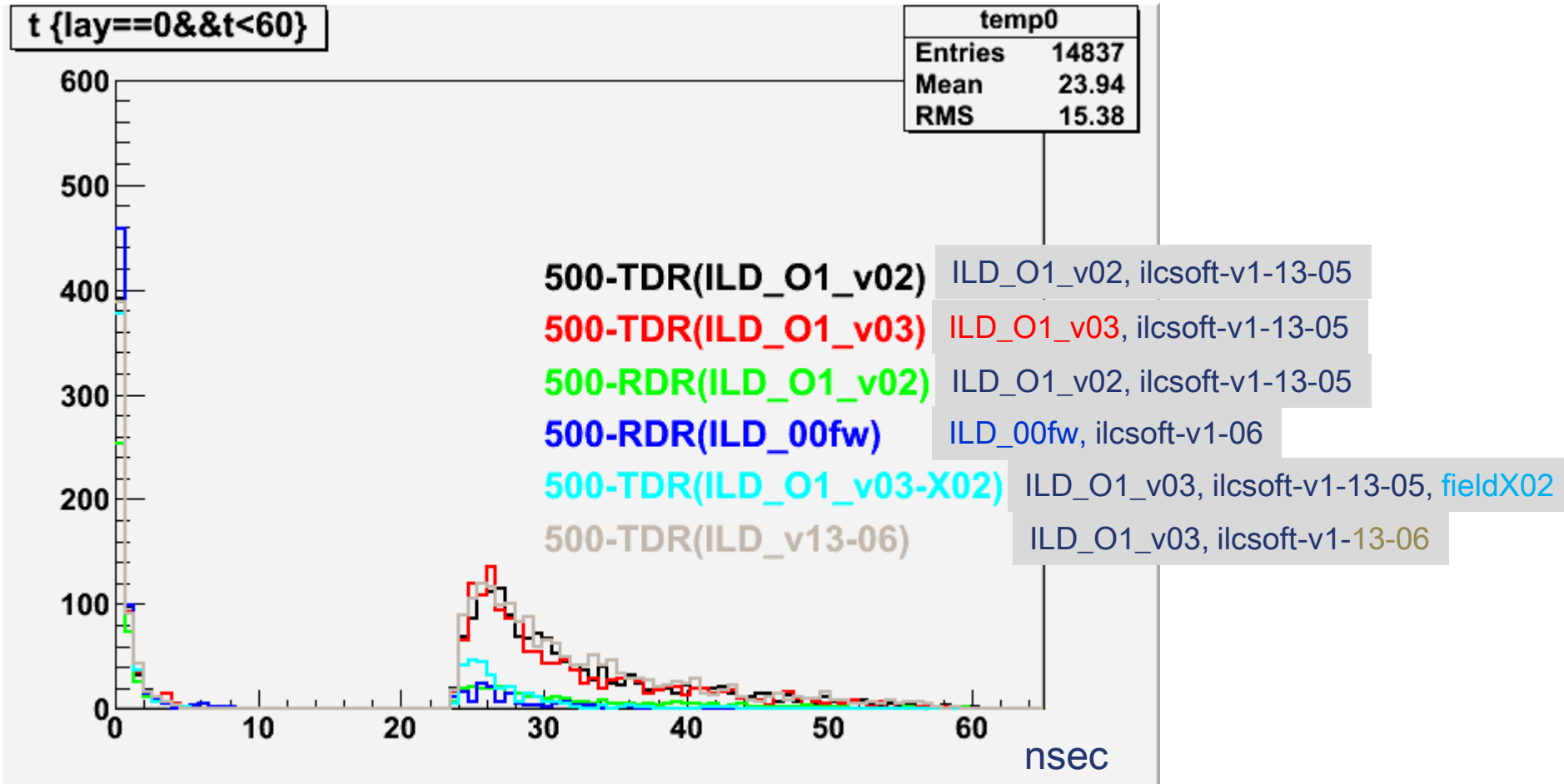
24-May-2012  
ILDWS

# VTX bkg hit occupancy ( w. “CMOS” ) KILC12

Beam para.	1000GeV-B1b_ws				1000GeV-A1		500 GeV_ws				LOI
DID	w. AntiDID		no. DID		w. AntiDID		w. AntiDID		w. AntiDID		
Detector	ILD_O1_v02								ILD_00fwp01		
Sim. Stat.	20Bx		20Bx		20Bx		7Bx		7Bx		
Layer	Hits/BX	occ.(%)	Hits/BX	occ.(%)	Hits/BX	occ.(%)	Hits/BX	occ.(%)	Hits/BX	occ.(%)	occ.(%)
0	6214	12.84	25821	53.35	2771	5.73	2132	2.93	2679	3.67	3.33
1	3334	6.89	14599	30.16	1525	3.15	1102	1.51	1674	2.30	1.90
2	1143	2.18	788	1.51	519	0.99	349	0.44	335	0.42	0.40
3	663	1.27	567	1.08	328	0.63	223	0.28	287	0.36	0.33
4	317	0.40	342	0.43	162	0.21	91	0.08	69	0.06	0.08
5	272	0.35	333	0.42	129	0.16	90	0.08	62	0.05	0.06

- Hit occupancies are estimated at 1 TeV and 500 GeV, with different det. config.
- 1 tracker hit = 4 pixel hits assumed. ( 9 pixel/hit might be used in LOI )
- 500 GeV case, ILD\_00fwp01 results consistent with LOI values  
 ILD\_O1\_v02 is about 20~30% less than ILD\_00fwp01 in L0&1.
- 1000 GeV : w. AntiDID is about x4 of 500 GeV  
 no DID/w.DID x4 more hits in 1<sup>st</sup> layer.  
 Note: # Pairs = 430k/BX(1TeV), 169k/BX(500GeV) → x 2.5
- Considering phi dep. Layer 0, ladder 3~5 have ~1/2 hits of 11 ladders.  
 → Occupancy would be ~ 3 larger in these ladders

# Time dist. of VTX hits



Back scattering from 3.6m ( = 24nsec x c/2 )

# Direct hits vs Backscatter

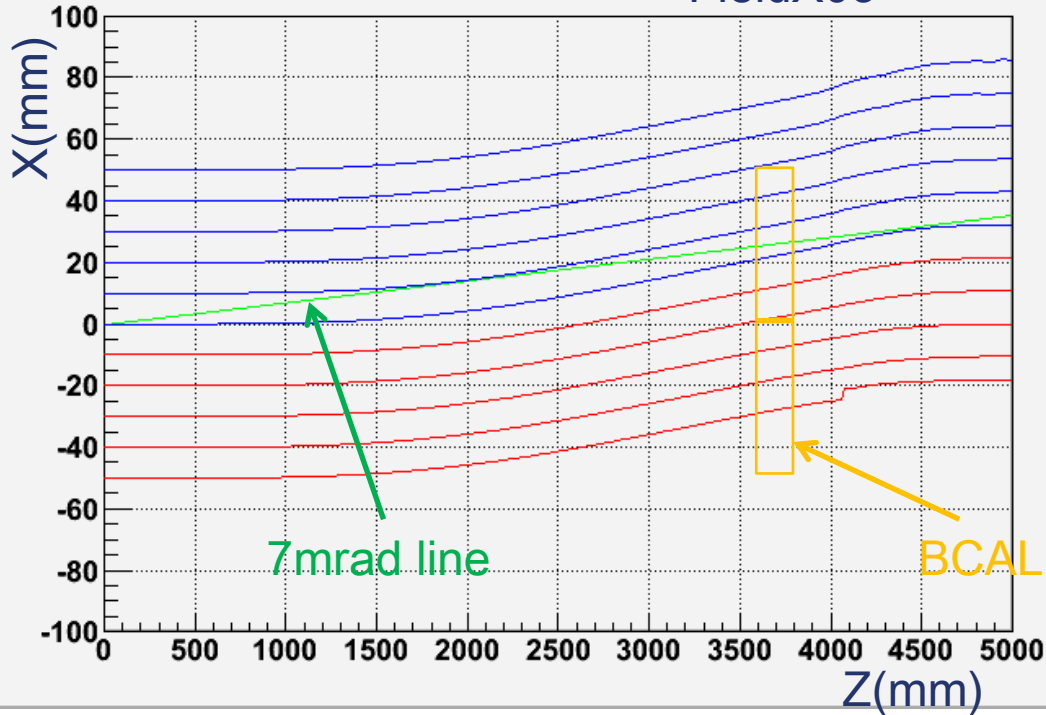
		Layer0 Hits/BX		
		t<20ns	t>20ns	(t>20)/(t<20)
500-TDR	O1_v02	557	1576	2.83
	O1_v03	568	1490	2.62
	O1_v03.w 13-06	563	1800	3.20
	O1_v03-X02	541	305	0.56
500-RDR	O1_v02	382	322	0.84
	ILD_00fw	650	150	0.23

- No difference between ILD\_O1\_V02 and ILD\_O1\_V03
- TDR/RDR (ILD\_O1\_V02)
  - direct hits ( t<20ns ) x 1.5, back scattering ( t > 20ns ) x 4.8
- 500-RDR (ILD\_00fw)
  - /grid/ilc/mc2008\_2/simulated/ILD\_00/pair\_bkgs\_nominalparams\_cms500/pairs\_nominal\_500GeV\_r unXX
  - Total rate of ILD\_O1\_V02 is similar to ILD\_00fw, but direct/backscattering ratio is different.

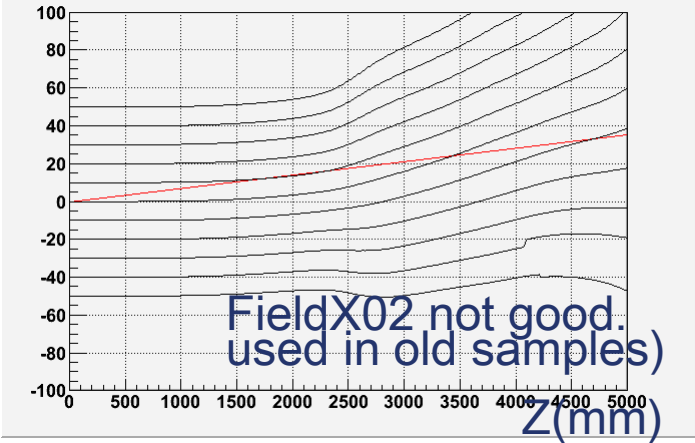
	ILD_00fw	ILD_O1_V02
FieldMap	fieldX02	fieldX03
TPCCut	10kev	0kev
range cut	0.2mm	0.1mm
userDeltaIntersection	default	1e-5mm
userDeltaOneStep	default	1e-4mm
PhysicsList	LCPHYS	QGSP_BERT

# Anti-DID field

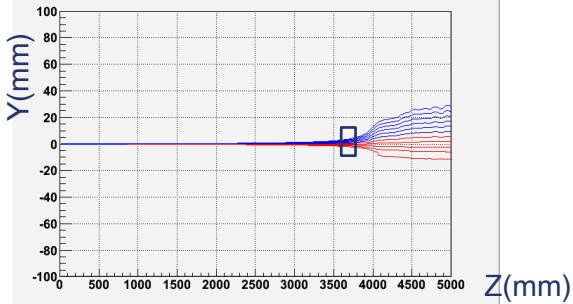
Field map(ZX-FieldX03: Z vs X)



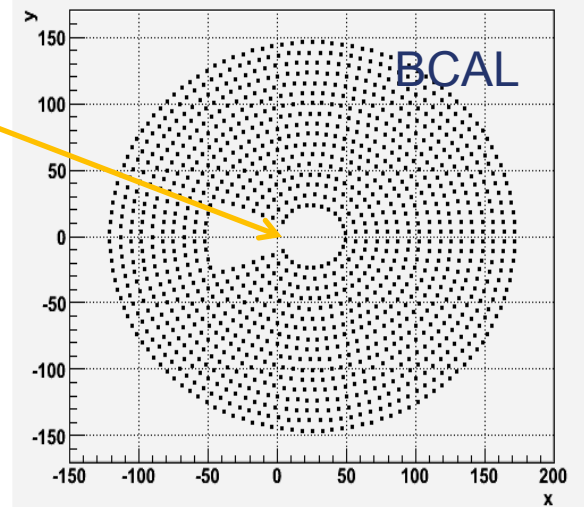
Field map(ZX-FieldX02: Z vs X)



Field map(ZY-FieldX03: Z vs Y)



y:x {K=1&&z>0}

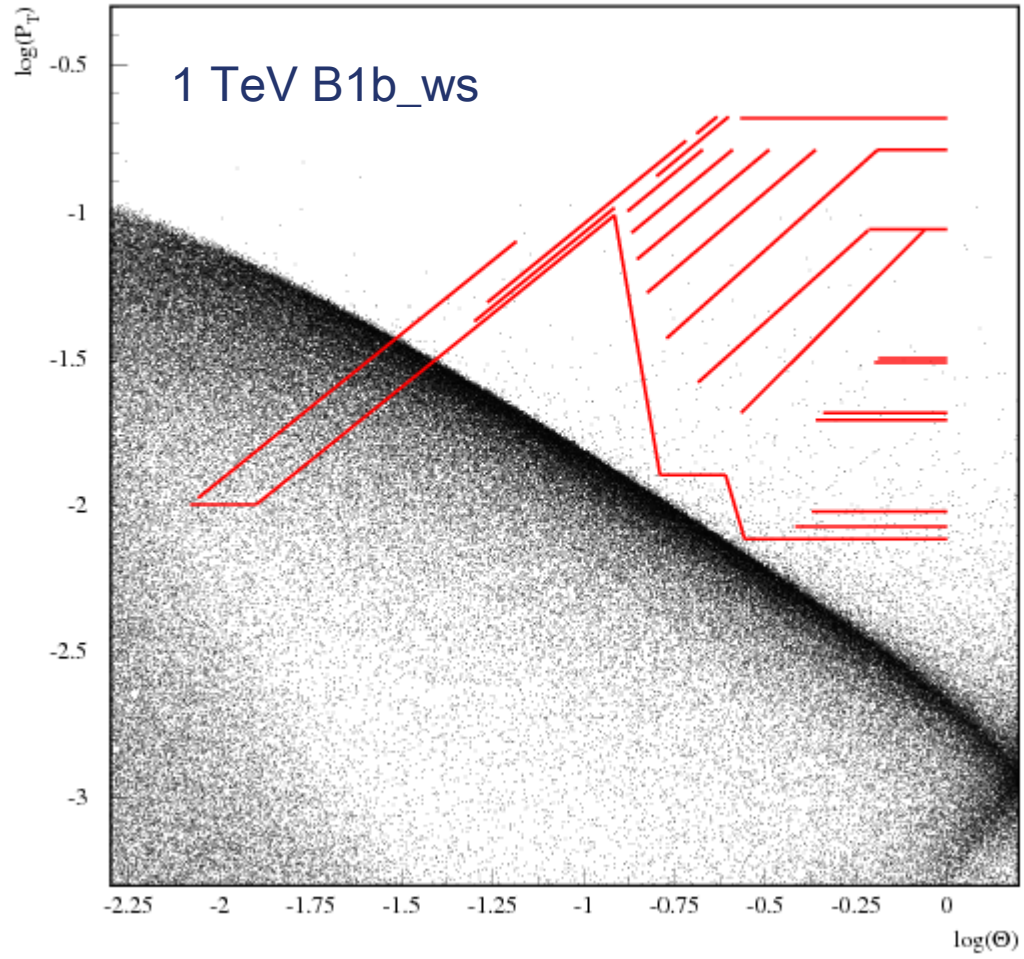


# Backup Slides

# TDR beam parameter

<http://ilc-edmsdirect.desy.de/ilc-edmsdirect/item.jsp?edmsid=D00000000965015>

					L upgrade	Ecm upgrade	
Center of mass energy	GeV	250	350	500	500	A1	B1b
Collision rate	Hz	5	5	5	5	4	4
Number of bunches		1312	1312	1312	1312	2450	2450
e-(e+) bunch poplation	$\times 10_{10}$	2	2	2	2	1.74	1.74
Bunch separation	ns	554	554	554	366	366	366
RMS bunch length	mm	0.3	0.3	0.3	0.3	0.25	0.225
Electron RMS energy spread	%	0.190	0.158	0.125	0.125	0.083	0.085
Positron RMS energy spread	%	0.150	0.100	0.070	0.070	0.043	0.047
Electron polarization	%	80	80	80	80	80	80
Positron polarization	%	30	30	30	30	20	20
Horizontal emittance	m	10	10	10	10	10	10
Vertical emittance	nm	35	35	35	35	30	30
IP horizontal beta function	mm	12	15	11	11	22.6	11
IP vertical beta function(no TF)	mm	0.48	0.48	0.48	0.48	0.25	0.23
IP RMS horizontal beam size	nm	700	662	474	474	481	335
IP RMS vertical beam size(no TF)	mm	8.3	7	5.9	5.9	2.8	2.7
Coherent waist shift	m	250	250	250	250	190	190
Luminosity incl. waist shift	$\times 10^{34} \text{cm}^{-2} \text{s}^{-1}$	0.8	0.9	1.8	3.6	3.6	4.9
Fraction of lum. in top 1%	%	84.1	79.3	62.5	62.3	60.2	45.5
Average energy loss	%	1.23	1.75	4.3	4.3	5.3	9.9
Number of pairs per BX	$\times 10^3$	70.5	89.1	139	139	200.5	382.6 >1MeV



By Mikael Berggren



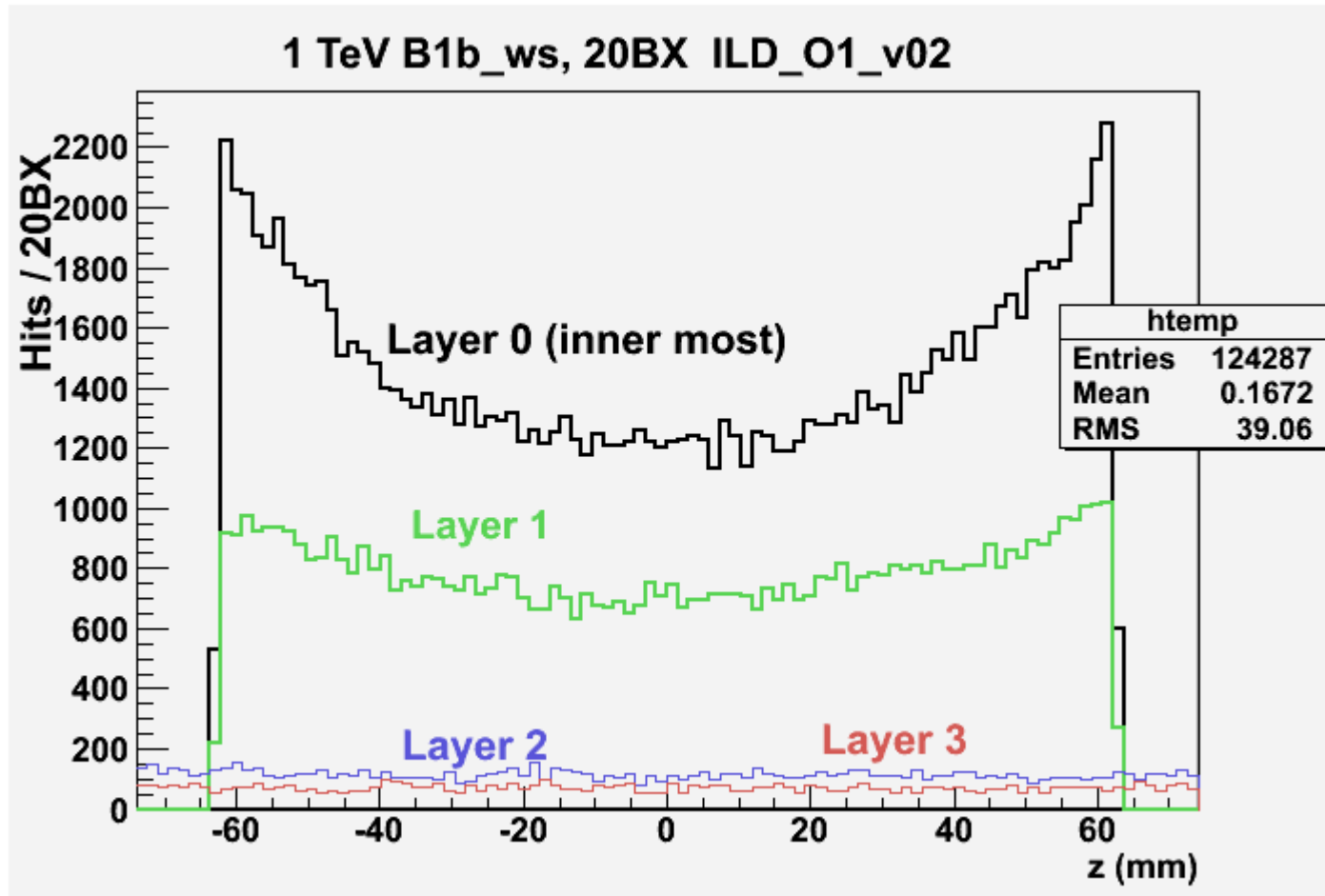
# Simulation conditions

- GuineaPig files : produced by Hartin. Taken from  
/afs/desy.de/group/flc/pool/analysis/public/pairs/hartin/[1000,500]GeV
  - Waisty\_opt\_Jan2012\_[1000GeV\_B1b, 1000\_A1]\_runX\_waisty\_190 20BX
  - Waisty\_opt\_Jan2012\_500GeV\_run9\_waisty\_250 7BX
  - RDR\_500 ...
- Mokka: ilcsoft-v01-13-04, Mokka-07-07
  - ILD\_O1\_v02 ( exist overlap geometry in beam pipe, ... not perfect yet. )
  - ILD\_00fwp01 (500GeV) for comparison with LOI
  - ILD\_O1\_v03 & ilcsoft-v01-13-06 ( mokka-07-07-p08 ) - new**
- Setting for Anti-DID and pair simulation in mokka.steer

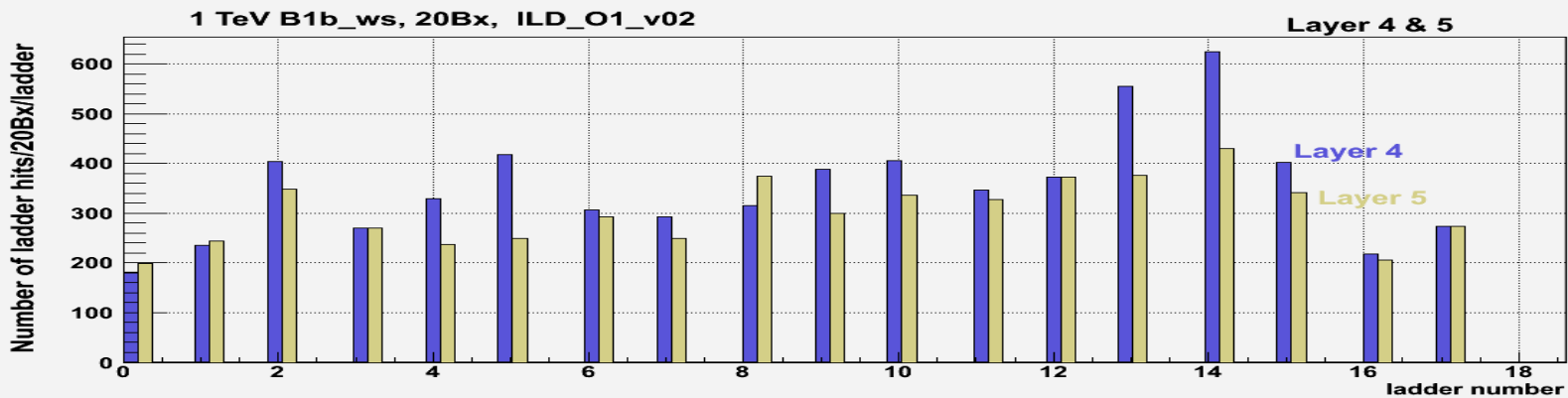
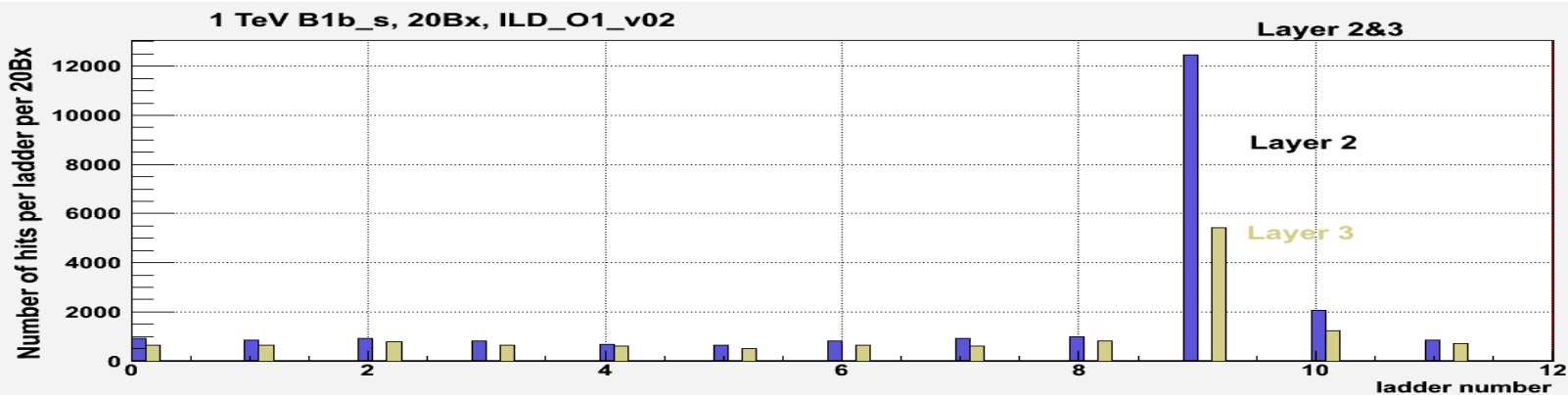
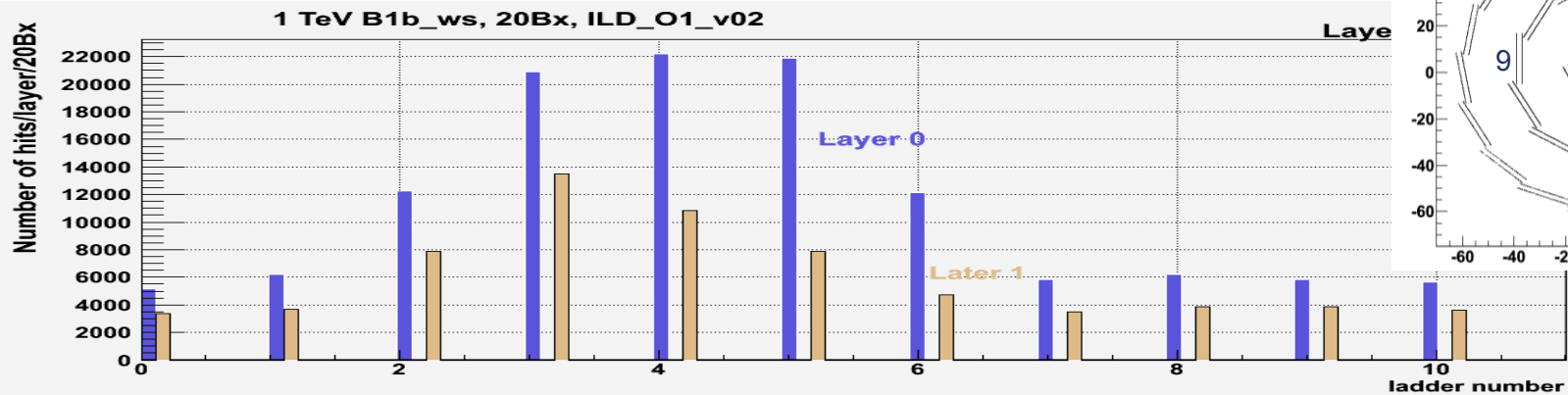
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/Mokka/init/EditGeometry/rmSubDetector SField01
/Mokka/init/EditGeometry/addSubDetector fieldX03 1000
/Mokka/init/IcioDetailedTRKHitMode SITCollection
/Mokka/init/IcioDetailedTRKHitMode VXDCollection
/Mokka/init/IcioDetailedTRKHitMode FTDCollection
/Mokka/init/IcioDetailedTRKHitMode TPCCollection
/Mokka/init/IcioDetailedTRKHitMode TPCSpacePointCollection
/Mokka/init/TPCLowPtStepLimit true
/Mokka/init/pairParticlesPerEvent 100
/Mokka/init/TPCCut 0 keV
/Mokka/init/RangeCut 0.1mm
```



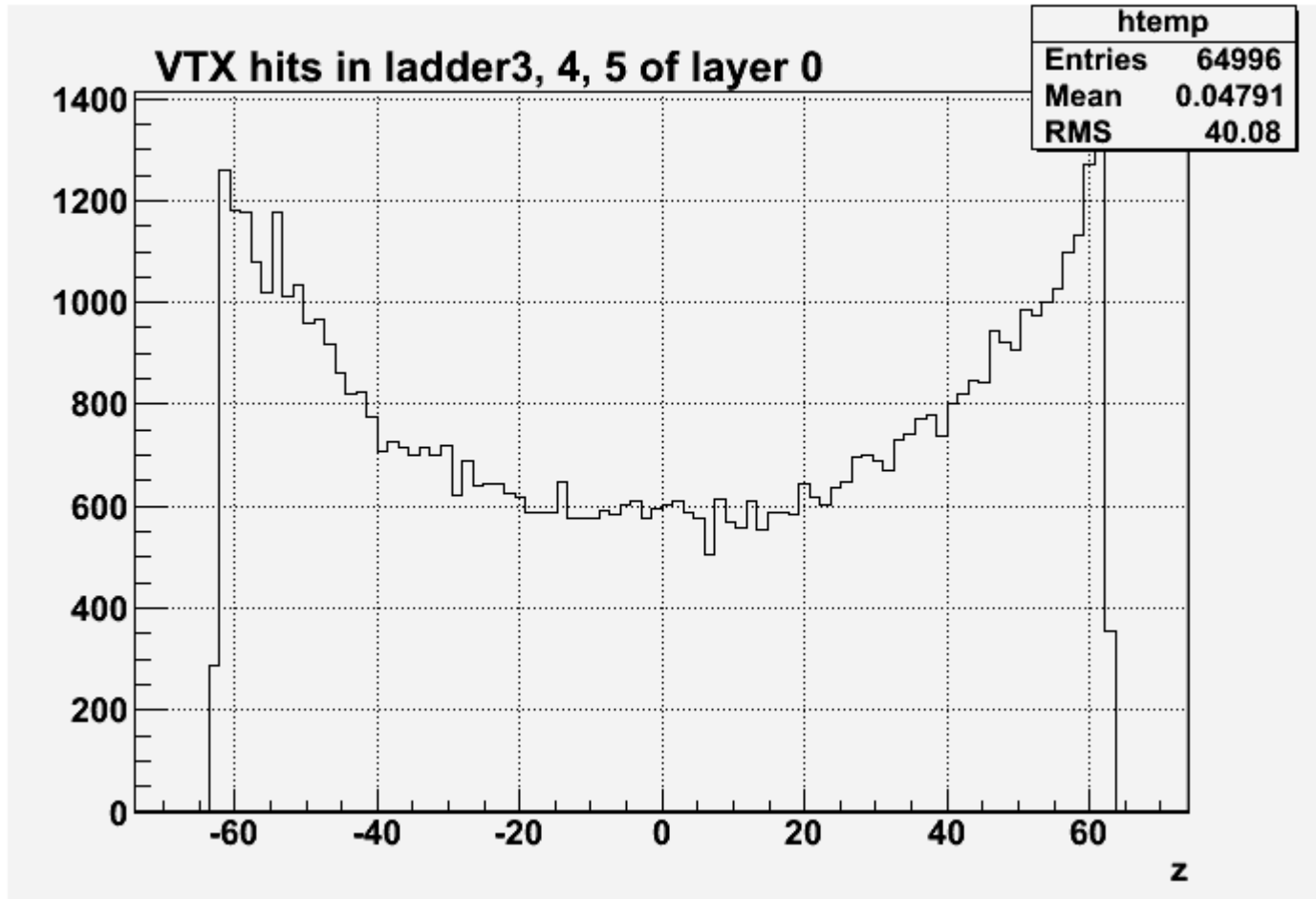
# Z distribution



# Phi dependance of VTX hits



## VTX hits in ladder 3 and 4 and 5

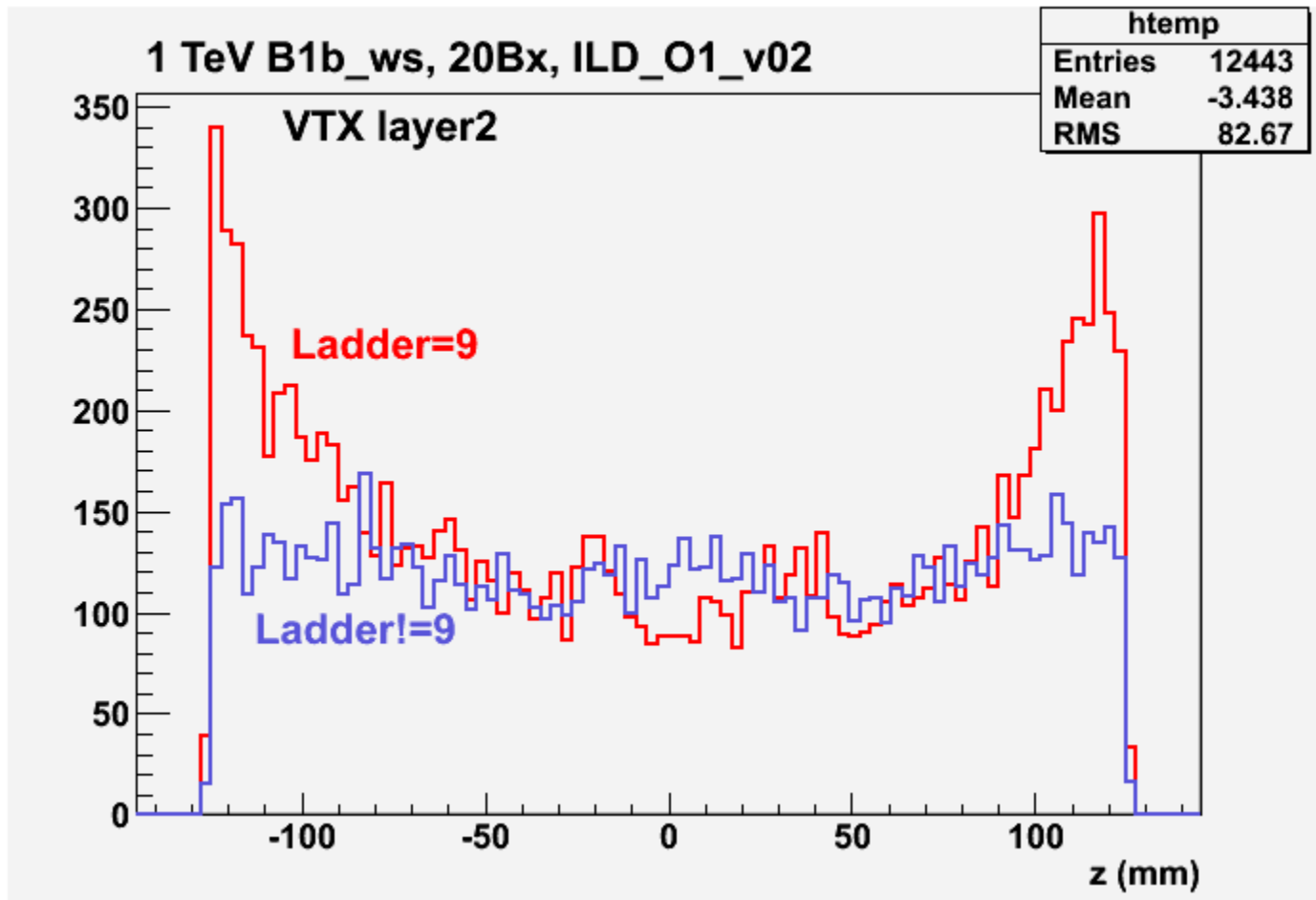


About half of hits in the inner most layer is in ladder 3, 4, and 5

Layer 2 ladder 9:

Z distribution of ladder 9 is similar to layer0 ladders.

Many hits due to back scattering ?



# VTX geometry to calculate hit occupancy

- Hit occupancy is calculated assuming 1 SimTrackerHit create 4 pixel hits

$$\text{Occupancy} = \frac{4 * (\# \text{ of simtracker hits /BX}) * (\# \text{ of BXs/Read out})}{\text{total number of pixels}}$$

Ladder width 11 mm  
 Half length  
 Layer 0&1 62.5 mm

Readout time  
 CMOS layer0&1 46 usec  
 layer2,3,4,5 184 usec

1 TeV  
 FPCCD inter-pulse  
 Number of bunches 2450  
 bunch separation 366 nsec

Layer	Width (mm)	HalfL (mm)	#Ladder	CMOS like			FPCCD like			FPCCD/CMOS
				#BX/RO	Pixel size (um <sup>2</sup> )	#Pixels (M)	#BX/RO	Pixel size (um <sup>2</sup> )	#Pixels (M)	#RO/#Pixel ratio
0&1	11	62.5	11	125	25 <sup>2</sup>	24.2	2450	5 <sup>2</sup>	605	0.784
2&3	22	125	12	504	25 <sup>2</sup>	105.6	2450	5 <sup>2</sup>	2640	0.194
4&5	22	125	18	504	25 <sup>2</sup>	158.4	2450	5 <sup>2</sup>	3960	0.194

500 GeV number of bunches 1312  
 bunch separation 554 nsec

Layer	Width (mm)	HalfL (mm)	#Ladder	CMOS like			FPCCD like			FPCCD/CMOS
				#BX/RO	Pixel size (um <sup>2</sup> )	#Pixels (M)	#BX/RO	Pixel size (um <sup>2</sup> )	#Pixels (M)	#RO/#Pixel ratio
0&1	11	62.5	11	83	25 <sup>2</sup>	24.2	1312	5 <sup>2</sup>	605	0.632
2&3	22	125	12	333	25 <sup>2</sup>	105.6	1312	5 <sup>2</sup>	2640	0.158
4&5	22	125	18	333	25 <sup>2</sup>	158.4	1312	5 <sup>2</sup>	3960	0.158

# Pixel occupancy

13

- Pixel occupancy for 1train.
  - cut : signal  $e^- > 200 e^- / \text{pixel}$
  - $\sim 5$  times greater than sb2009wTF-500 (# BX is different)

Layer	1TeV Without cut	1TeV With Cut	Sb2009wTF-500 w/ cut
1	20.1 %	15.5 %	3.079 %
2	10.1 %	7.79 %	1.74 %
3	0.854 %	0.674 %	0.0919 %
4	0.458 %	0.363 %	0.0731 %
5	0.145 %	0.116 %	0.017 %
6	0.116 %	0.094 %	0.015 %

This study

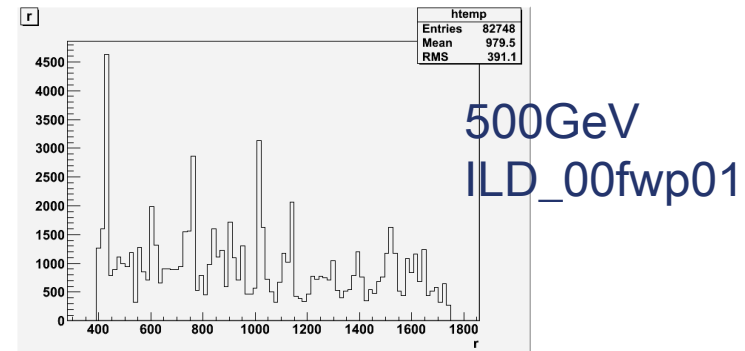
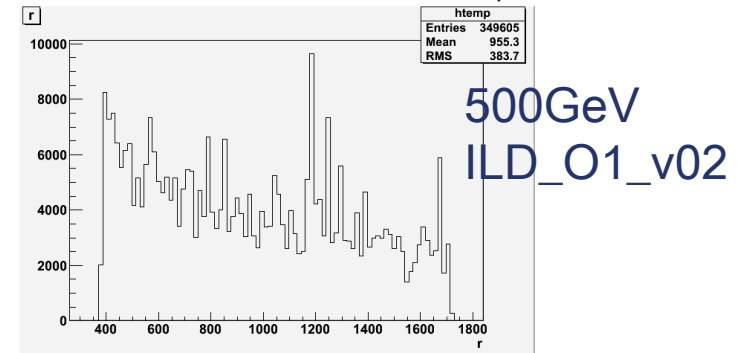
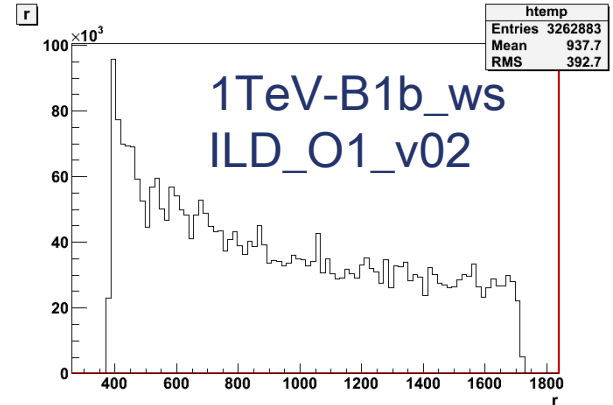
KILC 12 April 25, 2011

by D.Kamai @ KILC12

## TPC hits

1 TeV-B1b\_ws : 163k hits/BX (ILD\_O1\_v02)  
-A1 : 78k hits/BX (ILD\_O1\_v02)  
TDR- 500 GeV : 50k hits/BX (ILD\_O1\_v02)  
49k hits/BX (ILD\_O1\_v03)  
12k hits/BX (ILD\_00fwp01)  
RDR\_500 : 7k hits/BX (ILD\_O1\_v02)

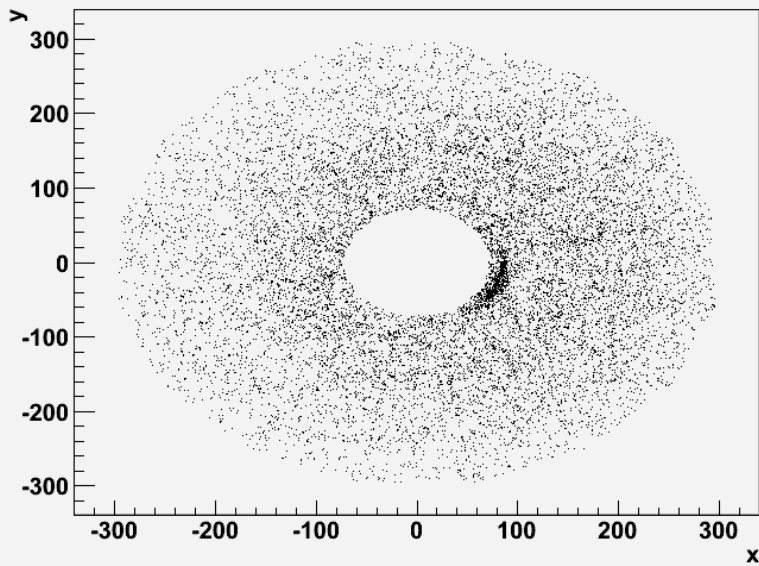
1 TeV ~ 3 x 500 GeV hits  
ILD\_O1\_V02 ~ 4xILD\_00fwp01



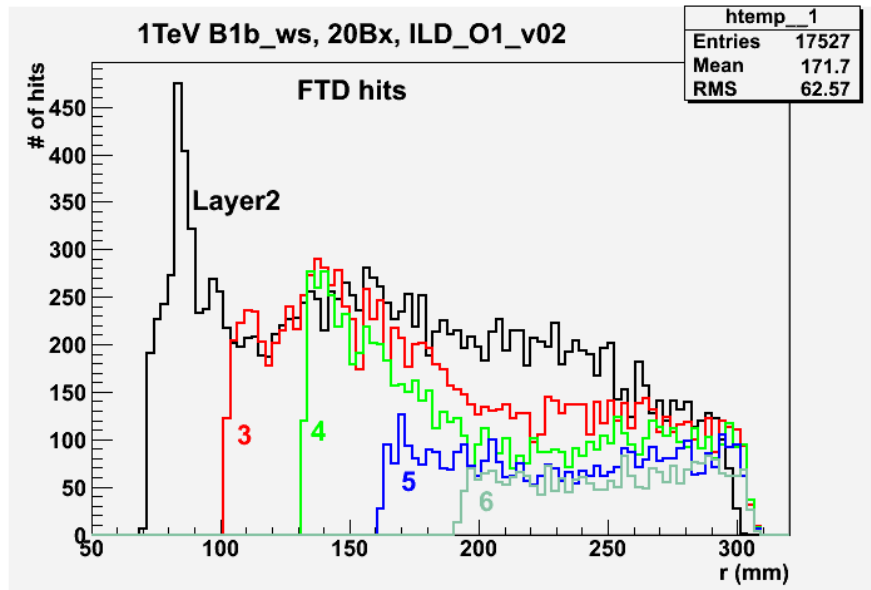
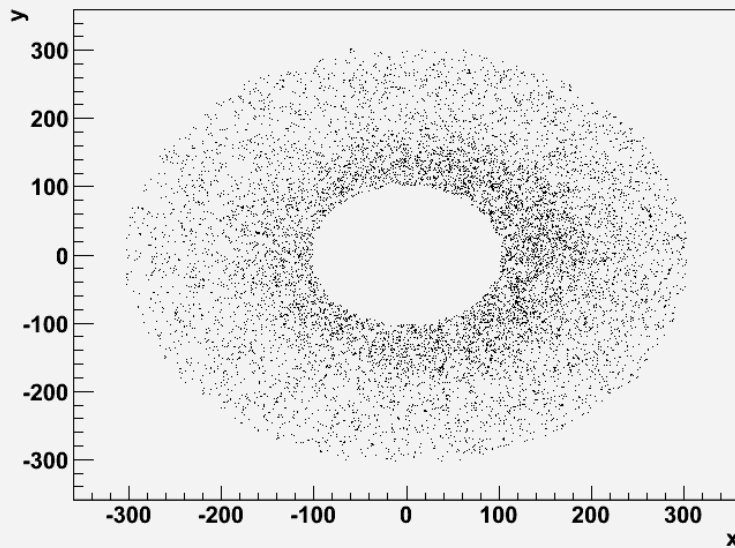


# FTD Hits 1 TeV (ILD\_O1\_V02)

y:x {lay==2&&z>0}



y:x {lay==3&&z>0}



Layer	#Hits/BX		Ratio
	1TeV B1b_ws	0.5TeV	
0	0	0	
1	0	0	
2	876	270	3.24
3	619	191	3.24
4	407	123	3.31
5	202	56	3.59
6	126	37	3.37

# Summary

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- Background hit occupancies were studied with the recent codes
- VXD
  - ◆ 500 GeV result is consistent with LOI result (assume 4pixels/hit)
  - ◆ CMOS like VXD,
    - Hit occupancy of SimTrackerHit at 1 TeV was about x4 of 500 GeV
    - Taking into account phi-dependence of hit distribution, the occupancy could be x3 larger
    - Faster readout is required.
  - ◆ FPCCD like VXD ( smaller pixels, inter-pulse readout ),
    - Occupancies at the inner layers would be higher.
- TPC, FTD, BCAL : 3~4 times more hits at 1 TeV-B1b
- 500 GeV ILD\_O1\_V02 : ~x3 more TPC hits than ILD\_00fwp01
- Larger backscattering were seen with 500-TDR beam parameter