TCMB – CR-0016

SiD Occupancy Studies for the ILC250 beam parameters

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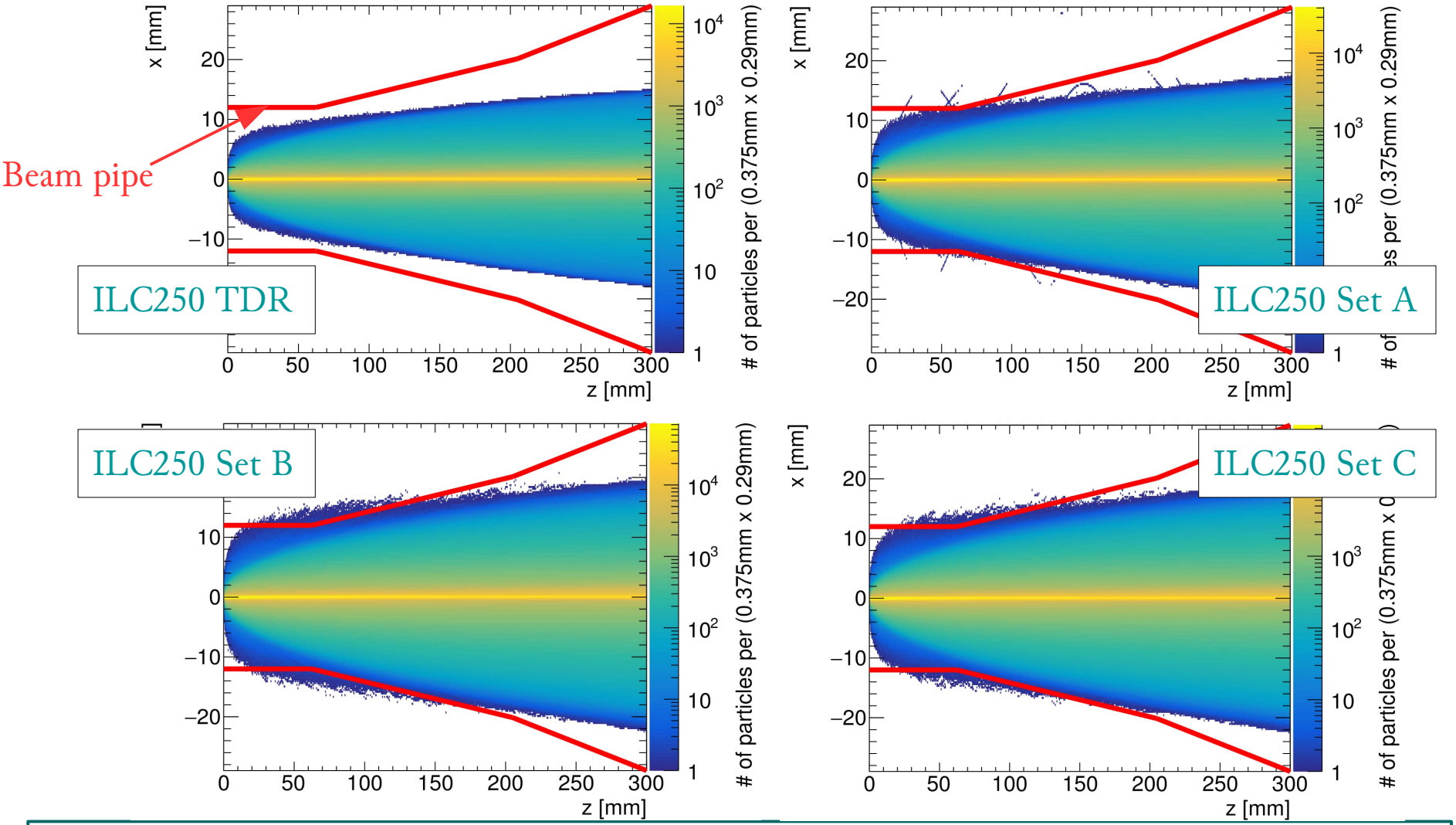
on behalf of the SiD Optimization Group

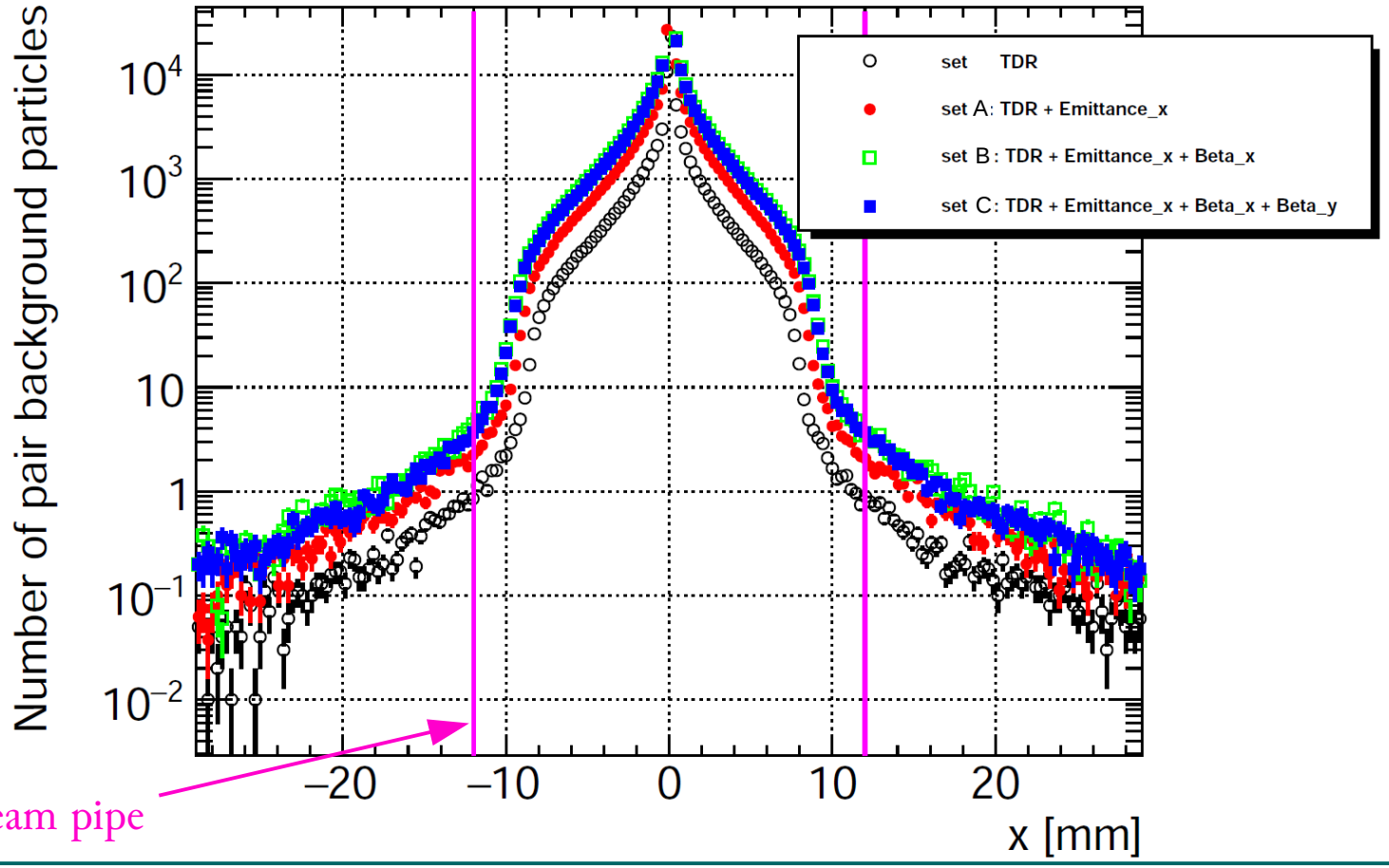
1. Pair Background Density
2. SiD Occupancy
3. Conclusion

Pair Background Density in the 5T solenoid field



The broader the envelope, the more particles reach the inner most layers of the detector.

Pair Background Density in the 5T solenoid field



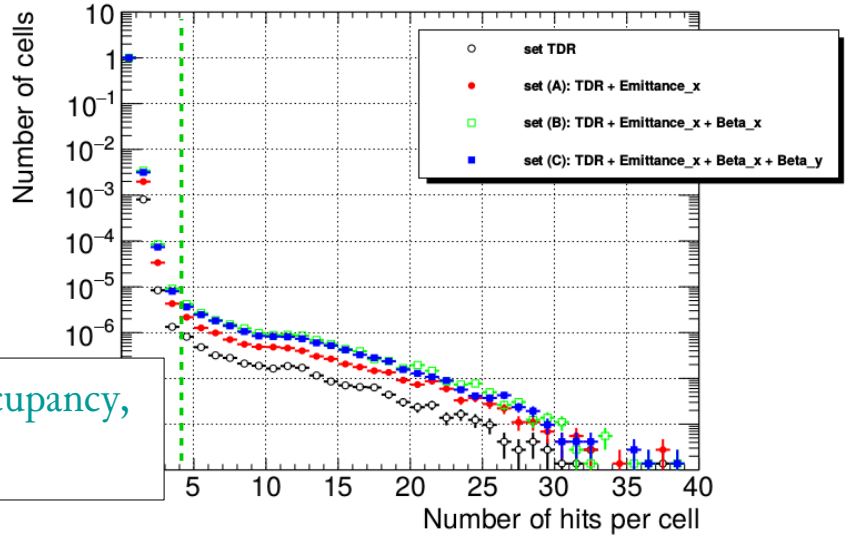
The number of pairs is increased by a factor of ~4-6 wrt the TDR scheme.

The so-called 'pair edge' is well contained within the beam pipe.

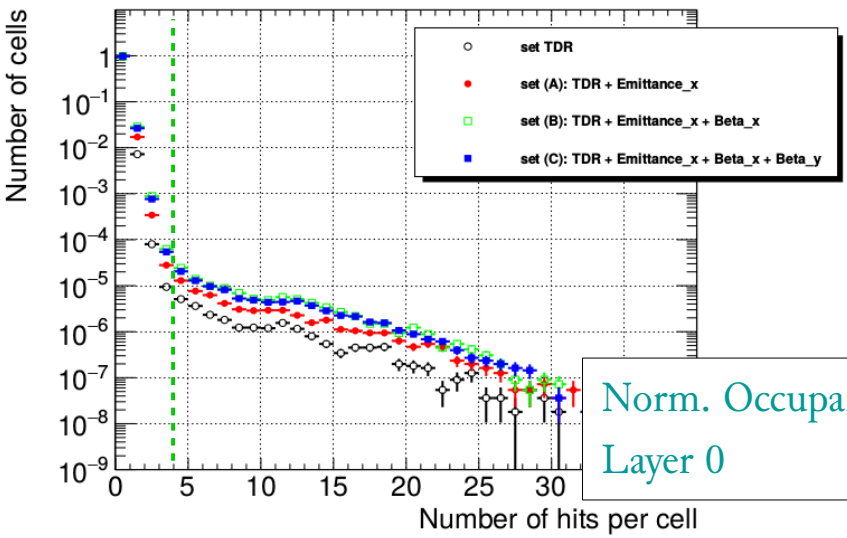
Less than 10 particles can be found outside the beam pipe at any given location.

SiD Vertex Detector Occupancy

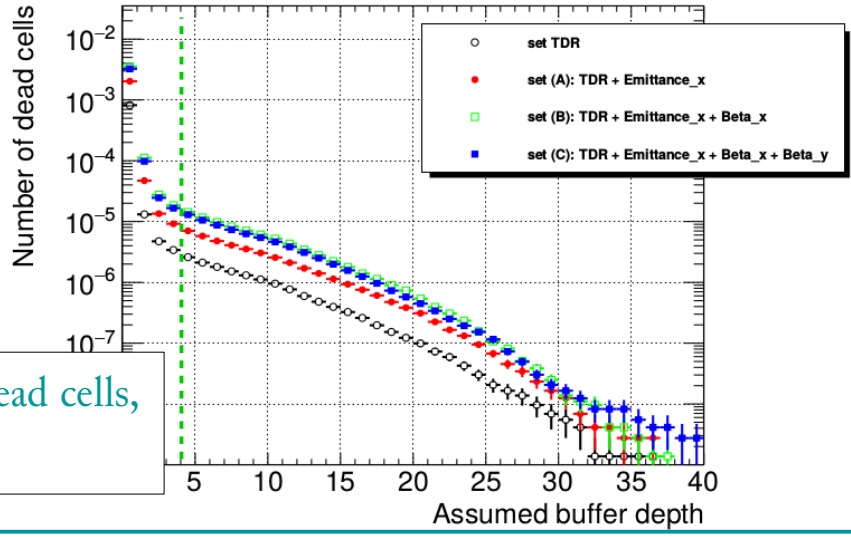
L* = 4.1 m, with antiDiD



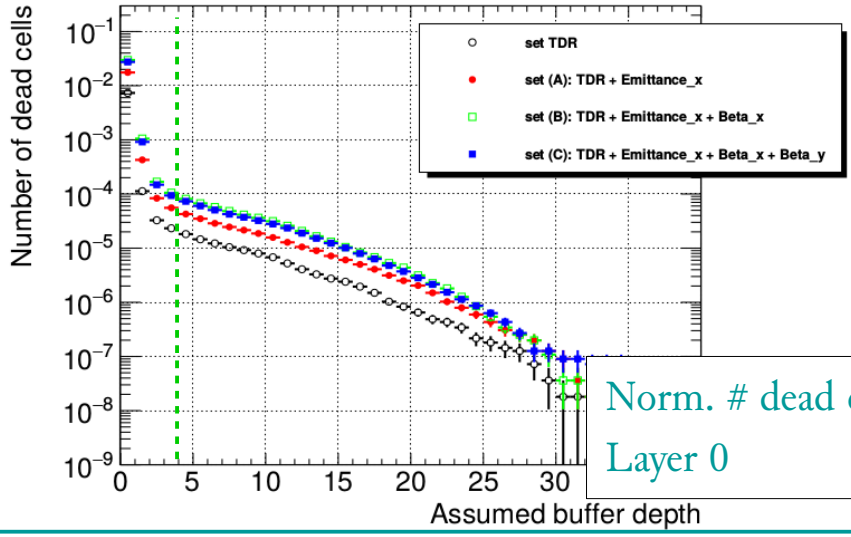
Norm. Occupancy, All layers



Norm. Occupancy, Layer 0



Norm. # dead cells, All layers



Norm. # dead cells, Layer 0

SiD is confident that the occupancy can be accommodated in the design of the pixel detector.

Conclusion

The SiD Optimization Group gives green light for the CR-0016, and welcomes the efforts on increasing the luminosity for the ILC250 stage.

Nevertheless further studies ongoing:

- Increased beam pipe and VXD radius
- Smaller VXD pixel size
- Effects on various physics processes

Statement on

CR-0016 250 GeV Beam Parameters

The SiD Detector Consortium

1. SiD endorses this change request as it potentially increases the luminosity or will provide more operating margin without unduly onerous consequences for SiD.
2. Please see the draft note from SiD for a preliminary analysis of the consequences to SiD. Due to the observed increase in occupancy, SiD will need to study in detail the beam pipe radius and possibly reposition the innermost layers of the VXD. The impact on the pixel readout architecture also needs to be studied.

https://www.overleaf.com/11200510zzjwfmzthhwp#/42243207/

3. Physics studies looking at the consequences of the luminosity energy spectrum on various physics processes will need to be done and a more detailed study of detector impacts carried out.
4. It should be however noted, that a further increase of the beam backgrounds may have a profound impact on the detector layout and needs to be studied in detail.

Backup

1. ILC beam parameters

The International Linear Collider

In comparison to LHC

		Baseline 500	Lumi Upgrade	TeV Upgrade	LHC 25ns
E_{CM}	[GeV]	500	500	1000	14 000
n_b		1312	2625	2450	2808
Δt_b	[ns]	554	366	366	25
N		2.0×10^{10}	2.0×10^{10}	1.74×10^{10}	11.5×10^{10}
q_b	[nC]	3.2	3.2	2.7	18.4
σ_x^*	[nm]	474	474	481	16 700
σ_y^*	[nm]	5.9	5.9	2.8	16 700
σ_z	[mm]	0.3	0.3	0.25	0.755
$\mathcal{L}$	[$cm^{-2}\,s^{-1}$]	1.8×10^{34}	3.6×10^{34}	3.6×10^{34}	1.0×10^{34}

The International Linear Collider

ILC250 beam parameter sets

Going from ILC500 to ILC250: New beam parameters under discussion in order to increase the luminosity:

		TDR Baseline	Set (A)	Set (B)	Set (C)
E_{CM}	[GeV]	250	250	250	250
n_b		1312	1312	1312	1312
N		2.0×10^{10}	2.0×10^{10}	2.0×10^{10}	2.0×10^{10}
ϵ_x^*	[µm]	10	**5**	**5**	**5**
ϵ_y^*	[nm]	35	35	35	35
β_x^*	[mm]	13	13	**9.19**	**9.19**
β_y^*	[mm]	0.41	0.41	0.41	**0.58**
$\mathcal{L}$	$[cm^{-2}s^{-1}]$	0.8×10^{34}	1.37×10^{34}	1.97×10^{34}	1.80×10^{34}

Work in progress...

Reduced emittance leads to stronger beam-beam interactions, and therefore to increased e^+e^- pair background.