very preliminary version, a lot of rearranging still to be done
probably no other significant plots will be added

Beam backgrounds at ILC

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Fukuoka

beamstrahlung
- e+ e- pairs produced in strong fields when bunches collide

gamma-gamma → hadrons
- high xsec physics process

background particles from upstream / downstream
- muons from Beam Delivery System
- neutrons from beam dump

beamstrahlung
large number of e+ e- pairs, with low pT,
produced at IP

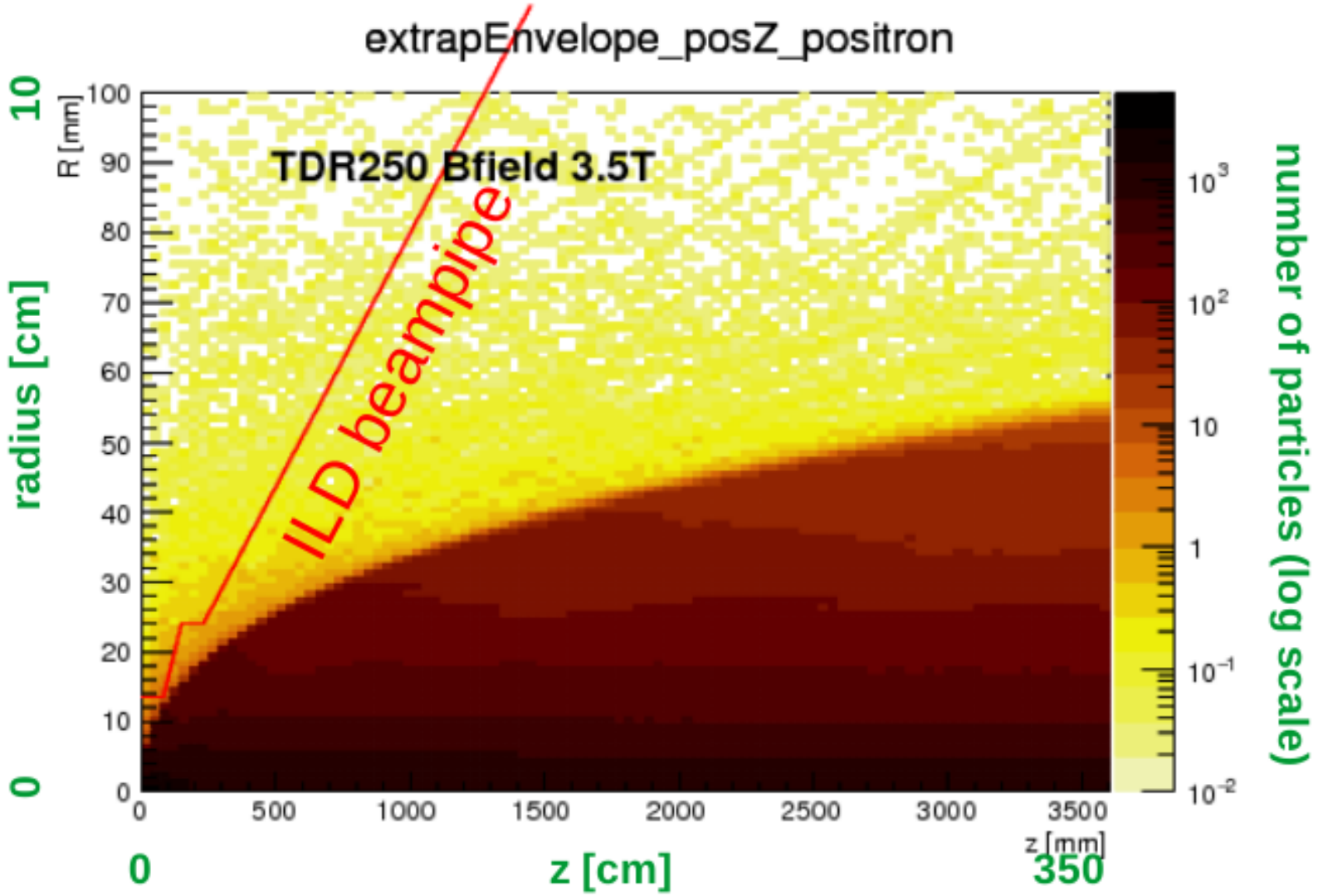
vast majority constrained within beampipe
by experiment's B-Field
→ avoid hitting any material, detectors

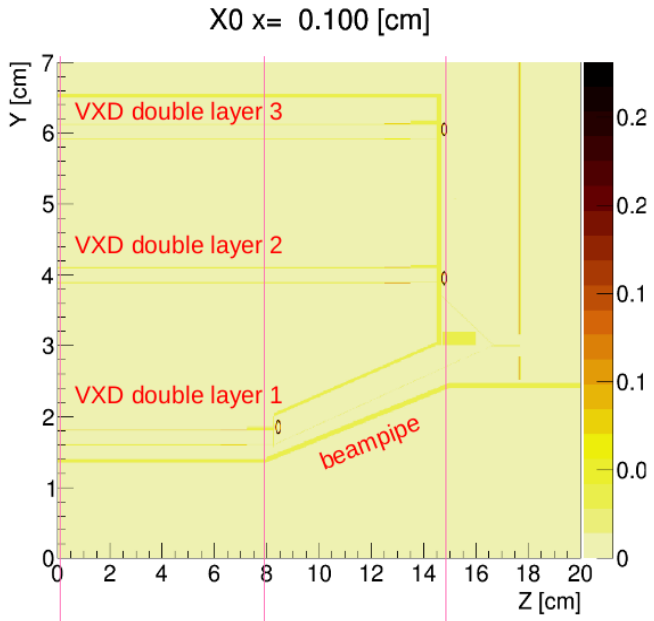
distribution of pairs depends on focusing of machine
number depends on luminosity

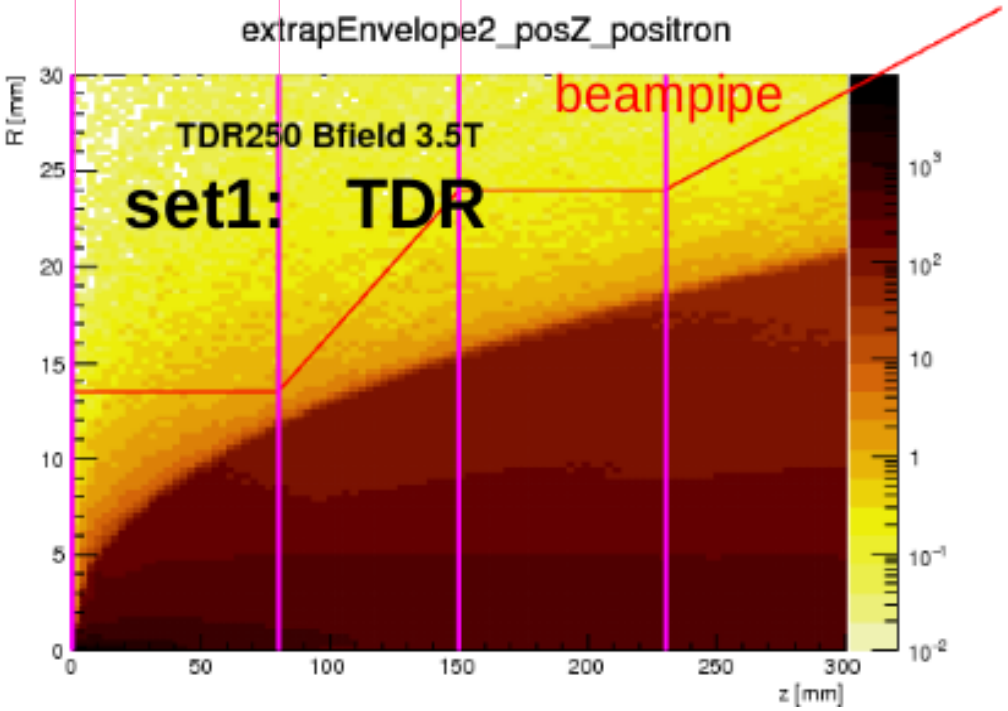
anti-DID field helps steer most of these particles
into outgoing beampipe,
however many still hit beamcal,
potentially reflected back into detector

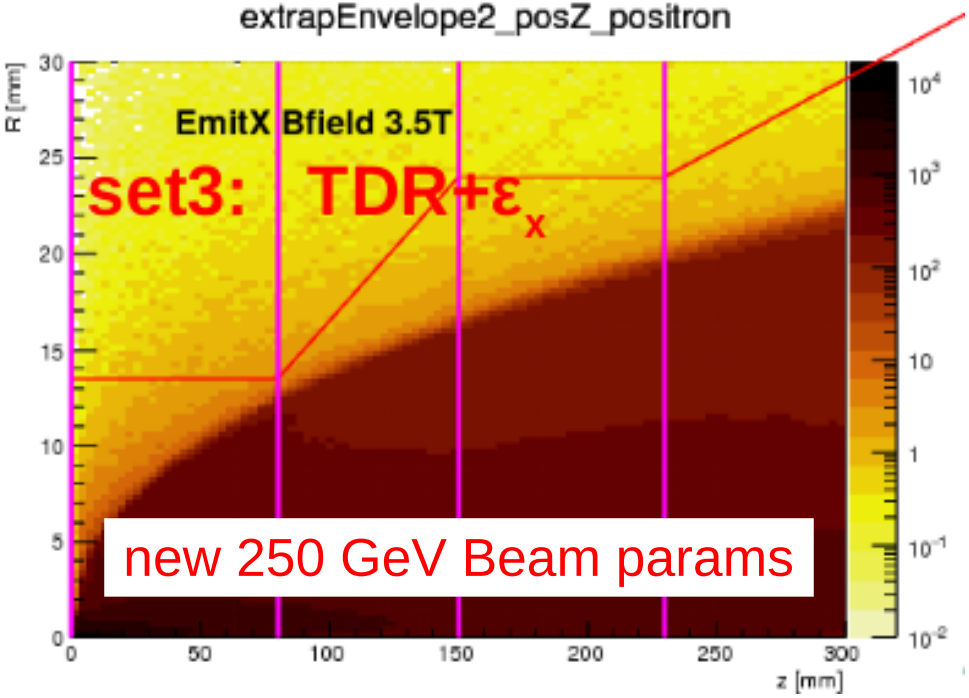
Distribution of incoherent pairs around beampipe

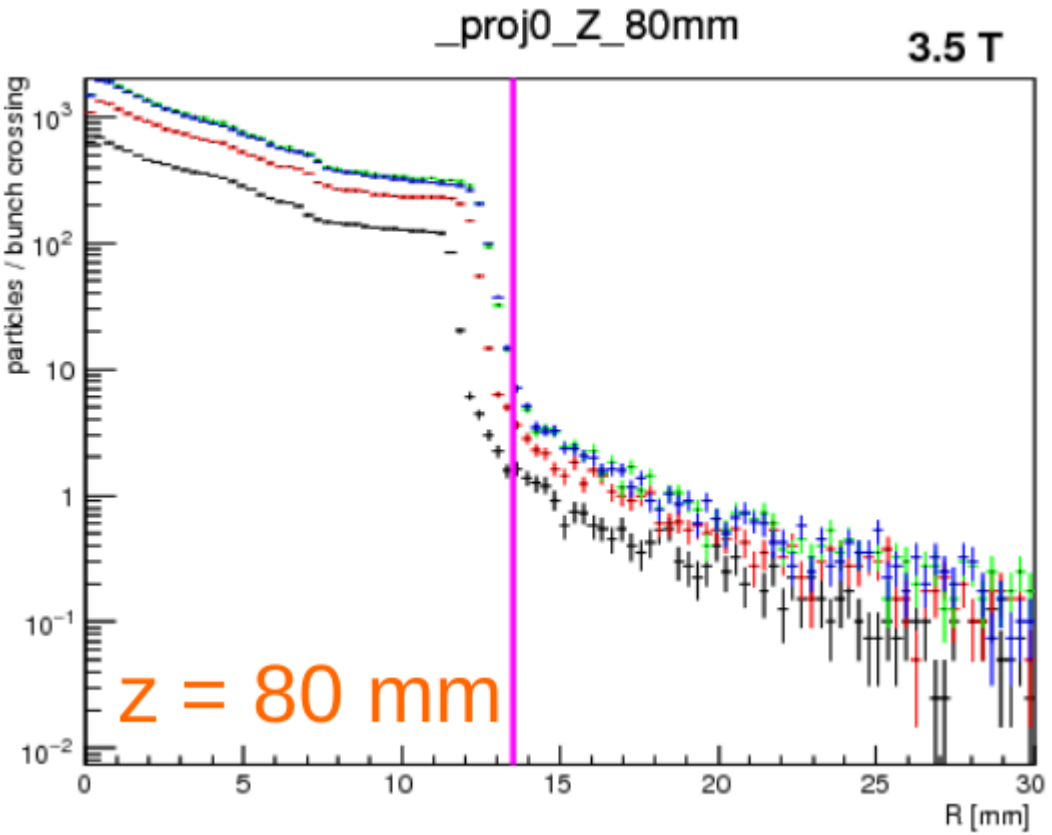
simple extrapolation in uniform 3.5T field, no beam crossing,
no material interactions, no backscatter from e.g. FCAL




X0 x= 0.100 [cm]
VXD double layer 3
VXD double layer 2
VXD double layer 1
beampipe
Y [cm]
Z [cm]


extrapEnvelope2_posZ_positron
beampipe
TDR250 Bfield 3.5T
set1: TDR
R [mm]
z [mm]


extrapEnvelope2_posZ_positron
EmitX Bfield 3.5T
set3: TDR+ε_x
new 250 GeV Beam params
R [mm]
z [mm]



different beam parameters @250 GeV

TDR

TDR+ε_x ←

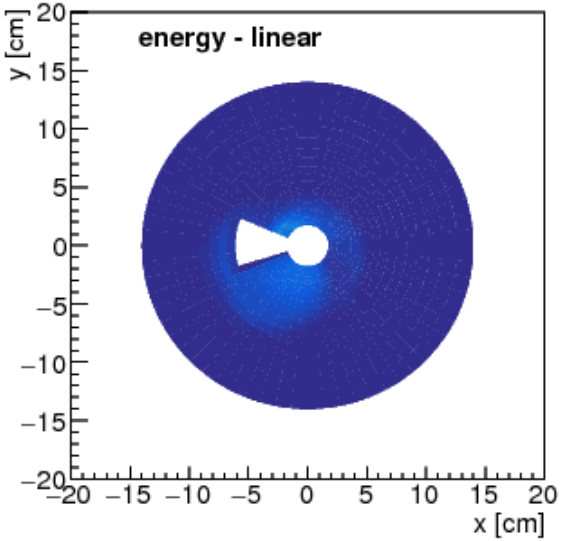
TDR+ε_x/β_x

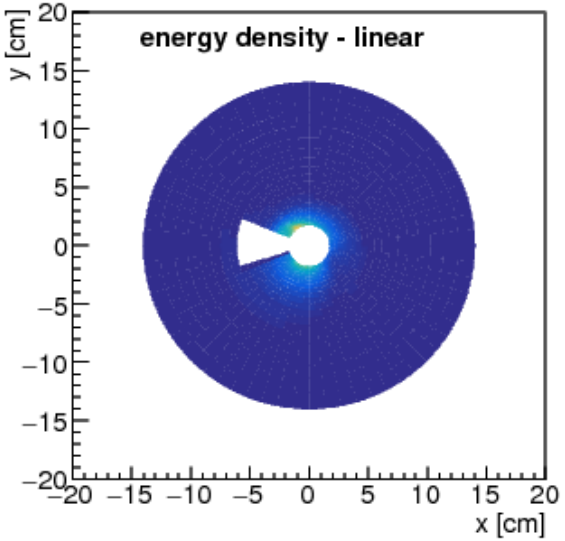
TDR+$\varepsilon_x/\beta_x/\beta_y$

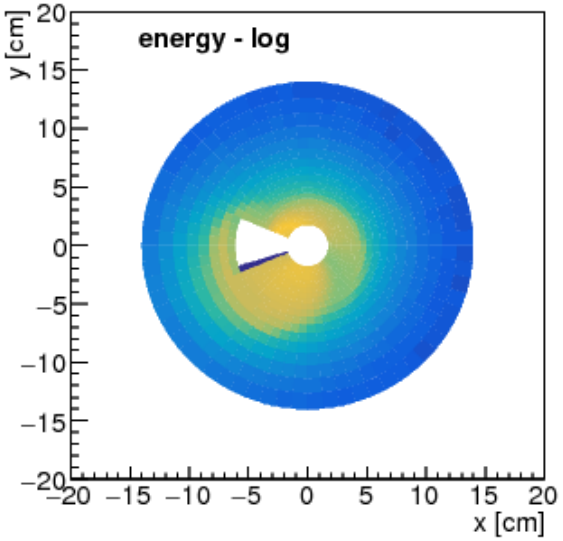
energy distribution in beamcal:

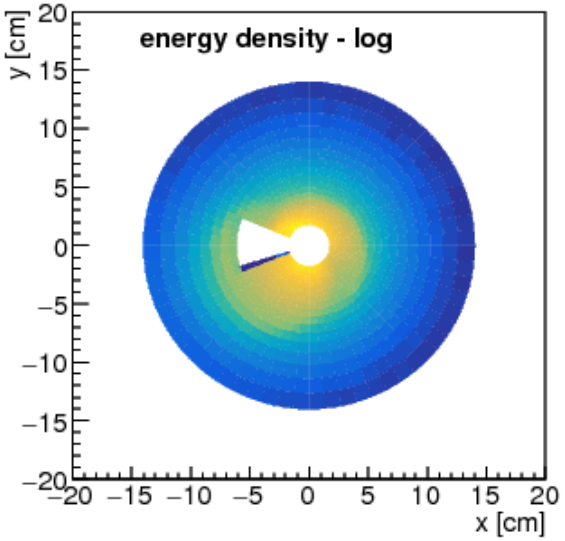
energy (density) per pad, per bunch crossing,

integrated over layers





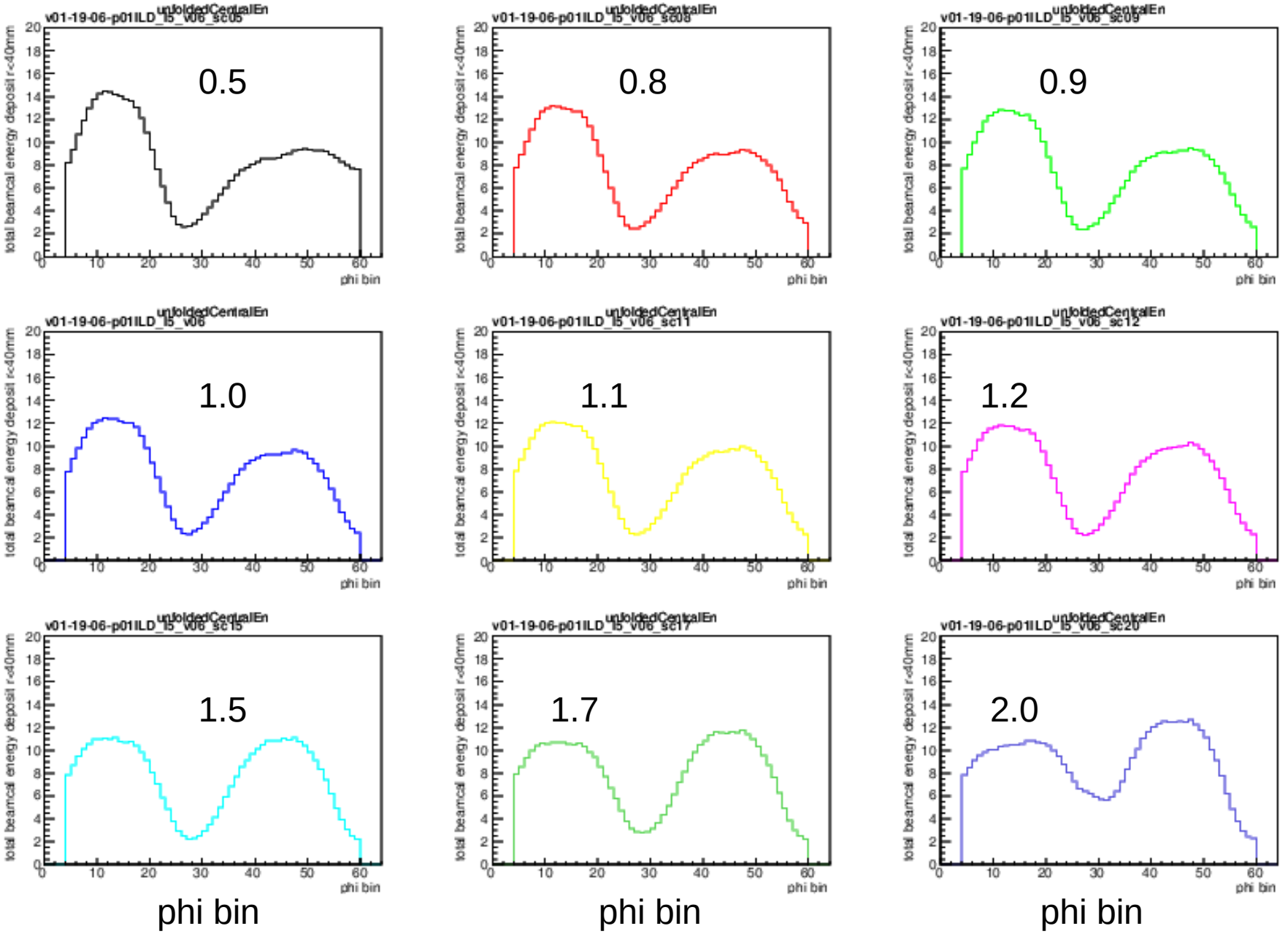




ILD_l5_v02, for illustration

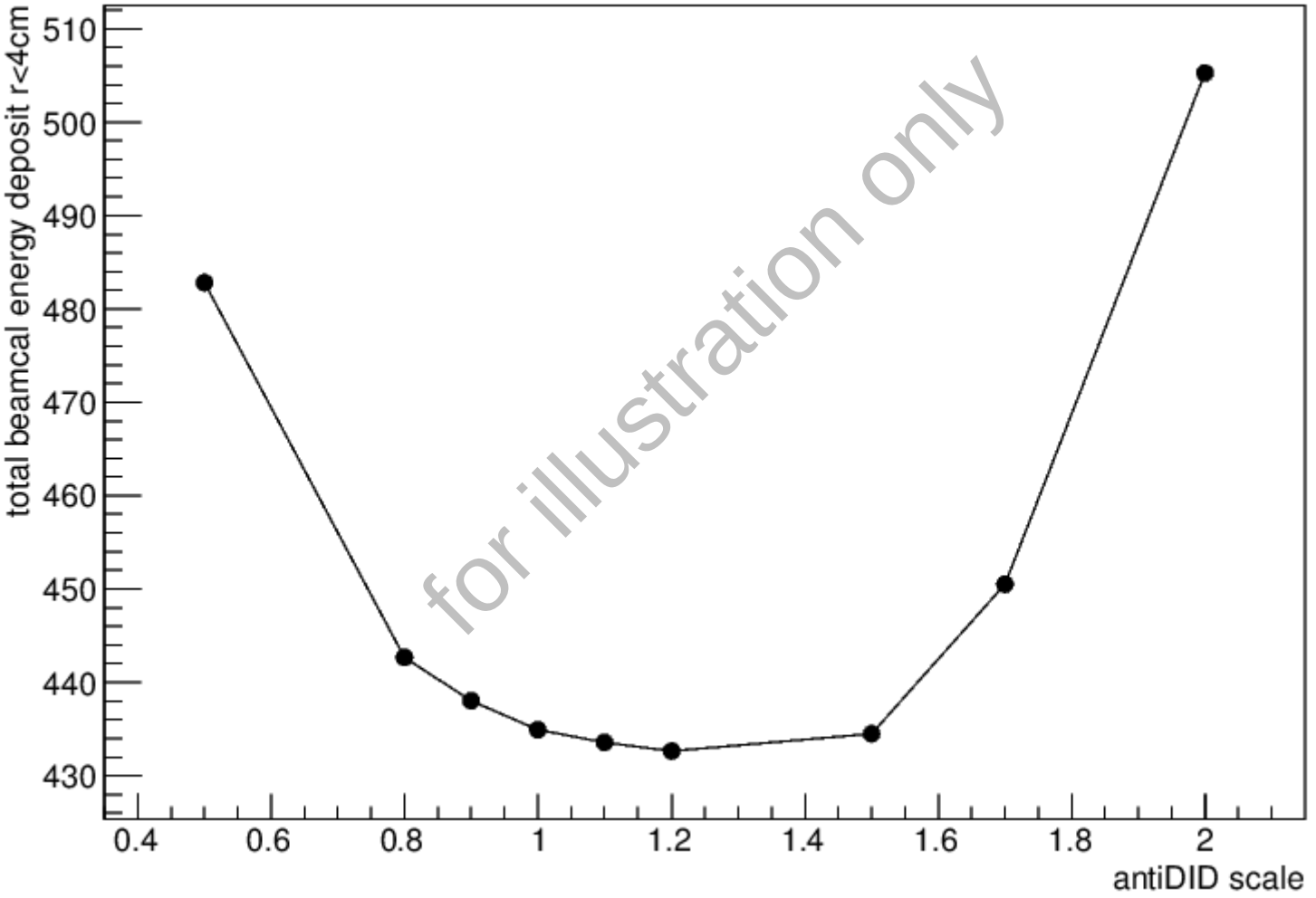
beamcal energy deposit (r<4cm) as function of anti-DID field strength

energy deposit (r < 4cm)



phi bin phi bin phi bin

total beamcal energy deposit [r<4cm] for different scaling of anti-DID field



total beamcal energy deposit, r<4cm [a.u.]

scaling of anti-DID field

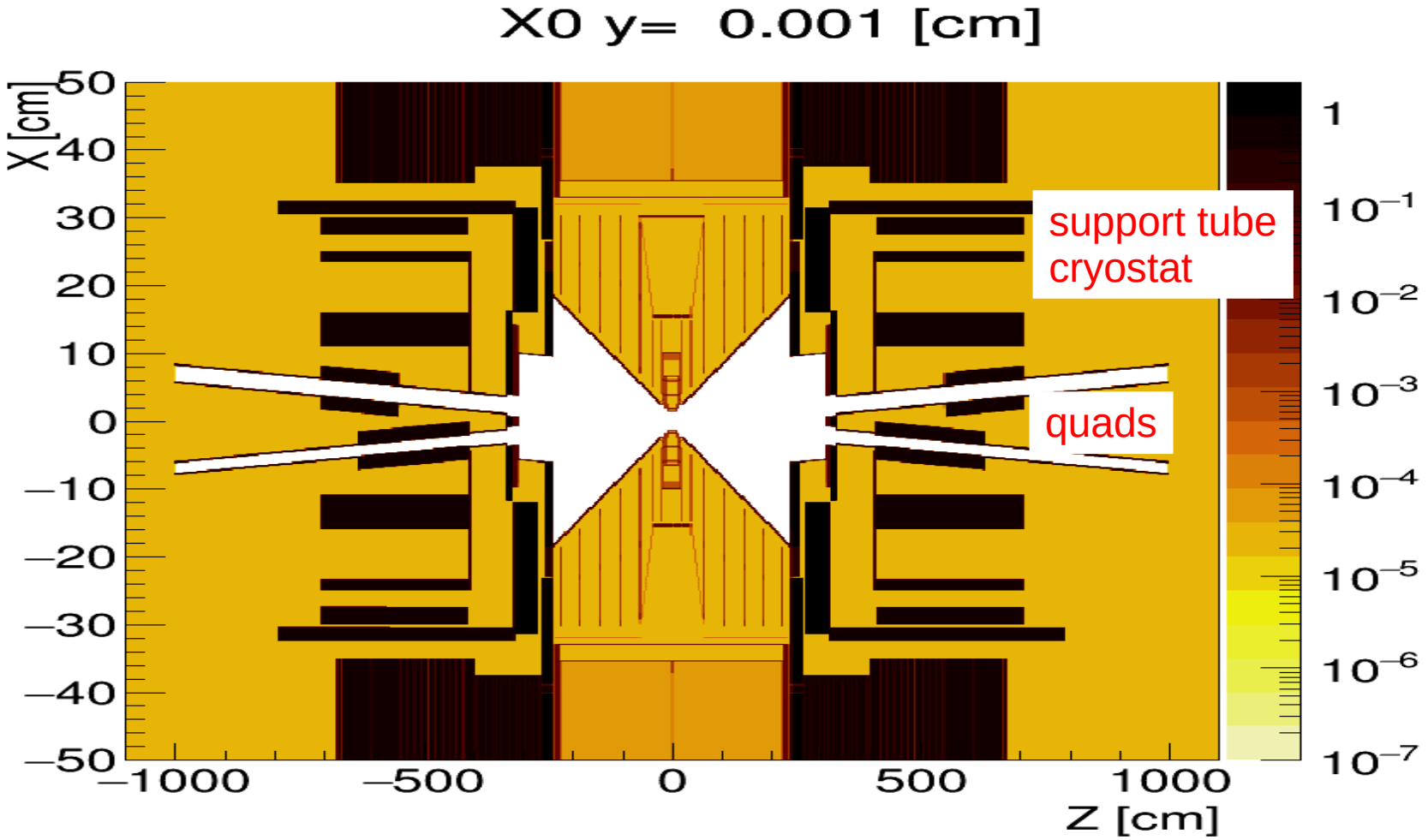
description of material in forward region

important to correctly simulate pair backgrounds, back-scatters

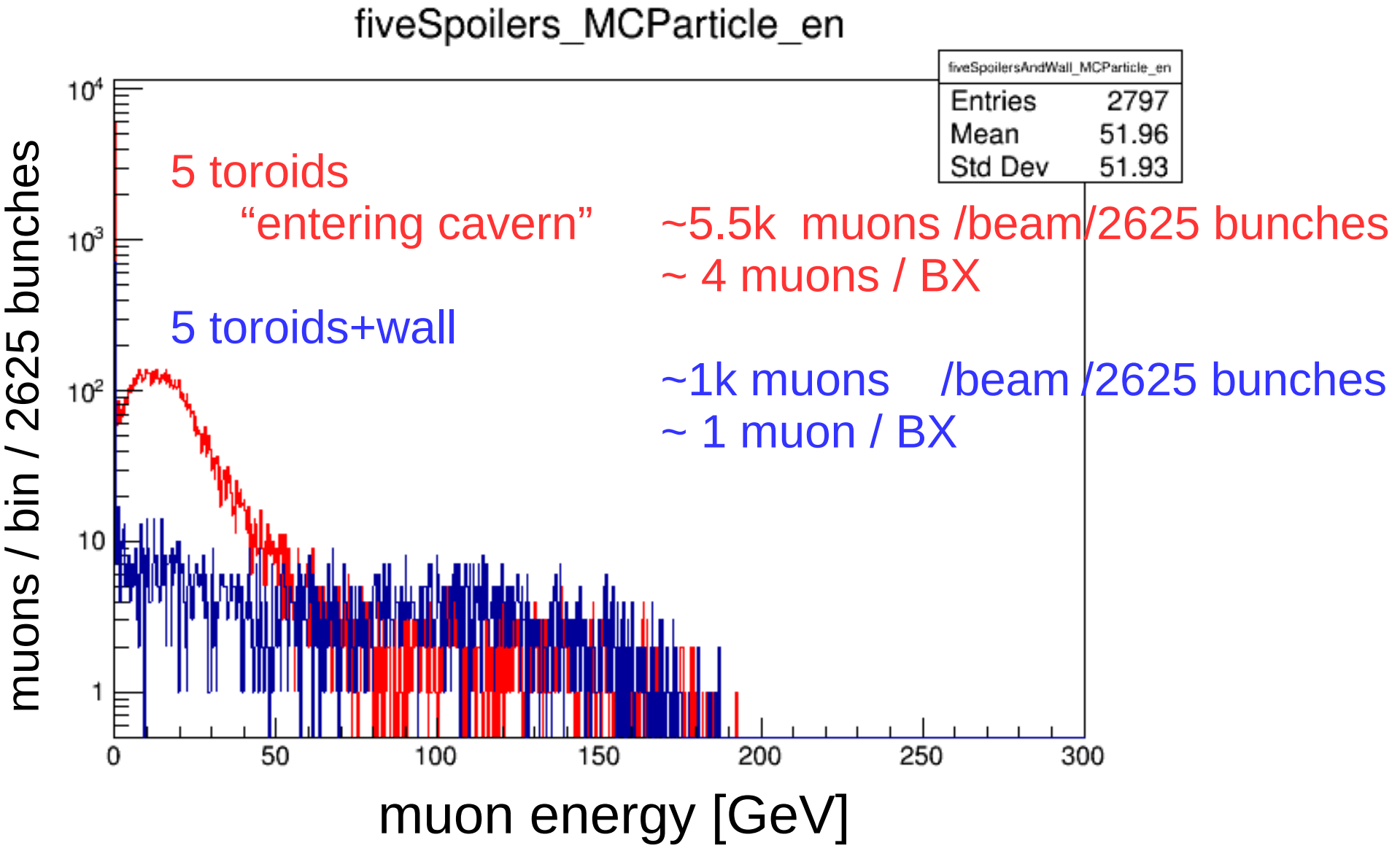
good description of B-fields also needed

recently implemented in ILD models :

reappraisal of backgrounds underway

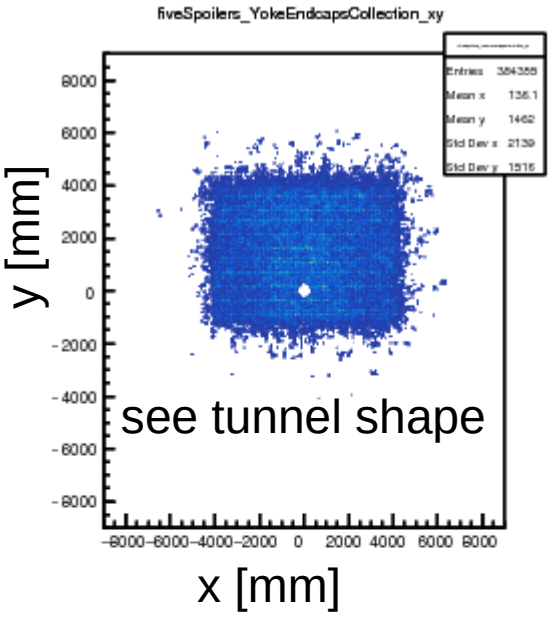


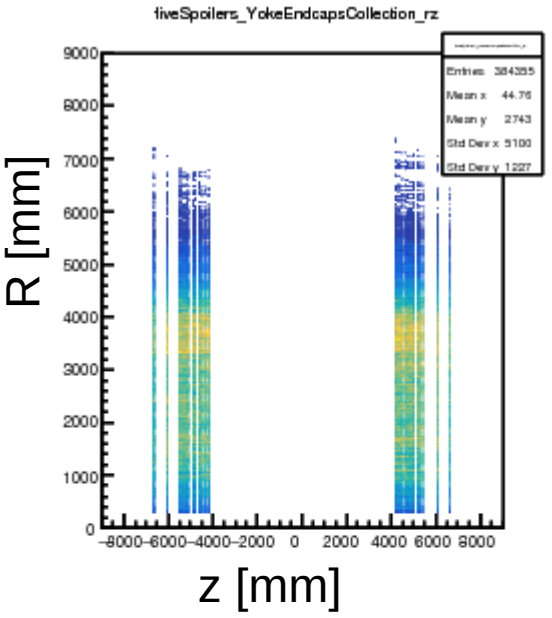
muon energy distribution @ 500 GeV



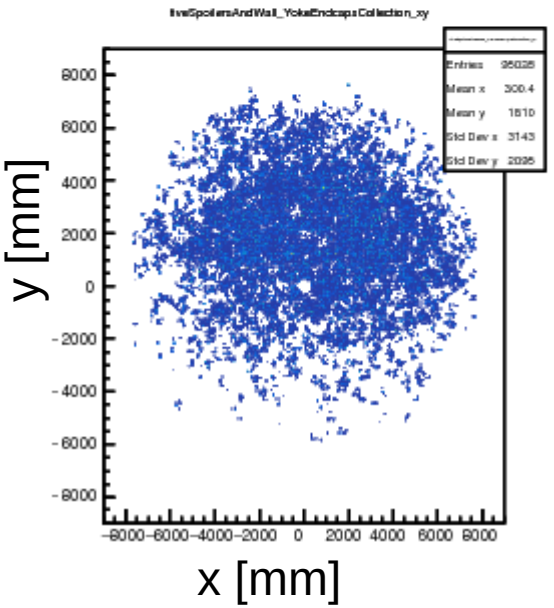
simulated hits in YokeEndcapsCollection

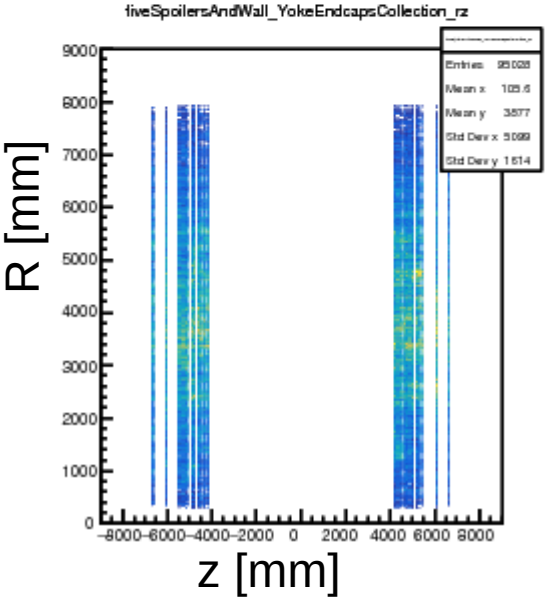
5 toroids

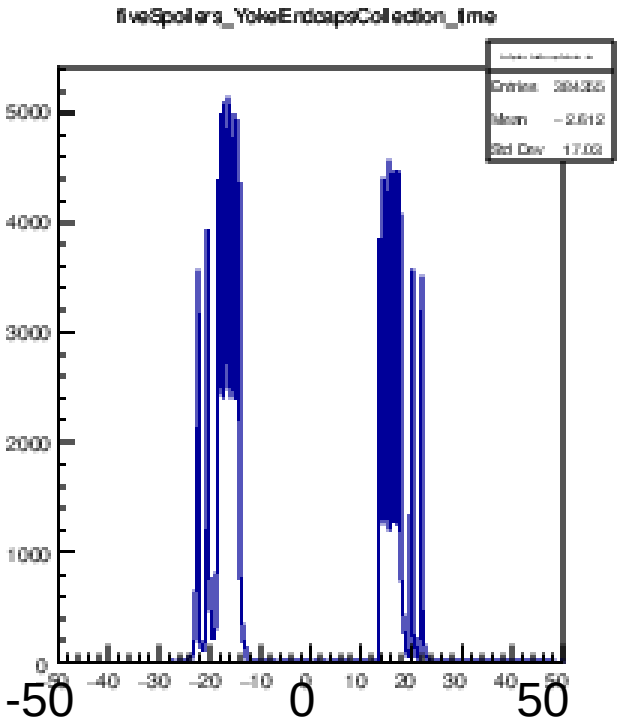




5 toroids
+ wall





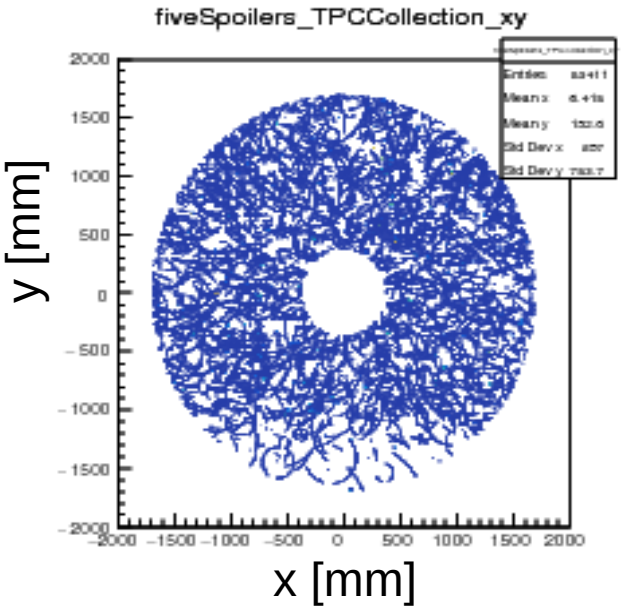


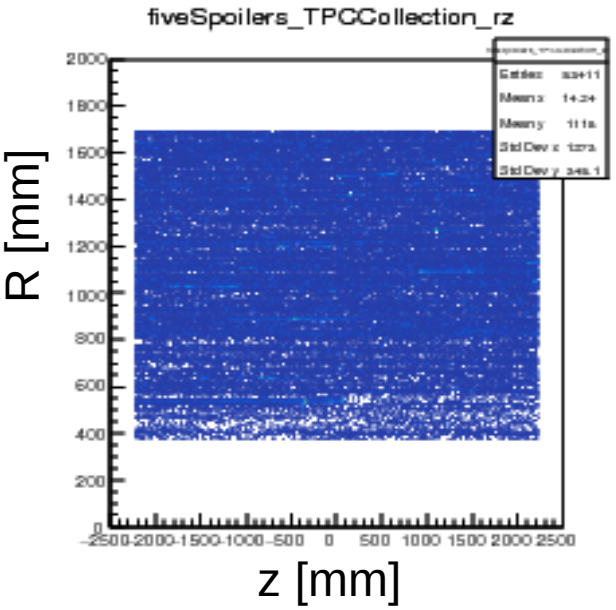
~5 ns-level timing will be able to identify 50% of muon hits

2625 bunches of ILC500

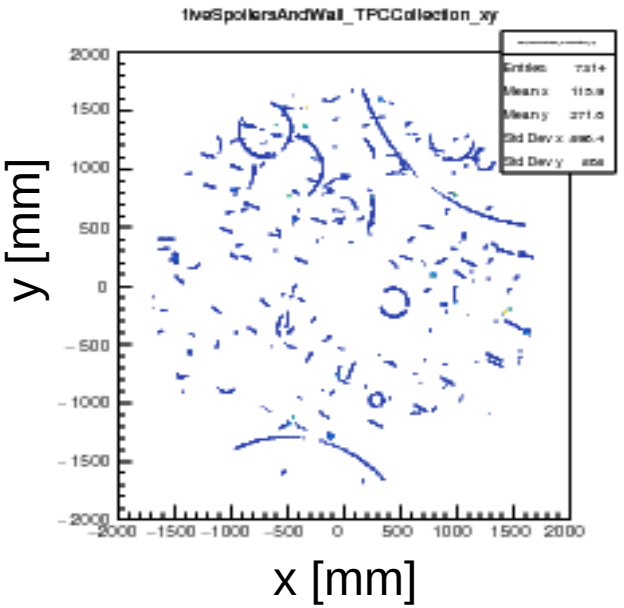
simulated hits in TPCCollection

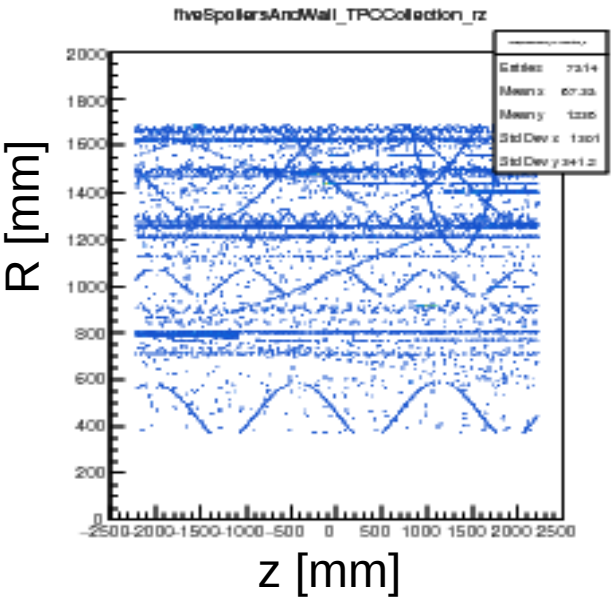
5 toroids





5 toroids
+ wall





largely parallel to TPC drift: hit only a few readout pads

2625 bunches of ILC500

total number of simulated hits per collection

2625 BX @ ILC500

	fiveSpoilers	fiveSpoilers + Wall
VXD	0	0
SIT	423	40
SET	5k	427
FTD	2k	172
TPC	83k	7k
ECalBarrel	80k	12k
ECalEndcap	210k	18k
EcalEndcapRing	82k	600
HcalBarrel	184k	40k
HcalEndcaps	565k	69k
HcalEndcapRing	31k	5k
YokeEndcaps	384k	95k
YokeBarrel	41k	41k
LumiCalCollection	2k	78
LHCalCollection	7k	609
BeamCalCollection	1k	30

don’t forget in DAQ rate estimations !

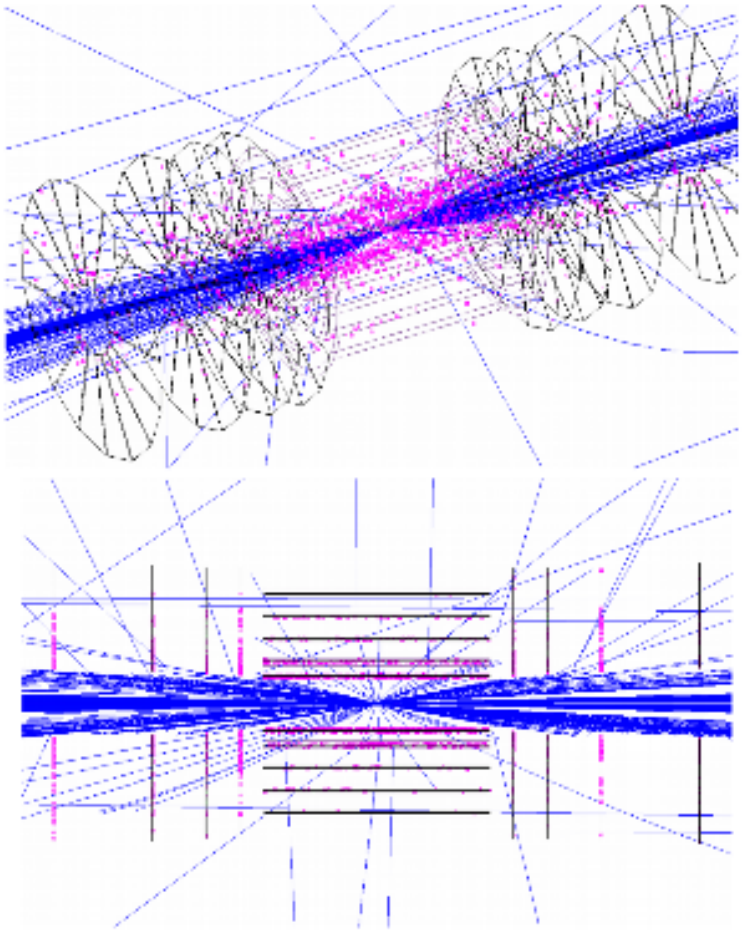
may dominate for forward calorimeters / muon detectors ?

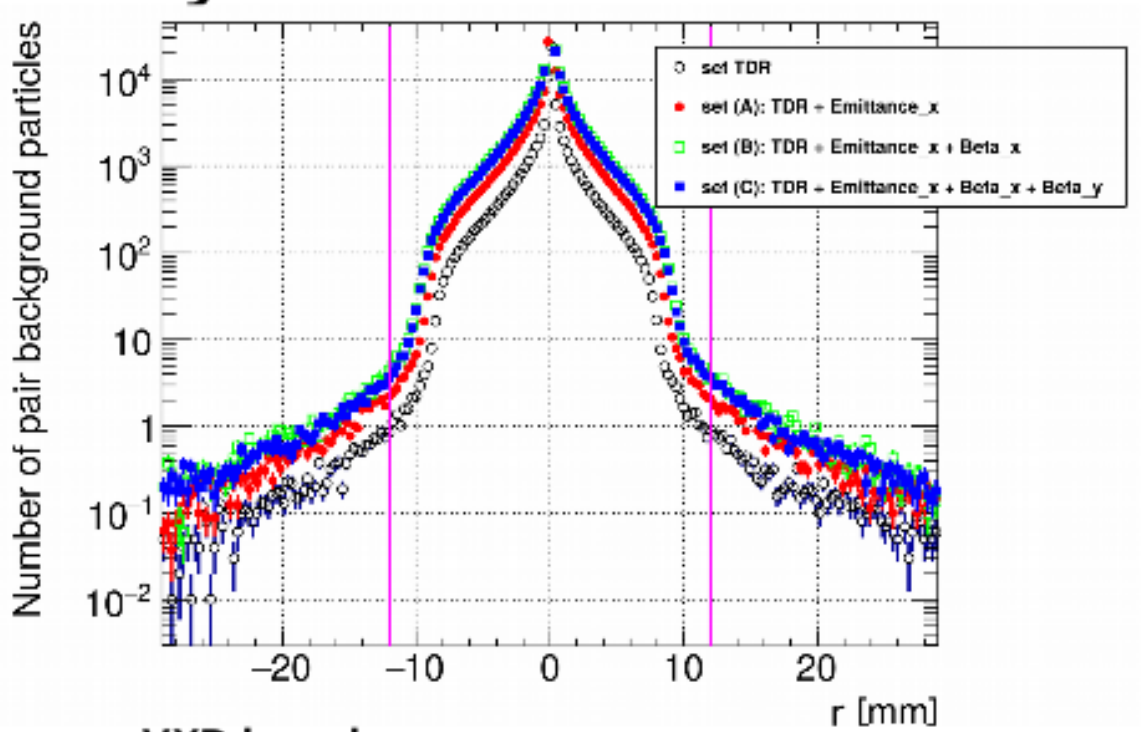
calorimeters: high granularity allow easy identification of beam muons
low energy (MIP-like) hit energies
many hits are “out of time” by several ns
not a big problem from reconstruction point of view
may have impact on DAQ system design

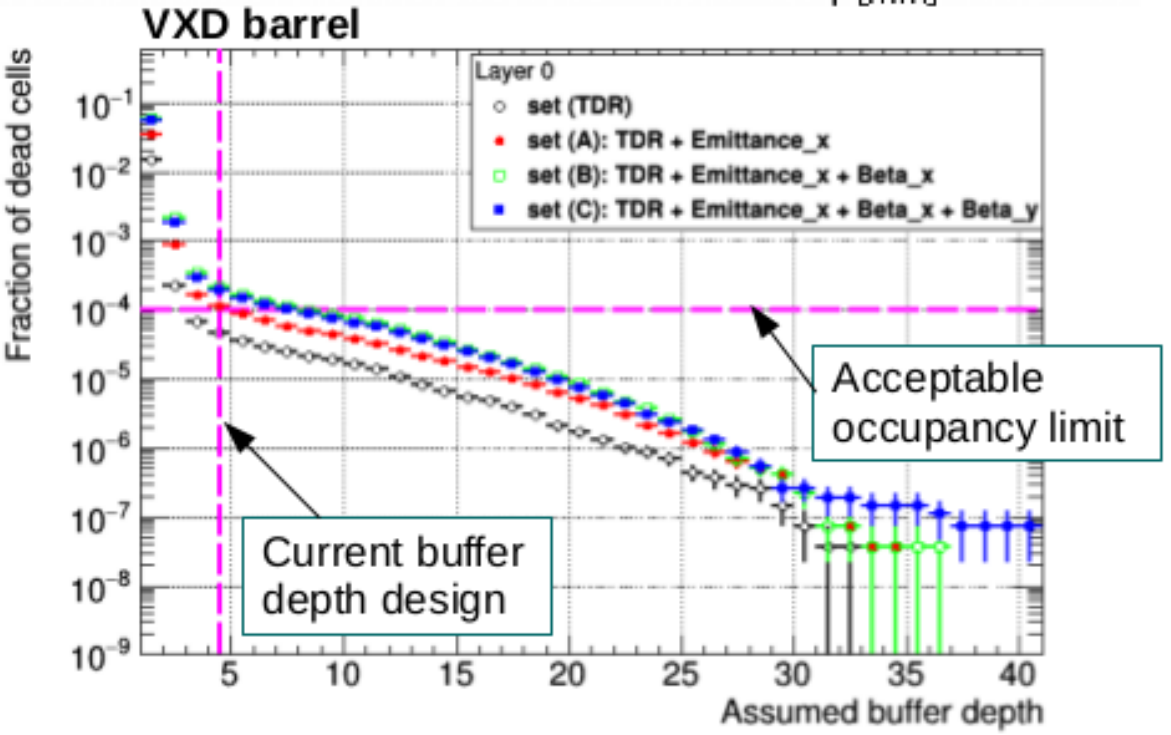
silicon trackers: limited influence
– most sensors are parallel to the muons
– others (FTD) have small area

TPC: almost all particles parallel to drift field:
each muon hits only a few readout pads

SiD pair background study







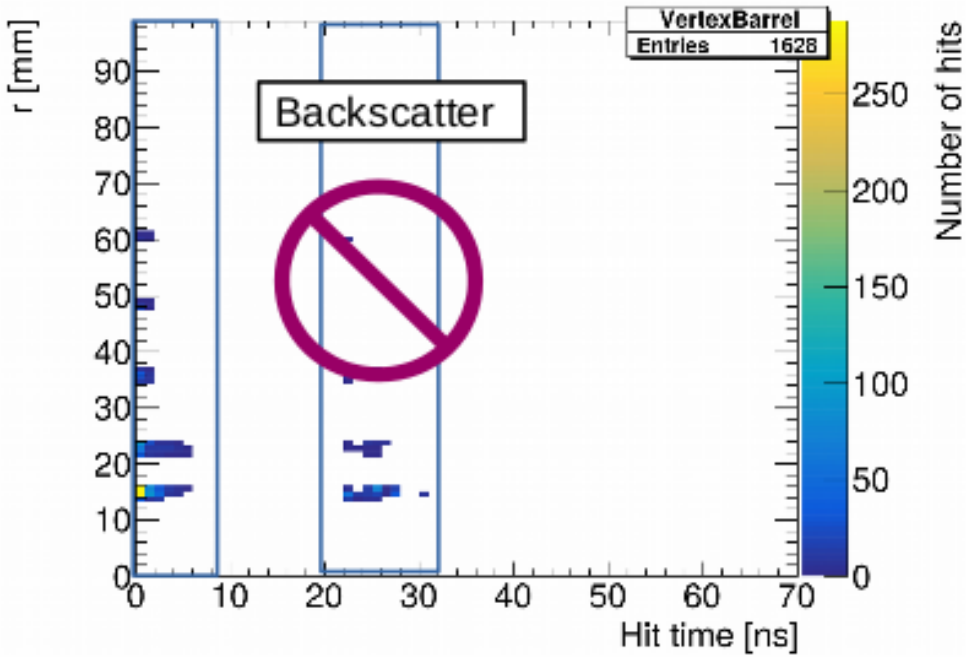
Comparison between the new ILC250 parameter sets:

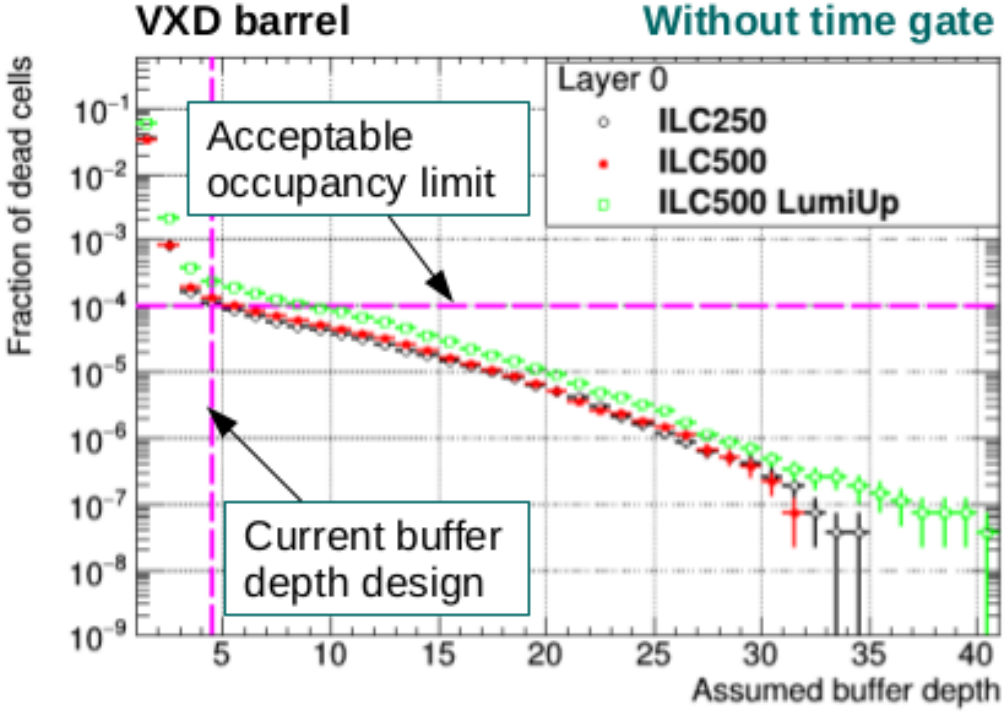
- Highest occupancy in the innermost VXD barrel layer
- Acceptable background level in SiD VXD: #dead cells < 10^{-4} of all cells
- Set (A) of CR-0016 just on the acceptable limit

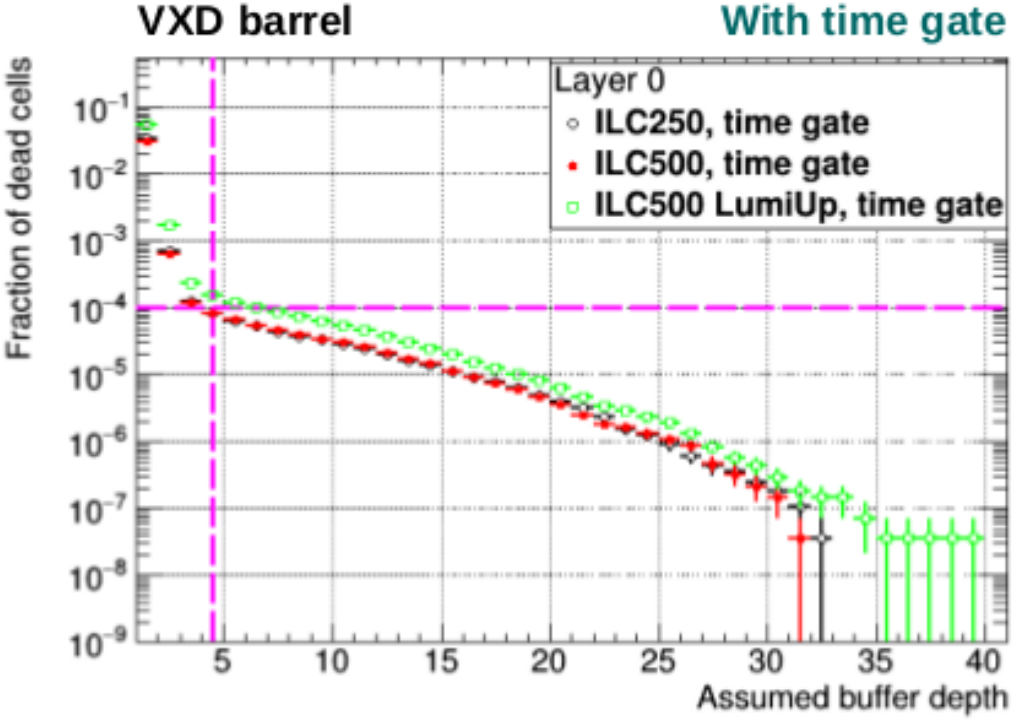
Hit time study revealed that pairs backscatter at BeamCal

→ backscatter pairs hit VXD 20ns after bunch crossing

→ **Time gate: reject all hits later than 10ns!**







Time gate reduces the occupancy by up to 36%.

Even for ILC500 LumiUp, occupancy close to acceptable limit →increasing the buffer depth by only 2 would guarantee similar VXD performance throughout the first ILC stages!