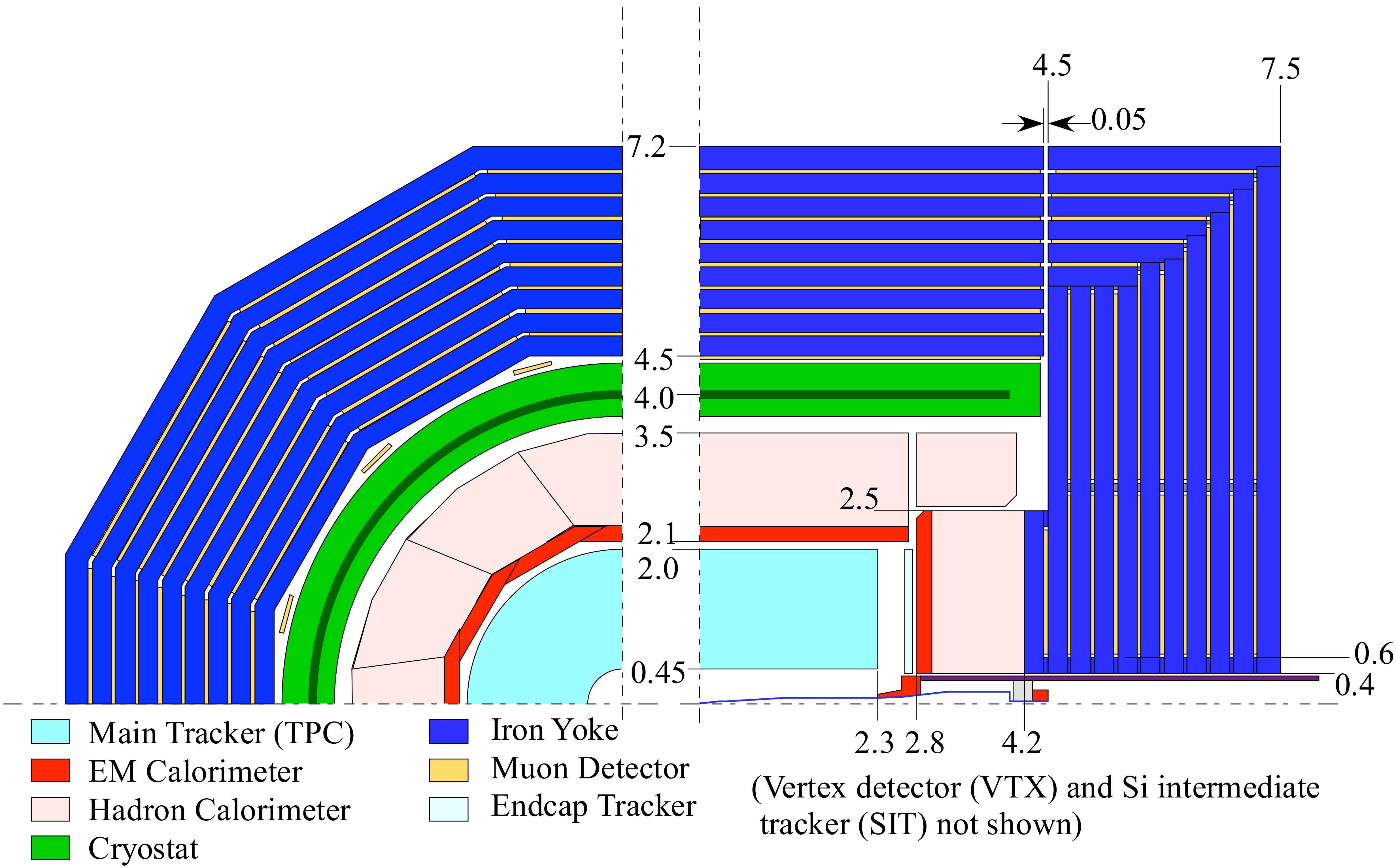
GLD IR Overview

T. Tauchi, MDI/Integration WG meeting

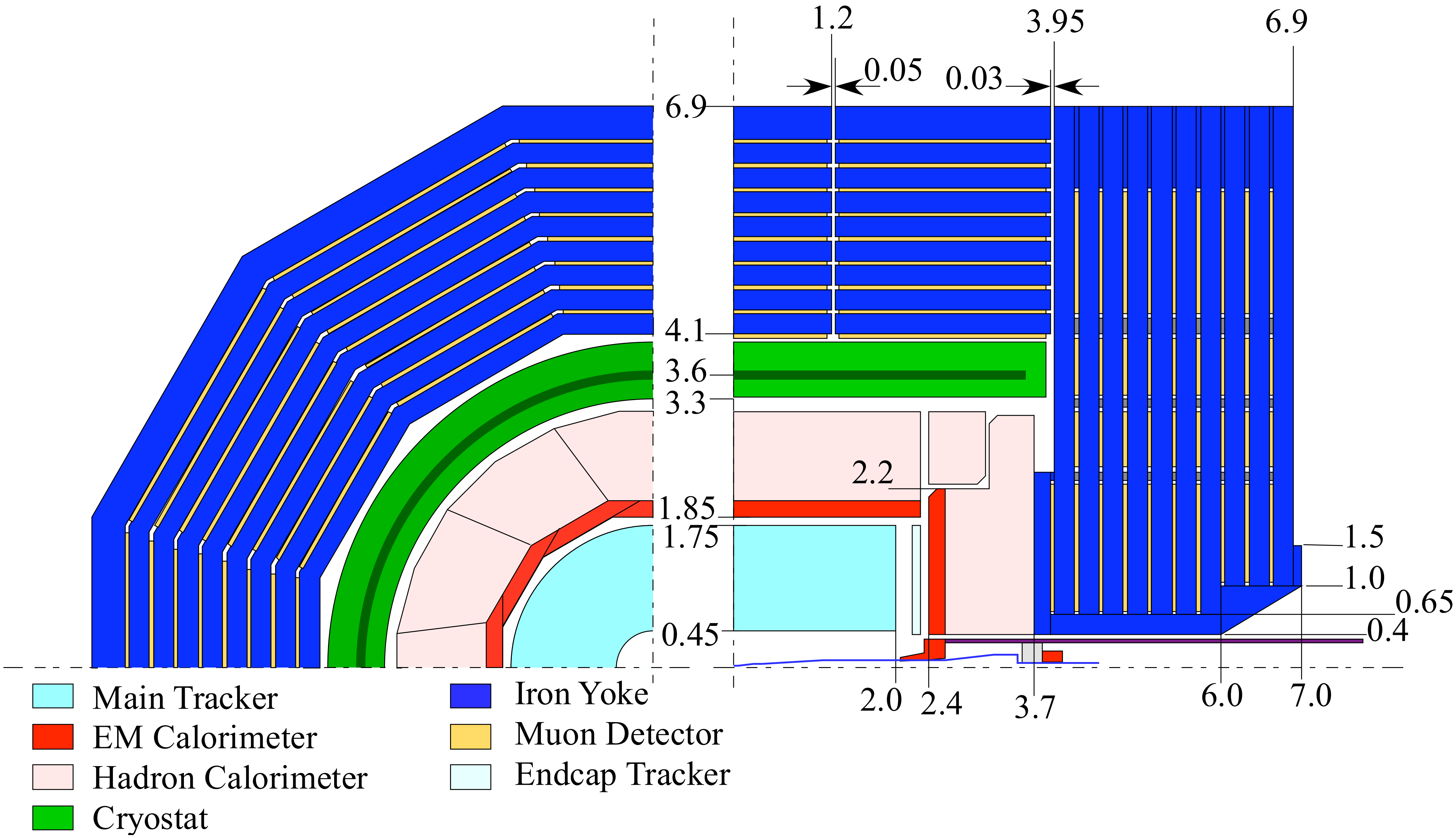
4 October 2007

GLD



(Vertex detector (VTX) and Si intermediate tracker (SIT) not shown)

Compact GLD (GLDc)



Tolerances in Detectors

Table 1: Tolerances for background in VTX, TPC and CAL.

Sources : pairs disrupted beams/pairs beam halo

Detector	Hits	Neutrons	Muons
VTX	1×10^4 hits/cm^2/train	1×10^{10} n/cm^2/year	-
TPC	4.92×10^5 hits/50μsec	4×10^4 n*/50μsec	$1.2 \times 10^3 \mu$/50μsec
CAL	1×10^{-4} hits/cm^3/100nsec	-	0.03 μ/m^2/100nsec

→ 1μ/30m^2/bunch

* : The neutron conversion efficiency is assumed to be 100% in the TPC.

1 hit in TPC consists of 5 pads(1mmx6mm) x 5 buckets(50nsec)
A muon creates 1 pad x 2000 buckets in parallel to the beam line.
A neutron creates 10 hits in TPC.

Note : 0.005μ/bunch by two "tunnel fillers"

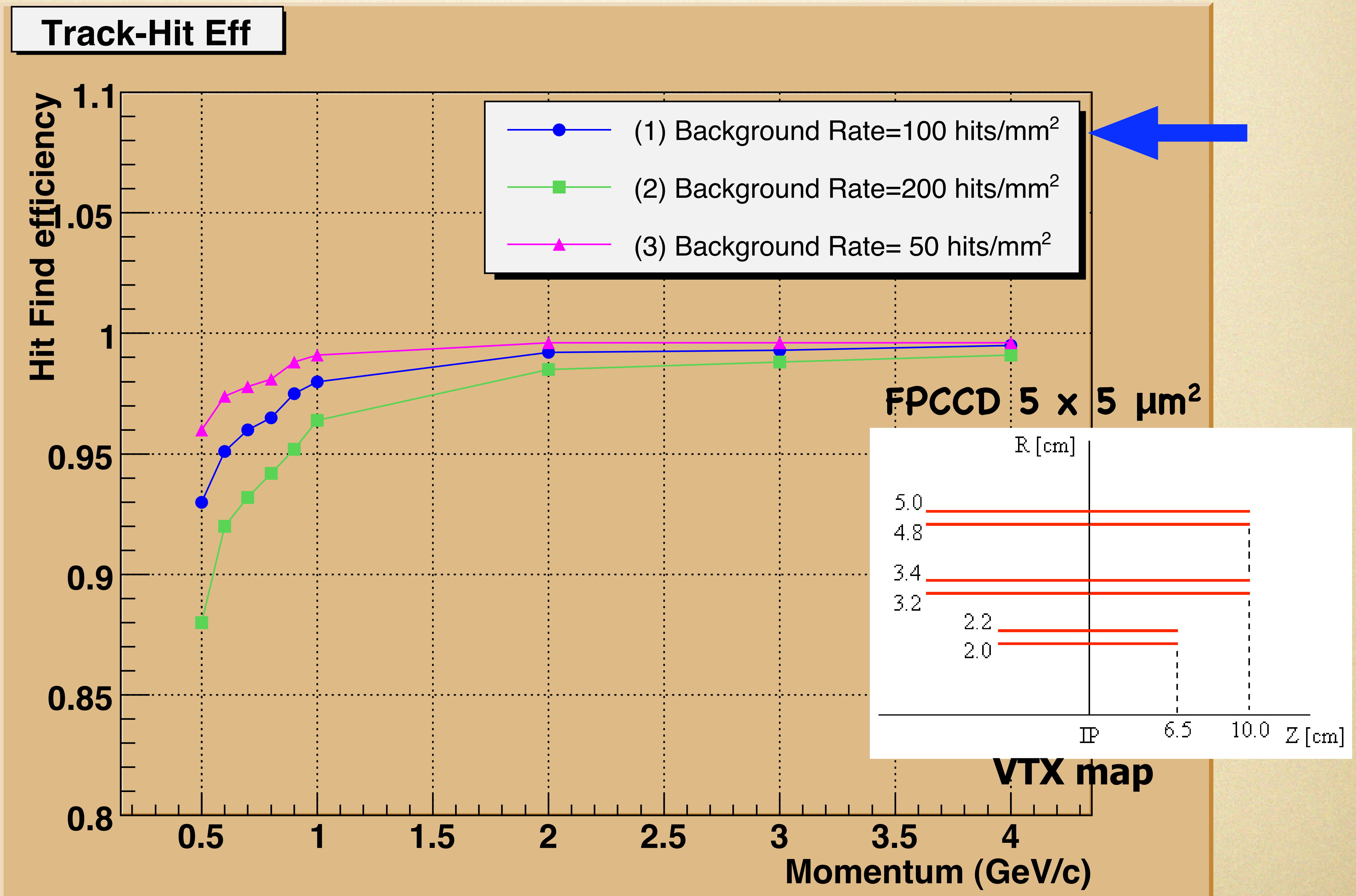
→ 0.8μ/150bunches

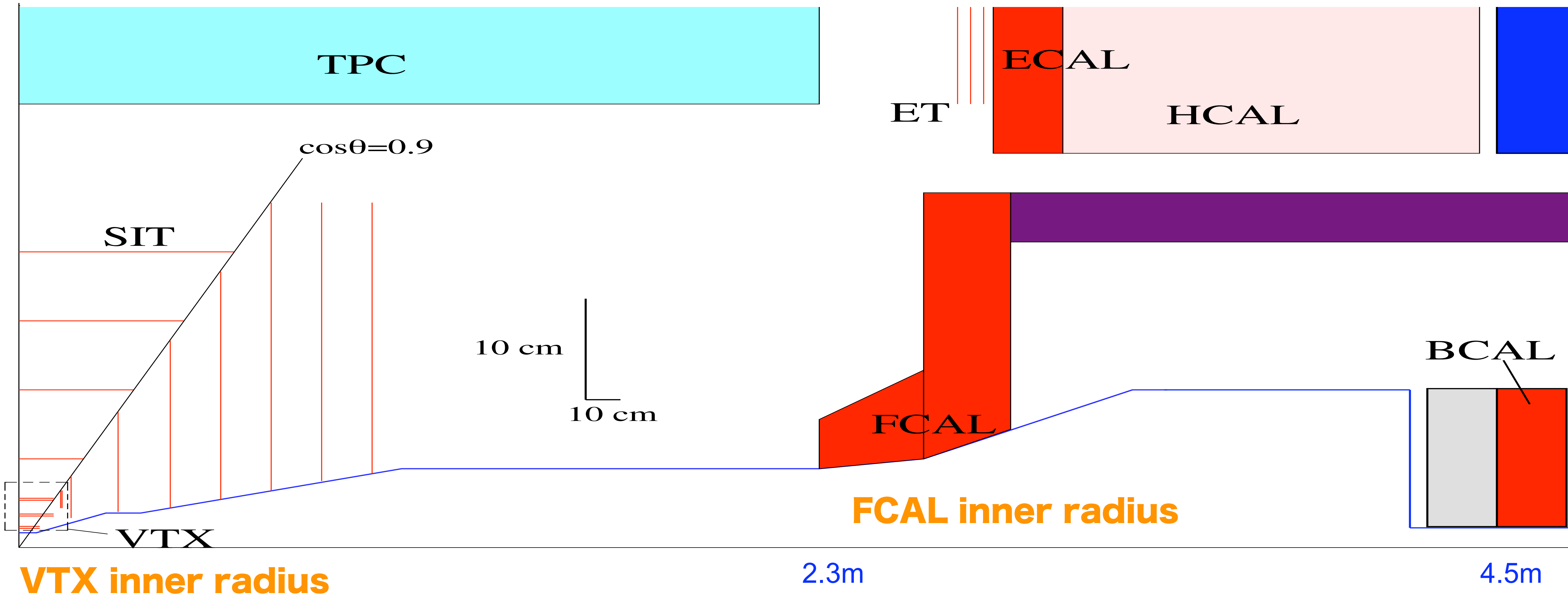
The 9 and 15m long spoilers at 660 and 350m from IP reduces muons by 10^{-4}

Background in GLD-VTX

T,Nagamine

Efficiencies for different hit rates



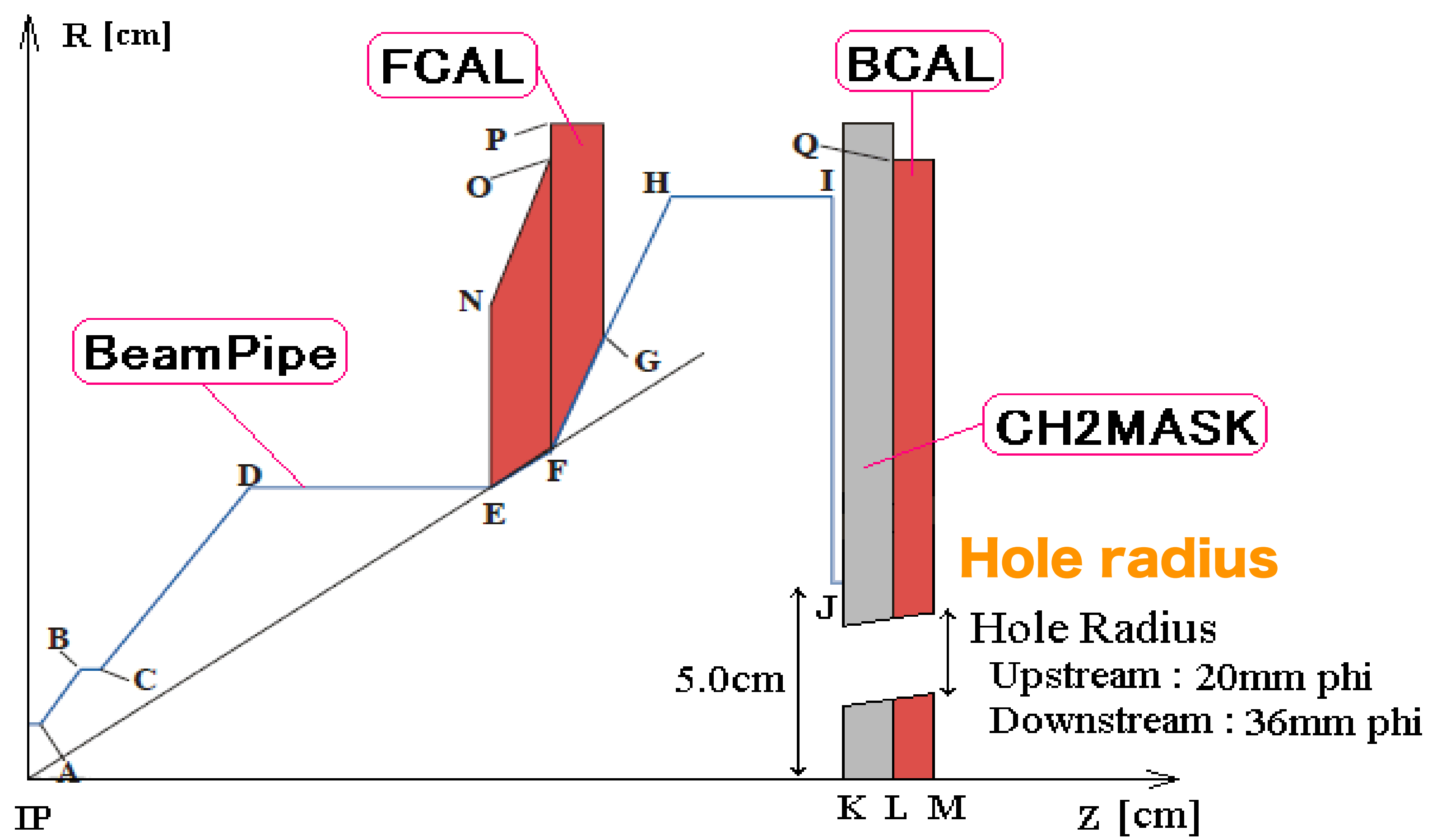


IR Optimization

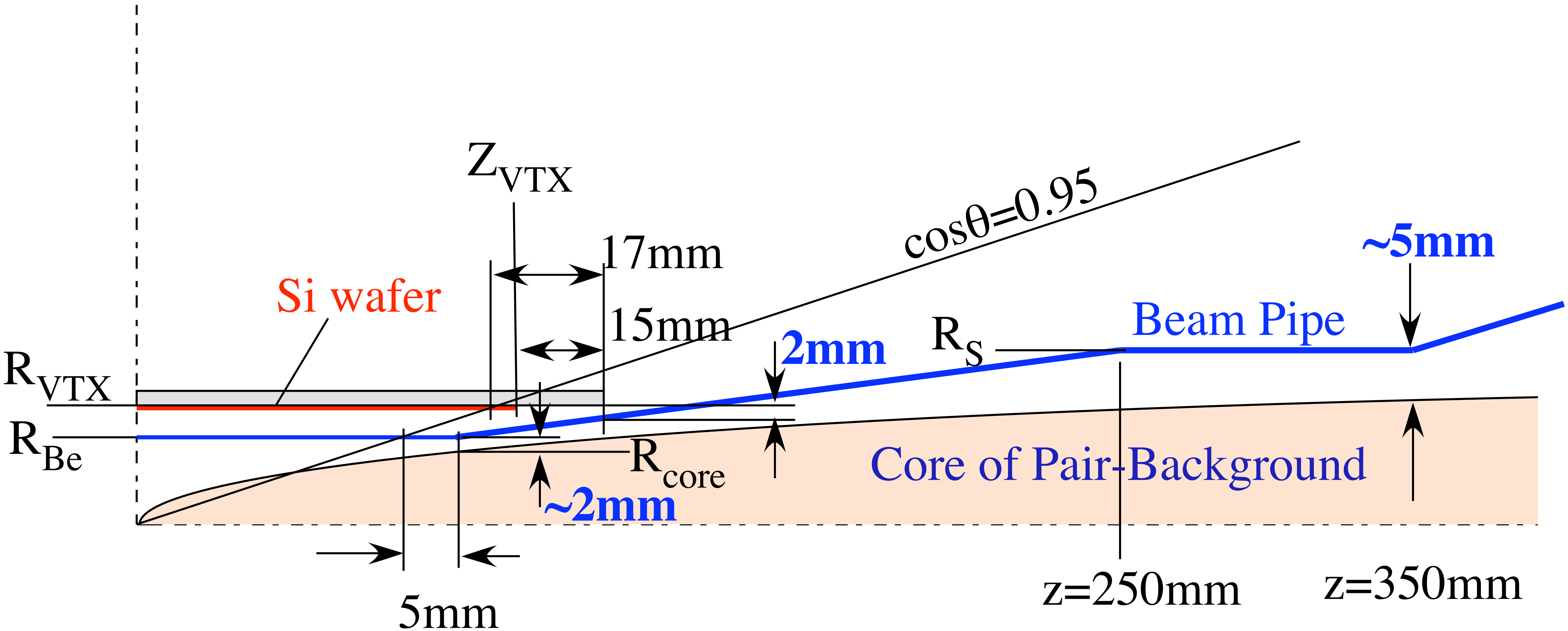
FCAL inner radius for TPC background hits.

Hole radius of extraction to decrease backscattering.

Radius of beam pipe @VTX



Interaction Region (IR) Design
Beam Pipes etc.



VTX (FPCCD, 5 μm x 5 μm pixels)

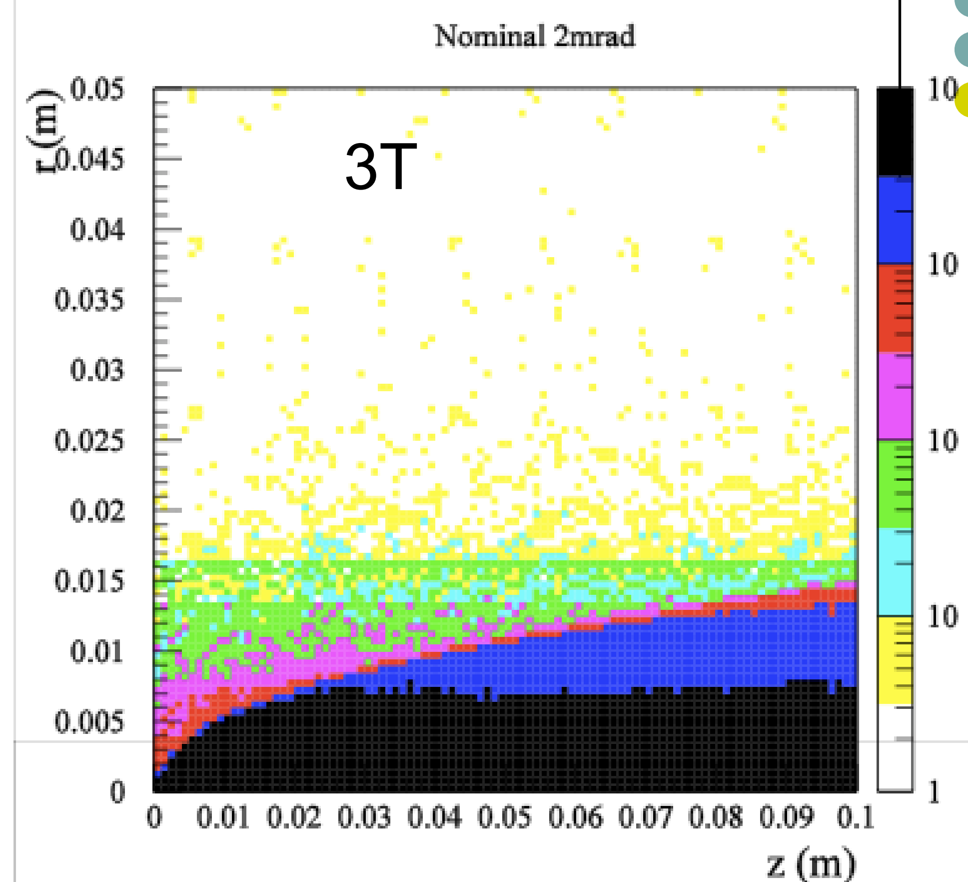
Si wafer length = $|\cos\theta| < 0.95$ + 2 mm

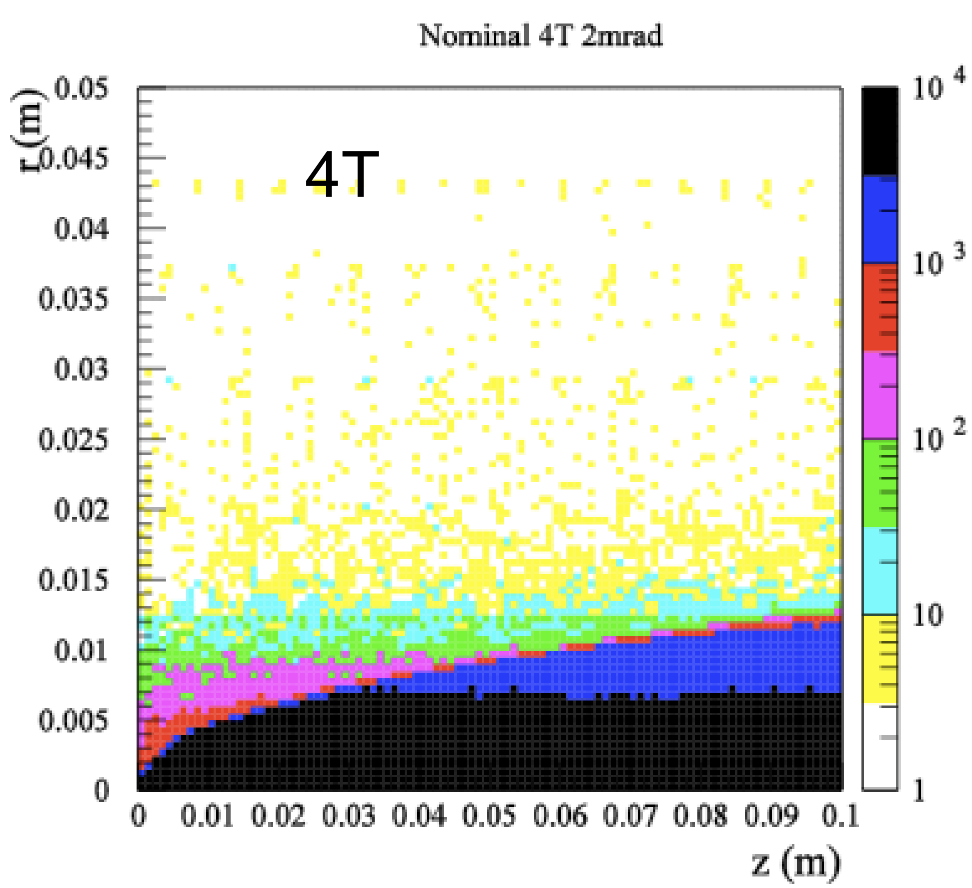
Ladder length = Si wafer length + 15 mm

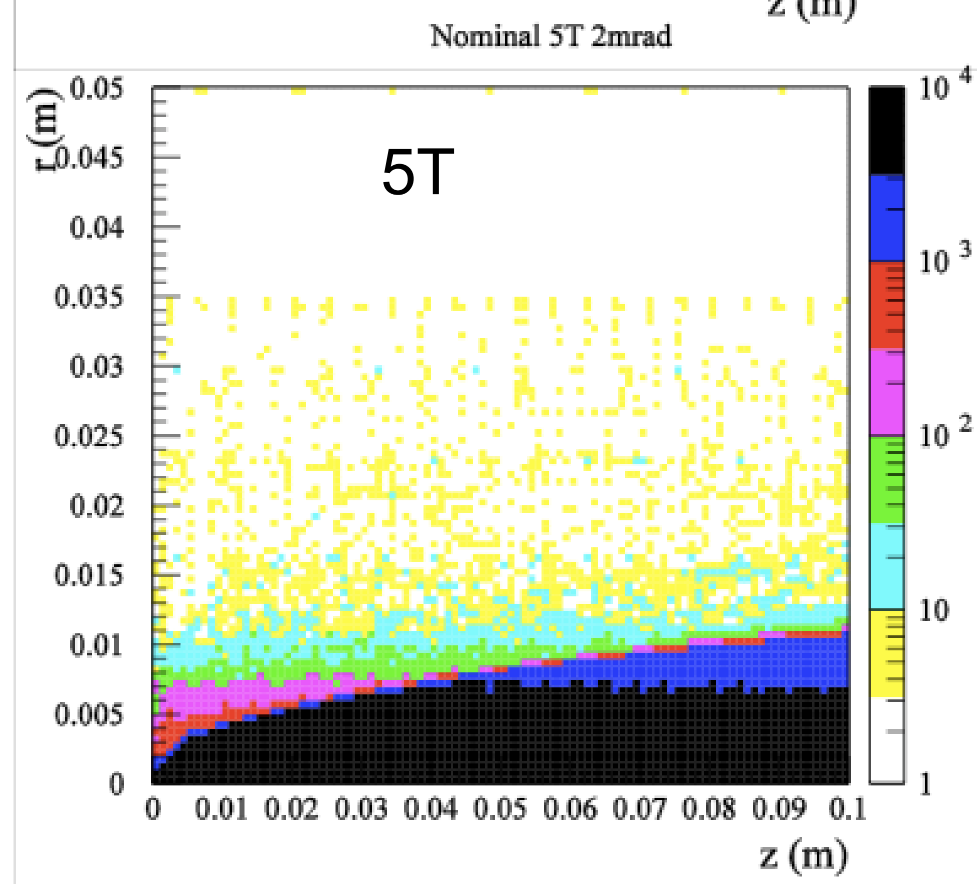
Pair background

- Simulation by CAIN
- B-dependence

  (Track density: $1/cm^2/BX$)





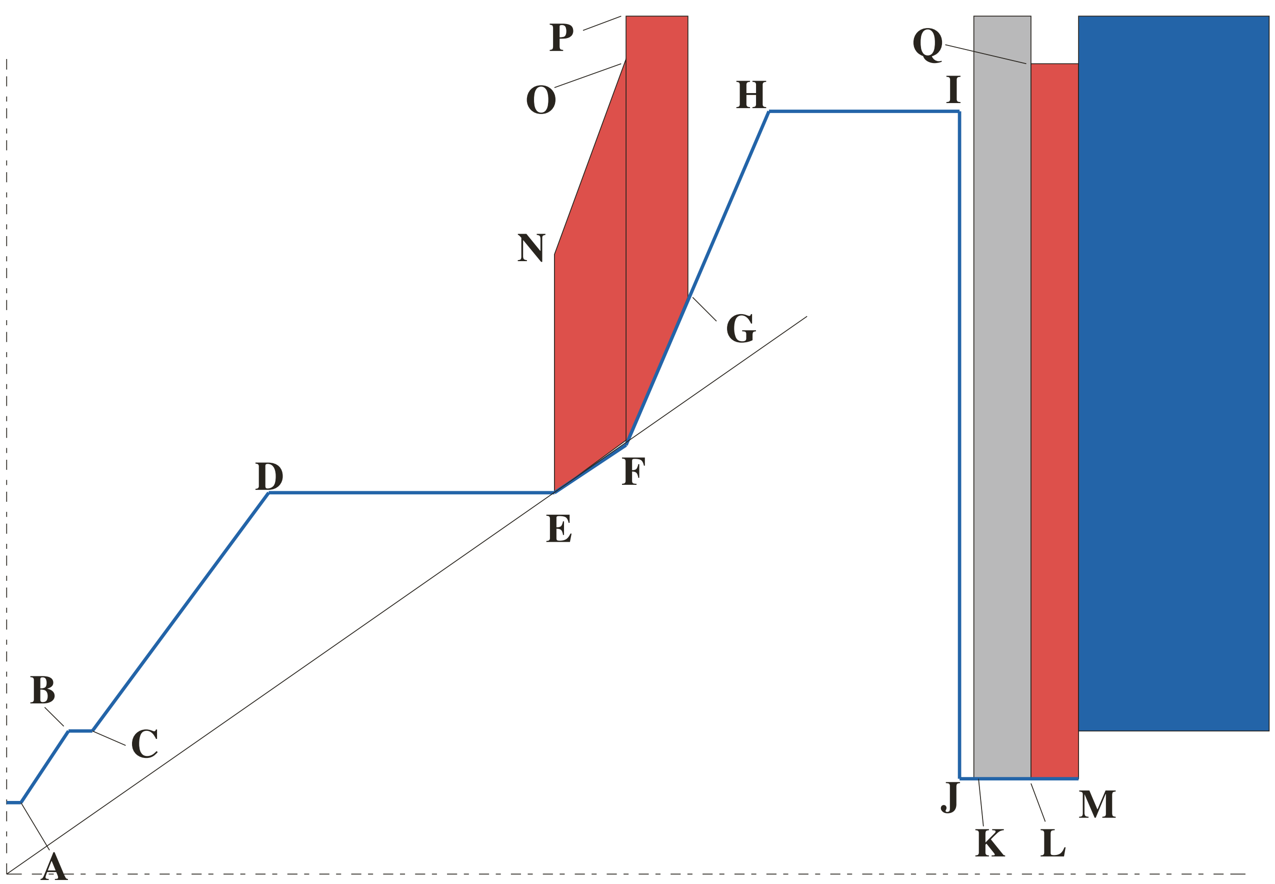


Results

ECM (GeV)	Option	B (T)	R_{core} (mm)	R_{Be} (mm)	R_s (mm)	R_{VTX} (mm)	Z_{VTX} (mm)
500	Nominal	3	10.5	12.5	30	16.6	52.4
		4	9	11	28	14.9	47.4
		5	7.5	9.5	25	13.2	42.0
500	High L	3	16.5	18.5	42	24.1	75.4
		4	13.5	15.5	36	20.2	63.6
		5	12	14	33	18.4	57.9
1000	High L	3	18.5	20.5	42	25.8	80.5
	High L'	**3**	**13**	**15**	**34**	**19.4**	**61.1**
	High L''	**3**	**11.5**	**13.5**	**32**	**17.8**	**56.1**

R_{VTX} has a weak B dependence $\sim 1/B^{1/2}$, but
it has strong dependence on machine parameter set

Interaction Region Design



Standard

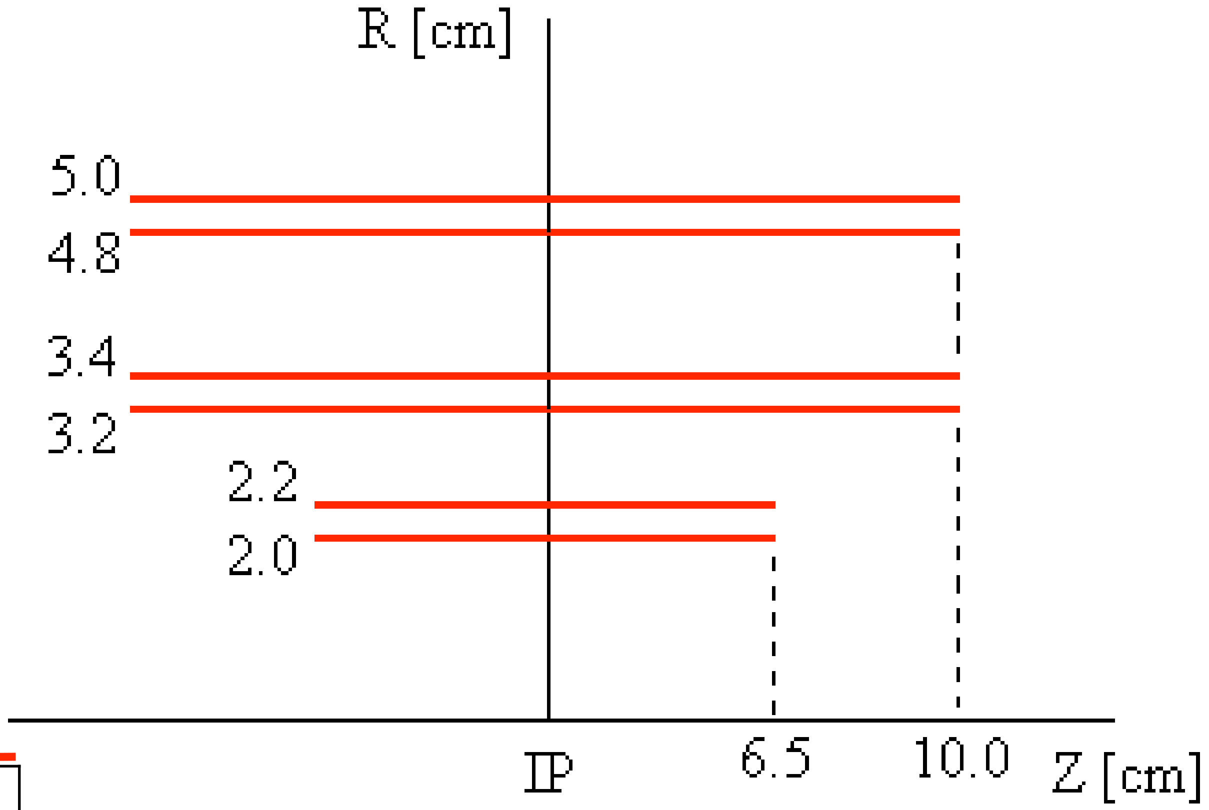
Table 2: IR geometrical data with 2 (20)mrad crossing angle; numbers in parentheses are those at 20 mrad crossing angle, while the others are common at the both angles.

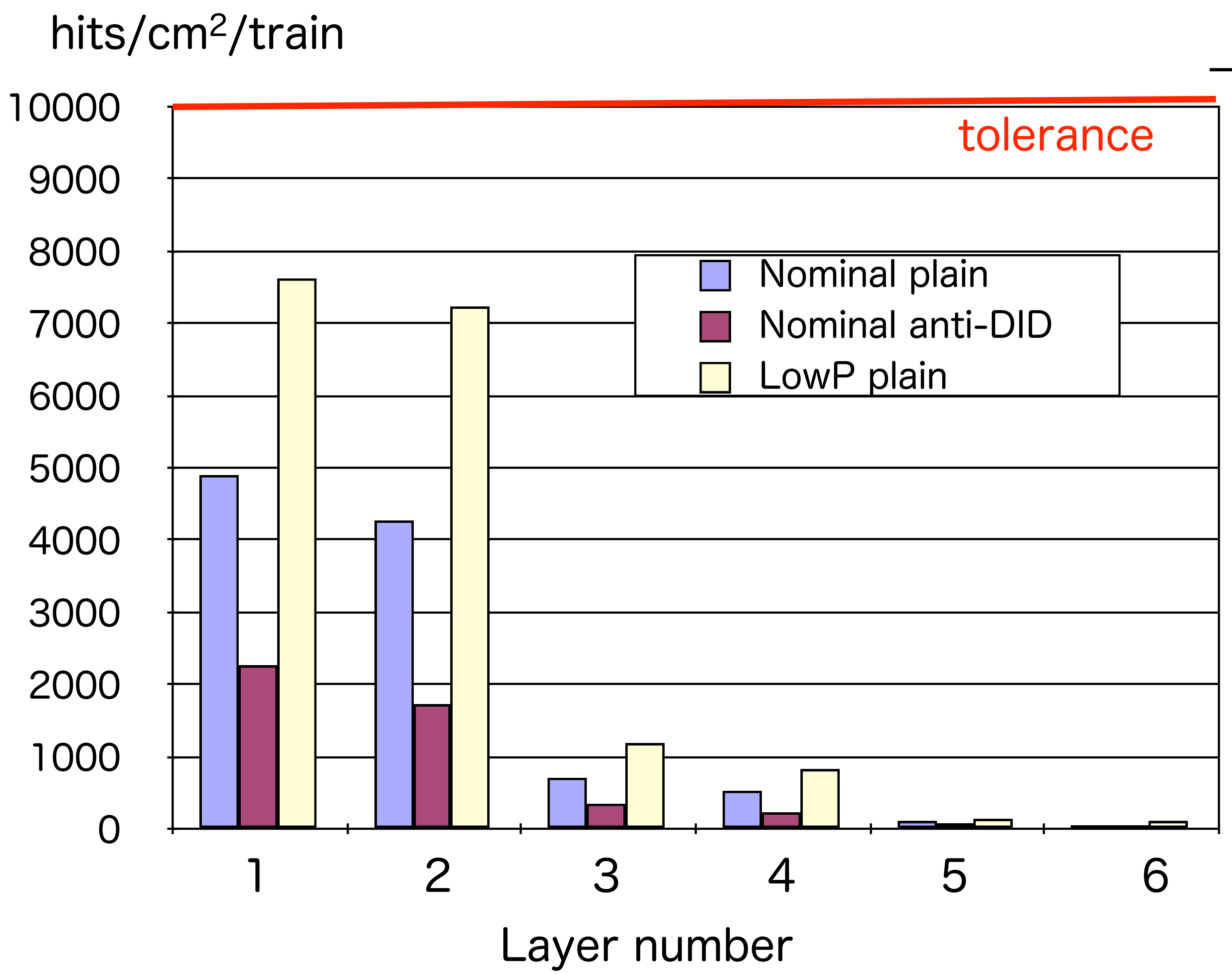
R_{Be} = 1.5cm
R_{VTX}= 2.0cm

E_{cm}	500GeV				1TeV	
para.set	Nominal		High Luminosity		High Luminosity-1	
position	R in cm	Z in cm	R in cm	Z in cm	R in cm	Z in cm
A	1.3	4.5	1.9	6.3	1.5	5
B	3(3.2)	25	4.2	25	3.4(3.5)	25
C	3(3.2)	35	4.2	35	3.4(3.5)	35
D	8	110	9(10)	110	8(9)	110
E	8	230	9(10)	230	8(9)	230
F	9.04	260	10.2(11.3)	260	9.04	260
G	11.94	285	12.60(13.26)	285	11.94(12.60)	285
H	16	320	16	320	16	320
I	16	400	16	400	16	400
J	2(2*)	400	2(2*)	400	2(2*)	400
K	2(2*)	405	2(2*)	405	2(2*)	405
L	2(2*)	430	2(2*)	430	2(2*)	430
M	2(2*)	450	2(2*)	450	2(2*)	450
N	13	230	14(15)	230	13(14)	230
O	17.70	260	18.83(19.96)	260	17.70(18.83)	260
P	36	260	36	260	36	260
Q	17.96	430	19.83(21.70)	430	17.96(19.83)	430

* : There are two holes with the same radius for incoming and exit beams at the 20mrad crossing angle.

VTX hit distribution



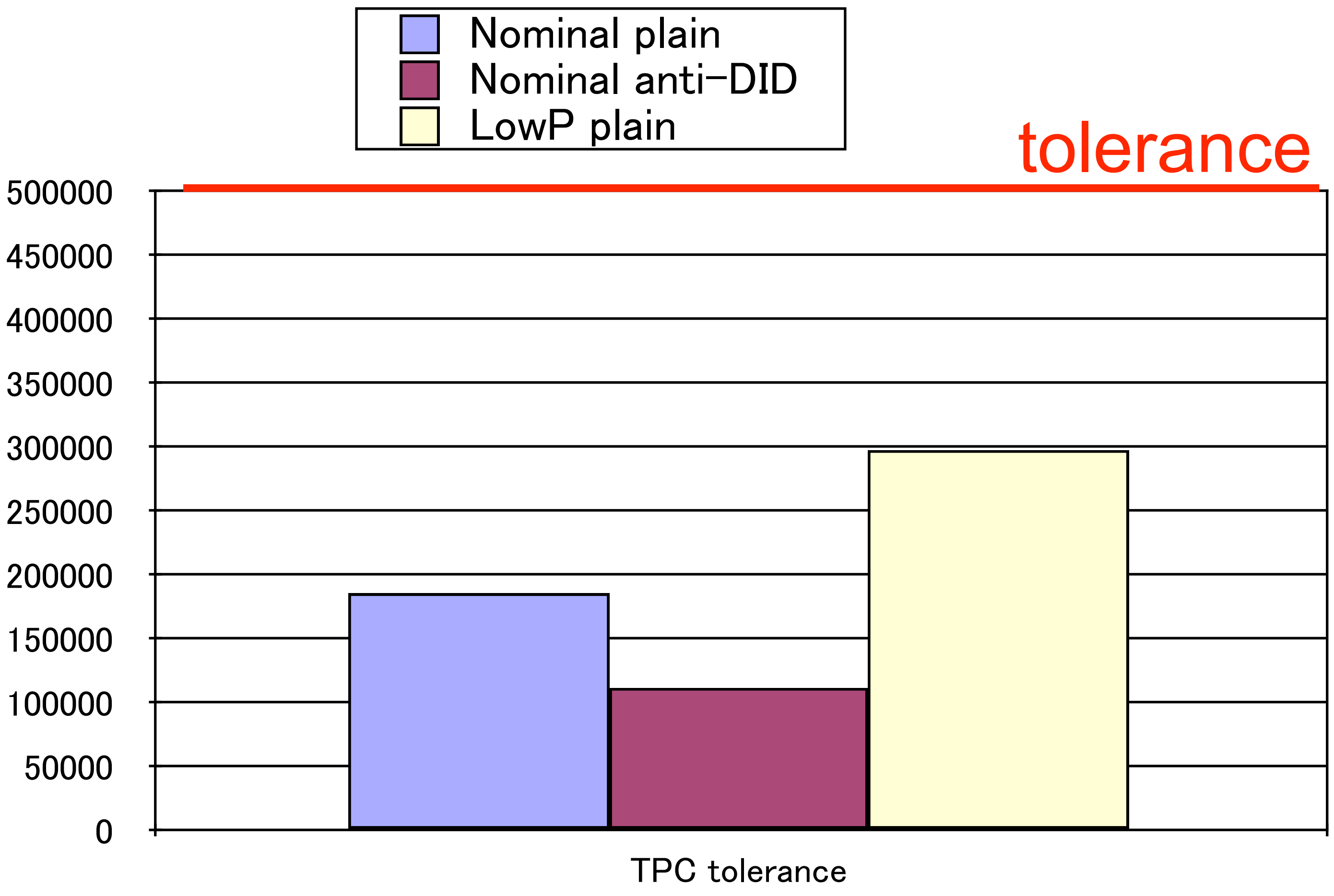


Nominal plain:20bunch

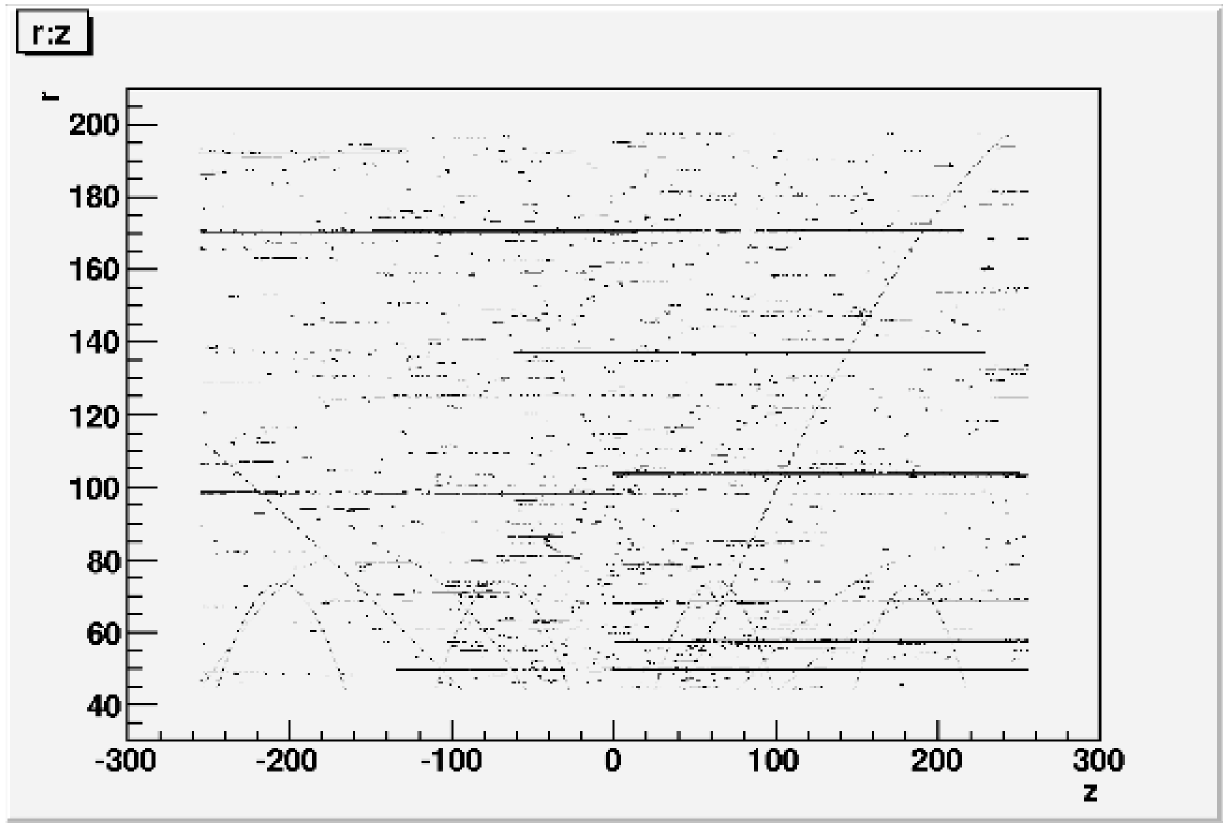
Nominal anti-DID:10bunch

Low P plain:1bunch

TPC hit



TPC digital hits

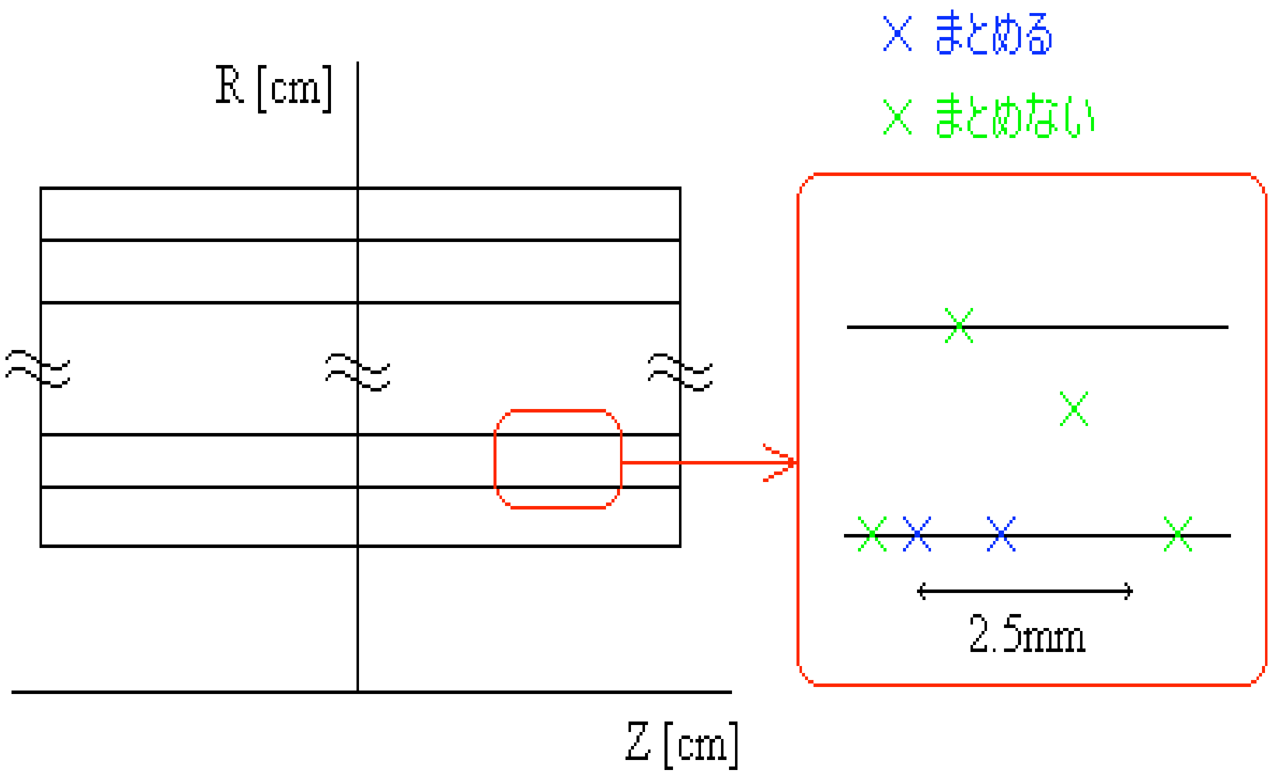


TPC Exact hits

Nominal plain:20bunch

Nominal anti-DID:10bunch

Low P plain:1bunch

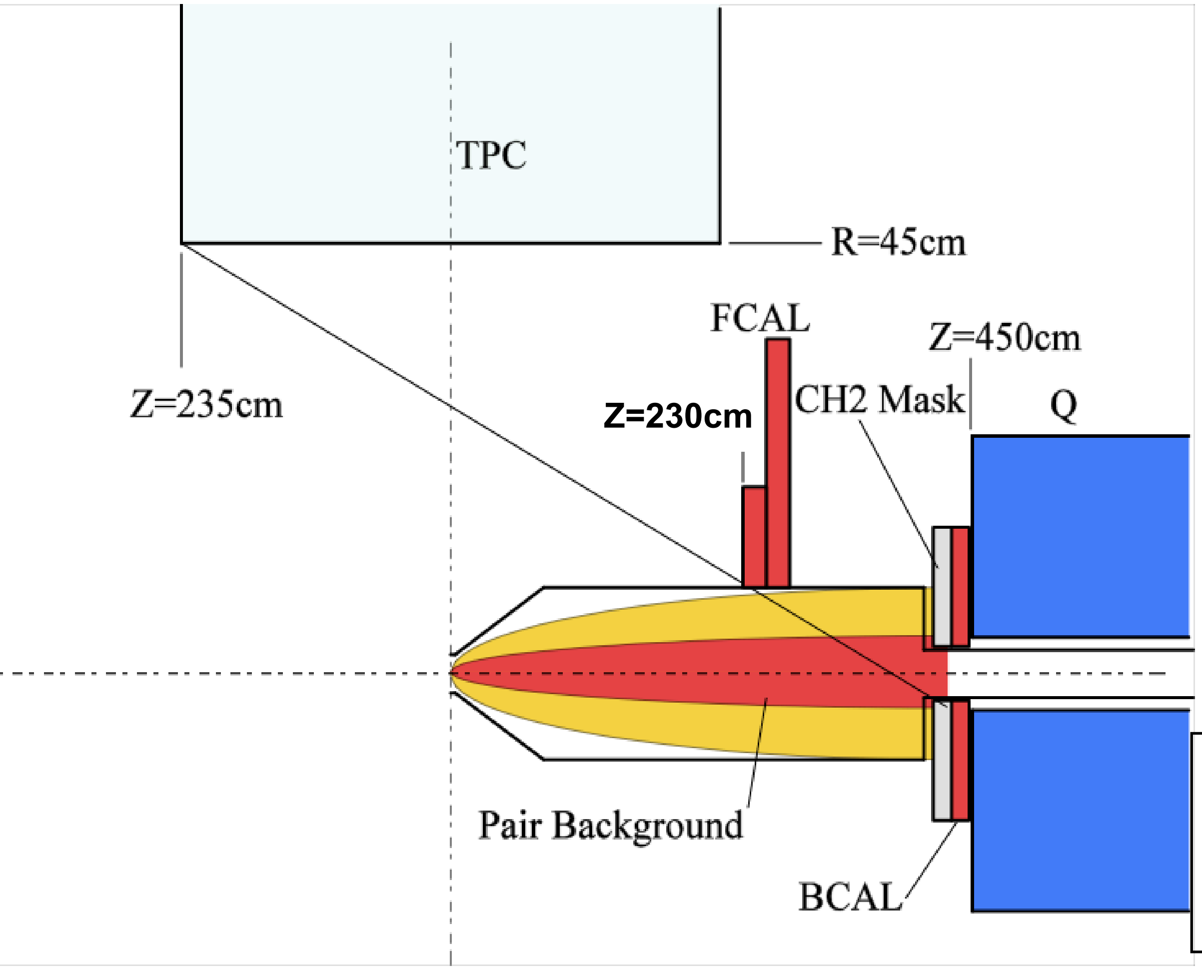


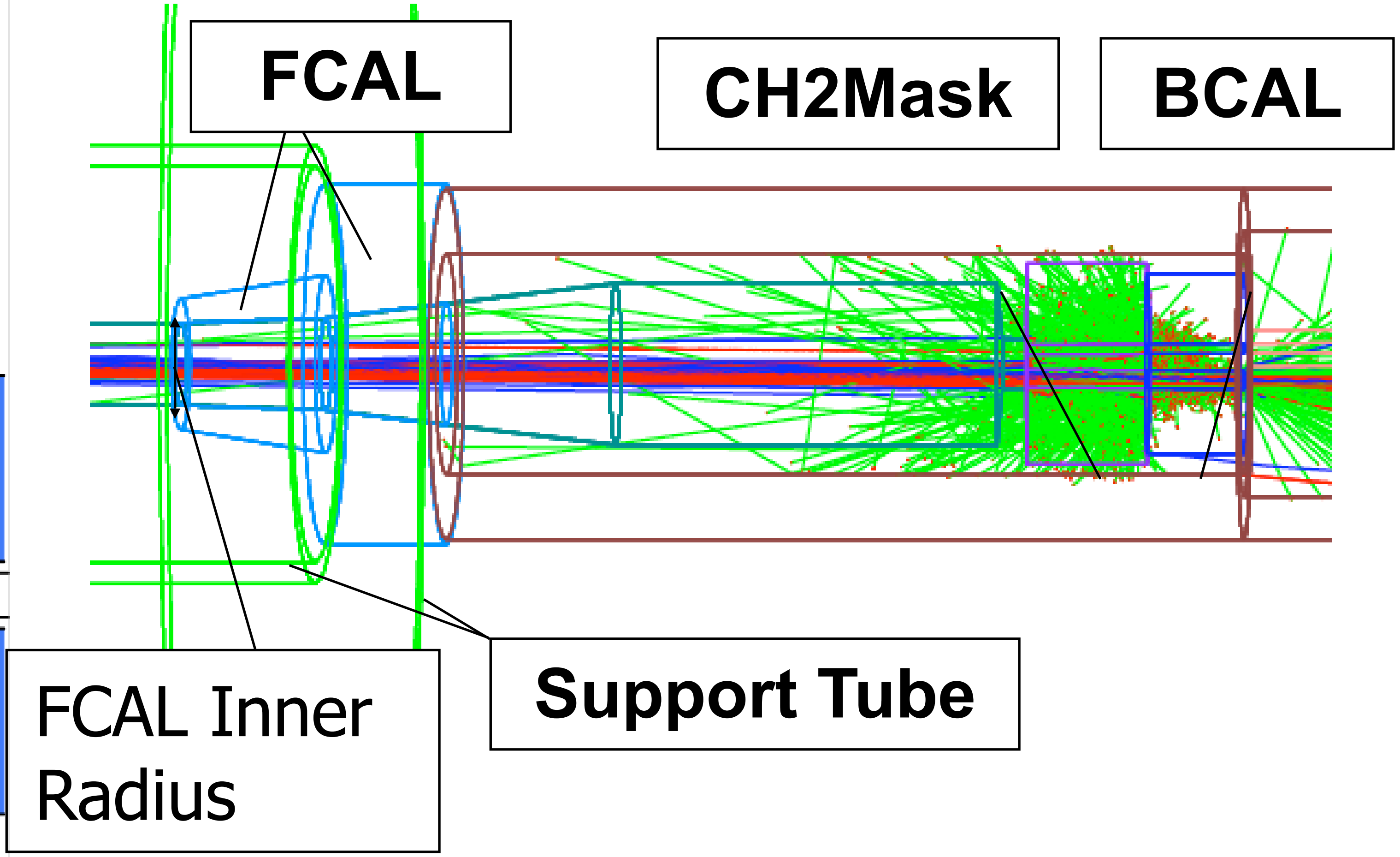
FCAL Inner Radius Optimization

The purpose is to optimize forward calorimeter (FCAL) inner radius to decrease TPC background.

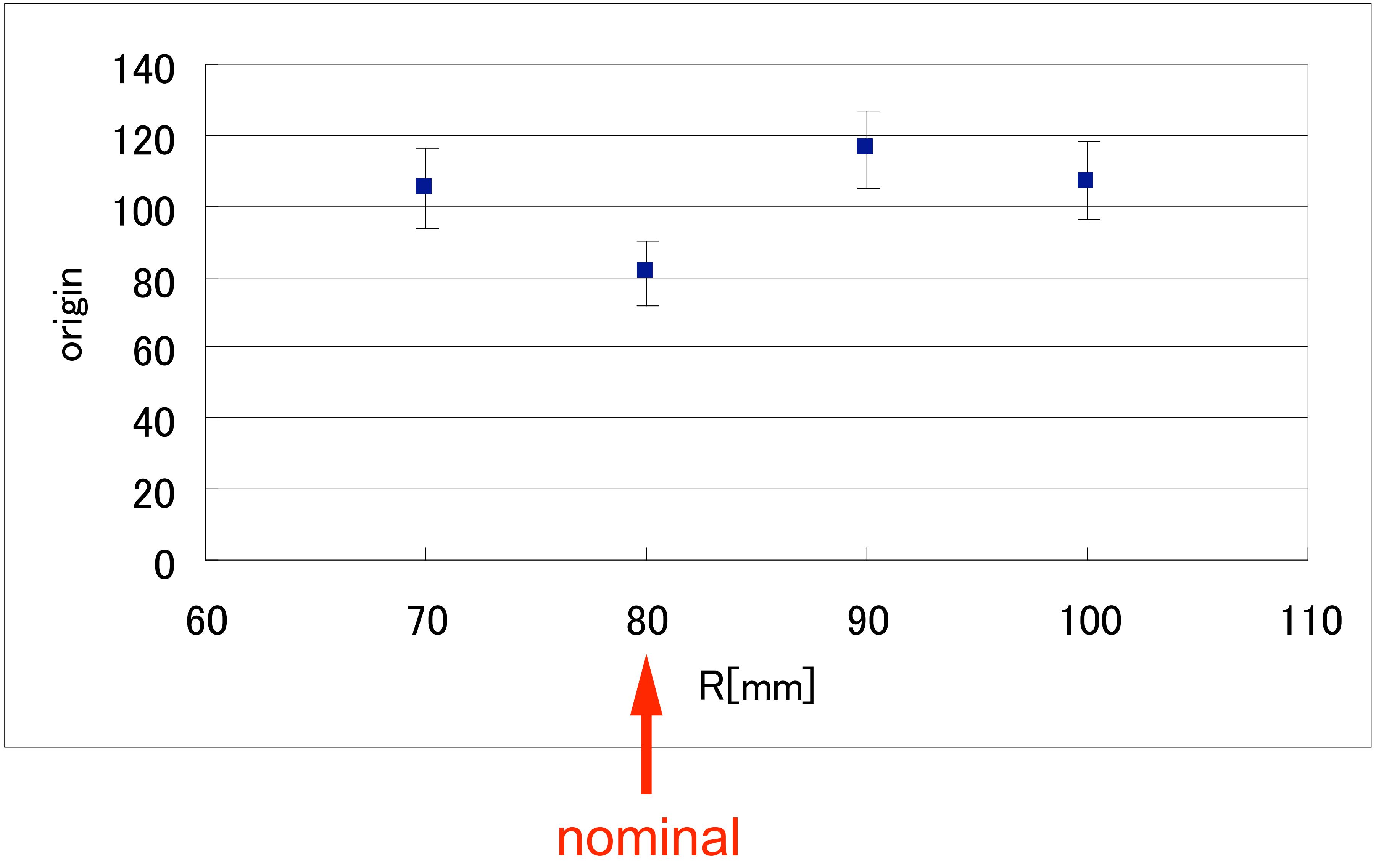
Default value of FCAL inner radius was determined by simple head on geometry.

But··· we have to verify it by full simulation.





No. of particles entered TPC as a function of FCAL inner radius



full simulation (Jupiter) : statistics/10 bunches with anti-DID

Collimation: Spoilers and Masks

Table 3: Major collimators' location from IP, aperture, length and material (ILCFF9).

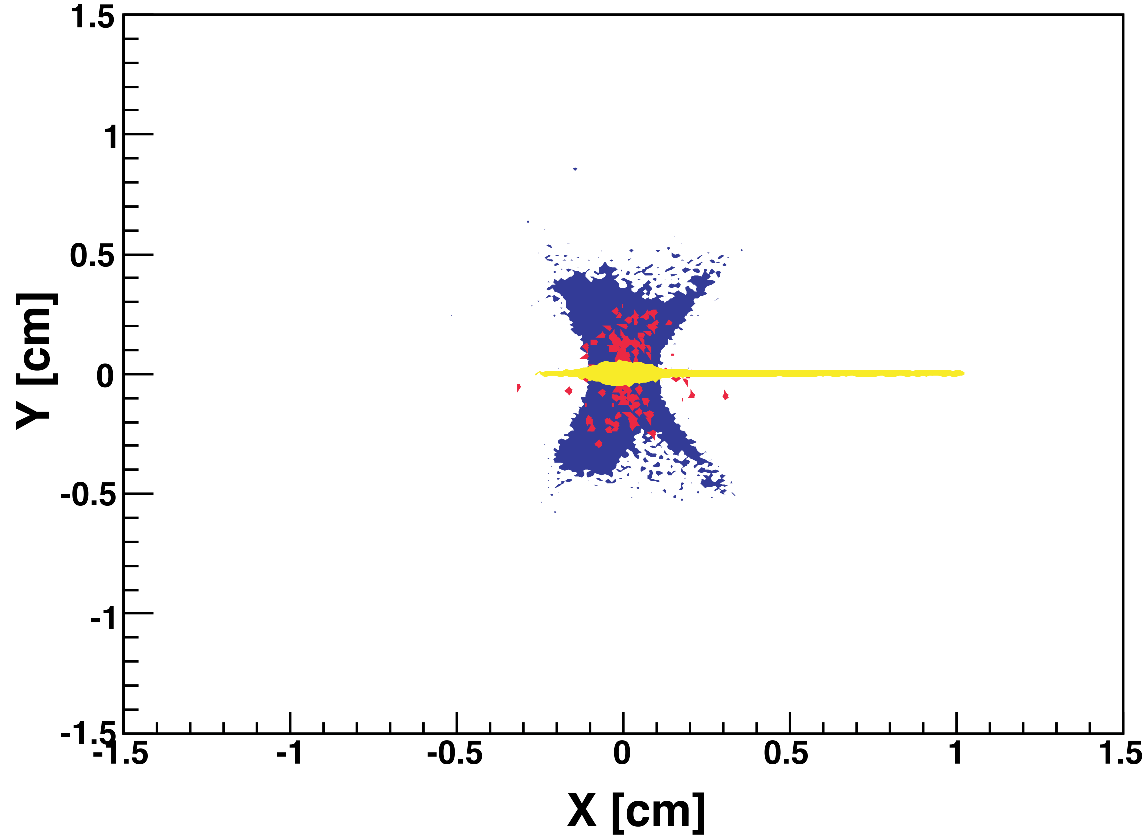
name	Location	Thickness	Material	Aperture			
	m	X_o		x(mm)	y(mm)	$x(\sigma_x)$	$y(\sigma_y)$
SP2	1483.27	0.6	Copper	0.9	0.5	8	65
SP4	1286.02	0.6	Copper	0.9	0.5	8	65
SPEX	990.42	1	Titanium	0.5	0.8	10	62
MSK1	49.81	30	Tungsten	7.8	4.0	16	178
MSK2	13.02	30	Tungsten	7.4	4.5	12	151

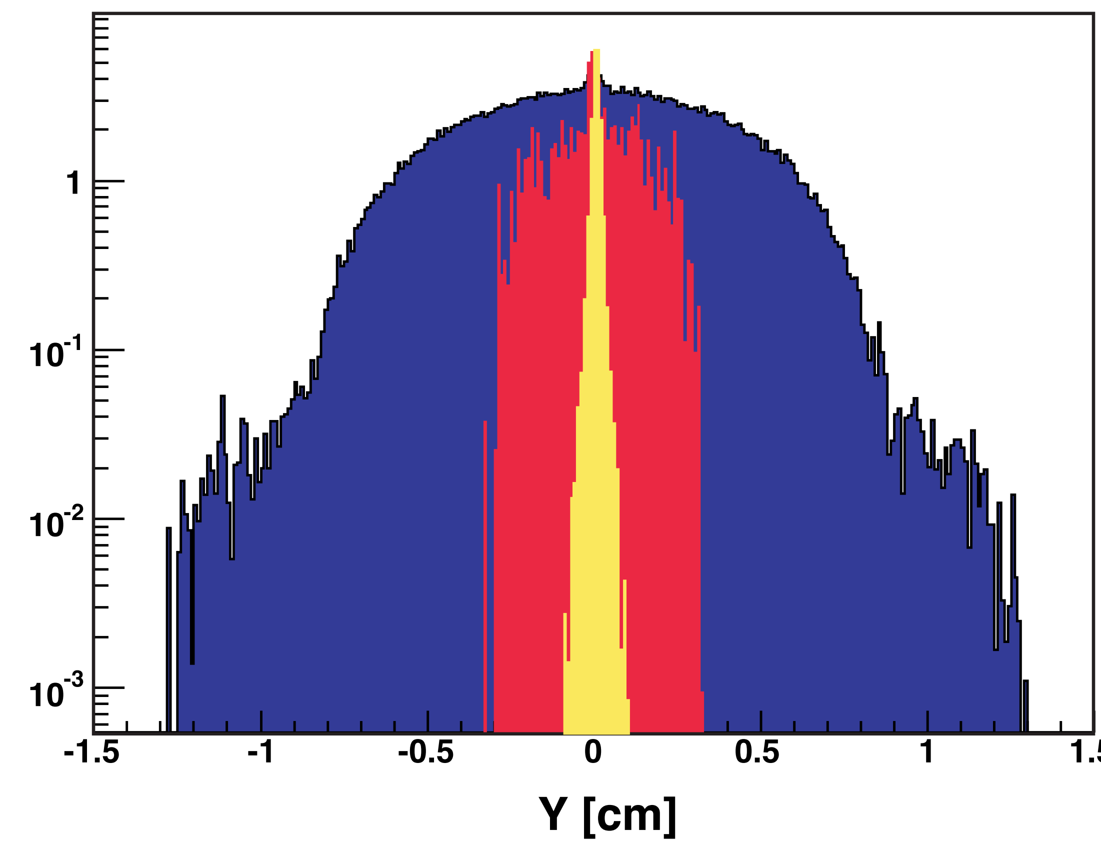
Masks for synchrotron photons

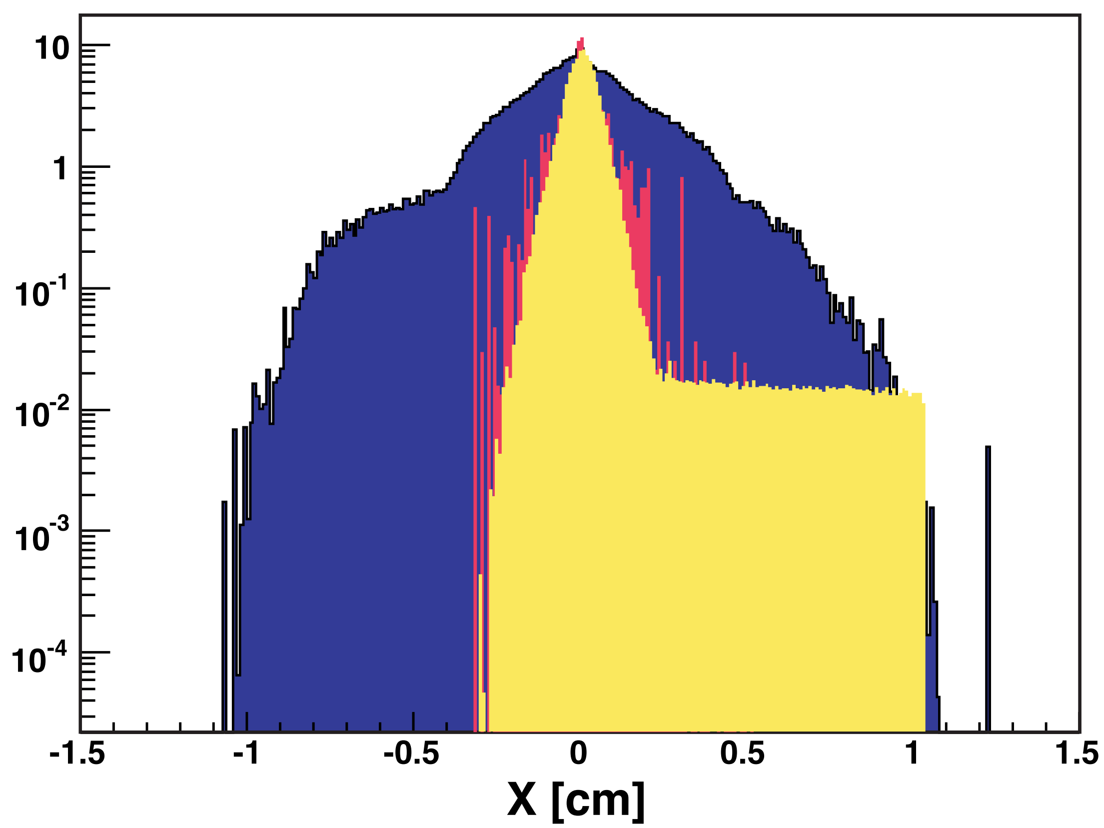
note: last bends at 108m from IP

Apertures have been optimized by A. Drozhdin for higher B field. (BDIR05)

Synchrotron Radiations at IP, by LCBDS







GLD standard :

beam pipe radius of 1.5cm

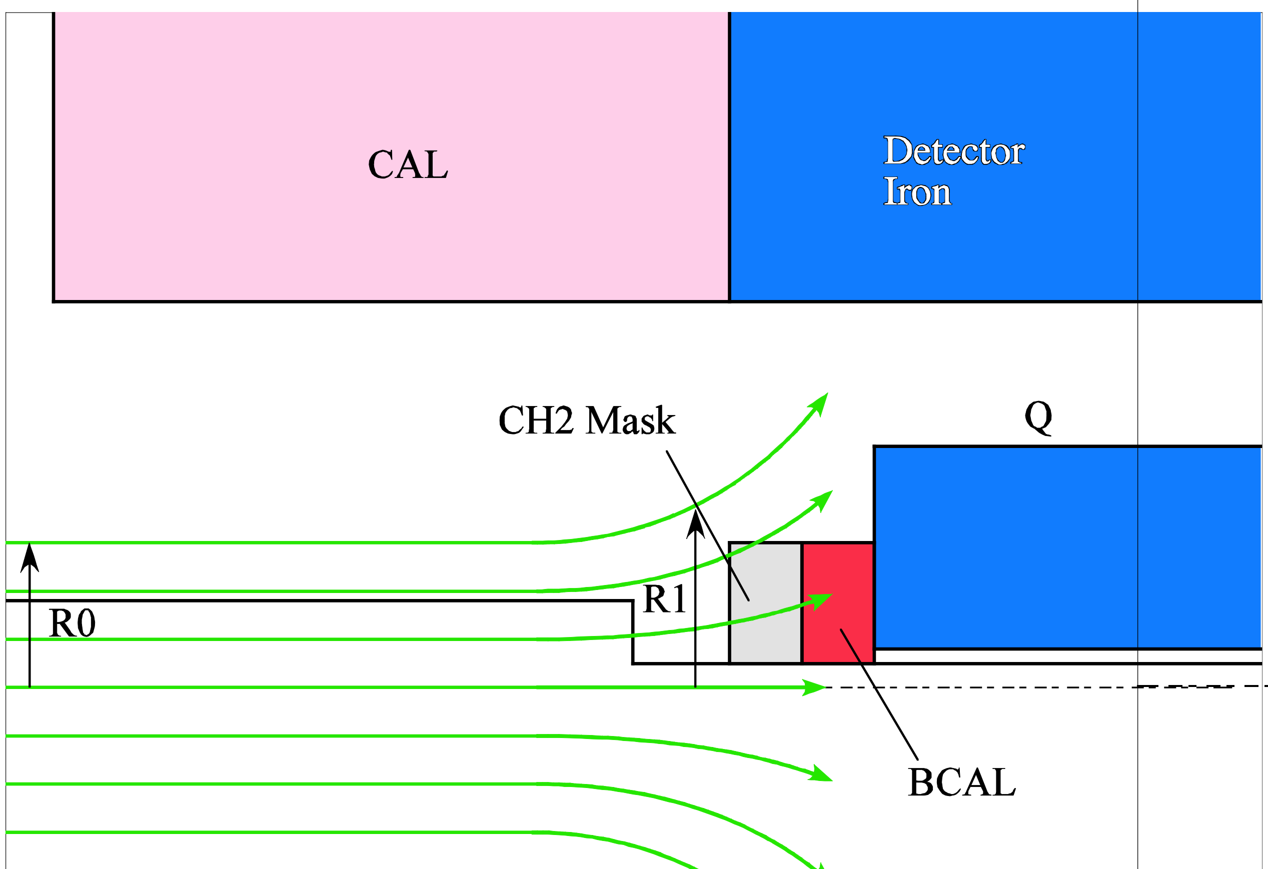
Collimation aperture can be larger.

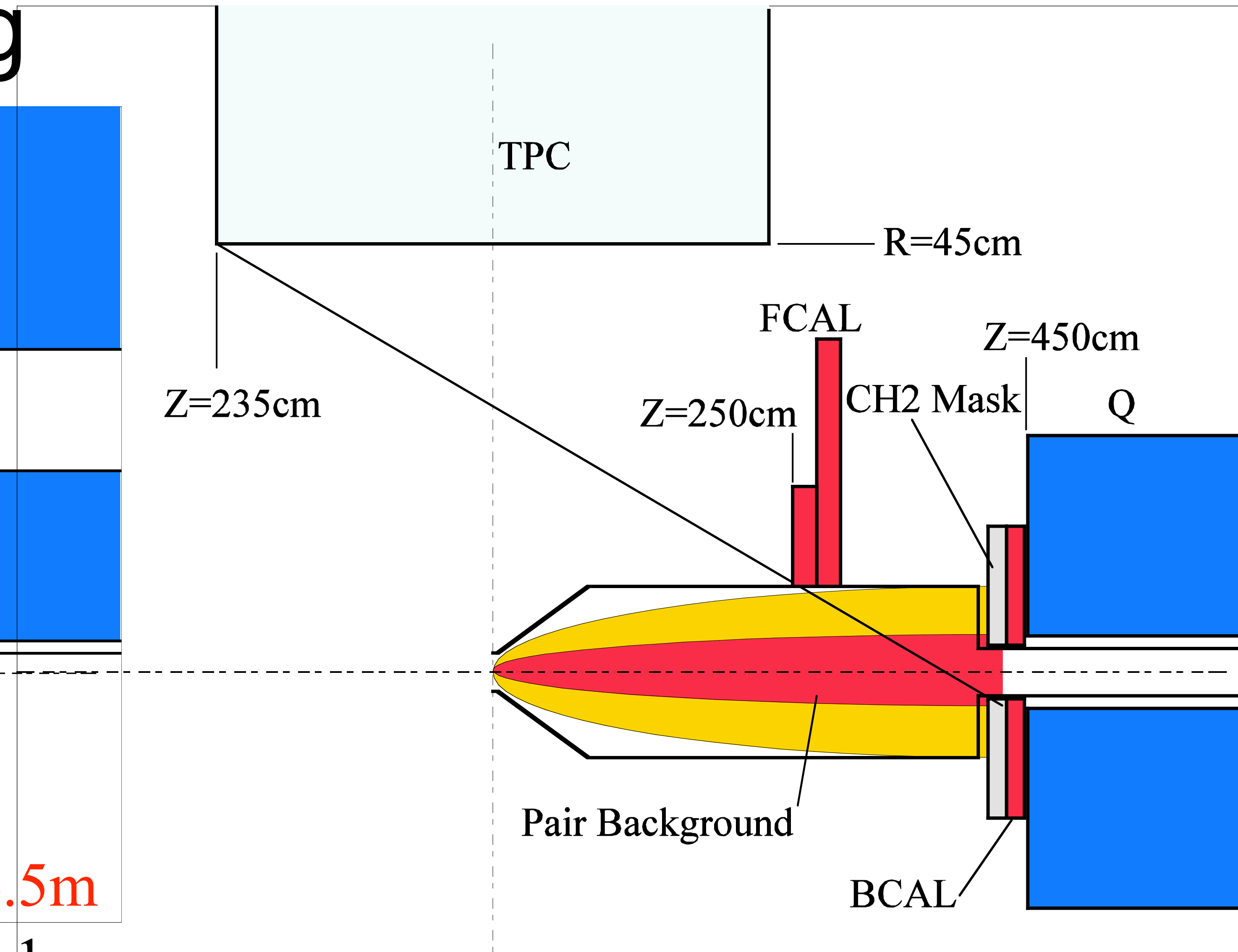
note: last bends at 108m from IP

GLD : Preference of L* > 4.7m

γ back scattering

e+/e- backscattering



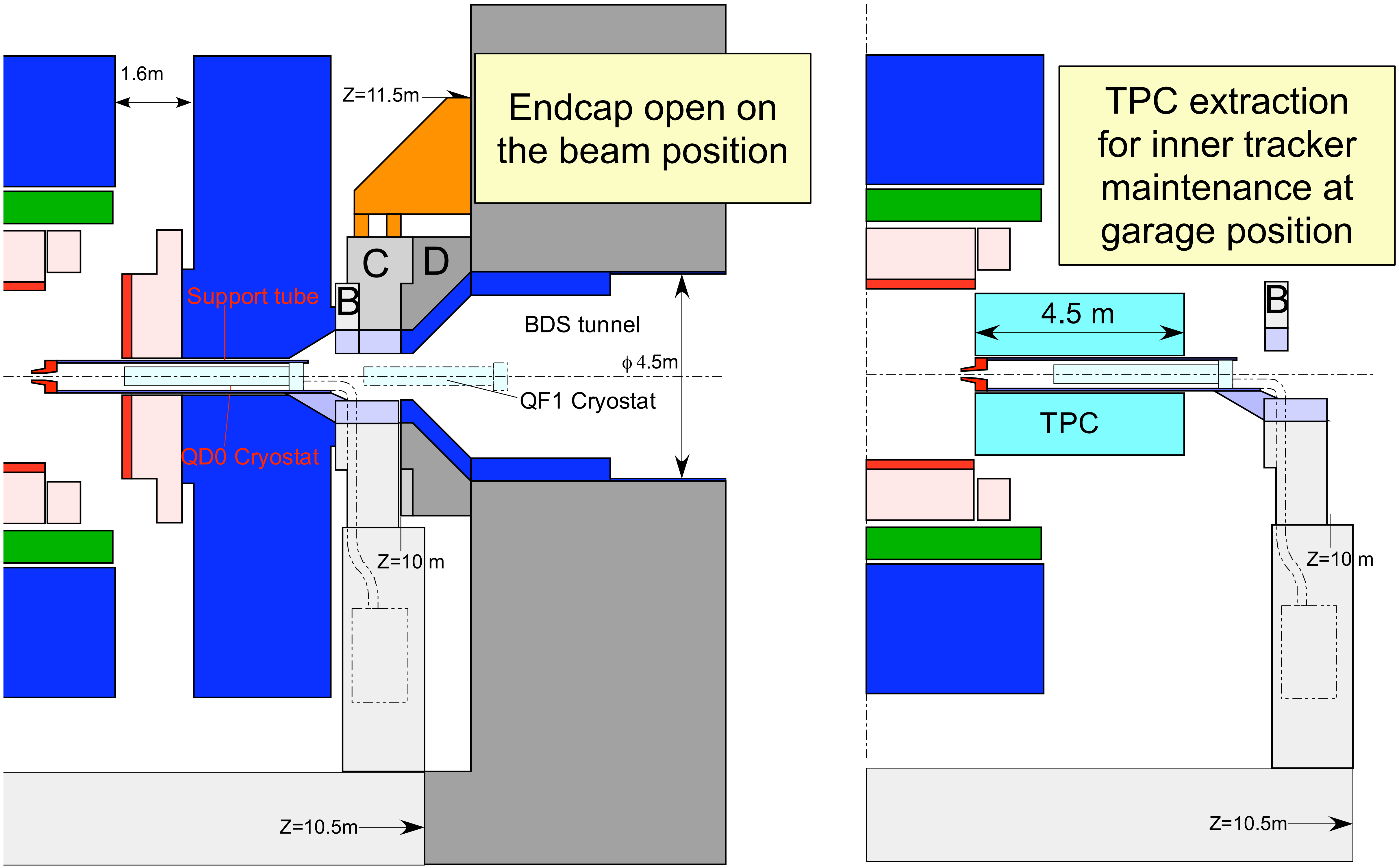


$R0/R1 = \sqrt{B1/B0}$ = 1.6 / 2.0 L*=4.5m

(Z1=4.3 m) 1.92/2.0 L*=4.1m

1.99/2.0 L*=3.6m

Pacman design and FD support



Summary

1. GLD will evolve to GLDc for the push-pull scheme, while we need detailed evaluation for optimization with full simulation.

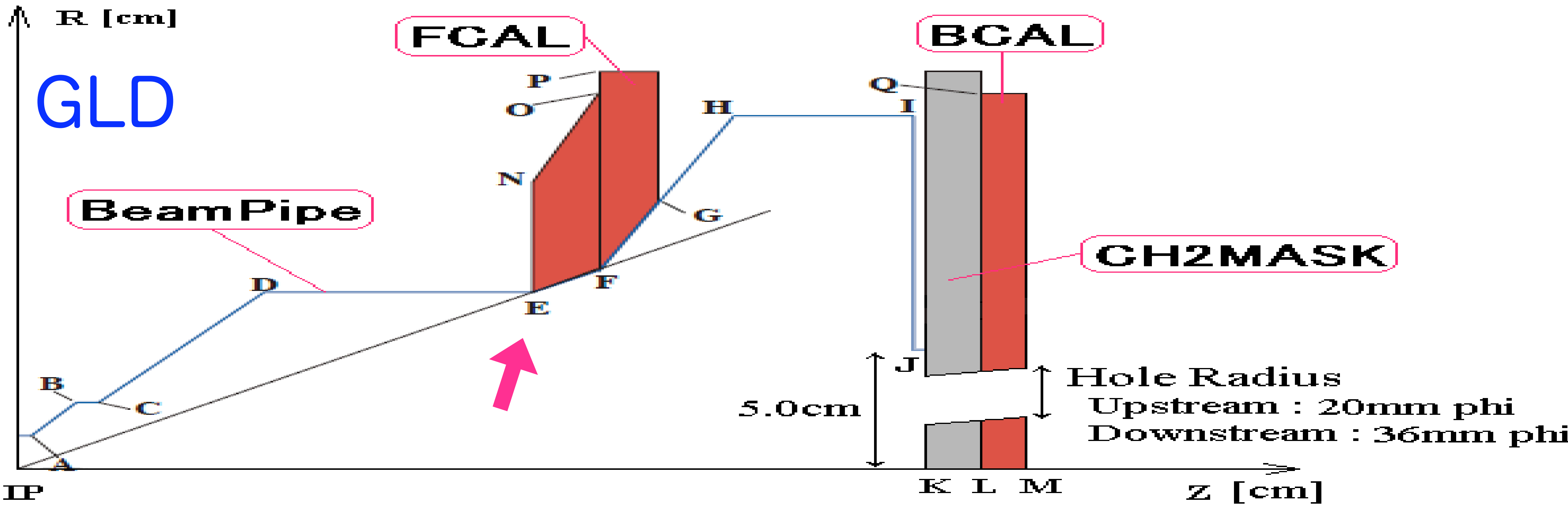
2. GLD IR region has been optimized with respect to backgrounds (pairs, synchrotron photons, muons ..) at VTX, TPC and minimum veto angle for 2 photon process.

3. Relevant parameters for IR optimization are listed below;

Machine parameter sets	1TeV, HiLum-1	
L* (m)	4.5	same at GLDc
B (Tesla)	3	3.5 at GLDc
R_{Be} (cm)	1.5	z < 5cm
R_{VTX} (cm)	2.0	FPCCD
VTX angular acceptance	|cos|<0.95	3 super-layers
R_{FCAL} (cm)	8	z=2.3m
R_{BCAL} (cm)	1 and 1.8	z=4.3m
QD0,FCAL,BCAL support	canti-lever	W-tube

Beam pipe at FCAL/LumiCAL

GLD



LDC