New JLC Mask System at B=3T

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Contents:

- **Pair background hits in JLC detector models**

  --- 2T, 3T(l^*=2m), 3T(l^*=4.3m)

- **Beam background from disrupt beam**

  --- Preliminary design of the beam extraction line

Background Source for Detector Components

Pair Background :	direct	e	VTX
	b.s. (QC1)	e	VTX
	b.s. (QC1)	γ, n	CDC,CAL,LUM
Disrupt Beam :	b.s. (extraction line)	γ, n	VTX, CDC
Beam-strahlung γ :	b.s. (γ beam dump)	γ, n	VTX
Main beam :	b.s. (e beam dump)	n	VTX
Synchrotron Rad. :	b.s. (extraction line)	γ	VTX, CDC

Simulation

Generation of pair background:

- **CAIN**
- **Ebeam=250GeV**
- **"A" option ("Y" option)**

Detector Simulation:

- **JIM (based on GEANT3)**
- **Ecut for γ: 10 keV**
- **Ecut for n: 1 keV**
- **Realistic B field (Compensatiom mag., QC1 included)**

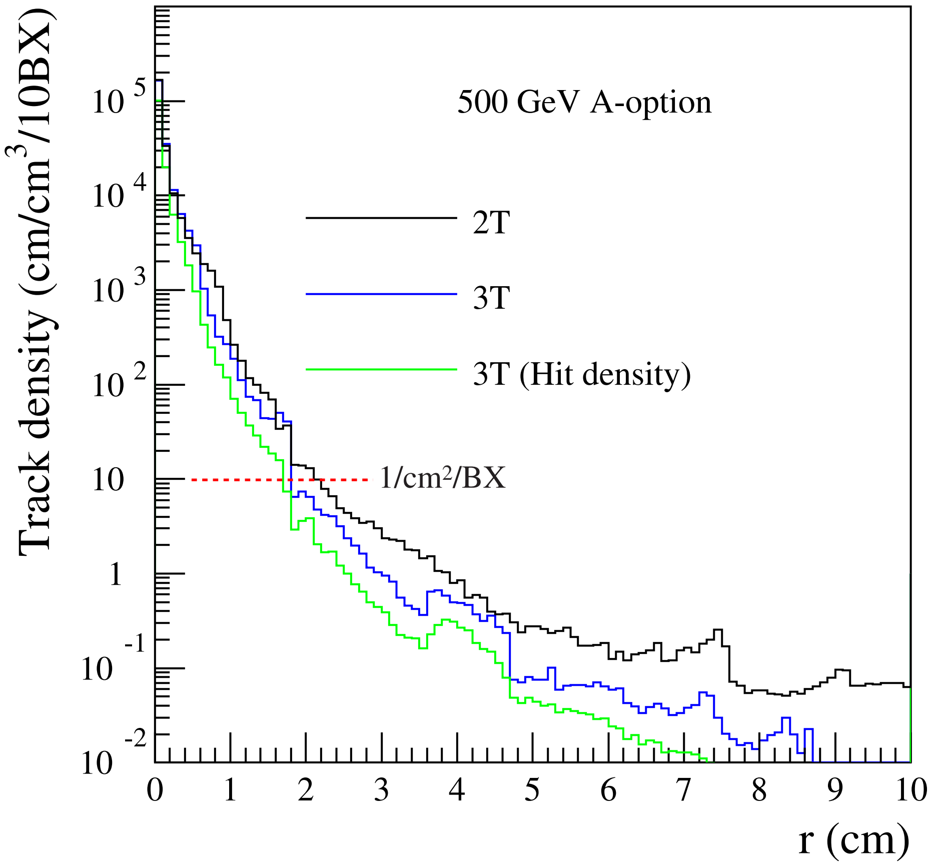
K. Yokoya, March 1999

500GeV (CM) Hi-Lum Parameters of JLC

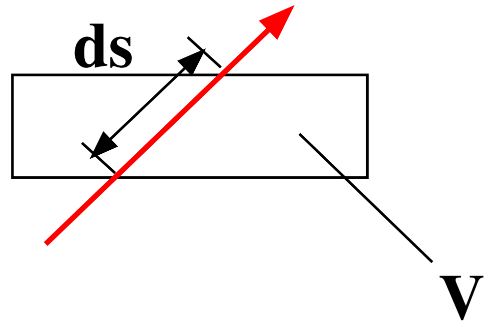
		A	X	Y
Luminosity	10^{34}/cm^{2}s	0.88	1.57	2.61
Nominal Lum.[3)]	10^{34}/cm^{2}s	0.63	1.08	1.75
Bunch Population	10^{10}	0.75	0.55	0.70
No. of bunches/pulse		95	190	190
Bunch separation	ns	2.8	1.4	1.4
Linac length/beam[7)]	km	5.21	5.54	5.97
AC power(2 linacs)	MW	117	126	136
Beam power/beam	MW	4.28	6.28	7.99
Loaded gradient[4)]	MV/m	57.6	54.2	50.2
Bunch length $_z$	μm	90	80	80
$_x$ (DR exit)	10^{-6} m	3	3	3
$_y$ (DR exit)	10^{-6} m	0.03	0.02	0.02
$_x$ (IP)	10^{-6} m	4	4	4
$_y$ (IP)	10^{-6} m	0.06	0.04	0.04
Cavity align. tol.[6)]	μm	15	18	14
$_x$	mm	10	6	6
$_y$	mm	0.1	0.1	0.1
IP beam size $_x$	nm	286	222	222
$_y$	nm	3.15	2.86	2.86
Diagonal angle $_x$/ $_z$	mrad	3.18	2.77	2.77
Disruption param D_x		0.094	0.102	0.130
D_y		7.64	7.89	10.04
Pinch enh. H_D[5)]		1.38	1.45	1.49
$_{ave}$		0.136	0.146	0.188
$_{BS}$	%	4.42	4.39	6.67
n		1.07	1.01	1.28

Pair background track density

|cos |<0.9



track density =   ds / V

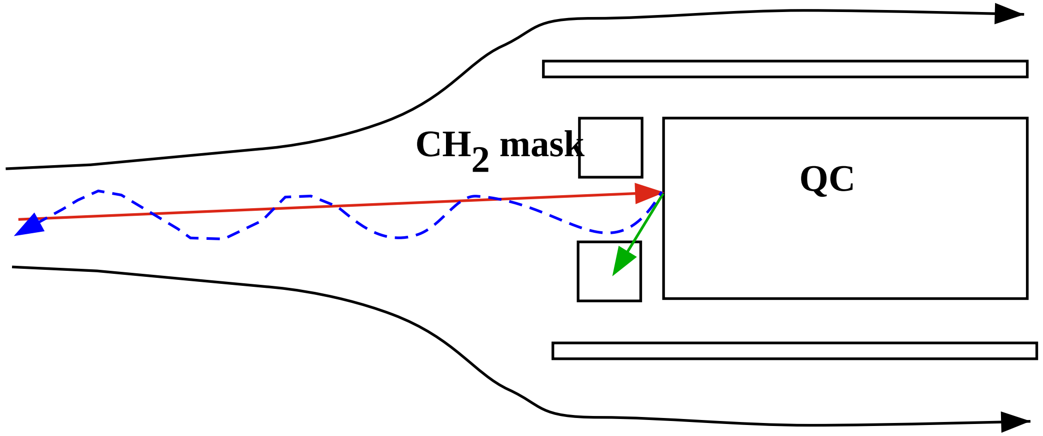


Detector models and Mask system

Detector Model		QC1 surrounded by	Mask System
Old	B=2T l*=2m	CDC	Long tungusten(W) mask inside support tube Low-Z (graphite/CH2) mask in front of QC1
Now	B=3T l*=2m	CAL	Long W Mask inside Support Tube (Short W Mask is enough) Low-Z mask
Future	B=3T l*=4.3m	Endcap Iron	Foward calorimeters (No W mask) Low-Z mask

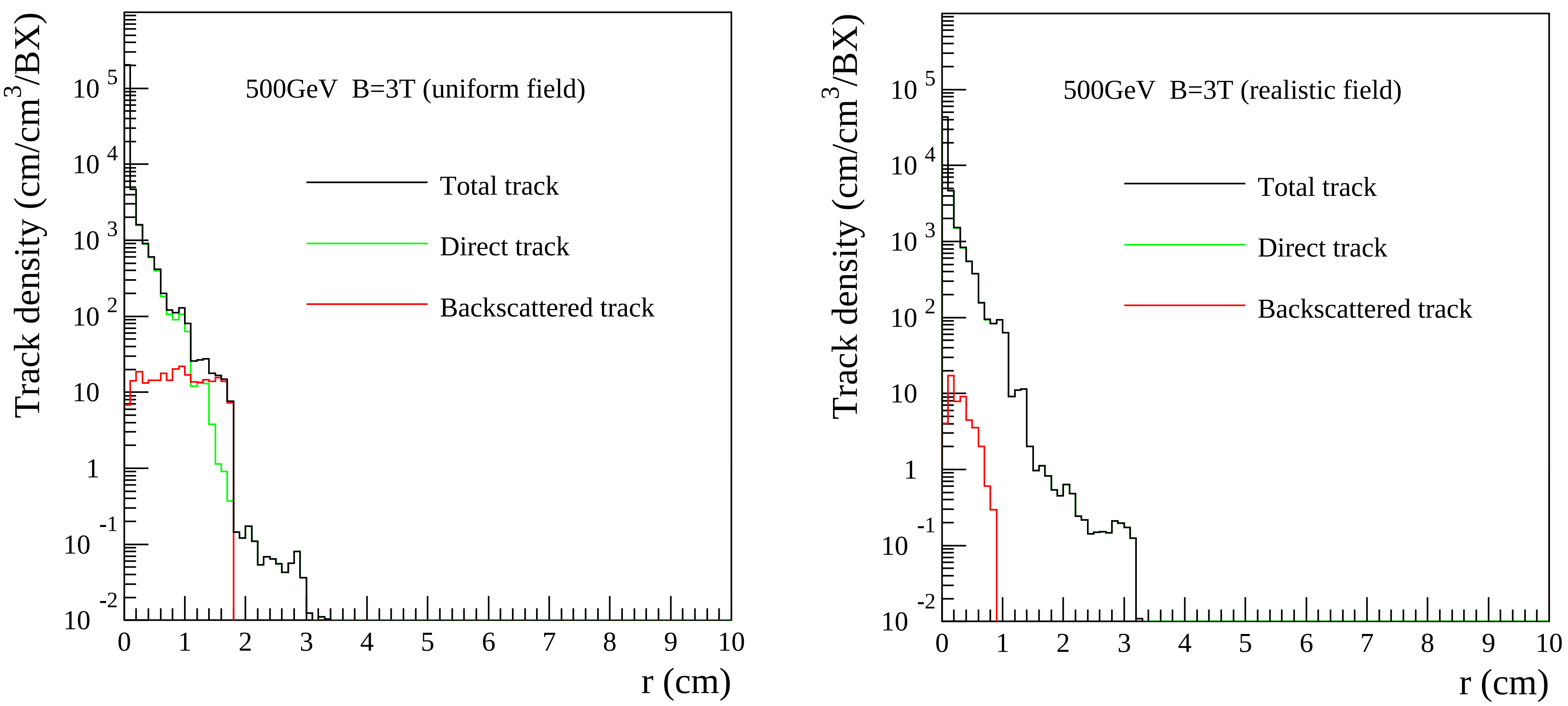
Effect of Low-Z Mask

- Low-Z mask at B~0 is very effective to absorb backscattered low energy e^+/e^-

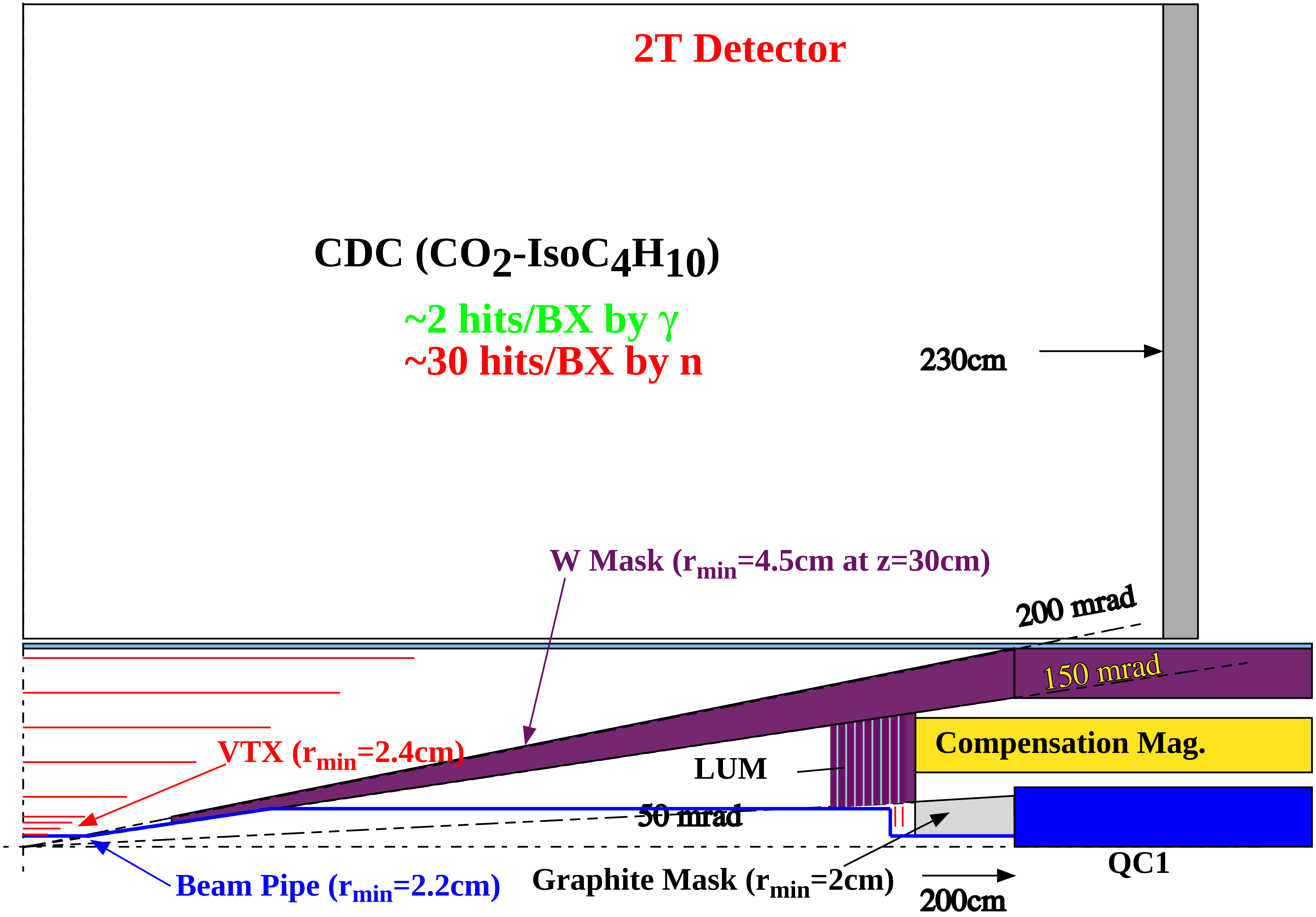


- Low-Z mask works as a neutron shield

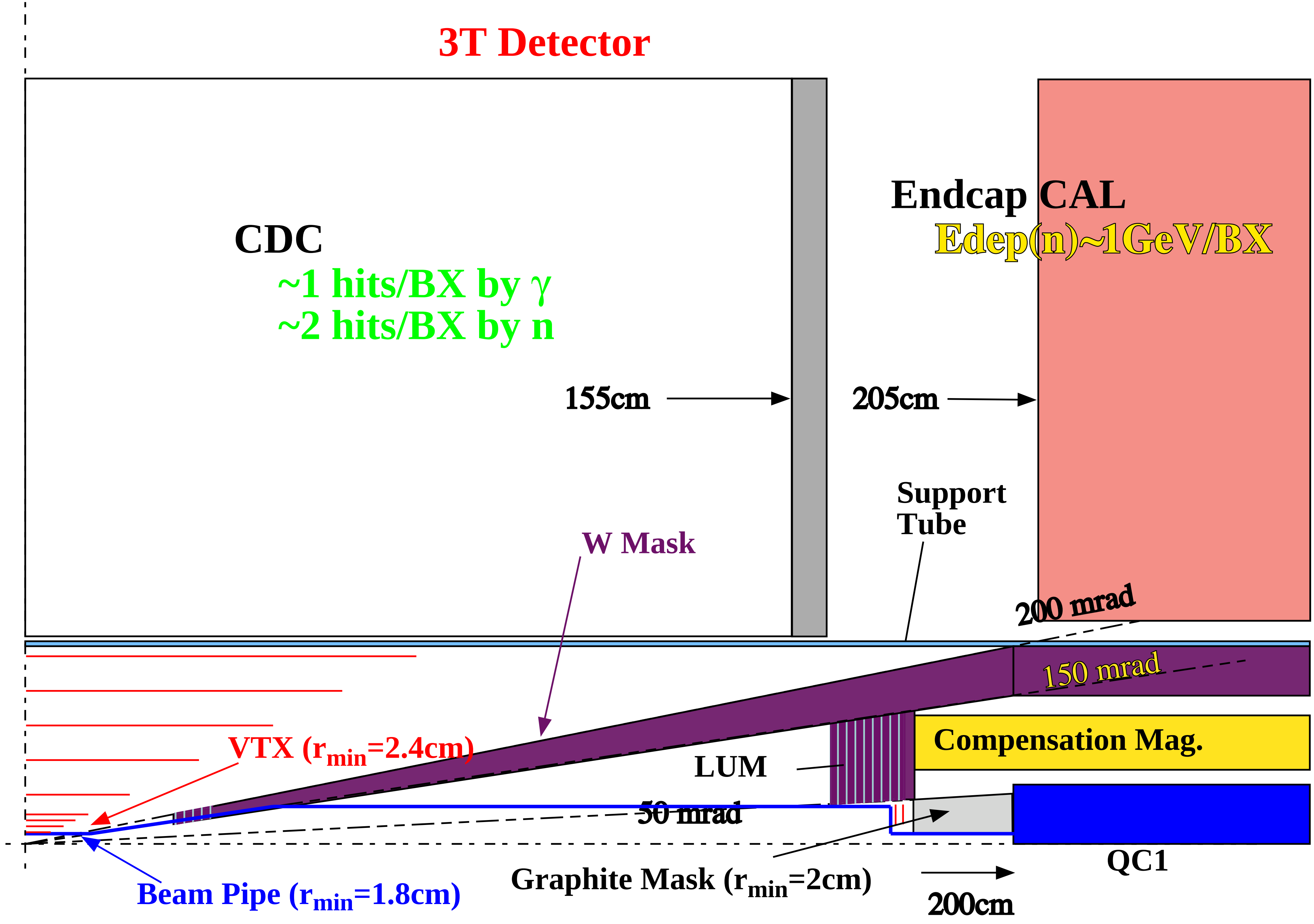
~1/10 attenuatin with 20cm CH_2
Boron-loaded CH_2 is available



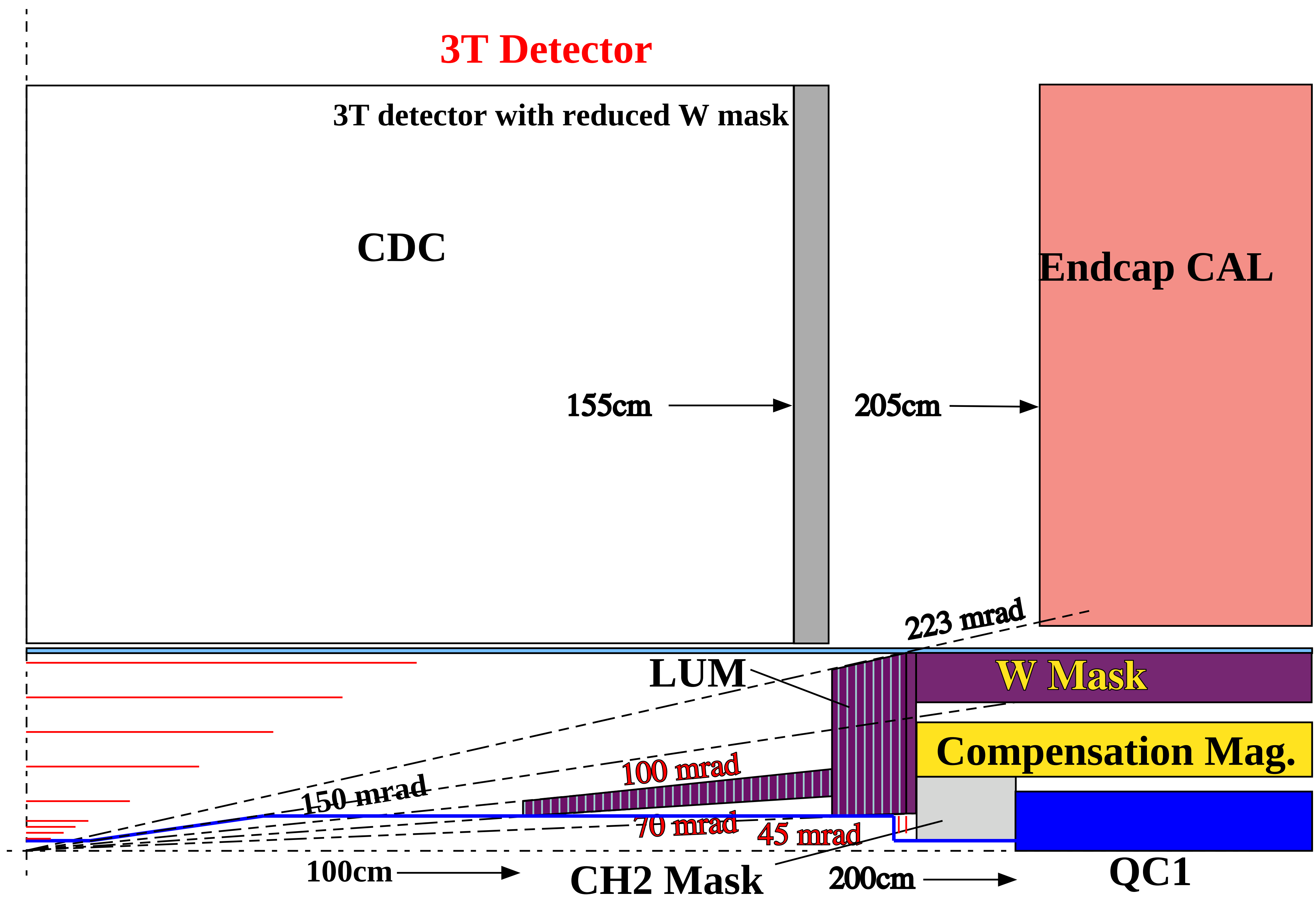
500GeV B=3T (uniform field)
Total track
Direct track
Backscattered track
Track density (cm/cm^3/BX)
r (cm)
500GeV B=3T (realistic field)
Total track
Direct track
Backscattered track
Track density (cm/cm^3/BX)
r (cm)



2T Detector
CDC (CO_2-IsoC_4H_{10})
~2 hits/BX by γ
~30 hits/BX by n
230cm
W Mask (r_{min}=4.5cm at z=30cm)
200 mrad
150 mrad
Compensation Mag.
VTX (r_{min}=2.4cm)
LUM
50 mrad
QC1
Beam Pipe (r_{min}=2.2cm)
Graphite Mask (r_{min}=2cm)
200cm

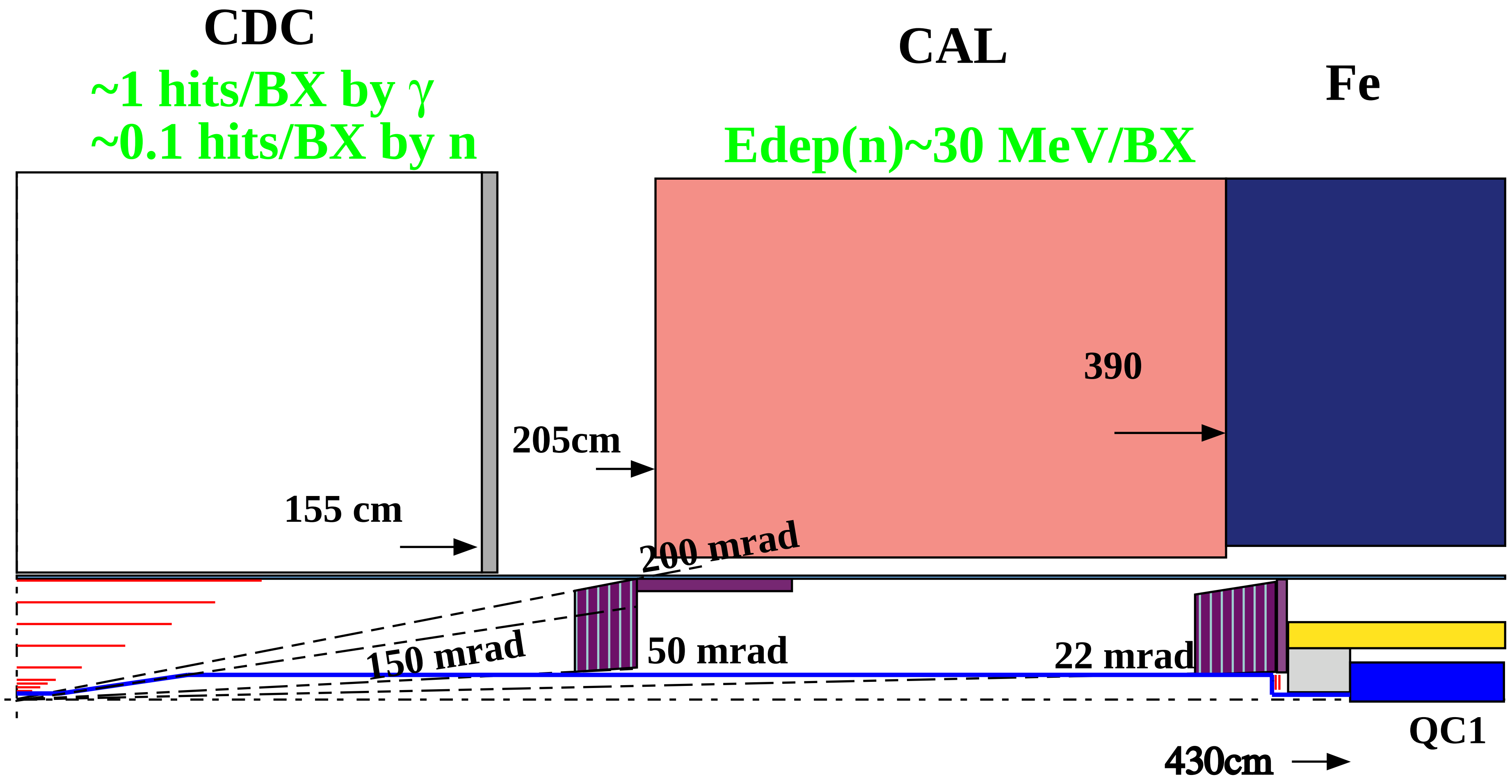


3T Detector
CDC
~1 hits/BX by γ
~2 hits/BX by n
Endcap CAL
Edep(n)~1GeV/BX
155cm
205cm
Support Tube
W Mask
200 mrad
150 mrad
Compensation Mag.
LUM
VTX (r_min=2.4cm)
50 mrad
QC1
Graphite Mask (r_min=2cm)
Beam Pipe (r_min=1.8cm)
200cm



3T Detector
3T detector with reduced W mask
CDC
Endcap CAL
155cm
205cm
223 mrad
LUM
W Mask
Compensation Mag.
100 mrad
150 mrad
70 mrad
45 mrad
100cm
CH2 Mask
200cm
QC1

3T *l**=4.3m Detector



Impact of the new optics (*l**=4.3m) on the detector

-Huge W-mask NOT needed

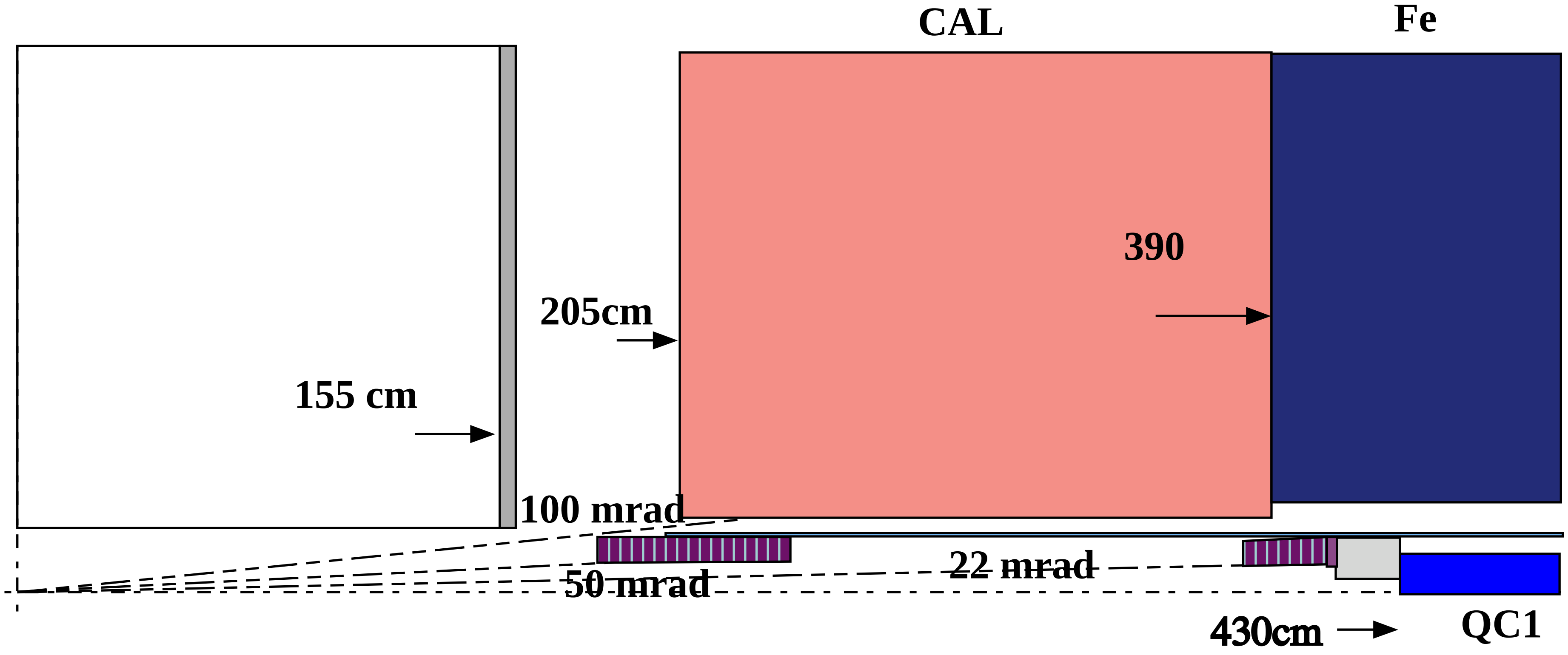
-Background hit much smaller (CDC, CAL)

-No need for Support tube (?)

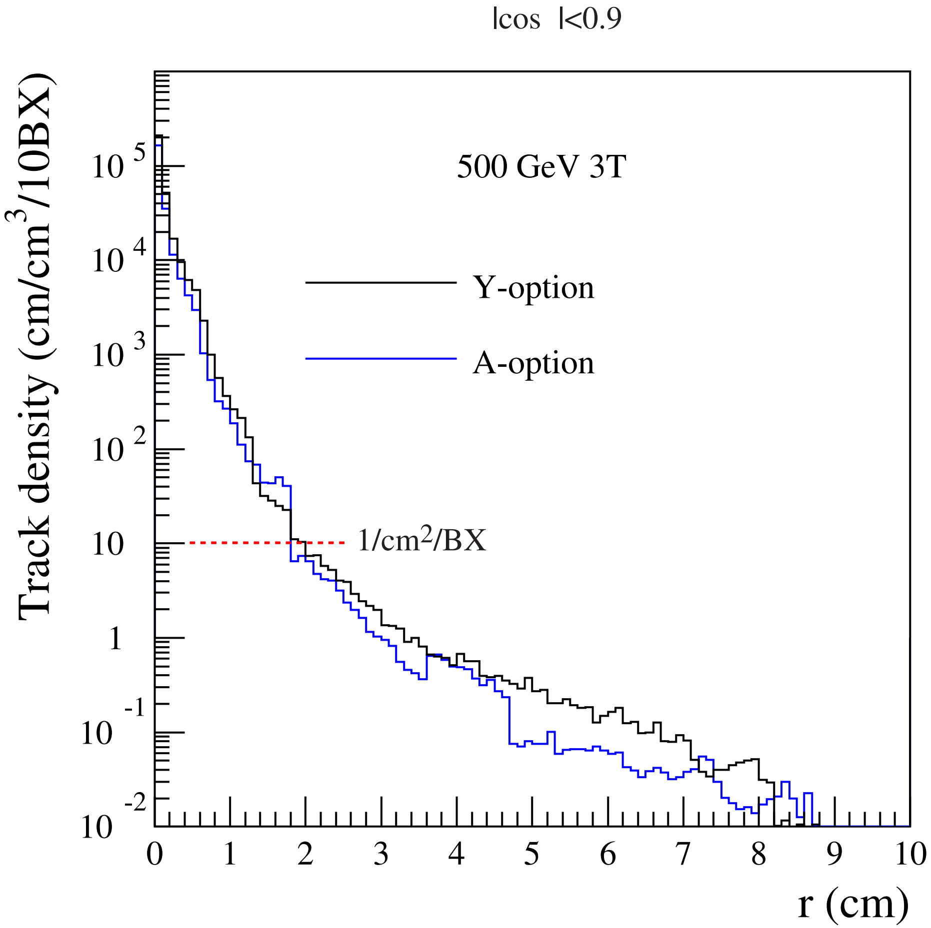
-No need for Compensation magnet (?)

if the B field @4.3m is weak enough

-Smaller R_{min} of CDC and CAL possible



Beam background with "Y" option



~ x2 more background than "A" option

Energy deposit in QC

"A"   17 TeV/BX

"Y"   30 TeV/BX

Detector Model	CDC Hits / BX		CAL Edep (GeV / BX)	
	(g)	(n)	(g)	(n)
2T	0.3	20		
3T (Old Mask)	~1	~1	~0	0.9
3T (Cone only)	~1	~1	7.5	4.4
3T (New Mask)				
3T (l*=4.3m)				