

ISG9
December 10 - 13 2002

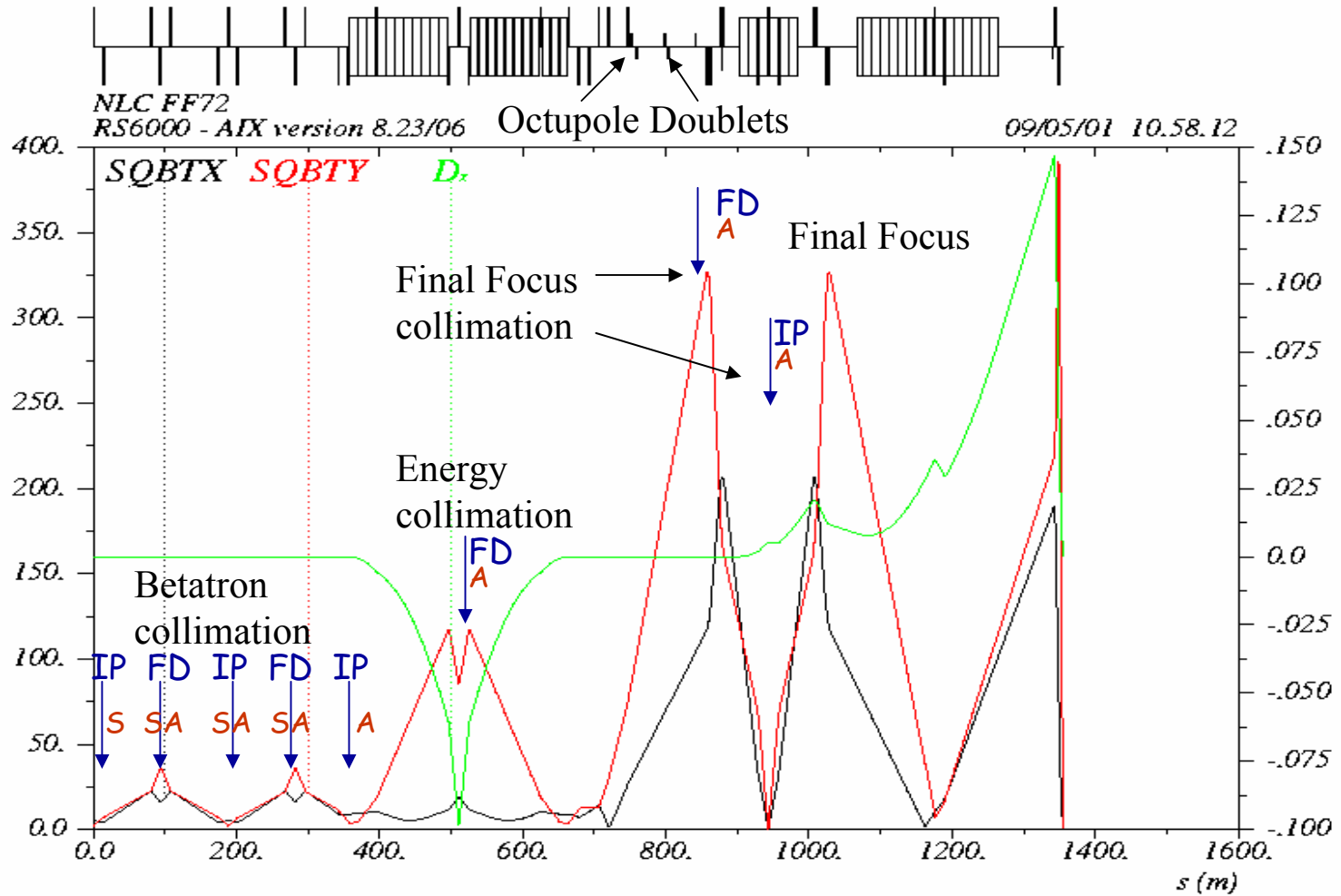
Backgrounds in the NLC BDS

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SLAC

Background and collimation

- Major source of detector background:
 - Halo particles hitting beamline components generate muons and low energy particles.
 - Halo particles generate sync. radiations that hit VXD.
 - Beam-gas scattering generates low energy particles.
- Collimate Halo particles:
 - Spoilers and Absorbers
 - Collimation depth - $(n_x\sigma_x, n_y\sigma_y)$
 - Reduce halo size using Octupoles
- What is Halo, and How much:
 - Drozhdin's $1/x-1/y$ model
 - Flat distribution with $50\sigma_x, 50\sigma_x', 200\sigma_y, 200\sigma_y', 3\%\Delta E/E$
 - Pencil beam hitting SP1
 - Calculated halo $\sim 10^{-6}$, but design collimation for 10^{-3} .

2001 Collimation System & FF integrated design



New scheme of the Collimation Section and Final Focus with ODs

NLC Beam Delivery Section in Geant 3

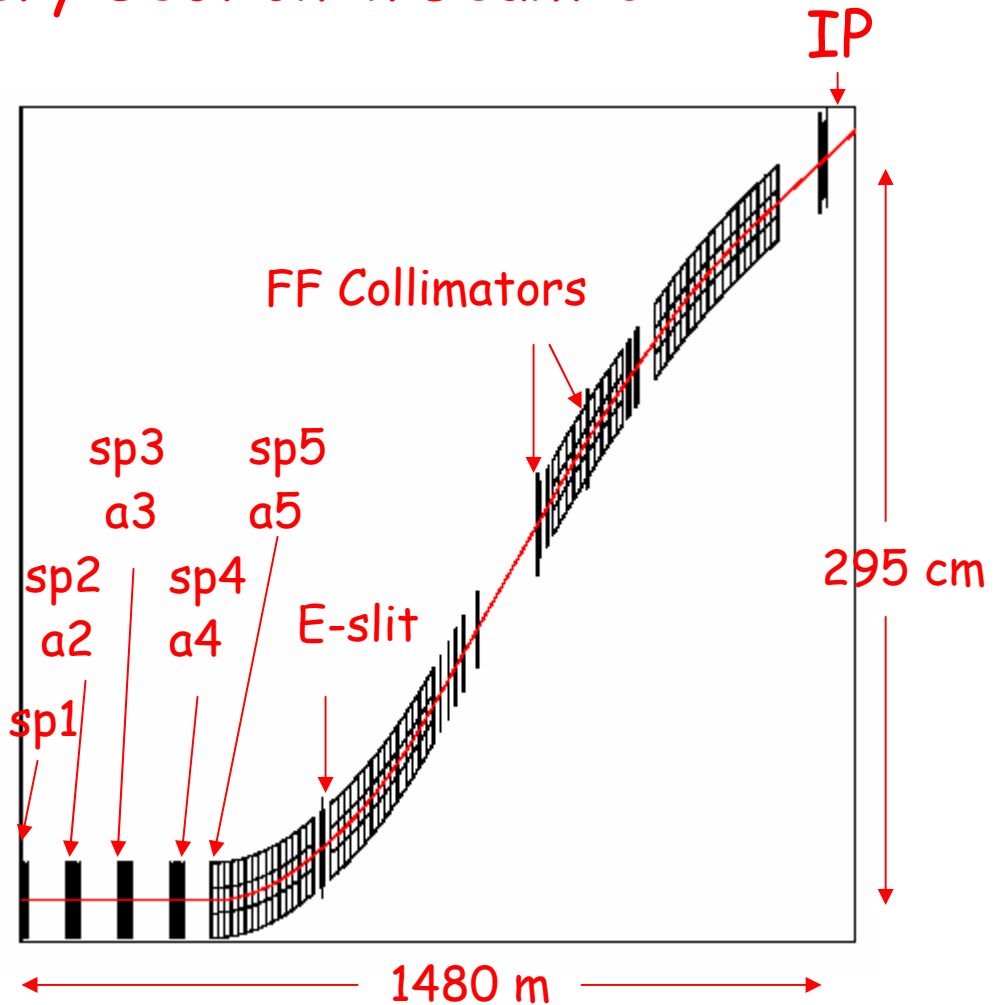
TRANSPORT lattice

Magnets (bands, quads, sexts, octs)

location, orientation, length, field strength, aperture

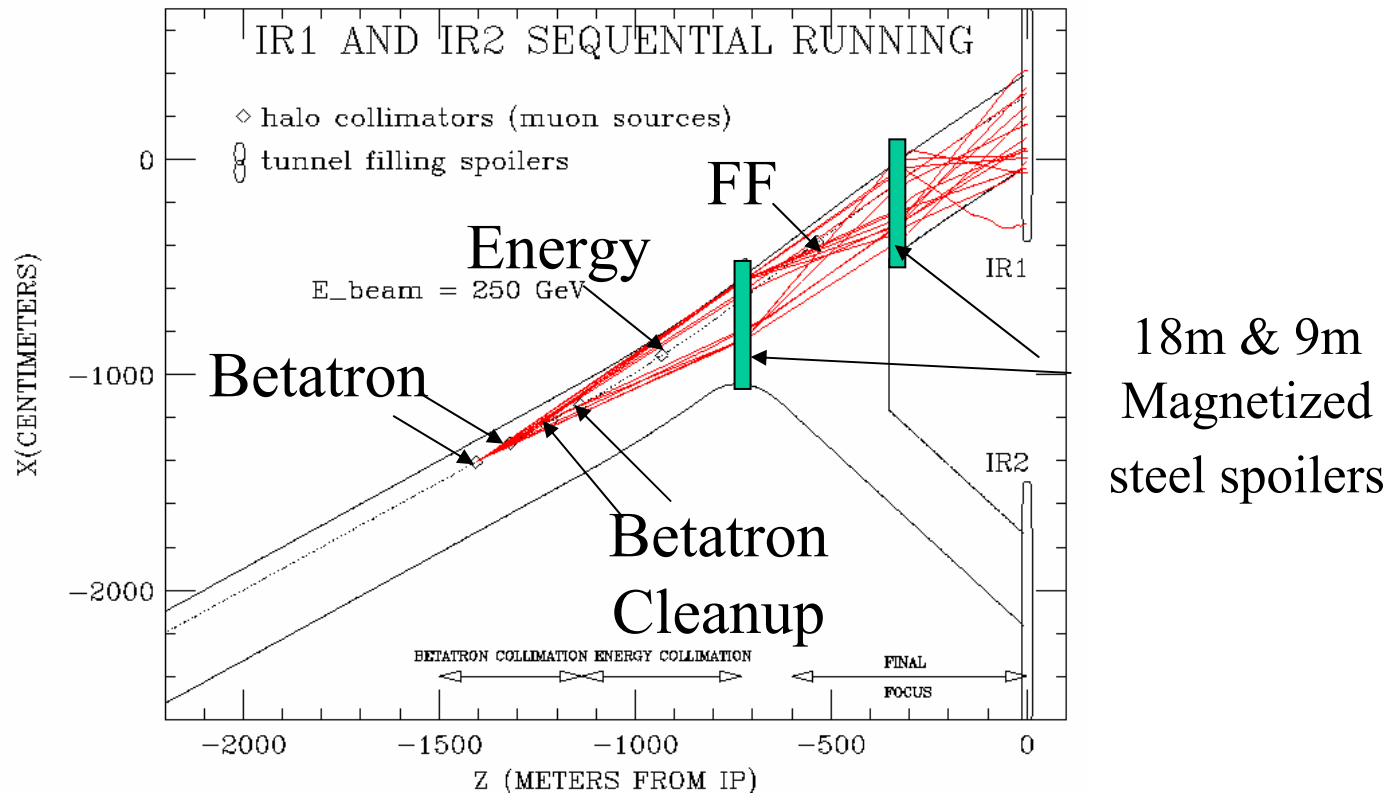
Spoilers and Absorbers

Geant 3



Muon Backgrounds from Halo Collimators

No Big Bend, Latest Collimation & Short FF



If Halo = 10^{-6} , no need to do anything

If Halo = 10^{-3} and experiment **requires** <1 muon per 10^{12} e- add **magnetized tunnel filling shielding**

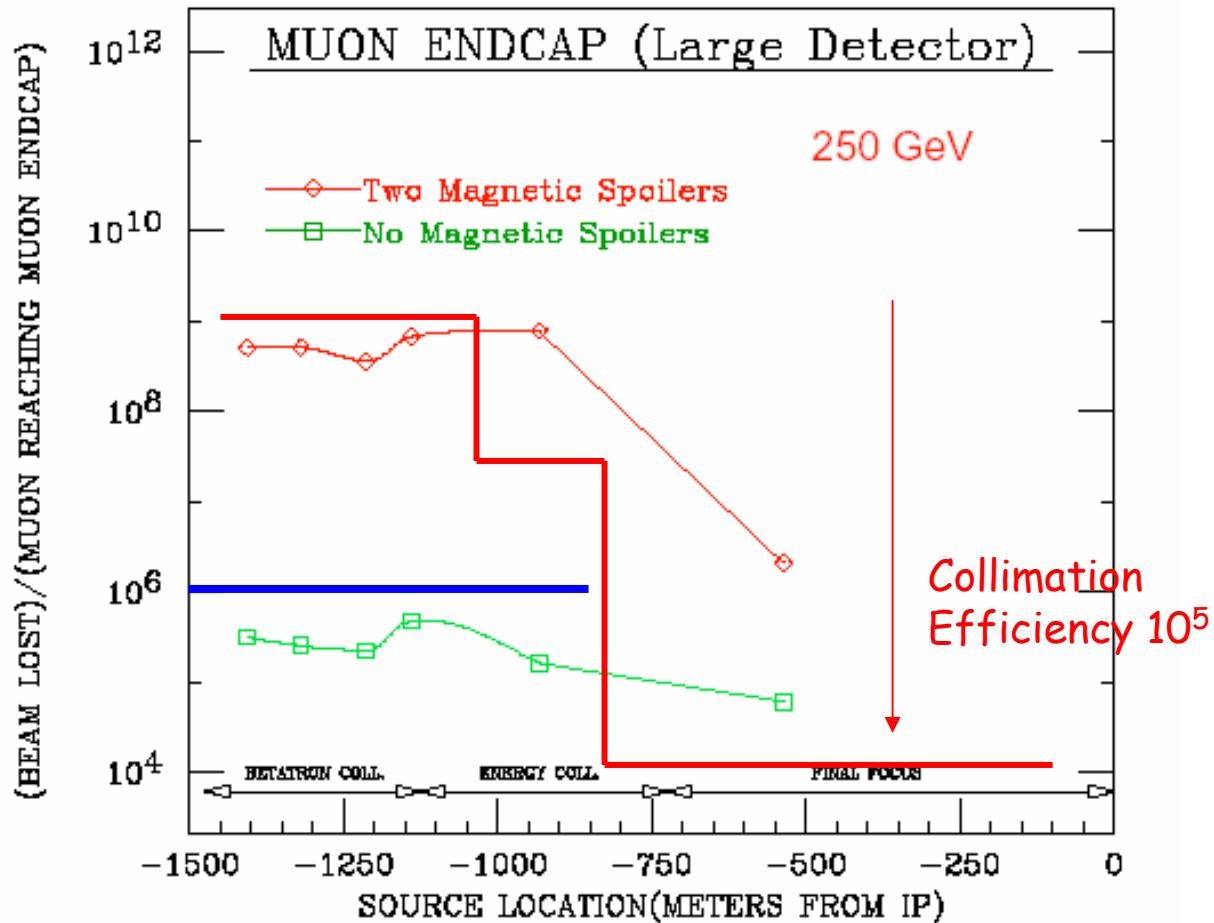
Reality probably in between

250 GeV/beam Muon Endcap Background

Bunch Train
= 10^{12}

Engineer for
 10^{-3} Halo

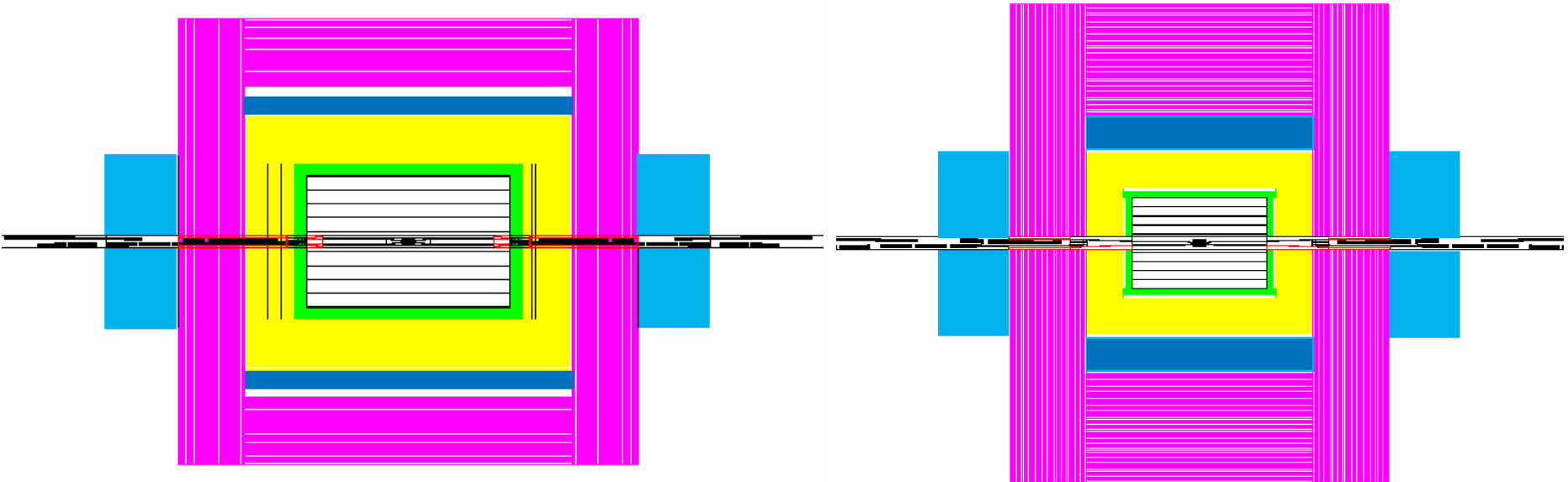
Calculated
Halo is 10^{-6}



LCD Detector in GEANT3/FLUKA

LD

SD



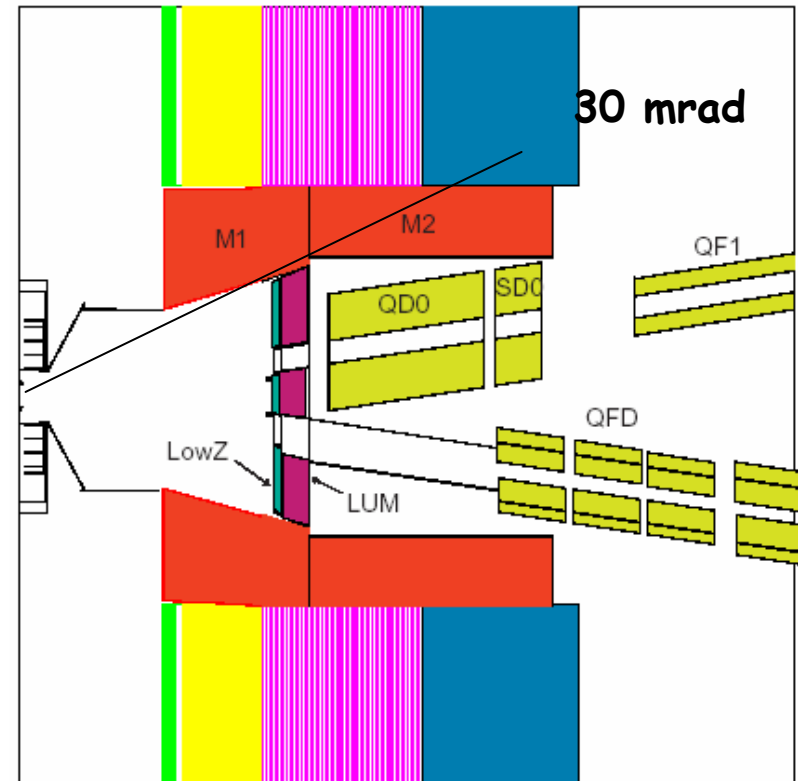
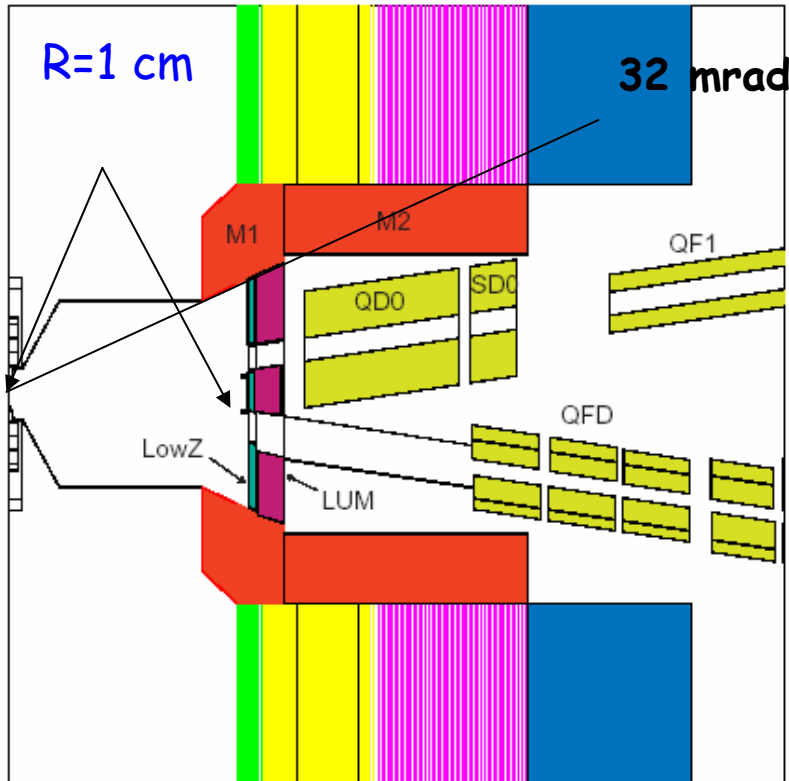
GEANT3: e^+/e^- and γ backgrounds

FLUKA: Neutrons

NLC Detector Masking Plan View w 20mrad X-angle

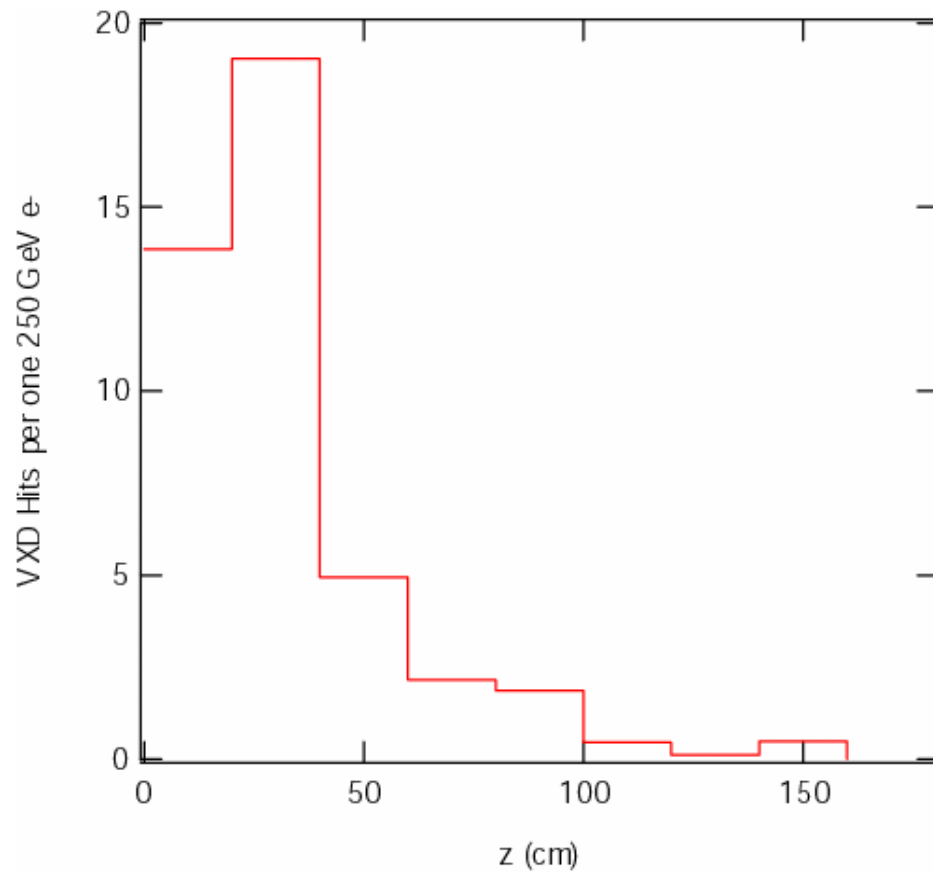
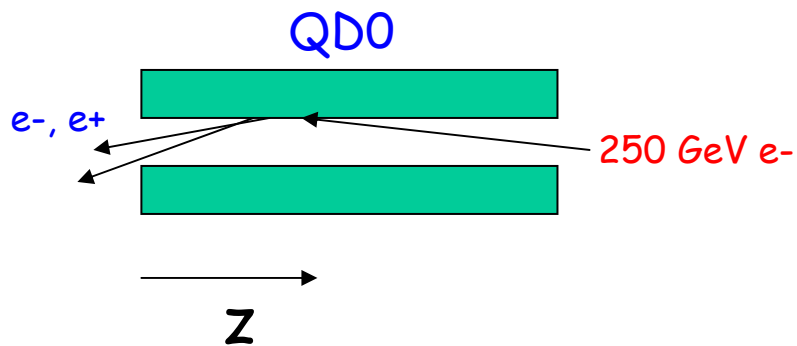
LD - 3 Tesla

SD - 5 Tesla

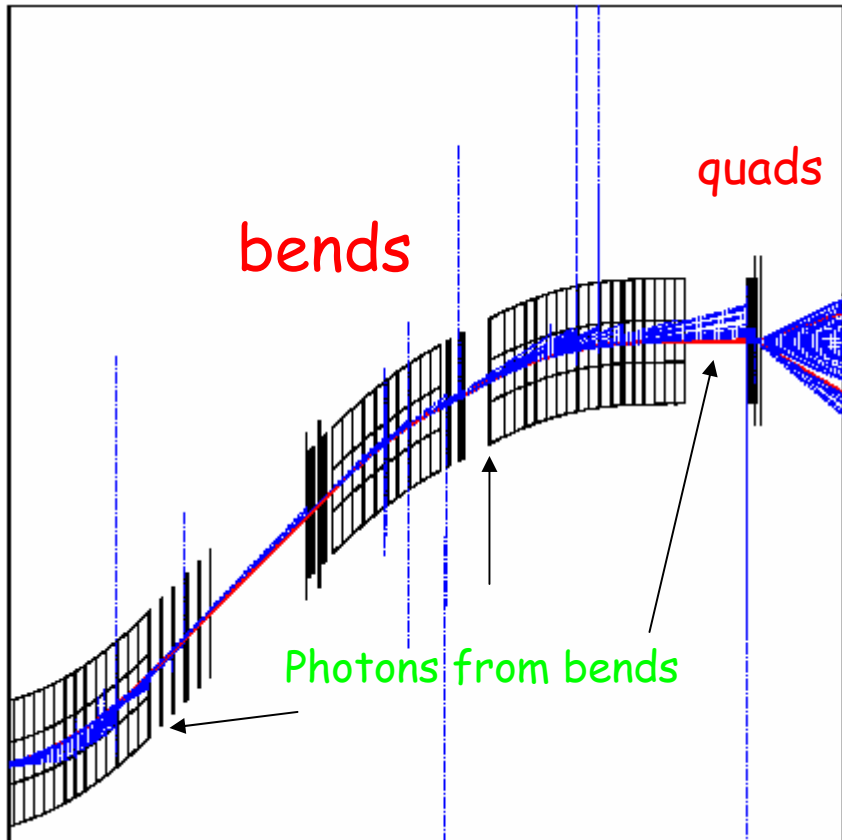


Apertures: 1 cm beampipe at the IP
1 cm at $Z = -350$ cm

VXD Hits from 250 GeV e^- hitting QDO



Synchrotron radiations



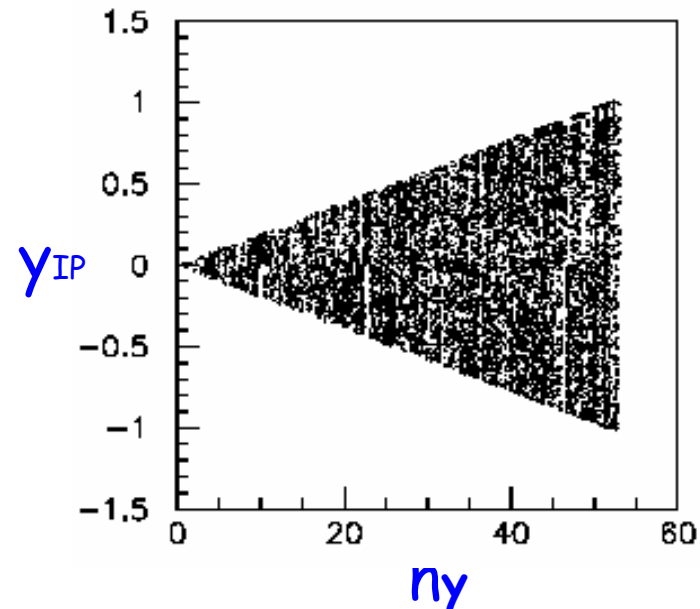
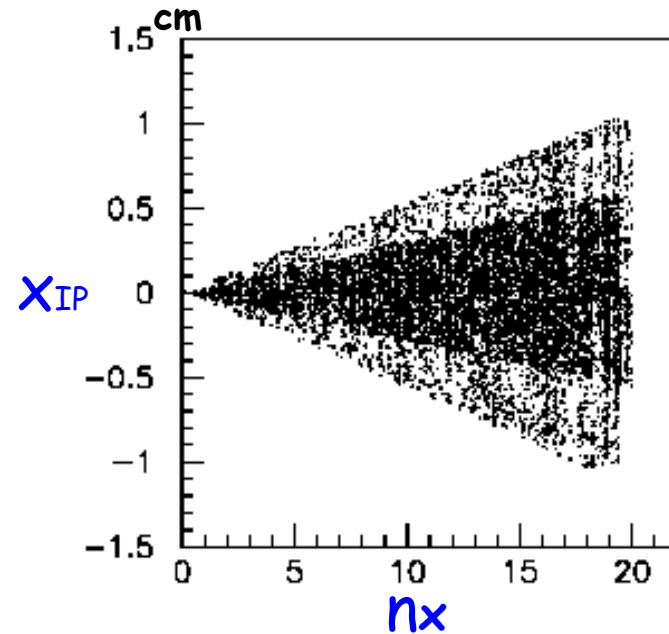
Photons from quads

Photons from bends

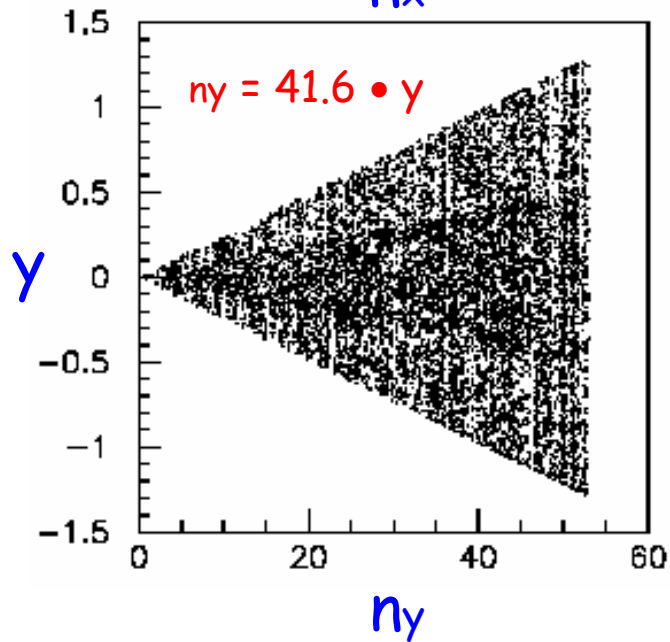
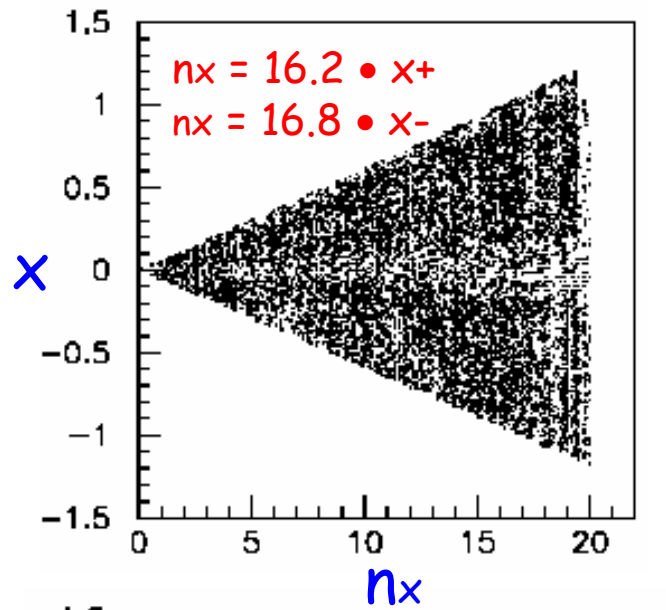
FF doublet aperture 1 cm

Sync. Radiation vs. σ_{IP}

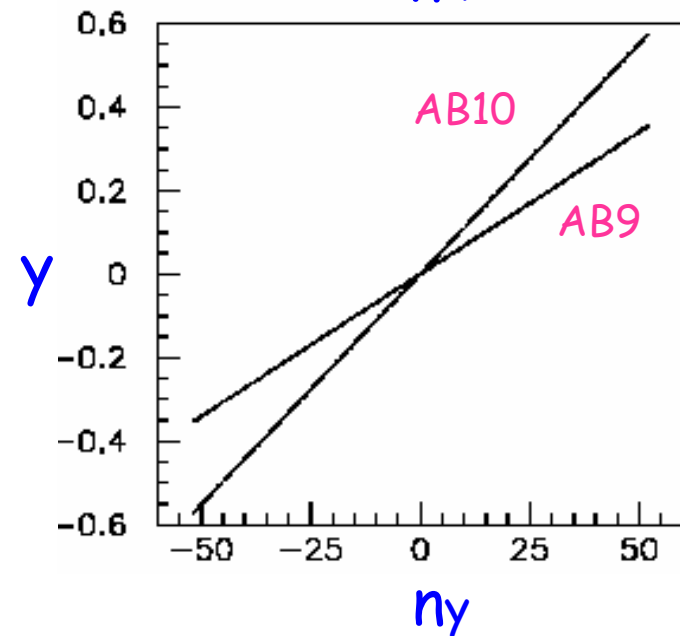
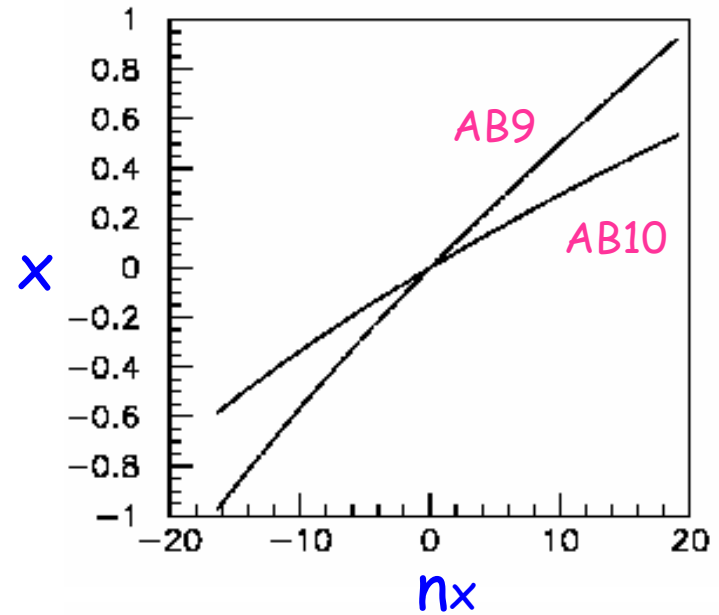
- Track particle with $n \cdot \sigma$ backward from IP to AB10.
- Track particle to IP and generate sync. radiations.
- Find sync. radiation edge as a function of (n_x, n_y) .
 $n_x = 18.5 \cdot x^+, 17.2 \cdot x^-$
 $n_y = 50.9 \cdot y$
- Find AB10 and AB9 apertures as a function of (n_x, n_y)



Sync. radiation at $z = -350$ cm

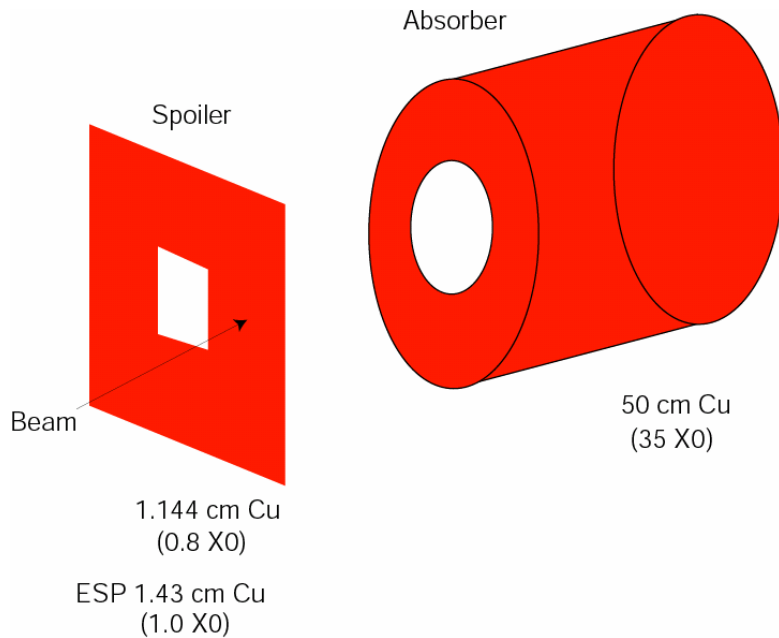


Apertures at AB10 & AB9



Spoiler/Absorber Scattering

Spoilers/Absorbers Settings for NO OCT



ESP 0.5 X0 ~x5 beamloss

Half apertures

	X	Y (um)	σ_X	σ_Y	
SP1	300	250	18.5	326	
SP2	300	200	10.9	31	
AB2	1000	1000			
SP3	300	250	18.5	326	
AB3	1000	1000			
SP4	300	200	10.9	31	
AB4	1000	1000			
SP5	420	300	20.0	450	
AB5	1400	1000			
ESP	3200	3200	78.3	112	
EAB	1000	1000	23.6	193	
AB10	4400	4400	14.1	40	* TRC
AB9	6600*	3000	12.5	45	6500
AB7	4200*	1000	256	385	3900
DP1	8300*	20000			8000
DP2	8500	20000			

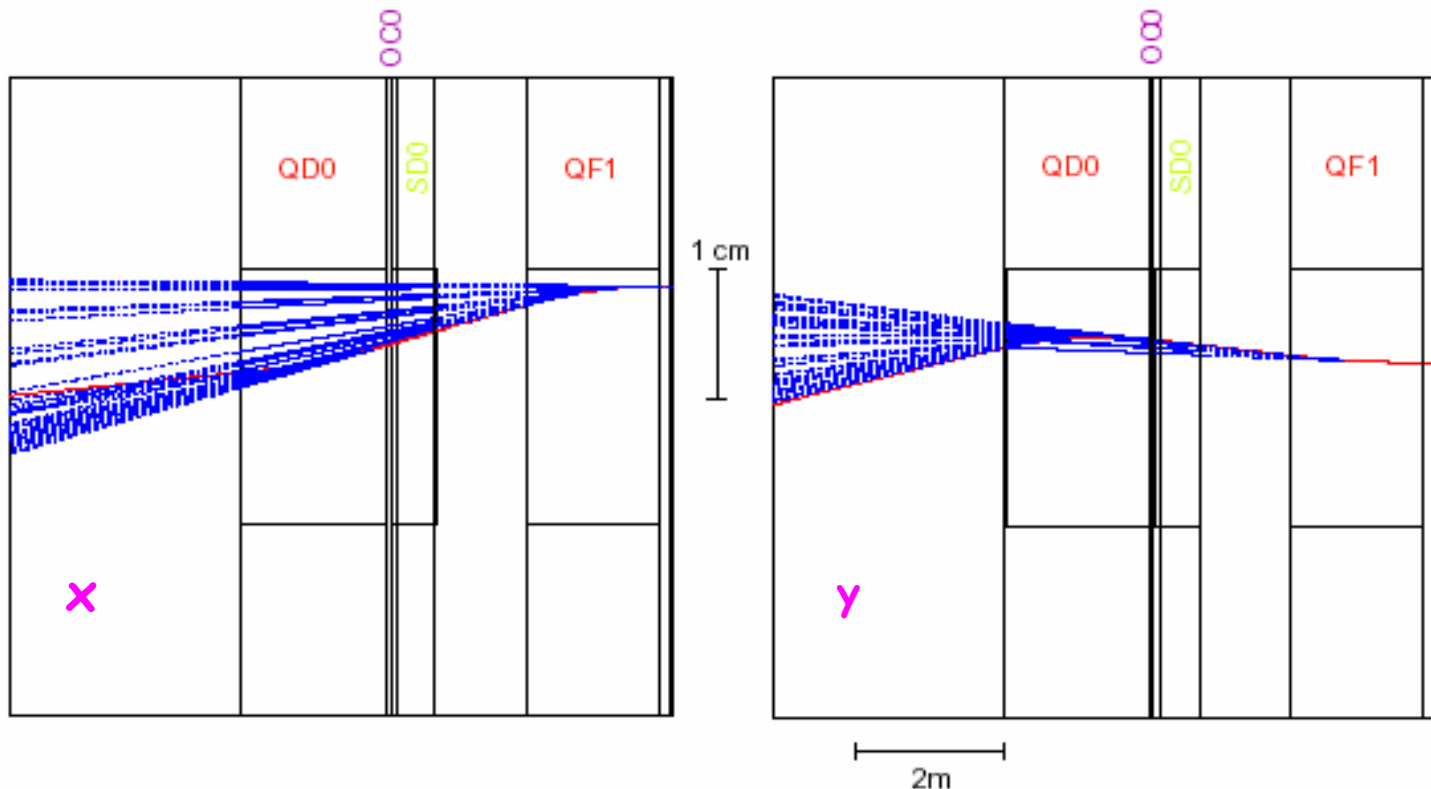
Sp1 ~ SP4 settings with OCT x2.5

Synchrotron Radiation and Collimation Depth

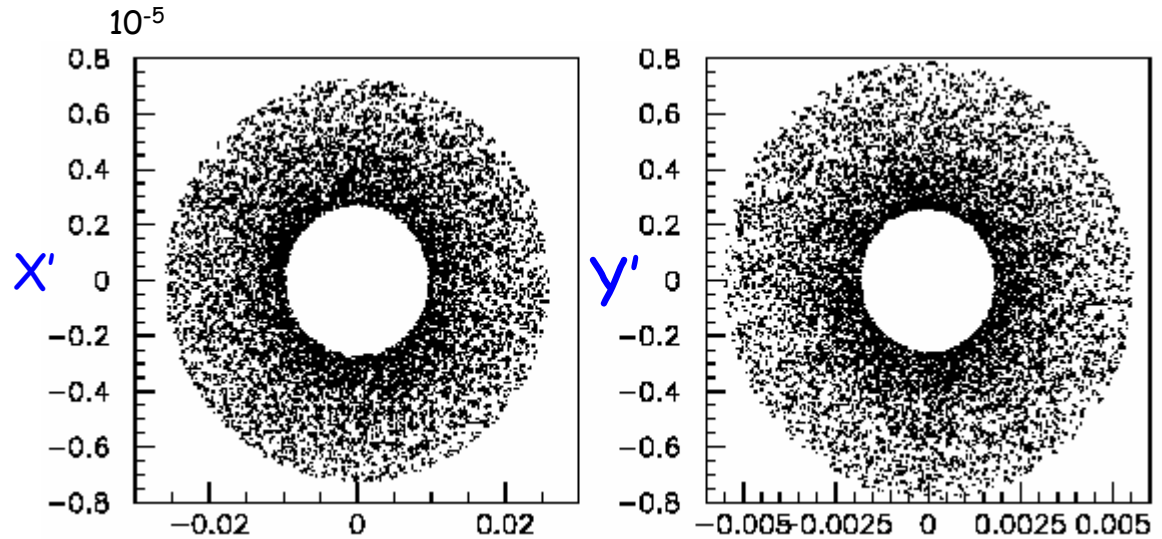
Criteria: No photons hit $R > 1$ cm at 1) $z = 0$ cm or 2) $z = 350$ cm

1) $x' < 570 \mu\text{rad} = 19 \times 30.3 \mu\text{rad}$ $y' < 1420 \mu\text{rad} = 52 \times 27.3 \mu\text{rad}$

2) $x' < 520 \mu\text{rad} = 17 \times 30.3 \mu\text{rad}$ $Y' < 1120 \mu\text{rad} = 41 \times 27.3 \mu\text{rad}$



Halo Model



X (cm)

Y (cm)

- $1/x$ and $1/y$ density over

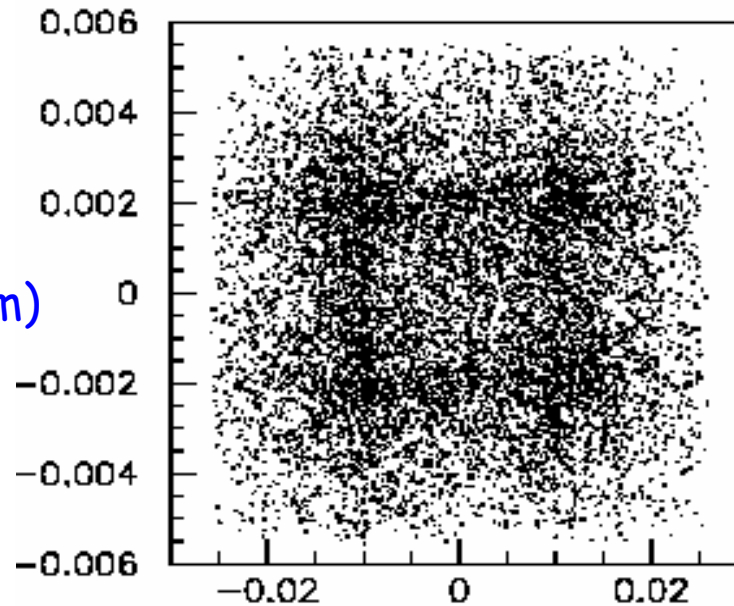
$$A_x = (6 - 16)\sigma_x \text{ and}$$

$$A_y = (24 - 73)\sigma_y$$

- $\delta E/E = 1\%$ (Gaussian)

- Halo rate 10^{-3}

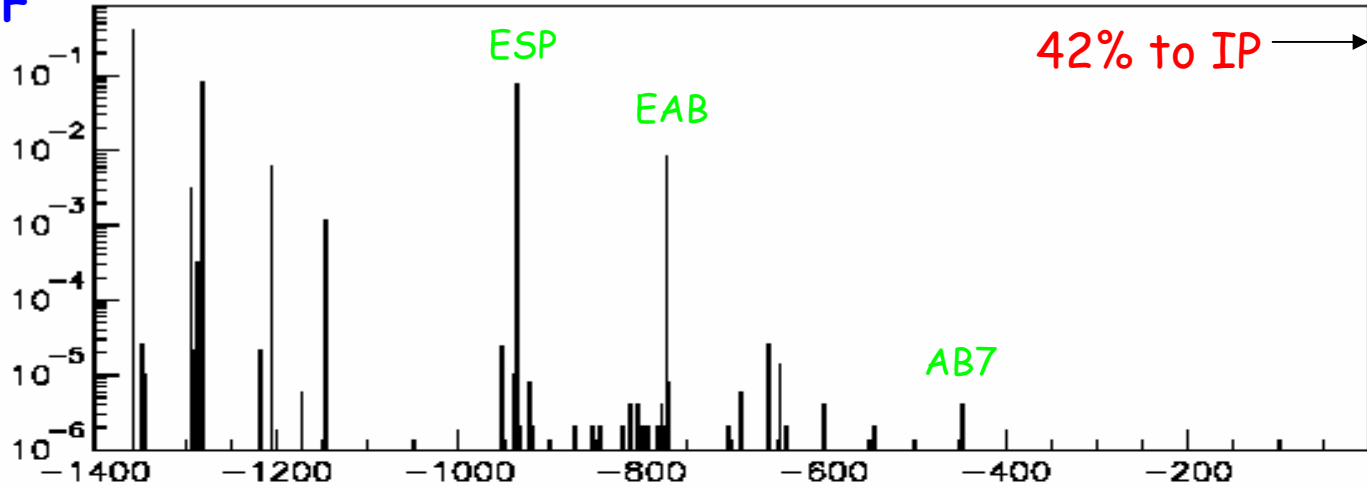
Y (cm)



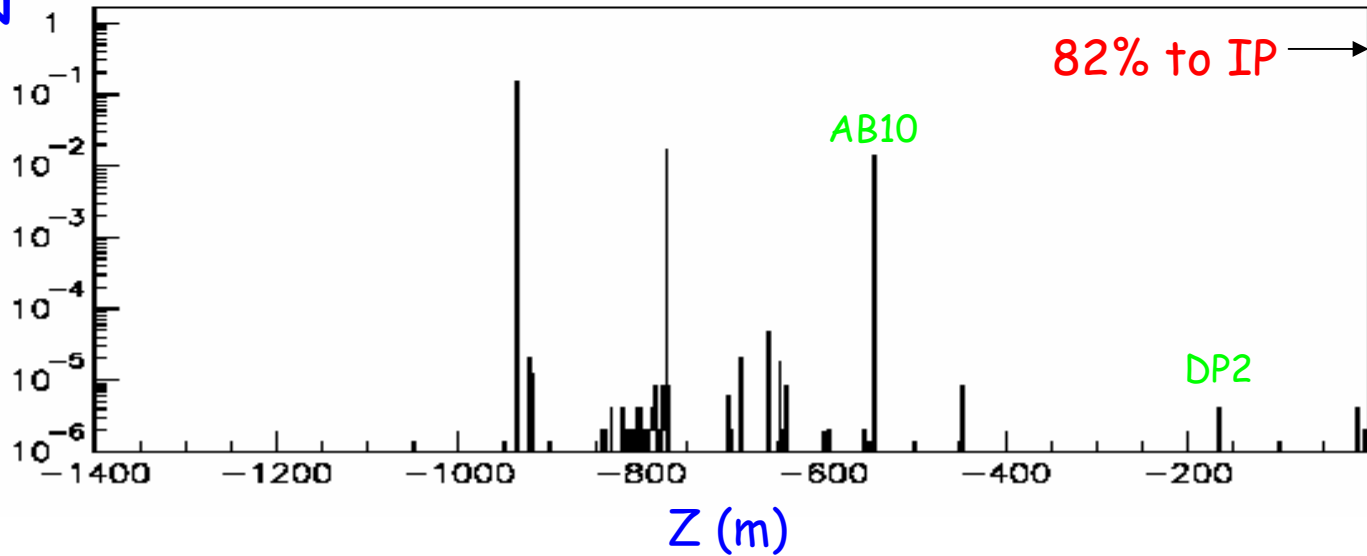
X (cm)

Particle loss distribution

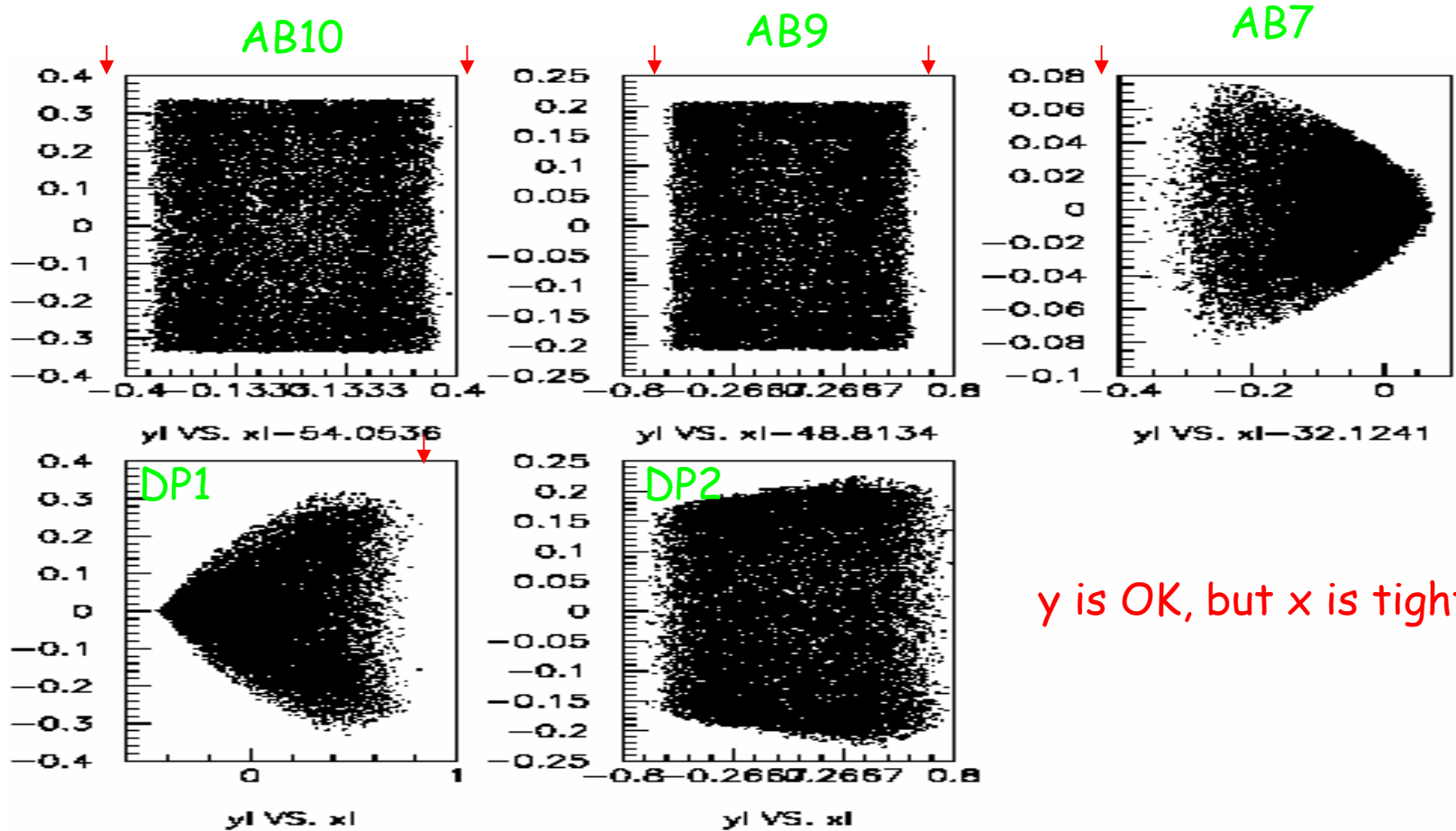
OCT-OFF



OCT-ON

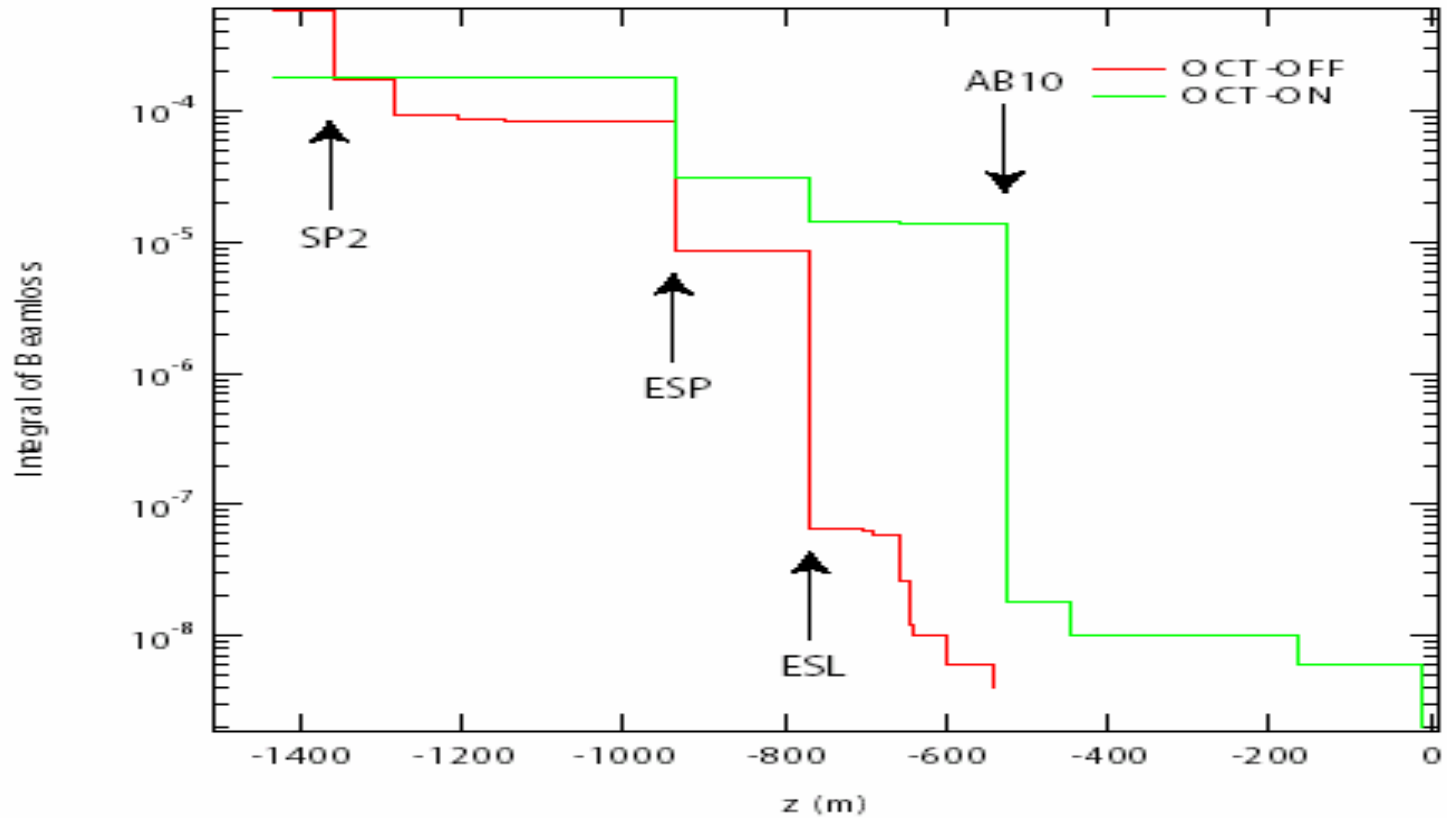


Particle distributions at FF absorbers.

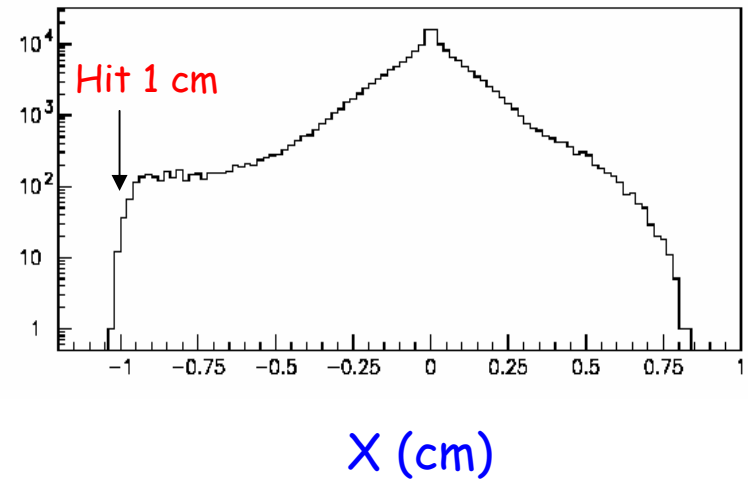
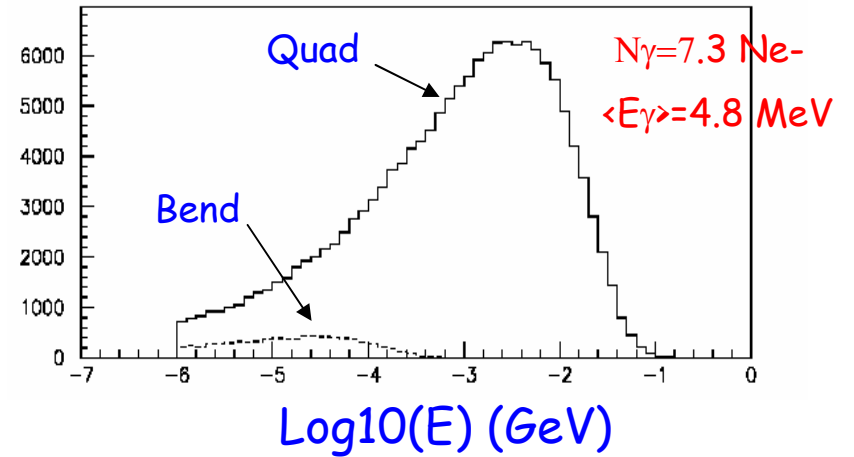
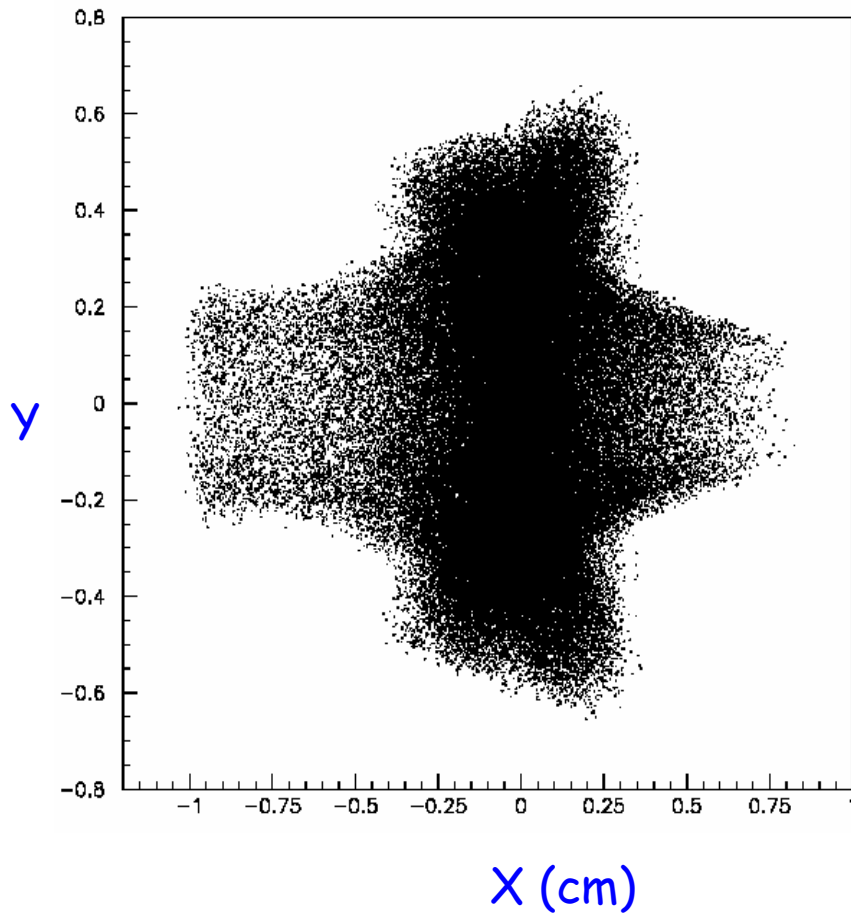


y is OK, but x is tight.

Integral Particle Loss Distribution



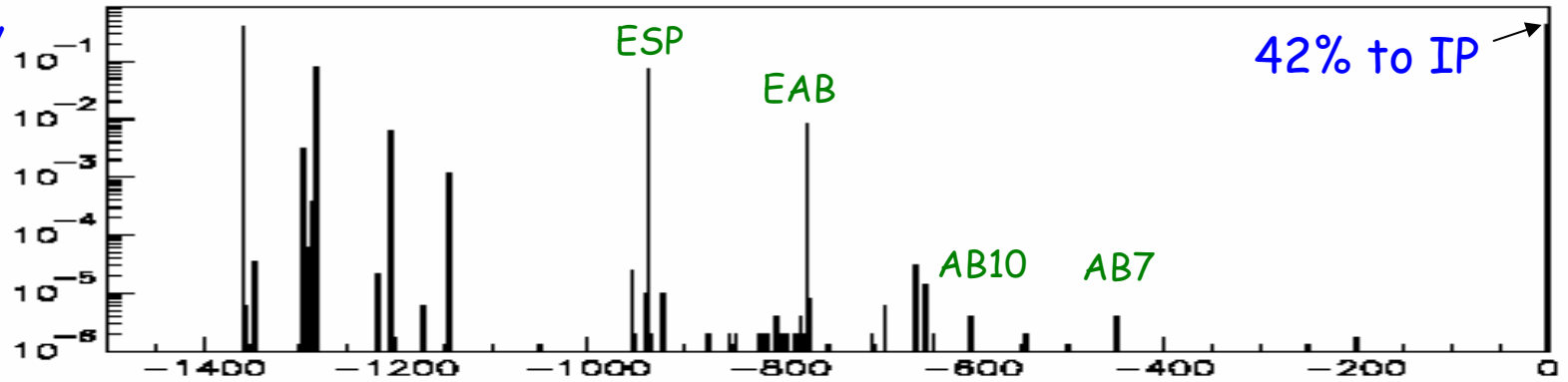
Sync. Radiations at IP



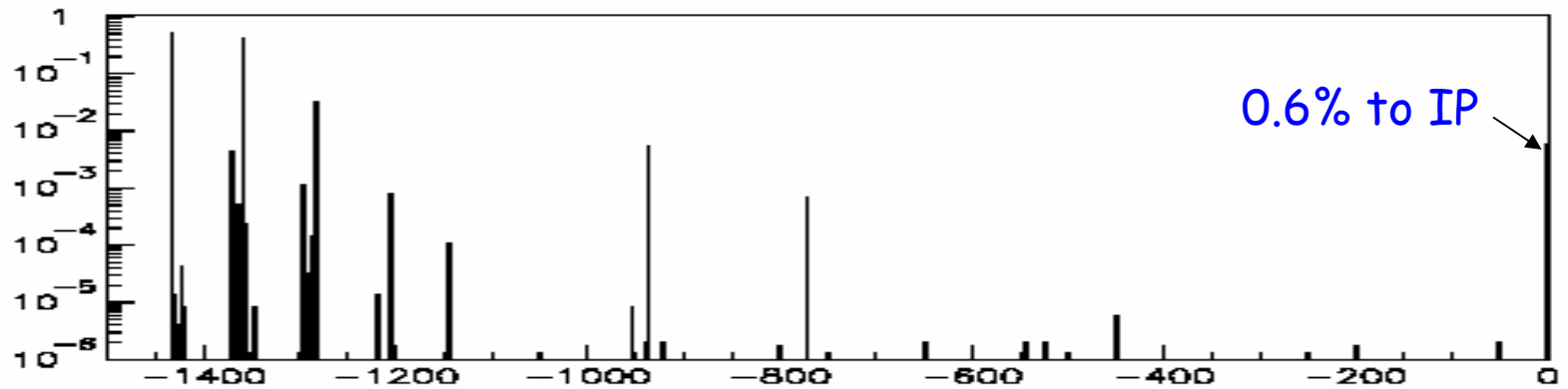
FLAT Halo $50\sigma_x, 50\sigma_x', 200\sigma_y, 200\sigma_y', 3\%\Delta E/E$

OCT-OFF

$1/x - 1/y$

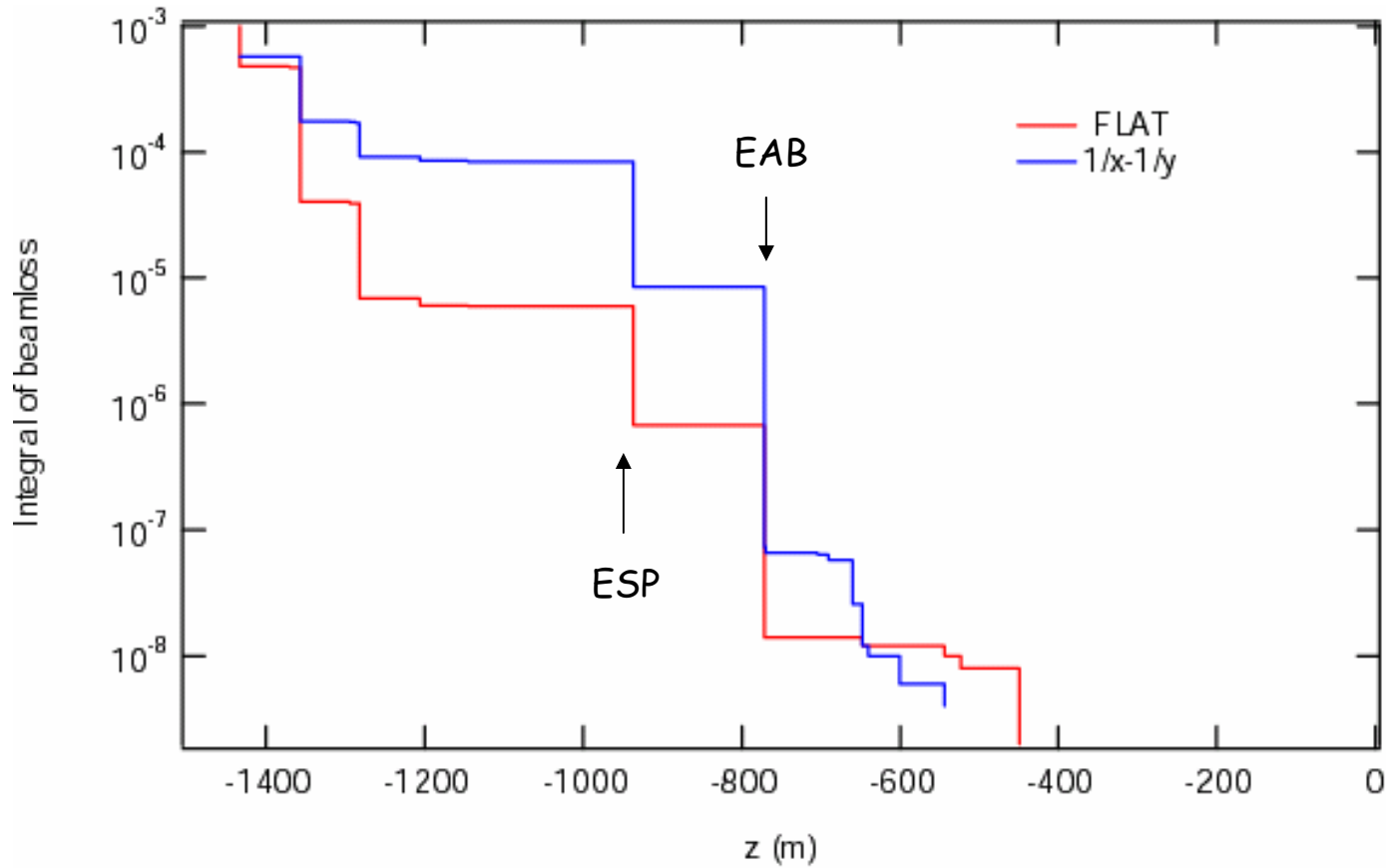


FLAT



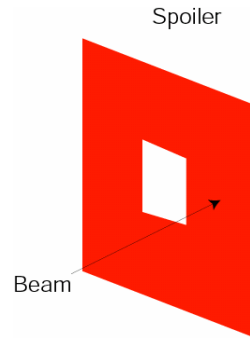
Z (m)

Integral Particle Loss Distribution

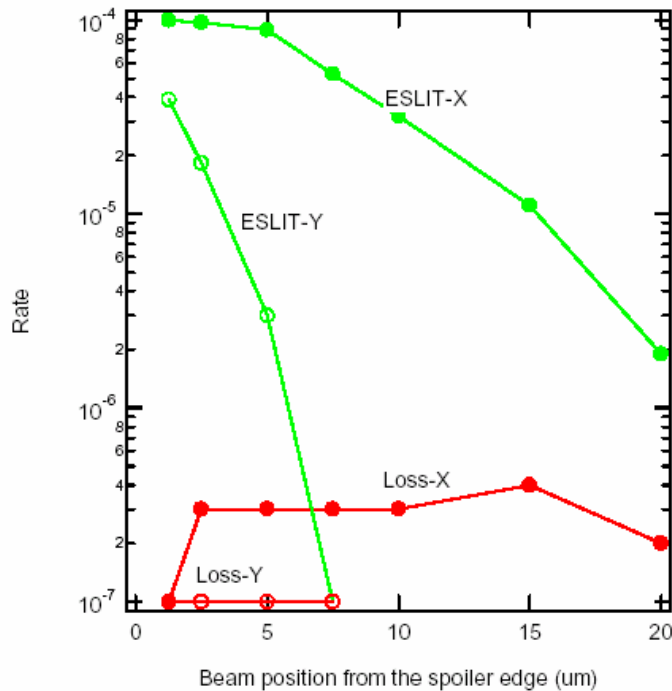


Transmission rate through E-slit and beam-loss in FF

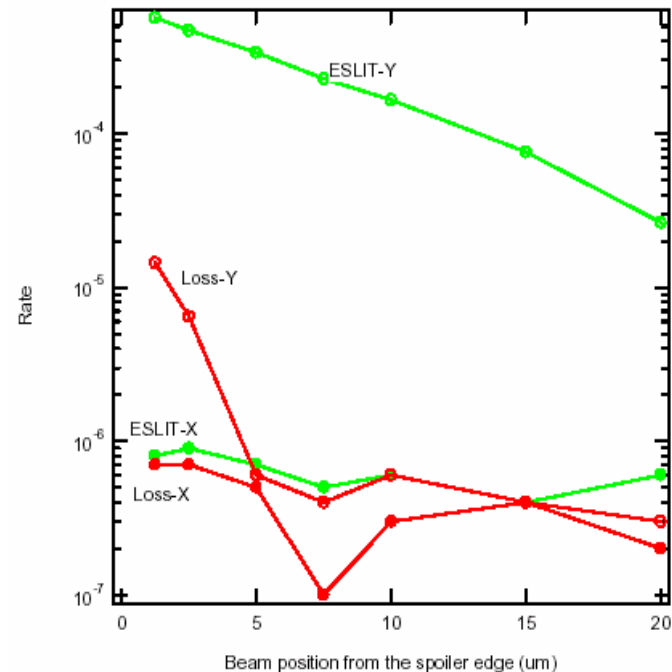
Pencil beam hitting SP1



OCT-OFF



OCT-ON



Summary

- NLC BDS and collimation system are studied using Geant 3.
- FF absorbers are set so that no sync. radiations hit the detector apertures.
- Assuming 10^{-3} halo, the particle loss is $< 10^{-8}$ in FF and the muon background is tolerable.
- Octuples allow x2.5 looser spoiler settings.
- OCT-OFF settings are well optimized, but OCT-ON settings need further optimization.