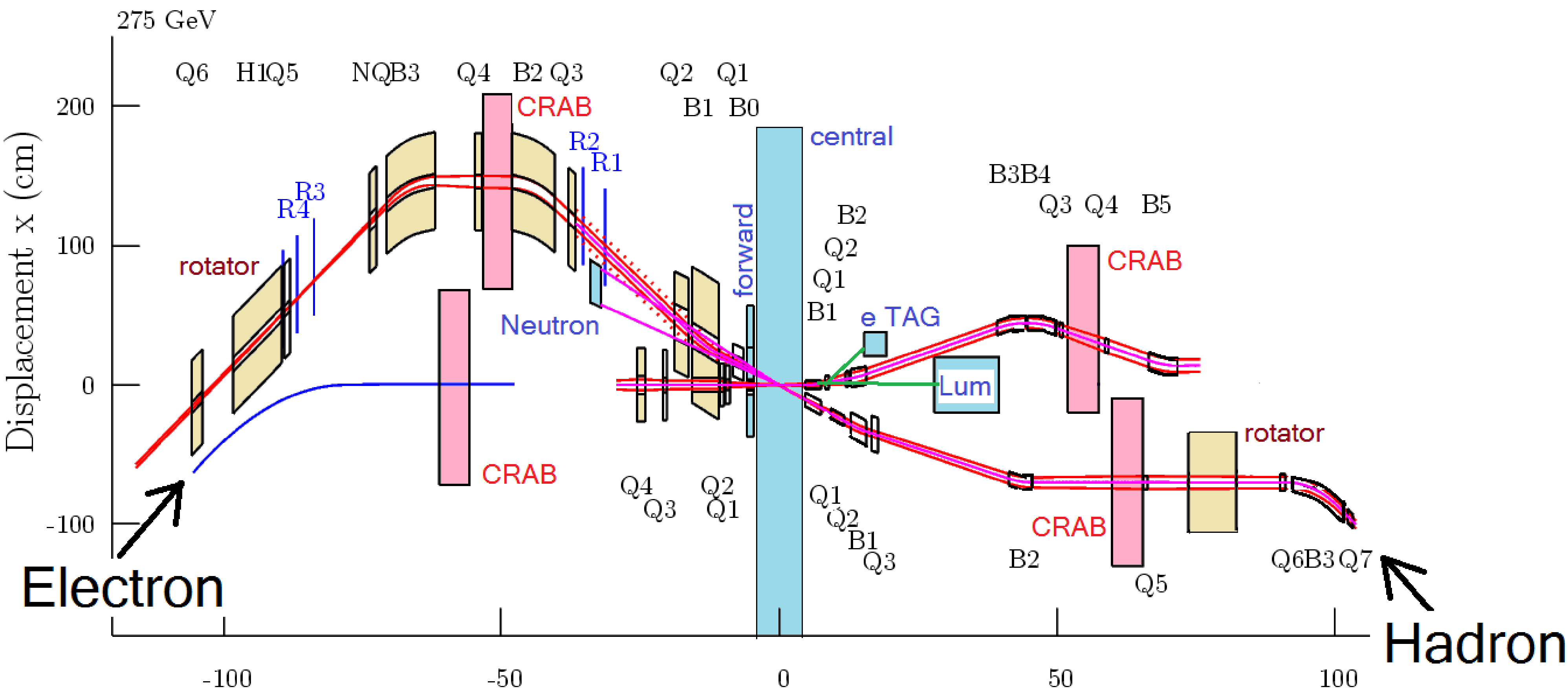
IR

3/15/2017

R. B. Palmer

- Layout
- Parameters
- Downstream electrons
- Downstream protons
- Acceptances
- Errors
- Conclusions

Layout



Not yet matched into hadron and electron rings

Parameters

For given emittances Luminosity

$$Lumin \propto \frac{1}{\sigma_x \sigma_y} \propto \frac{1}{\sqrt{\beta_x \beta_y}} \propto \frac{1}{x' y'}$$

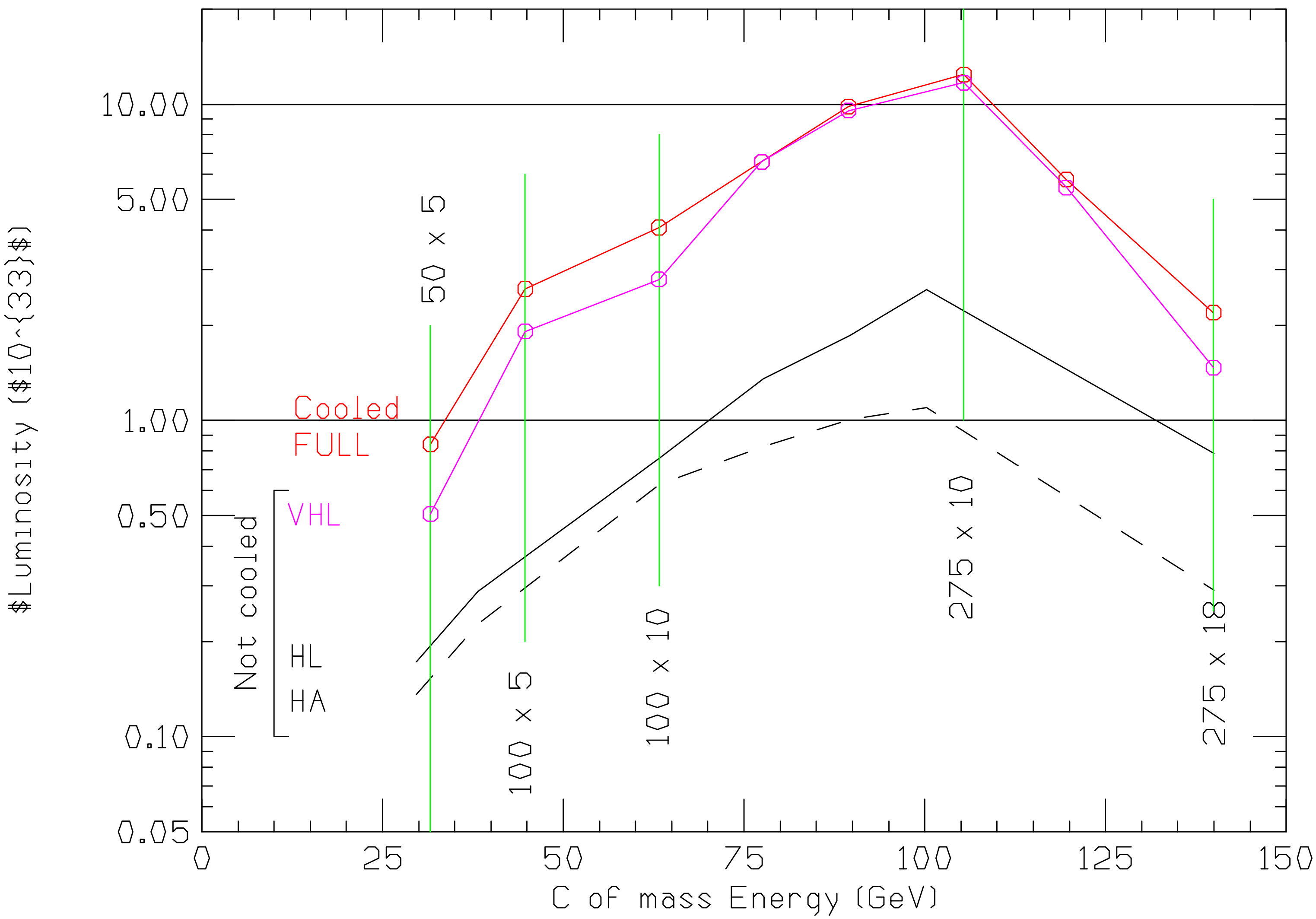
Using the same magnets, different settings can determine these divergences x', y' and thus the luminosity:

	cooling	x'_p μrad	y'_p μrad	Lum 10^{33}
HA	No	56	380	1.16
HL	No	131	382	2.9
FULL	yes	127	341	12.4

Parameters

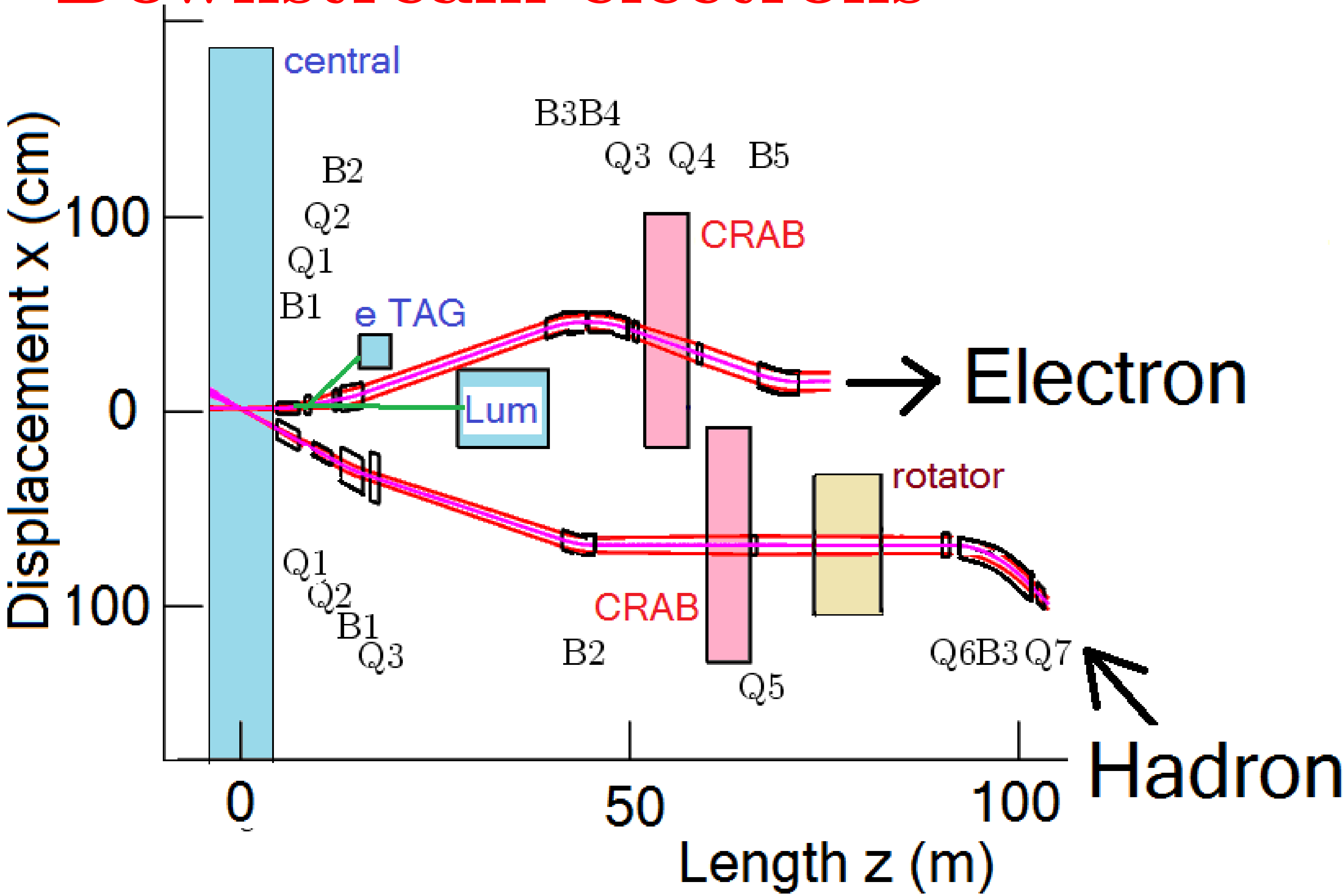
cooling		no High Accpt	no High Lum	yes Full
Luminosity	$10^{33} cm^{-2} s^{-1}$	1.2	2.9	11.4
bunches n_b		330	330	1320
Divergence$_p$	μrad	56	131	131
E$_p$	GeV	275	275	275
N$_p$	10^{10}	10.6	11.1	5.6
σ_{zp}	cm	8	7	3.5
E$_e$	GeV	10.1	10.1	10.1
N$_e$	10^{10}	30.5	30.5	15.1
σ_{ze}	cm	0.8	0.8	0.8
emit$_{Np}$ x	μm	4.7	4.7	2.4
emit$_{Np}$ y	μm	1.8	1.8	0.9
beta$_p$ x	cm	556	94	47.2
beta$_p$ y	cm	3.9	4.2	2.1
emit$_e$ x	nm	23.1	24.2	24.2
emit$_e$ y	nm	3.68	3.47	1.73
beta$_e$ x	cm	397	62.5	15.6
beta$_e$ y	cm	6.5	7.4	3.7

Luminosities



High Accept (HA); High Lumi (HL); With cool (FULL)

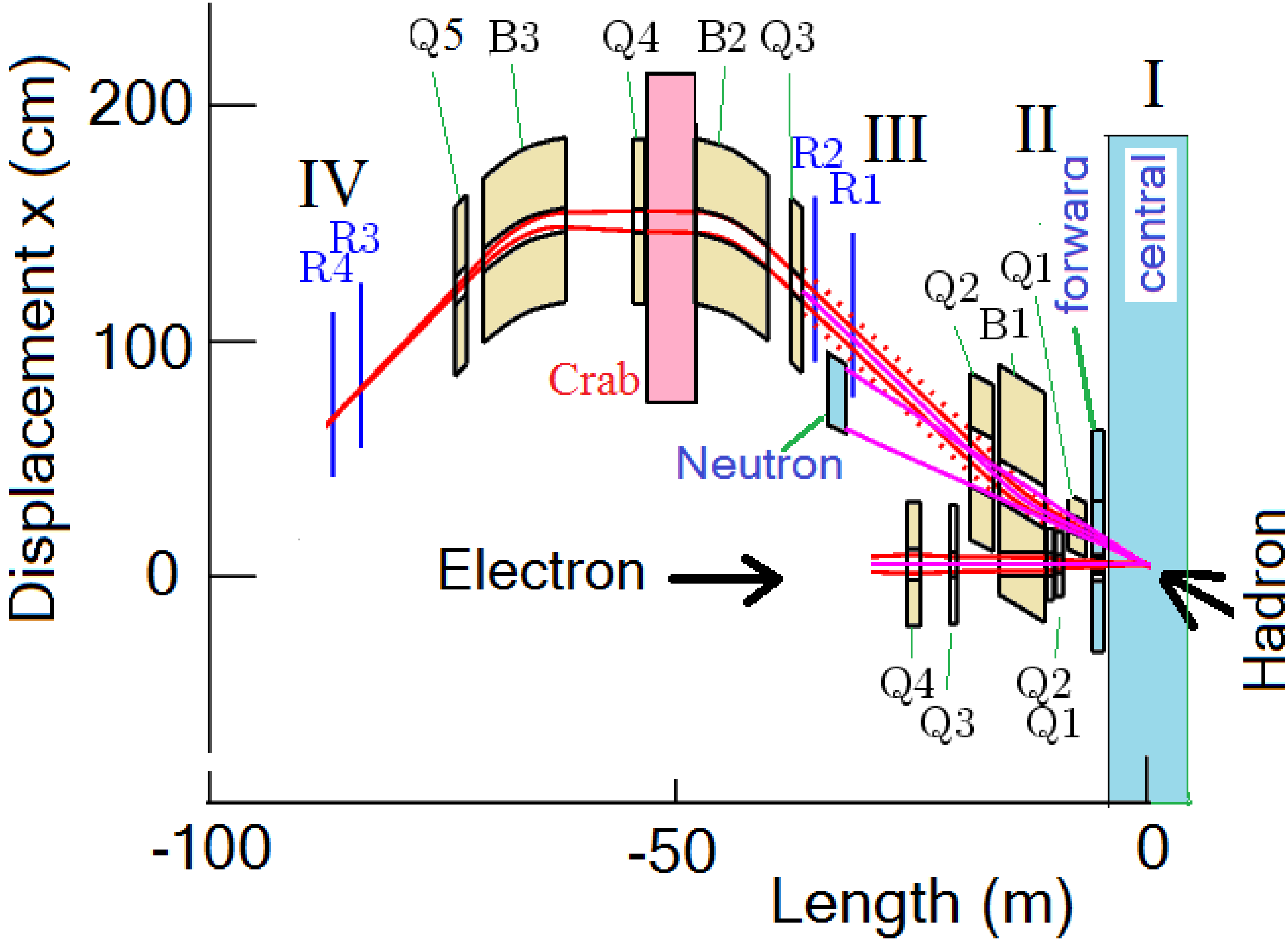
Downstream electrons



Electrons Detectors

- Luminosity monitor facing IR
  - Foil converts γs to e pairs
  - vertical bending magnet
  - electron detectors
- electron tag after weak horizontal bend (B1)
  - electron detector

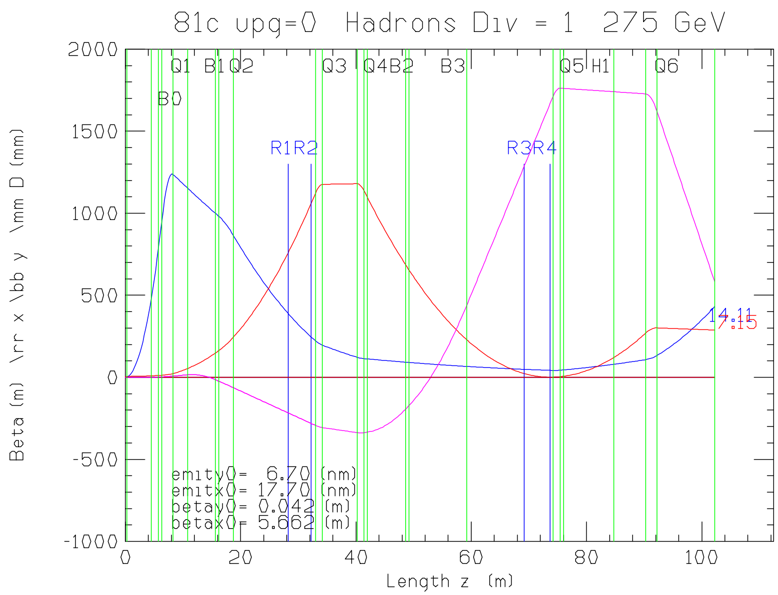
Downstream hadron

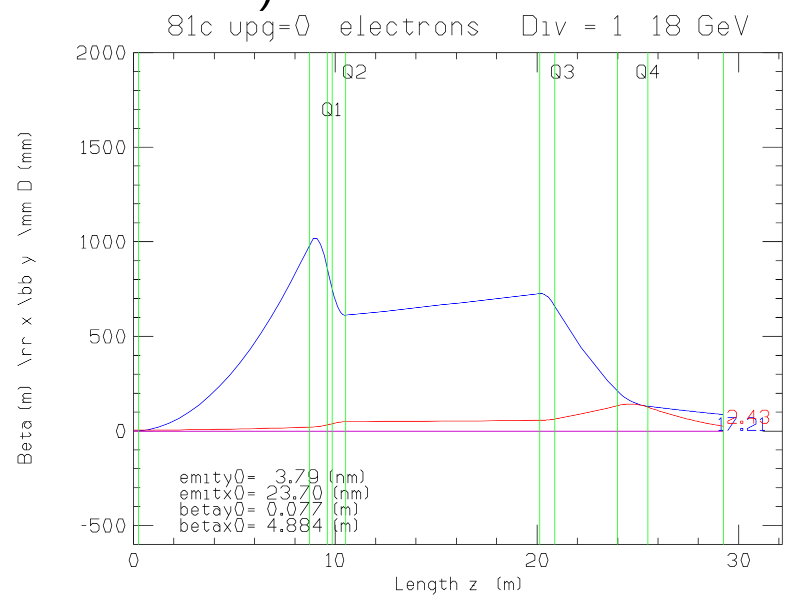


Betas

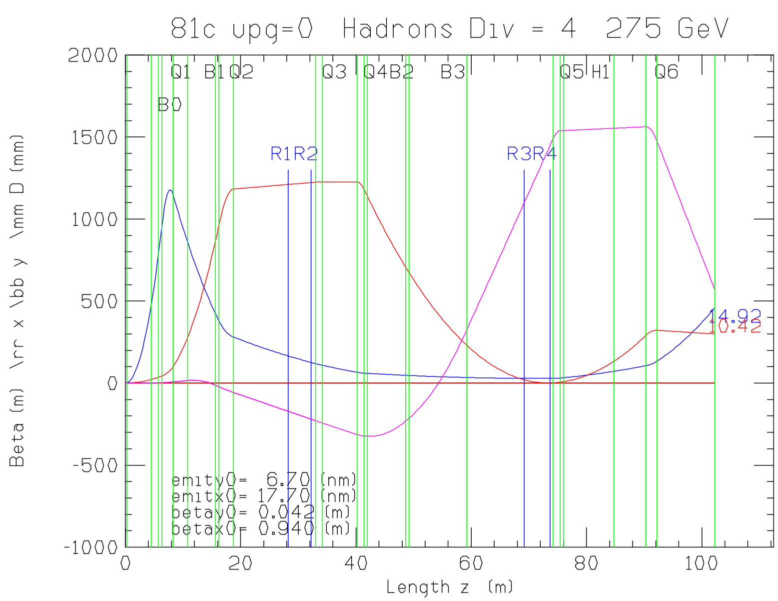
Hadron | Electron)

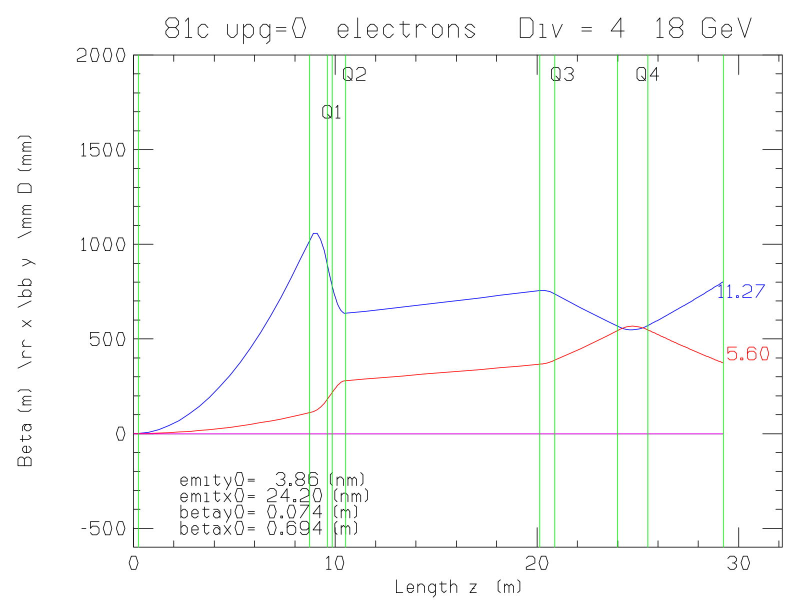
High Accept



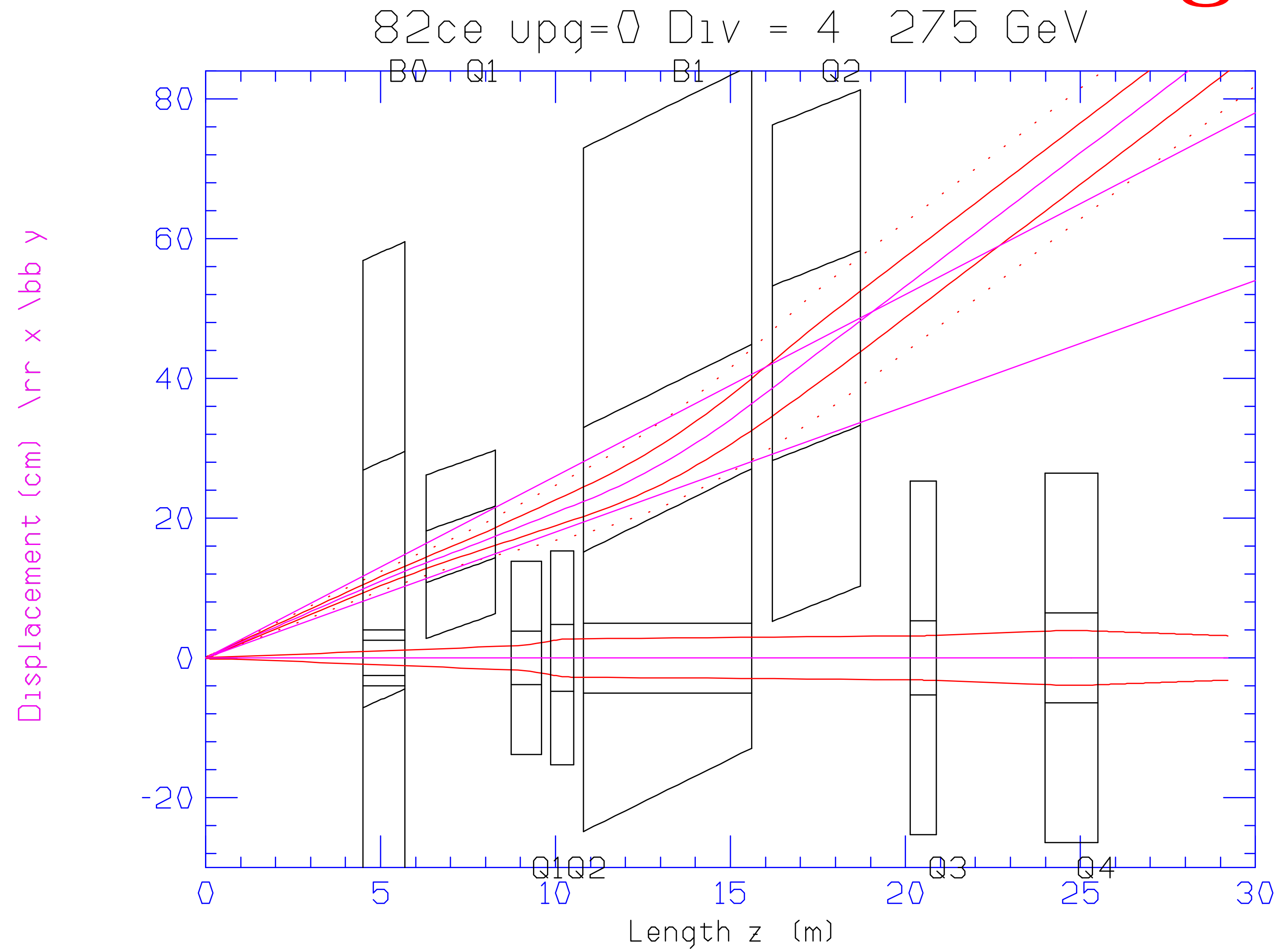


High Accept





Detail of Hadron leaving

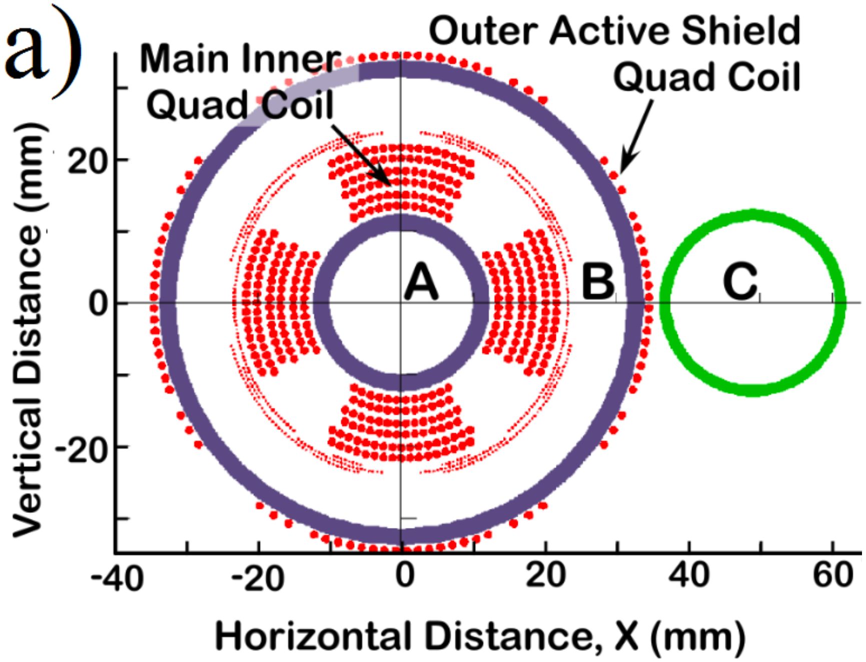


Magnets

- Maximum Aperture times gradient: 4 T
- Maximum Dipole field: 4.4 T
- Main challenge is shielding of early hadron magnets at electron beam
  Needed over a wide range of operating fields
- Probably needs active shielding in more than one case

Active mag shielding

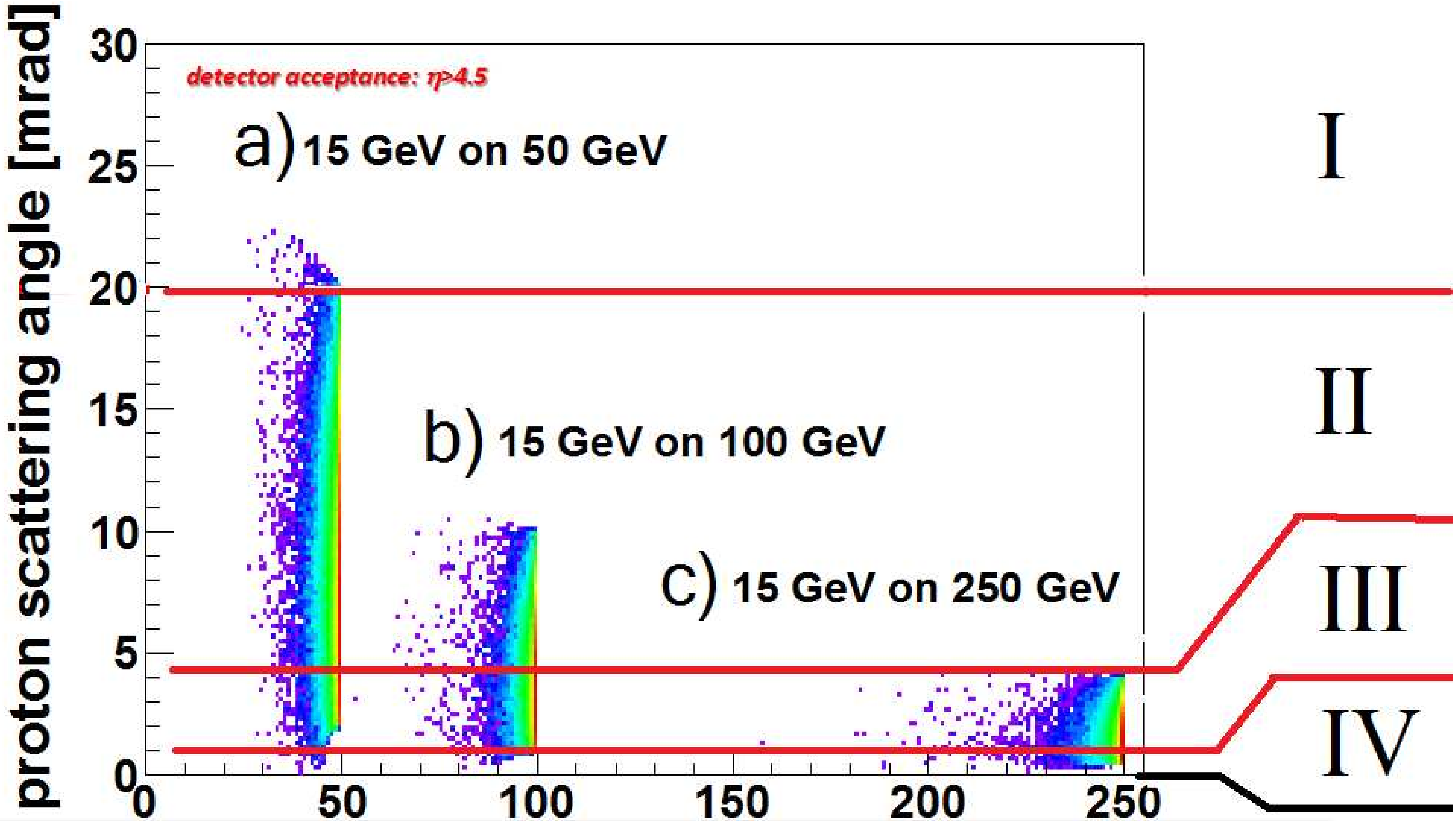
To cancel hadron magnet stray fields at electron beam



Actively shielded quadrupole Tested prototype of such a magnet built for the ILC

Required size and field higher, but concept the same

DVCS Physics

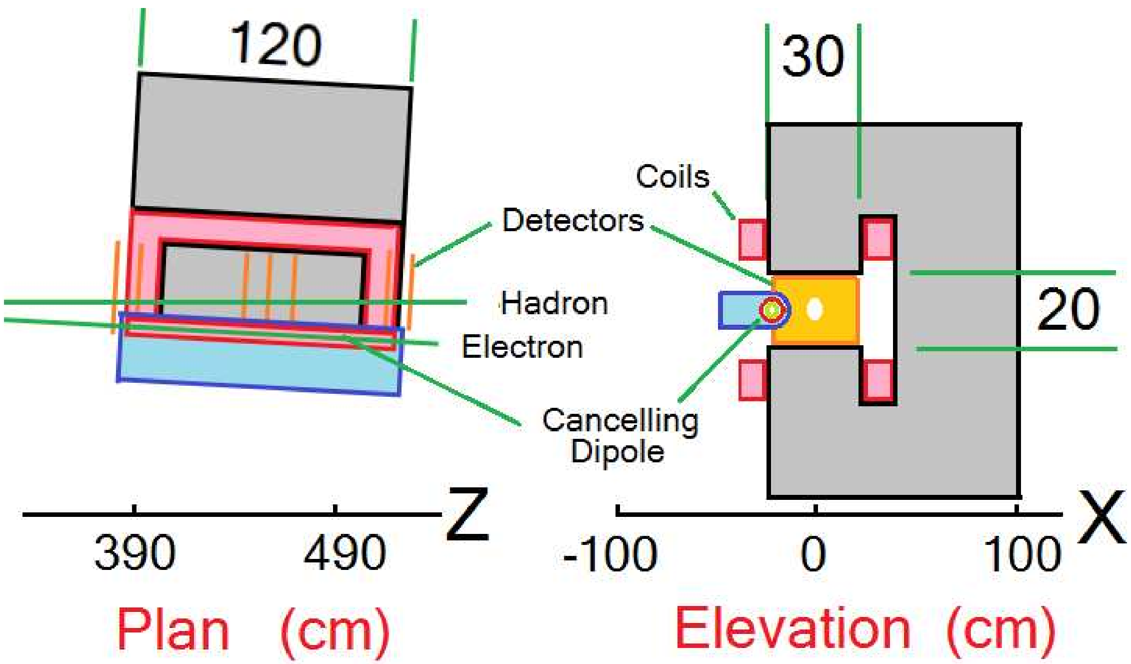


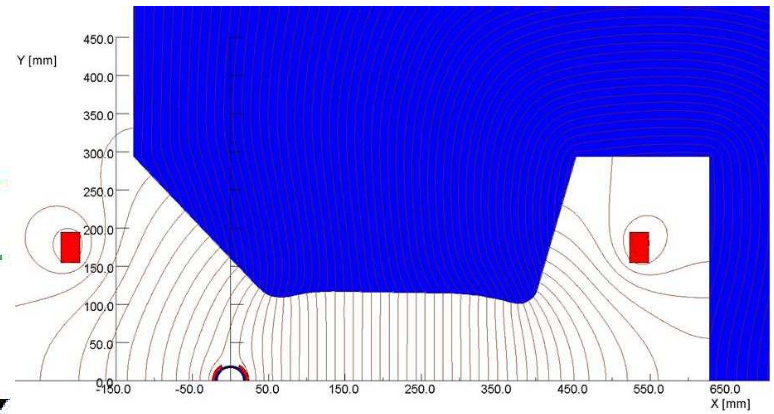
Hadron Detectors

		from	to
I	Central Detector	20 mrad	π - 20 mrad
II	Forward Spectrometer	$\approx$ 1.5 mrad	20 mrad
III	Roman pots before Crab Cavities	$\approx$ 1 mrad	$\approx$ 5 mrad
IV	Roman pots after Crab Cavities	0	$\approx$ 1 mrad
	Neutron detector	0	4 mrad

Forward Spectrometer

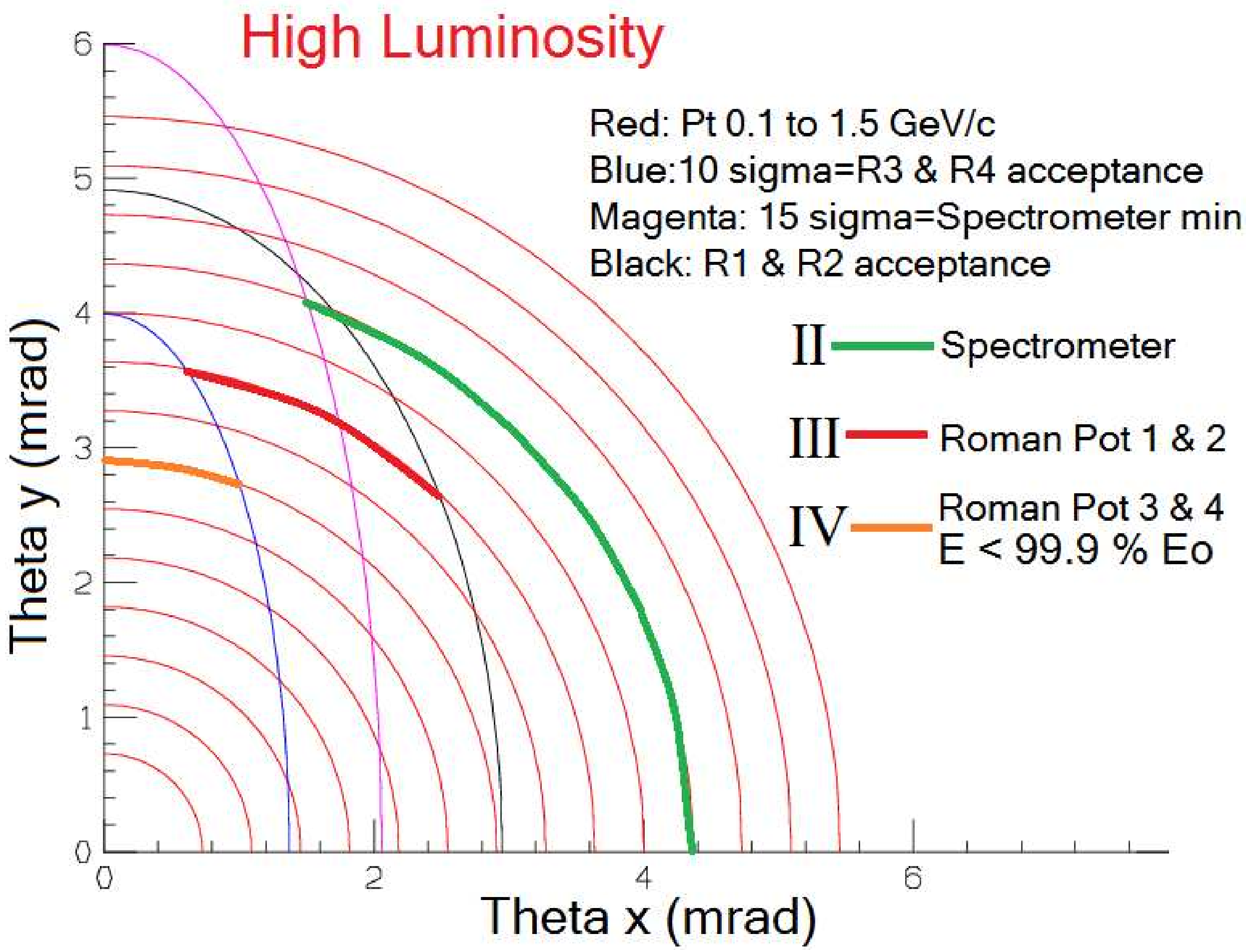
Covers angles 5 to 20 mrad   e.g. for forward p in lower energy DVCS (see above)





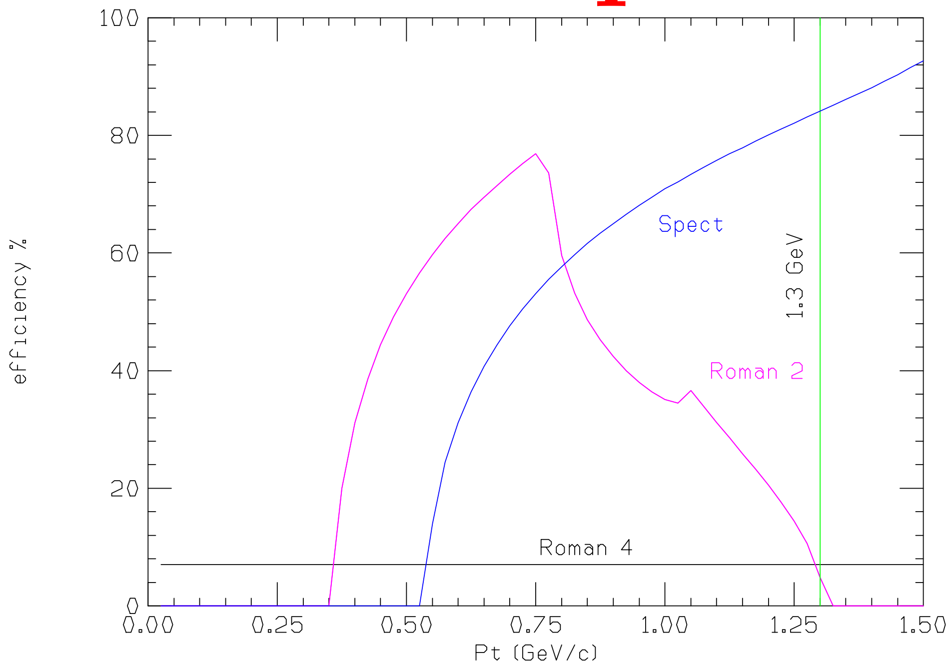
Warm iron and detectors   super-conducting coil
Direct wind cancelling dipole over electron beam

Azimuthal Acceptance

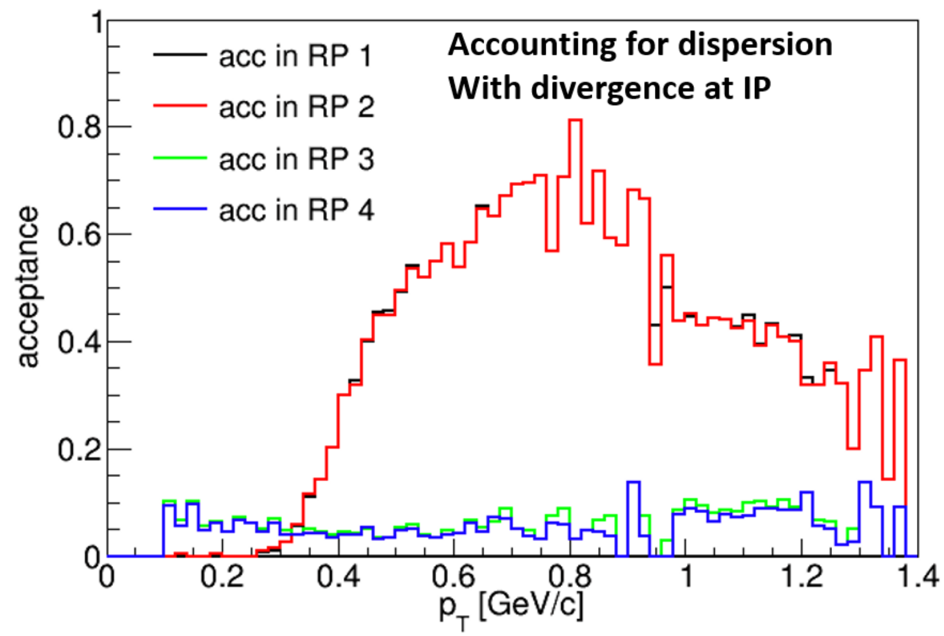


Azimuthal acceptances for regions II, III, and IV for the High Luminosity case.

HL Acceptances



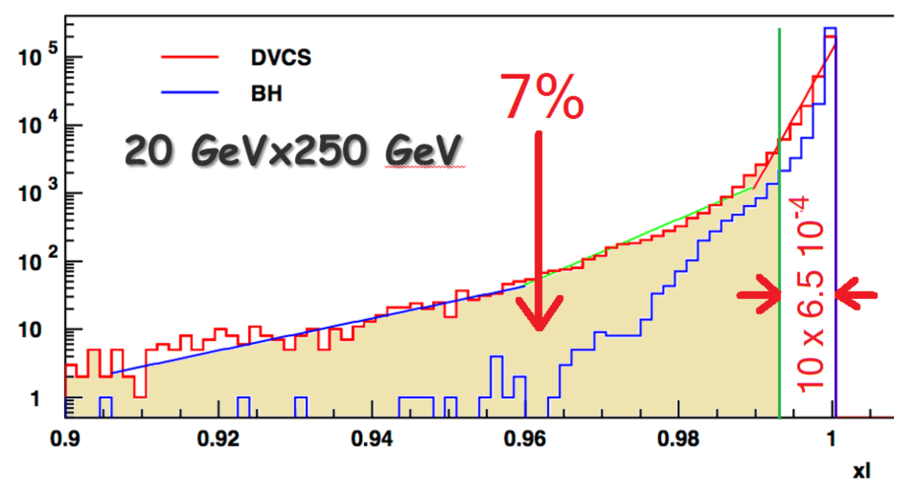
Simple Calculation



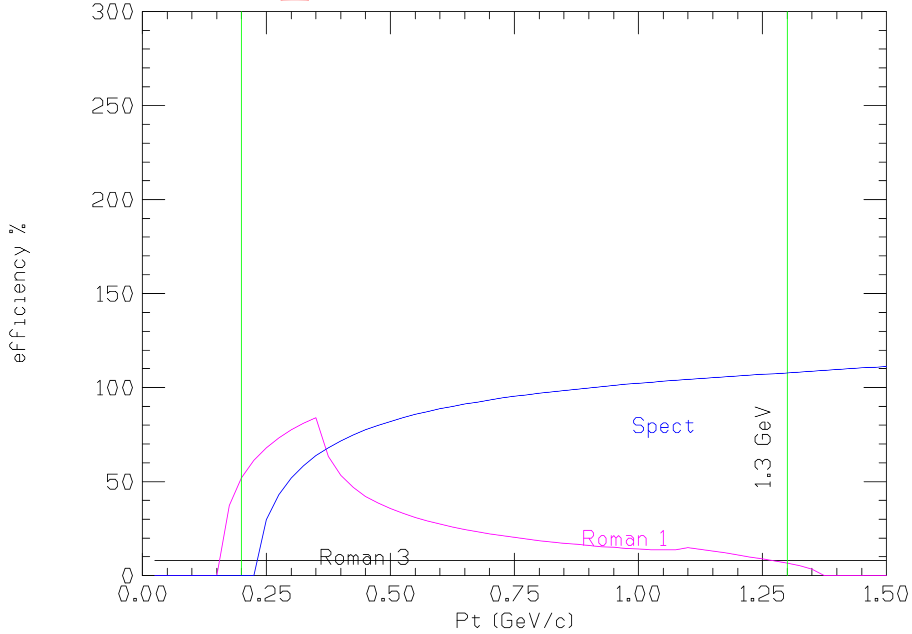
GEANT Simulation

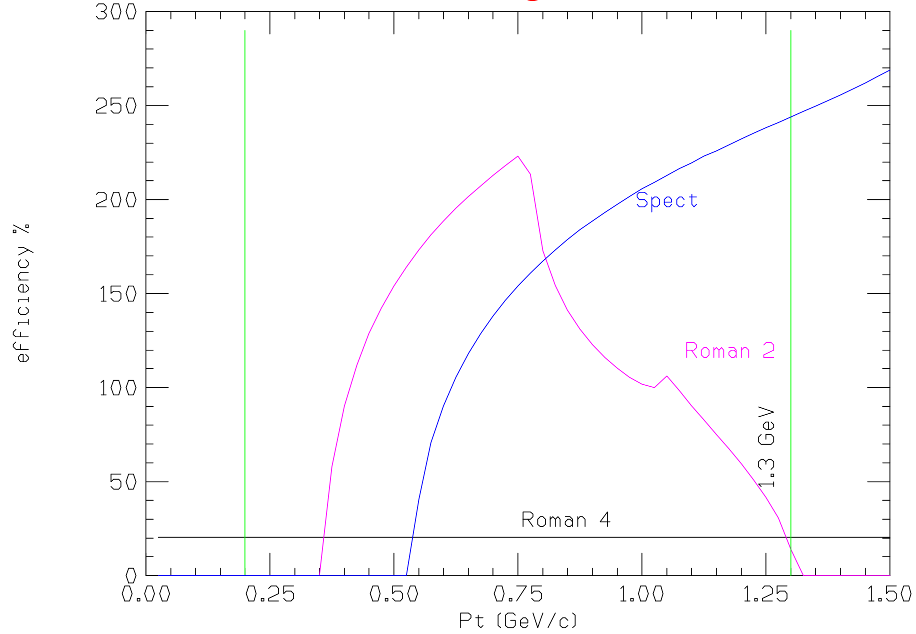
Efficiency with cut at
$dp/p = 10 \times 6.5\ 10^{-4}$

Qualitative agreement



Acceptances × Luminosity



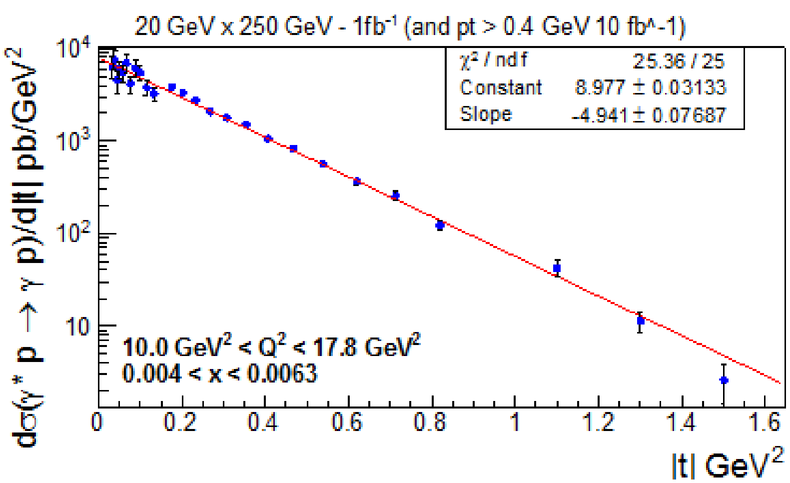


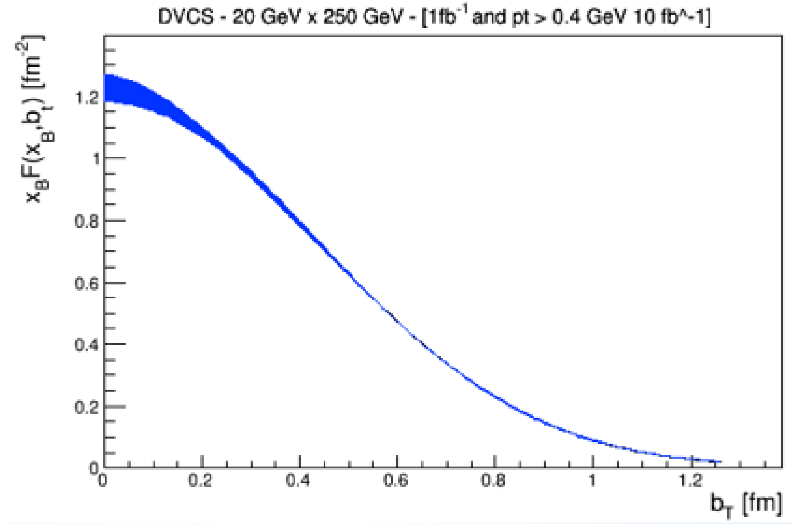
High Acceptance dir High Luminosity

Efficiency × Luminosity:

	$<$ 400 MeV/c	$>$ 400 MeV/c	ratio
HL	20	200	1:10
HA	55	50	1:1
50/50	37	125	1:3.4

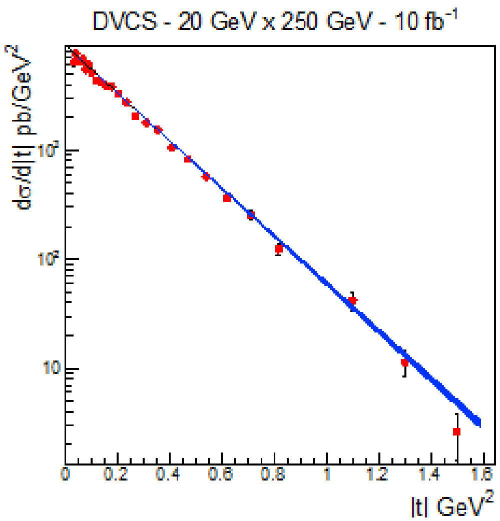
How Bad is HL alone

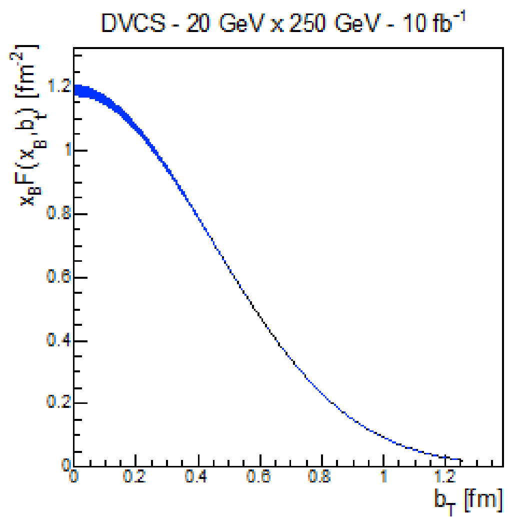




10 fb above
400 MeV/c

1 fb below
400 MeV/c





10 fb for all

Not obviously so bad, because cross sections are much higher at low pt. But some fracions of both probably best. We have the tools to study this

Measurement Errors

- Crab deflection effect R1-R2 pt determination
  but timing to $\approx$ 50 ps would resolve it
- Forward Spectrometer instrumentation
  Very high resolution tracking needed
- Large divergences needed for high luminosity
  but gives large errors on hadron pt
  needs luminosity vs. divergence optimization
- Dynamic fitting using pt conservation could help
  and needs study

Covered Topics?

IR Layout	Preliminary OK
Magnetic Shielding	Concepts OK
Parameters without Cooling	Preliminary OK
Parameters with Cooling	Less studied, but OK
Detector definitions	Preliminary OK
HE GEANT DVCS Simulations	Tools OK
Consideration of Errors	Starting

To Be Done?

- Matching IR into rings
- Refine layout of outgoing e detectors
- IR magnet designs with possible R&D
- Iterate operating parameters with/without cooling
- Adding one or more Low Divergence (LD) cases
- Iterate detector designs
- Study DVCS at lower energies
- Study e-He3 e-D e-Au parameters