IR

3/15/2017

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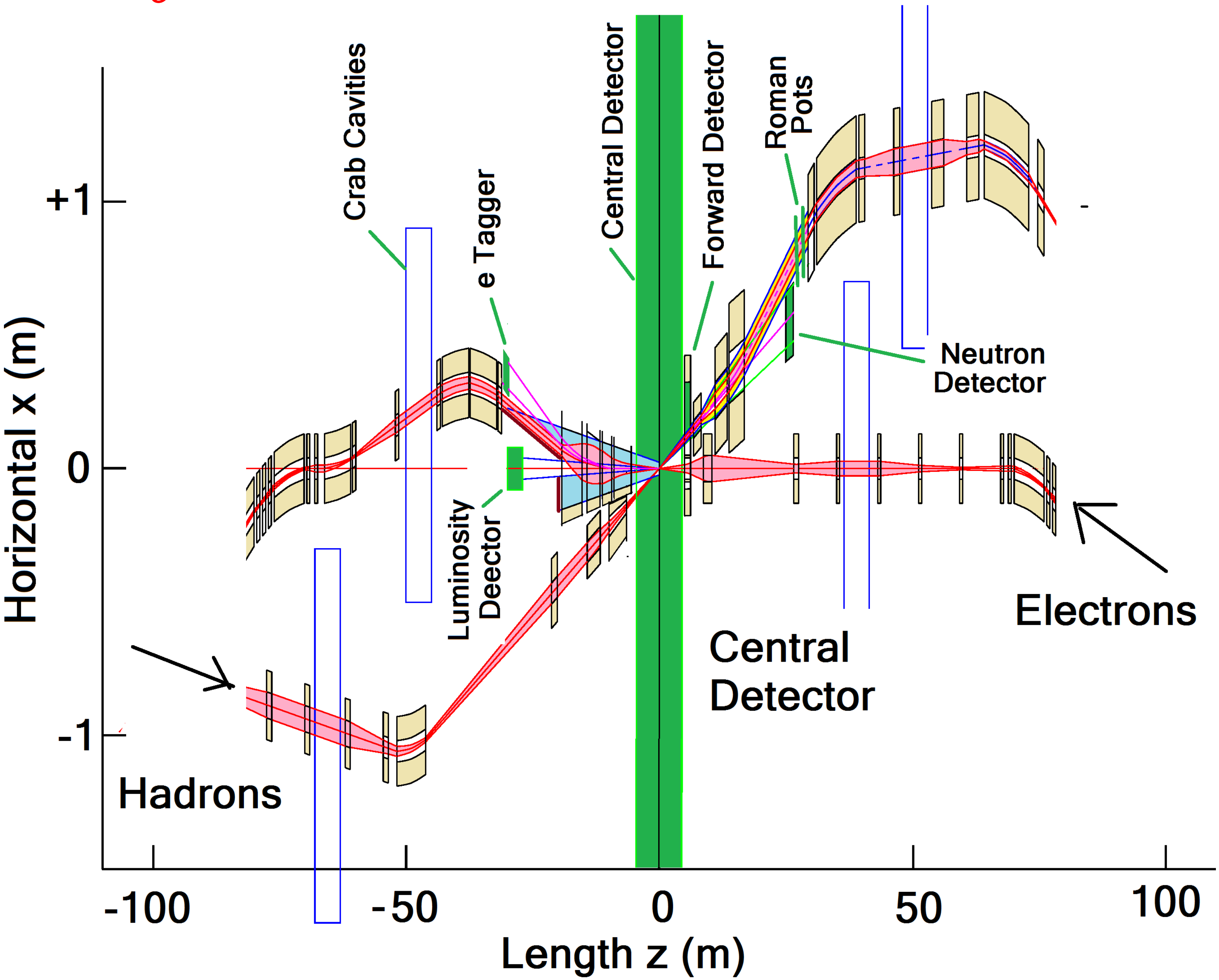
Lattice Requirements

- Achieve required betas at IP:
  $\geq$ 4 cm in y, $\geq$ 50 cm in x
- Provide locations for crabs with β_x=1200 m for p, and 250 m for e
- Minimize all other maximum betas to control chromaticity
- Minimize fields in all magnets to allow NbTi at 4 K
- Adequately shield between e and p beams
- Minimize fan of synchrotron Radiation SR in IP and beyond (Rear)

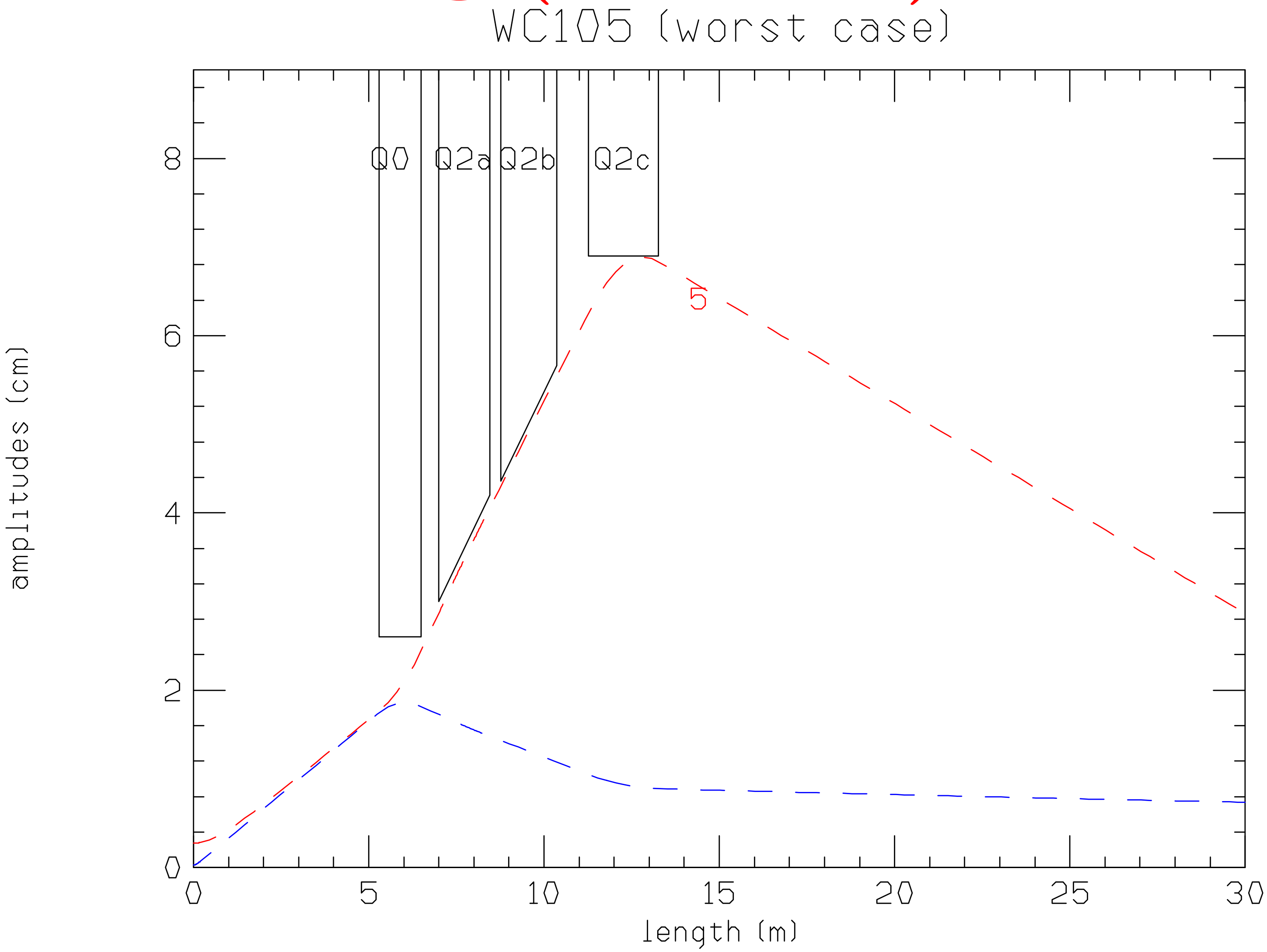
Layout (full4)



Synchrotron Radiation from incoming (Forward) Electrons

- Radiation from electrons up stream must be collimated
- Electron bends upstream near the IP are avoided
- Electron focusing is designed to minimize angular spread (fan) of synchrotron radiation from quads near the IP
- To avoid SR scattering into the central detector, the beam pipes and downstream (Rear) quads have apertures greater than any fan from up to 13.5 sigma upstream electrons
- These fans are smaller if the upstream (Forward) quad doublets are weak and far apart
- But this gives higher betas and more chromaticity

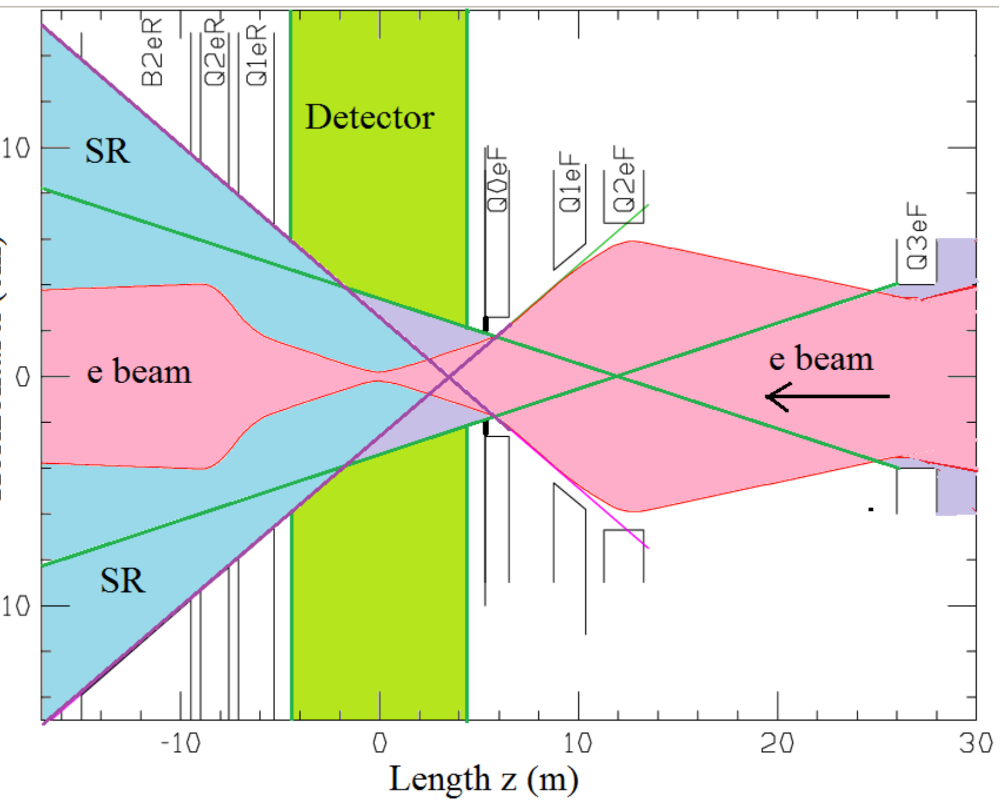
Incoming (Forward) e focusing



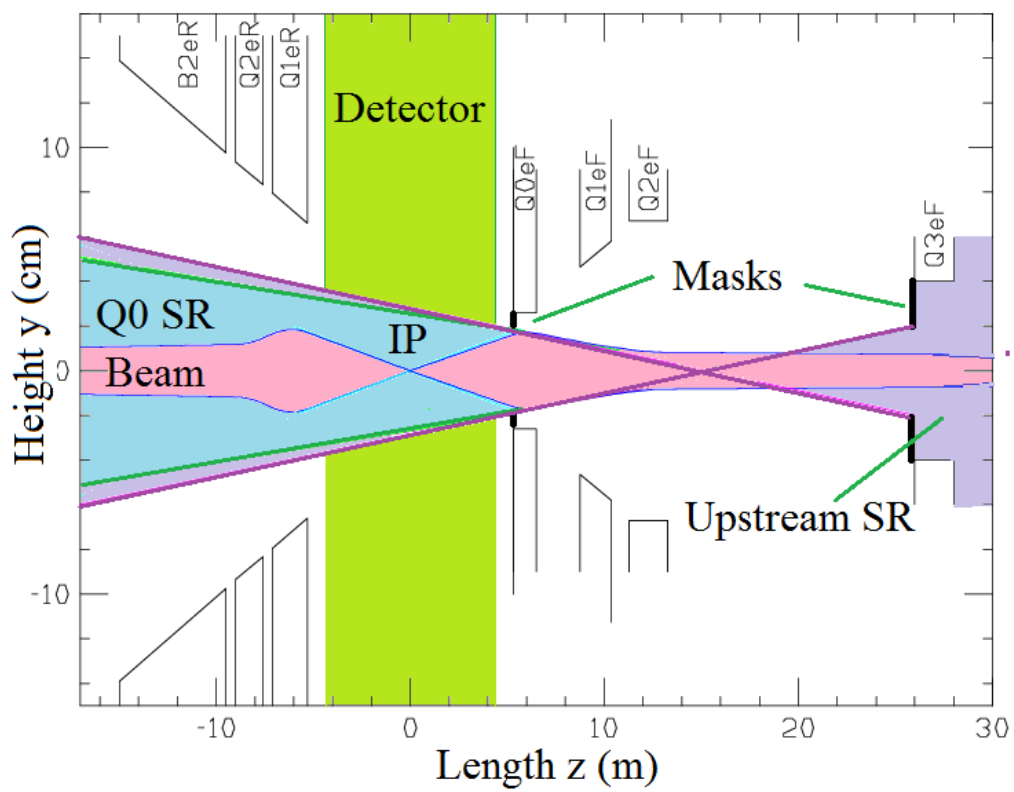
Beam size for no cooling HD 140 GeV case, scaled by divergence in worst (cooled case). This sets the magnet apertures

Synchrotron fans SRfanx SRfany

Synchrotron fan set at 13.5 sigma for worst case of Cooled 105 GeV HD. This is large enough to cover 15 sigmas for all No Cooling cases



X



Y

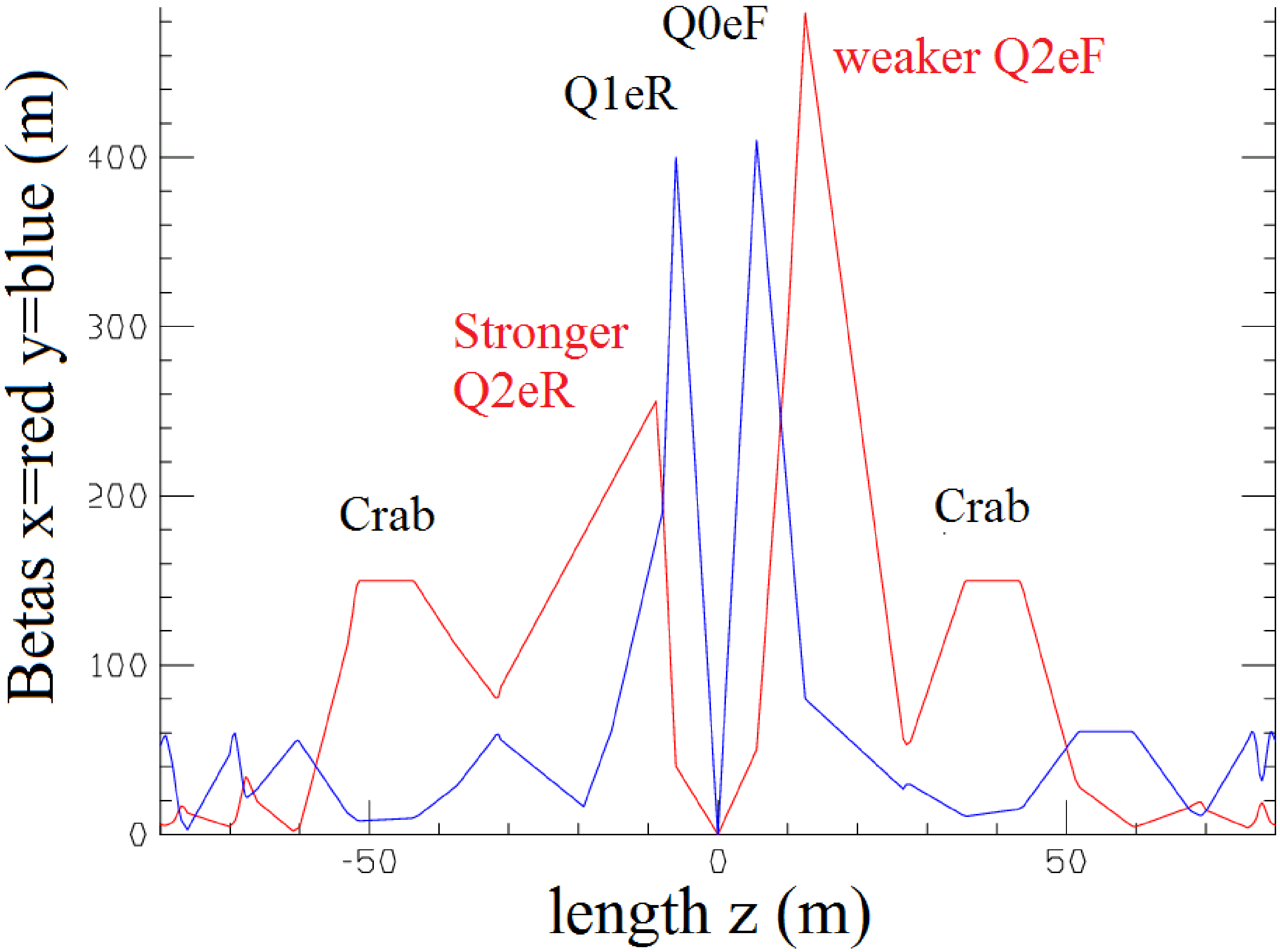
Fan Dimensions

x y	Source	dependence on z
width x	Q0	x=7.5 10^{-3} (-z + 3.5) (m)
width x	upstream	x=1.5 10^{-3} (-z + 17) (m)
height y	Q0	y=1.5 10^{-3} (-z + 15) (m)
height y	upstream	y=1.9 10^{-3} (-z + 13) (m)

Vacum ellipse radii in detector

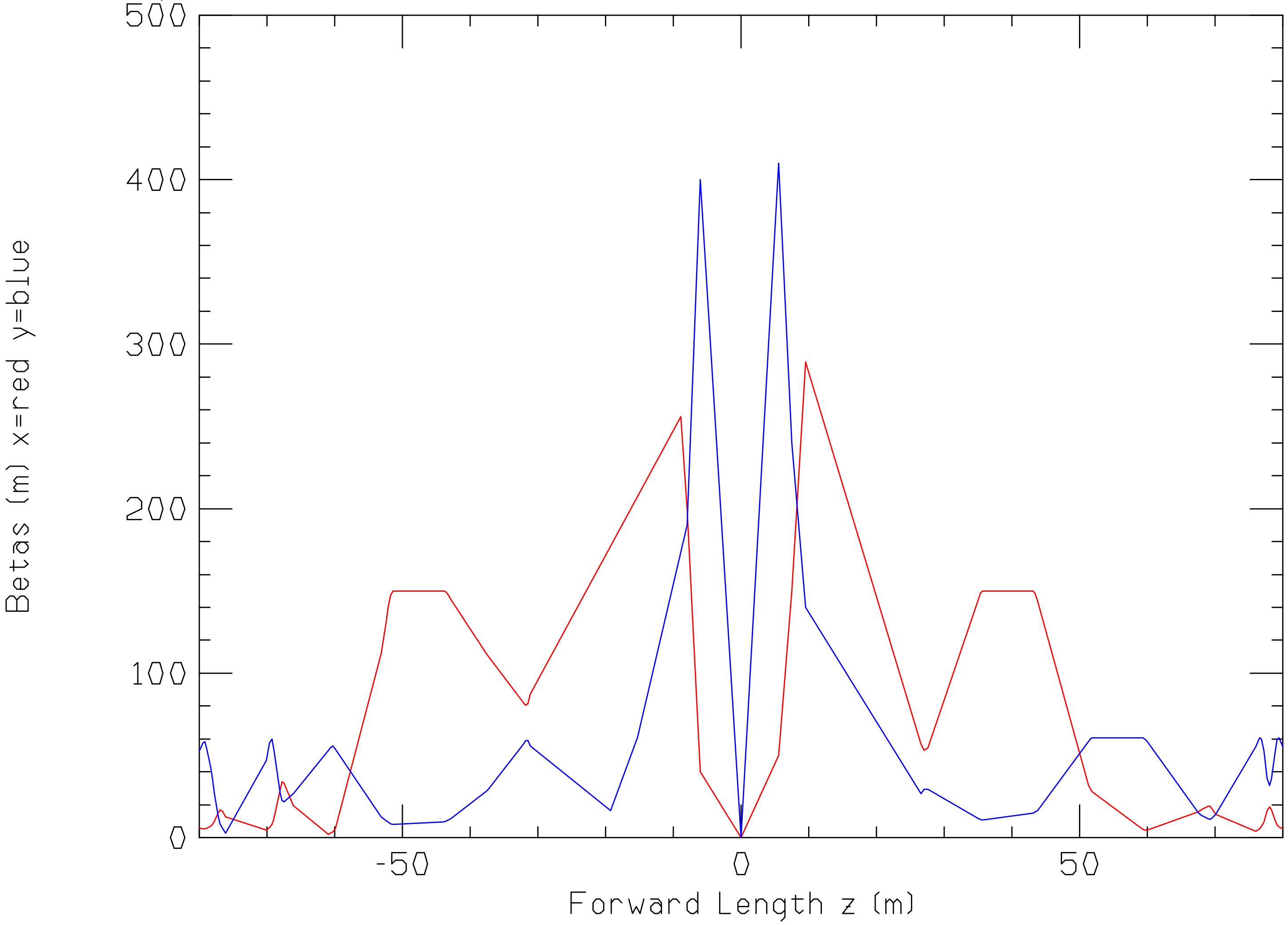
z (m)	x (cm)	y (cm)
-4.5	6.0	3.3
0	2.6	2.5
4.5	1.9	1.6

Worst case β_es (Div=220 μrad) (xyebet2)



High divergence when cooled give largest SR fan which requires larger quad separations of "forward" e focus and resulting higher beta.

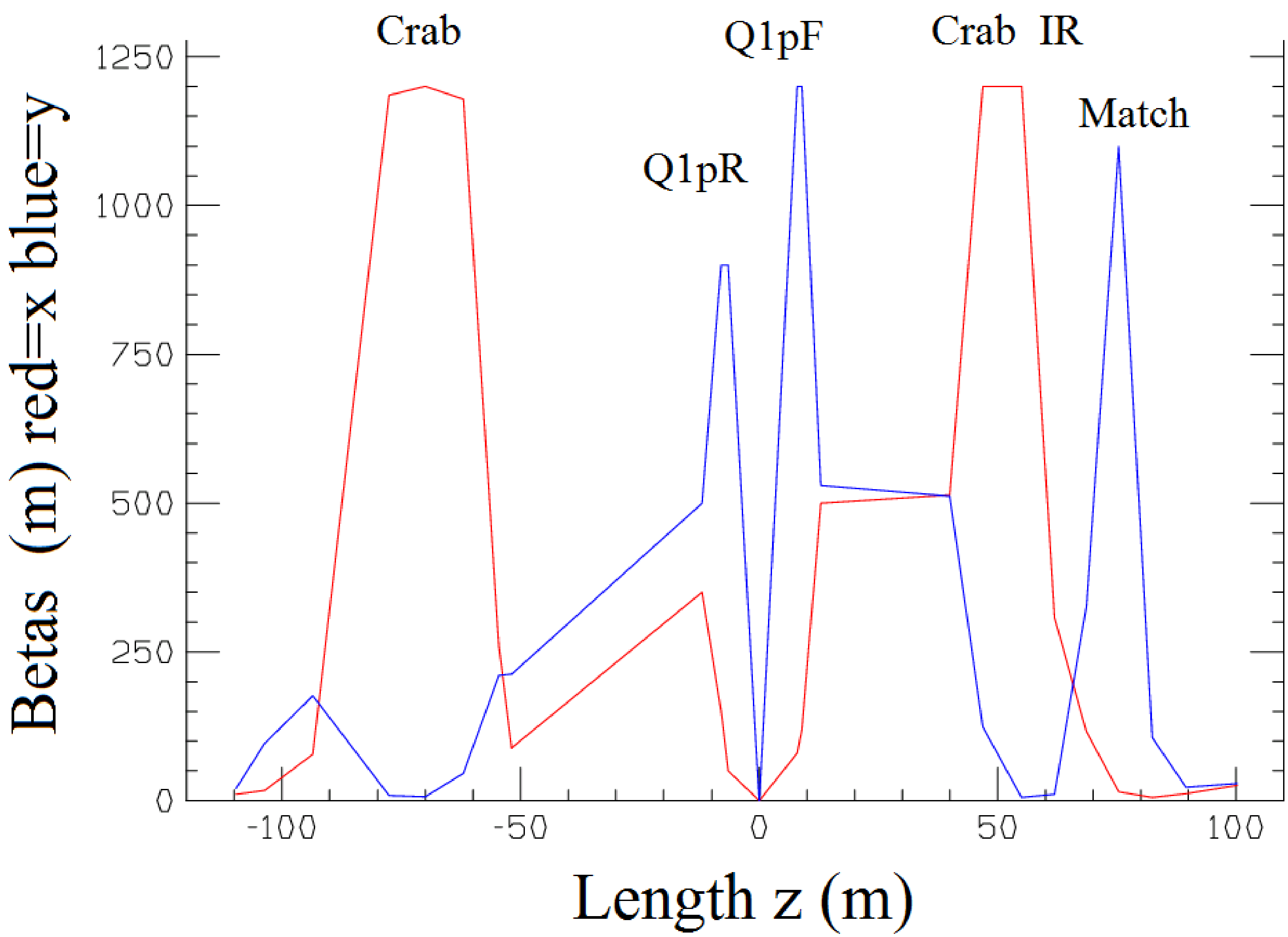
Electron βs for No Cool 140HD (xye-bet3)



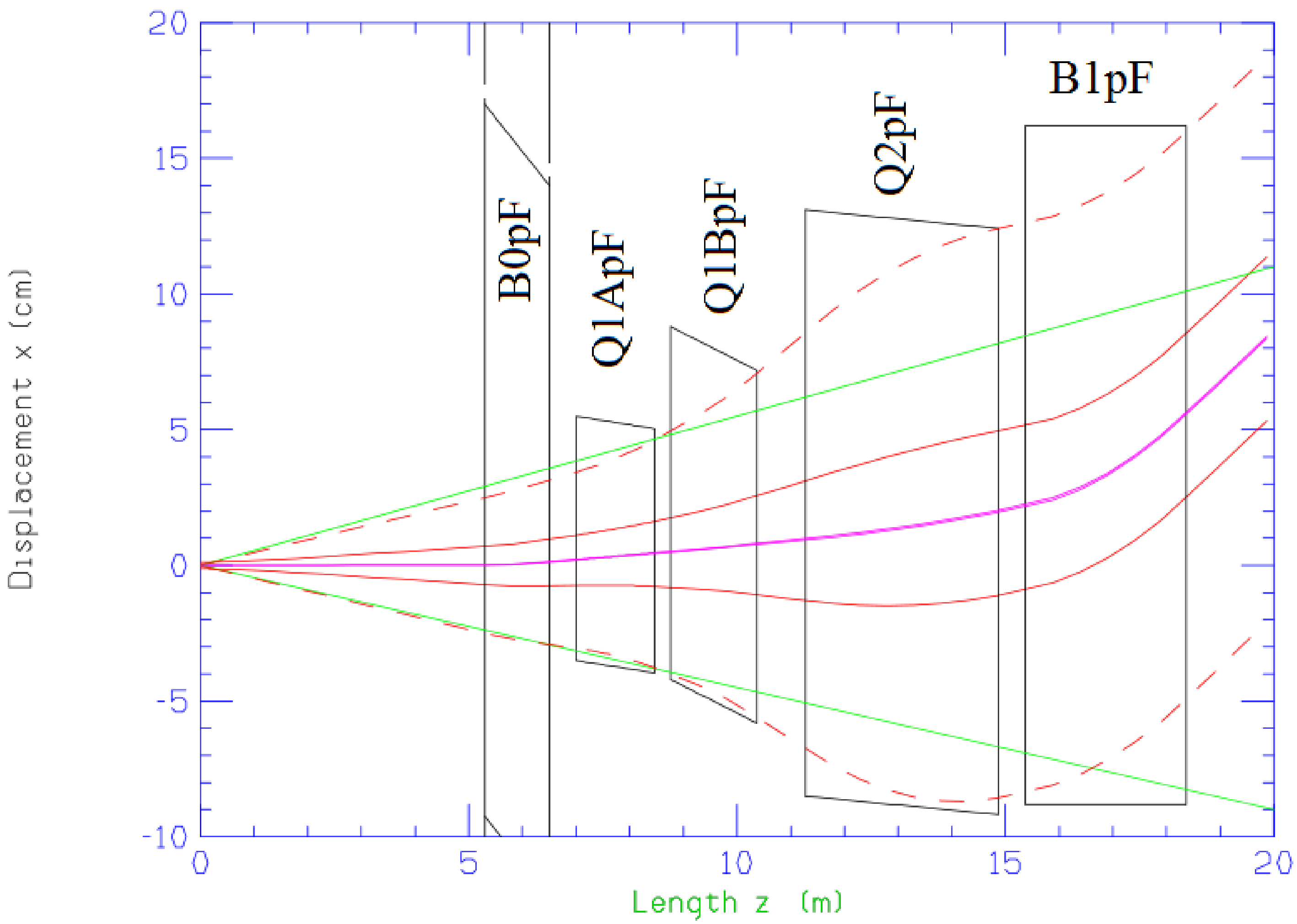
Lower divergences for no cooling cases allow effective quads closer (using two quads) reducing the beta maxi-

mums

Hadron Betas (pbetas3)

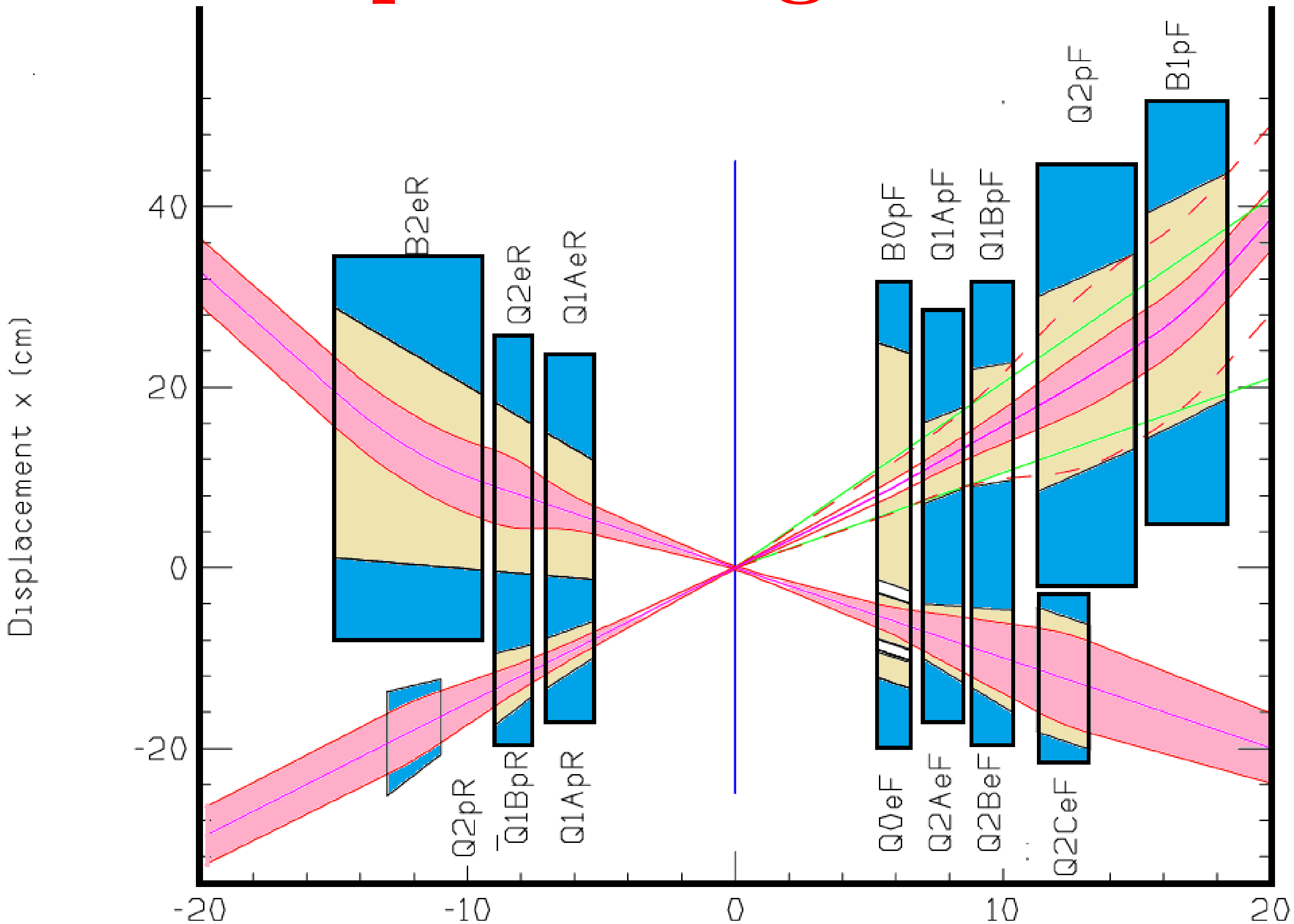


Forward Hadron Tilts (dnnp336w.png)



Tilting untapered magnets increases space between e and Ion beams

Conceptual Magnet Outlines (detail.png)



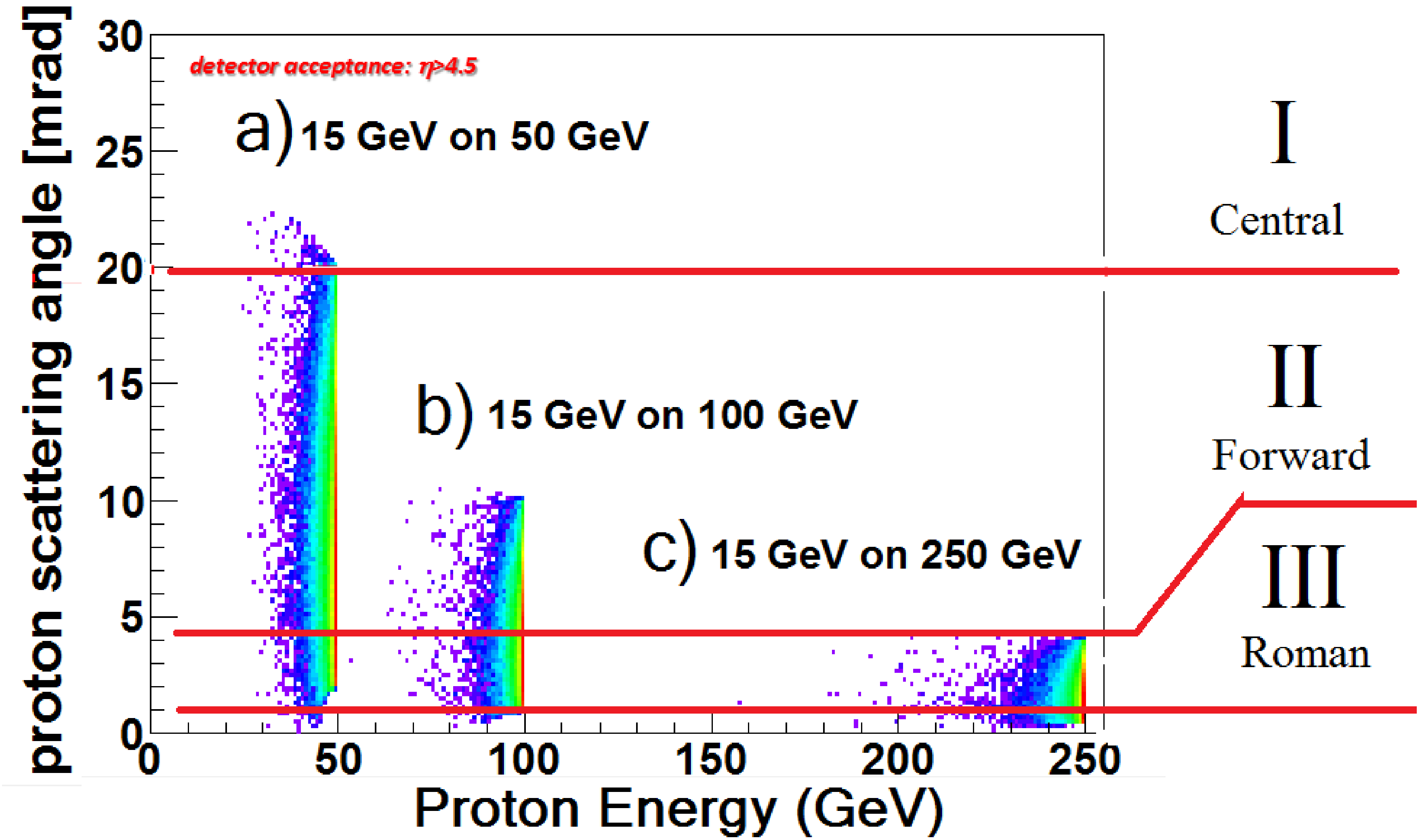
Magnets close to one another must be designed as single units with good isolation one from the other (see Brett Parker talk)

Detector Requirements

- Central detector with particle ID -20 mrad to +20 mrad (ideal)
- Forward neutron detection $\geq$ 4 mrad (-4.5 to 5.5 mrad provided)
- Forward proton detection to 4.7 mrad (pt 1.3 GeV) for p=275 GeV
- Forward proton detection to 10 mrad (pt 1 GeV) for p=100 GeV
- Forward proton detection to 21 mrad (pt 1 GeV) for p=50 GeV
- Forward proton detection down to pt=200 MeV/c for all energies
- Tagger for rear electrons on axis but p $<$ 90% p initial
- Luminosity measurement of rear on axis photons

Coverage for Diffractive Physics

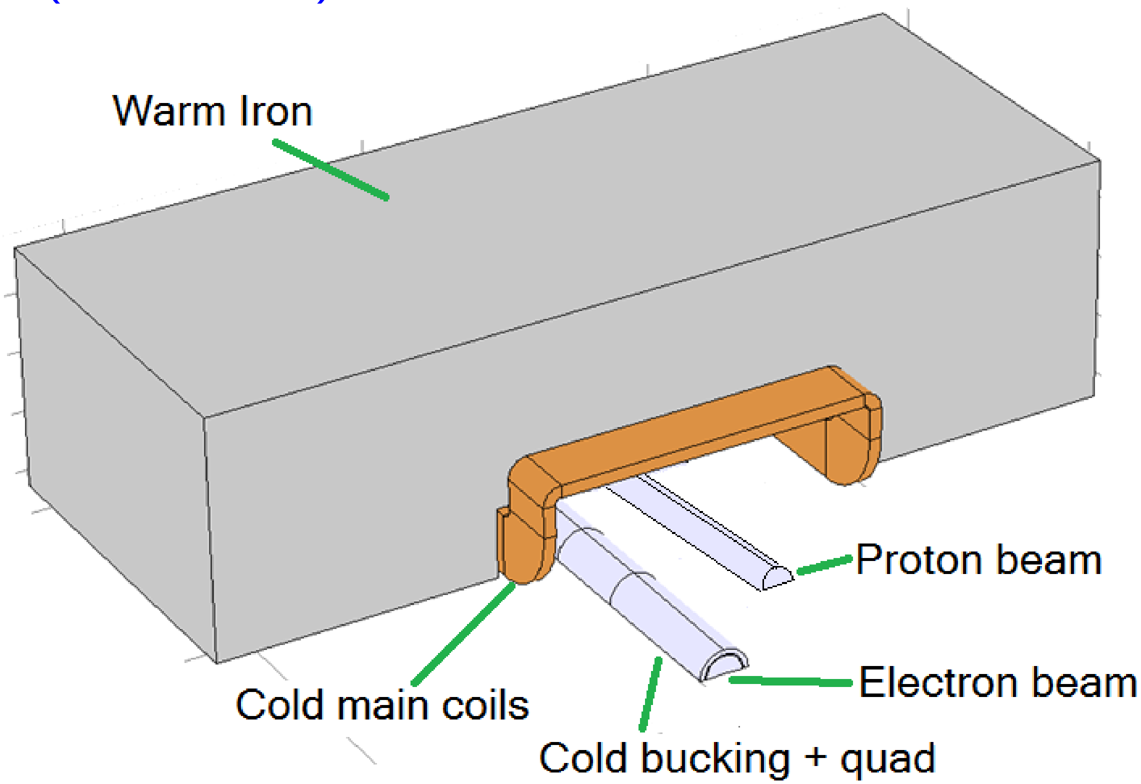
Deeply Virtual Compton Scattering probing gluon distributions



Rear outgoing electrons down to 1 degree

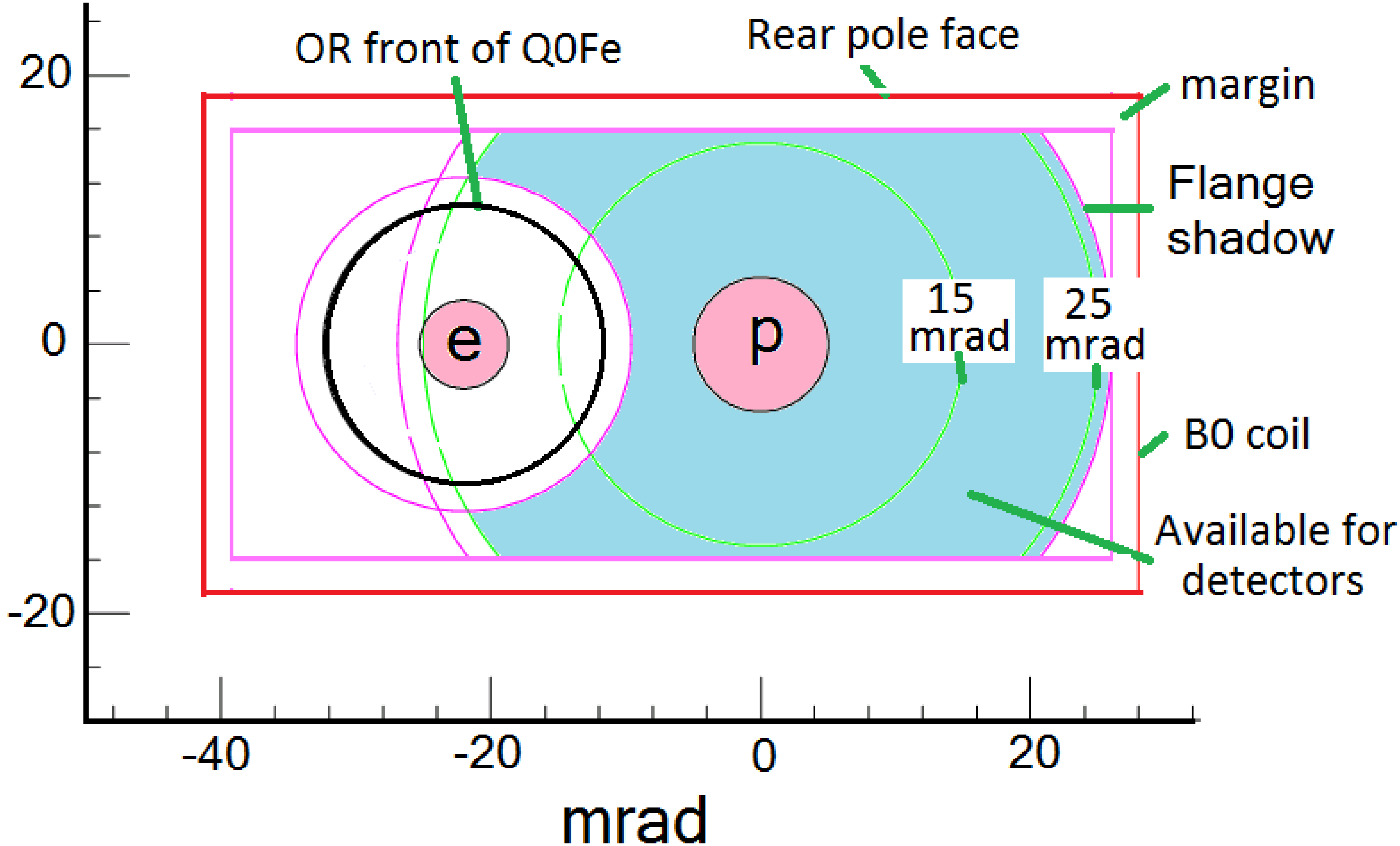
Forward Spectrometer

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

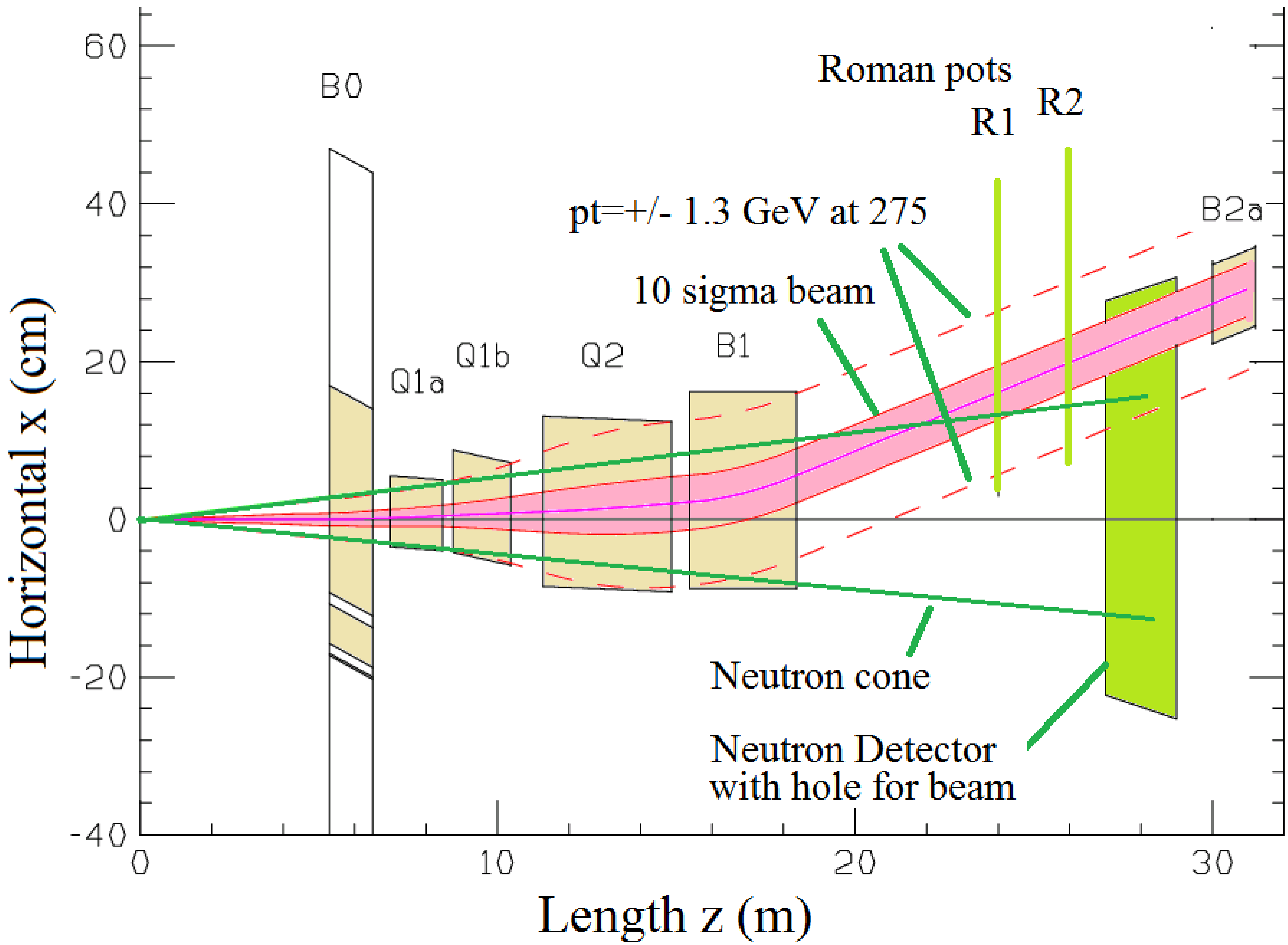


Warm iron and detectors super-conducting coil
Direct wind cancelling dipole over electron beam

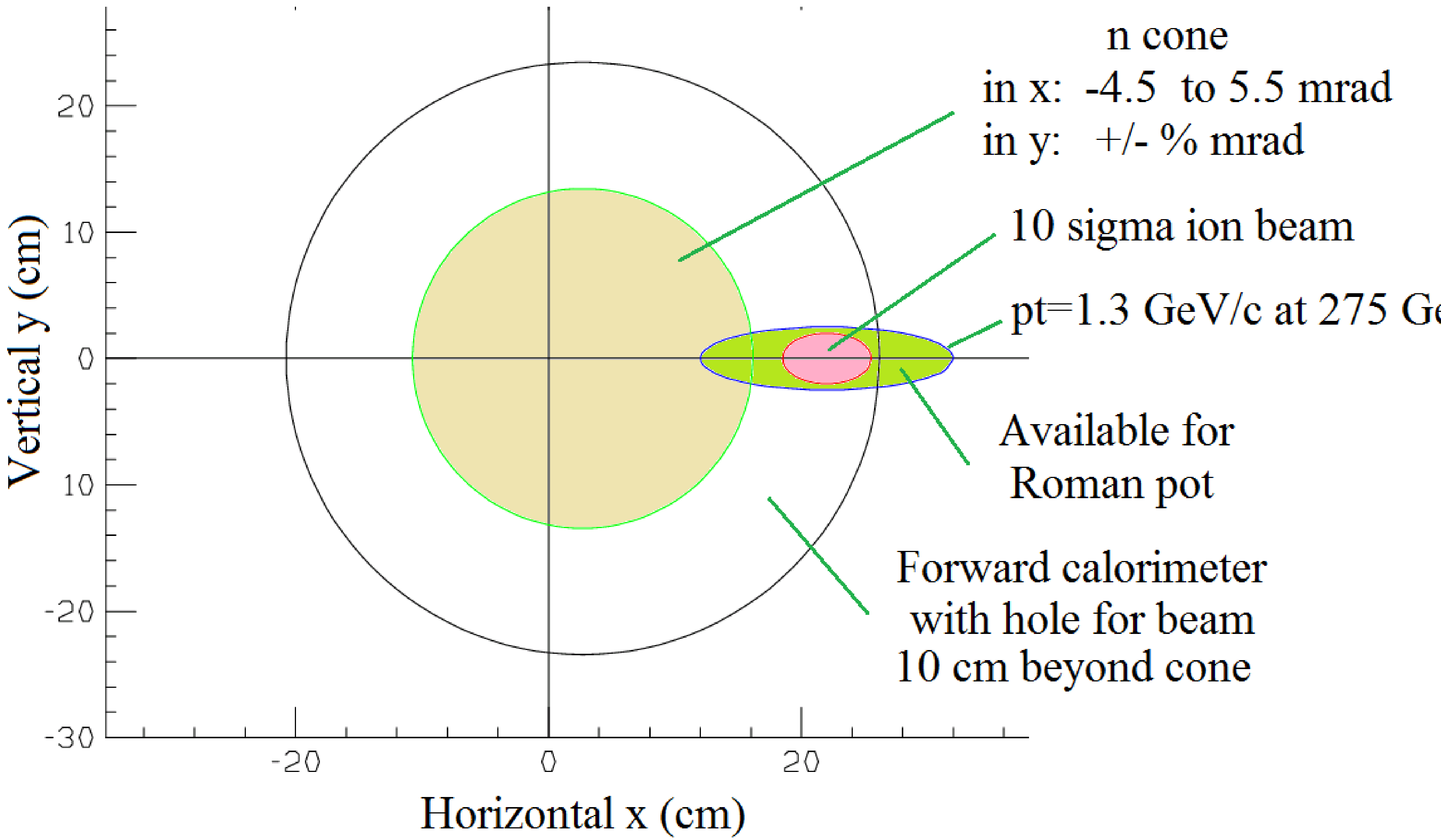
Azimuthal Acceptance



Other Hadrons Detectors



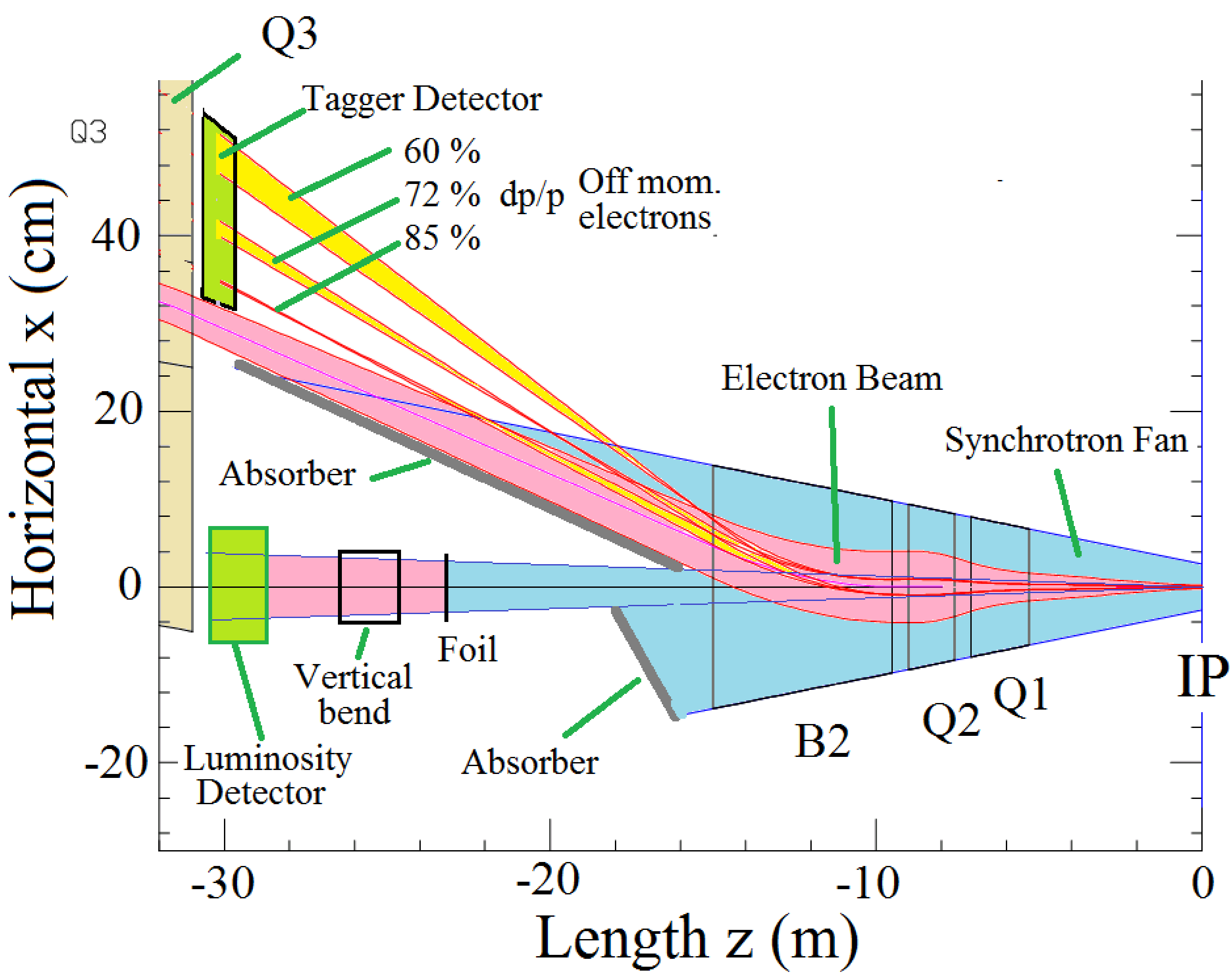
xy of beam, Calorimeter, & Roman Pots



Electron Detectors

- Luminosity monitor facing IR
  - Foil converts γs to e pairs
  - vertical bending magnet
  - electron detectors
- electron tag after weak horizontal bend (B2)
  - electron detector
- Polarization measurement will be in another straight section

Rear Electrons & Detectors



Conclusion

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