Synchrotron Radiation in eRHIC IR

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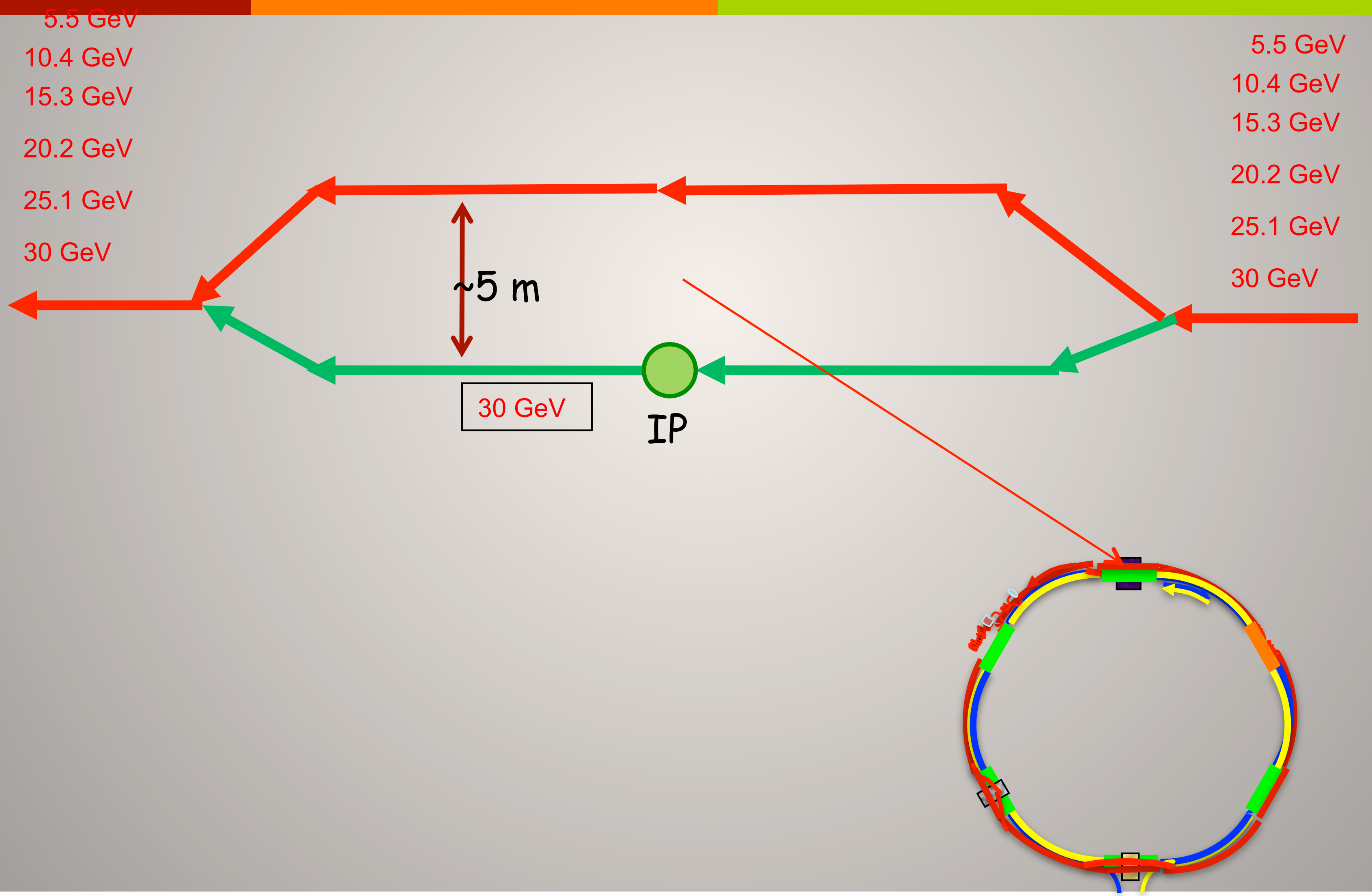
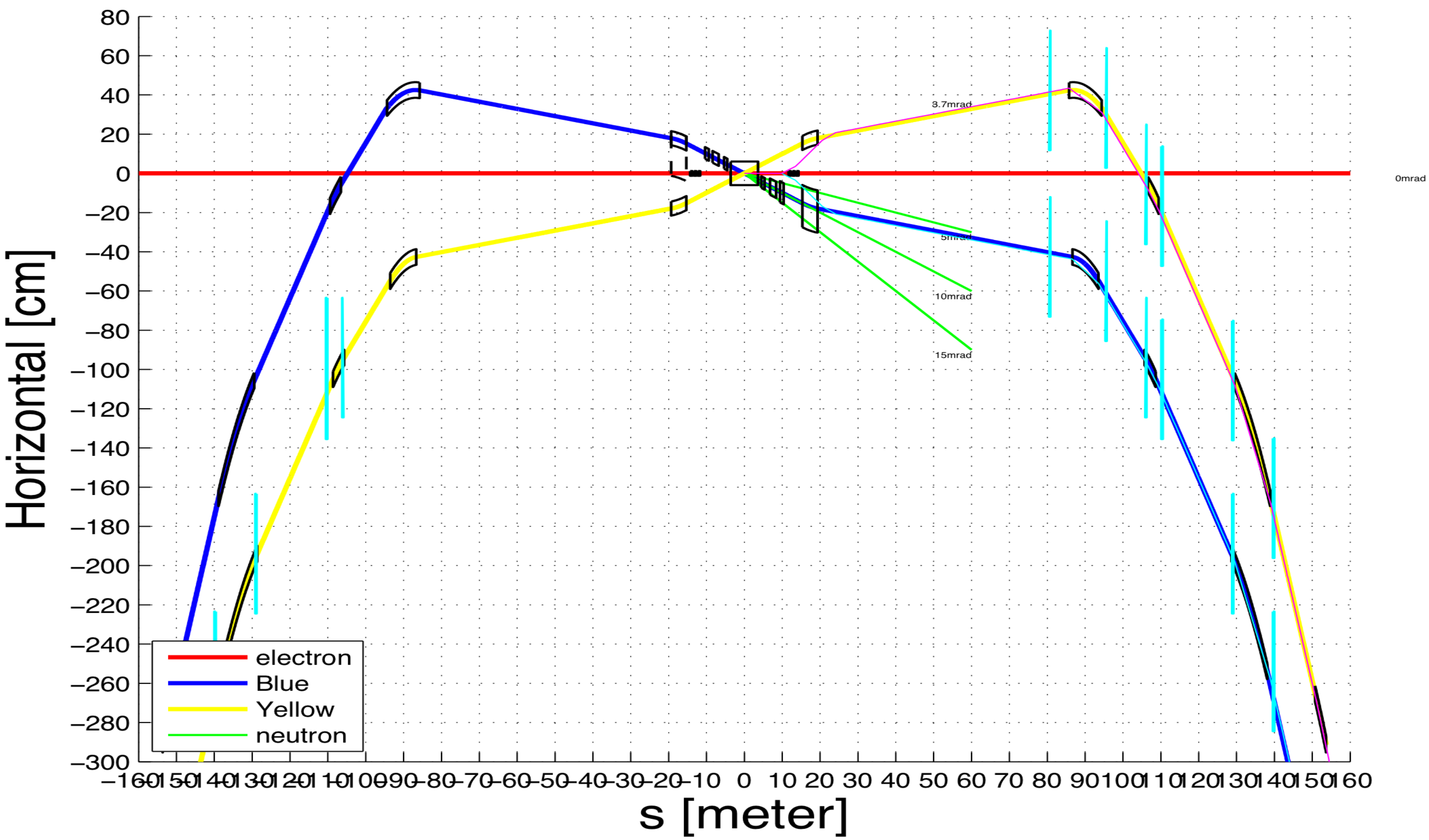
Bring Final Energy e Beam into IR

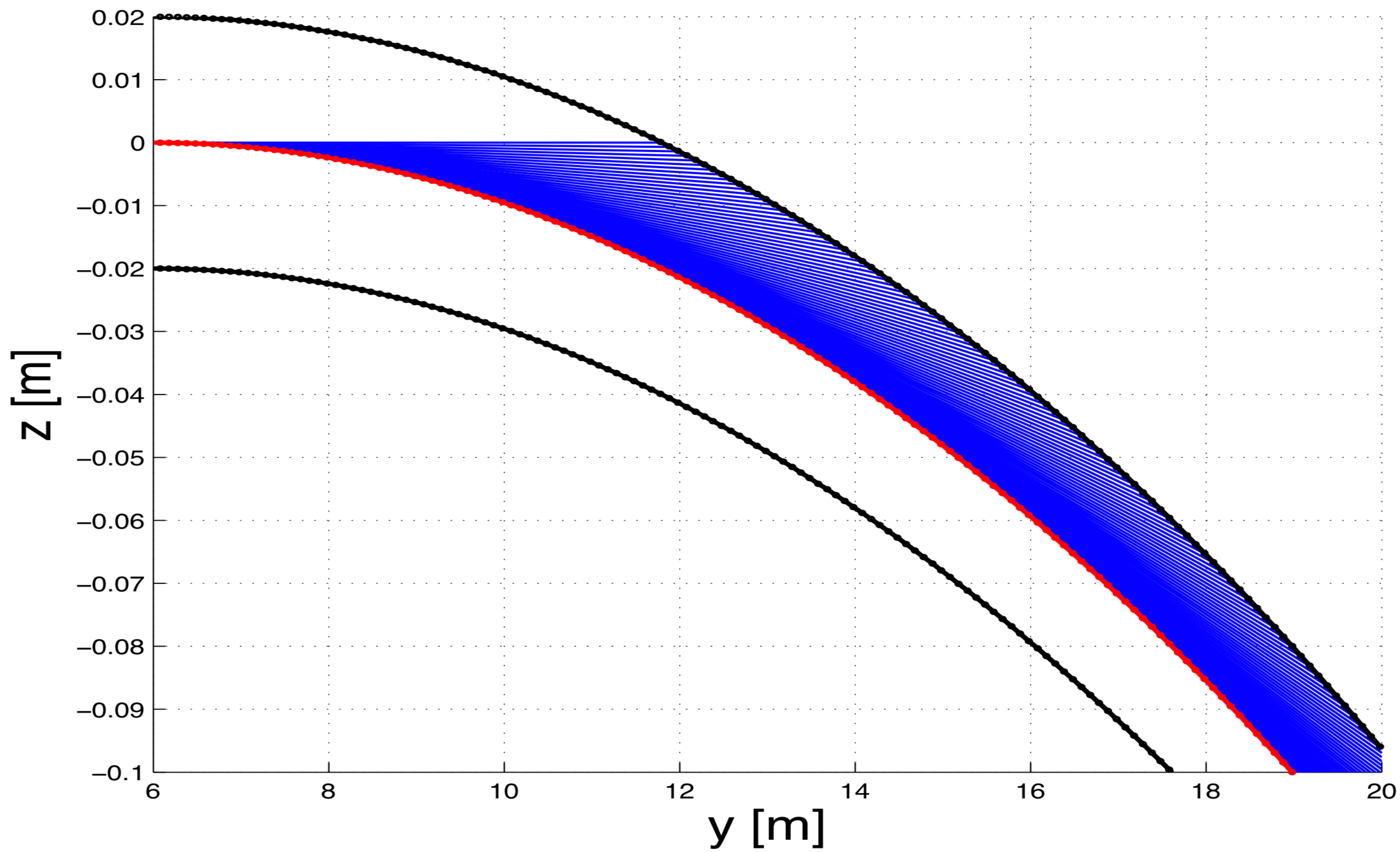


eRHIC IR (IR8, from left D9 to right D9)



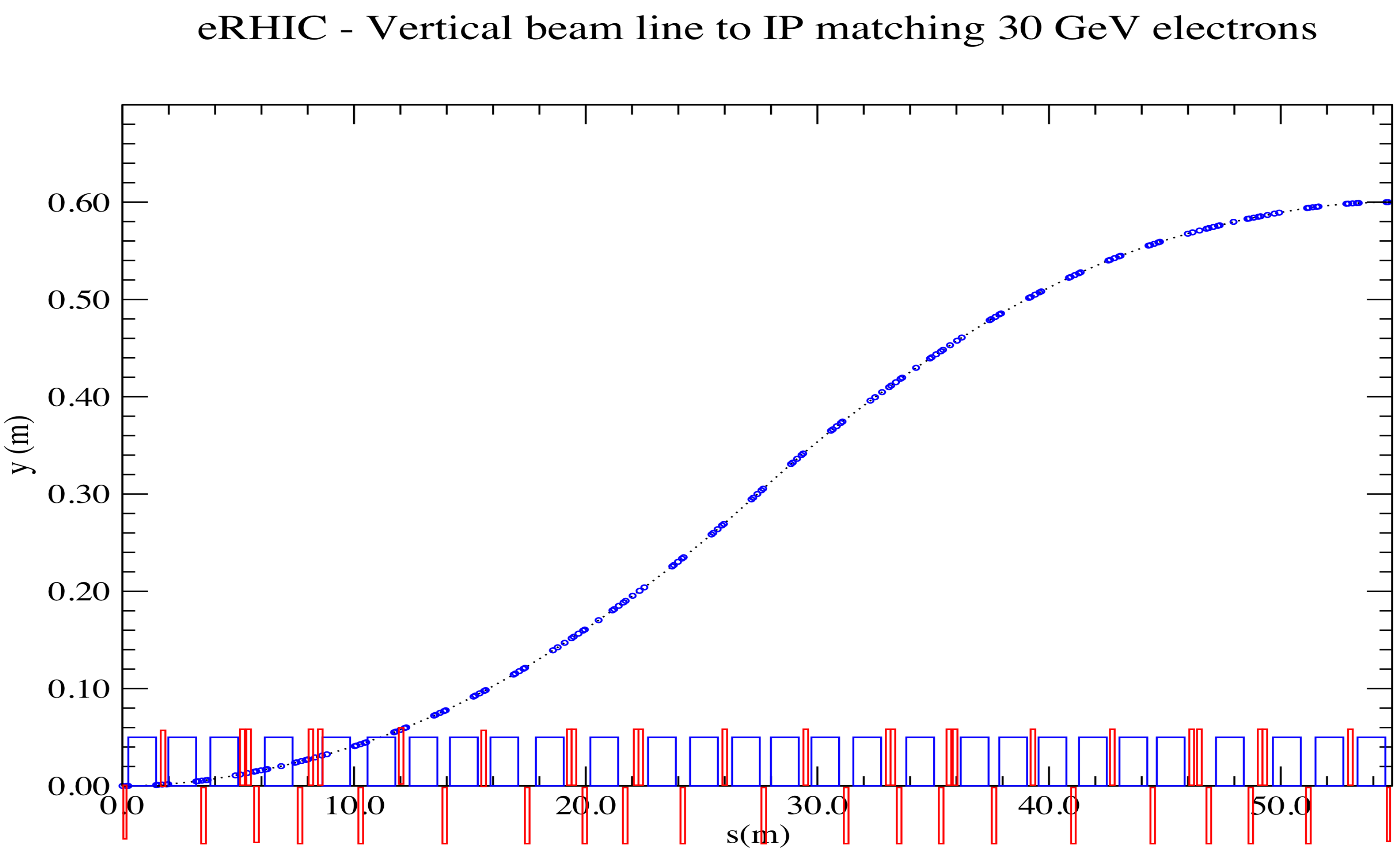
Direct Synchrotron Radiation onto Absorbers

The electron beam line right after the arc



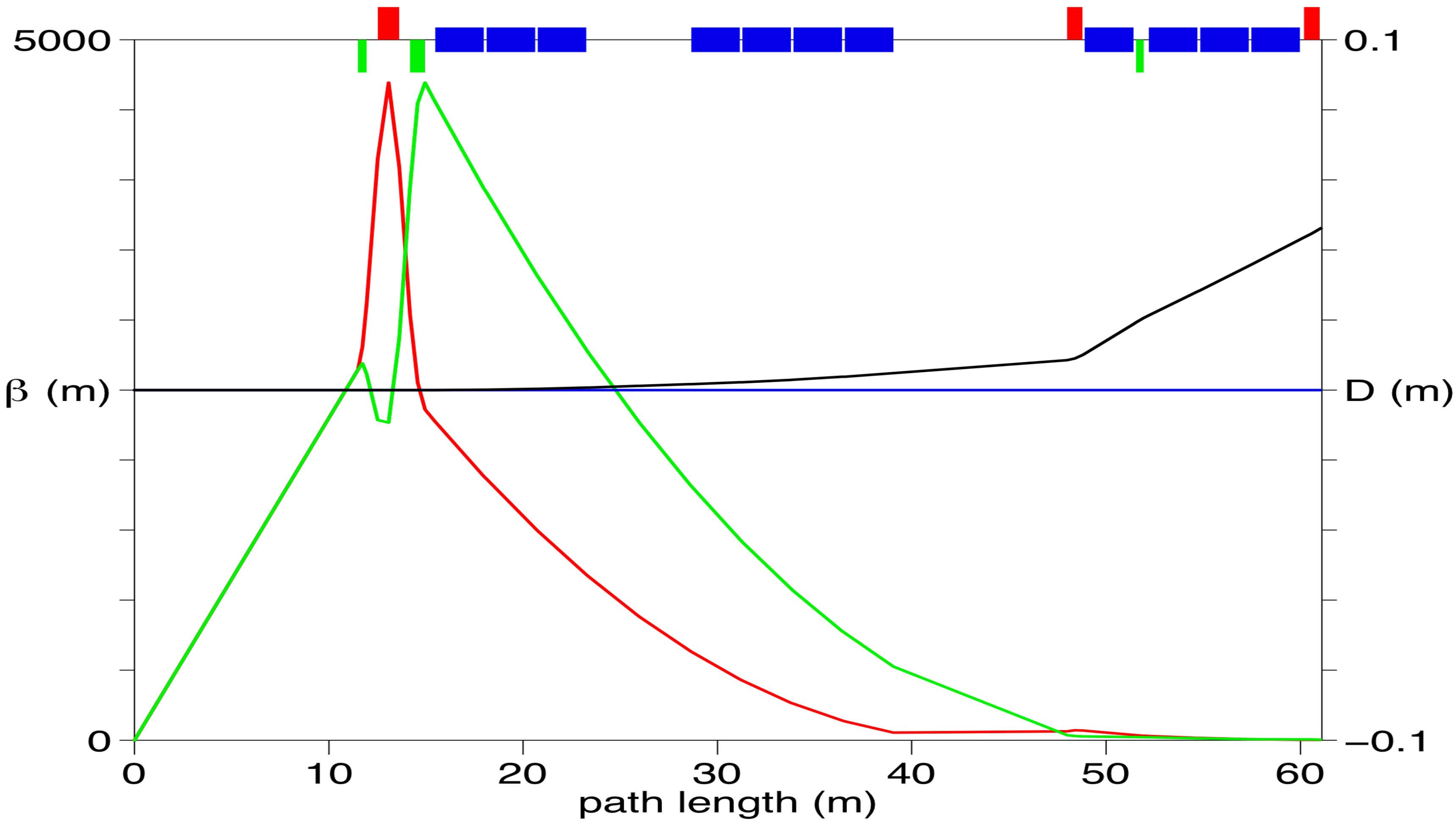
Final Energy e Vertical Beamline Matched to IP

4 basic cells (2 bending up, 2 bending down) bring beam down 60cm over 55m



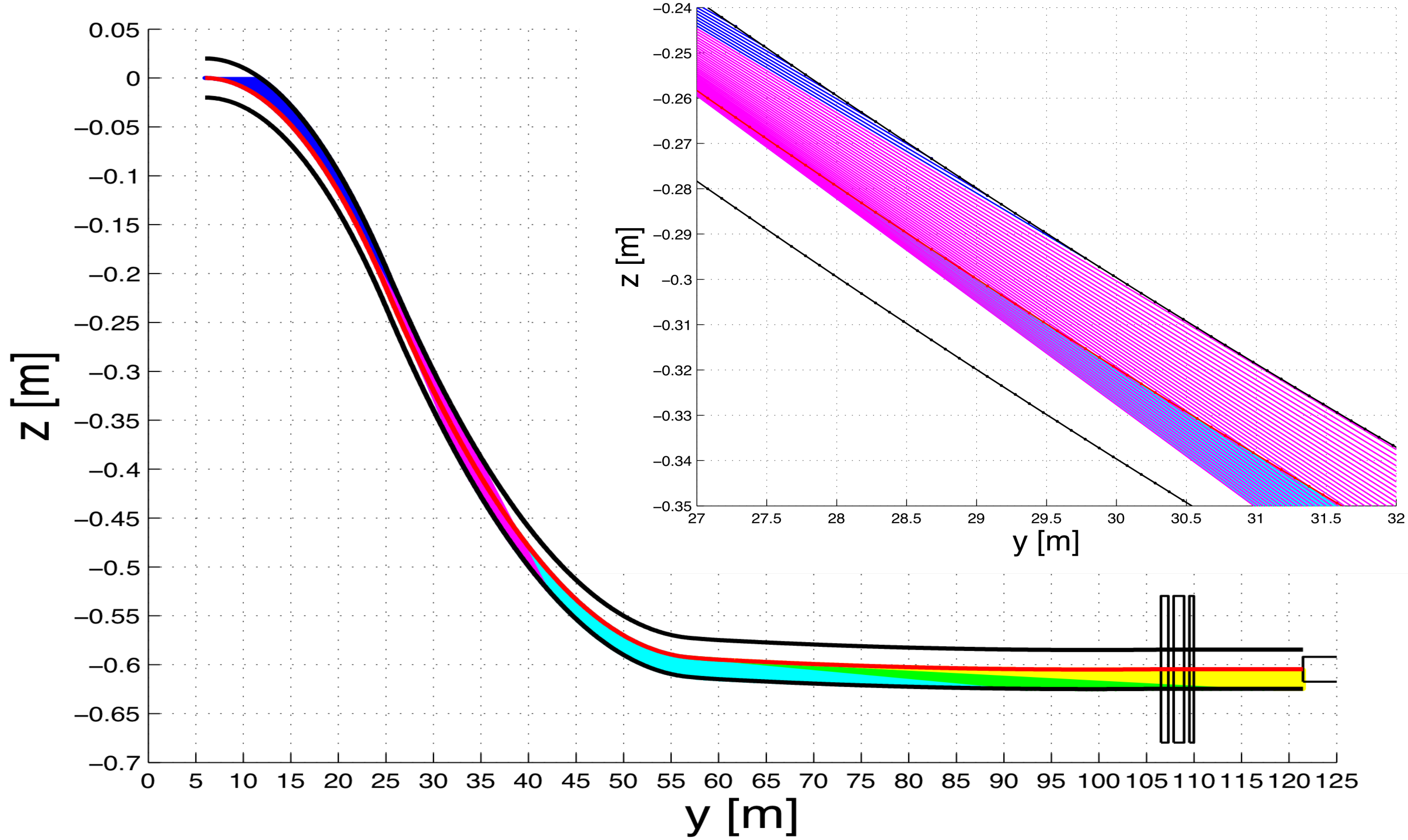
eRHIC IP to Arc Beamline (vertical)

mid & soft bending cleans SR at the detector



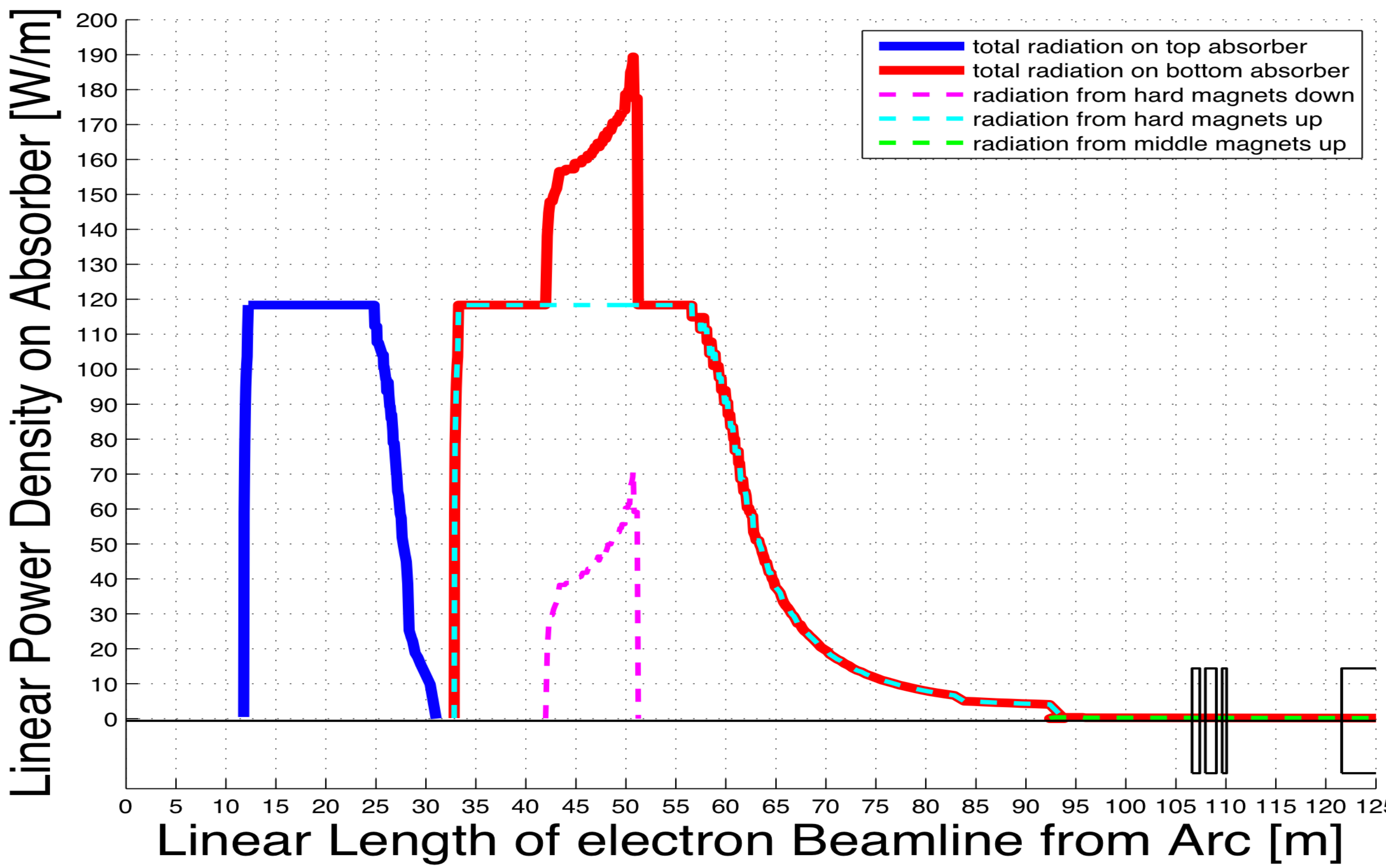
Direct Synchrotron Radiation onto Absorbers

The electron beam line from arc to IP

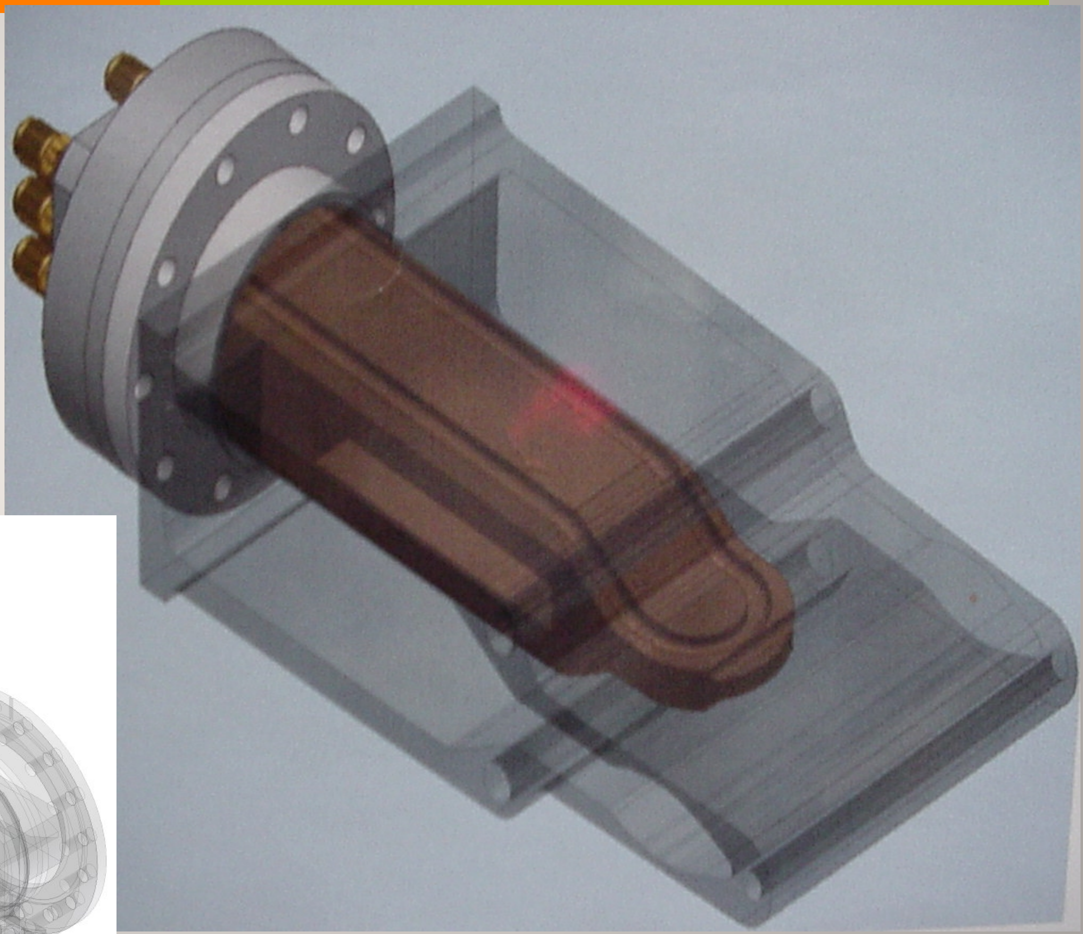


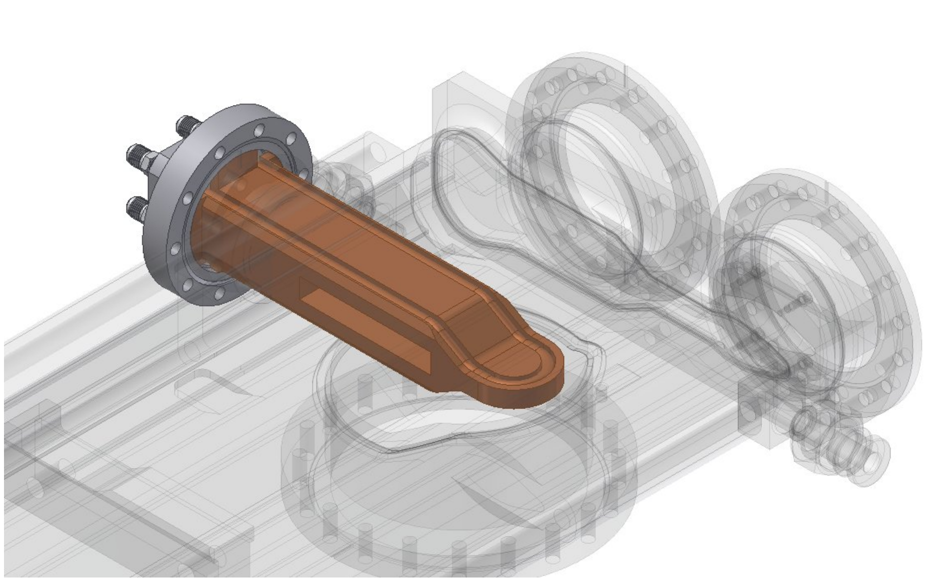
Linear SR Power Density onto Absorbers

The electron beam line from arc to IP



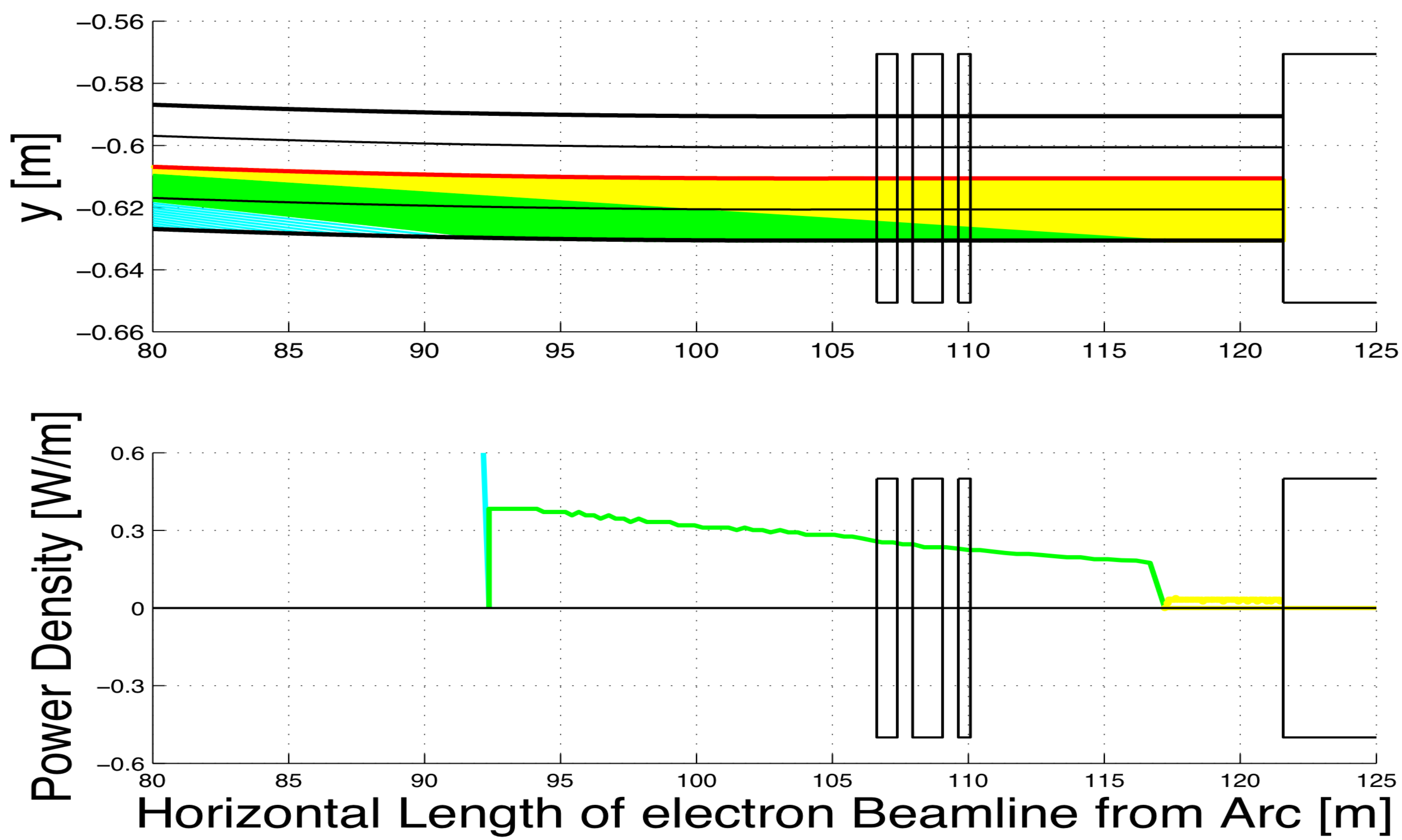
Vacuum Chamber with Integrated Absorber





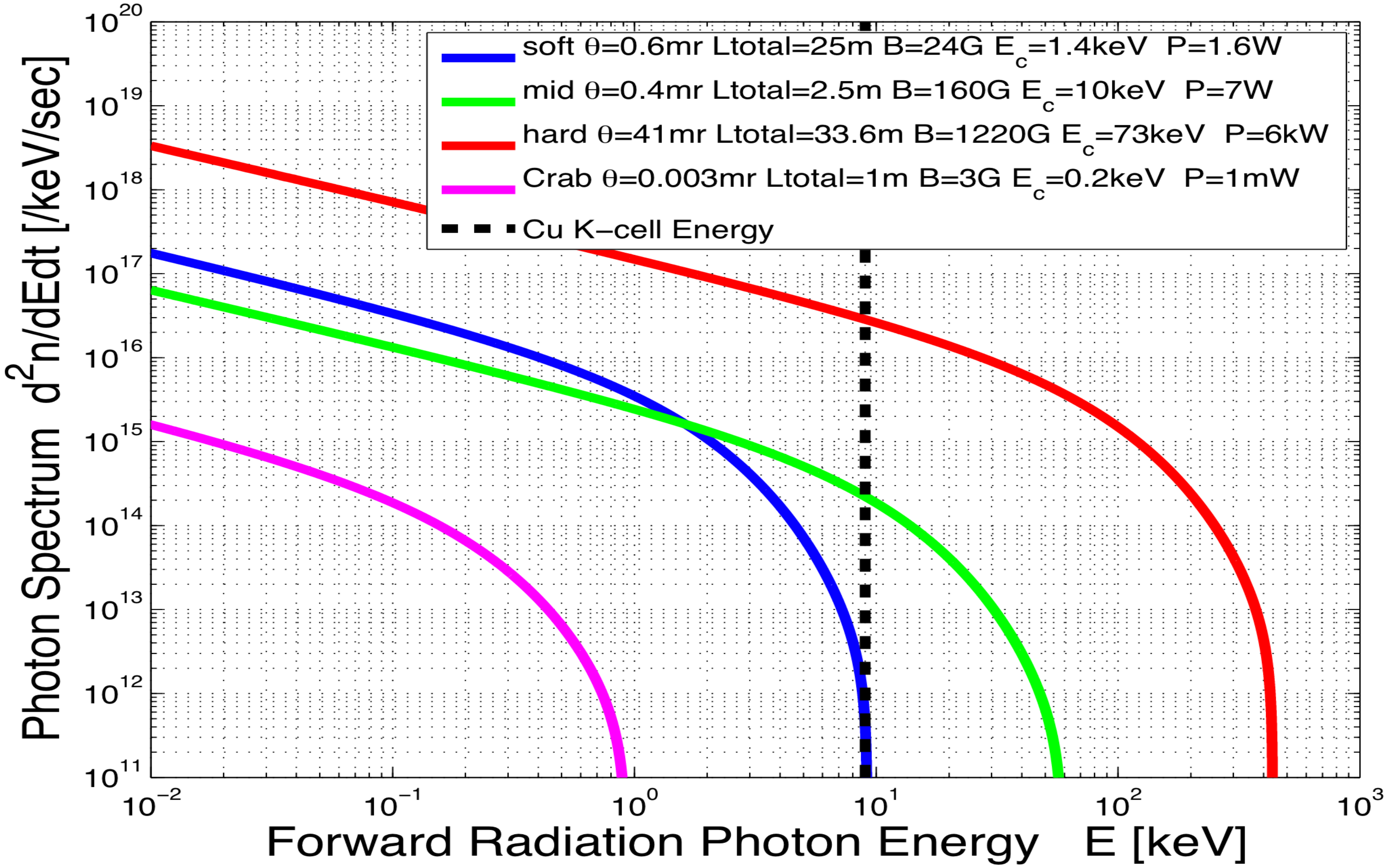
Synchrotron Radiation & Linear SR Power Density

The electron beam line 40m from IP



Direct Synchrotron Radiation from Vertical Bending

hard bending brings beam in, mid & soft cleans SR at the detector



Direct Synchrotron Radiation from Vertical Bending

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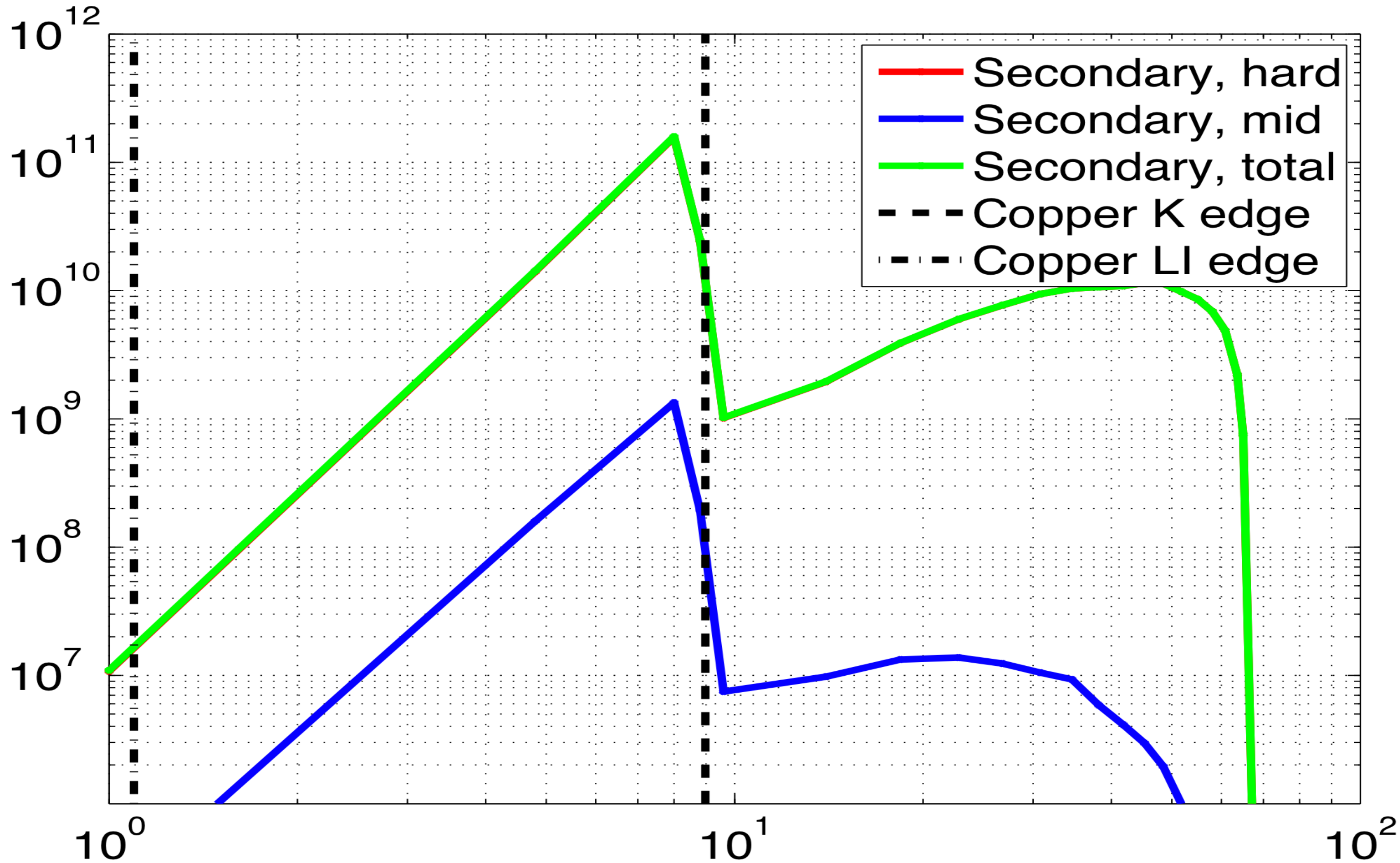


Conclusion and Discussion

1. Needs 25m/65m integrated absorber above/bellow the electron beam line on both side of the IP.

2. The absorber needs to hold max. 200W/m load.

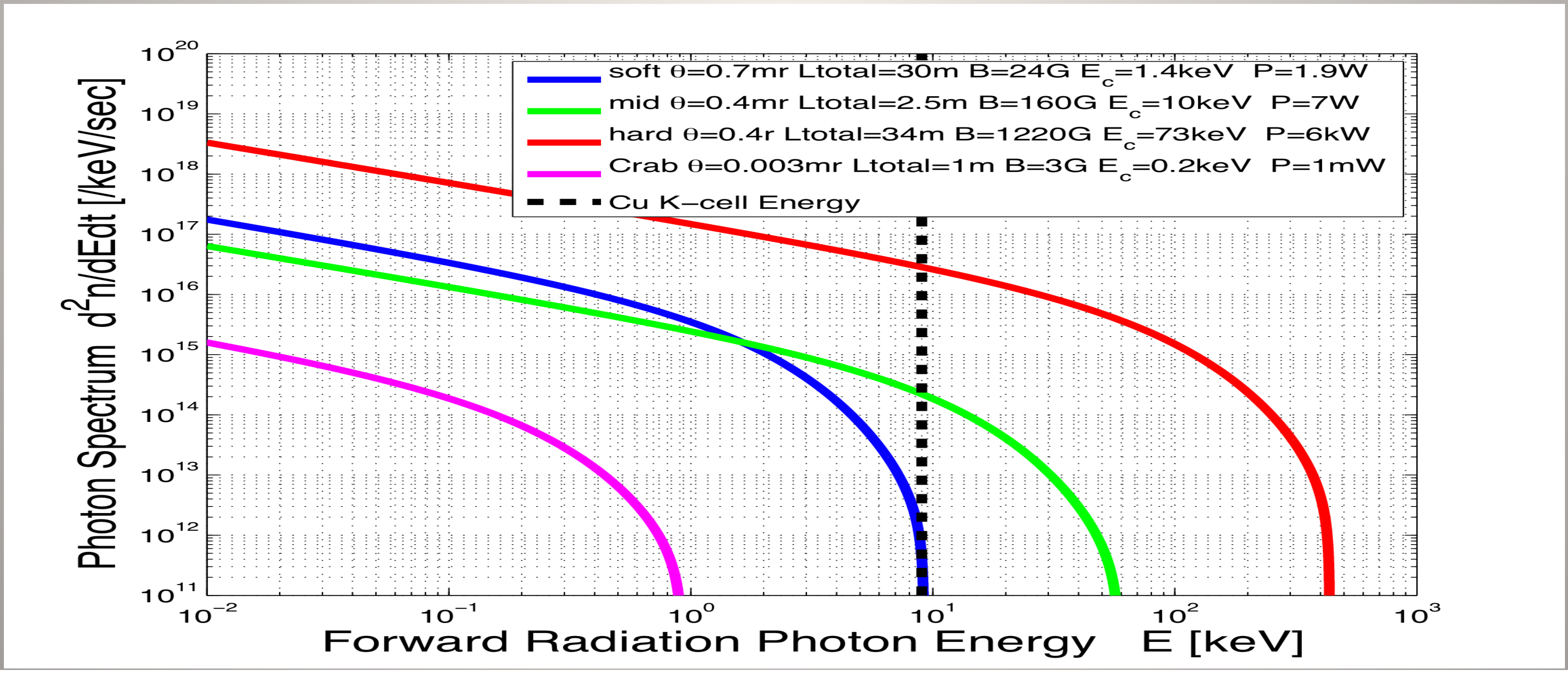
3. If water cooling is not required, it is better to make the absorber movable, so the absorber can double as collimator.

4. Detector background:

From soft bending: few KeV, 10^16/keV/sec
From secondary: 10keV, 10^11
From secondary:100keV 10^10
From crab cavaty: 0.2keV, 10^14

Synchrotron Radiation from Crab Cavity

Parameters	Unit	Jlab	BNL
Electron Energy	GeV	7.5	30
Tilt Angle	mrad	50	5
Cavity Length	m	4	1
Benging Angle	mrad	100~200	0.003



eRHIC IR Design Principle

IR design based on:

Present technology of the superconducting magnets D=90 or 120 mm

Layout made by interaction with experiments ?

Ion beam cooling

Present RHIC operating conditions

Using the crab cavities for ions – 10 mrad angle

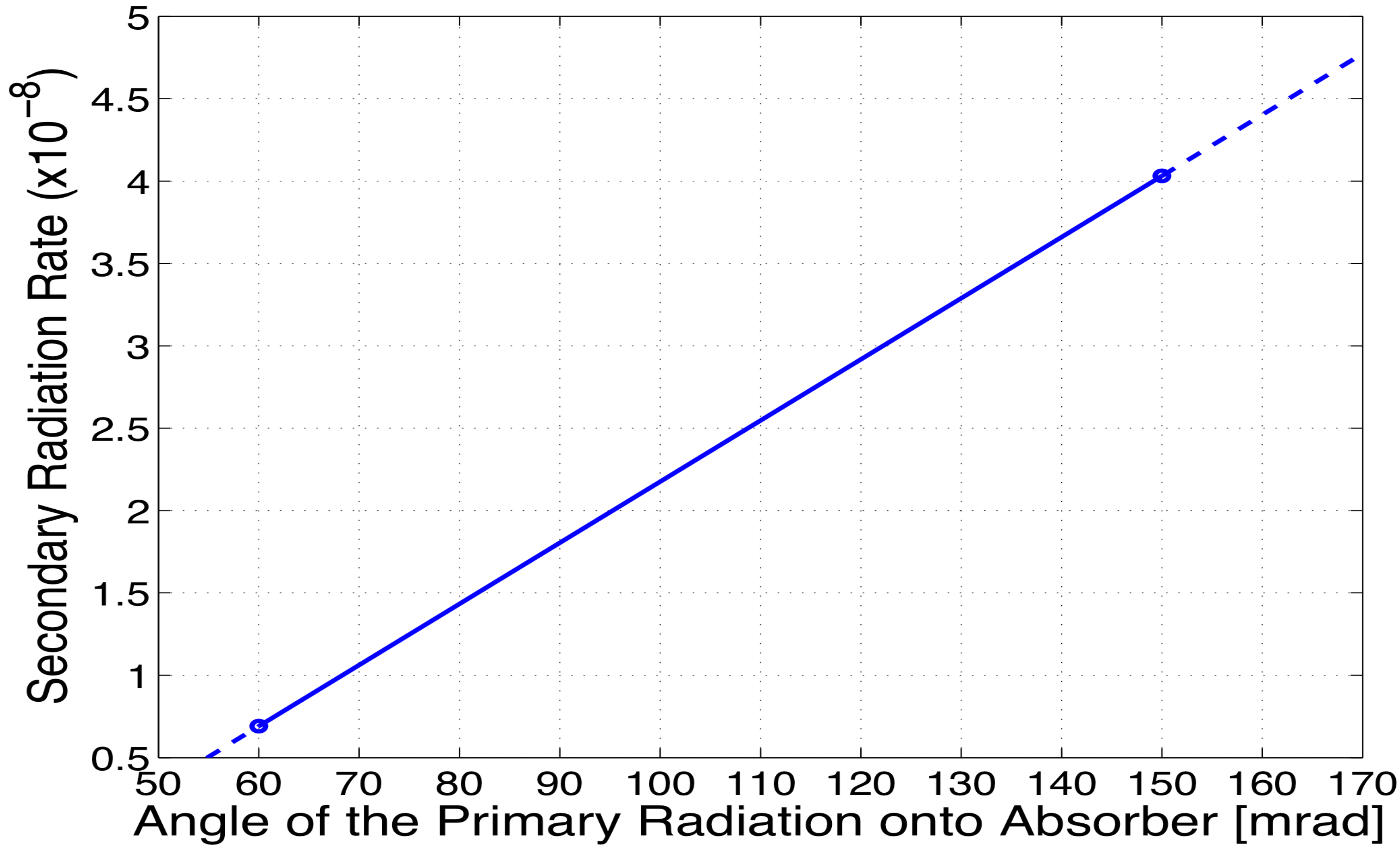
IR designs for the luminosity of ~10^{34} cm^{-2} s^{-1}

β^* = 5 cm and β^* = 7 cm : designs are done by keeping the maximum of β functions in triplets equal to the existing RHIC lattice

β^* = 5 cm - raised β functions in triplets from β_{max}=1800 m -> 2960 m ->β_{max}= 4294 m.

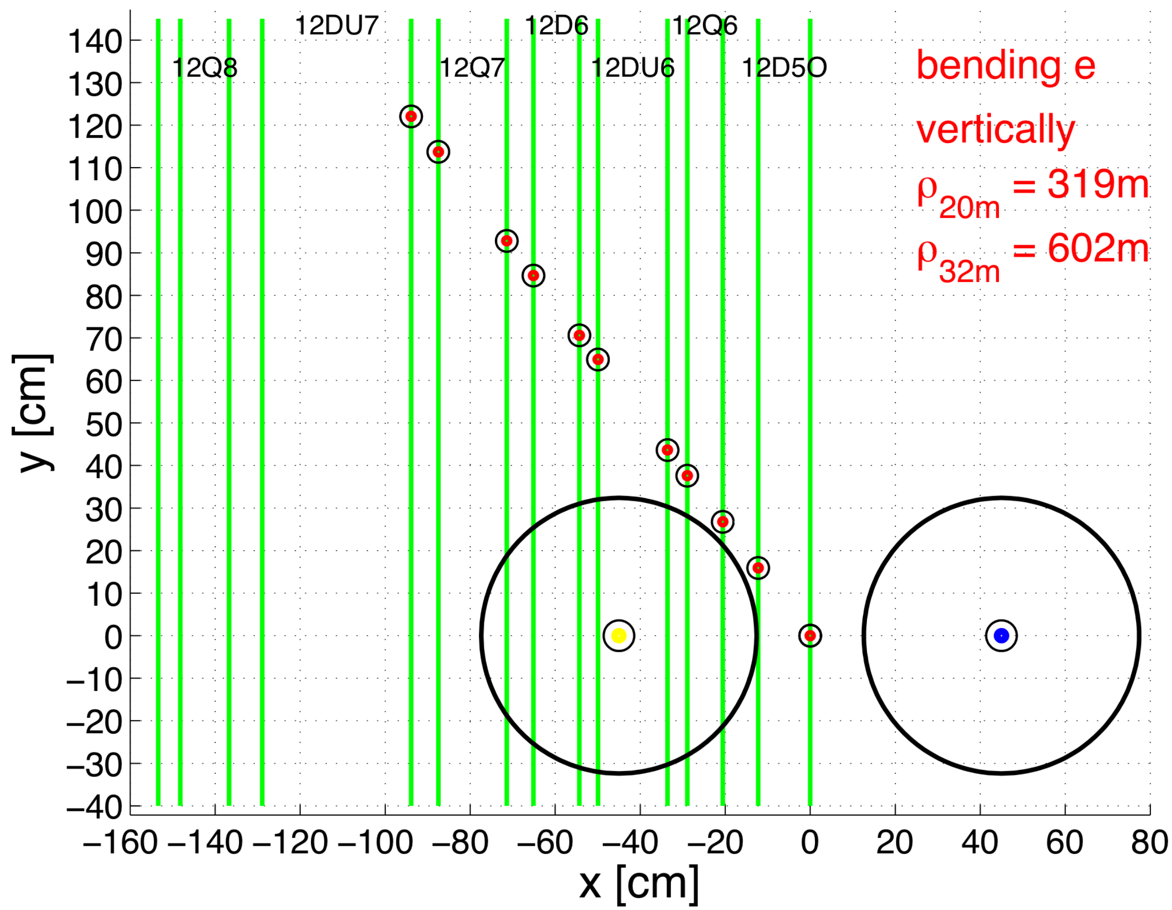
Chromatic correction – arc + local sextupoles in the IP

Secondary Radiation Rate vs Angle of the Primary Radiation into Copper Absorber



Option b (vertical bending)

Cryo stats clearance requirement based on the engineer drawing



1. Reviewing from the detector in IR8 onto IR10 along RHIC beam lines;
2. Reference coordinates is on the RHIC beam line which curves to the right starting from 8D5;
3. If e beam left unbent, its x position shifts to the left and hits Yellow ring cryo stats at the end of 8D5.

Synchrotron Radiation Control in eRHIC IR

1. There are no strong bending magnets within 70m from eRHIC detector in the current eRHIC interaction region design. It ensures that there are no radiation sources near the detector.

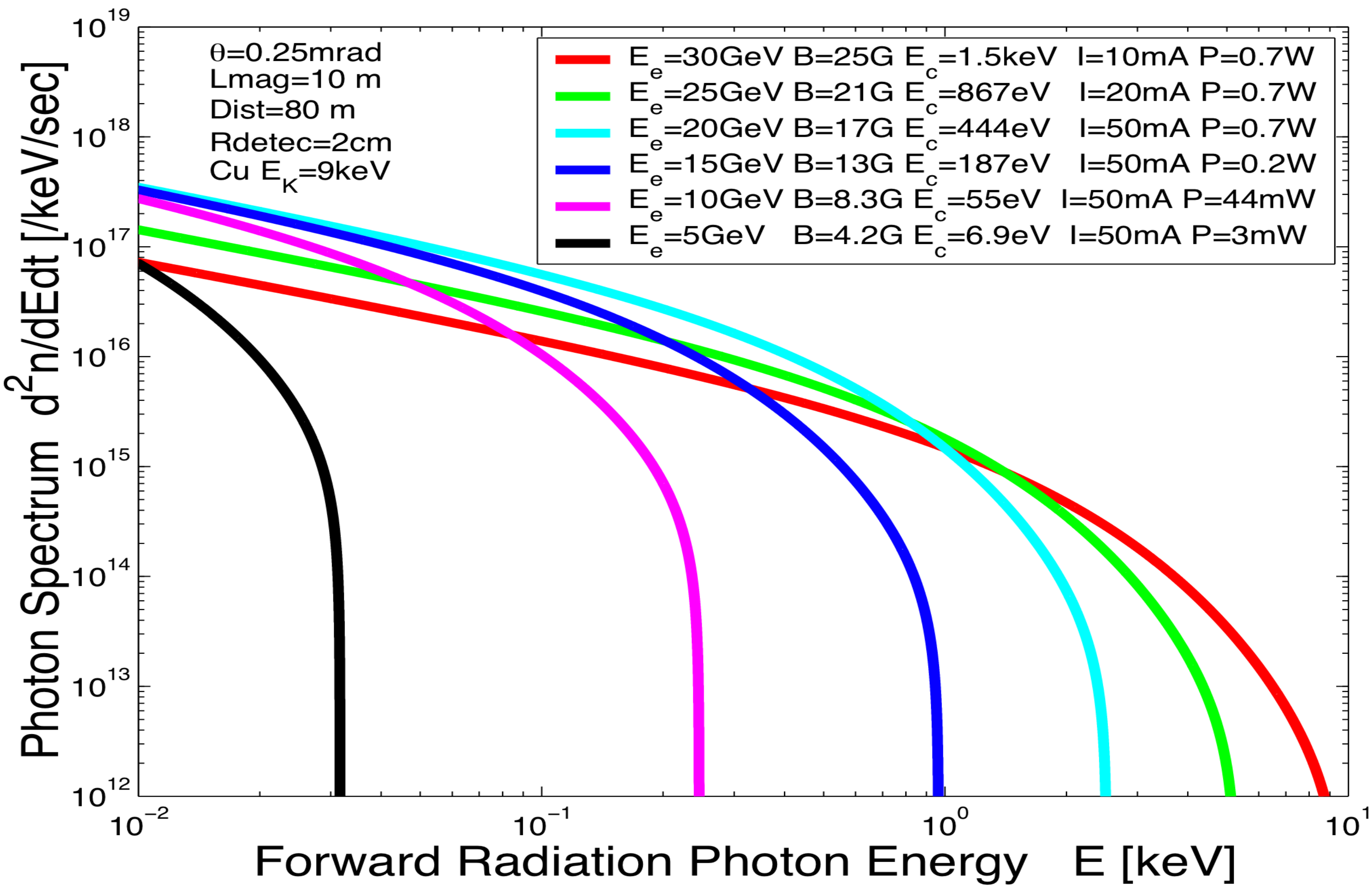
2. The forward radiation from the up stream hard bend is completely masked. No hard radiation passes through the detector;

3. Soft bend on both side of the detector. The forward radiation from the up stream soft bend pass through the detector.

4. The secondary backward radiation induced by the forward radiation generated in down stream bends is largely masked from the detector;

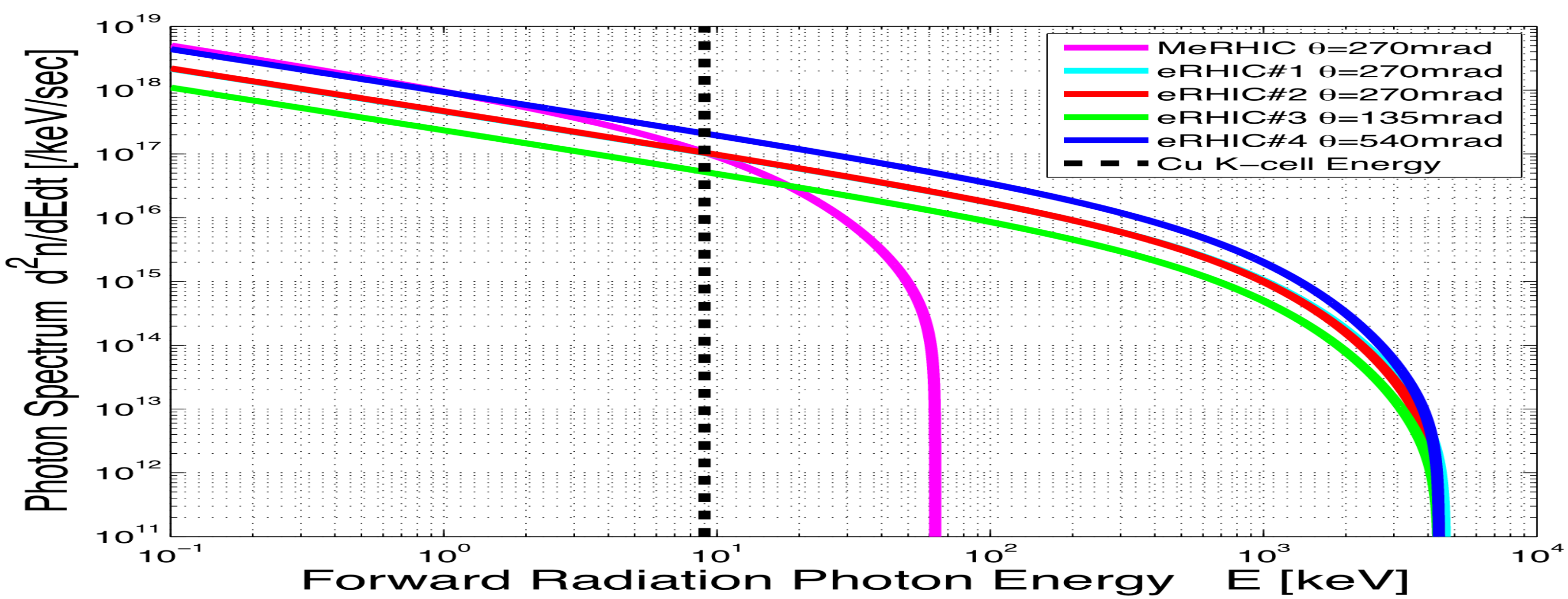
Direct Synchrotron Radiation from Soft Bend

(this part of direct radiation + some indirect radiation will get into eRHIC detector)



Outgoing electron Dipole Design

DS Magnet	e Energy (GeV)	B Field (T)	Length (m)	Total Mag	total Lmag (m)	total Ang (mrad)	Critical E (keV)	SR Power (kW)
MeRHIC	4	1.2	3	1	3	270	13	4
eRHIC case 1	30	1.287	3	7	21	270	770	395
eRHIC case 2	30	1.227	2.75	8	22	270	735	377
eRHIC case 3	30	1.227	2.75	4	11	135	735	189
eRHIC case 4	30	1.227	2.75	16	44	540	735	754



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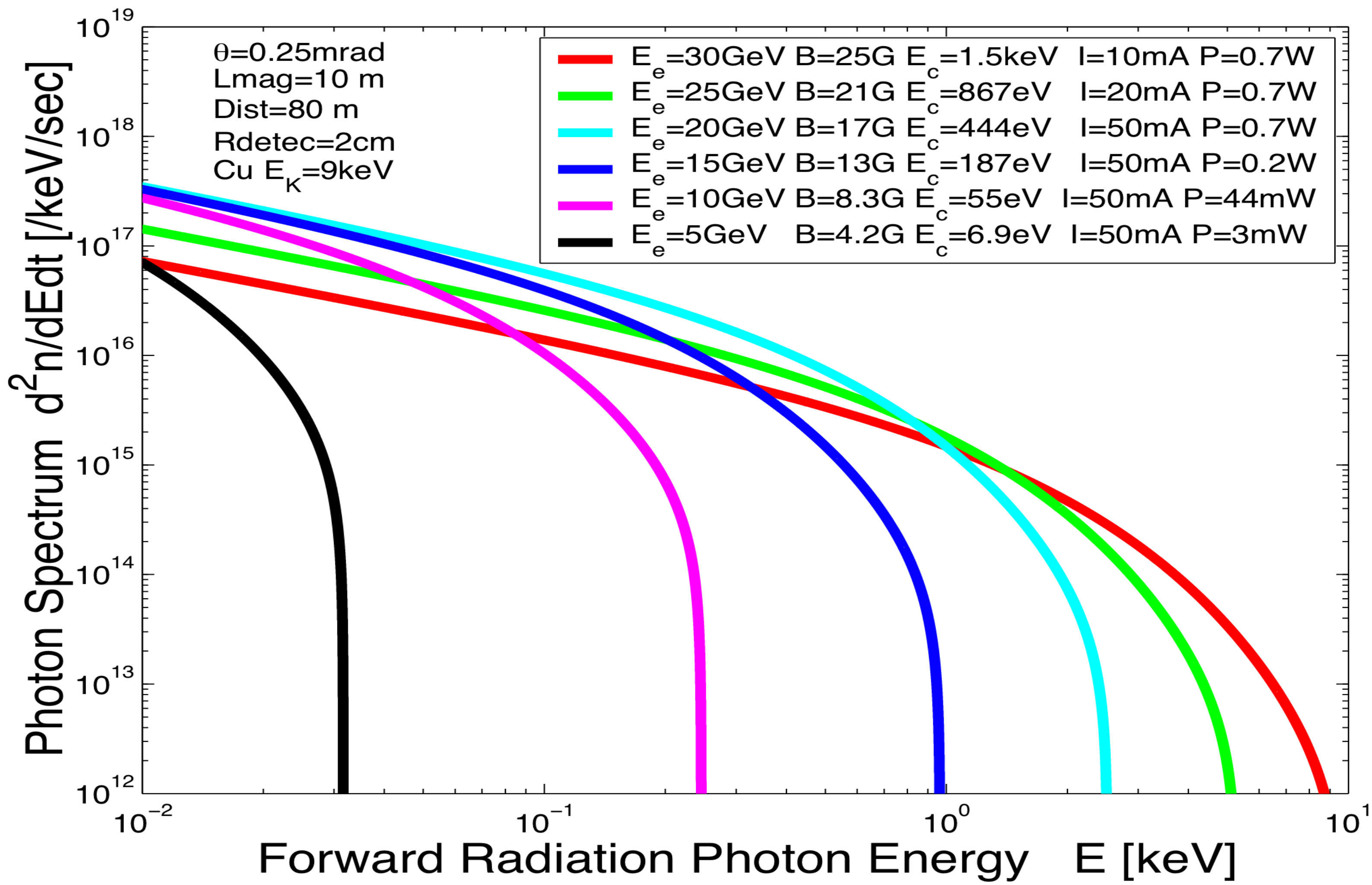

Summary and Status

1. There are no strong bending magnets within 70m from eRHIC detector in the current eRHIC interaction region design. It ensures that there are no radiation sources near the detector.

2. The design options of final energy electron beam line are identified and investigated. The current design concept appears to meets both engineering challenge and radiation control requirements.

3. The radiation from the splitter/merger is estimated based on the current design. The improved design is been developed which will reduce the radiation level to an acceptable level.

4. The possible radiation sources into IR are identified and their direct radiation levels are calculated.

5. The GEANT simulation is in progress to estimate the secondary radiation into the detector and the heat load on the elements.

6. There appear to be no show stopper in eRHIC IR radiation control.