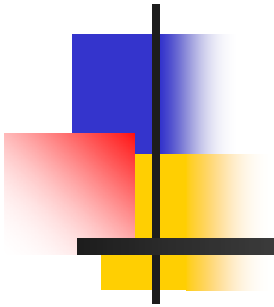
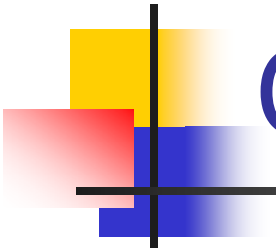


Size of Central Beam Pipe
LHeC Ring-ring IR

Uwe Schneekloth
DESY

LHeC Mtg
2.02.2010



Outline

- First look at synchrotron radiation shielding, collimators and size of central beam pipe
- Ring-ring, high luminosity, 10^{o} detector acceptance IR

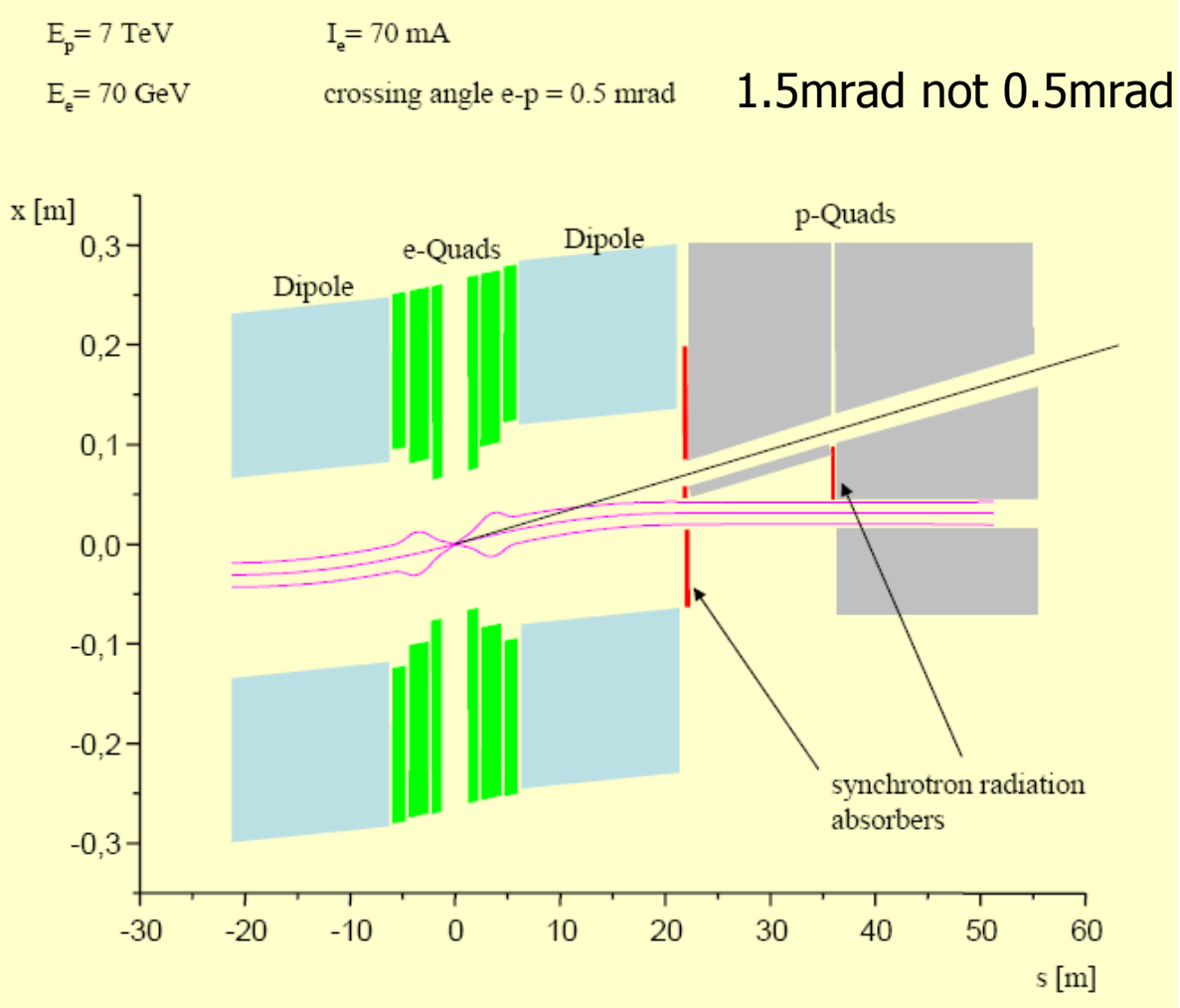
- Input
  - Simulation of synchrotron radiation B.Nagorny
  - Beam orbits and envelopes from B.Holzer

- Warning:
  - Still some inconsistency (direct SR fan)
  - Collimator and central beam pipe dimensions may change

Synchrotron Radiation

B. Nagorny

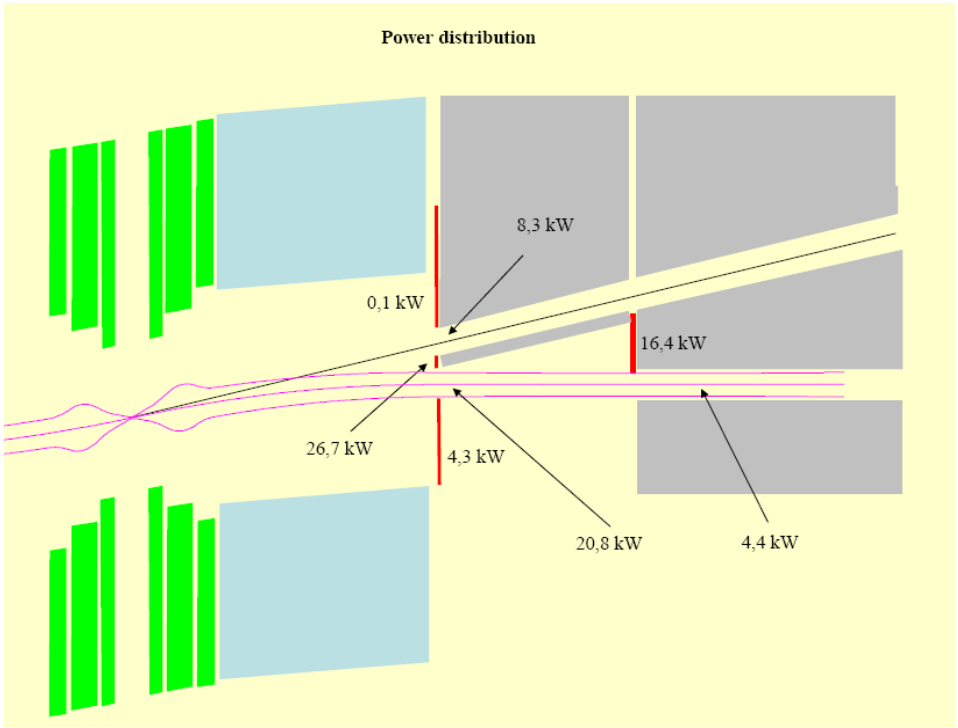
Topview of IR



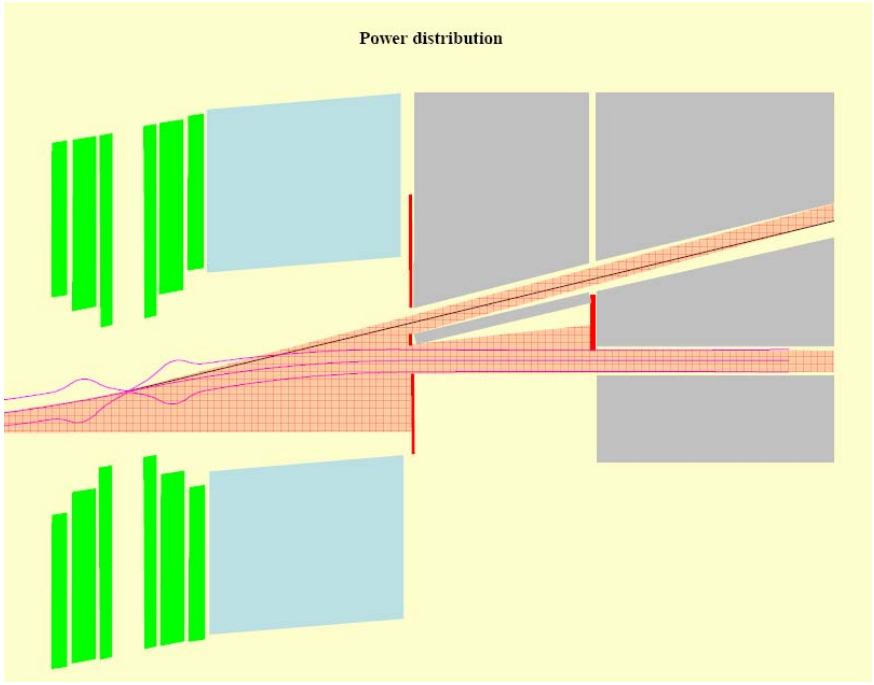
Synchrotron Radiation

Synchrotron radiation power

B. Nagorny



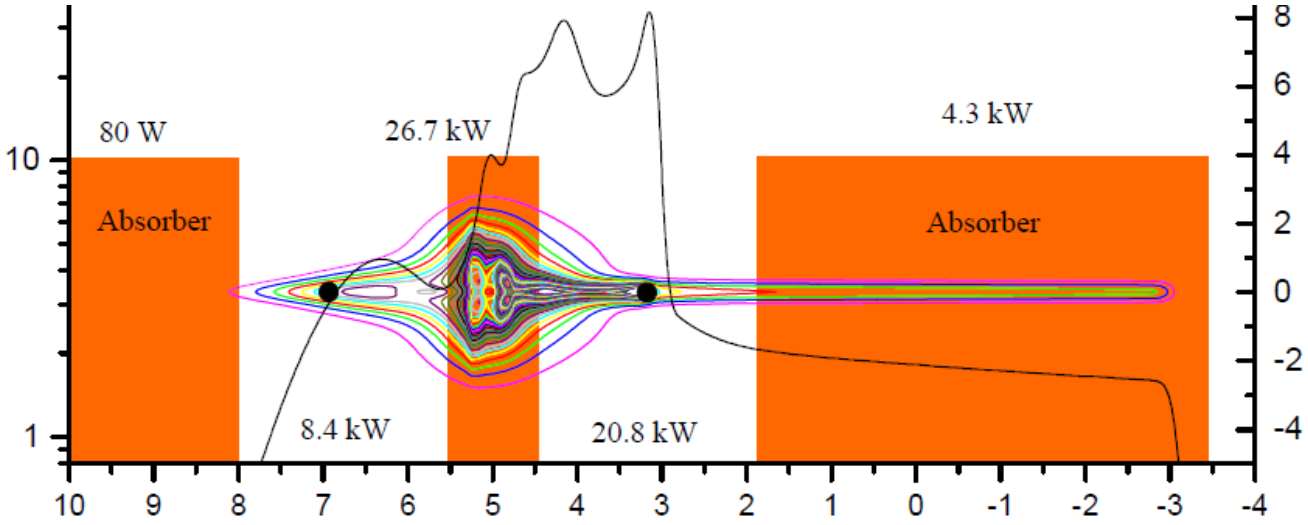
Location of absorbers

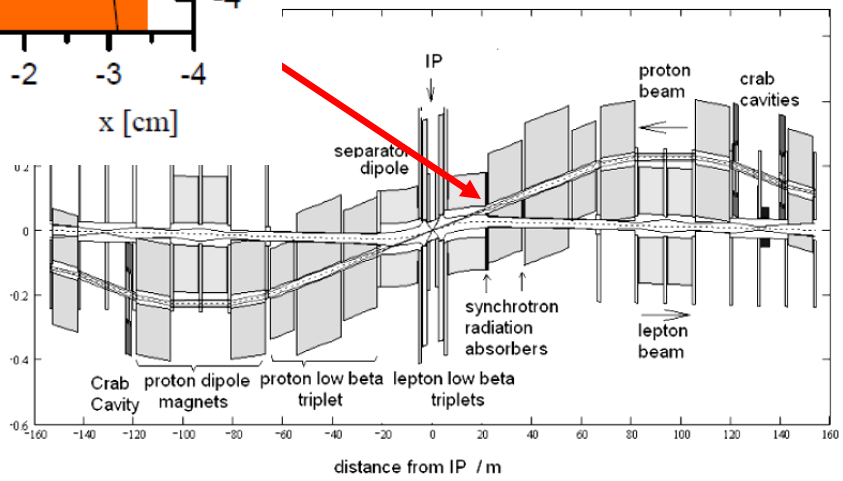


Synchrotron Radiation

2D distribution of synchrotron radiation at absorber B.Nagorny

power (kW/cm^2)





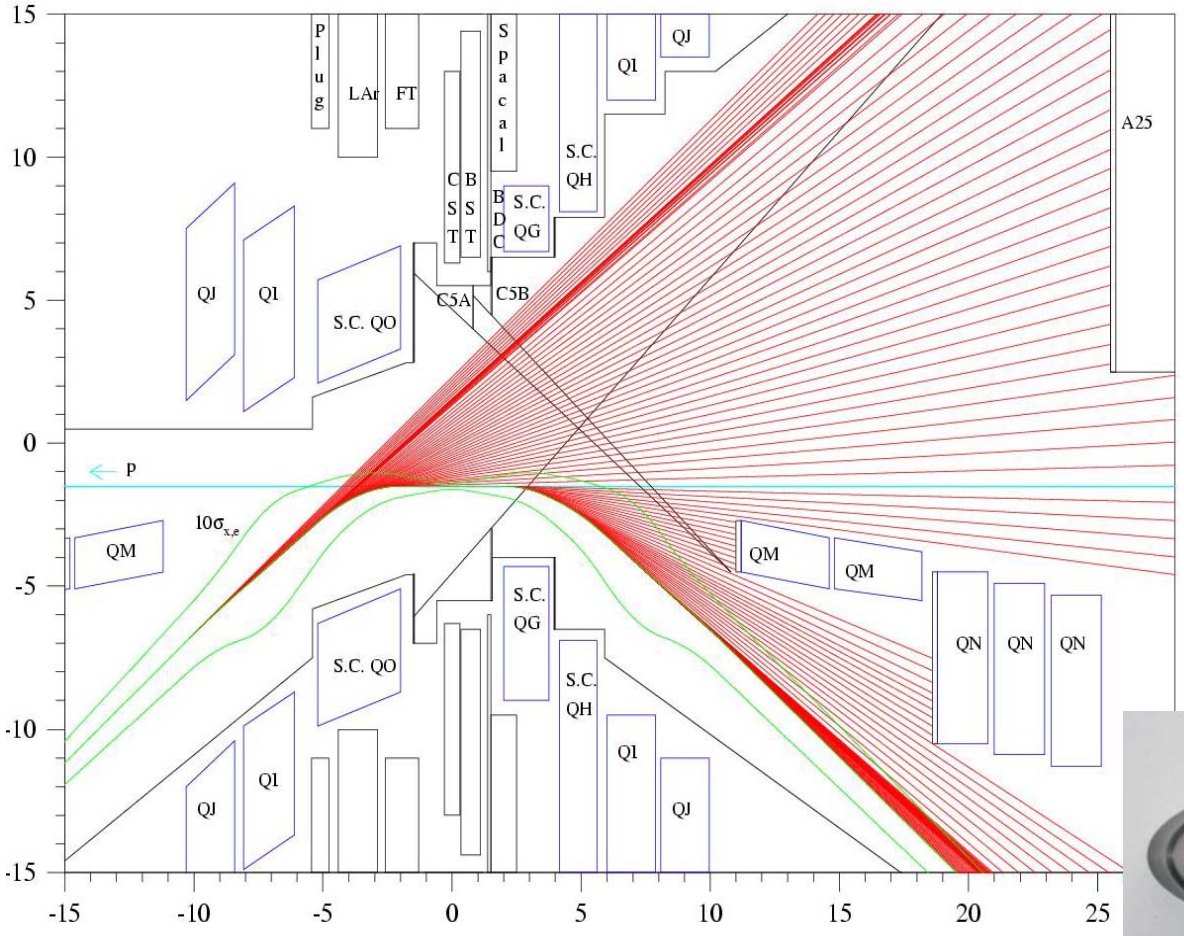
Synchrotron Radiation in IR

- Beam separation very close to IP, starting at 1.2m
- Upstream collimation and partial absorption of synchrotron radiation not possible
- Direct synchrotron radiation must pass through IR
- Most SR absorbed by absorber at 21m
- Must protect detector from SR backscattered from absorber at 21m by downstream collimators
  - No space for moveable collimators
  - Collimators inside central detector, not accessible

  → use fixed collimators
- Size of central beam pipe determined by backscattered SR

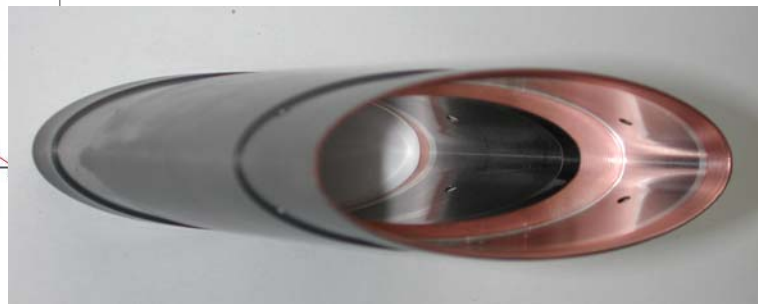
HERA II IR

Topview of HERA II IR

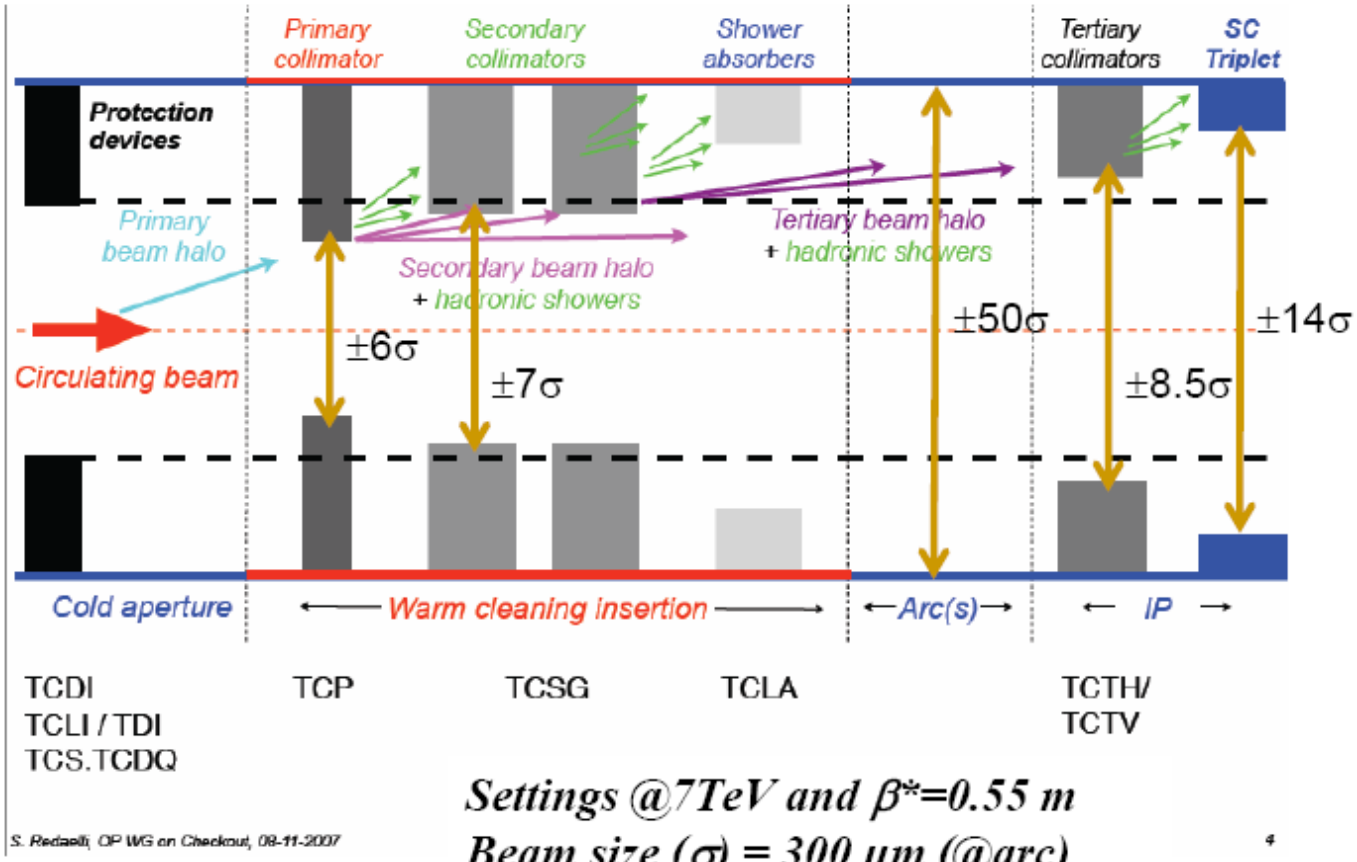


- Direct SR passing through IR
- Detector protected from backscattered SR by downstream collimators
- Central beam pipe size determined by backscattered SR

Collimator at 0.8m with integrated shielding



LHC Apertures

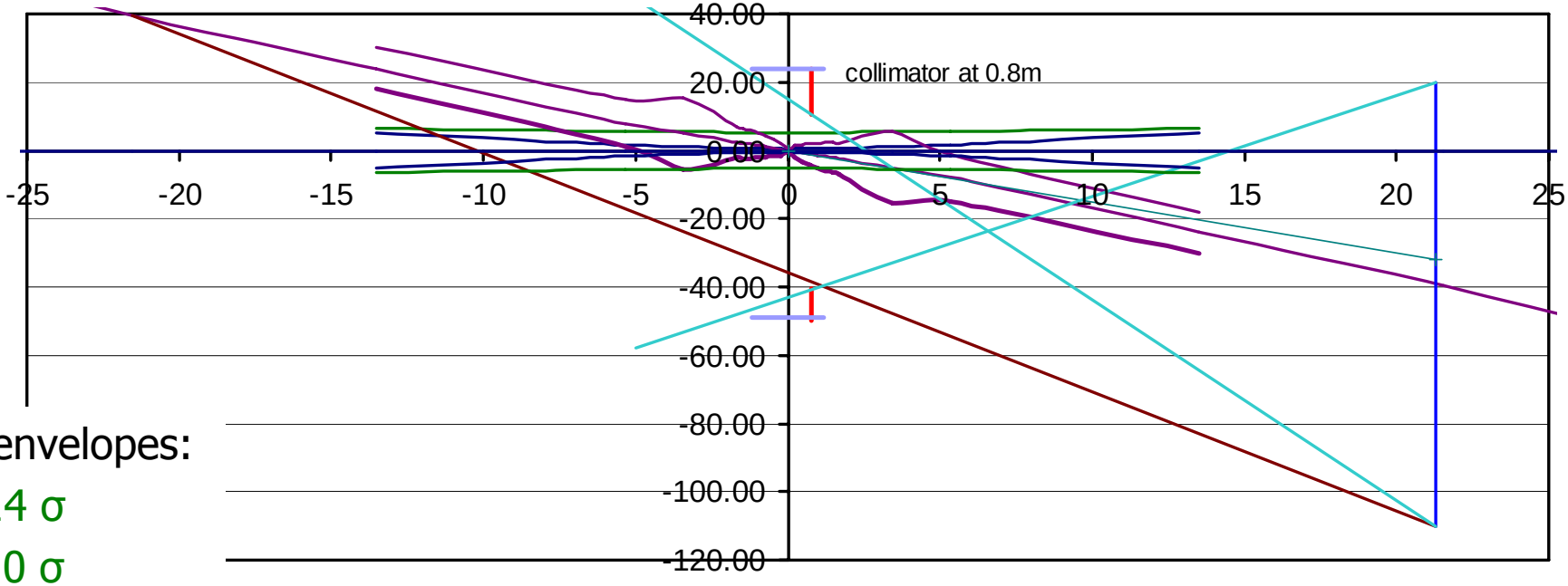


Settings @7TeV and β=0.55 m*
Beam size (σ) = 300 μm (@arc)
Beam size (σ) = 17 μm (@IR1, IR5)

Lesson for SR collimators

Aperture > ±14σ

IR Sketch Top-view

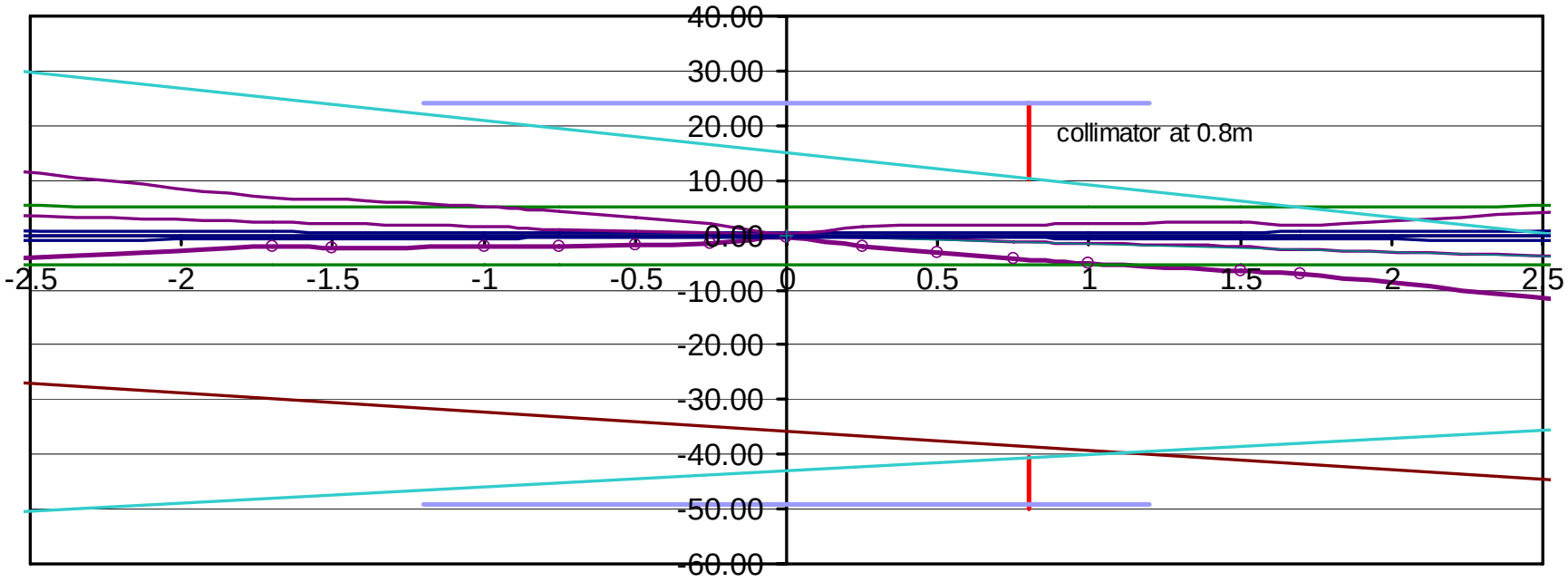


Beam envelopes:

- p 14 σ
- e 10 σ

- Distance of collimator 14sigma + 5mm from proton orbit at injection (ring outside)
- Distance of collimator 2 mm from direct SR fan (ring inside)

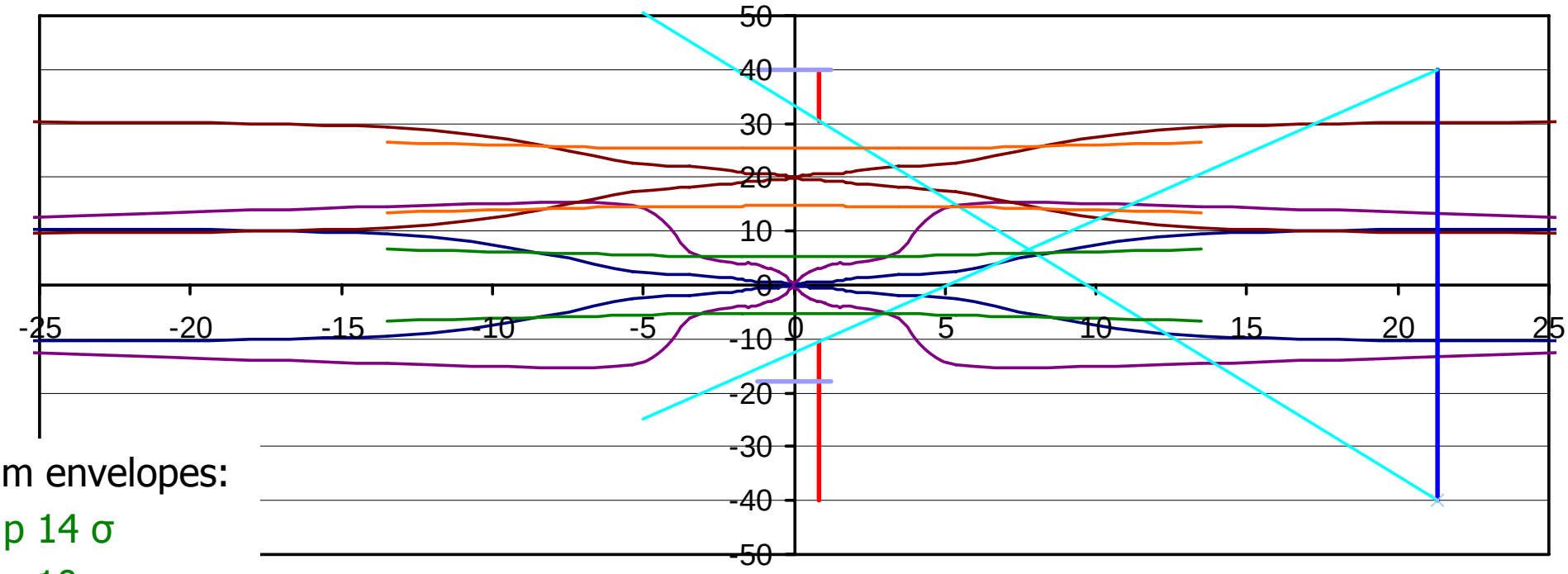
IR Sketch Top-view - Zoom



- Horizontal distance of collimator from proton beam 10.5mm
- Minimum width of central beam pipe 73mm
  - Horizontal distance to proton beam 24mm ring outside, 49mm ring inside

Direct synchrotron radiation fan to be checked

IR Sketch Side-view

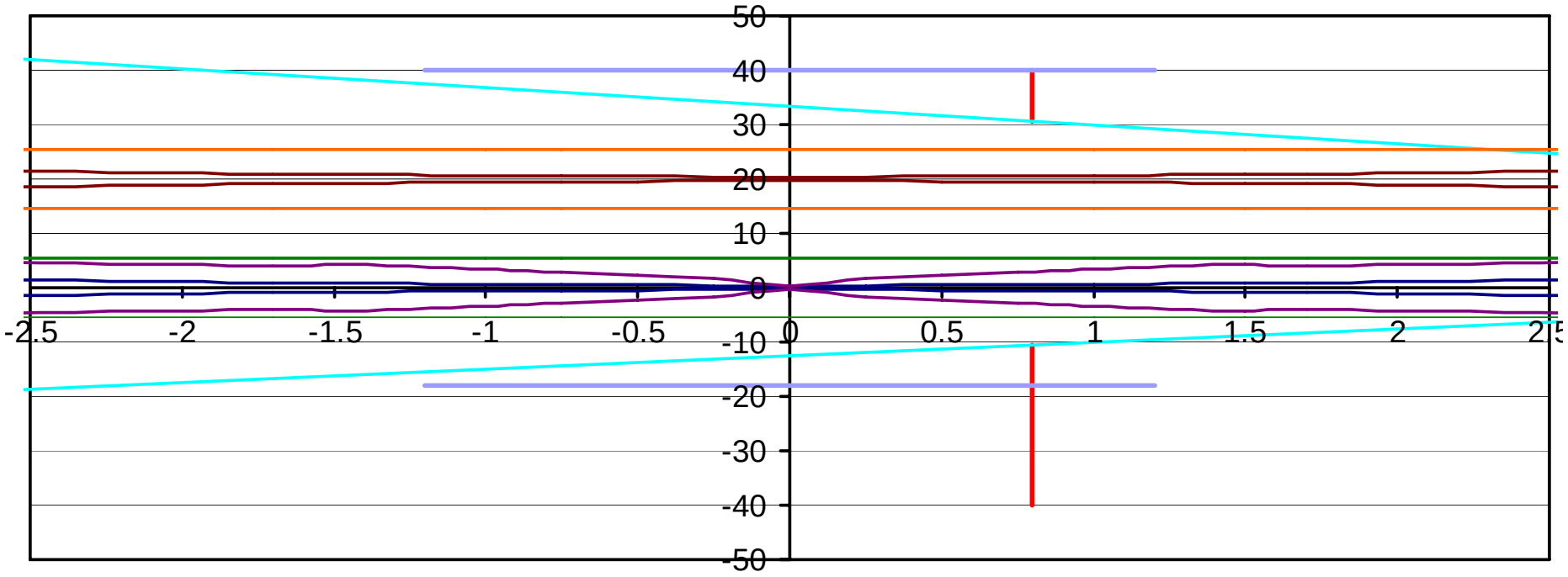


Beam envelopes:

- p 14 σ
- e 10 σ

- Second proton beam vertically off set by 20mm
- Distance of collimator 14sigma + 5mm from proton orbit at injection

IR Sketch Sideview - Zoom



- Vertical distance of collimator from proton beams 10.5mm
- Minimum height of central beam pipe 58mm
  - Vertical distance to colliding proton beam 18mm down, 40mm top

To be done

- Is optics and orbit of 2nd proton beam correct?
  - Where are proton beams separated?
  - 2nd proton beam will go off center through quadrupole magnets!
- Is beam clearance sufficient: 14 and 10 σ?
  - Quite close to proton beams
  - Eventually have to check proton background in detector (beam gas and proton halo). Not for CDR.
- Have to calculated 'n_1' parameter for all cases:
  - Injection, luminosity. Not high beta optics.
- Need scaled electron aperture for injection
  - Oscillations at injection
- Have to calculated power of backscattered synchrotron radiation (V. Andreev)
  - Estimate number of photons hitting detector
  - Estimate power hitting vacuum chambers (beam screen) of superconducting magnets
- Should add second collimator 1 to 1.2m from IP
- In principle, have to include electron orbit offsets and tilts in simulation of direct SR (not for CDR)