IR Beamline and Sync Radiation

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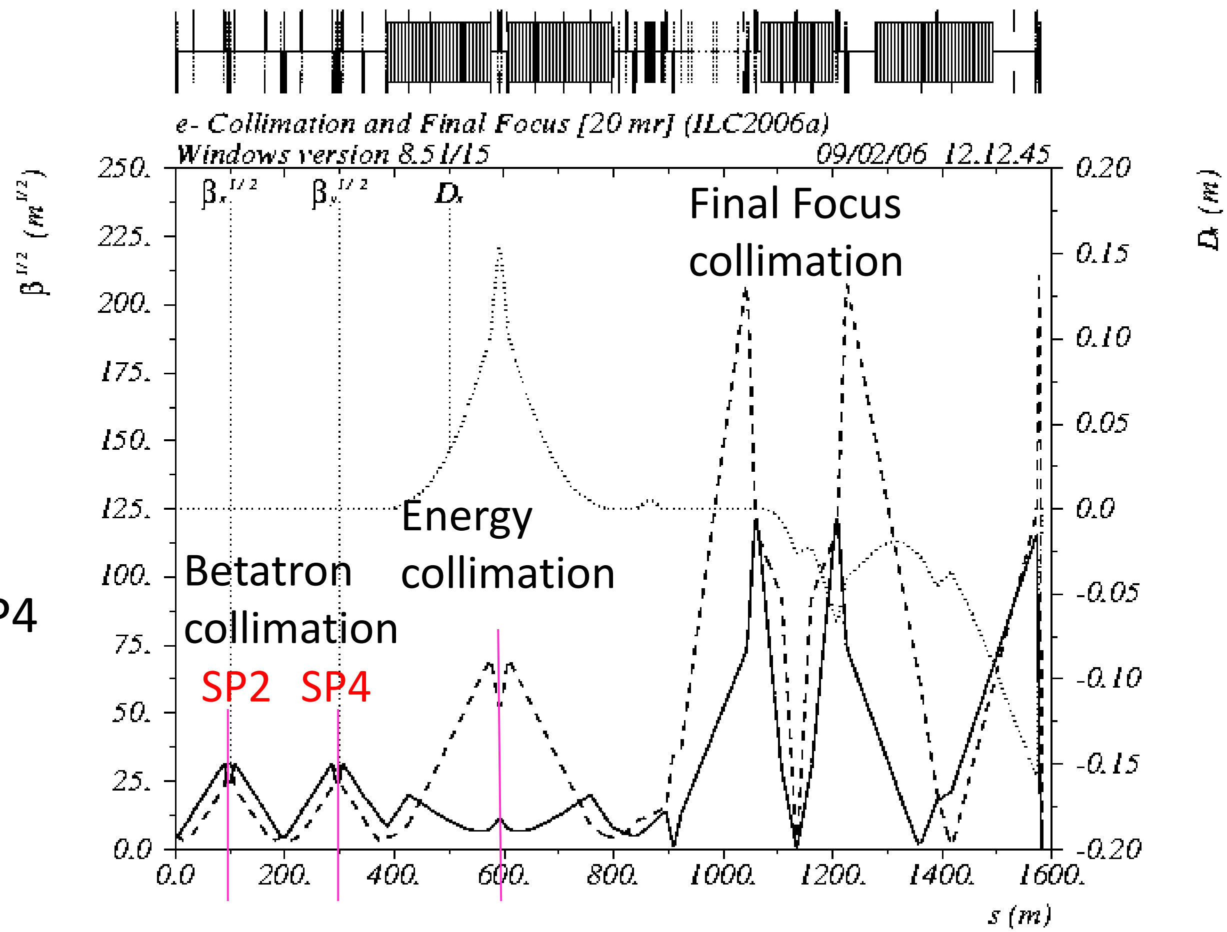
Collimation

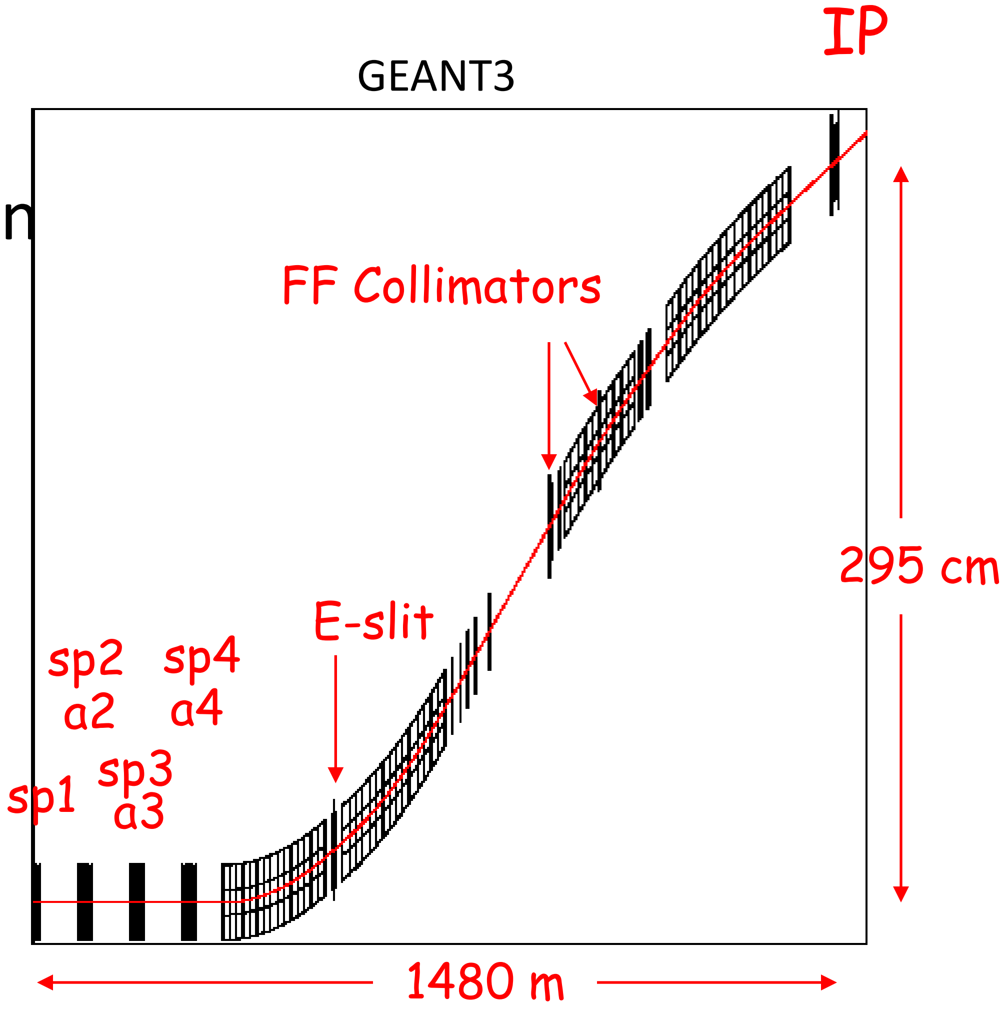
- No beam loss within 400 m of IP
- Muon background can be acceptable.
- No sync radiations directly hitting the detector

- Spoilers SP2 and SP4 are set at the collimation depth.

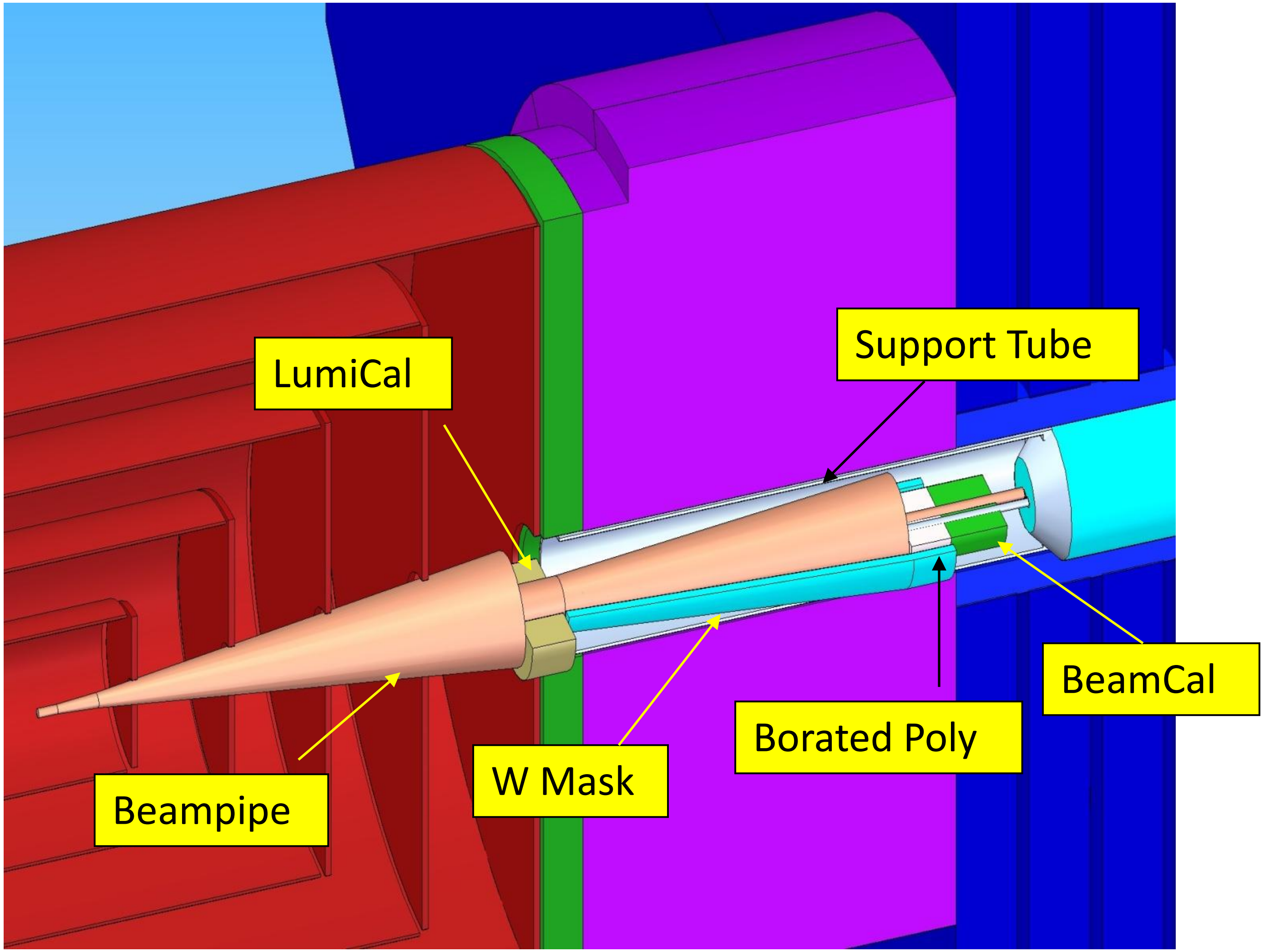


Collimation studies

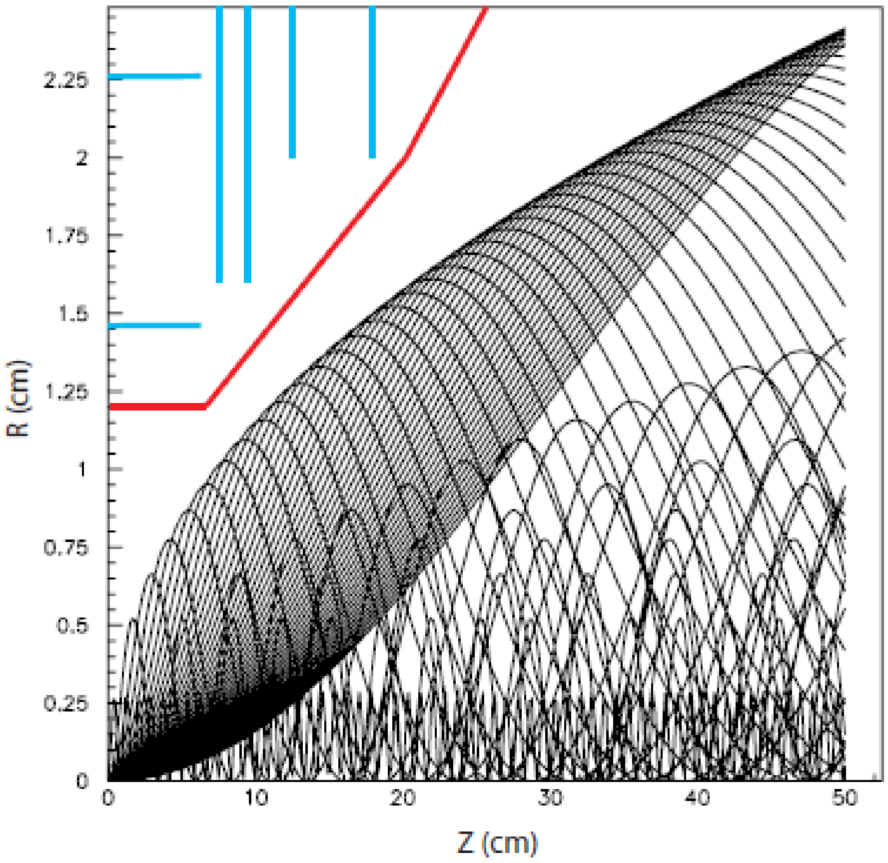
- Particle tracking and interaction simulation
  - Decay TURTLE
  - STRUCT
  - GEANT3
  - GEANT4
  - MuCarlo
  - MARS



SiD Forward Region



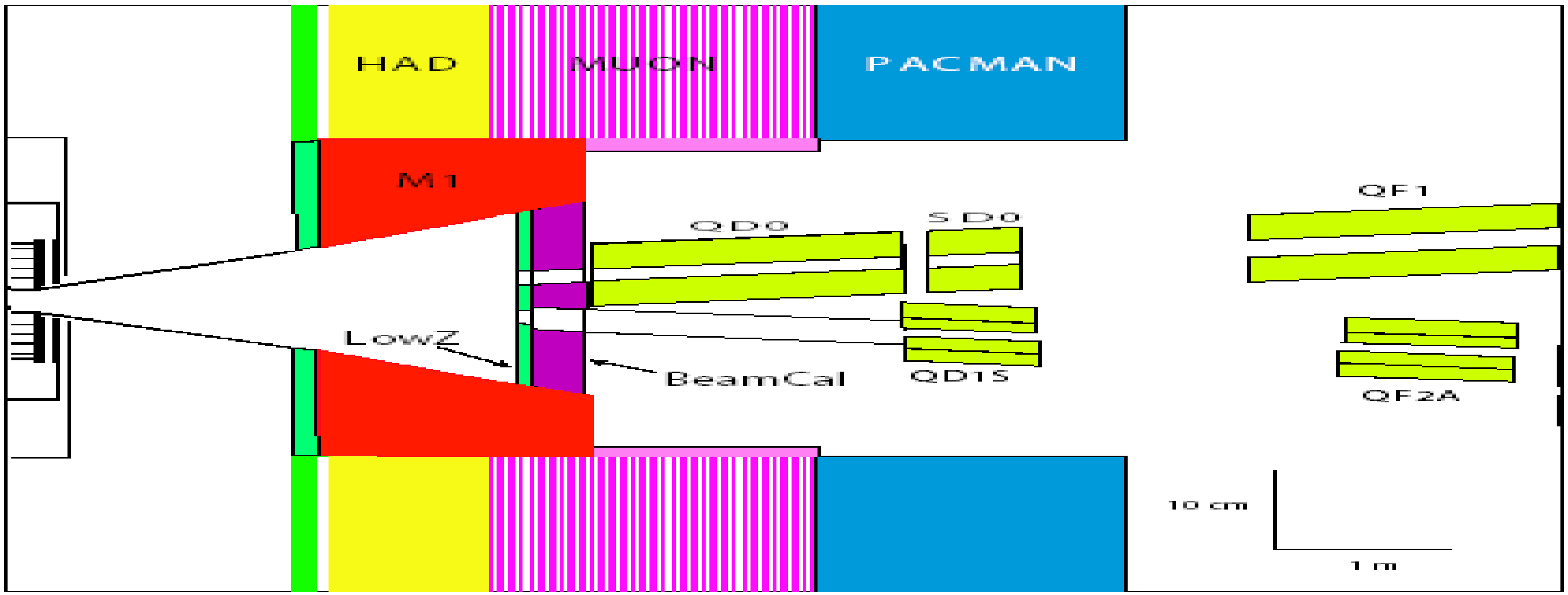
Pair background



- Beam-beam interaction generates ~75 K e+/e-/BX
- No material can be placed inside the pairs.
- Mask M1 contains the pairs and protects the detector from back splash.
- Want to place the vertex detector at R=1.4 cm.
- Want a hermetic detector to small polar angles.

Conventional sync radiation masks are not compatible with these requirements.
Collimate the beam so that no sync radiations directly hit the detector .

14 mrad crossing geometry



Apertures:

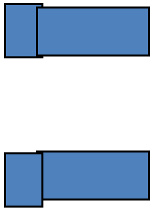
QD0

R=1.0 cm@z=-3.51 m

Beampipe@IP

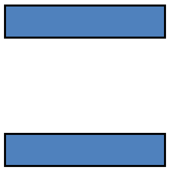
1.2 cm@0.0m

Low Z



1.5 cm
@2.85-2.95m

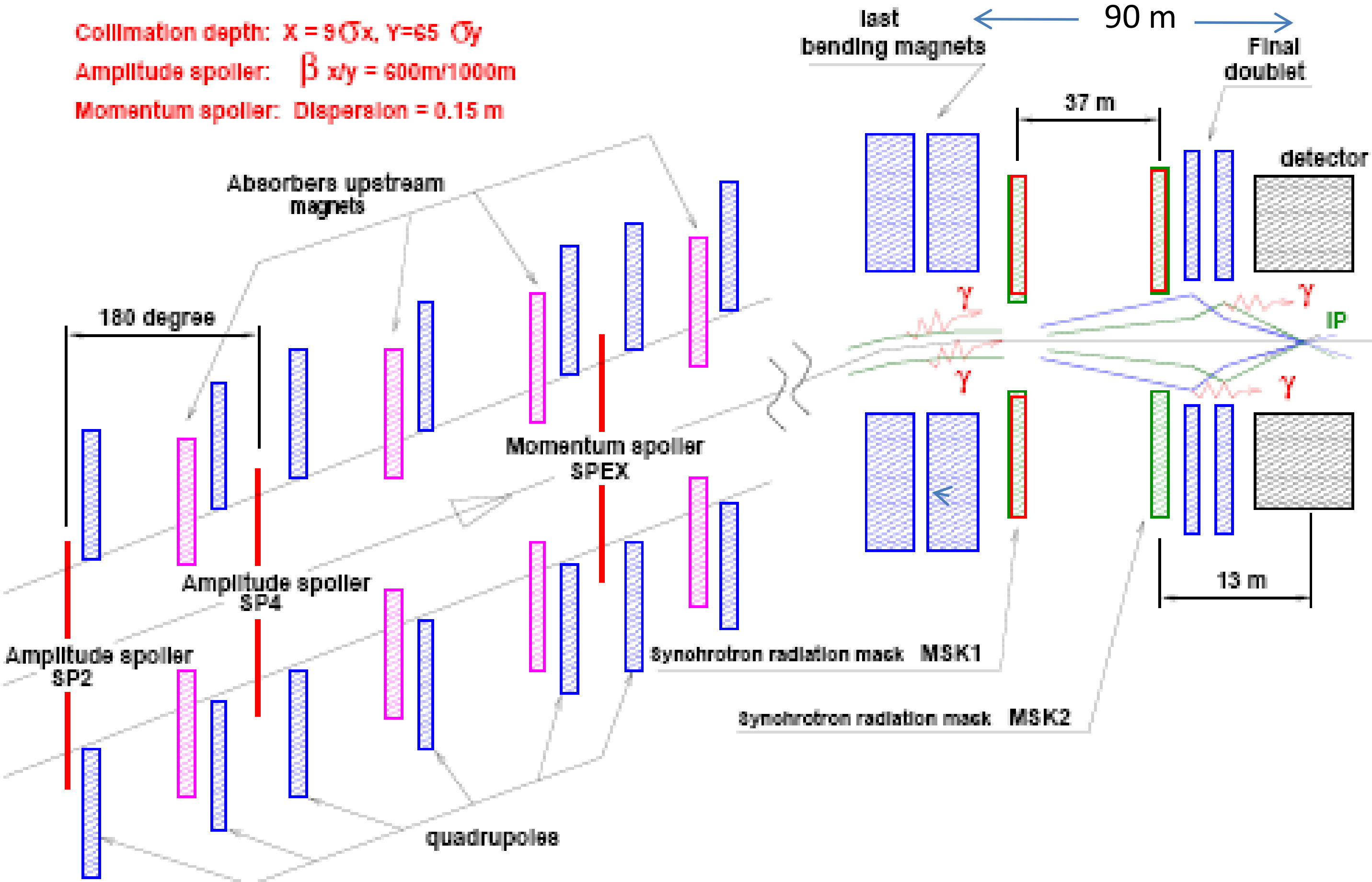
QD1S



1.5 cm
@5.5-6.56m

Sync radiation from Soft Bend

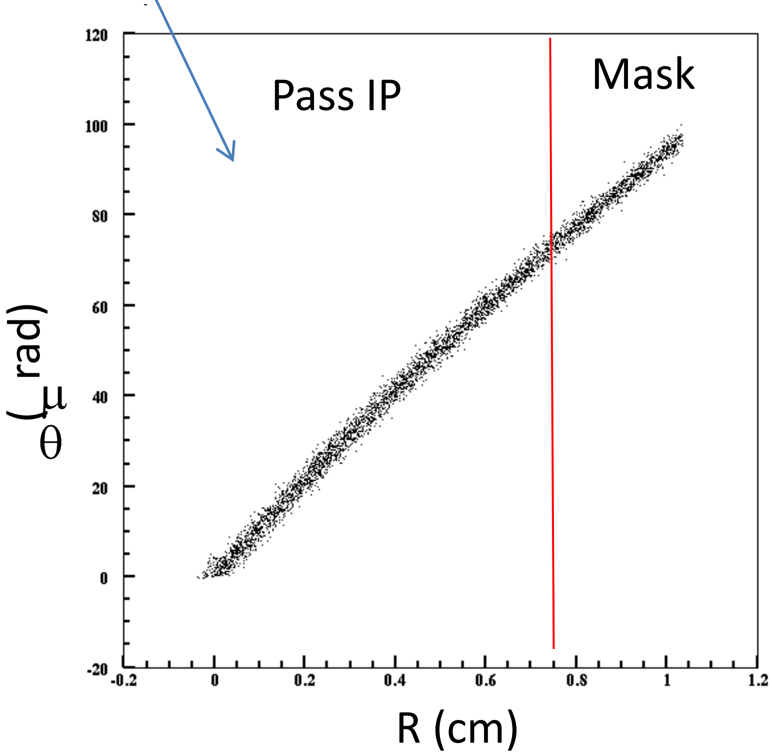
Drozhdin



Soft Bend Sync Radiation

$N\gamma = 3\times10^{8}$ / BX

<k>= 32 keV



The edge scattering from Mask 2 is a potential source of detector background, which is not estimated yet.

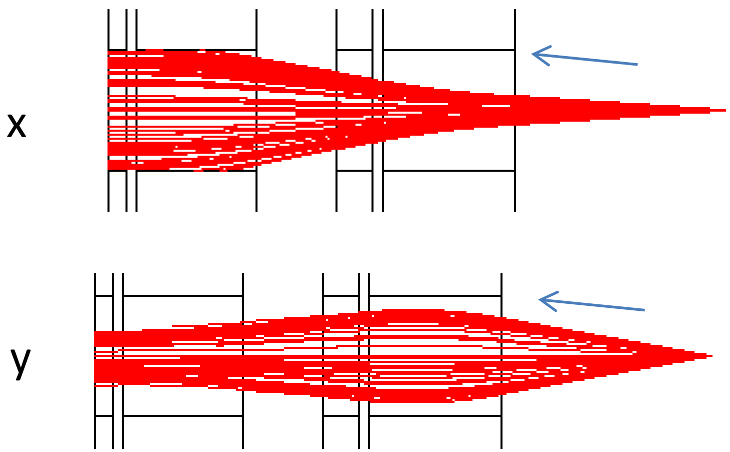
Quadrupole sync radiation and Collimation depth

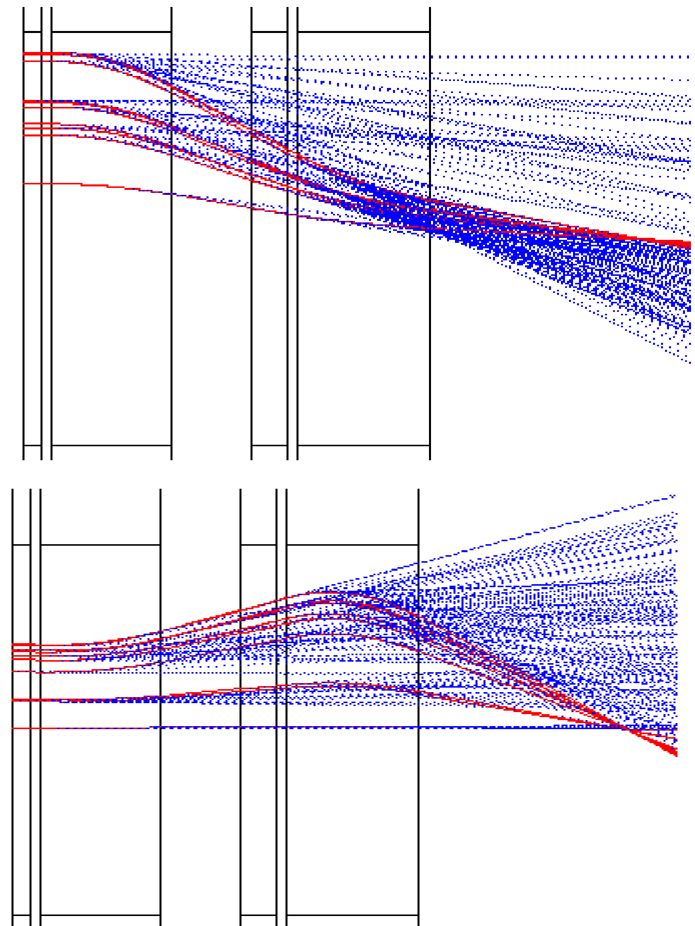
- Find collimation settings at SP2 and SP4.

  Collimation depth – ($n_x\sigma_x$, $n_y\sigma_y$)

- Back track particles from IP to QF1.

- Track particles from QF1 to IP, while generating SR. Find Nx and Ny that generate SR hitting the detector.



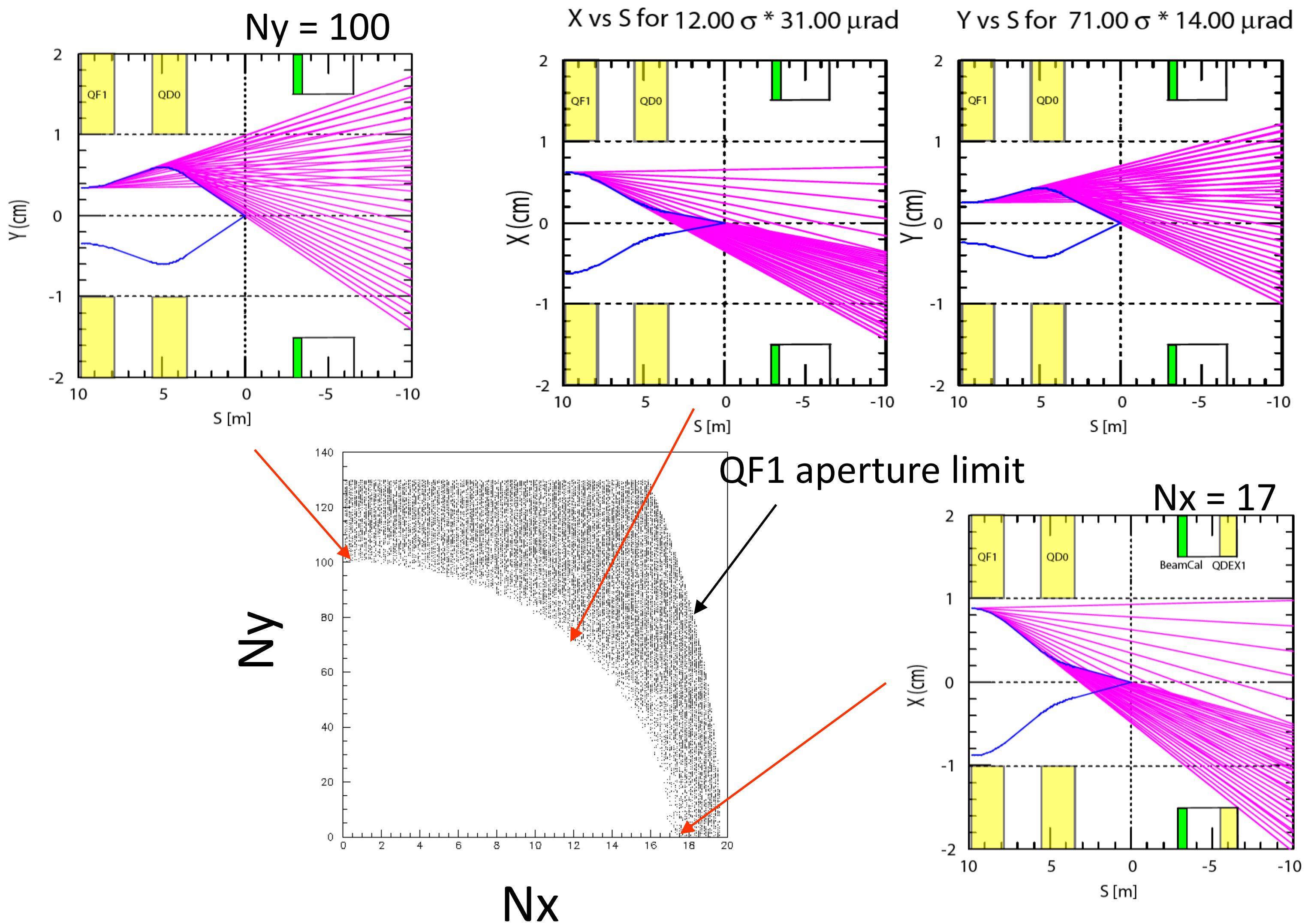


$$\theta = n \times \theta_{IP}$$

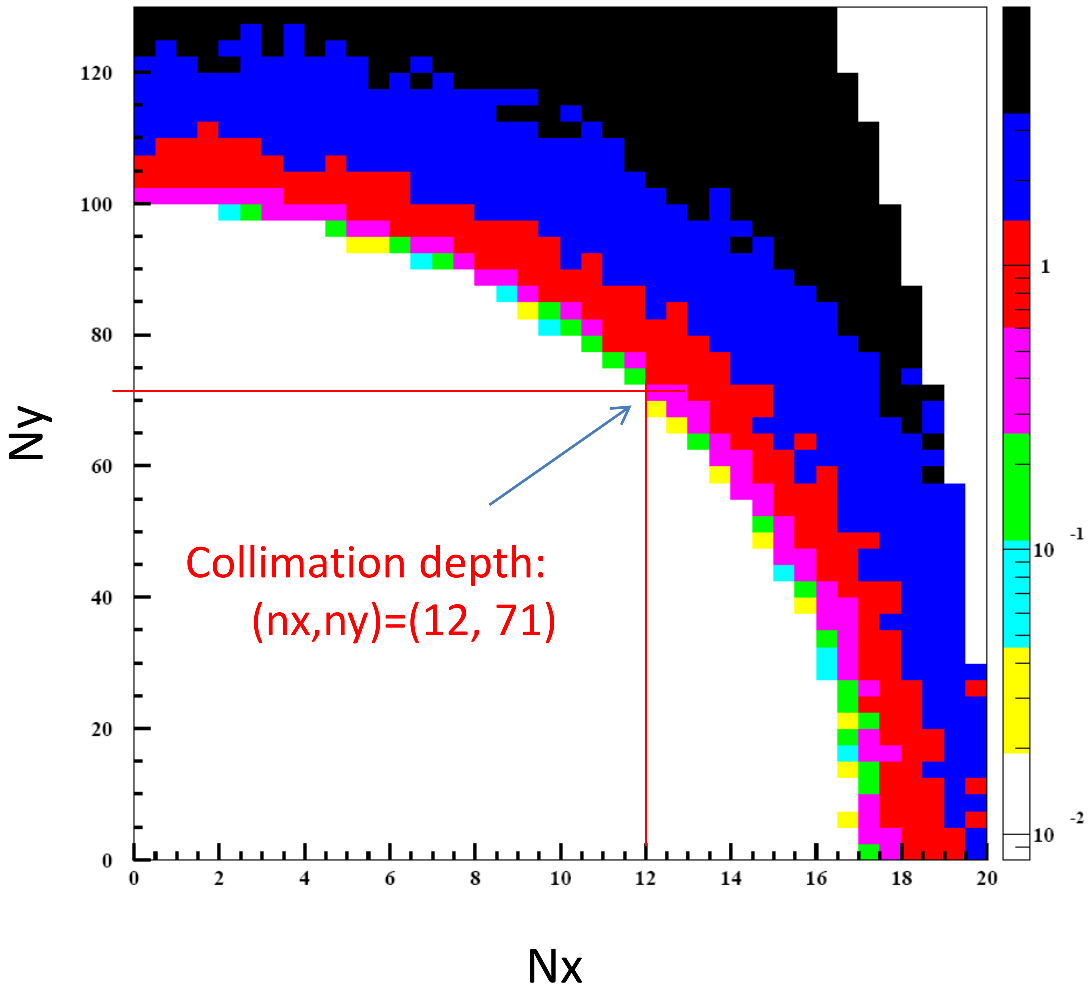
$$\theta_{IP} = \sqrt{\frac{\varepsilon}{\beta}}$$

θx = 31 μrad
θy = 14 μrad

Collimation Depth from Exit aperture

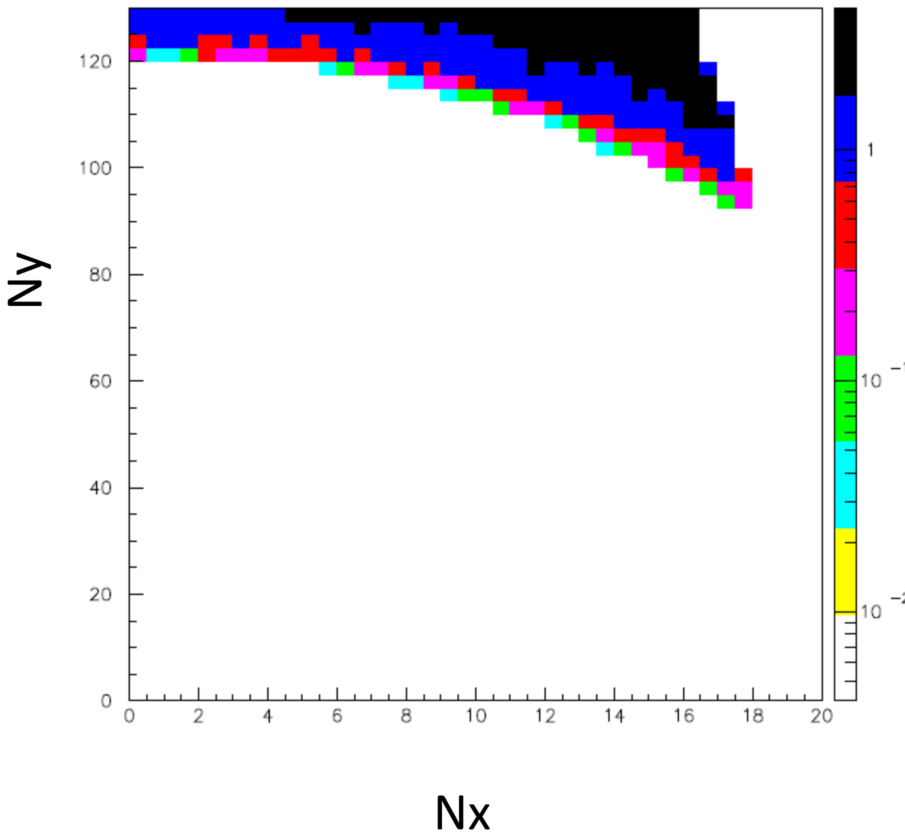


No. photons per e- - Exit aperture

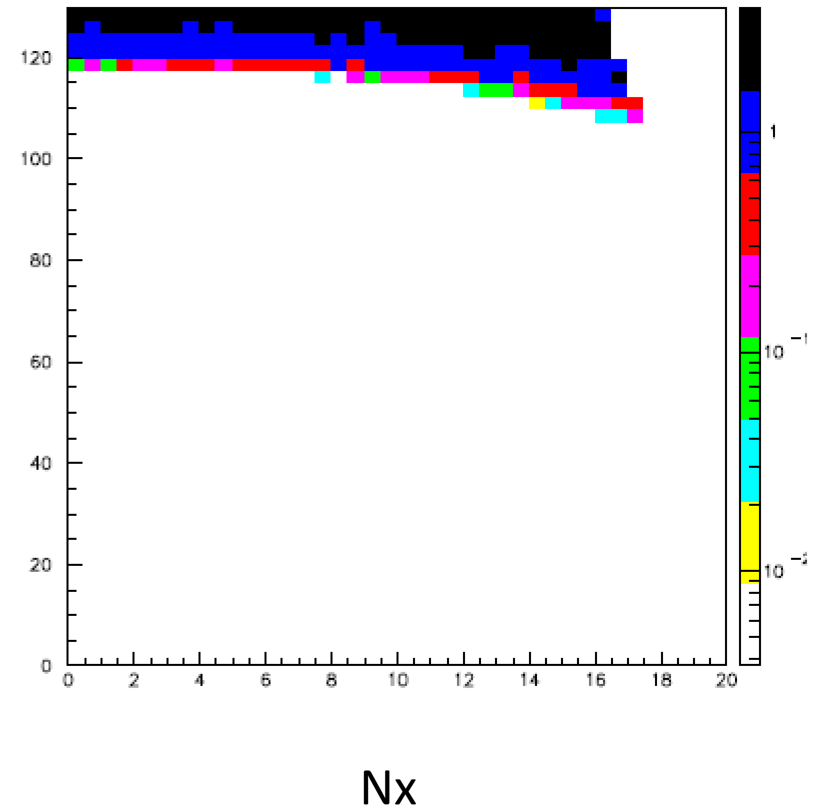


Other apertures

BeamCal 1.5 cm



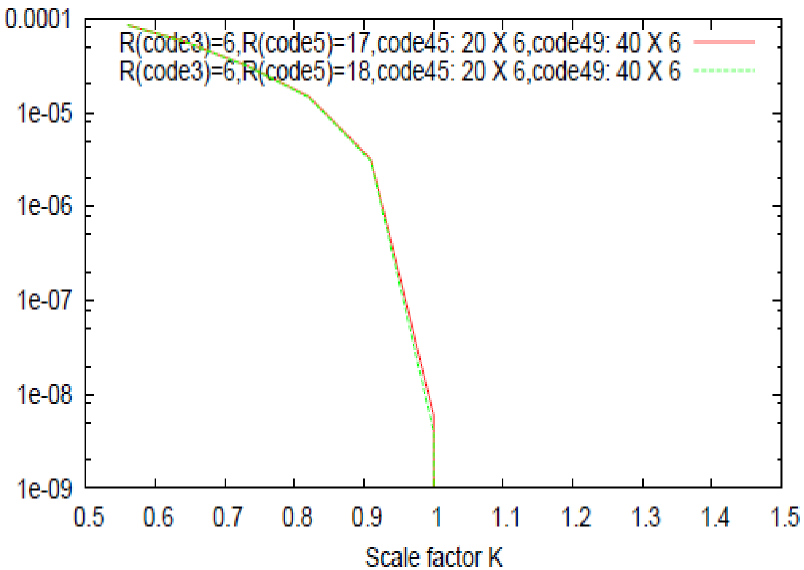
IP 1.2 cm



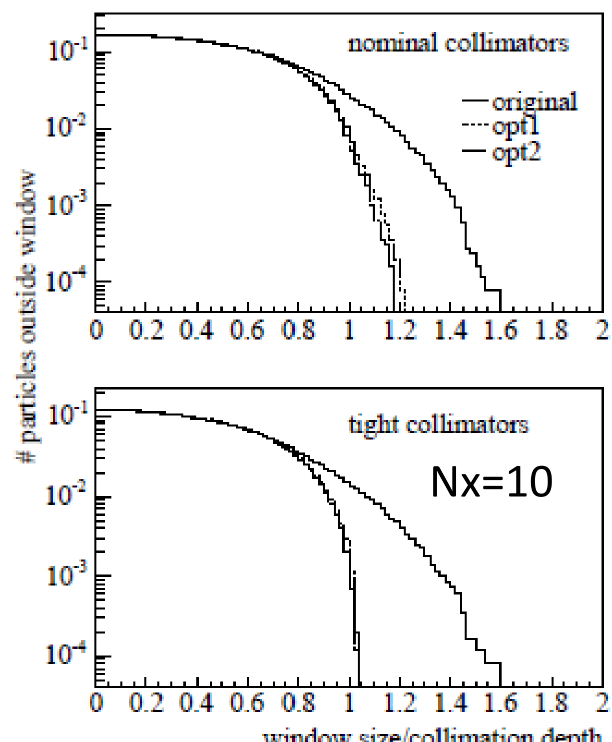
Collimation performance

- Set the collimators at (nx,ny) = (12, 71)
- Find # particles outside the collimation window.

Drozhdin
1/x halo model



Jackson (PAC07)
Halo: uniform over 1.5x collimation depth.

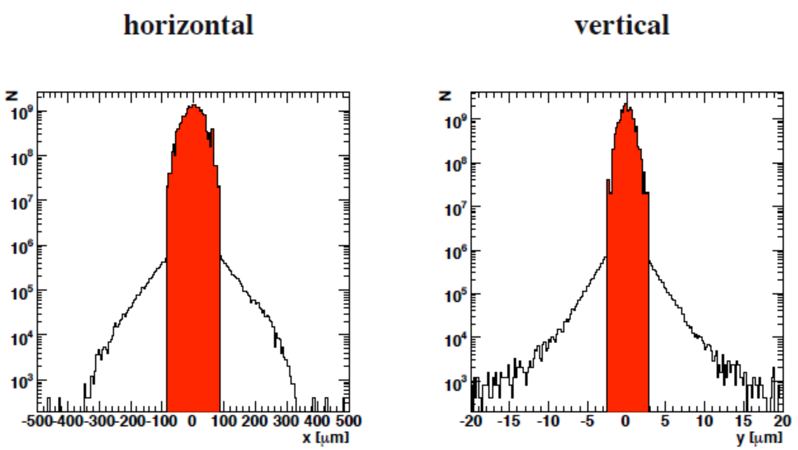


Collimation performance depends on the halo model.

Beam Halo

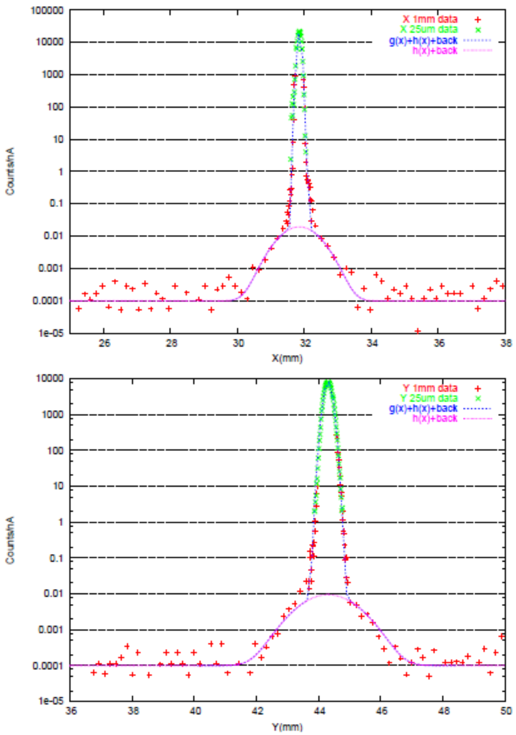
- Simulation finds 3×10^{-5} halo.

  Burkhardt (PAC07)



Transverse beam profiles at the BDS entrance

Jlab beam halo is small.



Possible SR studies

- Assume a halo uniformly distributed over 1.5x collimation depth.
- Assume 10^{-3} halo (2×10^{7}/BX)
- Find SR rate