Pair Backgrounds

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Tools

Simulations have been done using

- GUINEA-PIG as generator for the pairs
- Ideal TESLA beam parameters
- Full GEANT3 based TESLA detector simulation BRAHMS
- Cut-offs in GEANT3 have been lowered to 10keV for EM particles

A hit is

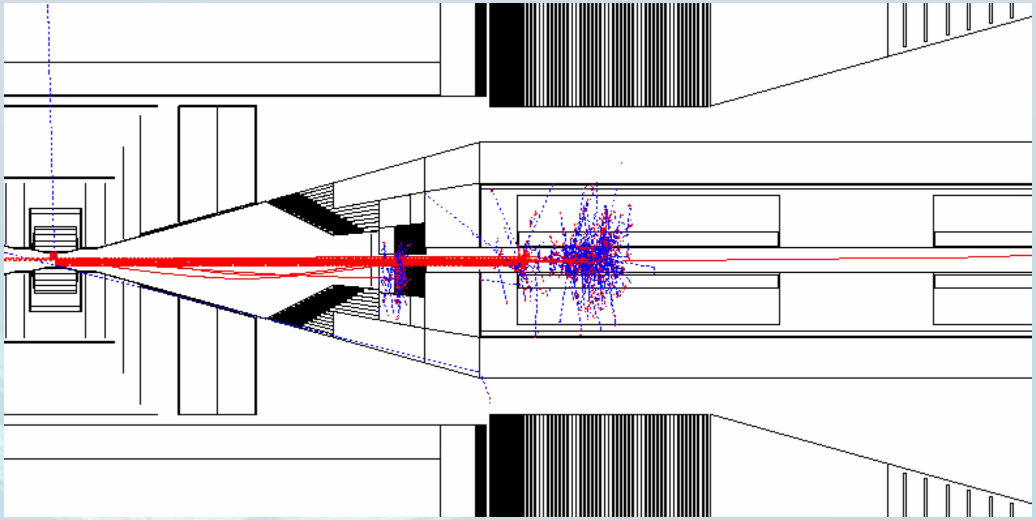
- every charged particle which deposes energy in a SI device
- every 3d hit in the TPC

The following crossing angles have been studied:

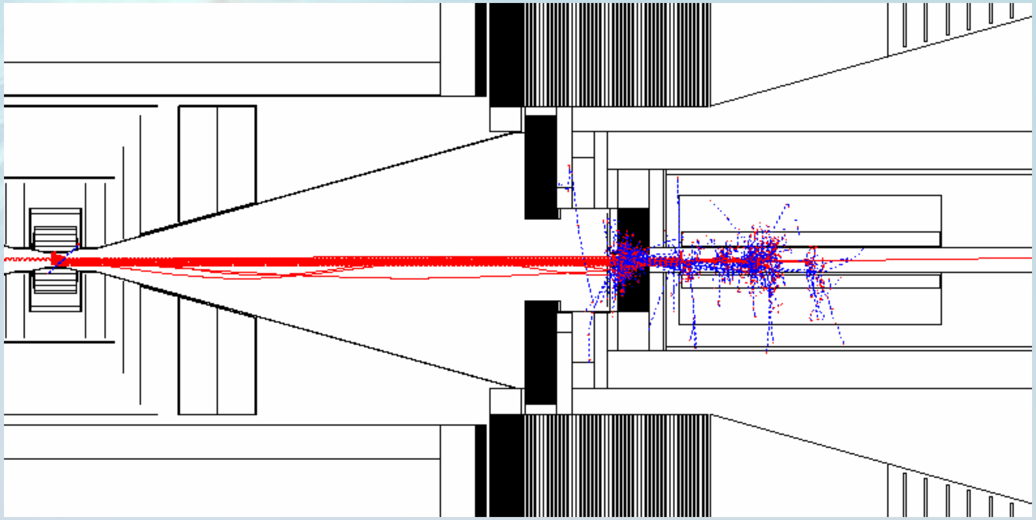
- head-on collisions
- 2*10 mrad crossing angle
- 2*1 mrad crossing angle

Head-On Geometries

1) TESLA TDR design:
L*=3.0 m, head-on

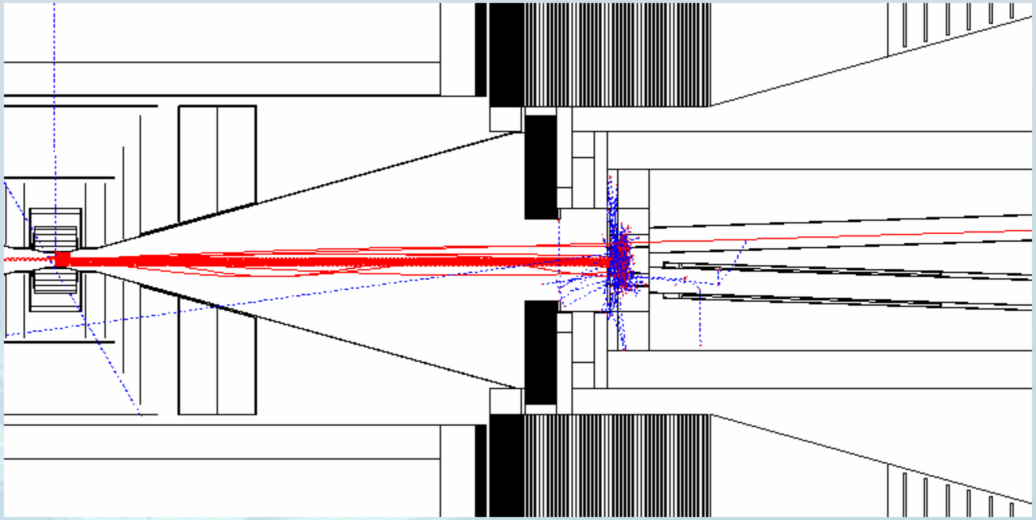


2) New TESLA design:
L*=4.05 m, head-on

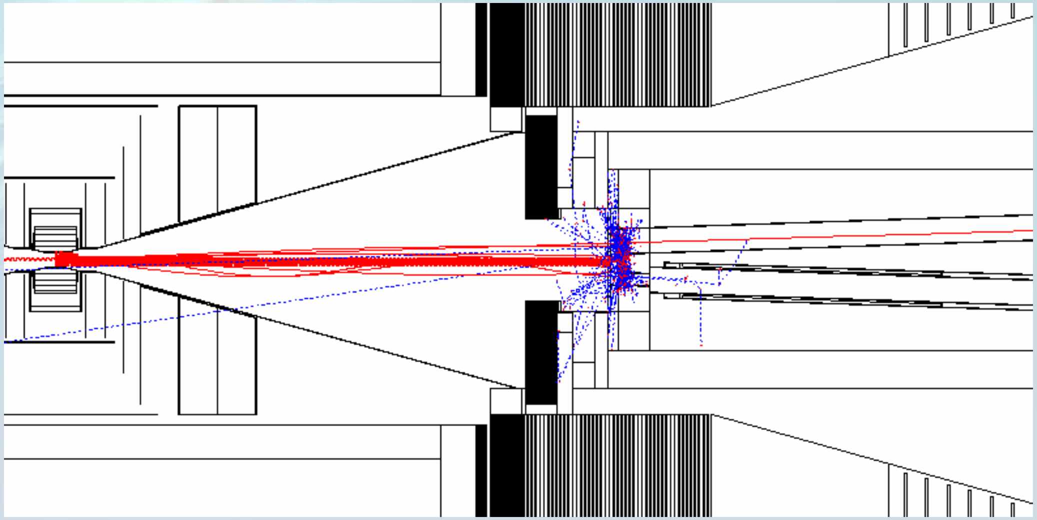


2*10 mrad Geometries

3) 2*10 mrad x-angle, outgoing hole: r=1.2 cm

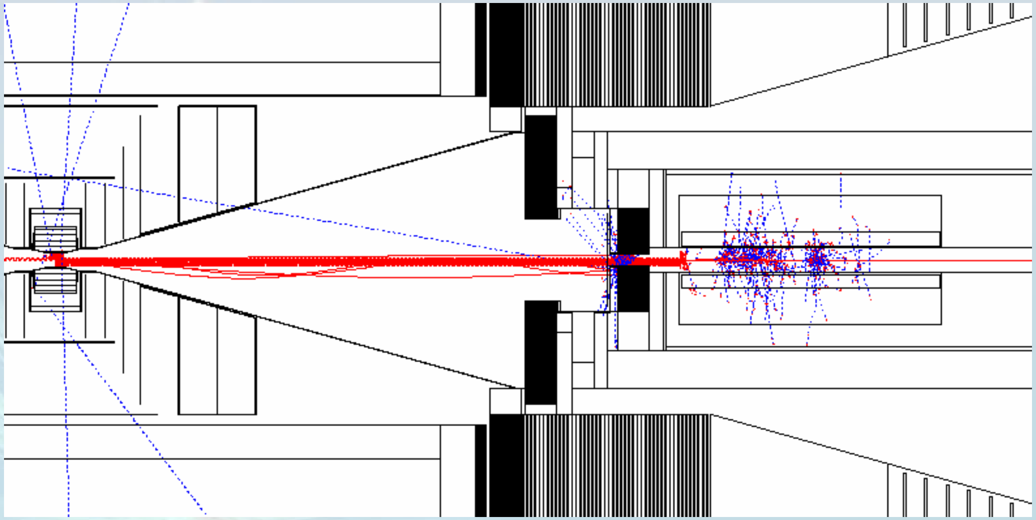


4) 2*10 mrad x-angle, outgoing hole: r=2.4 cm

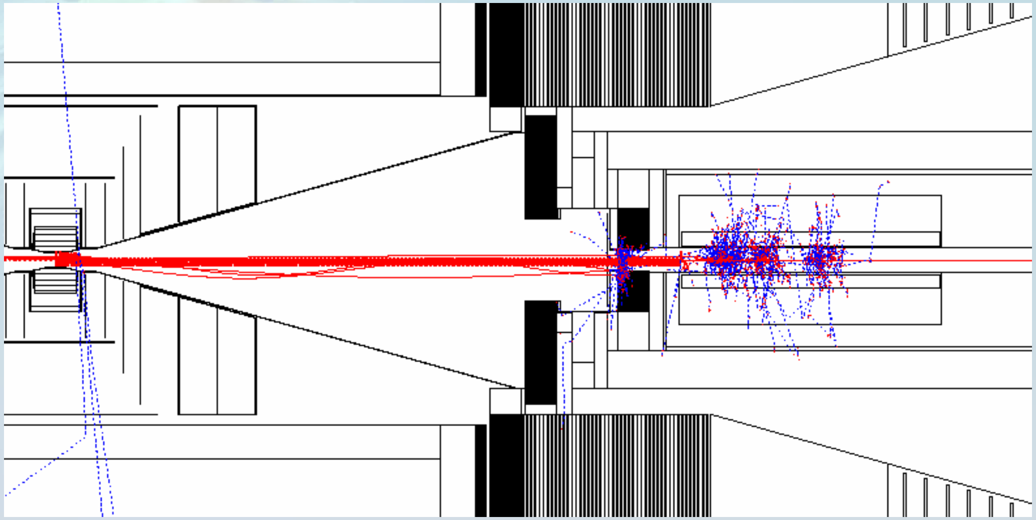


2*1 mrad Geometries

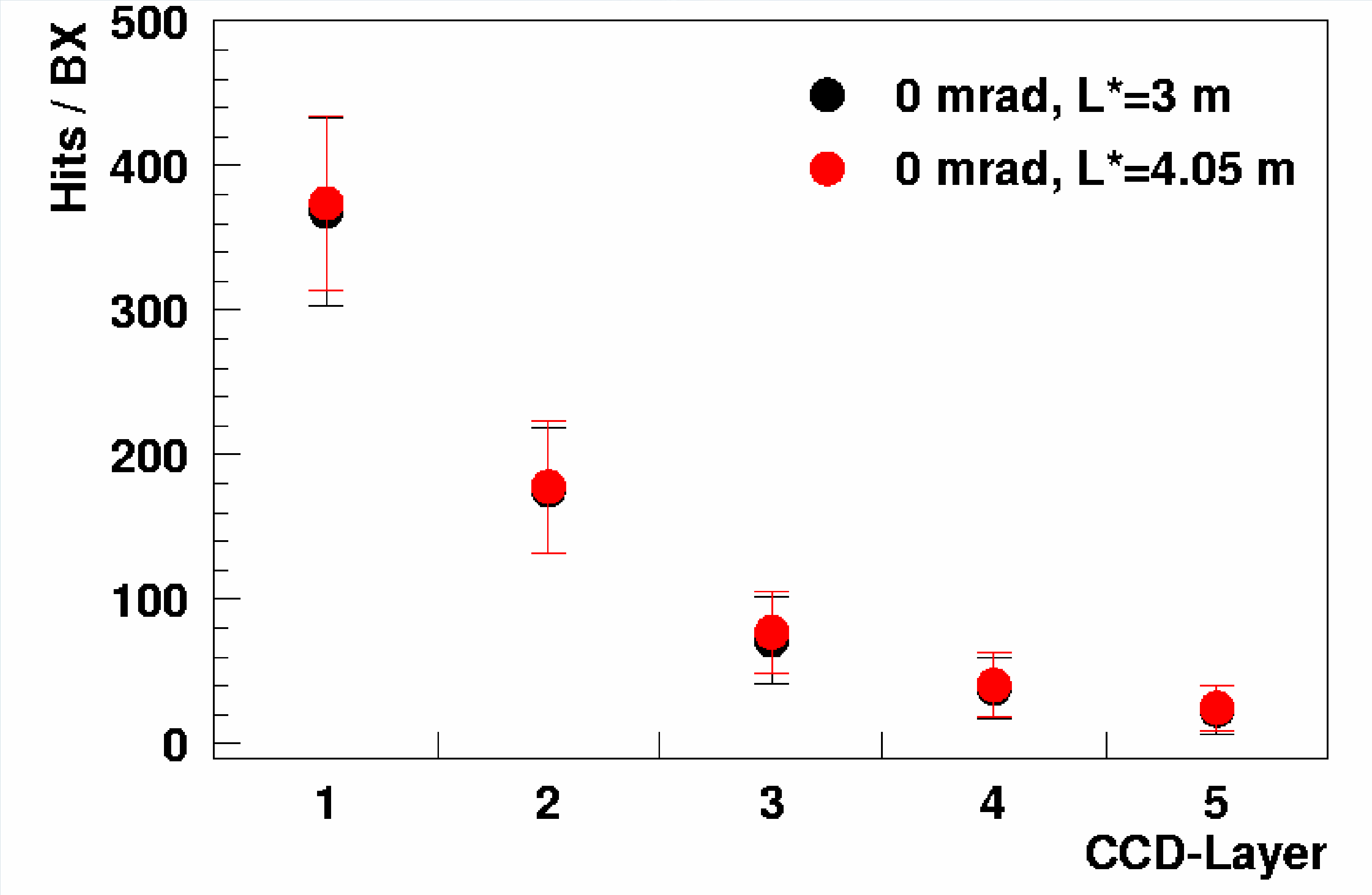
5) 2*1 mrad x-angle, outgoing hole: r=1.2 cm



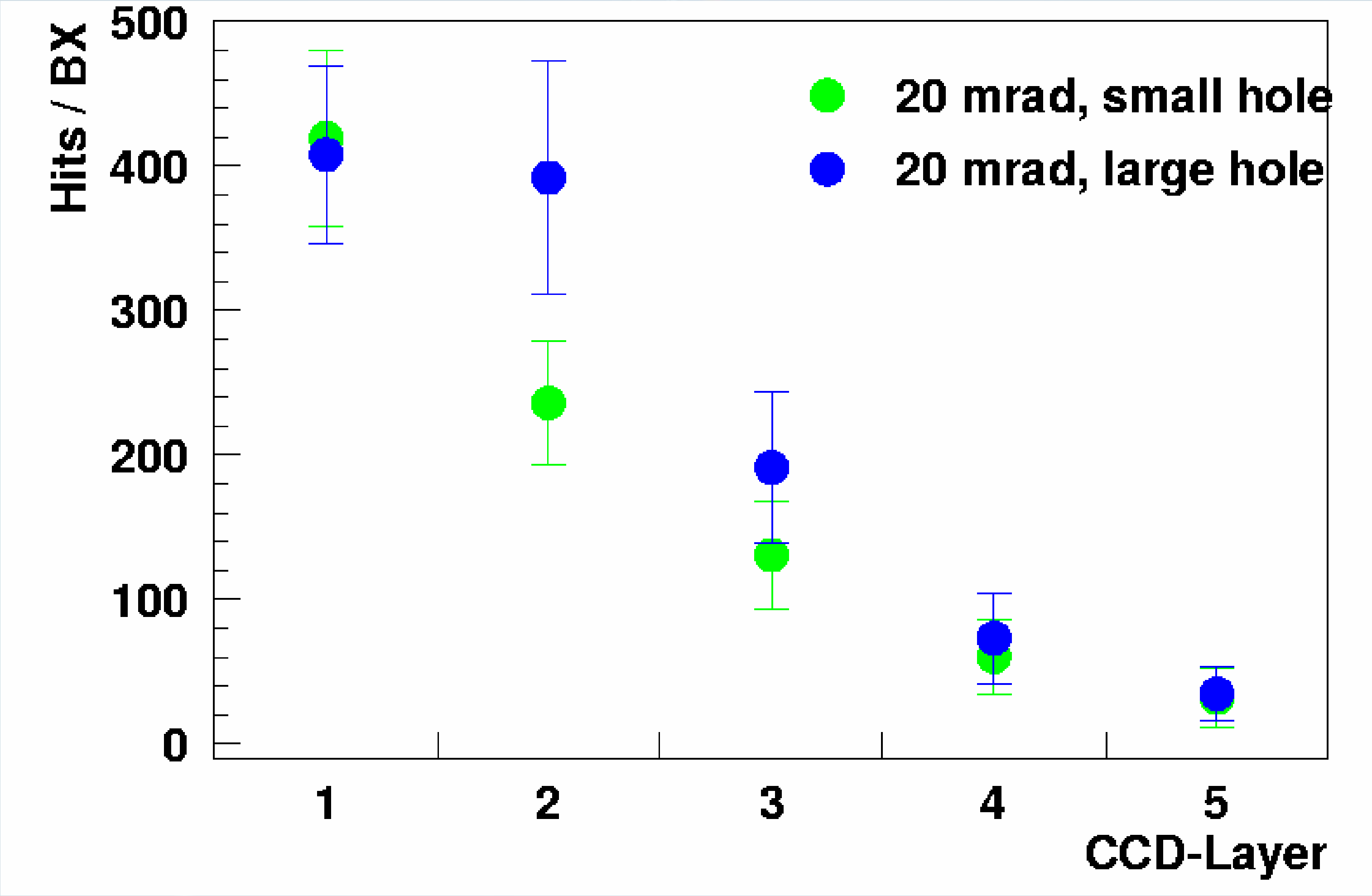
6) 2*1 mrad x-angle, outgoing hole: r=2.0 cm → eases collimation requirements



Vertex Detector: Head-on

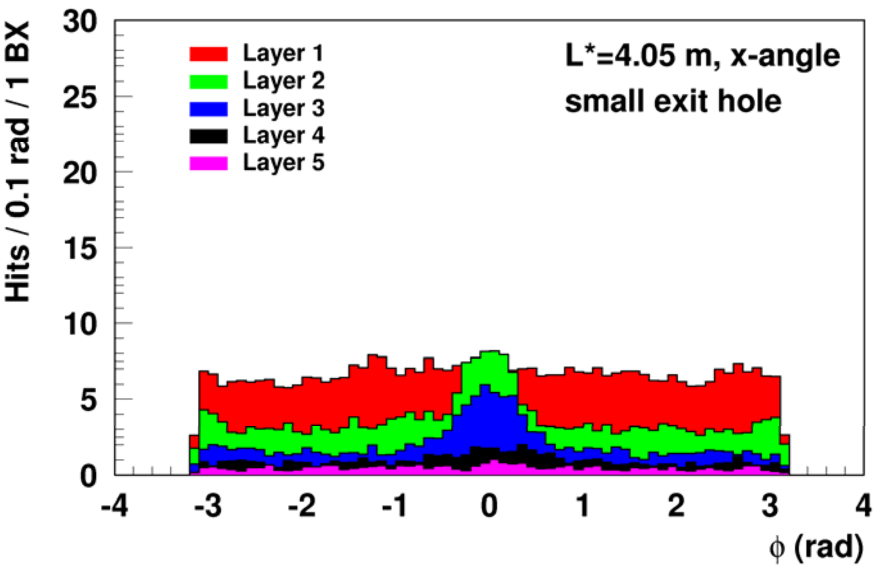


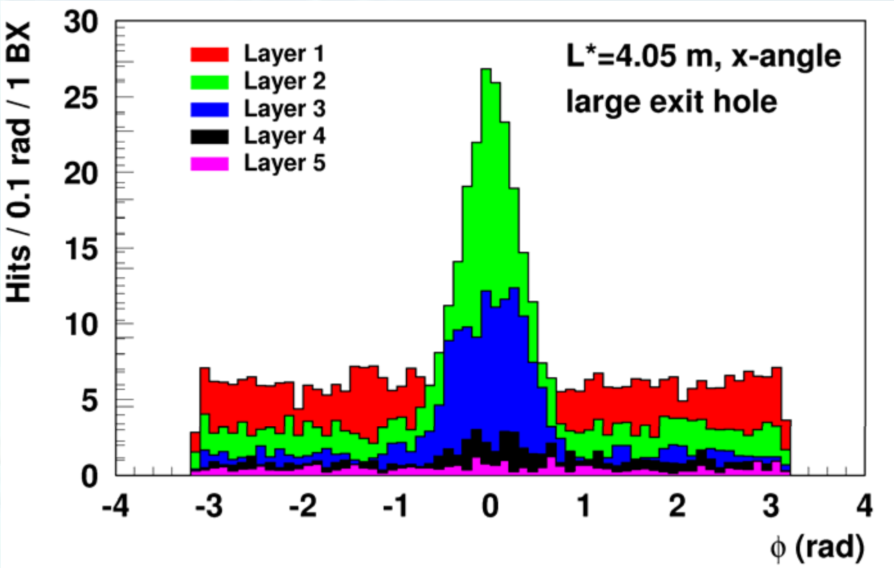
Vertex Detector: 2*10 mrad



Hot Spots

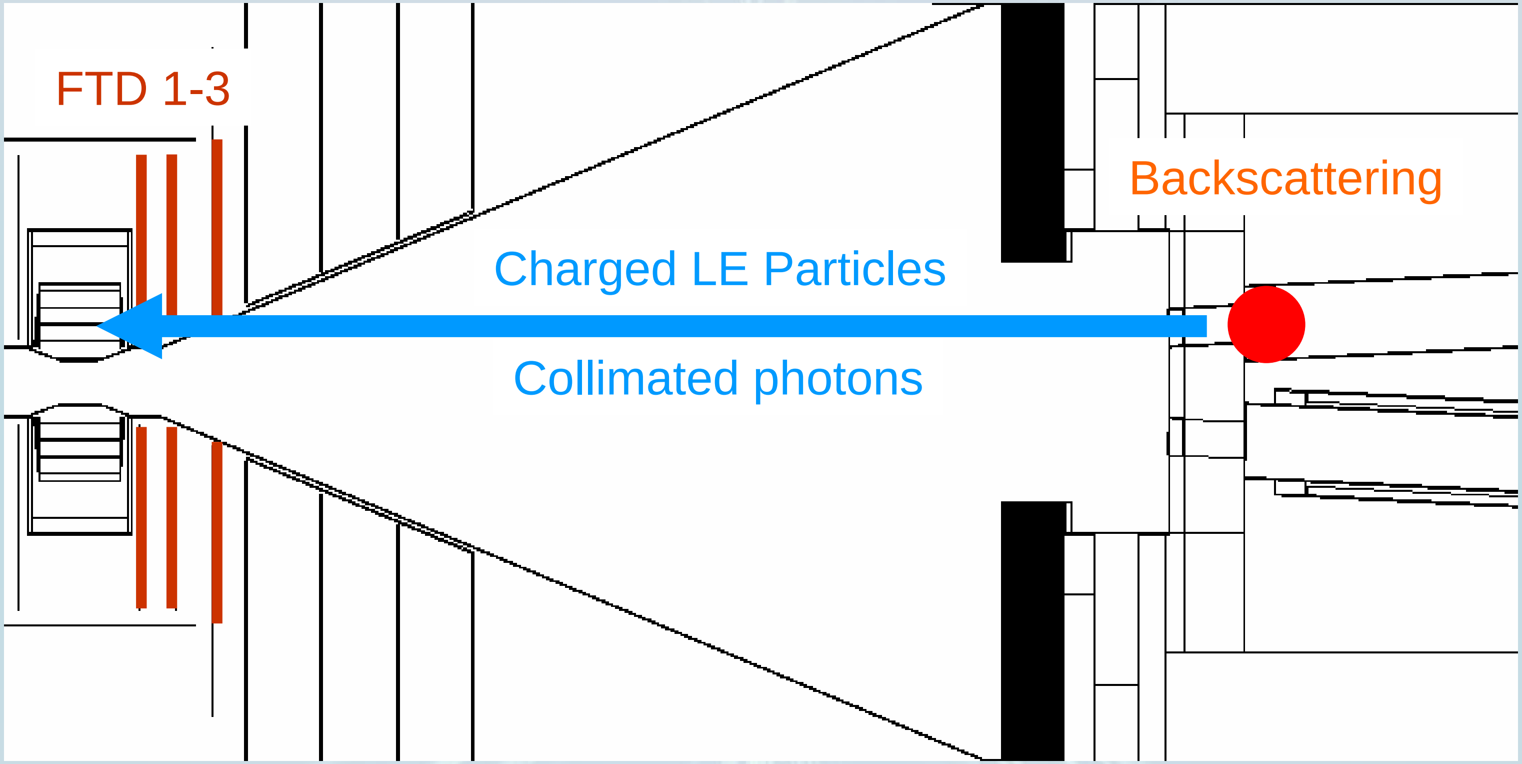
Azimuthal hit distributions in the Vertex Detector





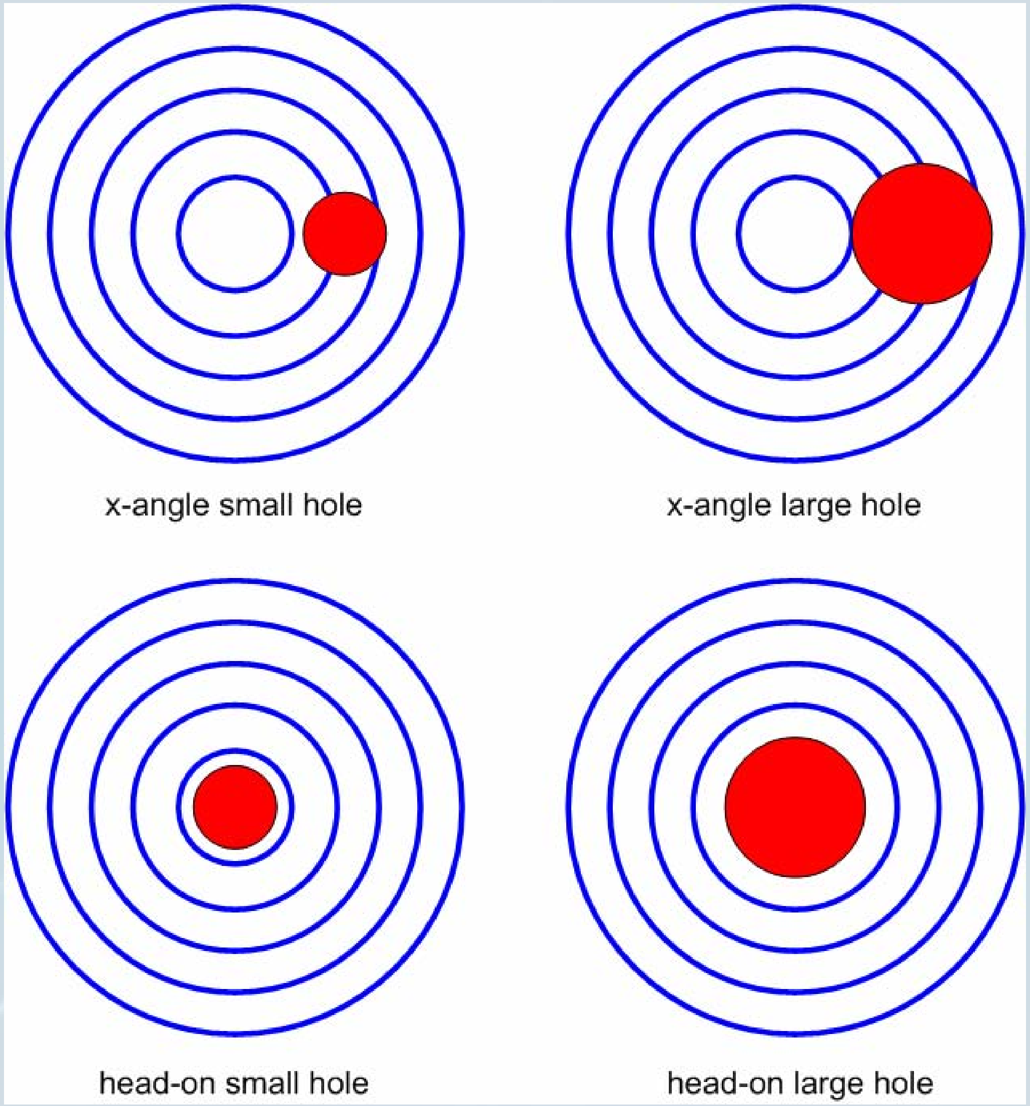
- Distributions for x-angle geometries show a peak of hits in the horizontal plane
- Peak is just visible in Layers 2 and 3 (maybe also in 4).
- Peak is much more pronounced with the increased exit hole

Hot Spots Origin

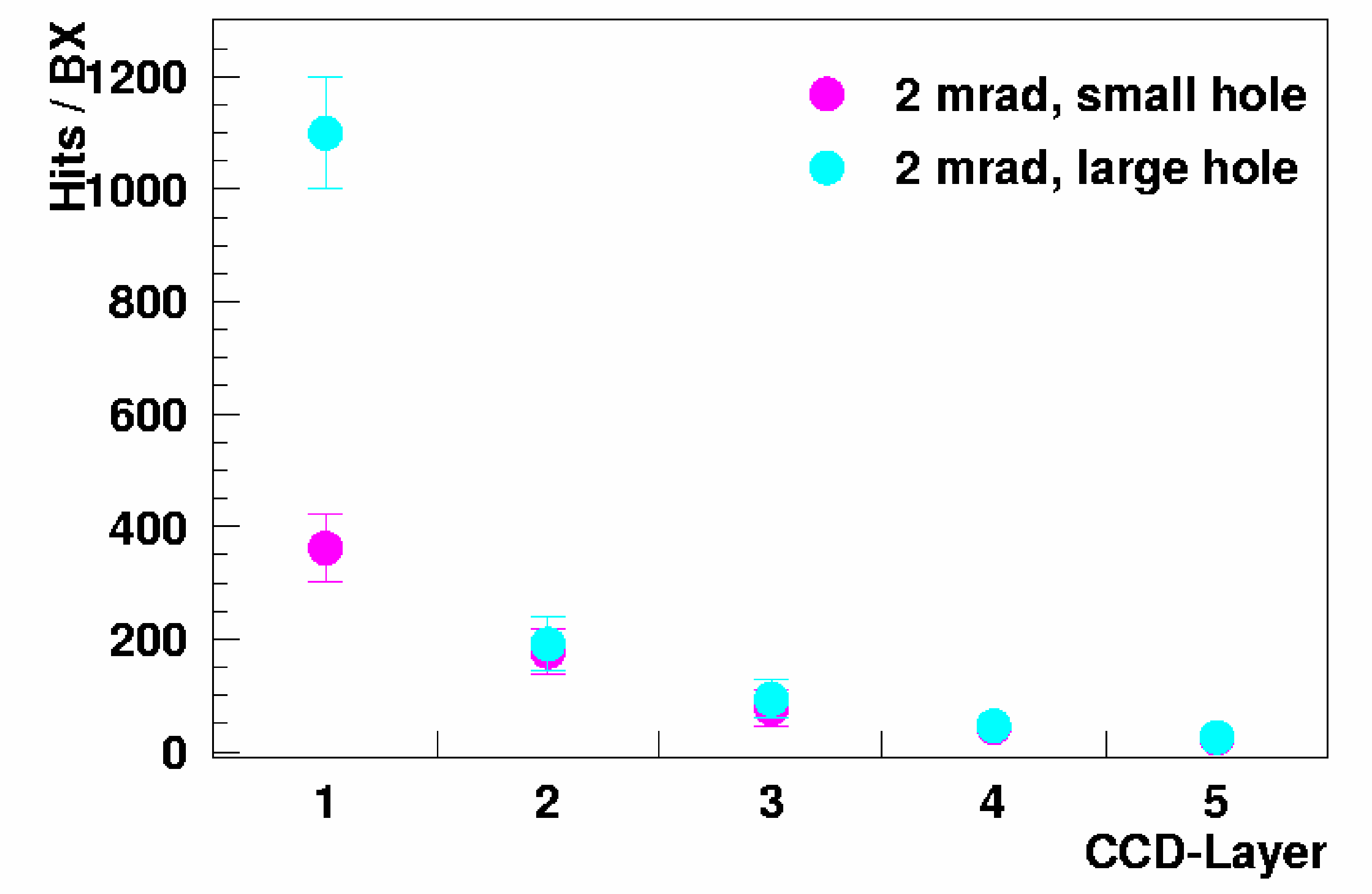


- Backscattered particles are collimated by the exit hole and aim directly to the VTX
- LE charged particles produced in the hot region are focused additionally by the solenoidal field

Hot spots origin

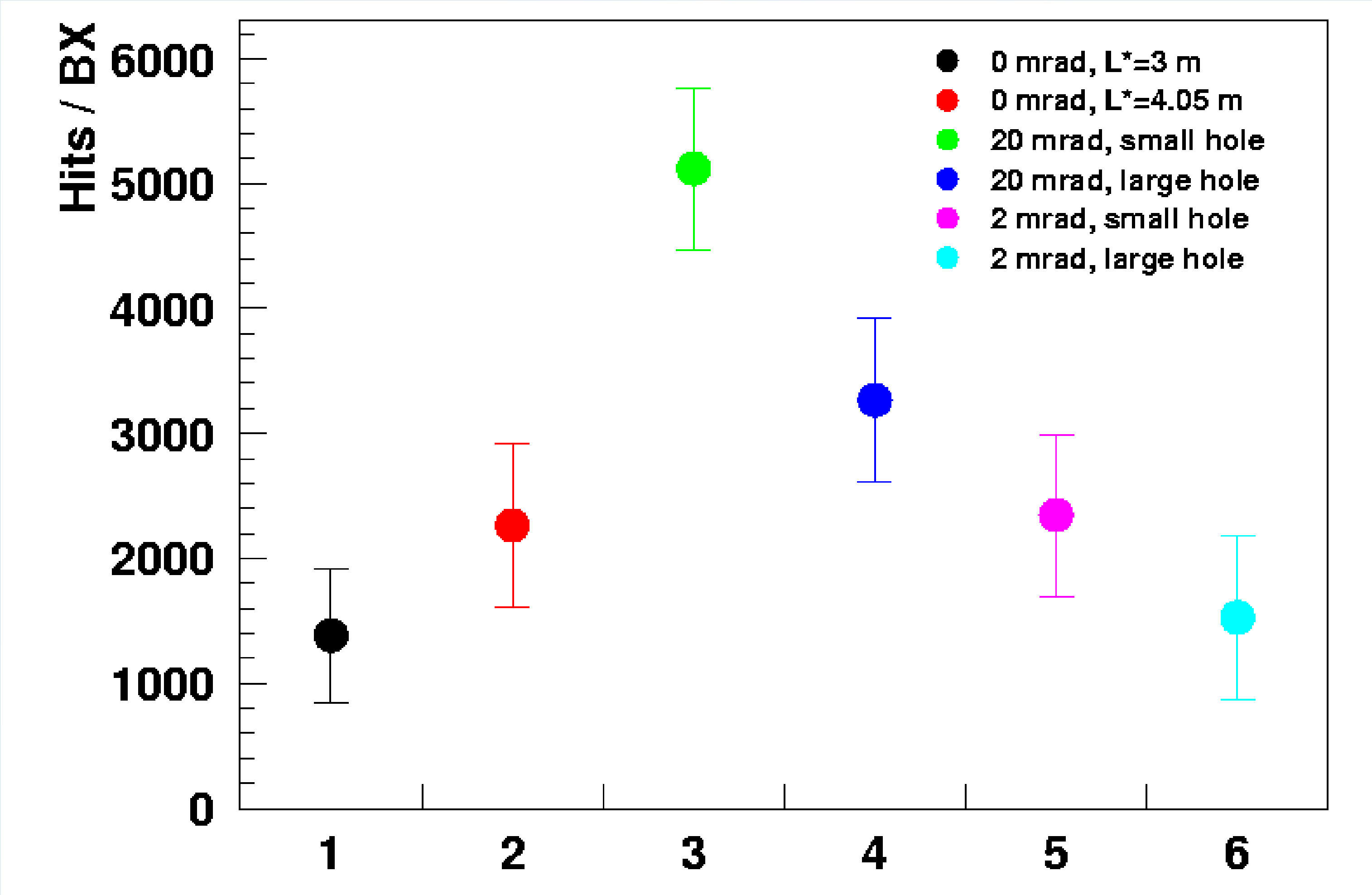


Vertex Detector: 2*1 mrad



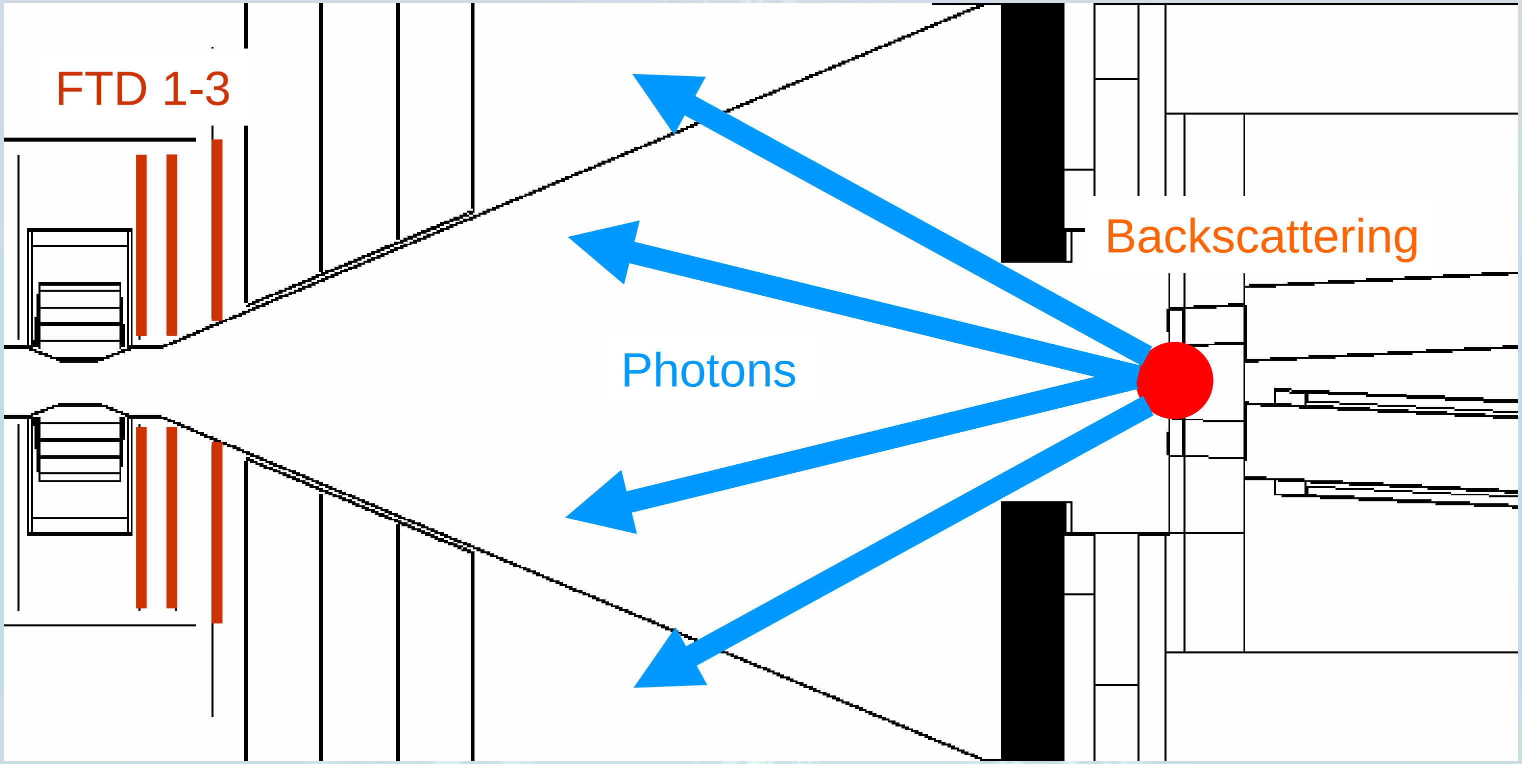
Backscattering out of the exit hole is significant!

TPC



Increasing the exit holes decreases backscattering into TPC volume

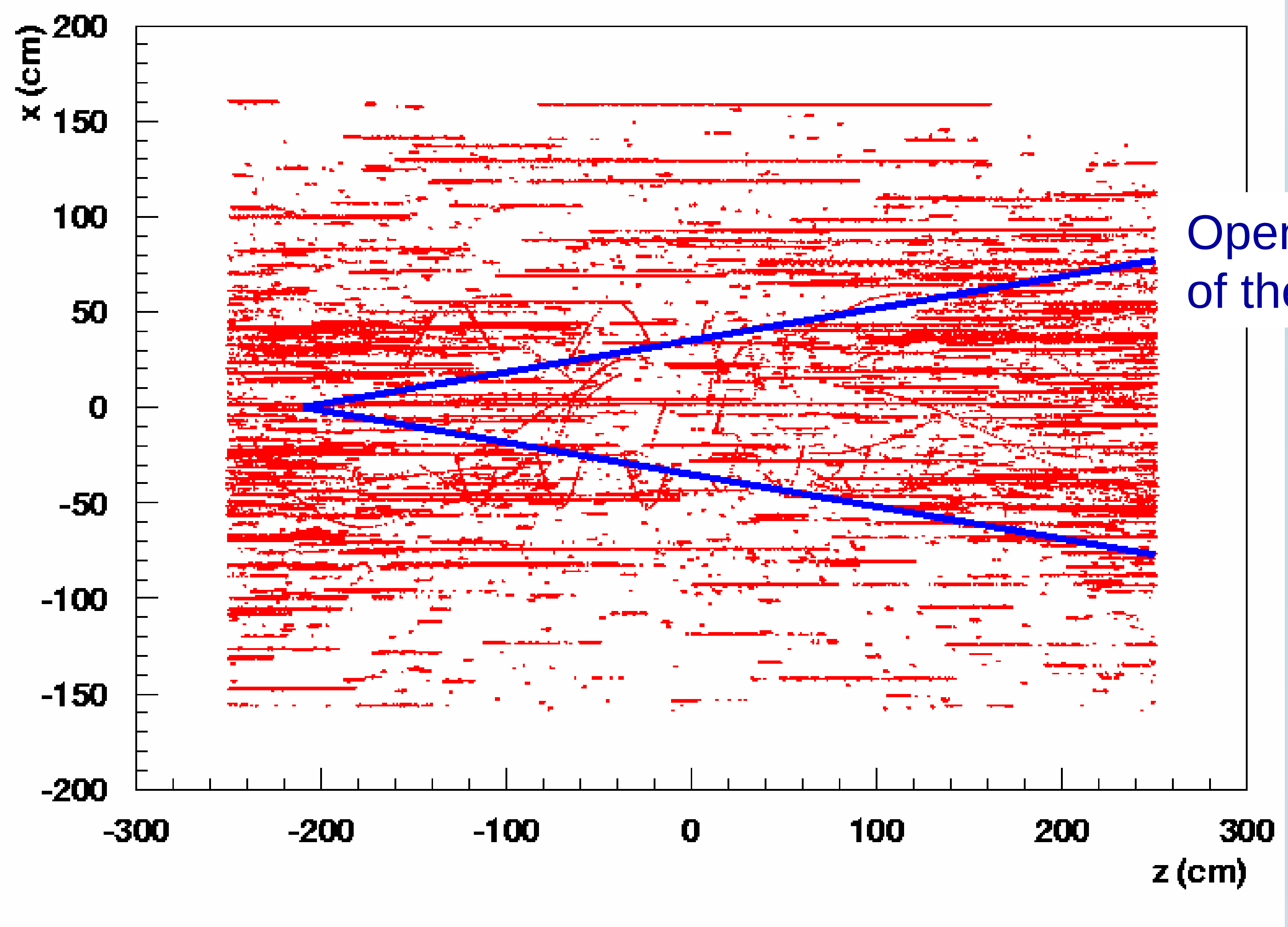
TPC Backgrounds



- TPC backgrounds are dominated by backscattered photons converting to e+e- pairs in the gas
- Photons from the frontside of the BeamCal are scattered back (more or less) isotropically
- Larger exit hole reduces isotropical backscattering (→TPC) but increases collimated backscattering (→VTX)

3d Hits in the TPC

Increase in TPC hits with larger L* is a geometrical effect



Opening angle of the mask

L*=3.0 m, head-on collisions

3d Hits in the TPC

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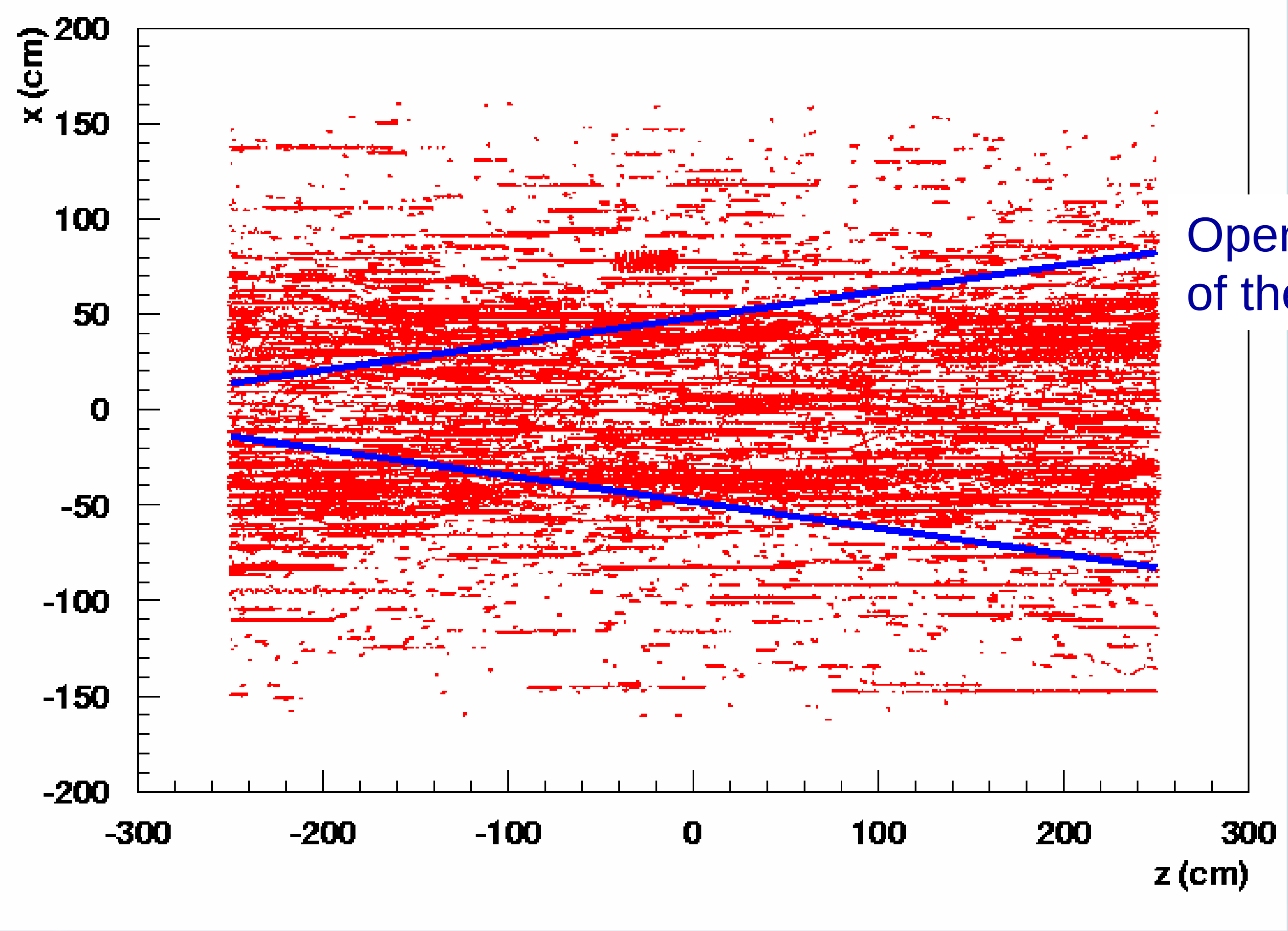
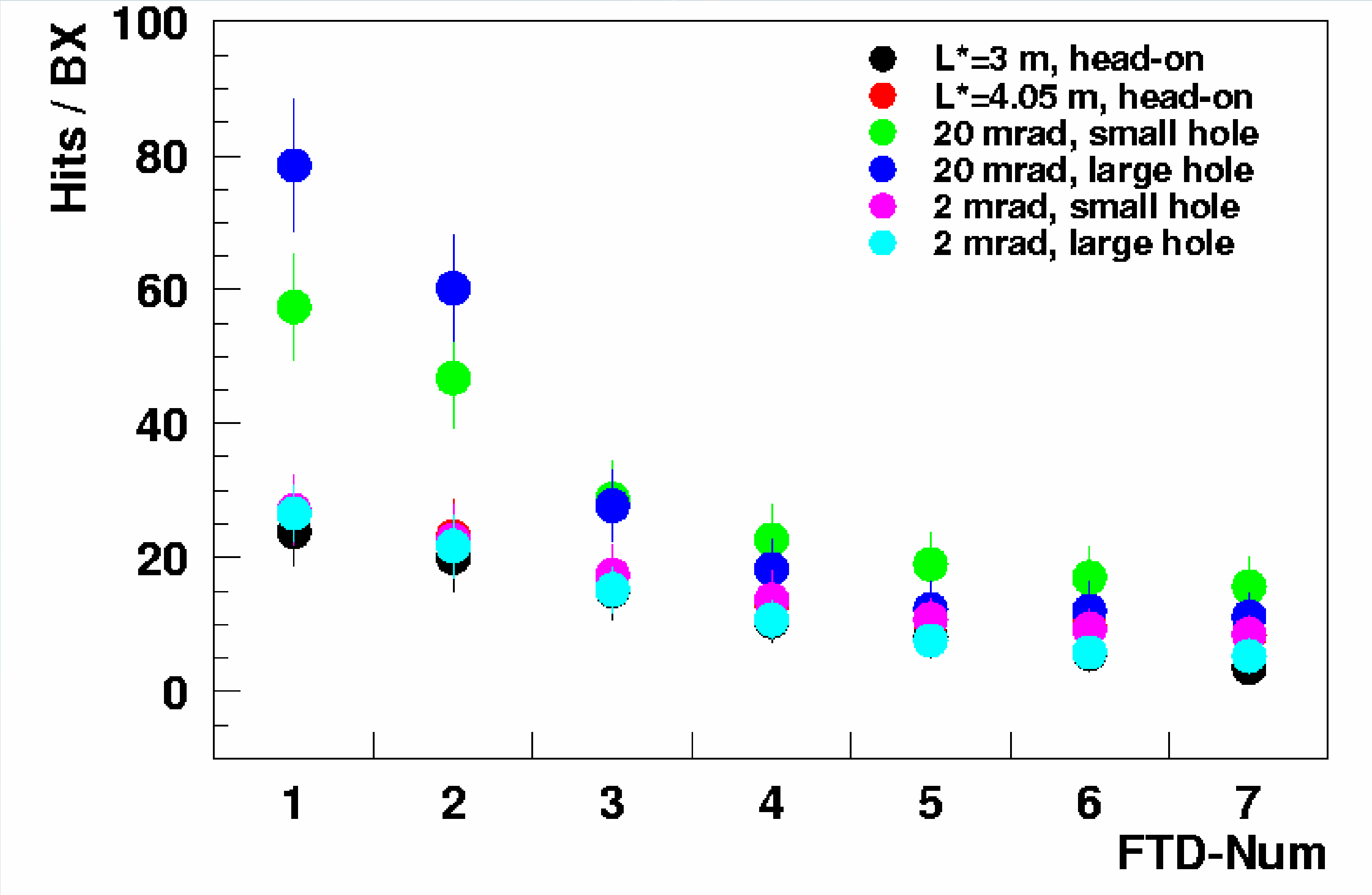


Opening angle of the mask

L*=4.05 m, head-on collisions

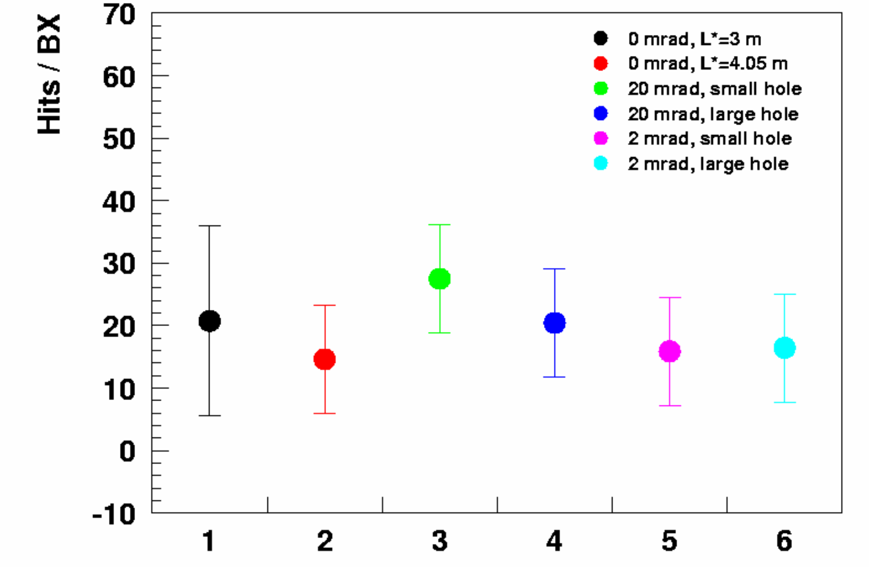
Forward Tracking Disks

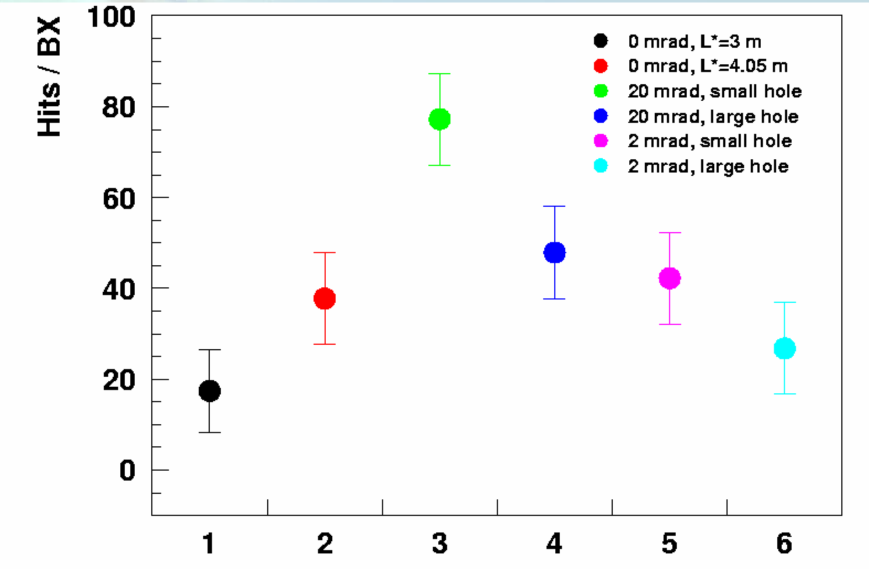


SI Intermediate Tracker

SIT1: r=16 cm, l=76 cm

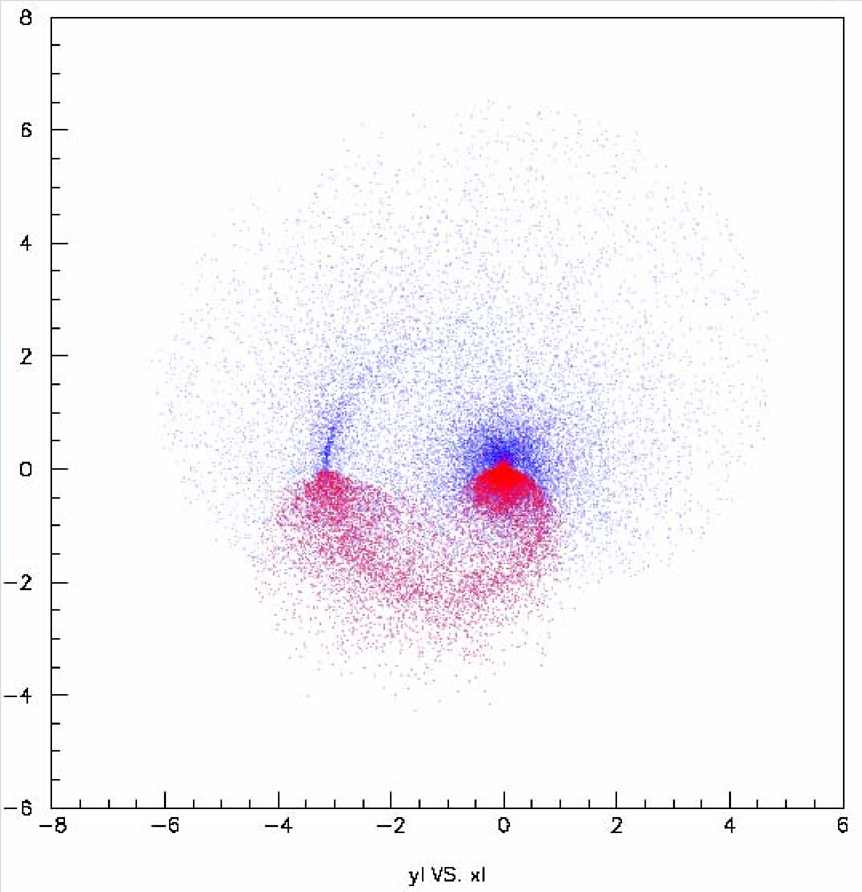
SIT2: r=30 cm, l=132 cm



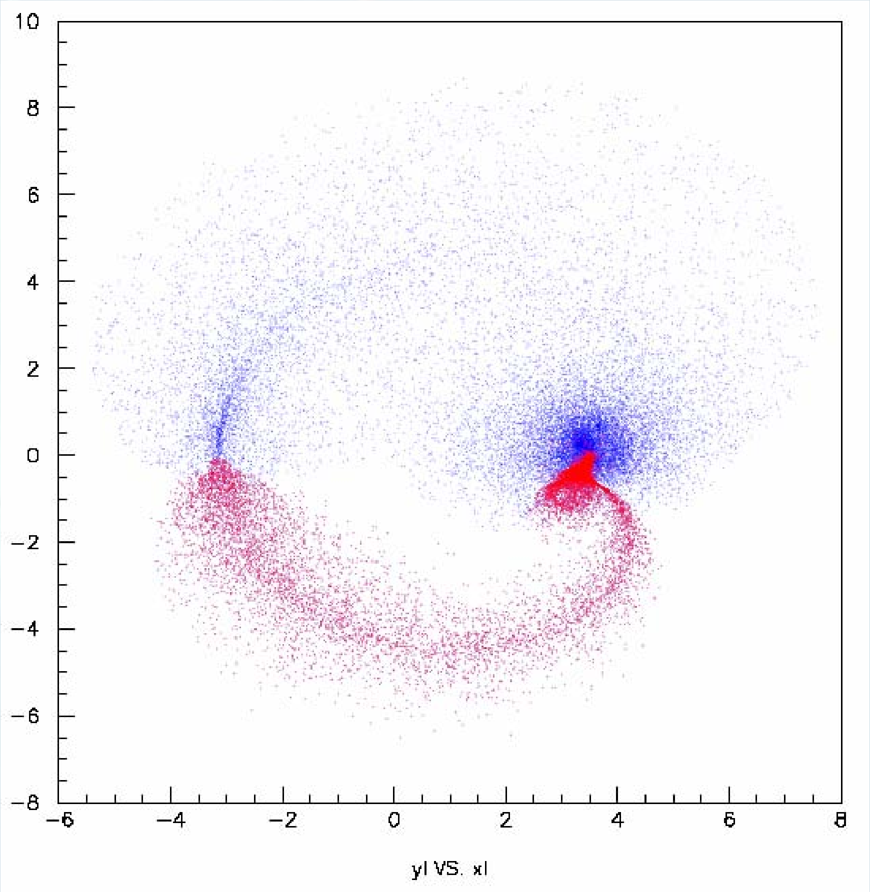


Influence of Serpentine Field

Pairs in the forward region (T. Maruyama): 2*10 mrad x-angle, 5T B-field



B_z=5T

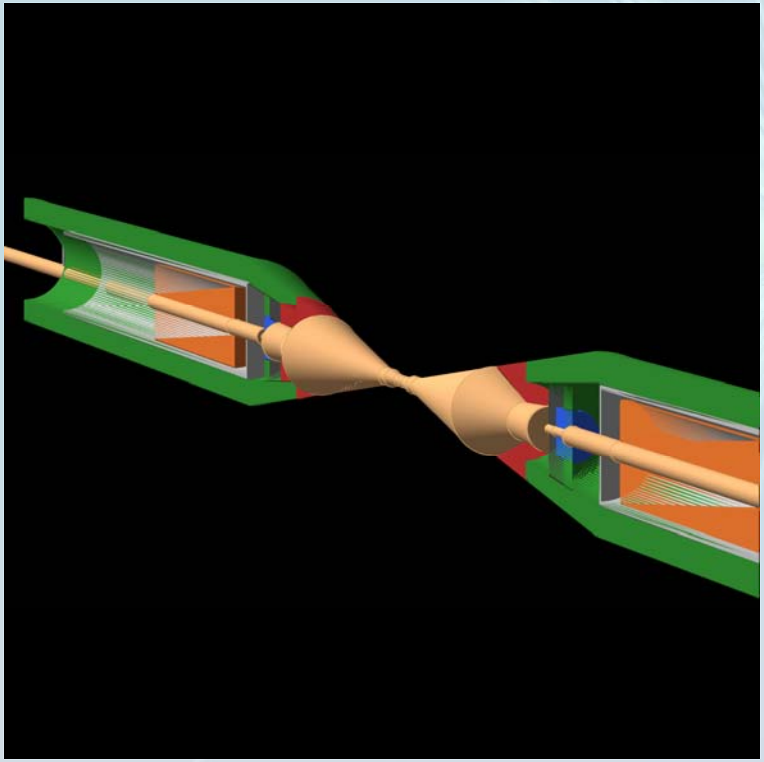


B_z=5T, $B_x=0.01 \cdot B_z$

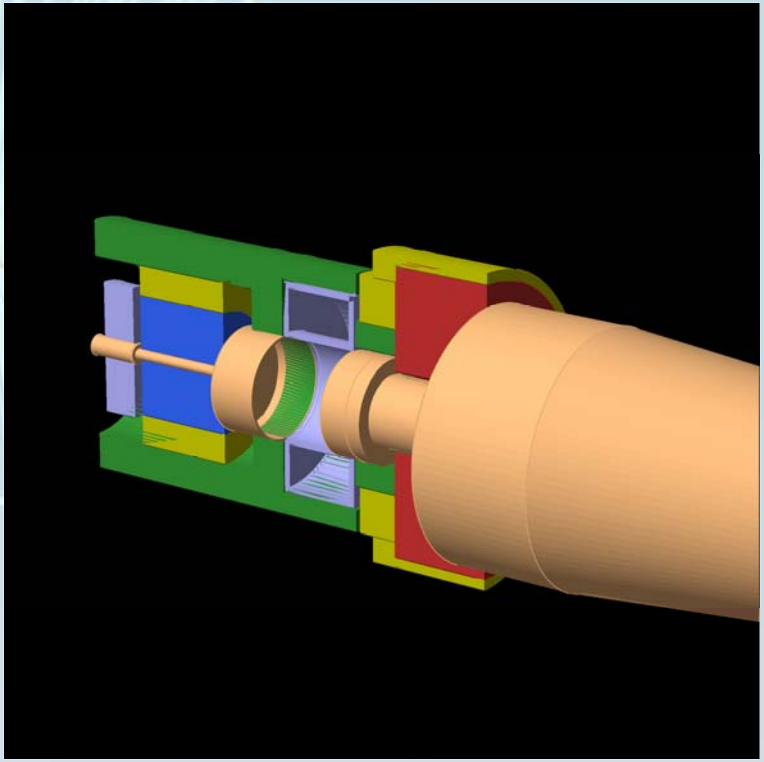
Switching to GEANT4

- Cross-check background numbers
- Study neutron backgrounds in the TPC in detail
- Beam-gas backgrounds

TDR Geometry



New Geometry



A. Vogel

Conclusion

- Background numbers depend on geometrical details
- The parameter space for simulations in infinite
  - Small geometry changes might have big impact on backgrounds
- Comparison of results is difficult
  - We should start an effort here!
- Opening the exit holes
  - increases backscattering into the vertex detector
  - decreases backscattering into the outer trackers (e.g. TPC)
- Head-on geometries or small crossing angles seem to produce less backgrounds from backscattered pairs
- Backscattering with serpentine field has to be studied
- Optimisation of interaction region is an iterative task