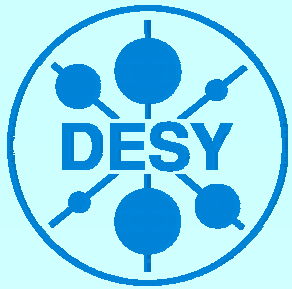
Pair Backgrounds in the Large Detector with realistic Solenoid and DID Fields

Karsten Büßer



2nd ILC Workshop
Snowmass
16. August 2005

Introduction

- Backgrounds from pairs are the largest background source for the ILC detectors
- For the large detector a lot of different geometries have been studied:
  - different crossing angles
  - holes for incoming/outgoing beams
  - magnetic field configurations

    → see talks presented at LCWS2005 and BDIR/ILC-Europe WS
  - So far: used ideal magnetic fields for
    - solenoid
    - Detector Integrated Dipole (DID)
  - New: introduced more realistic field maps into simulations

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

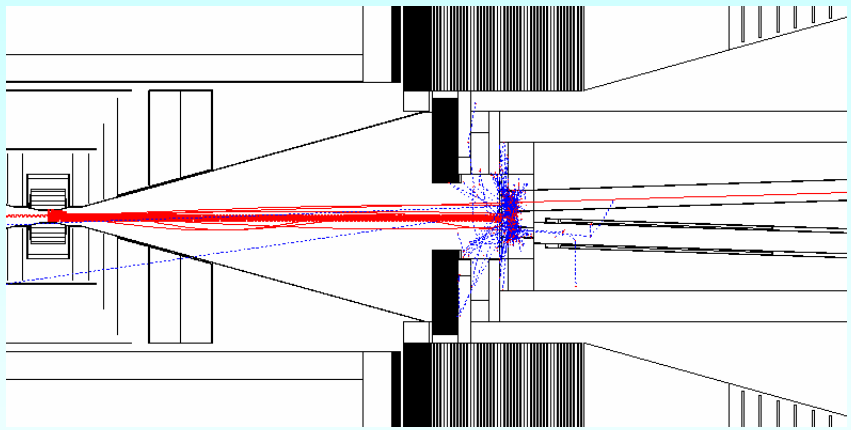
- every charged particle which deposes energy in a SI device
- every 3d hit in the TPC

Basic geometry used

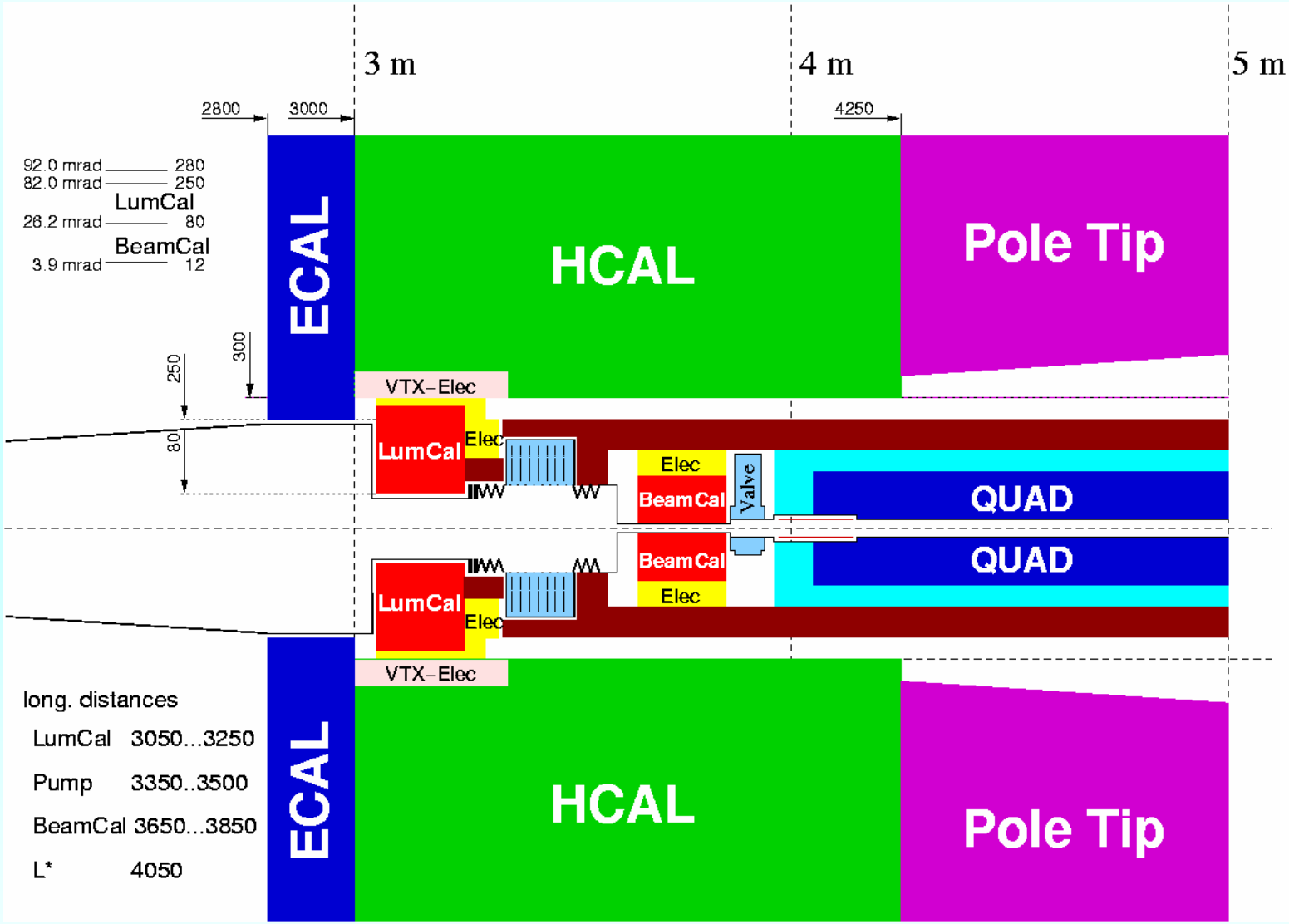
- 2*10 mrad crossing angle
- 2*1 mrad crossing angle

Modifications

- solenoid field map
- DID field map (for 20 mrad only)



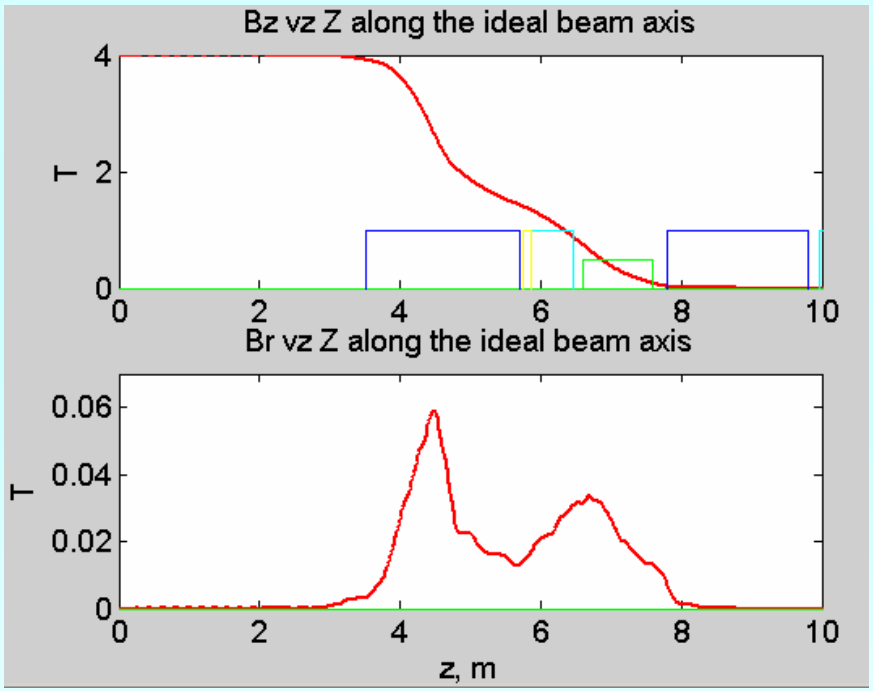
Reminder: the Forward Region Design

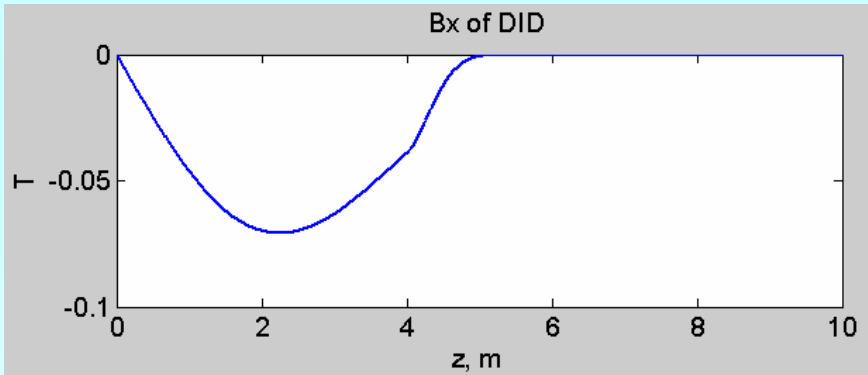


Realistic Magnetic Fields

Field map for the TESLA solenoid by F. Kircher et al.

Field map of DID by B. Parker and A. Seryi

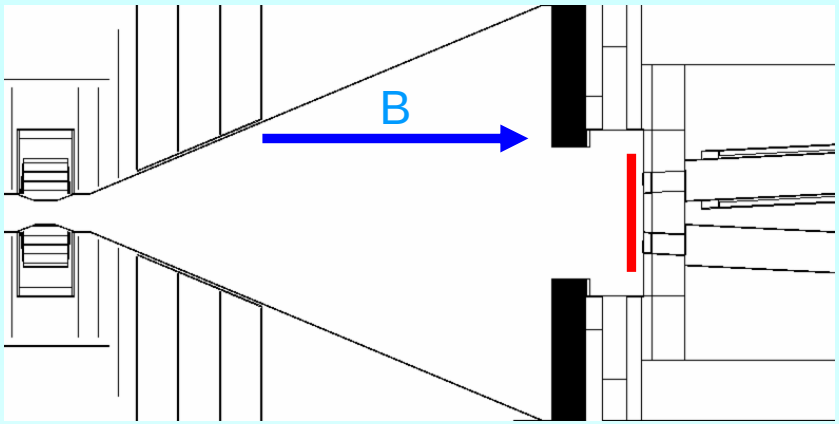


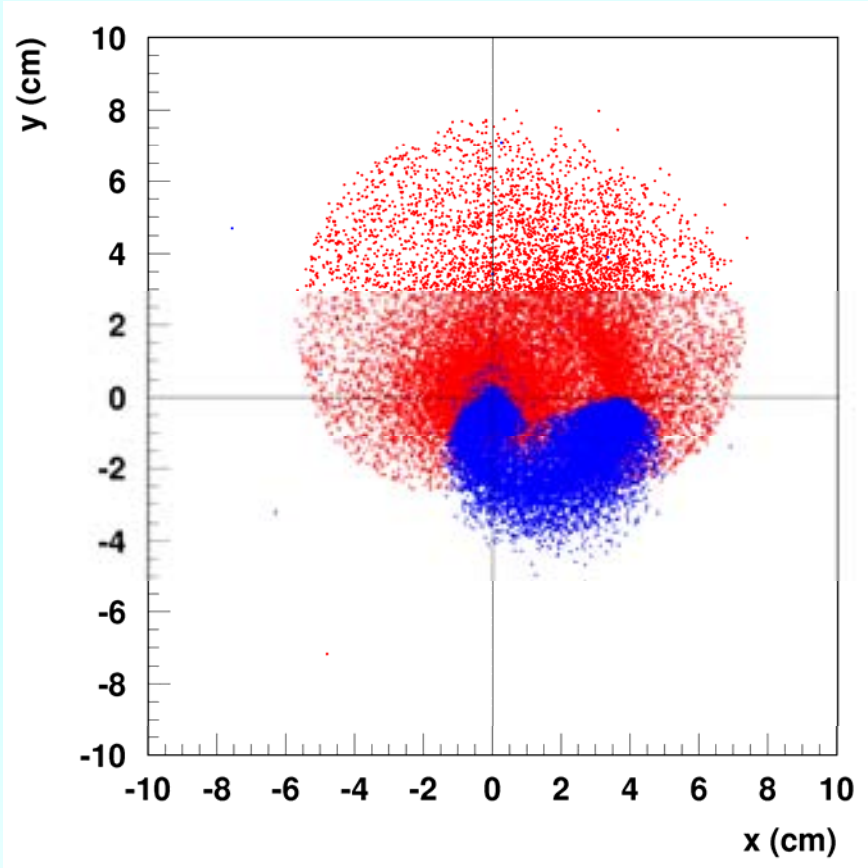


DID field combined with FD offset to zero both angle and position at the IP

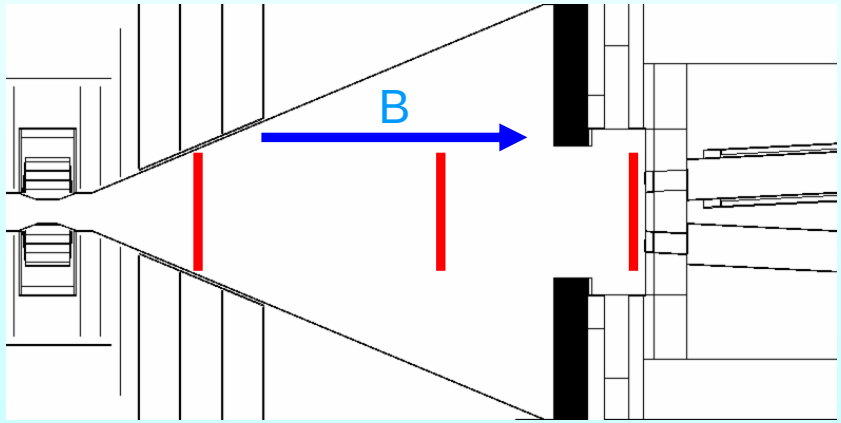
Pairs on the BeamCal

Solenoid B-field only (realistic field map)

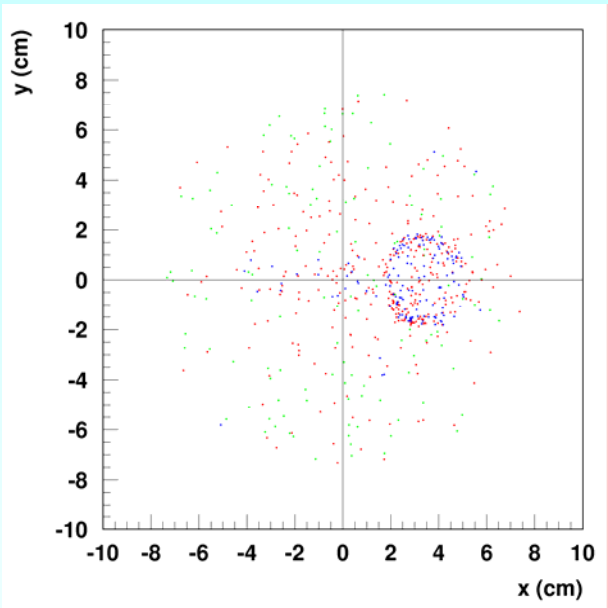


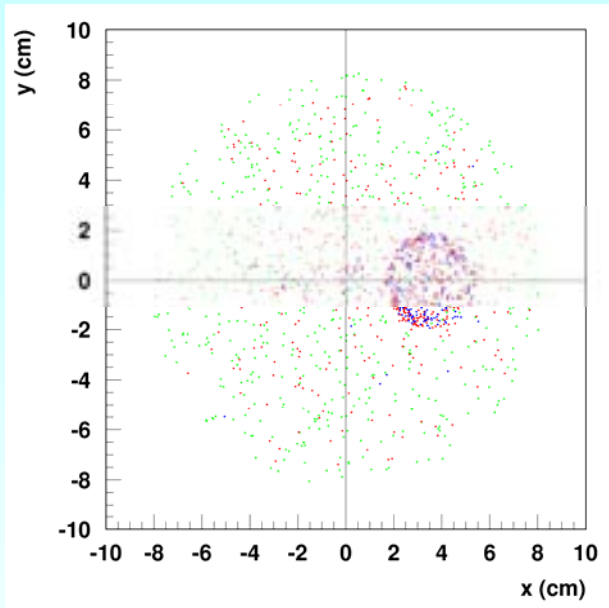


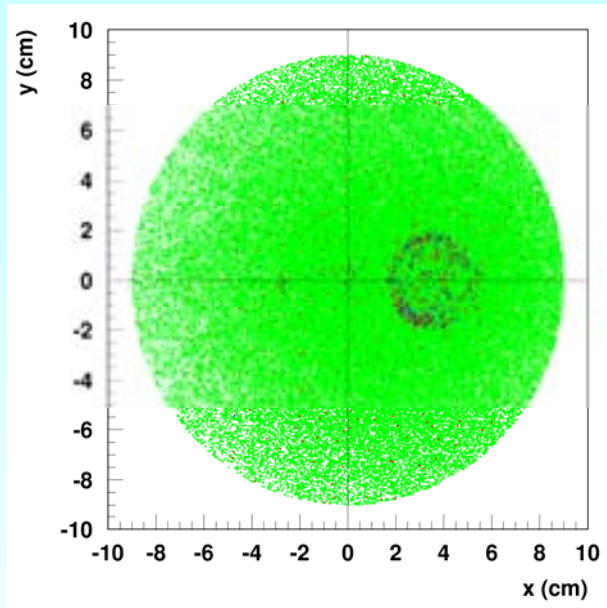
Backscattering in Solenoidal Field



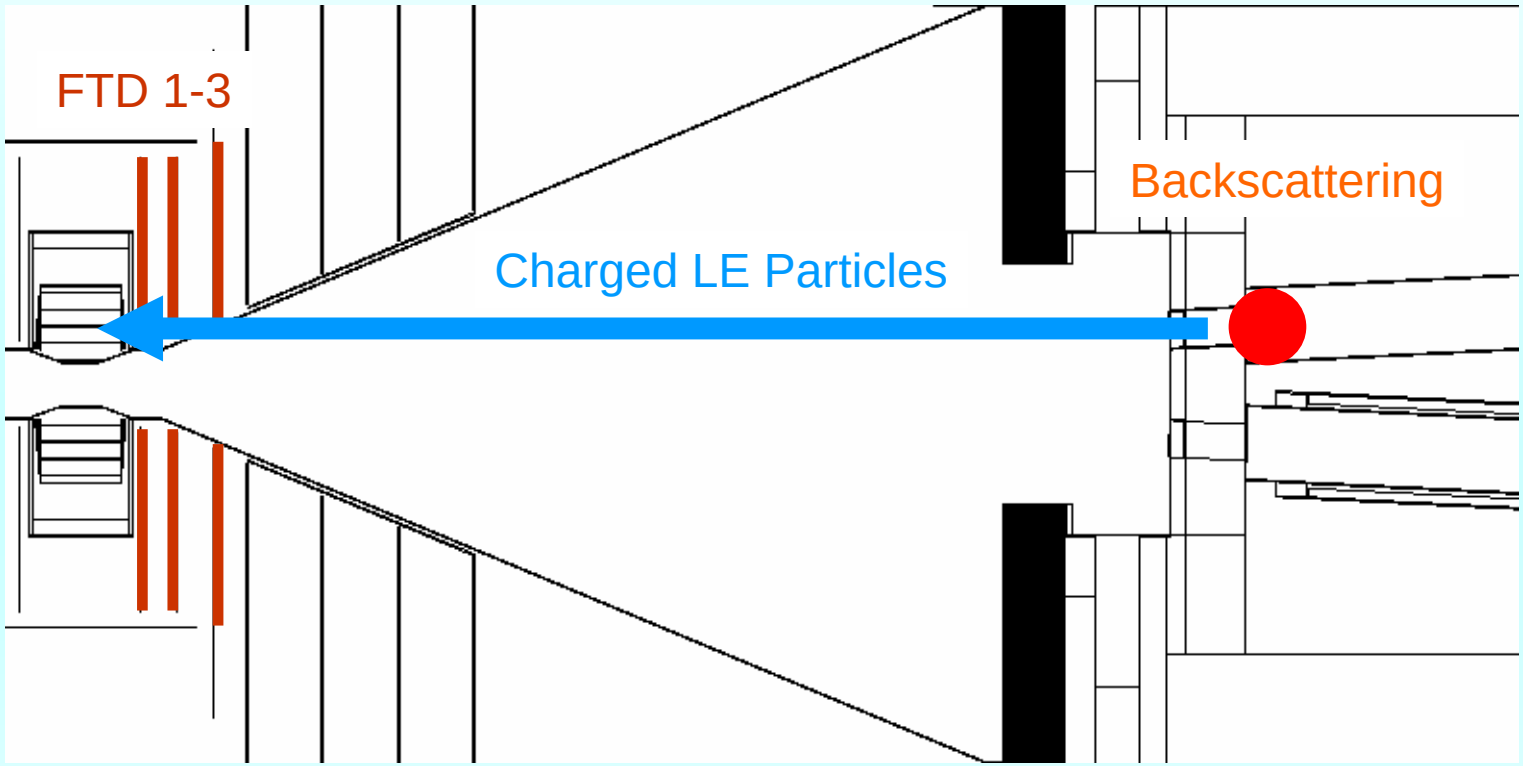
Color coding:
Photons
Electrons
Positrons





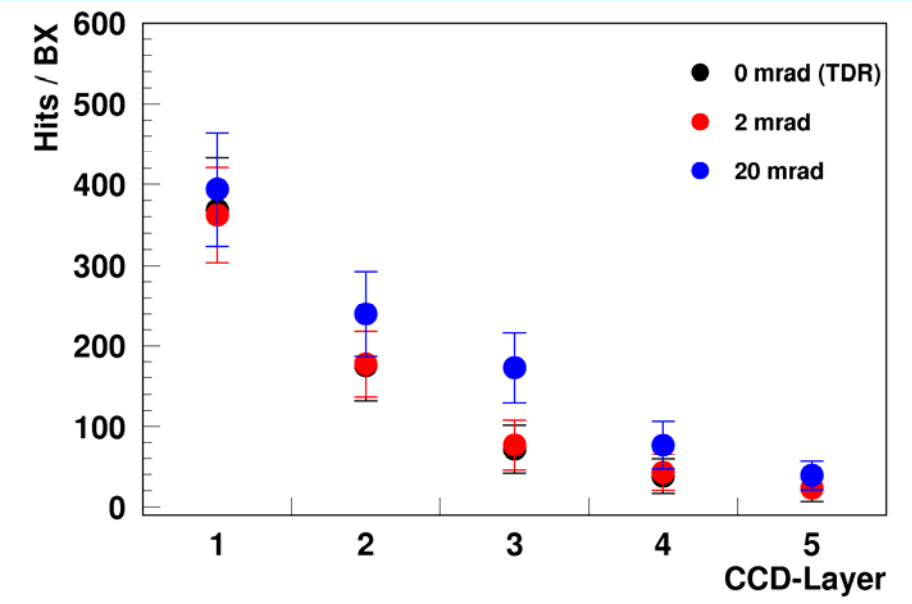


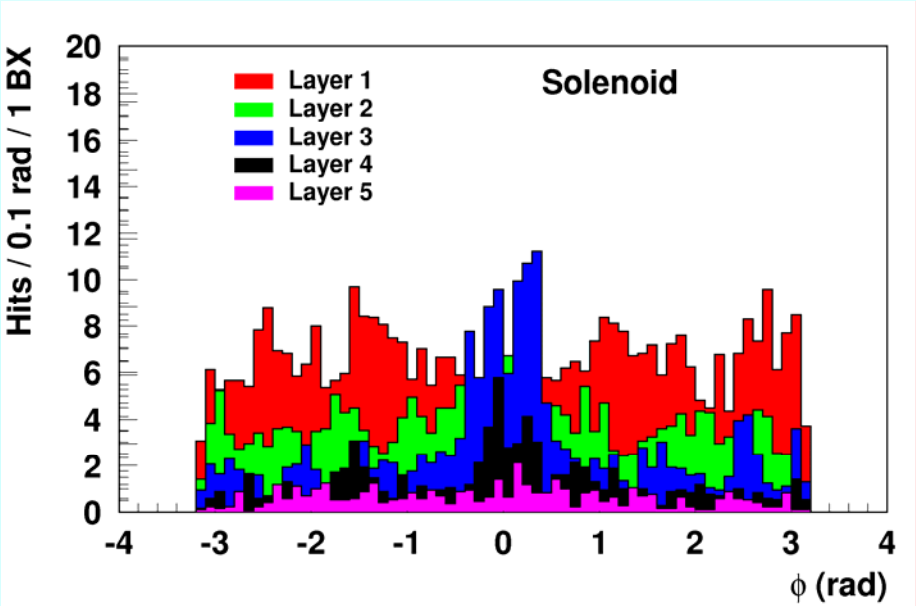
Hits on the VTX



- 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

Hits on the Vertex Detector with Solenoid Field, 20 mrad

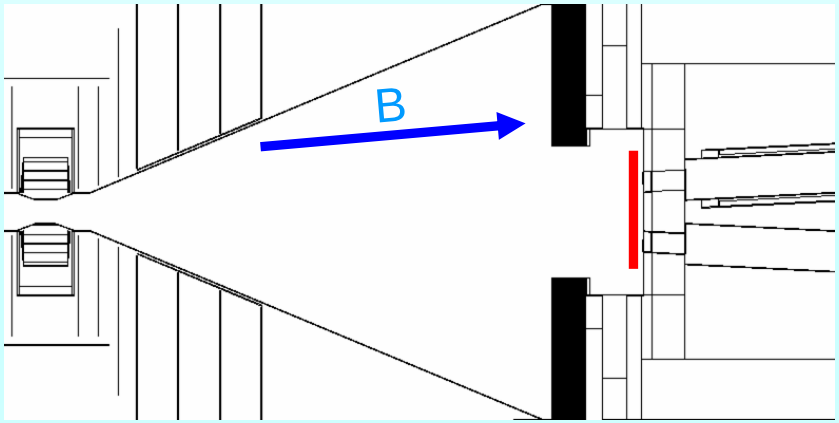


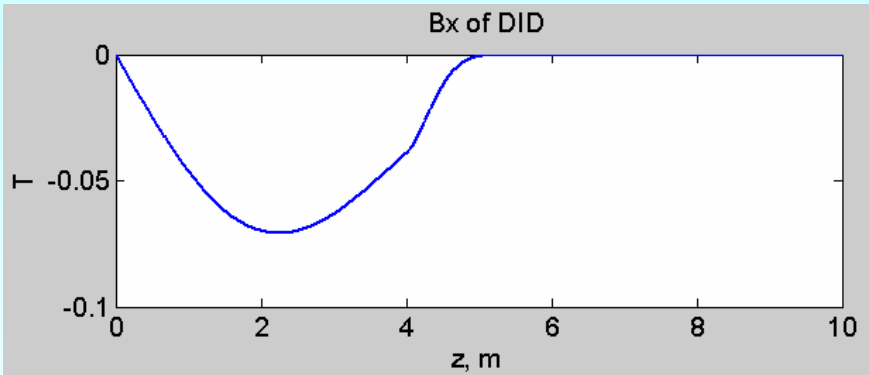


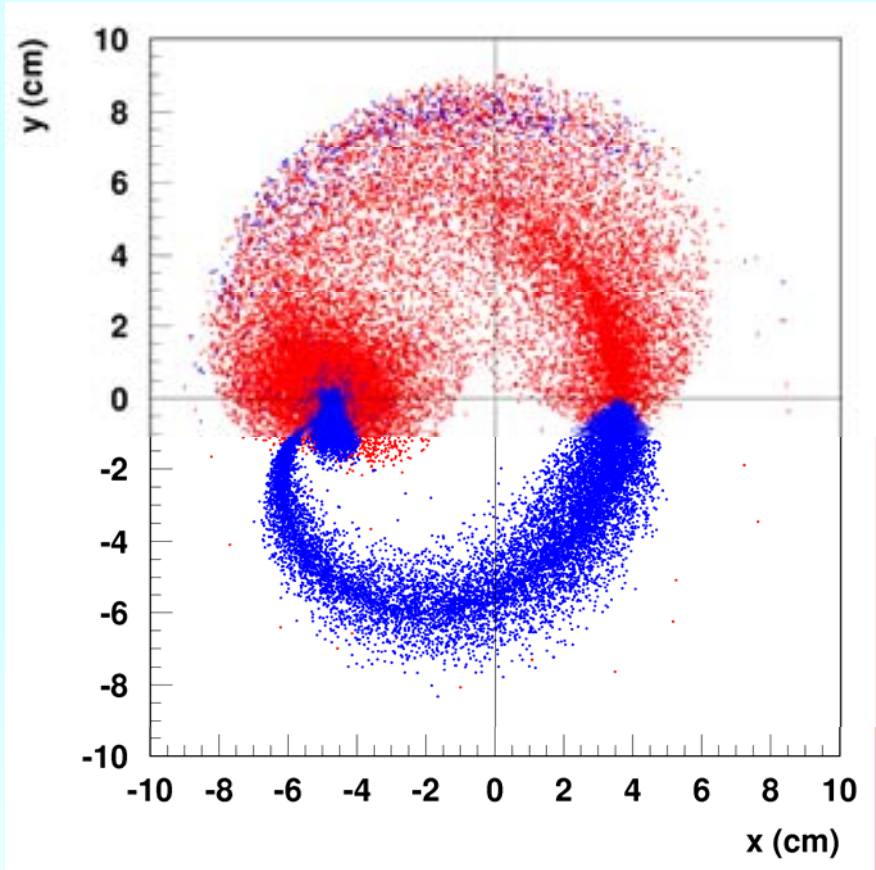
- ‘Pictures’ from the holes produce asymmetries

Pairs on the BeamCal

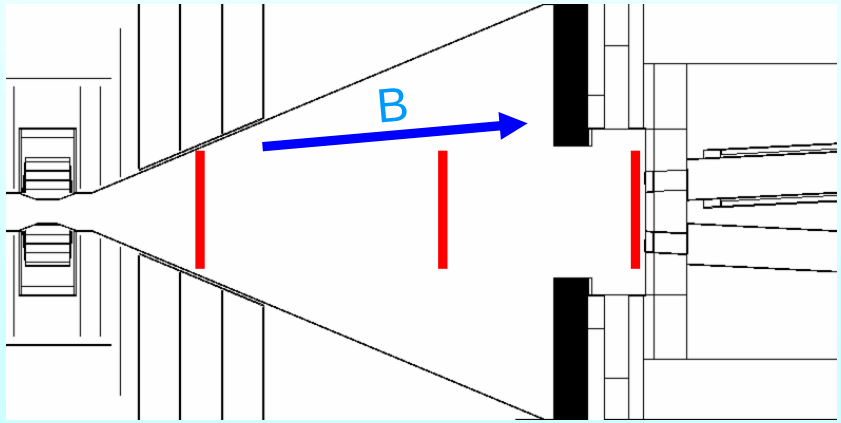
Added dipole correction field (“DID”)







Backscattering with DID



Color coding:
Photons
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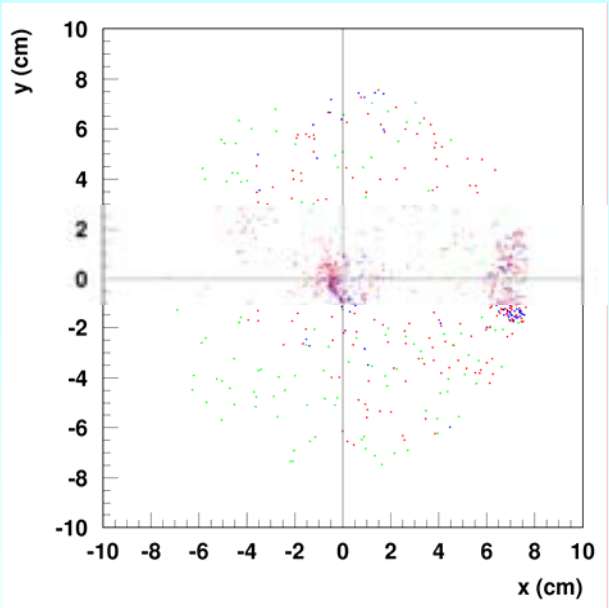
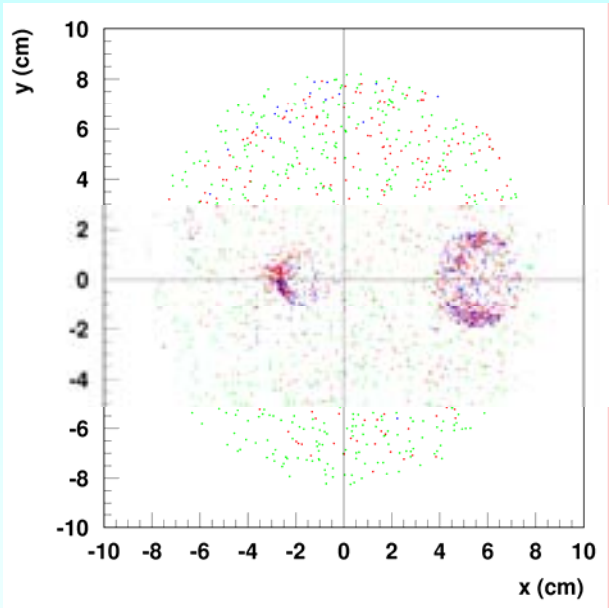
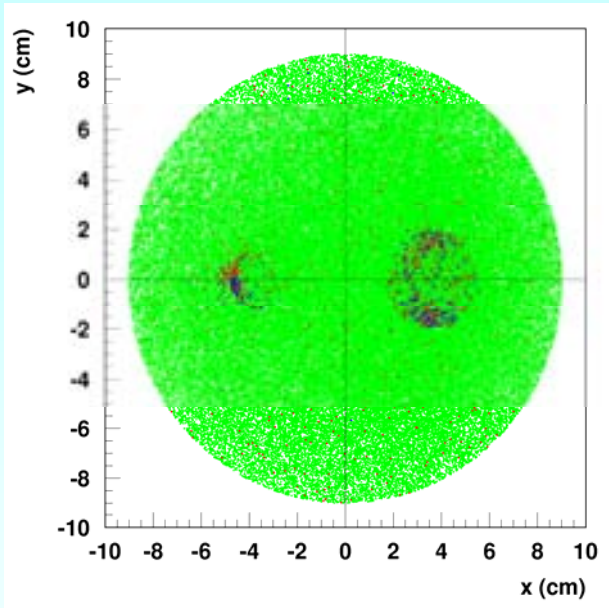
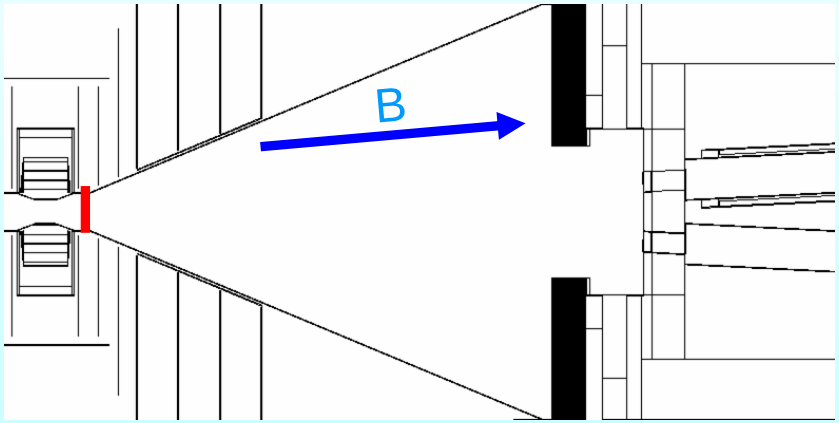
Poitrons







Backscattering with DID



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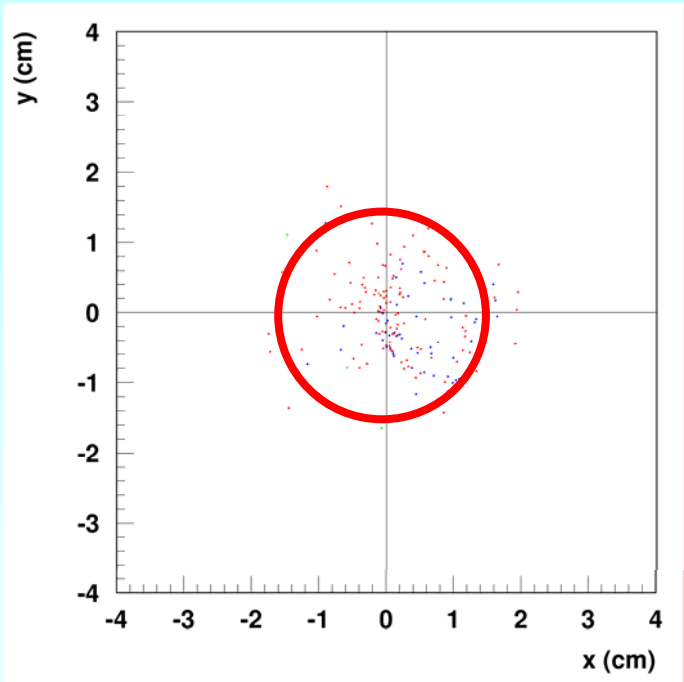
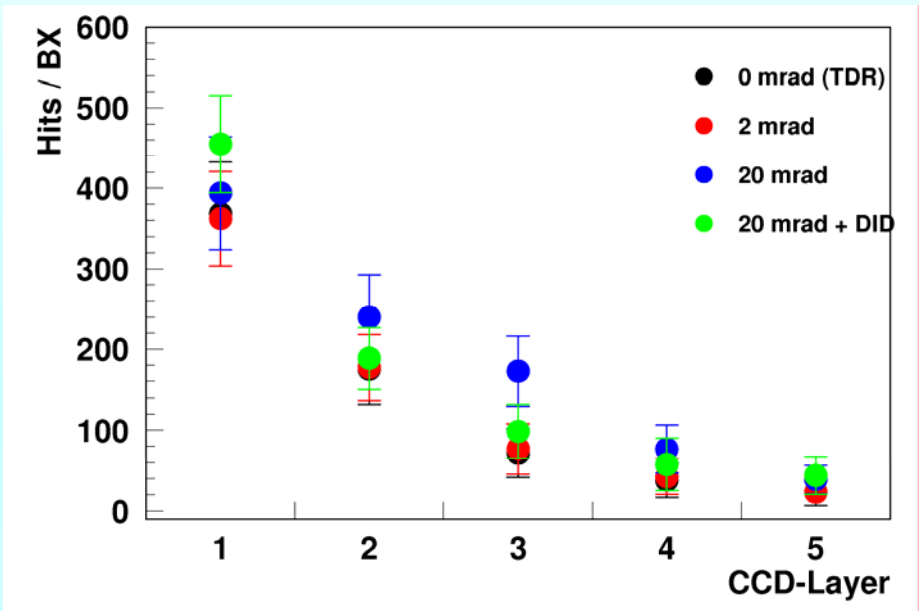
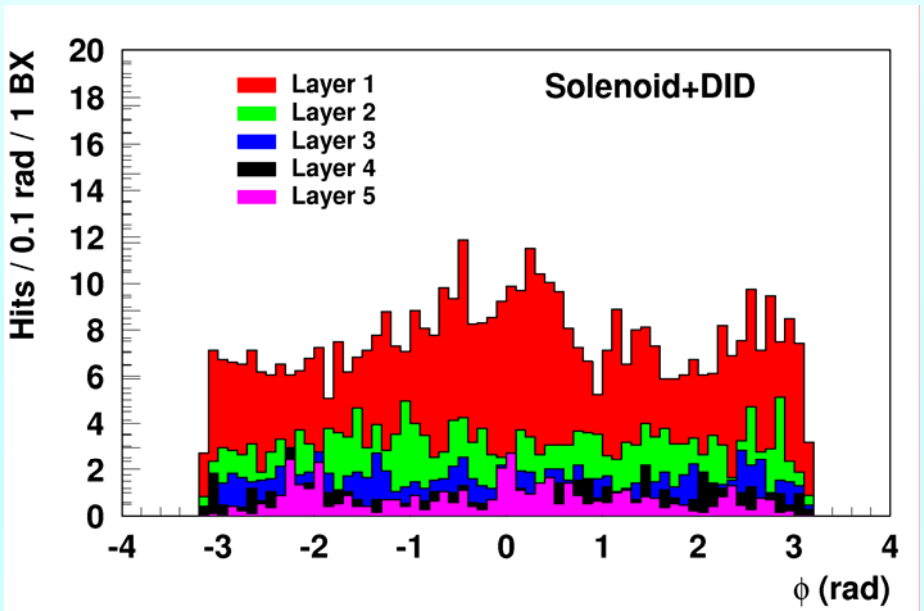


Inner VTX layer

Hits on the Vertex Detector with Solenoid+DID, 20 mrad





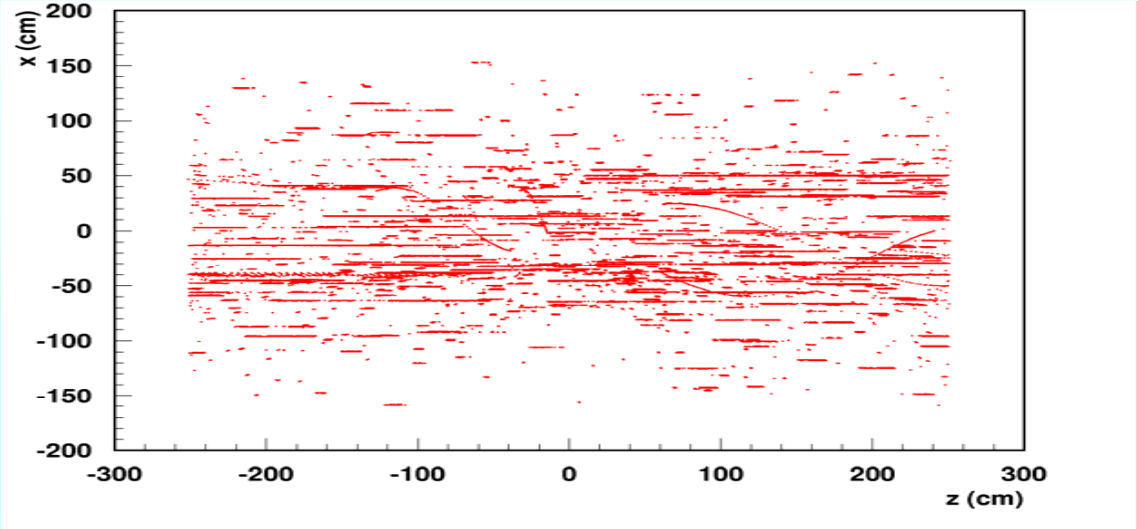
Realistic DID:

- guides charged particles from exit hole away from outer layers
- guides charged particles from incoming hole into layer 1

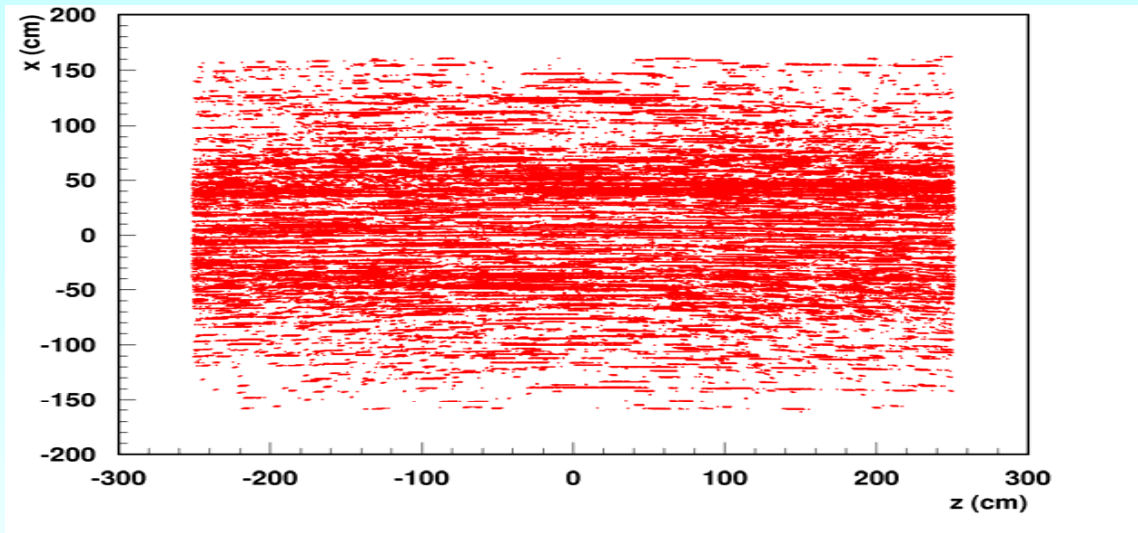
→ though the effect is small here, that is potentially dangerous!

Hits in the TPC

Solenoid field:
3304 ± 704 Hits/BX

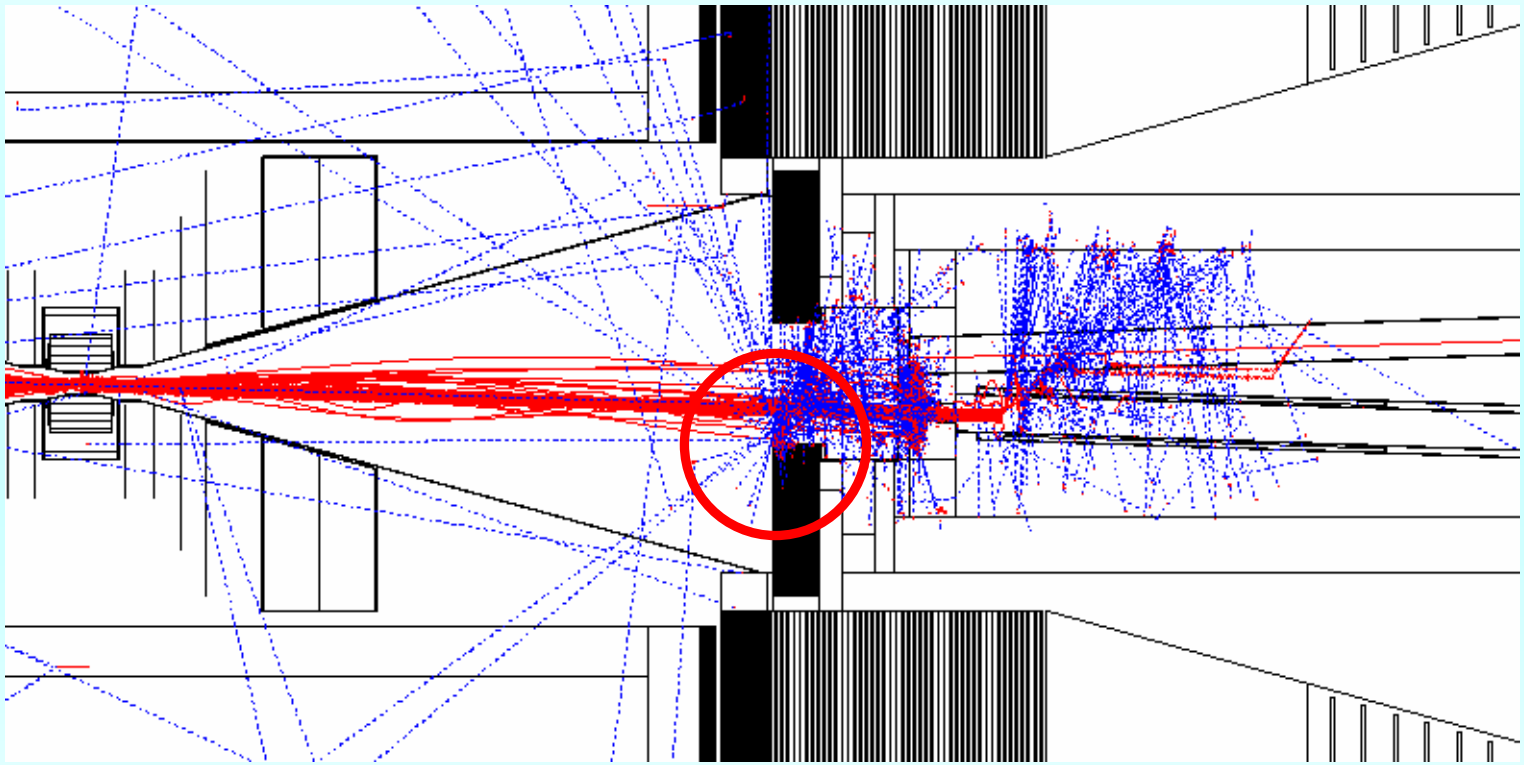


Solenoid+DID field:
18145 ± 2518 Hits/BX



Plots show hits of 17 BX overlaid

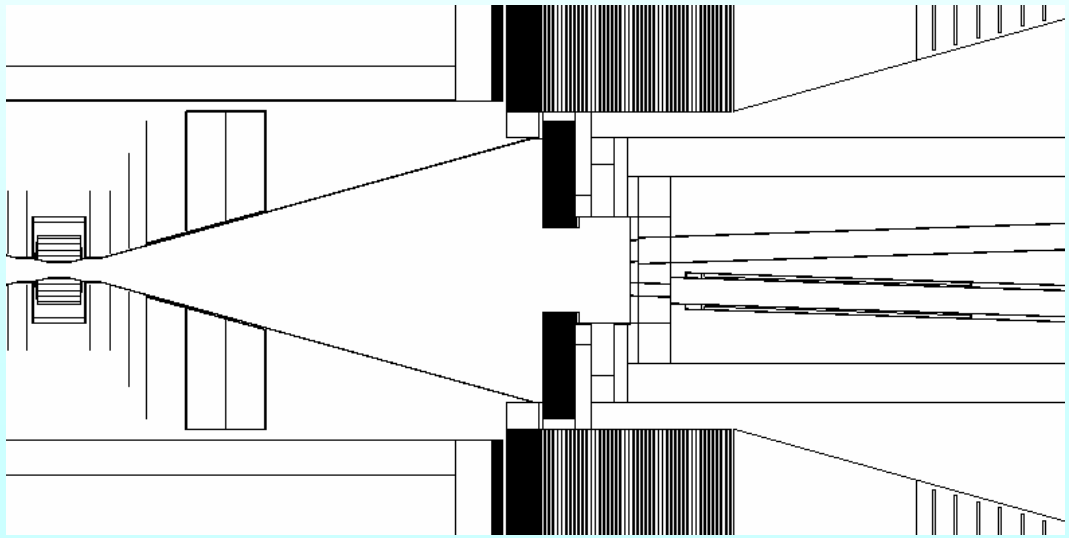
Origin of TPC Photons with Solenoid+DID



Pairs hit edge of LumiCal

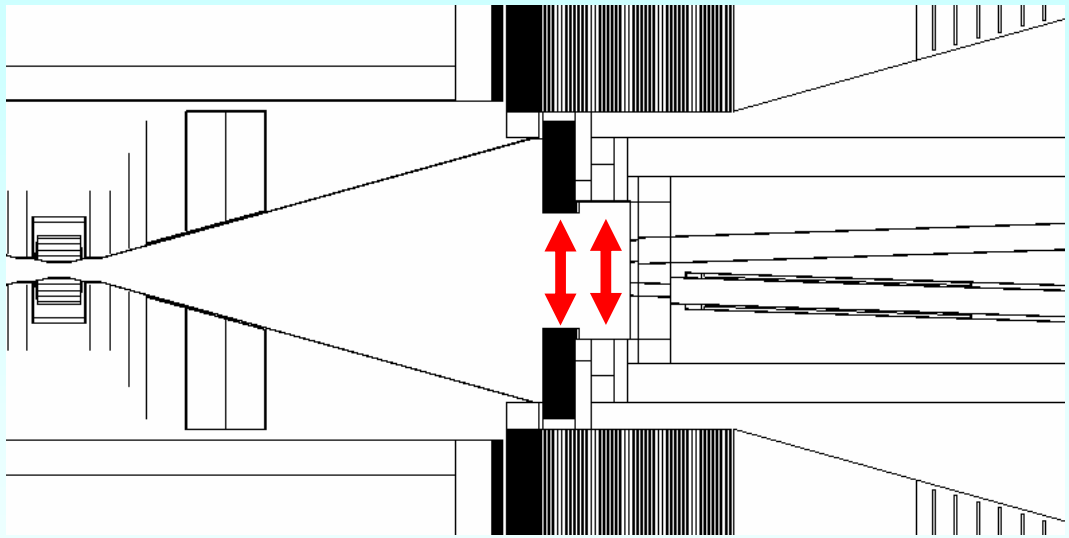
First Try for a Fix

Original geometry



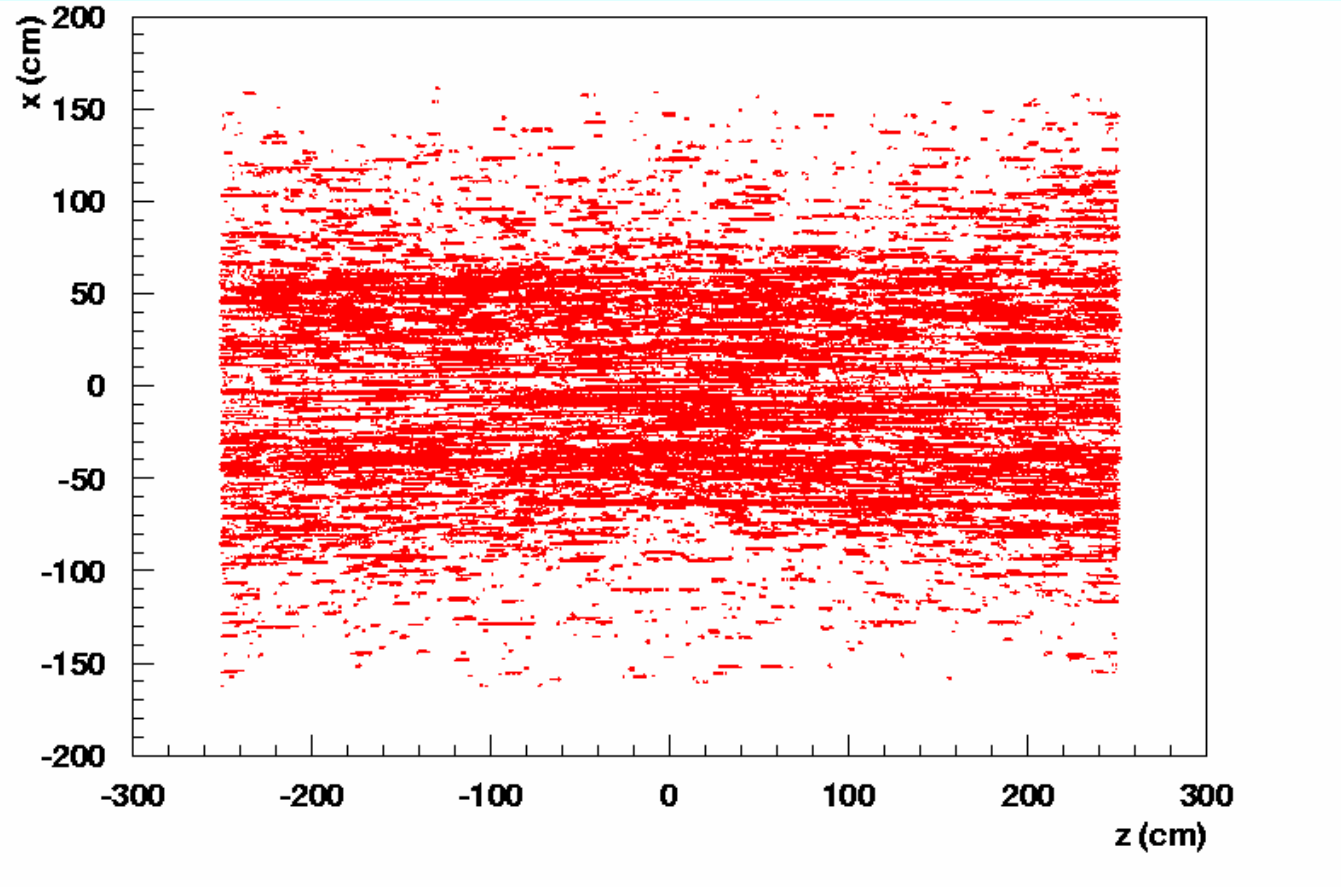
New geometry:

- increased aperture of LumiCal by 3 cm
- increased outer radius of BeamCal by 3 cm
- increased apertures in between accordingly



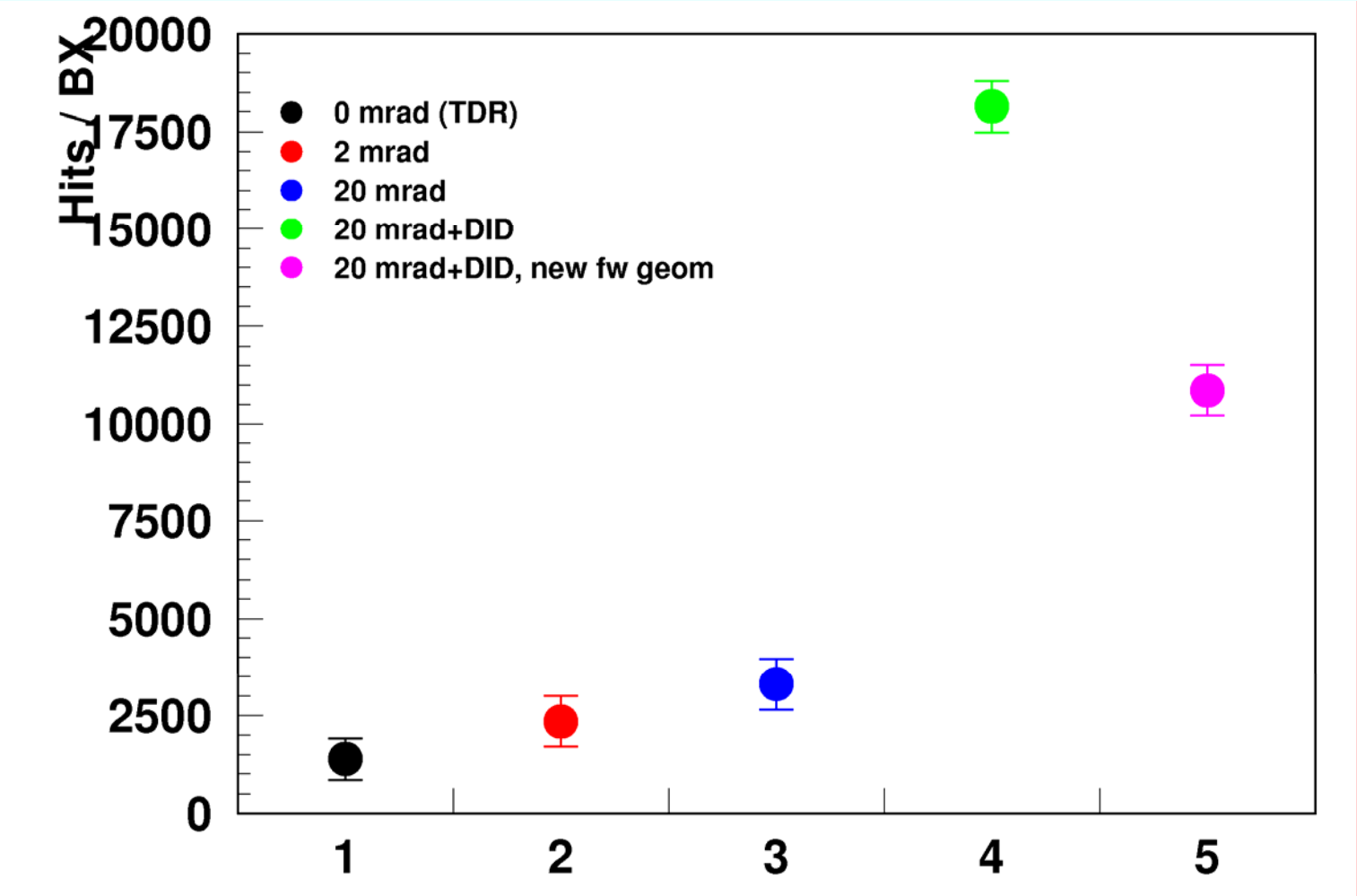
Hits in the TPC – New Geometry

10861 ± 1840 Hits



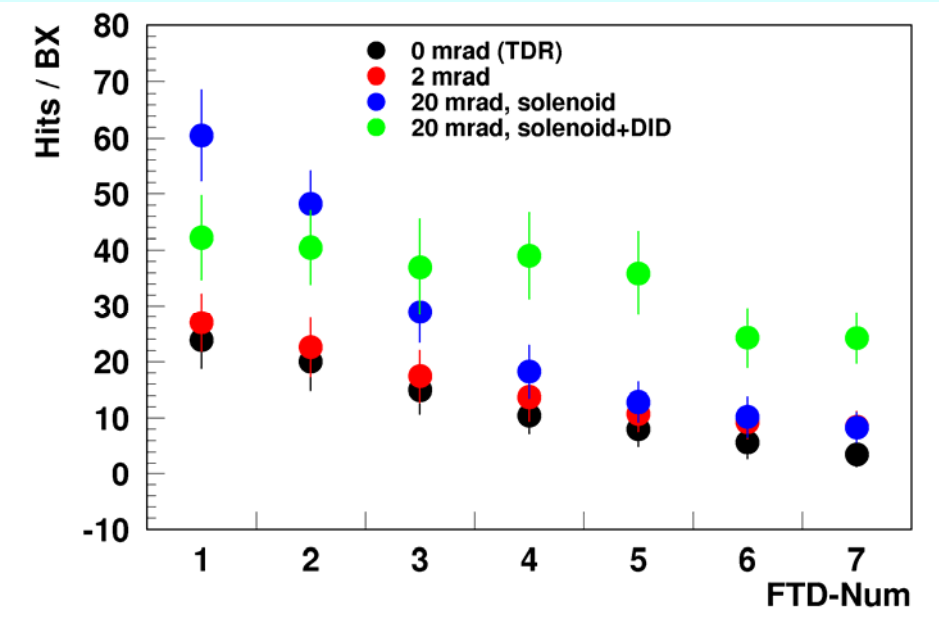
Larger opening angle of the mask results in more backscattering into the TPC

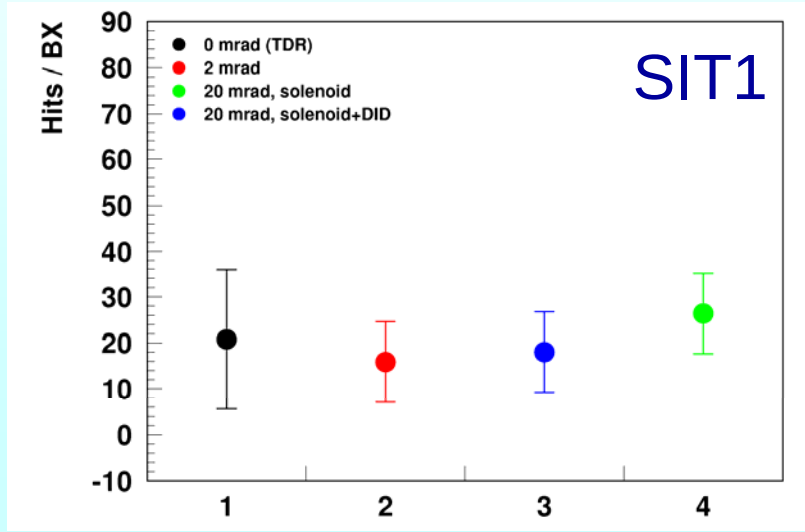
Hits in the TPC Summary

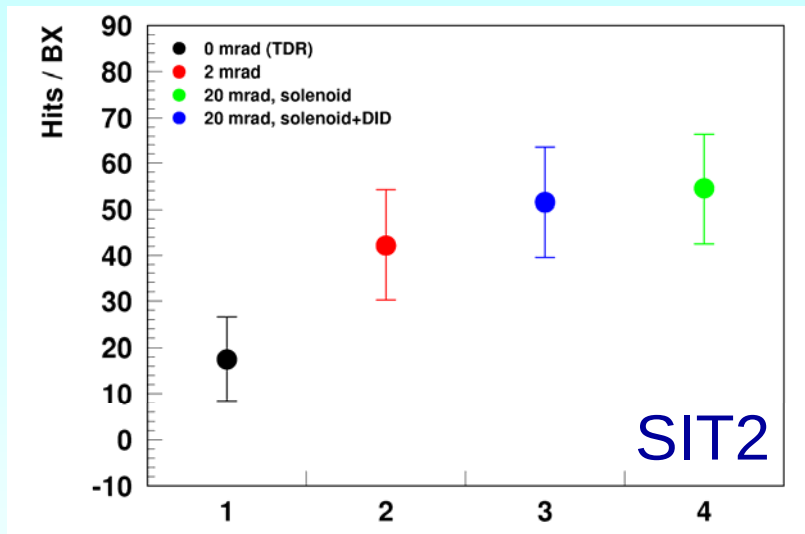


Other Tracking Devices

Forward Tracking Disks







Conclusion

- current DID fields (with the current detector design)
  - guides low energetic charged particles coming from the hole for the incoming beam into the first layer of the vertex detector
    - The effect is small here, but this is potentially dangerous for the vertex detector
  - increase backgrounds in the TPC (and the forward chambers) by a factor of 4 compared to pure solenoid field configurations, this is a factor of 6 above the 2 mrad case and a factor of 10-12 above the TDR head-on case
  - a quick fix to the geometries of the forward region brings no substantial improvement to the TPC backgrounds
- To be done
  - invent a solution for the vertex detector backgrounds (tune DID field?)
  - invent a clever solution to heal the TPC background problem
  - understand detector tolerances
- Be careful:
  - Magnetic field configurations can have big impact on backgrounds!