Beam-induced background effects in the ILD

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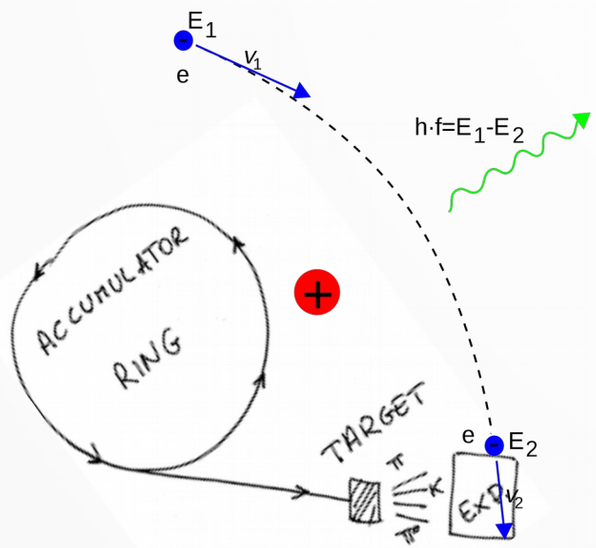
Outlook

- Intoduction :
  - ILC background
  - ILD detector
  - Role of Anti-DID field for beam-induced background
- Data and results
- Future plan

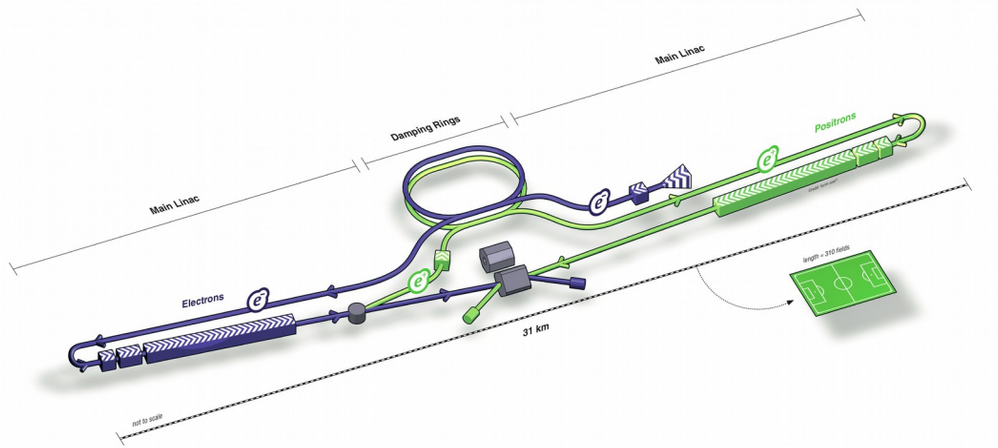
ILC background

Circular lepton collider



- more challenging to analyze
- harder to precision measurements
- large energy losses from synchrotron radiation.

Linear lepton collider



- no synchrotron radiation
- electron-positron collider, ILC may provide a very clean experimental environment
- cprecise measurements ,

  but still has some background

Beam-induced background in ILD

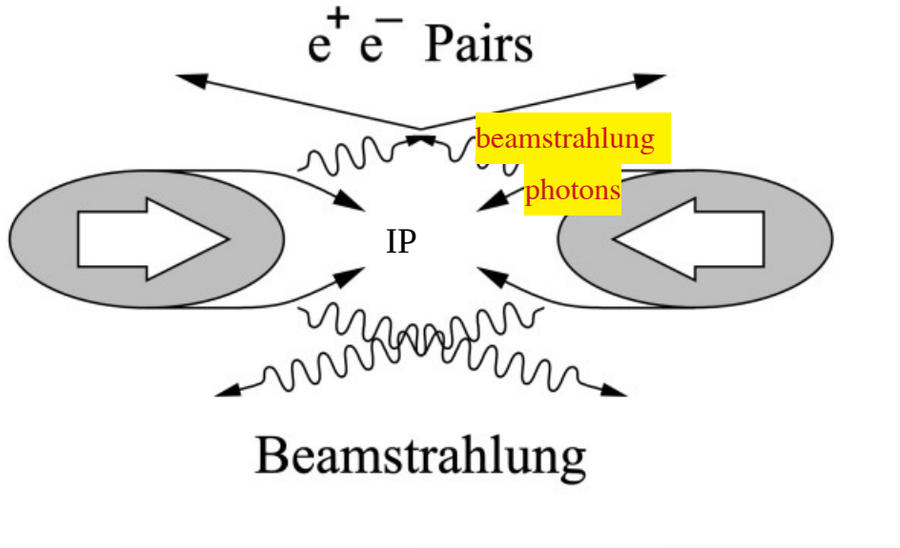
In order to reach a luminosity we want small bunch

$$\mathcal{L} = \frac{n_b N^2 f_{\text{rep}}}{4\pi\sigma_x\sigma_y} H_D,$$

Size of bunch

1) Beam need to be focused to an extremely small spot;
2) Smaller beam size implies higher charge density
3) Some particles accelerated towards to centre of bunch

} **"pinch effect"**

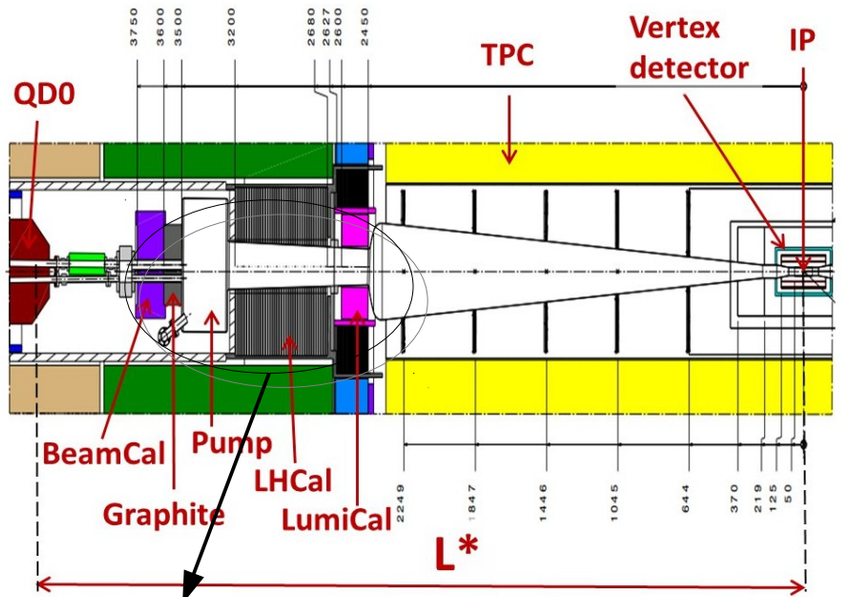


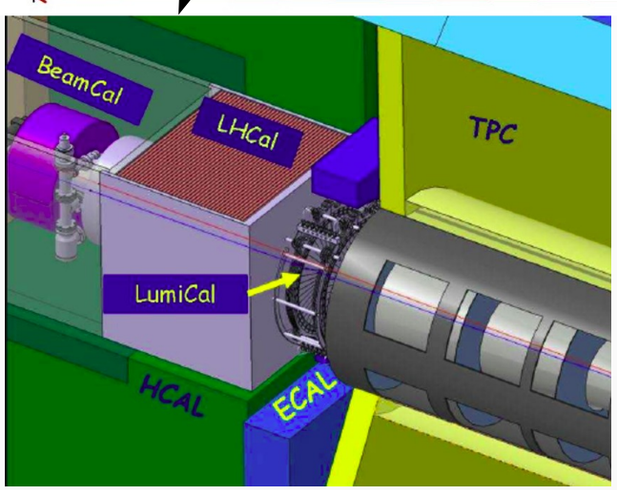
Average energy loss:

$$\delta \propto \frac{\gamma}{E\sigma_z^*}\left(\frac{N}{\sigma_x^* + \sigma_y^*}\right)^2$$

e+e− pairs focused in the forward direction and hitting the detector material

ILD detector



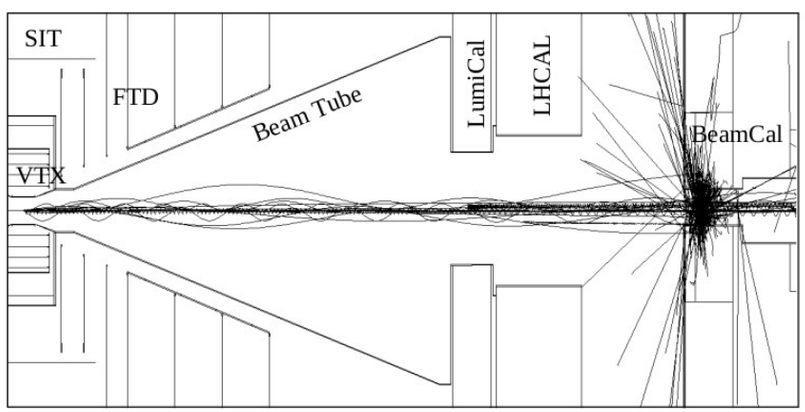


Forward calorimeters system

The beam-induced pairs are also mainly focused in the forward direction here

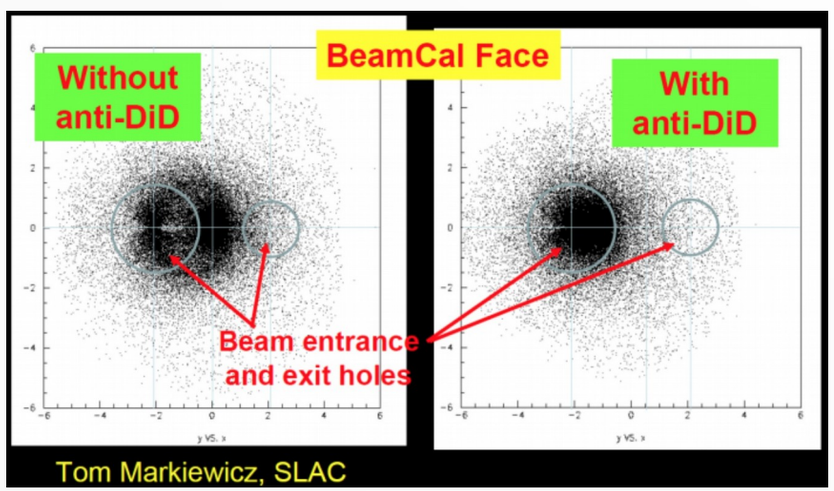
Hitting material between incoming and outgoing beampipes and inducing intense electromagnetic showers

Many of the particles with slightly larger polar angles or transverse momenta will hit the forward calorimeters of the detector, where they will deposit a large amount of energy

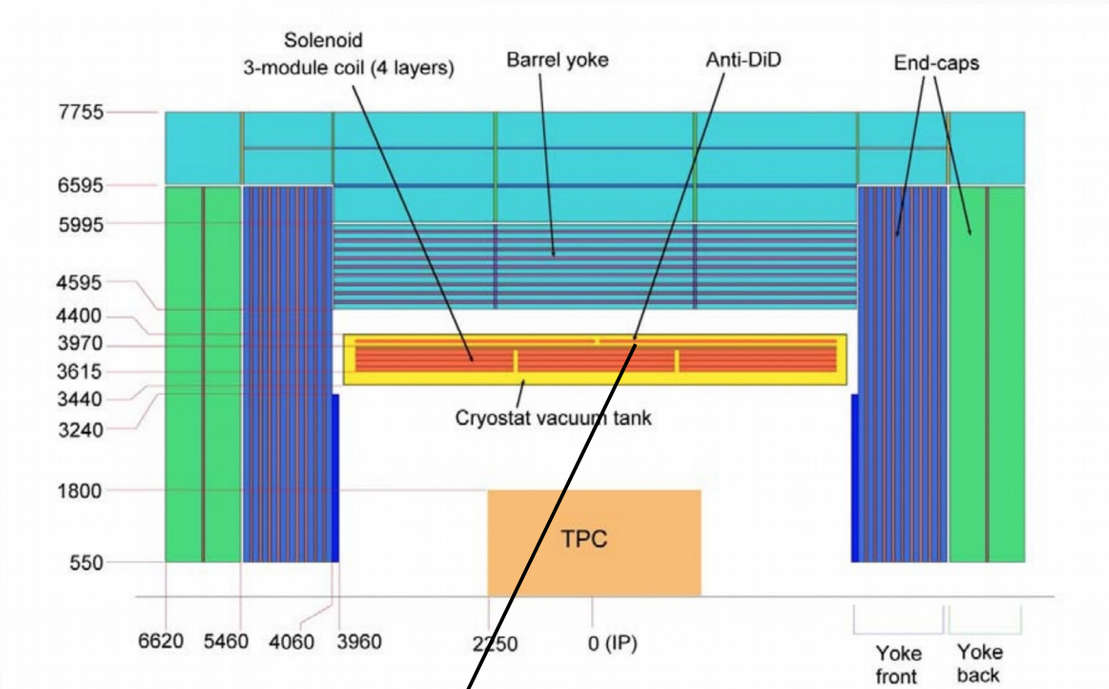


The goal of Anti-DiD field

The anti-DID field designed to guide particles into the outgoing beampipe →



→ reducing the number of particles backscattered into the central detector region.



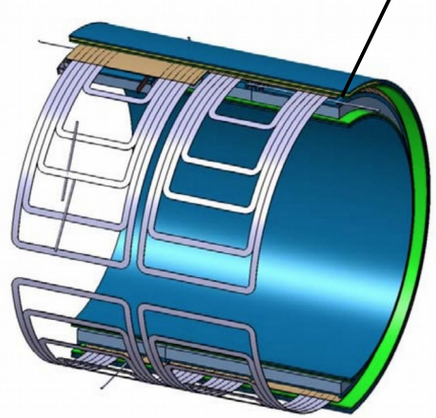


Fig 2. Position and designed of AntiDID dipole

Tasks

- Get familiar with LCIO soft
- Reproduce analysis done by Daniel and Akiya
- Get similar plots for energy distribution for LumiCal and LHCal

Data

.sclio → .root

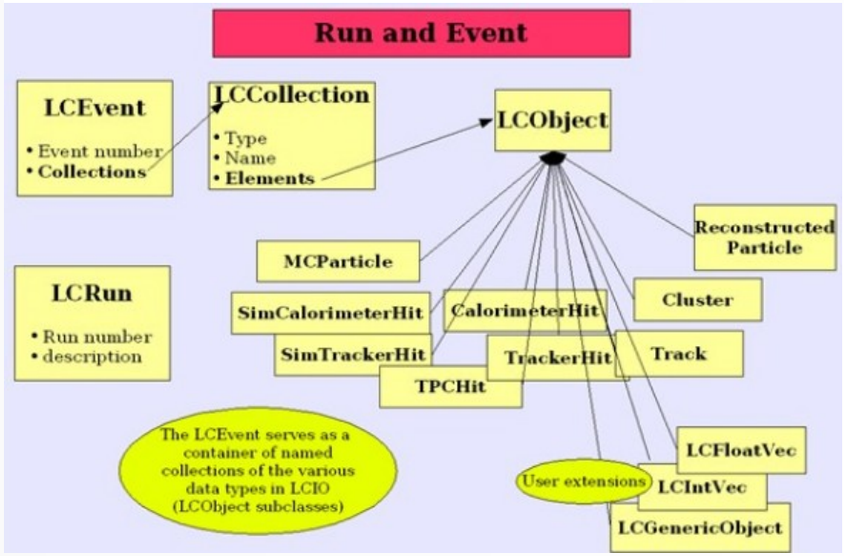
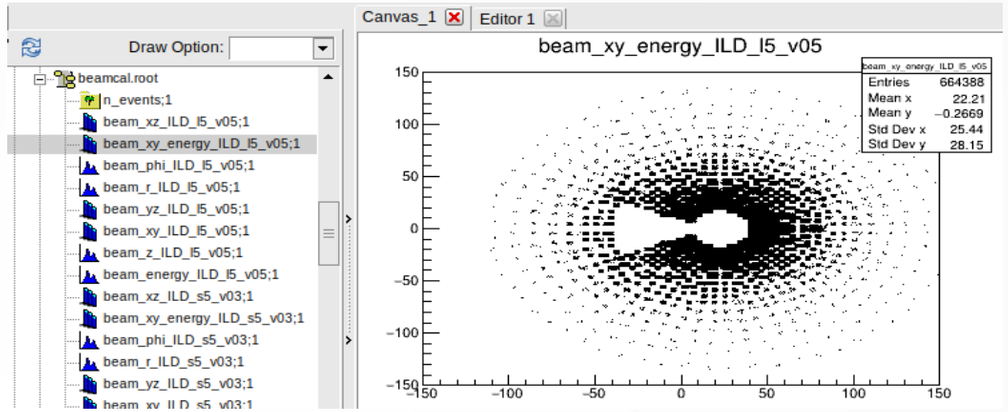


Fig 1.Overview of the data model defined by LCIO.



For different part of detector
Different “Collection” of events

model	size	energy	anti-DID
ILD_l5_v03	large	250	no
ILD_l5_v05	large	250	yes
ILD_s5_v03	small	250	no
ILD_s5_v05	small	250	yes

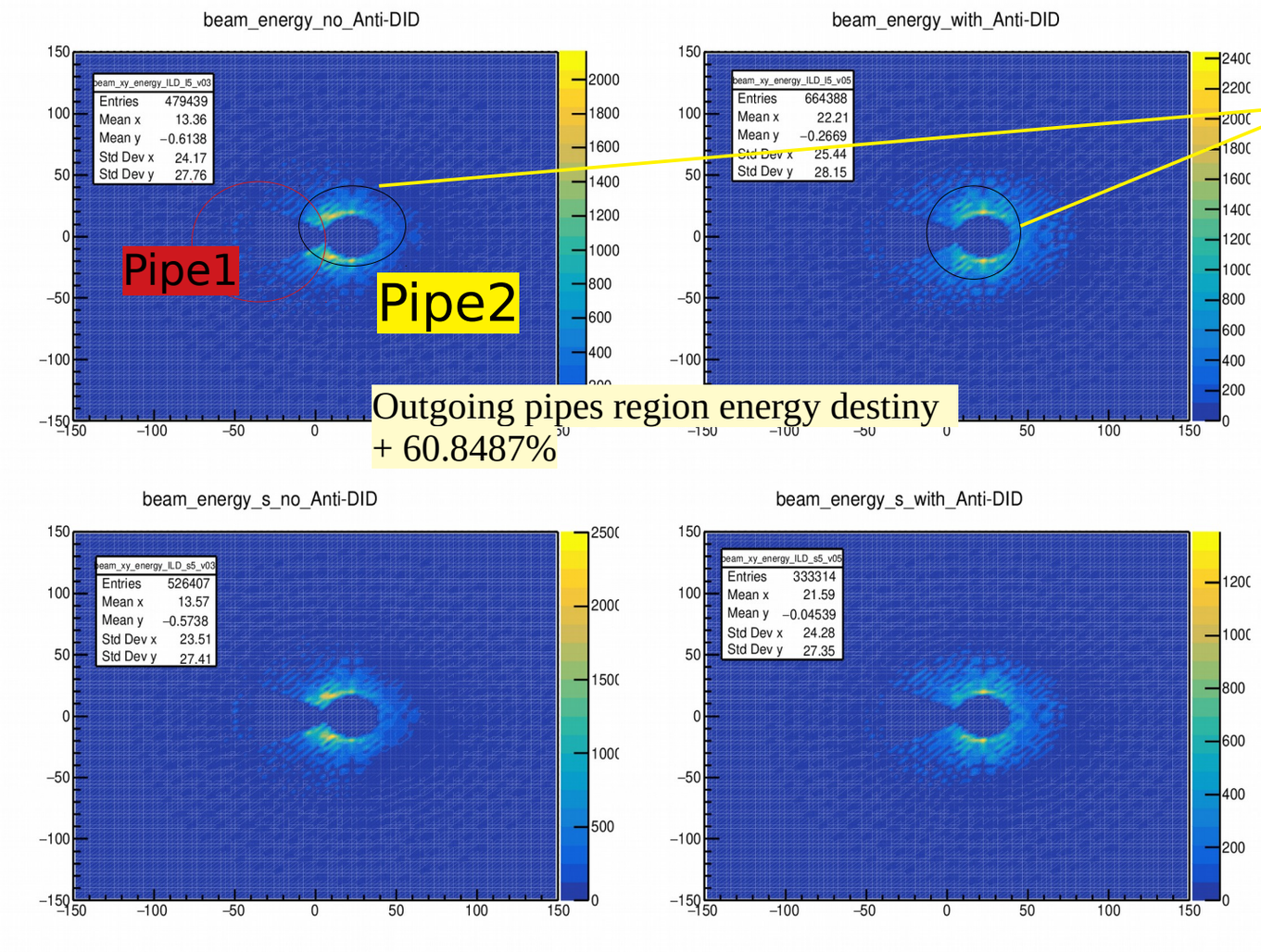
Fig 2. Detector models ILD

[l/s] refers to Large and Small detector models,

[3/5]- without/with the anti-DID field at 250 GeV

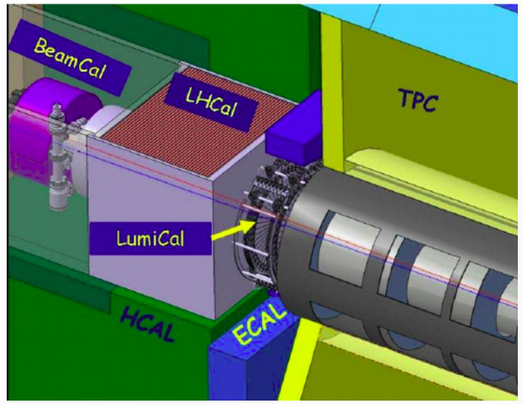
Results : Beamcal

1.Energy distribution in beamcal in x-y plan.



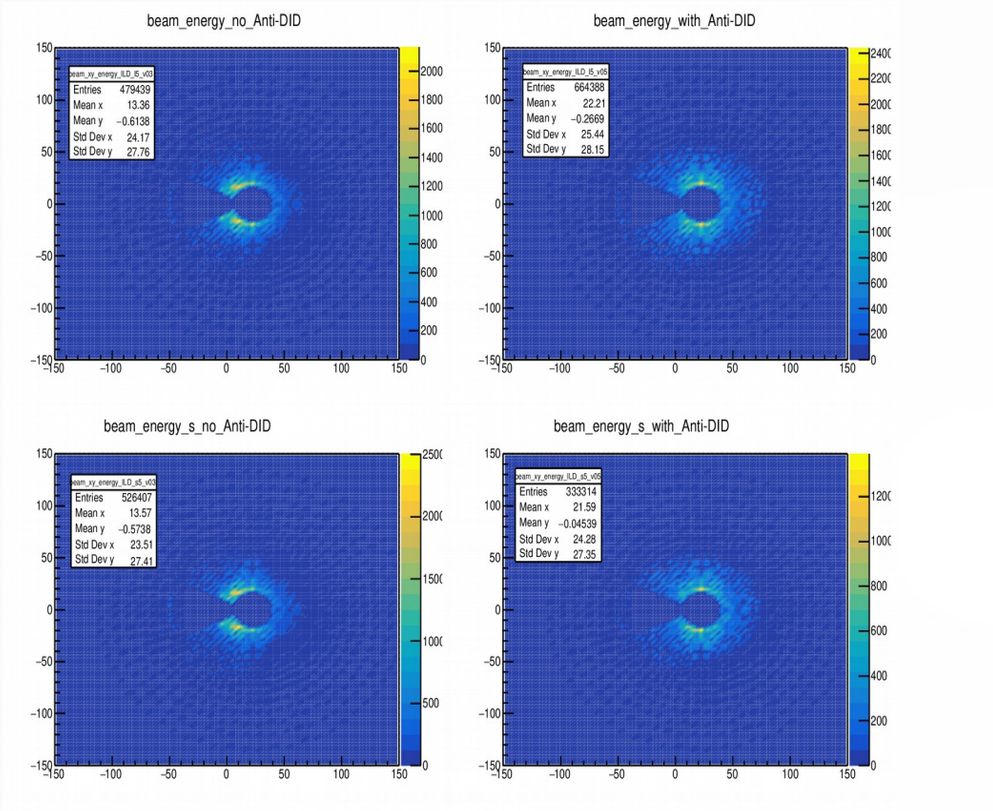
With AntiDID application a energy distribution better centred on the outgoing beampipe (ie the centre of BeamCal)

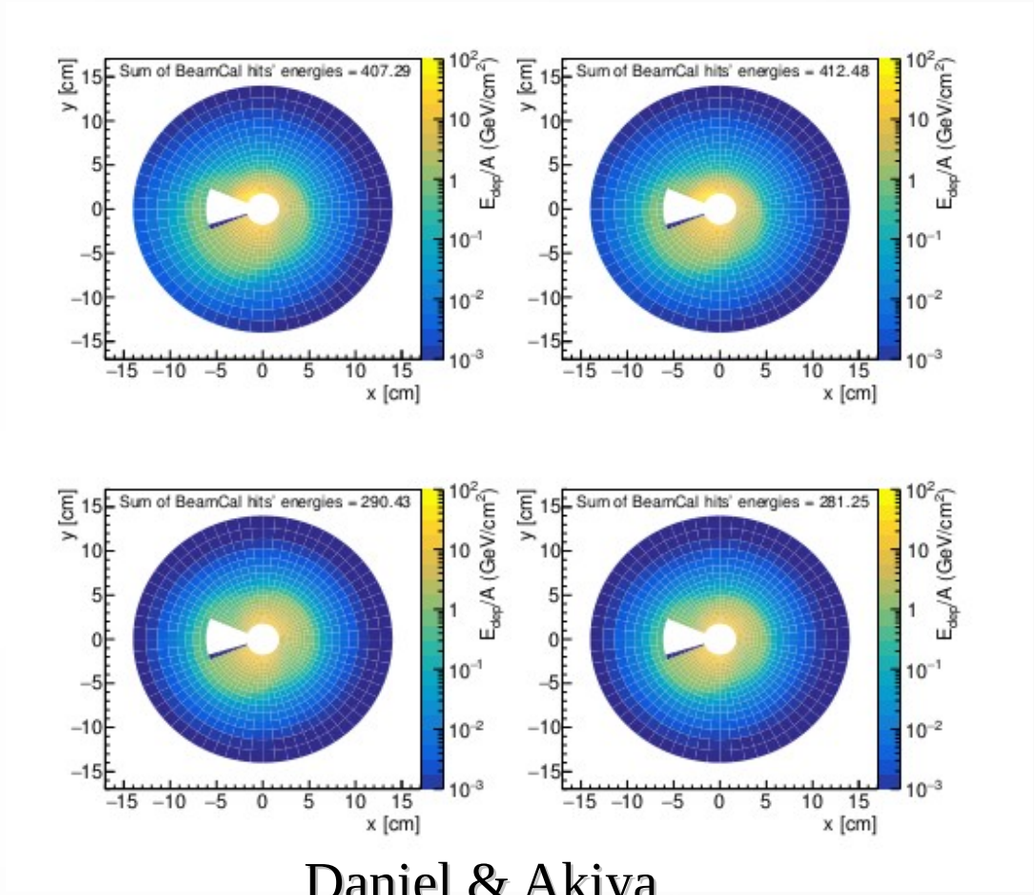
Outgoing pipes region energy destiny + 60.8487%



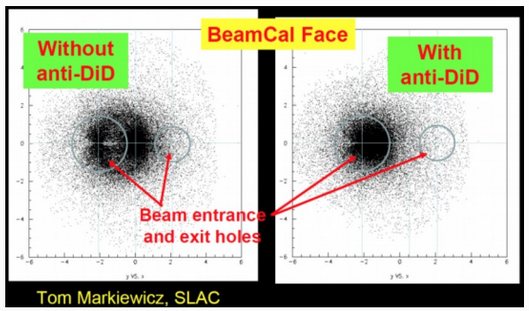
Energy density in the x − y plane, for the large and small detectors, each with and without the anti-DID field

Comparison with Daniel's resaults



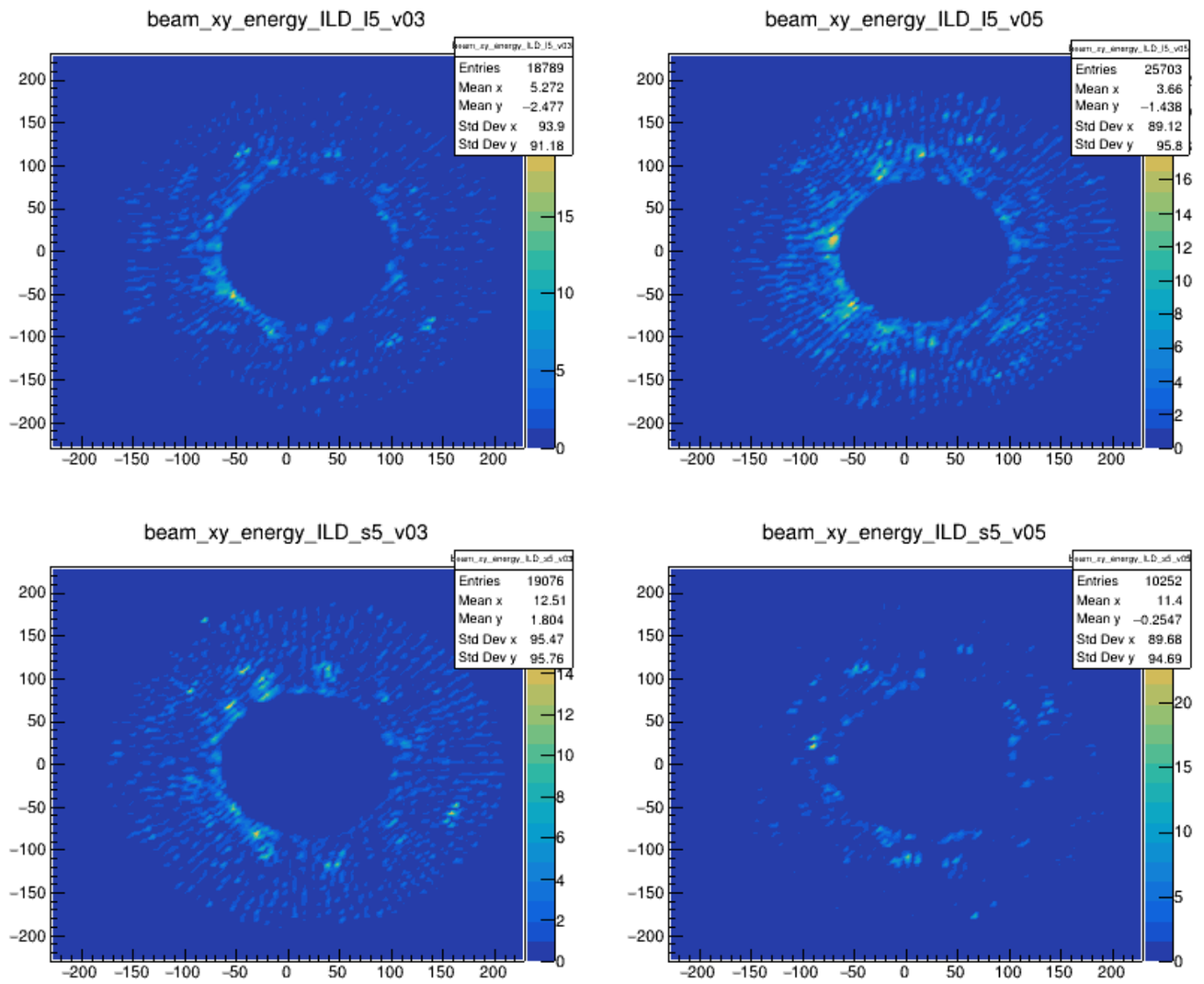


Daniel & Akiya



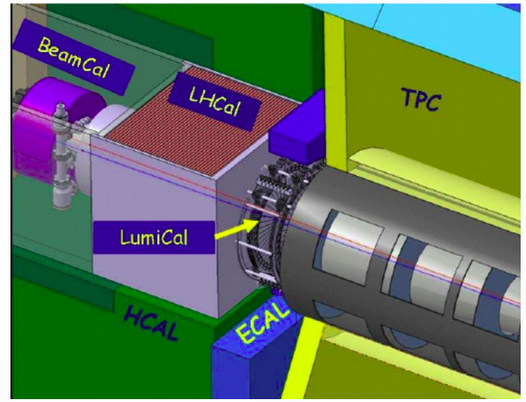
The applicatioation of the anti-DID field clearly results in a distribution better centred on the outgoing beampipe (ie the centre of the BeamCal), with a resulting reduction in the total BeamCal energy deposit of around 30% (40%) in the large (small) model.

Results : LumiCal



1. Large model :
Application of AntiDID-> more Hits +7k

2. Smal model :
Application of AntiDID-> less hits -9k
3.Because of AntiDID

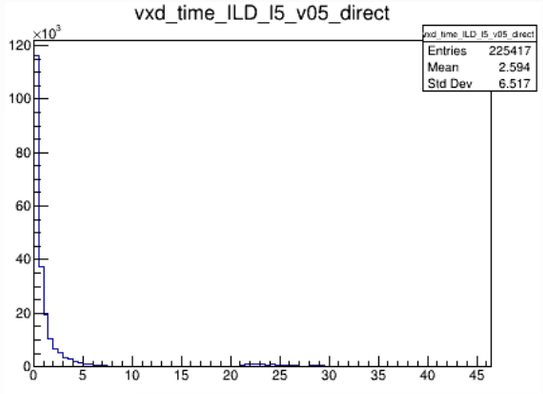


Future plan: consider particle time distribution

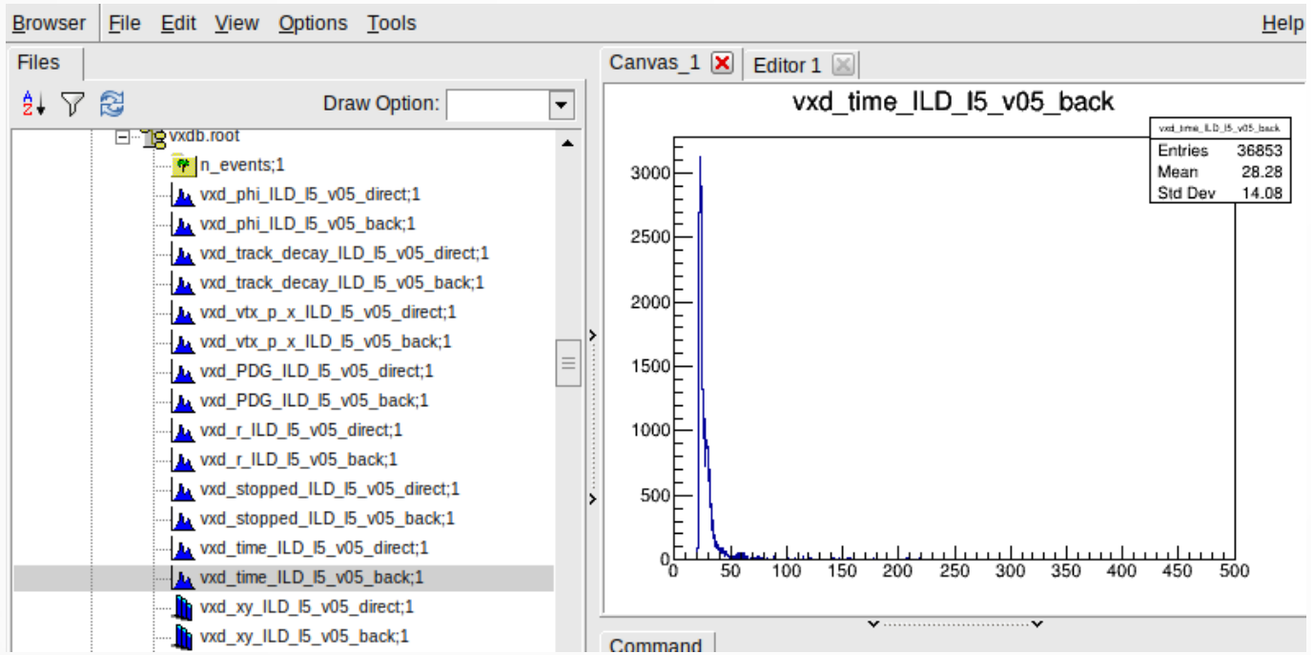
Results : Vertex detector

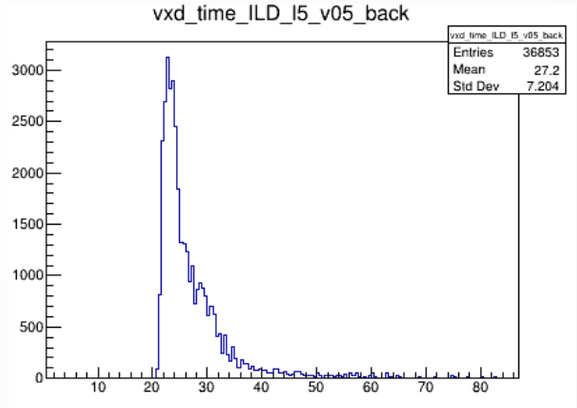
From Daniel results ...

Hits in VXD are split into early and late hits, with a boundary at 15 ns. This provides a clear boundary between *direct* and *late* hits , produced by particles coming directly from the IP, and those hits produced by particles backscattered from the forward region (mostly the forward calorimeters).



Particles from IP



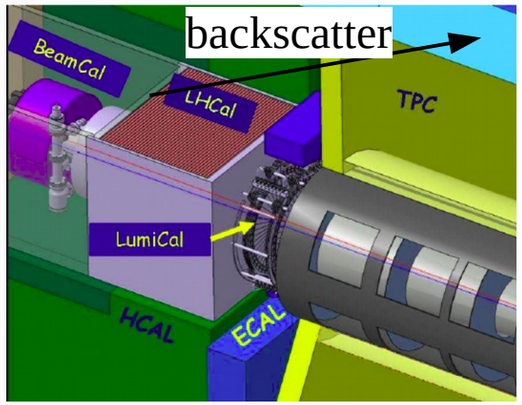


back-scattered particles

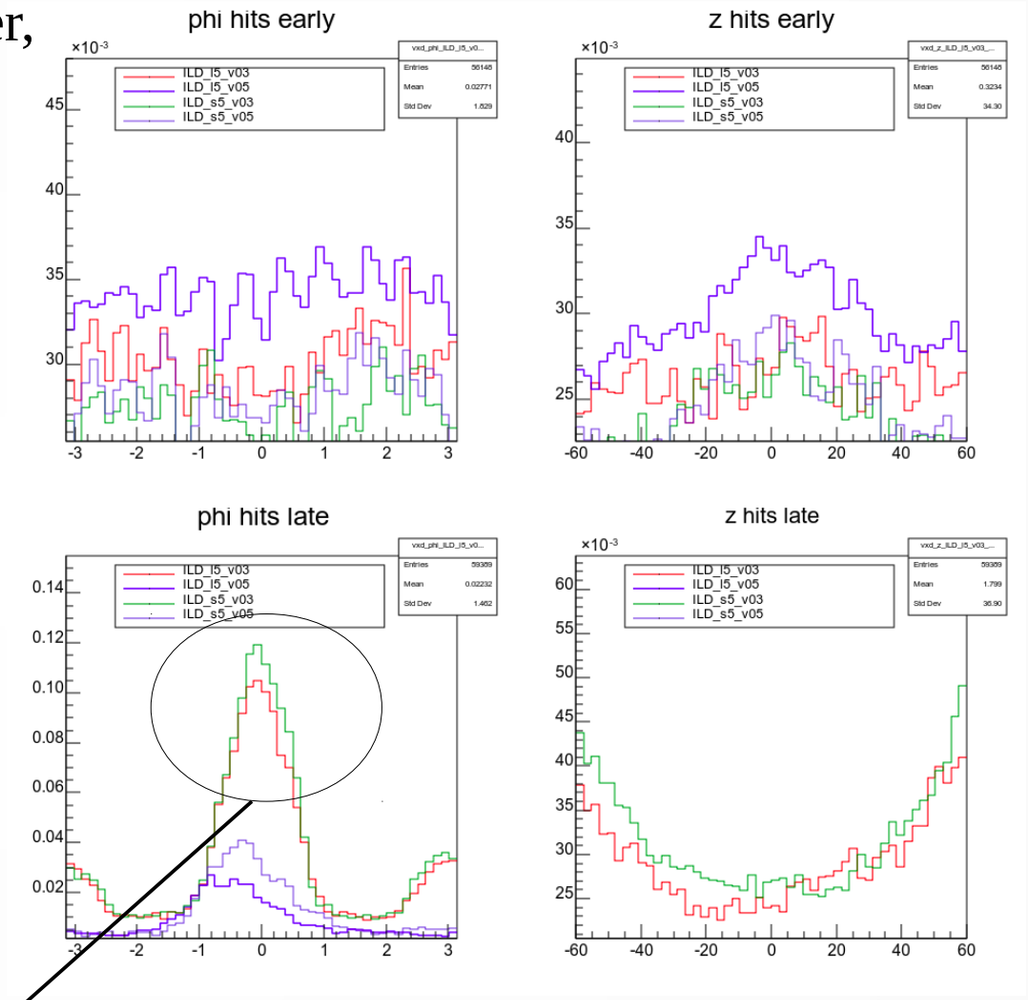
=6hits/1backscatter

Results : Vertex detector

A lot of pairs get into the BeamCal calorimeter, which leads to backscatter and increase in background photon shocks in TPC :



IP



Need consider phi distridution
Of TPC Collection hits

Small detector models

Conclusion

- Got familiar with LCIO toolkit and beam-induced backgrounds in ILD. Studied Daniel's and Akiya's results
-
- Reproduced Daniel's resaults for large and small detector models without/with implemintetion of AntiDID field with 250 GeV

Reproduce same (like for BeamCal) energy distribution in xy plane for LumiCal

Future plan

- To reproduce Daniel's results
- master LCIO tools
- study influence of AntiDID field
- Complete master thesis

Thanks for attention !