BeamCal simulation with BeCas

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BeamCal

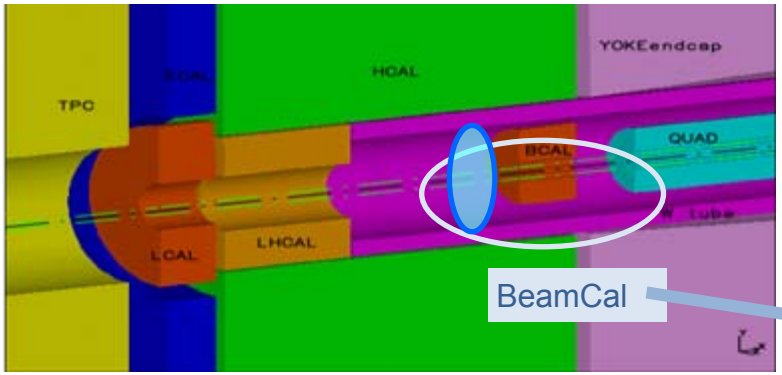
Motivation: For the very forward region of an ILC detector special calorimeters are needed. BeamCal will be hit by a large fraction of e^--e^+ pairs stemming from beamstrahlung. Sensors have to withstand a very high levels of total ionizing dose.

Purposes : ->Highly efficient detection single high energetic electrons (photons) at lowest angles.

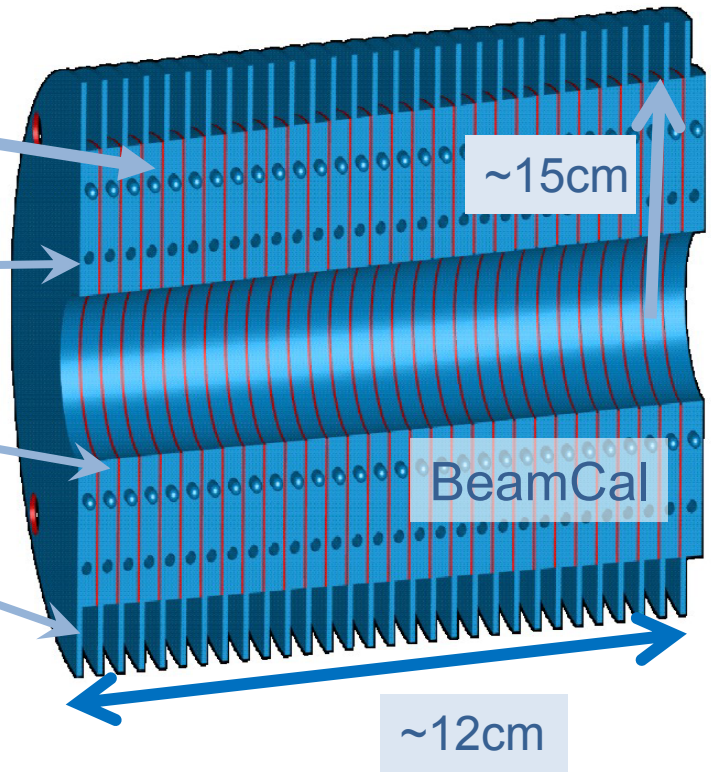
Minimize the amount of backscattered particles into the Inner Detector, while shielding QD0 against pairs from beamstrahlung.

Provide a signal for the use of luminosity optimization and beam diagnostics.

BeamCal Design



3350 mm to IP
Support tube ø750



W absorber layers

Radiation hard sensors

with thin readout planes

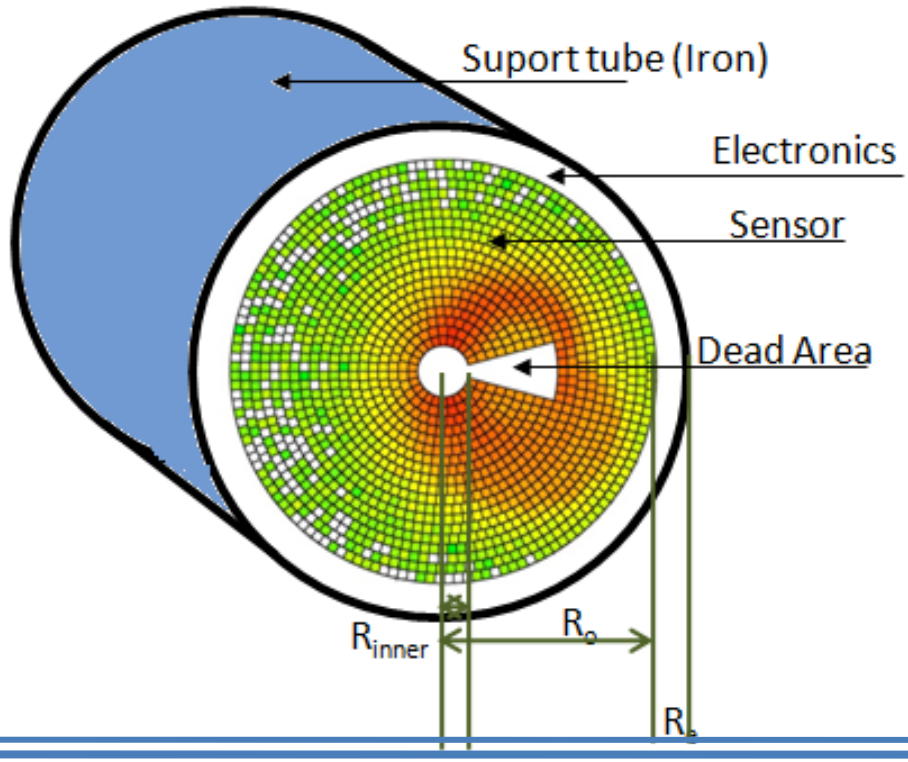
Space for readout electronics

+ graphite in front of BeamCal
to reduce backscattering

Sandwich EM calorimeter

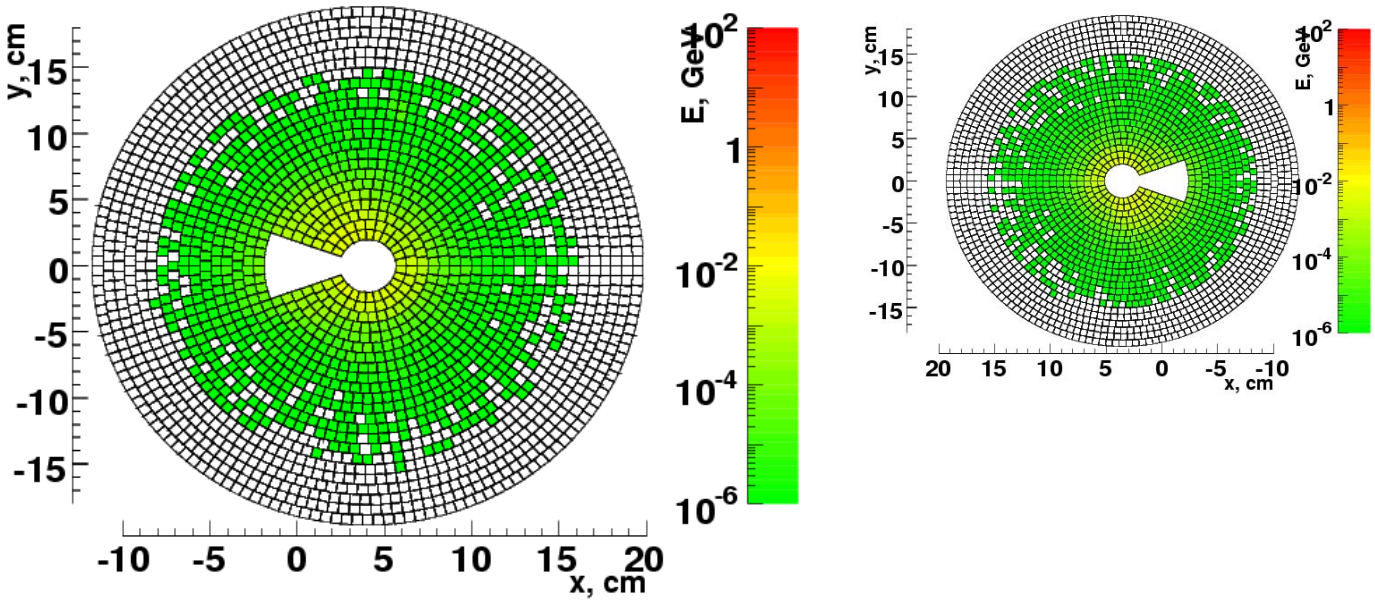
- 30 Xo W sampling calorimeter (30 layers)
- Layer thickness ~Xo (3.5 mm W)
- Sensor thickness ~0.3 mm (each sensor layer divided into 8 sectors)
- Weight ~160 kg (+ support)
- 10 cm Graphite in front
- θ range 5.8 – 43.5 mrad
- ~ 10^4 - 10^5 channels of ~0.8 R_M

Rin (sensor) 20 mm
Rout (sensor) 150 mm
Rout (mech) 200 mm



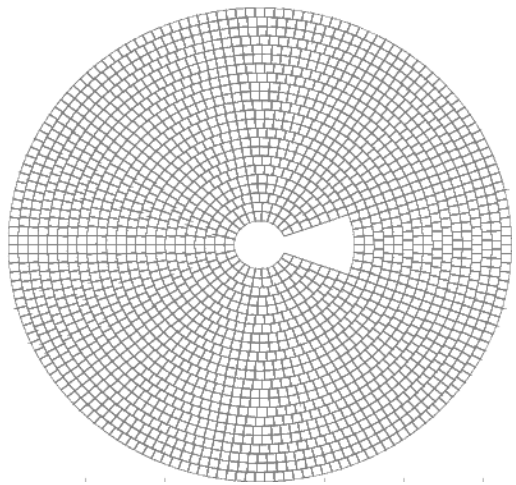
First step

- Monte Carlo studies of background of beam calorimeter (BeamCal) with BeCas program for future optimization of granularity of the BeamCal



Geant 4 Simulation - BeCaS

- A Geant4 BeamCal simulation has been set up (A.Sapronov).
- BeCaS can be configured to run with:
  - different crossing angles now -> 14 mrad
  - magnetic field
  - detailed material composition of BeamCal including sensors with metallization, absorber, air gap
  - geometry description (30 layers, 17 rings, 36 sectors and dead area

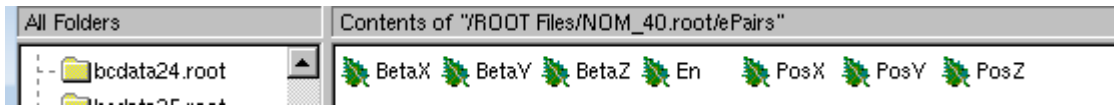


Simulation chain

1. **Guinea Pig** Simulate Collision: (nominal parameter set)
   input-> accelerator parameters output->pairs.dat (ASCII file)
   (E, GeV, velecities in x-, y-, z- directions /c)

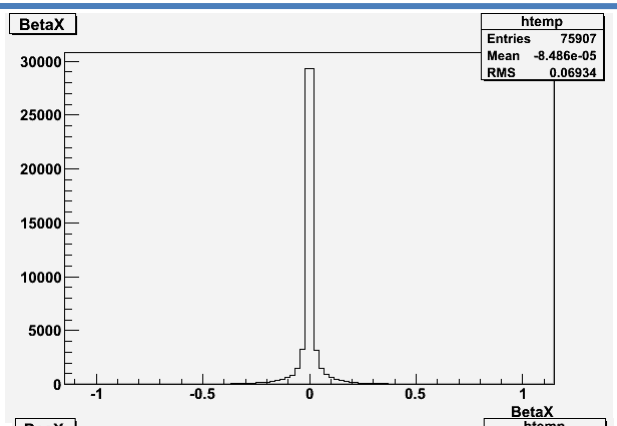
```
[pub4] ~/workspace/geant4/prsTOroot % more pairs.dat
-0.0195231 0.178687 -0.151442 0.971829 87865.3 -74044.4 32593.8
0.0232386 -0.00117221 0.0197505 0.999562 -1844.88 2601.52 45837.1
0.0825597 -0.00109356 -0.00163778 0.999979 -1136.89 -178.303 13050.7
-0.0154896 -0.0592611 -0.278483 0.958043 -28207.5 -131725 11438.6
0.090212 0.0115869 0.00326938 0.999911 1494.45 59.7509 32669.4
```

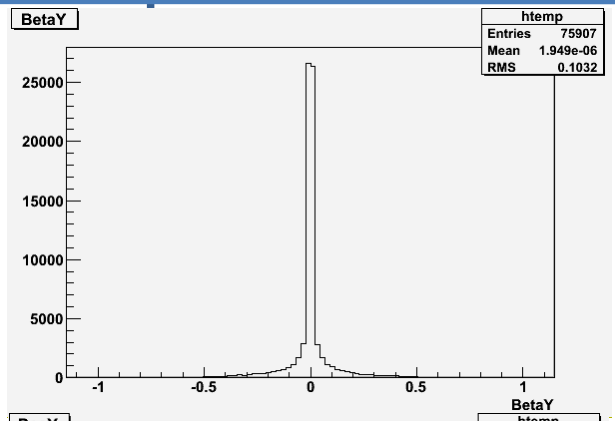
2. **PrsTORoot** Transfer e+e- pairs from pairs.dat to root file

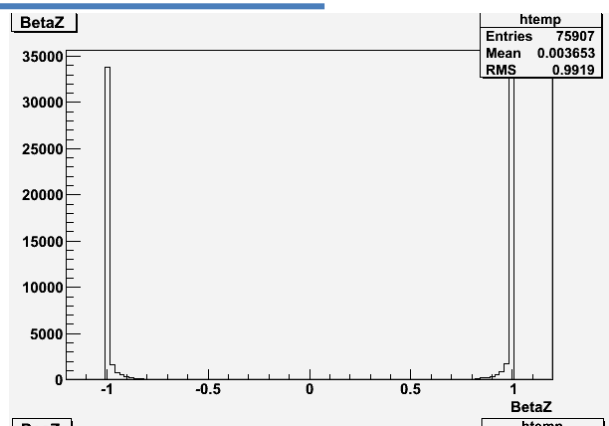


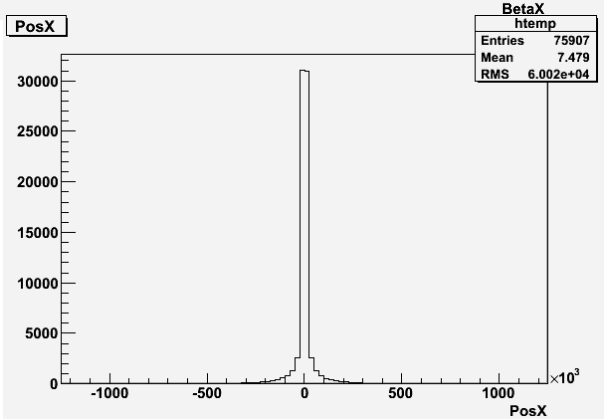
3. **BeCas** Detector simulation (input-> root file with particle descriptions;
   output->root file format)
4. **ROOT** For analysing

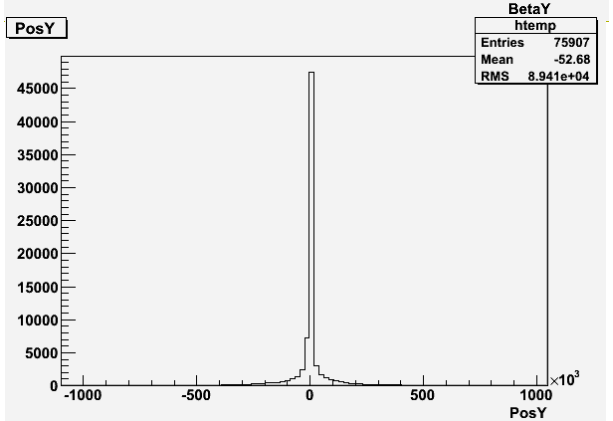
Input root file

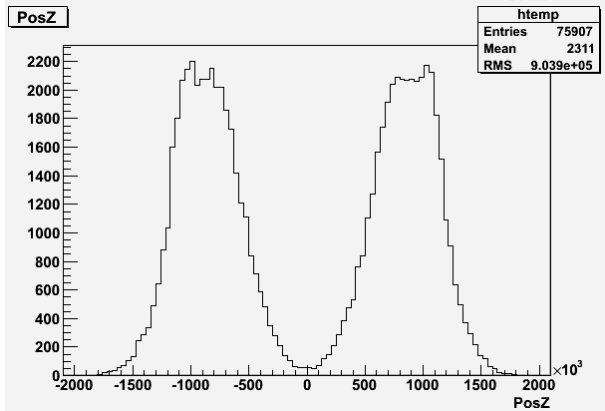


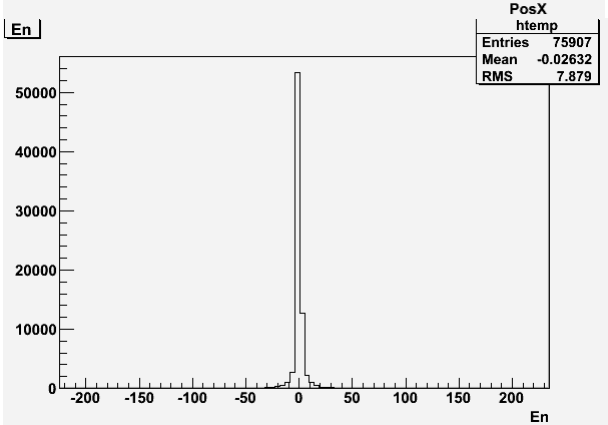






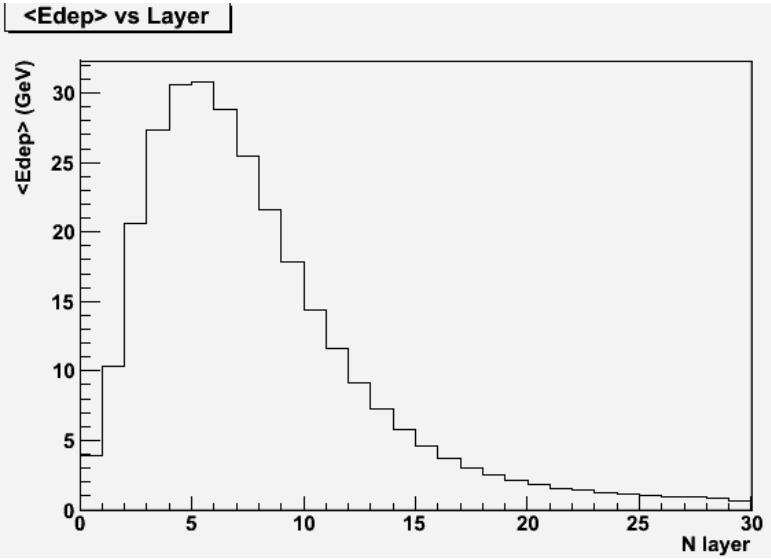


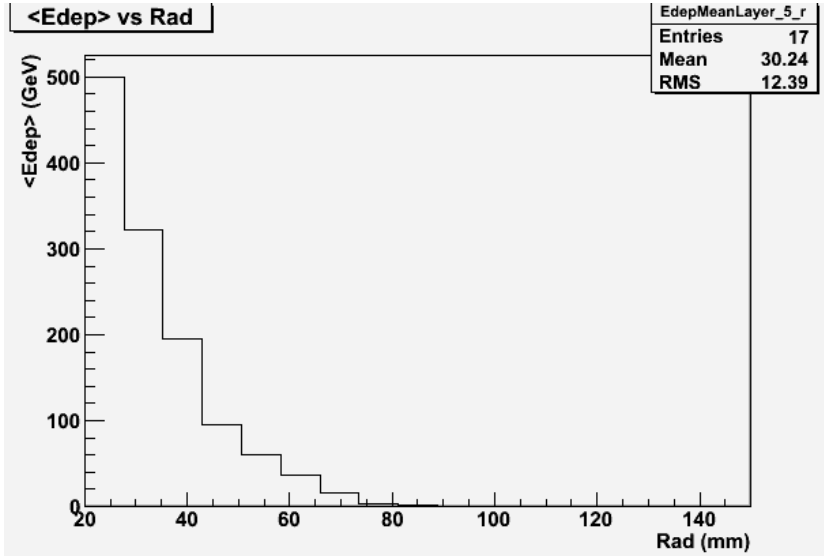




Shower properties

40 BX

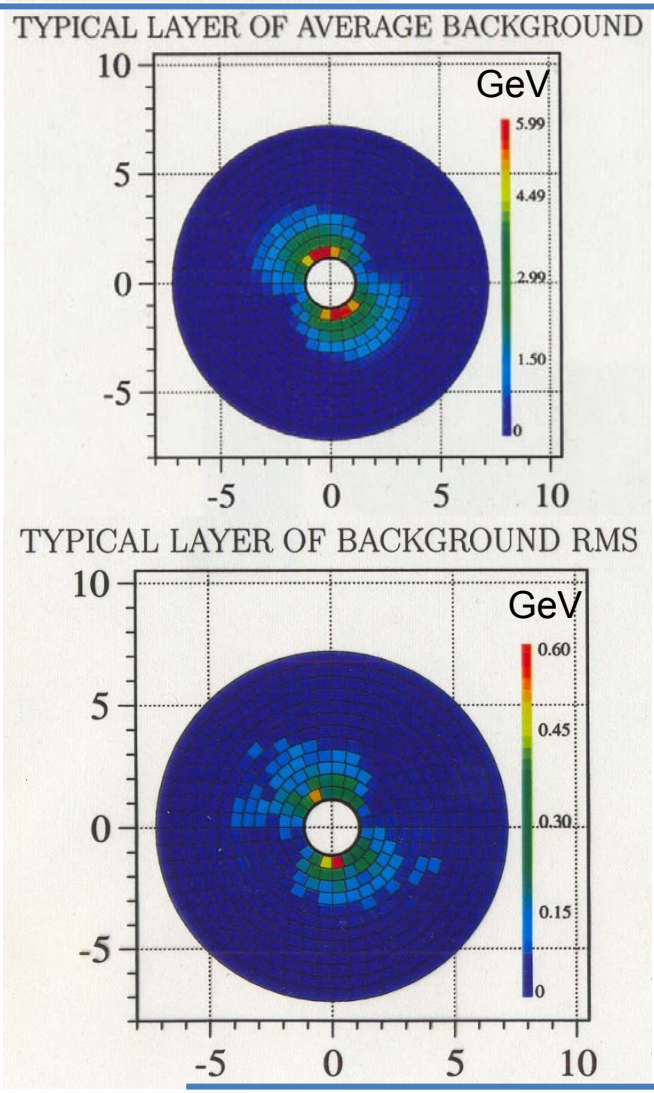




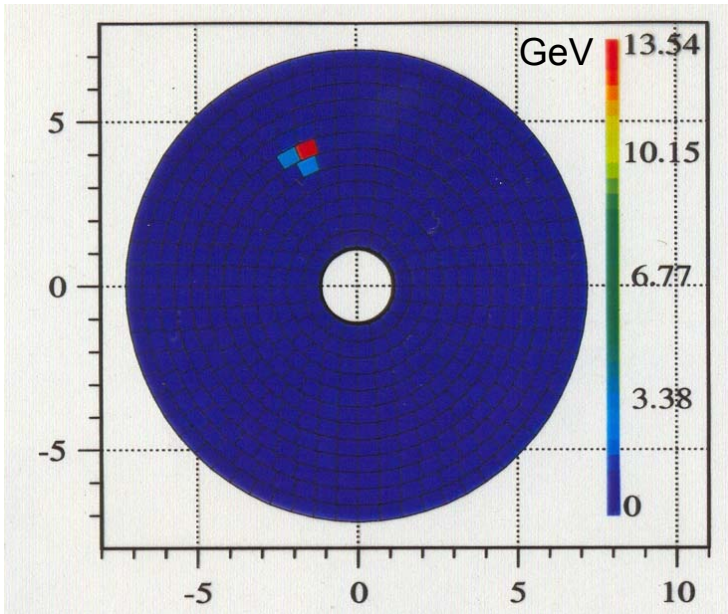
<Edep> dependance of layer's number
-> Maximum of background is in 5-6 layers

<Edep> vs radius for 5-th layer

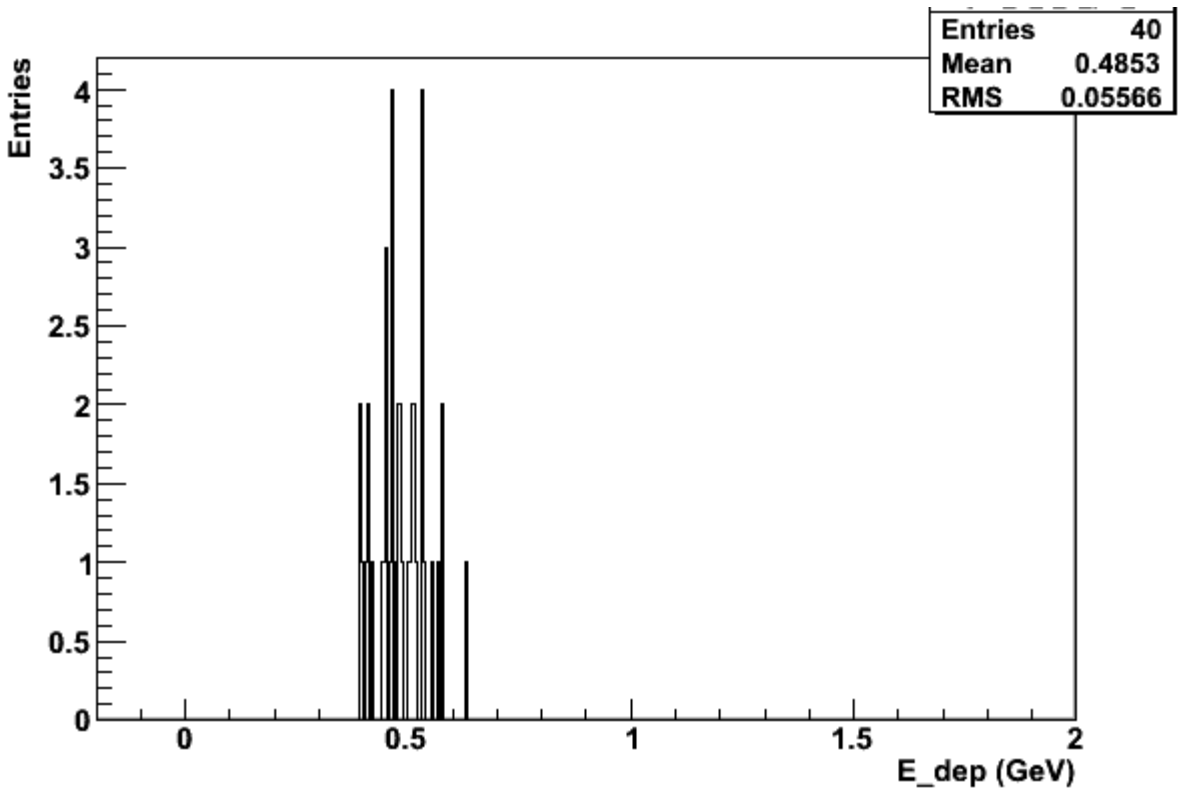
a 250 GeV e⁻ Earlier simulation



Simulation in 2002
Left for background
Right for one single high energetic e-



One pad example

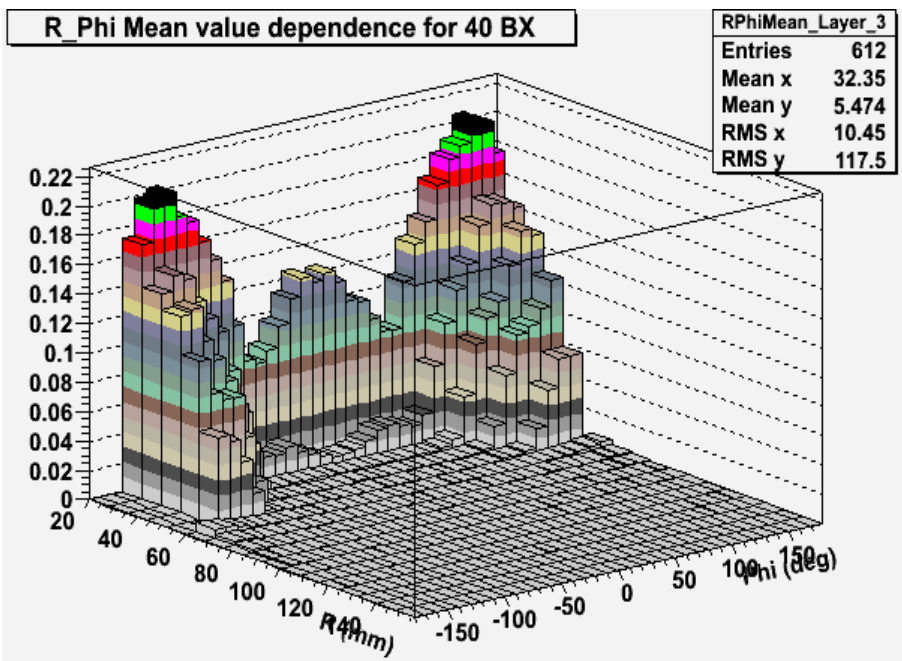


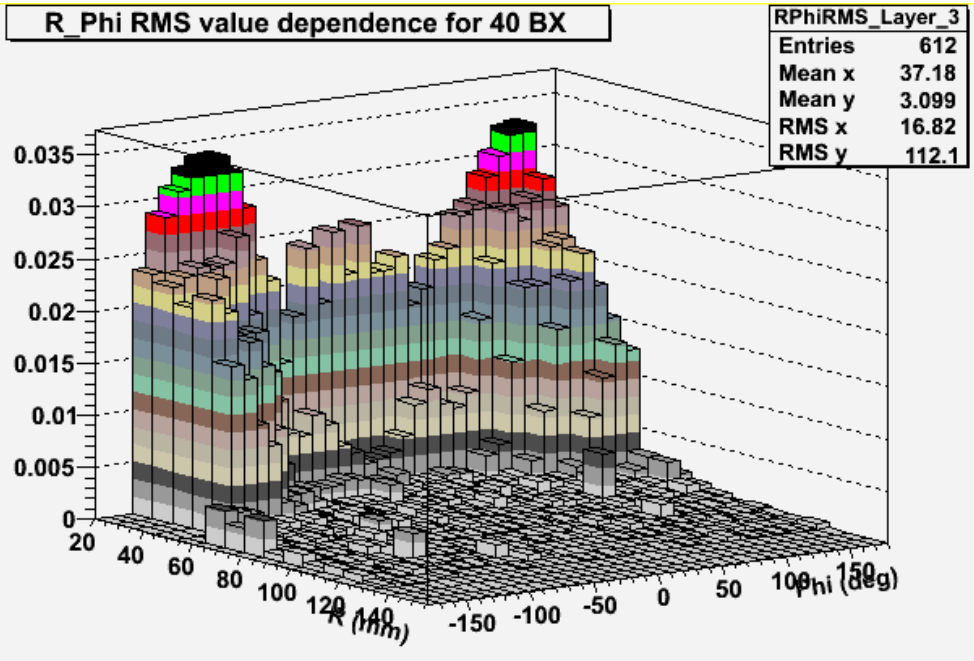
For one cell in 3-th Layer first radius layer and phi 140 deg

<Edep> -> Mean

σdep -> RMS

One layer pads distributions





Distribution for mean values of deposited energy vs. radius (mm) and phi (deg)

Distribution for RMS values of deposited energy vs. radius (mm) and phi (deg)

Conclusions

- Background investigation -> Continuous background simulation
- Single high energetic electron simulation
- Comparison of signals from beamstrahlung and single high energetic electron
- Optimization of BeamCal geometry

Thank You!