Updates on the efficiencies for the detection of high energy electrons in the ILC Beam Calorimeter

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Plan

> Introduction

> Algorithm

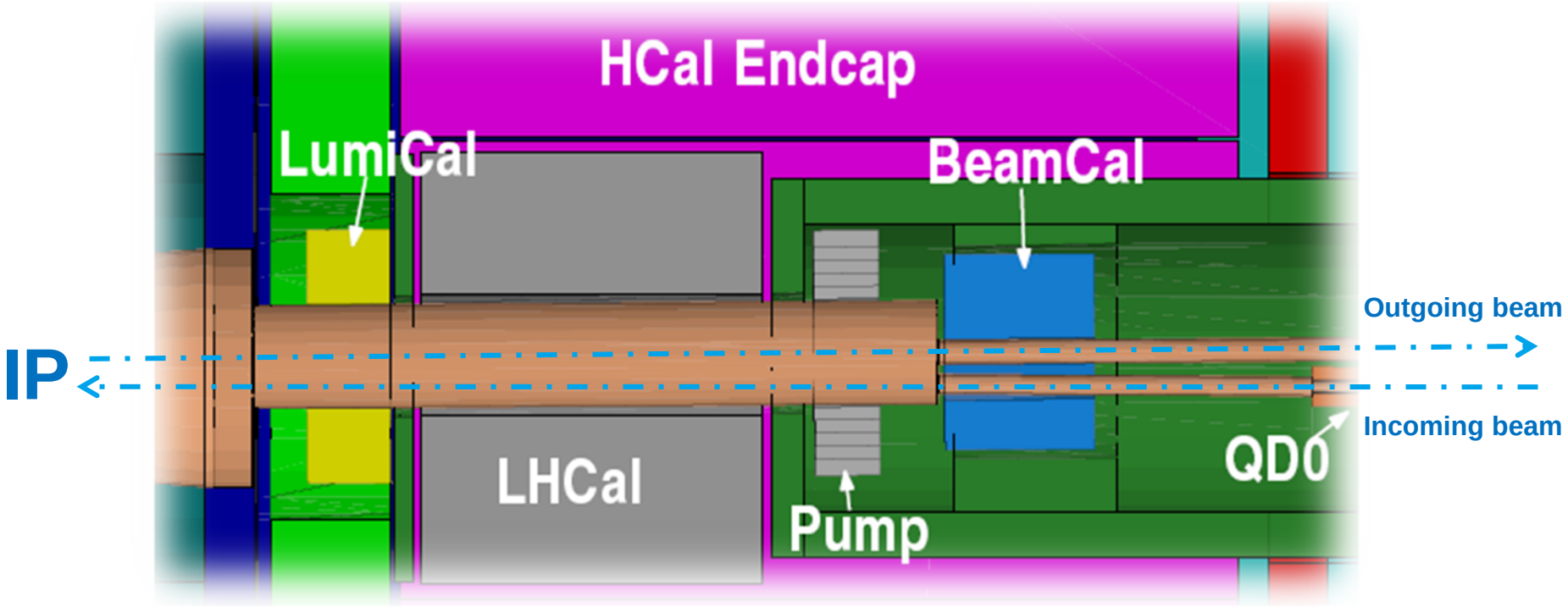
> Calibration for clusters

> Fake rate and reconstruction efficiency

> SHEe at big radii

> Conclusions

Forward Region



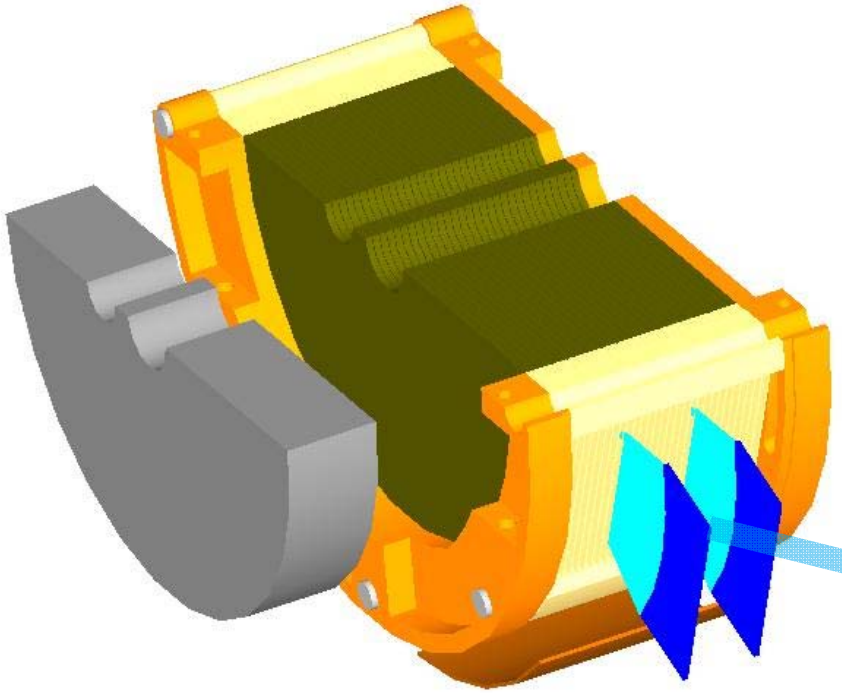
Precise luminosity measurement,

Hermeticity,

Assisting beam tuning (fast feedback of BeamCal data to machine)

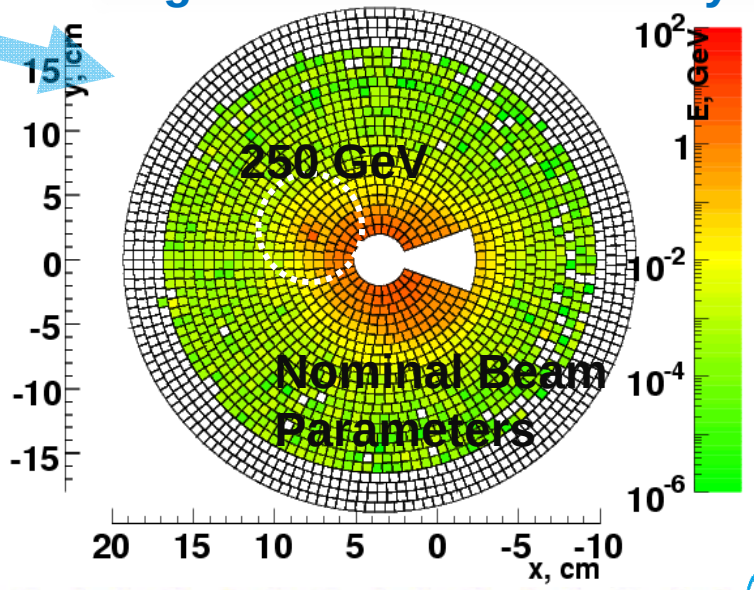
Challenges: radiation hardness (BeamCal), high precision (LumiCal) and fast readout (both)

Beam Calorimeter



- Around Beam-pipe
- 30 Layers
  - Tungsten absorber:
  - Sensor layer GaAs or Di
- Radii 2…15 cm, depth ~12 cm
- Sensor segmentation 8x8 mm^2

Segmentation of sensor layer

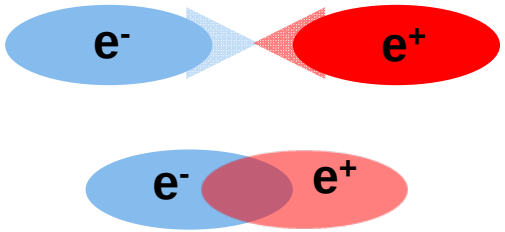


BeCaS; Mokka; Guinea Pig; ROOT

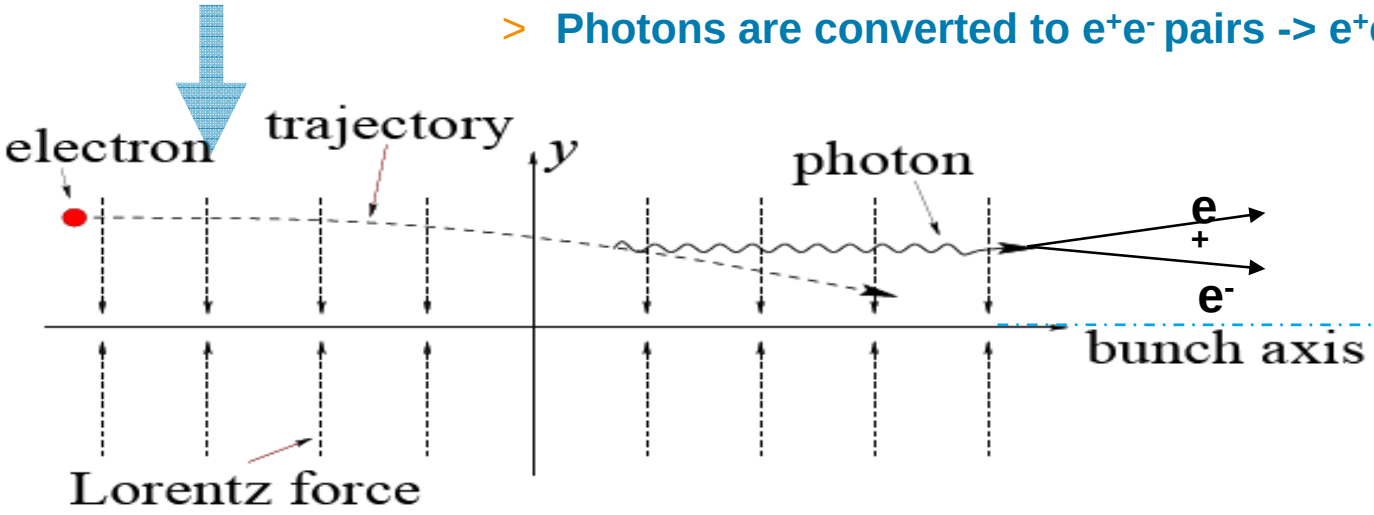
BeCaS describes :

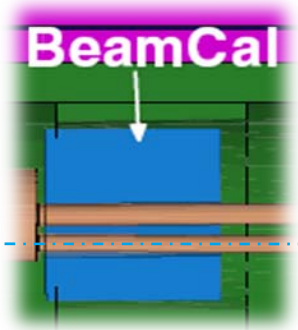
- different crossing angles (14 mrad)
- magnetic field
- detailed material composition of BeamCal
- geometry description
- surrounding detectors (LumiCal, QD0)

Beamstrahlung Problem



- Beamstrahlung - new phenomenon
- Small bunches and high luminosity
- the bunch particles accelerated by the Lorentz force radiate photons, which are mostly collinear with the direction of the bunch motion
- Photons are converted to e^+e^- pairs -> e^+e^- pairs are deflected





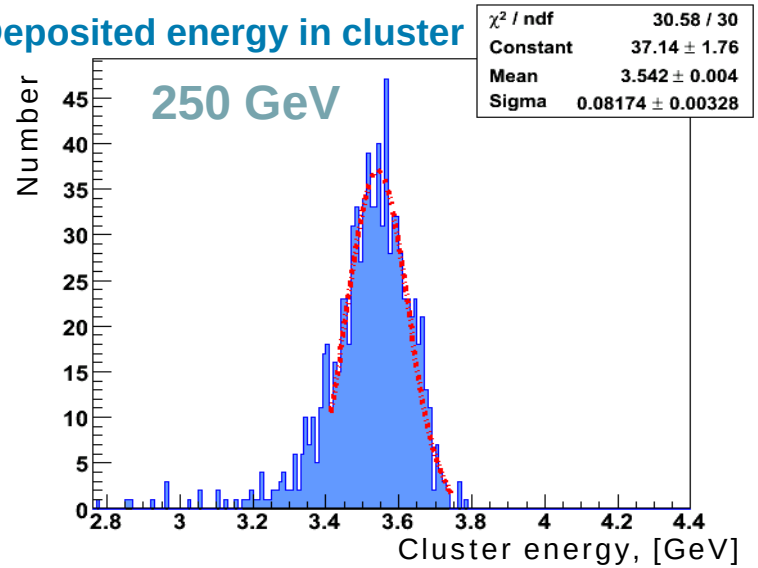
- Hermeticity - electron detection at low polar angles
- To distinguish between new physics and background processes (Stau production and standard model)

Algorithm

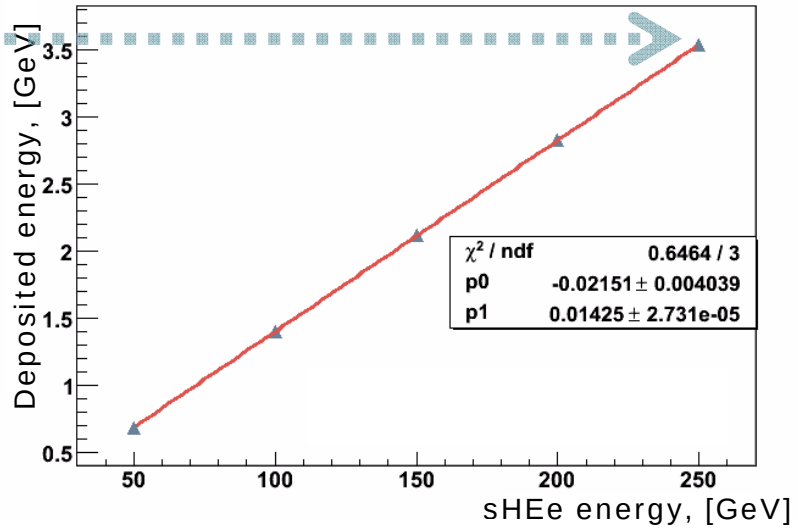
- sHEe on top of BX search in respect to average of 10 BX
- 10 BX -> average and fluctuation calculation
- 1 BX + 1 sHEe
- Define a cluster:
  - Towers after 5-th layer with more then 10 consecutive cells
  - Search tower with maximum deposited summary energy
  - Two or more neighbors towers
  - Exclude all towers correspond to found cluster and repeat searching
- Reconstruction efficiency and fake rate calculations
- Algorithm was written for BeCaS files → LCIO to Root format (M. Stanescu Bellu)
  - ~ 2.000 BeCaS samples for sHEe
  - ~ 2.000 Mokka samples for Bunch Crossings (Nominal Beam Parameters)

Calibration

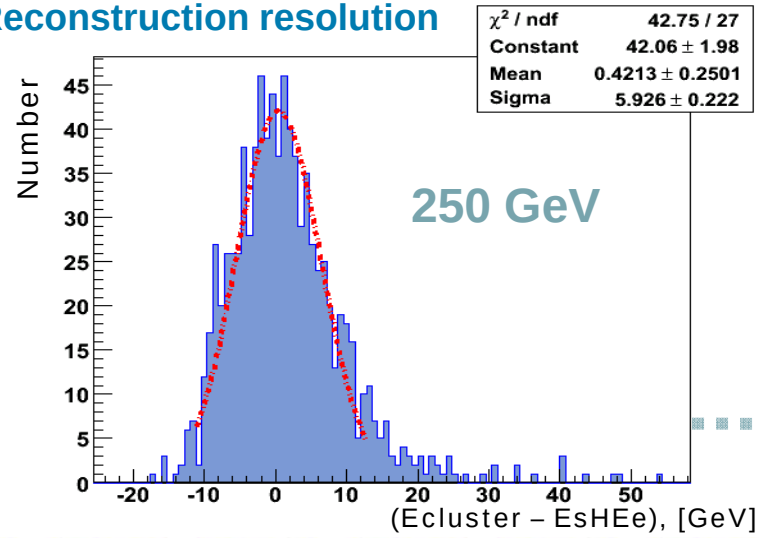
Deposited energy in cluster



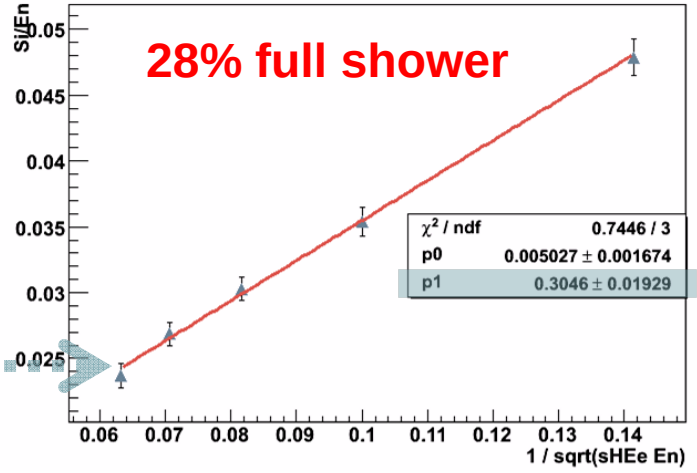
Calibration curve



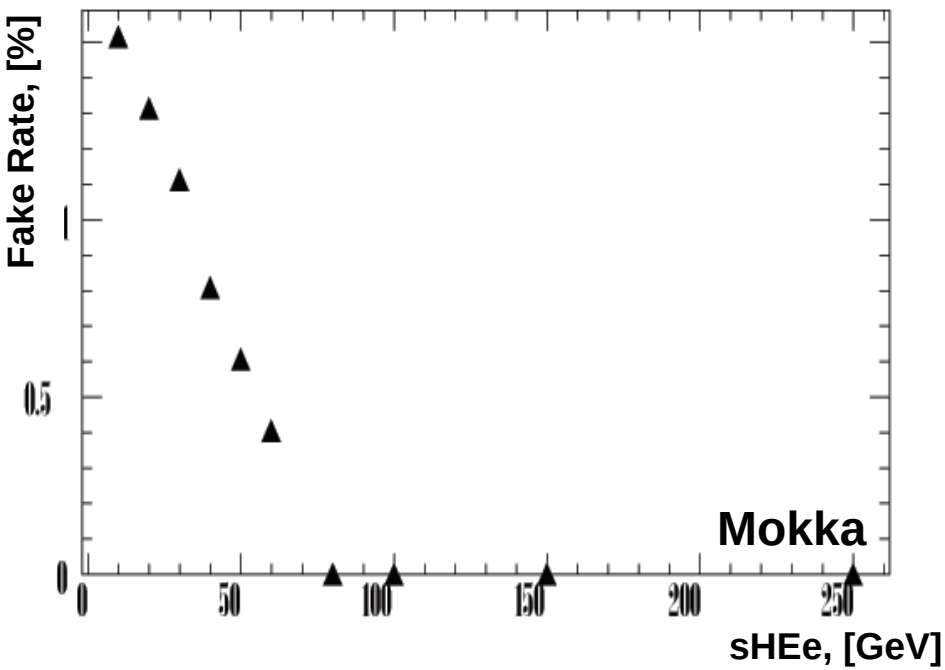
Reconstruction resolution

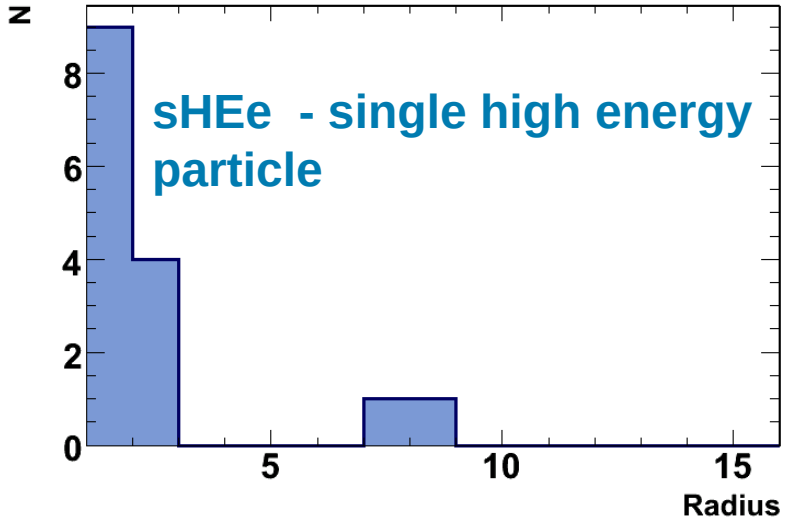


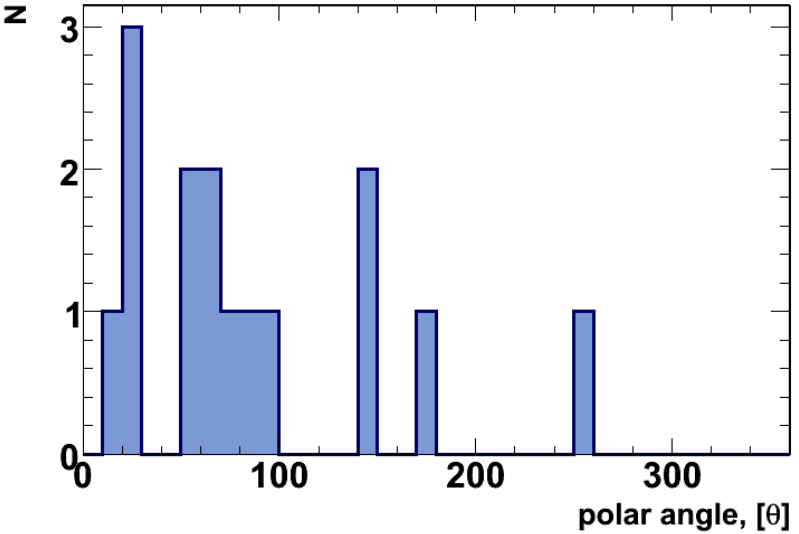
Reconstruction resolution



Fake rate







Fake Rate calculated for 1000 bunch crossings with applying an reconstruction algorithm for sHEe.

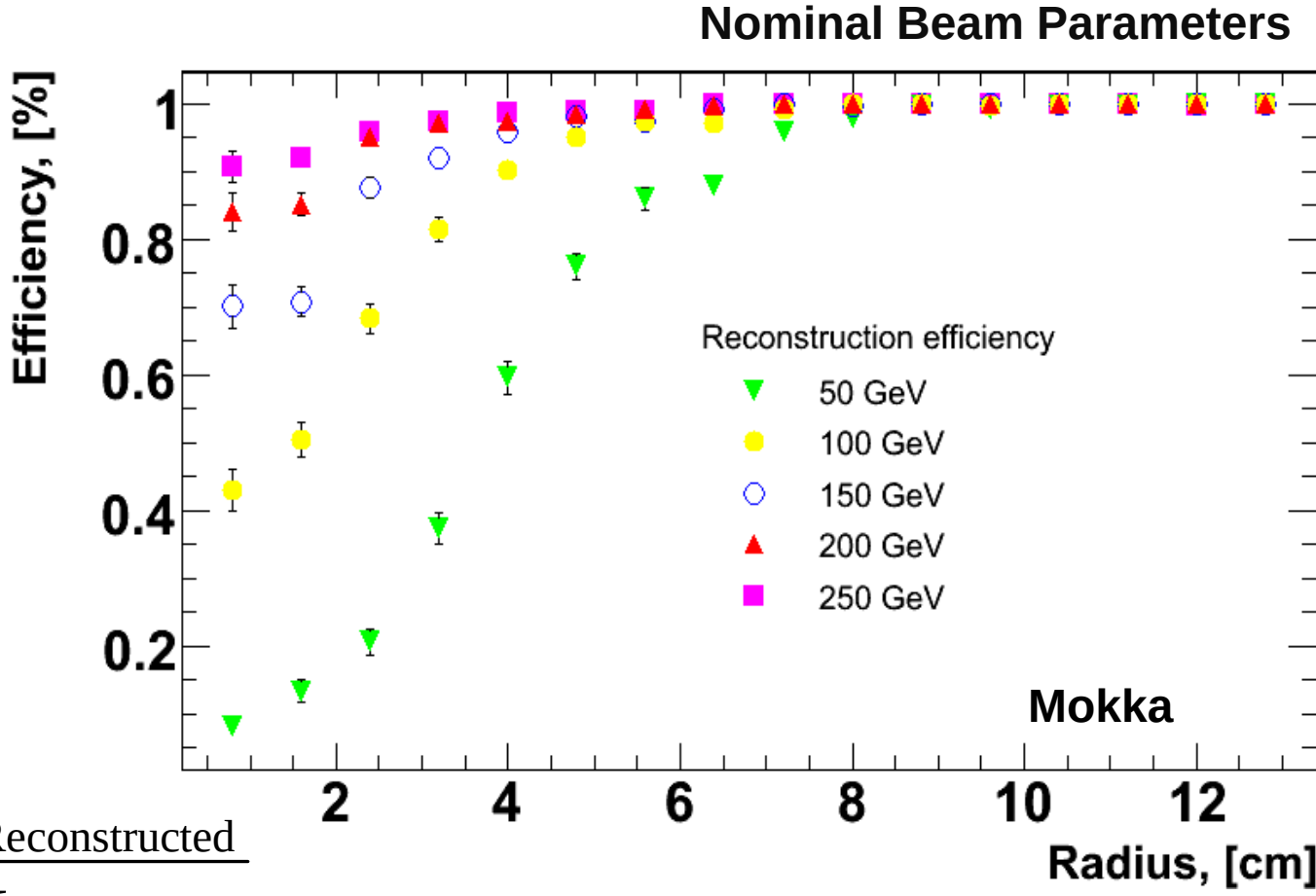
Number of fake electrons with reconstructed energy higher then threshold 10, 20, 30 … GeV

15 events out of 1000 were reconstructed

Efficiency of Electron Reconstruction

Efficiency analysis
The analysis was done with signal files generated in BeCas.

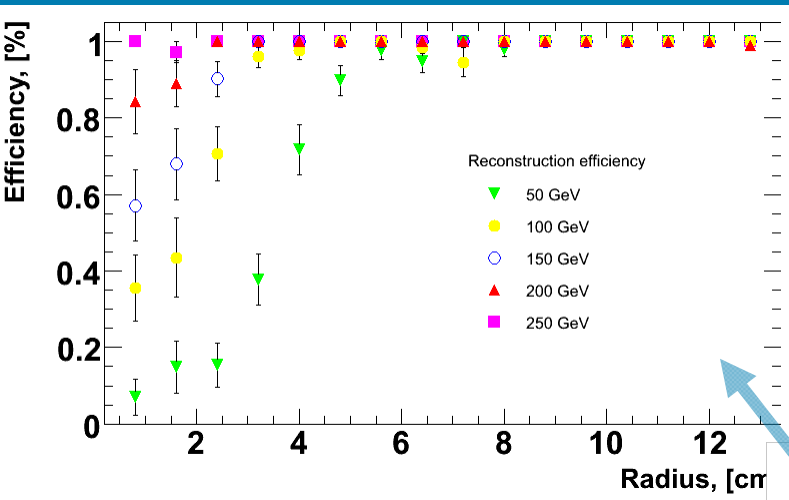
Electrons of higher energies or at higher radii are better reconstructed.

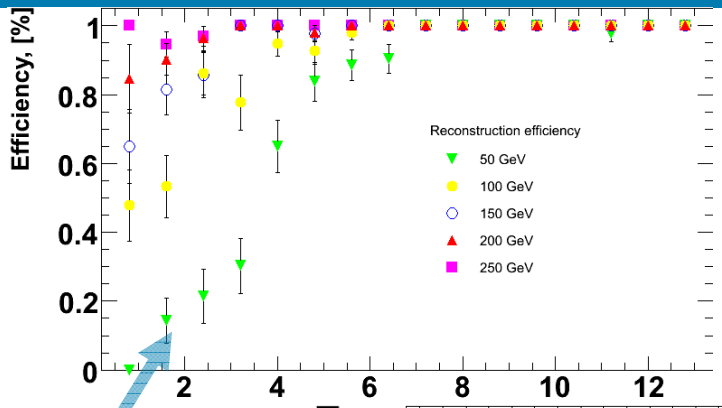


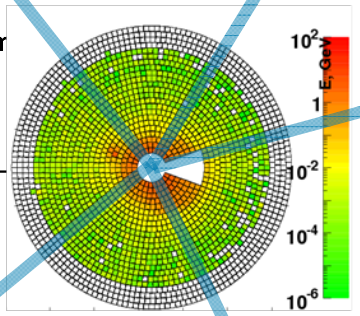
$$\text{Efficiency} = \frac{N_{\text{Reconstructed}}}{N_{\text{Generated}}}$$

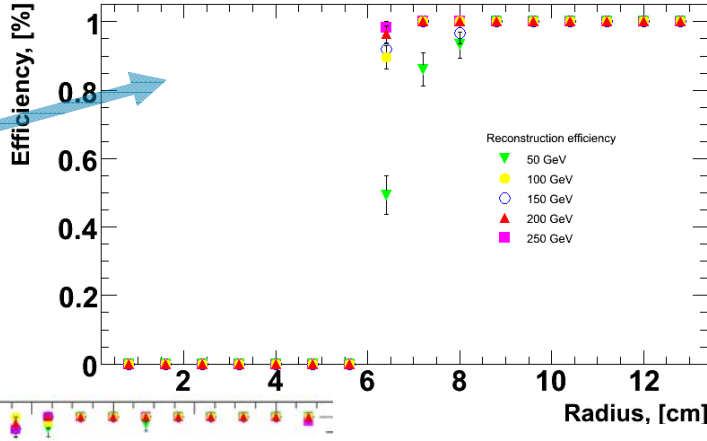
Reconstruction efficiency as a function of Radius (start from beam-pipe) for 50, 150, 250 GeV sHEe with nominal beam parameters.

Radial Slices

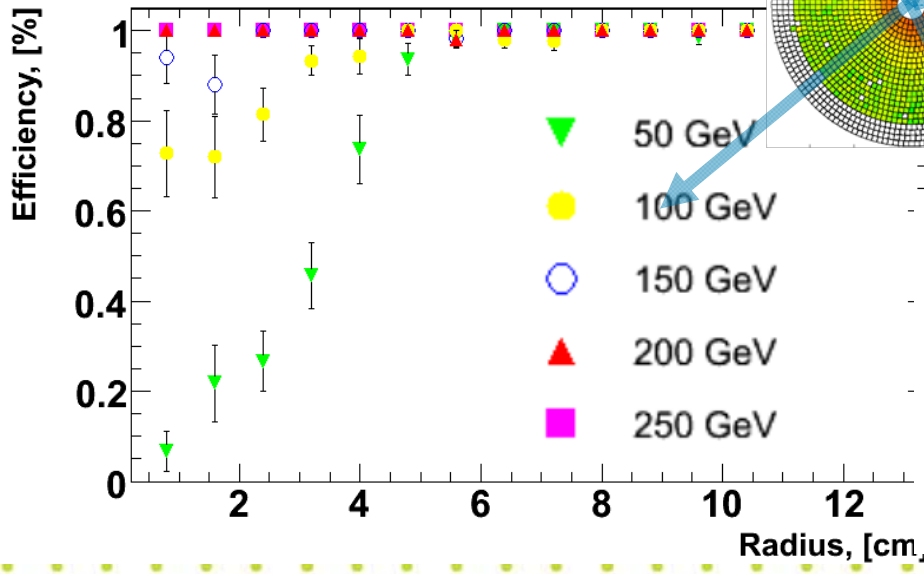


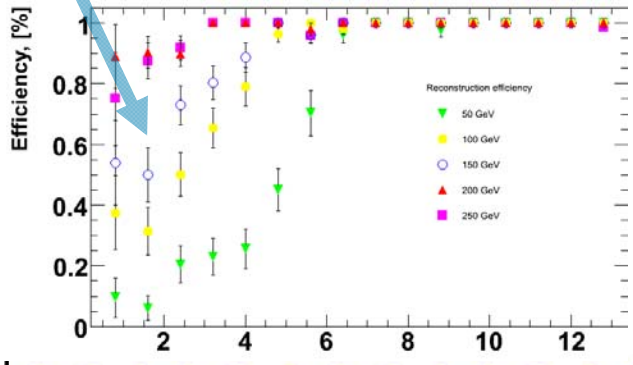




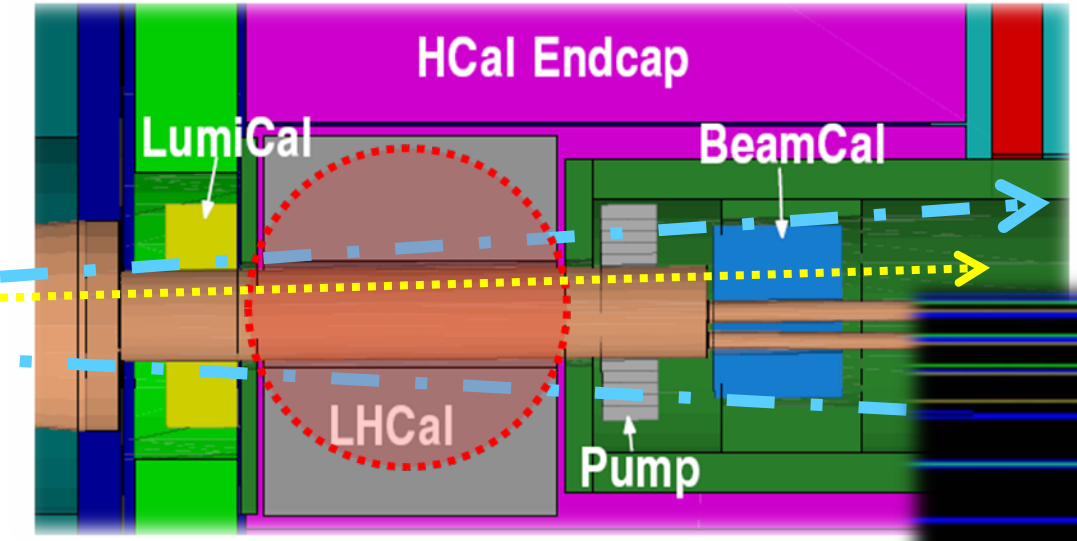


Radius thickness ~ 8 mm

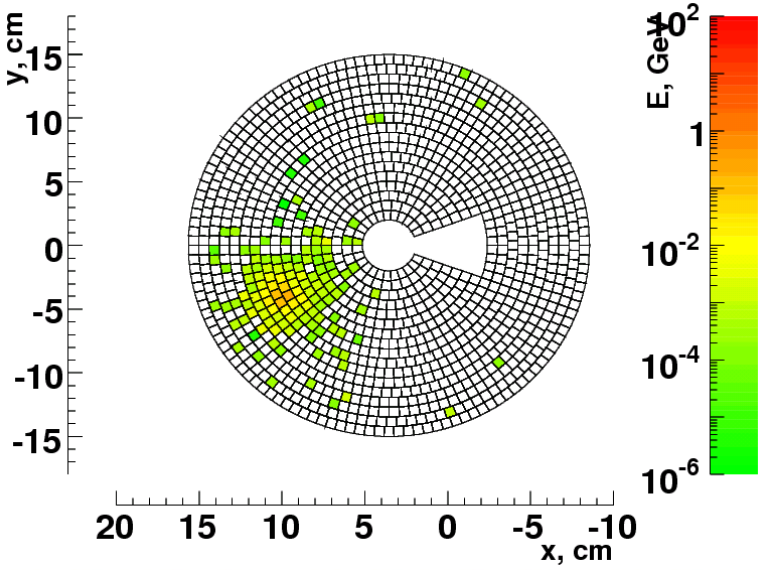


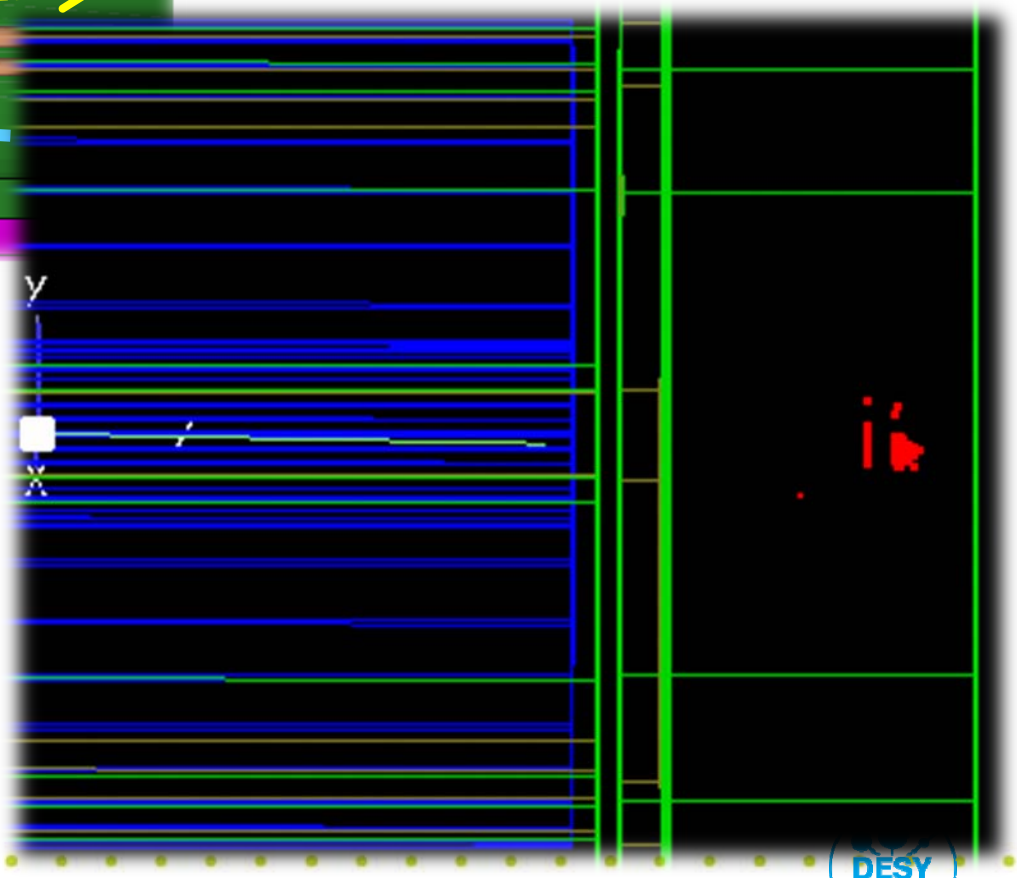


Big Radii sHEe

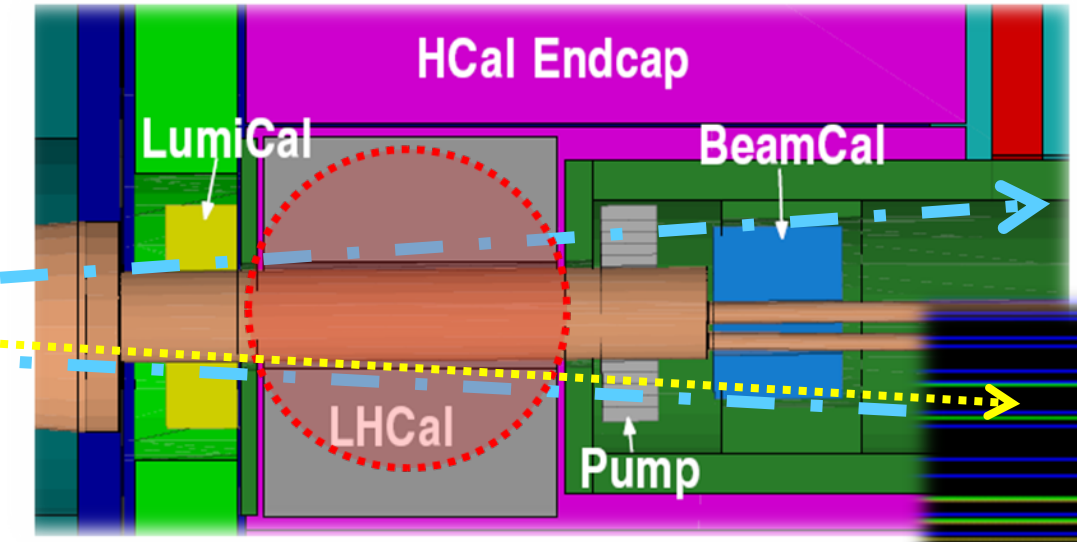


- sHEe on the center part of BeamCal
- Shower starts at BeamCaL

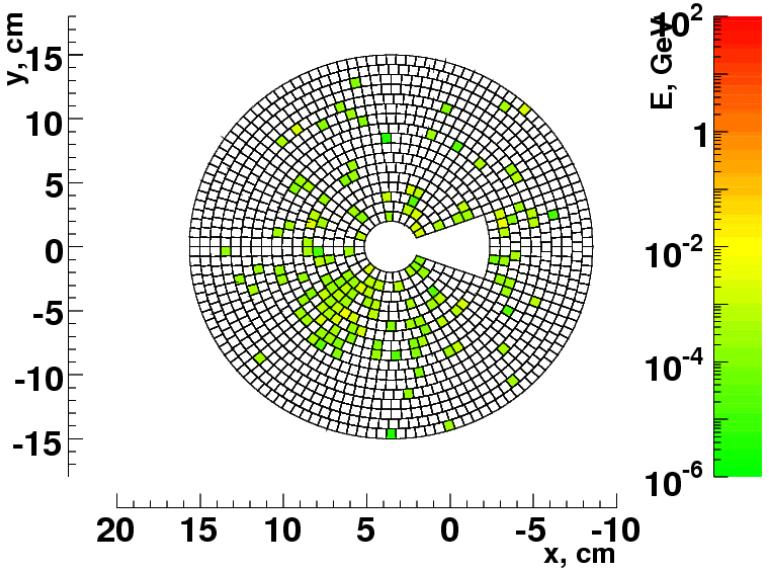


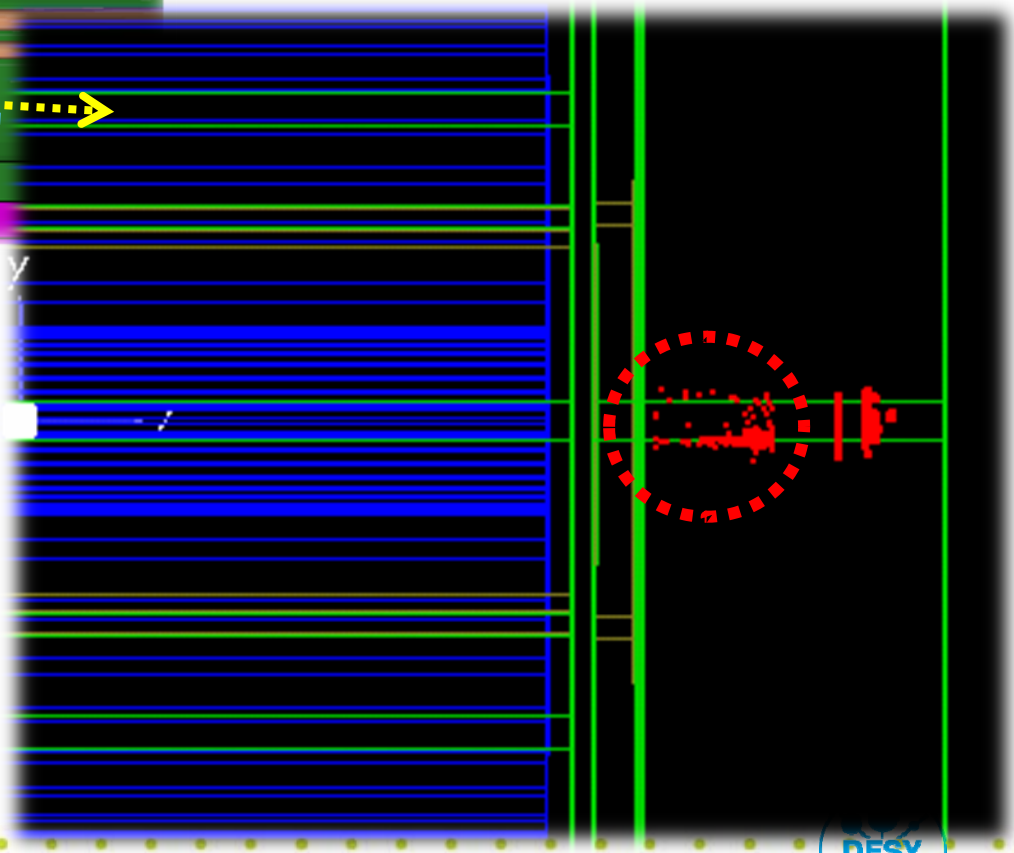


Big Radii sHEe



- sHEe on the outer radii of the BeamCal
- Shower starts at LHCAL





Conclusions

- Work on sHEe reconstruction is continuing with higher statistics and for new beam parameters (SB-2009)
- Parameterization of electron reconstruction efficiency is ongoing (there is enough statistics now for nominal beam parameters, for SB-2009 will follow)
- There are difference between BeCaS and Mokka found and have to be equalized for forward region

Back up Slide

> *Thank You!*