ECAL for SPD

Ivan Orlov

JINR

NICA-SPIN-2014, Prague, February 10-16, 2014

Calorimeter purpose

Direct photon program

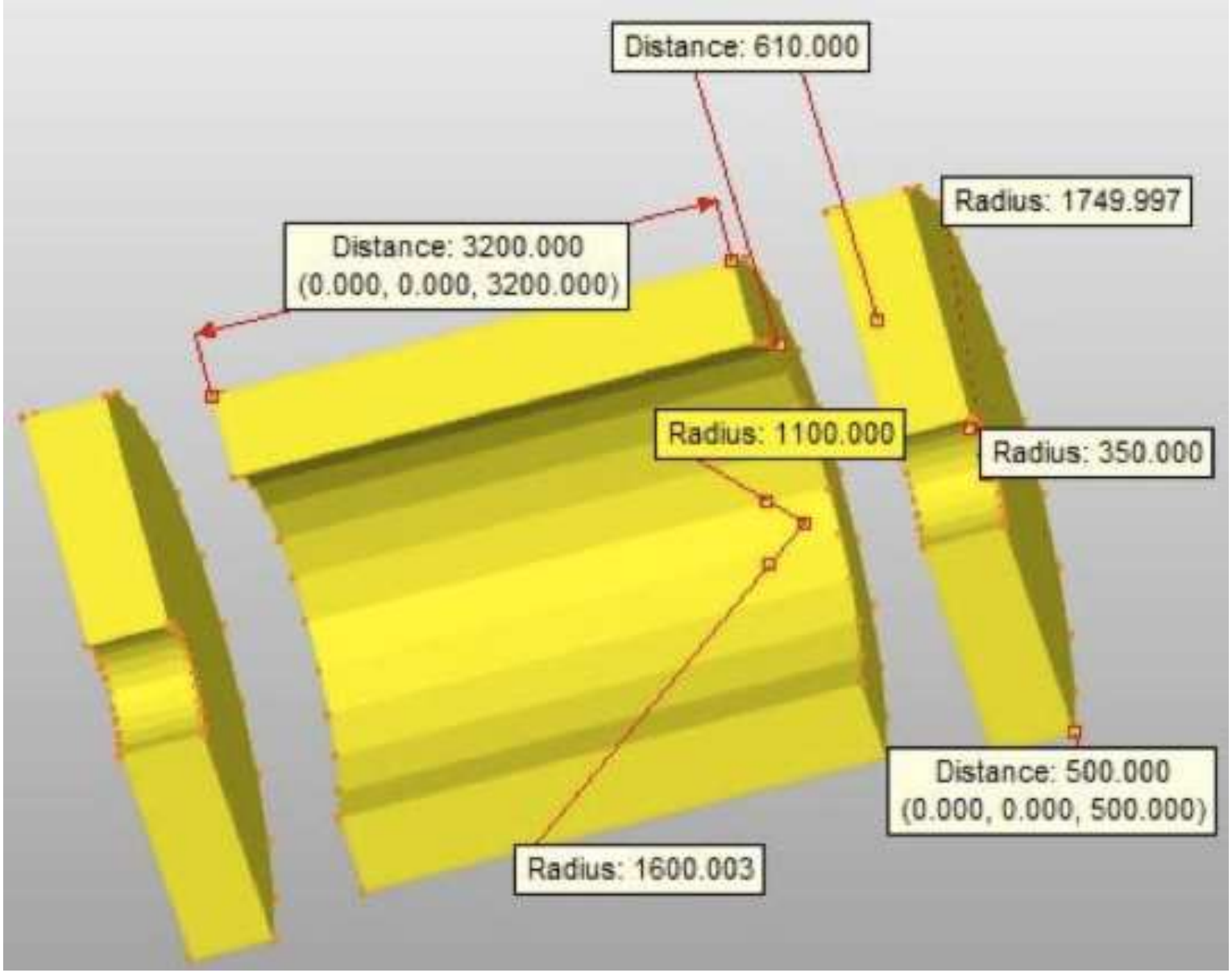
- Detect and identify direct photons from the non-polarized and polarized pp (pd) reactions.
- Exclude photons from π^0-decays

Electron identification

- Detect e^+e^- pairs from Drell-Yan processes and from J/ψ-decays

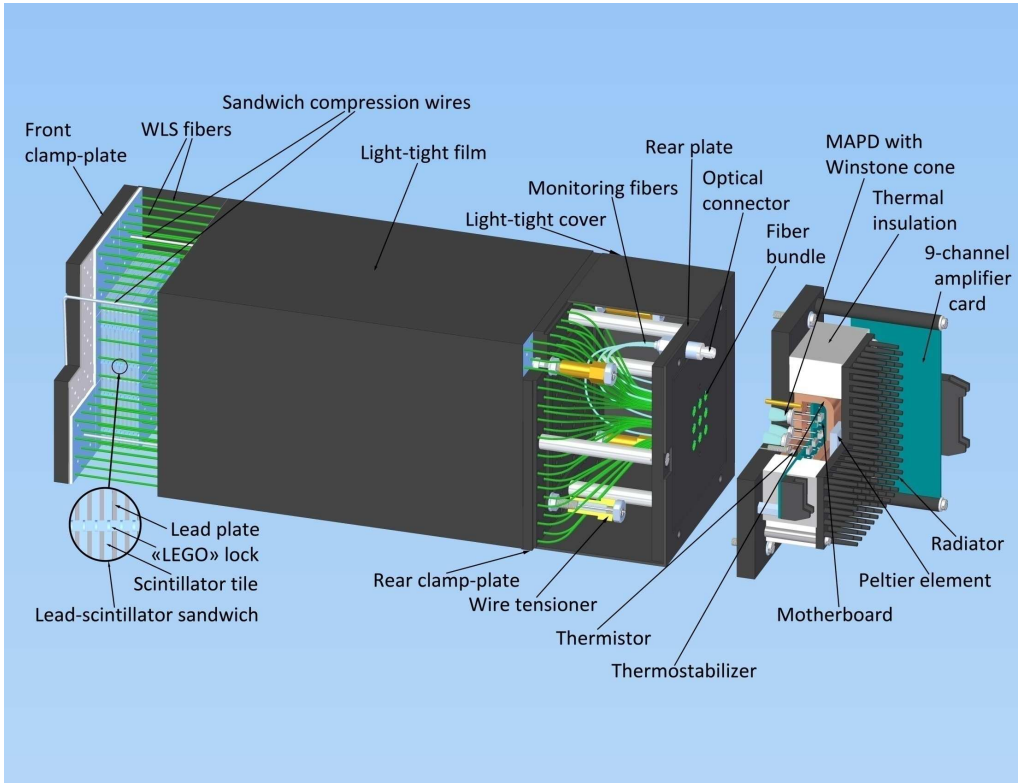
Participation in trigger

Calorimeter construction

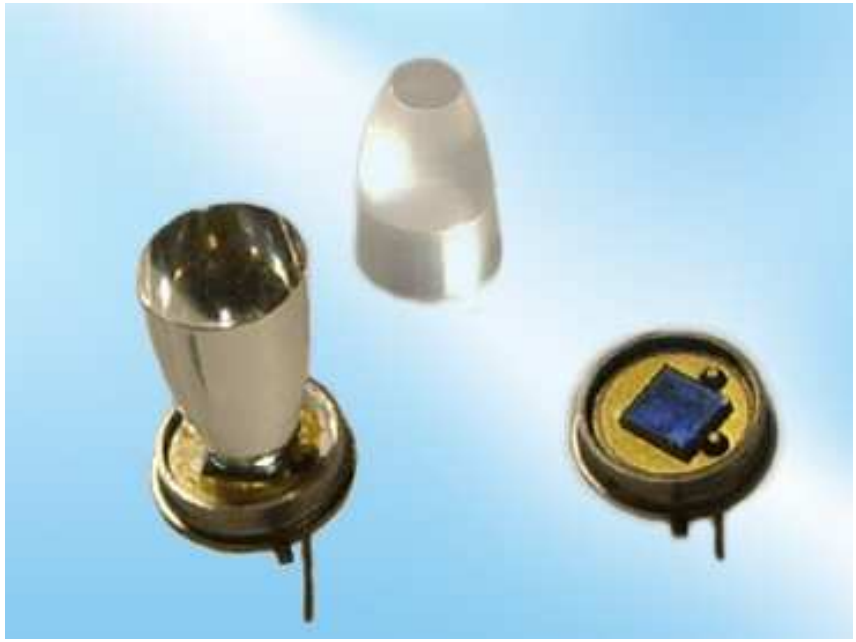


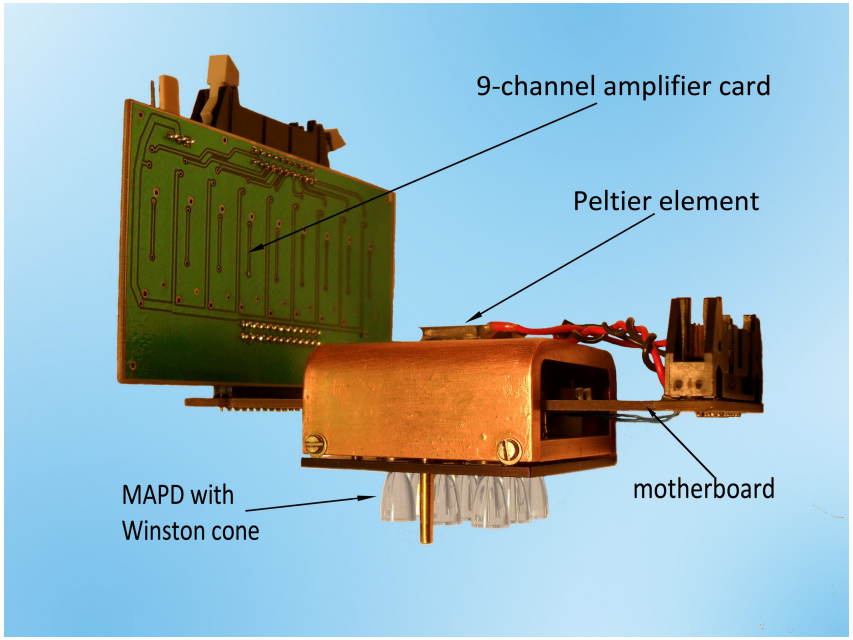
Calorimeter construction

Scintillator	Polystyrene Kharkov
Absorber	Lead
Number of layers	109
Lead plate thickness	0.8 mm
Scintillator plate thickness	1.5 mm
Length	250.7 mm
Pb plate dimension	12 cm
Sc plate dimension	4 cm
Number of towers	9
Number of fibers per tower	16
Diam. of bundle	6.5 mm
Light guide	Winston cone glued to photodetector
Photodetector	MAPD -3N
Modul size	$120 \times 120 \times 250.7$ mm^3
Effective Moliere radius	3.5 cm
Effective radiation length	1.64 cm
Total radiation lengt	$\approx 15X0$
Temperature stabilization	Peltier cooler
Number of modules	≈ 2000



Multi-pixel Avalanche Photo Diodes





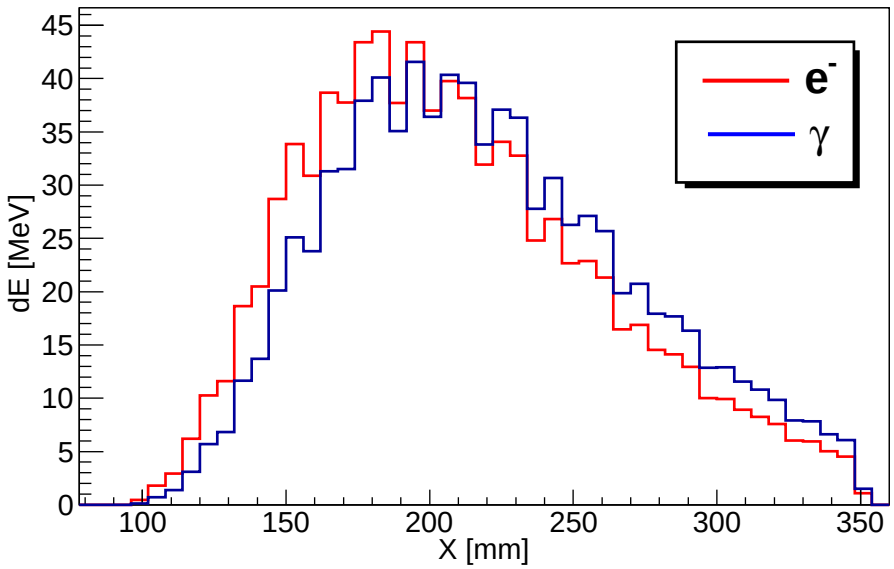
Strong magnetic field prevents use of PMT. MAPD are insensitive to magnetic field and can be used in our case.

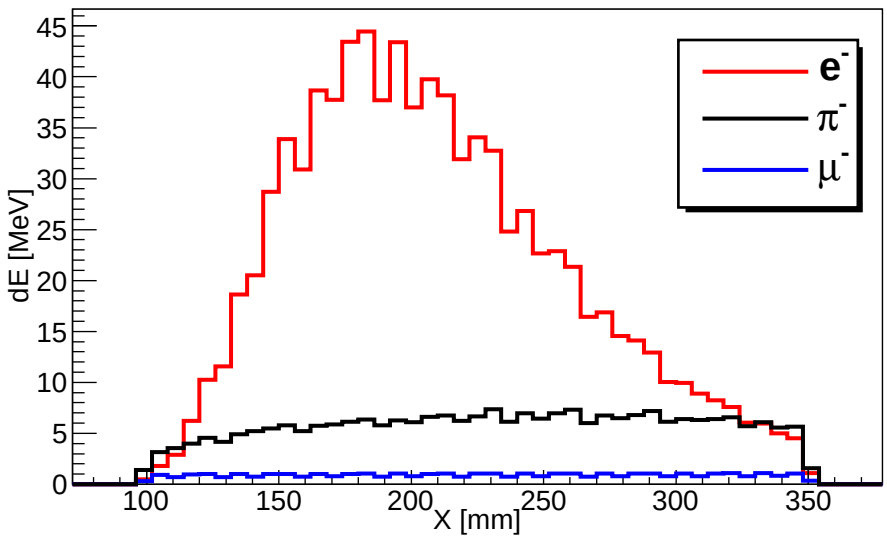
Monte Carlo Simulation

- The simulations presented were performed using Geant4 version 10.0
- Geometry: block of 9 modules (3x3)
- QGSP_BERT physics list
- Read-out electronics, optics and light collection were not simulated

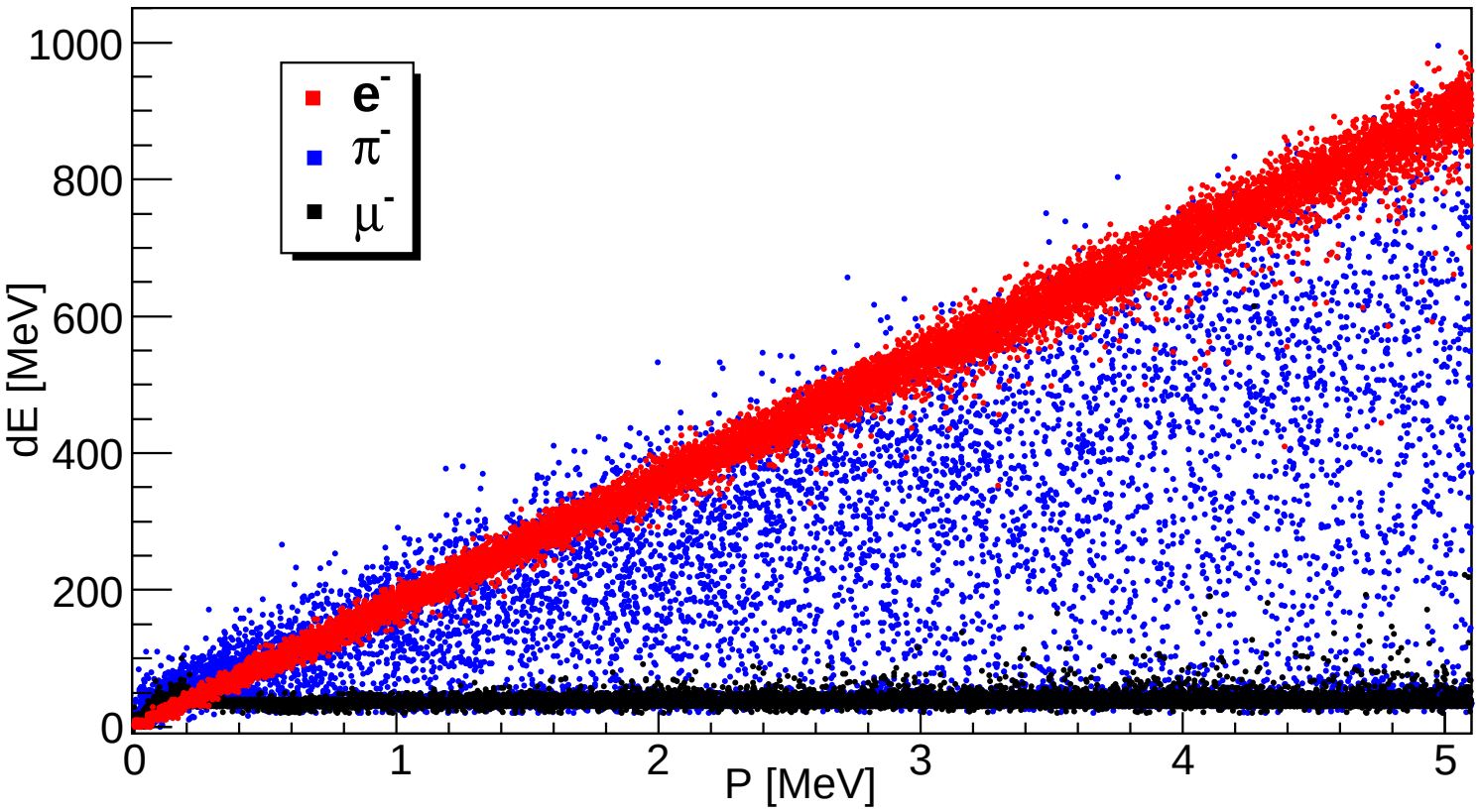
Shower Profile

Average shower profile for $e^-, \mu^-, \pi^-, \gamma$ (5 GeV)



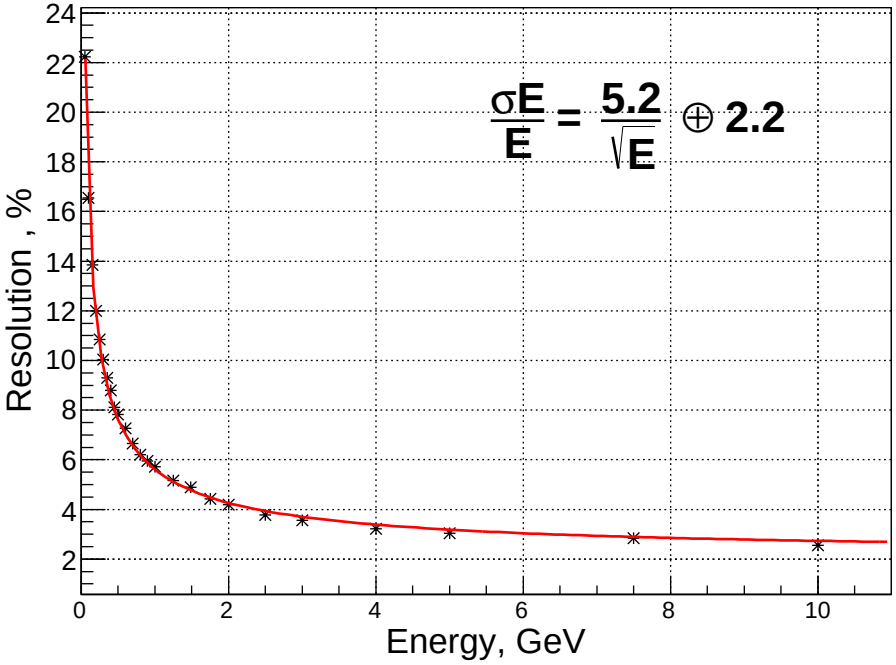


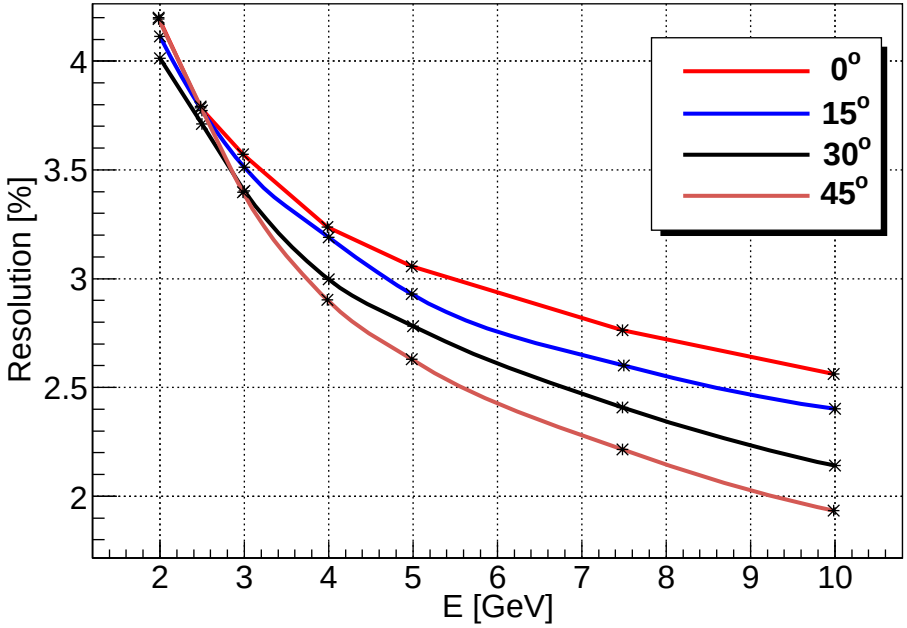
Energy deposit



Energy resolution

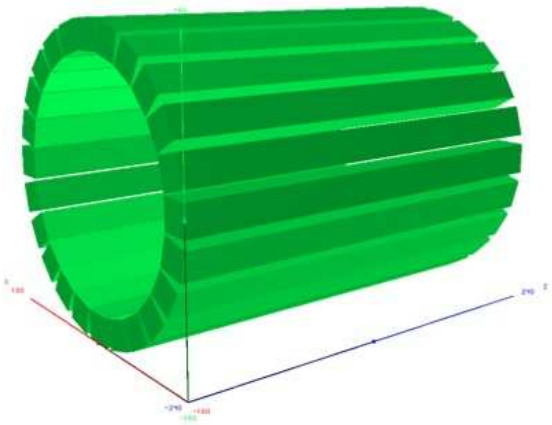
Energy resolution for electrons with energies from 50 MeV to 10 GeV

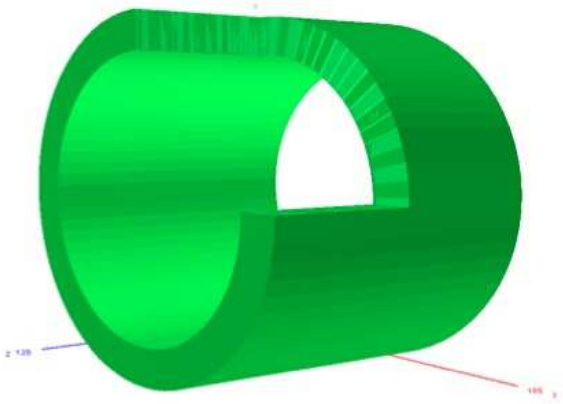


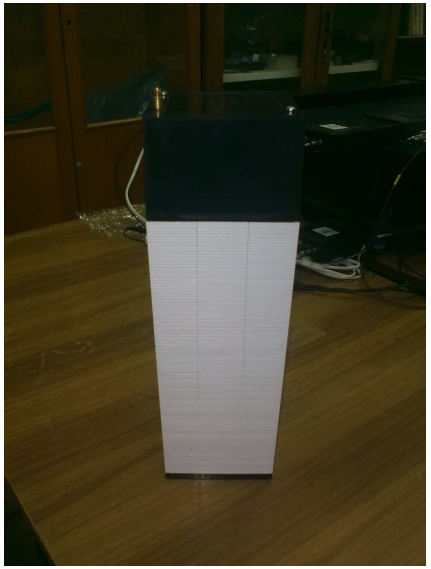


Increase in angle of incidence improves energy resolution for the region of interest.

Projective geometry

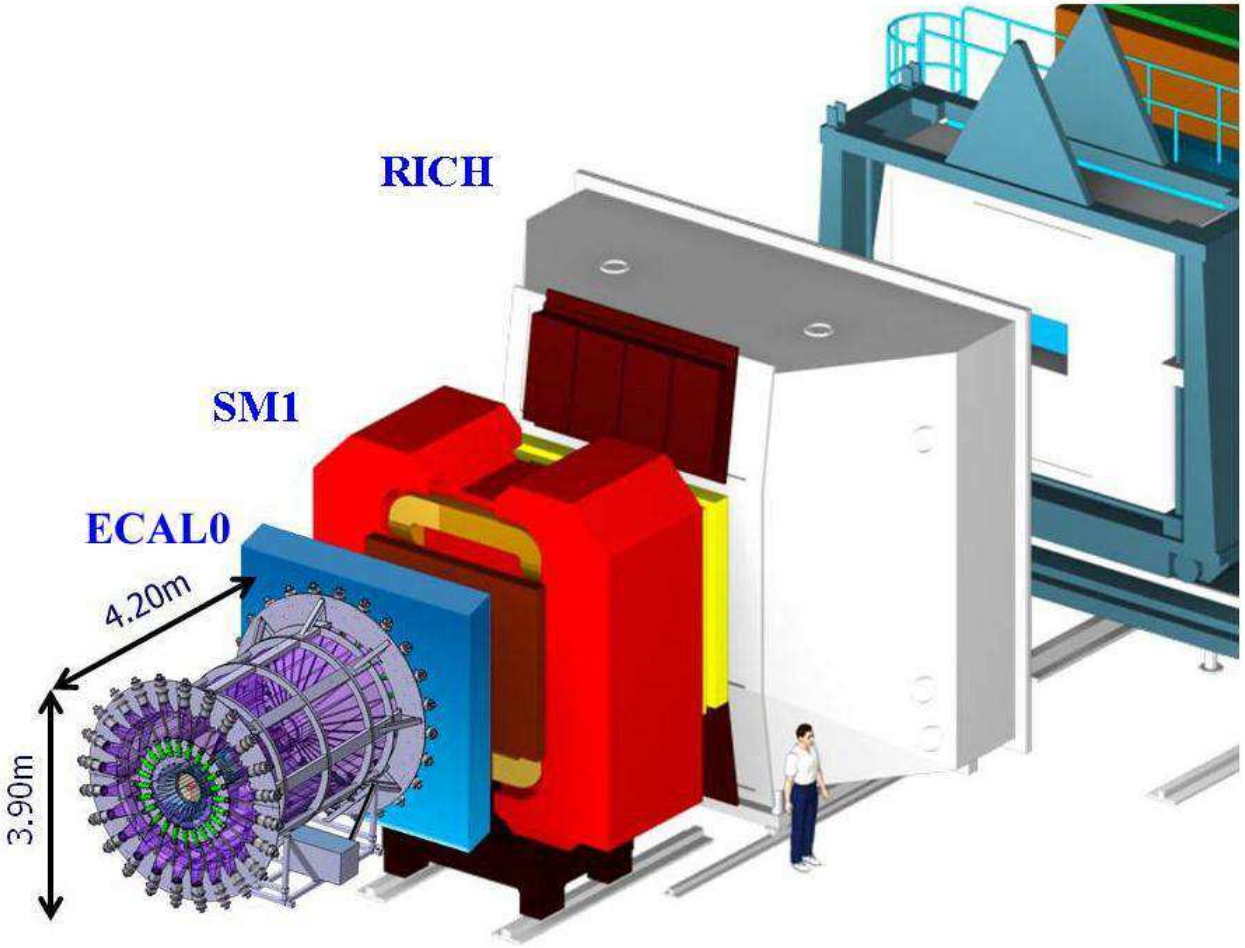






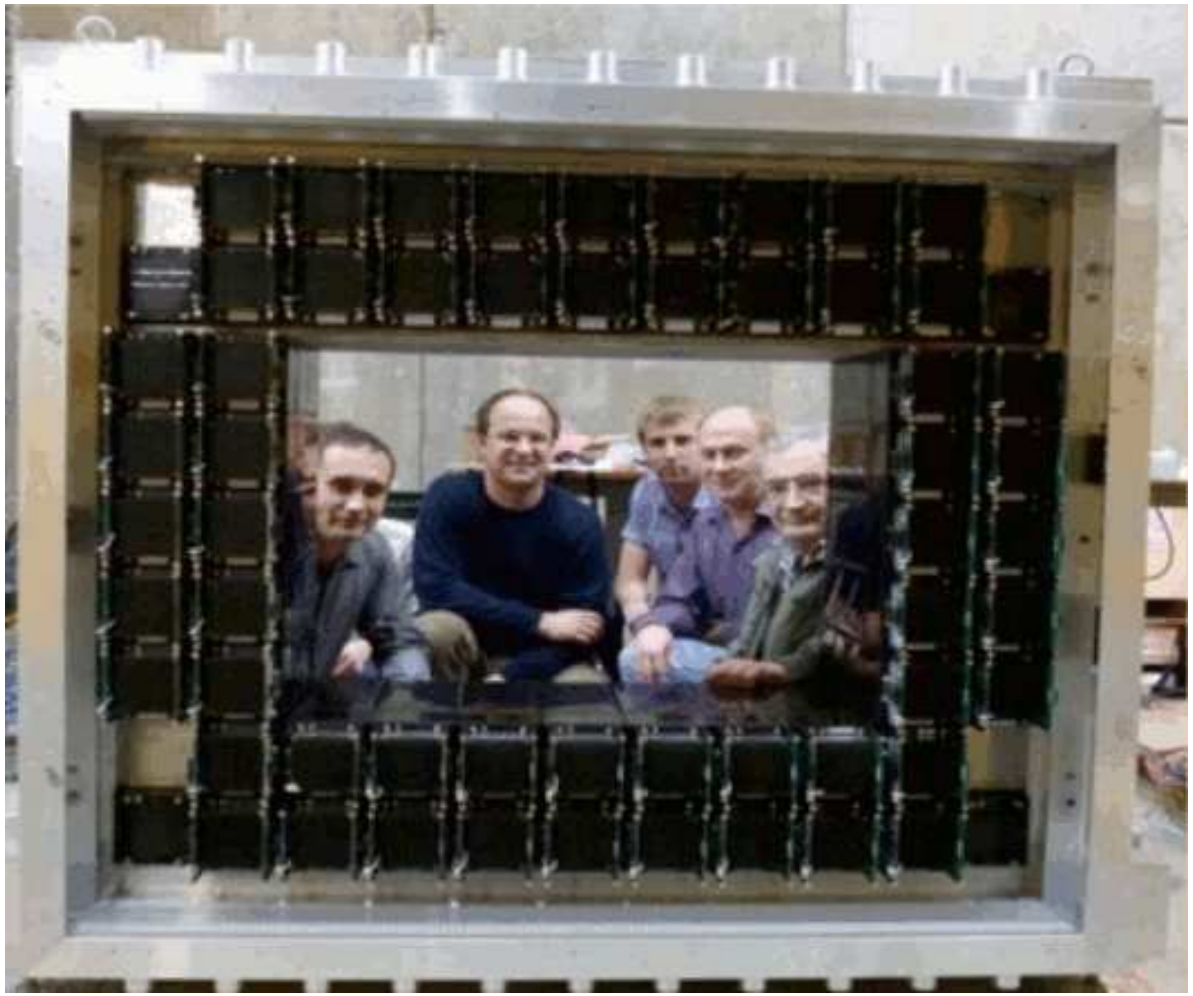
- Gaps in the calorimeter seriously affects energy resolution and particle detection.
- Projective geometry is needed to eliminate such problems.
- It was already tested that we can produce trapezoidal modules.

Modules in COMPASS (ECAL0)



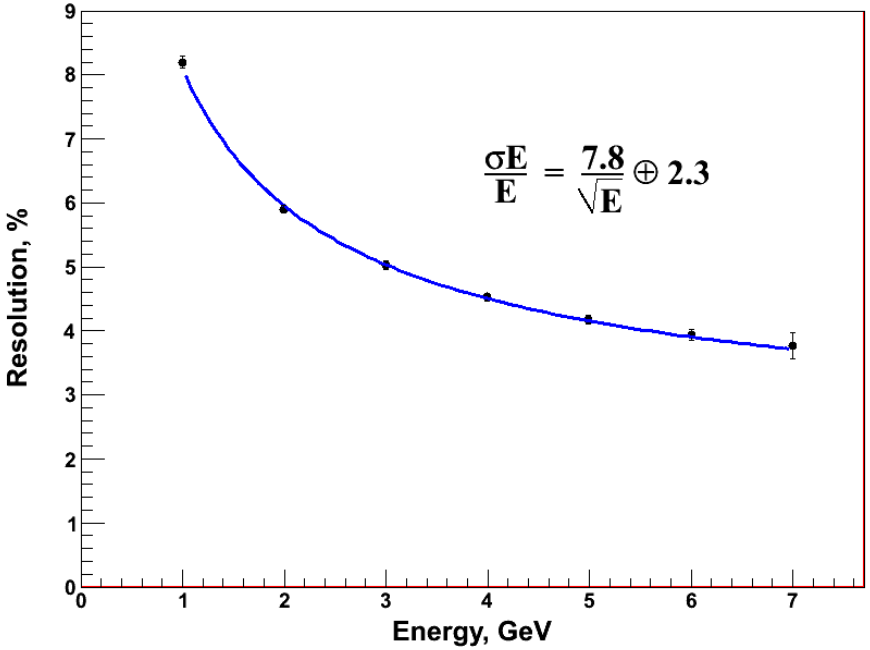
Similar modules are already in use in COMPASS. Their parameters were measured in experiments.

Modules in COMPASS (ECAL0)

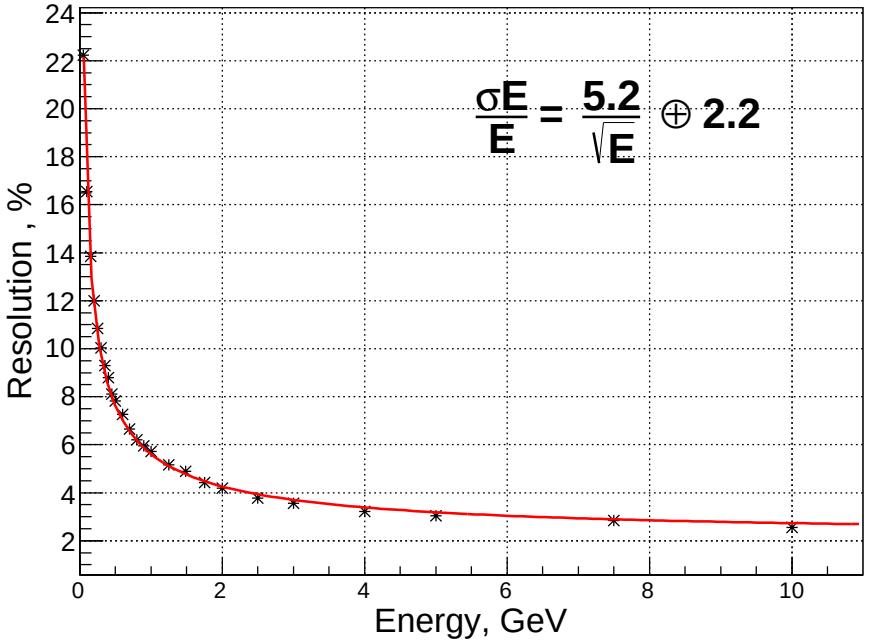


Modules in COMPASS (ECAL0)

Experimental data

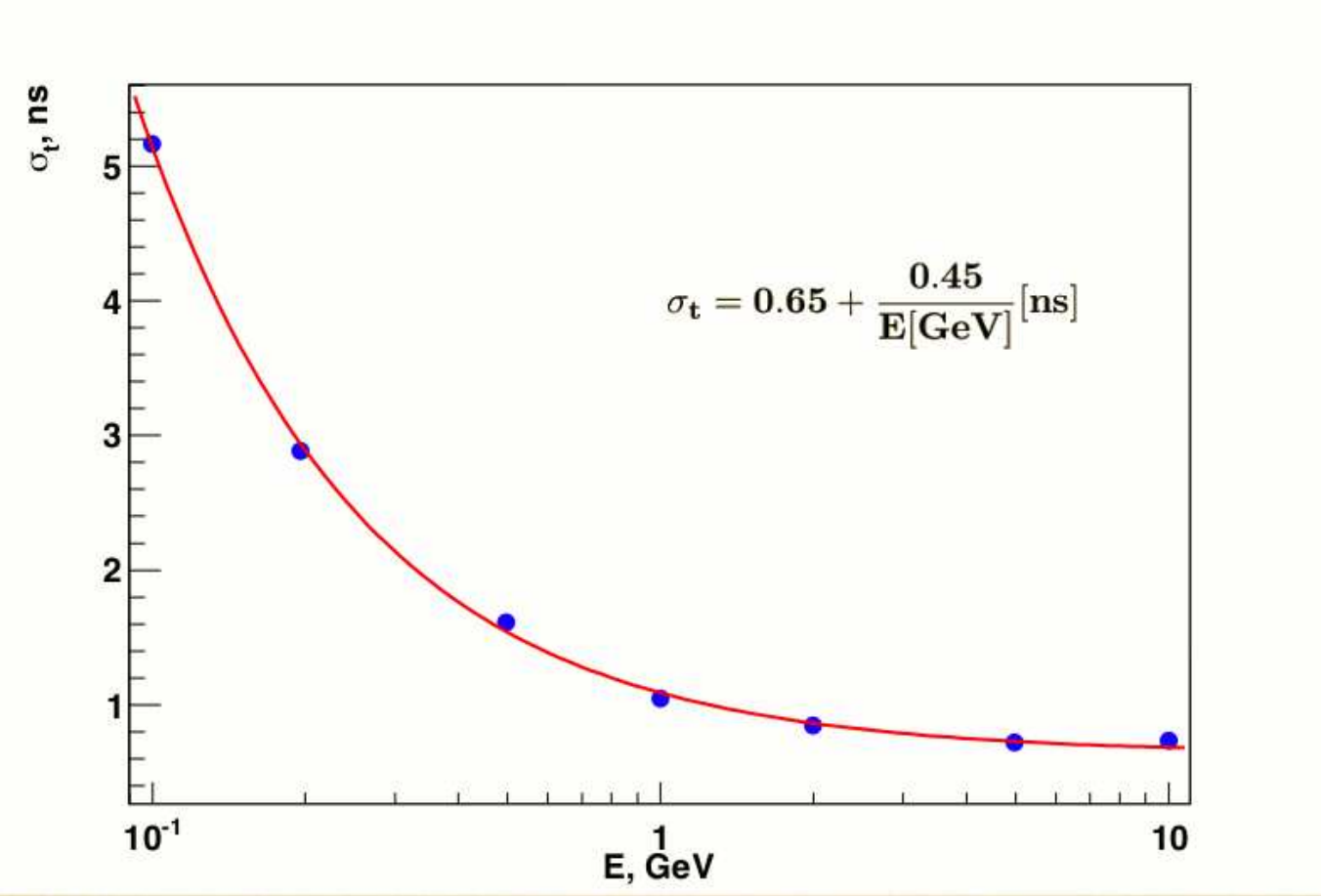


Monte carlo simulation



Energy resolutions of the ECAL0 3×3 module matrix readout by the MAPD at $T = 15^o$C versus the electron beam energy.

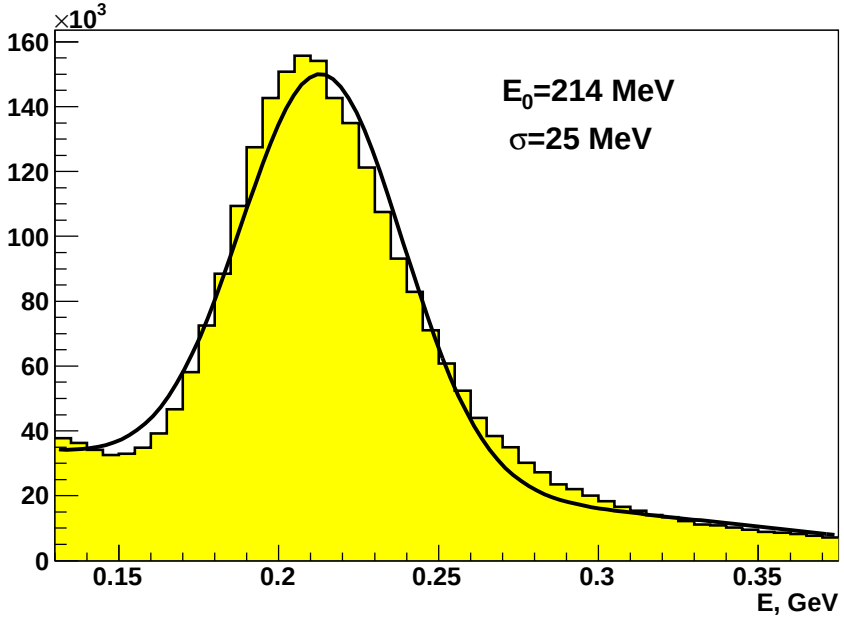
Modules in COMPASS (ECAL0)



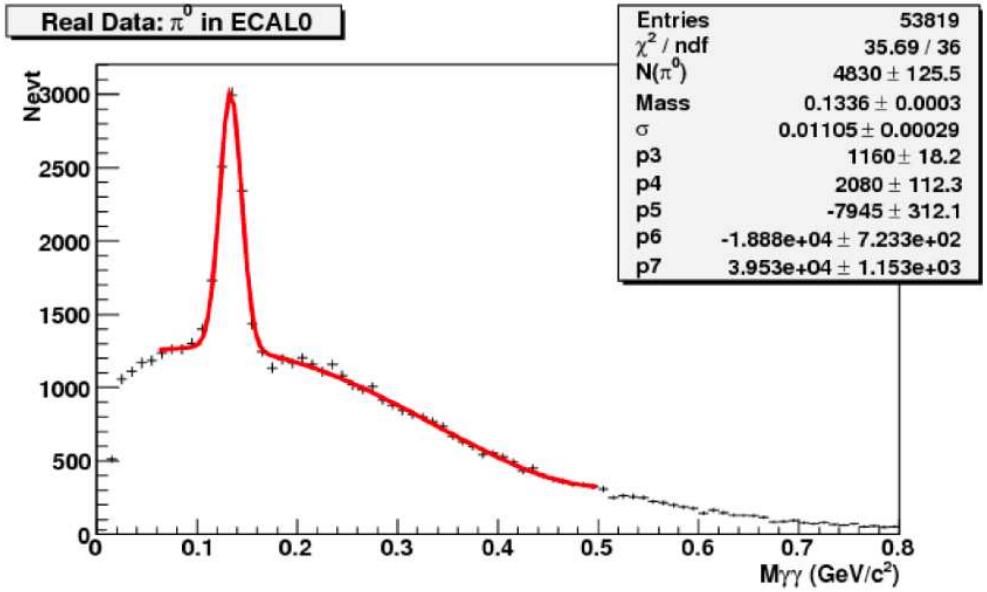
Time resolution can be compared to Time-of-Flight camera and it is suitable for a trigger.

Modules in COMPASS (ECAL0)

MIP peak



π^0 peak



Summary

- ECAL - important part of SPD
- Already existing modules are suitable for the purposes of SPD
- Simulation is reasonably reproducing responses of calorimeter