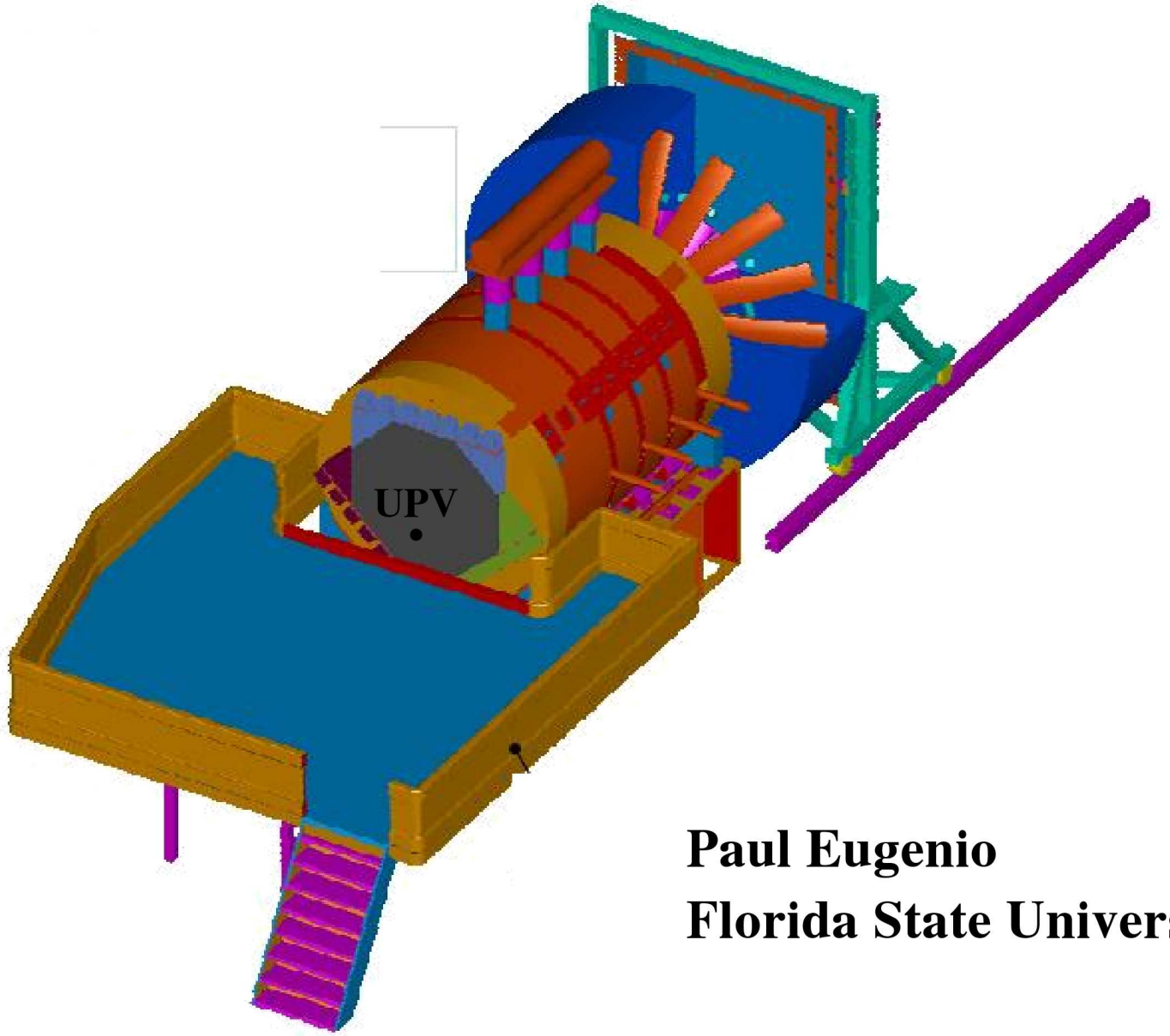
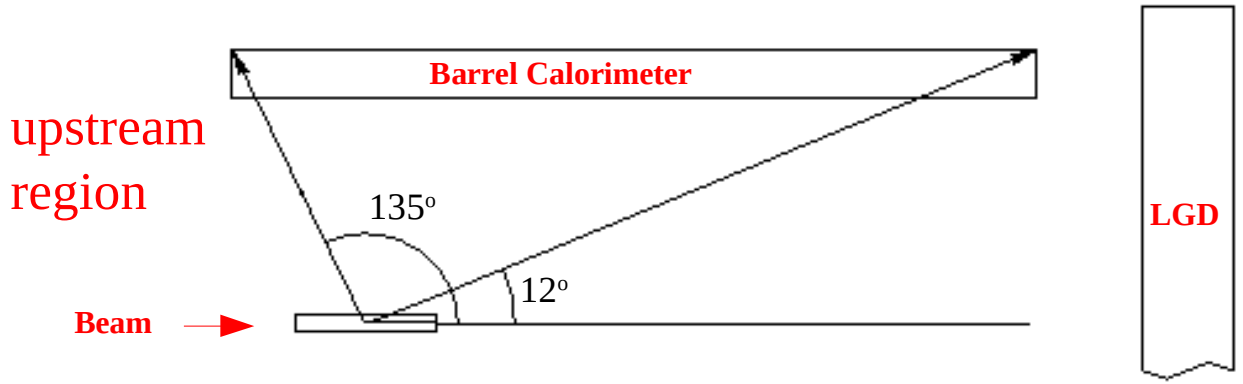
Upstream Photon Veto (UPV)



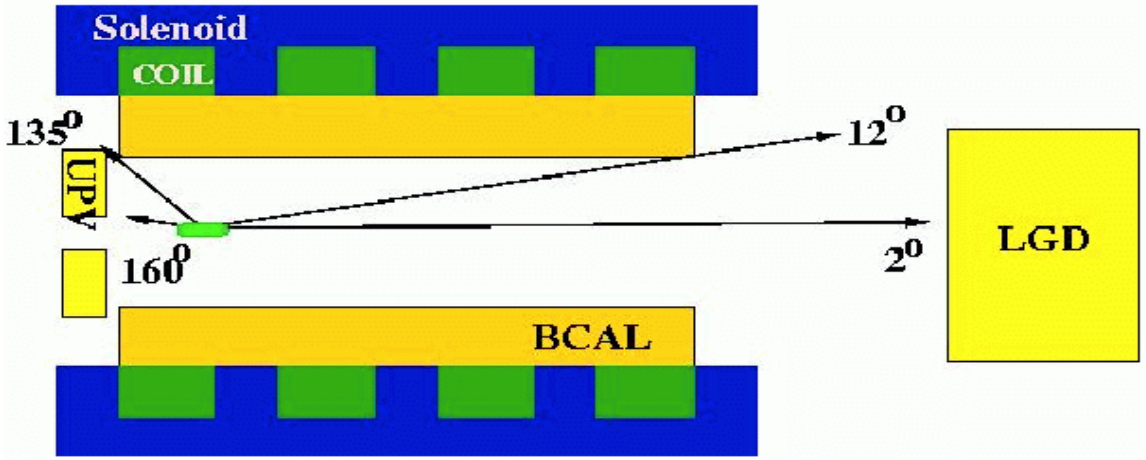
Paul Eugenio
Florida State University

Main Objective

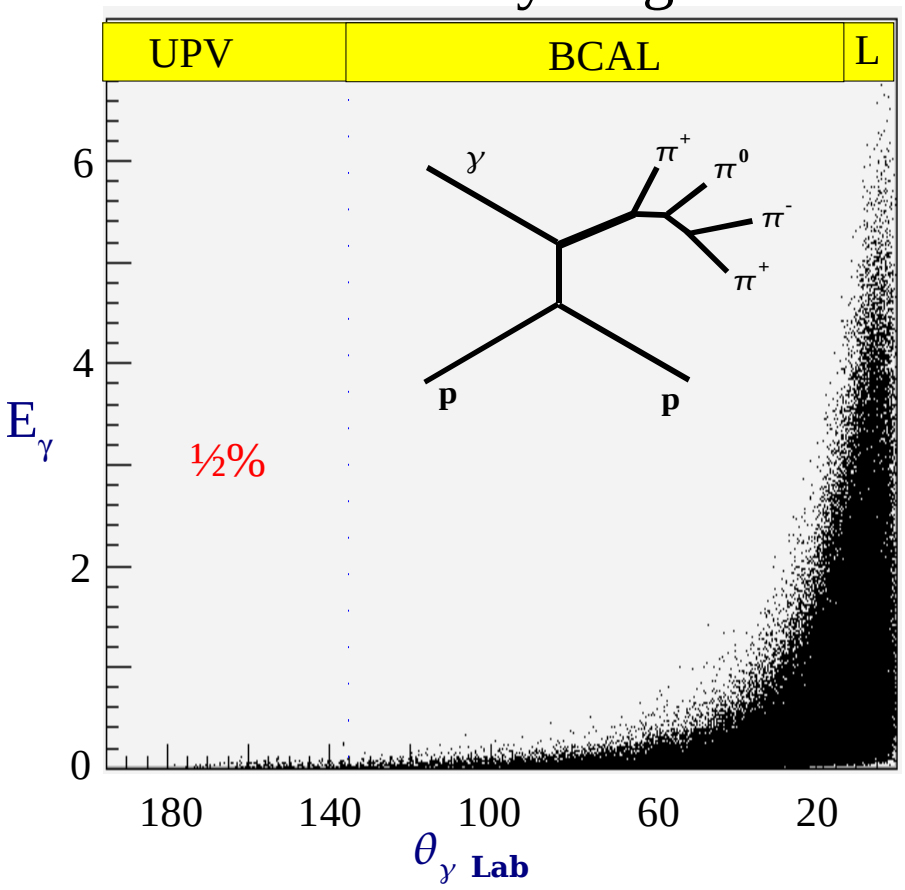


- The UPV is a photon detector directly upstream of the hydrogen target
- Its function is to detect backward-going photons by summing energy deposition in the backward direction

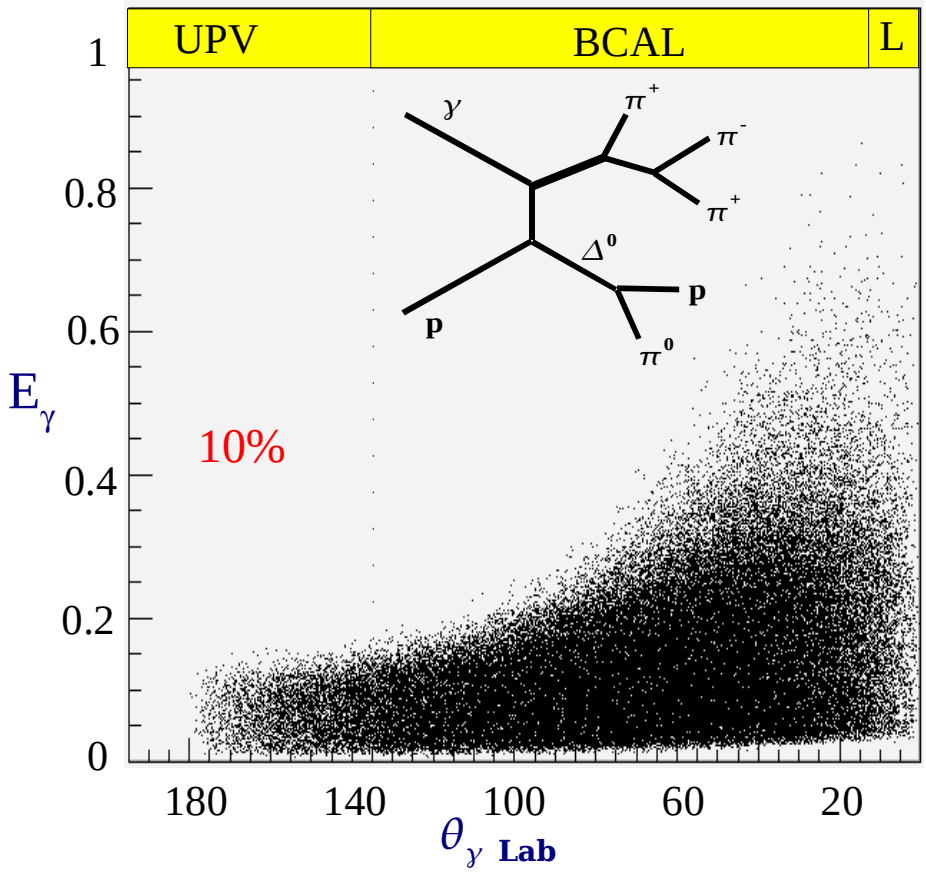
Soft Photon Backgrounds



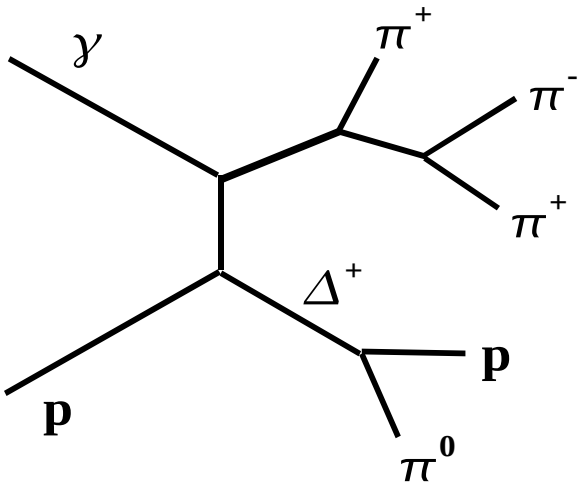
Photon Decay Angles

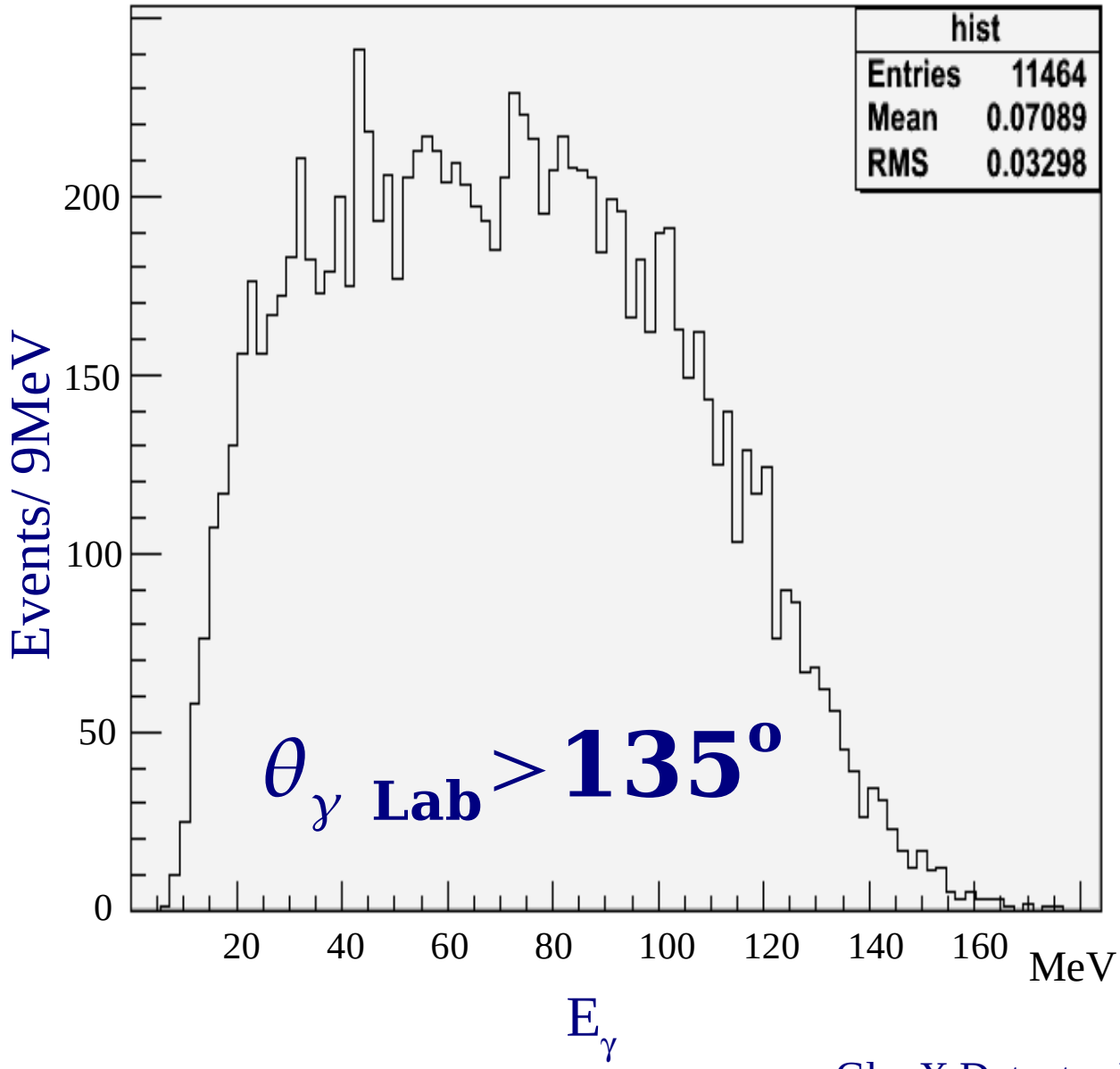


Photon Decay Angles



Soft Photon Energy Spectrum





Beamline Related Backgrounds

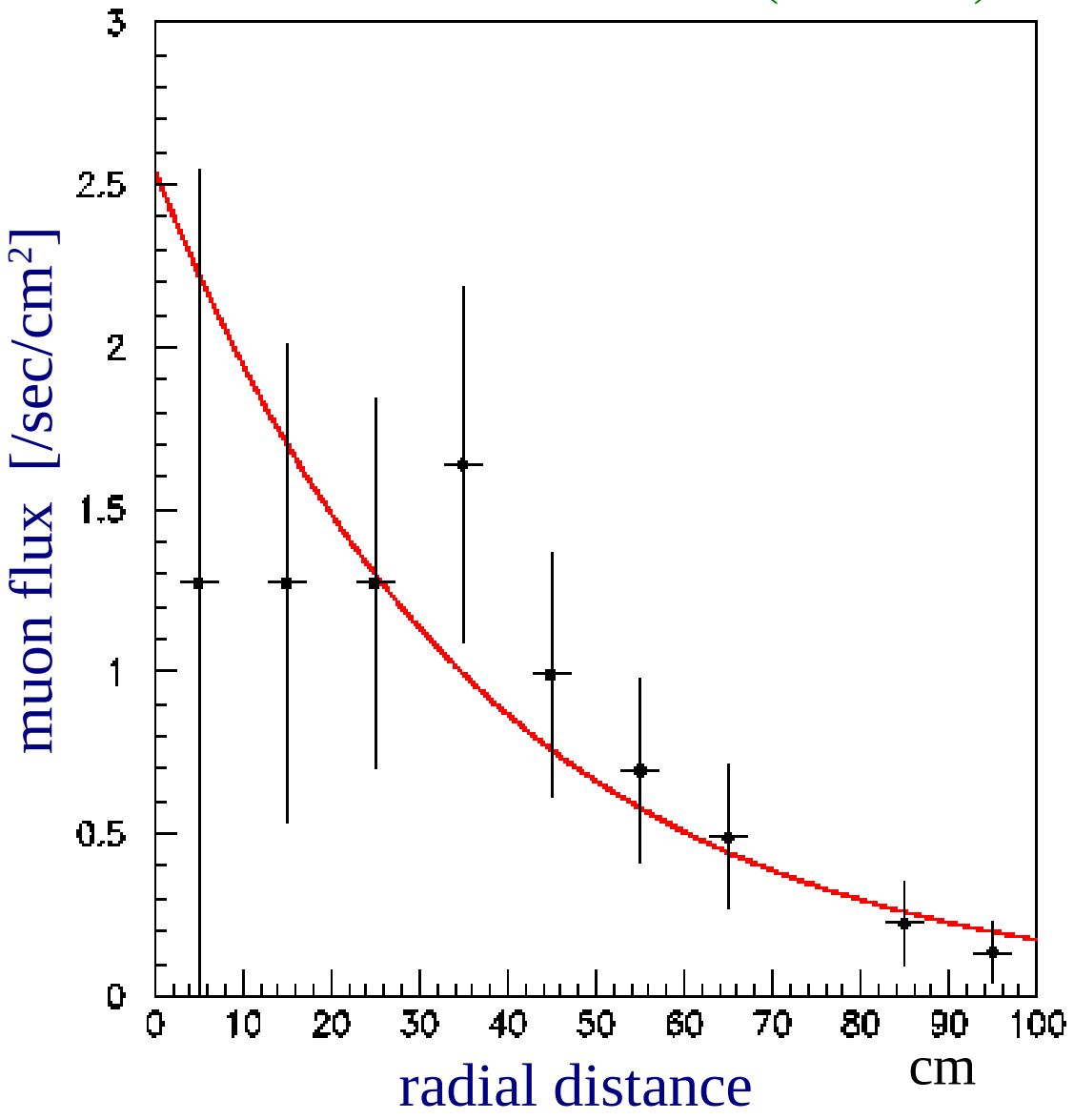
Geant simulation of beamline and shielding including photo-hadronic interactions and muon pair production.

Conclusion:

negligible background

~25 kHz whole region

R.T. Jones *et al.* GlueX-doc-60-v1 (2003/2004)



Design Options

Sampling Calorimeter

lead-scintillator sandwich

Benefits of design choice

- fast detection (10-20 nSec)
- good photon detection
  - good energy resolution

Advantages

- relatively simple design
- **low** cost

Disadvantages

- coarse photon reconstruction

Homogeneous Calorimeter

pointing crystal design

Benefits of design choice

- good photon reconstruction
  - good energy resolution
  - good position resolution

Disadvantages

- increase complexity
- slower detection(10^2-10^3nSec)
- **significant** increase in cost

Veto Design Choice

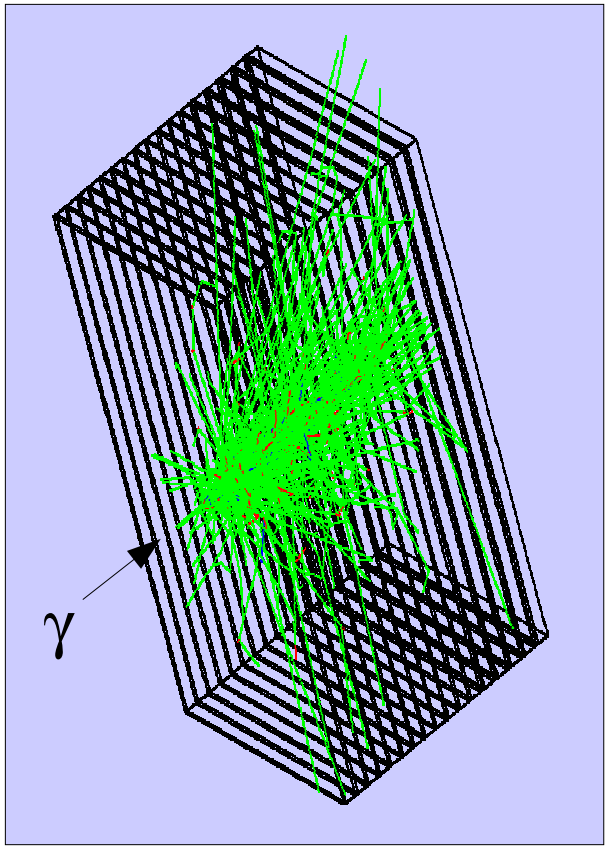
Lead/Scintillator Sandwich

Alternating lead/scintillator layers

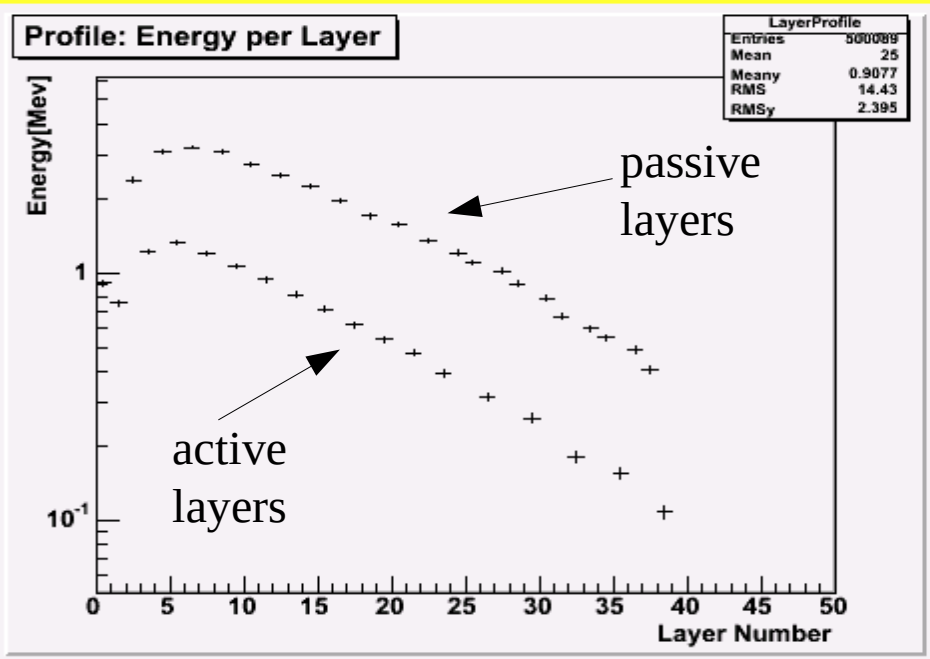
- 18 layers of 1cm thick scintillator
- First 12 layers of 0.185 cm thick lead sheets ($0.36X_0$ each)
- Remaining 6 layers 0.370 cm thick lead sheets ($0.72X_0$ each)

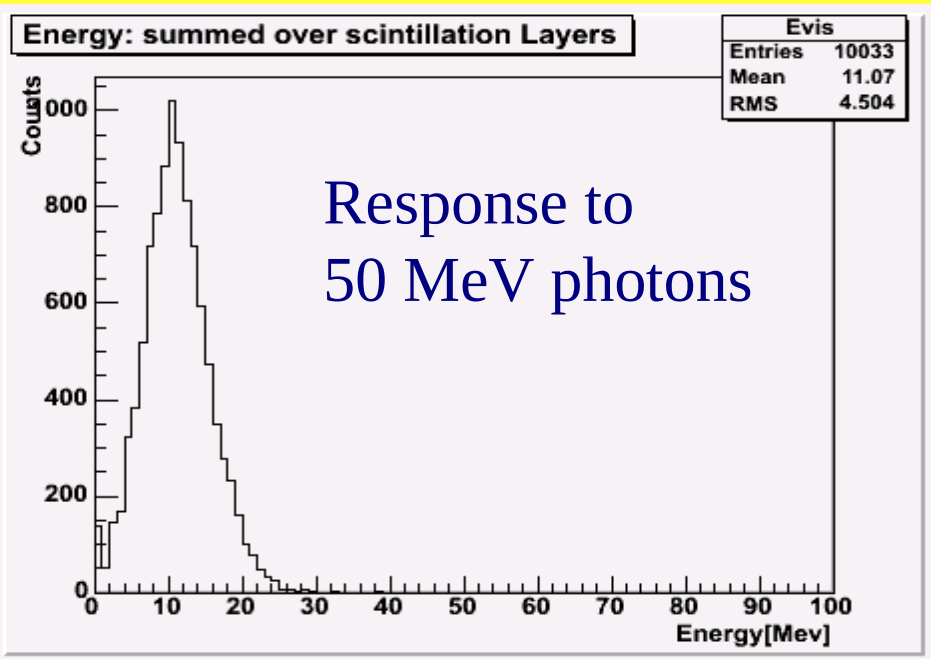
Total thickness: 22.4 cm or $8.91X_0$

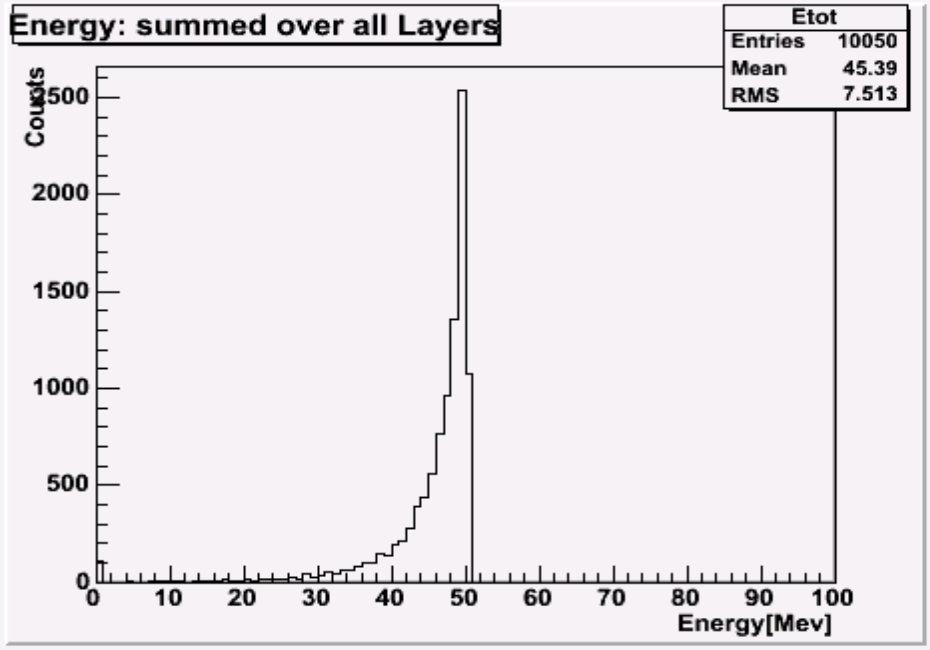
24% sampling fraction

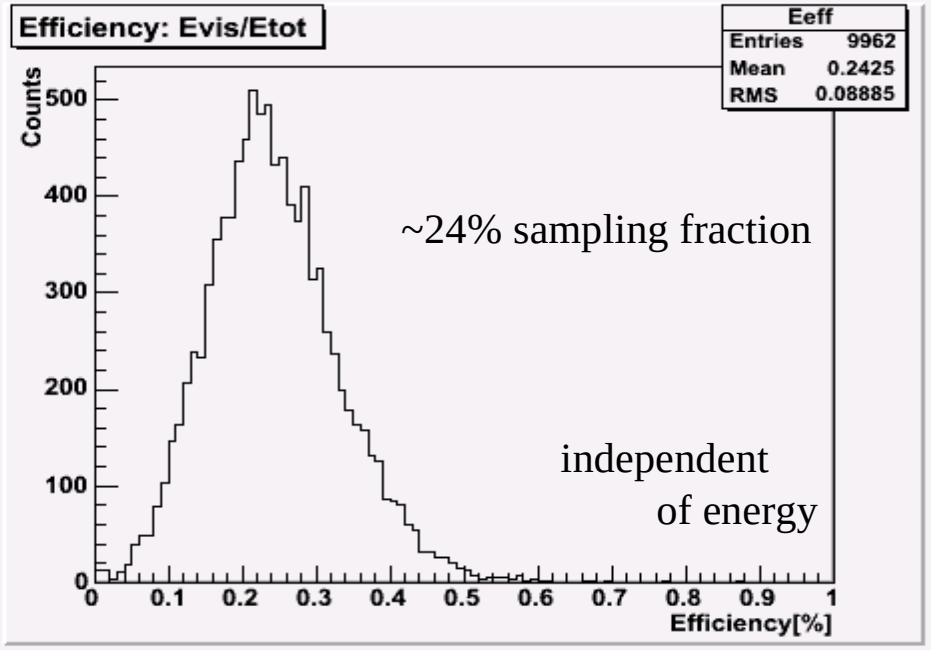


GEANT Simulations

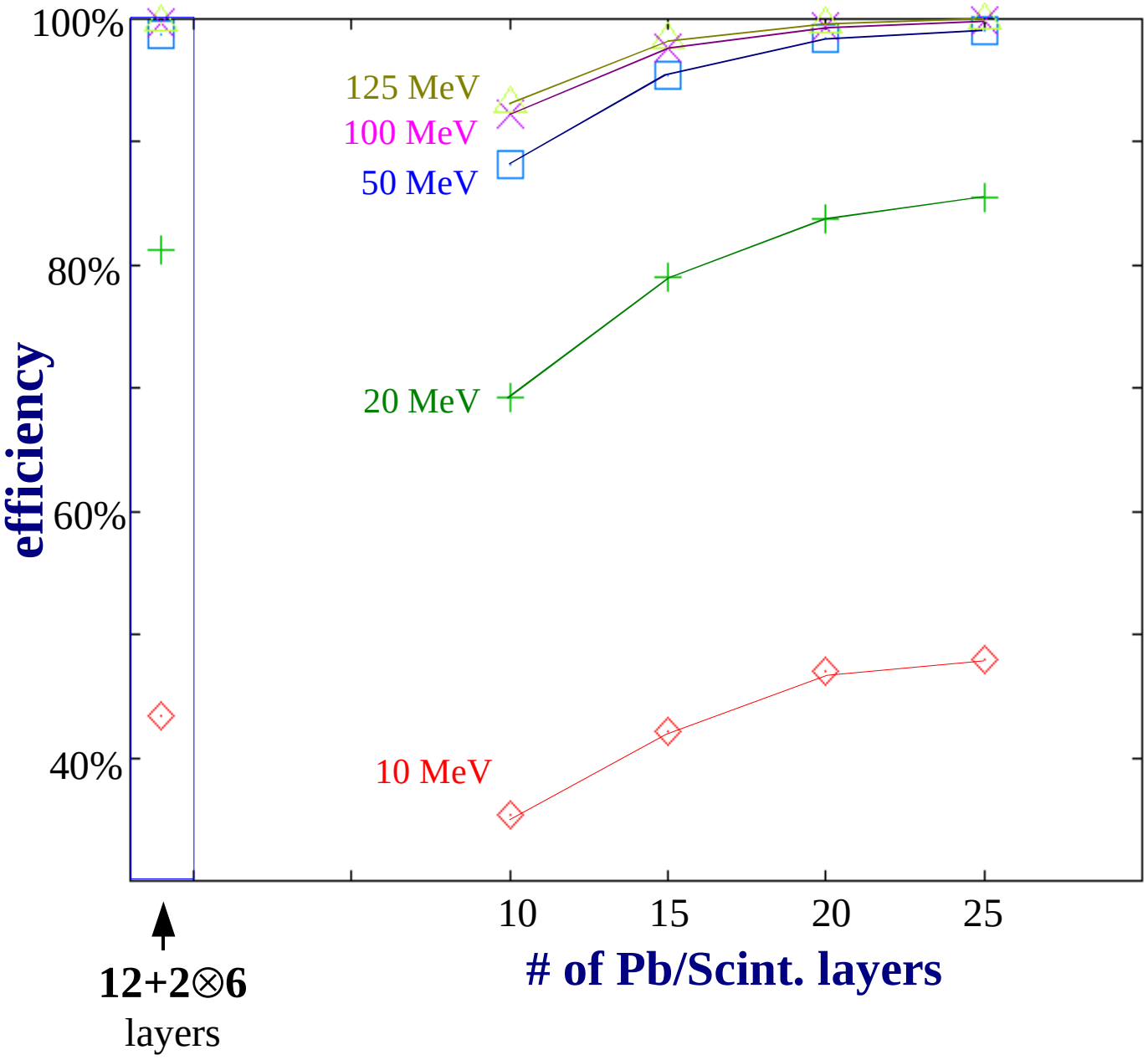






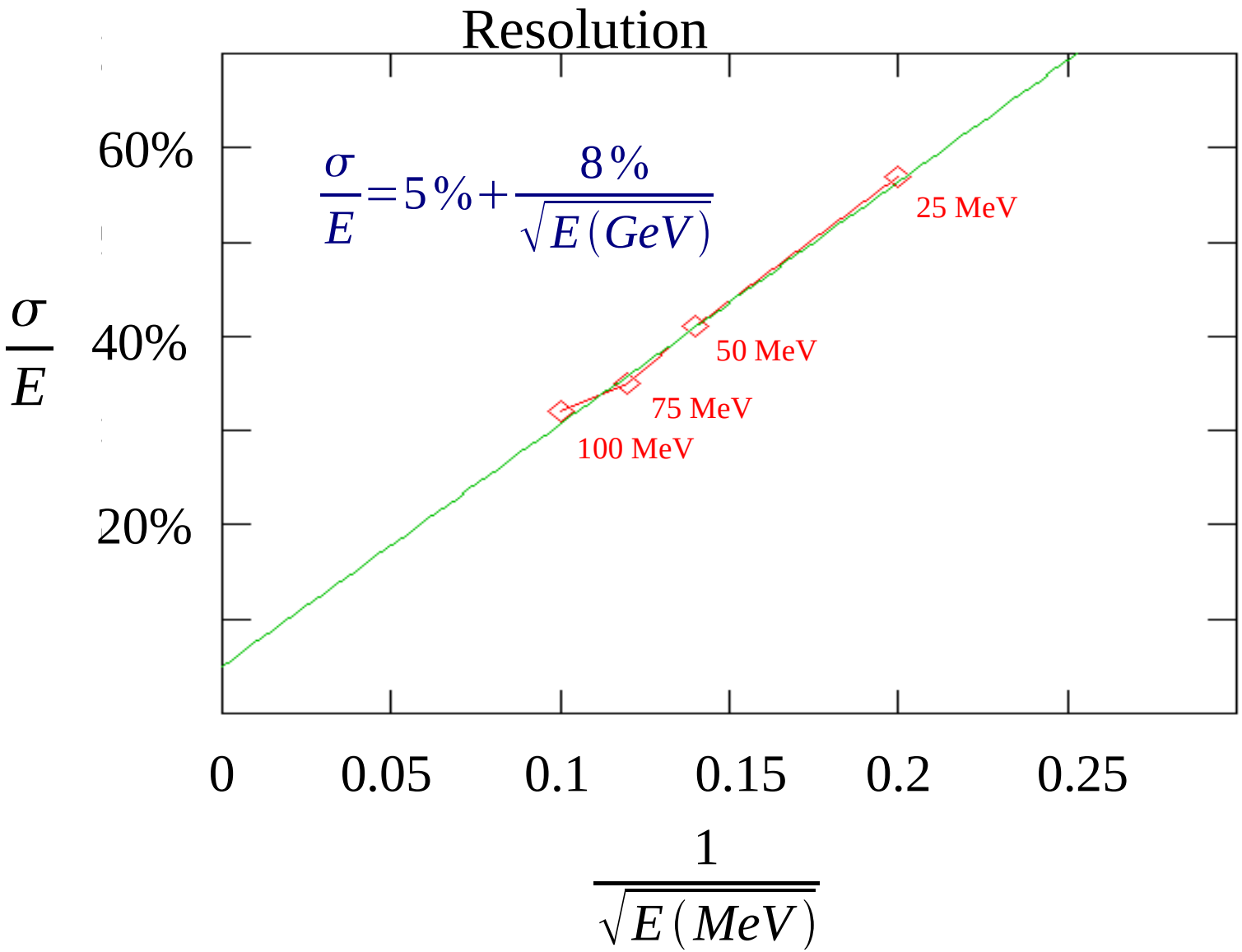


GEANT Detection Efficiency



Events were accepted if the visible energy exceeded a threshold of 2.0 MeV

GEANT Resolution

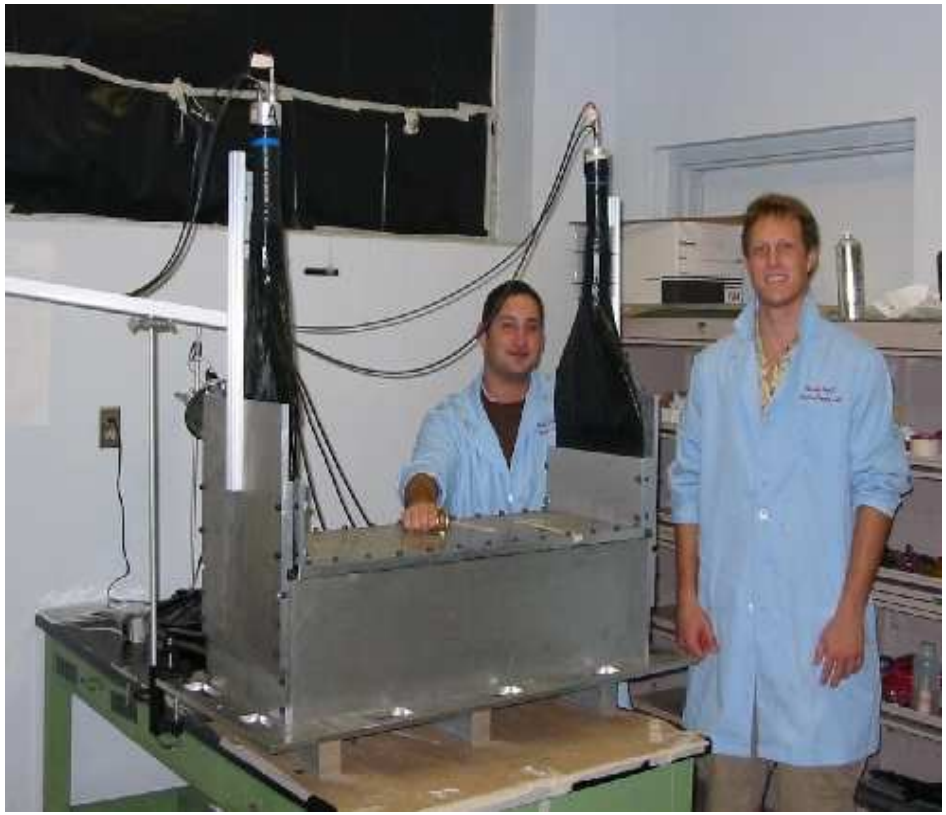


R & D Prototyping

- **Veto Prototype**

18 layers of 1 cm scint. interleaved with first 12 layers of 2.2mm lead then 6 layers of 4.4mm lead

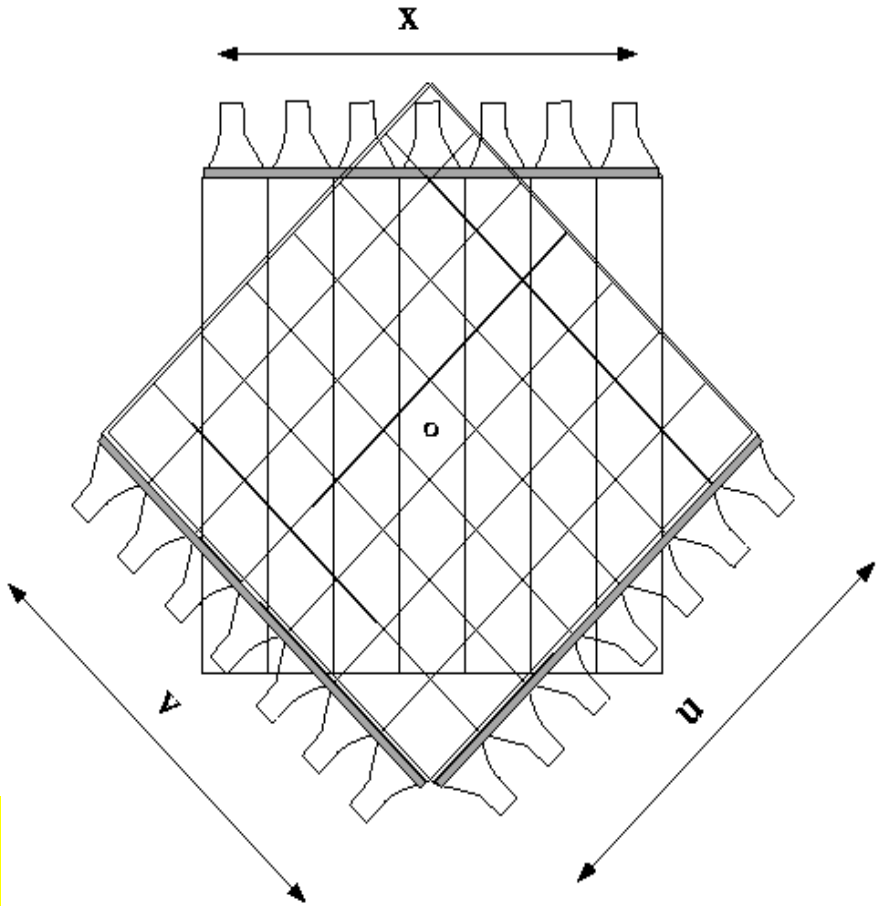
  - Measure prototype performance in a low energy electromagnetic beam and compare results to GEANT4 simulations.
  - Instrument to test the building technique
  - Build infrastructure in place for future R&D w/ final goal of the construction of the UPV



Prototype has been constructed and initial testing is well underway. The study of prototype performance in a low energy beam ($E_{e^-} < 50$ MeV) is planned by the end of 2004.

Segmentation Options

- Each scintillator layer is divided into 7-34 cm sections (238 cm x 238 cm scintillator plane)
  - Light collection is realized at one end of each section only
- Every 3rd scintillator layer is readout in one orientation
  - x, u, v readout orientations



We are presently studying alternative segmentations
- increased/variable lateral segmentation
- 3-sided -vs- 2-sided

Detector Readout

Light Collection

- Various options are being explored
  - WSB light redirection
  - Clear fibers
  - WS fibers

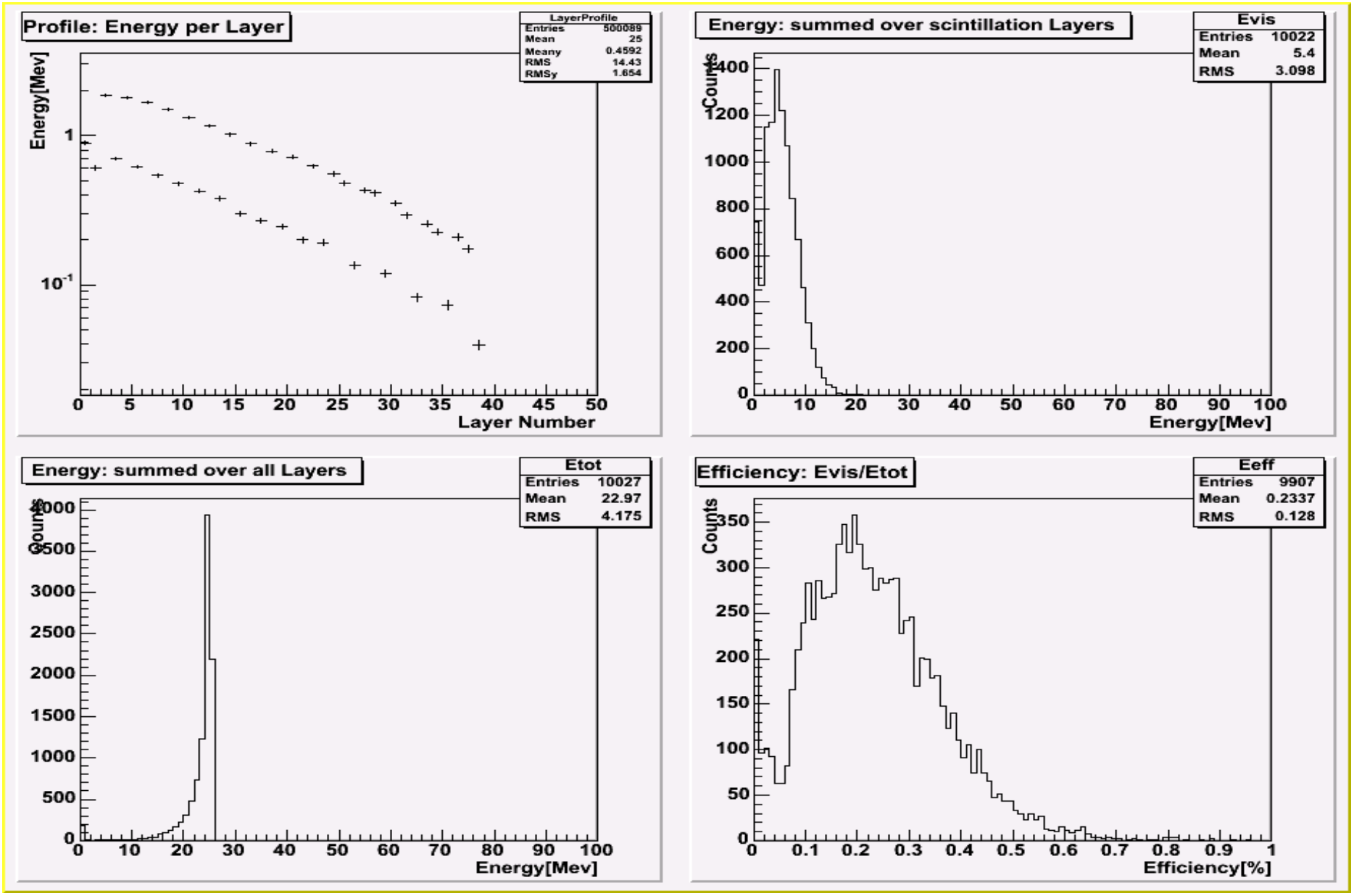
Signal Electronics

- The UPV readout is almost the same as the BCAL
  - FADCs but no TDCs
- The UPV will use the same technology

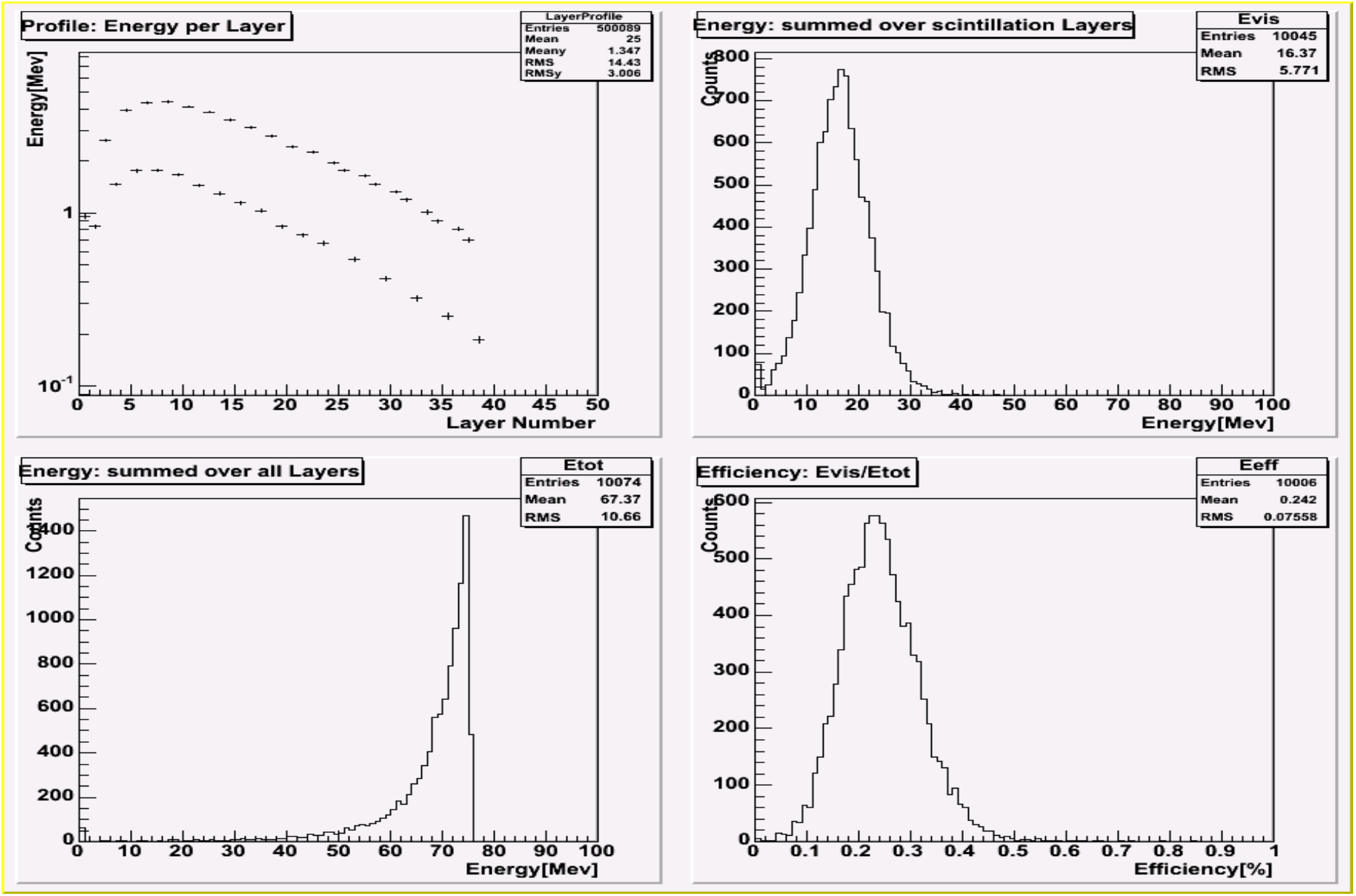
Conclusions

- The UPV is designed to tag soft photons by summing the energy deposition in the backward direction
- The UPV together with the BCAL & LGD form a near hermetic photon detection package
- A lead-scintillator sampling design provides good detection at modest costs
- R & D continues with focus to optimize performance , costs, and ease of construction

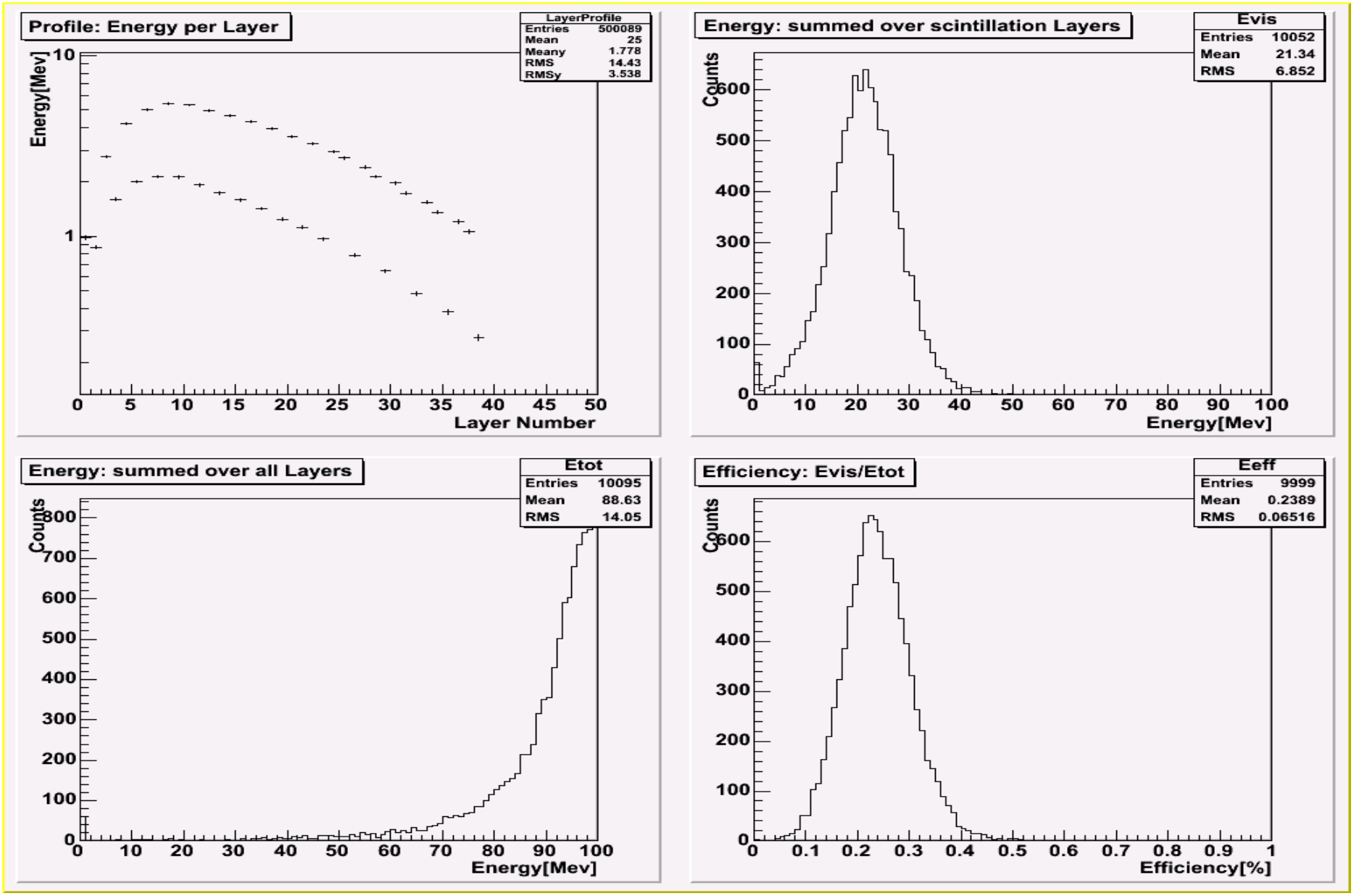
25 MeV


Profile: Energy per Layer
LayerProfile
Entries 500089
Mean 25
Meany 0.4592
RMS 14.43
RMSy 1.654
Energy[Mev]
Layer Number
Energy: summed over scintillation Layers
Evis
Entries 10022
Mean 5.4
RMS 3.098
Counts
Energy[Mev]
Energy: summed over all Layers
Etot
Entries 10027
Mean 22.97
RMS 4.175
Counts
Energy[Mev]
Efficiency: Evis/Etot
Eeff
Entries 9907
Mean 0.2337
RMS 0.128
Counts
Efficiency[%]

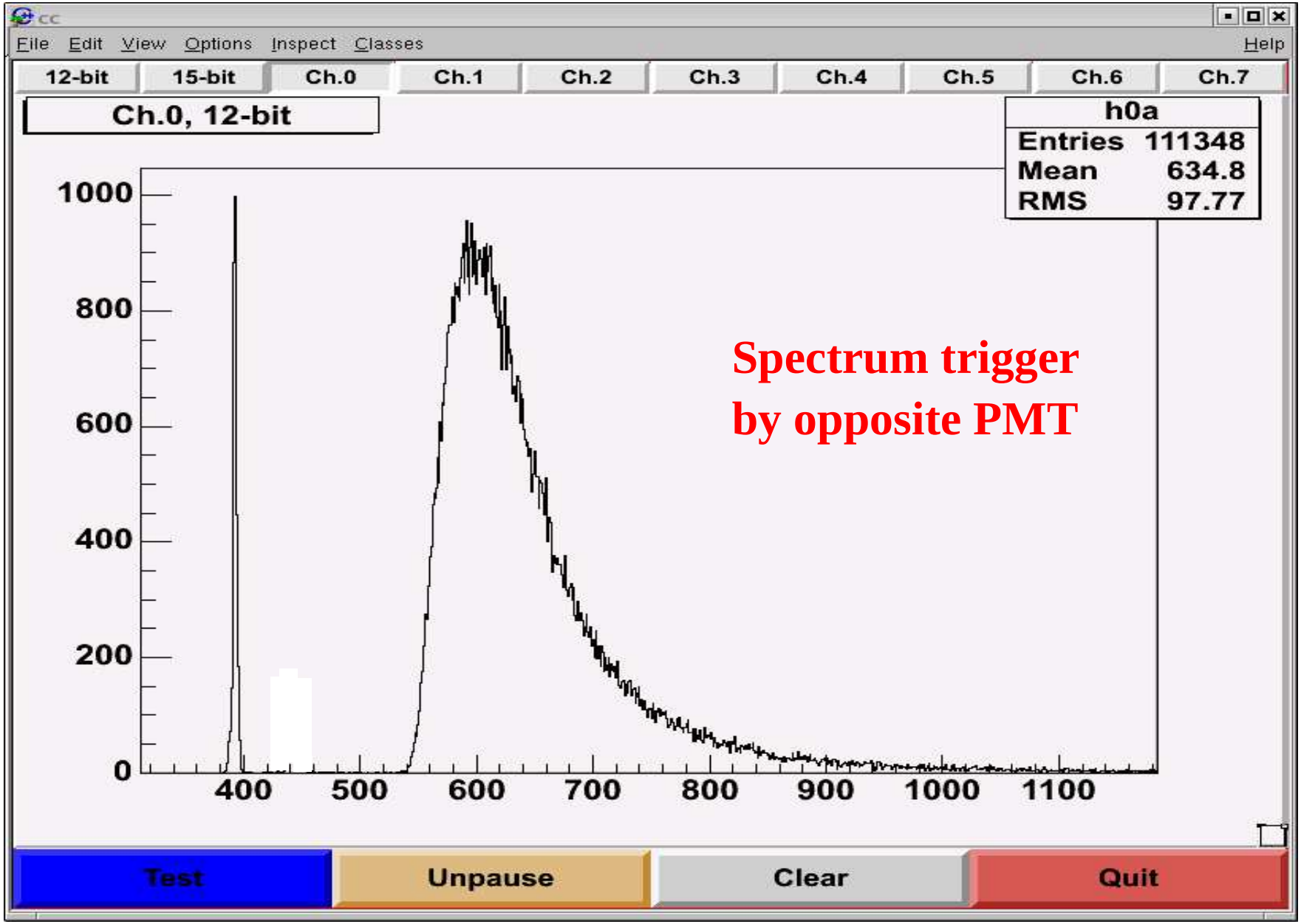
75 MeV


Profile: Energy per Layer
LayerProfile
Entries 500089
Mean 25
Meany 1.347
RMS 14.43
RMSy 3.006
Energy[Mev]
Layer Number
Energy: summed over scintillation Layers
Evis
Entries 10045
Mean 16.37
RMS 5.771
Counts
Energy[Mev]
Energy: summed over all Layers
Etot
Entries 10074
Mean 67.37
RMS 10.66
Counts
Energy[Mev]
Efficiency: Evis/Etot
Eeff
Entries 10006
Mean 0.242
RMS 0.07558
Counts
Efficiency[%]

100 MeV


Profile: Energy per Layer
LayerProfile
Entries 500089
Mean 25
Meany 1.778
RMS 14.43
RMSy 3.538
Energy[Mev]
Layer Number
Energy: summed over scintillation Layers
Evis
Entries 10052
Mean 21.34
RMS 6.852
Counts
Energy[Mev]
Energy: summed over all Layers
Etot
Entries 10095
Mean 88.63
RMS 14.05
Counts
Energy[Mev]
Efficiency: Evis/Etot
Eeff
Entries 9999
Mean 0.2389
RMS 0.06516
Counts
Efficiency[%]

Prototype ADC Spectrum



UPV Prototype Construction