Simulation of a Liquid Argon Electromagnetic Calorimeter in Geant4
ROUGH DRAFT

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I. INTRODUCTION

What is Geant4 ?
-summary
-how it works, what it models
-when, how, who its used
Scope and goals
-goal to learn geant4, motivation
-electromagnetic calorimeter
- what is a calorimeter, why
- electromagnetic vs hadronic
- sampling vs homogenous
- issues and engineering: efficiency, resolution, sampling fraction
-scope: modeling basic calorimeter
- example models

II. SIMULATION SETUP

- Detector model
- based on example b4d – modified DetectorConstruction, RunAction, EventAction
- geometry: layers, absorber, gap
- change: geom calculated from layer thickness and material ratio
- large size, so energy can only leak by reflecting out incident surface
- scoring volumes, energy deposit
- change: created scorers for each layer, removed track scorers
- event
- what is an event
- particlegun - electron, variable energy
- steps, tracks, scoring
- physics list
- end of event
-change: 2d histograms, profiles, energy deposition, removed track info
- run
- what is a run
- run initialization
- analysis manager, end of run
- file save
- execution and computation
- macro file to run 1000 events for various beam E
- powershell script to automate runs for various geometries

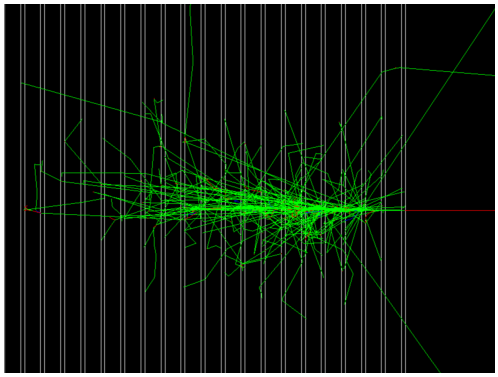

FIG. 1. Visualization of a simulated particle shower produced by a 1 GeV electron in a sampling calorimeter. Cross-sectional view is shown, with the electron incident from the right. The liquid argon and lead layers (white wire-frame) are 8 cm and 2 cm thick, respectively. Tracks are shown for particles with negative charge (red), positive charge (blue), and neutral charge (green).

III. DATA AND ANALYSIS

- Data collected:
- Total energy deposited in all LAr or in all Pb layers per event.
- Energy deposited in each LAr layer or in each Pb layer per event (position of each layer can be extracted)
- Variables
- LAr to Pb thickness ratio: r = 0.05, 0.25, 0.5, 0.75, 0.95
- Thickness of both layers combined: t = 10, 50, 100, 500 mm
- incident electron energy: Ebeam = 10, 100, 1000, 10000 MeV
- data stored in Root files
-Plot 1: Efficiency vs electron beam energy for every geometry

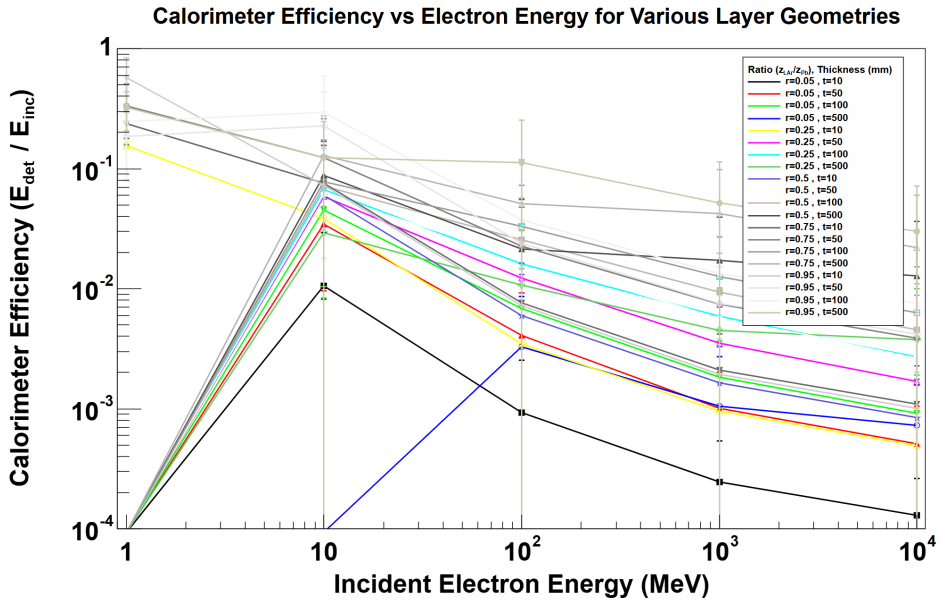

FIG. 2.

-Plot 2: longitudinal shower profile for each electron energy (at one geometry)

Examples: ratio = 95% Lar, layer thickness = 10mm

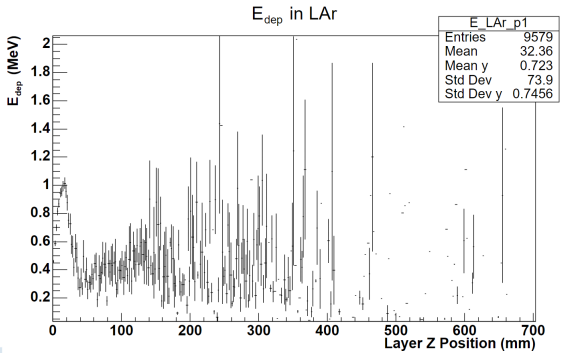

FIG. 3. 10 MeV

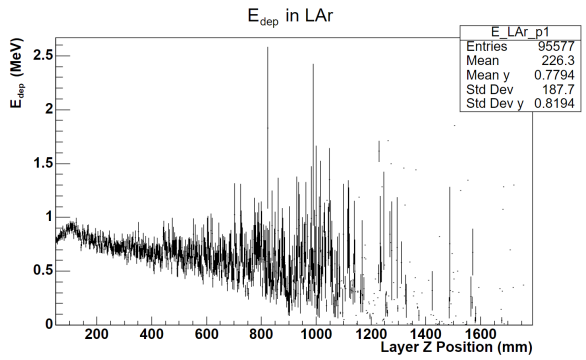

FIG. 4. 100 MeV

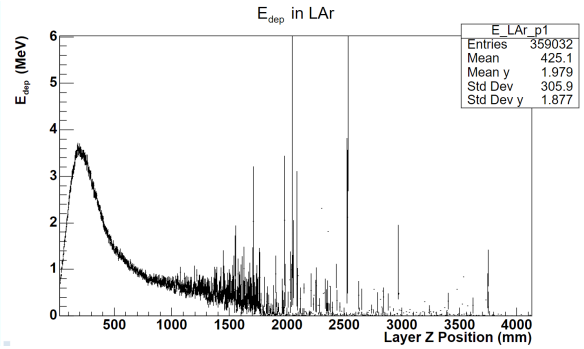

FIG. 5. 1 GeV

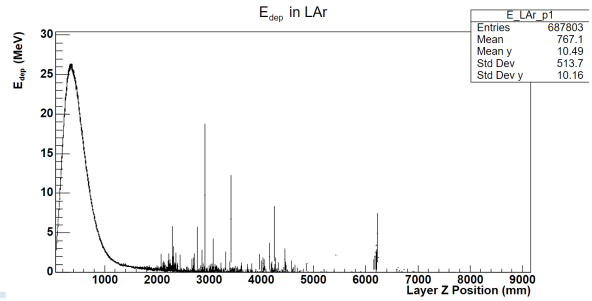

FIG. 6. 10GeV

-Plot 3: longitudinal profile for each geometry (at one electron energy)

Examples: longitudental energy deposition profile for electron energy of 1 GeV and layer thickness of 50mm. Varying LAr/Pb ratio

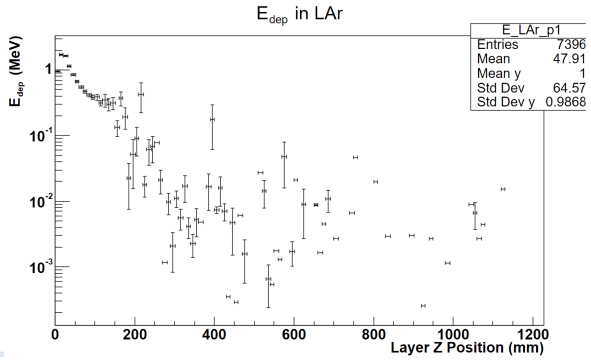

FIG. 7. 5% LAr

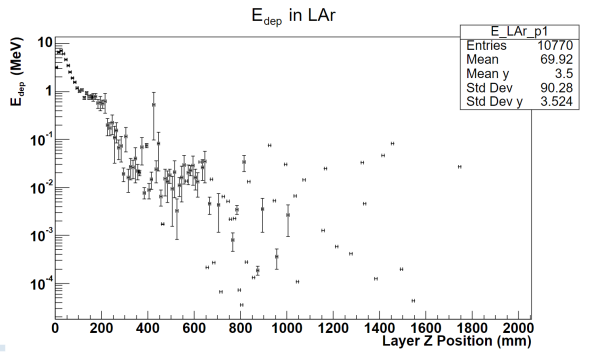

FIG. 8. 25% LAr

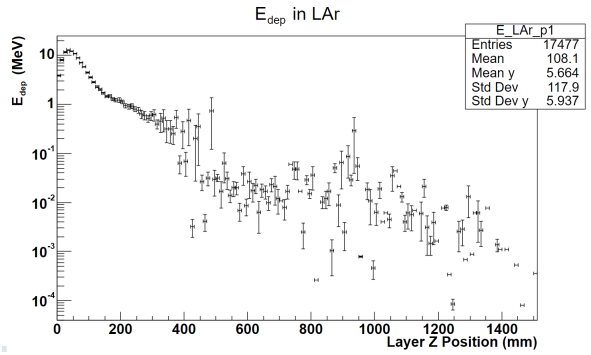

FIG. 9. 50% LAr

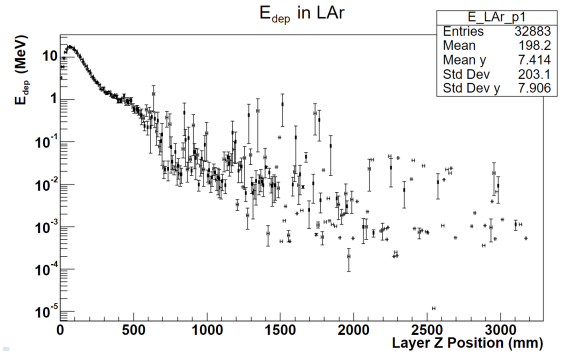

FIG. 10. 75% Lar

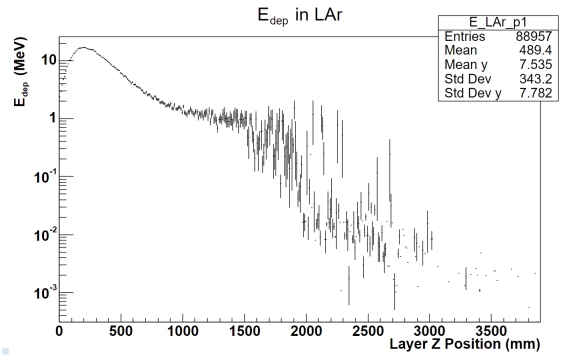

FIG. 11. 95% Lar

IV. CONCLUSION

- simulation physics perhaps not very accurate. How is energy deposition modeled?
- energy efficiency is very low all around – captures 10% of electron energy at best

ACKNOWLEDGMENTS

[Acknowledgements]