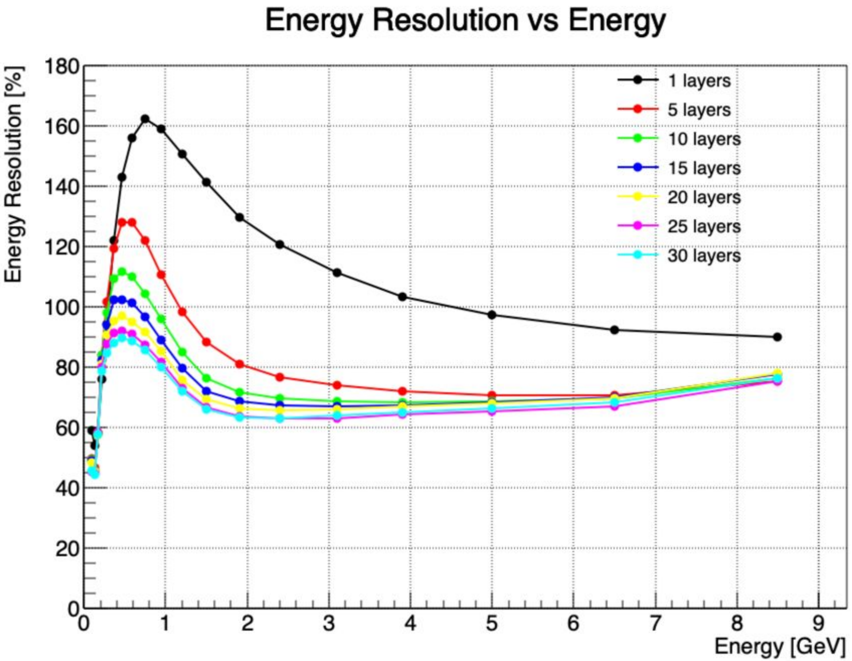
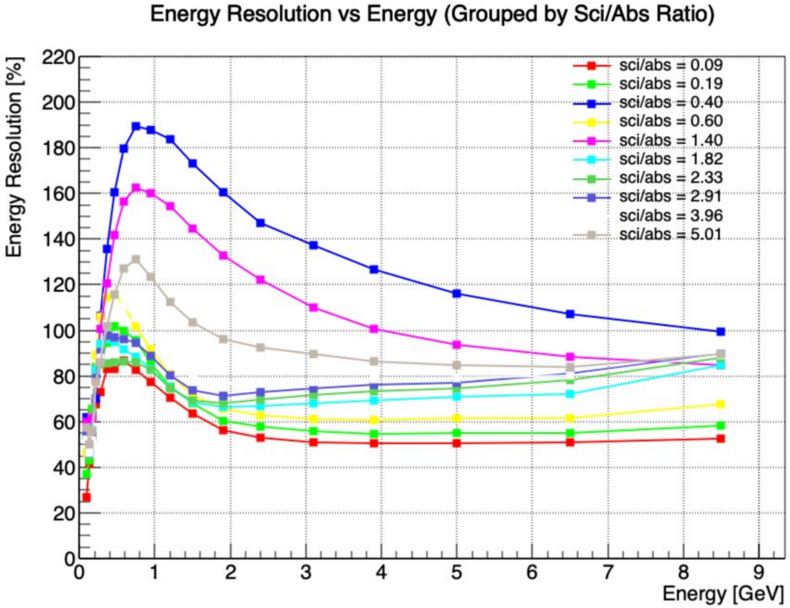
Update on nHCal Energy Resolution

Energy Resolution Plots

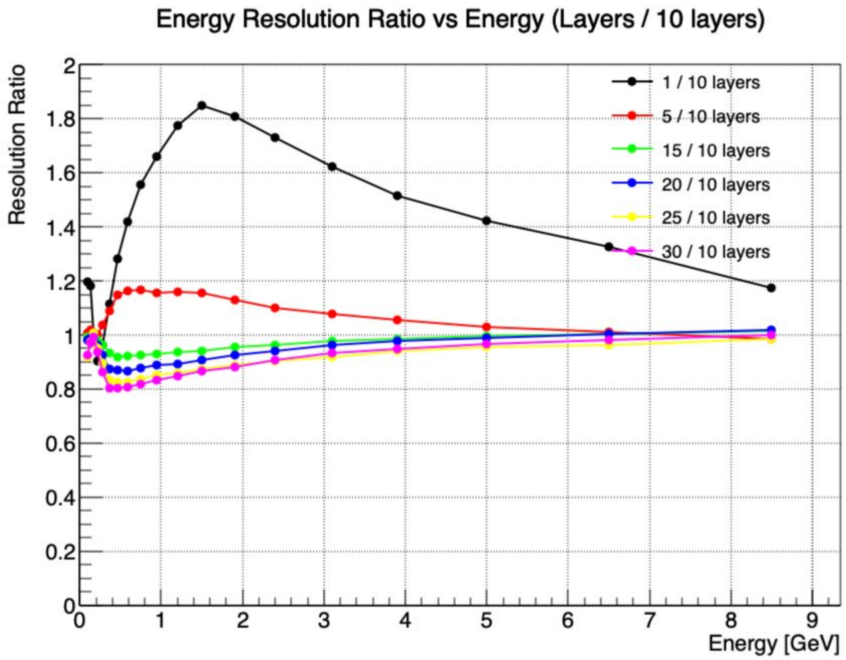
Cut out below 1 MeV events

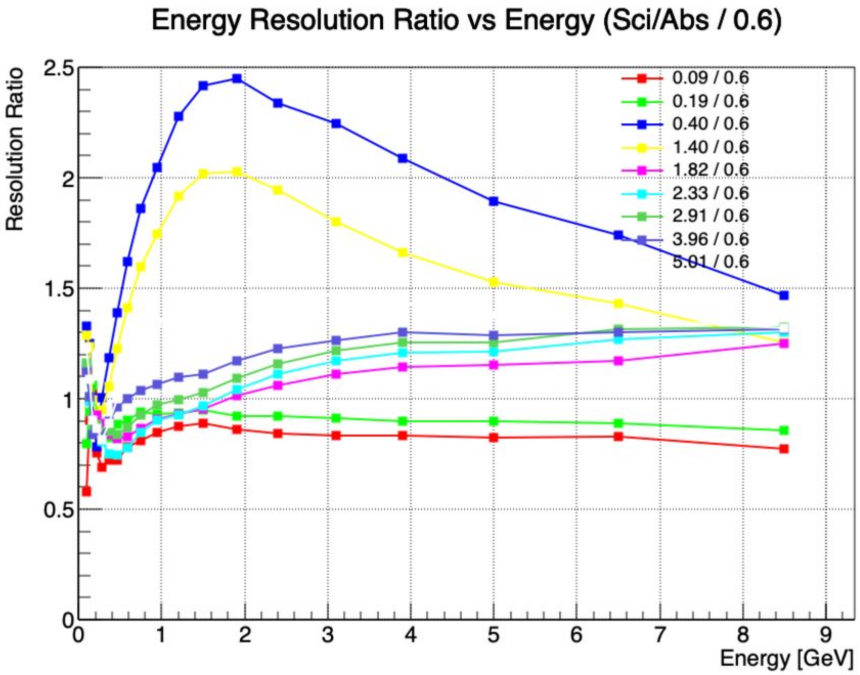


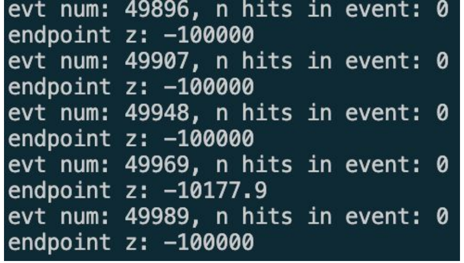


Ratios with Respect to Chosen Geometry

Cut out above 1 MeV events

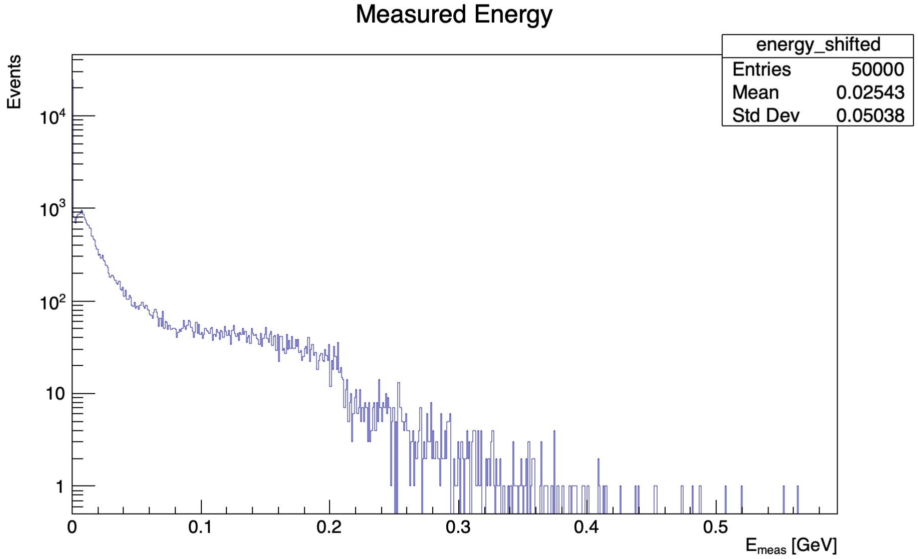


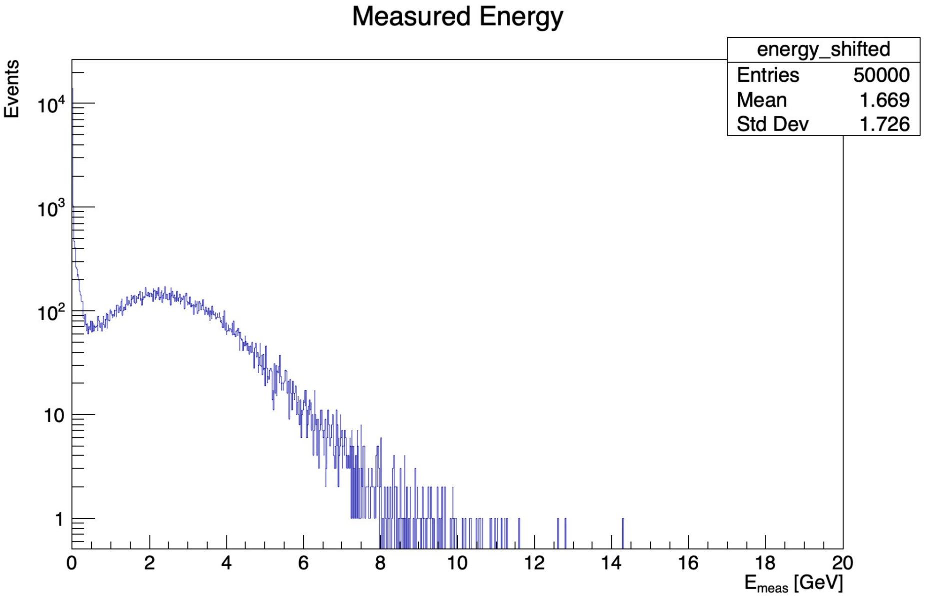




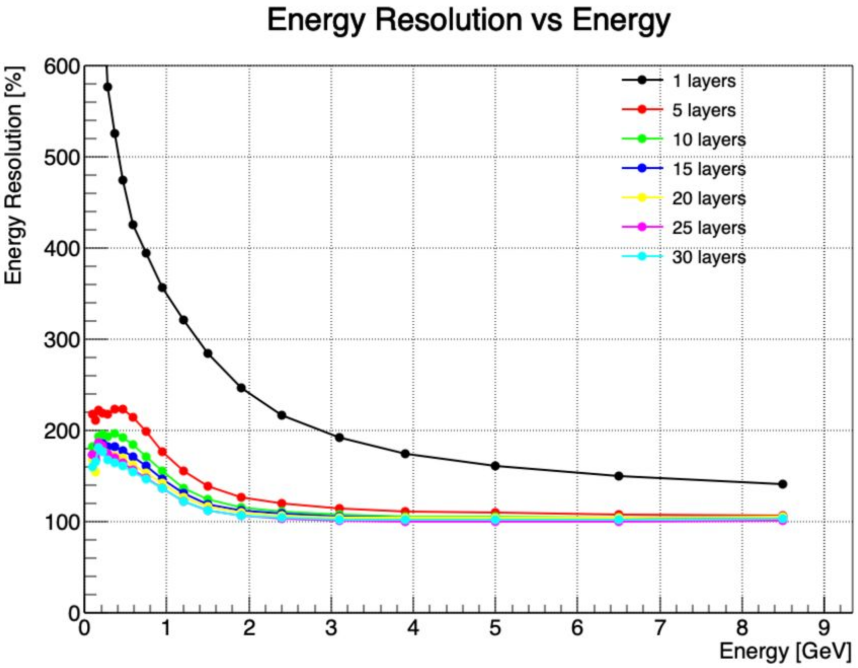
Addressing Low-energy structure

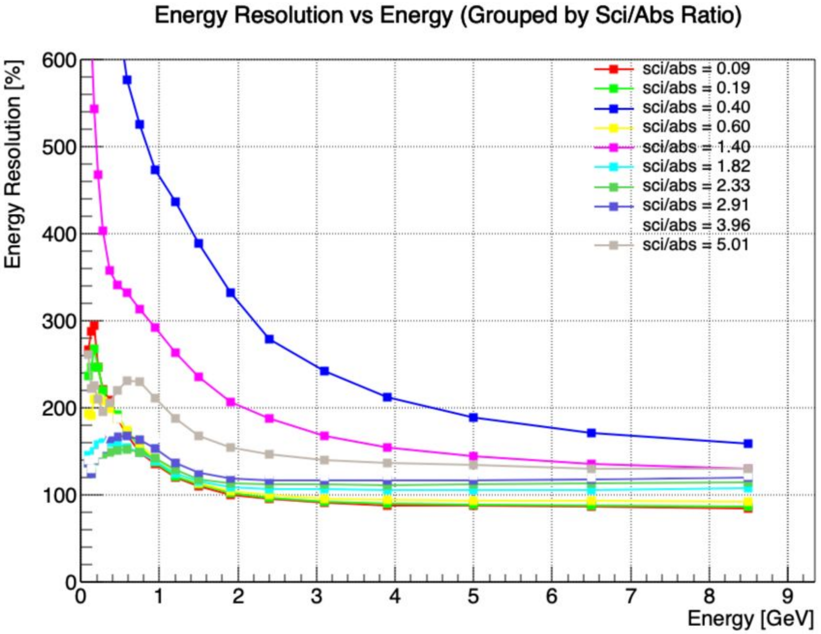
- Take this hit energy sum plot for 10 layers, 4 cm abs, 2.4 cm sci at 0.13 GeV as an example (left). Many events with zero energy, and poor separation between low-energy peak peak and energy deposited
- When we get up to higher energies such as 2.4 GeV (right), separation is more clear
- Skews mean too low – first try getting rid of just zero energy deposit events (from particles that don't interact with the detector at all)



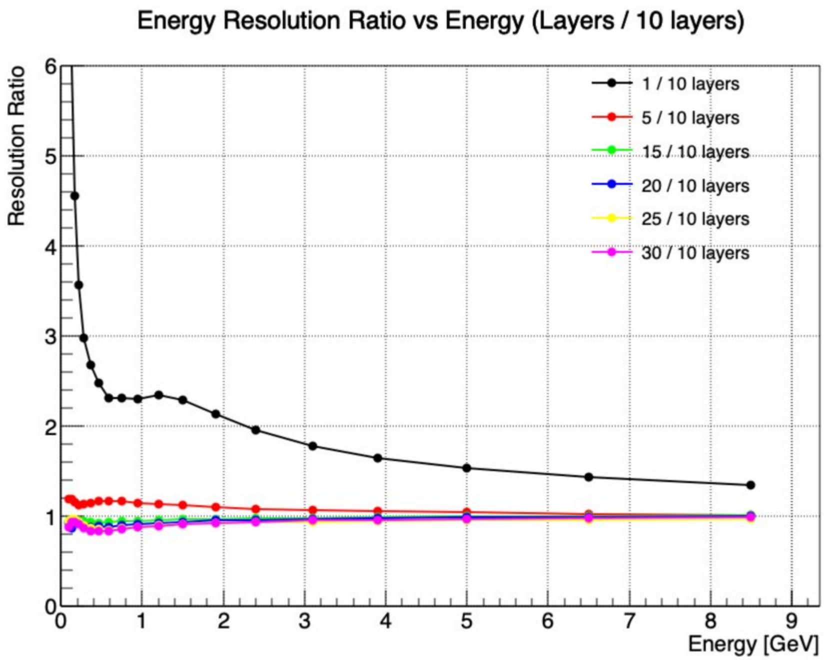


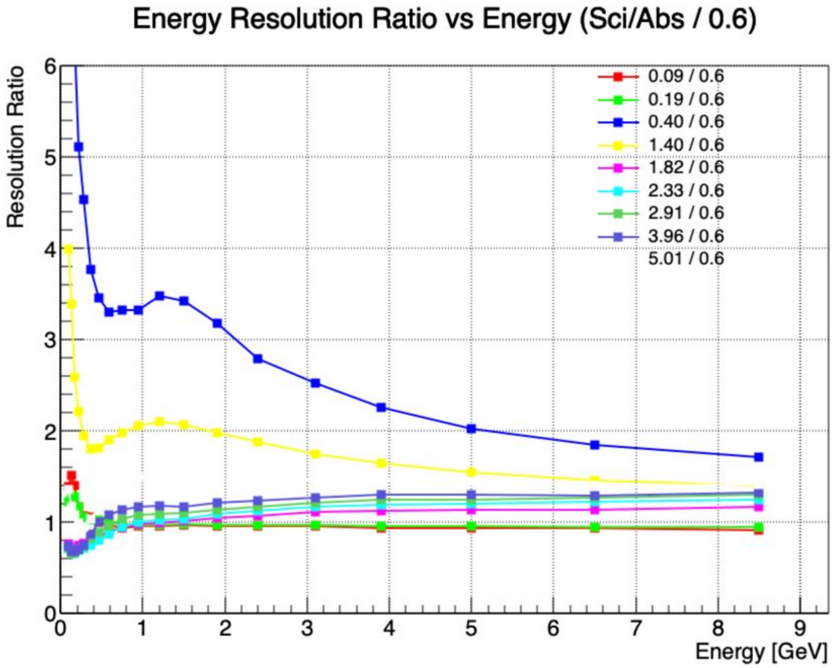
Energy Resolution Plots Excluding zero energy events





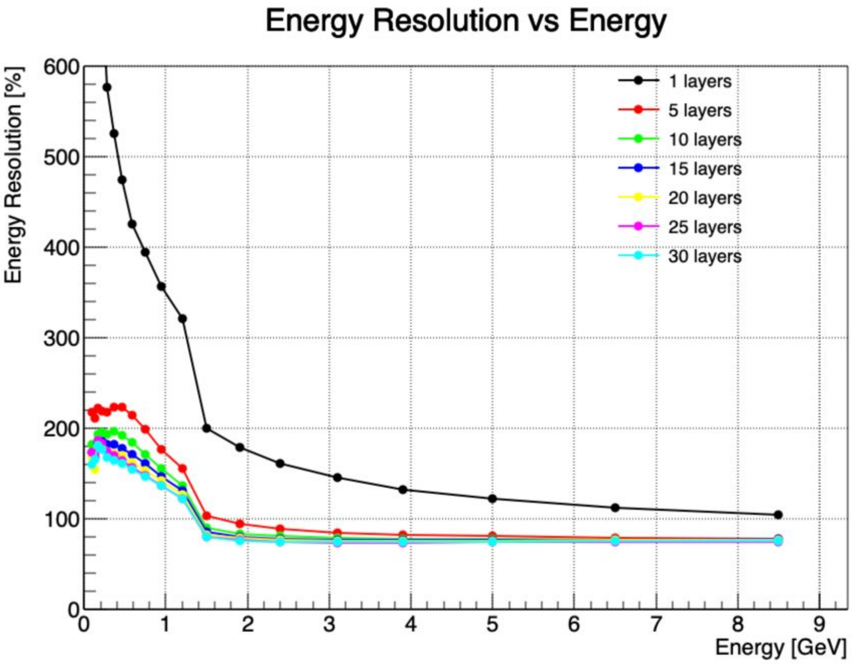
Ratios Excluding zero energy events

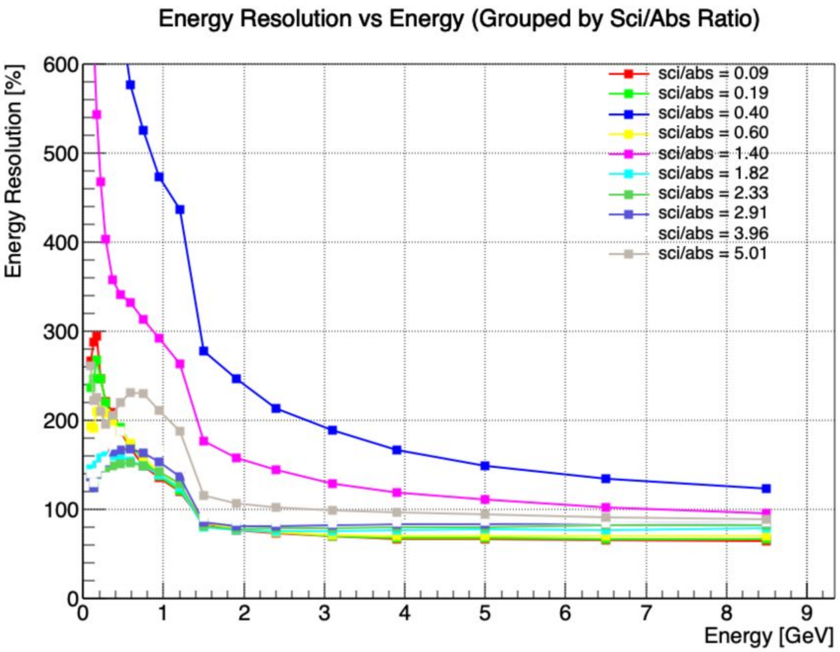




Attempt to exclude the low-energy peak for higher energies

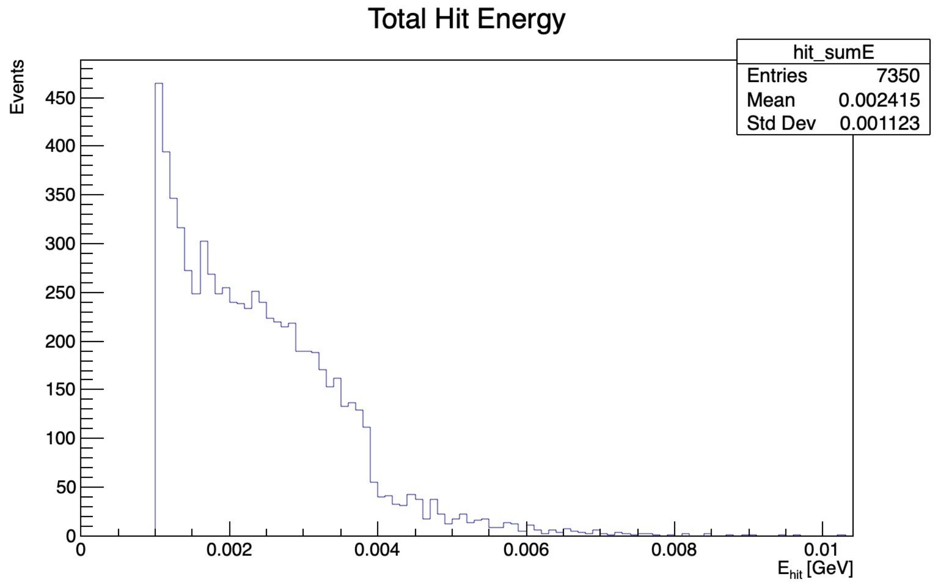
Find a local minimum in the hit energy sum histograms and cut there, recalculated resolution. Energy resolution improves compared to just excluding zero

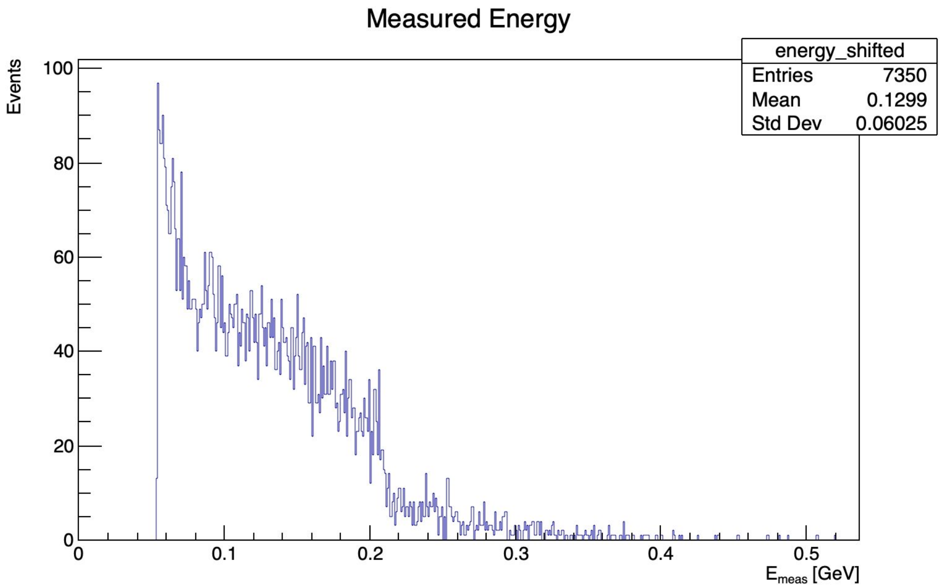




Energy Distributions (raw and shifted by sampling fraction)

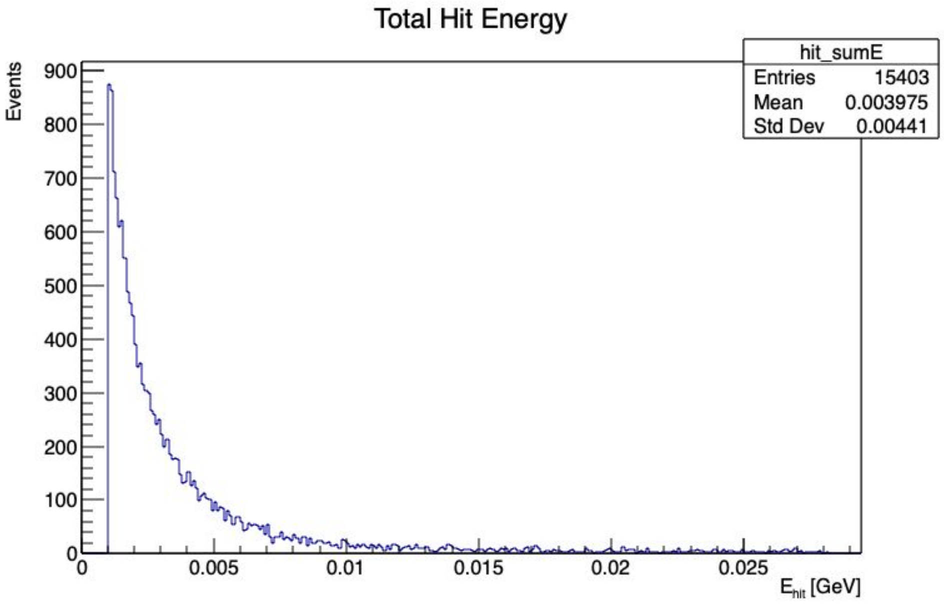
10 layers, 4.0 cm abs, 2.4 cm scintillator – 0.13 GeV

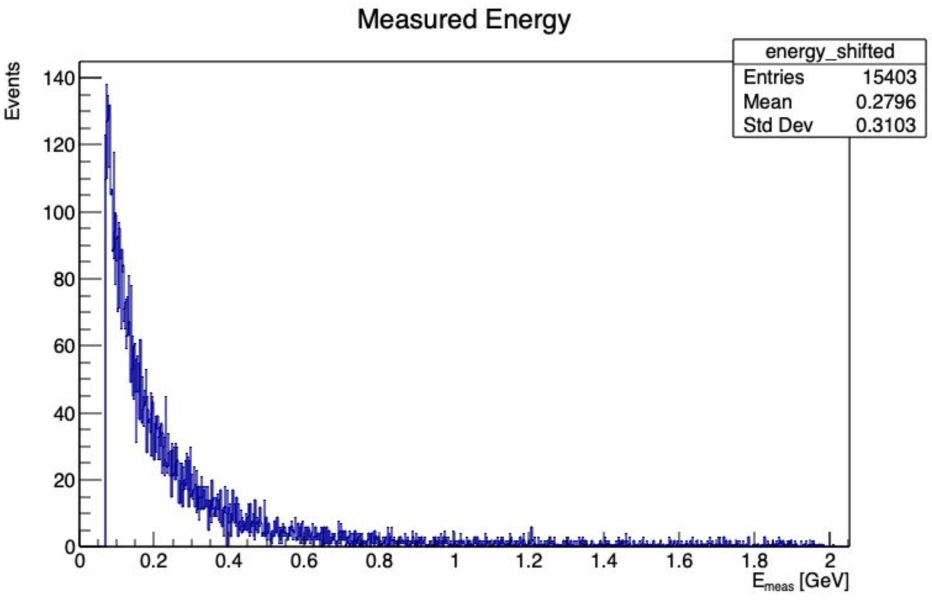




Energy Distributions (raw and shifted by sampling fraction)

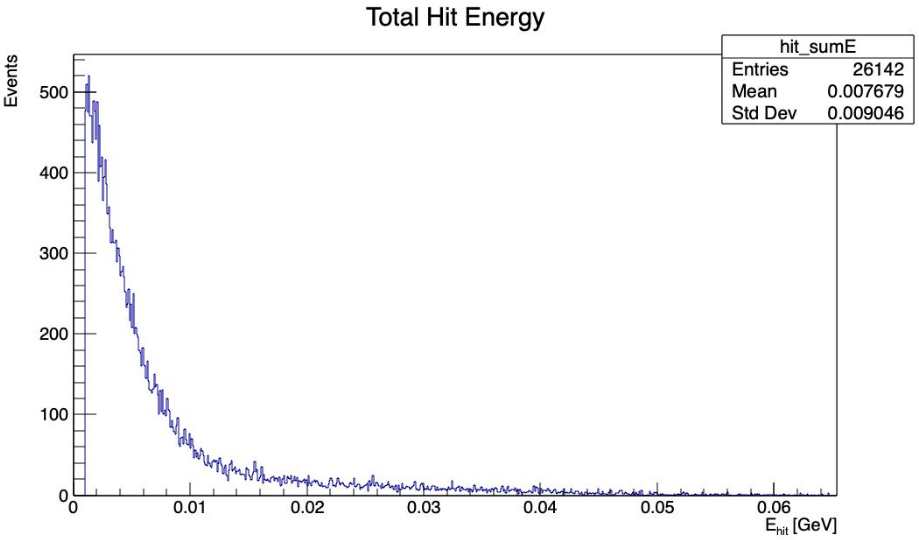
10 layers, 4.0 cm abs, 2.4 cm scintillator – 0.28 GeV

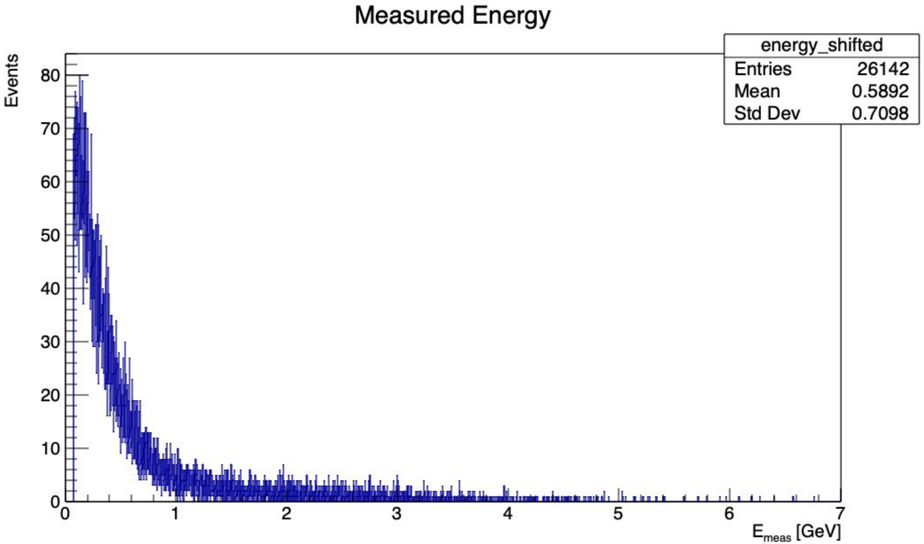




Energy Distributions (raw and shifted by sampling fraction)

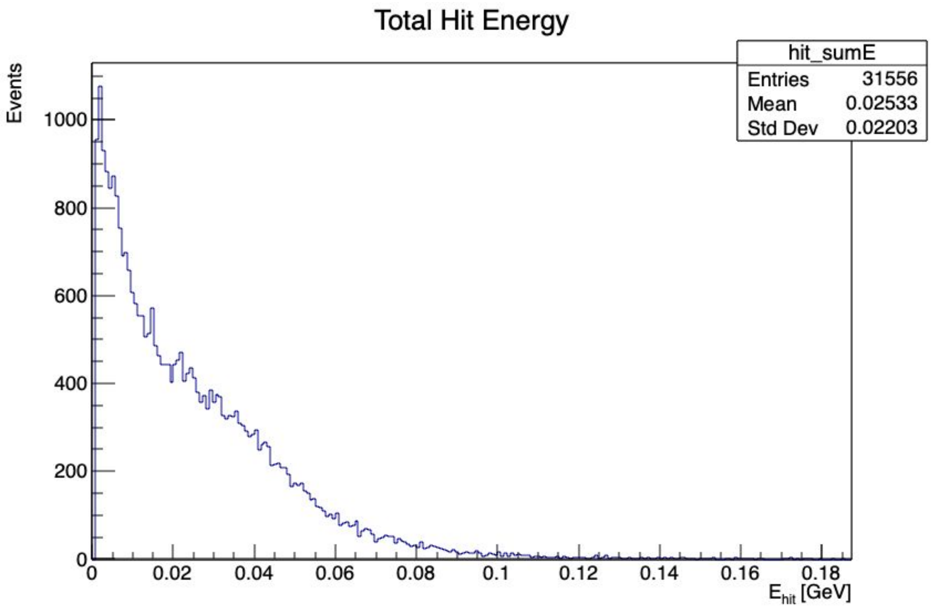
10 layers, 4.0 cm abs, 2.4 cm scintillator – 0.59 GeV

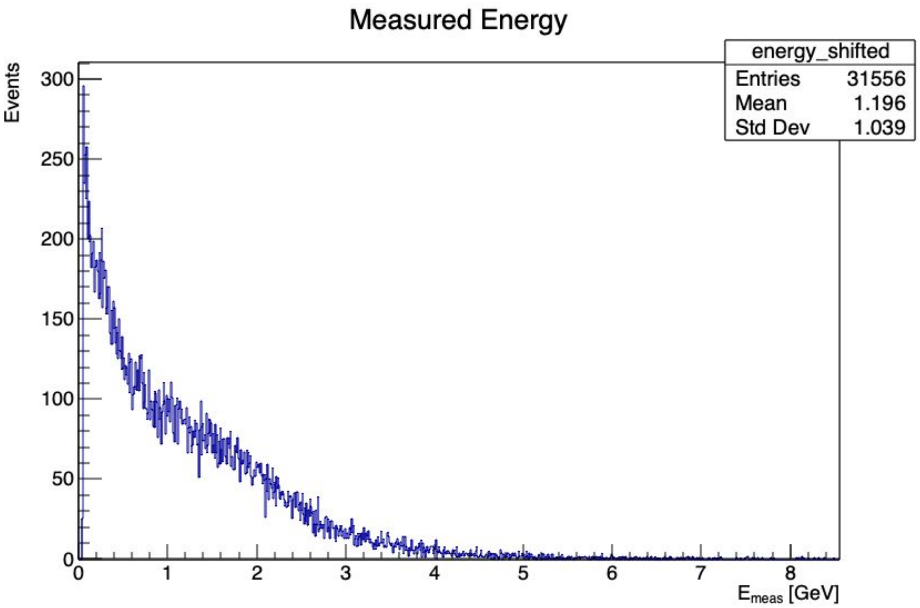




Energy Distributions (raw and shifted by sampling fraction)

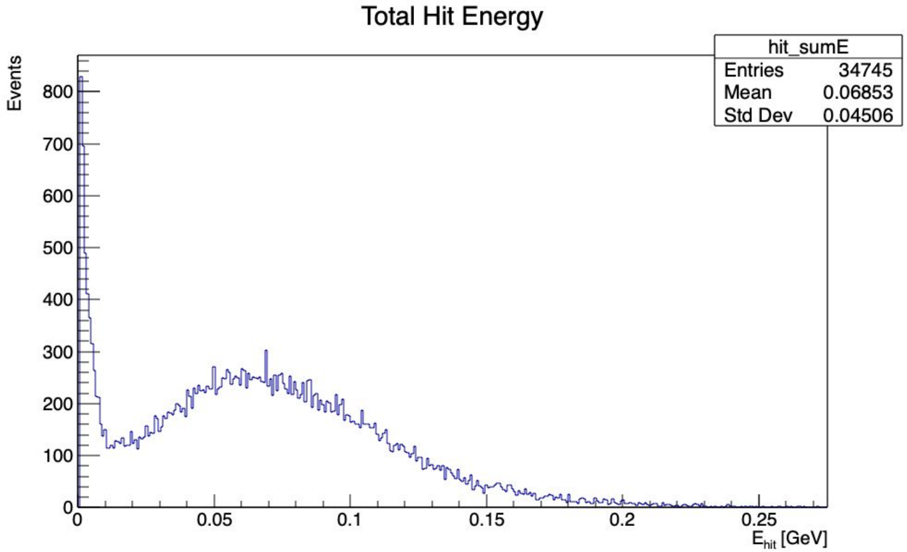
10 layers, 4.0 cm abs, 2.4 cm scintillator – 1.2 GeV

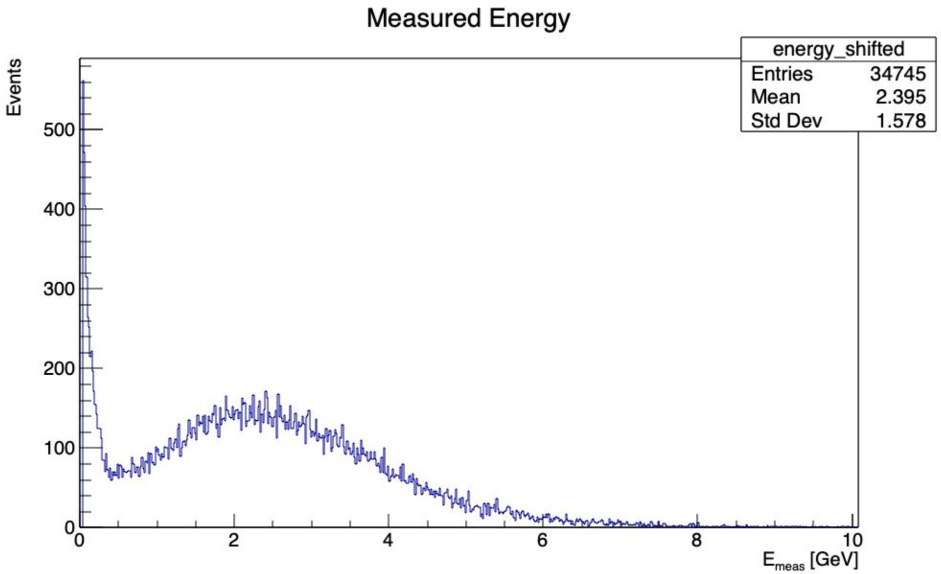




Energy Distributions (raw and shifted by sampling fraction)

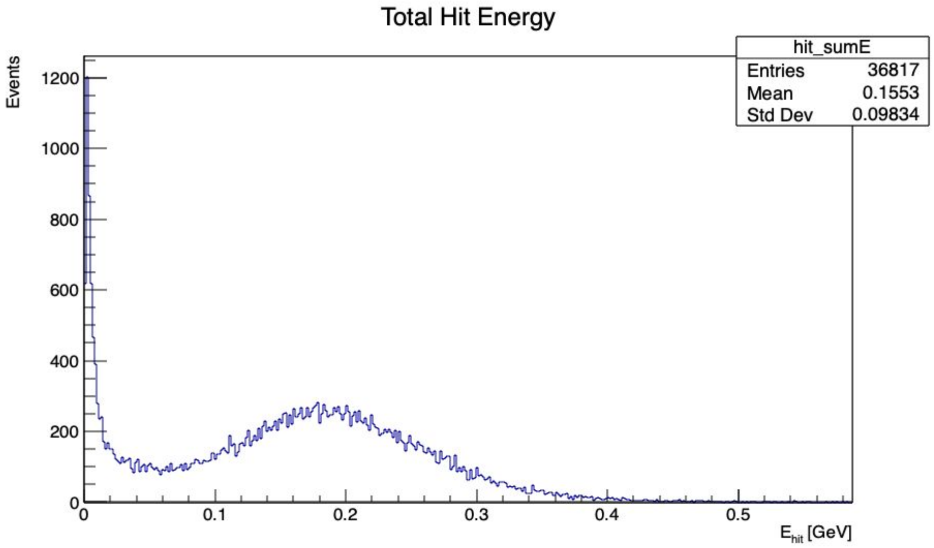
10 layers, 4.0 cm abs, 2.4 cm scintillator – 2.4 GeV

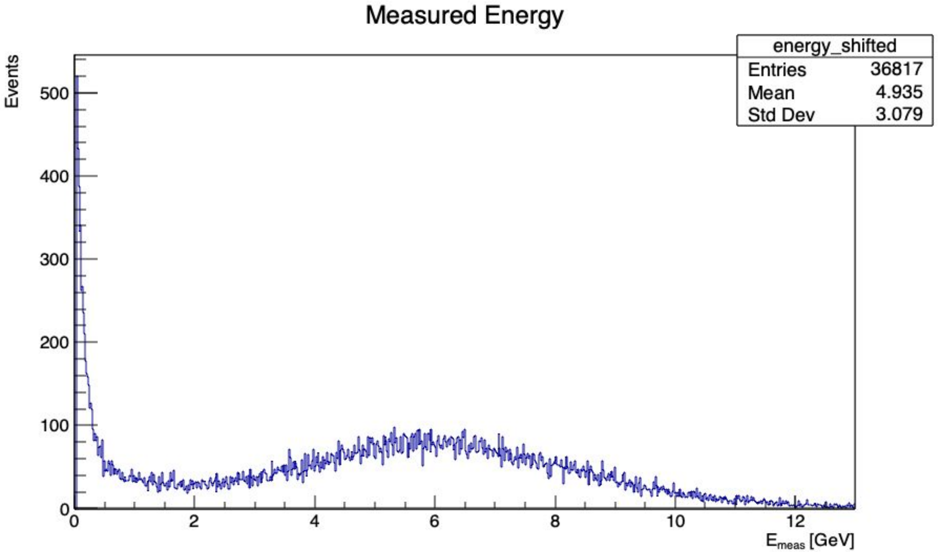




Energy Distributions (raw and shifted by sampling fraction)

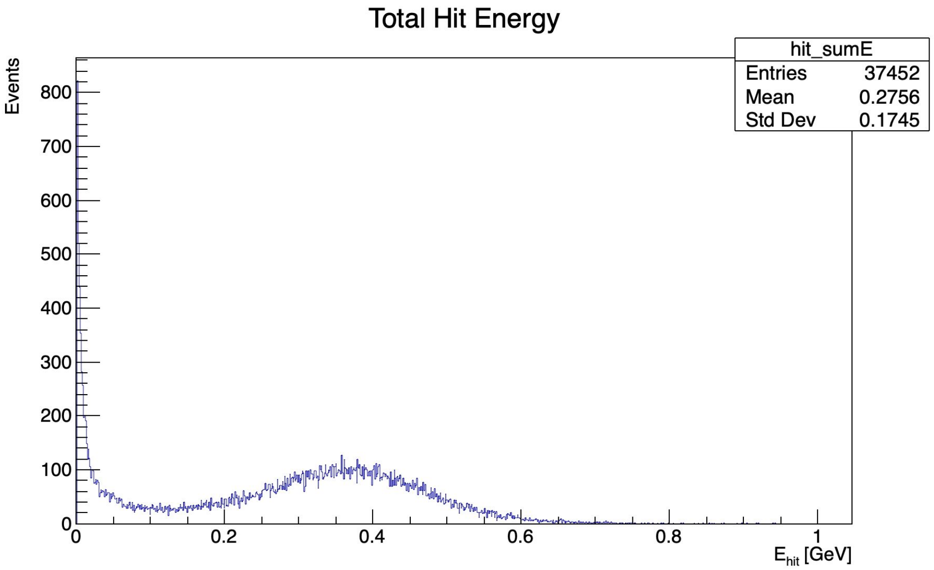
10 layers, 4.0 cm abs, 2.4 cm scintillator – 5.0 GeV

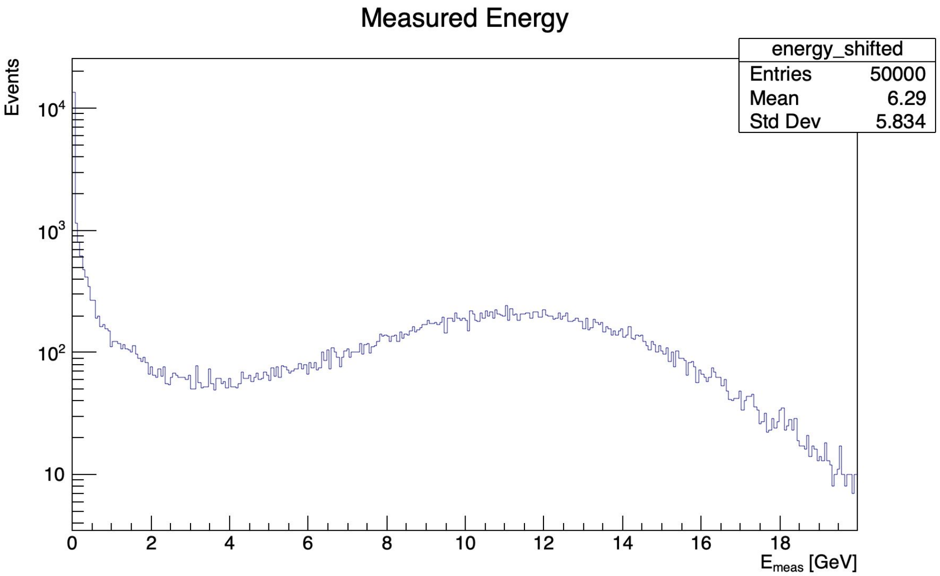




Energy Distributions (raw and shifted by sampling fraction)

10 layers, 4.0 cm abs, 2.4 cm scintillator – 8.5 GeV





Next Steps

Find a more robust way to exclude the low-energy peak from energy resolution calculations

Implement eta cut for all (it almost uniformly reduces the statistics for the entire histogram, it is not the cause of 0 energy events)

Perhaps a double fit to a Gaussian and a decaying exponential to apply the MIP cut to lower input energy histograms (< 2 GeV)