Leakage Energy Studies

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Texas Tech University | Advanced Particle Detector Laboratory | CaloX Simulation

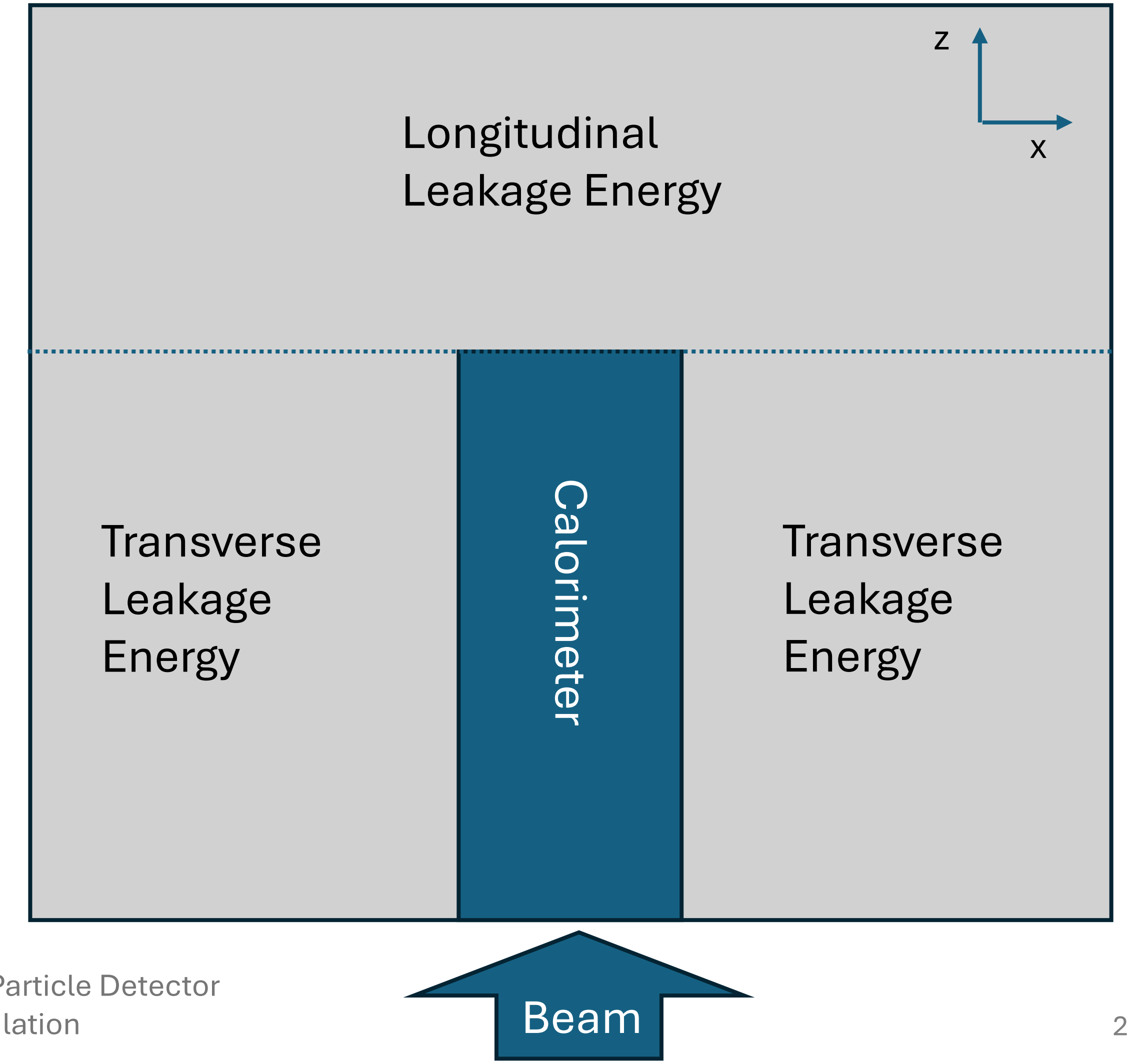
Geant4 Simulations

- Leakage Energy = energy deposited outside of the calorimeter

    - How does this change with detector size?

- Simulated 1000 events of 10, 30, 50, 75, 100, and 150 GeV pions respectively
- Calorimeter modeled after HG-DREAM calorimeter

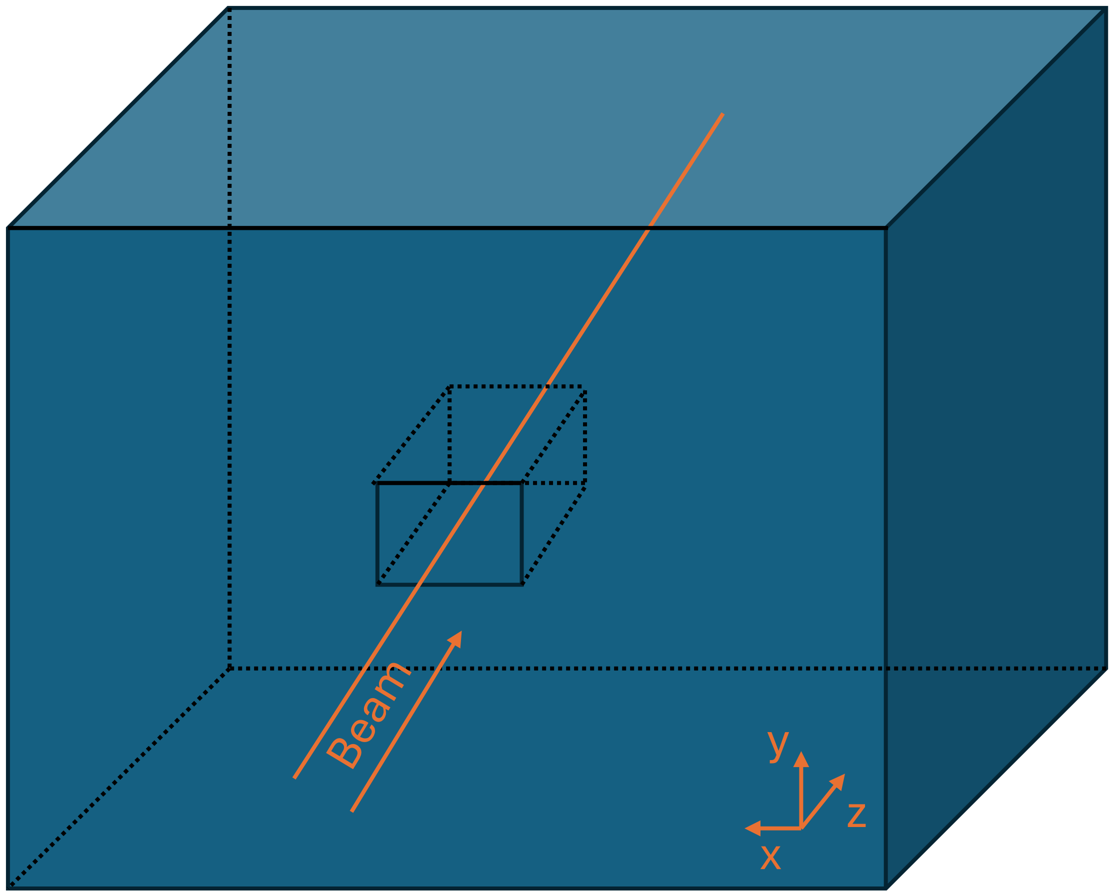
    - Copper absorption material, scintillating and cherenkov optical fibers



Geant4 Simulations

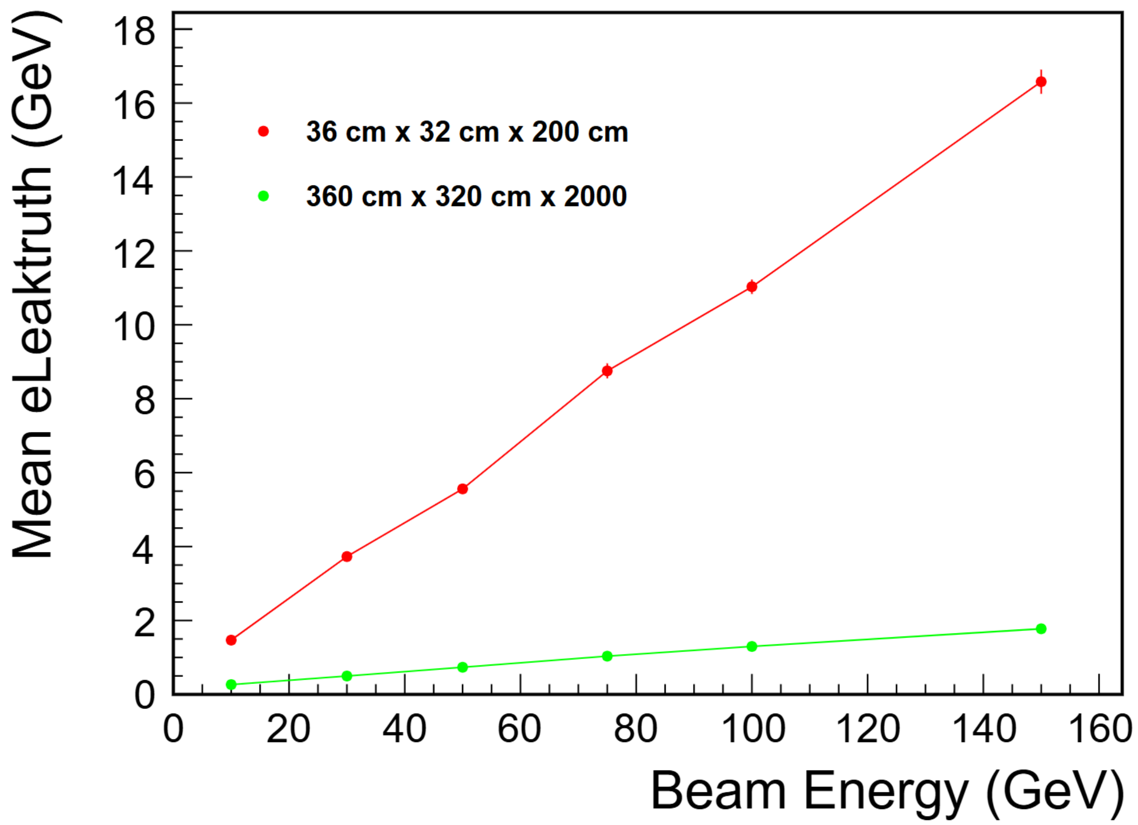
- Leakage energy is found by summing energy deposition in extremely large calorimeter outside of a defined geometry

- This allows us to determine the leakage energy for different detector sizes by changing the dimensions of the smaller interior volume

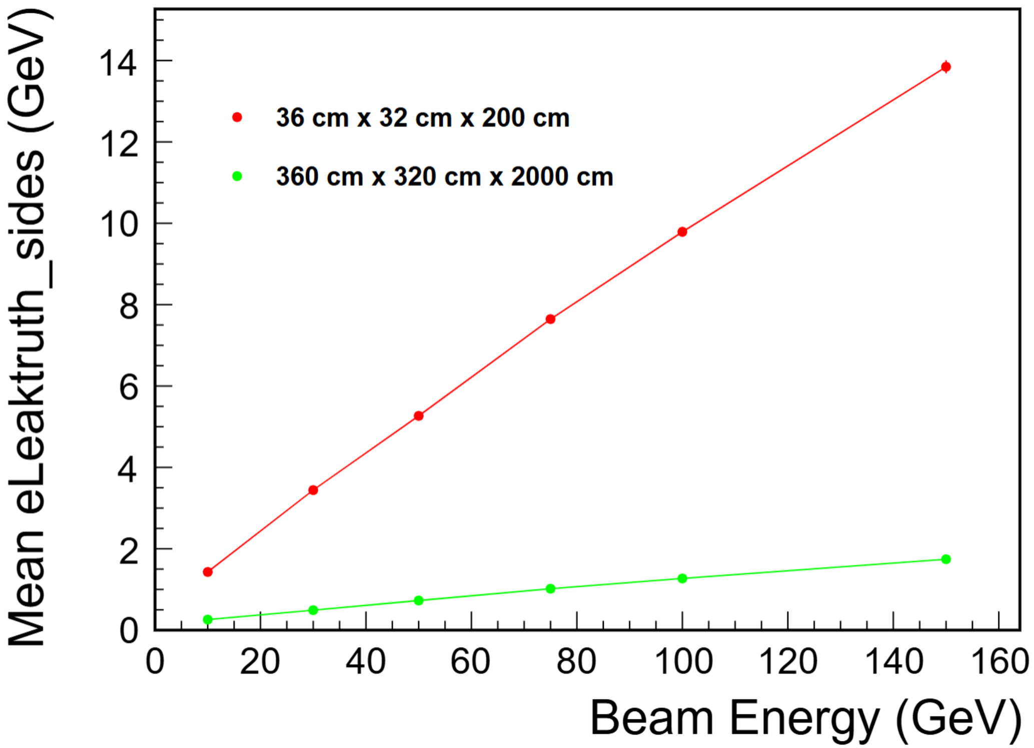


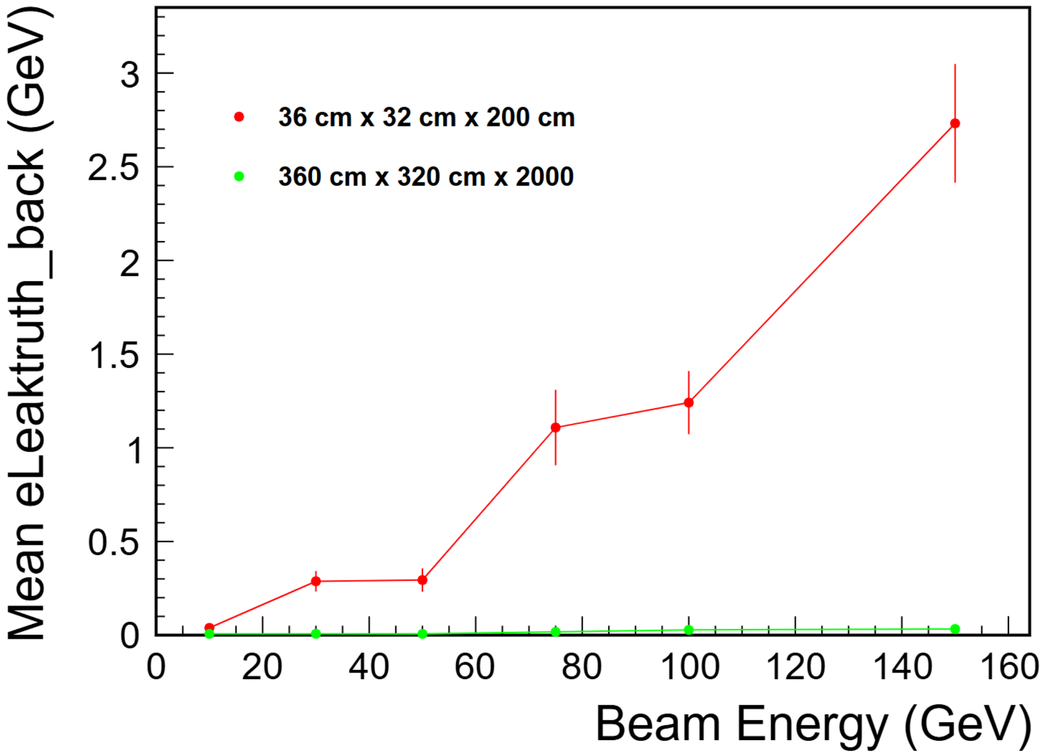
Total Leakage Energy for Extremely Large Calorimeter

- 36 cm x 32 cm x 200 cm are the dimensions used for HG-DREAM simulations
- Extremely large calorimeter is defined as 360 cm x 320 cm x 2000 cm
- Very small amount of leakage energy outside of extremely large calorimeter



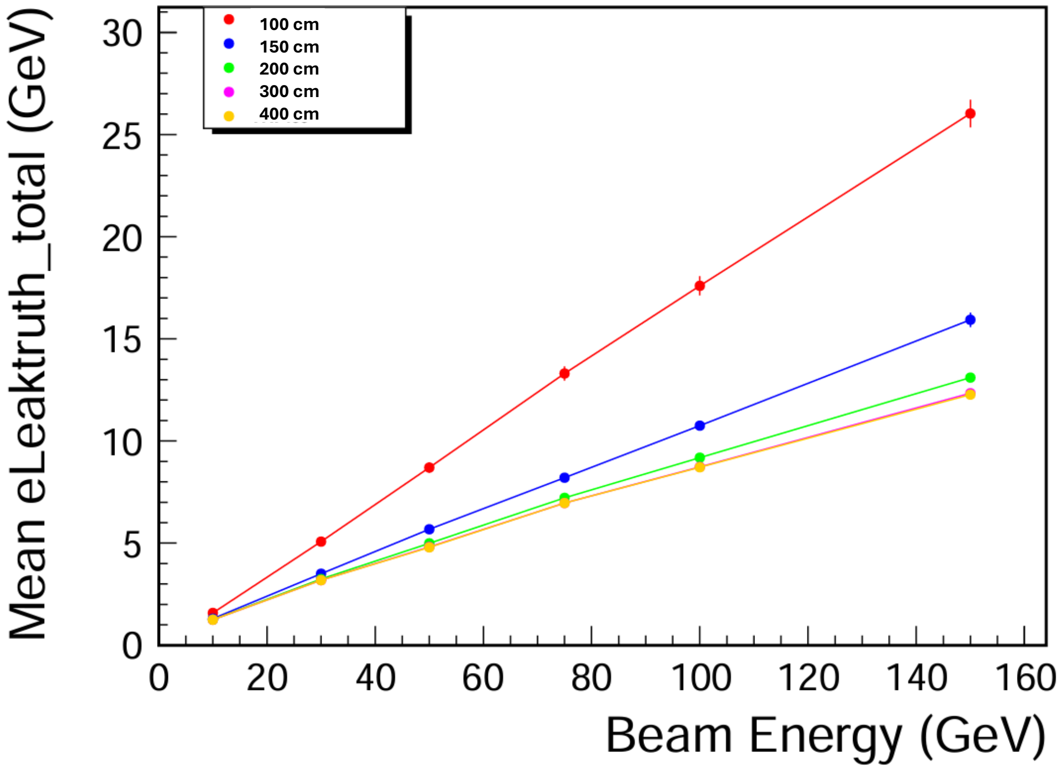
Transverse and Longitudinal Leakage Energy for Extremely Large Calorimeter

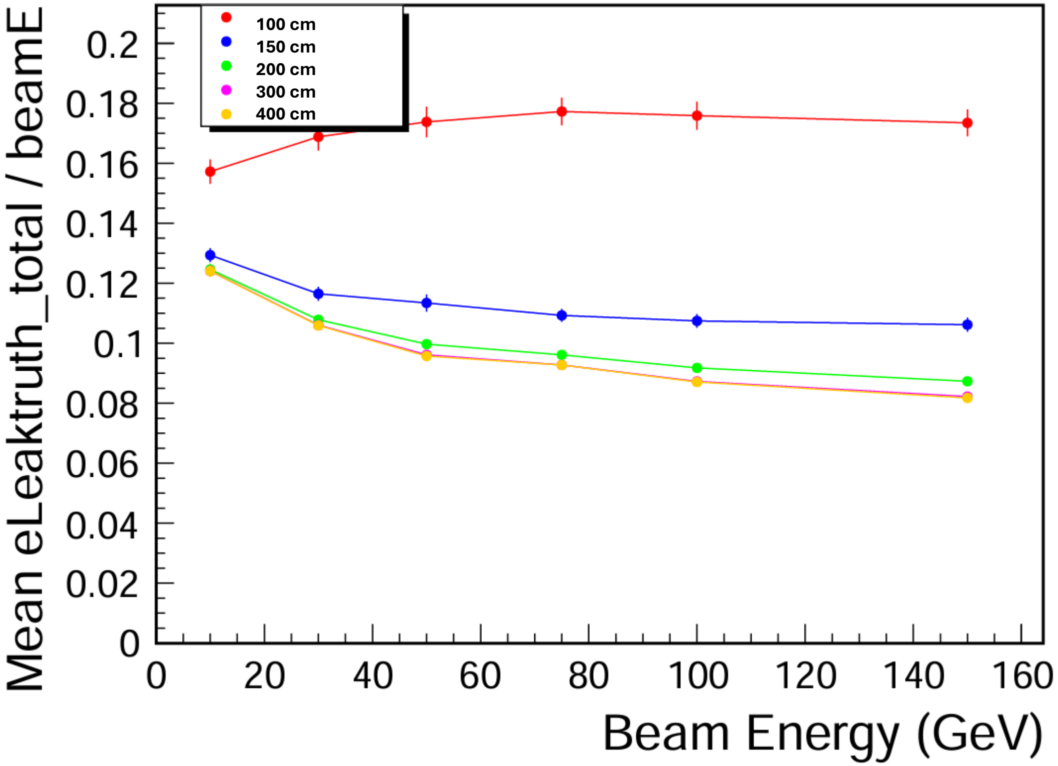




- All Leakage energy for extremely large calorimeter is transverse leakage energy
- eLeaktruth_sides = Transverse leakage energy
- eLeaktruth_back = Longitudinal leakage energy

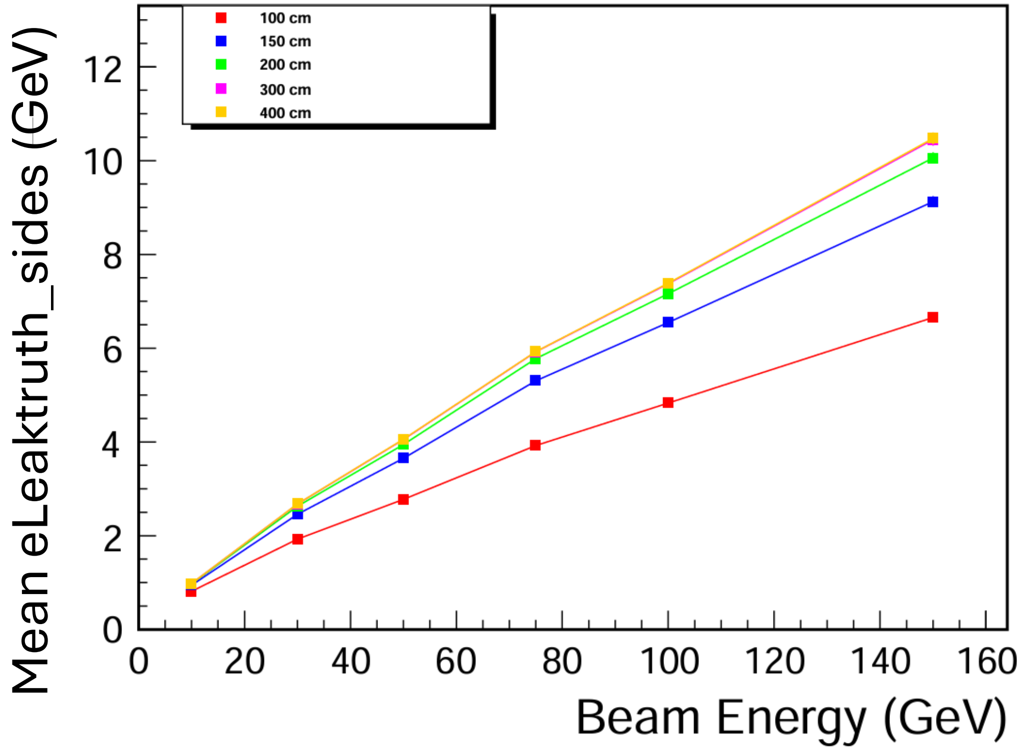
Total Leakage Energy

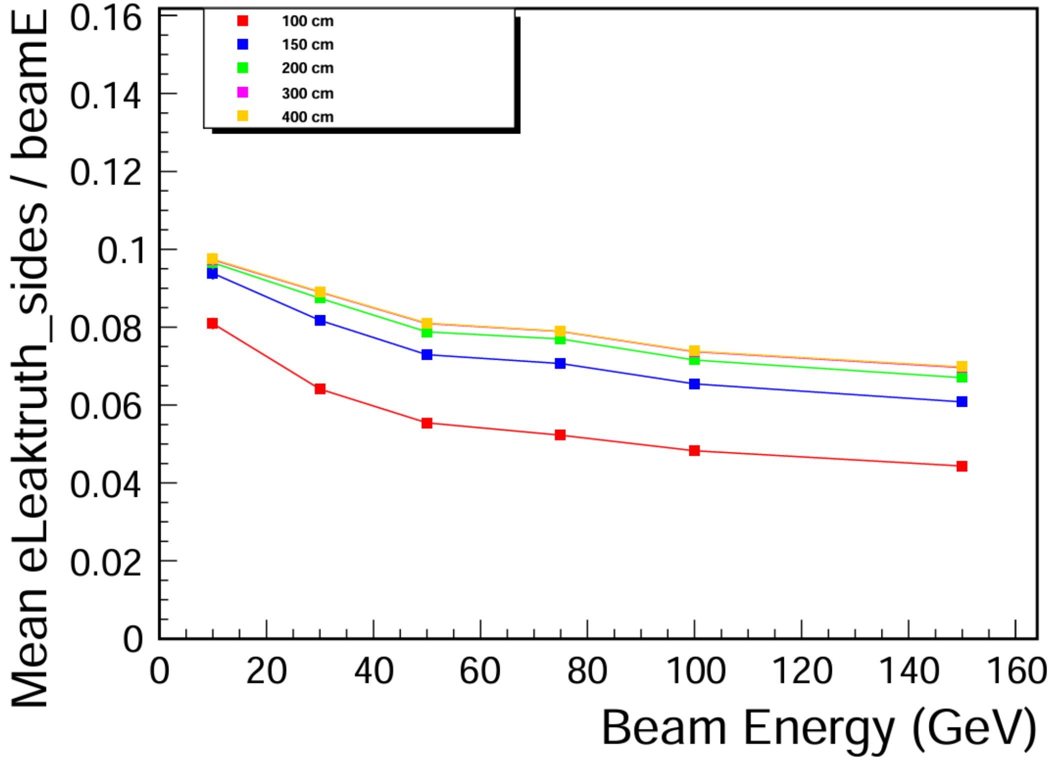




- The total leakage energy decreases as detector length increases with very little change for detector lengths greater than 200 cm

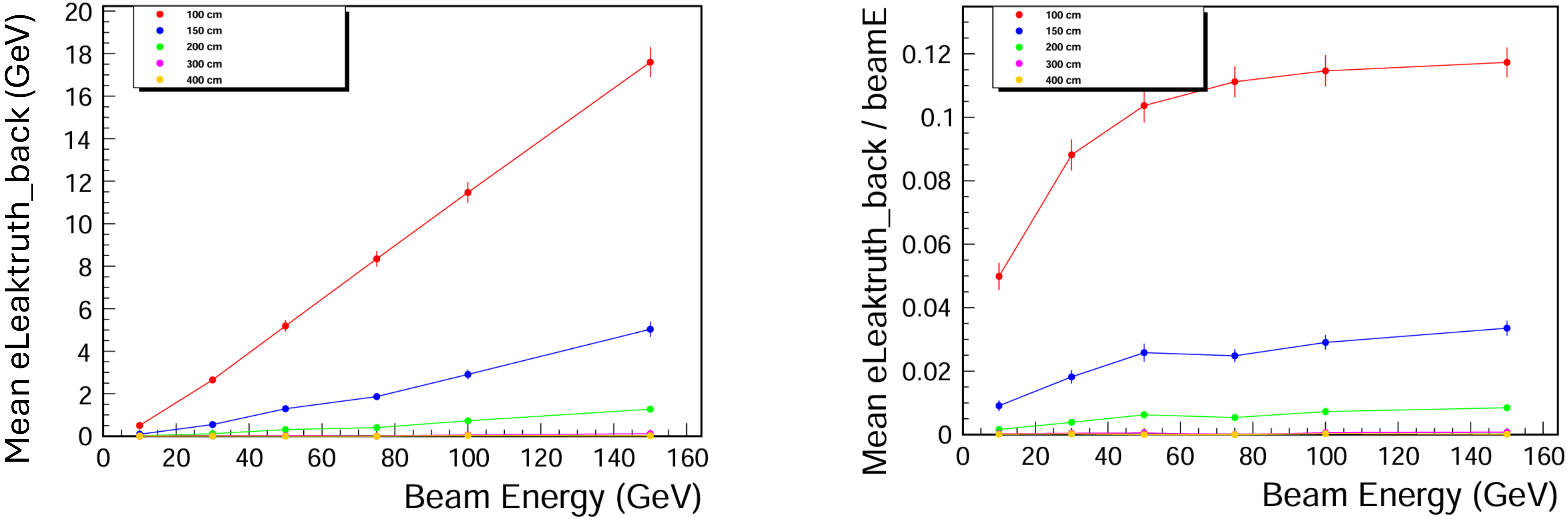
Transverse Leakage Energy





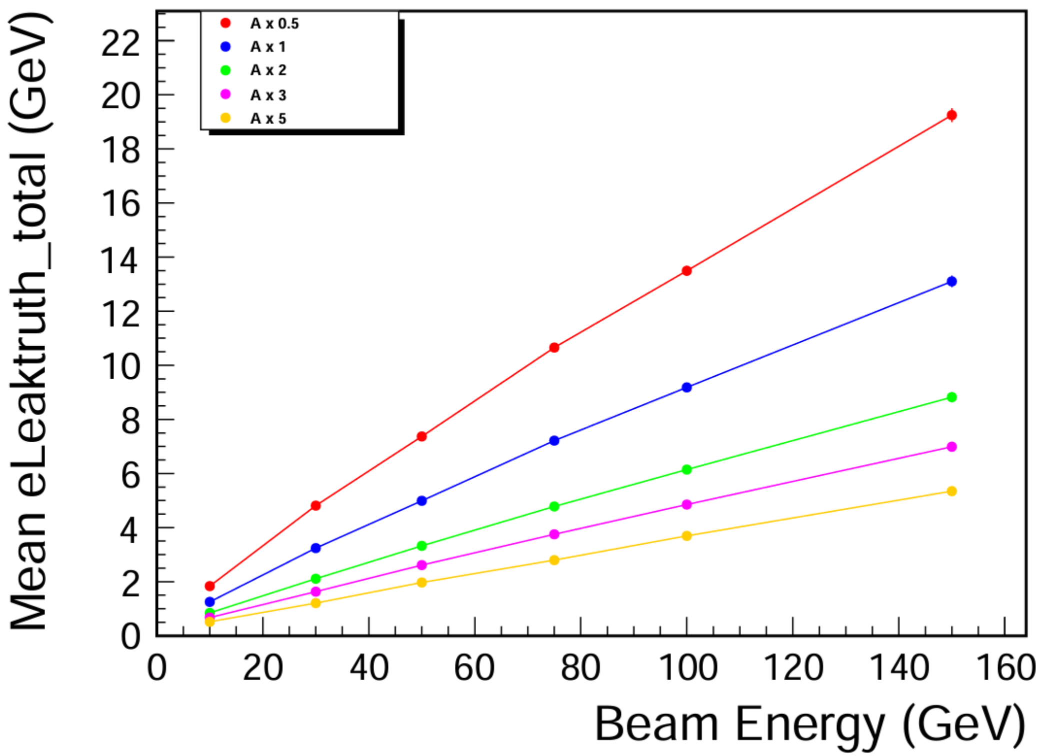
- The transverse leakage increases with detector length until 300 cm
- This increase is likely because increasing the detector length increases the volume in which transverse leakage energy is defined

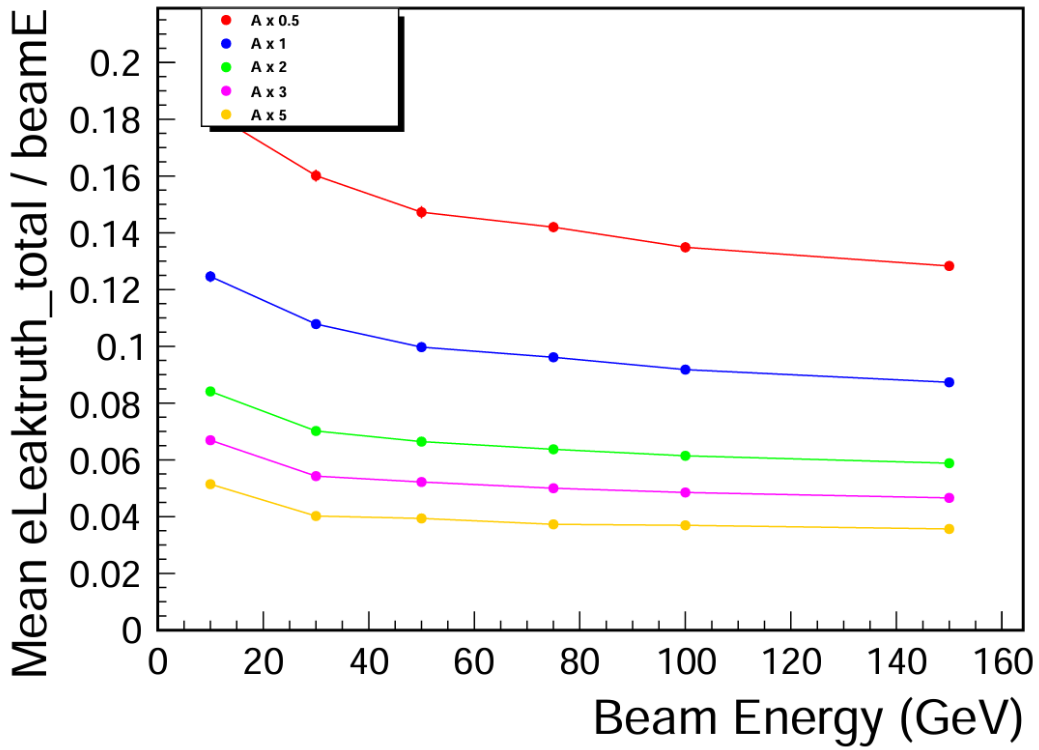
Longitudinal Leakage Energy



- Longitudinal leakage energy drops significantly for detector lengths greater than 150 cm and goes to zero at 300 cm

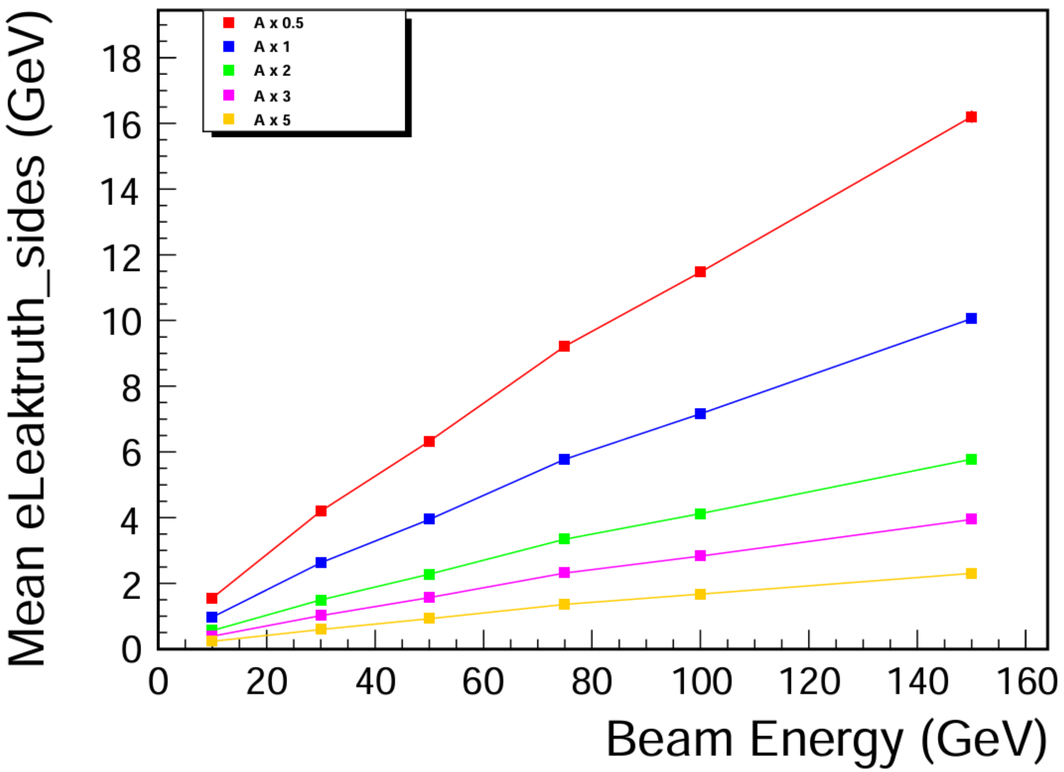
Total Leakage Energy

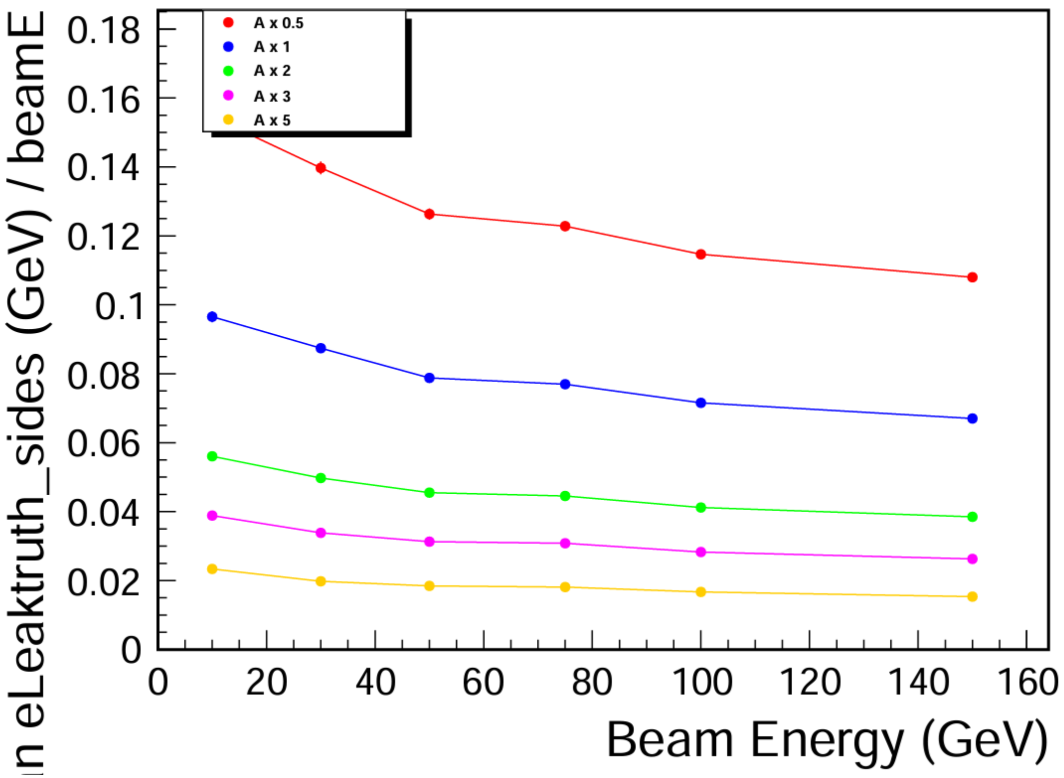




- A = 32 cm x 36 cm = 1152 cm^2
- Total leakage energy decrease as transverse area of detector increases

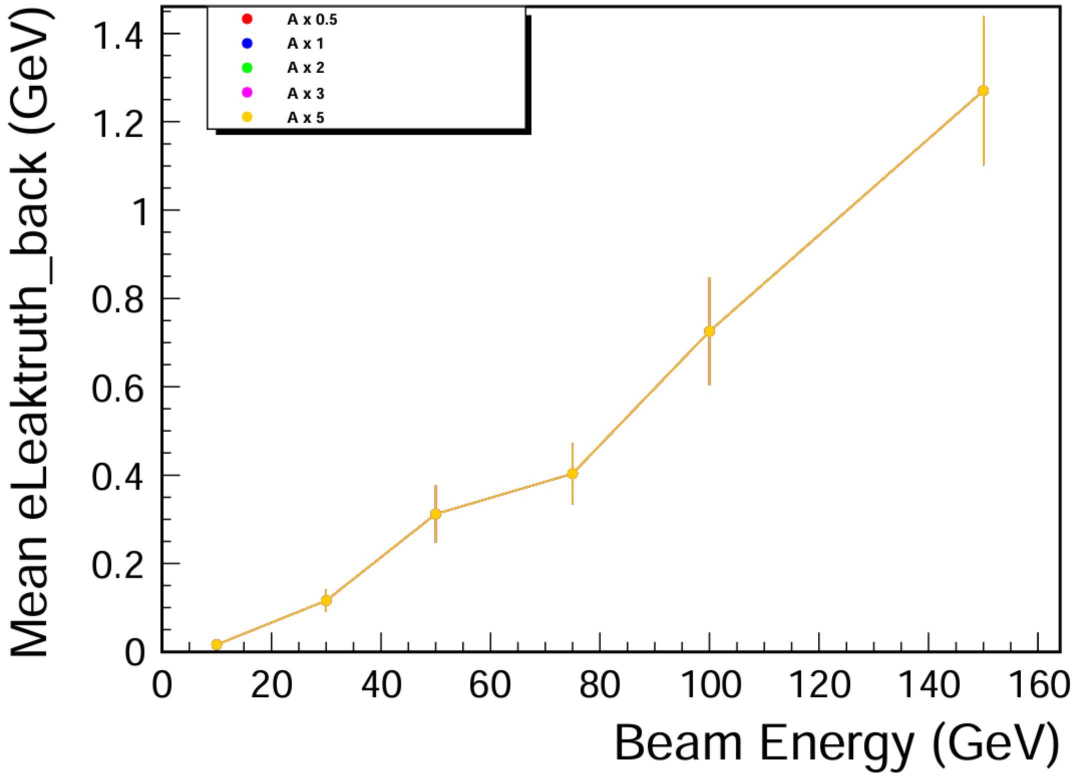
Transverse Leakage Energy

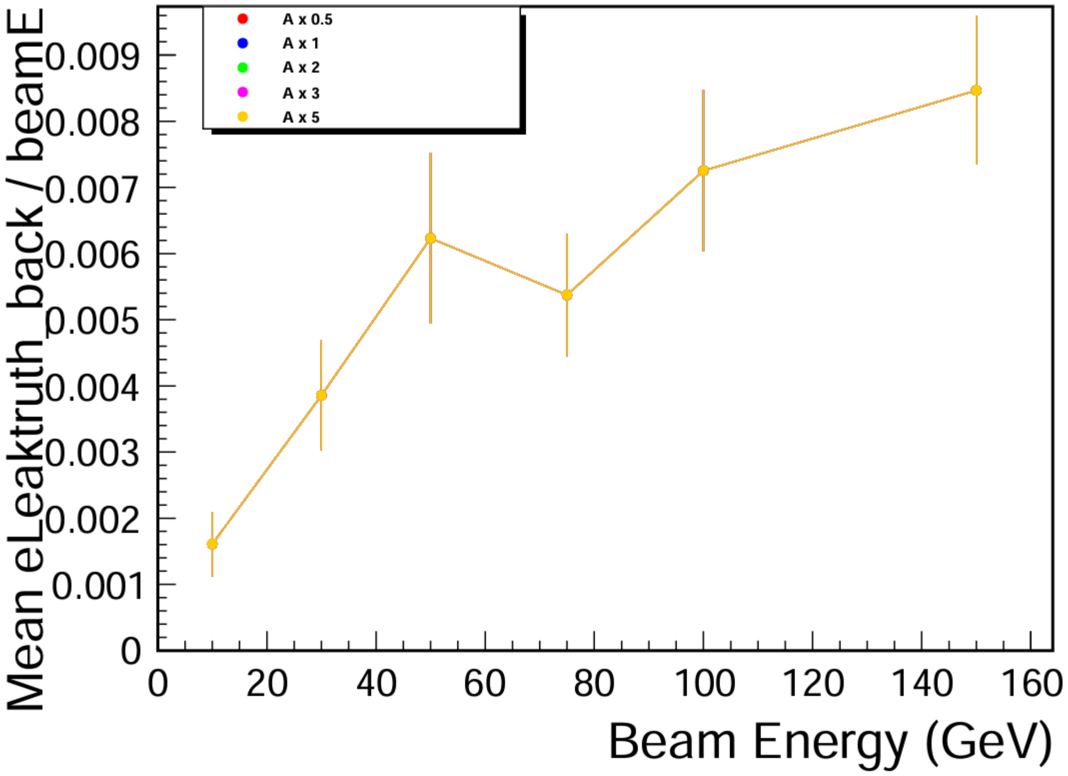




- Transverse leakage energy decreases as transverse area of detector increases
- More impact of leakage energy than detector length

Longitudinal Leakage Energy





- No change in longitudinal leakage energy because same events were used for each transverse area

Conclusions

- Increasing detector length beyond 200 cm has very little impact on reducing leakage energy
- Increasing the transverse area of the detector has a more significant impact on leakage energy reduction than increasing detector length
- For detector lengths greater than 150 cm, the majority of the leakage energy is transverse leakage energy