Rad Hard Lead Glass Update

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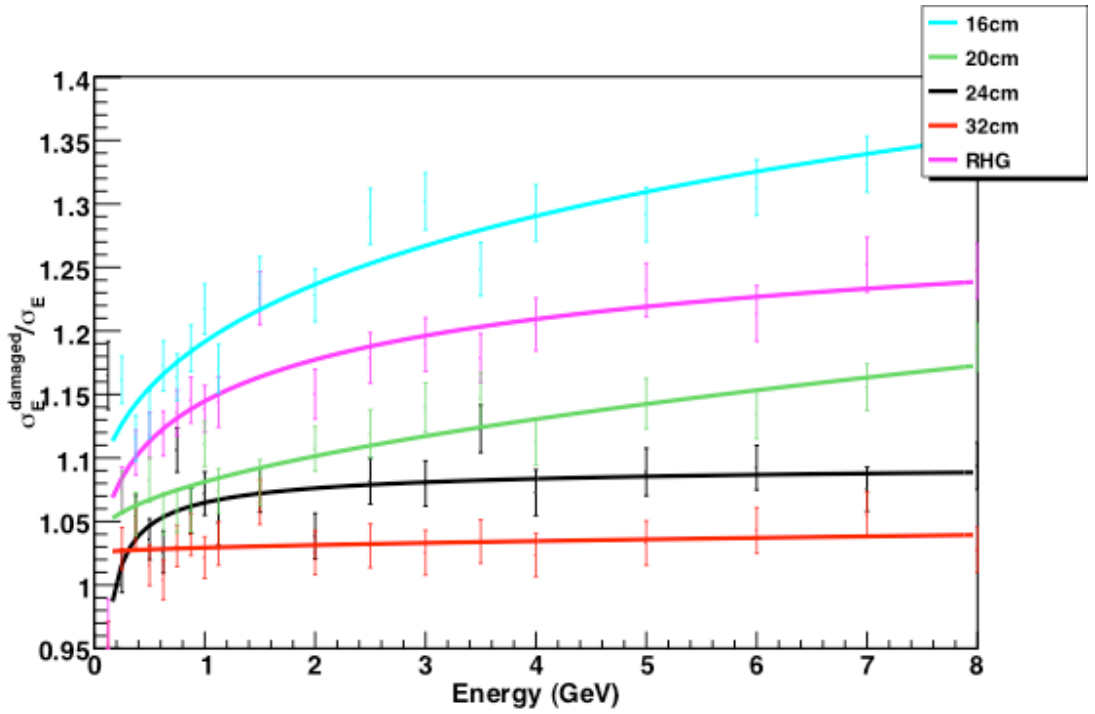
Goal

We want to determine the optimum amount of radiation hard glass (RHG) to insert into the FCAL

Previous Work

- Ratios of energy resolution of damaged to undamaged glass at various radii of the FCAL after one year of running.
- Each line represents a different radius.
- RHG curve is the first guess of the energy resolution of the radiation hard lead glass.
- Now that we have a RHG block we can determine the energy resolution better.



Pinning Down the Energy Resolution

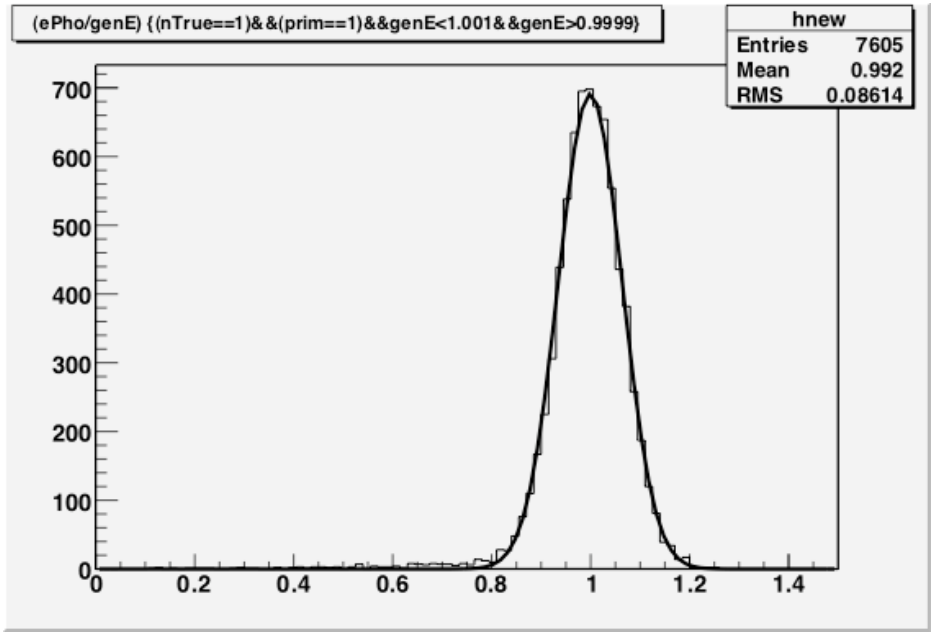
- Previous estimate of energy resolution of RHG based on HDGEANT simulation of F101 lead glass not F108, which we plan on using.
- Used spectrophotometer to find the transmission for various wavelengths.
- Since GEANT4 tracks optical photons, we can insert the data from the spectrophotometer into a simulation to determine the energy resolution of the RHG.
- The detector setup included the lead glass, aluminum foil, cookie, light guide, PMT window and PMT Cathode.
- The quantum efficiency of the PMT was included in the simulation.
- The indices of refraction for various wavelengths were inserted.
  - Assuming F108 radiation hard has equivalent indices as its non-hard counterpart F8 (the regular lead glass).
- A 7 block by 7 block array using 1 GeV photons was used to determine the energy resolution

Comparison to HDGEANT(GEANT3)

- Original simulations done with HDGEANT so we need to determine the differences between HDGEANT and GEANT4
- GEANT4 tracks individual optical photons so we can include many of the properties of the lead glass and PMT
- GEANT3 uses the attenuation length of the block and attenuates the deposited energy down the length of the block (includes 3% smearing to account for photostatistics,tuned by data from RADPHI).

F8 (regular lead glass) Energy Resolution results for 1 GeV photons incident on array

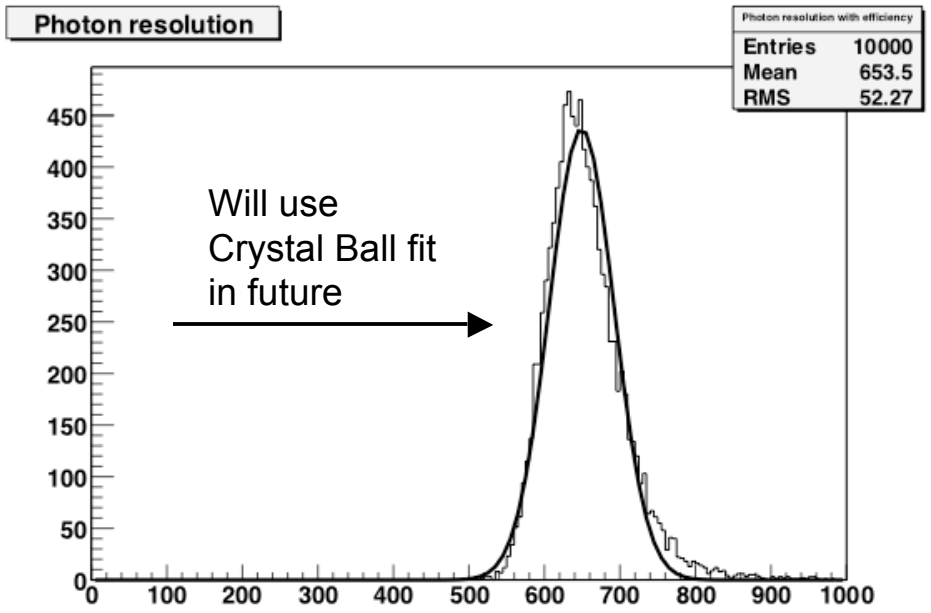
HDGEANT (GEANT3)



Mean energy:
0.9991 +/- 0.0007

$\sigma_E/E = 6.444 \pm 0.006$ %

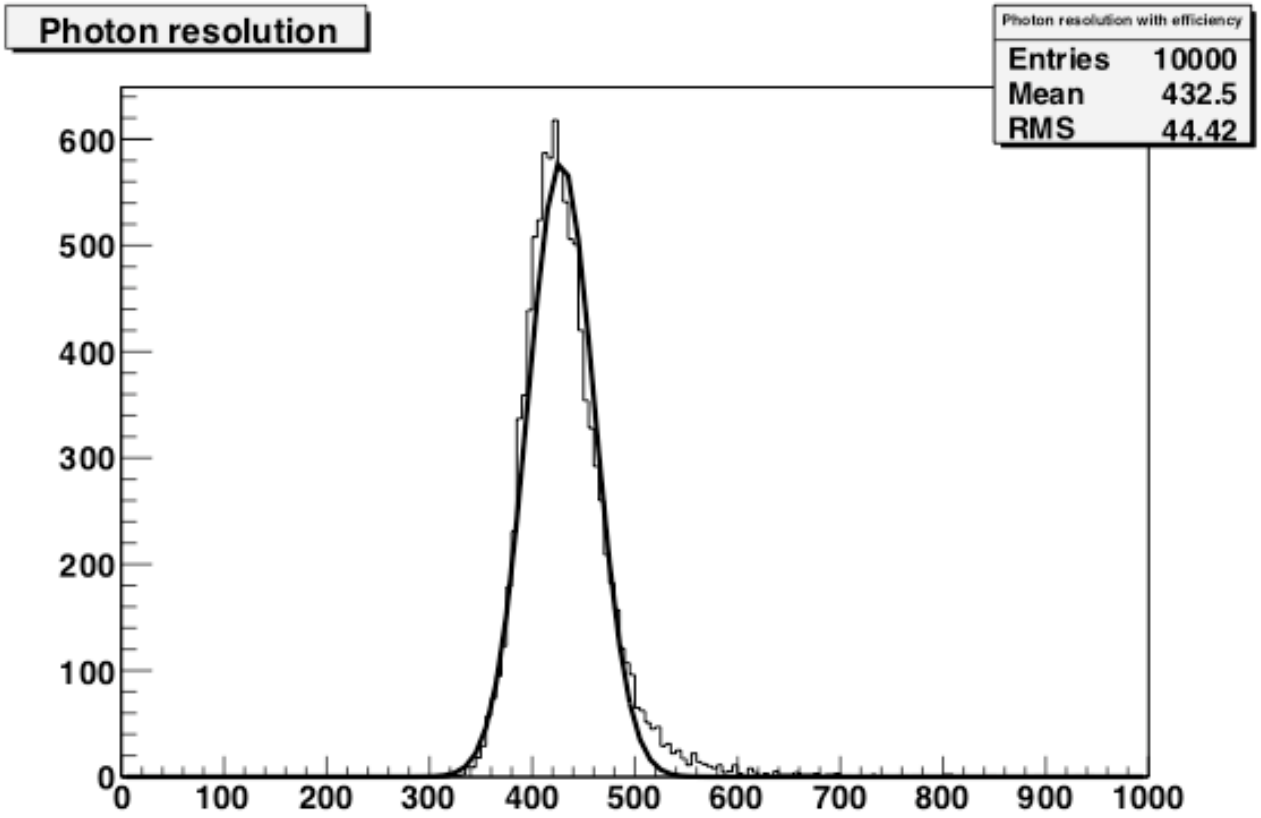
GEANT4



Mean number of Photons:
652.0 +/- 0.5

$\sigma_N/N = 6.71 \pm 0.06$ %

F108 Results



Number of Photons:

428.0 +/- 0.4

σ_N/N = 7.59 +/- 0.06 %

Conclusion

- GEANT4 predicts an energy resolution for RHG (F108) as **7.59 +/- 0.06 %.** F8, the regular lead glass, has a predicted energy resolution of **6.71 +/- 0.06 %.** These energy resolutions are for 1 GeV photons incident on the array.
- Tune HDGEANT with the correct attenuation length and rerun previous simulations
- More accurate energy resolutions could come from a beam test.