Monte Carlo material studies

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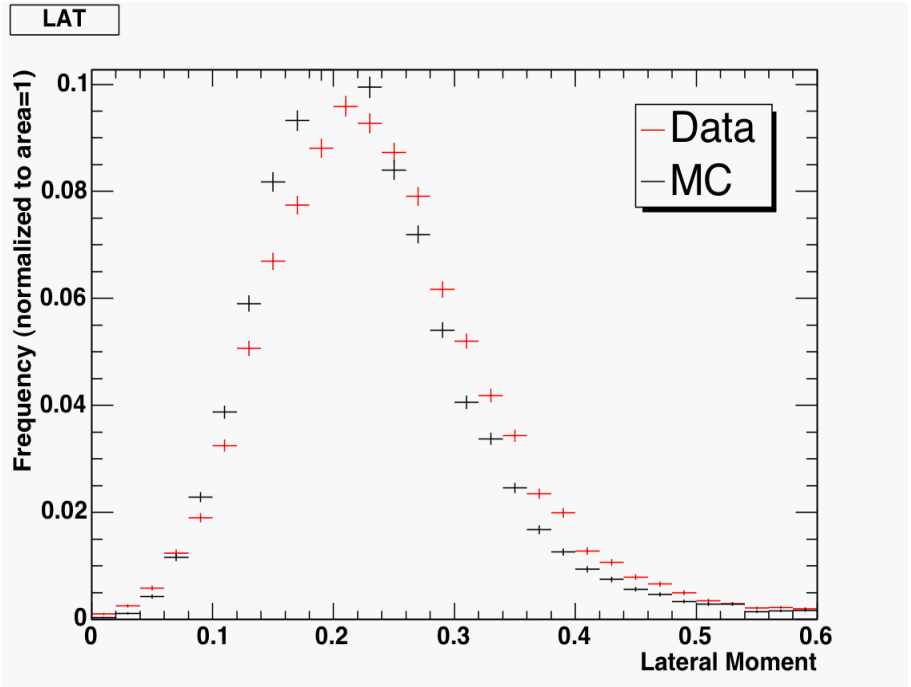
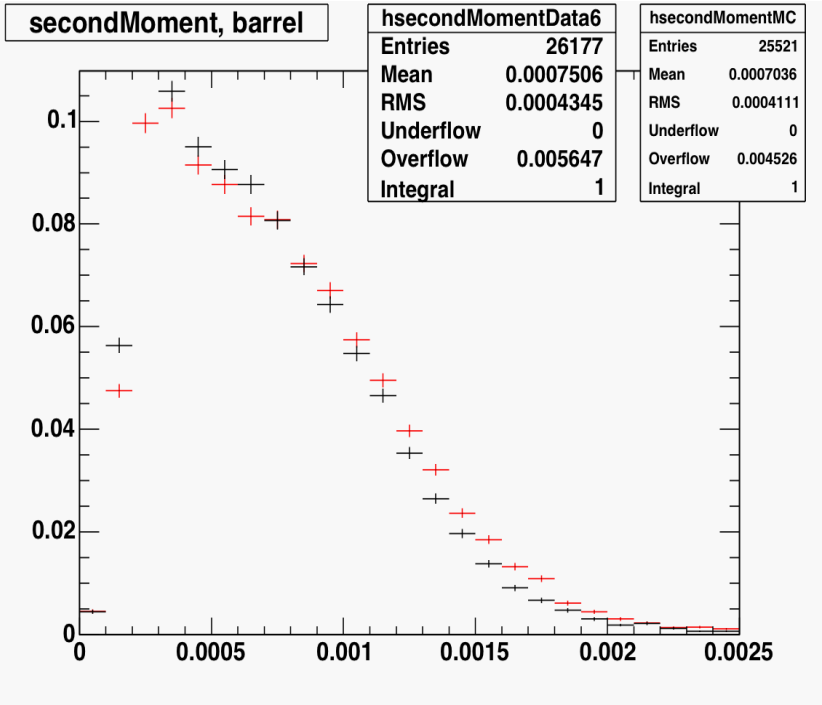
Why material studies?

✗ There are discrepancies between data and MC that are not understood:

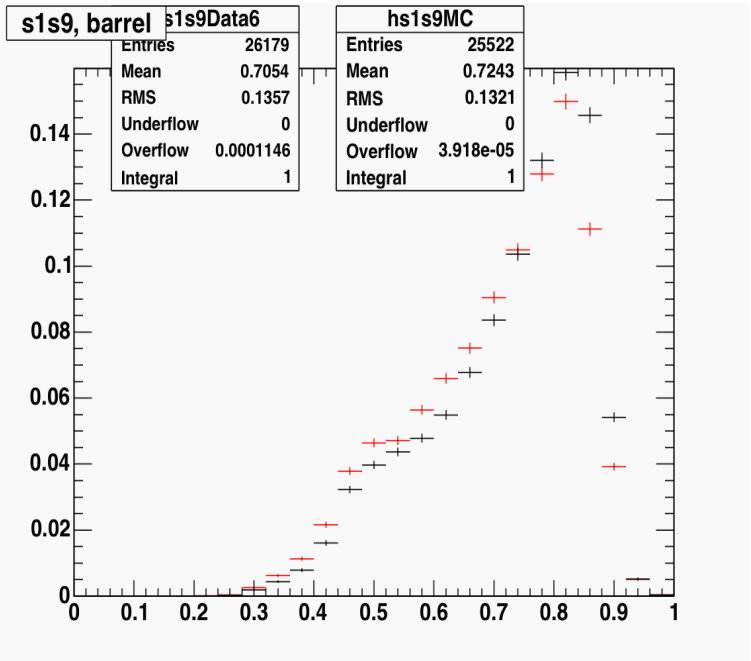
Shower shape variables for photons of energy 0.3-3GeV from mumugamma events in the EMC barrel

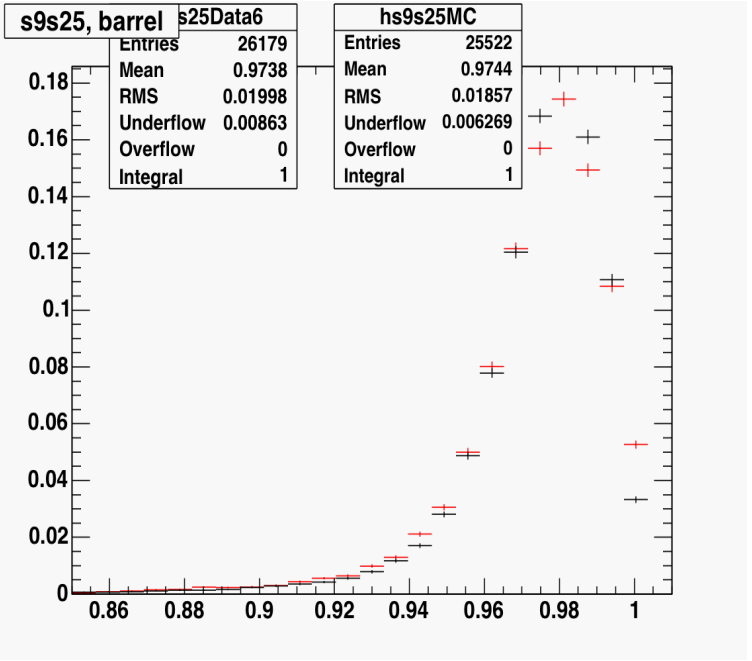


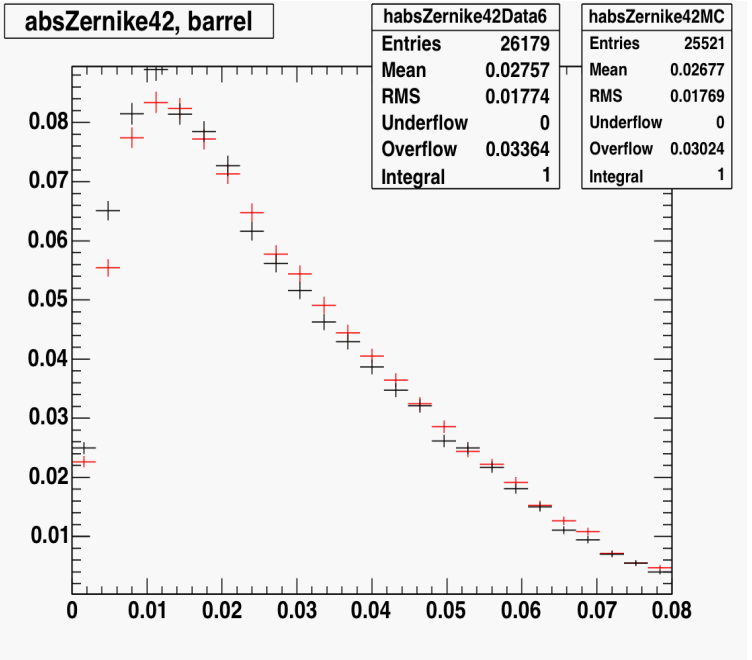


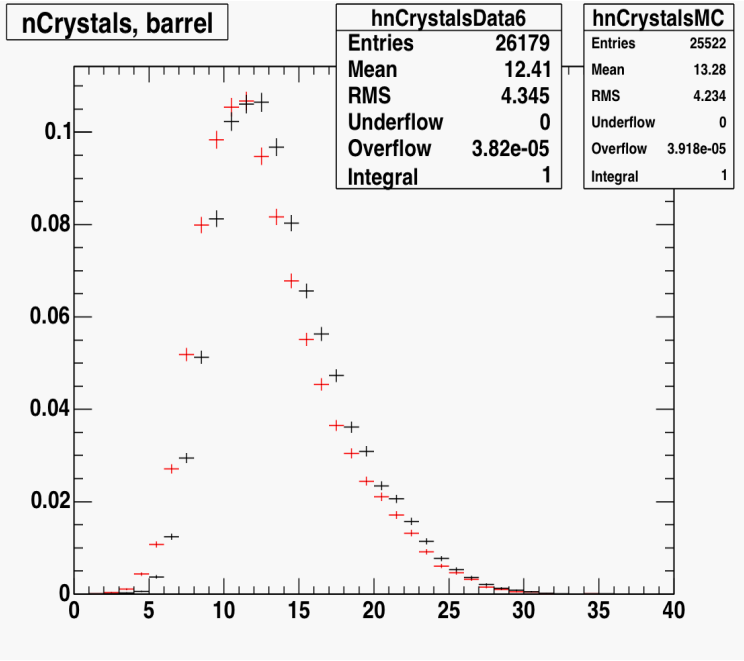
(thanks to Katharine Schofield)

Why material studies?









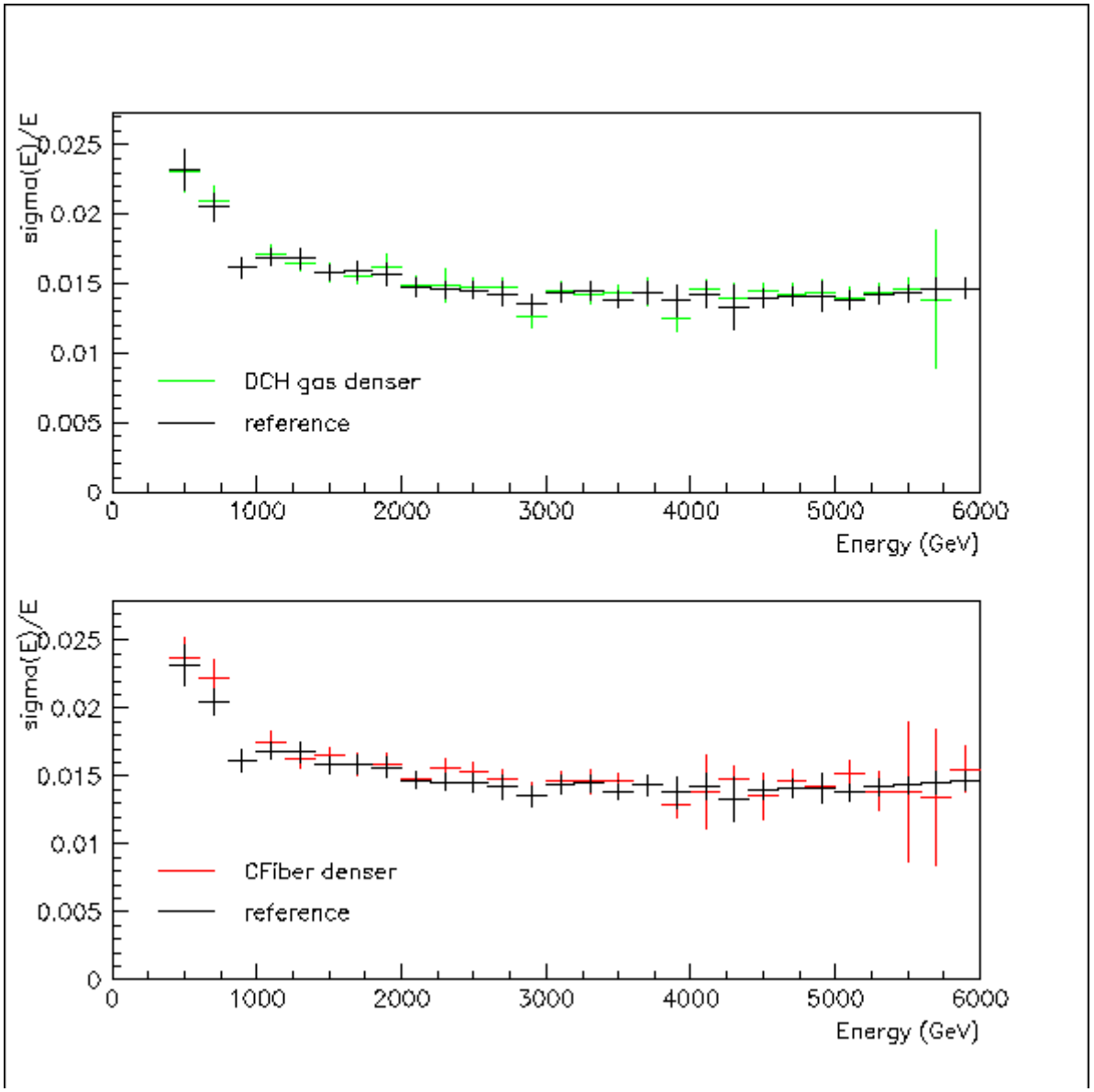
Material Studies - density

- The goal of this study is to understand how different descriptions of the material in the EMC (and upstream) can affect the shower shape variables and EMC energy resolution
- Practically, instead of changing the geometrical description of the material, I changed its density
- In fact, I increased the material density, to see if I could reproduce the energy resolution seen in data
- I focussed on two materials: emc-CFC (CF+Tyvek+Al) and dch-He-Ibu (gas in the DCH)

Material studies - density

- I generated samples of single photons in the energy range 600 MeV - 6 GeV using release 18.6.0a
- The tcl files I used for the generation are modeled on $BFDIST/packages/ProdDecayFiles/V00-05-78/single_gamma_1000MeV.tcl
- I generated a reference sample with the usual condition database (cond18boot)
- In addition, I generated a sample with emc-CFC material denser by 20% and another one with dch-He-Ibu denser by 10% by changing the MatEnv/MaterialsList_IR2.data file
- I calculated the energy resolution dependence by fitting a CrystalBall to the distribution (E - Etrue)/ Etrue

Material studies - density

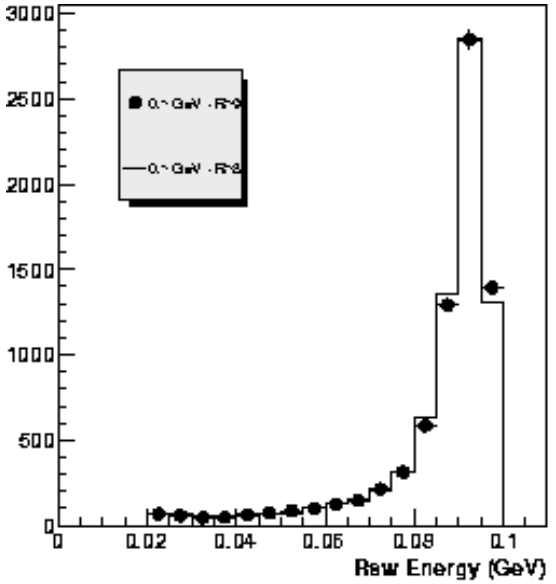


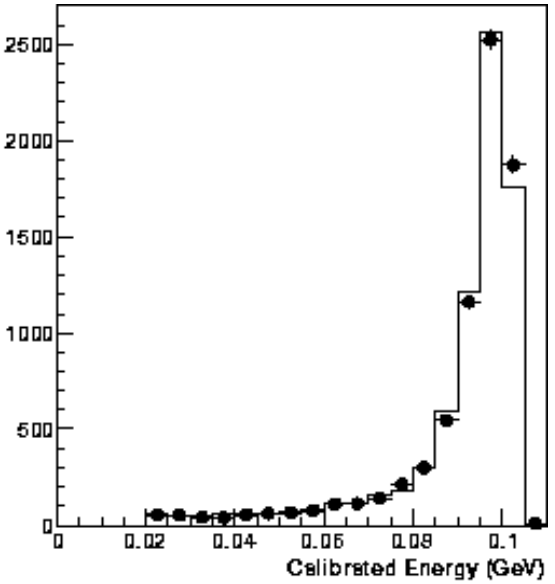
Material studies – release 19

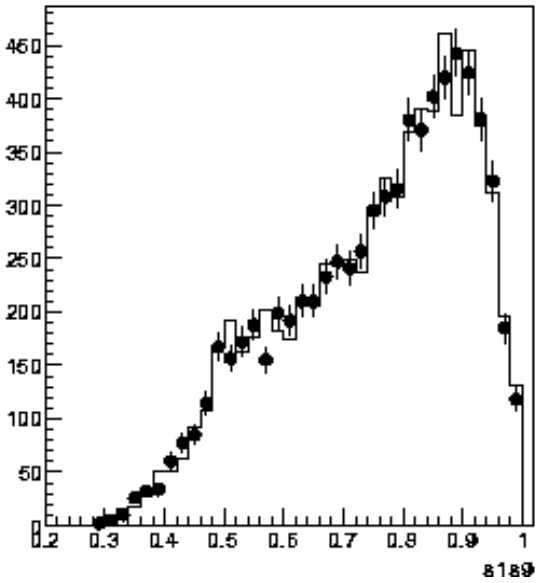
- Release 19.4.1 contains the latest GEANT4 release 7.1 patch 01
- This includes a change in the description of the multiple scattering, in particular "a change in angular distribution for e+, e- due to correction of Highland formula for central part of distribution."
- I tried to see what changes are visible with the new release in the generation of photons, with a focus on shower shape variables and energy resolution
- I tried to generate single photon samples in the same conditions as the ones that I used for the density studies
- I only succeeded in generating single photons in the range 100 – 3000 MeV

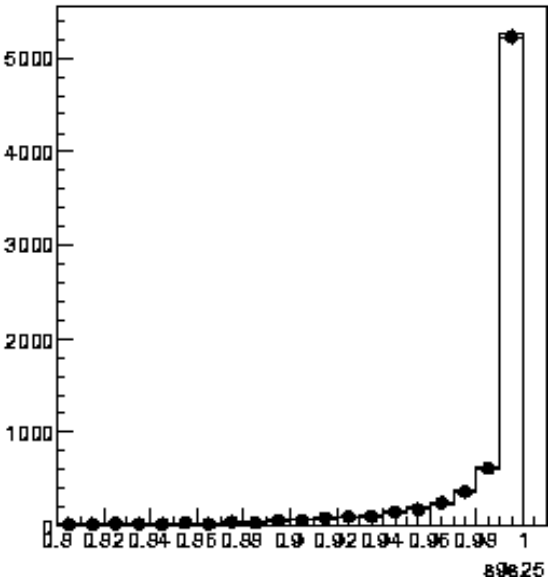
Material studies - R19

Single photons – 100 MeV



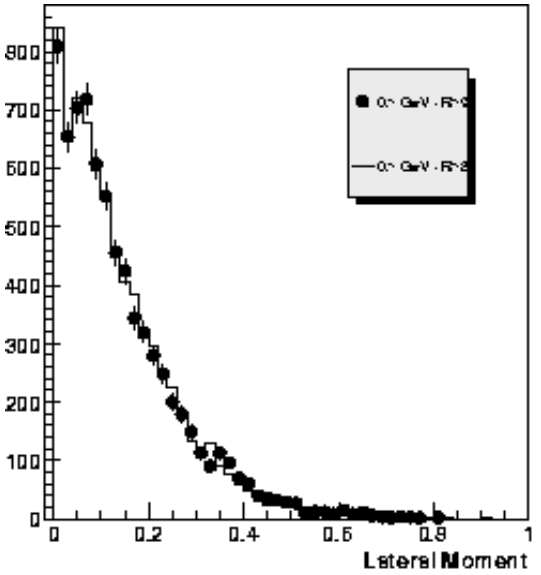


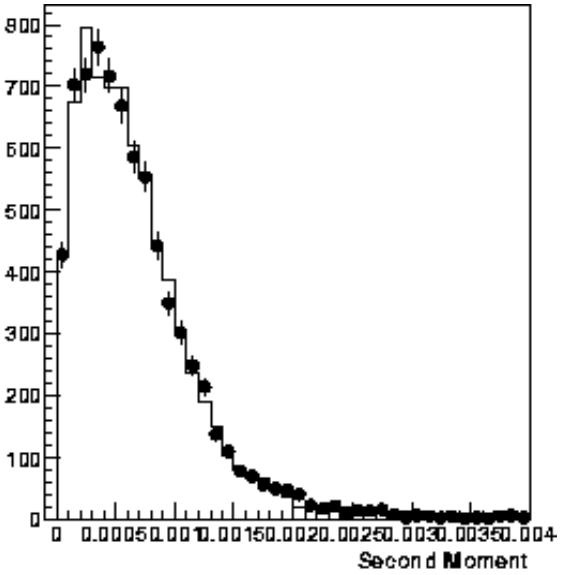


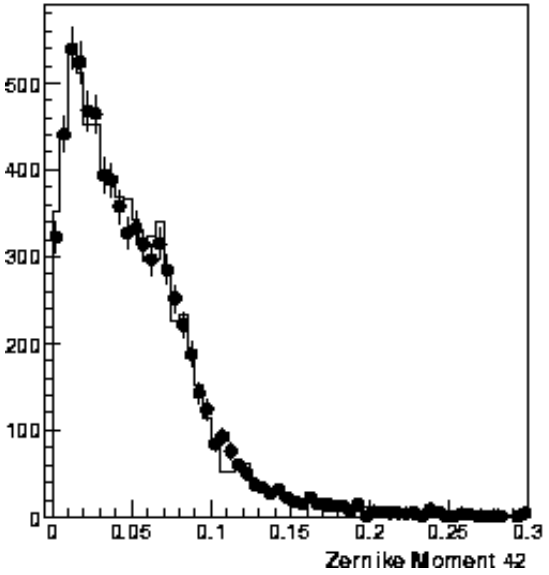


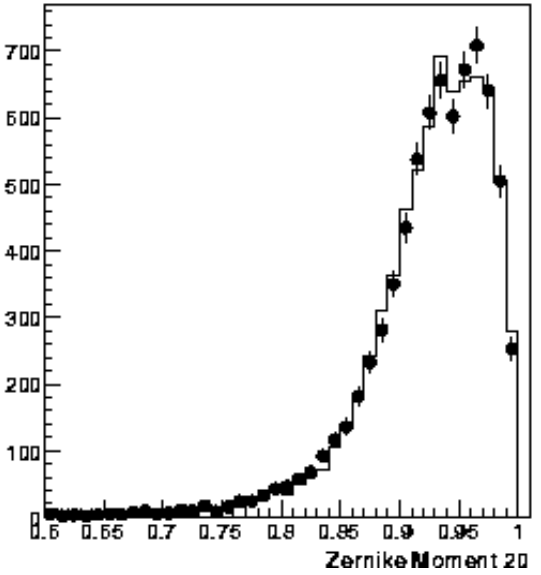
Material studies - R19

Single photons – 100 MeV



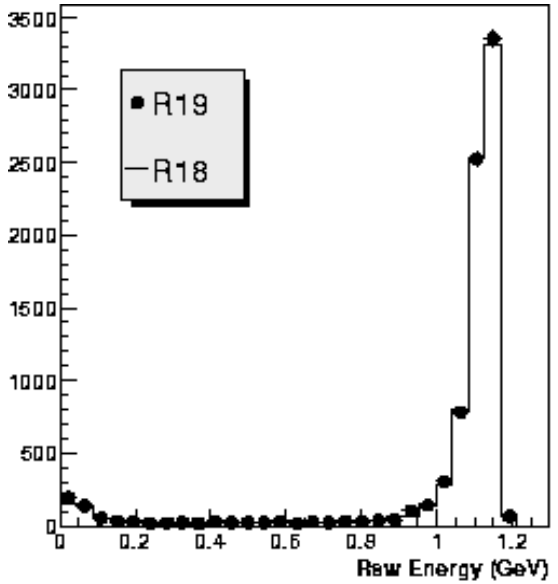


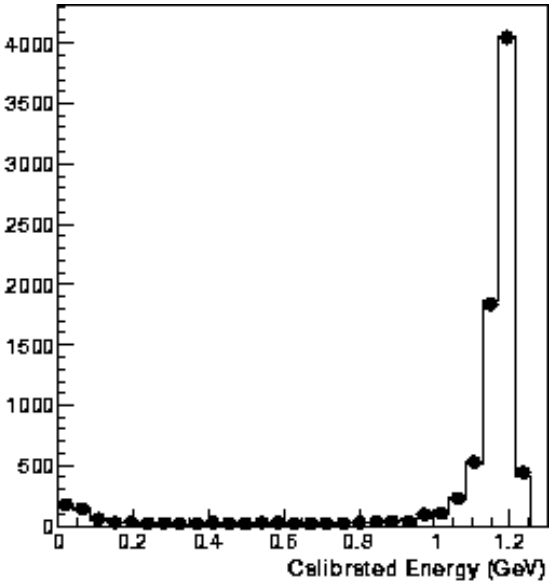


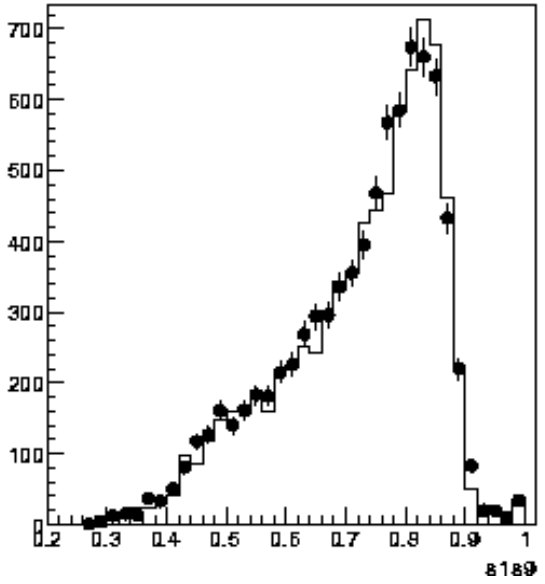


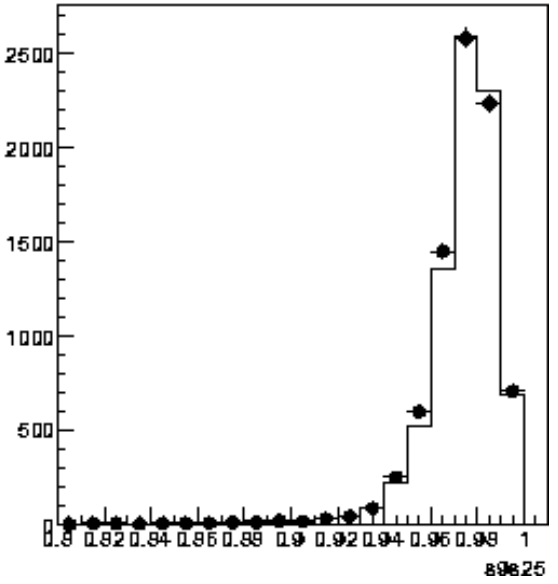
Material studies - R19

Single photons – 1200 MeV









Material studies - R19

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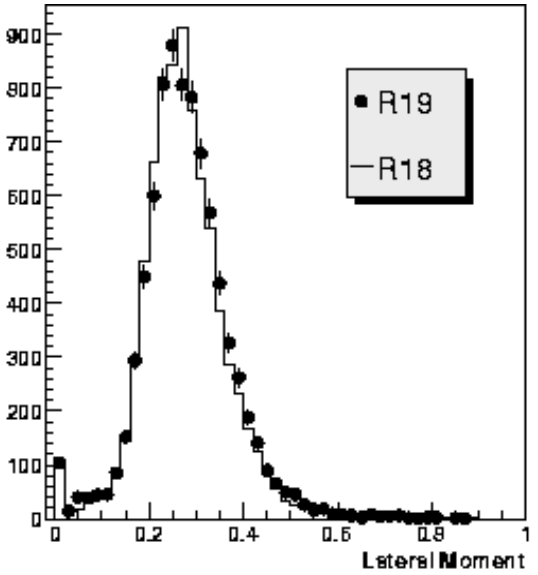

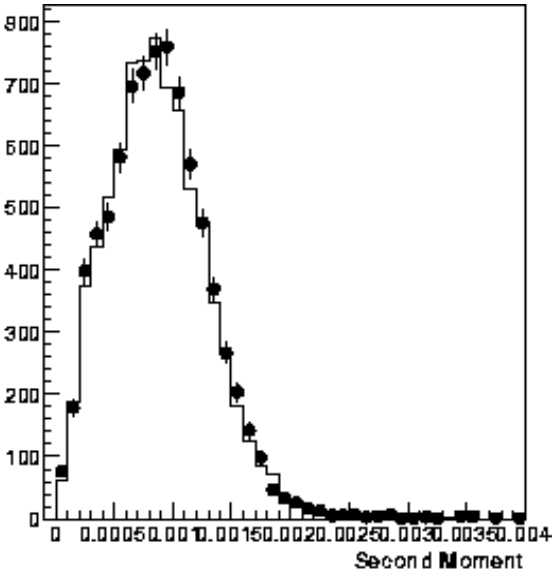

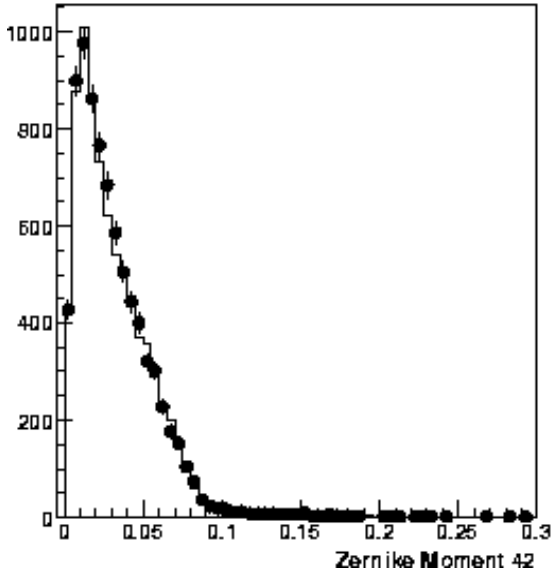

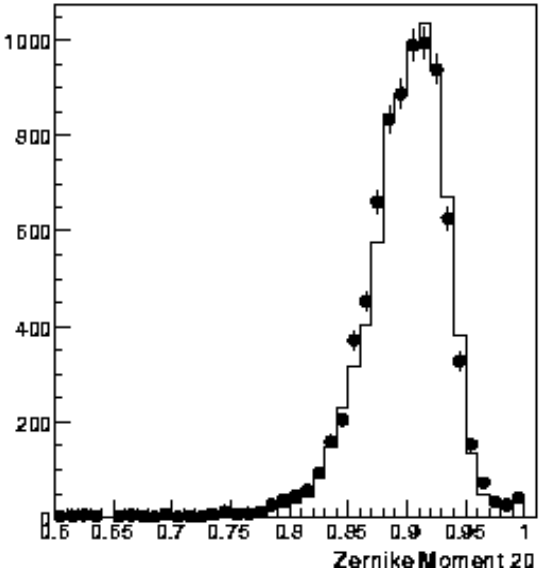

Conclusions

- ✗ Making the material reasonably more dense does not help in understanding the discrepancy in the energy resolution between data and simulation
- ✗ The new GEANT version does not induce big changes in the shower shape distributions