

# Pion Showers in the HCAL

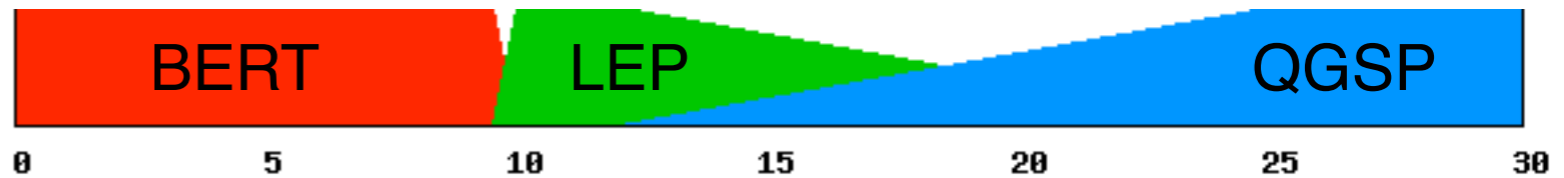
Alexander Kaplan, Universität Heidelberg / DESY FLC



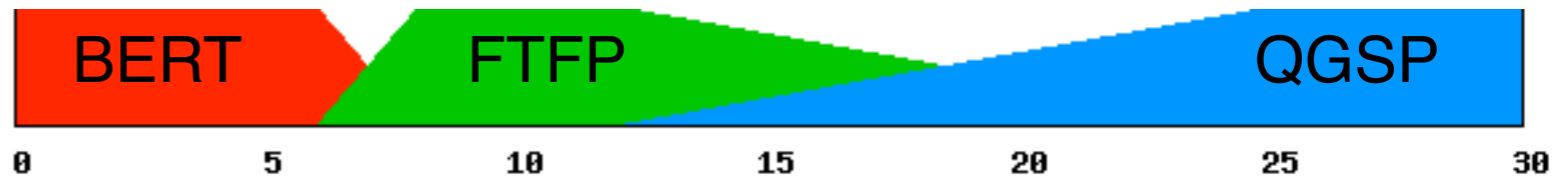
# Physics Lists

Mokka 7-00 / GEANT4-9.3 (final)

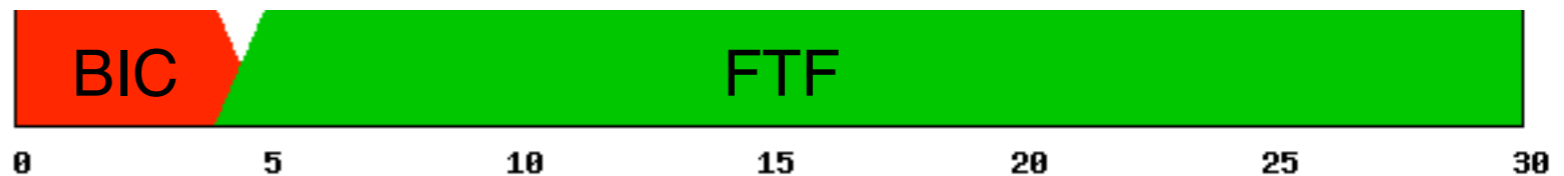
QGSP\_BERT



QGSP\_FTFP\_BERT



FTF\_BIC

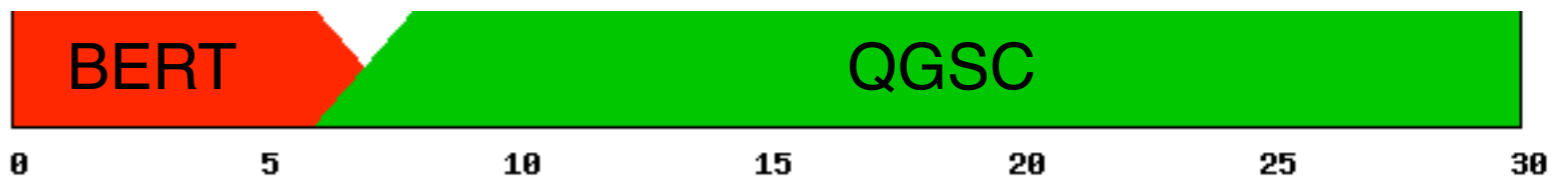


FTFP\_BERT\_TRV

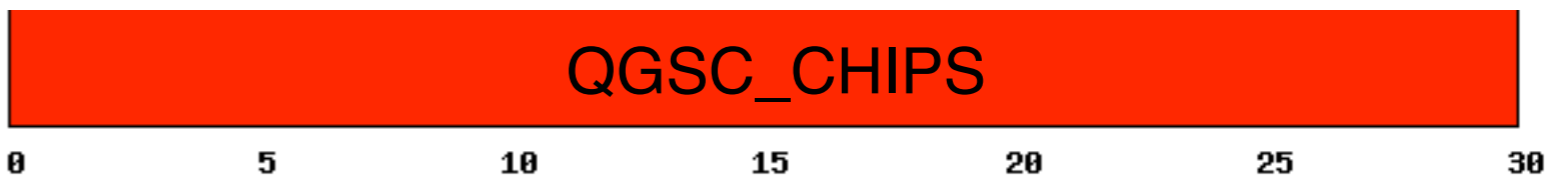


Problem in final version - no plots today (work in progress):

QGSC\_BERT



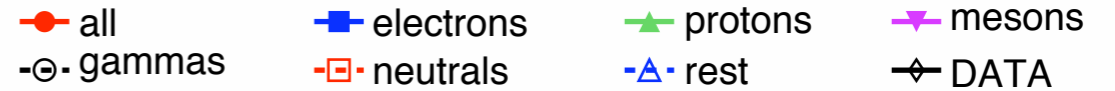
QGSC\_CHIPS



Energy [GeV]

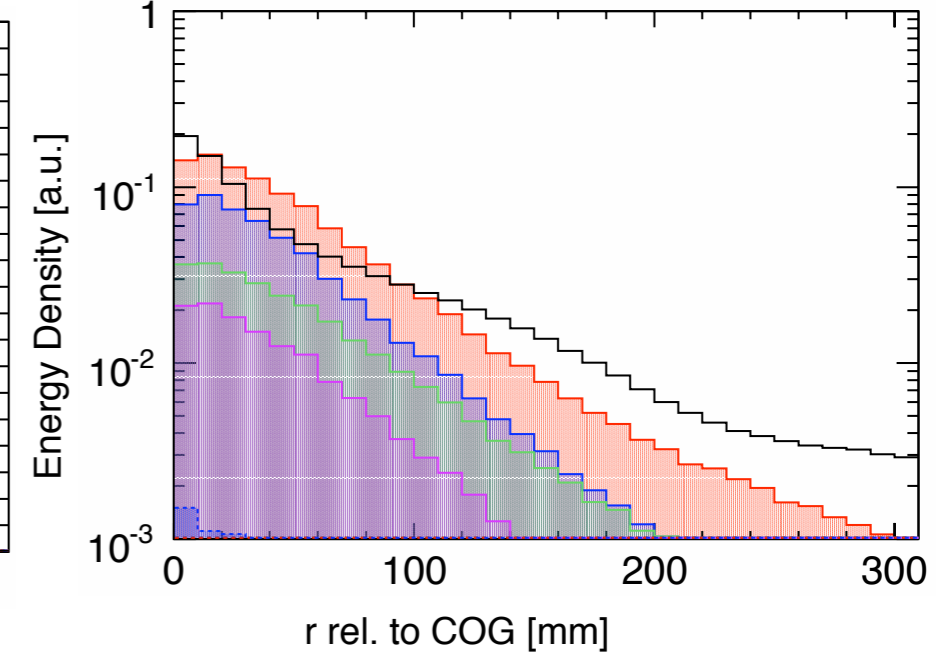
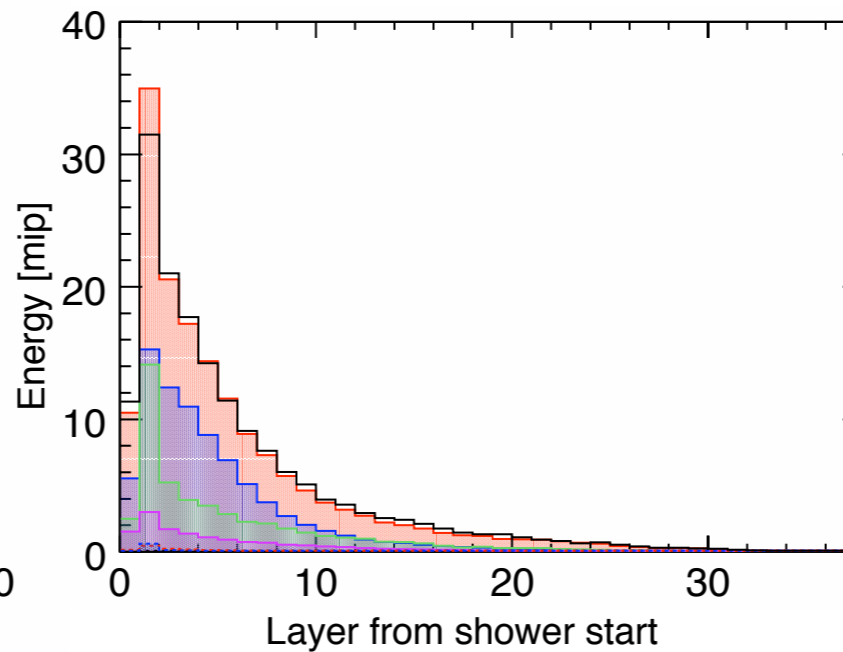
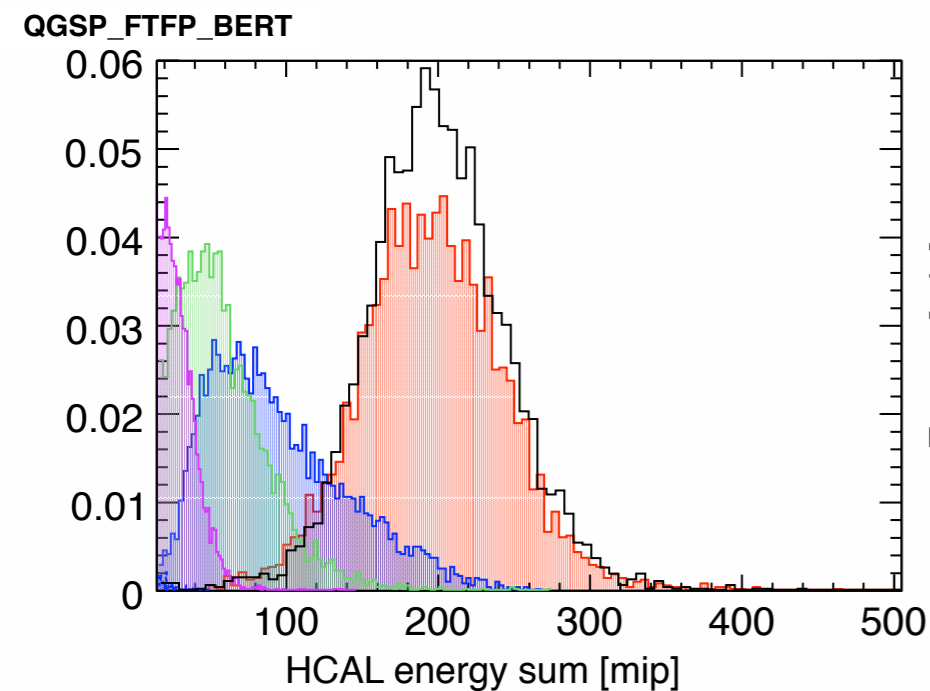
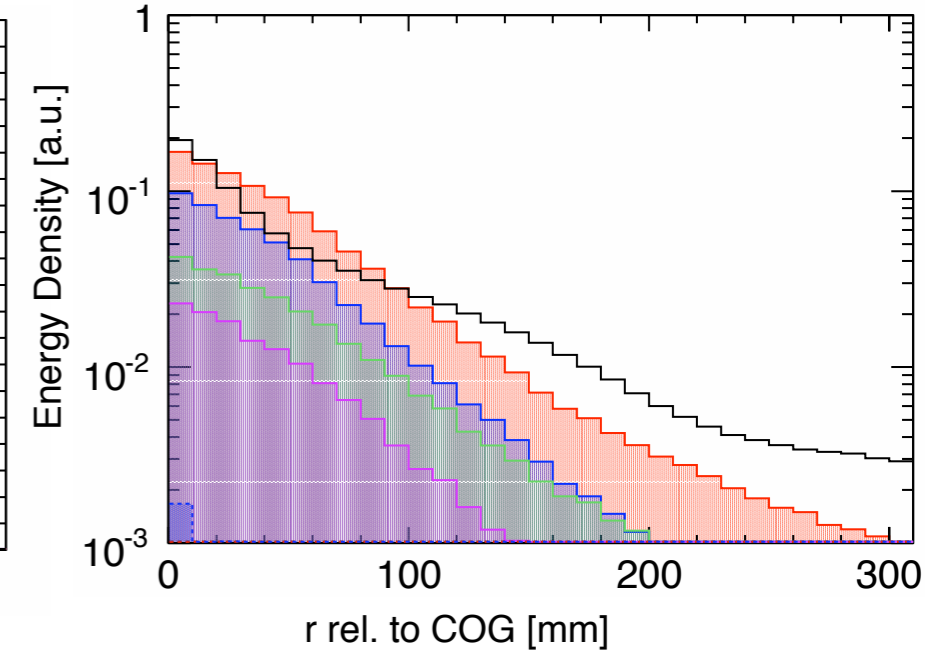
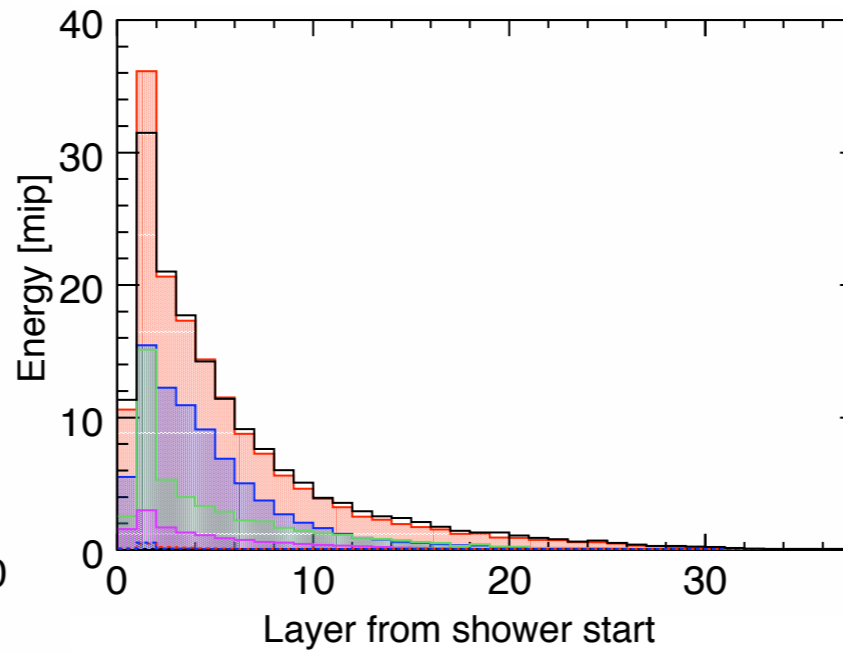
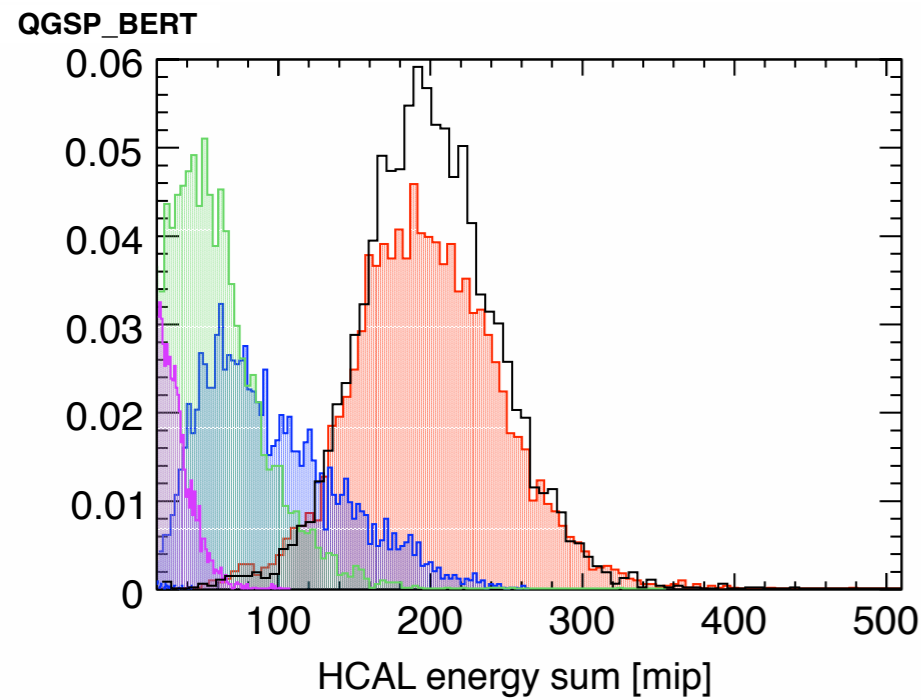
# QGSP\_BERT vs. QGSP\_FTFP\_BERT

ahcal/ahcal\_ss\_leSum, run 330908, 6 GeV



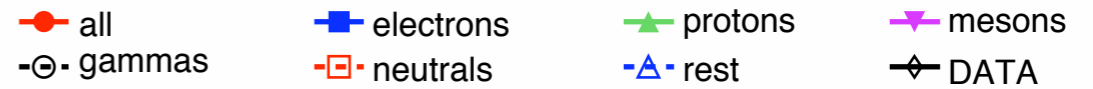
Longitudinal Profile

Transverse Profile



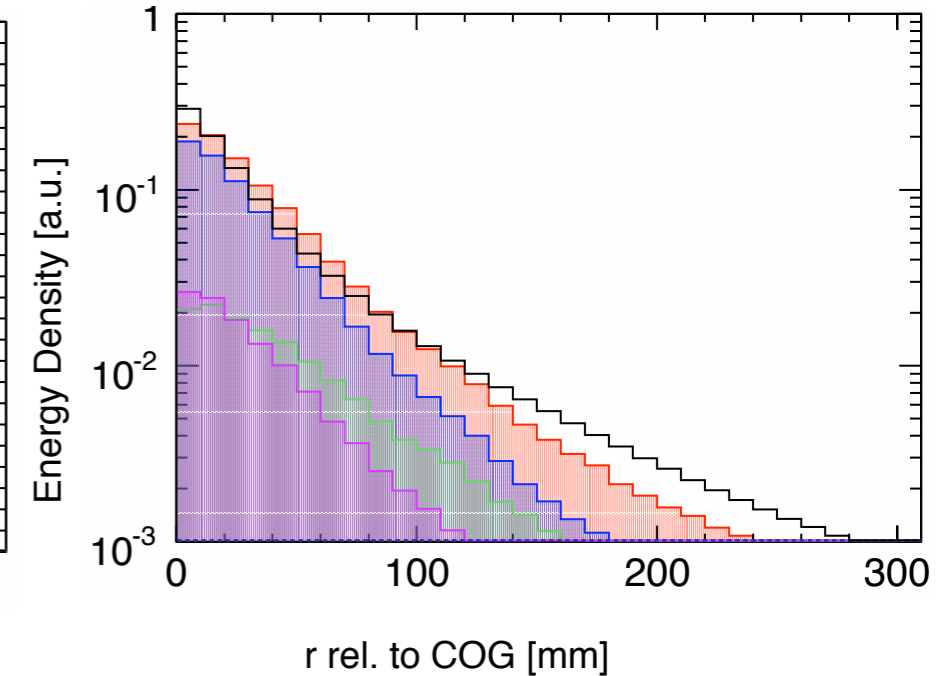
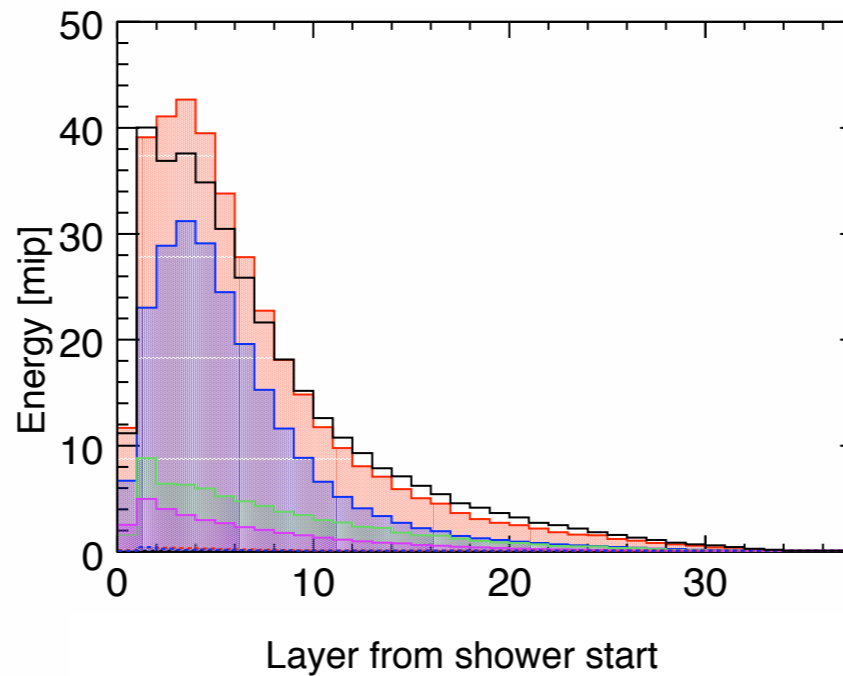
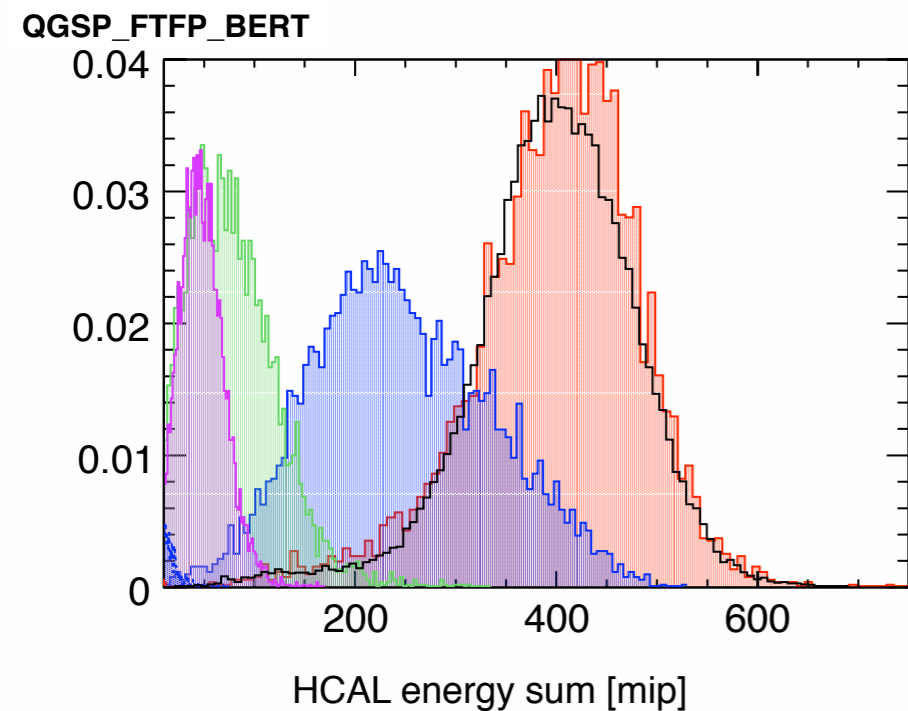
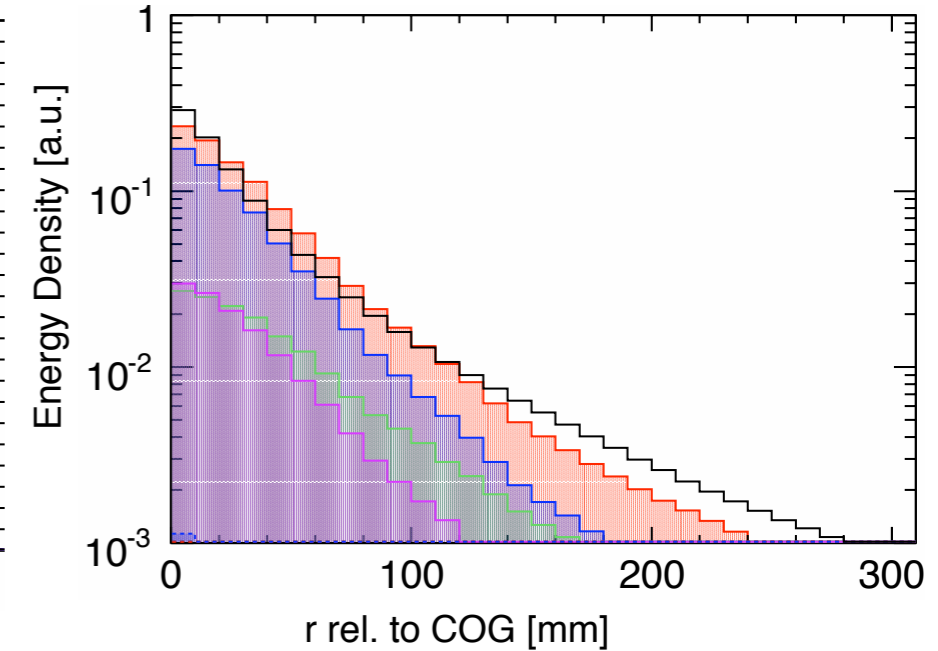
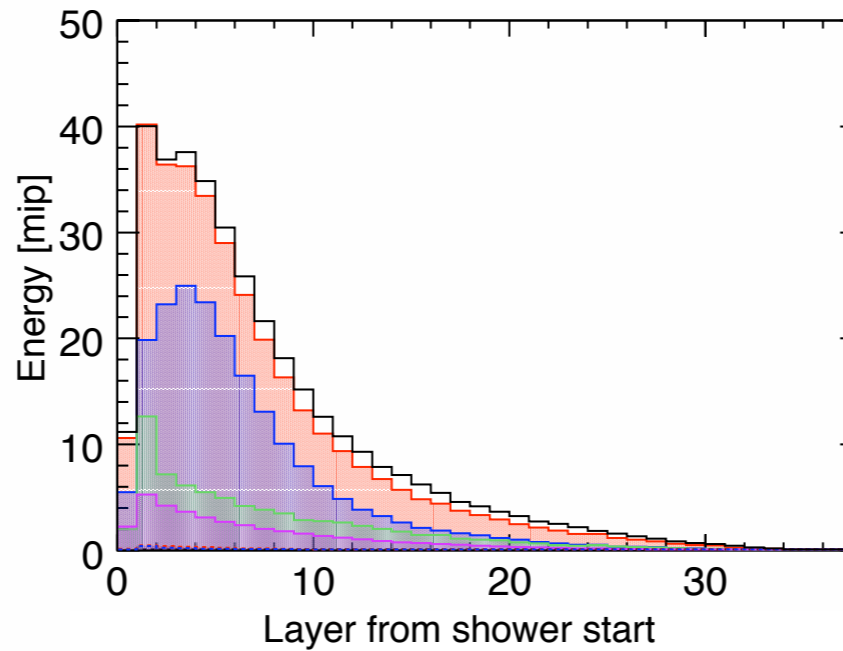
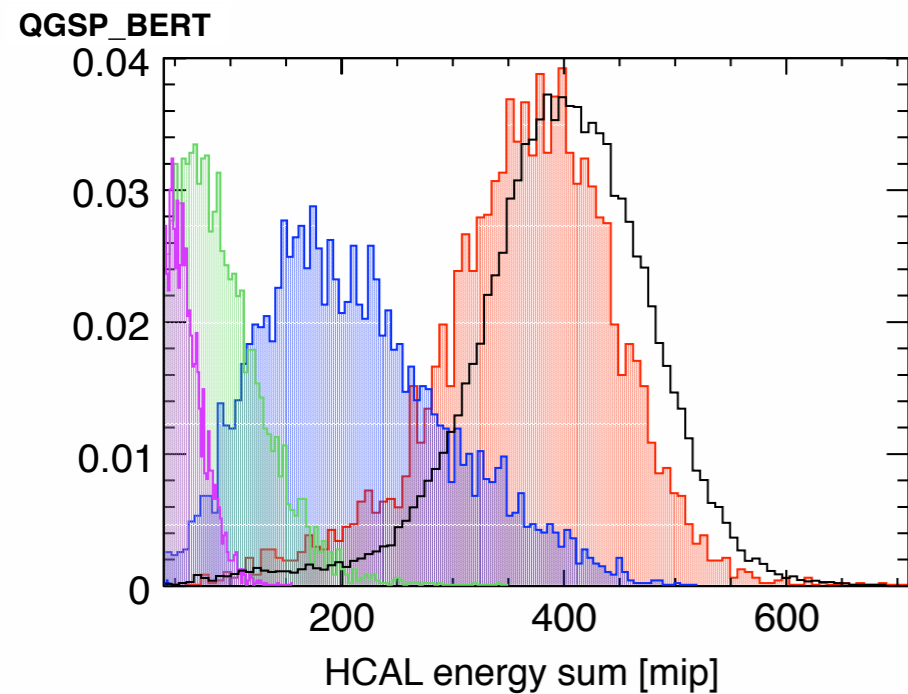
# QGSP\_BERT vs. QGSP\_FTFP\_BERT

ahcal/ahcal\_eSum, run 330330, 12 GeV



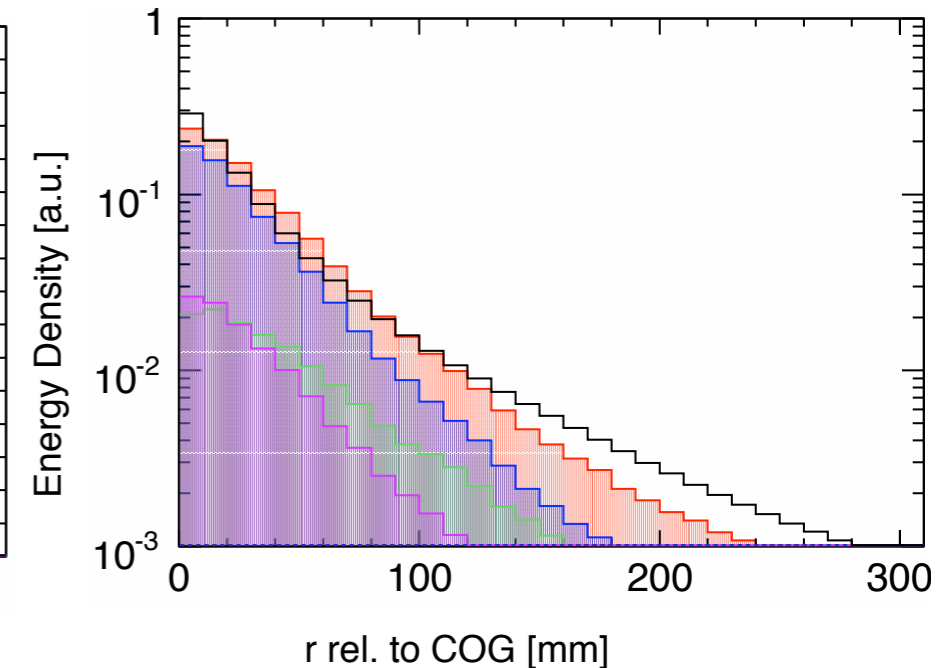
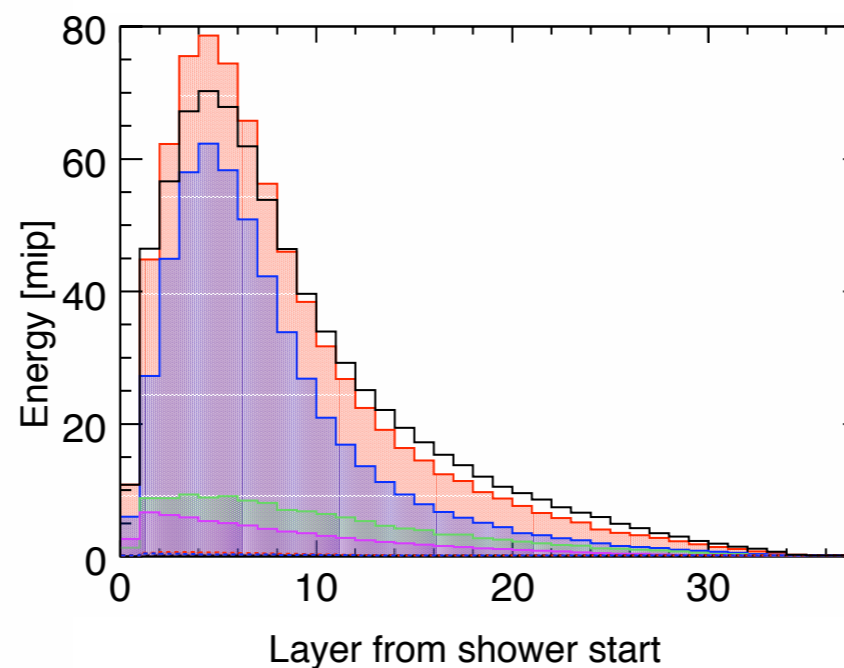
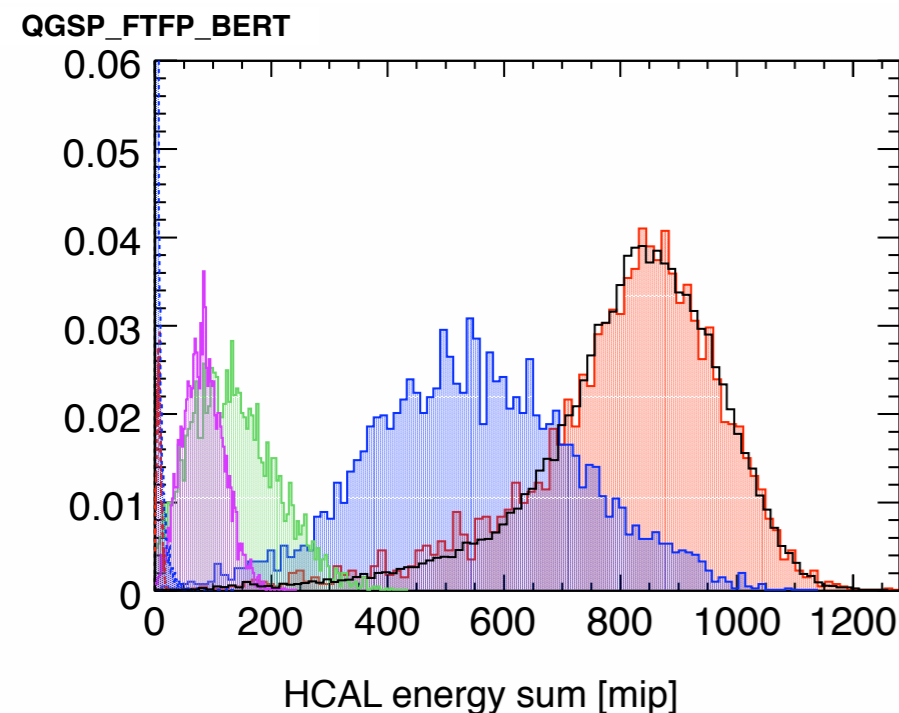
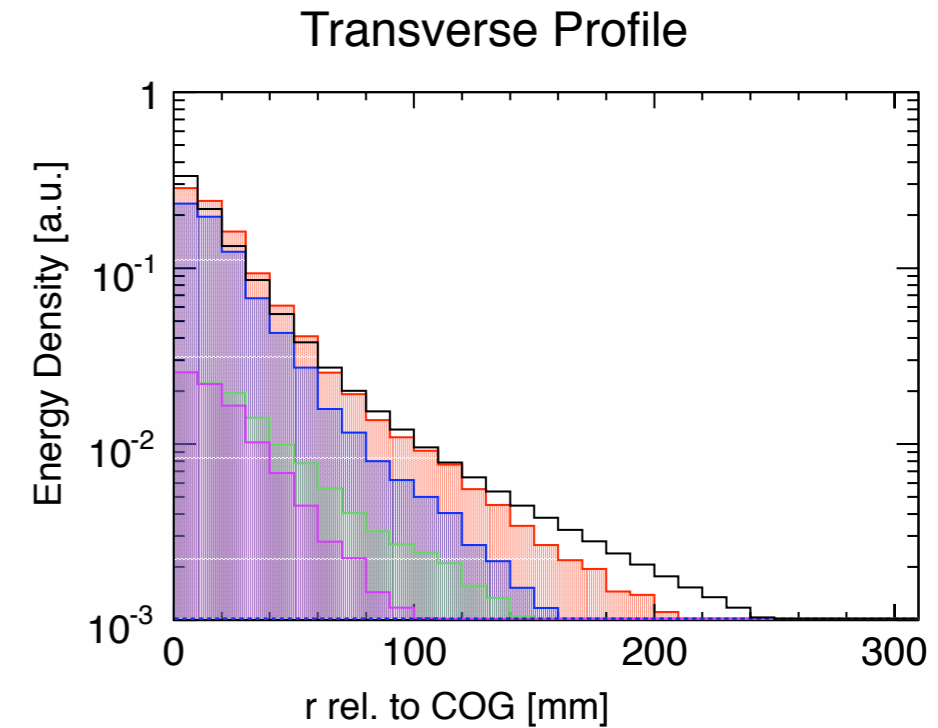
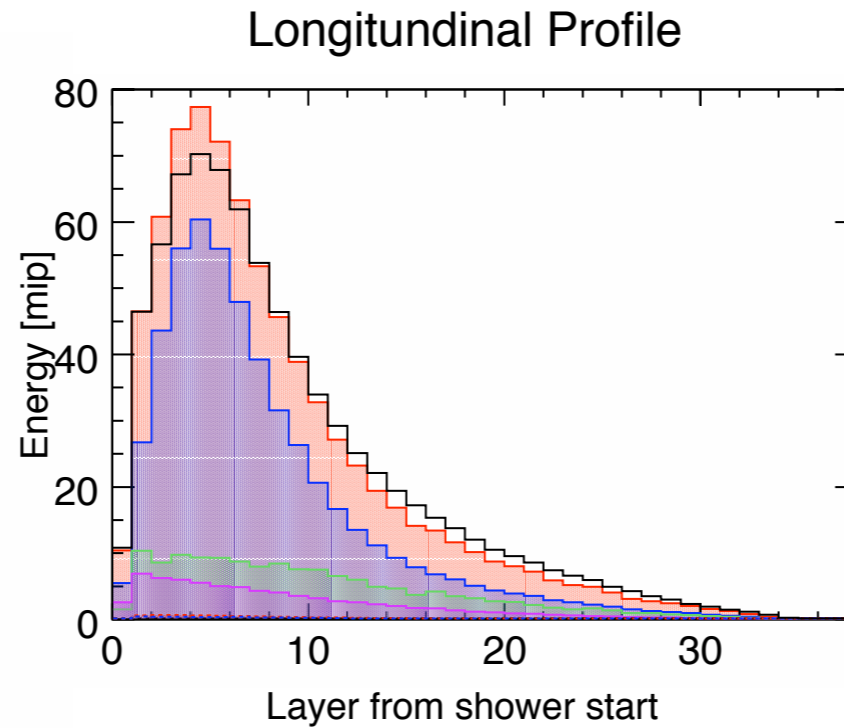
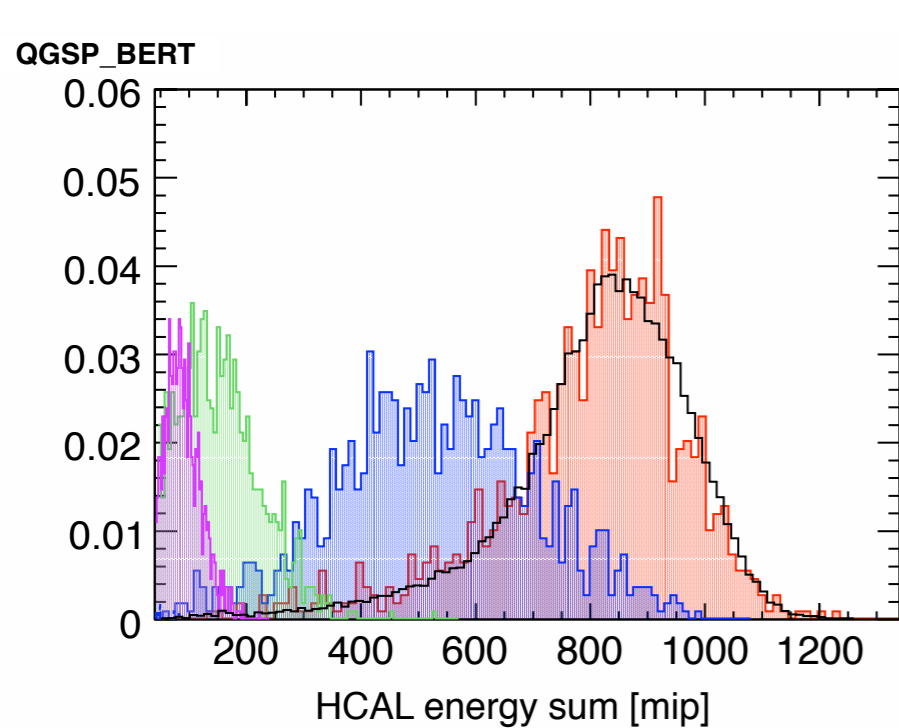
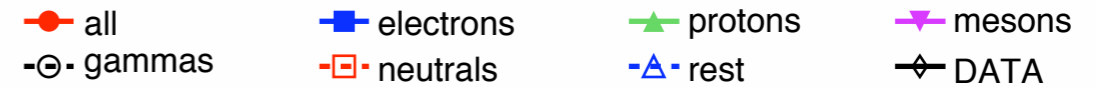
Longitudinal Profile

Transverse Profile

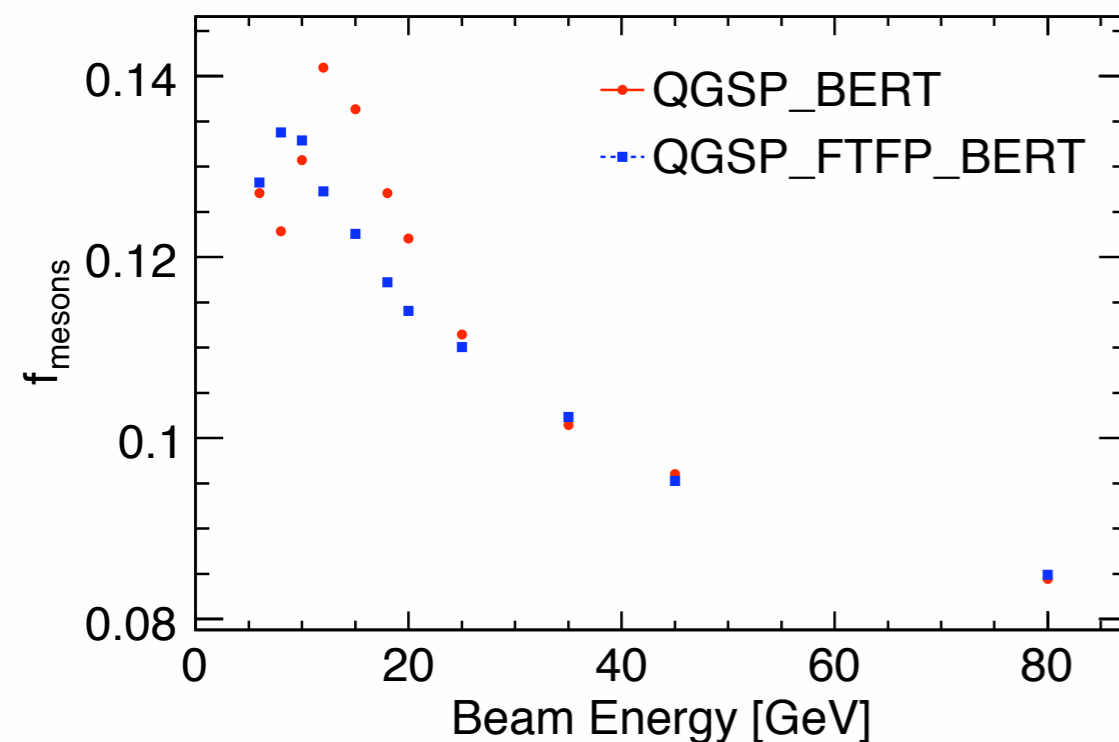
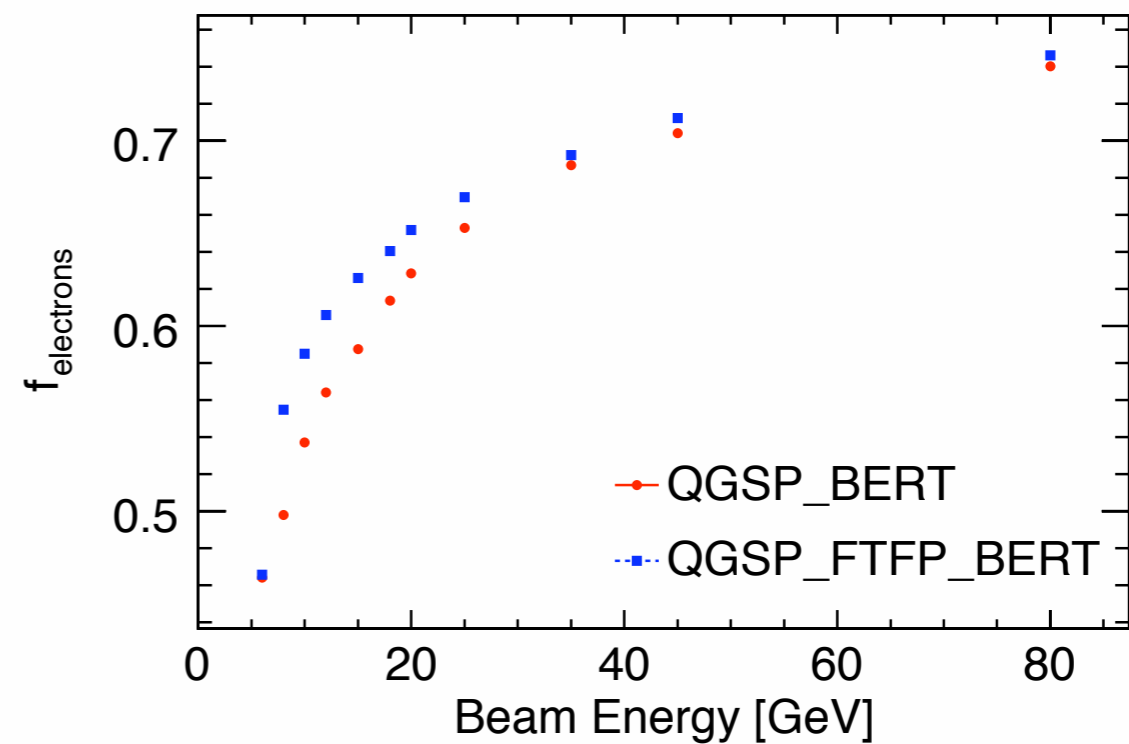
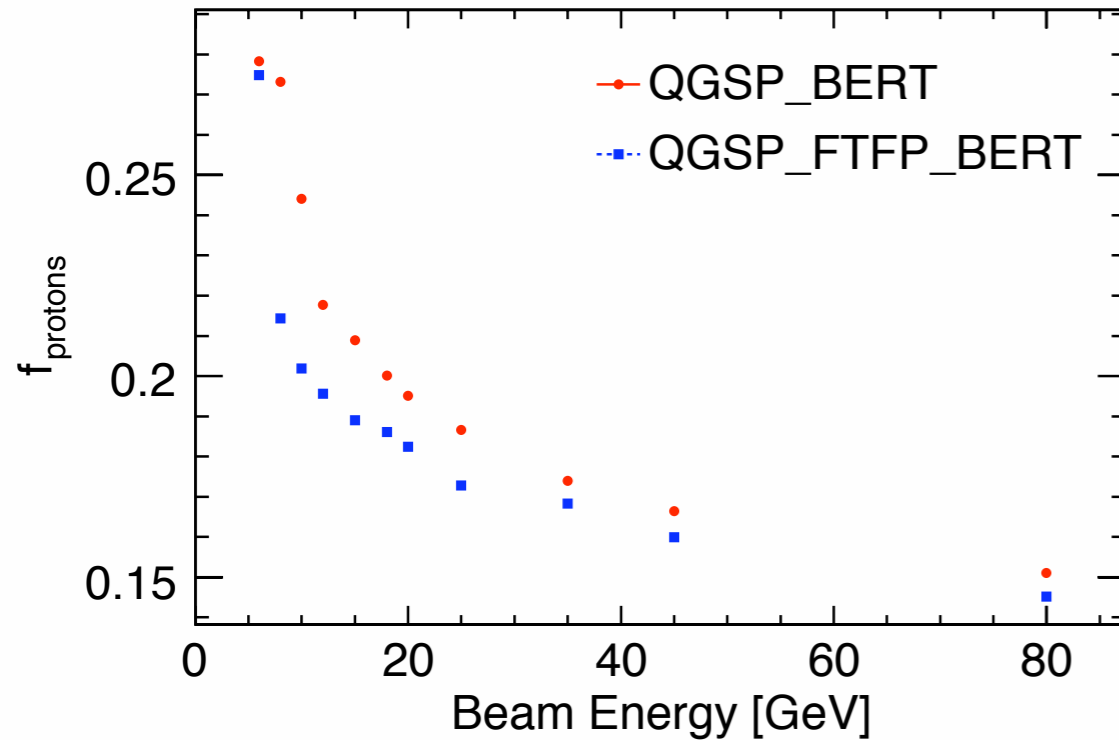


# QGSP\_BERT vs. QGSP\_FTFP\_BERT

ahcal/ahcal\_eSum, run 330325, 25 GeV



# Energy Fractions

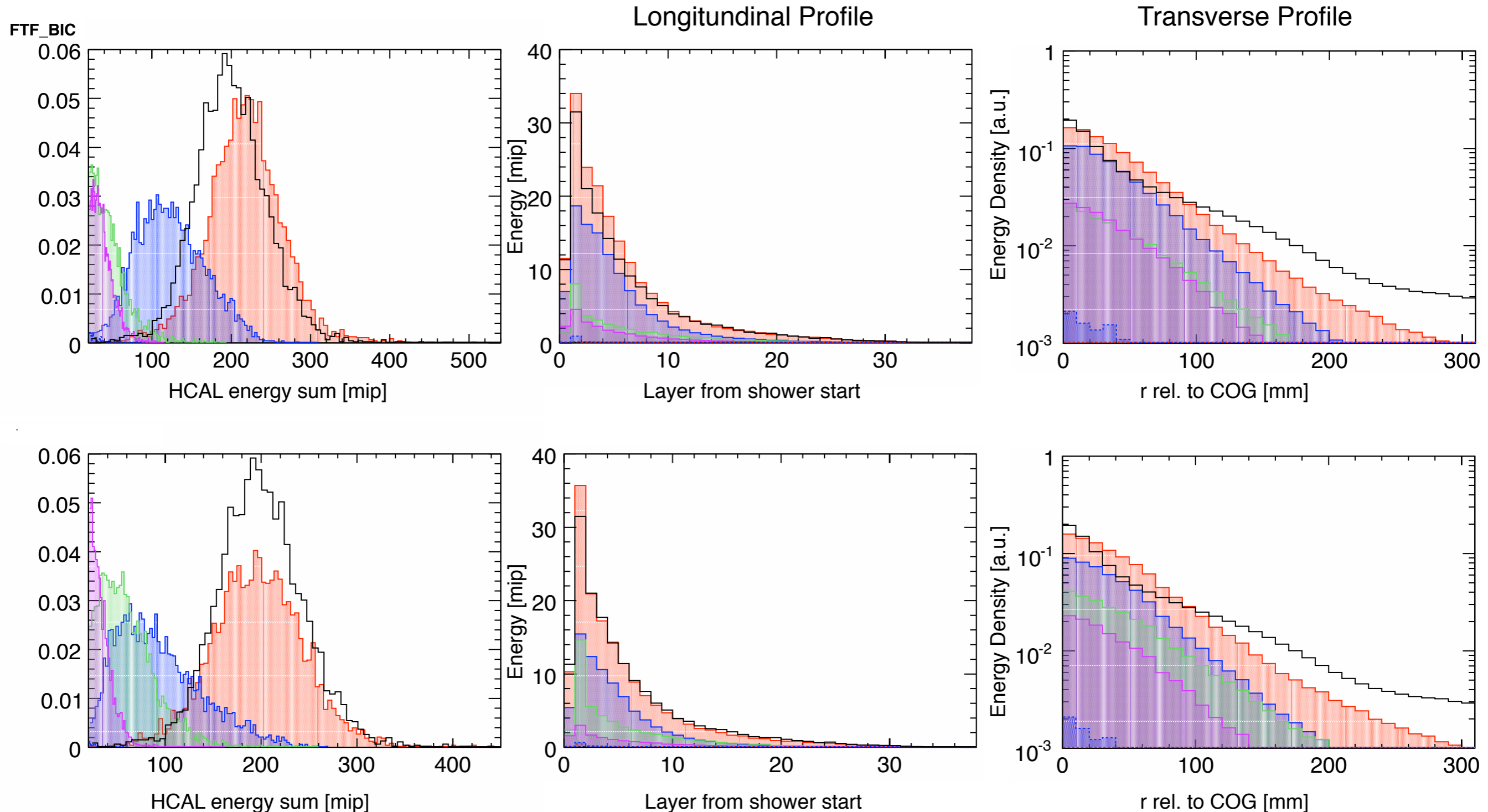


- $f_{\text{electrons}}$  grows with energy,  $f_{\text{protons}}$  and  $f_{\text{mesons}}$  fall
- QGSP\_BERT (LEP) produces less electrons and more protons & mesons than the FTFP list
- QGSP\_BERT proton fraction at 6 GeV looks strange
- In Both QGSP\_BERT and QGSP\_FTFP\_BERT there is a strange kink in the meson energy.

# FTF\_BIC vs FTFP\_BERT\_TRV

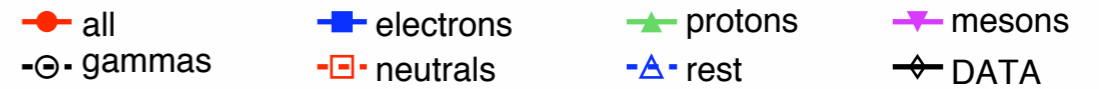
ahcal/ahcal\_ss\_leSum, run 330908, 6 GeV

● all    ● electrons    ▲ protons    ▼ mesons  
○ gammas    □ neutrals    △ rest    ◆ DATA



# FTF\_BIC vs FTFP\_BERT\_TRV

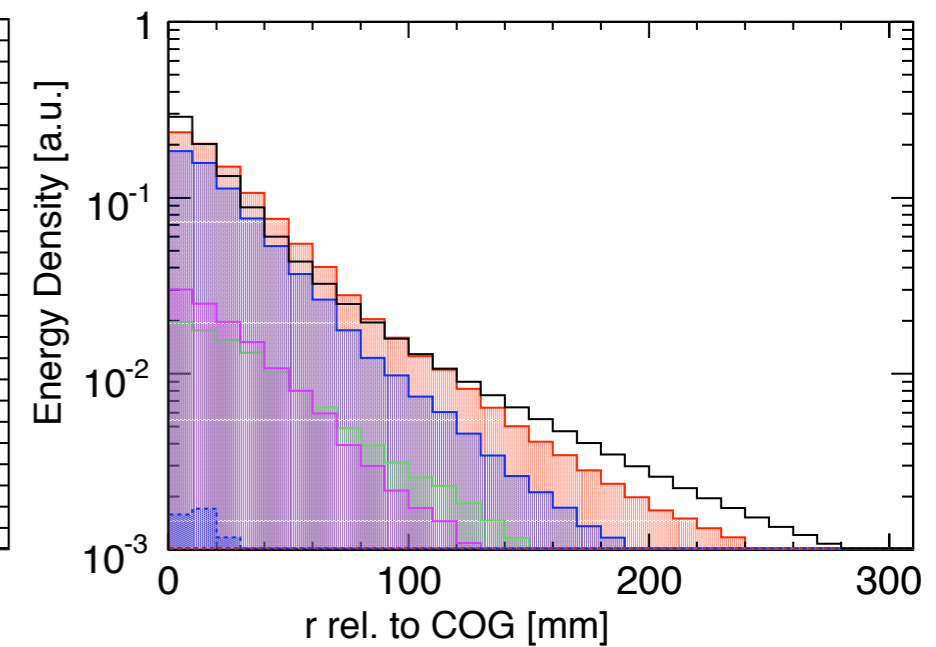
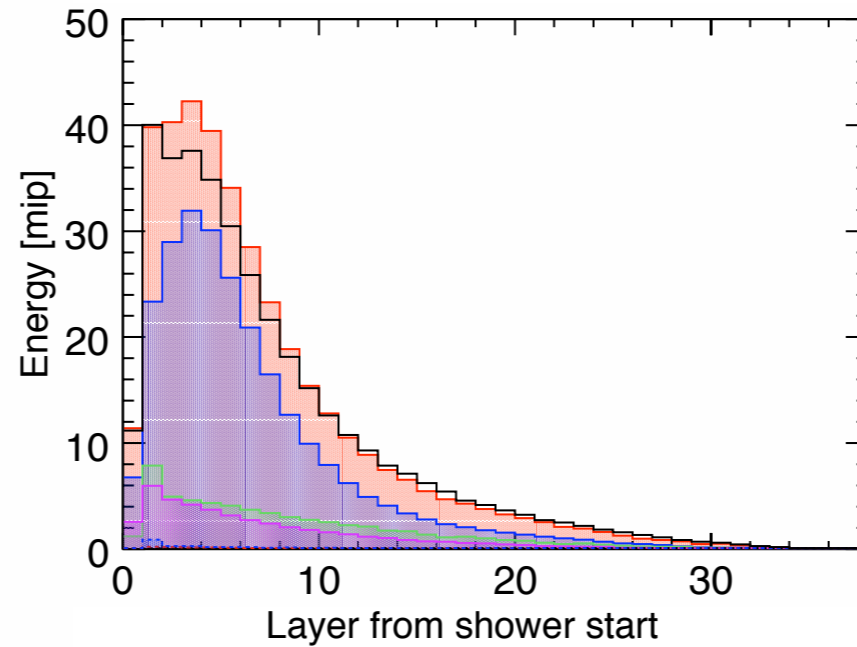
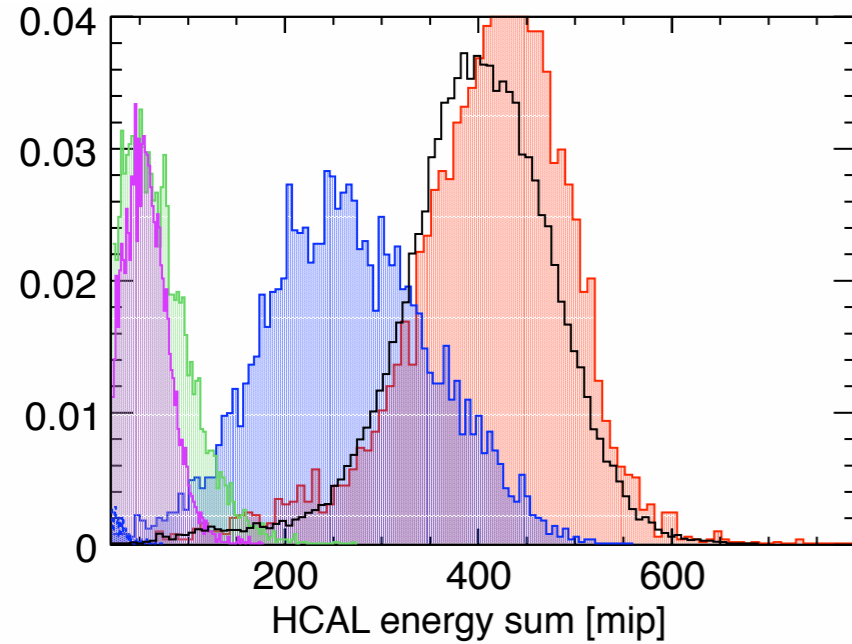
ahcal/ahcal\_eSum, run 330330, 12 GeV



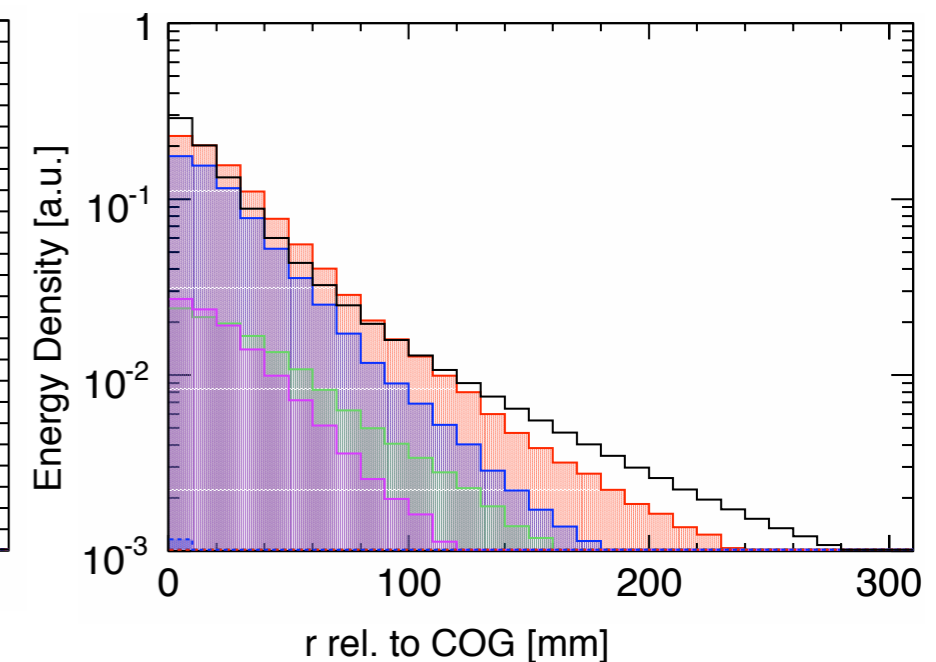
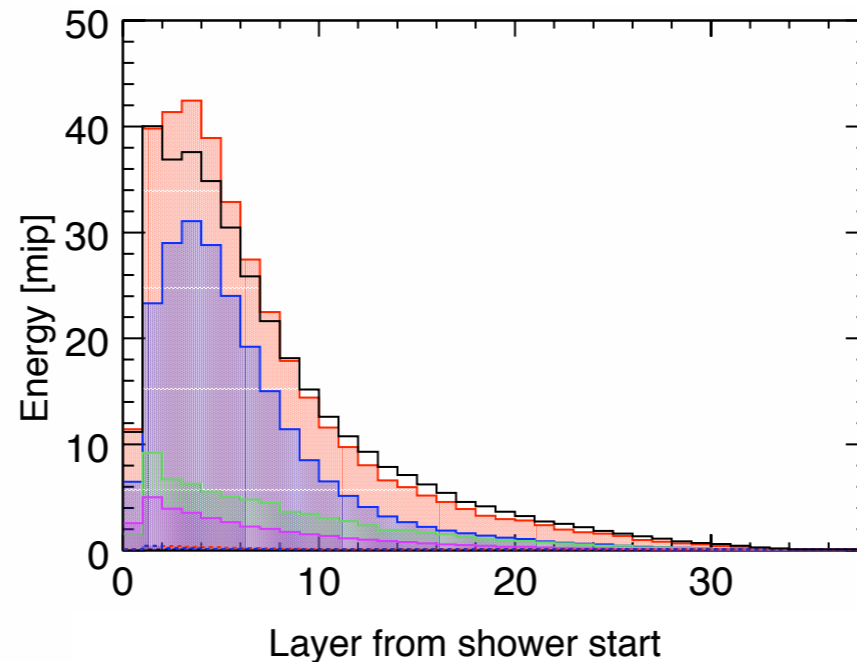
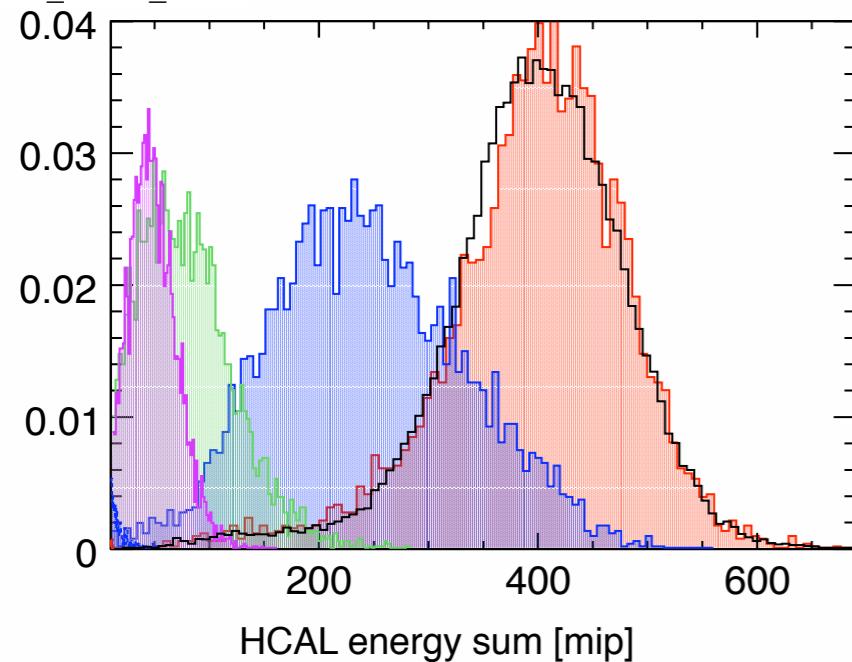
Longitudinal Profile

Transverse Profile

FTF\_BIC



FTFP\_BERT\_TRV





# FTF\_BIC vs FTFP\_BERT\_TRV

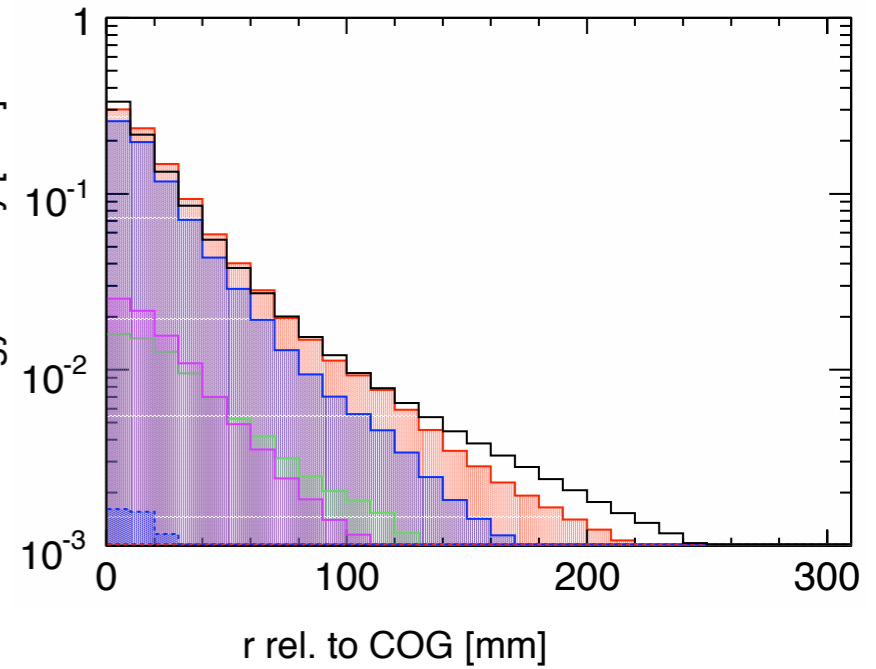
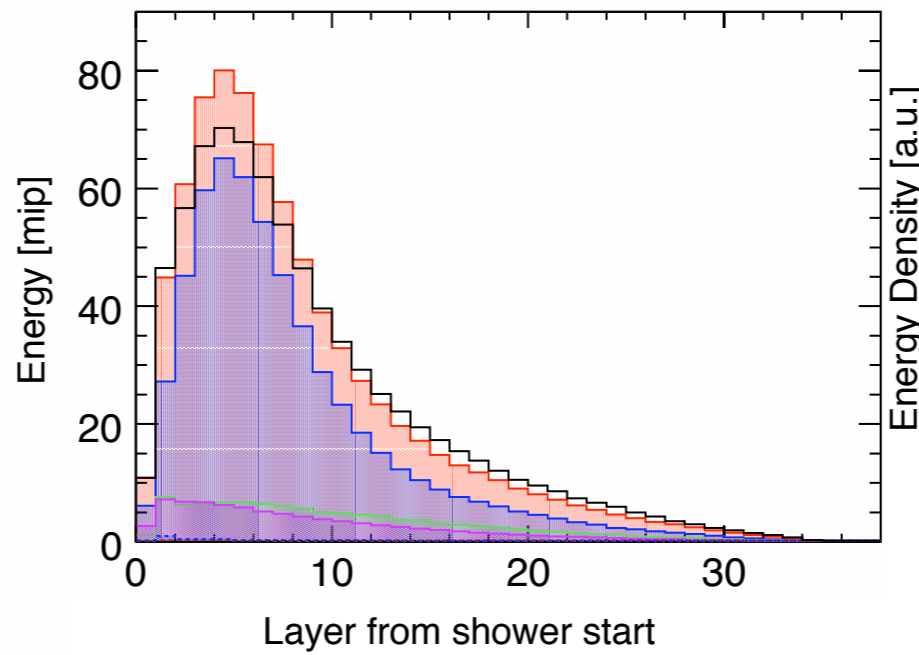
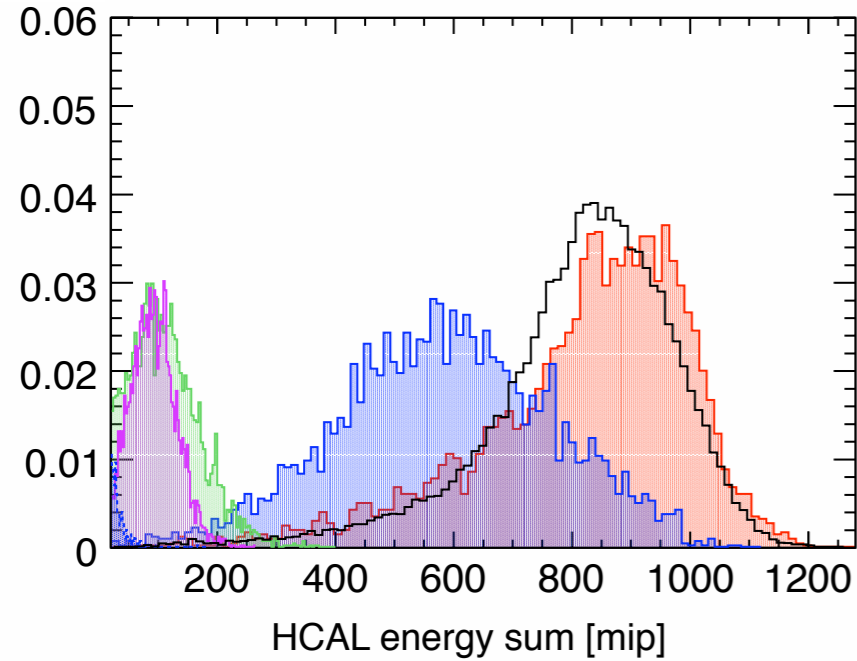
ahcal/ahcal\_eSum, run 330325, 25 GeV



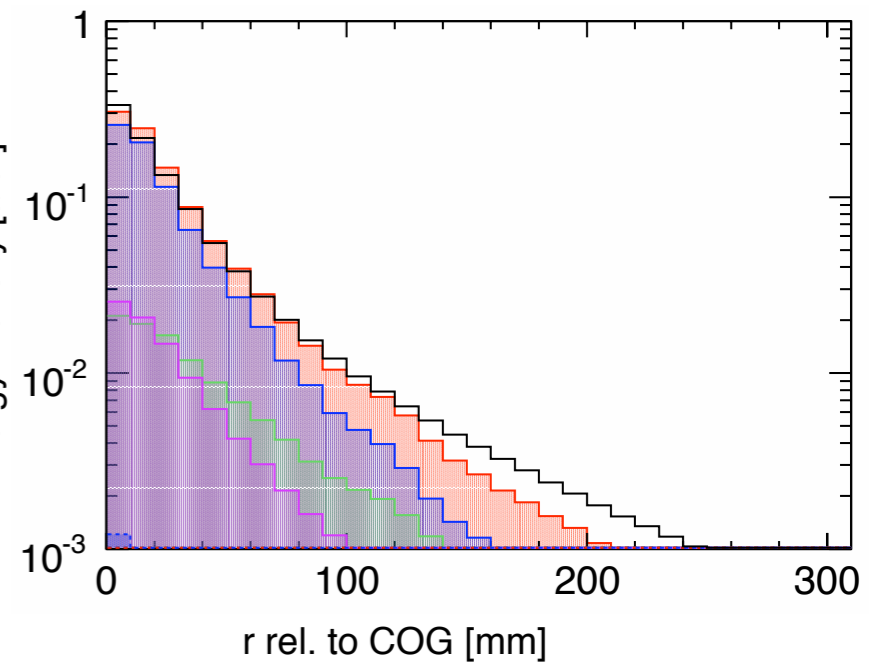
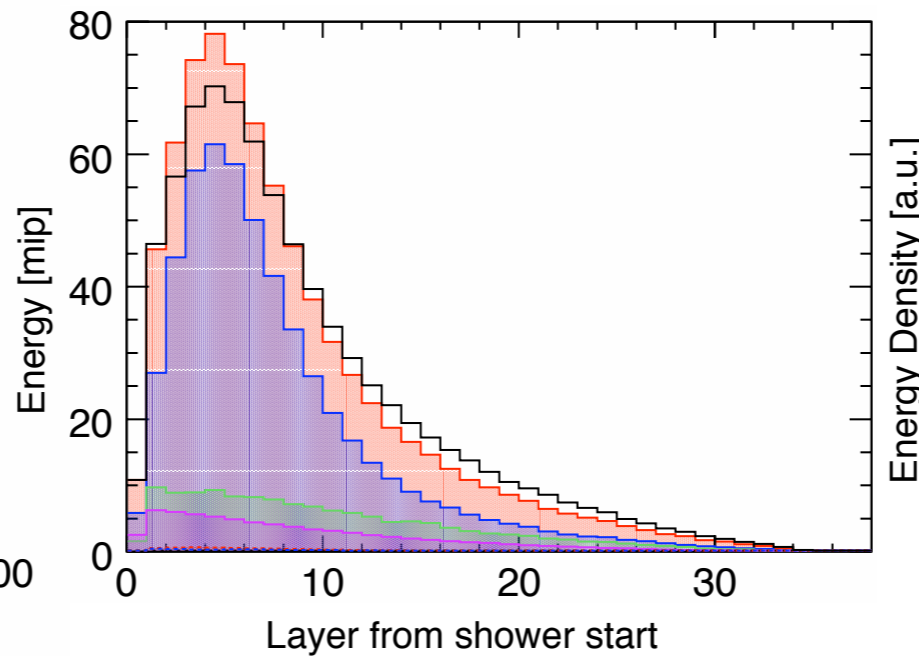
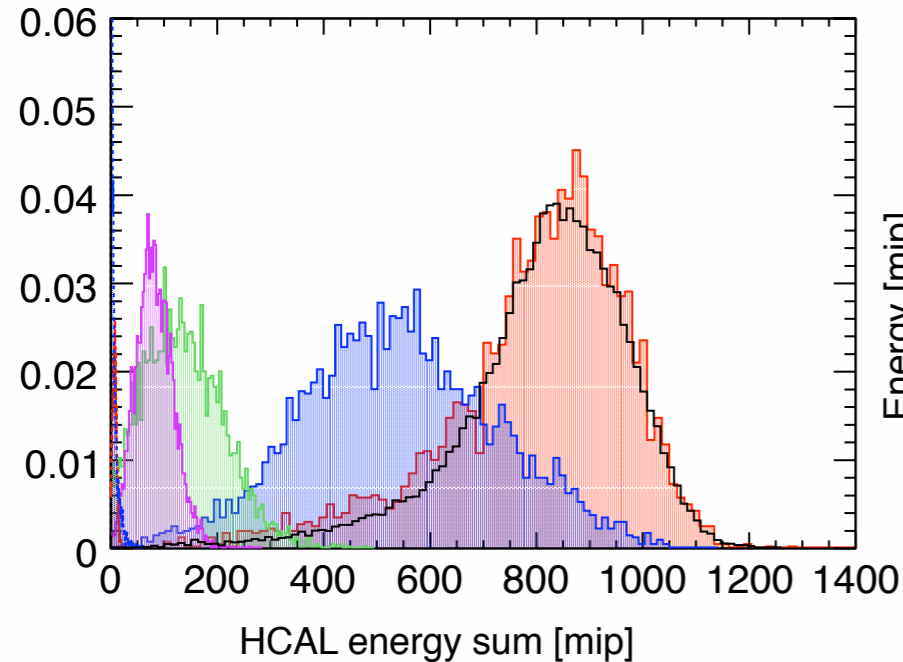
Longitudinal Profile

Transverse Profile

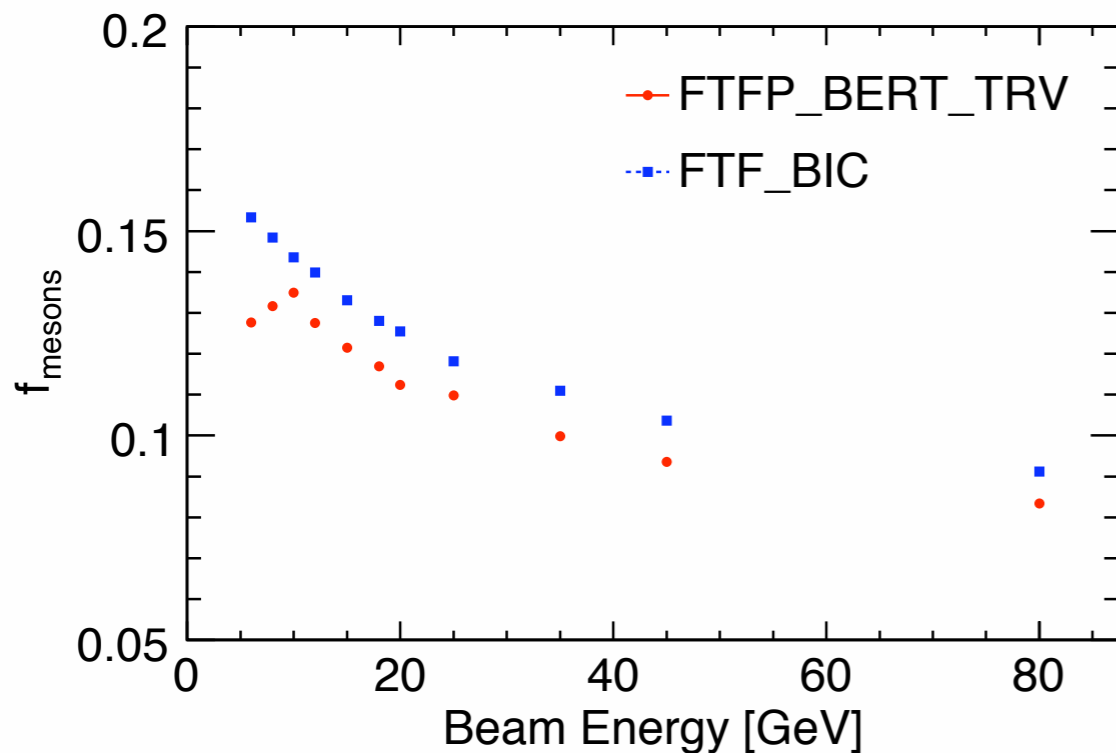
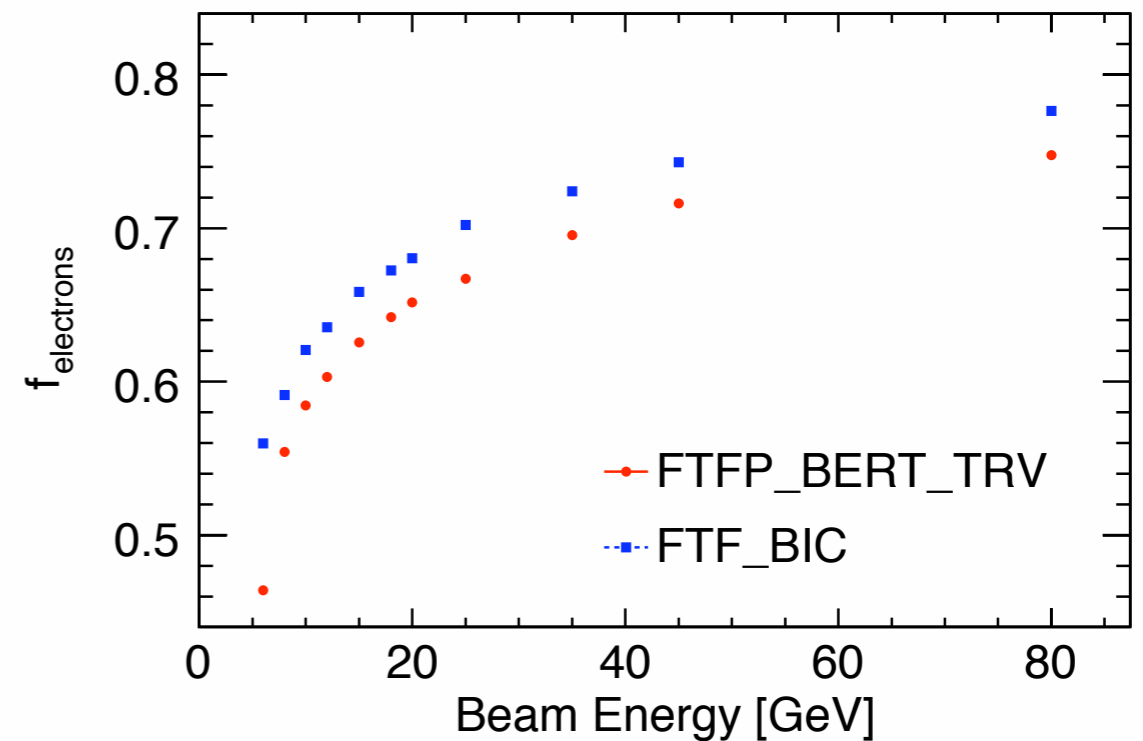
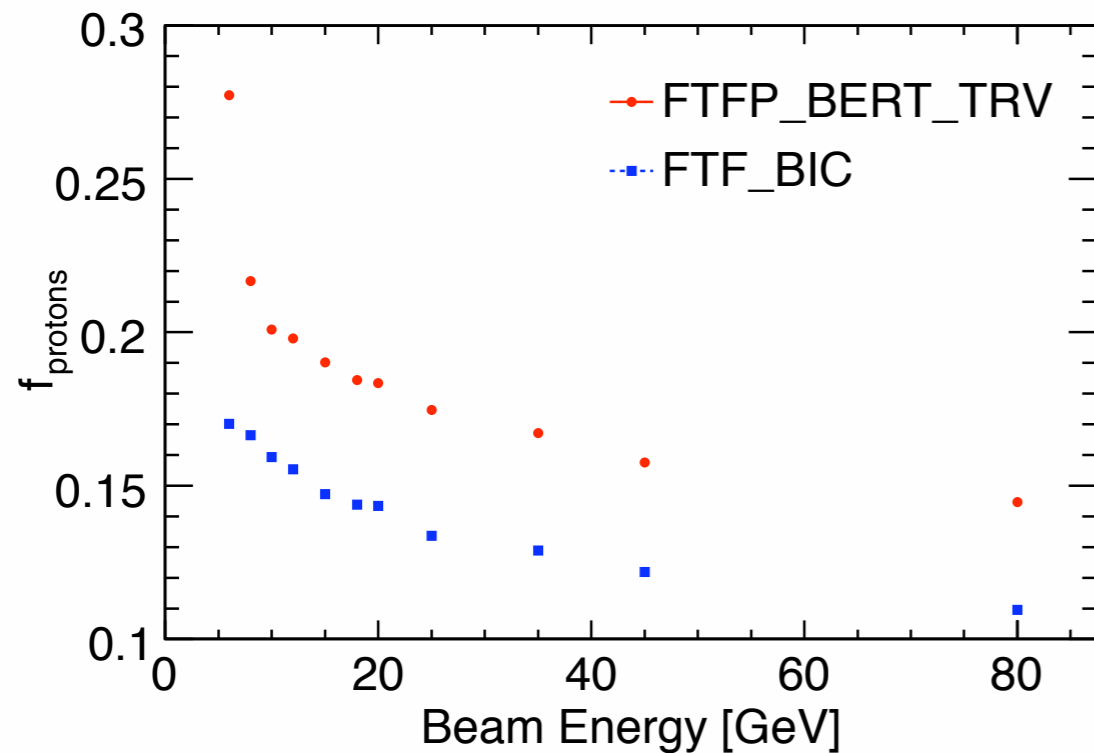
FTF\_BIC



FTFP\_BERT\_TRV



# Energy Fraction for FTF models



- FTF\_BIC produces less protons and more electrons/mesons compared to FTFP\_BERT\_TRV
- Strange kink in meson fraction for energy below 10 GeV

# Summary / Outlook

- Comparison of energy sum, longitudinal profiles (from shower start) and transverse profiles (rel. to COG) QGSP\_BERT to QGSP\_FTFP\_BERT and FTF\_BIC to FTFP\_BERT for 6, 12 and 25 GeV
- Comparison of electron, proton and meson fraction as a function for energies from 6 to 80 GeV
- Outlook:
  - investigate more models, e.g. CHIPS models in beta
  - compare MC component fractions to Deep Analysis clustering algorithm
  - look for upper limit in offline composition by using MC fractions (how well can we theoretically do?)