# Pion Showers in the HCAL Alexander Kaplan, Universität Heidelberg / DESY FLC



### **Physics Lists**

### Mokka 7-00 / GEANT4-9.3 (final)



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

QGSC\_BERT



Energy [GeV]

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# QGSP\_BERT vs. QGSP\_FTFP\_BERT



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# QGSP\_BERT vs. QGSP\_FTFP\_BERT



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# QGSP\_BERT vs. QGSP\_FTFP\_BERT

all electrons ----- protons 开 mesons ahcal/ahcal\_eSum, run 330325, 25 GeV -⊙- gammas ---- neutrals -A- rest 🔶 DATA Longitundinal Profile **Transverse** Profile **QGSP BERT** 0.06 80 0.05 Energy Density [a.u.] 60 Energy [mip] 66 0.04 10 0.03 10<sup>-2</sup> 0.02 20 0.01 00 10<sup>-3</sup> 0 600 800 1000 1200 10 20 30 100 200 300 200 400 0 r rel. to COG [mm] HCAL energy sum [mip] Layer from shower start **QGSP FTFP BERT** 0.06 80 0.05 60 Energy Density [a.u.] 0.04 10<sup>-1</sup> Energy [mip] 50 0.03 0.02 10<sup>-2</sup> 0.01 10<sup>-3</sup> 00 00 200 400 600 800 1000 1200 0 200 100 300 20 10 30 HCAL energy sum [mip] Layer from shower start r rel. to COG [mm]

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# **Energy Fractions**





- felectrons grows with energy, fprotons and fmesons 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



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# FTF\_BIC vs FTFP\_BERT\_TRV

🔶 all electrons mesons ahcal/ahcal\_eSum, run 330330, 12 GeV -⊙- gammas -A- rest → DATA Longitundinal Profile **Transverse** Profile FTF\_BIC 50 0.04 Energy Density [a.u.] 40 0.03 Energy [mip] 05 05 10 0.02 10<sup>-2</sup> 0.01 10 00 10<sup>-3</sup> 0 200 400 600 10 20 30 100 200 300 0 r rel. to COG [mm] HCAL energy sum [mip] Layer from shower start FTFP BERT TRV 0.04 50 40 0.03 Energy Density [a.u.] 10<sup>-1</sup> 00 [mip] 20 20 0.02 10<sup>-2</sup> 0.01 10 00 10<sup>-3</sup> 0 20 30 200 400 600 10 100 200 300 0 r rel. to COG [mm] Layer from shower start HCAL energy sum [mip]

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# FTF\_BIC vs FTFP\_BERT\_TRV

ahcal/ahcal\_eSum, run 330325, 25 GeV

← all -⊙- gammas -<u>→</u> protons -A - rest

electrons

---- neutrals

-<del>▼-</del> mesons -<del>◆-</del> DATA



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# 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 (form 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?)