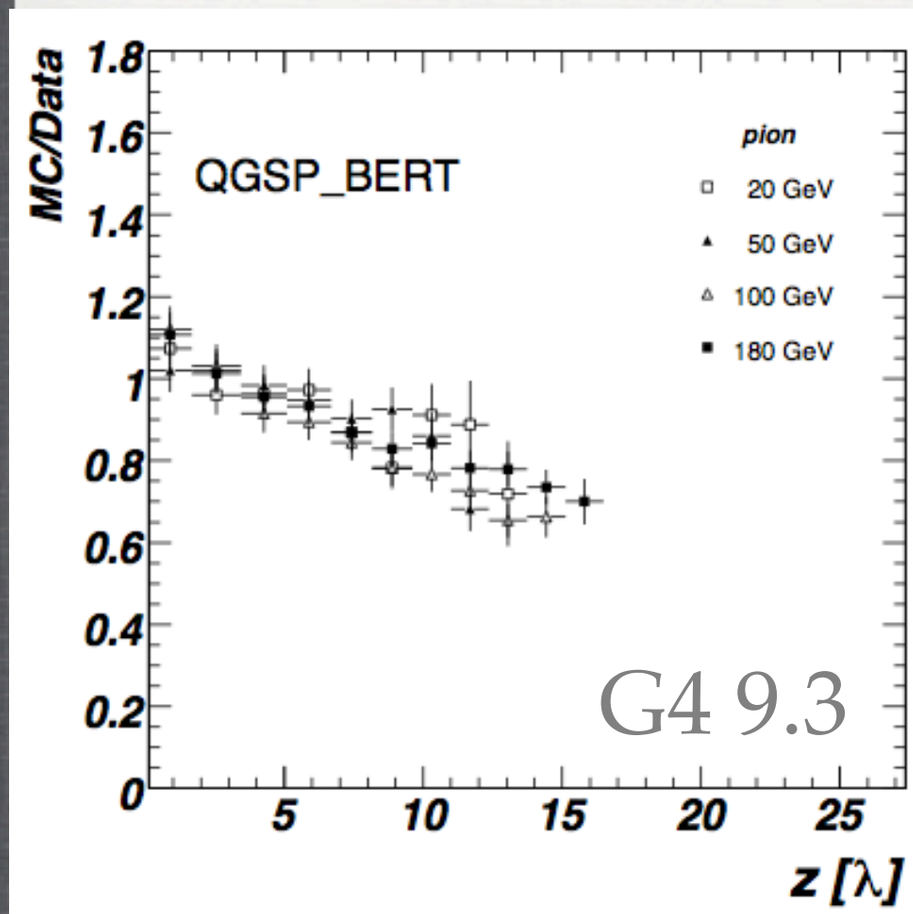
Selected results from LHC and CALICE calorimeters: Shower Shapes

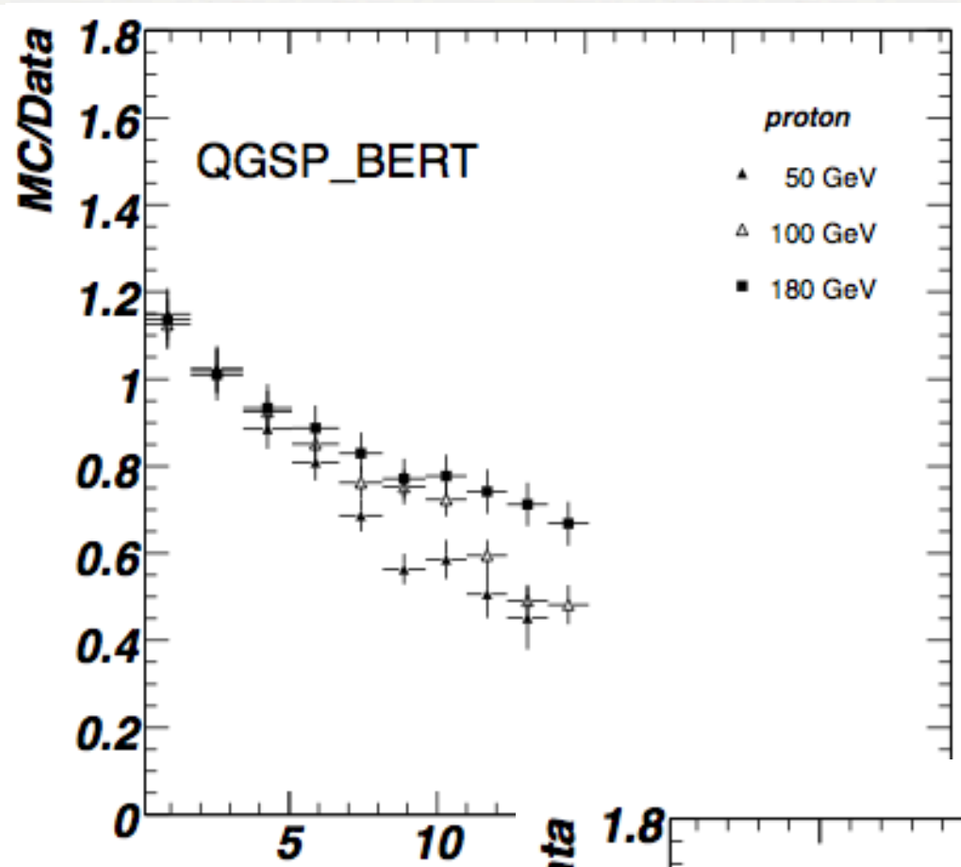
Parallel 6-A: Transition region/shower shape

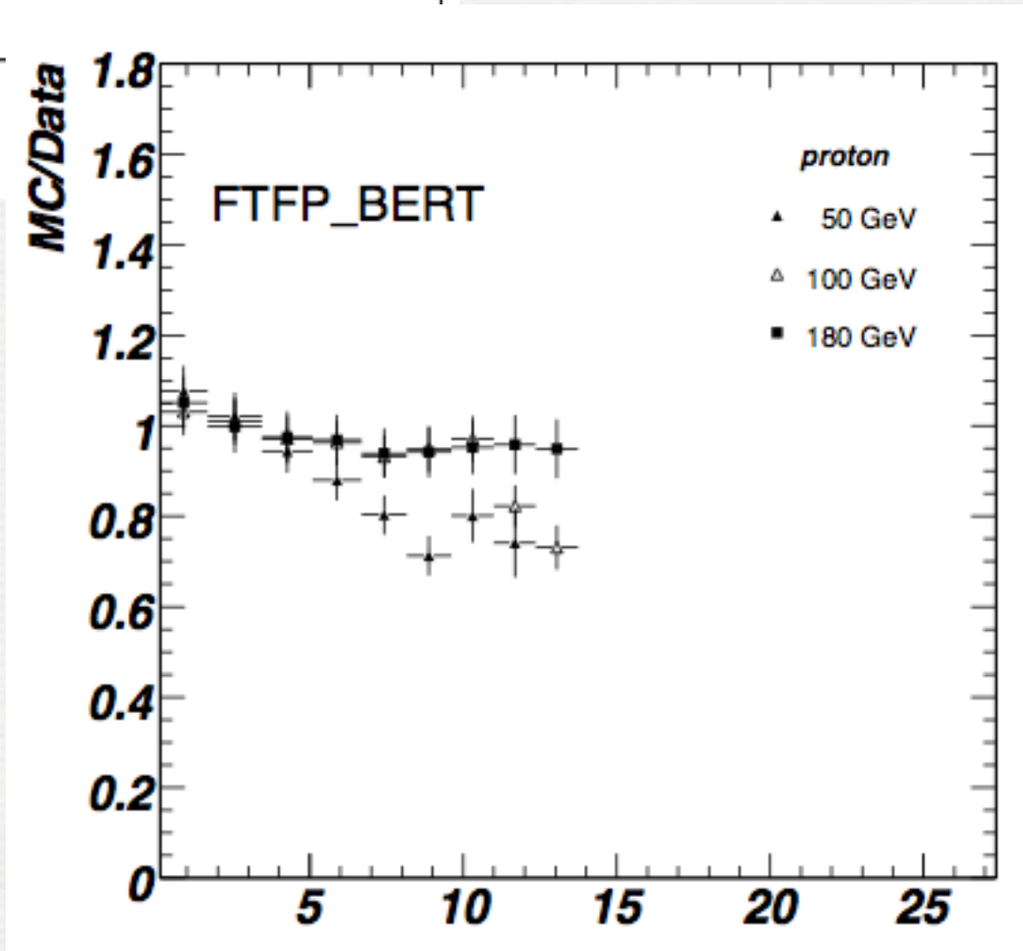
A. Dotti

LONGITUDINAL

ATLAS: Fe/Sci TileCal







Showers are too short, protons are worse.

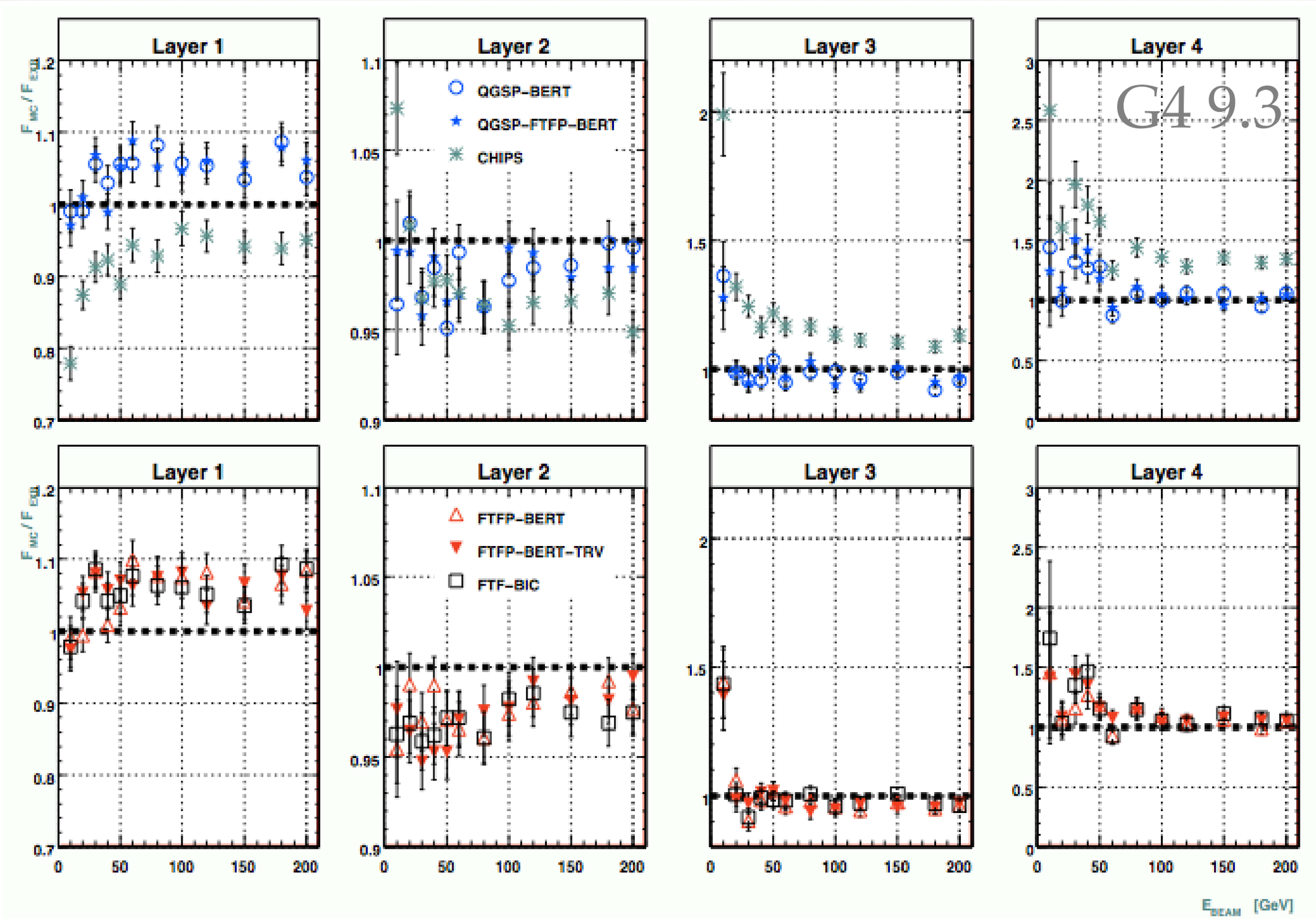
No changes with QGSP_FTFP_BERT

FTFP_BERT is a bit better from protons at high energy (role of diffraction?)

GOOD: full containment

BAD: only high E, very rough granularity (20cm)

ATLAS: Cu/LAr HEC



GOOD: full containment

BAD: little segmenttion only 4 layers (1.5:2.9:3.0:2.8)

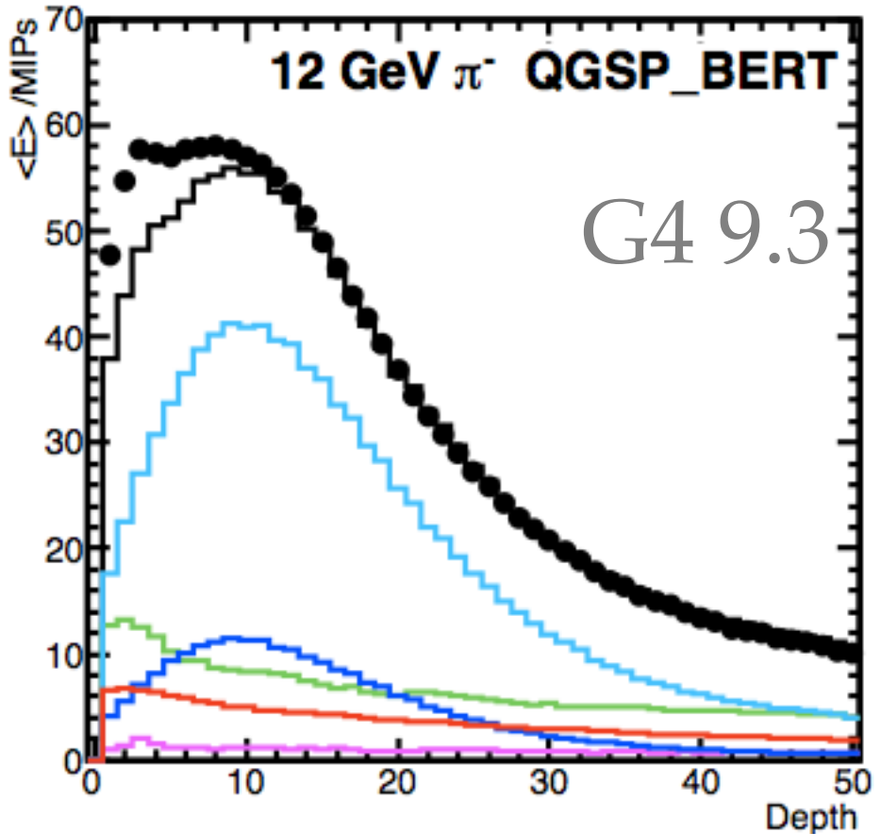
Too much energy in first sample

No big differences QGS/FTF

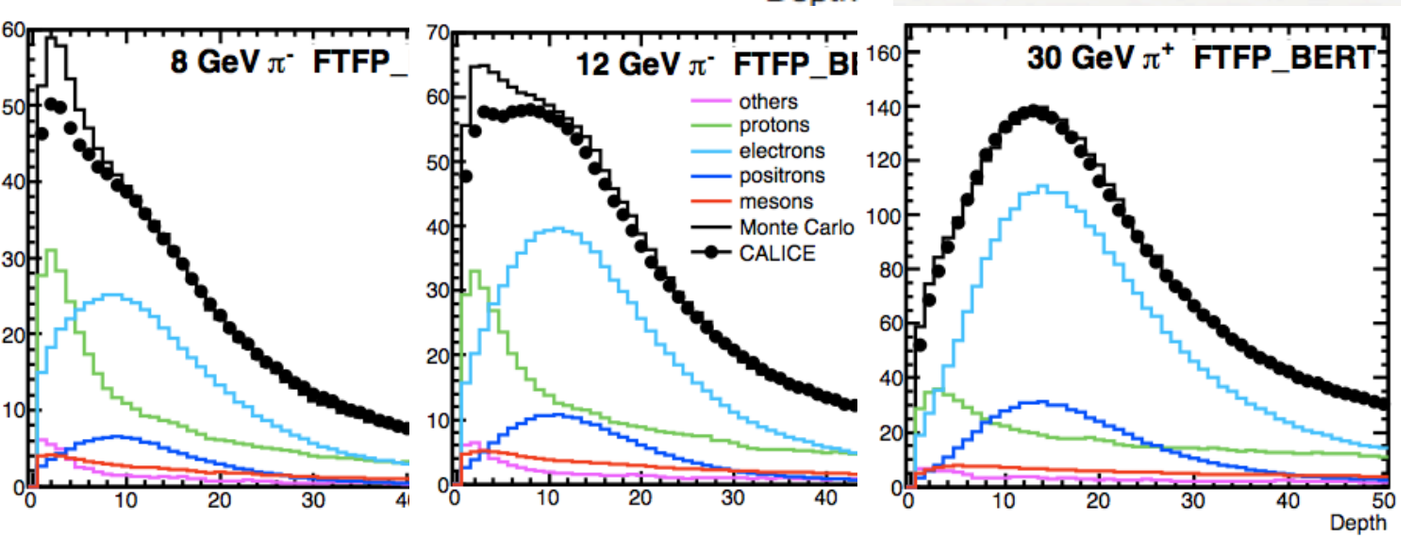
CHIPS is the opposite (also for Tile).

No significant differences 9.2 Vs 9.3

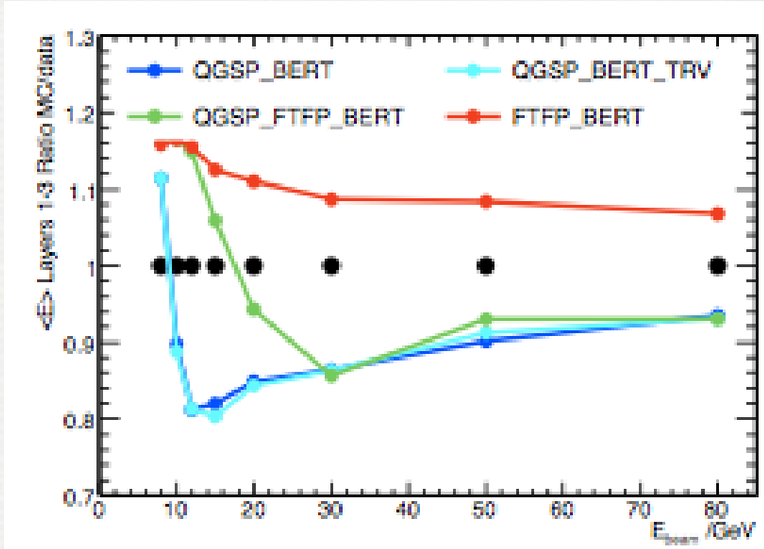
CALICE: Si-W ECAL



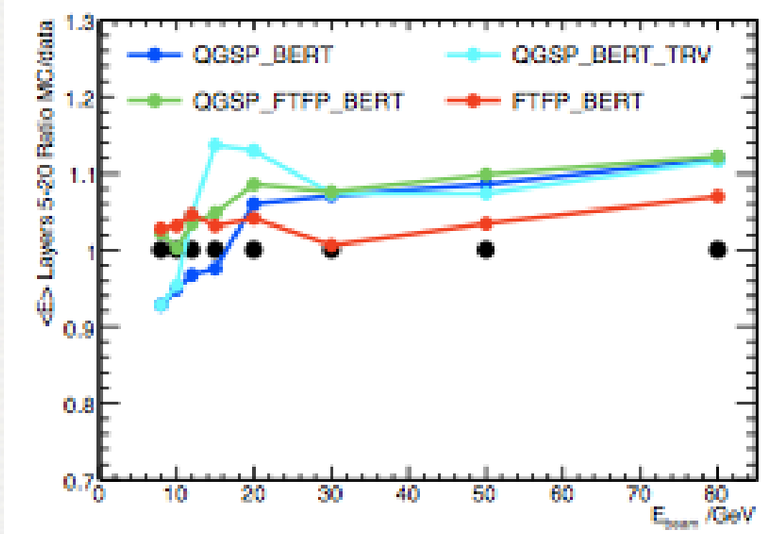
FTFP_BERT relatively good at high energy for "bulk", too much penetrating hadrons. First interaction QGSP_BERT: low for QGS, BERT high



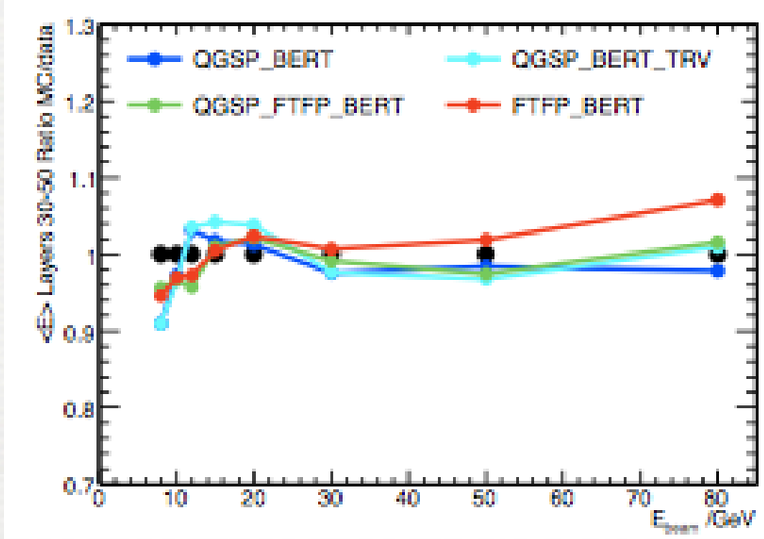
First interaction region



"bulk" region



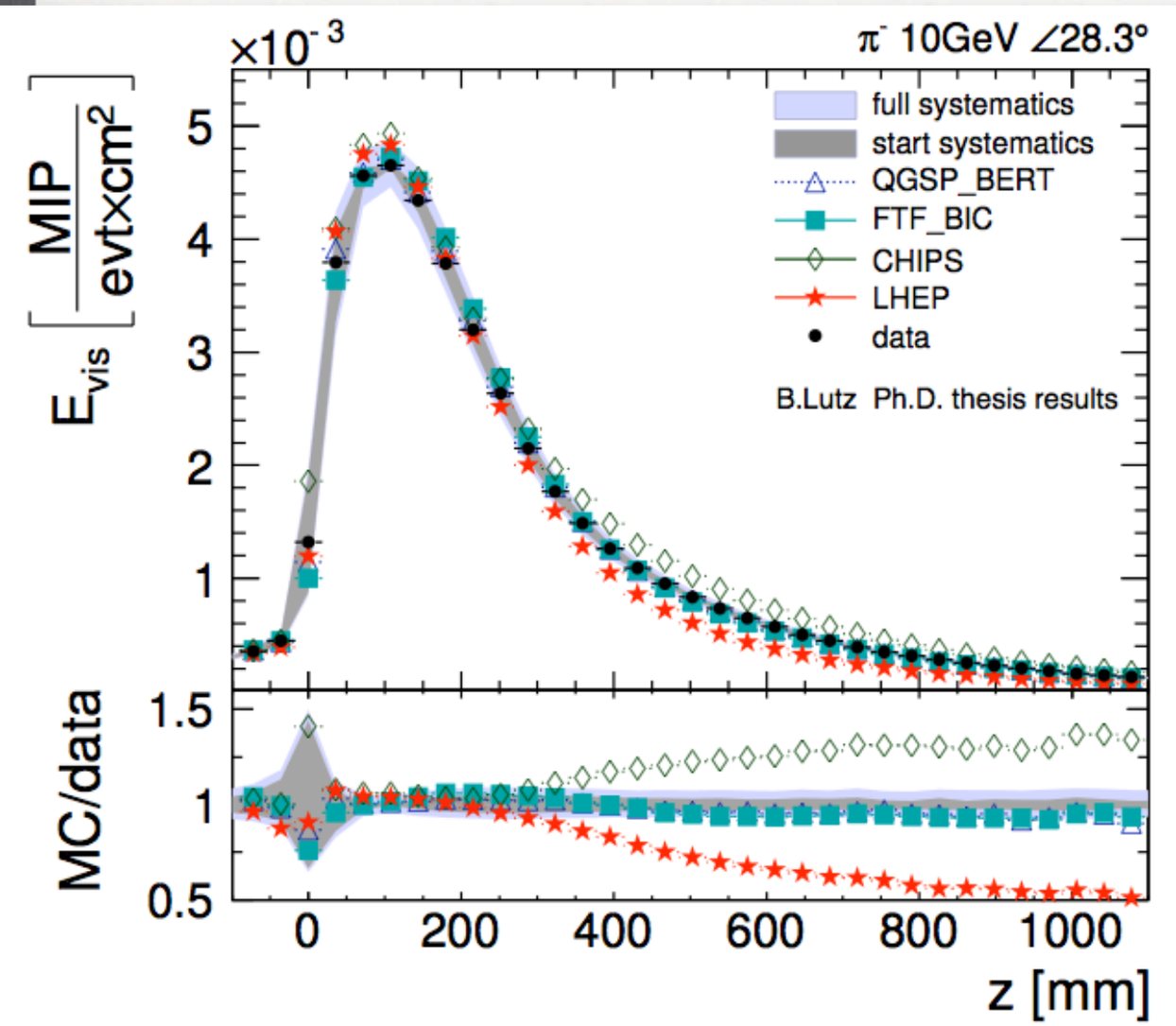
"tail" penetrating hardons

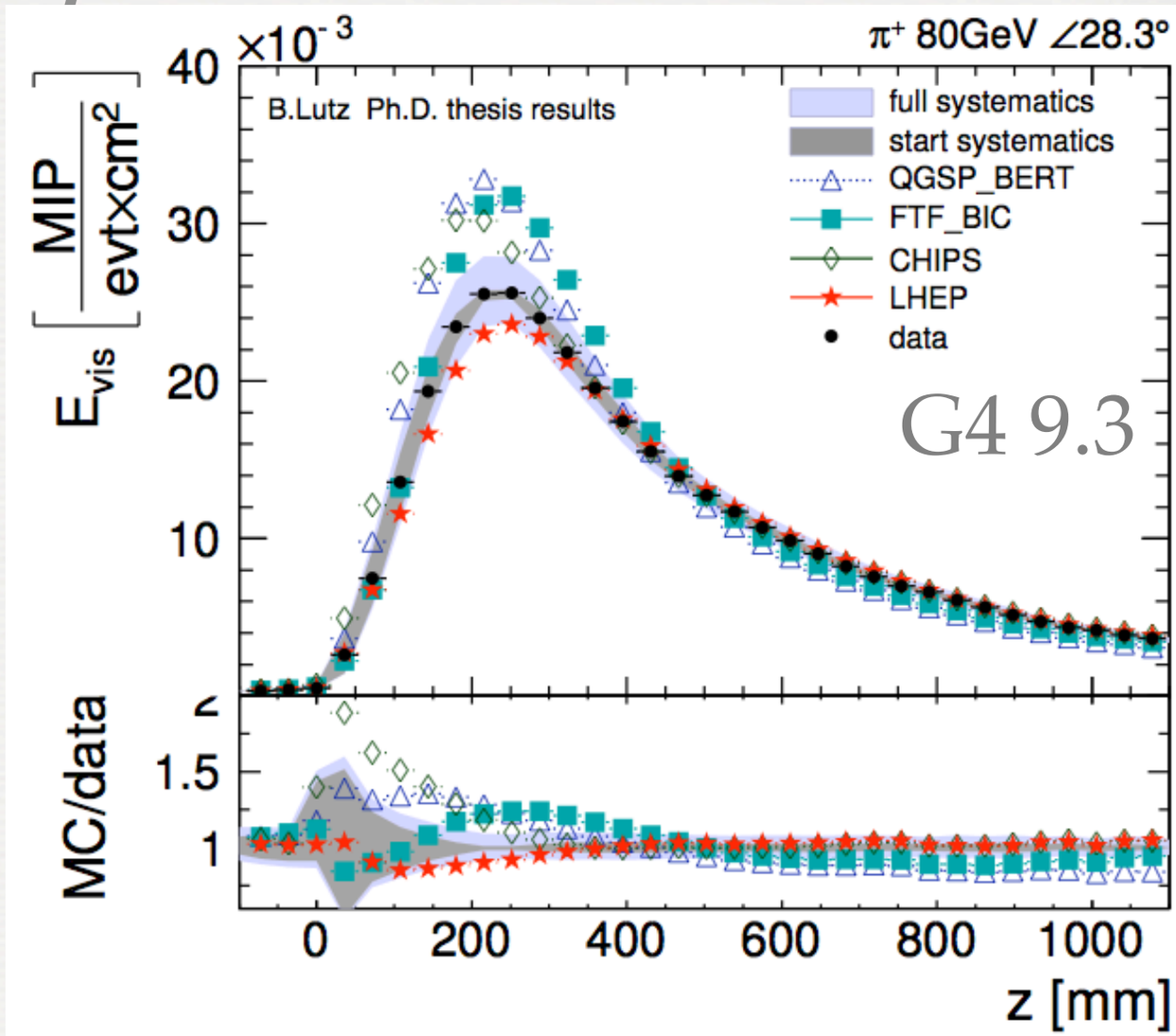


GOOD: very high granularity, identify start of shower, different contributions, lower energies

BAD: very short (0.8λ) calorimeter

CALICE: Sci/Fe AHCAL





Better w.r.t. TileCal results

Main difference in the "bulk" energy (FTFP_BERT missing)

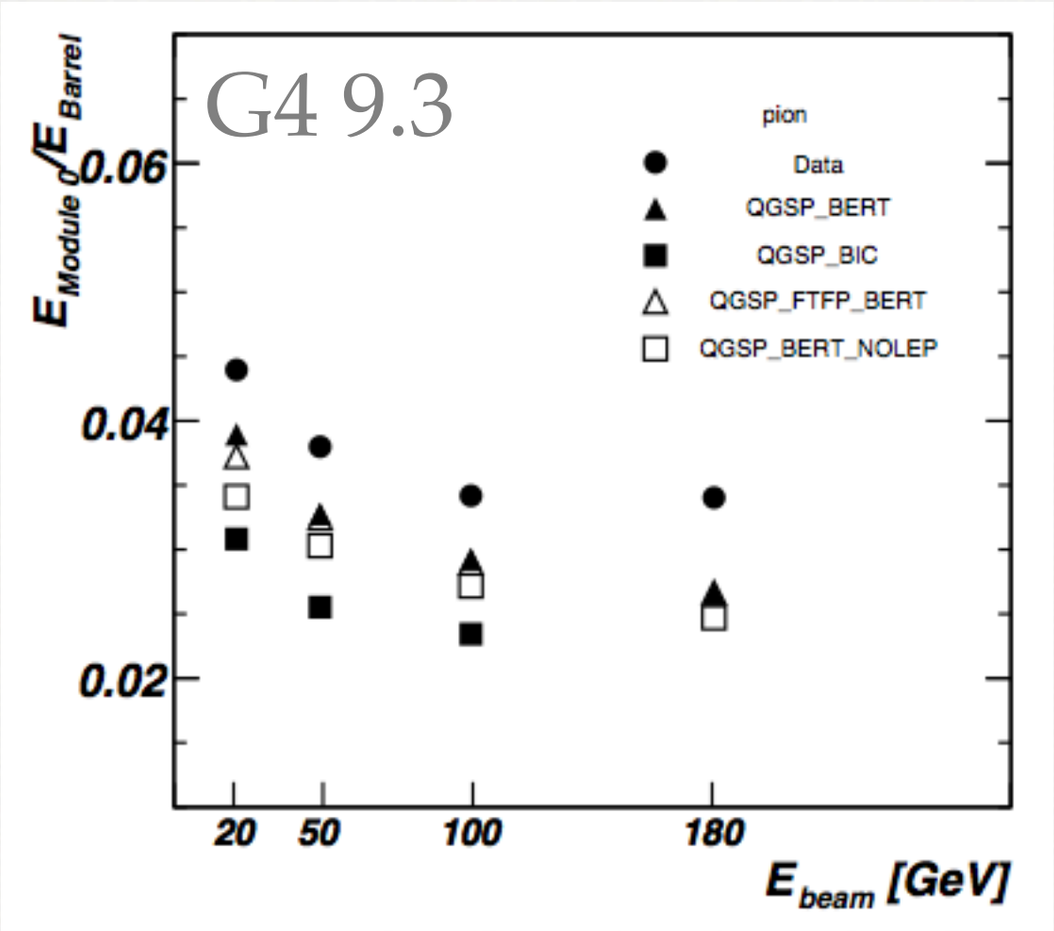
Better description at low energies, need tuning of FTF quasi-elastic , diffraction?

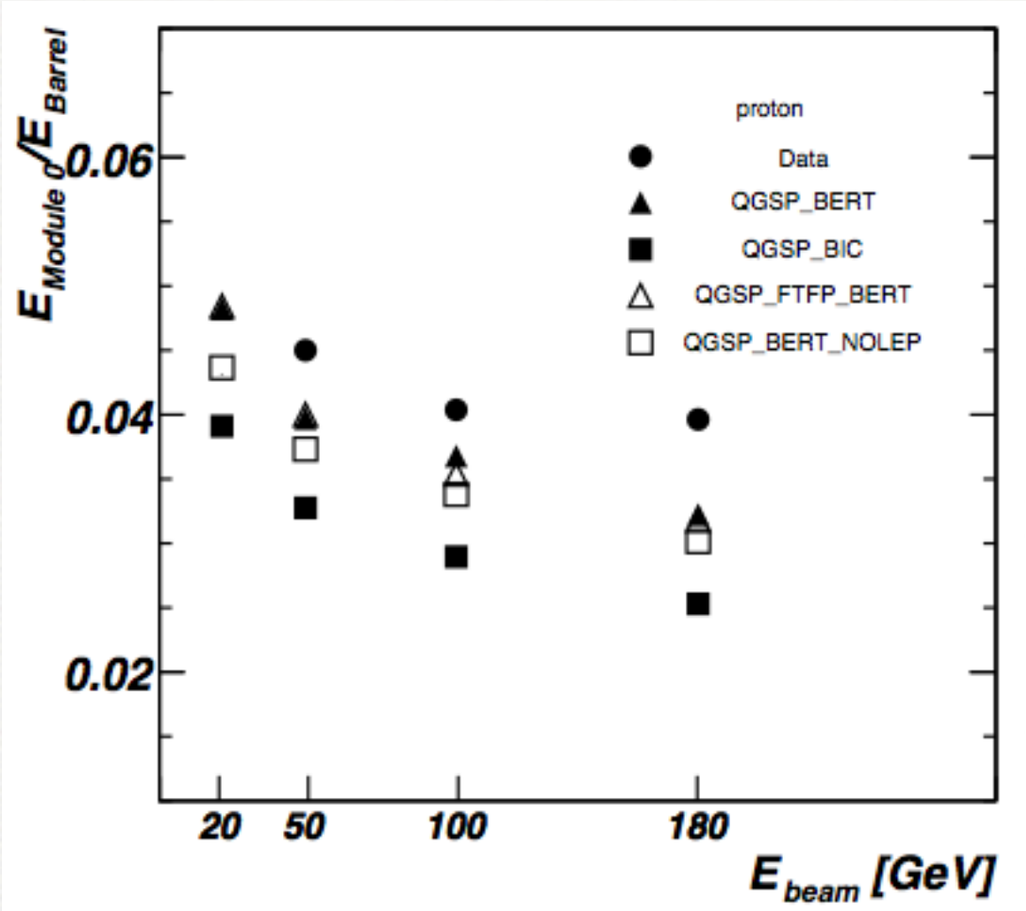
GOOD: very high granularity, identify start of shower

BAD: short (5.3λ) calorimeter

LATERAL

ATLAS: Fe/Sci TileCal





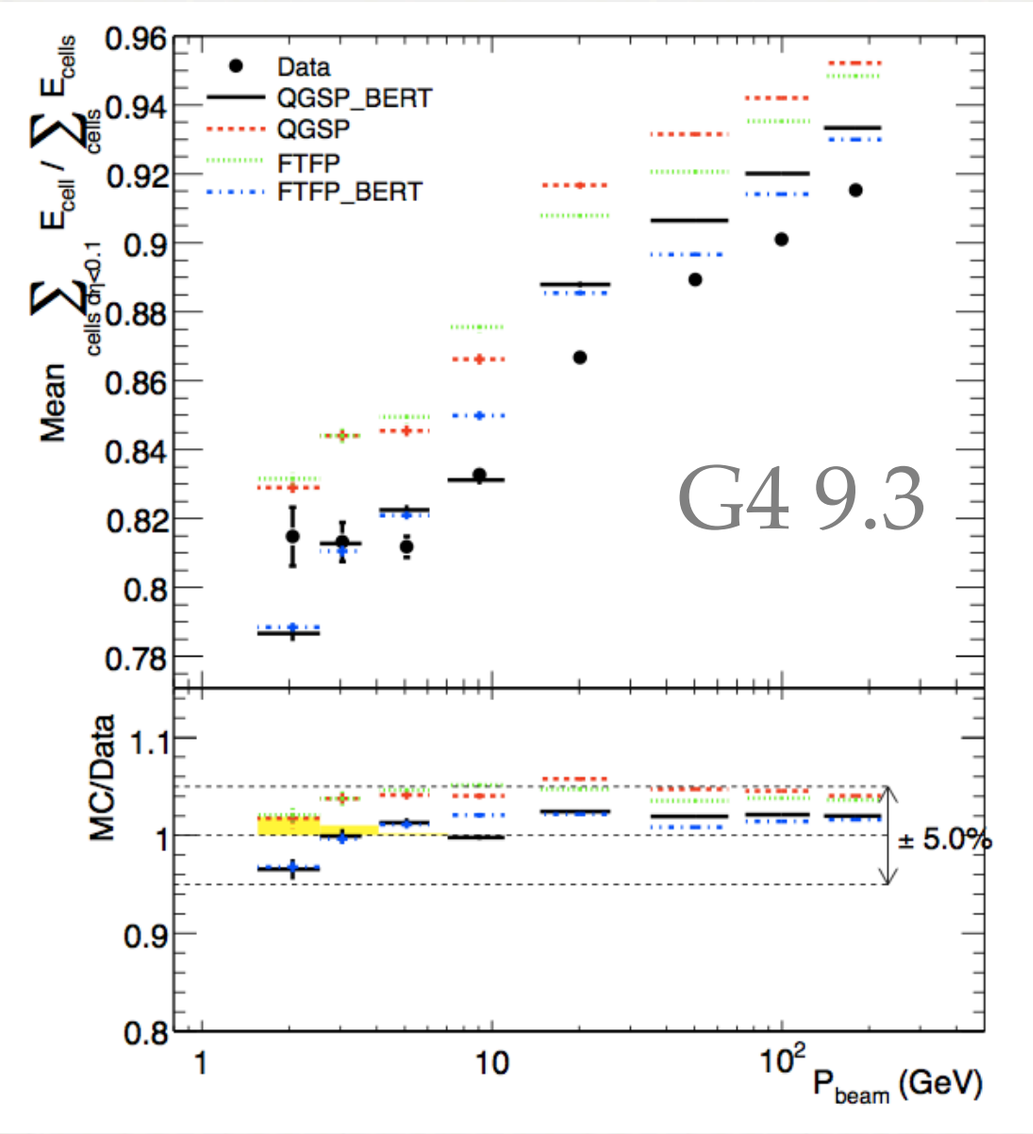
Showers too compact

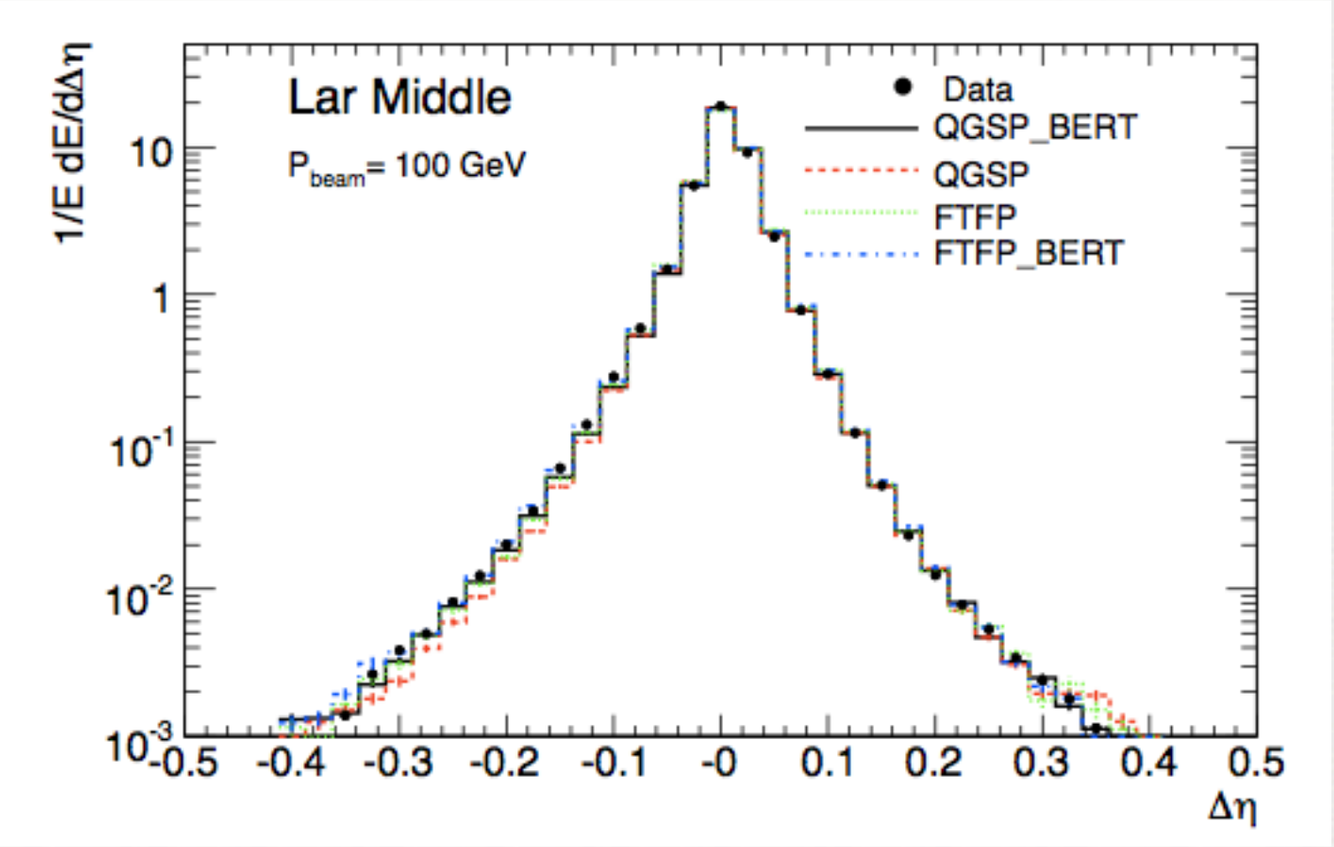
Not so much can be said

GOOD: full (long.) containment

BAD: only high E, very rough granularity (20cm)

ATLAS: Combined Pb/LAr ECAL+ Fe/Sci TileCal



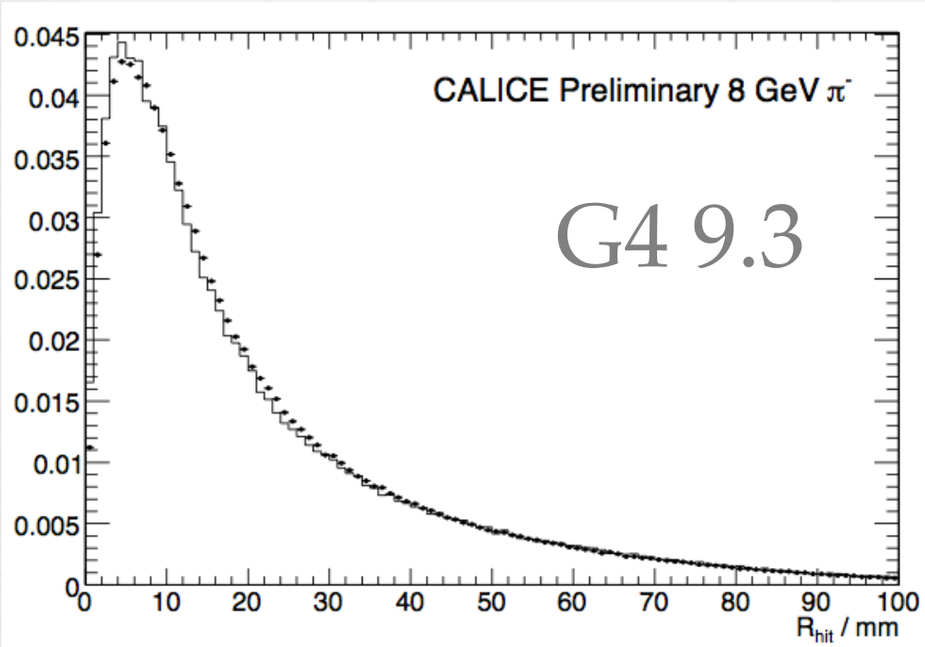


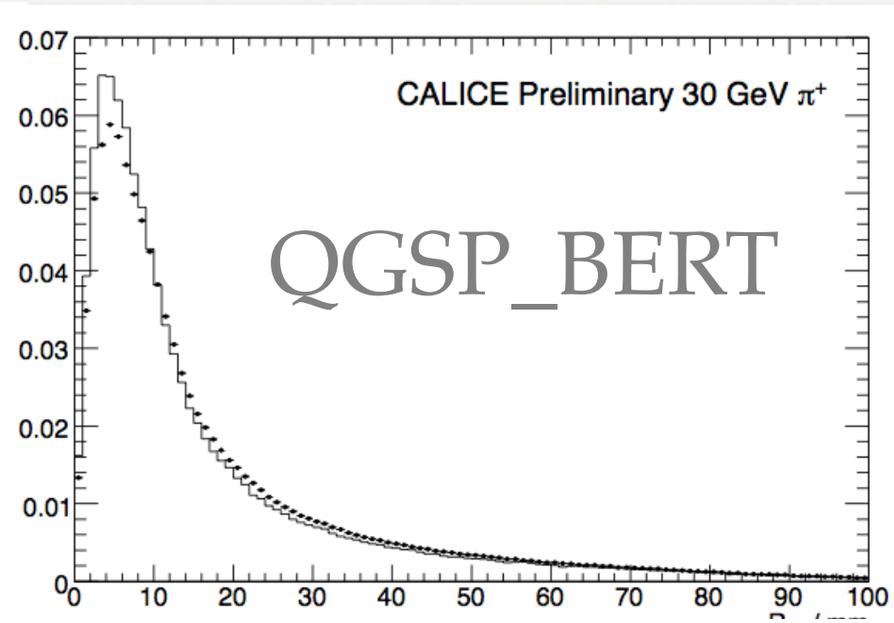
Showers too compact, however agreement is better than Tile alone

GOOD: full (long.) containment
BAD: different technologies with different granularities

Bertini, increase energy in "halo"

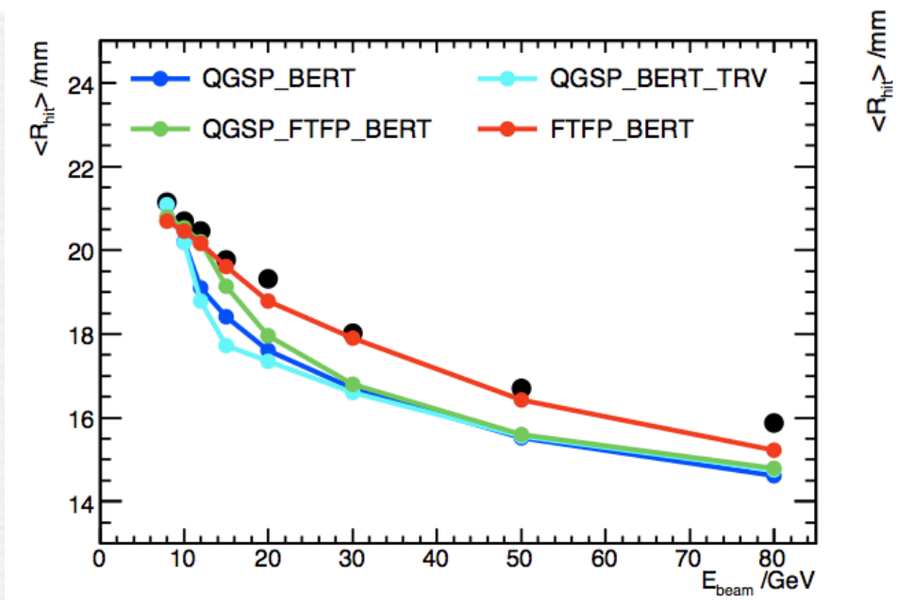
CALICE: Si-W ECAL

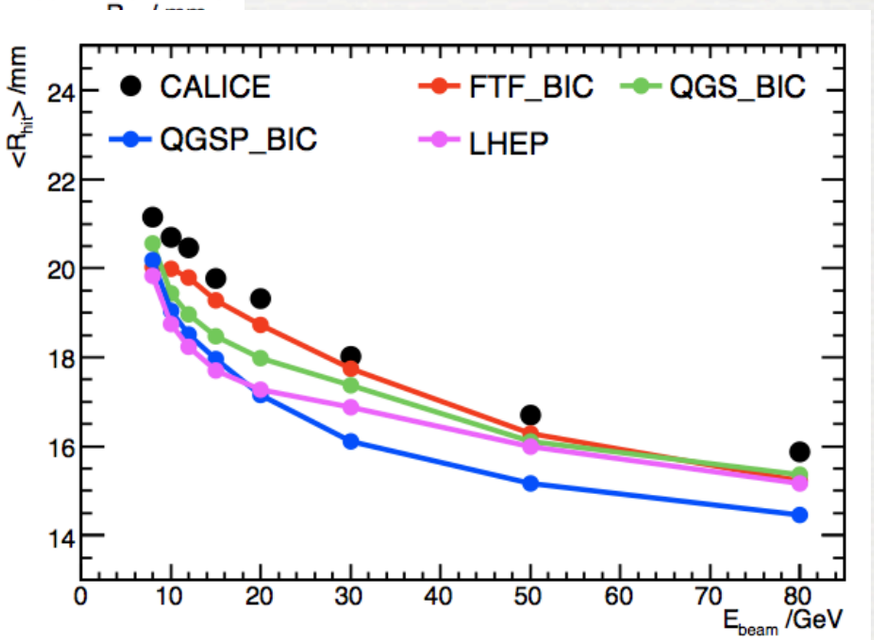




Lower energy distributions seems better described (BERT)

FTF clearly increase quality of simulation. Difficult to disentangle QGS or parametrized in QGSP_BERT (many interactions at medium energy)

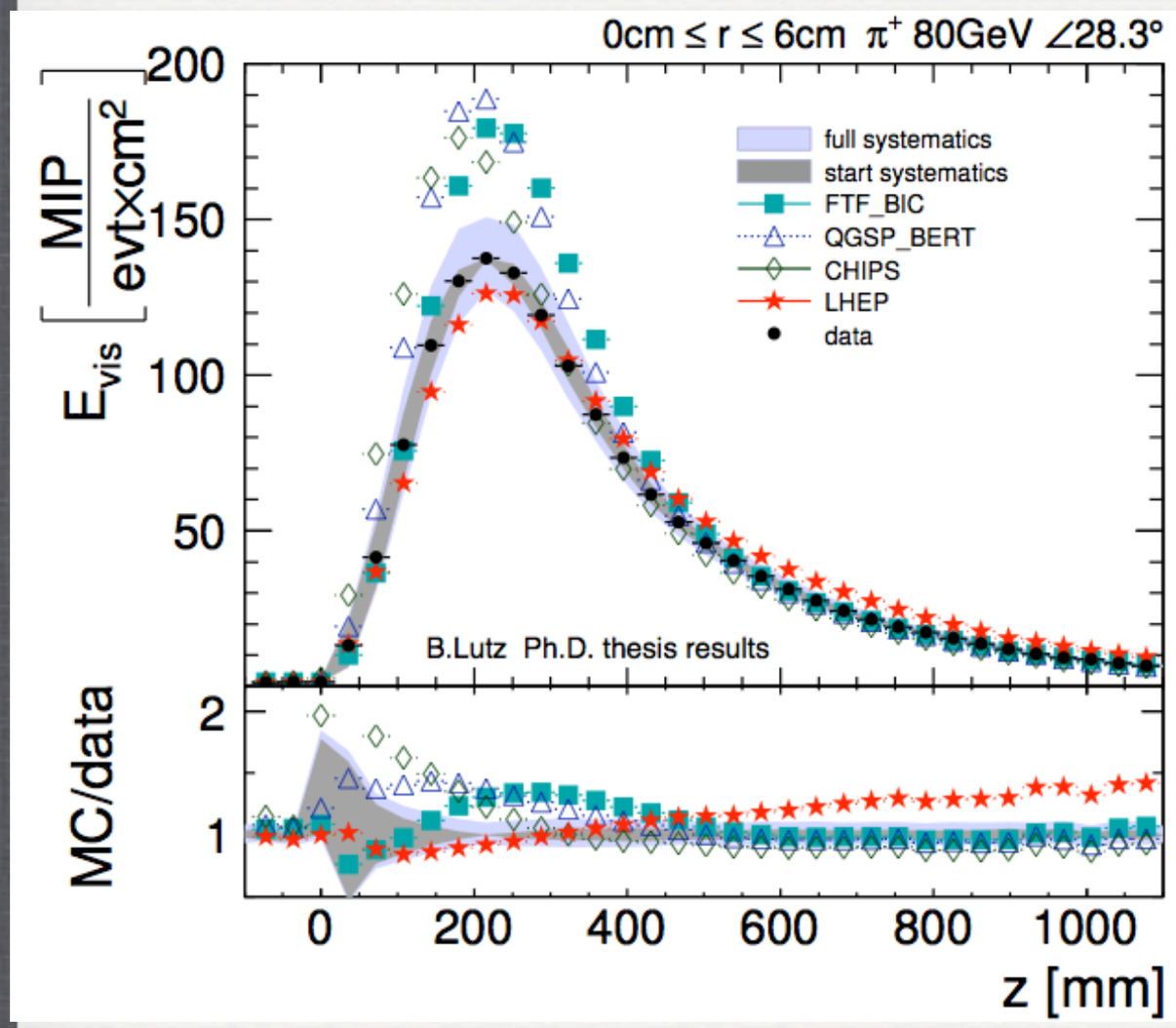


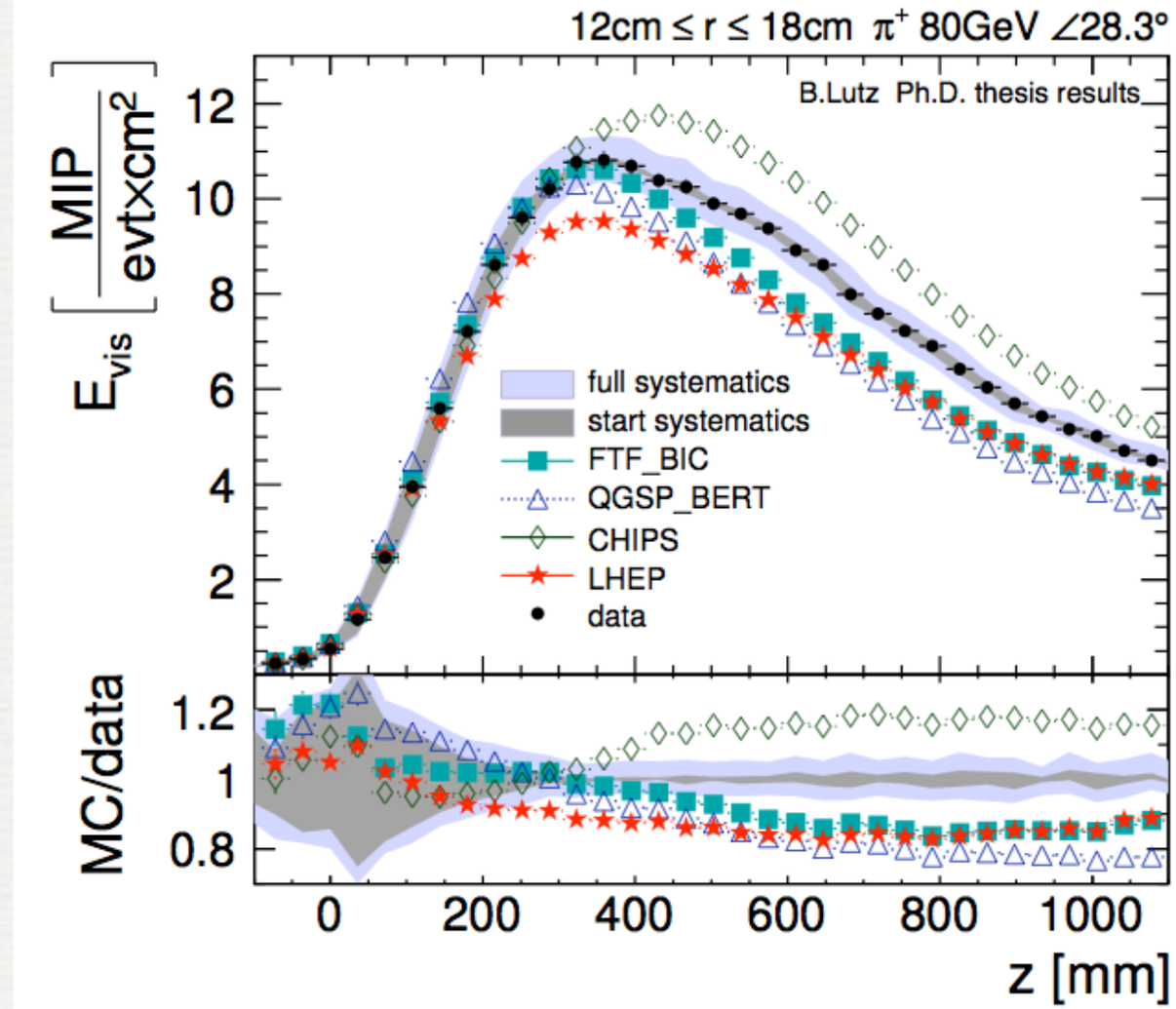


GOOD: very high granularity, lower energies

BAD: very short (0.8λ) calorimeter

CALICE: Sci/Fe AHCAL





Longitudinal profile, but seen in radial "core" and "halo"

Disagrement is in the "penetrating" hadrons region

GOOD: very high granularity
BAD: short (5.3λ) calorimeter

Conclusions

- We should:
  - Use more and more CALICE data, use LHC to confirm (since full containment)
  - Also for shapes FTFP_BERT seems a bit better
  - Need further tuning of high-energy (E>10GeV): quasi-elastic, diffraction?
  - Well established: importance of cascade (BERT) for lateral shower. Focus on large-angle scattering validation with thing target data to improve
  - Additional complication in QGSP_BERT: when description is not perfect is a QGS limitation or is it due to the (many) LHEP interactions? If we believe the statement that LHEP is relatively good for shower shape than we need to look at QGS