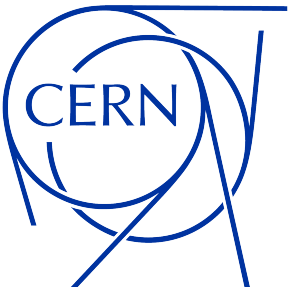


Regression testing and physics list comparison with ATLHECTB

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Simulation bi-weekly meeting
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Geant4 validation using ATLAS HEC beam tests

The project aims to validate **Geant4** using the **ATLAS Hadronic End-cap Calorimeter (HEC)** test-beam data.

Three **main tasks** identified:

◆ Porting the official ATLAS HEC simulation into a **new standalone Geant4 simulation**.

❖ Completed in June 2021, presented at this meeting [[presentation](#)].



◆ Perform **Geant4 validation** against ATLAS HEC test-beam data.

❖ First results presented in July 2021 at this meeting [[presentation](#)],

❖ and at the ATLAS Simulation Group Meeting [[presentation](#)].



◆ Porting the application into the **Geant Val testing suite**.

❖ Presented in October 2021 at this meeting [[presentation](#)].



◆ Perform **regression testing** and **physics list comparison**.

❖ Today's topic, reporting on hadronic energy response and resolution.



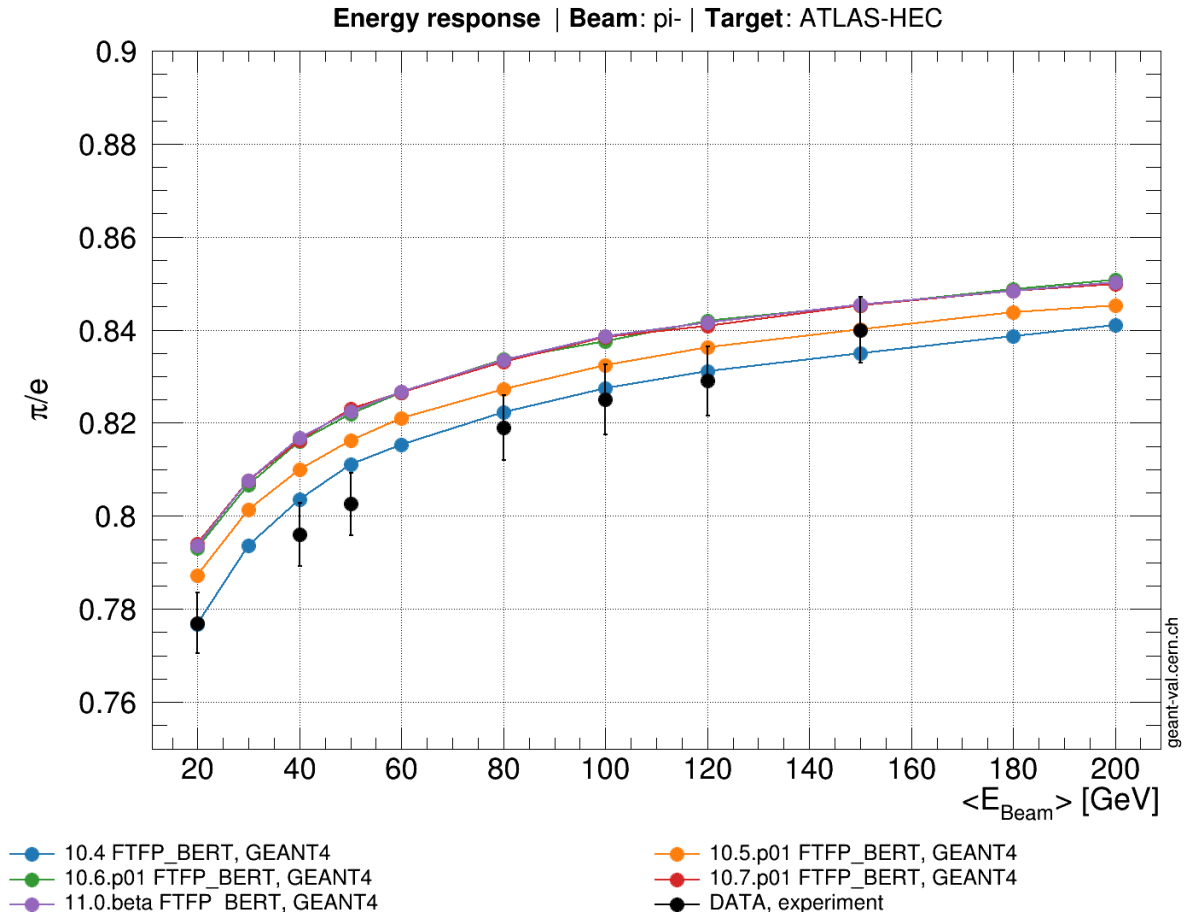
Relative response to pions

(π/e)



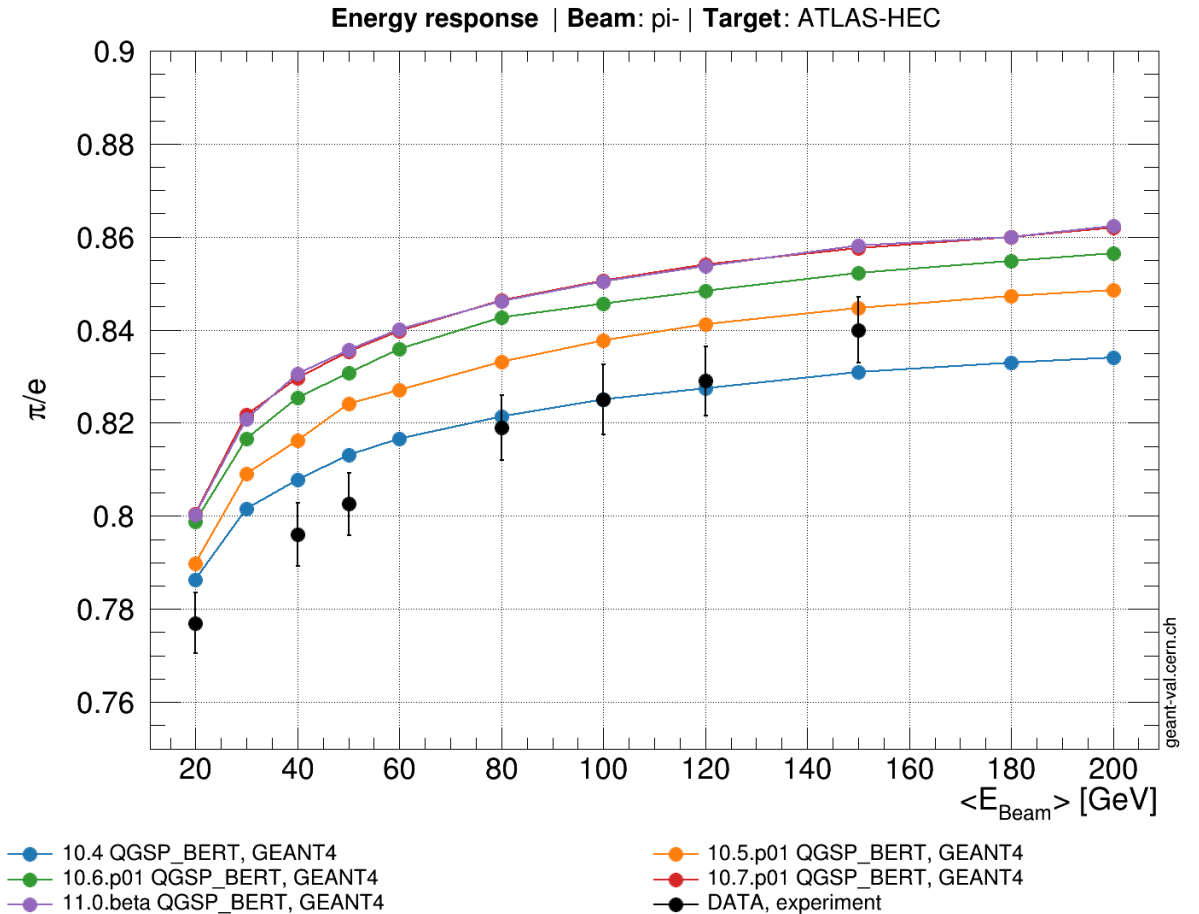
Regression testing (π/e) - FTFP_BERT

- ◆ Results from Geant Val as on 28/10/2021, for v10.4, 10.5.p01, 10.6.p01, 10.7.p01, 11.0.beta.
- ◆ The relative response to charged pions (π/e) increases from 10.4 to 10.5.p01 (0.5% to 1%) and from 10.5.p01 to 10.6.p01 (1%). No changes from 10.6.p01 to 11.0.beta.
- ◆ Best test beam data description provided by 10.4.



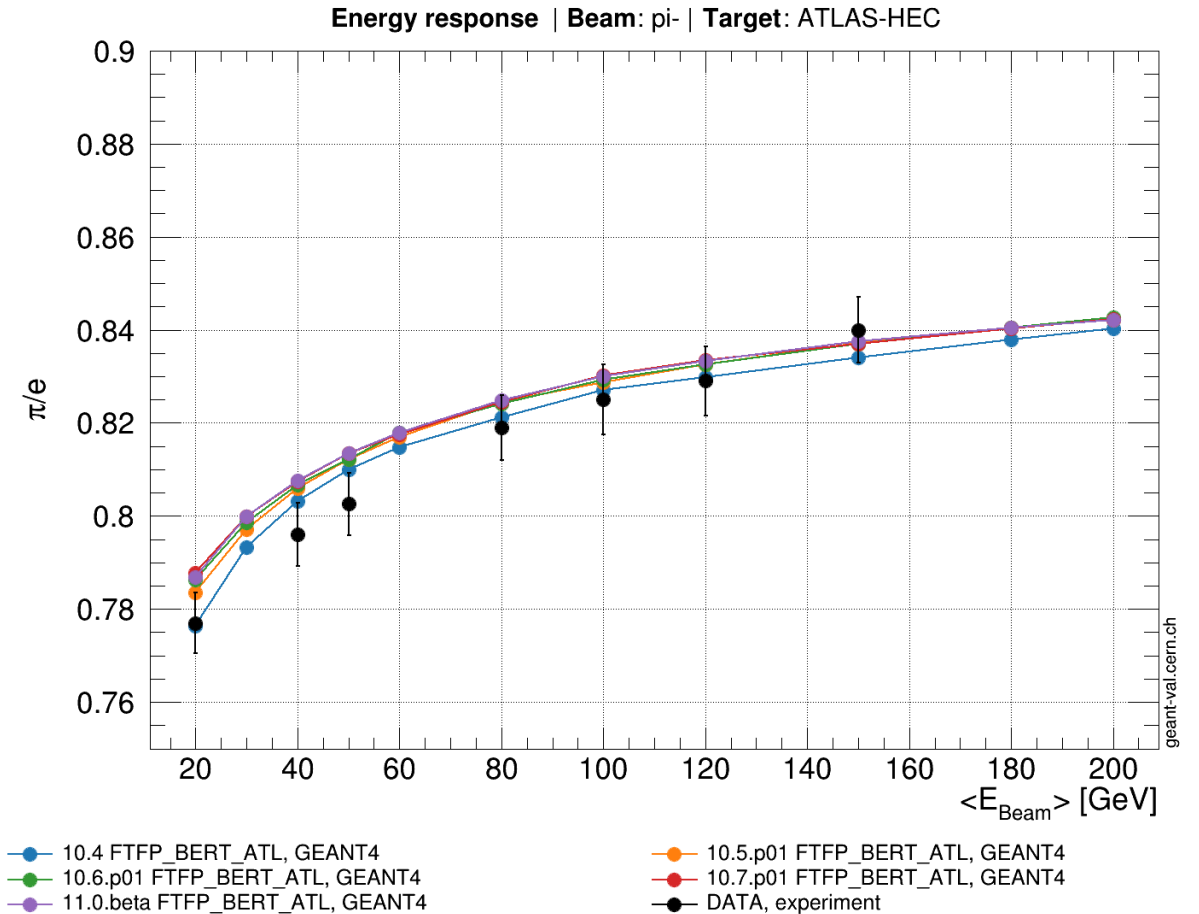
Regression testing (π/e) - QGSP_BERT

- ◆ Results from Geant Val as on 28/10/2021, for v10.4, 10.5.p01, 10.6.p01, 10.7.p01, 11.0.beta.
- ◆ The relative response to charged pions (π/e) increases from 10.4 to 10.5.p01 (1%), from 10.5.p01 to 10.6.p01 (1%), and from 10.6.p01 to 10.7.p01 (0.5%)
No changes from 10.7.p01 to 11.0.beta.
- ◆ Best test beam data description provided by 10.4.



Regression testing (π/e) - FTFP_BERT_ATL

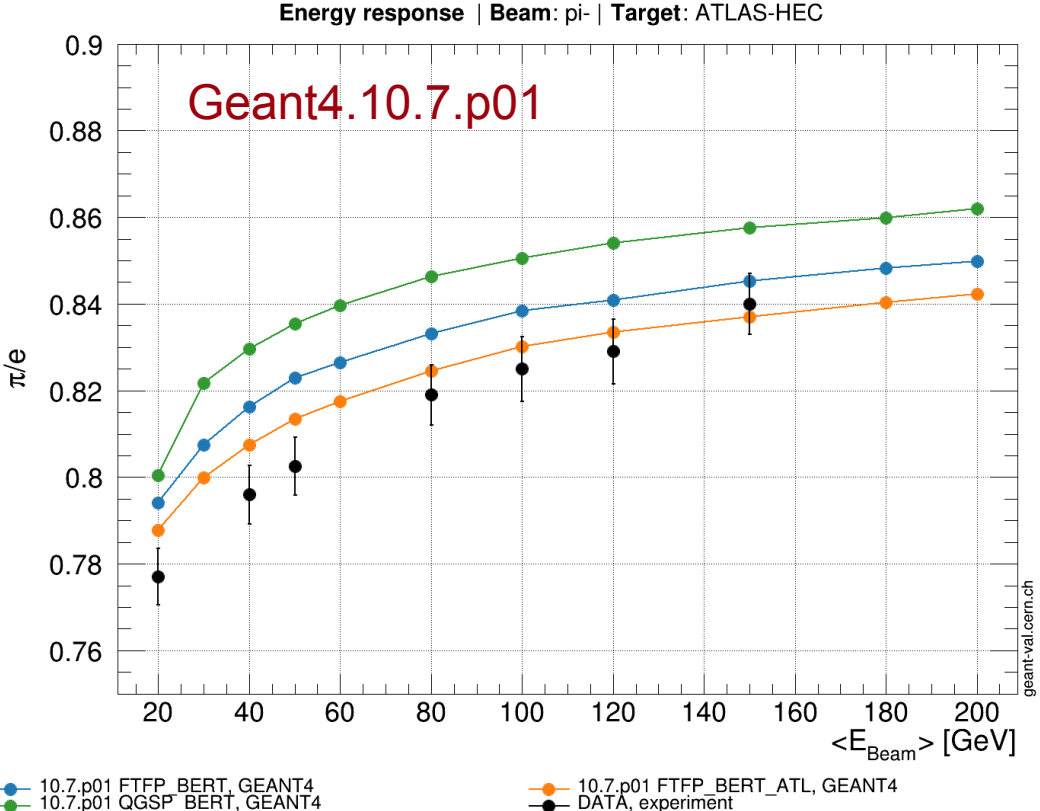
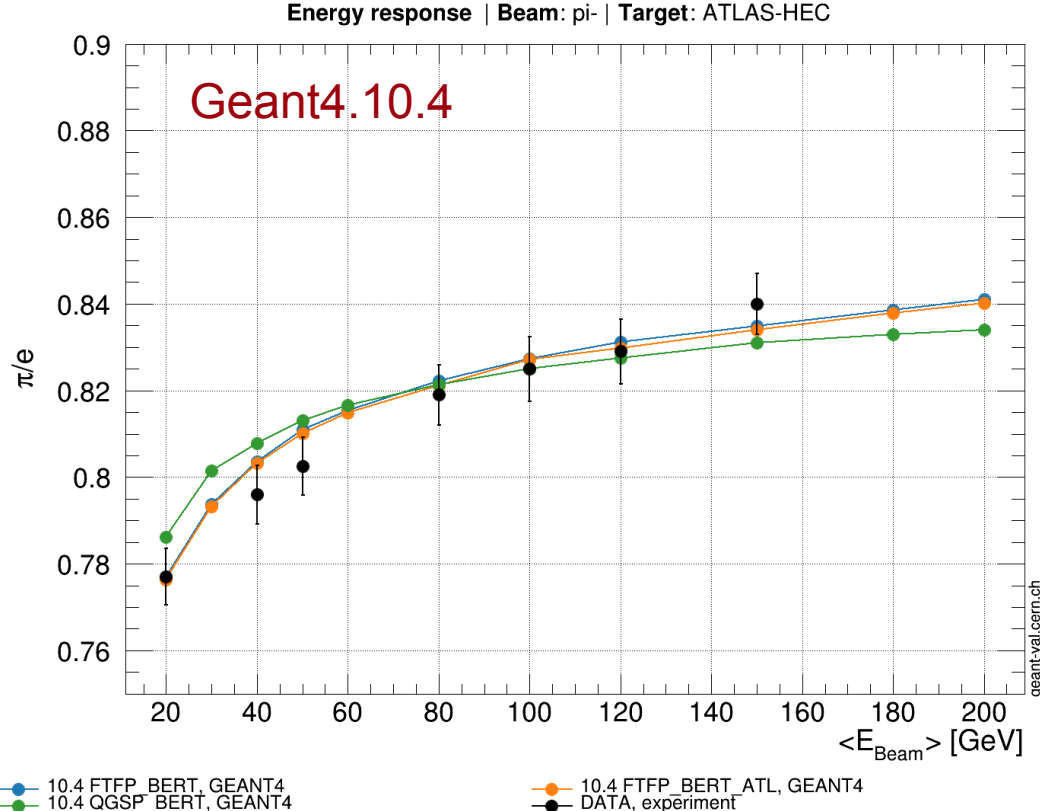
- ◆ Results from Geant Val as on 28/10/2021, for v10.4, 10.5.p01, 10.6.p01, 10.7.p01, 11.0.beta.
- ◆ The relative response to charged pions (π/e) increases from 10.4 to 10.5.p01 (0.4%). No changes from 10.5.p01 to 11.0.beta.
- ◆ Best test beam data description provided by 10.4.
- ◆ Overall, every Geant4 version provides a description within 1% w.r.t. test beam data.



Physics list comparison (π/e)

Almost identical values for FTFP_BERT_ATL and FTFP_BERT, compatible with test beam data. QGSP overestimating data of 1% below 40 GeV and underestimating of 1% at 140 GeV.

Best description provided by FTFP_BERT_ATL, FTFP_BERT is 1% higher and QGSP_BERT is 2%-3% higher w.r.t. FTFP_BERT_ATL.

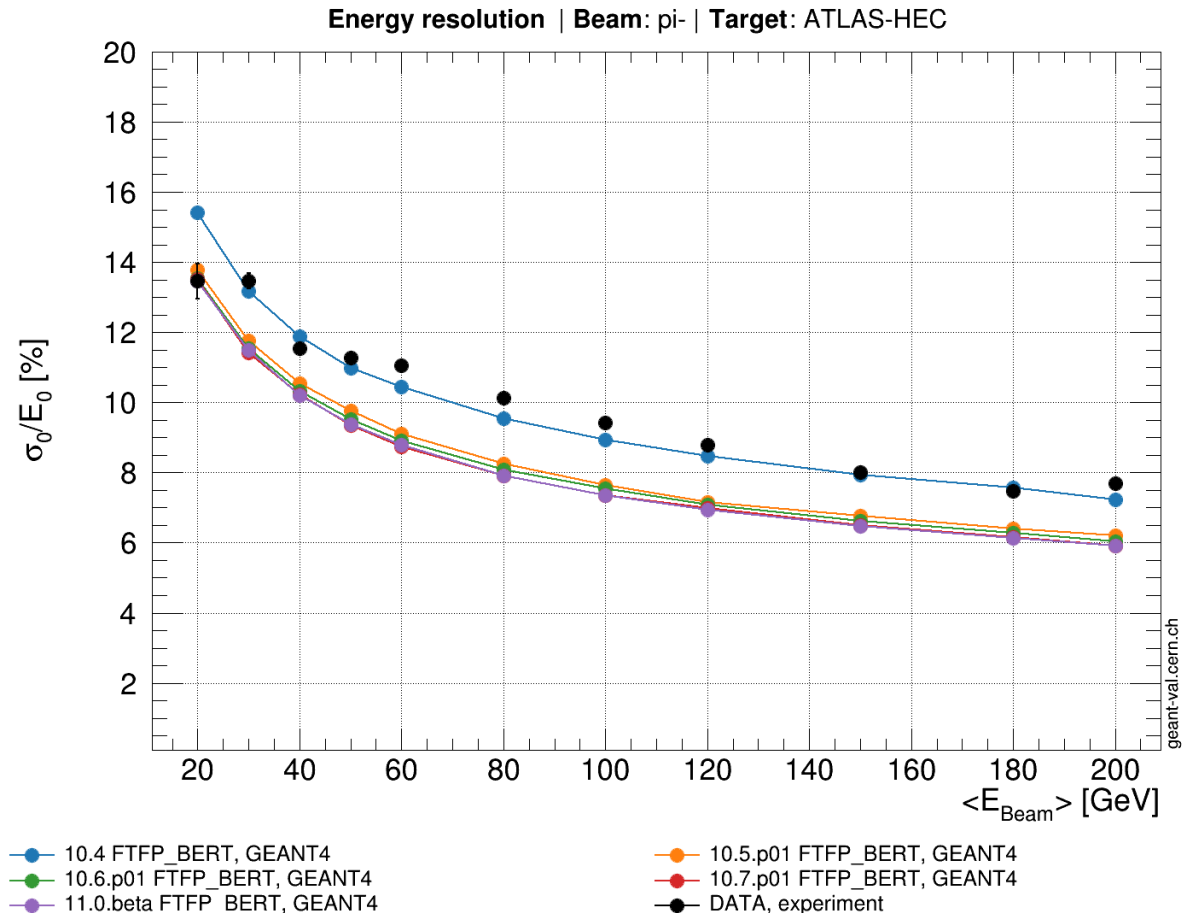




π^{\pm} energy resolution

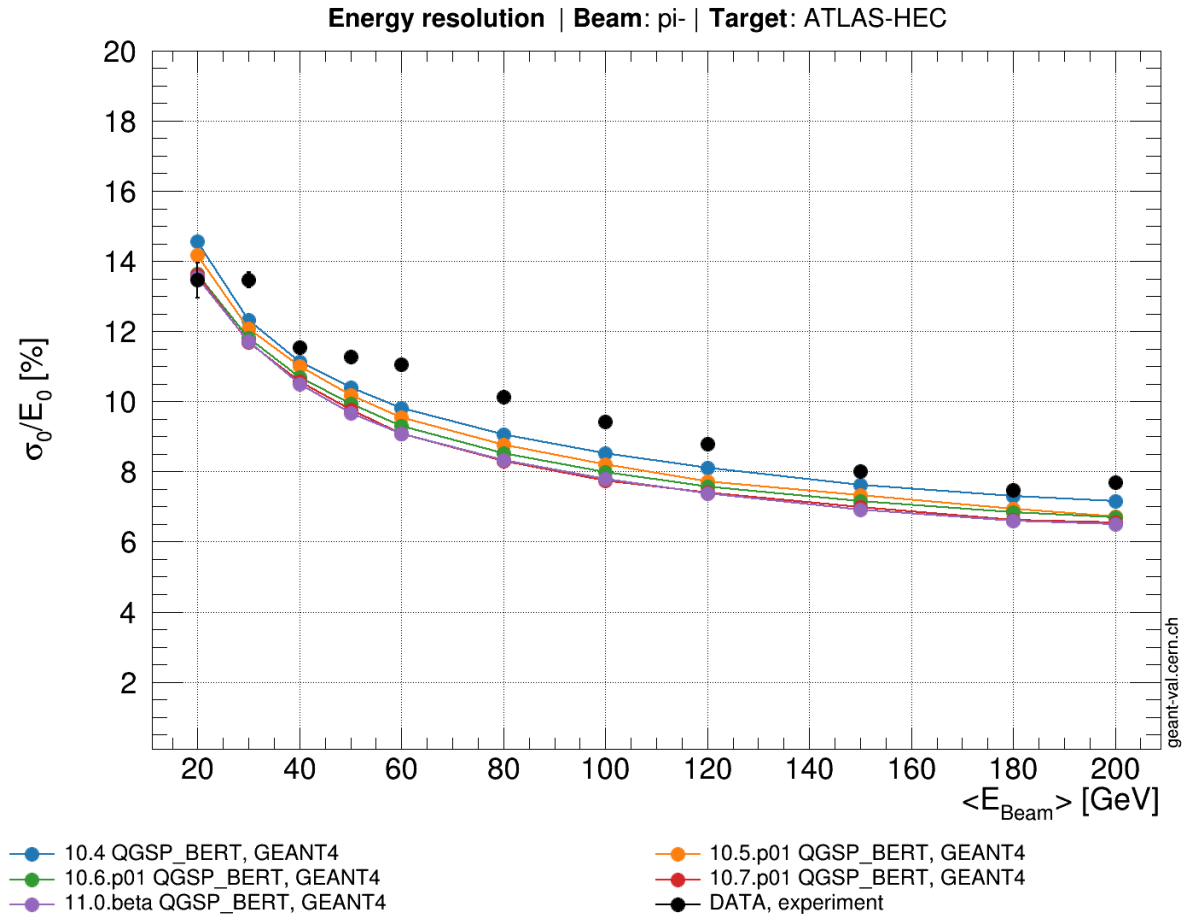
Regression testing (π^- en. res.) - FTFP_BERT

- ◆ Results from Geant Val as on 28/10/2021, for v10.4, 10.5.p01, 10.6.p01, 10.7.p01, 11.0.beta.
- ◆ Energy fluctuations decrease by 10%-15% from 10.4 to 10.5.p01. Further reduction of 2% from 10.5.p01 to 10.6.p01 and from 10.6.p01 to 10.7.p01. 11.0.beta is compatible with 10.7.p01.
- ◆ Best test beam data description provided by 10.4.



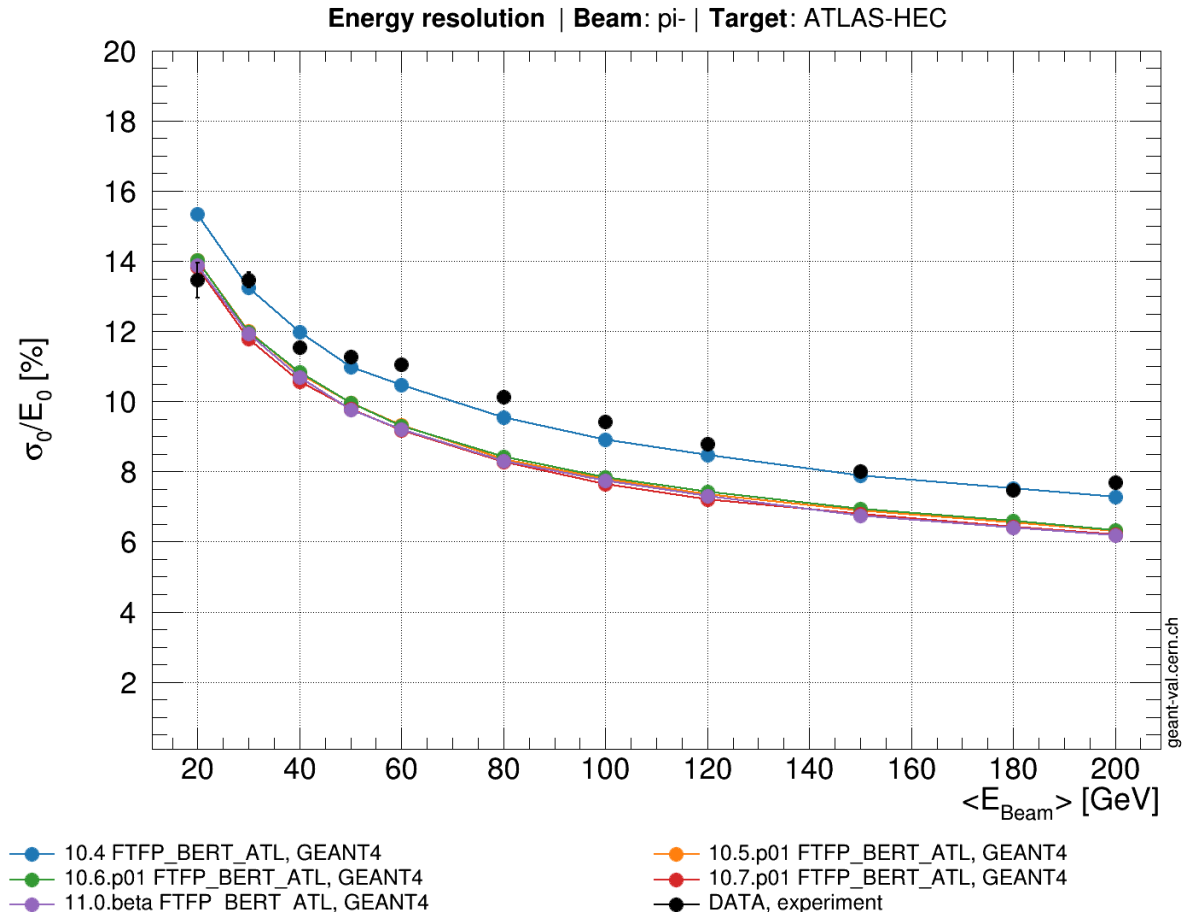
Regression testing (π^- en. res.) - QGSP_BERT

- ◆ Results from Geant Val as on 28/10/2021, for v10.4, 10.5.p01, 10.6.p01, 10.7.p01, 11.0.beta.
- ◆ (Almost) constant 2.5% reduction in the energy fluctuations for every version from 10.4 to 10.7.p01. 11.0.beta is compatible with 10.7.p01.
- ◆ Best test beam data description provided by 10.4.



Regression testing (π^- en. res.) - FTFP_BERT_ATL

- ◆ Results from Geant Val as on 28/10/2021, for v10.4, 10.5.p01, 10.6.p01, 10.7.p01, 11.0.beta.
- ◆ Energy fluctuations decrease by 10%-15% from 10.4 to 10.5.p01. Further reduction of 1% from 10.5.p01 to 10.6.p01 and from 10.6.p01 to 10.7.p01. 11.0.beta compatible with 10.7.p01.
- ◆ Evolution similar to the FTFP_BERT one.
- ◆ Best test beam data description provided by 10.4.



Physics list comparison (π^- en. res.)

Almost identical description from FTFP_BERT and FTFP_BERT_ATL, differences w.r.t. test beam data below 5%. QGSP_BERT predicts energy fluctuations 5% smaller w.r.t FTFP_BERT.

All physics lists predicts energy fluctuations from 15% to 20% smaller w.r.t. test beam data.

