

Grid testing of Geant4 **10.5.ref10**

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Main Changes in Hadronics vs. 10.5.ref09

No changes in BERT, INCLXX, Elastic, Pre-equilibrium, Radioactive Decay, *etc.*

- **Cross sections** : changes at low-energies (< 20 MeV)
- **FTF, QGS** : Extended both Lund and QGS string fragmentation to allow charm and/or bottom quarks and diquarks in the strings
- **Binary cascade** : Added simple coalescence model for ion-ion
- **De-excitation** : Several changes...
- **ParticleHP** : New dataset **G4NDL4.6** (based on **JEFF-3.3**) and removed restriction of using isotopes with $Z > 92$
- **Physics Lists** : Use more widely and consistently BGG xsec; use Radioactive Decay in all physics lists which use NeutronHP

Crashes & Warnings

- No crashes, no infinite loops
- No warnings on high excitation energy for nuclear fragments
- New warnings on no decay channels for heavy hadrons (Λ_c)
 - Already done MR to fix it

Reproducibility

- As in Ref08 and Ref09, few MT violations observed
 - Due to the Starkov's elastic class G4ElasticHadrNucleusHE
 - Fixed by the MR (already accepted): **hadr-cohe-V10-05-06**

Pion- showers: FTFP_BERT

G4 10.5.ref10

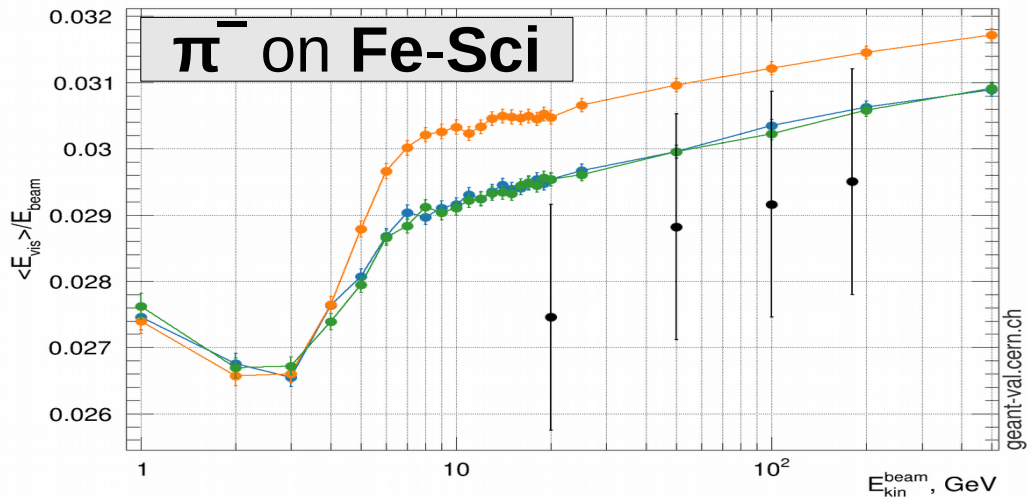
G4 10.5.ref10c (*bug-fix in FTF*)

G4 10.5.ref09a (*Urban msc as in Ref07*)

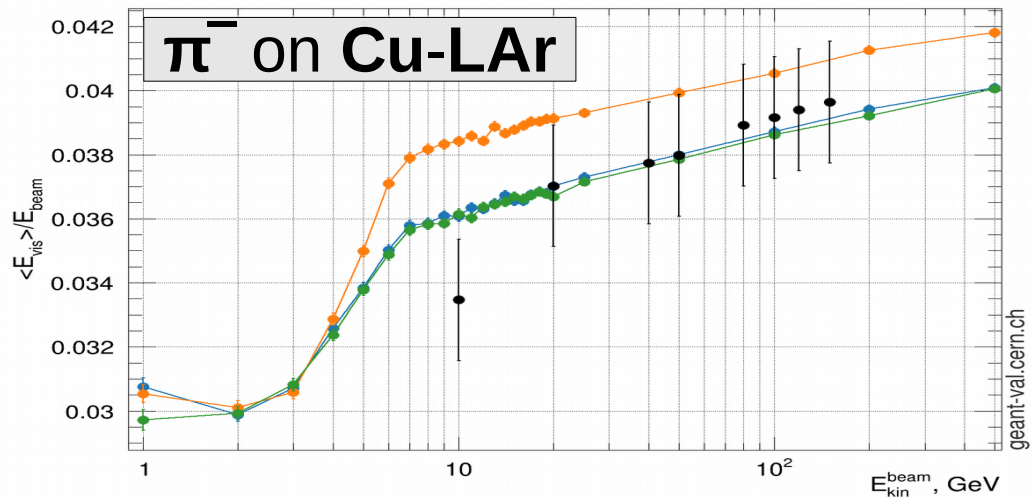
*Note : conventional Birks treatment
(easier and no experimental h/e to fit !)*

FTFP_BERT : Energy Response

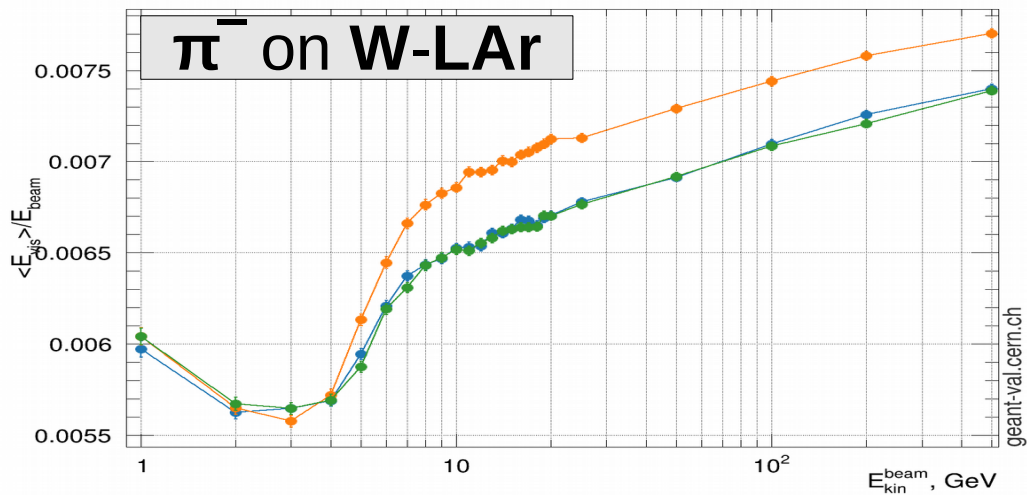
Energy response | Beam: pi- | Target: TileCal



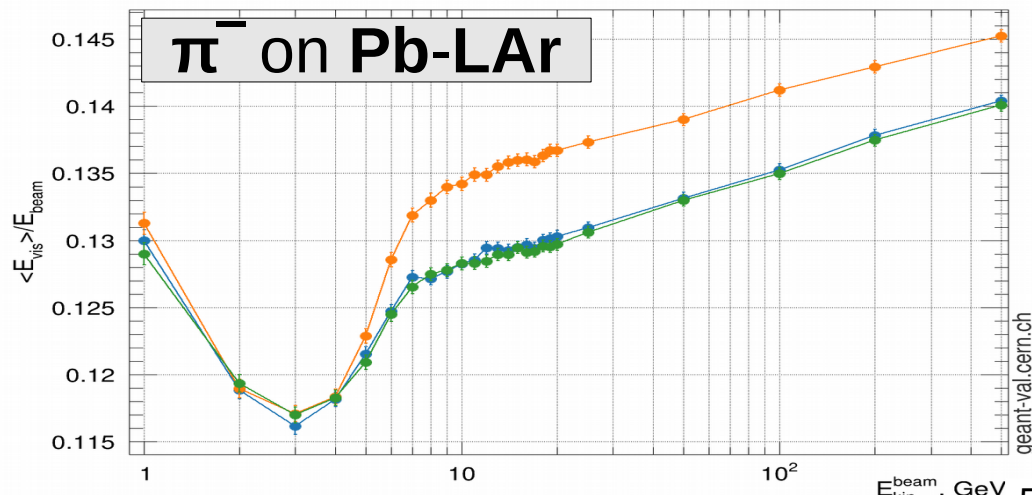
Energy response | Beam: pi- | Target: AtlasHEC



Energy response | Beam: pi- | Target: AtlasFCAL | FTFP_BERT

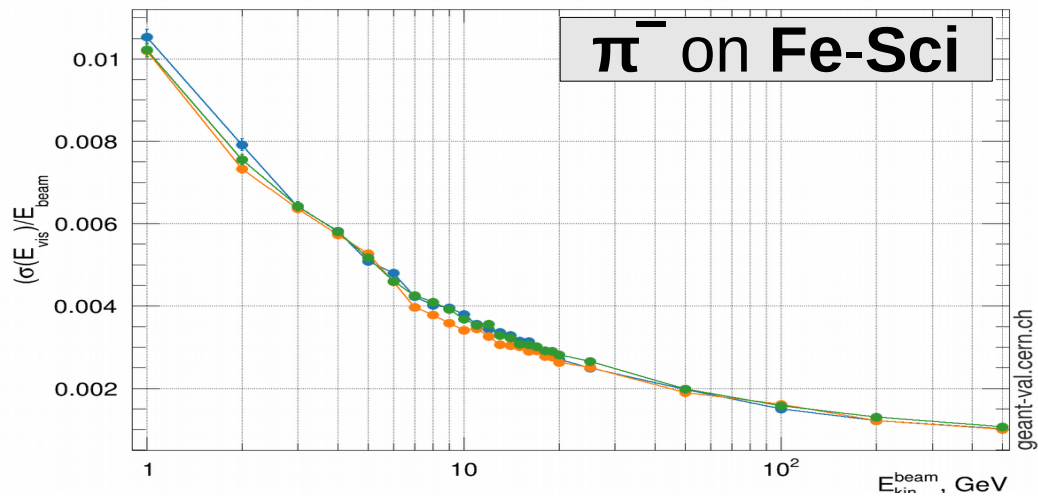


Energy response | Beam: pi- | Target: AtlasECAL | FTFP_BERT

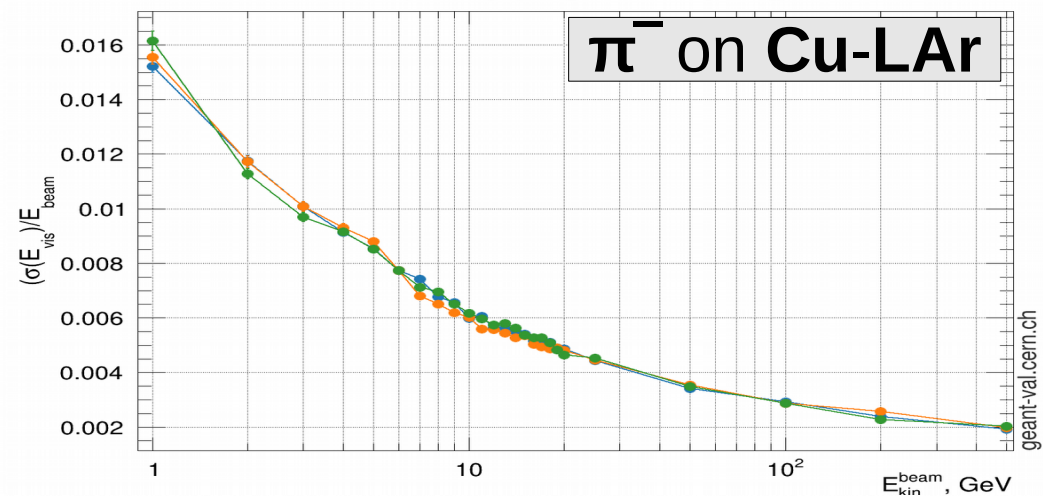


FTFP_BERT : Energy Width

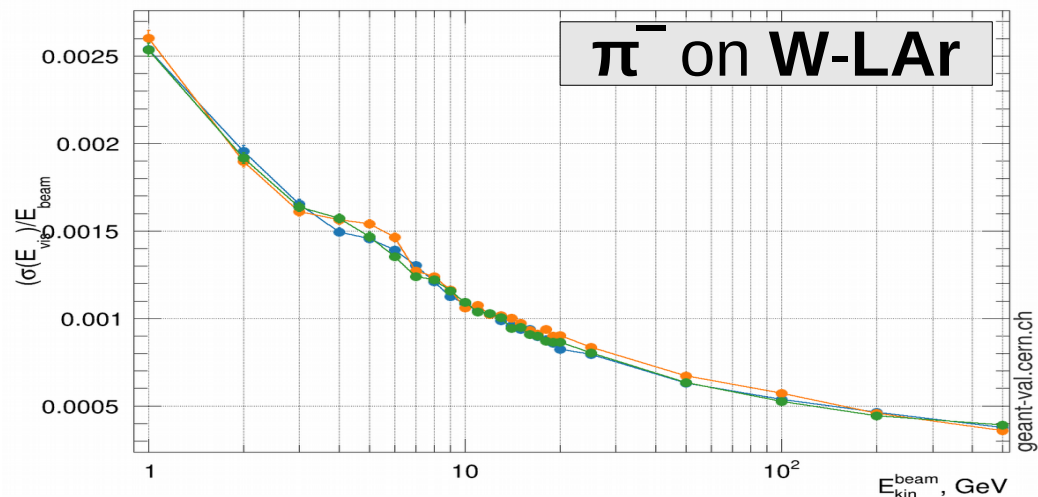
Normalized width | Beam: pi- | Target: TileCal | FTFP_BERT



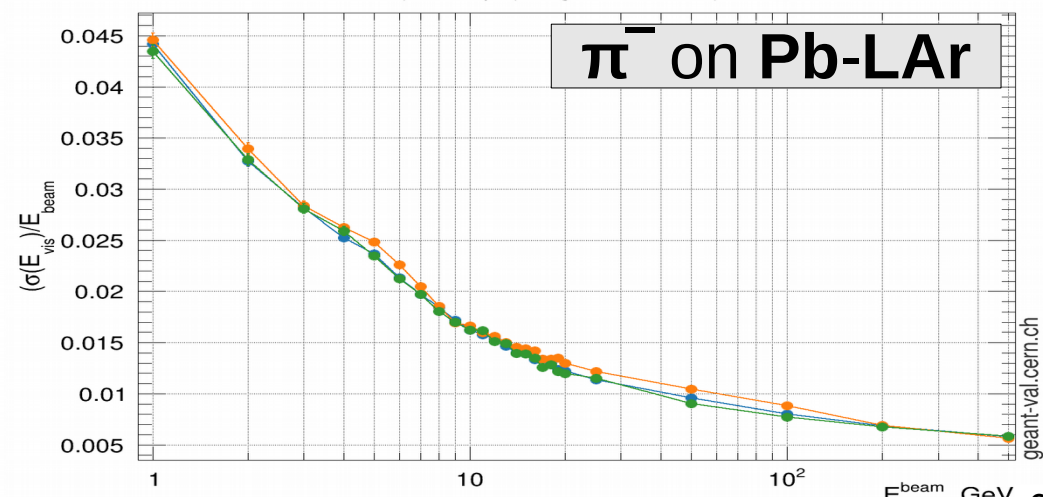
Normalized width | Beam: pi- | Target: AtlasHEC | FTFP_BERT



Normalized width | Beam: pi- | Target: AtlasFCAL | FTFP_BERT

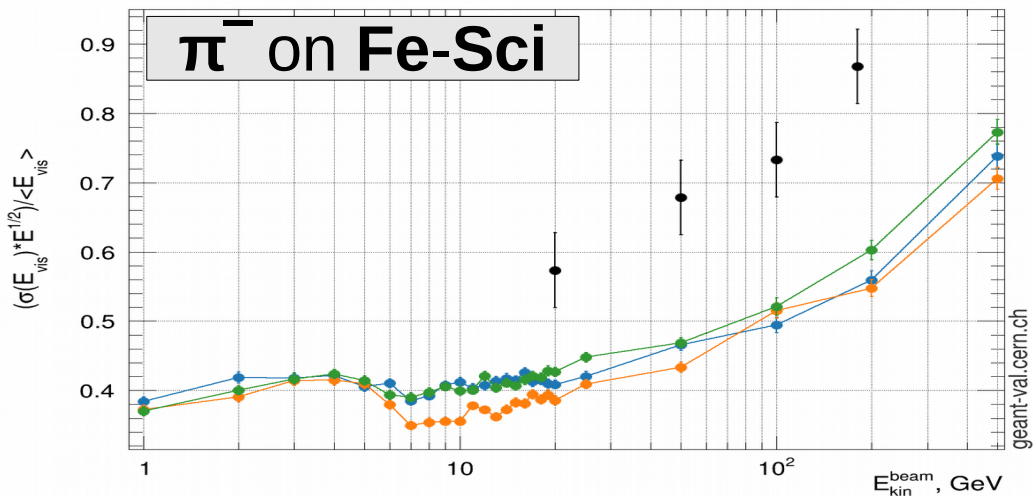


Normalized width | Beam: pi- | Target: AtlasECAL | FTFP_BERT

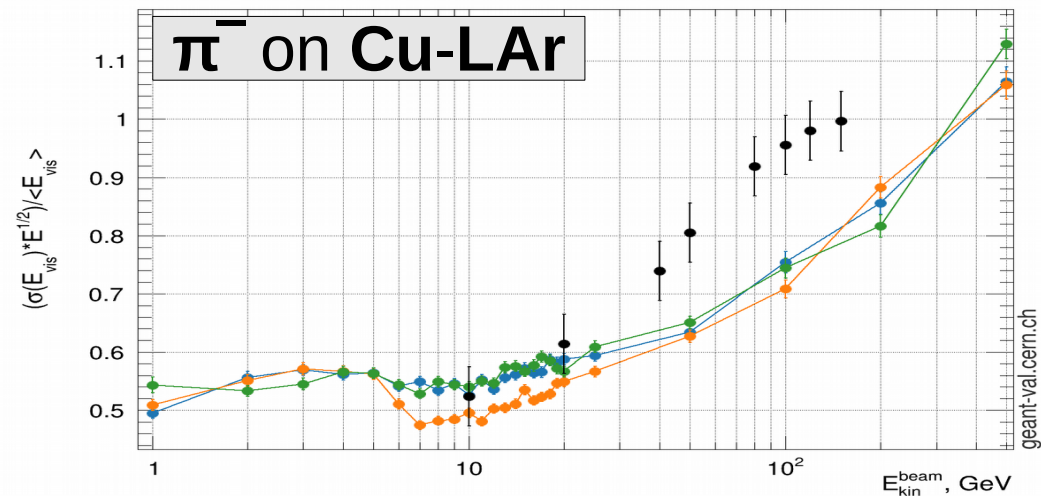


FTFP_BERT : Energy Resolution

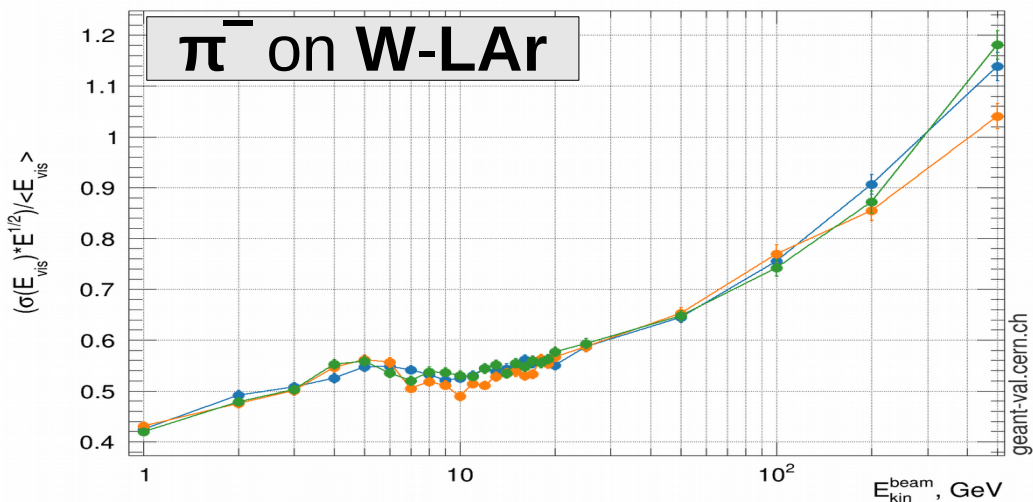
Energy resolution | Beam: pi- | Target: TileCal



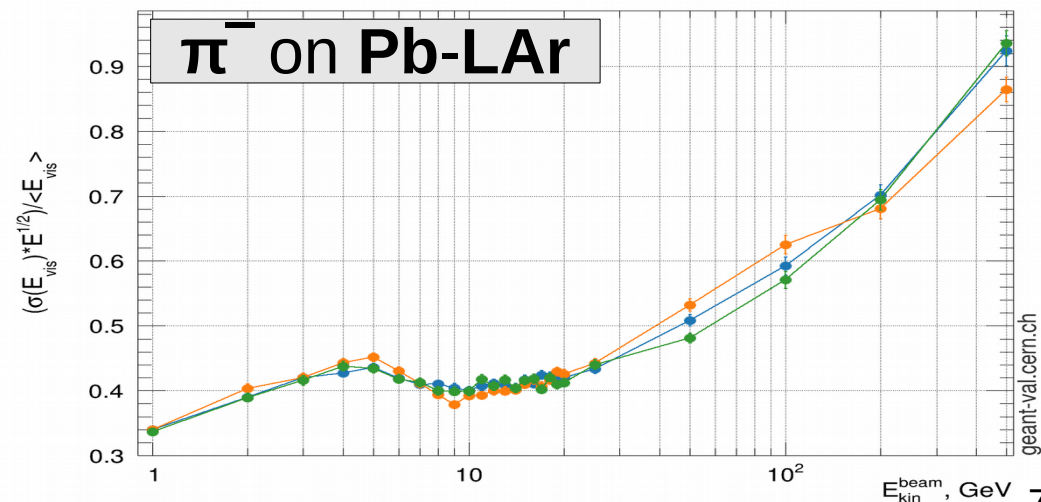
Energy resolution | Beam: pi- | Target: AtlasHEC



Energy resolution | Beam: pi- | Target: AtlasFCAL | FTFP_BERT

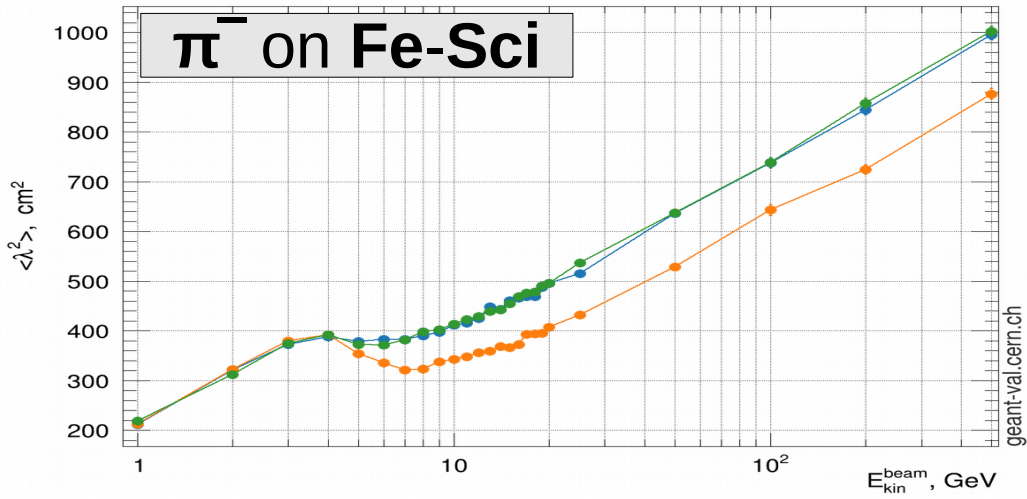


Energy resolution | Beam: pi- | Target: AtlasECAL | FTFP_BERT

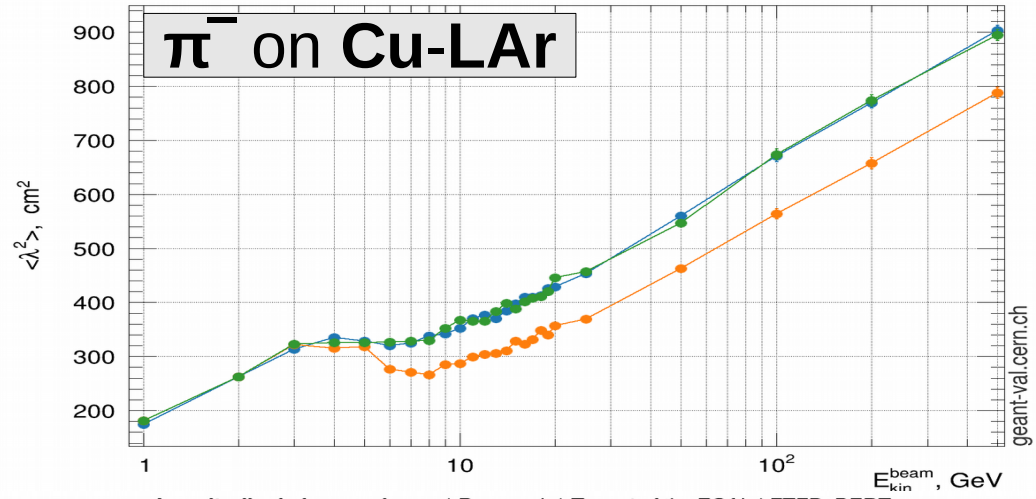


FTFP_BERT : Longitudinal Shape

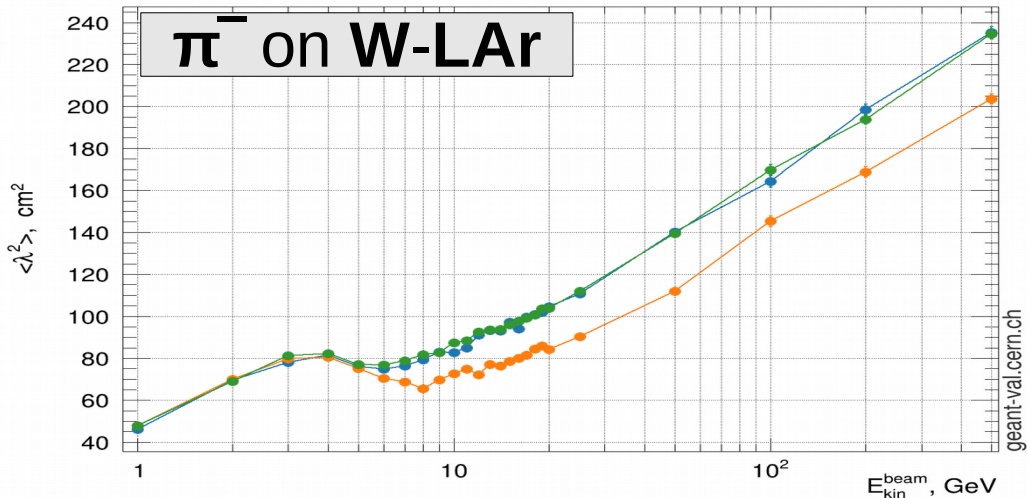
Longitudinal shower shape | Beam: pi- | Target: TileCal | FTFP_BERT



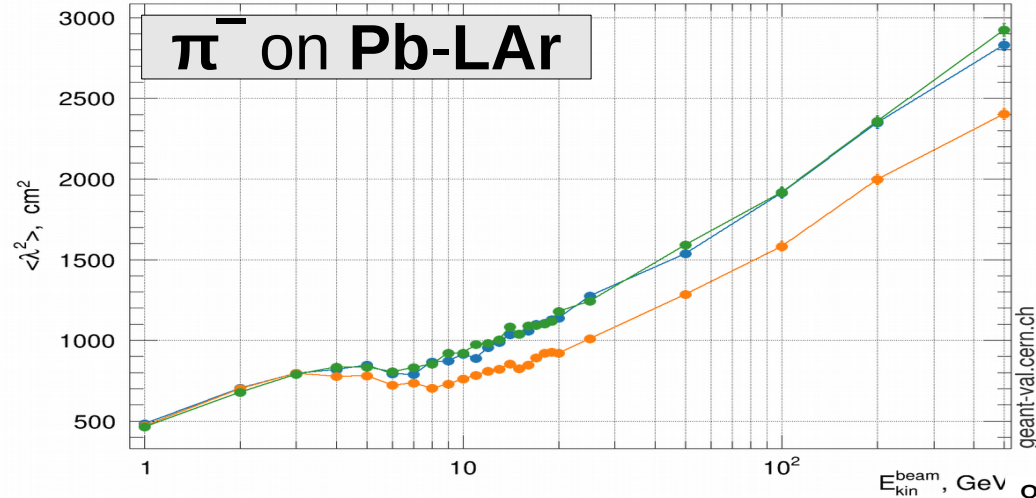
Longitudinal shower shape | Beam: pi- | Target: AtlasHEC | FTFP_BERT



Longitudinal shower shape | Beam: pi- | Target: AtlasFCAL | FTFP_BERT



Longitudinal shower shape | Beam: pi- | Target: AtlasECAL | FTFP_BERT



10.5.ref10c
10.5.ref09a

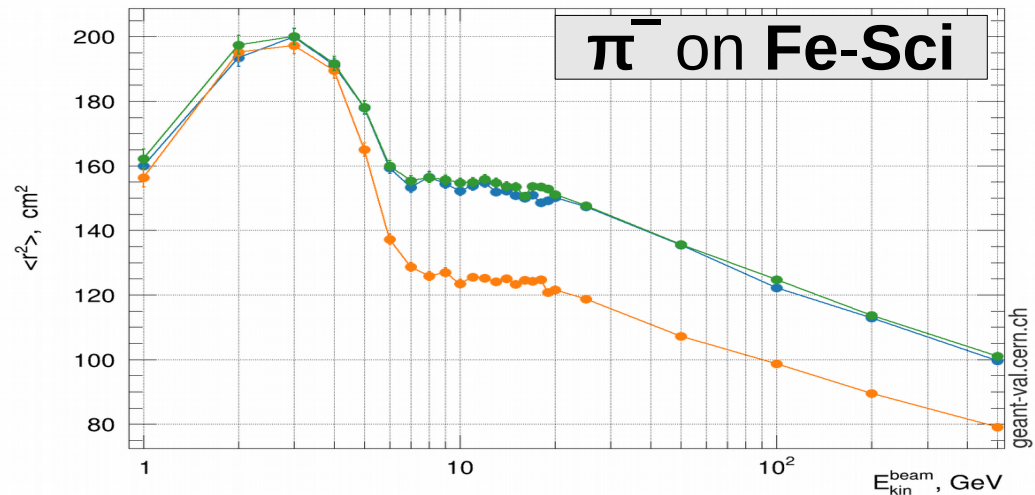
10.5.ref10

10.5.ref10c
10.5.ref09a

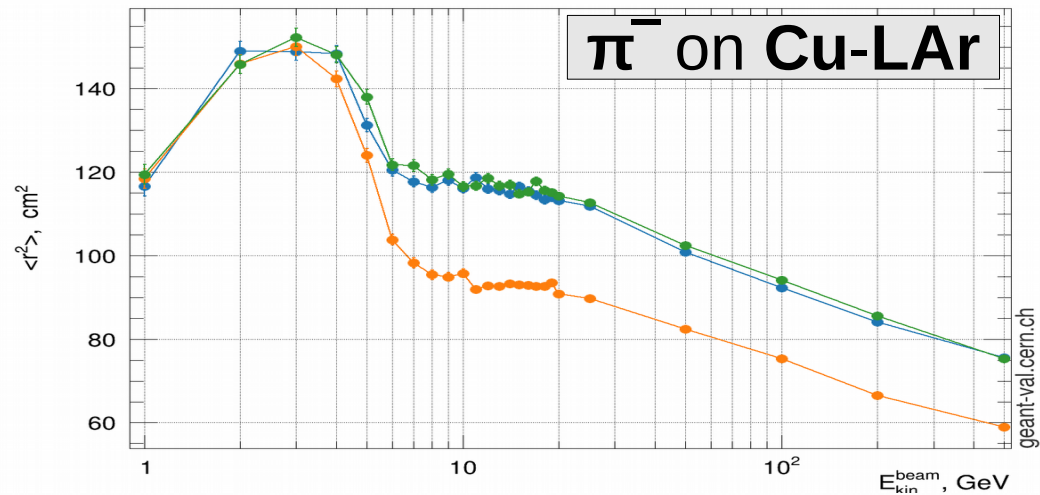
10.5.ref10

FTFP_BERT : Lateral Shape

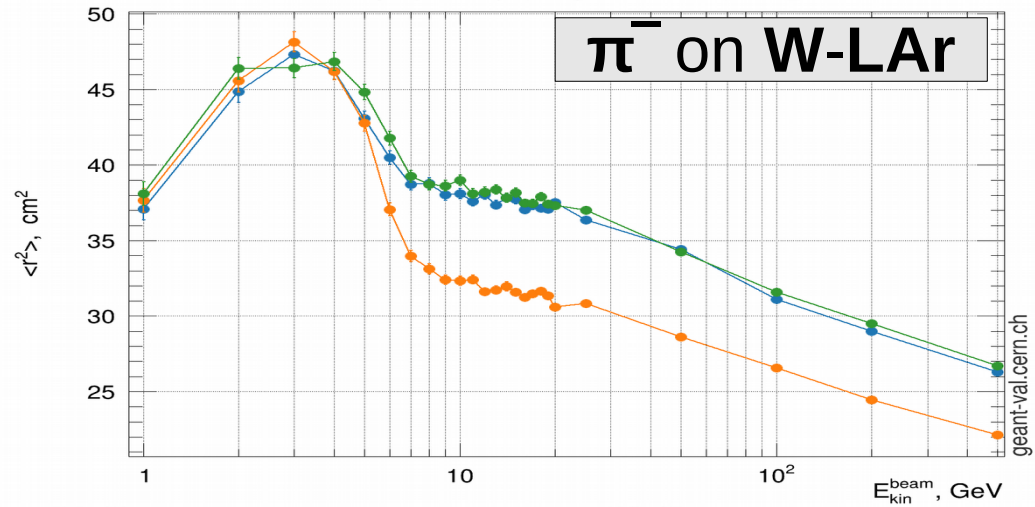
Lateral shower shape | Beam: pi- | Target: TileCal | FTFP_BERT



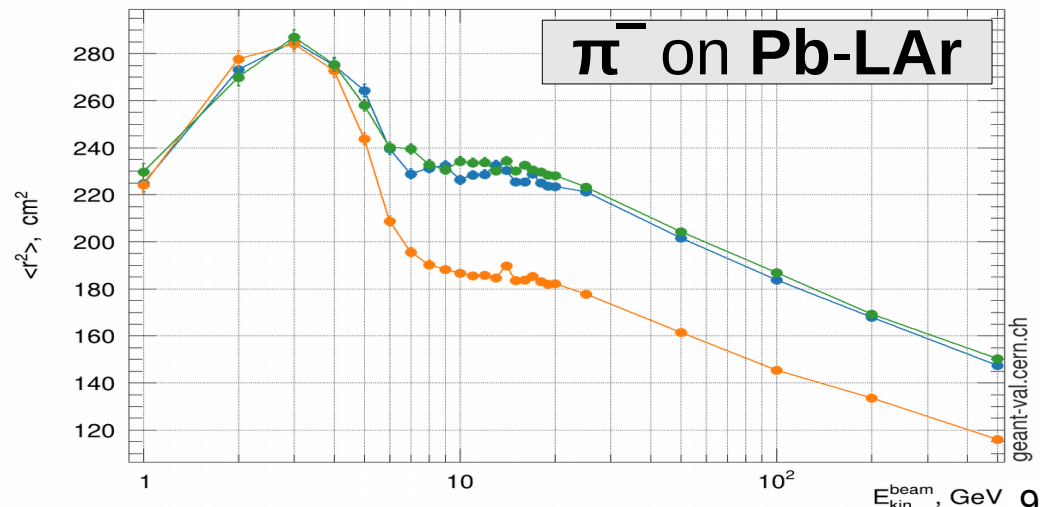
Lateral shower shape | Beam: pi- | Target: AtlasHEC | FTFP_BERT



Lateral shower shape | Beam: pi- | Target: AtlasFCAL | FTFP_BERT



Lateral shower shape | Beam: pi- | Target: AtlasECAL | FTFP_BERT



10.5.ref10c
10.5.ref09a

10.5.ref10

10.5.ref10c
10.5.ref09a

10.5.ref10

FTFP_BERT cross sections

G4 10.5.ref10

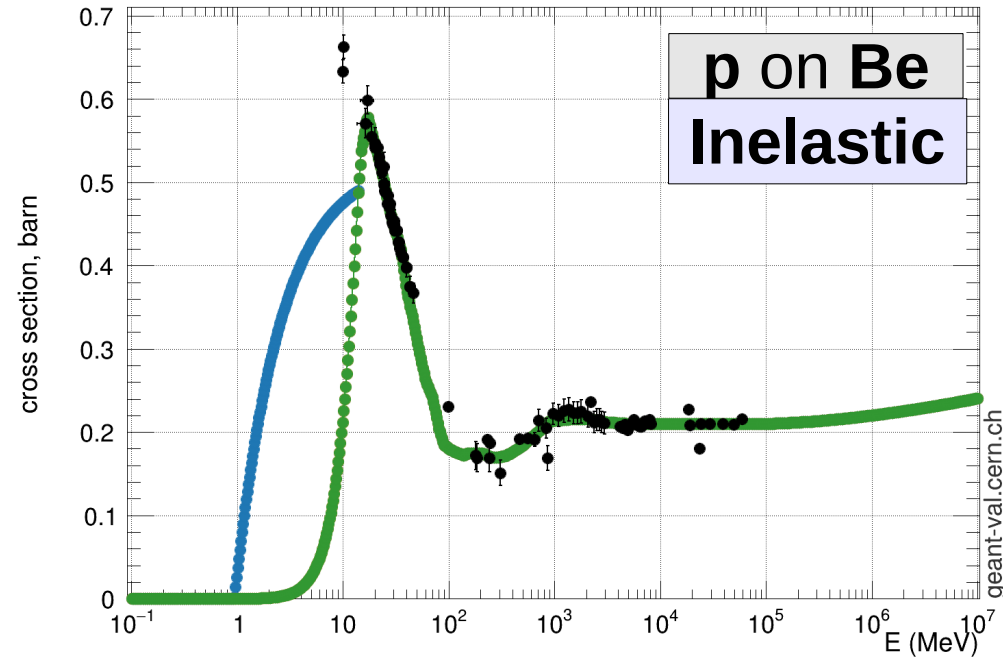
10.5.ref09

10.5.ref08

- Changes only for p (inelastic) and π^+ (elastic & inelastic)

Proton inelastic cross sections

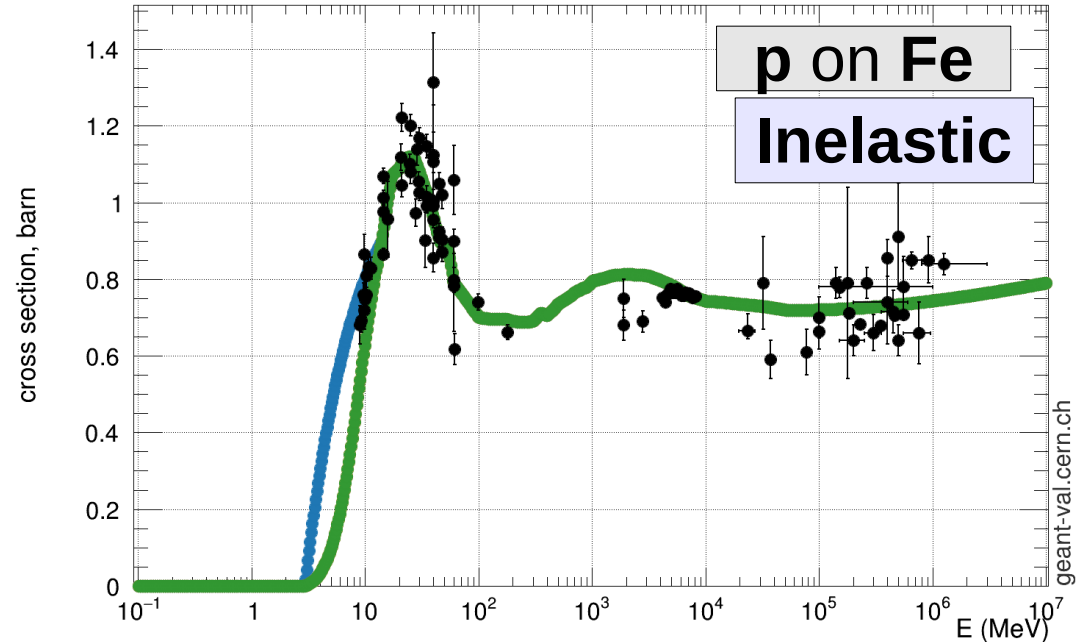
Inelastic cross section | Beam: proton



10.5.ref08 Be FTFP_BERT
10.5.ref10 Be FTFP_BERT

10.5.ref09 Be FTFP_BERT
Barashenkov Be9

Inelastic cross section | Beam: proton

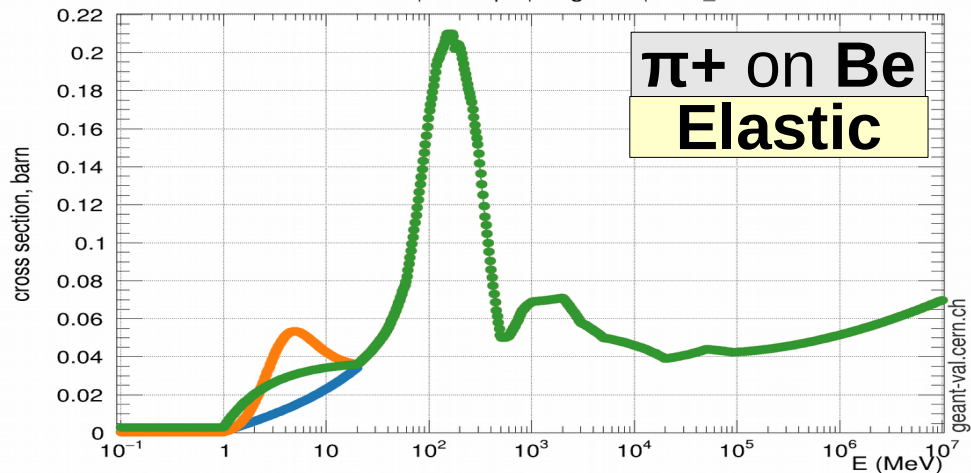


10.5.ref08 Fe FTFP_BERT
10.5.ref10 Fe FTFP_BERT
Barashenkov Fe55.8
Barashenkov Fe57

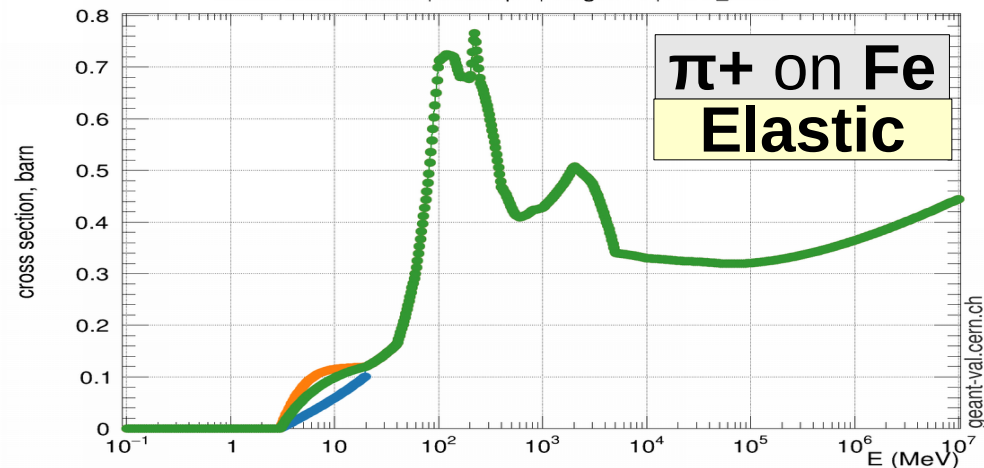
10.5.ref09 Fe FTFP_BERT
Barashenkov Fe54
Barashenkov Fe56
Barashenkov Fe58

π^+ elastic & inelastic cross sections

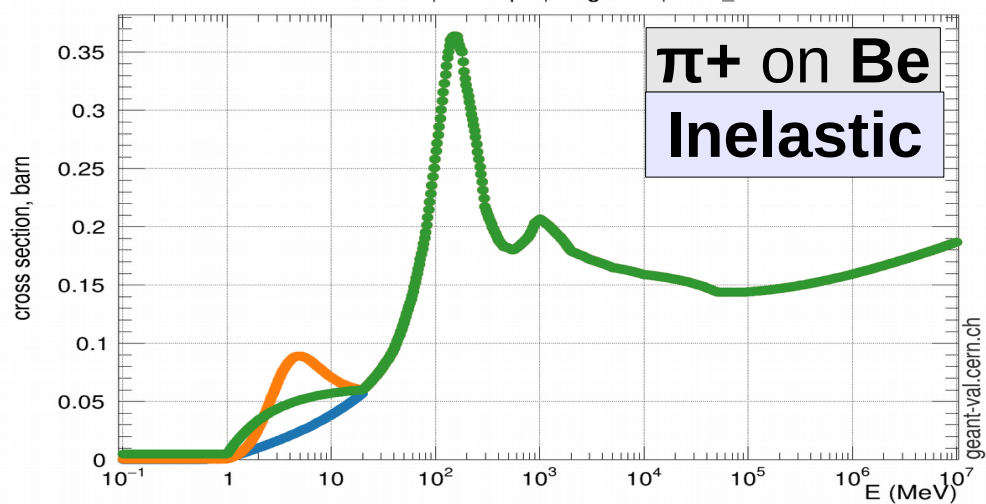
Elastic cross section | Beam: π^+ | Target: Be | FTFP_BERT



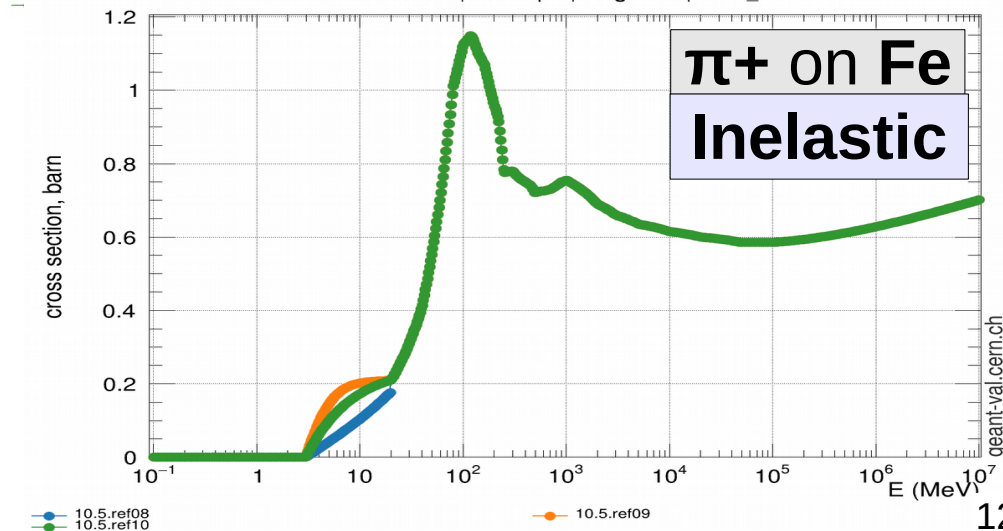
Elastic cross section | Beam: π^+ | Target: Fe | FTFP_BERT



Inelastic cross section | Beam: π^+ | Target: Be | FTFP_BERT



Inelastic cross section | Beam: π^+ | Target: Fe | FTFP_BERT



Conclusions

- **G4 10.5.ref10**
 - No crashes, no infinite loops
 - No more warnings of too high excitation energy; new warnings on no decays for Λ_c (*fix already merged*)
 - Same, few MT reproducibility violations as in Ref09 (*fix already merged*)
 - Cross sections are fine now
 - Much higher energy response and narrower showers with respect to Ref09
 - Due to a bug in FTF (*fix already merged : solves also the CPU slow down seen in Ref10*)