Hadronic Showers in Geant4 10.6.**p02** and 10.6.**ref05**

G. Folger, D. Konstantinov, G. Latyshev,
I. Razumov, A. Ribon
CERN EP/SFT

CERN/SFT Geant4 meeting, 9 June 2020

G4 10.6.p02

Main Changes in Hadronics *vs.* 10.6.p01

No changes in BERT, BIC, Pre-equilibrium, INCLXX, *etc.*

- De-excitation : fixed problem with isomers
  - **G4DeexPrecoParameters** : set default time limit to **1 microsecond** for isomer production (now, in all cases, isomers with half-life time above 1 microsecond are produced, whereas before this happened only when Radioactive Decay was activated, else only above 1000 sec). Addressing problem report #2226.
- ParticleHP : several bug fixes
- String (both FTF & QGS) hadronization : Coverity fixes
- Radioactive Decay : verbosity fixes

Crashes & Warnings

- No crashes
- No infinite loops
- No new warnings

Reproducibility

- All OK

G4 10.6.ref05

Main Changes in Hadronics *vs.* 10.6.ref04

Technical changes in nearly all sectors of hadronics (due to compilation warnings on clang-10, or new CMake system). Other changes:

- Introduced “global” messenger for hadronics
  - Motivated by “**/process/had/verbosity 0**” to switch off all hadronic print-out at initialization
  - Affect: management/ , de_excitation/ , inclxx/ , particle_hp/ , radioactive_decay/
- Cross sections : technical improvements of G4HadronNucleonXsc
- Neutrino interactions : extensions and improvements

- Physics lists
  - In QGS-based physics lists, use QGS above 12 GeV (and FTFP below 25 GeV) for anti_proton, anti_neutron, hyperons and anti_hyperons
  - Introduced a new utility class G4HadParticles to facilitate the handling of kaons, hyperons, charmed and bottom hadrons

Crashes & Warnings

- No crashes
- No infinite loops
- Large number of energy non-conservation warnings due to the application of QGSP to anti-baryons
  - On-going work to improve it

Reproducibility

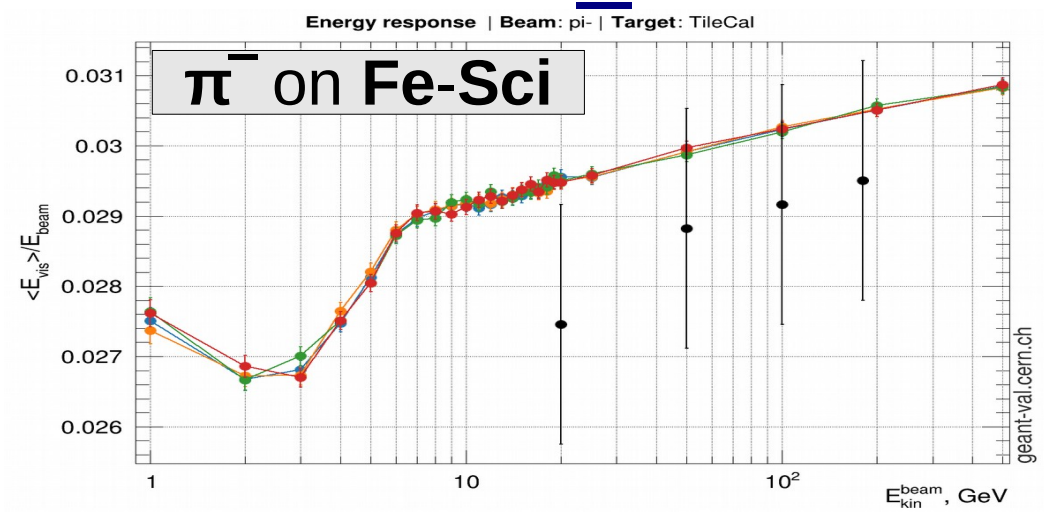
- Many violations of MT vs. SEQ reproducibility
  - Sequential reproducibility is fine
  - Seems to be due to EM physics for hadrons
  - On-going work to fix it

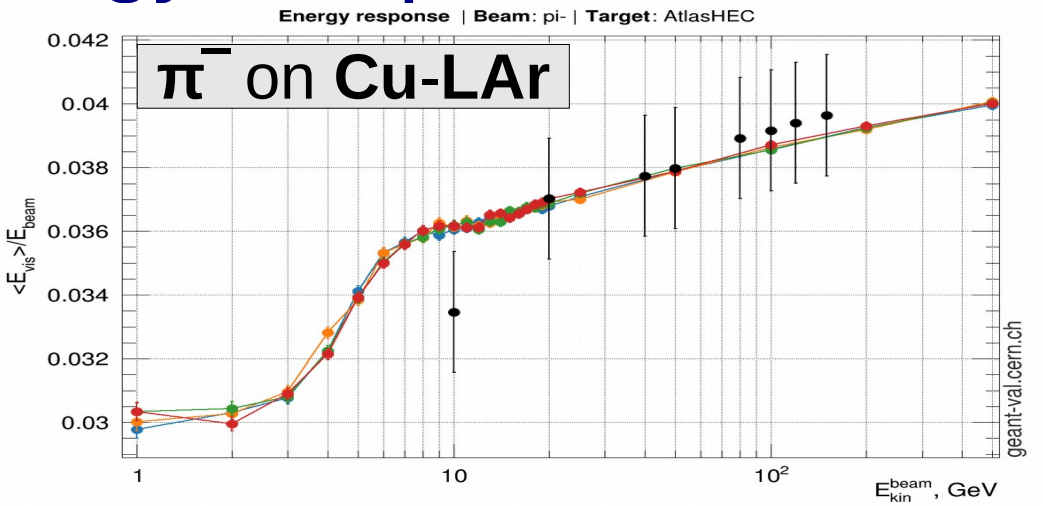
Pion- showers: FTFP_BERT

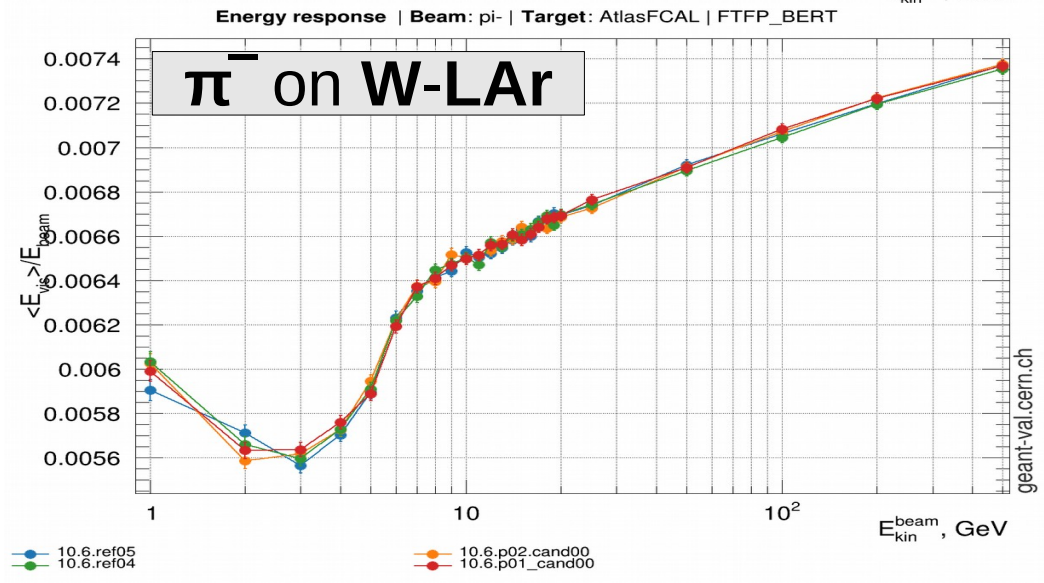
G4 10.6.ref05
G4 10.6.ref04
G4 10.6.p02
G4 10.6.p01

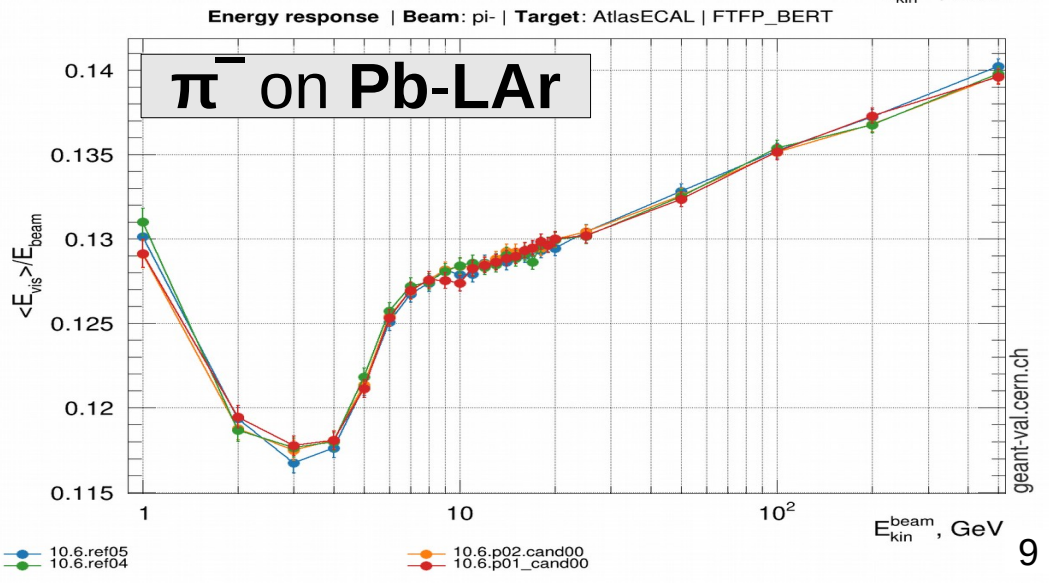
Note : conventional Birks treatment
(easier and no experimental h/e to fit !)

FTFP_BERT : Energy Response

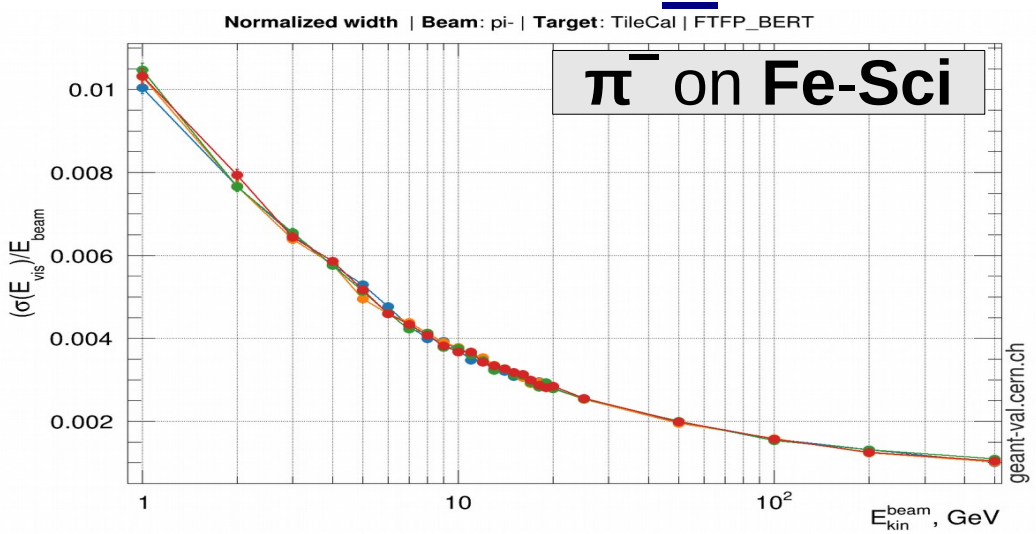


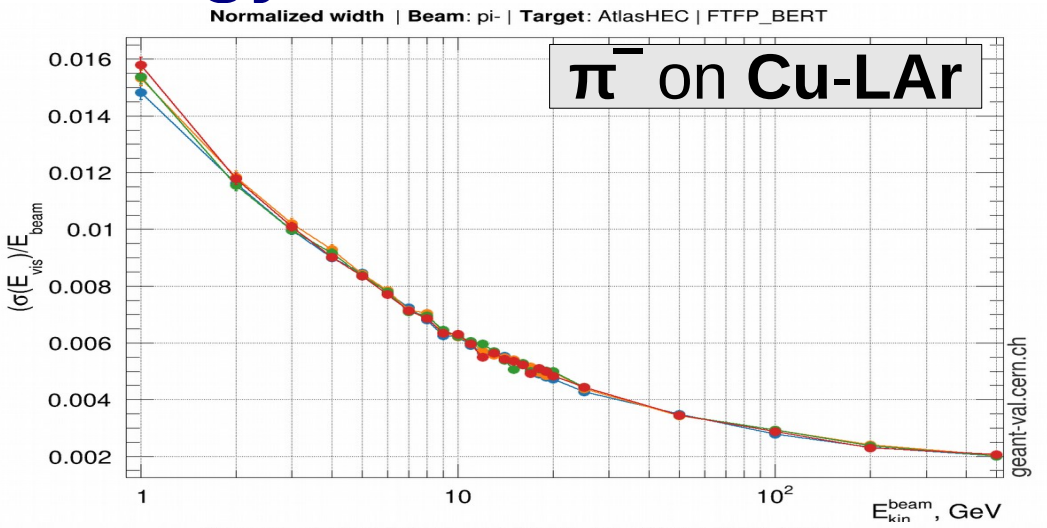


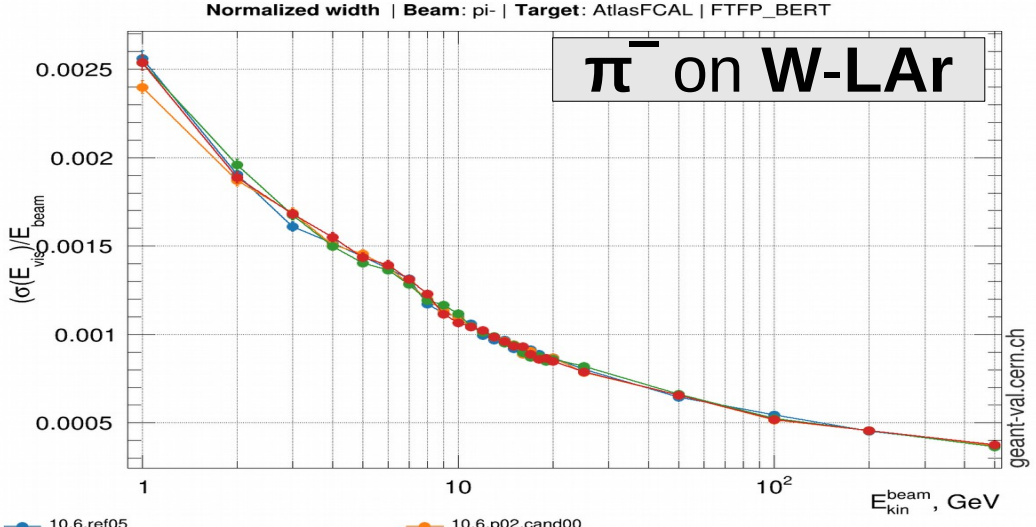


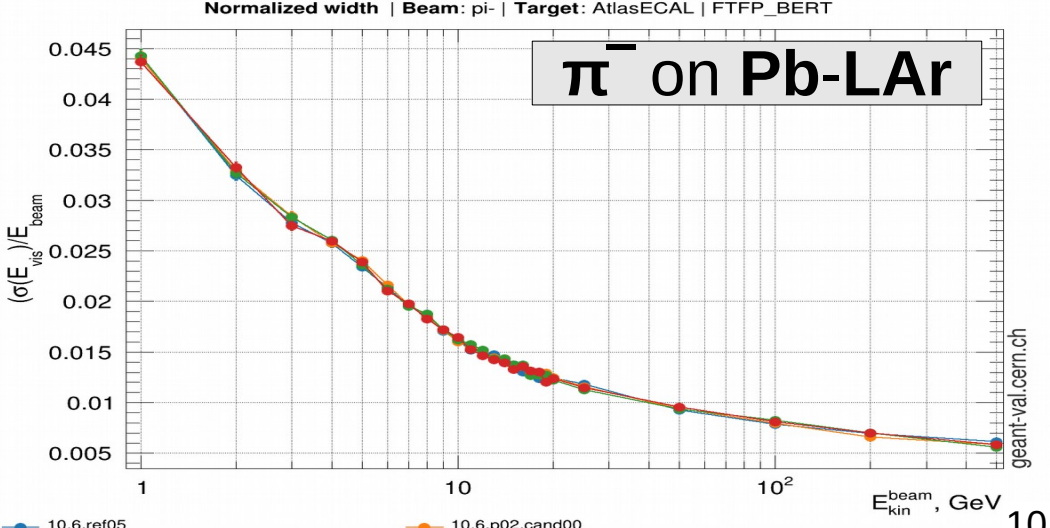


FTFP_BERT : Energy Width

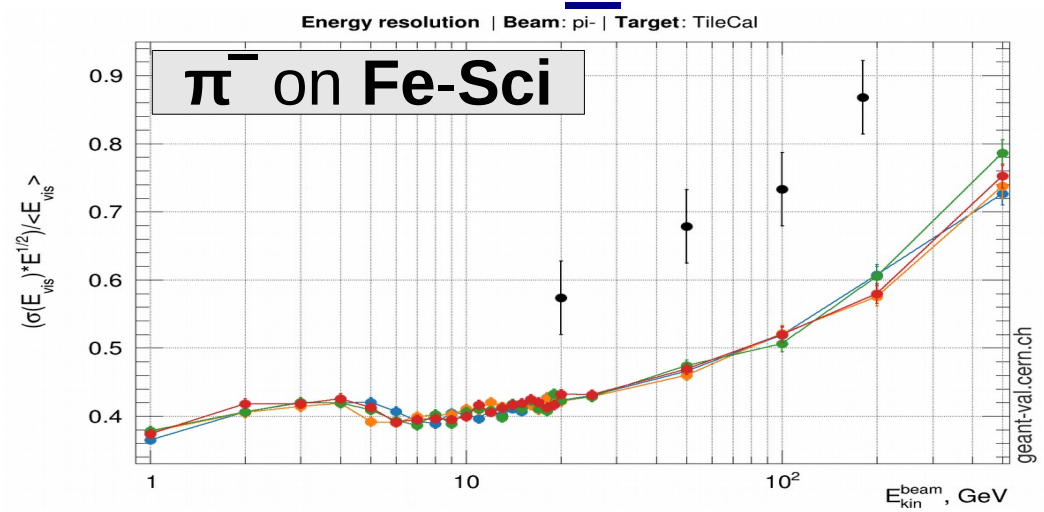


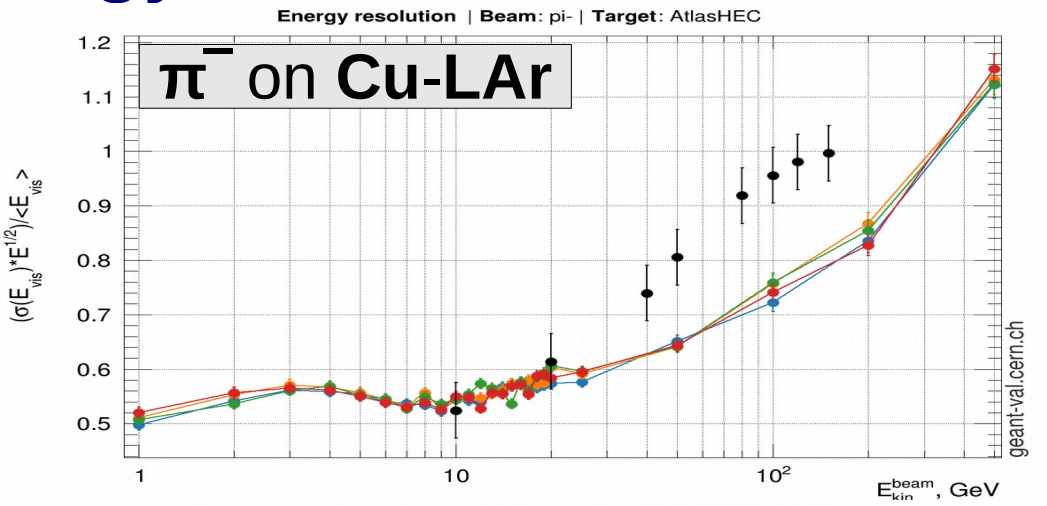


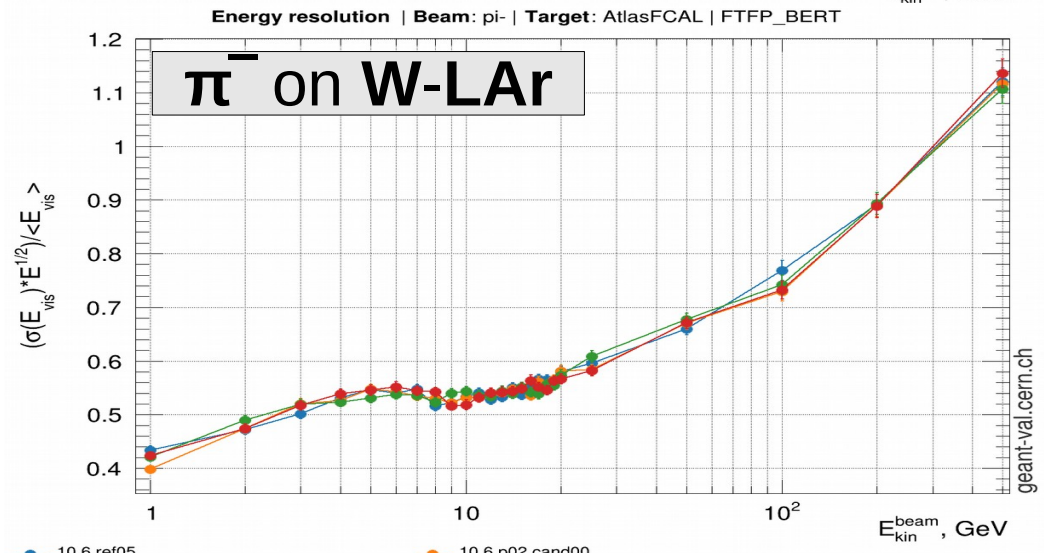


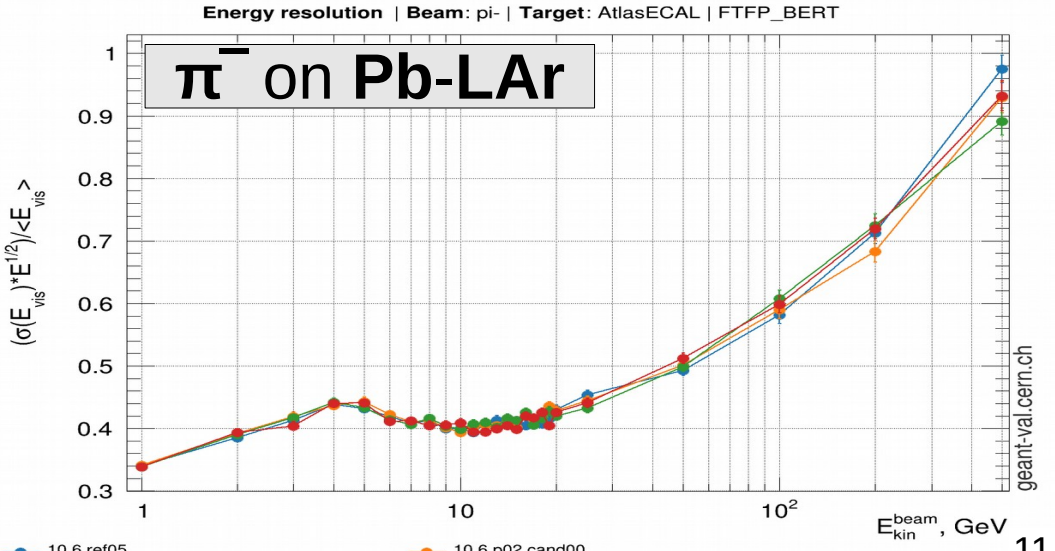


FTFP_BERT : Energy Resolution

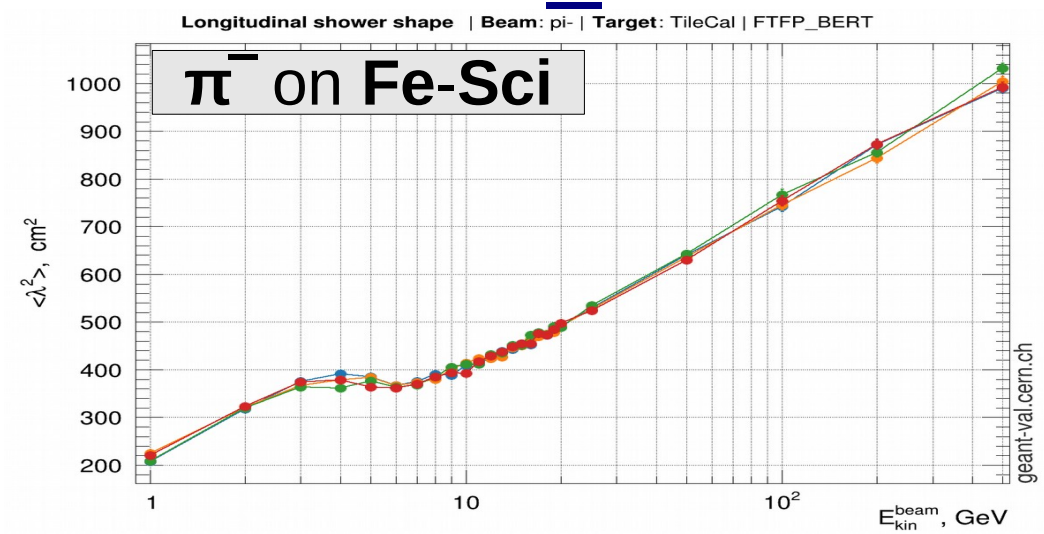


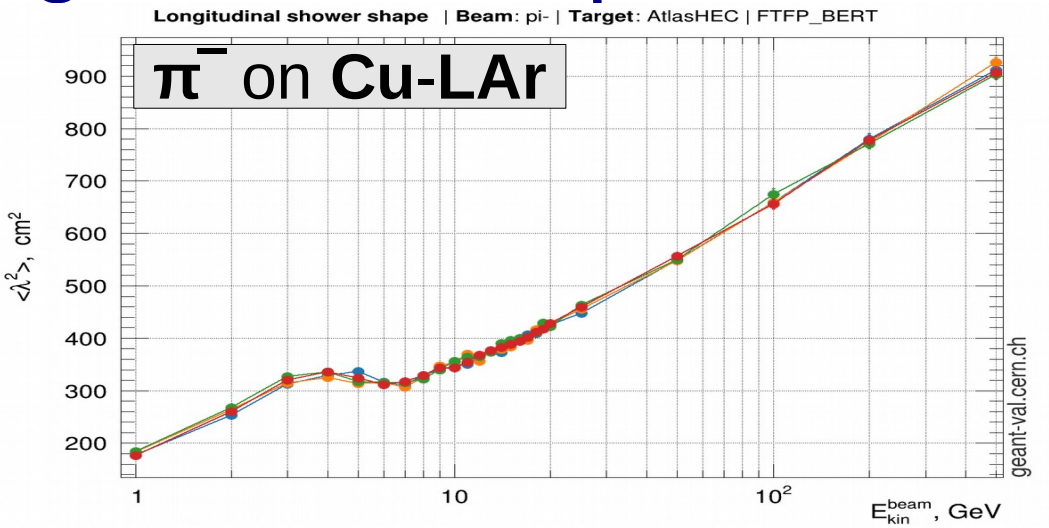


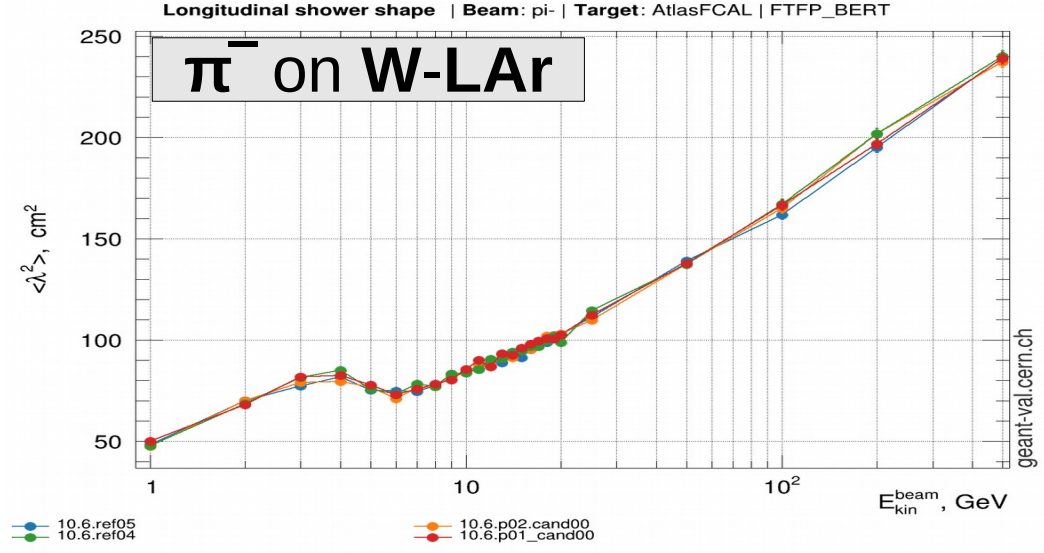


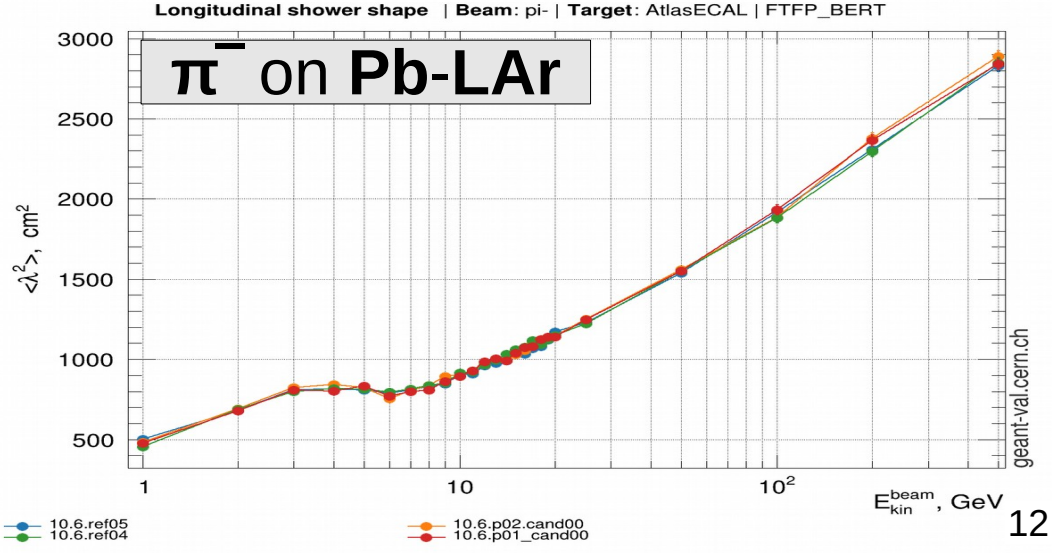


FTFP_BERT : Longitudinal Shape

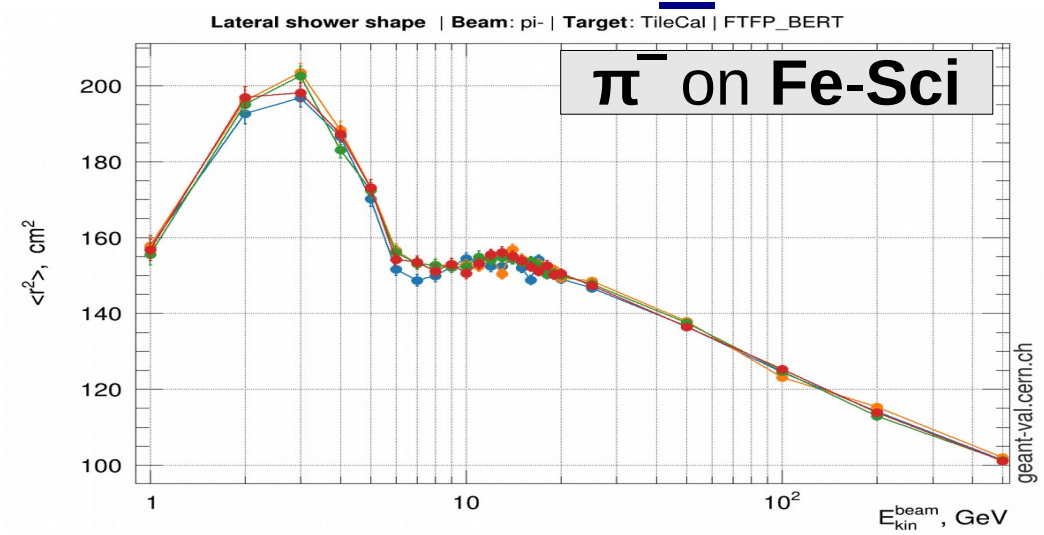


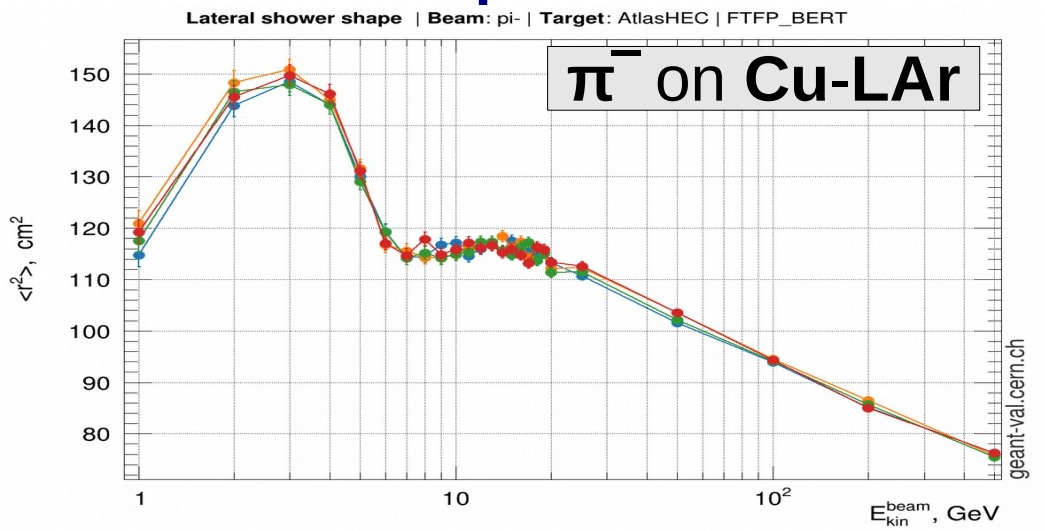


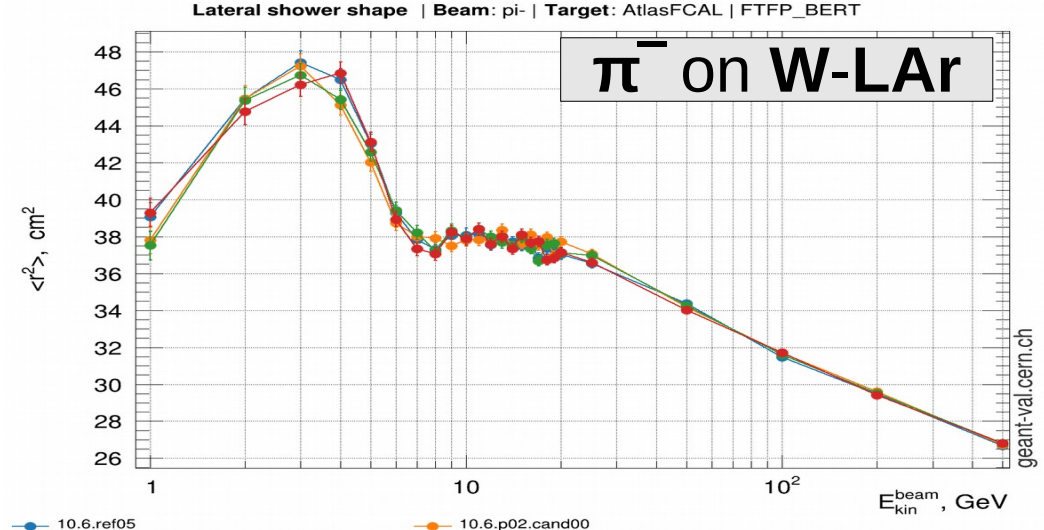


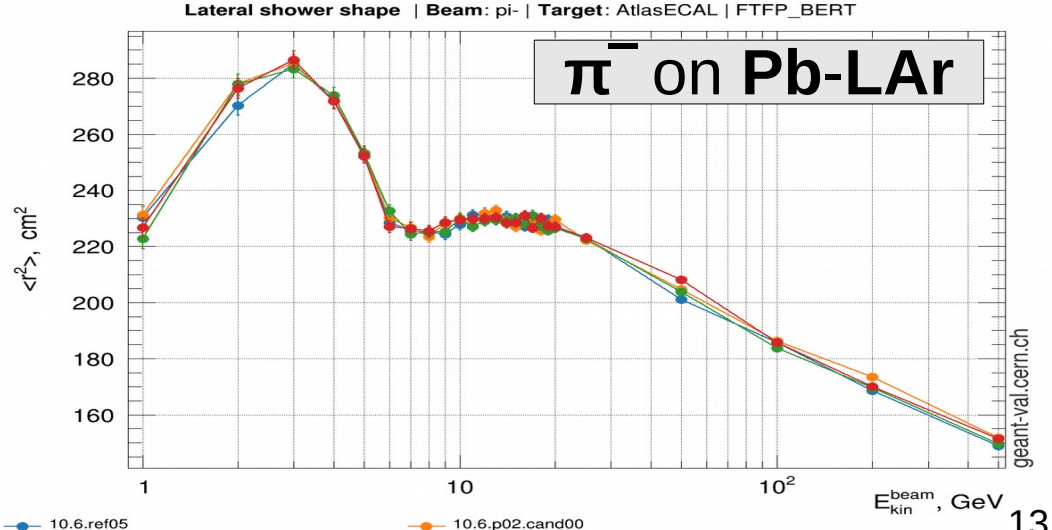


FTFP_BERT : Lateral Shape









Conclusions

- **G4 10.6.p02**
  - No crashes, infinite loops, or new warnings
  - Reproducibility OK

- **G4 10.6.ref05**
  - No crashes, infinite loops
  - Many warnings due to QGS applied to anti-baryons
  - Many reproducibility violations for MT vs. SEQ.

- Hadron showers
  - For all physics lists, similar showers for G4 10.6.{p01, p02, ref04, ref05}