Hadronic Showers in Geant4 **11.2.ref03**

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CERN EP-SFT

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Main Hadronic Changes in G4 11.2.ref03 *vs.* ref02

- New data library G4PARTICLEXS-**4.1**
  - Updated data for all isotopes, for neutron, protons and light ion cross-sections
  - Fixed cross-sections for Argon, Promethium, Astatine, Radon, Francium
  - Fixed low-energy cross-section; low-energy limits of cross-sections per target are verified and updated based on neutron data
- *hadronic/cross_sections/*
  - Updates to cross-section classes to rationalise initialisation of data in MT mode
    - *G4HadronXSDataTable* : make class a singleton for registration and destruction of static objects with cross-section data, data are deleted only at the end of run
    - *G4BGGNucleonElasticXS, G4BGGNucleonInelasticXS, G4BGGPionElasticXS, G4BGGPionInelasticXS, G4ComponentBarNucleonNucleusXsc, G4HadronNucleonXsc, G4UPiNuclearCrossSection, G4CrossSectionDataSetRegistry* : removed 'isMaster' checks and mutex locks
    - *G4BGGNucleonElasticXS, G4BGGNucleonInelasticXS, G4NeutronInelasticXS, G4ComponentBarNucleonNucleusXsc, G4ComponentGGNuclNuclXsc, G4PiData, G4NucleonNuclearCrossSection* : removed unneeded mutex locks; cross-sections outside data tables are equal to low or high edge of a table (instead of zero)

Crashes & Warnings

- No crashes
- No infinite loops
- 1 unsual warning

  G4VParticleChange::CheckSecondary :
  Ekin(MeV)=-5.82425e-07 is negative !!
  anti_nu_e created by model_RDM_BetaMinus

  - The fix *radioactive_decay-V11-02-02* made by Vladimir I. on February 20th, and included in 11.2.ref02, was the first attempt to fix the problem
  - The new MR #4325 (made by Alvaro yesterday) aims to solve the problem

Reproducibility

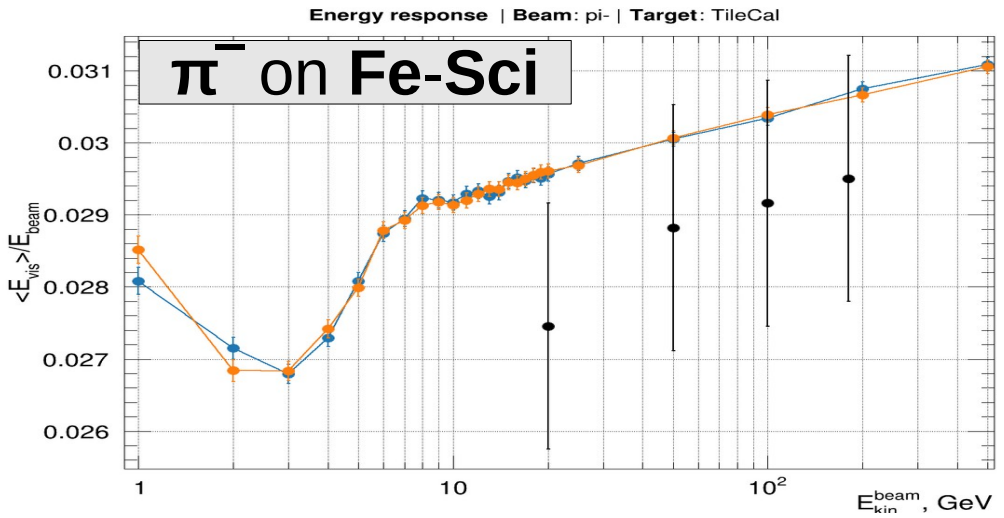
- OK in all cases

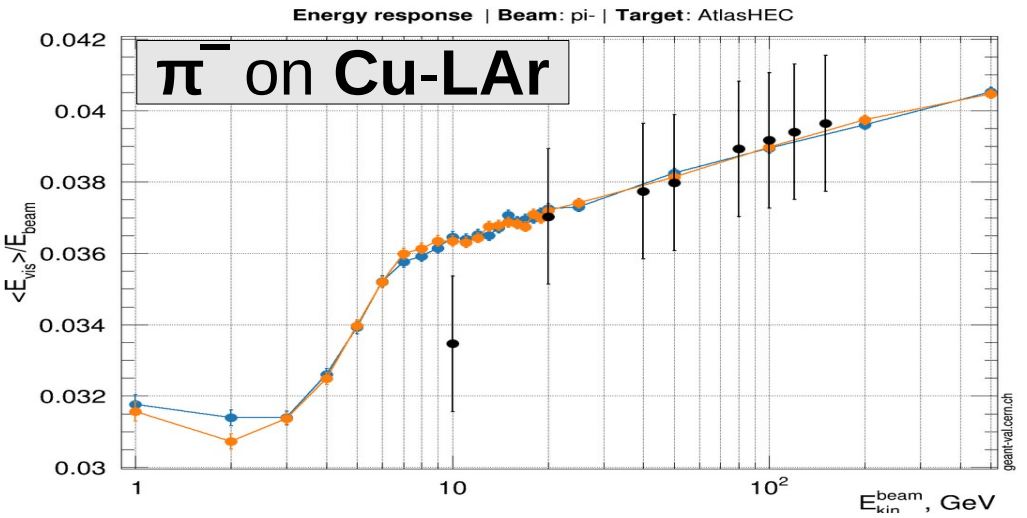
Pion- showers: FTFP_BERT

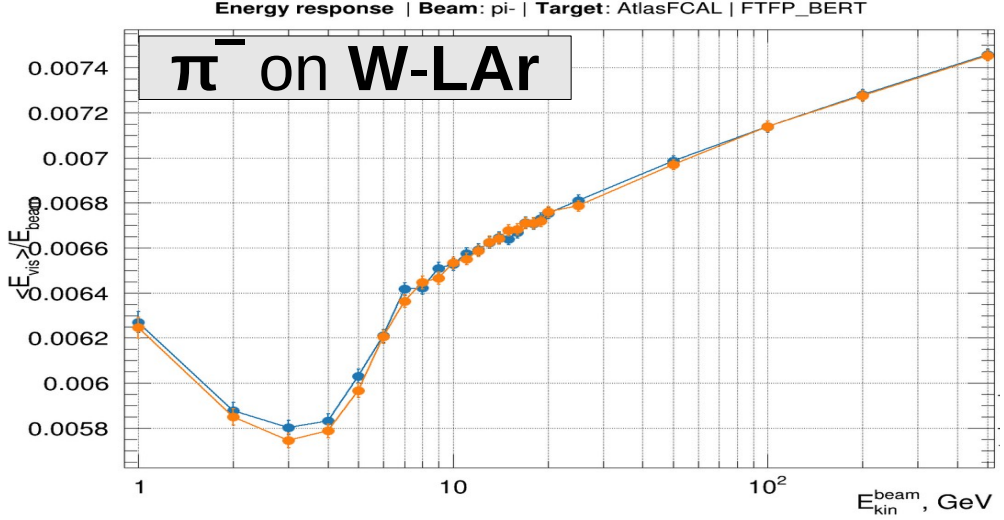
G4 11.2.ref02
G4 11.2.ref03

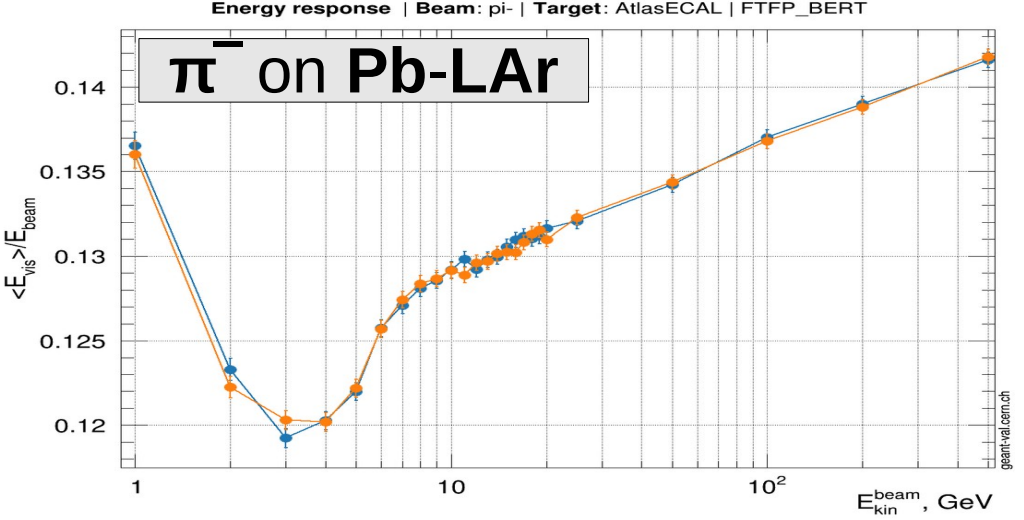
Note : conventional Birks treatment
(easier and no experimental h/e to fit !)

Energy Response

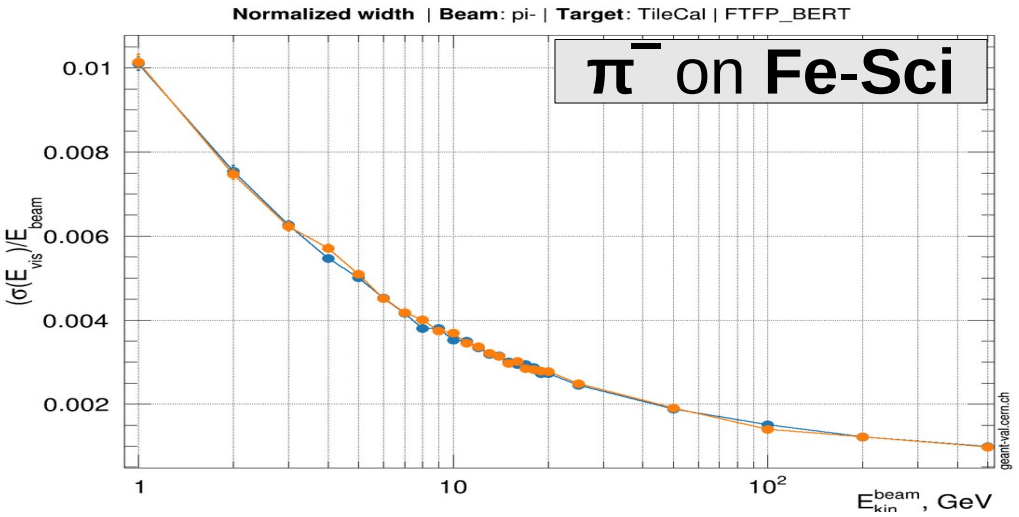


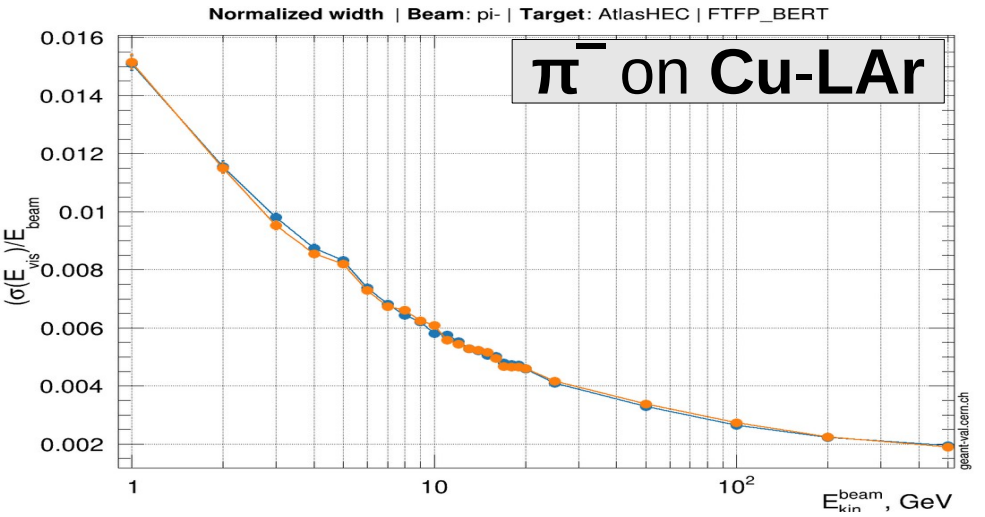


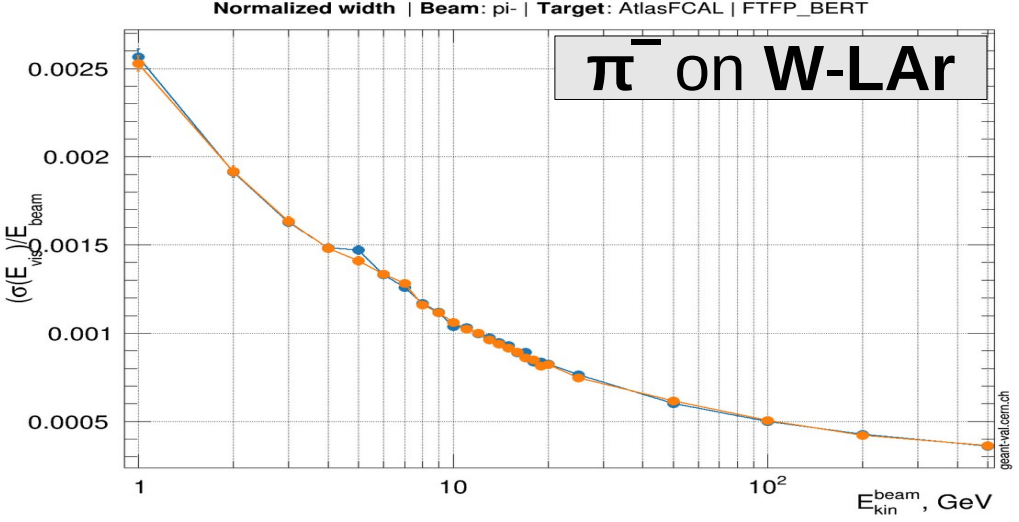


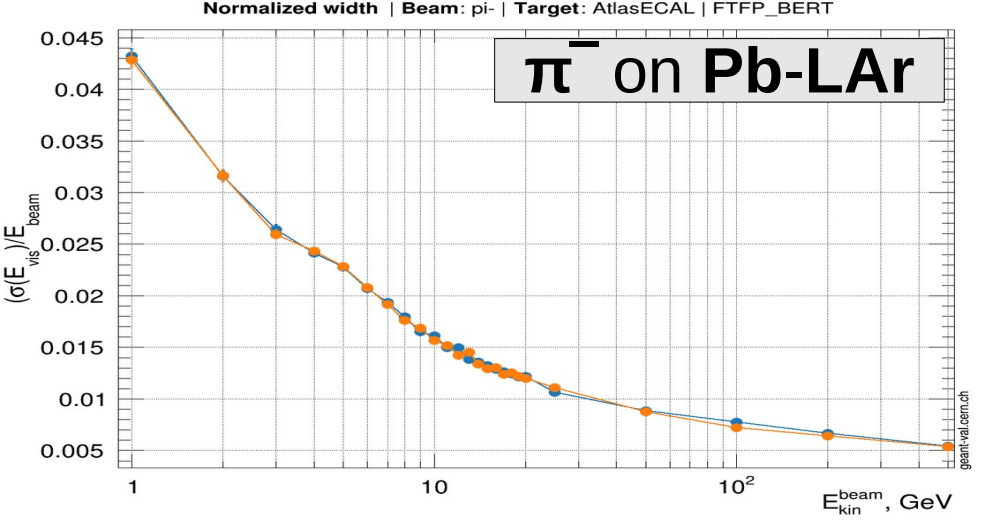


Energy Width

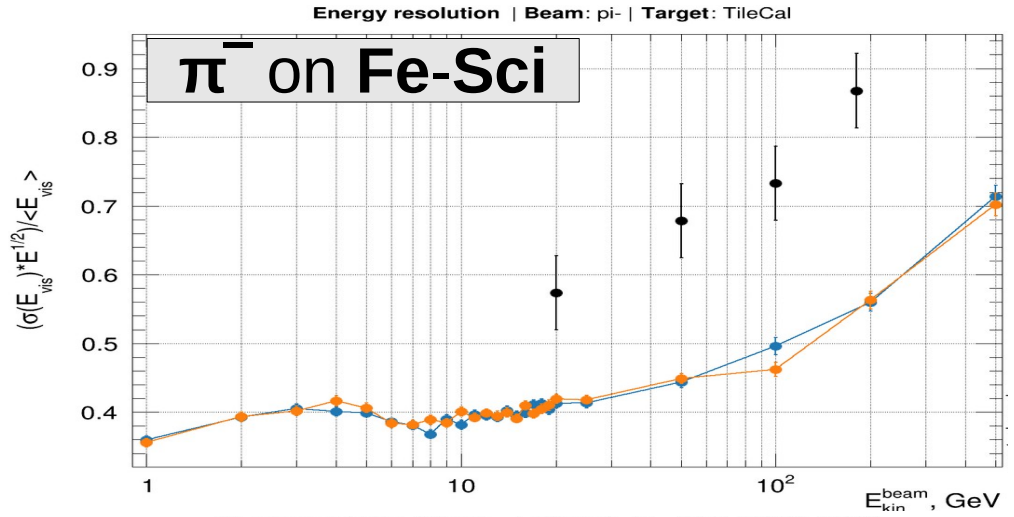


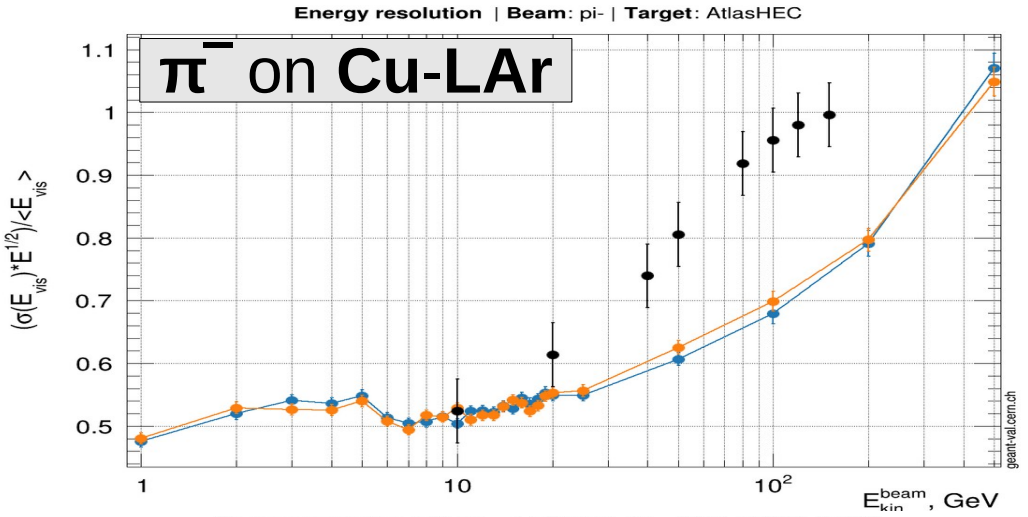


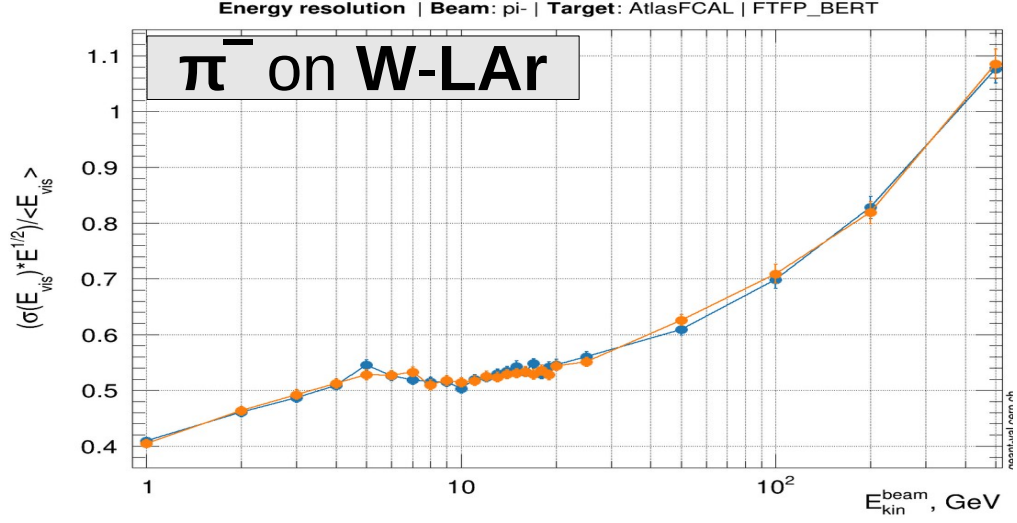


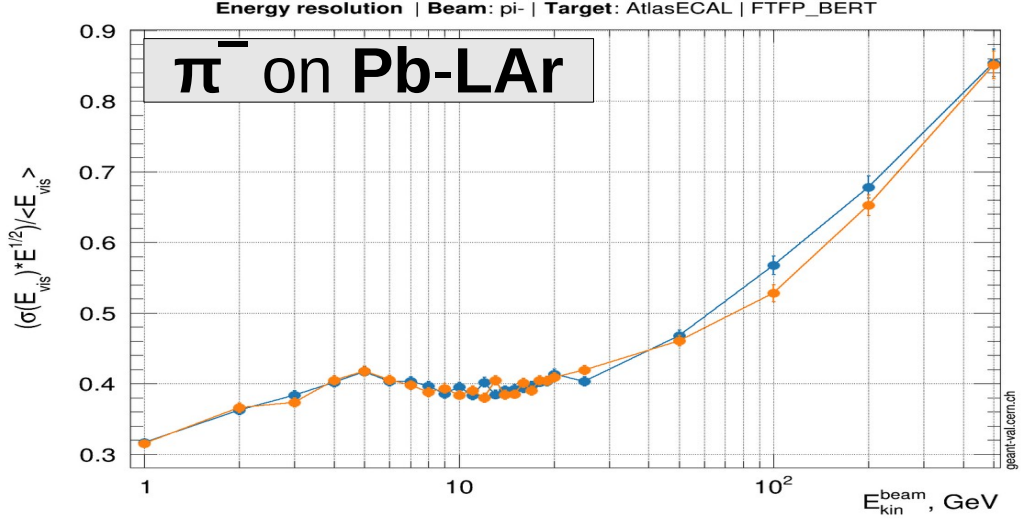


Energy Resolution

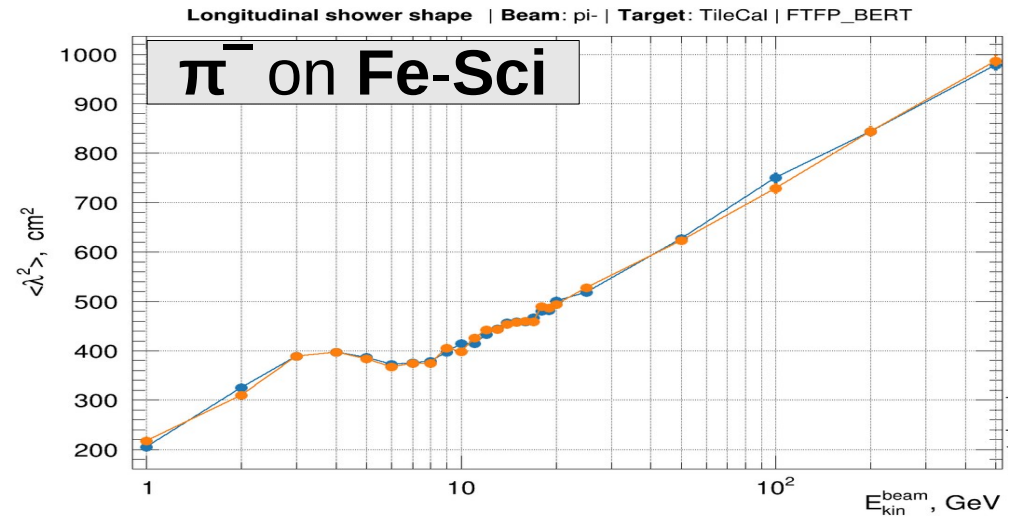


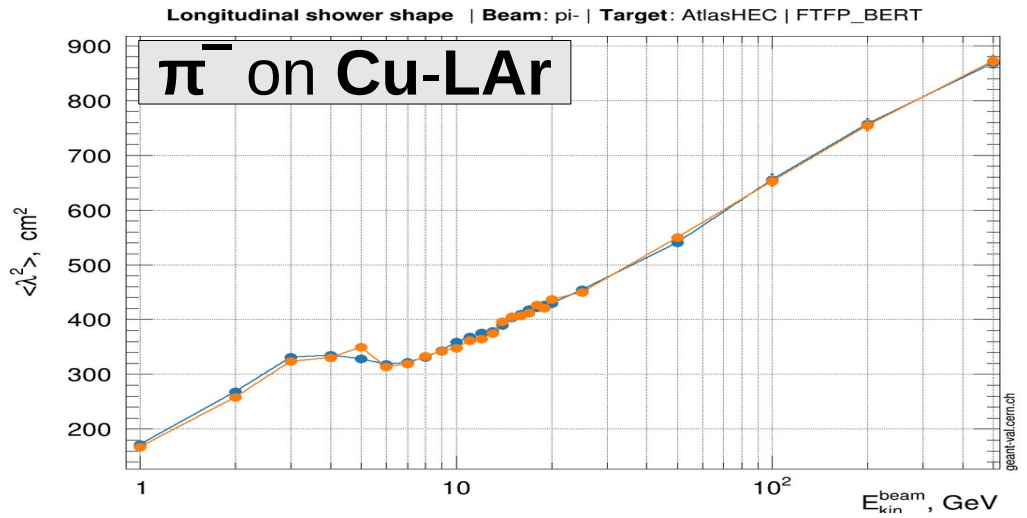


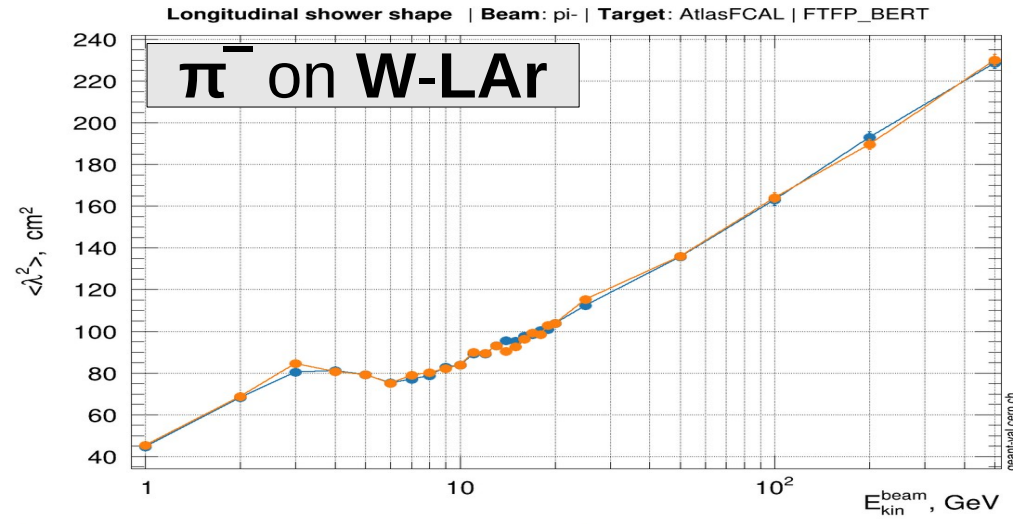


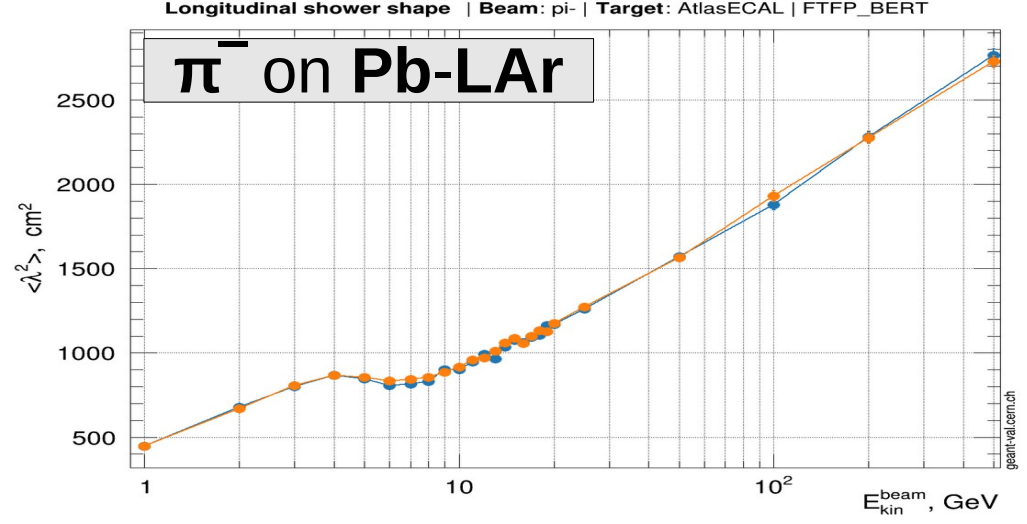


Longitudinal Shape



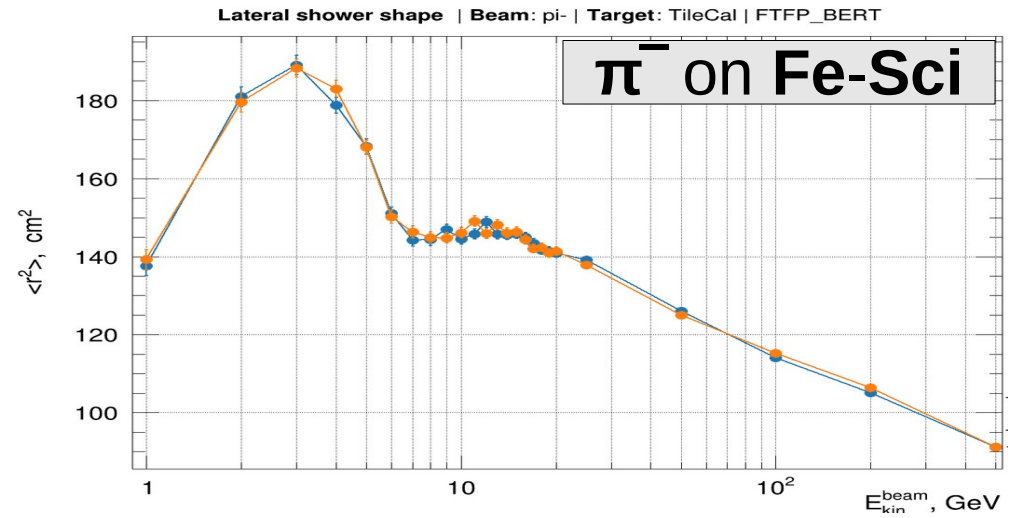


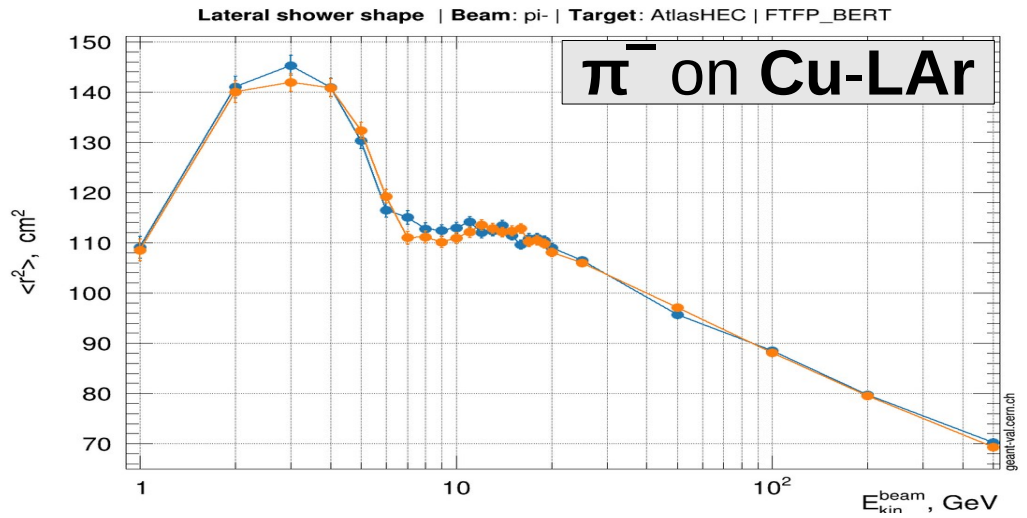


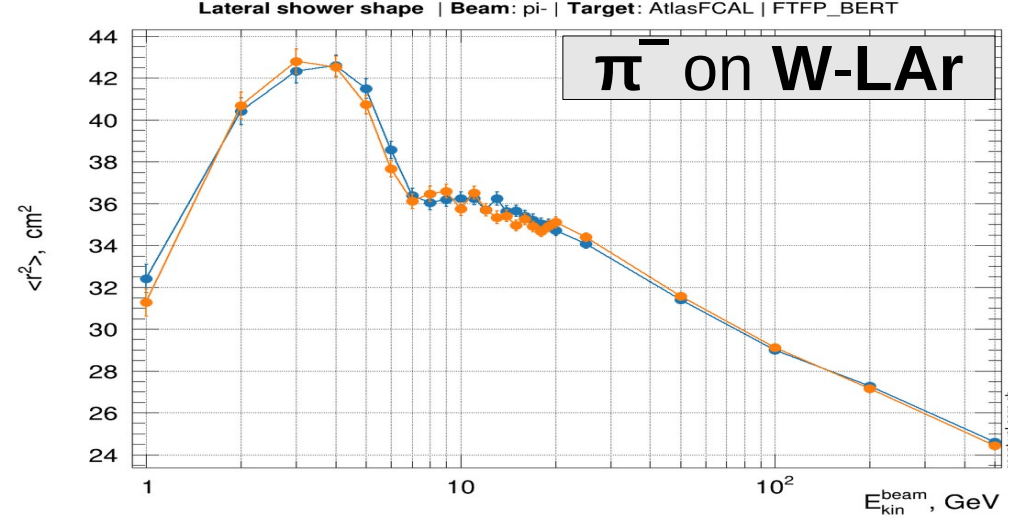


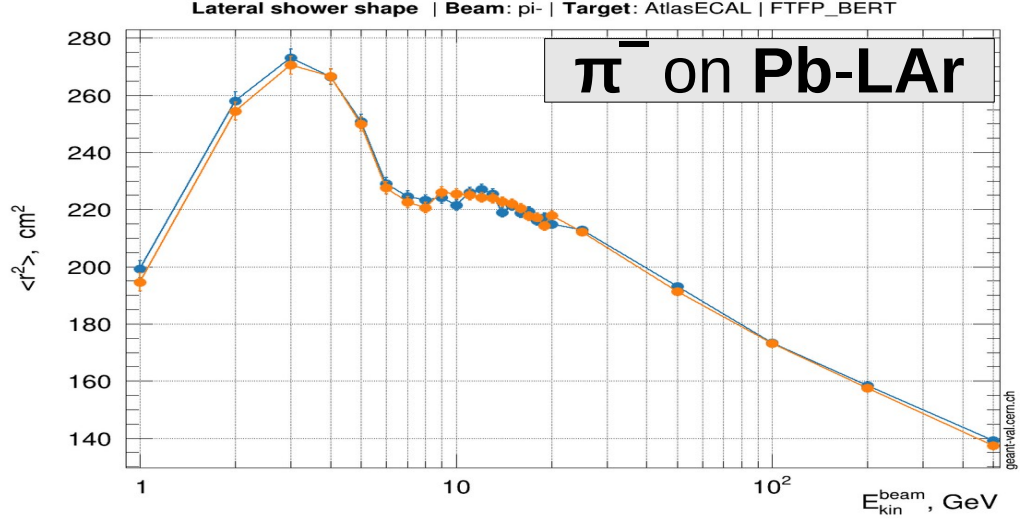
11.2.ref02 11.2.ref03 11.2.ref02 11.2.ref03

Lateral Shape









Conclusions

- **G4 11.2.ref03**
  - No crashes and no infinite loops
  - One unusual warning from Radioactive Decay to be fixed
    - Neutrino with negative kinetic energy in radioactive beta decay
  - Reproducibility fine in all cases
  - Hadron showers similar to those of G4 11.2.ref02 for all physics lists