Kaons in GEANT4

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GEANT4

During the simulation process after the generation stage is done GENIE passes a list of particles (FSI particles) into GEANT4 to simulate the pass through matter

GEANT4 will calculate its energy loss (dE/dx), it would calculate the cross section and decide whether it goes under elastic, inelastic or charge exchange interaction

GEANT4 uses a parametrization that was developed using extensive data samples and contains a number of parameters which depend on the particle

How is GEANT4 handling kaons?

kaon+ p total cross section

Courtesy of Hans Wenzel
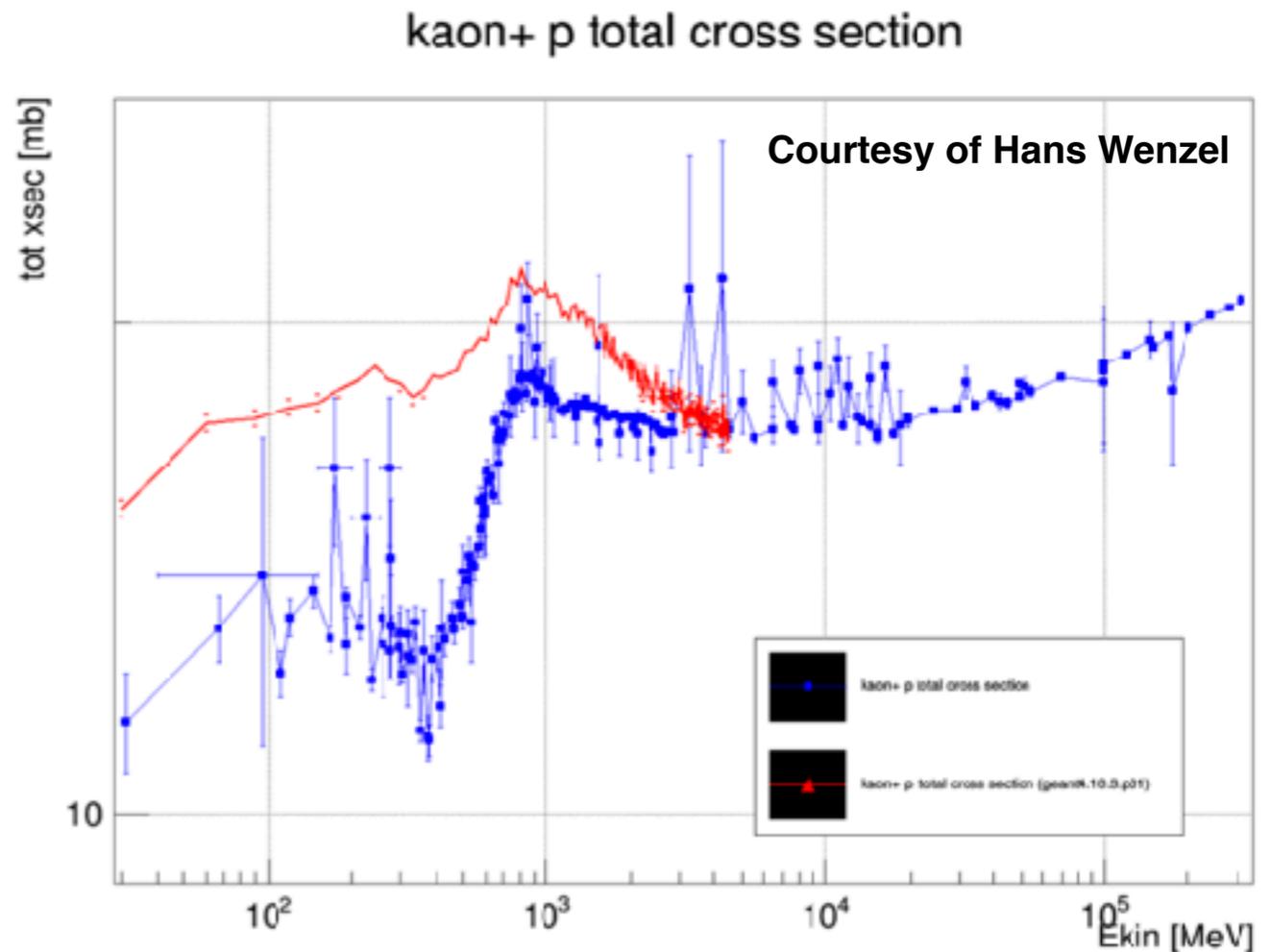
GEANT4

Prior to version G4.10.3 patch-03 GEANT4 was not in a good agreement with PDG data

This has been fixed (see version release note)

    o Physics Lists:

      + constructors/hadron_elastic:
       o G4HadronElasticPhysics, G4HadronHElasticPhysics: changed kaon elastic
        cross-sections from, respectively, Gheisha and Chips, to Glauber Gribov
        ones. This way, the total (elastic + inelastic) kaon cross sections are
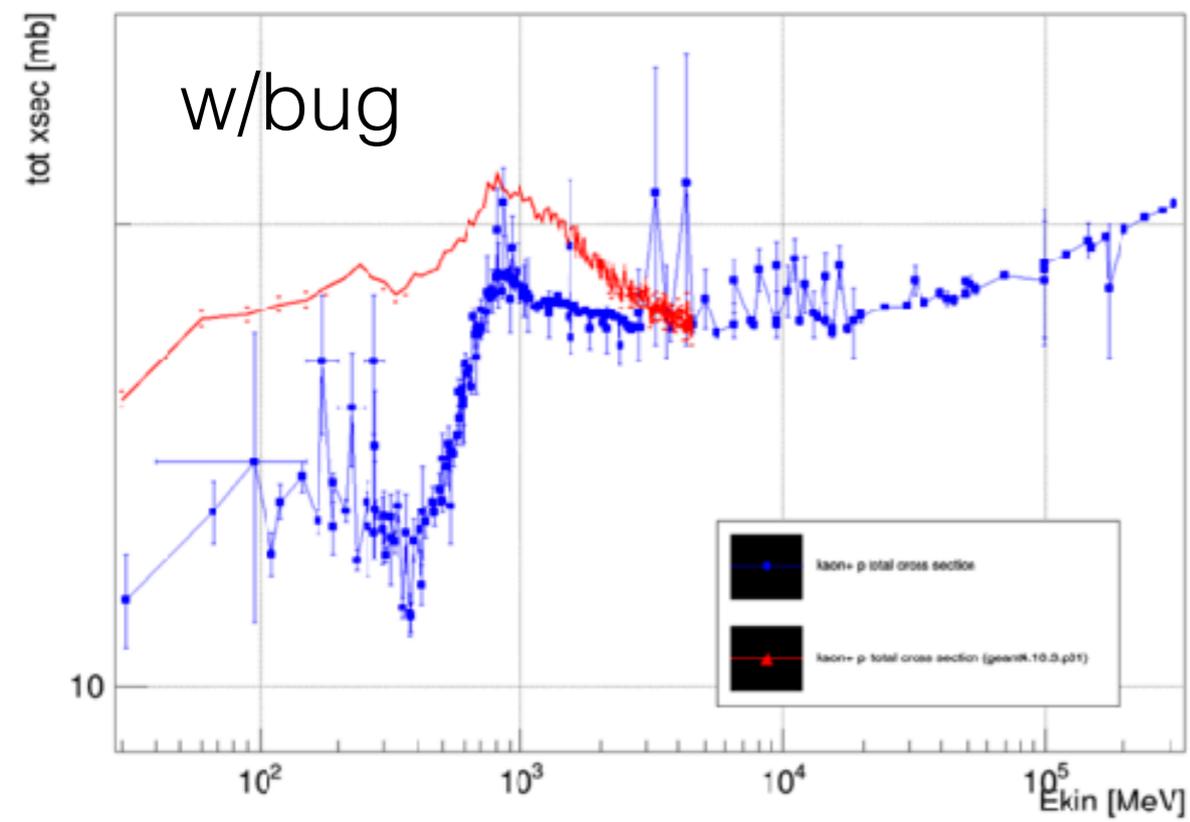   consistent with the PDG ones.

   o Processes - Hadronic:

      + cross_sections:
       o Bug fix in G4ComponentGGHadronNucleusXsc to use the correct cross-
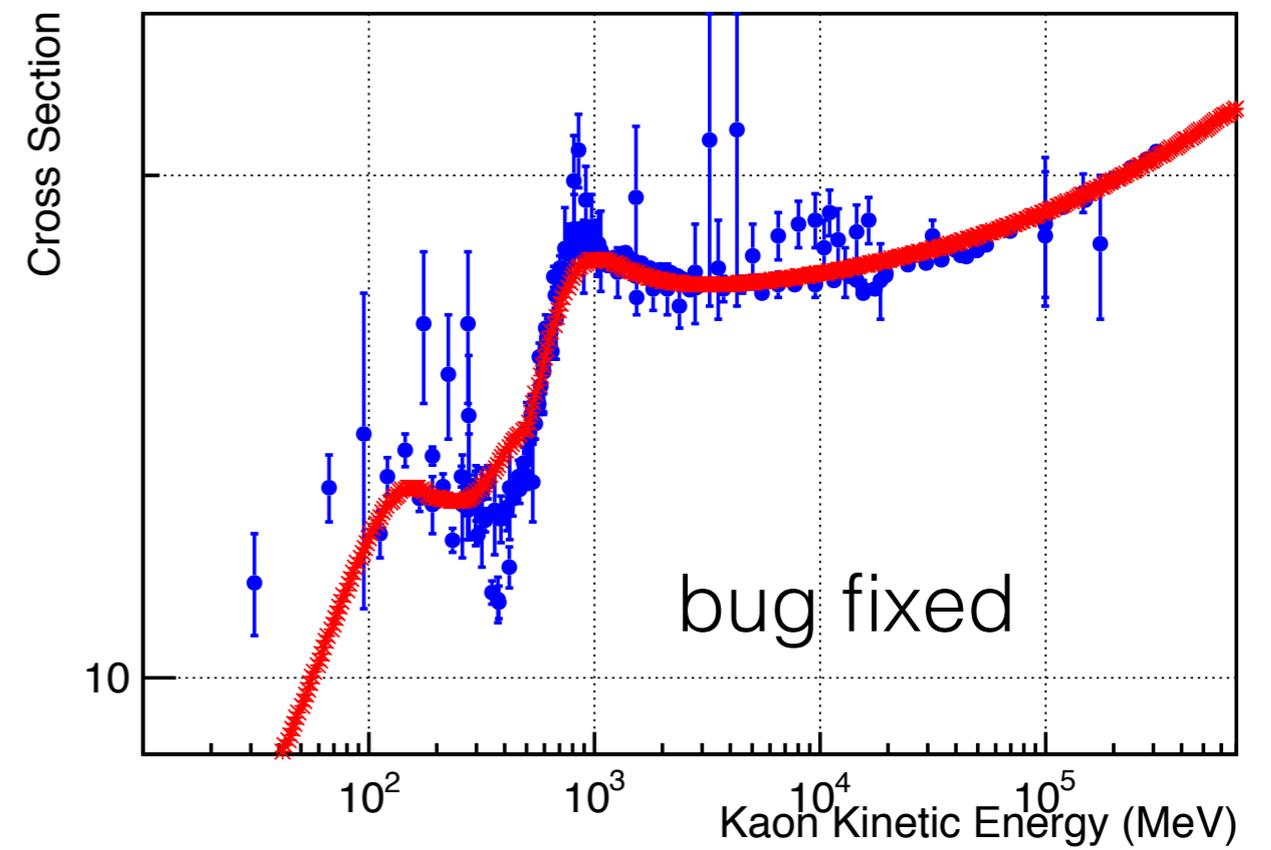   sections for kaons on Hydrogen; use Starkov parameterization for them.
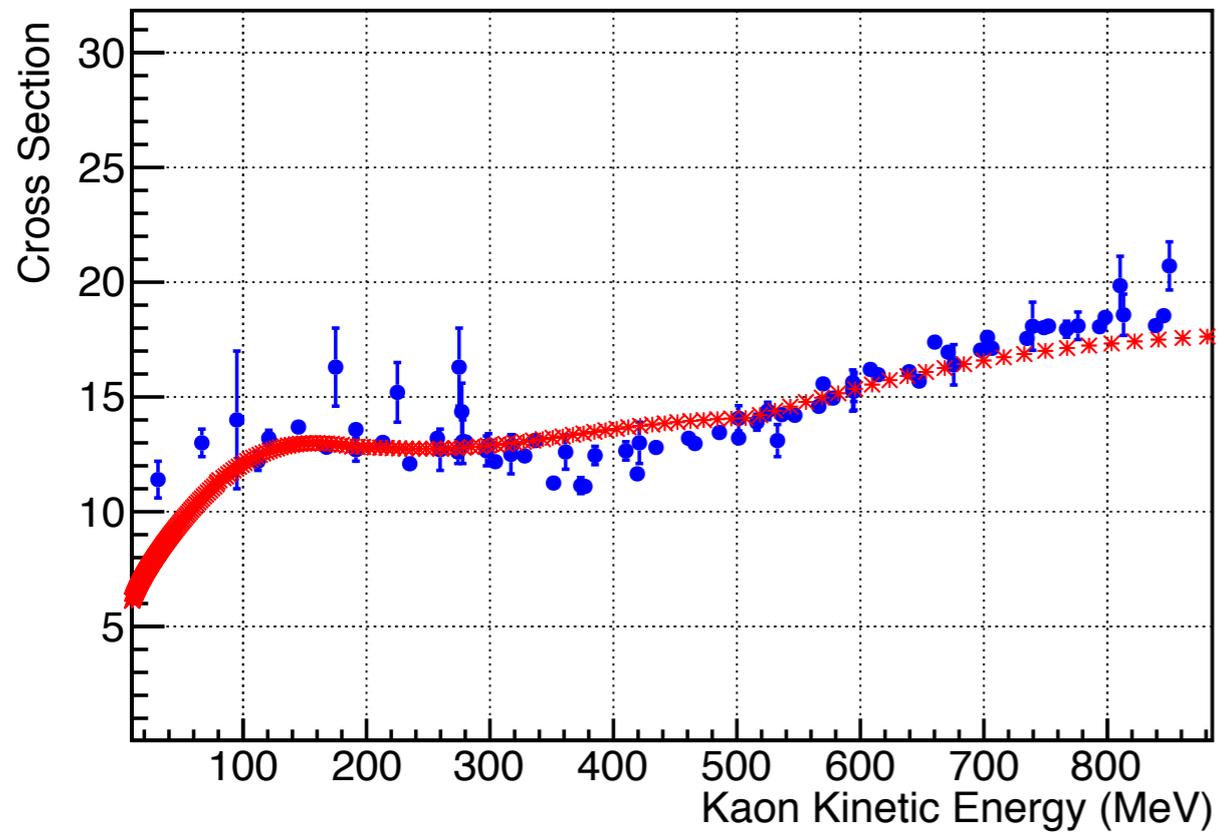   + models/cascade:

GEANT4

kaon+ p total cross section

w/bug

kaon+P total cross section 4.10.3.p03 FTFP_BERT

bug fixed

4
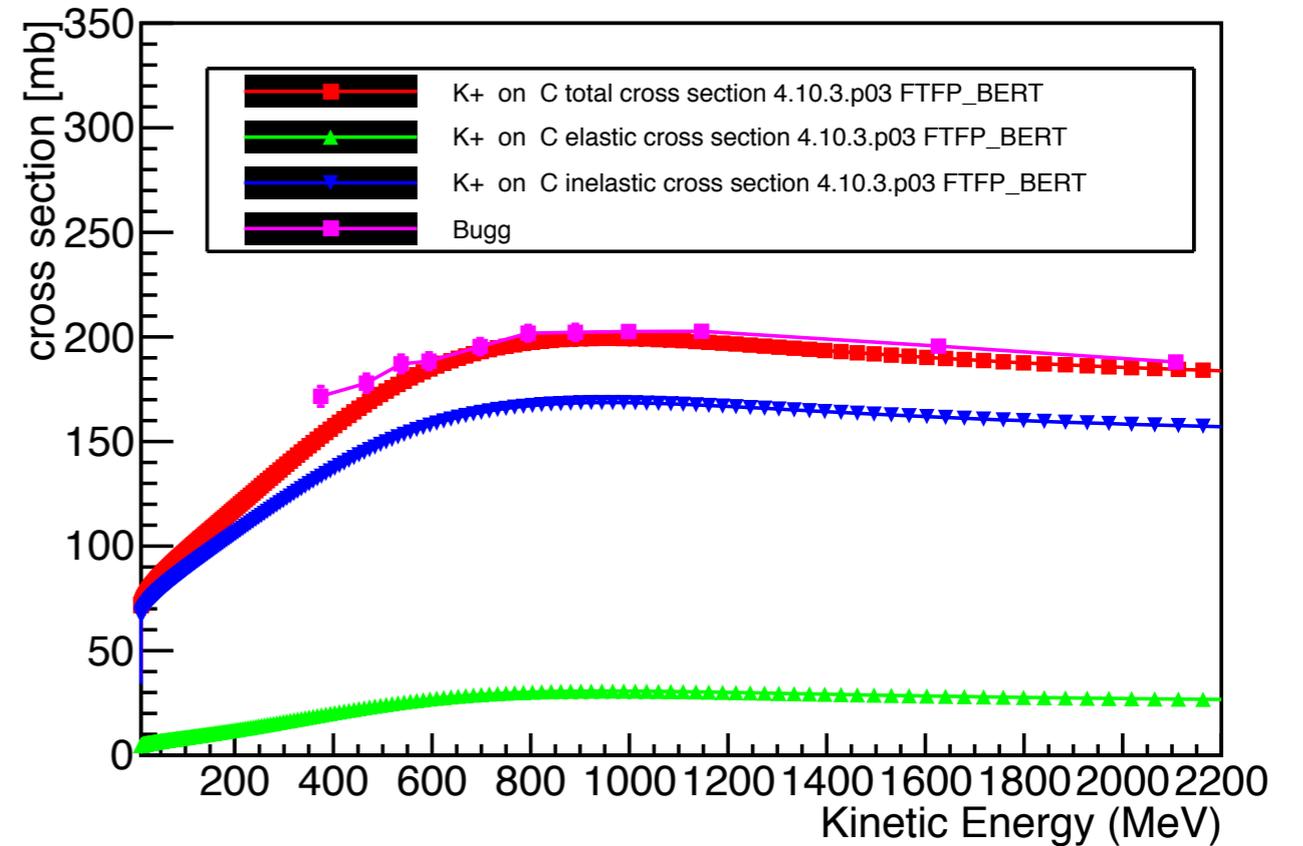
GEANT4

Carbon

kaon+ p total cross section 4.10.3.p03 FTFP_BERT
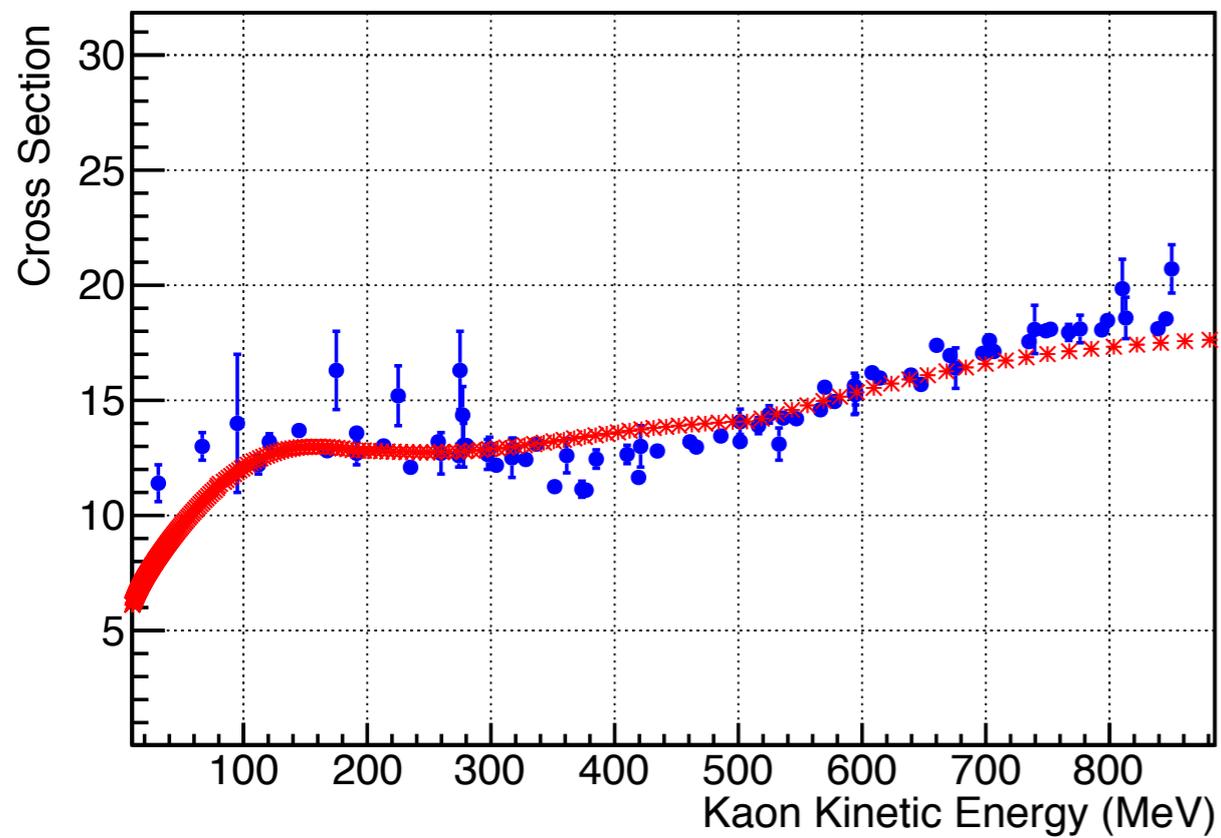
K+ on C total cross section 4.10.3.p03 FTFP_BERT

Thanks to Hans Wenzel for provide Geant4's cross section tables

GEANT4

kaon+ p total cross section 4.10.3.p03 FTFP_BERT

Argon

K+ on Ar total cross section 4.10.3.p03 FTFP_BERT

Legend:
- K+ on Ar total cross section 4.10.3.p03 FTFP_BERT
- K+ on Ar elastic cross section 4.10.3.p03 FTFP_BERT
- K+ on Ar inelastic cross section 4.10.3.p03 FTFP_BERT

Left plot axes: Cross Section vs Kaon Kinetic Energy (MeV)

Right plot axes: cross section [mb] vs Kaon Kinetic (MeV)
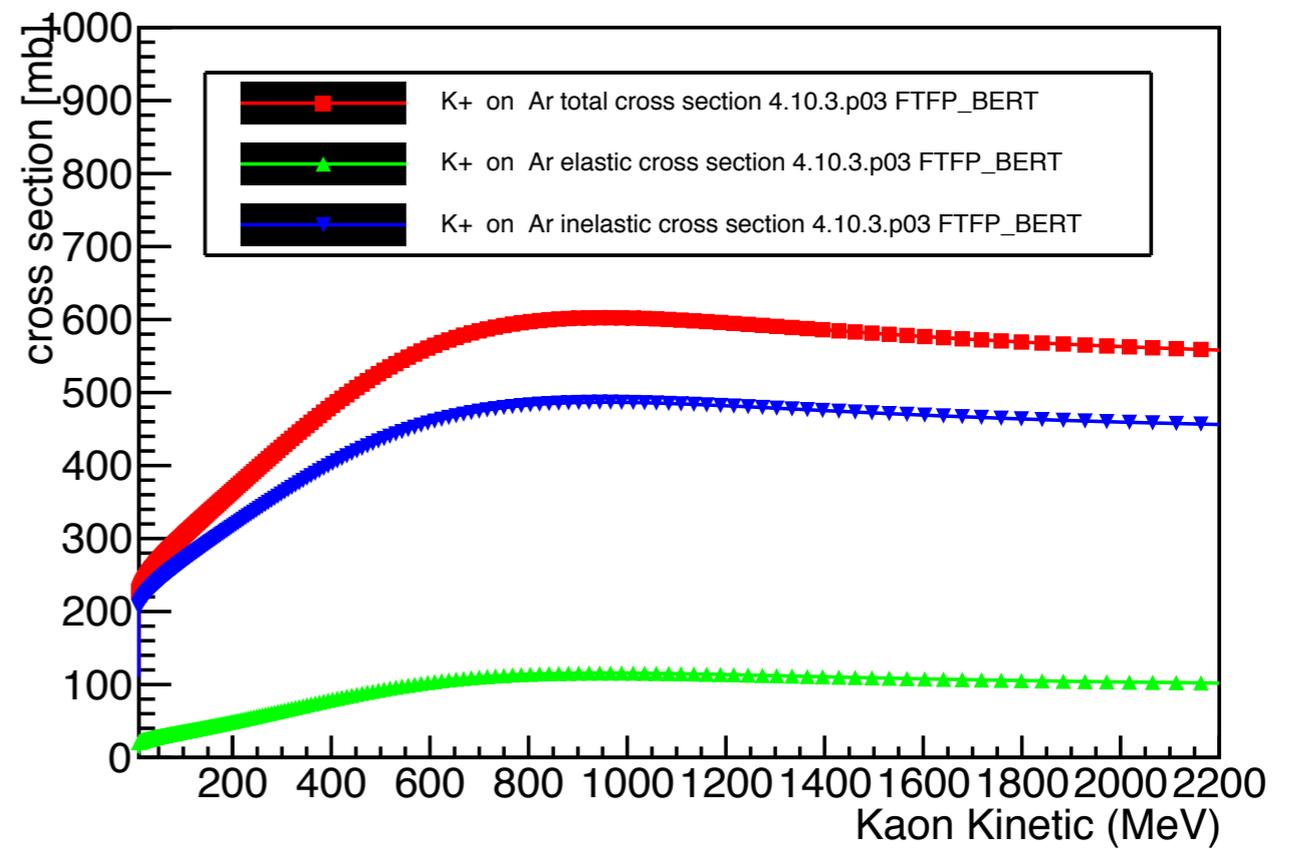
$A^{2/3}$ scaling

Comments

Current version of GEANT4 (geant4-10-03-patch-01a) in LArSoft has a known bug for kaons

We request LArSoft team to update GEANT4 version to 4.10.3.p03 or later

The End

Geant4 total cross section simulation vs. data (Ashery)

Liquid Argon

π^+ total Xs

total Xs [mb]

Geant4 at 300 MeV

Ashery at 315 MeV

atomic mass

40

C1*(atomic mass)^C2

total cross section fit results

Geant4
C2 = 0.67 +/- .01

Experimental data
C2 = 0.70+/- .008

Close to expected C2 = 0.66