# Comments on cross section library

V. Ivanchenko CERN & Tomsk State University, Russia

Geant4 Hadronic group meeting

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What is new in 10.7 for hadronic cross sections

- G4PARTICLEXSDATA is based on ParticleHP data
  - New G4NDL4.6 requires regeneration of the G4PARTICLEXS
  - Special attention to fusion reactions
- G4NeutronCaptureXS, G4NeutronElasticXS, G4NeutronInelasticXS, G4ParticleInelasticXS G4GammaNuclearXS are updated
  - Adopted for extended list of isotopes
  - Removed special (but not accurate) treatment of cross sections on deuterium, tritium, He3 targets
  - Below 20 MeV isotope cross-sections available
- Below some plots are shown
  - I cannot compare with geant-val, because 10.7 data is not yet available

Neutron Cross section off Si
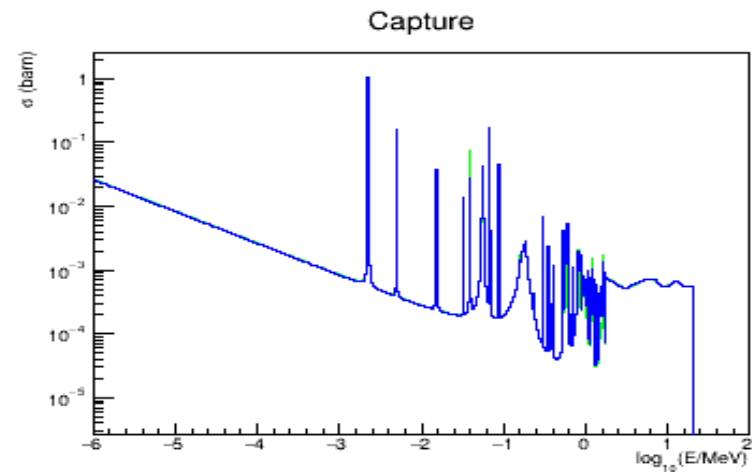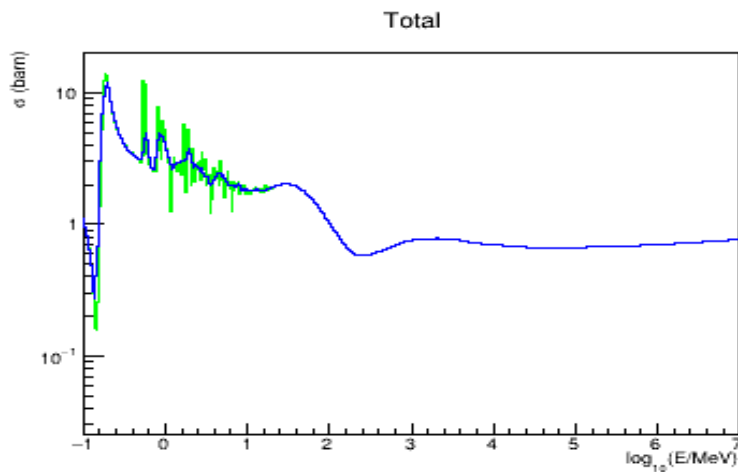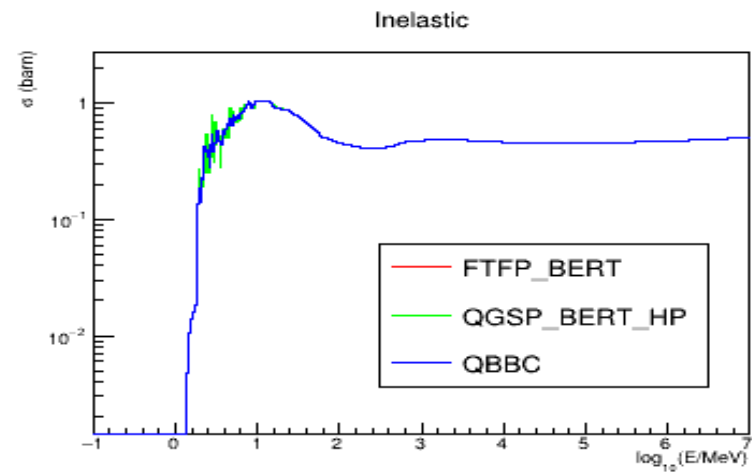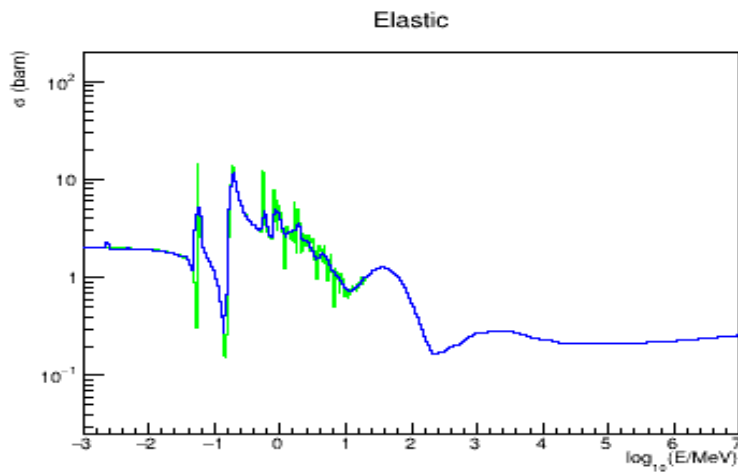
Neutron Cross section off W
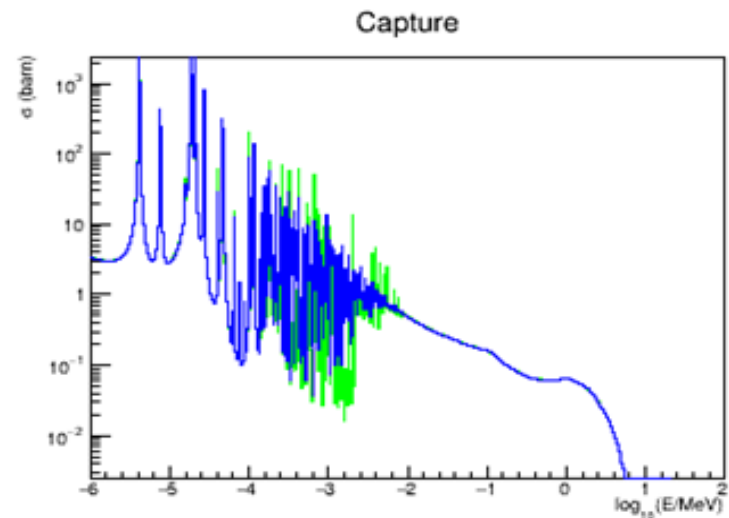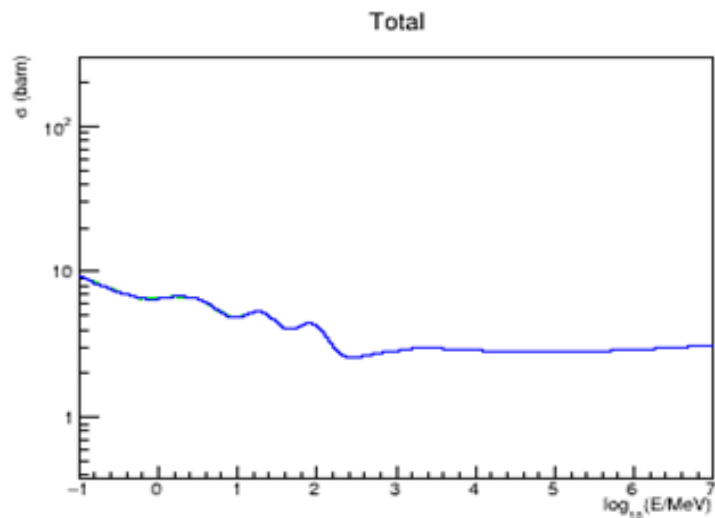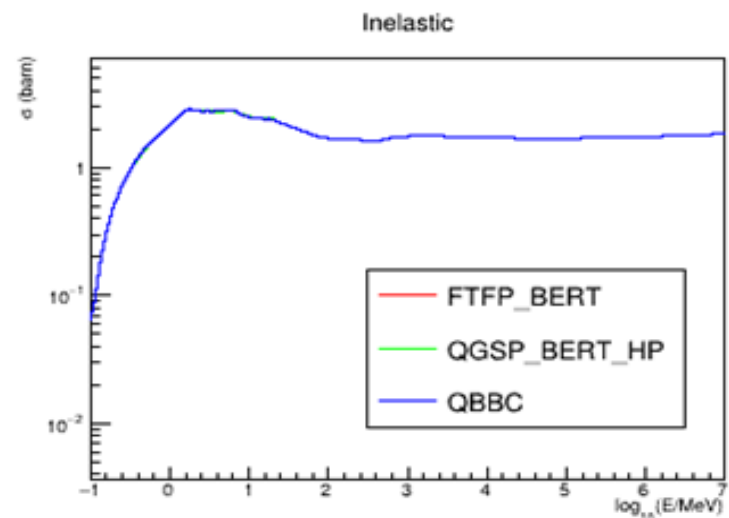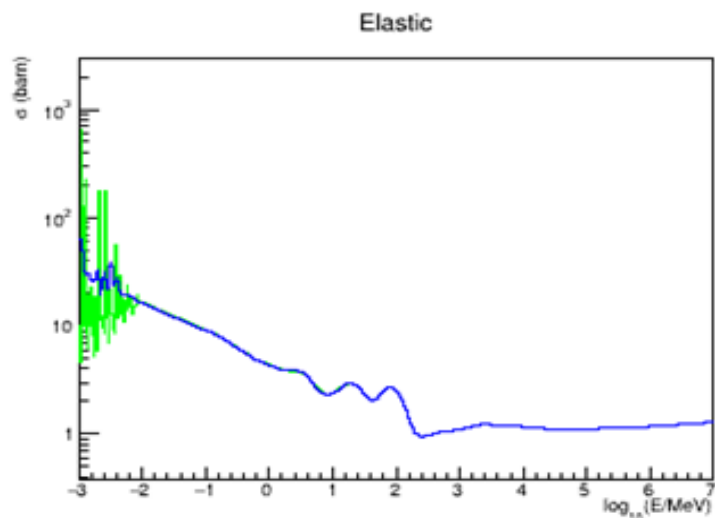
Total, elastic and inelastic cross sections p + p in mb, model = XS
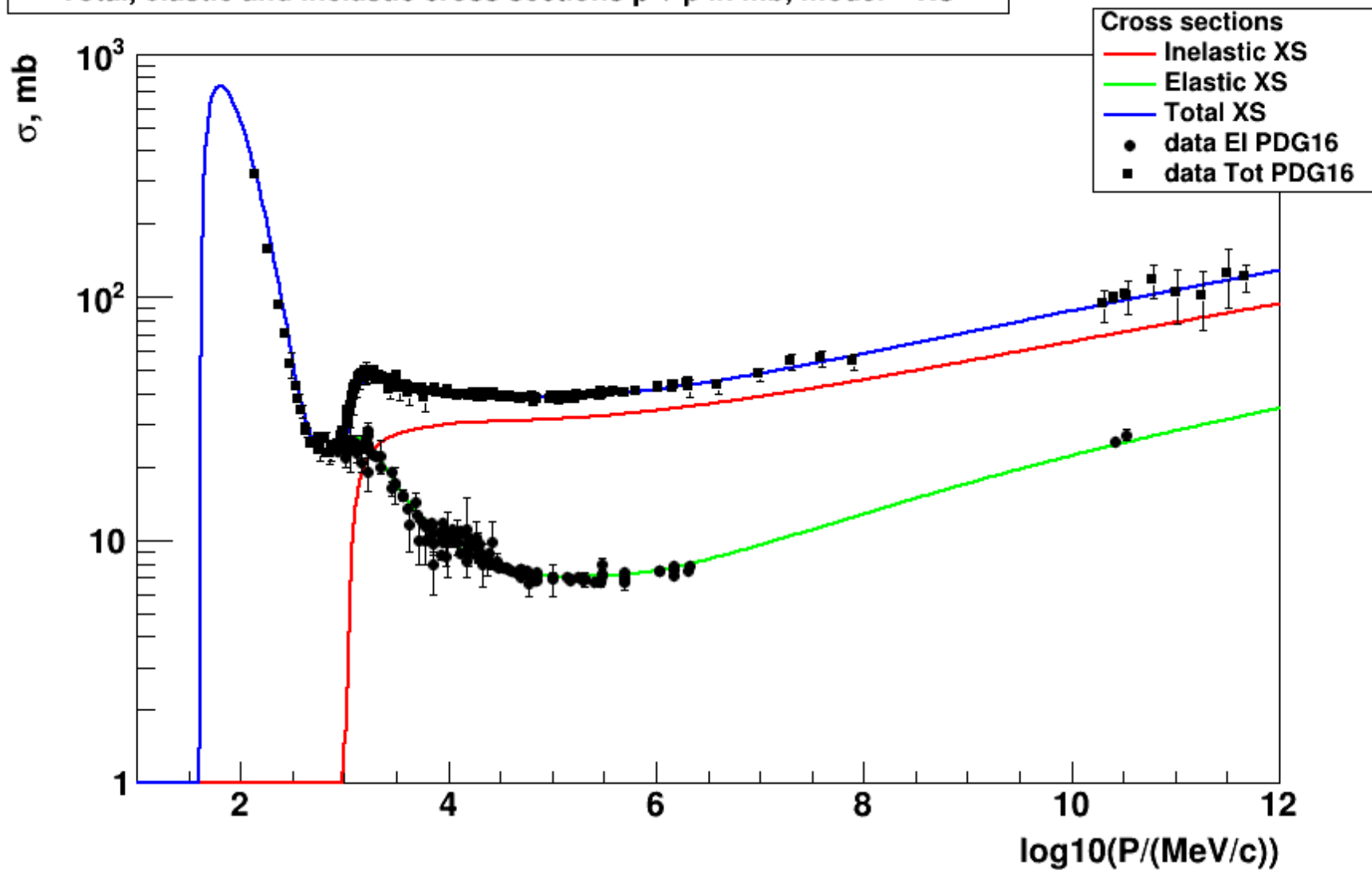
Total, elastic and inelastic cross sections $\pi^+ + p$ in mb, model = BGG
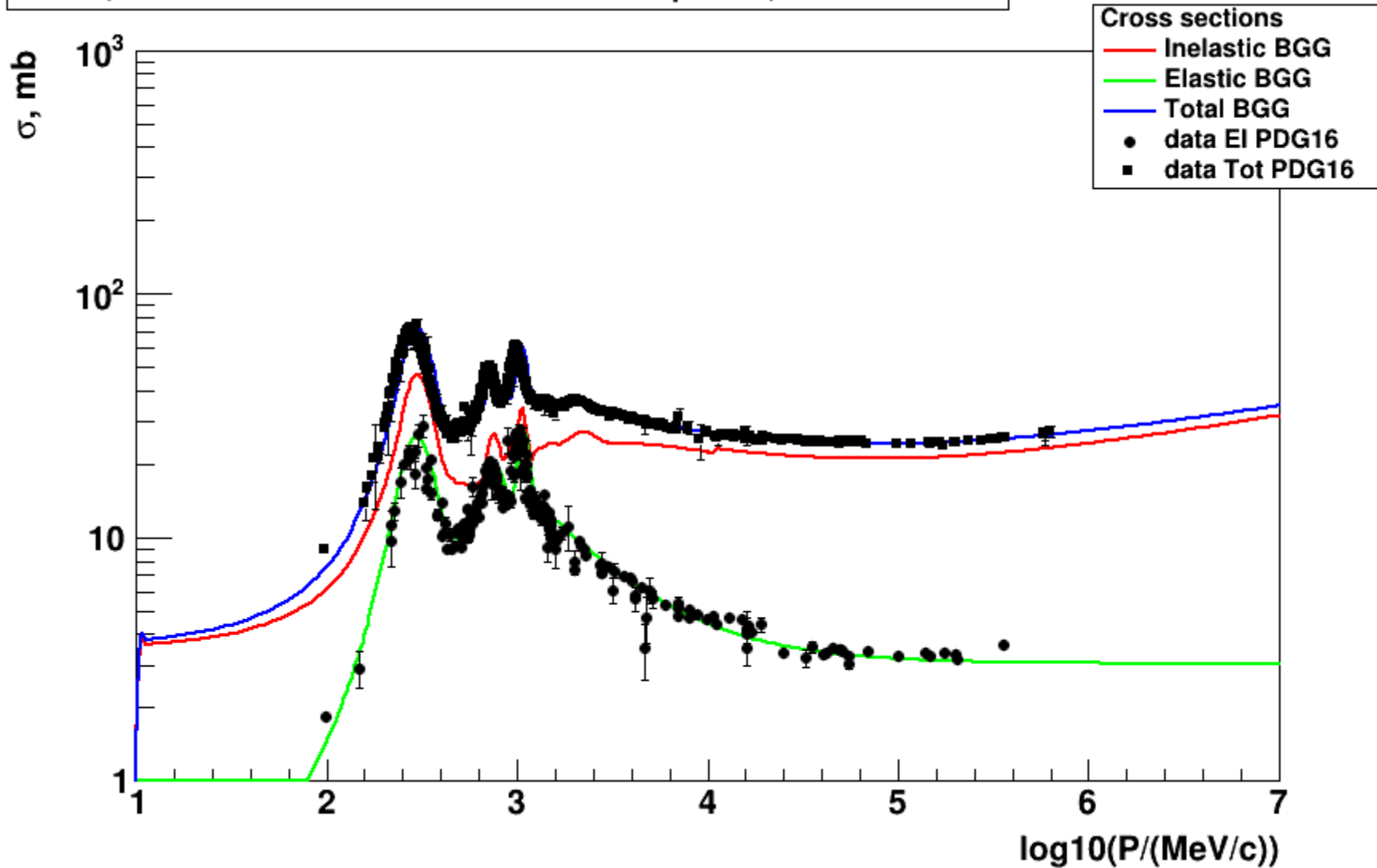
Cross sections
— Inelastic BGG
— Elastic BGG
— Total BGG
● data El PDG16
■ data Tot PDG16

σ, mb

$\log_{10}(P/(\text{MeV}/c))$

Total, elastic and inelastic cross sections π^- + p in mb, model = BGG

Cross sections
— Inelastic BGG
— Elastic BGG
— Total BGG
● data El PDG16
■ data Tot PDG16

σ, mb

log10(P/(MeV/c))

Total, elastic and inelastic cross sections K$^+$ + p in mb, model = NS

Cross sections
Inelastic NS
Elastic NS
Total NS
data El PDG16
data Tot PDG16

σ, mb

$\log10(P/(MeV/c))$
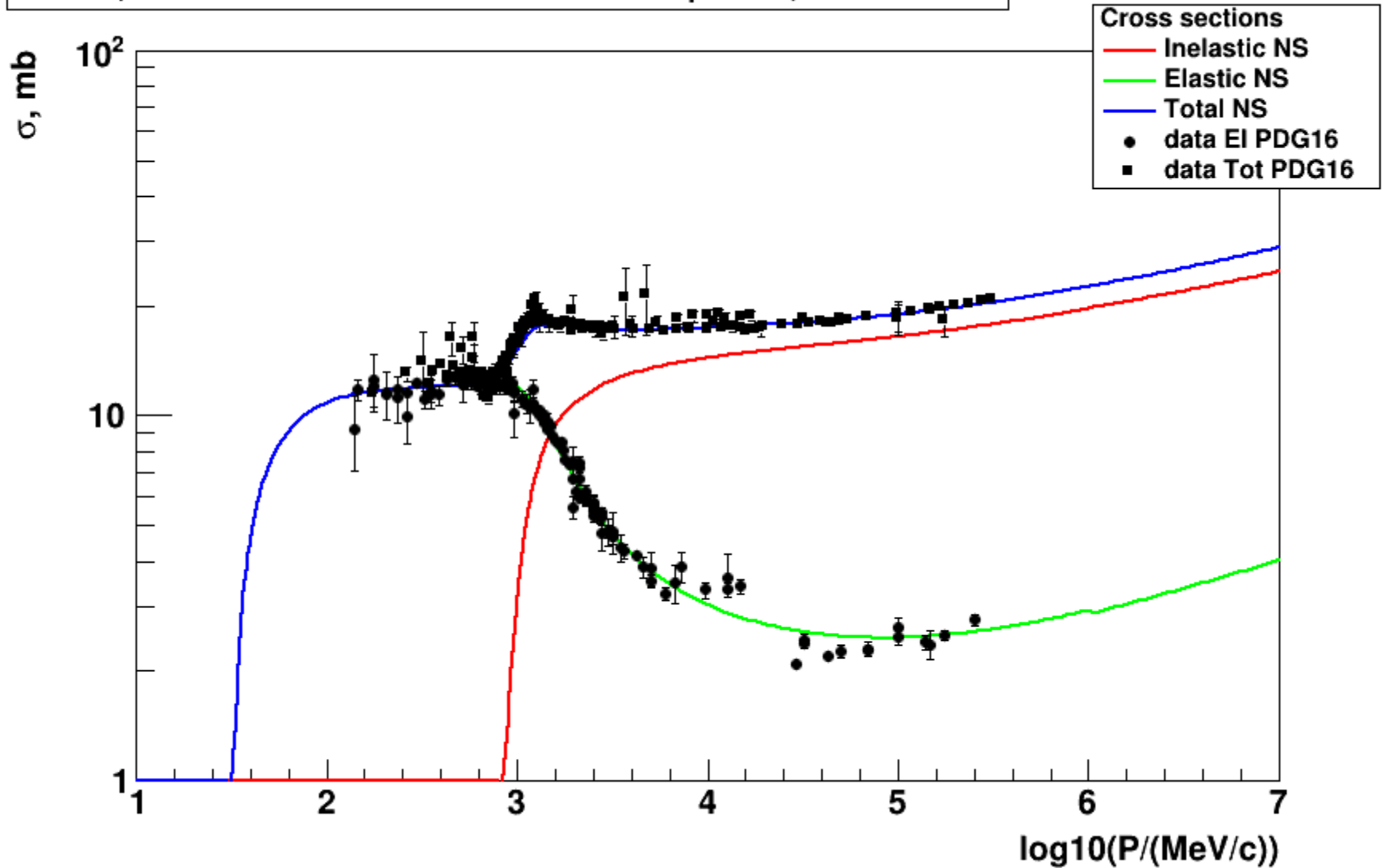
Total, elastic and inelastic cross sections K⁻ + p in mb, model = NS
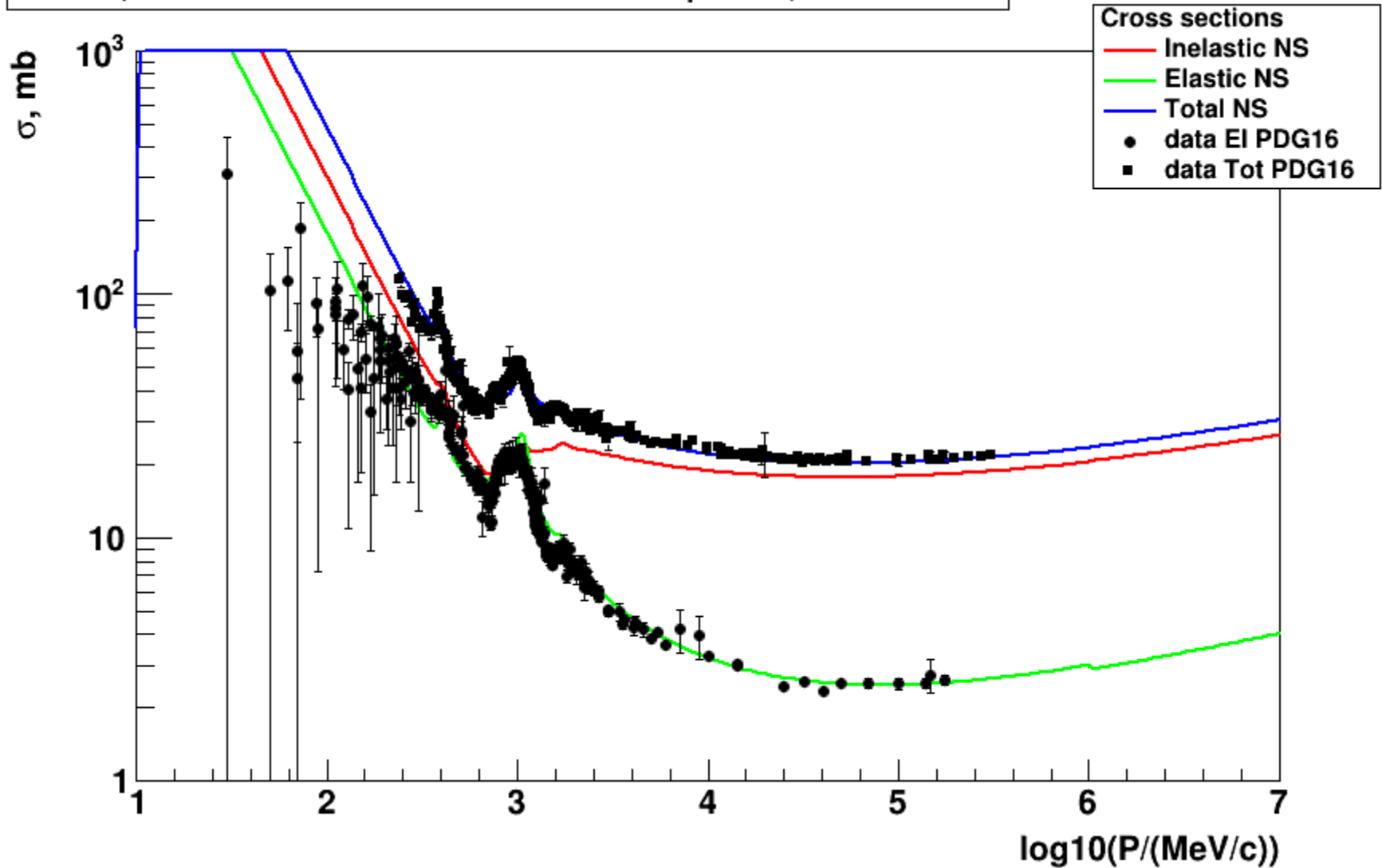
Comments on Glauber-Gribov cross sections

- In the current GG x-section for hadrons and ions
  - Elementary x-sections are used to compute NN x-section following GG formulas
    - Elementary x-sections are likely correct
  - Parameterisation of nuclear radius G4NucleaRadii
    - Explicit values for a set of light ions and parameterizations
    - It is possible to extend the list of explicit nuclei

- On top of GG cross section Coulomb barrier correction is applied
  - Using change of projectile and target nuclei
  - It is kind of simplified model the same for all ions
  - GG cross section cannot be accurate at the threshold by the theoretical arguments

G4ParticleXS approach

- Cross sections are combined:
  - HP isotope and element x-sections below 20 MeV
    - This excludes the inaccuracy of the Coulomb barrier in GG
    - A problem may happen if HP data are absent for important isotopes
  - GG element x-section above 20 MeV for light ions
    - For He4 + C13 we have data from 1 MeV up
    - For He4 + C12 there is no data in HP, this makes Coulomb barrier computed at 17 MeV, in the native HP code C13 data are used
    - The fix should be likely to use He4 + C13
  - A smooth x-section is tabulated up to 20 GeV
    - As Alberto shown there are bug, at least, for He4+C12
  - Analytical GG is used above 20 GeV
  - In 10.7 G4ParticleXS is used only in QBBC Physics List
- What is the problem:
  - Less effective test for NN cross sections
    - In contrary, for G4NeutronXS we have test, which run for all elements, compare FTFP_BERT, FTFP_BERT_HP, and QBBC

Proposals for 11.0

- Extend testing for G4ParticleXS to be on the level of G4NeutronXS
  - Extend tests for light ions x-sections
  - Try to fix existed bugs like He4+C12 and other similar problems
    - These fixes should be backported to 10.7 as a new version of G4PARTICLEXS3.2
  - Investigate possibility to create G4PARTICLEXS extend HP cross section up to 200 MeV
  - We may tune parameterization of nuclear radii for specific nuclei
    - Having data is essential – here help is really needed

- Implement tests of cross sections for light inti-ions and hypernuclei
  - Both geant-val and standalone tests will be useful

- Spend time on general clean-up of hadronic code
  - Very often the code is fine but if any problem debugging may be a nightmare
  - Remove obsolete cross sections and interfaces to reduce ability of users to peak up wrong cross sections