Update on neutron cross sections

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New neutron cross sections data G4NEUTRONXS1.3

- Recently new dataset G4NEUTRONXSDATA1.3 was created
  - Ndata and HadrCap test applications of A.Ivantchenko
  - G4NDL4.2 for E < 10 MeV
  - G4BGGNucleonInelasticXS, G4BGGNucleonElasticXS above 20 MeV
    - Barashenkov data for Z > 1
    - SAID data for Z=1 and E< 1.3 GeV
    - Starkov parametrisation for Z=1 and 1.3 GeV< E < 5 GeV
    - PDG parameterisation for Z=1 and E> 5 GeV
  - Linear interpolation in interval 10 – 20 MeV
- NEUTRONXS data used in classes
  - G4NeutronCaptureXS – with isotope x-section
  - G4NeutronElasticXS
 - G4NeutronInelasticXS – with isotope x-section

Method

- HP data and high energy models are used to tabulate data structure which is G4PhysicsLogVector
- Number of bins larger for «important» elements
  - H, He, B, C, N, O, Al, Si, Ar, Ca, Ge, Zr, Ar, Cd, Sn, W, Au, Pb, U
    - Up to 800 bins
  - Isotope x-sections is abundance > 0.1%
- At low-energy x-section is obtained as an average value for the bin – integration of HP cross section is performed
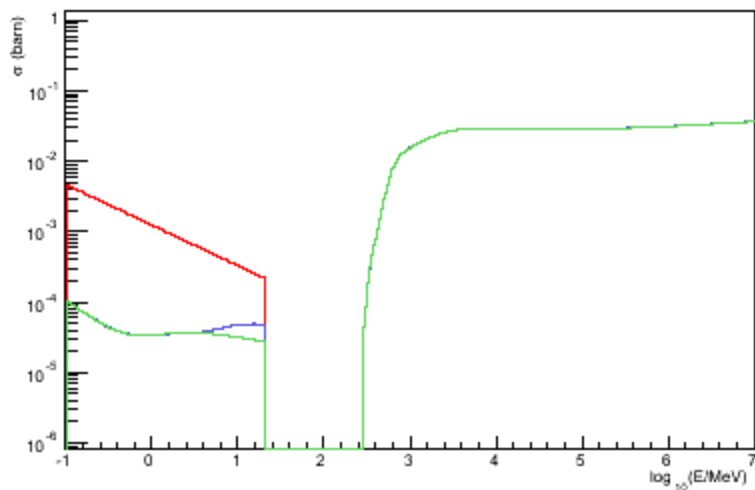 - Due to elastic scattering neutron effectively see average x-section

Elastic Cross Section for H
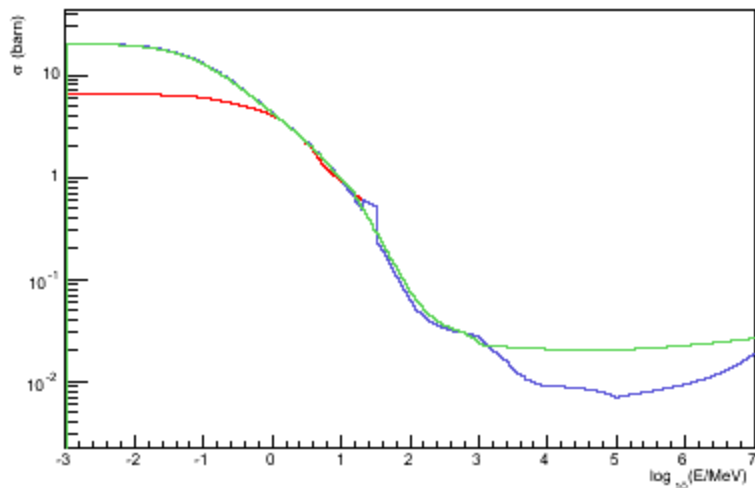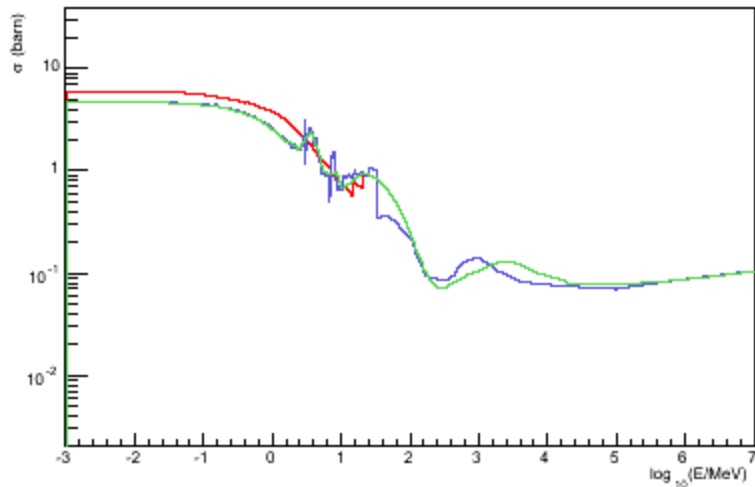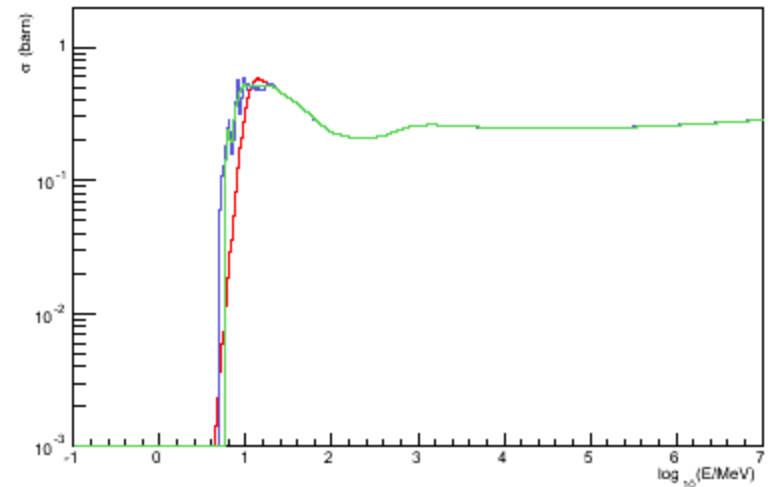
Inelastic Cross Section for H
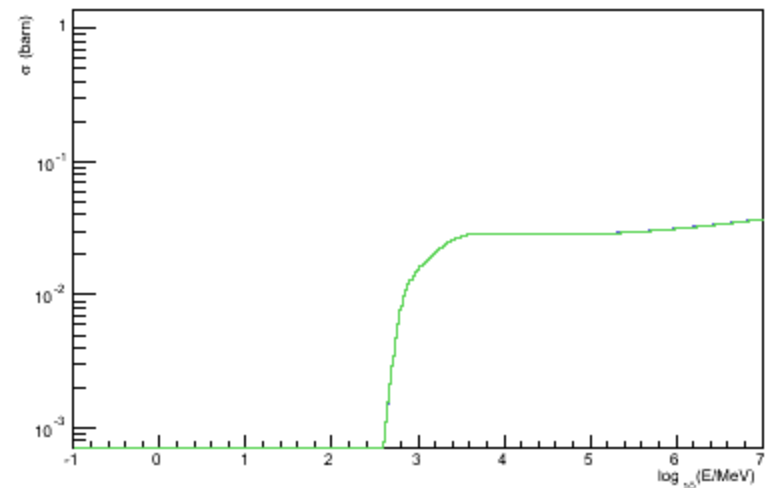
Production Cross Section for H

Capture Cross Section for H
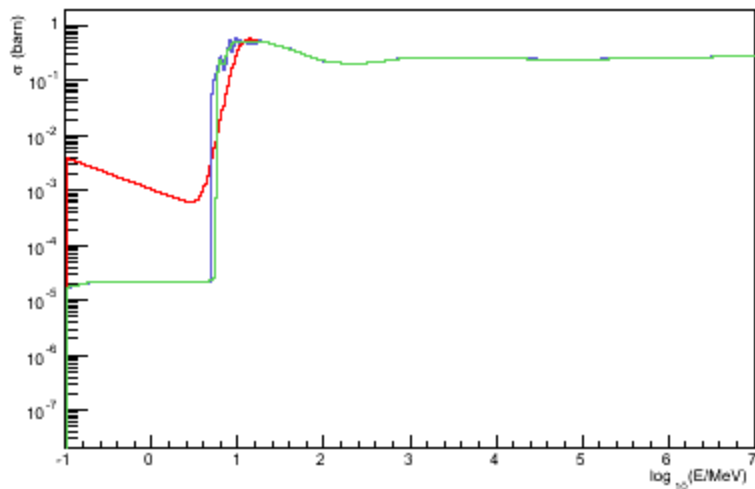
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FTFP_BERT_HP
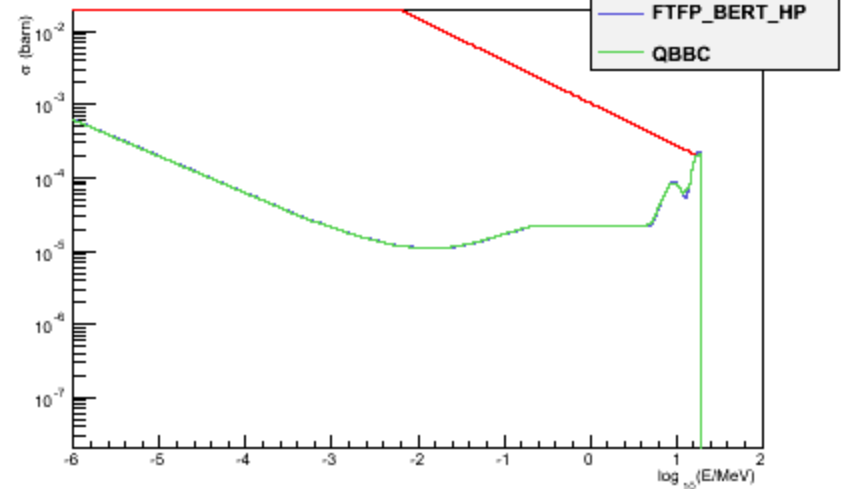QBBC

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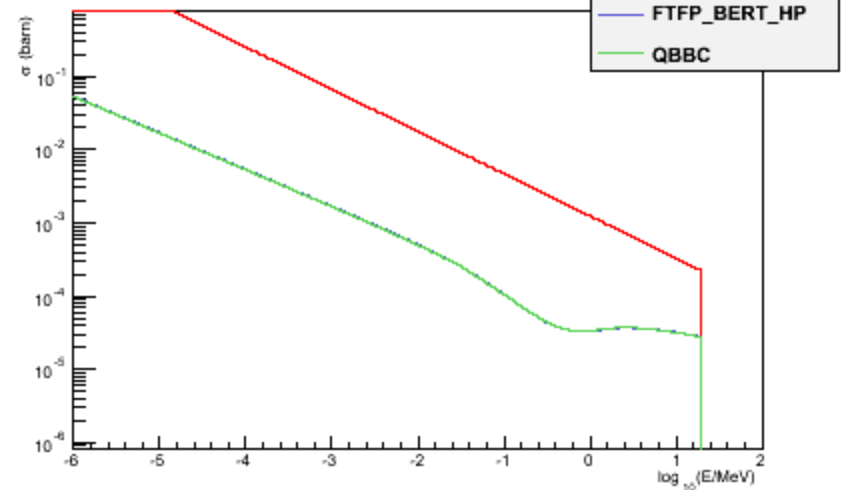
Elastic Cross Section for C

Inelastic Cross Section for C

Production Cross Section for C

Capture Cross Section for C
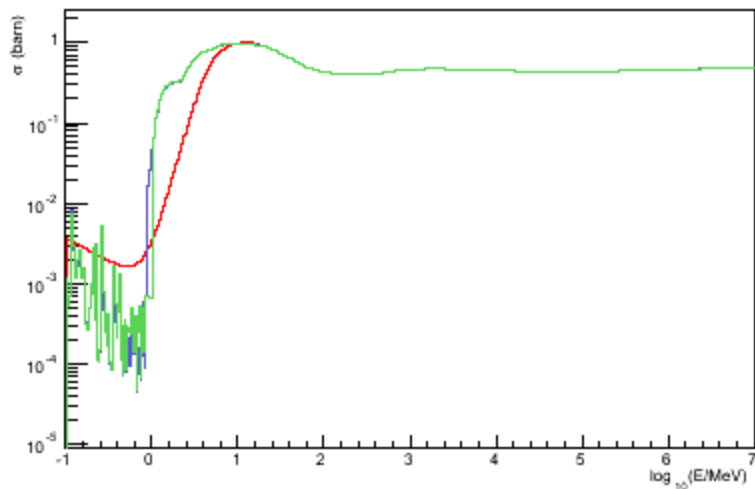
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FTFP_BERT_HP
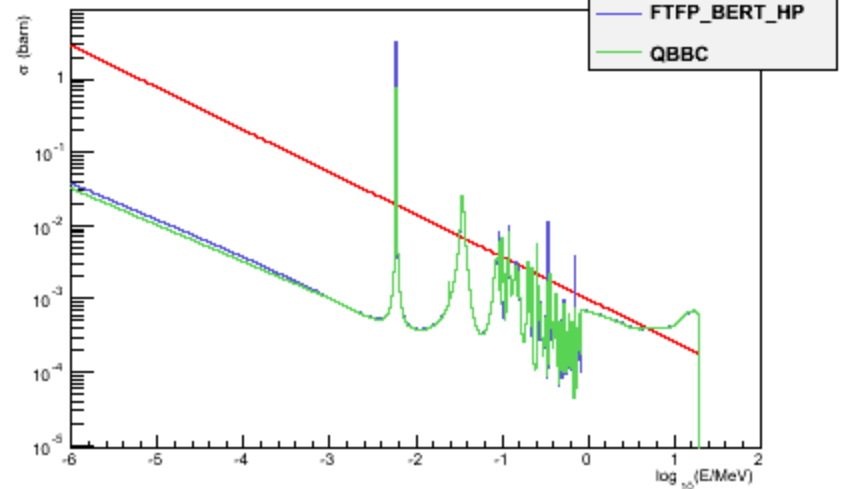QBBC

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Elastic Cross Section for Al
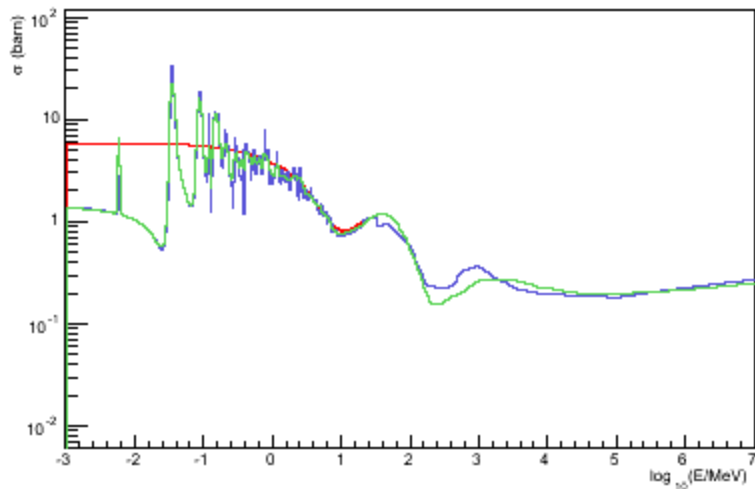
Inelastic Cross Section for Al
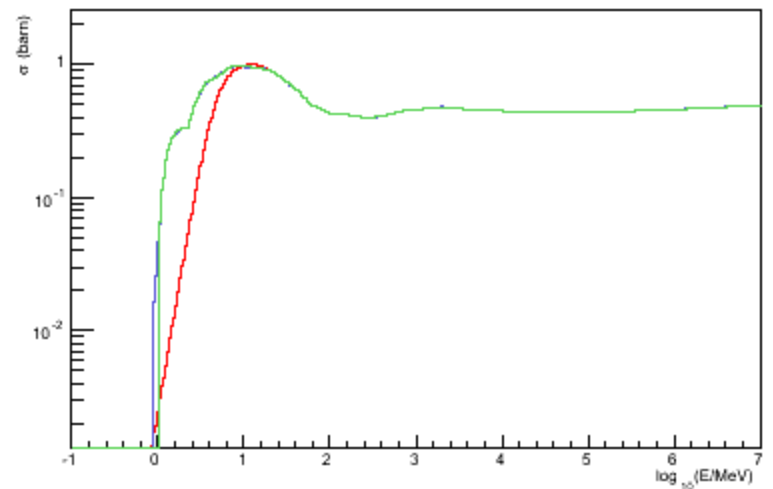
Production Cross Section for Al

Capture Cross Section for Al
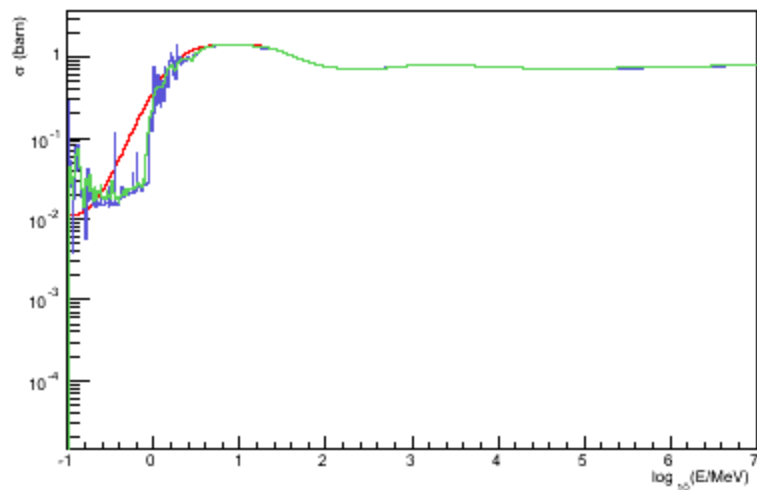
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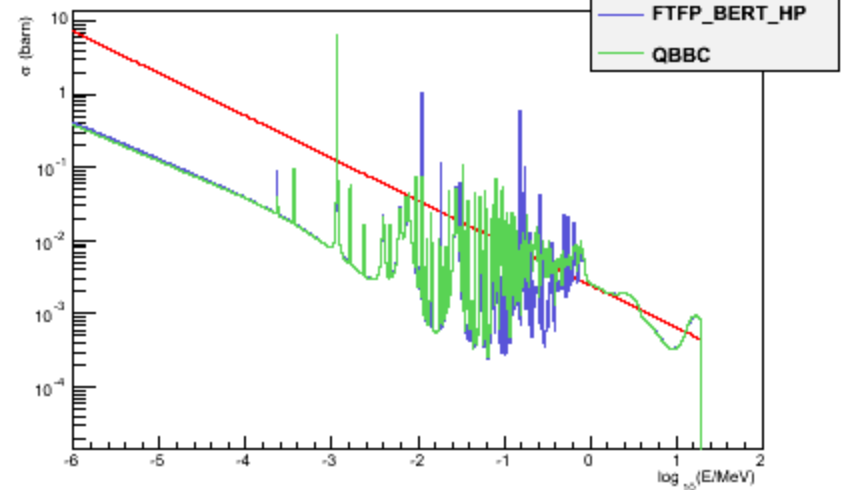FTFP_BERT_HP
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Elastic Cross Section for Fe
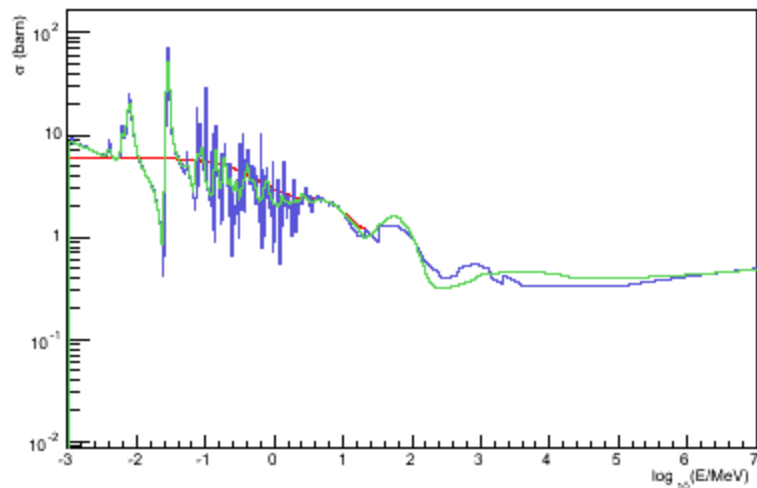
Inelastic Cross Section for Fe
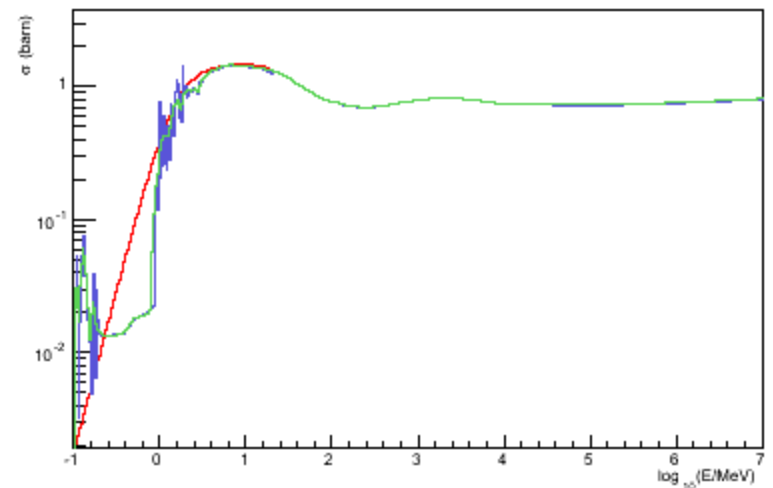
Production Cross Section for Fe

Capture Cross Section for Fe
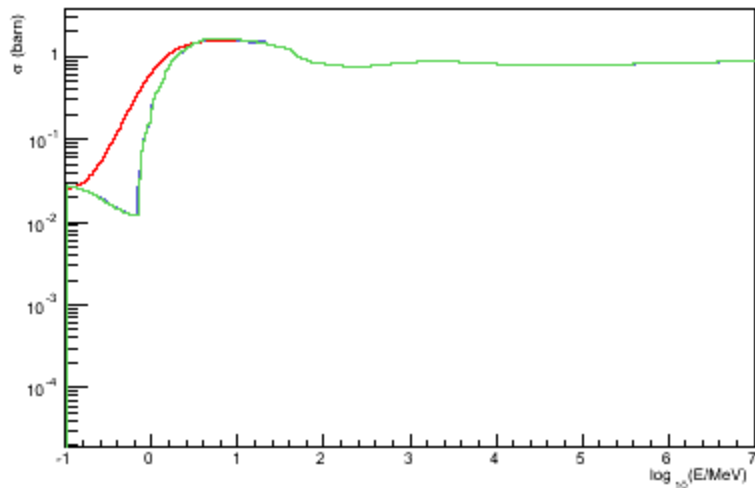
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FTFP_BERT_HP
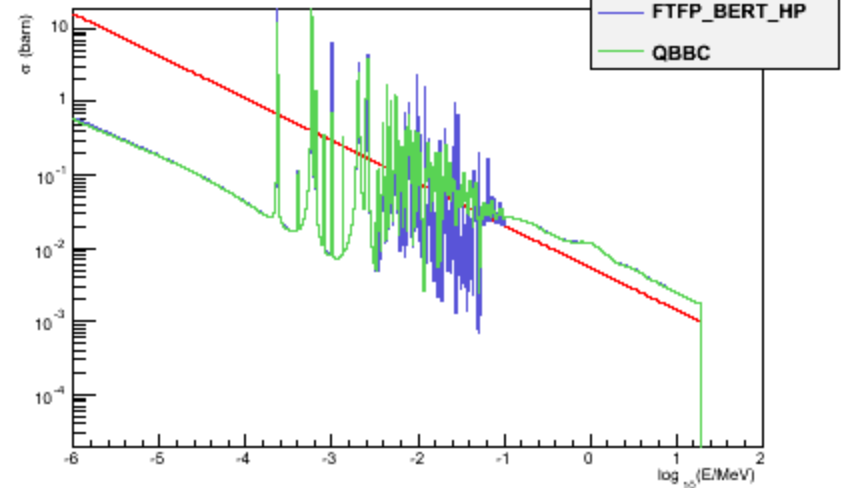QBBC

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Elastic Cross Section for Cu
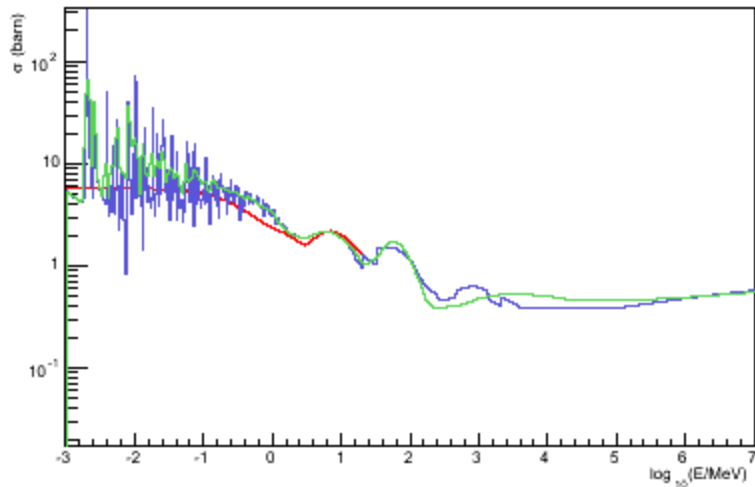
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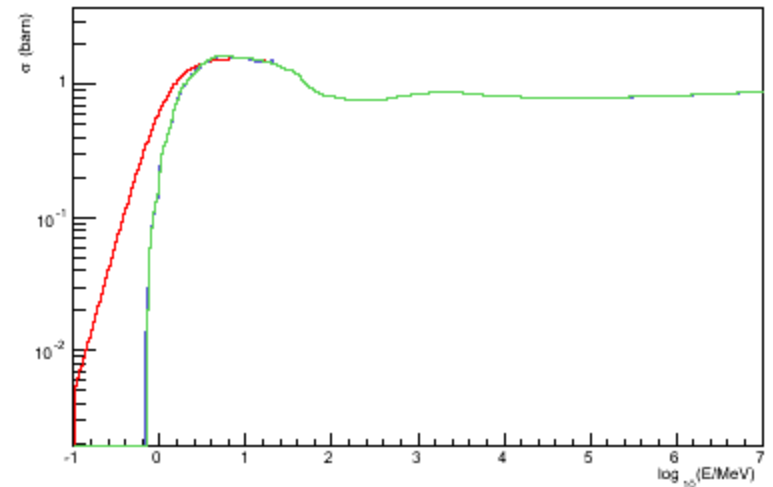
Production Cross Section for Cu

Capture Cross Section for Cu
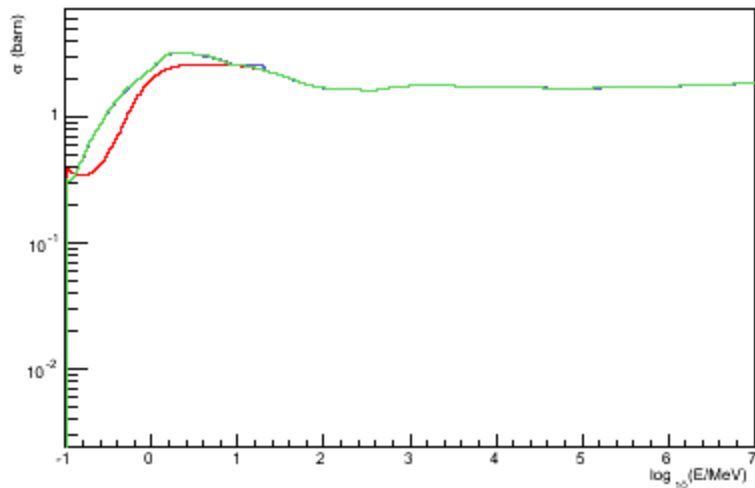
FTFP_BERT
FTFP_BERT_HP
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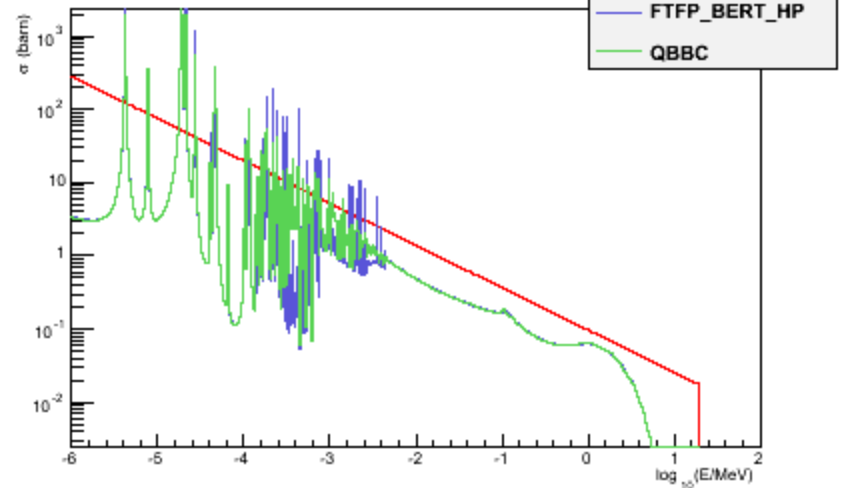
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Elastic Cross Section for W
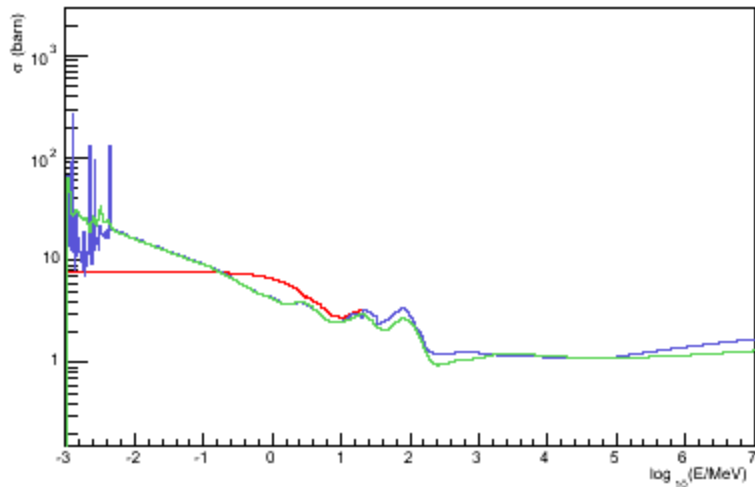
Inelastic Cross Section for W
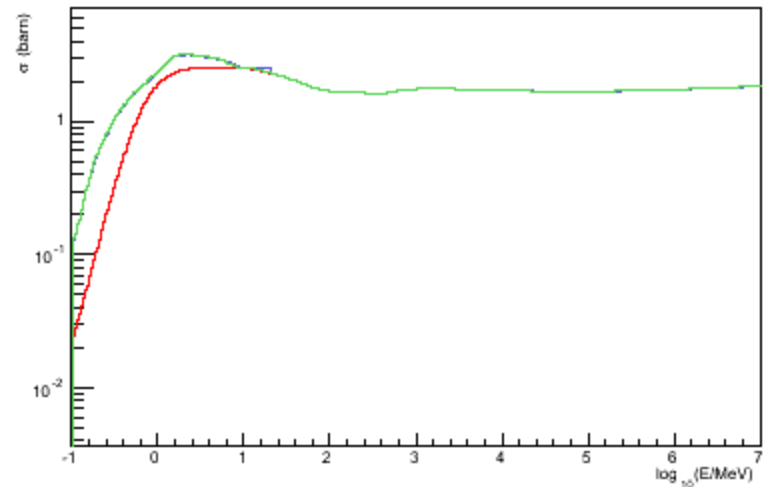
Production Cross Section for W

Capture Cross Section for W

FTFP_BERT
FTFP_BERT_HP
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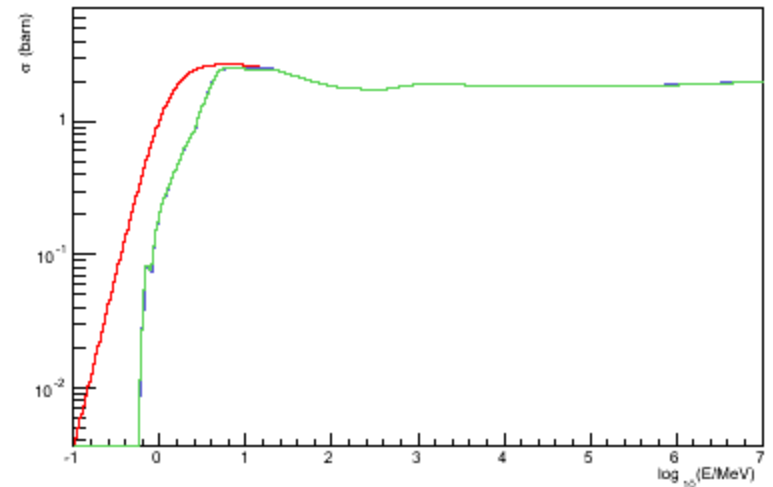
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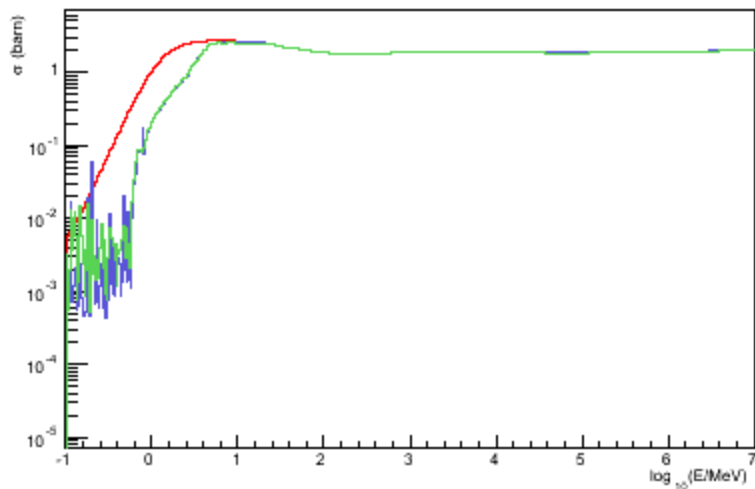
Elastic Cross Section for Pb
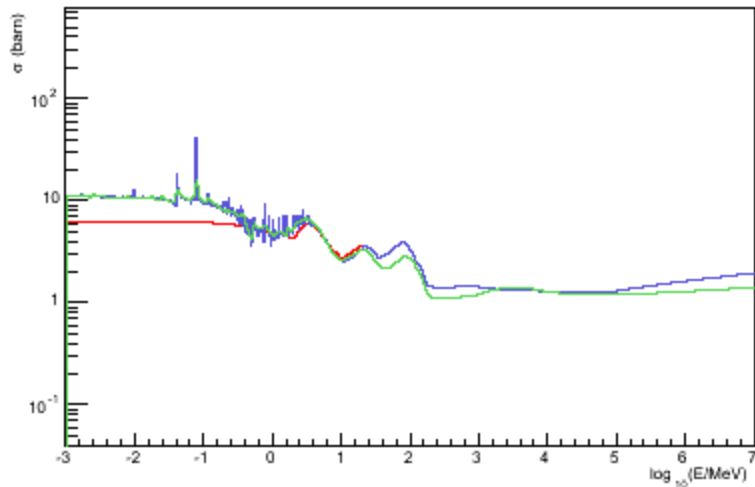
Inelastic Cross Section for Pb

Production Cross Section for Pb

Capture Cross Section for Pb

FTFP_BERT
FTFP_BERT_HP
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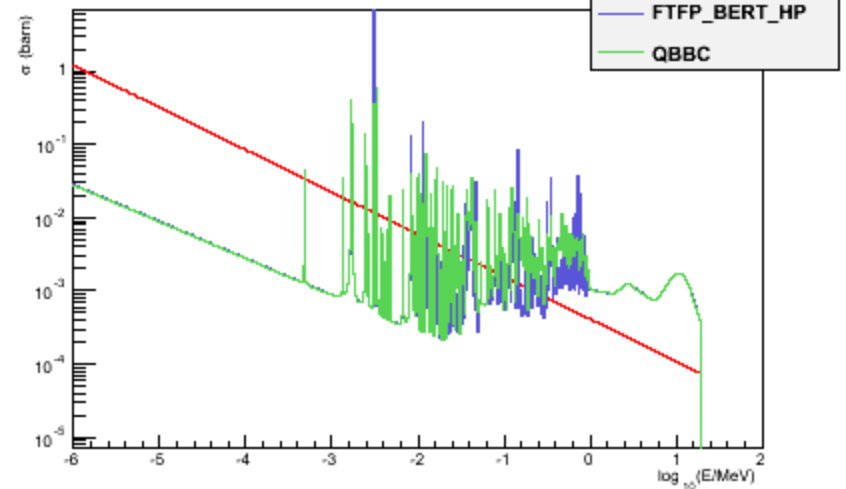
Summary

- New dataset G4NEUTRONXS1.3 is done on top of G4NDL4.2
- Production cross section for E<10 MeV significantly different from one of the default Physics List
  - Default cross section is very approximate
- There is still problem reported by Michel – in Hadr03 element cross section is returned instead of isotope cross section
- When the problem will be understood and fixed we propose to start to use this data as a default neutron cross section for Capture and Inelastic
- Elastic cross section effects needs to studied – CPU of simulation may be affected
  - Currently we underestimate low-energy neutron elstic cross section