

Current status of neutron production in FTF model

A. Galoyan 18.10.2017

Validation of FTF model for neutron production in hA interactions - subdirectory:

/test22 /hA_neutron

Files for corresponding calculations and visualization have been improved and now ready for use.

Comparison of FTF old results in 10-02 ref 09 with new results in 10-03 ref 08 are presented.

1. S. Leray (DAPNIA, Saclay) et al., PRC 65(2002) , 044624

«Spallation neutron production by 0.8 GeV, 1.2 GeV and 1.6 GeV protons on various targets».

2. K. Ishibashi et al., J.Nucl. Sci. Tech., Vol.34, N6 (1997) 529-537

«Measurement of Neutron-Production Double-Differential Cross Sections for Nuclear Spallation Reaction Induced by 0.8, 1.5 and 3.0 GeV Protons».

3. Yu.D. Bayukov et al., ITEP preprint No 172 (1983)

«Cross sections of neutron production with energies 7.5 – 190 MeV in reactions $p+A \rightarrow n+X$ ».

4. T. von Egidy et al., Eur. Phys. J. A 8, 197 (2000); LEAR collab. data

B. Lott et al., Phys.Rev.C 63 (2001) 034616

«Thermal excitation and decay of nuclei from anti-proton - nucleus interactions at 1.22 GeV».

5. V. I. Yurevich, R.M. Yakovlev, V. G. Lyapin (JINR, RI St.Peterburg)

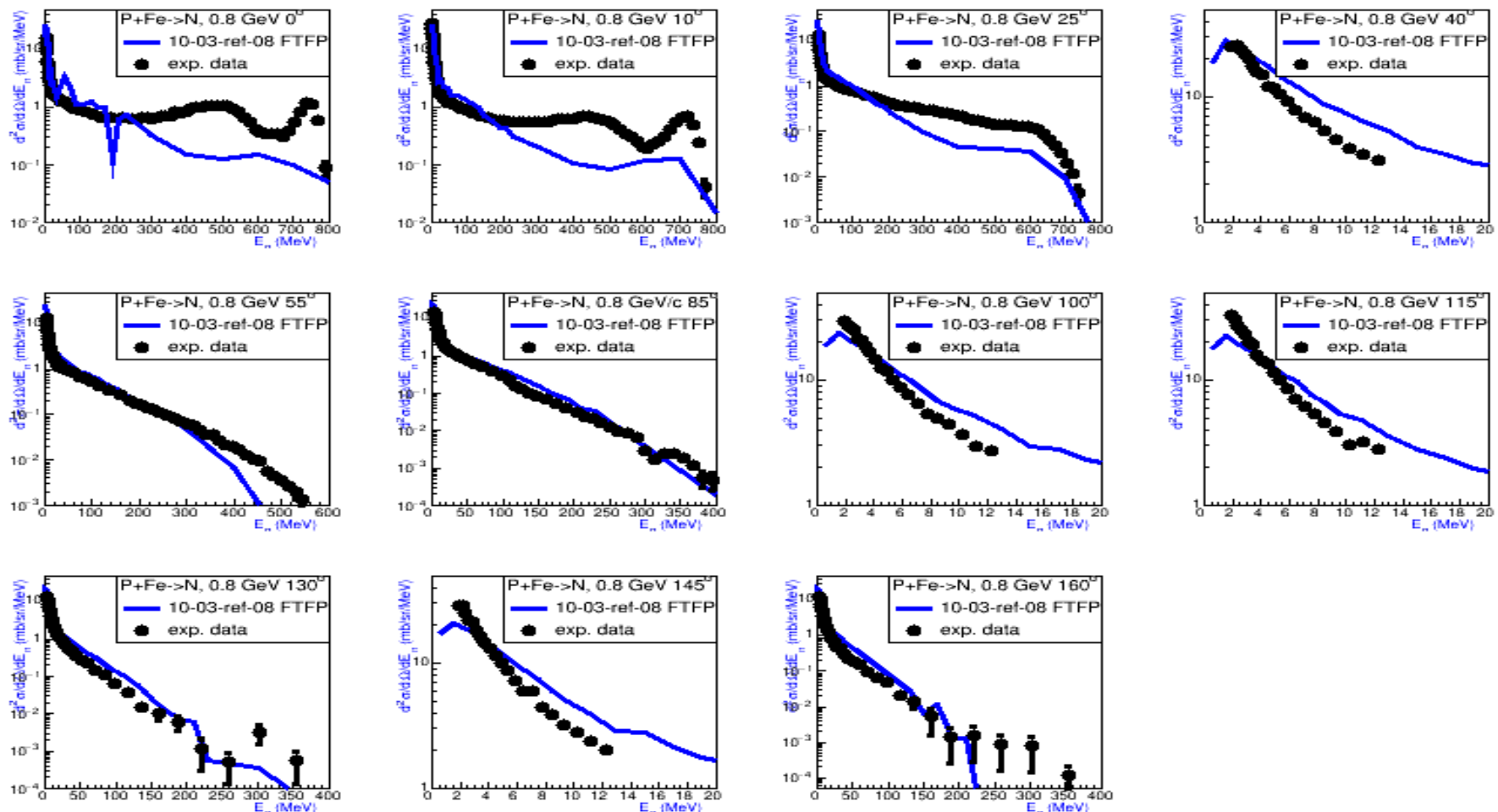
Physics of Atomic Nuclei, 2006, Vol. 69, No. 9, pp. 1496–1509. *«Neutron Emission in Interactions of H-1, H-2, He-4, and C-12 Nuclei with Lead Nuclei at 1–2 GeV per Nucleon».*

Physics of Atomic Nuclei, 2012, Vol 75, No 2, pp191-202. *«Neutron production in Collisions between Carbon Nuclei of Energy 2 GeV per Nucleon and Carbon, Aluminium, ... Nuclei».*

Current status of neutron production in FTF model

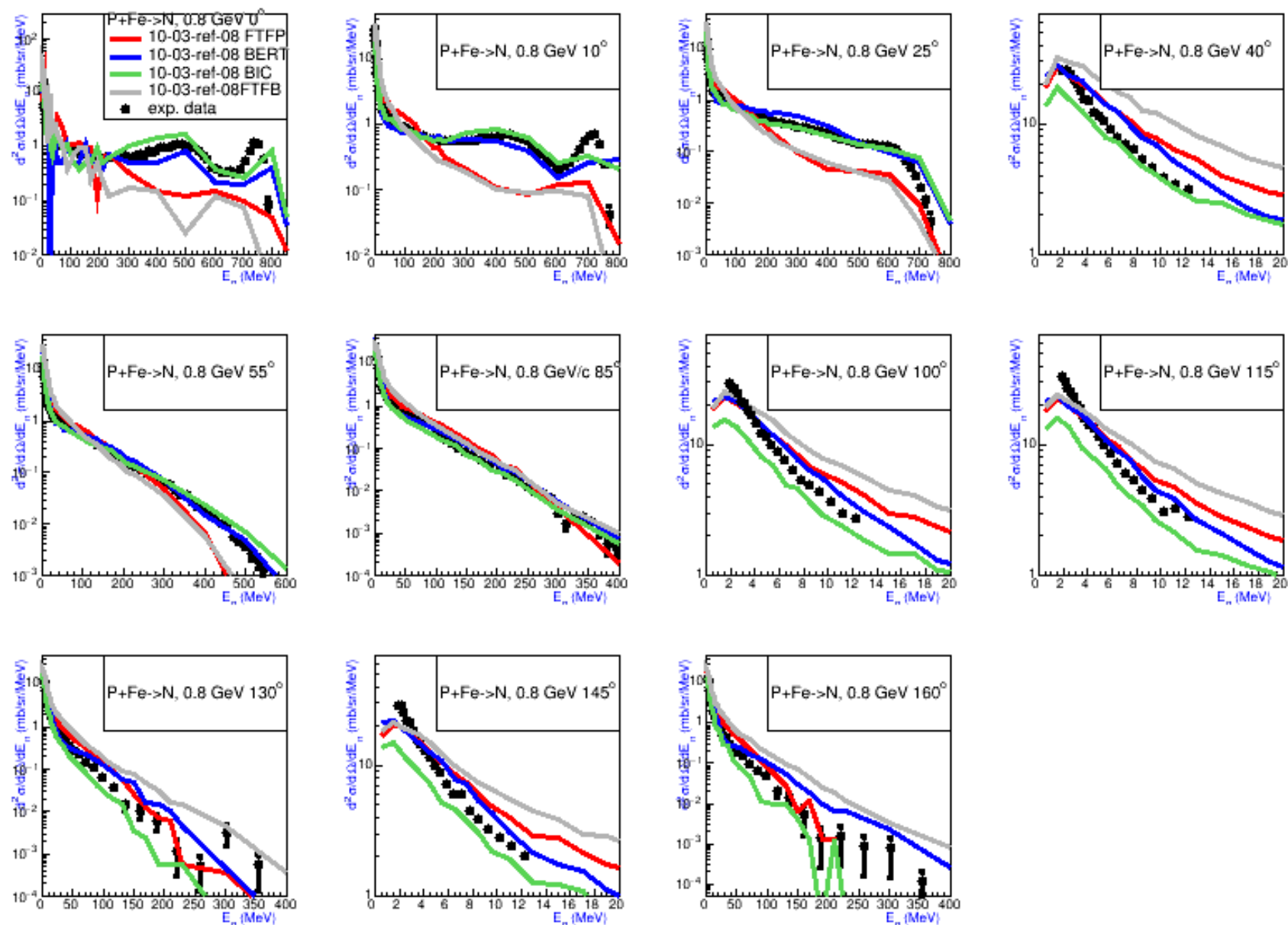
The main changes from old release (10-02 ref 09) up to new release (10-03 ref 08) in FTF model are connected with implementation of **Rotating Quark-Gluon Strings** at fragmentation processes. They reflected on **proton spectra** in hadron-nucleus interactions. Let us check **neutron spectra** in hadron-nucleus interactions.

S. Leray (DAPNIA, Saclay) et al., PRC 65(2002) , 044624



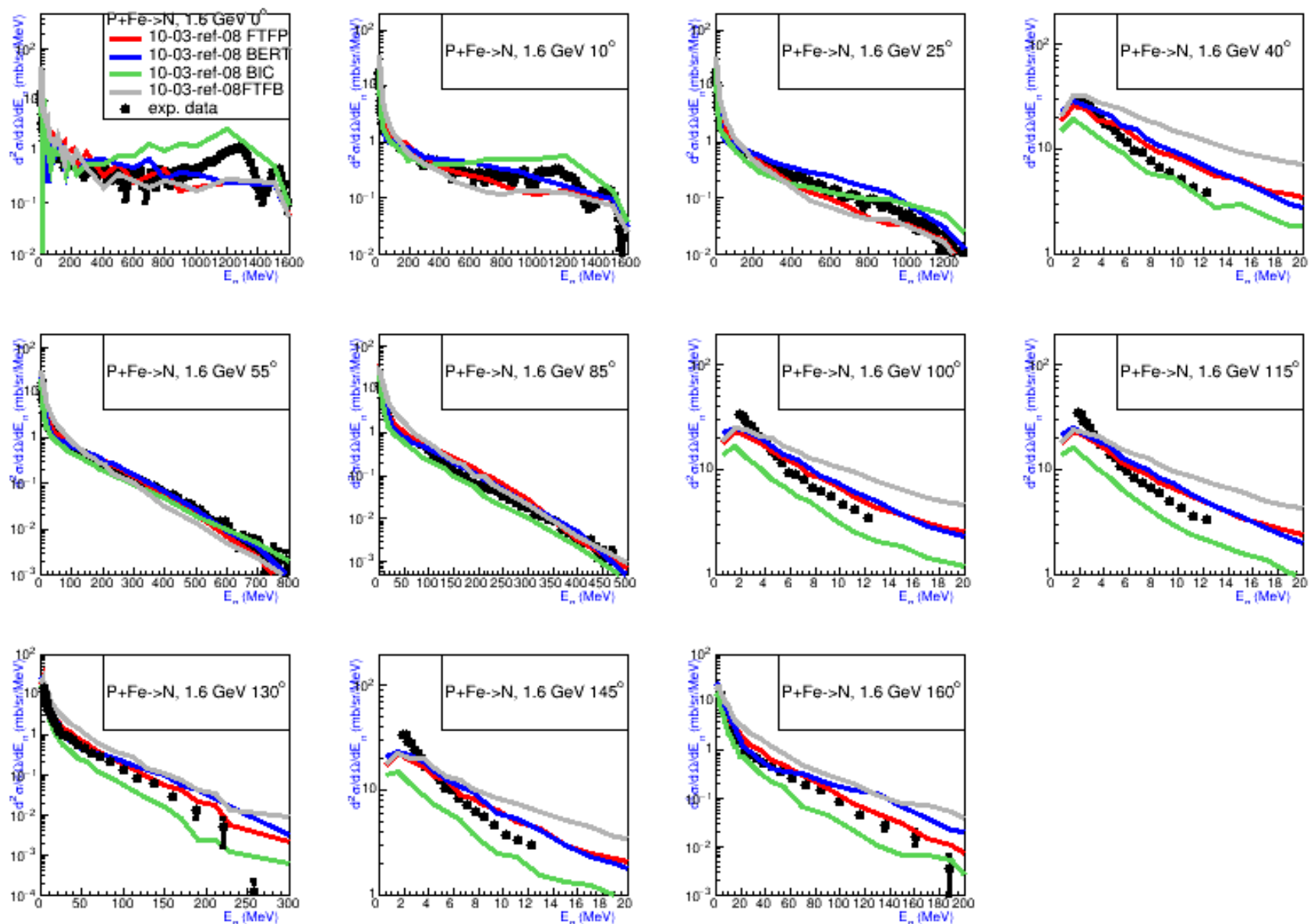
Current status of neutron production in FTF model

S. Leray (DAPNIA, Saclay) et al., PRC 65(2002)044624



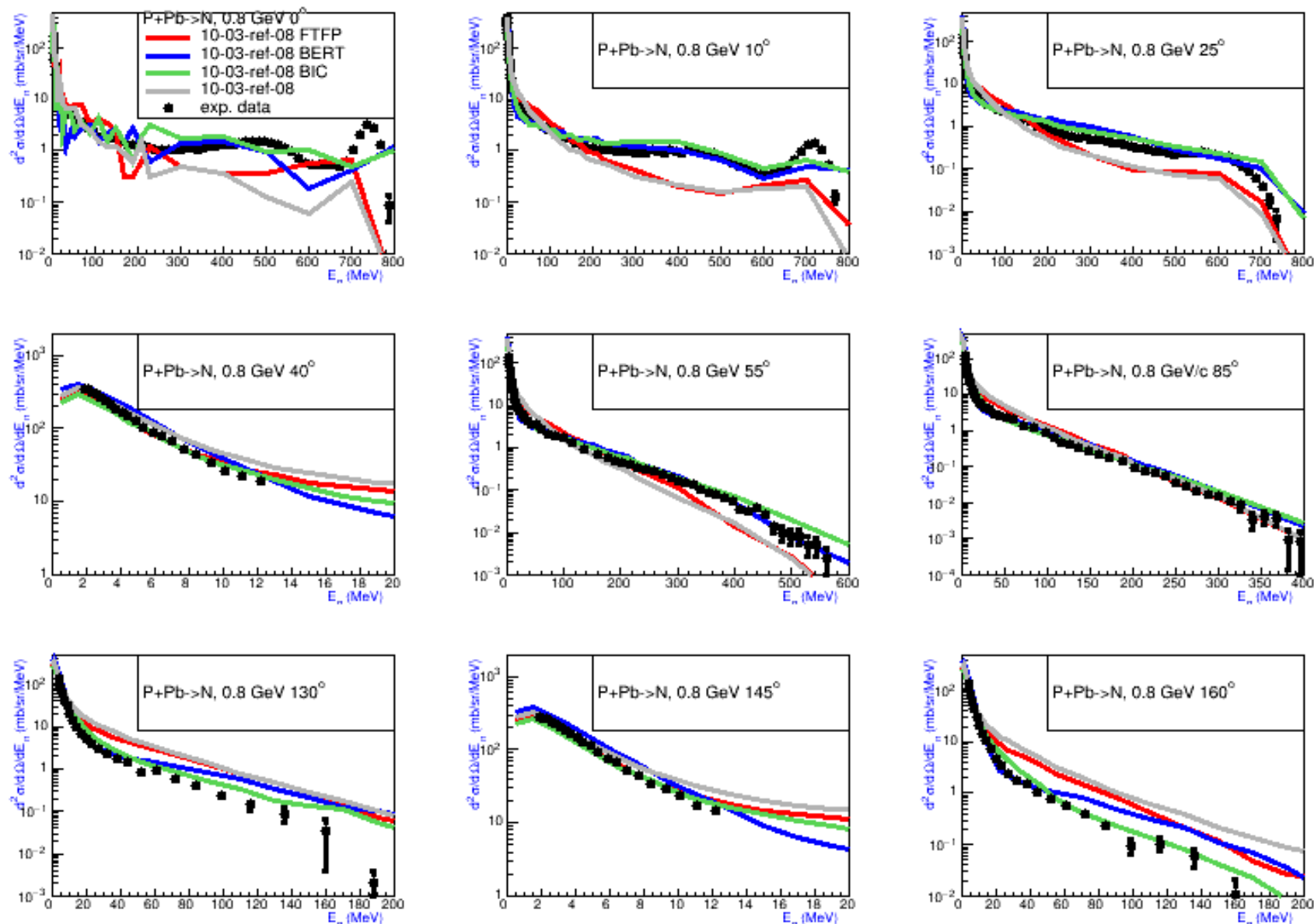
Current status of neutron production in FTF model

S. Leray (DAPNIA, Saclay) et al., PRC 65(2002)044624



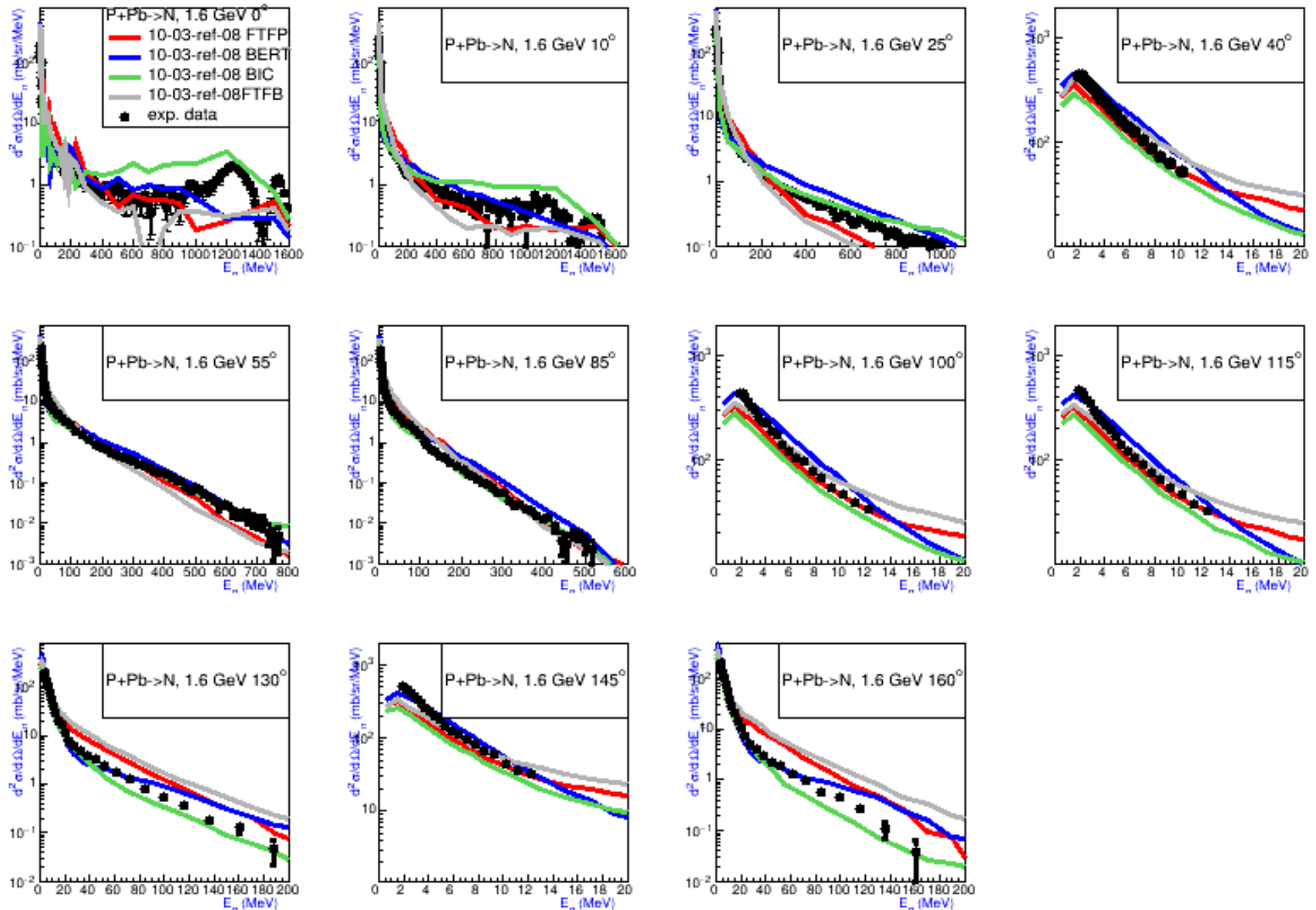
Current status of neutron production in FTF model

S. Leray (DAPNIA, Saclay) et al., PRC 65(2002)044624



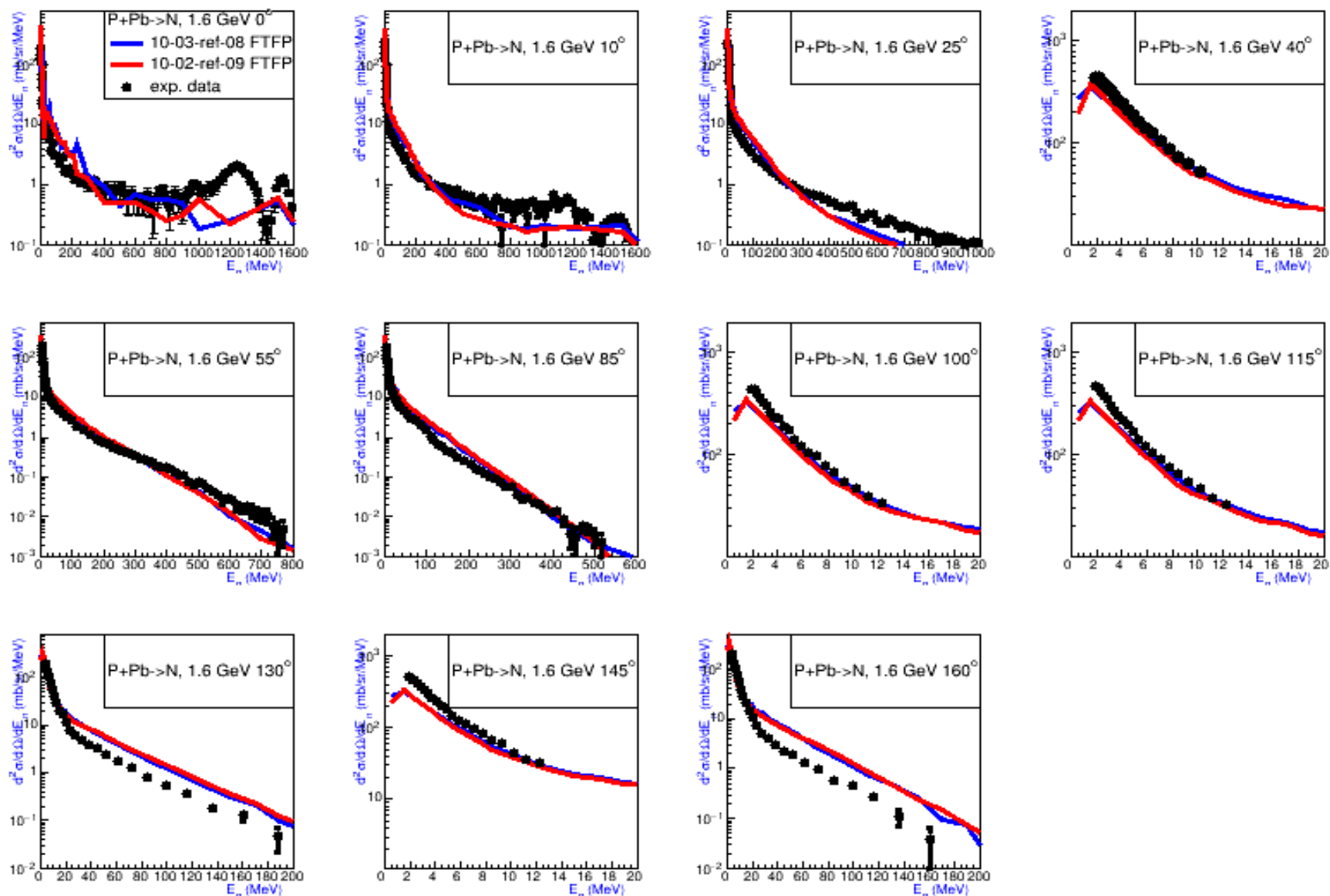
Current status of neutron production in FTF model

S. Leray (DAPNIA, Saclay) et al., PRC 65(2002)044624



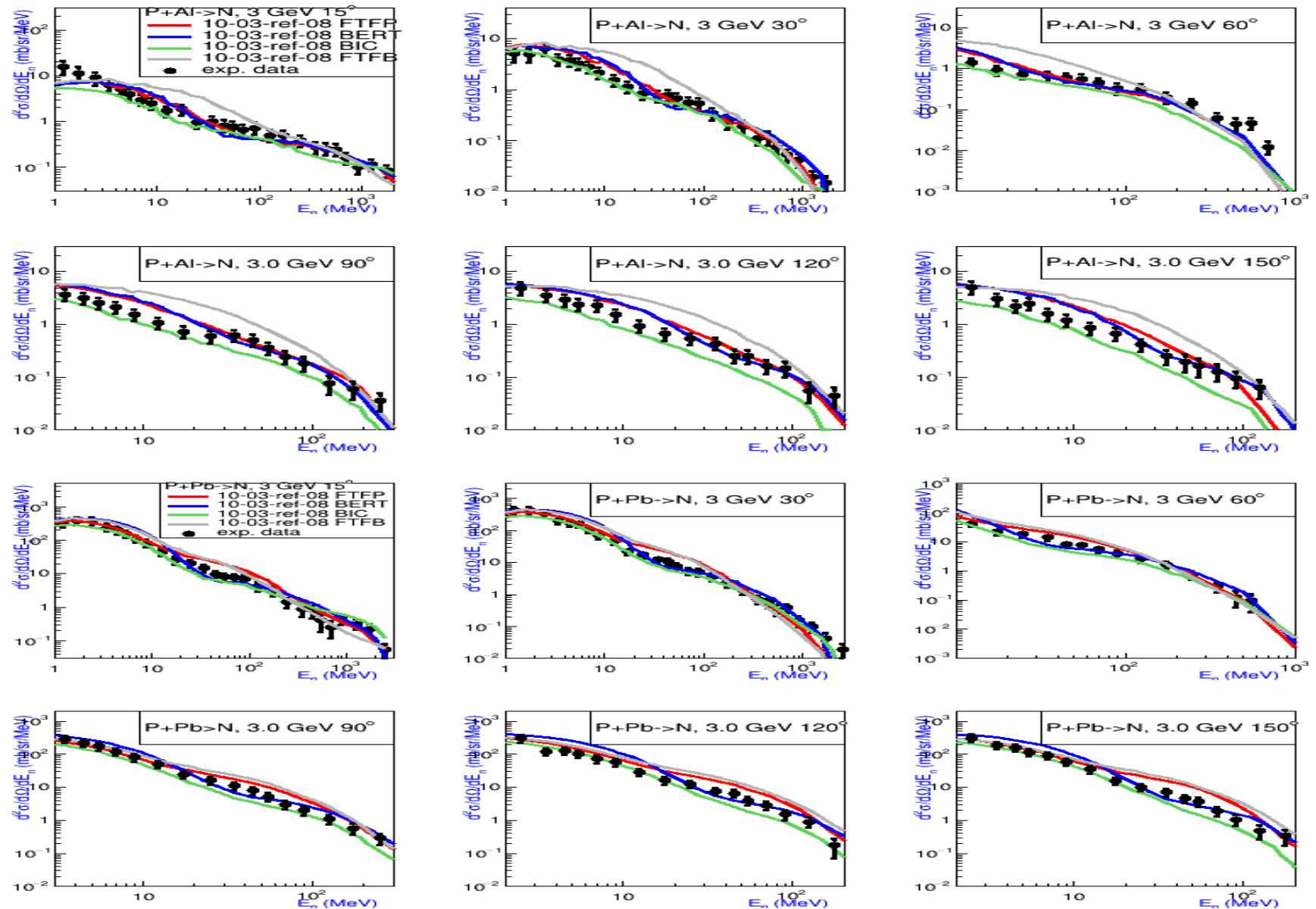
Current status of neutron production in FTF model

S. Leray (DAPNIA, Saclay) et al., PRC 65(2002)044624



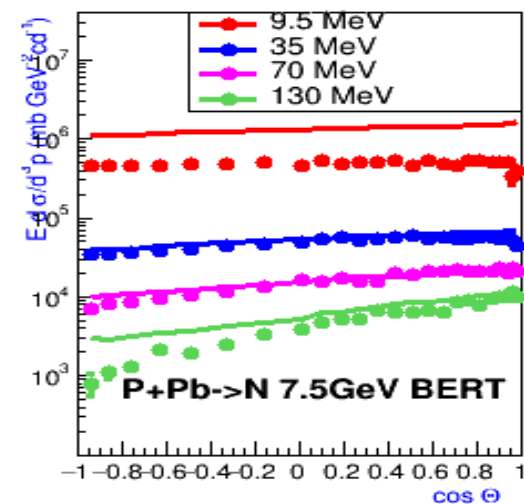
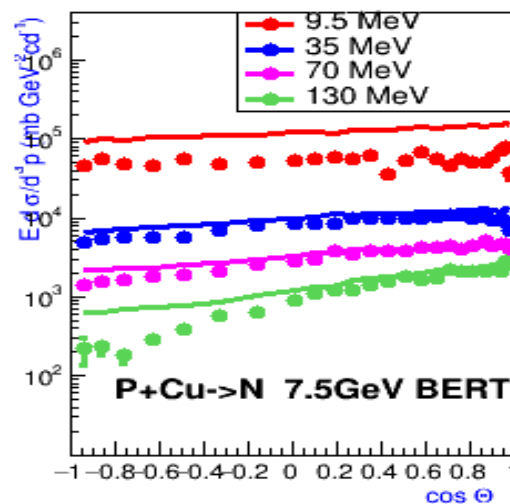
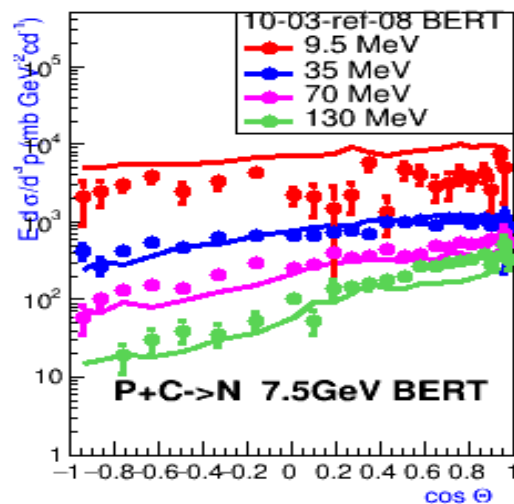
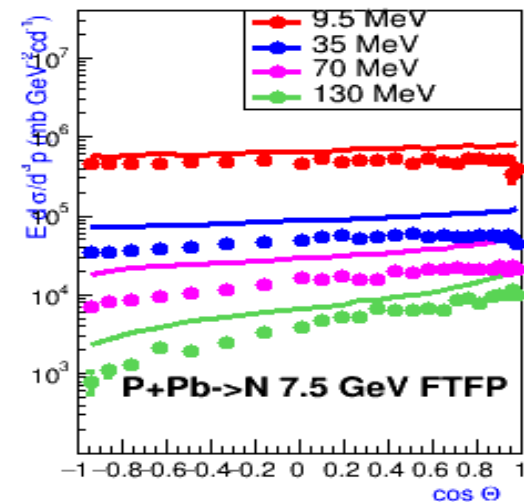
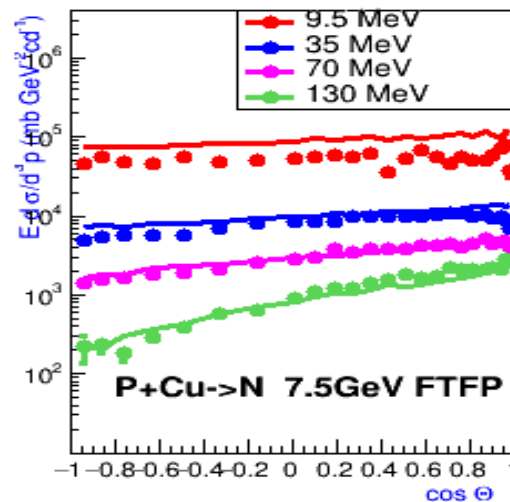
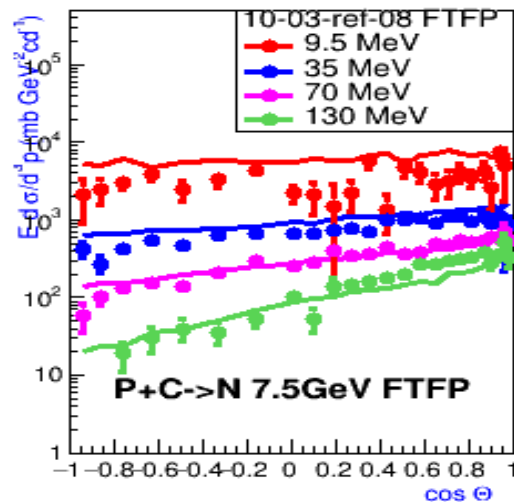
Current status of neutron production in FTF model

K. Ishibashi et al., J.Nucl. Sci. Tech., Vol.34, N6 (1997) 529-537



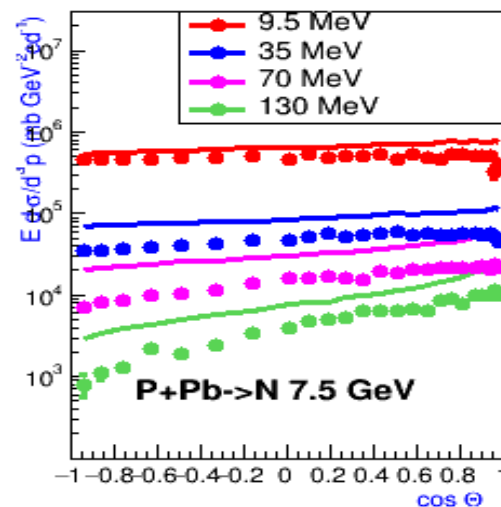
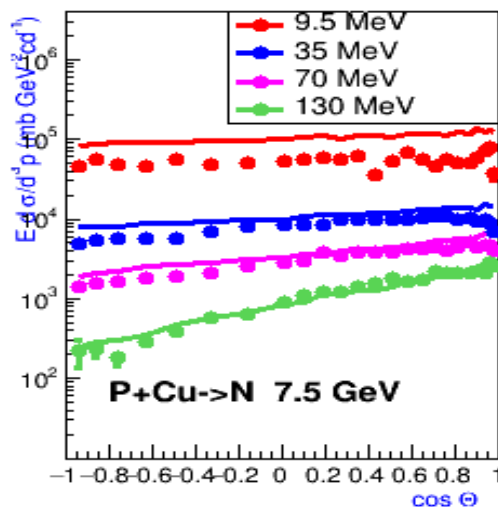
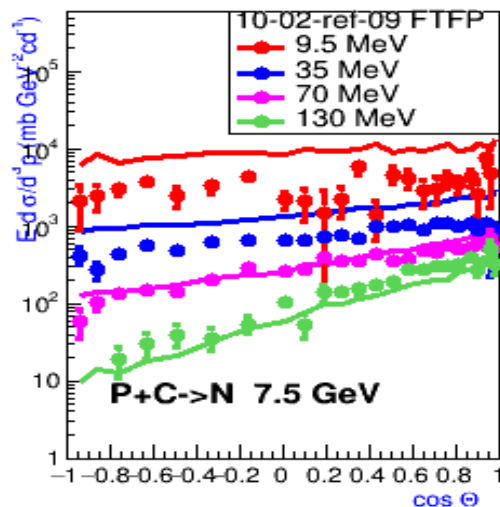
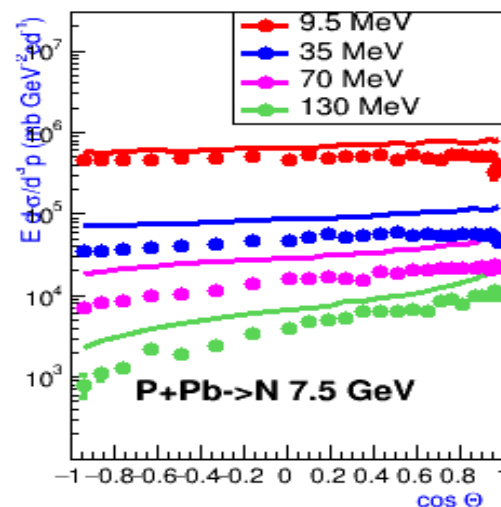
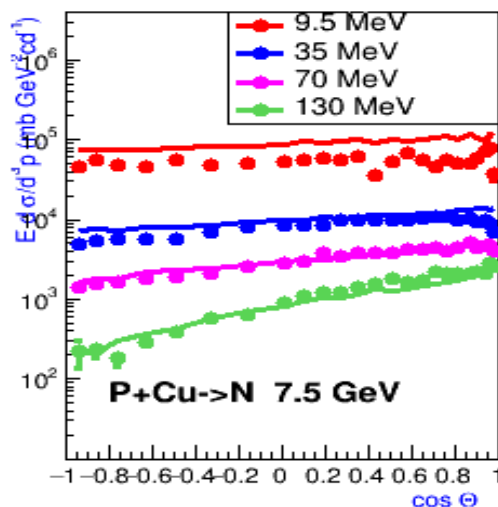
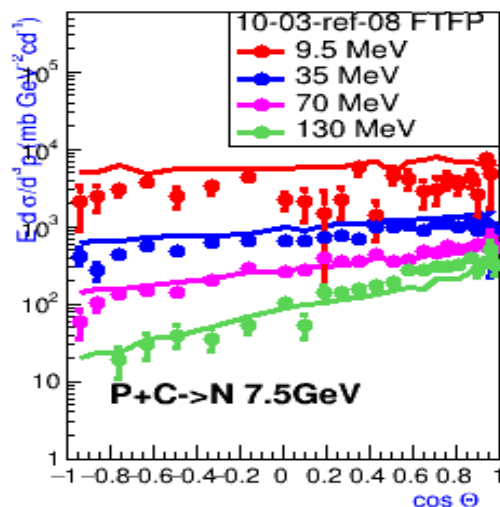
Current status of neutron production in FTF model

Yu.D. Bayukov et al., ITEP preprint No 172 (1983) «Cross sections of neutron production with energies 7.5 – 190 MeV in reactions $p+A \rightarrow n+X$ ».



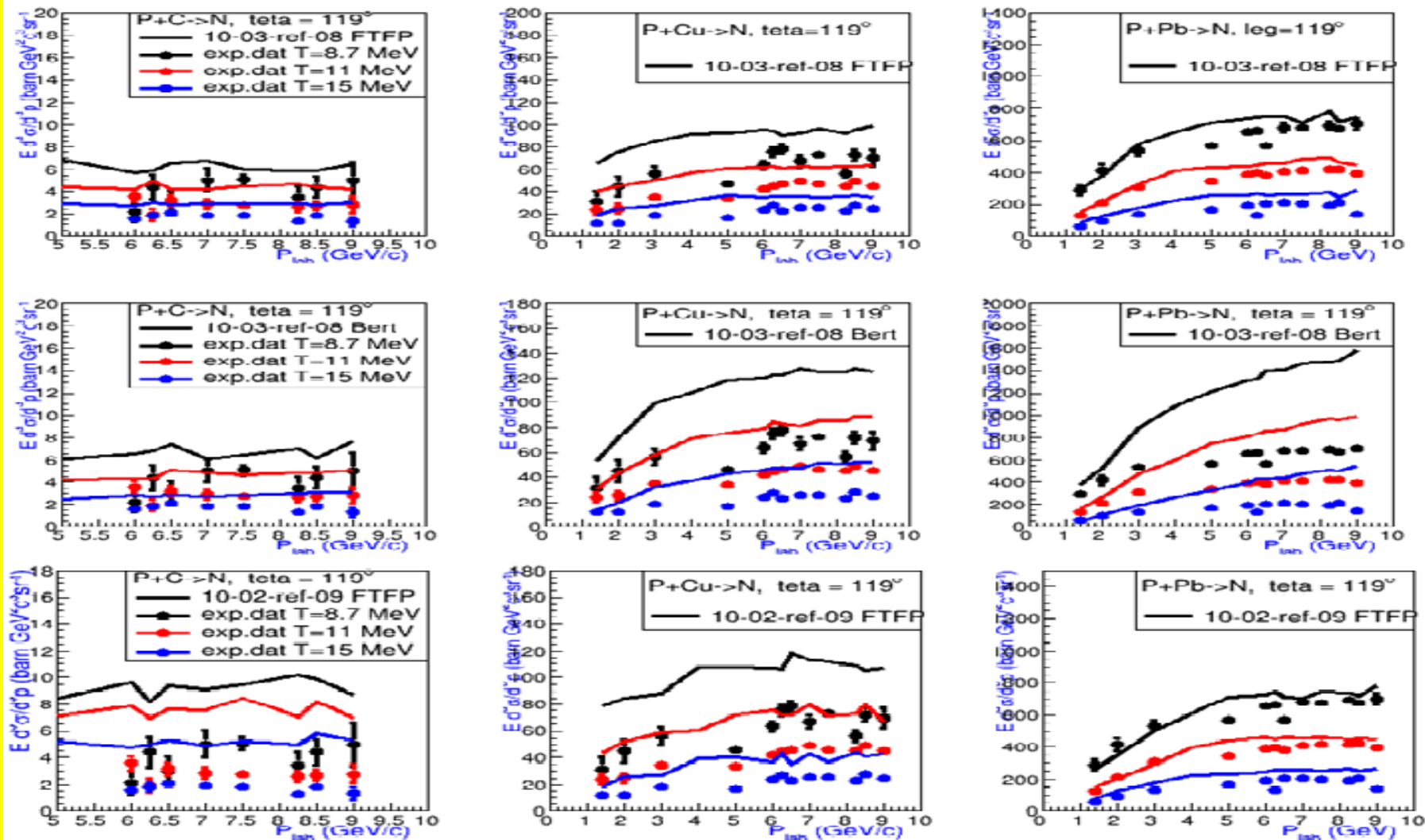
Current status of neutron production in FTF model

Yu.D. Bayukov et al., ITEP preprint No 172 (1983)) «Cross sections of neutron production with energies 7.5 – 190 MeV in reactions $p+A \rightarrow n+X$ ».



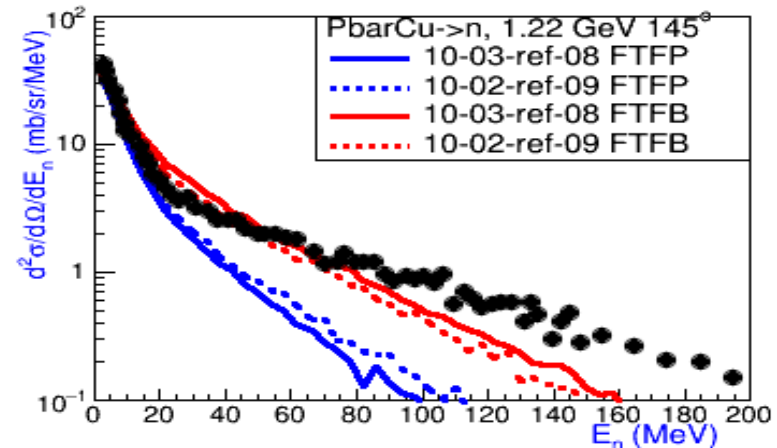
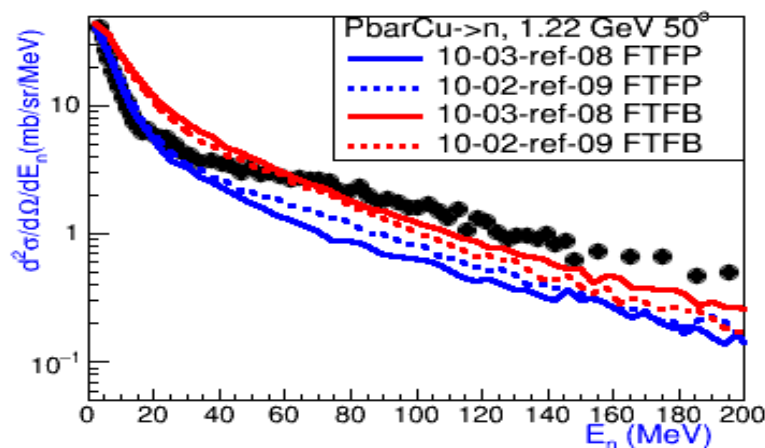
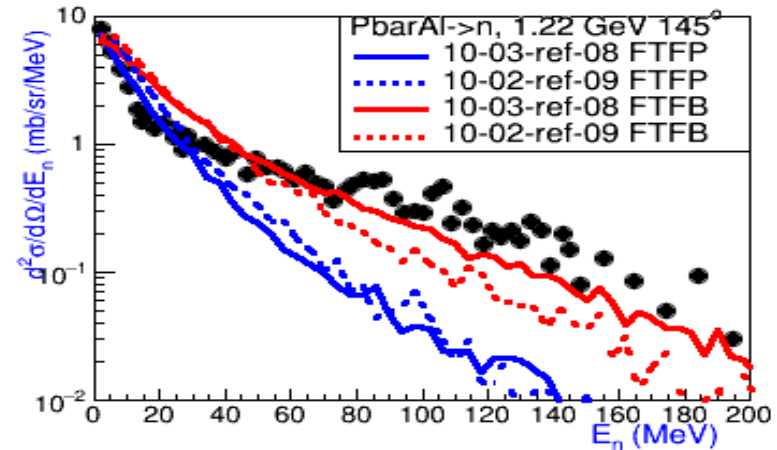
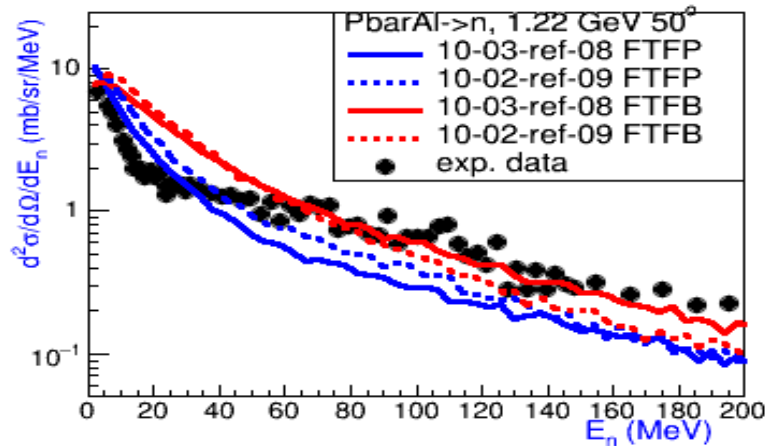
Current status of neutron production in FTF model

Yu.D. Bayukov et al., ITEP preprint No 172 (1983) «Cross sections of neutron production with energies 7.5 – 190 MeV in reactions $p+A \rightarrow n+X$ ».



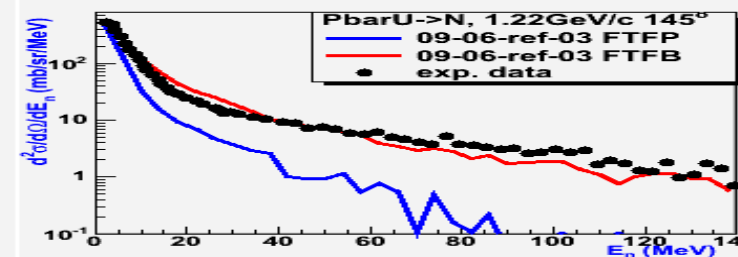
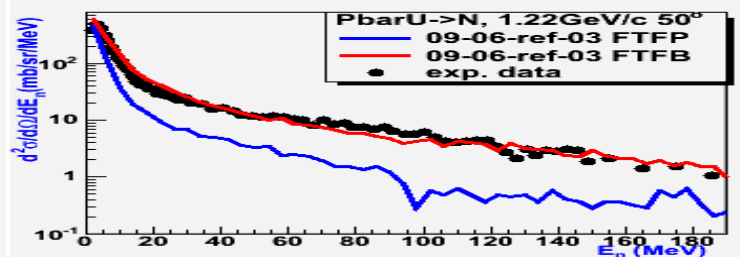
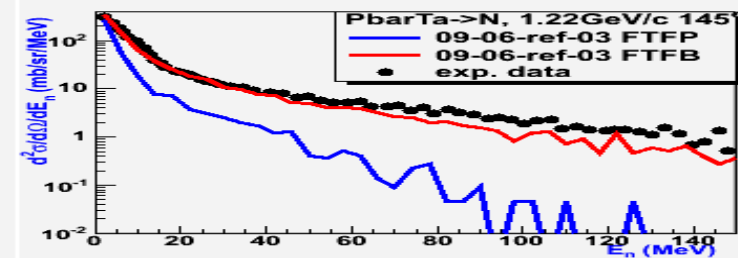
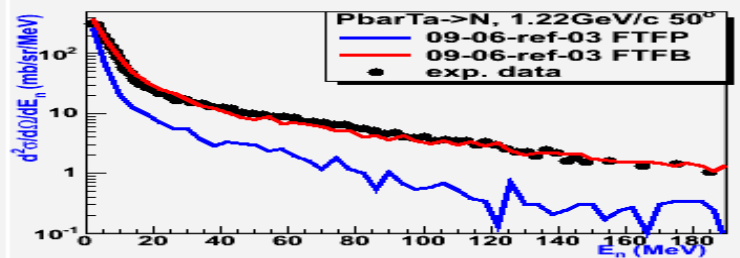
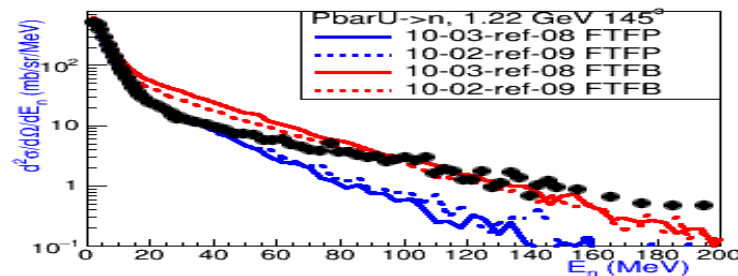
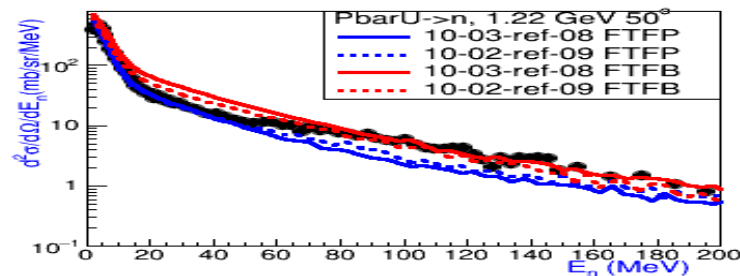
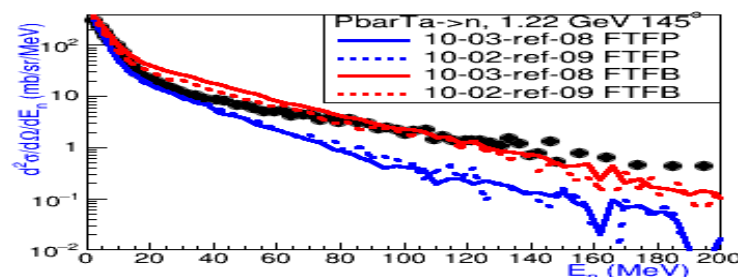
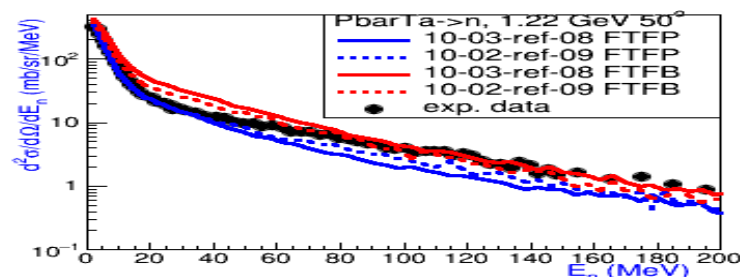
Results of FTF validation for AntiProton–Nucleus reactions inflight

Kinetic energy spectra of neutrons produced in Pbar-Al, Pbar-Cu at projectile energy 1.22 GeV



Results of FTF validation for AntiProton–Nucleus reactions

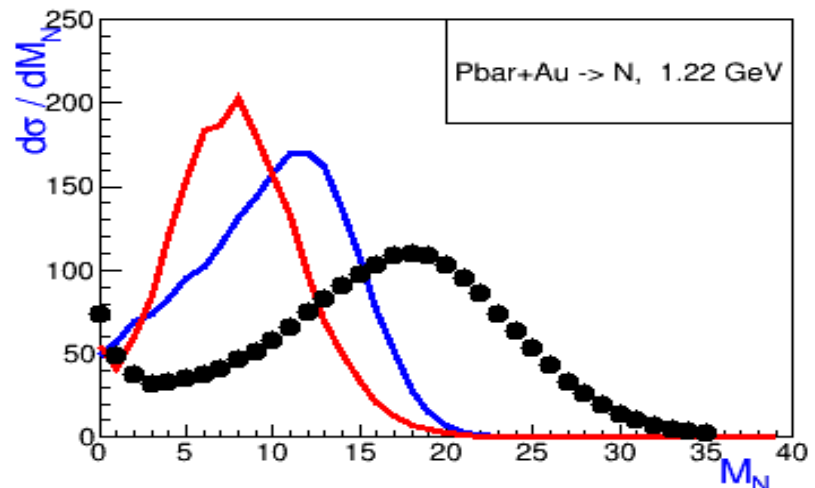
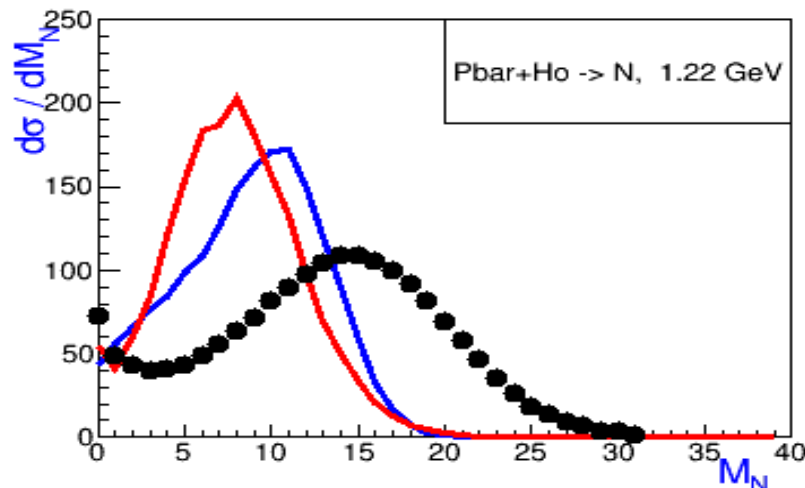
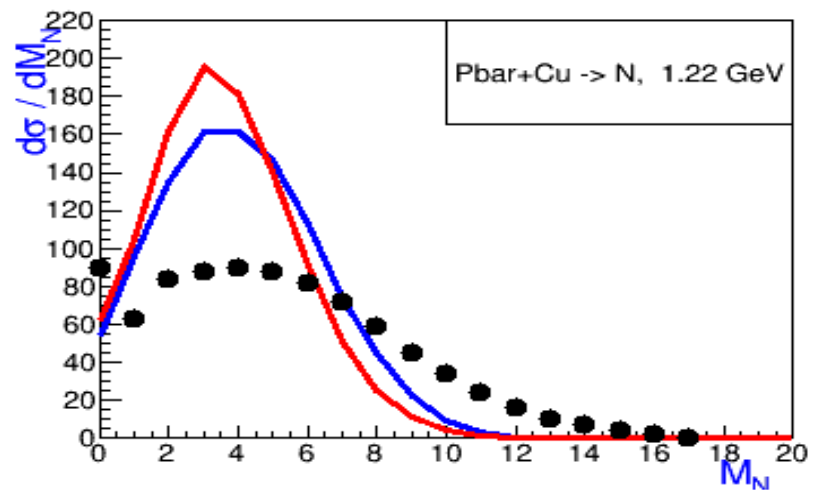
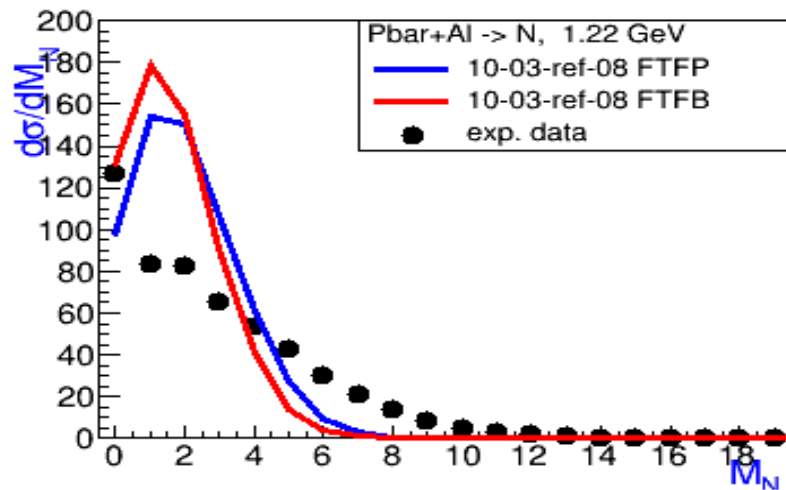
Kinetic energy spectra of neutrons produced in Pbar-Ta, Pbar-U at 1.22 GeV



Results of FTF validation for Antiproton–Nucleus reactions

Multiplicity distributions of neutrons produced in Pbar-Nucleus at energy 1.22 GeV in FTF and UrQMD+SMM models

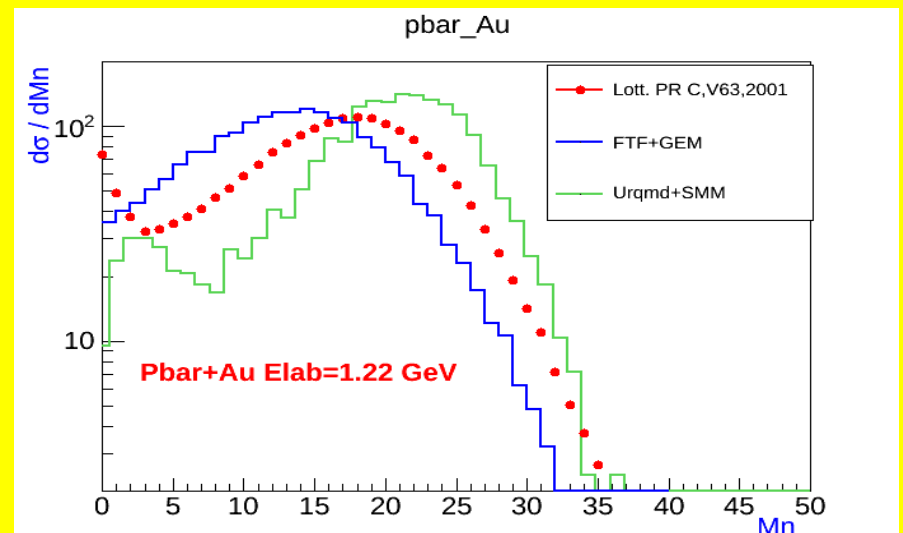
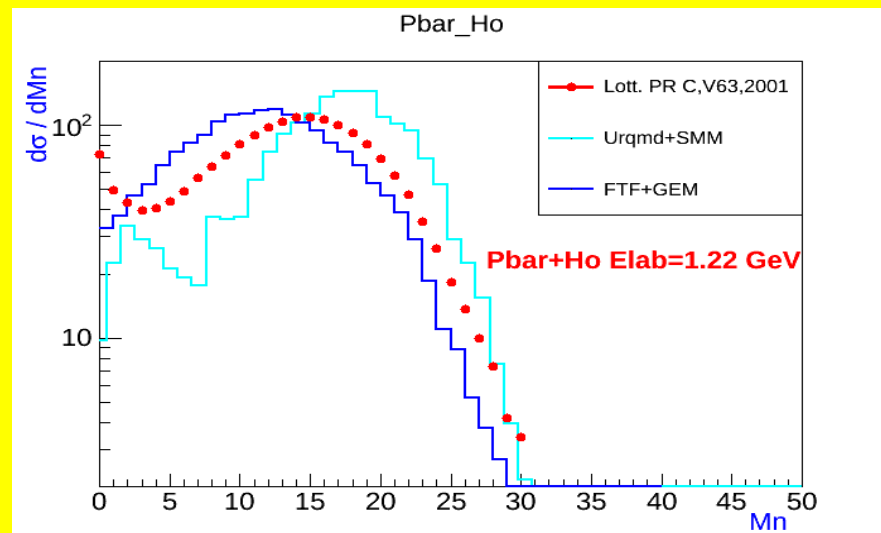
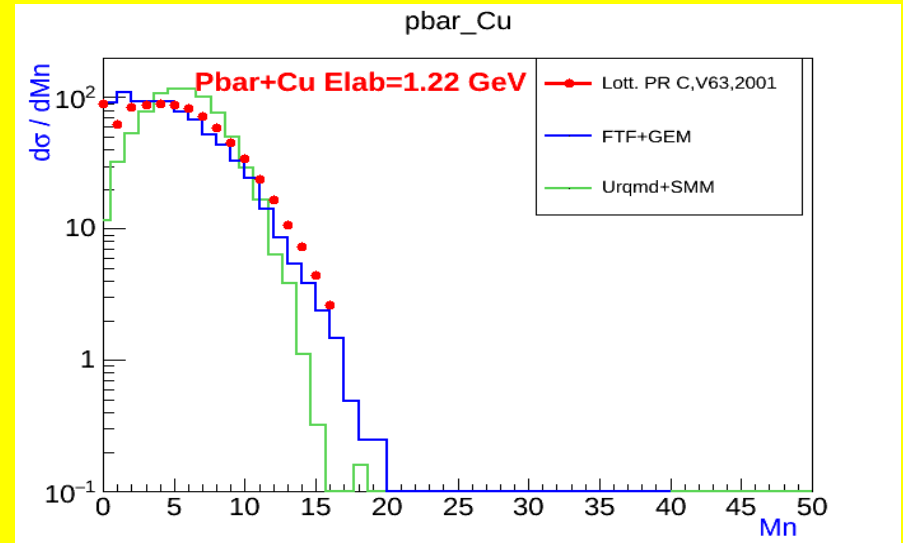
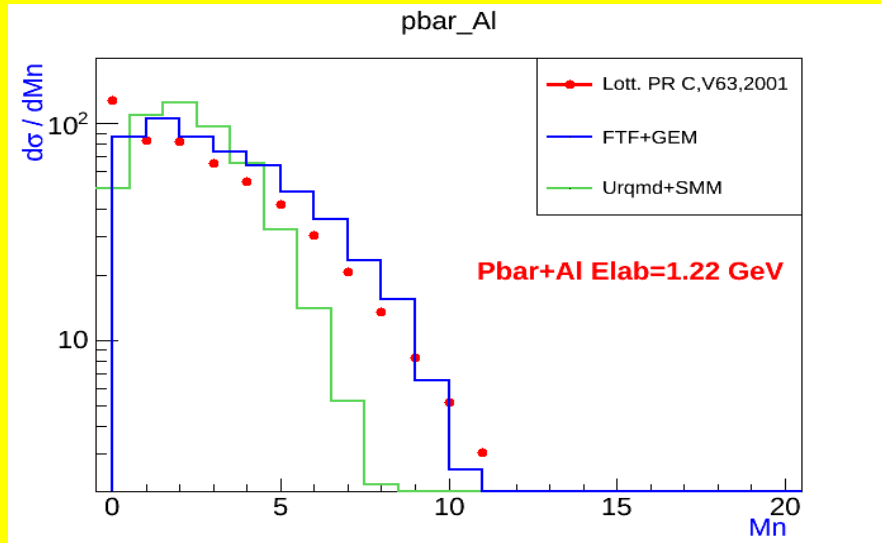
exp.data : B. Lott et al., Phys.Rev.C 63 034616



Results of FTF validation for Antiproton–Nucleus reactions

Multiplicity distributions of neutrons produced in Pbar-Nucleus at energy 1.22 GeV in FTF and UrQMD+SMM models

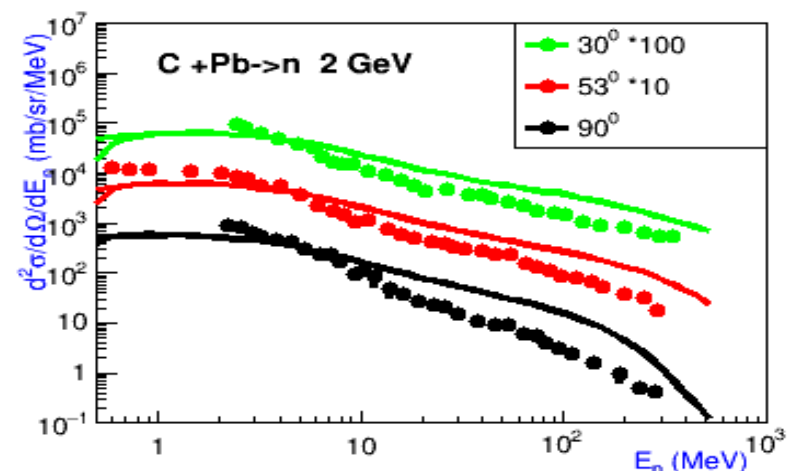
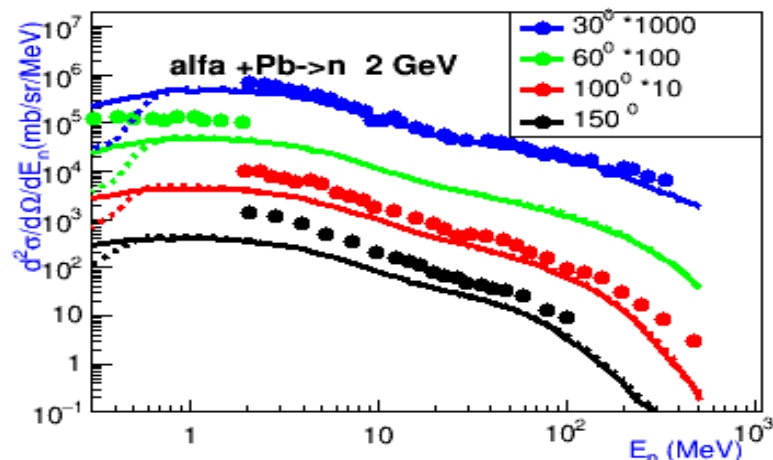
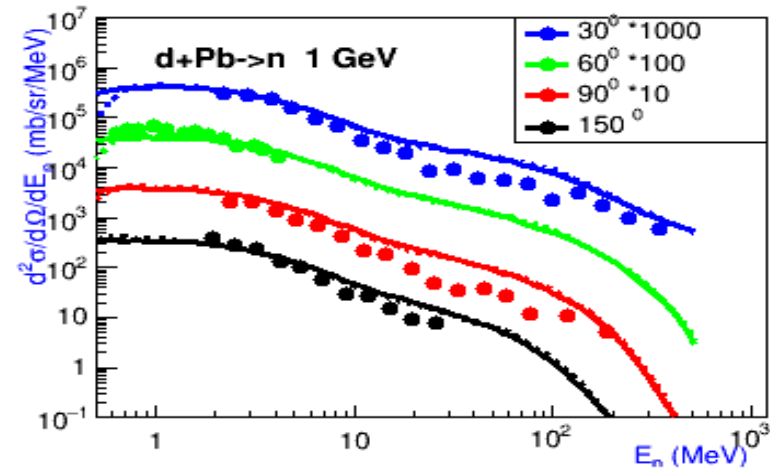
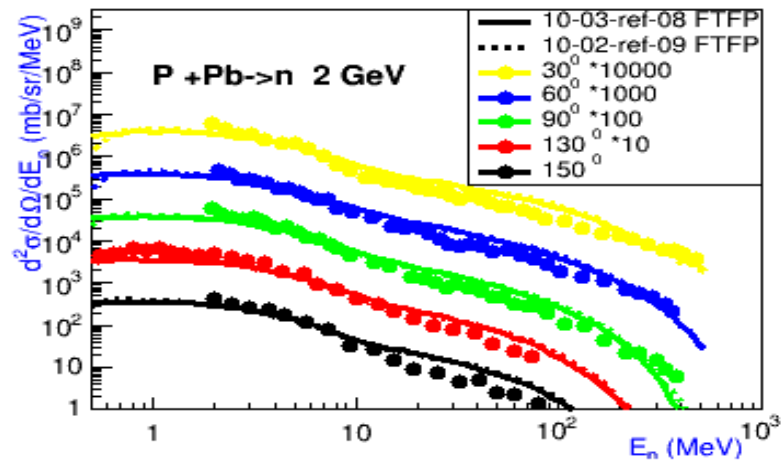
exp.data : B. Lott et al., Phys.Rev.C 63 034616



Current status of neutron production in FTF model

Yurevich, R.M. Yakovlev, V. G. Lyapin (JINR, RI St.Peterburg)

Physics of Atomic Nuclei, 2006, Vol. 69, No. 9, pp. 1496–1509 «Neutron Emission in Interactions of H-1, H-2, He-4, and C-12 Nuclei with Lead Nuclei at 1–2 GeV per Nucleon».

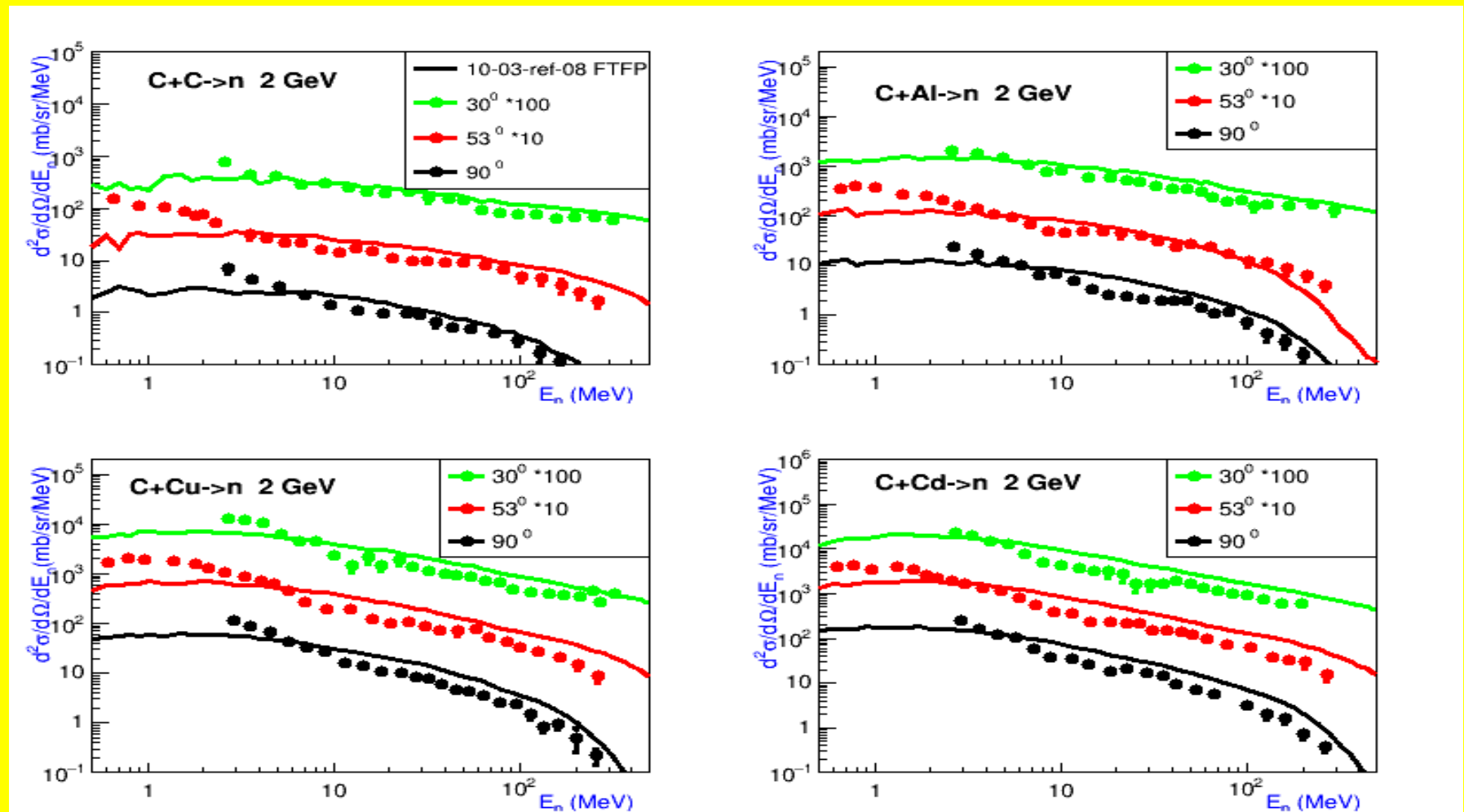


Current status of neutron production in FTF model

Yurevich, R.M. Yakovlev, V. G. Lyapin (JINR, RI St.Peterburg)

Physics of Atomic Nuclei, 2012, Vol 75, No 2, pp191-202.

«Neutron production in Collisions between Carbon Nuclei of Energy 2 GeV per Nucleon and Carbon, Aluminium, Cadmium and Lead Nuclei».



Conclusion

1. Files of FTF model validation for neutron production in **hadron-nucleus** interactions are improved and ready to commit in folder **test22/hA_neutron**.
2. At comparison with exp. data, it was obtained that FTF model gives acceptable results for neutron production in **proton-nucleus** interactions at projectile energies more than 1.0 GeV. Good agreement were obtained for neutron spectra in p-A interactions at projectile energy 3 GeV.
3. At comparison of FTF results with ITEP experimental data, it was obtained, fine tuning of parameters of FTF model improved slow neutron production in P-C and P-Cu interactions. Now we need to improve model parameters for heavy target nuclei, for example, for P-Pb interactions.
4. For neutron production in antiproton-nucleus interactions, it was shown that **FTF+PRECO** results became better at comparison with exp. data from LEAR collaboration. At the same time, **FTF+BIC** results for slow neutrons are worse (a little bit) than the same ones obtained two years ago. We need to improve **FTF+BIC** results.
5. For the first time, FTF model gives promising results for neutron production in **Carbon - nucleus** interactions at projectile energy 2 GeV per nucleon.

Current status of neutron production in FTF model

K. Ishibashi et al., J.Nucl. Sci. Tech., Vol.34, N6 (1997) 529-537

