

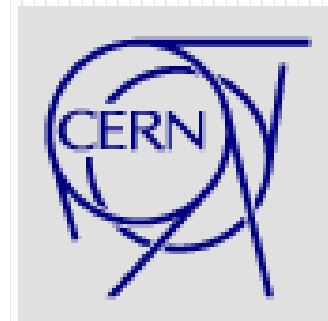
# Validation of hadronic physics with thin target data

V. Ivanchenko, A. Ivantchenko

16<sup>th</sup> Geant4 Workshop

19-23 September 2011

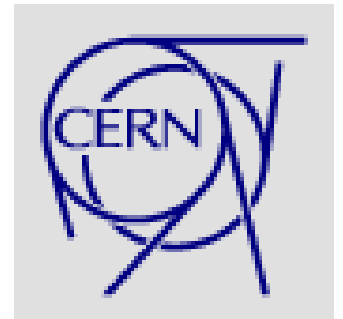
SLAC, Stanford, CA, USA



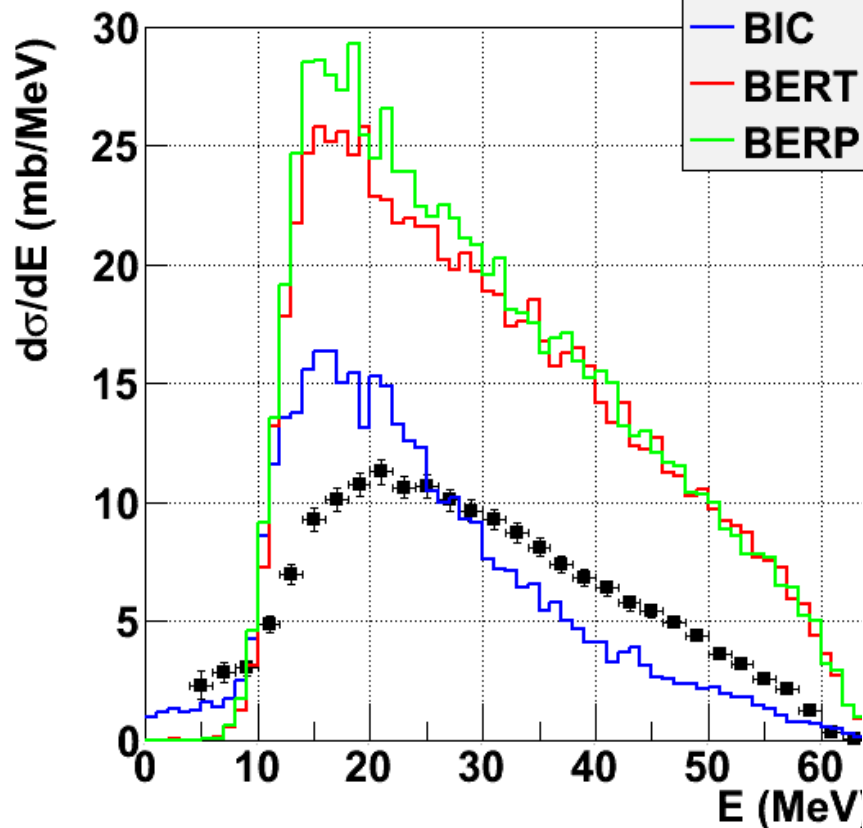
# Main modifications after 9.4

- Condition of transition from pre-compound to de-excitation models:
  - $(Z < 9 \ \&\& \ A < 17) \ \|\ \|\ (E_{ex} < 10 \text{ keV})$
  - Equilibrium of excitation and decay
- Logic in G4ExcitationHandler:
  - Only one Fermi-BreakUp reaction – products may only have photon evaporation
- Fermi Break-Up (FBU) model re-written
  - Model is the same but implementation is understandable both to me and J.M.Quesada
- GEM model was fixed (many lost states were recovered)
- Intensive developments for the Bertini cascade (see M.Kelsey talk)
  - Interface to native pre-compound/de-excitation models
- Cross section redesign

# Test30 selected results for 9.4ref08



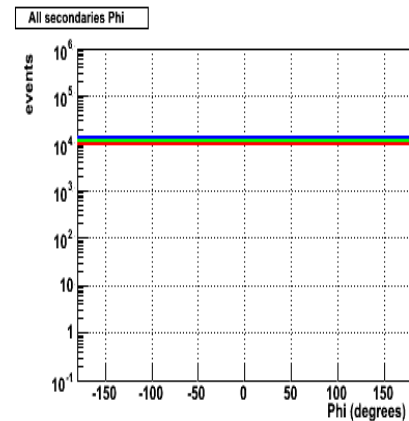
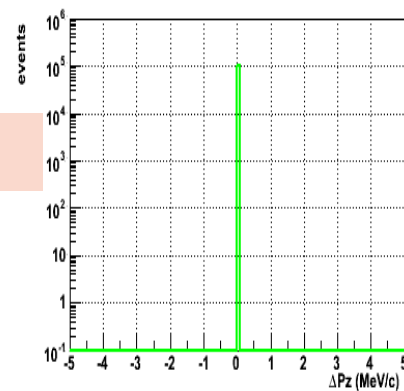
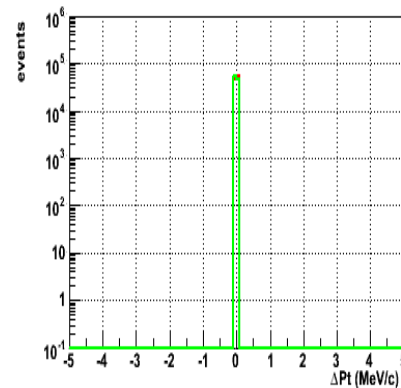
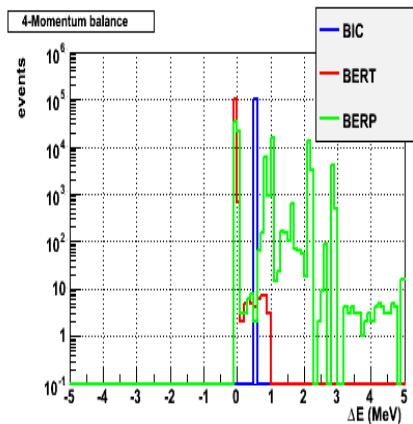
$n + \text{Bi} \rightarrow p + X, E = 63 \text{ MeV}$



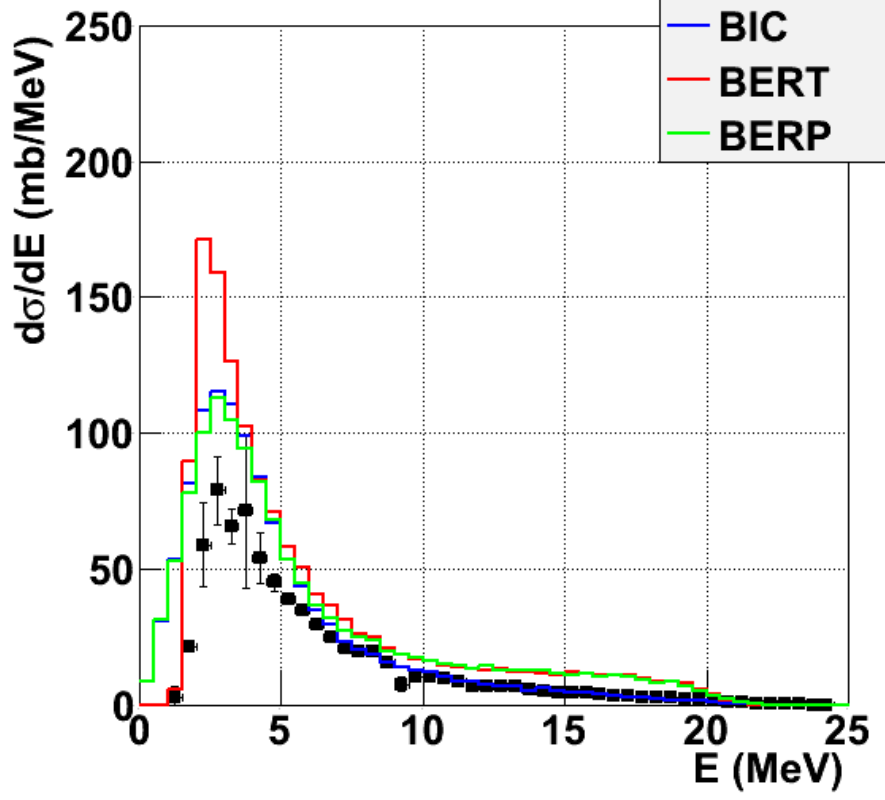
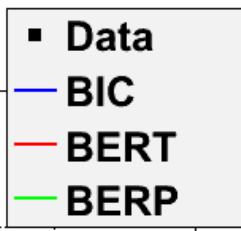
■ Data  
— BIC  
— BERT  
— BERP

Energy balance problems in both cascades  
No problem with momentum balance

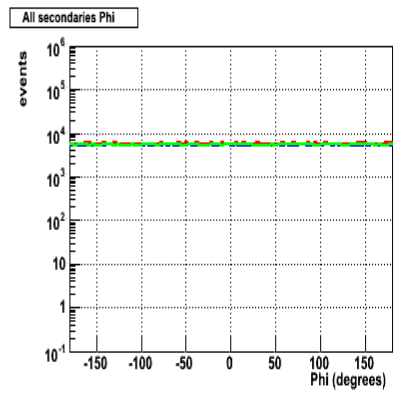
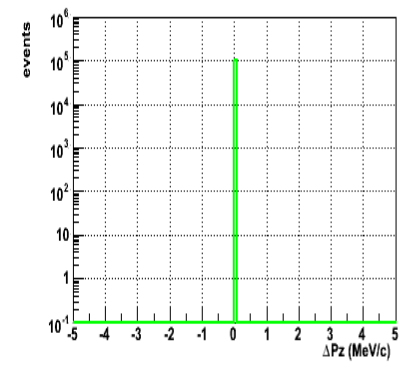
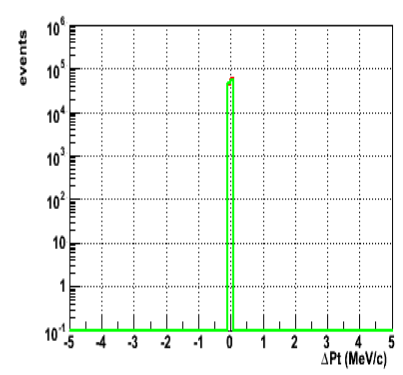
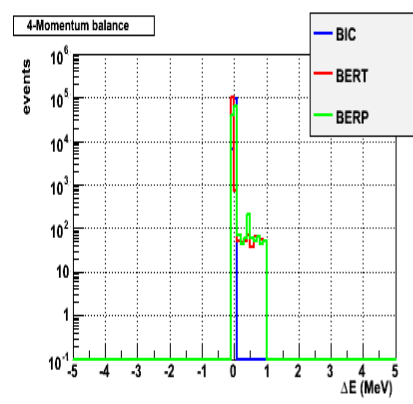
No visible effect of native de-excitation

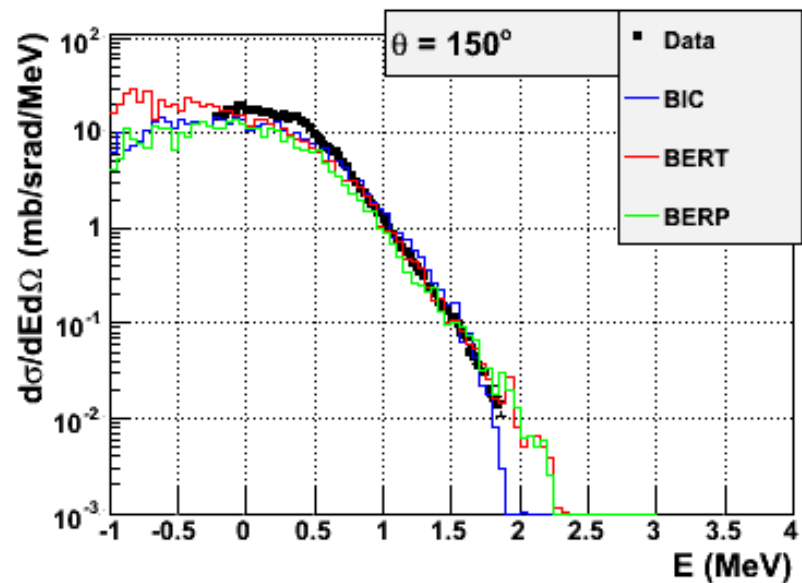
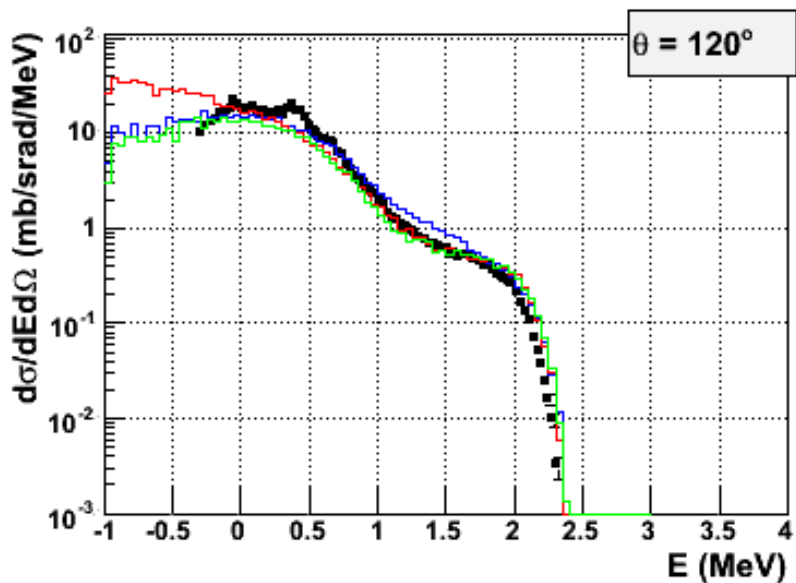
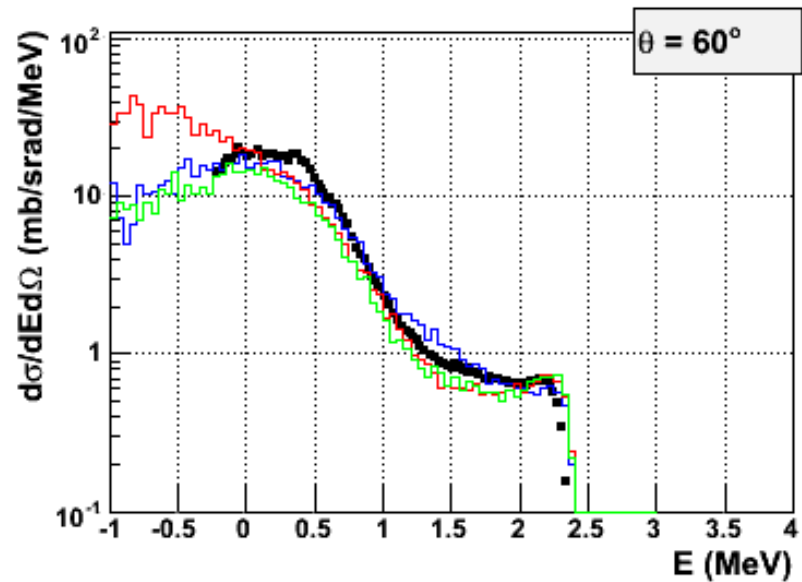
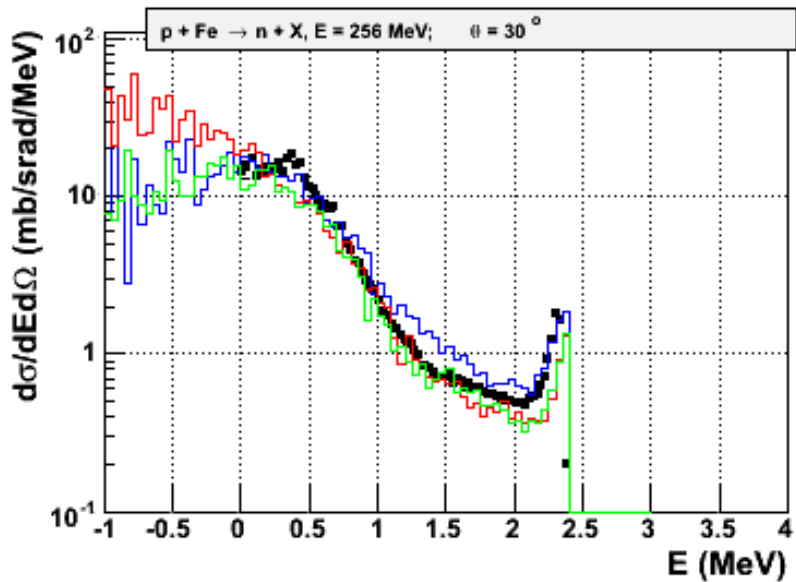


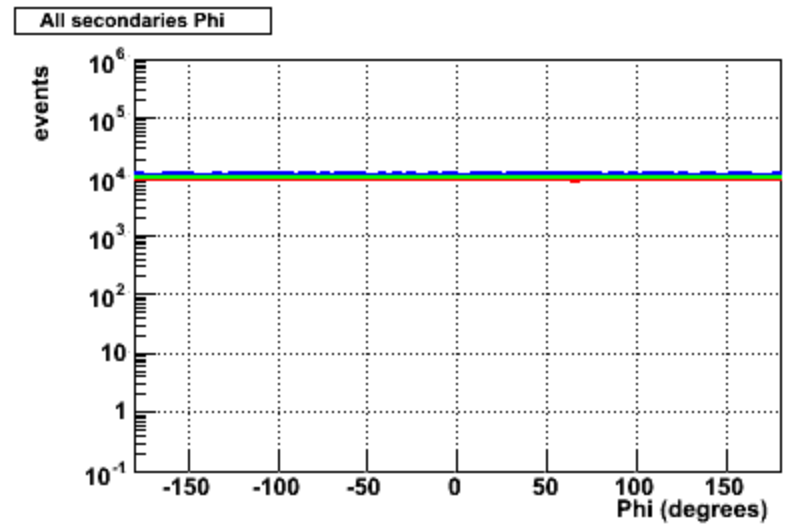
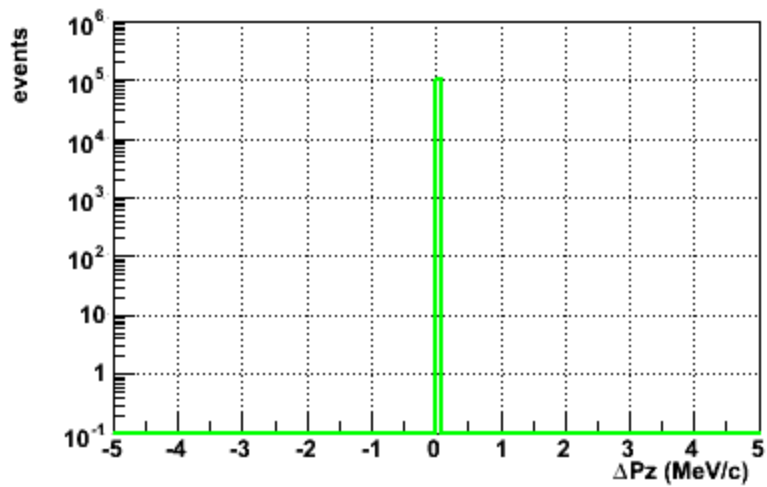
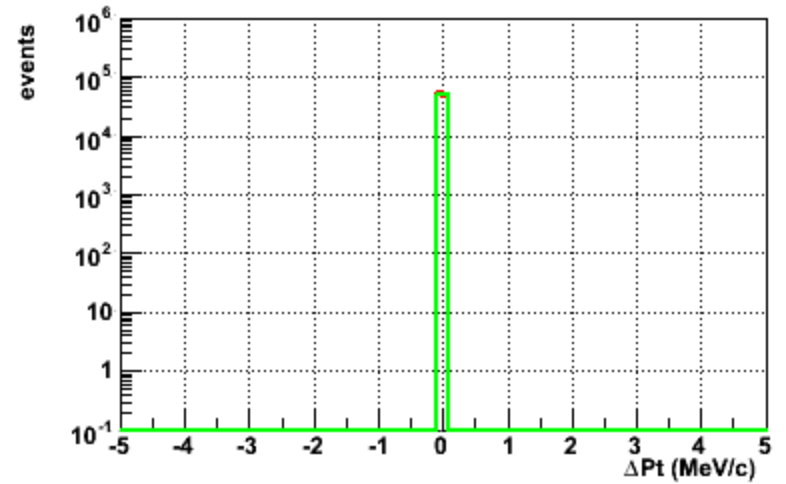
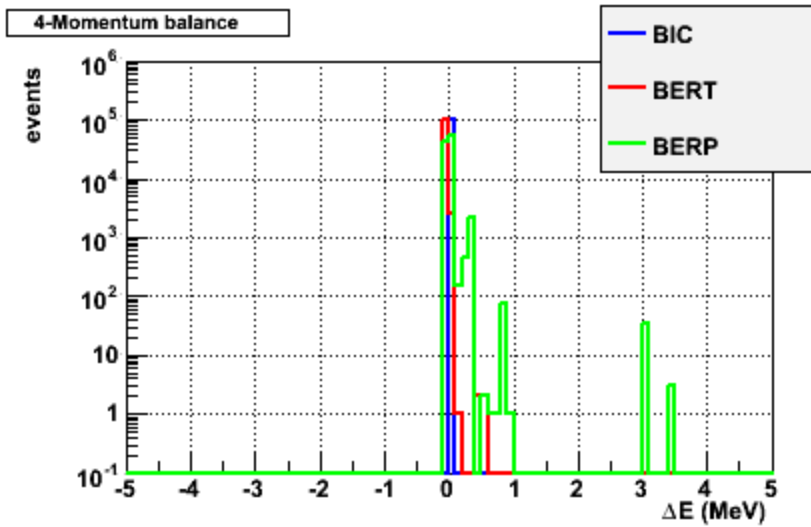
$n + \text{Si} \rightarrow p + X, E = 25 \text{ MeV}$

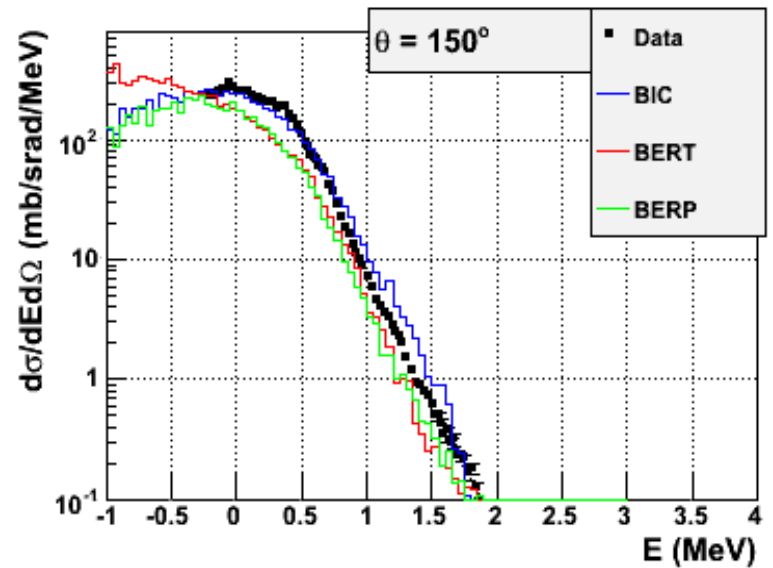
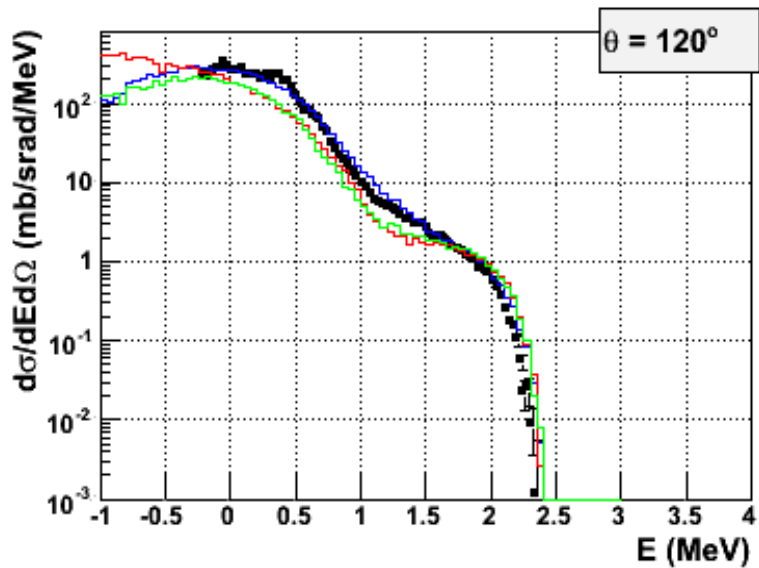
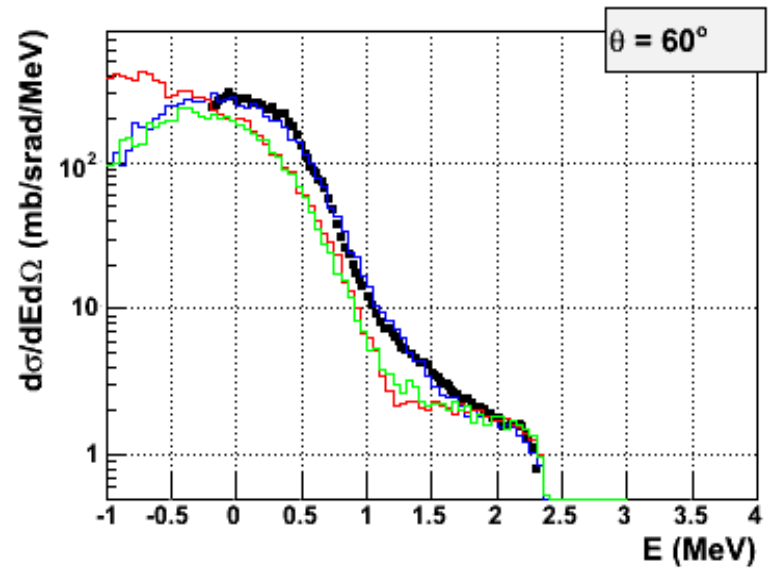
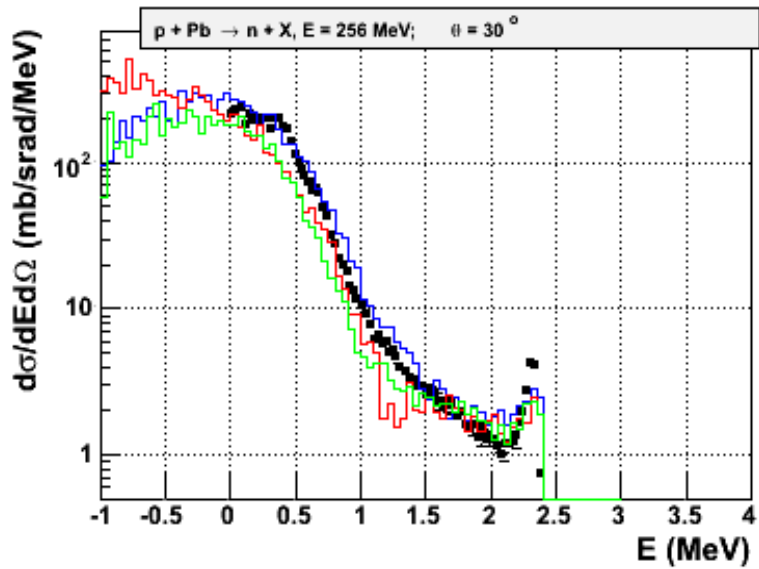


Is visible effect of native de-excitation  
No 4-momentum balance problem

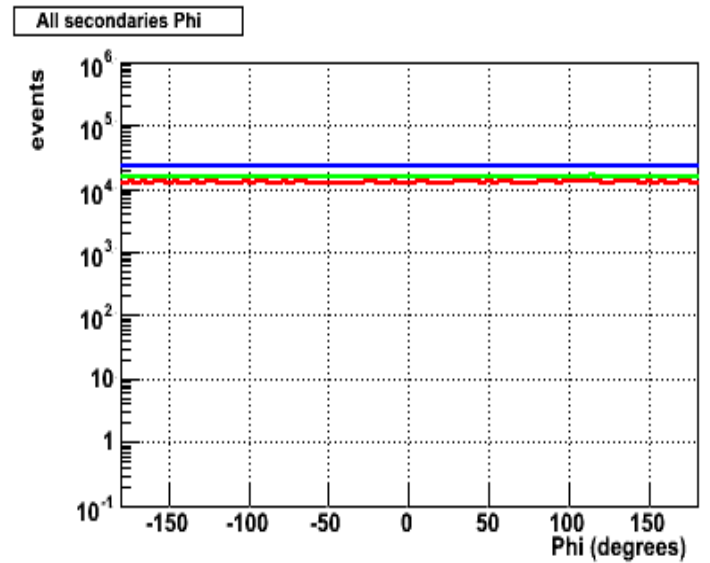
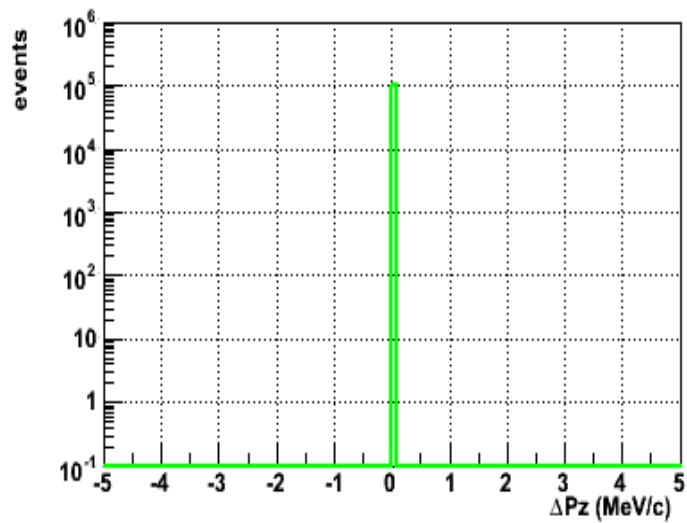
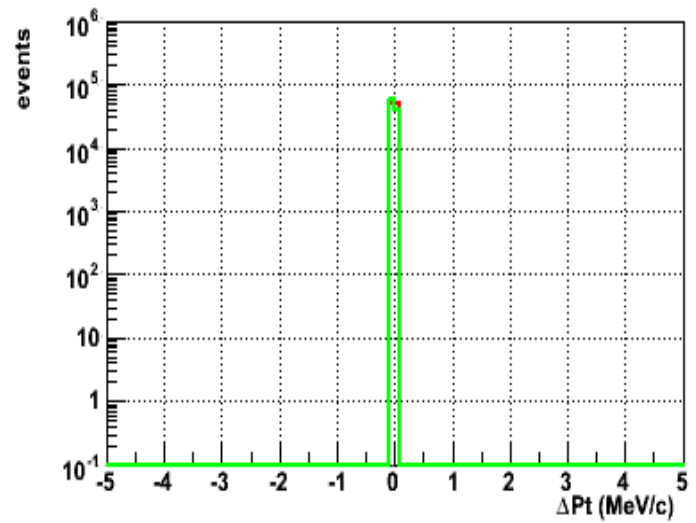
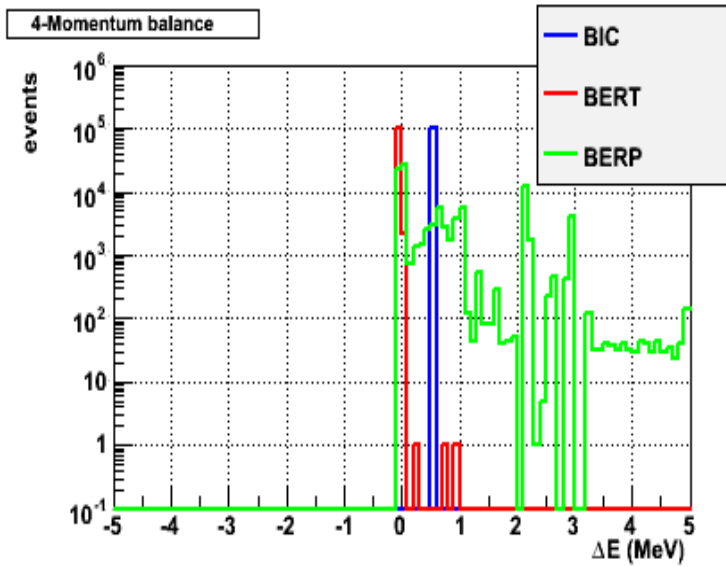




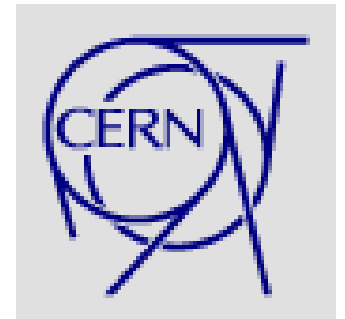




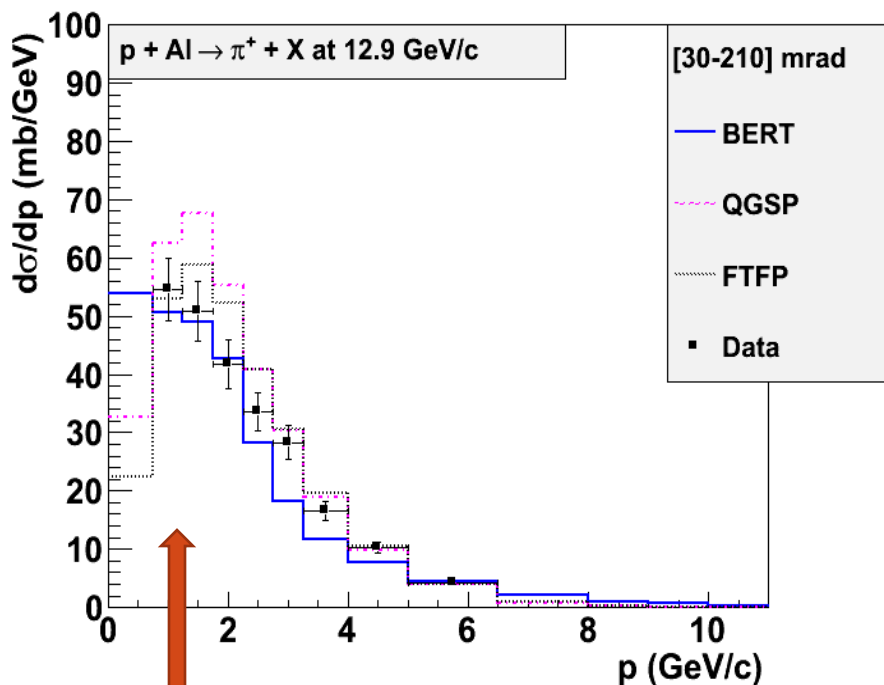




Test35 selected results for 9.4ref08  
New plots in linear scale are shown

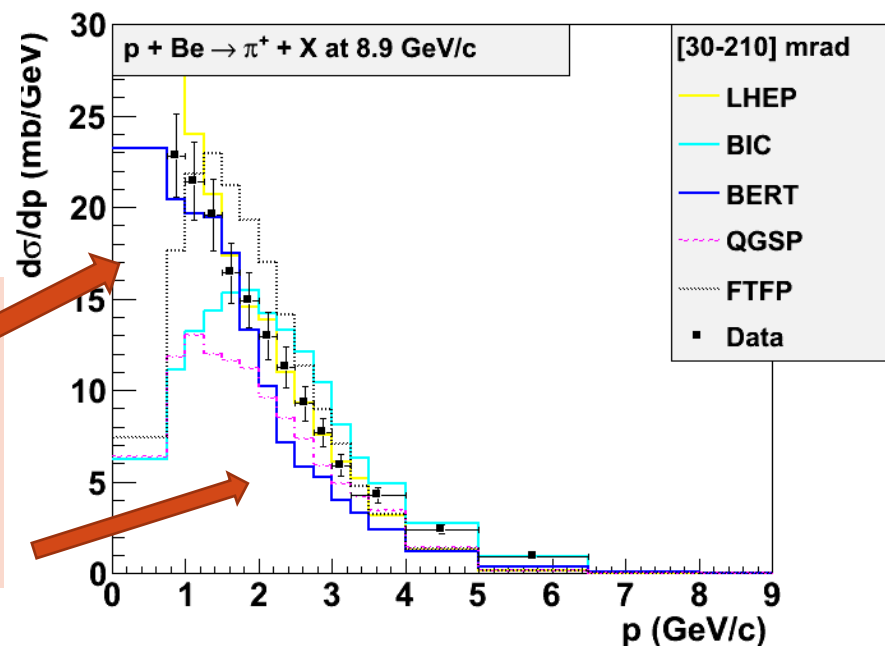


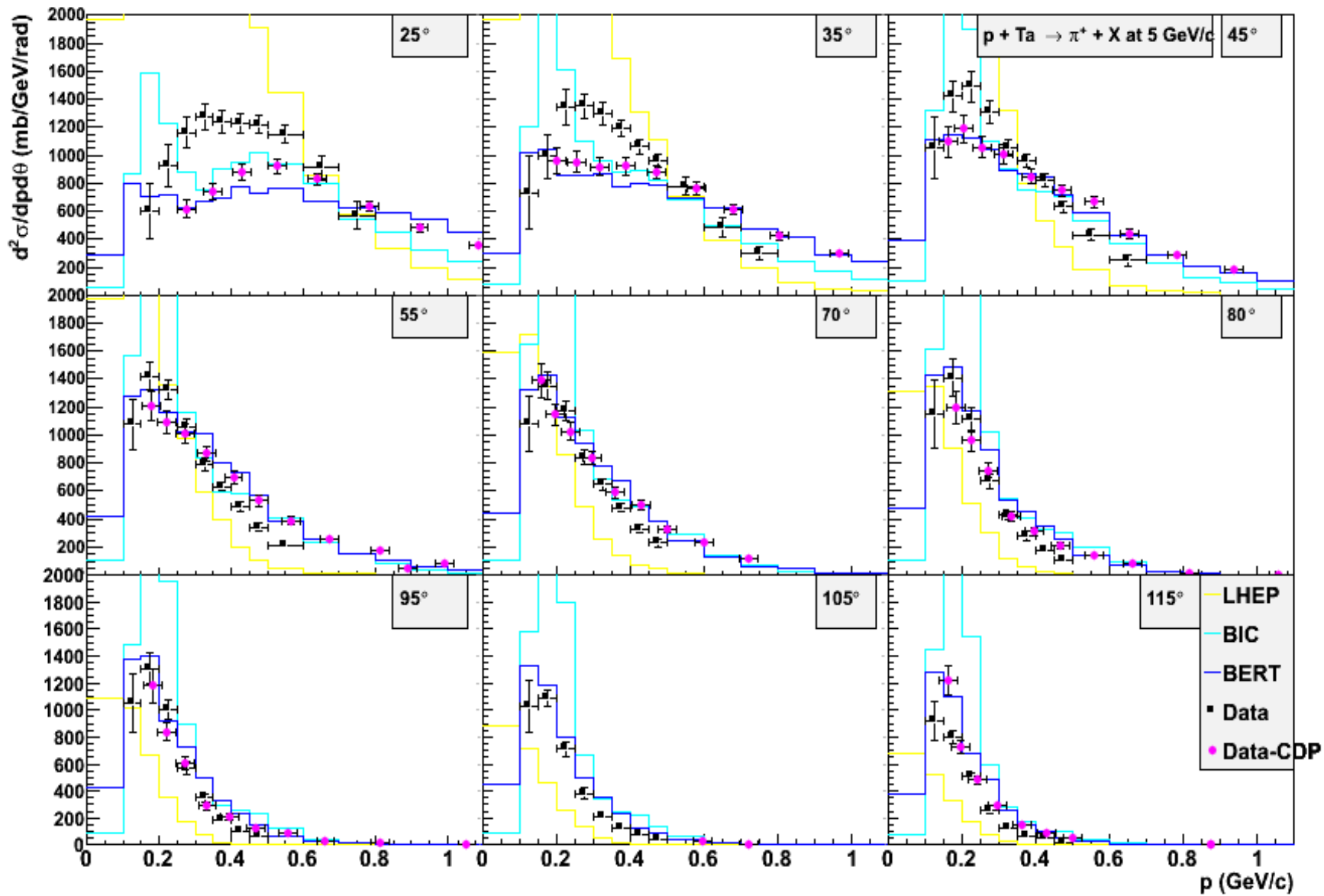
# Forward pion production

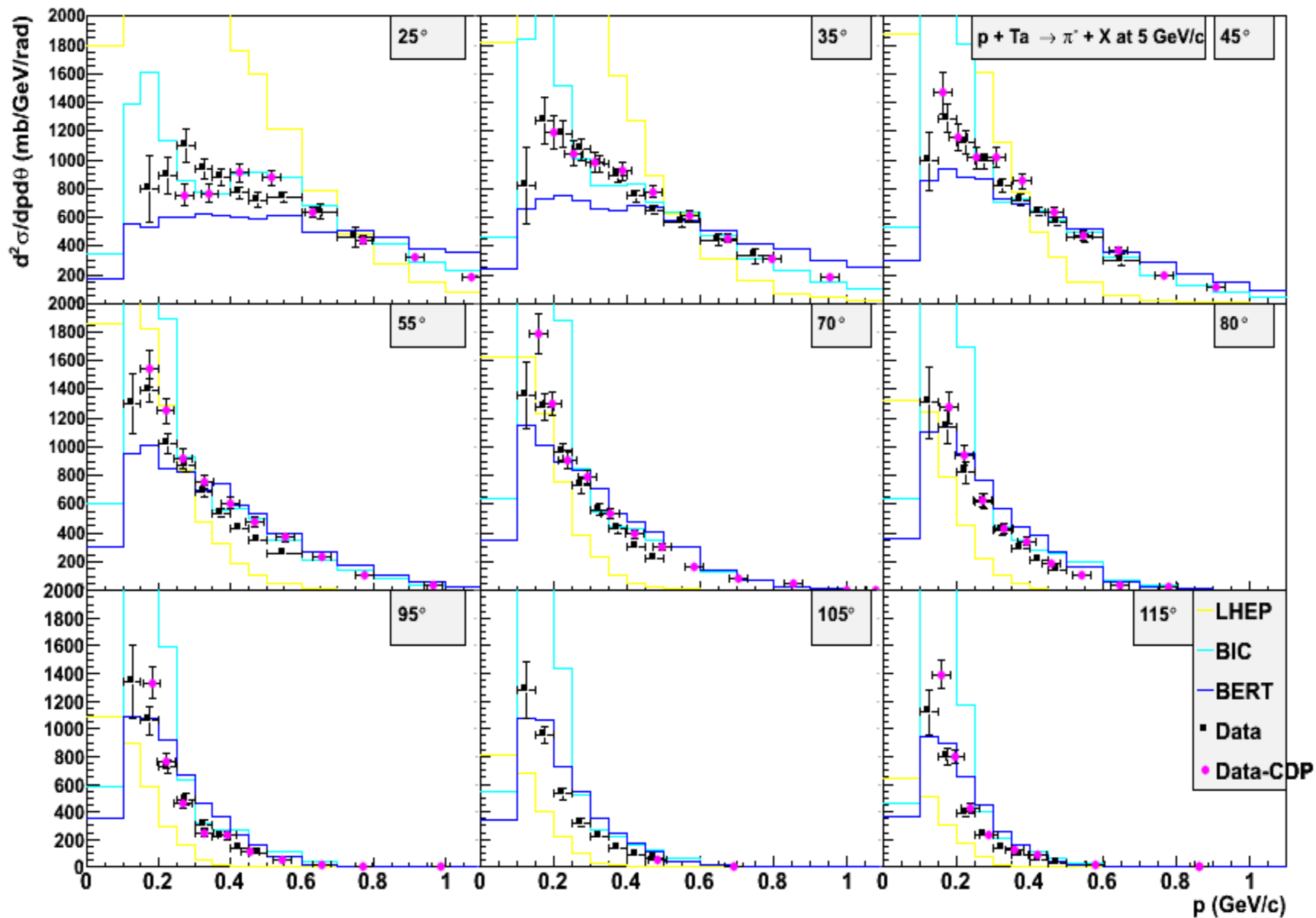


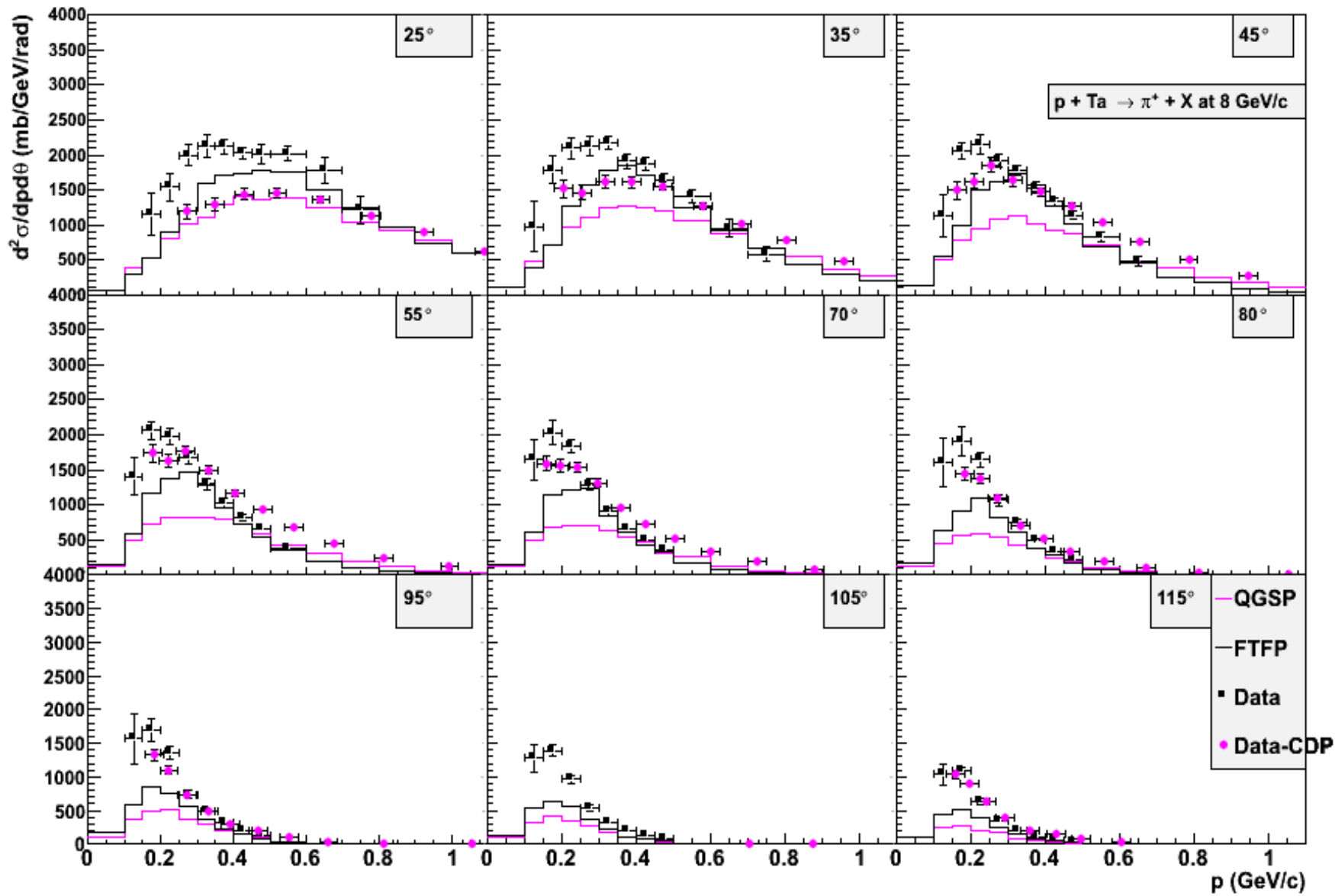
Main problem in correct simulation of re-scattering of low-energy pions in different hadronic models

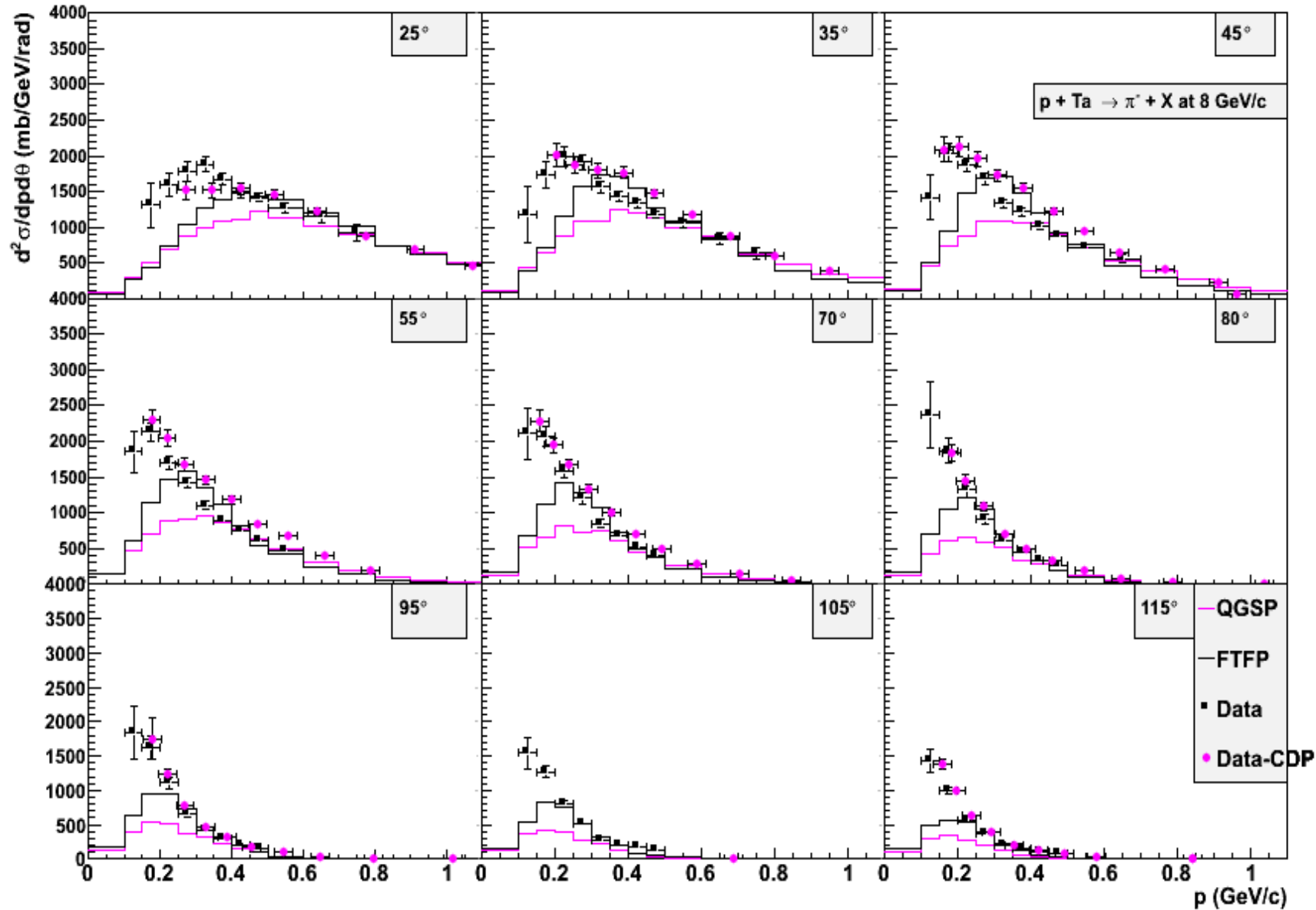
Bertini underestimates high energy tail

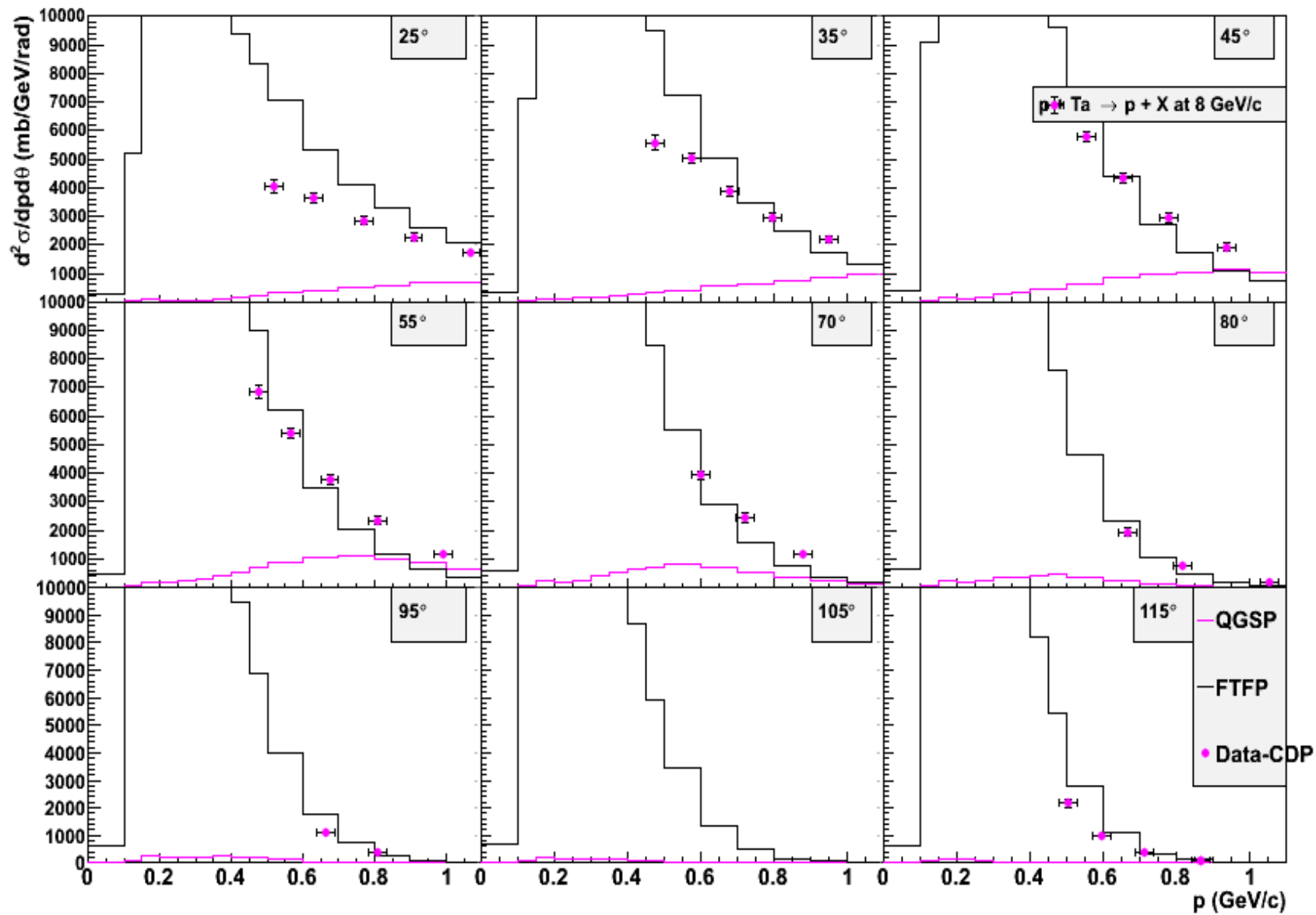




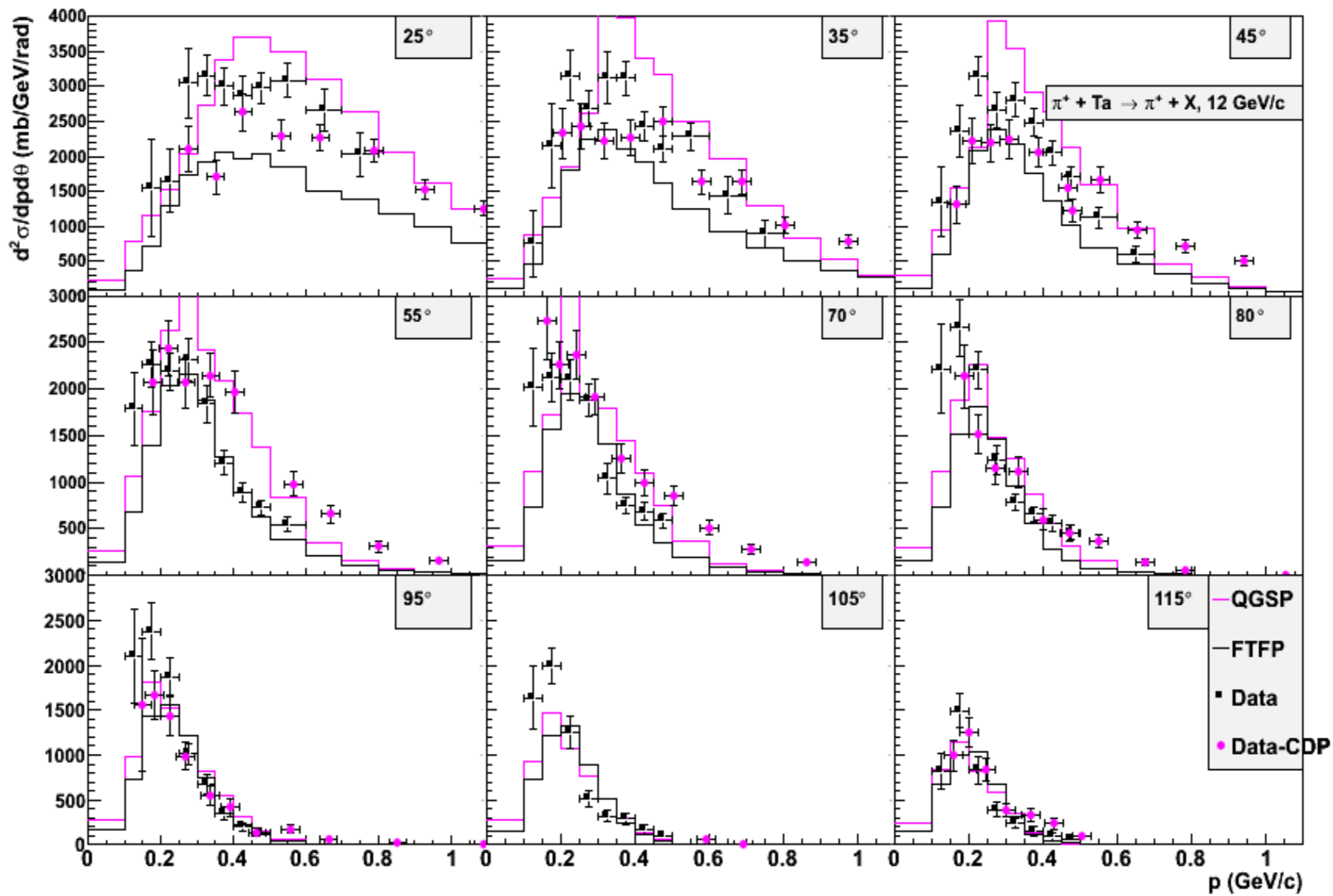


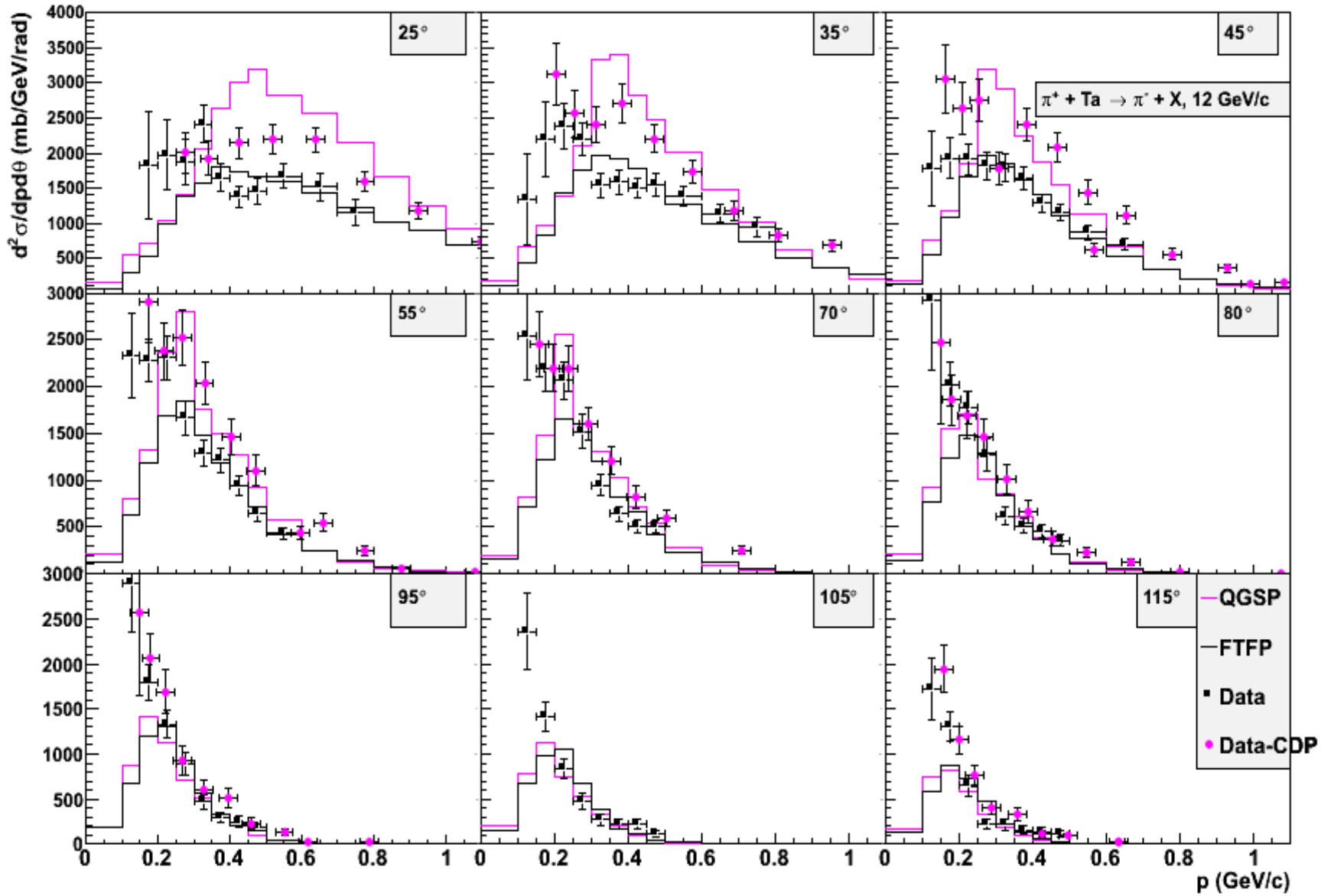


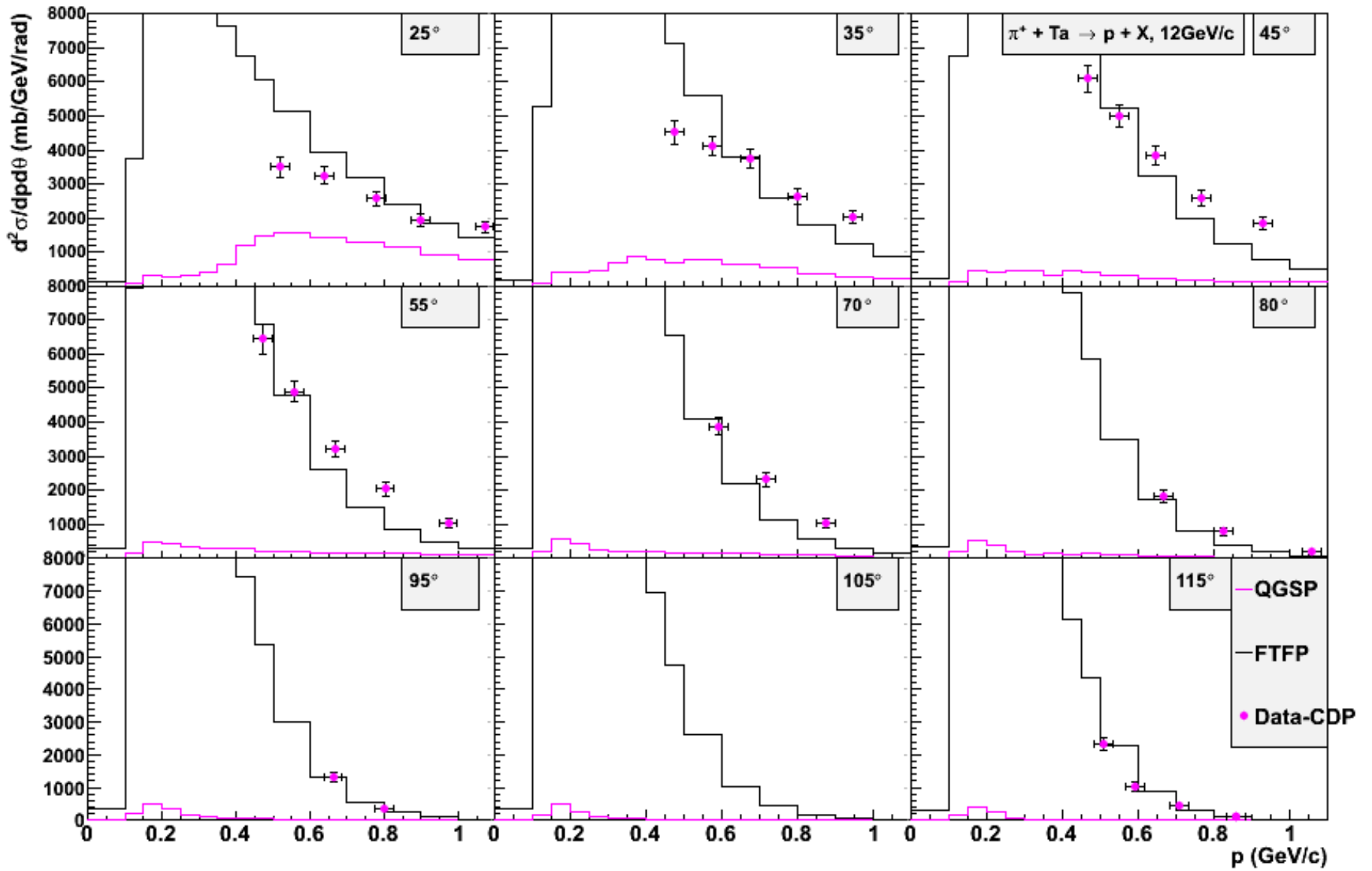












# Summary

- Results for ref08 show that there is no major bugs in cross section after migration to new design
- Bertini+Preco is added to test30 and working fine
  - Reduction of low-energy proton/neutron production
  - There are issues with energy balance
  - CPU is acceptable
- There are underestimation of forward pion production practically in all models
  - Re-scattering simulation should be improved
  - Shower shape may be affected
- Proton production by QGS is wrong below 15 GeV
  - QGSP\_FTFP\_BERT and FTFP\_BERT Physics Lists seems to be more precise than QGSP\_BERT