Validation of Geant4.10.1-ref05
Brief Summary
from test19, 47, 48, and 75

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Geant4 Hadronic Group Meeting

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General Information

- Included:
  - AtRest processes – test48
  - Gamma-N interactions – test75
  - Baryon production by Bertini, Binary, FTF at intermediate energies – test47
  - FTFP, QGSP(+G4LundStringFragm.) at 31GeV/c or 158GeV/c – test19
- Releases:
  - Geant4.10.1.p01
  - Geant4.10.1-ref04
  - Geant4.10.1-ref05
- Only signature plots shown (interesting/non-negligible changes)
- Otherwise, a verbal overview
- All results/plots uploaded to G4 Validation Repository:

http://g4devel.fnal.gov:8080/G4WebAppNG

G4.10.1-ref05 Summary (I)

- NO major changes found in Bertini, Binary, INCLXX, or QGS
- Various changes observed in FTF(P)
  - Pbar annihilation (test48)
    - Pion multiplicity is affected (some bins are “better”, some are “worse”)
    - Charged pion momentum spectrum moves closer to the data
  - Baryon production in p- or pi-nucleus interactions in the intermediate energy (test47 – ITEP or pbar production)
    - Spectra for light target (C) move away from ITEP data
    - Most of the nice improvements of ref04 seem to be gone
    - For p+nucleus->pbar, FTF(P) results move further away from the data
      - NOTE: only a couple of sample plots are included but the affect is the same for all targets (Be,Al,Cu,Au,Ta)
    - Pion production in p- or pi-nucleus interactions in the intermediate energy range only mildly affected (if at all)

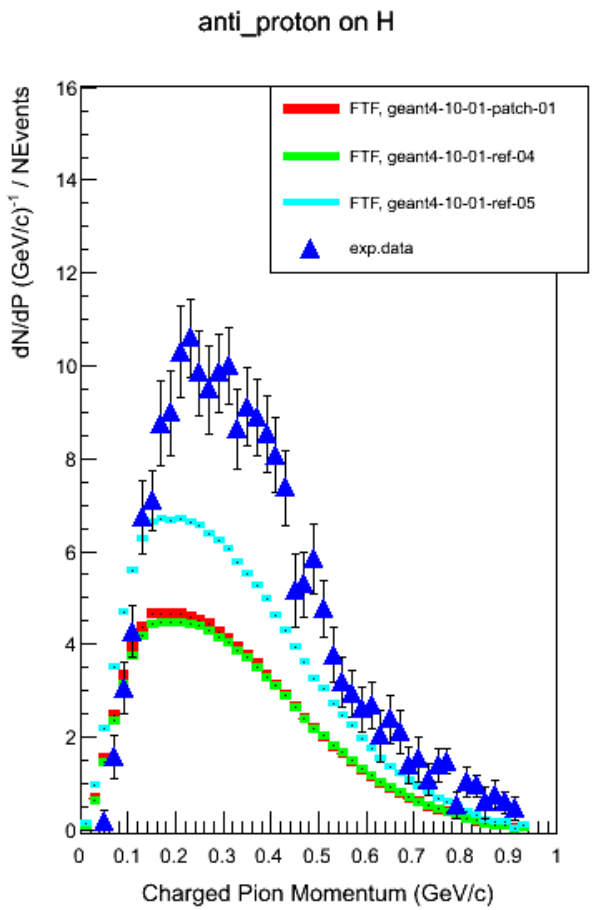
G4.10.1-ref05 Summary (II)

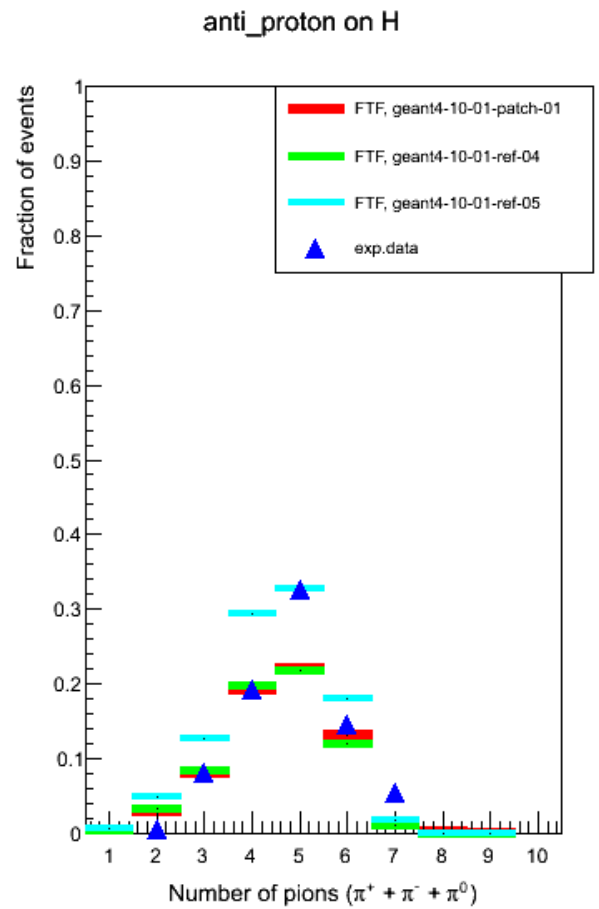
- Various changes observed in FTF(P) (cont.)
  - Hadron production in p+C at 31GeV/c – only mild effects (if any)
  - Hadron production in p+C at 158GeV/c
    - Pion production mildly affected
    - p + C -> p + X - looks “goofy” ?
    - p + C -> pbar + X – looks like an improvement
    - P + C -> n + X – no significant changes
- General note: can NOT tell if the changes are to be attributed to FTF or maybe to PreCompound
- Several illustrative plots in the following slides

FTF(P): Annihilation pbar on H -> pions + X

Data: C. Amsler, Rev. Mod. Phys. 70, 1293 (1998)

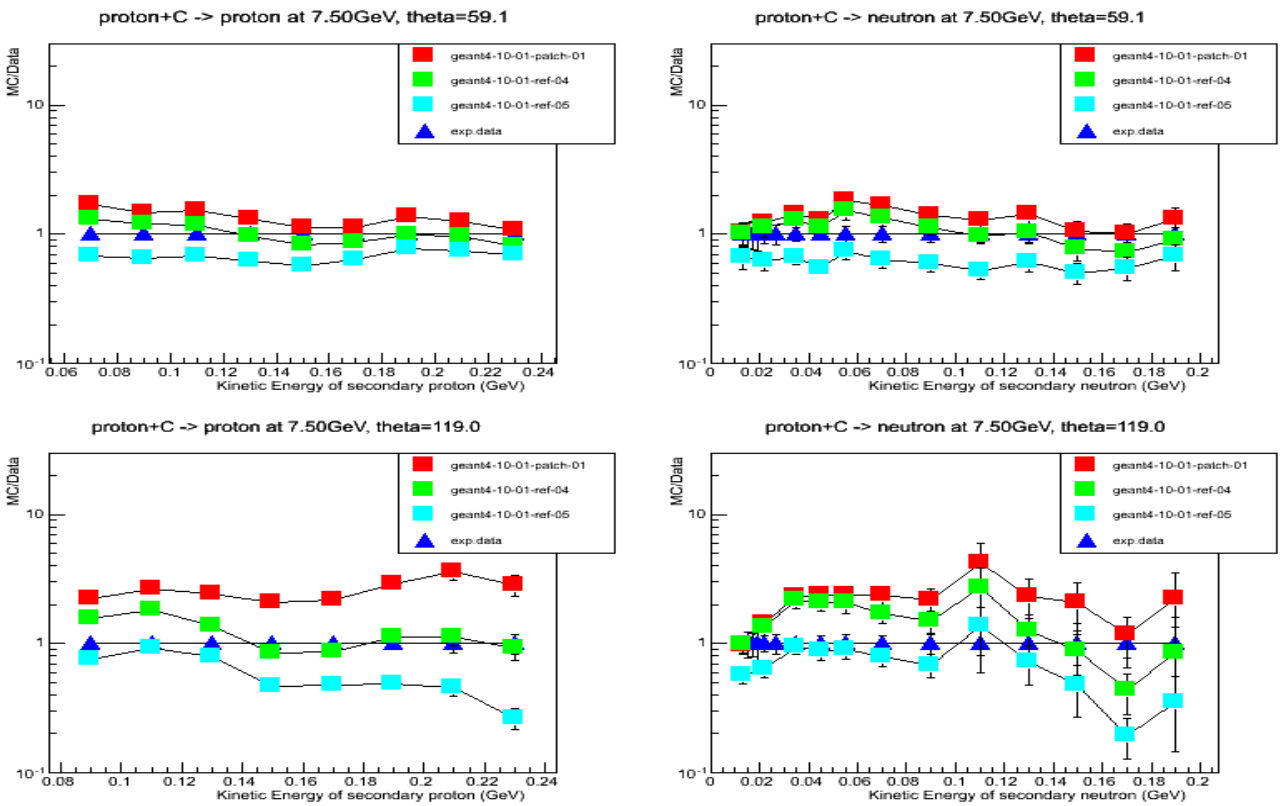
C.B. Dover et al., Prog. Part. Nucl. Phys., Vol.29, pp.87-173 (1992)





FTF(P): 7.5GeV/c p on C -> p,n + X at 59.1deg or 119deg

Data: Yu.Bayukov et al., ITEP-148-1983

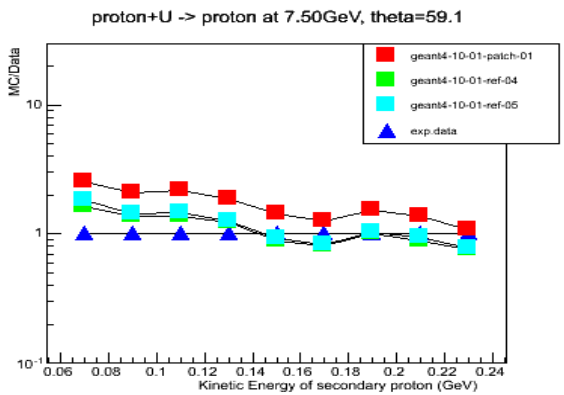


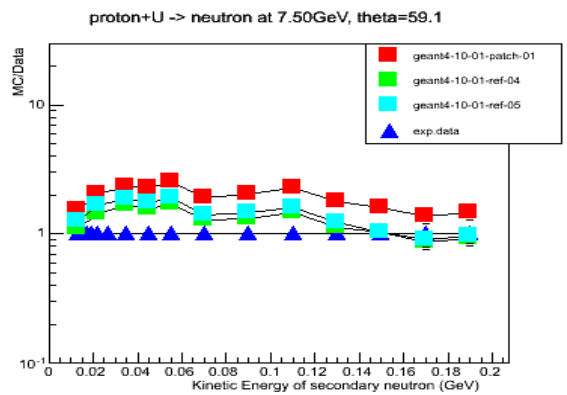
ftfp vs (ITEP) Data
χ^2/NDF = 85.7625 for geant4-10-01-patch-01
χ^2/NDF = 12.3416 for geant4-10-01-ref-04
χ^2/NDF = 19.9946 for geant4-10-01-ref-05

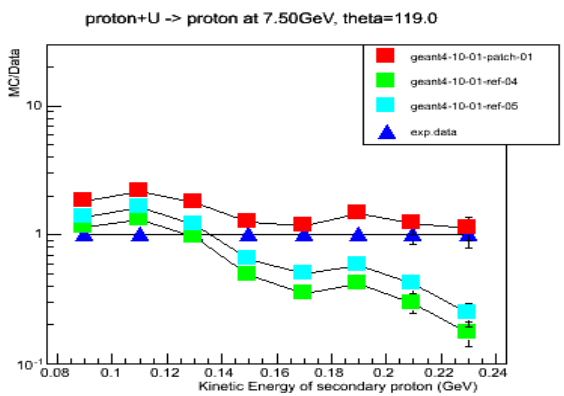
ftfp vs (ITEP) Data
χ^2/NDF = 21.9913 for geant4-10-01-patch-01
χ^2/NDF = 10.0278 for geant4-10-01-ref-04
χ^2/NDF = 4.56085 for geant4-10-01-ref-05

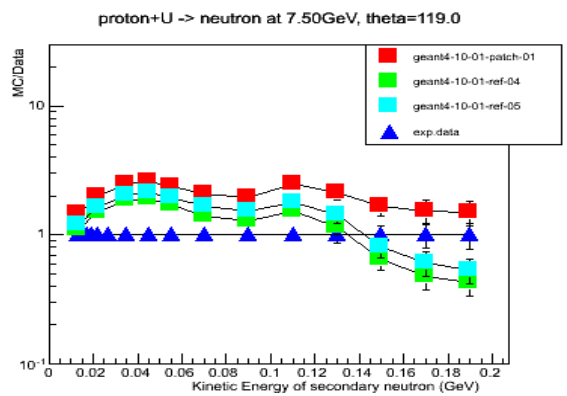
FTF(P): 7.5GeV/c p on U -> p,n + X at 59.1deg or 119deg

Data: Yu.Bayukov et al., ITEP-148-1983







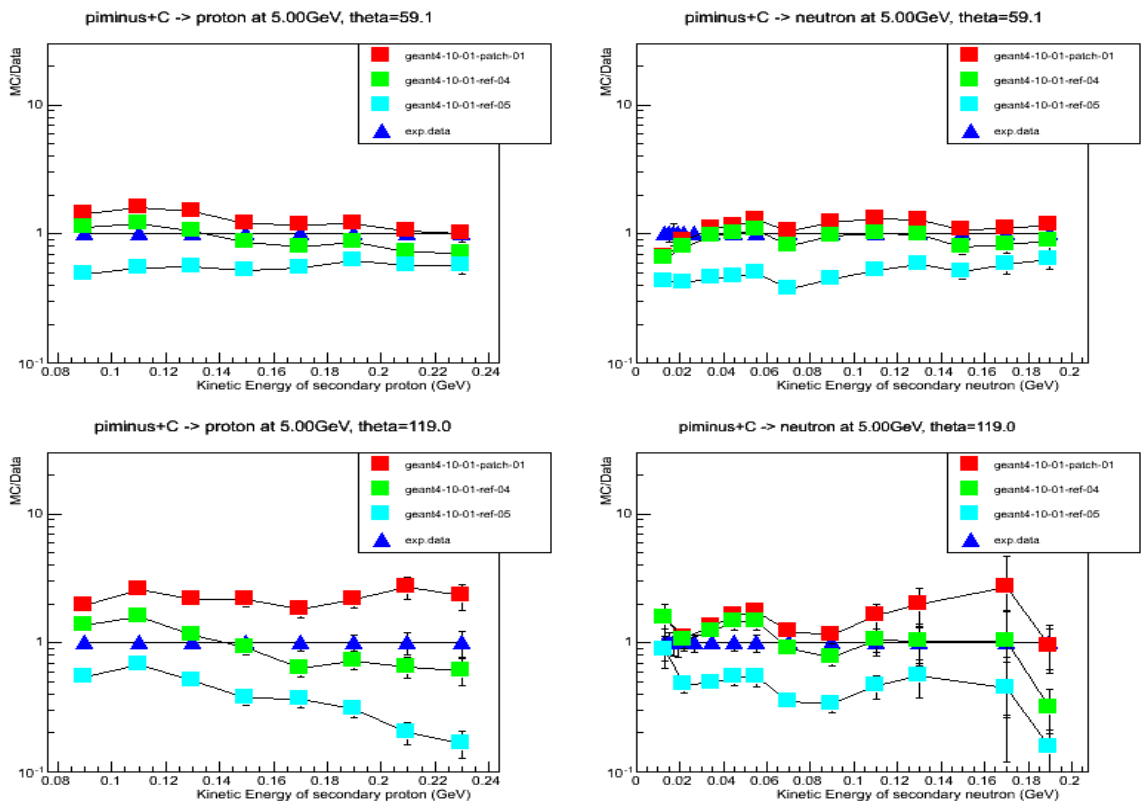


ftfp vs (ITEP) Data
χ^2/NDF = 117.195 for geant4-10-01-patch-01
χ^2/NDF = 22.6945 for geant4-10-01-ref-04
χ^2/NDF = 28.2164 for geant4-10-01-ref-05

ftfp vs (ITEP) Data
χ^2/NDF = 187.037 for geant4-10-01-patch-01
χ^2/NDF = 40.6341 for geant4-10-01-ref-04
χ^2/NDF = 69.6435 for geant4-10-01-ref-05

FTF(P): 5GeV/c pi- on C -> p,n + X at 59.1deg or 119deg

Data: Yu.Bayukov et al., ITEP-148-1983

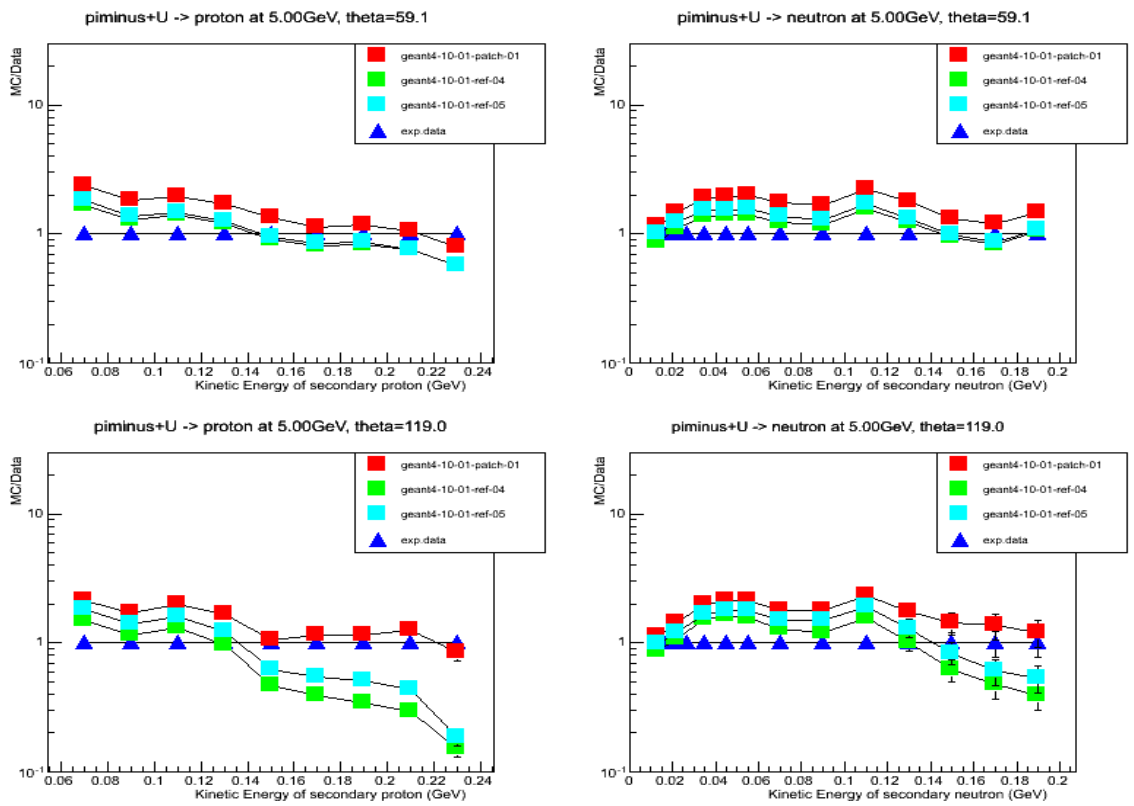


ftfp vs (ITEP) Data
χ^2/NDF = 49.7461 for geant4-10-01-patch-01
χ^2/NDF = 6.47533 for geant4-10-01-ref-04
χ^2/NDF = 24.5958 for geant4-10-01-ref-05

ftfp vs (ITEP) Data
χ^2/NDF = 5.75509 for geant4-10-01-patch-01
χ^2/NDF = 2.57057 for geant4-10-01-ref-04
χ^2/NDF = 19.0275 for geant4-10-01-ref-05

FTF(P): 5GeV/c pi- on U -> p,n + X at 59.1deg or 119deg

Data: Yu.Bayukov et al., ITEP-148-1983

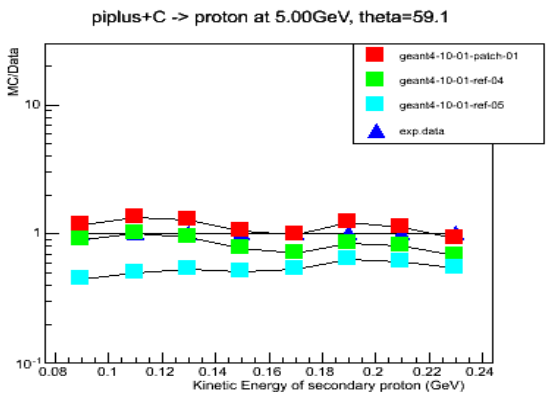


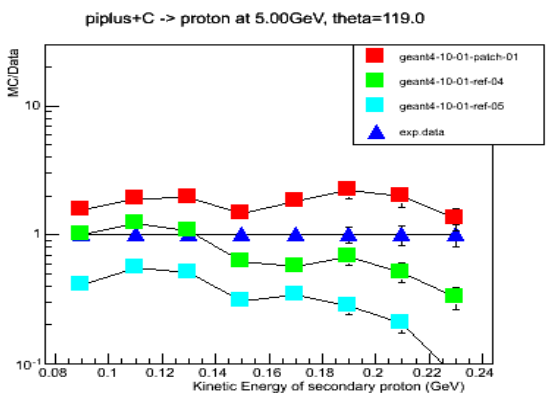
ftfp vs (ITEP) Data
χ^2/NDF = 73.8177 for geant4-10-01-patch-01
χ^2/NDF = 23.8033 for geant4-10-01-ref-04
χ^2/NDF = 30.967 for geant4-10-01-ref-05

ftfp vs (ITEP) Data
χ^2/NDF = 112.291 for geant4-10-01-patch-01
χ^2/NDF = 21.0784 for geant4-10-01-ref-04
χ^2/NDF = 39.8945 for geant4-10-01-ref-05

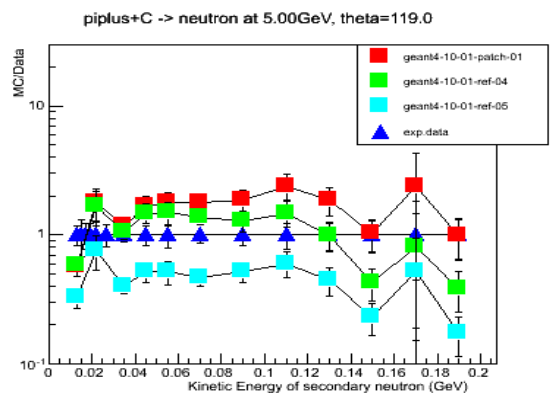
FTF(P): 5GeV/c pi+ on C -> p,n + X at 59.1deg or 119deg

Data: Yu.Bayukov et al., ITEP-148-1983





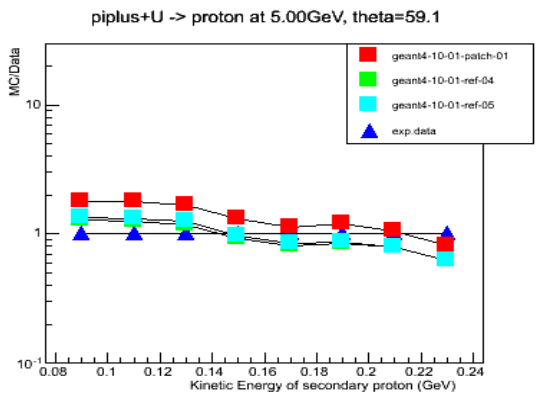
ftfp vs (ITEP) Data
χ^2/NDF = 23.7309 for geant4-10-01-patch-01
χ^2/NDF = 5.66798 for geant4-10-01-ref-04
χ^2/NDF = 29.2091 for geant4-10-01-ref-05

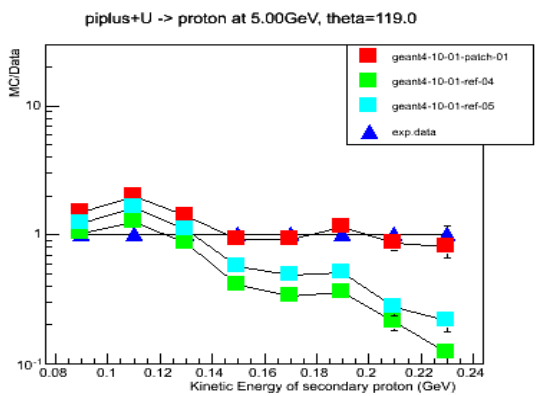


ftfp vs (ITEP) Data
χ^2/NDF = 12.7441 for geant4-10-01-patch-01
χ^2/NDF = 3.89727 for geant4-10-01-ref-04
χ^2/NDF = 8.16333 for geant4-10-01-ref-05

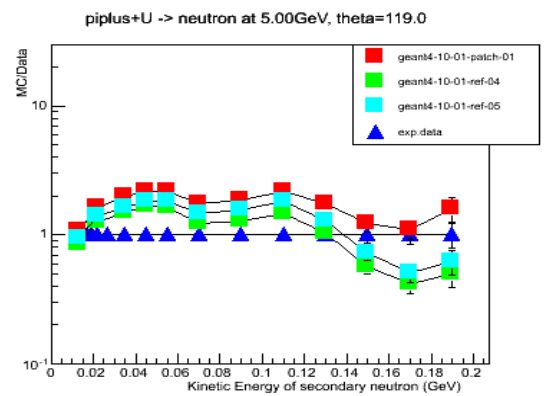
FTF(P): 5GeV/c pi+ on U -> p,n + X at 59.1deg or 119deg

Data: Yu.Bayukov et al., ITEP-148-1983





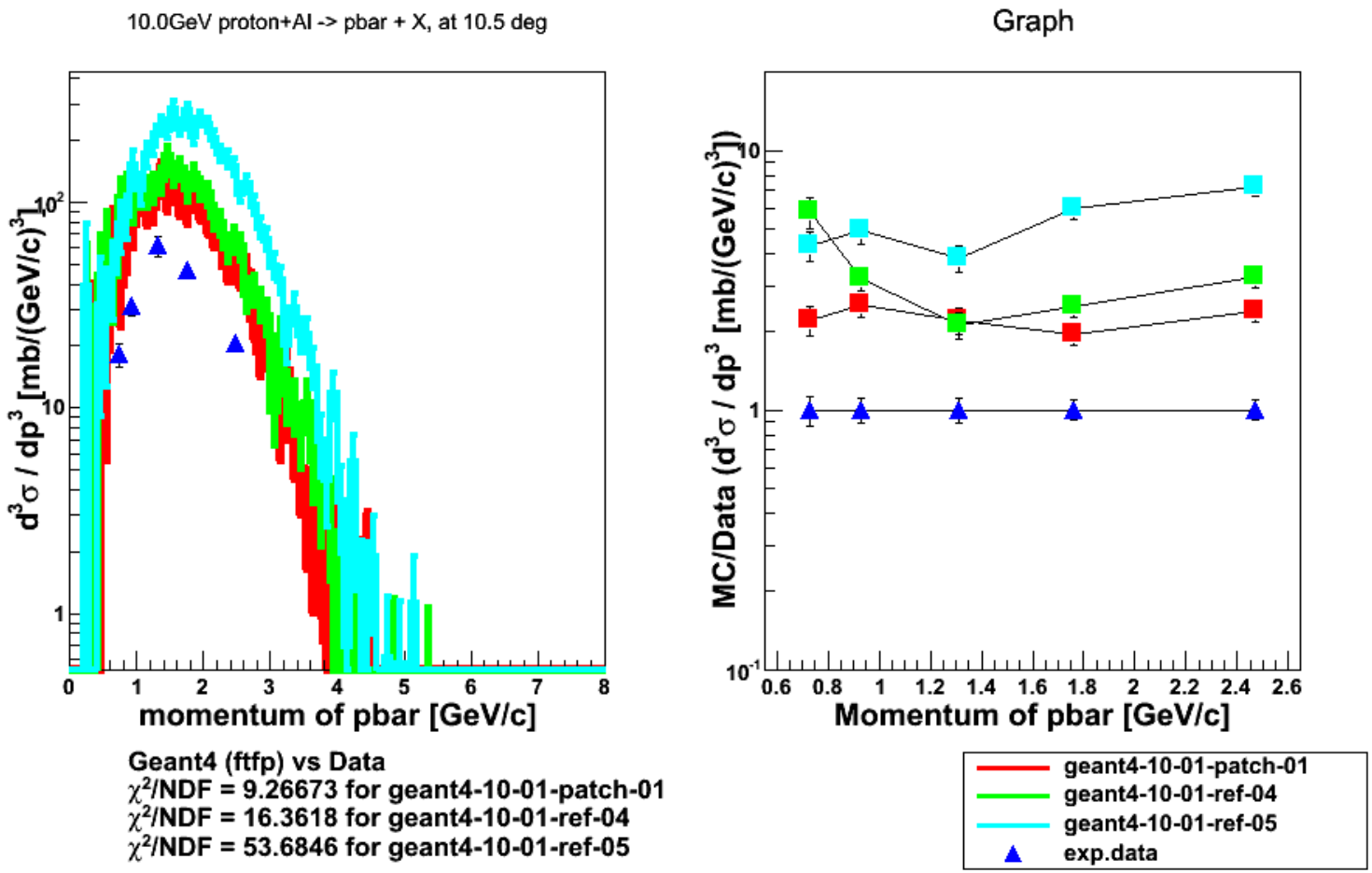
ftfp vs (ITEP) Data
χ^2/NDF = 36.4977 for geant4-10-01-patch-01
χ^2/NDF = 18.2787 for geant4-10-01-ref-04
χ^2/NDF = 18.9691 for geant4-10-01-ref-05



ftfp vs (ITEP) Data
χ^2/NDF = 127.585 for geant4-10-01-patch-01
χ^2/NDF = 31.4395 for geant4-10-01-ref-04
χ^2/NDF = 59.1322 for geant4-10-01-ref-05

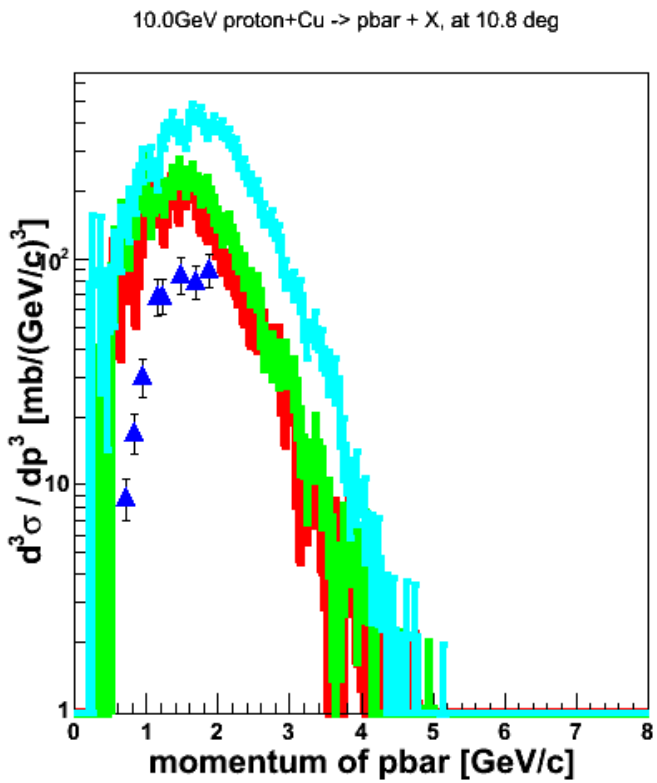
FTF(P): 10GeV/c p on Al -> pbar + X at 10.5deg

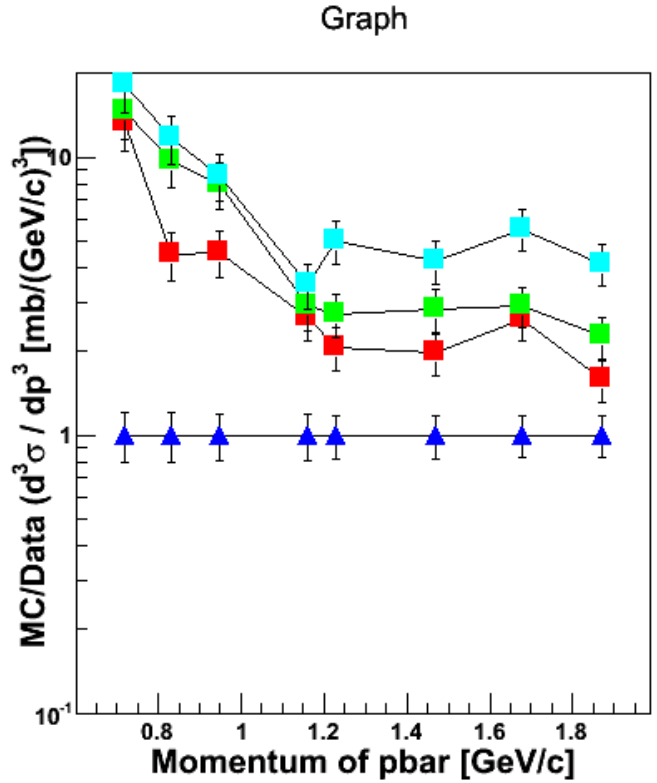
Data: Kiselev et al., Phys.Rev.C85:054904,2012



FTF(P): 10GeV/c p on Cu -> pbar + X at 10.8deg

Data: Barabash et al, ITEP-48-1980 (http://durpdg.dur.ac.uk/view/ins154929)



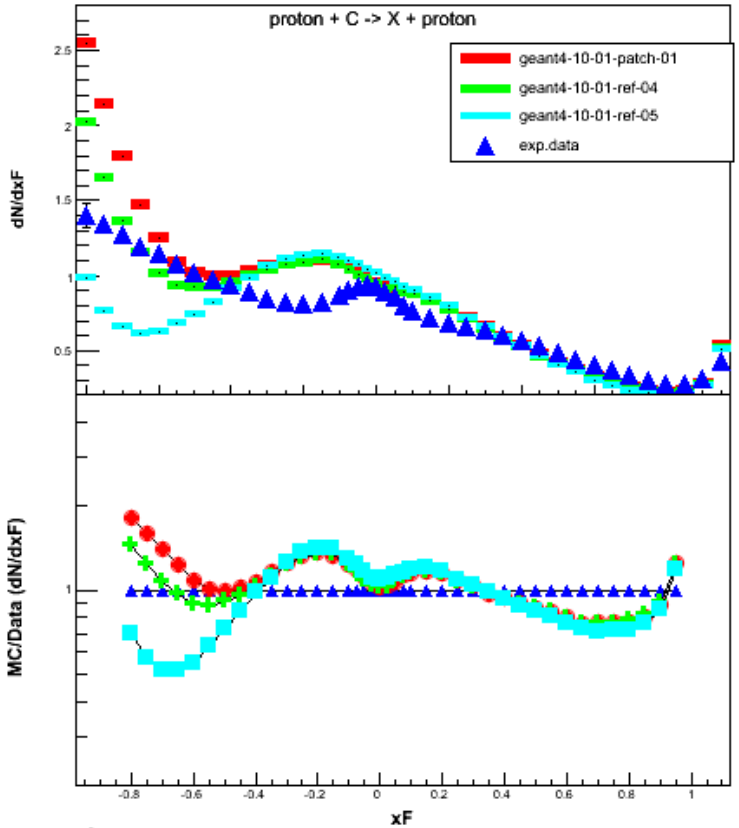


Geant4 (ftfp) vs Data
χ^2/NDF = 9.20814 for geant4-10-01-patch-01
χ^2/NDF = 17.0319 for geant4-10-01-ref-04
χ^2/NDF = 37.61 for geant4-10-01-ref-05

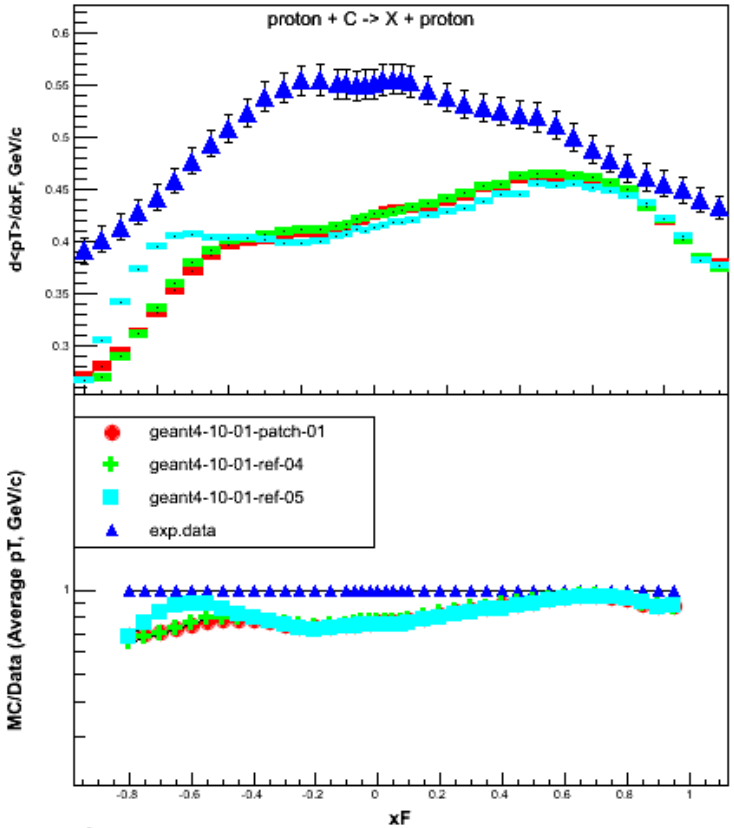
geant4-10-01-patch-01
geant4-10-01-ref-04
geant4-10-01-ref-05
exp.data

FTF(P): 158GeV/c p on C -> p + X

Data: NA49 (http://spshadrons.web.cern.ch/spshadrons)



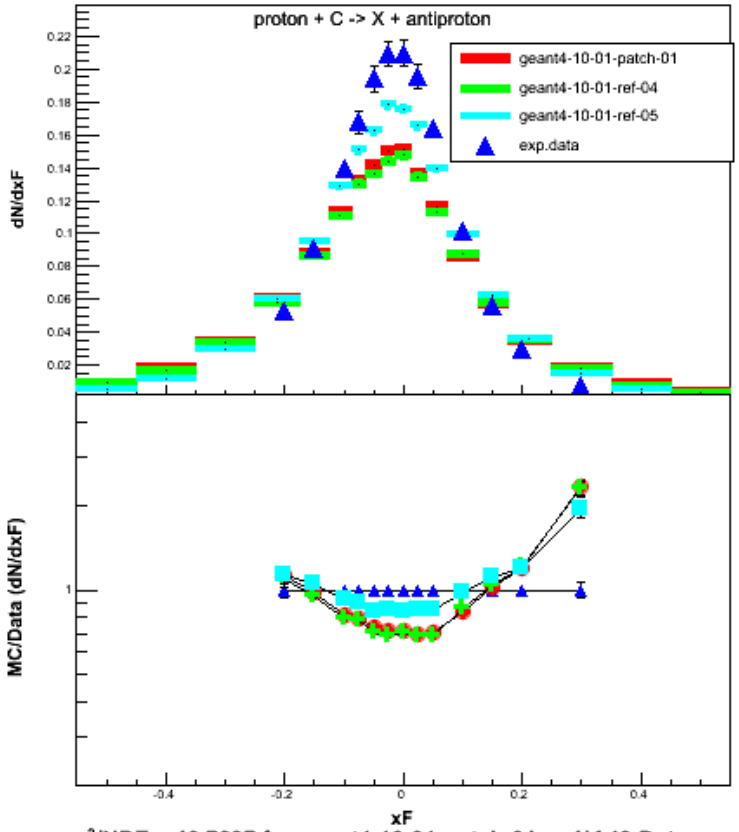
χ^2/NDF = 38.0313 for geant4-10-01-patch-01 vs NA49 Data
χ^2/NDF = 27.302 for geant4-10-01-ref-04 vs NA49 Data
χ^2/NDF = 52.327 for geant4-10-01-ref-05 vs NA49 Data



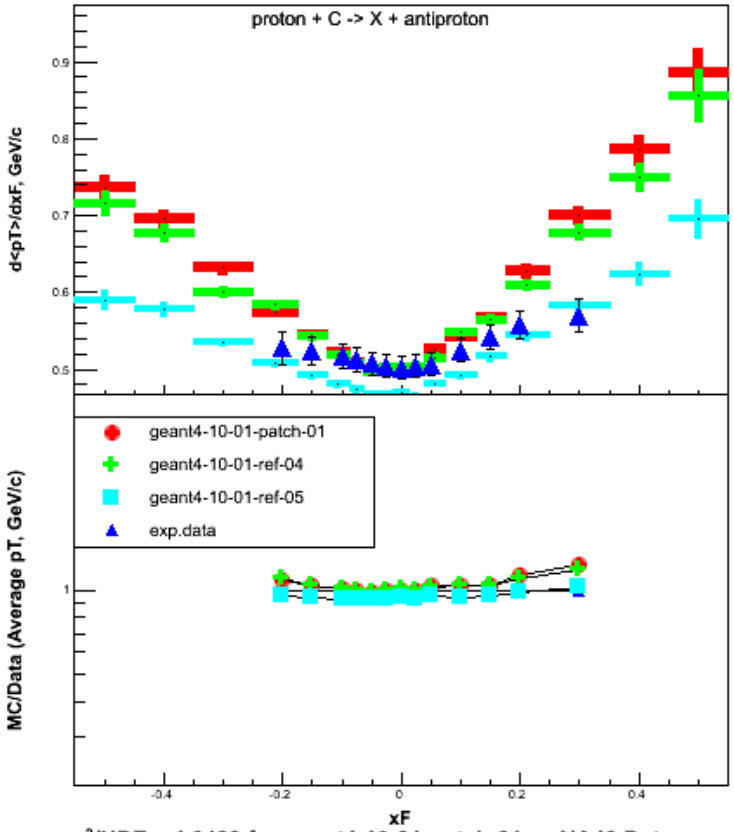
χ^2/NDF = 57.853 for geant4-10-01-patch-01 vs NA49 Data
χ^2/NDF = 56.2972 for geant4-10-01-ref-04 vs NA49 Data
χ^2/NDF = 54.6044 for geant4-10-01-ref-05 vs NA49 Data

FTF(P): 158GeV/c p on C -> pbar + X

Data: NA49 (http://spshadrons.web.cern.ch/spshadrons)



χ^2/NDF = 46.7637 for geant4-10-01-patch-01 vs NA49 Data
χ^2/NDF = 49.585 for geant4-10-01-ref-04 vs NA49 Data
χ^2/NDF = 19.1129 for geant4-10-01-ref-05 vs NA49 Data



χ^2/NDF = 4.0489 for geant4-10-01-patch-01 vs NA49 Data
χ^2/NDF = 3.12965 for geant4-10-01-ref-04 vs NA49 Data
χ^2/NDF = 3.81063 for geant4-10-01-ref-05 vs NA49 Data

Summary of Geant4.10.1-ref05 Validation

- No major changes in Bertini, Binary, or INCLXX
- Multiple changes are observed in FTF, and they are somewhat controversial in ref05 (more often negative than positive):
  - In particular, most of the improvements in ref04 to baryon (p or n) production in p- or pi-nucleus interactions in the intermediate energy seems to go away
- All results are available "internally" (collab.only):

http://g4devel.fnal.gov:8080/G4WebAppNG