Geant4.10.1.p01 : Summary of Validation Results 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:
  - Geant4.9.6.p04
  - Geant4.10.0.p04
  - Geant4.10.1.p01
- Signature plots shown if non-negligible changes
- Otherwise, a verbal overview
- All results/plots have been uploaded to G4 Validation Repository:

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

At Rest Processes (test48)

- No changes in pi-, K-, Sigma-, pbar capture/annihilation throughout 4.10 development cycles (although non-negligible changes for pi- vs 9.6 series – reported at previous meetings)
- Resolved issue for mu- capture (G4MuonMinusCapture) – NO "stuck" jobs detected (neither in 4.10.p04, nor in 4.10.1.0p01)

Gamma-N Interactions (test75)

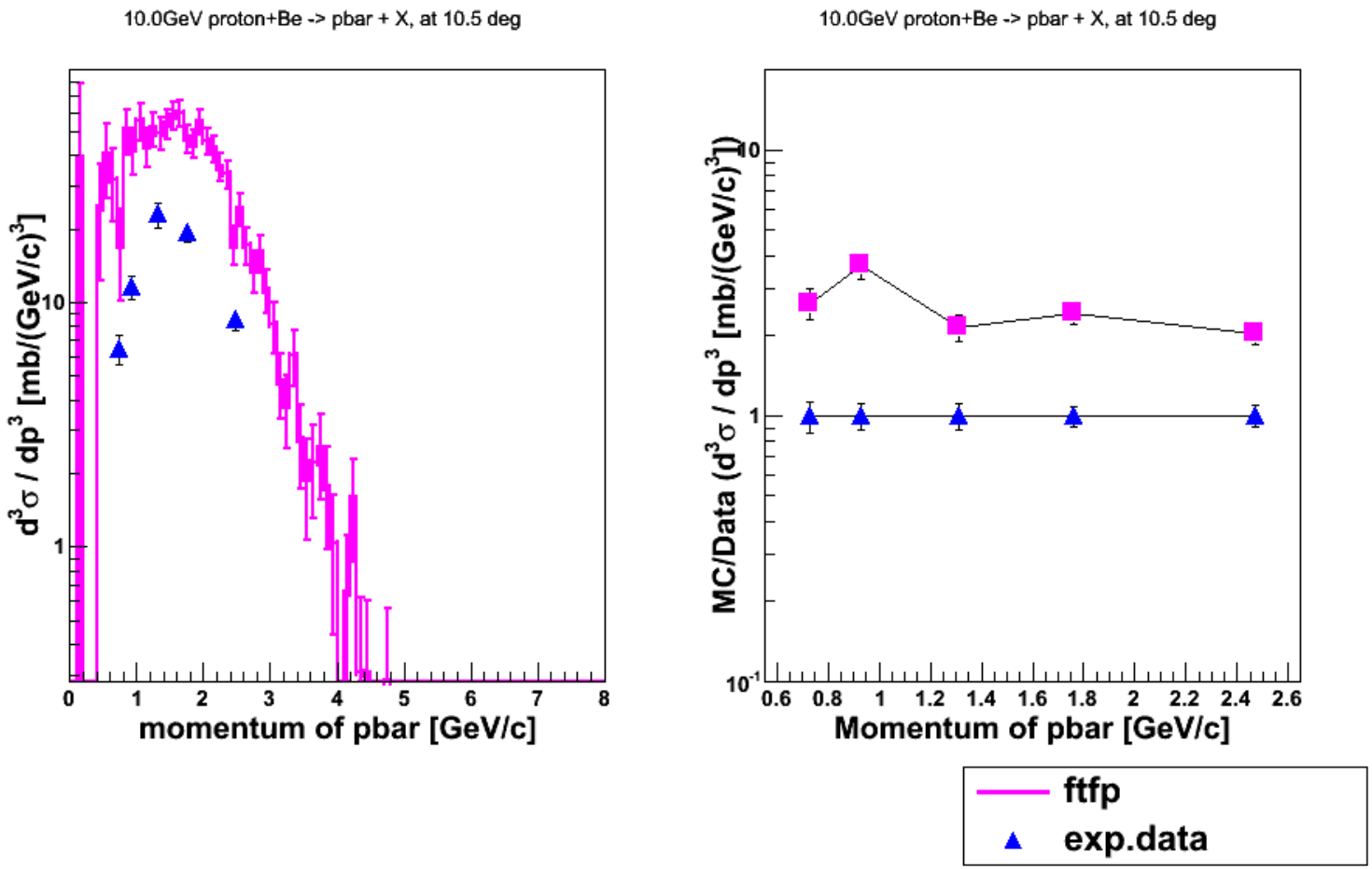
- No significant changes throughout 4.10 development cycle
- Changes from 9.6 series have been reported at previous meetings
- Where we have data, the changes are “neutral” (statistically)

Baryon Production in Proton or Pion Interactions in the Intermediate Energy Range (test47)

- Technical aspect: test47 restructured, now uses common infrastructure (similar to test23, test19, test75)
  - There's a slight chance that some details still need to be refined but overall everything is operational as before
- Minor variations in Bertini, Binary, or FTF results through 4.10 cycle (any changes vs 9.6 cycle have been reported at earlier meetings)
- NEW: validation (FTF) of p+N→pbar+X (per FNAL/Mu2e request)
  - Datasets:
    - Barabash et al., ITEP-48-1980 (durpdg.dur.ac.uk/view/ins154929)
    - Kiselev et al., Phys.Rev.C85:054904,2012
  - More datasets exists (from earlier days), will be added in the future
  - See following slides/plots
- "NEW": reinstating tests of INCL++ (results in the near future)

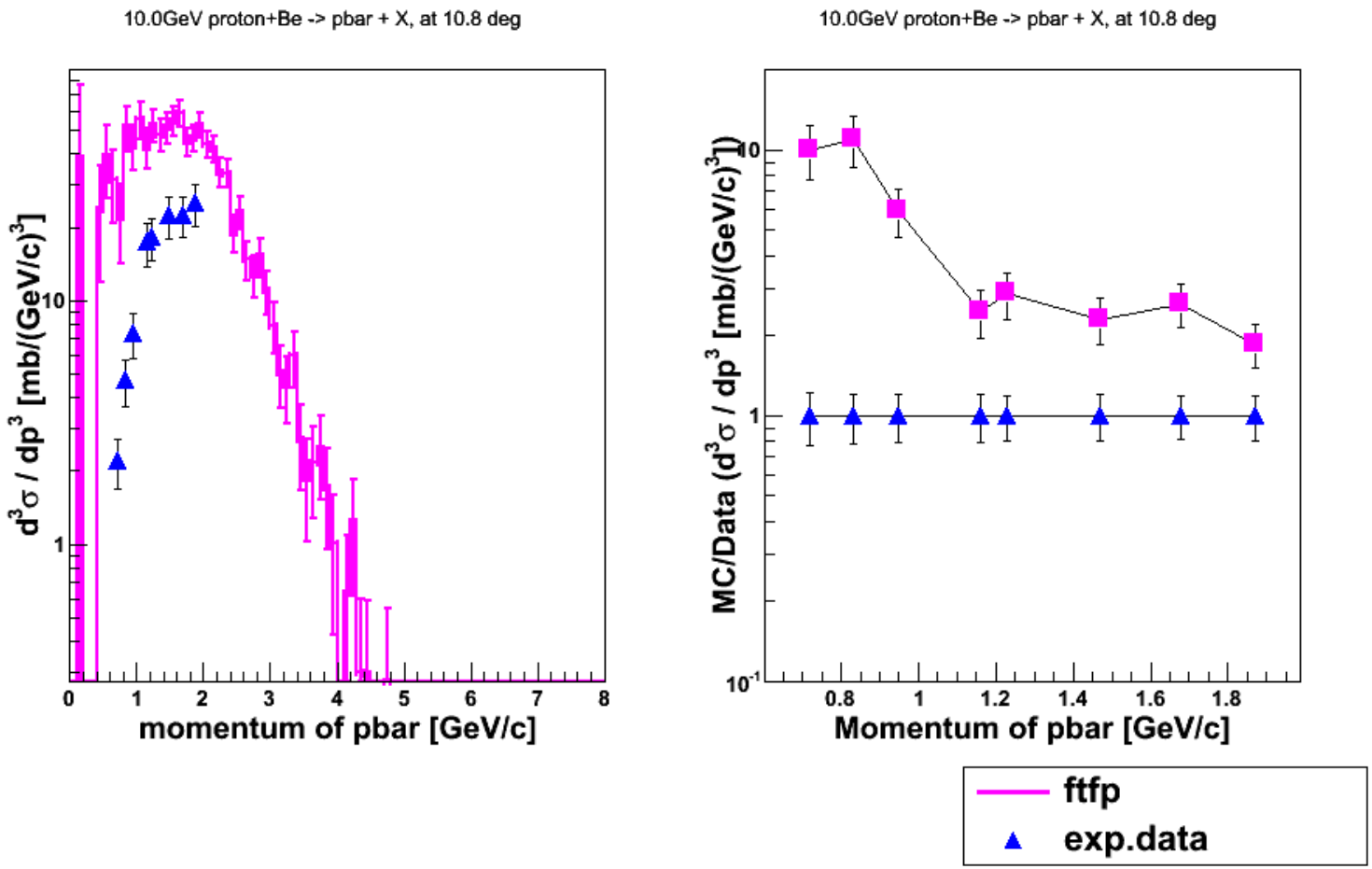
10GeV p+Be->pbar+X, at 10.5deg (test47)

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



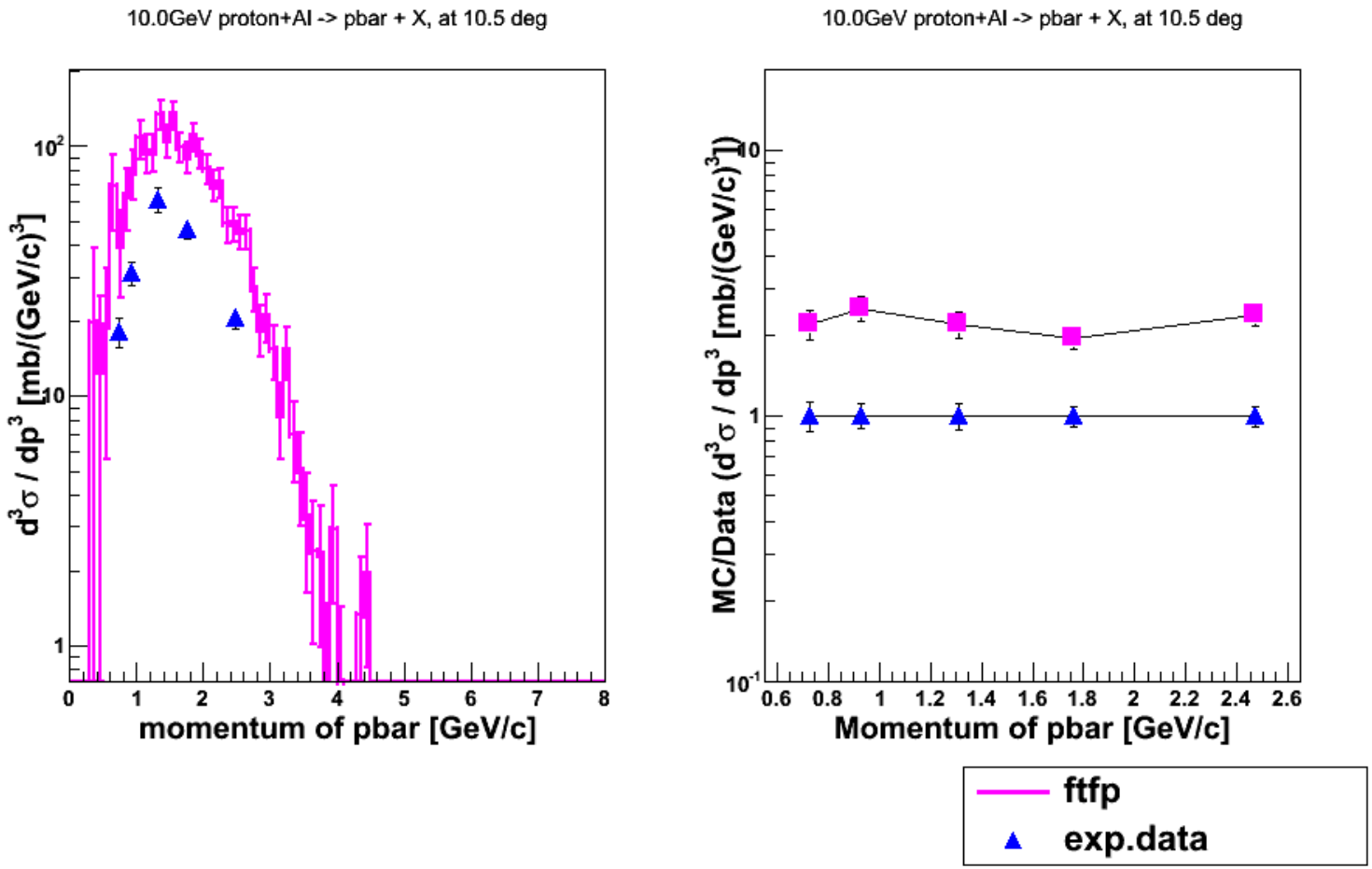
10GeV p+Be->pbar+X, at 10.8deg (test47)

Data: Barabash et al., ITEP-48-1980



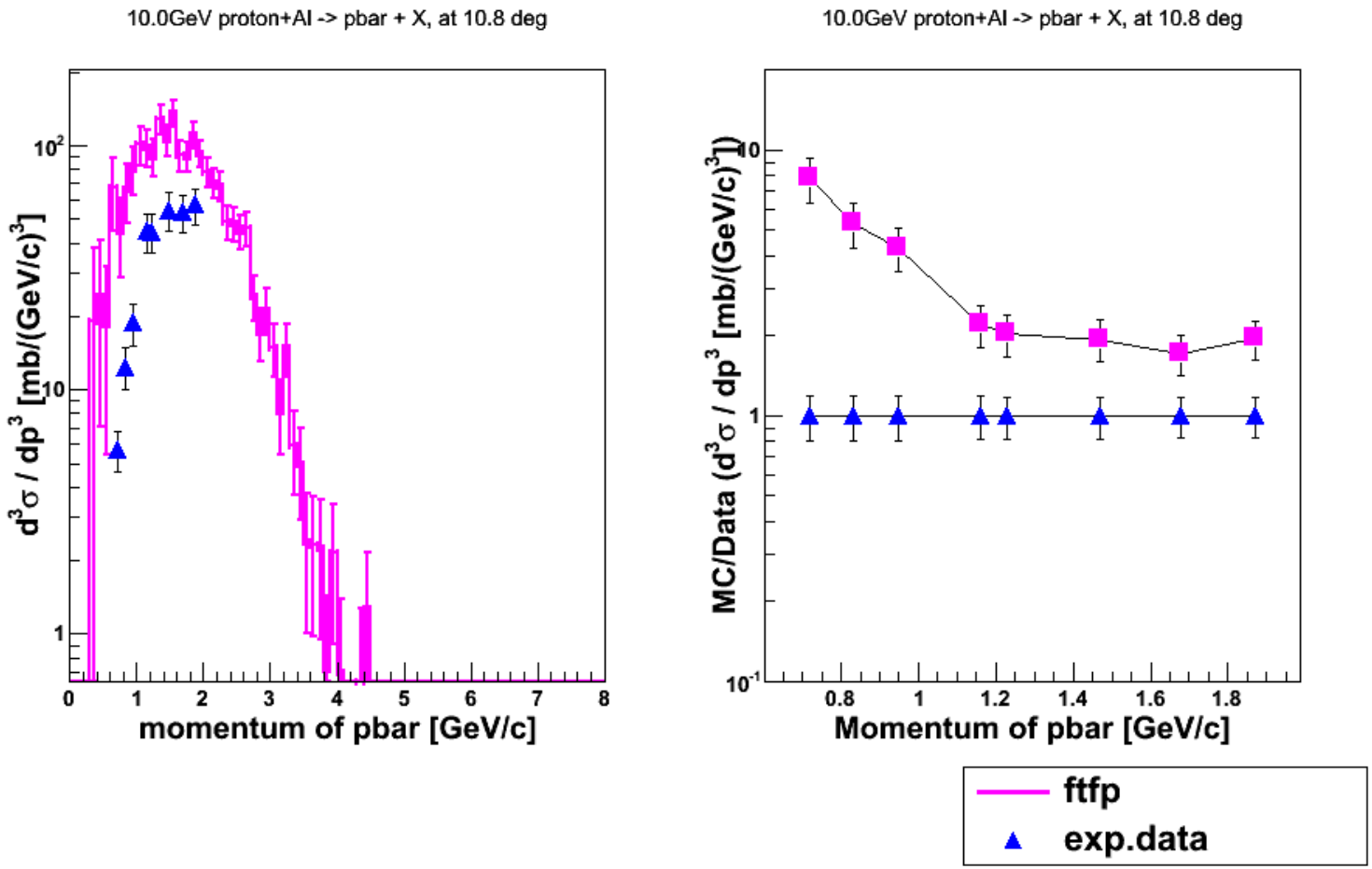
10GeV p+Al->pbar+X, at 10.5deg (test47)

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



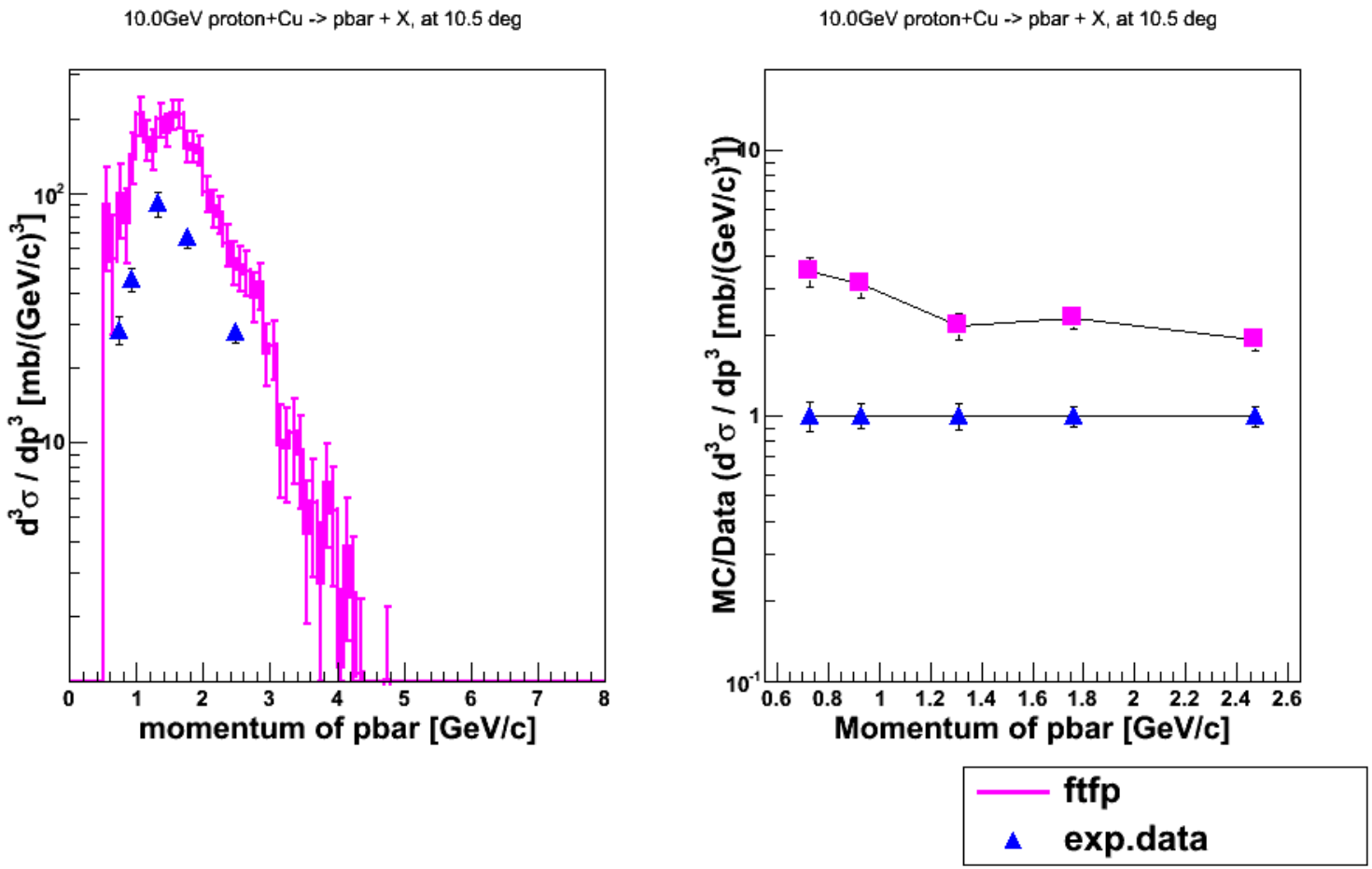
10GeV p+Al->pbar+X, at 10.8deg (test47)

Data: Barabash et al., ITEP-48-1980



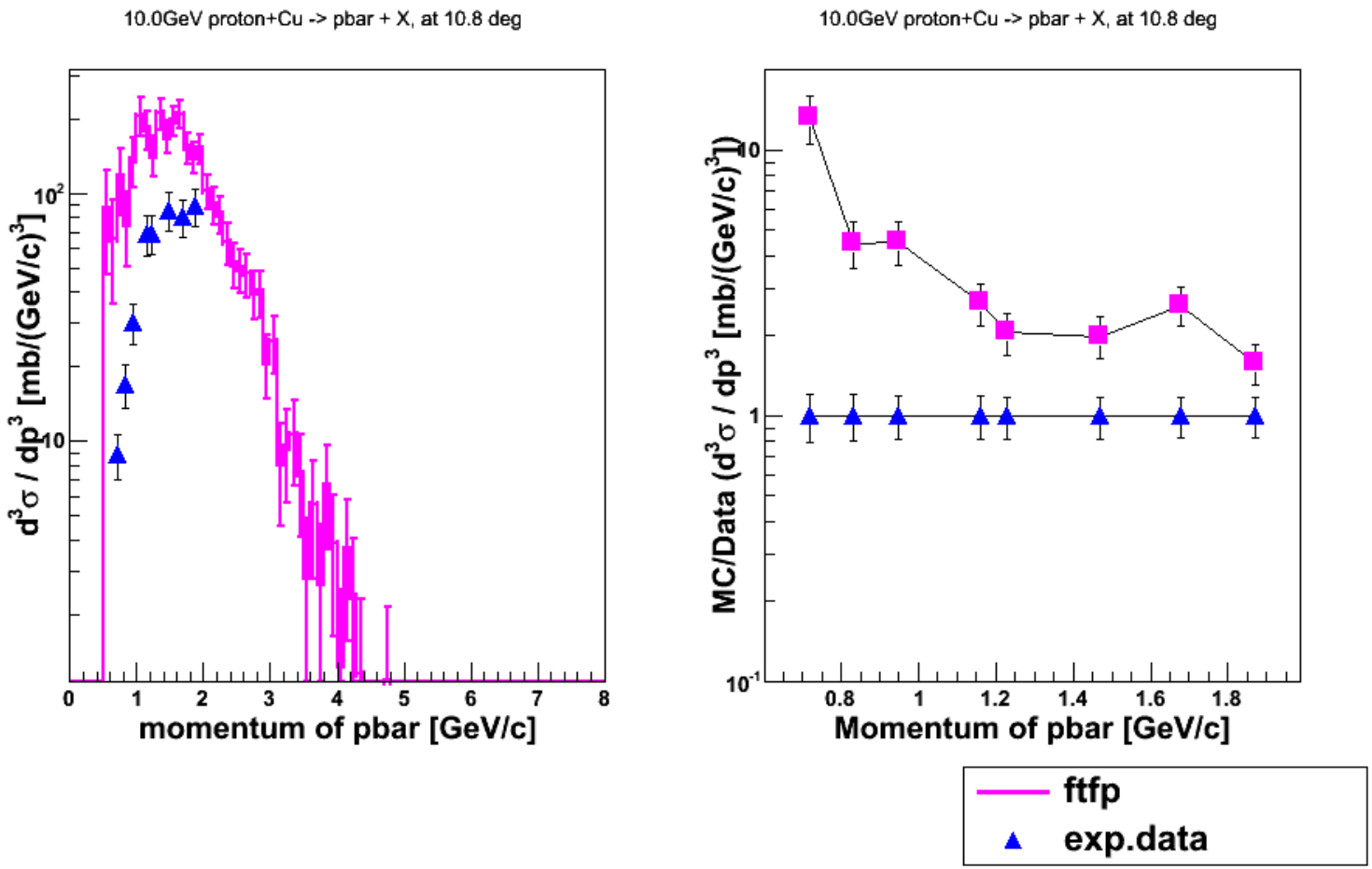
10GeV p+Cu->pbar+X, at 10.5deg (test47)

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



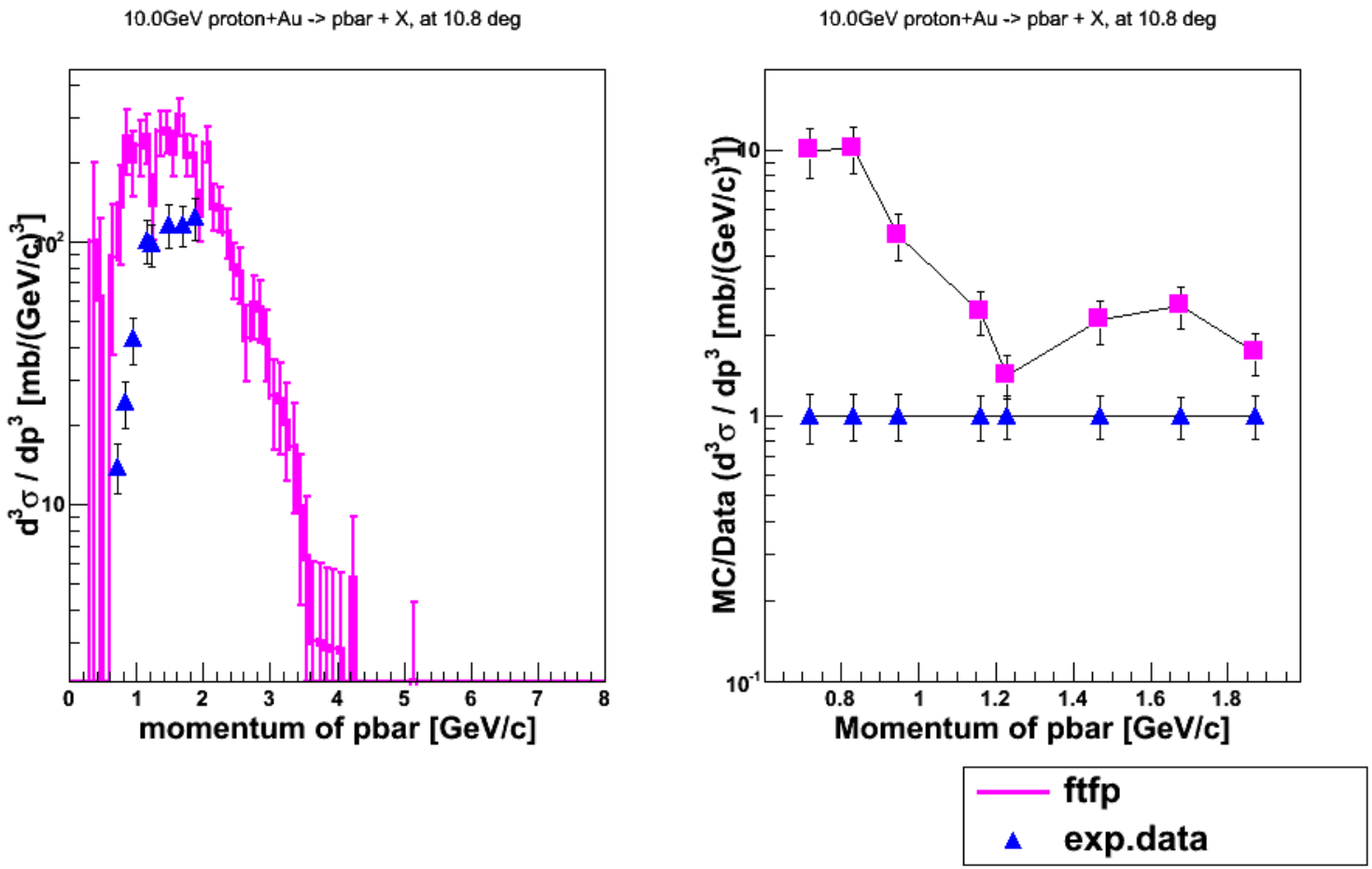
10GeV p+Cu->pbar+X, at 10.8deg (test47)

Data: Barabash et al., ITEP-48-1980



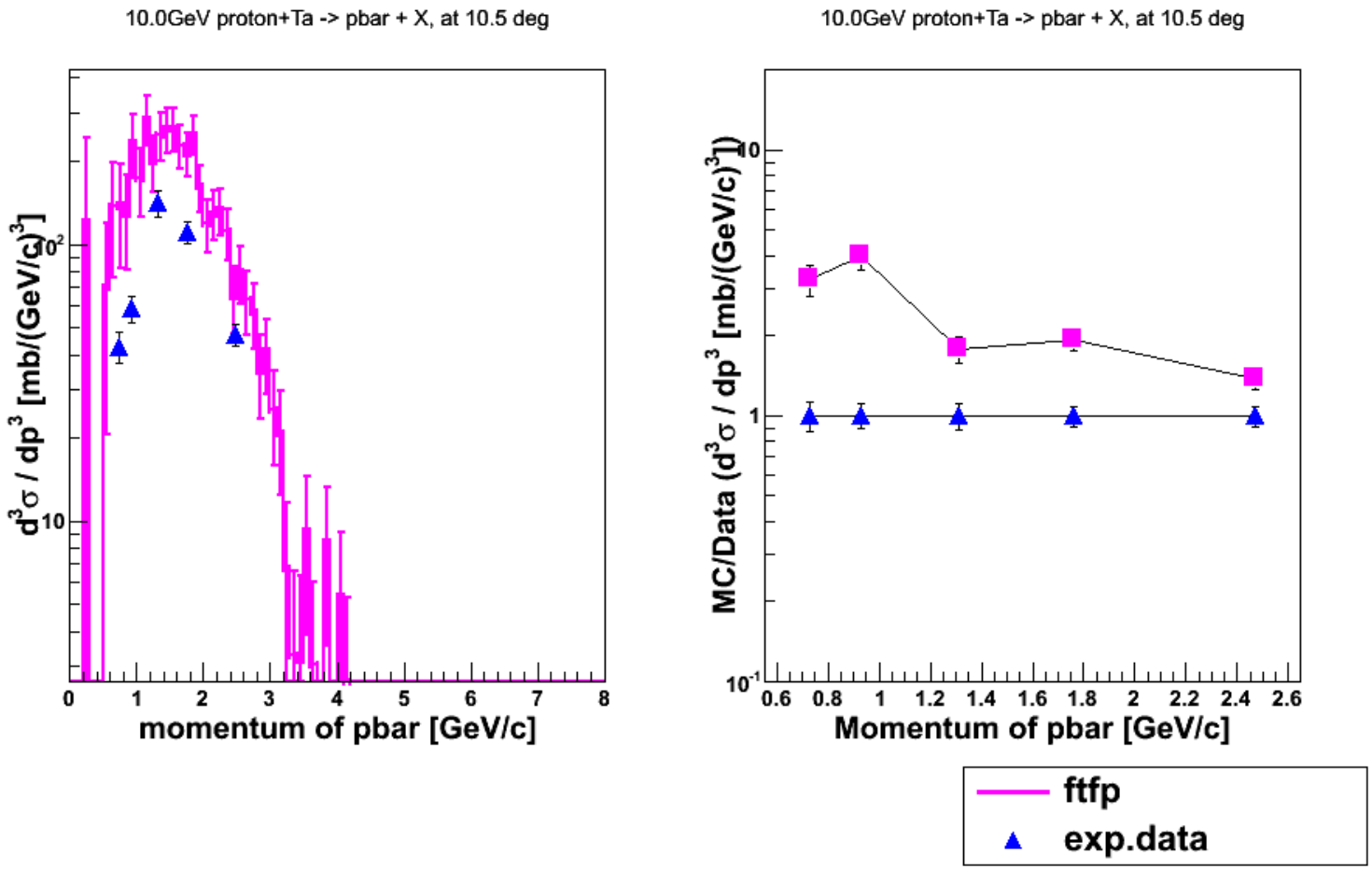
10GeV p+Au->pbar+X, at 10.8deg (test47)

Data: Barabash et al., ITEP-48-1980



10GeV p+Ta->pbar+X, at 10.5deg (test47)

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



Hadron Production in p+N at High Energies (test19)

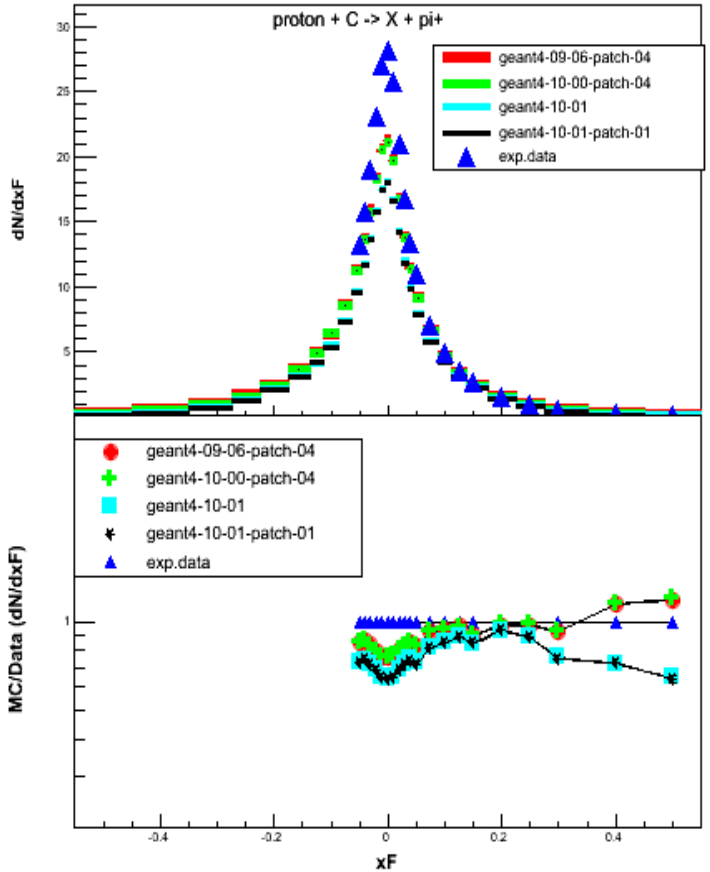
- FTF – repaired deviation from data introduced in 4.10.0:
  - Results of 158GeV/c p+C-->pion,p,pbar,n are substantially closer to data that of 4.10.0, and even somewhat better that of 9.6 cycle
  - Results of 31GeV/c p+C-->pion are closer to data that of 9.6;

    deviations from data in p+C→K+/pi+ reasonable repaired;

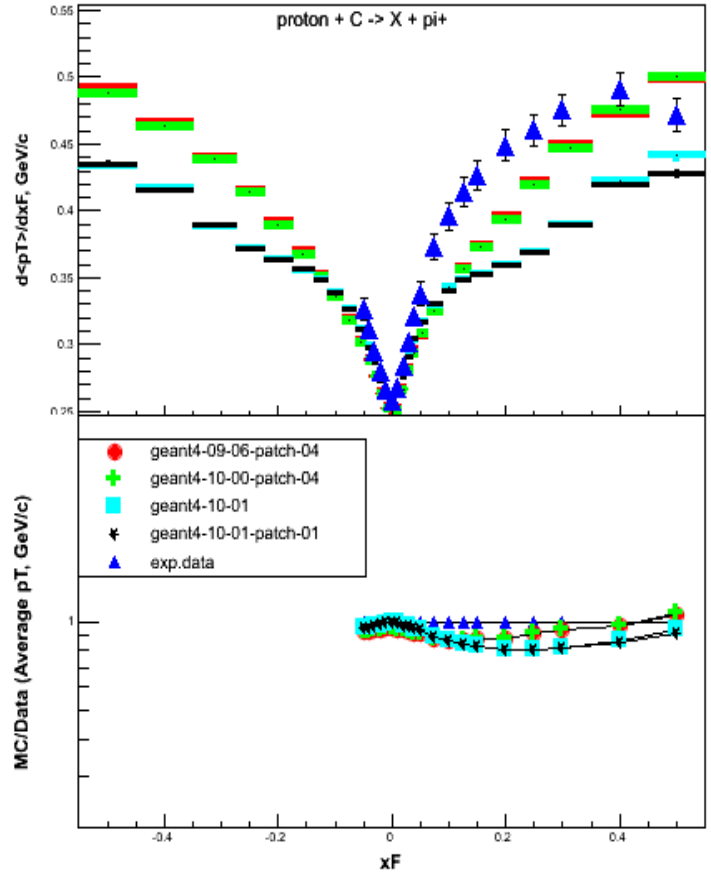
    p+C→p is still somewhat of concern (as compared to 9.6 results)
- QGS – changes/concerns observed in 4.10.1 cycle (10.1&10.1.p01)
  - See selected plots for 158GeV/c p+C in the following slides
  - At 31GeV/c, QGS has never been perfect; hard to say if current changes are good or not (statistically "the same")
- NEW: tests of INCL++ are being added (results in the near future)
- Additional info from test23:
  - FTF - deviations from data p,pion+N→pion seem to be repaired

QGS(P): 158GeV/c p + C-> pi+ + X (test19)

Data: NA49



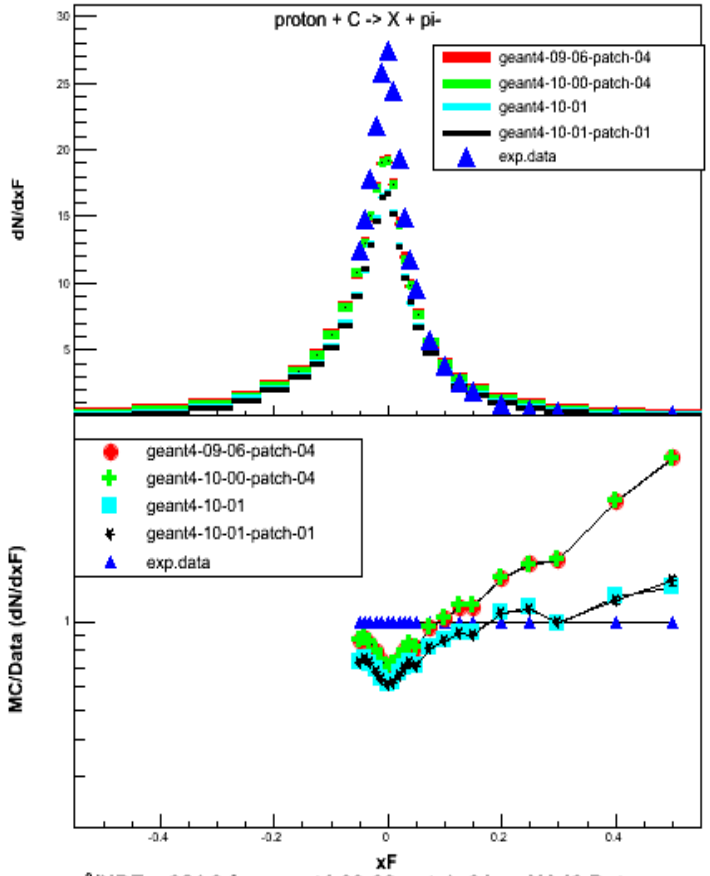
χ^2/NDF = 36.3626 for geant4-09-06-patch-04 vs NA49 Data
χ^2/NDF = 36.7379 for geant4-10-00-patch-04 vs NA49 Data
χ^2/NDF = 104.465 for geant4-10-01 vs NA49 Data
χ^2/NDF = 105.006 for geant4-10-01-patch-01 vs NA49 Data



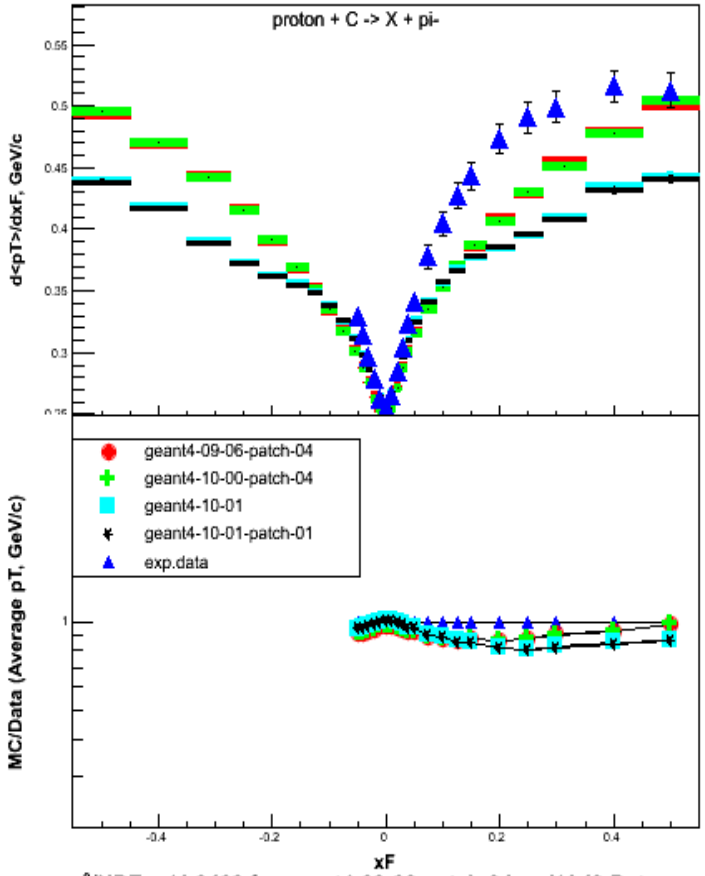
χ^2/NDF = 11.7152 for geant4-09-06-patch-04 vs NA49 Data
χ^2/NDF = 11.8102 for geant4-10-00-patch-04 vs NA49 Data
χ^2/NDF = 18.3769 for geant4-10-01 vs NA49 Data
χ^2/NDF = 18.9821 for geant4-10-01-patch-01 vs NA49 Data

QGS(P): 158GeV/c p + C-> pi- + X (test19)

Data: NA49



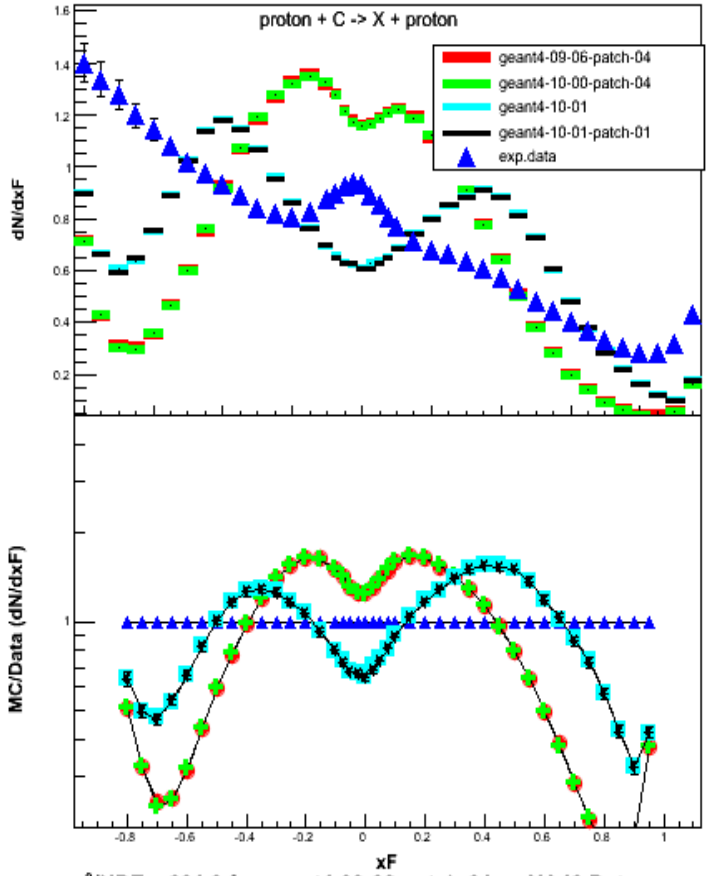
χ^2/NDF = 354.8 for geant4-09-06-patch-04 vs NA49 Data
χ^2/NDF = 350.552 for geant4-10-00-patch-04 vs NA49 Data
χ^2/NDF = 98.0229 for geant4-10-01 vs NA49 Data
χ^2/NDF = 99.0614 for geant4-10-01-patch-01 vs NA49 Data



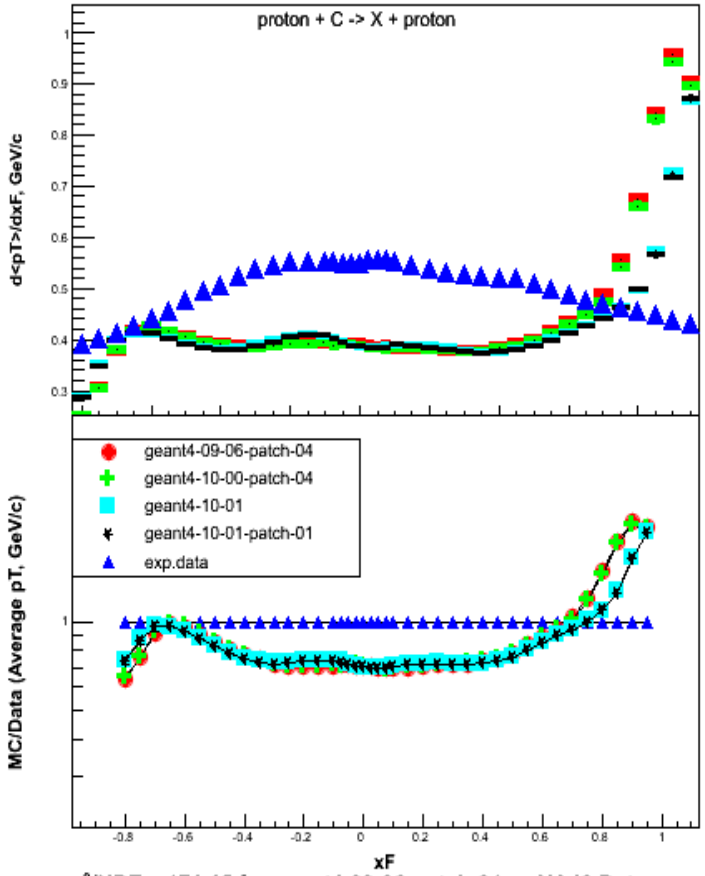
χ^2/NDF = 11.9402 for geant4-09-06-patch-04 vs NA49 Data
χ^2/NDF = 11.961 for geant4-10-00-patch-04 vs NA49 Data
χ^2/NDF = 17.1443 for geant4-10-01 vs NA49 Data
χ^2/NDF = 17.2169 for geant4-10-01-patch-01 vs NA49 Data

QGS(P): 158GeV/c p + C-> p + X (test19)

Data: NA49



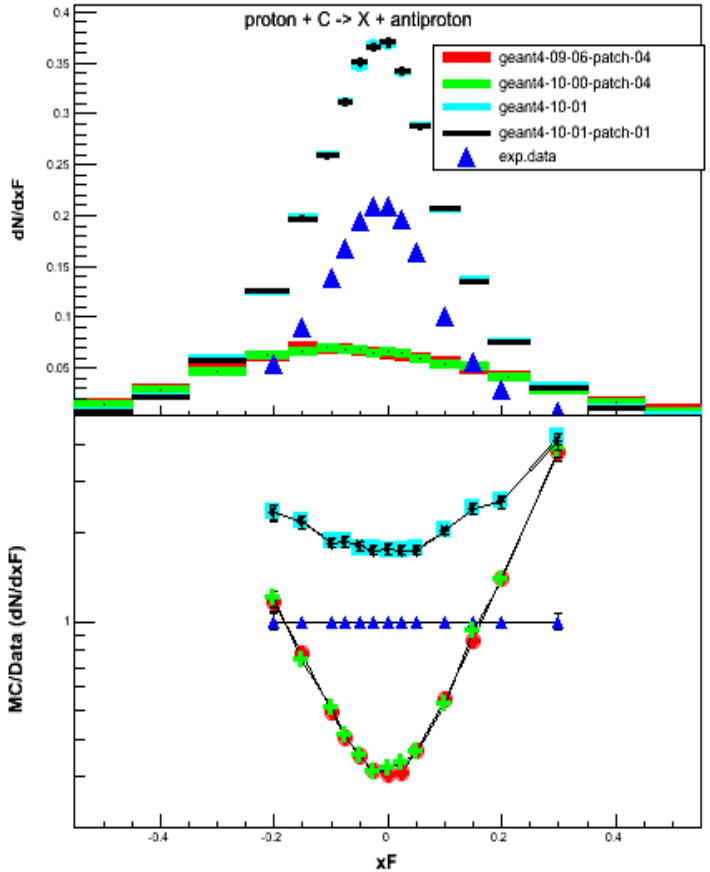
χ^2/NDF = 231.3 for geant4-09-06-patch-04 vs NA49 Data
χ^2/NDF = 233.19 for geant4-10-00-patch-04 vs NA49 Data
χ^2/NDF = 102.13 for geant4-10-01 vs NA49 Data
χ^2/NDF = 102.58 for geant4-10-01-patch-01 vs NA49 Data



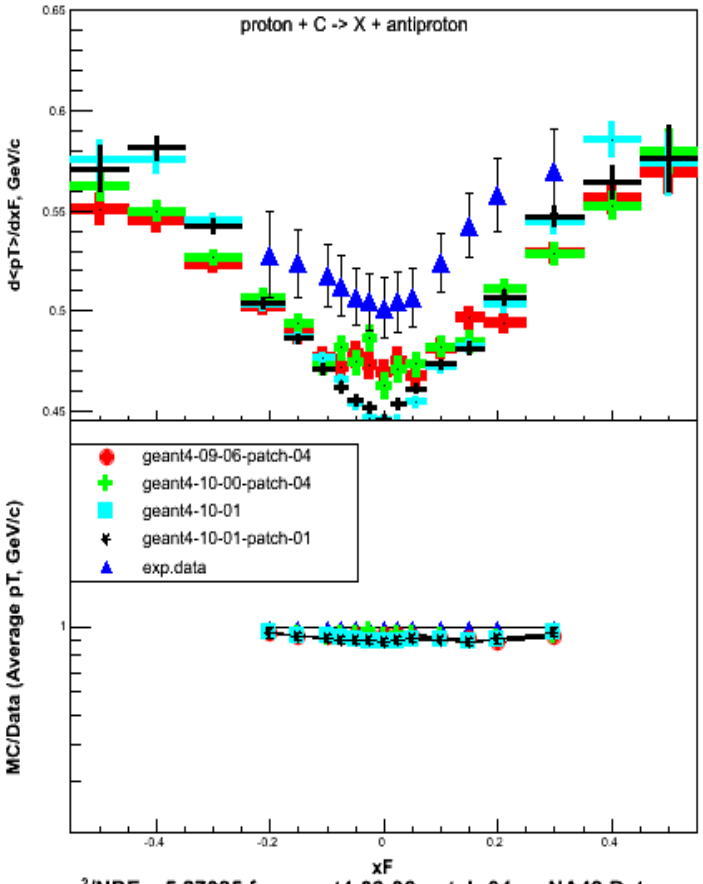
χ^2/NDF = 171.15 for geant4-09-06-patch-04 vs NA49 Data
χ^2/NDF = 166.412 for geant4-10-00-patch-04 vs NA49 Data
χ^2/NDF = 120.908 for geant4-10-01 vs NA49 Data
χ^2/NDF = 121.225 for geant4-10-01-patch-01 vs NA49 Data

QGS(P): 158GeV/c p + C-> pbar + X (test19)

Data: NA49



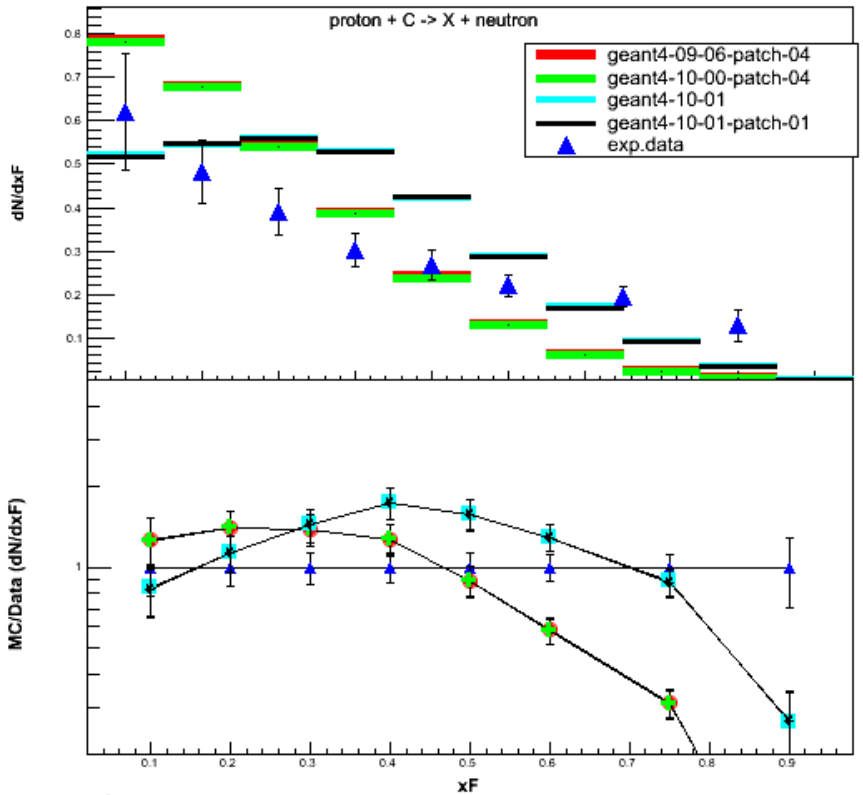
χ^2/NDF = 234.989 for geant4-09-06-patch-04 vs NA49 Data
χ^2/NDF = 236.727 for geant4-10-00-patch-04 vs NA49 Data
χ^2/NDF = 517.935 for geant4-10-01 vs NA49 Data
χ^2/NDF = 511.68 for geant4-10-01-patch-01 vs NA49 Data



χ^2/NDF = 5.27085 for geant4-09-06-patch-04 vs NA49 Data
χ^2/NDF = 4.8692 for geant4-10-00-patch-04 vs NA49 Data
χ^2/NDF = 9.87537 for geant4-10-01 vs NA49 Data
χ^2/NDF = 9.12816 for geant4-10-01-patch-01 vs NA49 Data

QGS(P): 158GeV/c p + C-> n + X (test19)

Data: NA49



χ^2/NDF = 9.88563 for geant4-09-06-patch-04 vs NA49 Data
χ^2/NDF = 9.97345 for geant4-10-00-patch-04 vs NA49 Data
χ^2/NDF = 9.68972 for geant4-10-01 vs NA49 Data
χ^2/NDF = 9.86694 for geant4-10-01-patch-01 vs NA49 Data

Summary of Geant4.10.1.p01 Validation

- After a number of concerns throughout 4.10 development cycle, release 4.10.1.p01 appears to be of good quality
- It features various upgrades (FTF, mu- capture…)
- Some of the recent developments of concern (QGS)
- Validation efforts continue and are been expanded
- All results are publically available:

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