

**Summary of Validation Results from
test48, test75, test47, and test19
Geant4.9.6.p02 through Geant4.10.0.ref04**

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General Remarks

- Included tests: test48 (capture), test75 (gamma-N), test47 (intermediate E), test19 (high E)
- Included releases: 4.9.6.p02 (reference), 4.9.6.p03, 4.10.0, 4.10.0.p01, 4.10.0.ref03, and 4.10.0.ref04
- Detailed results reported if significant changes observed; otherwise plots will appear in the Geant4 Validation Repository in the next few days
- All plots will be uploaded to G4 Validation Repository

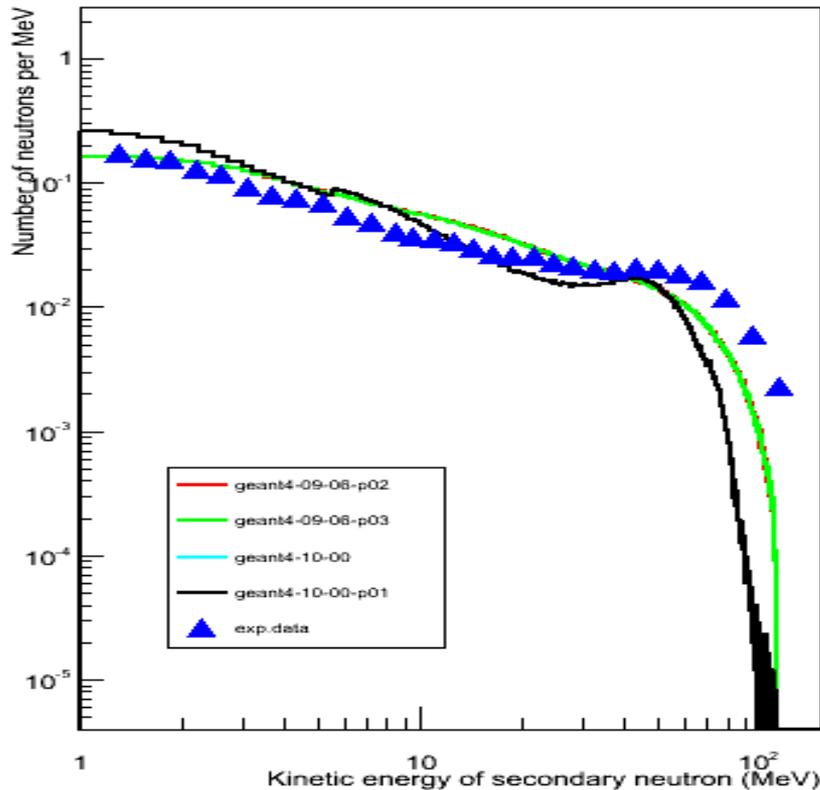


Test48 (partial)

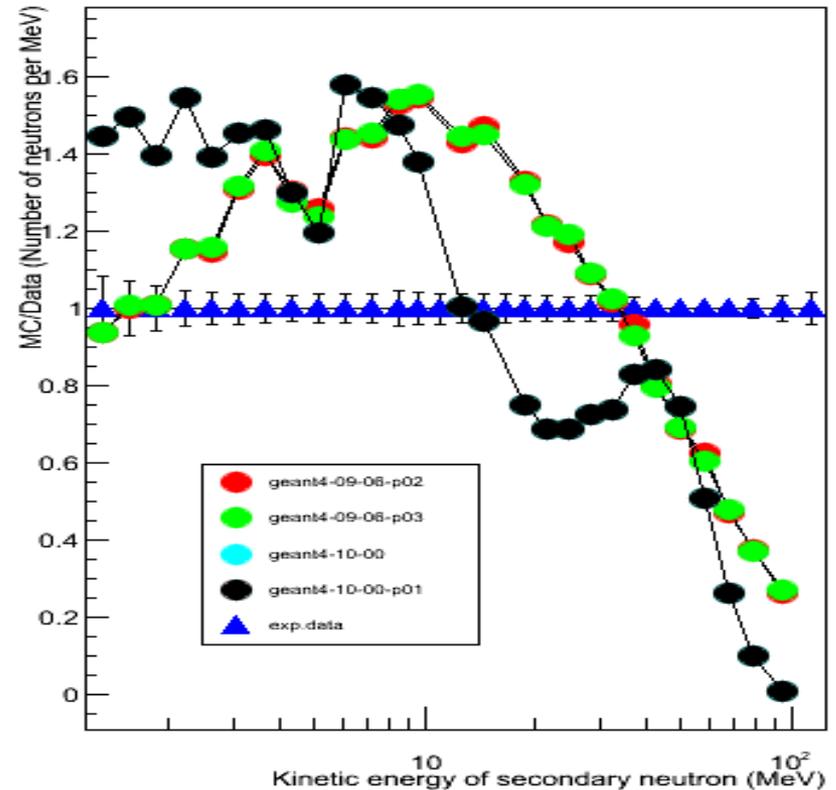
- Only pi- capture tested (pbar, K, Sigma will be done later)
- Substantial difference between 4.9.6.p02 and 4.10.0 (apparently started ~4.9.6.ref05 ? never fixed despite earlier reports on this matter)
- Some “funny bumps”, especially for lighter targets
- See following plots (slides 4-10)
- No changes for 10.0-10.0-ref04 (plots to G4 Val)
- Exp.data used for comparison:
R.Madey et al., Phys.Rev.C25, 2050 (1982)

Test48: pi- capture on C -> n + X

pi- on C, BertiniPreCo

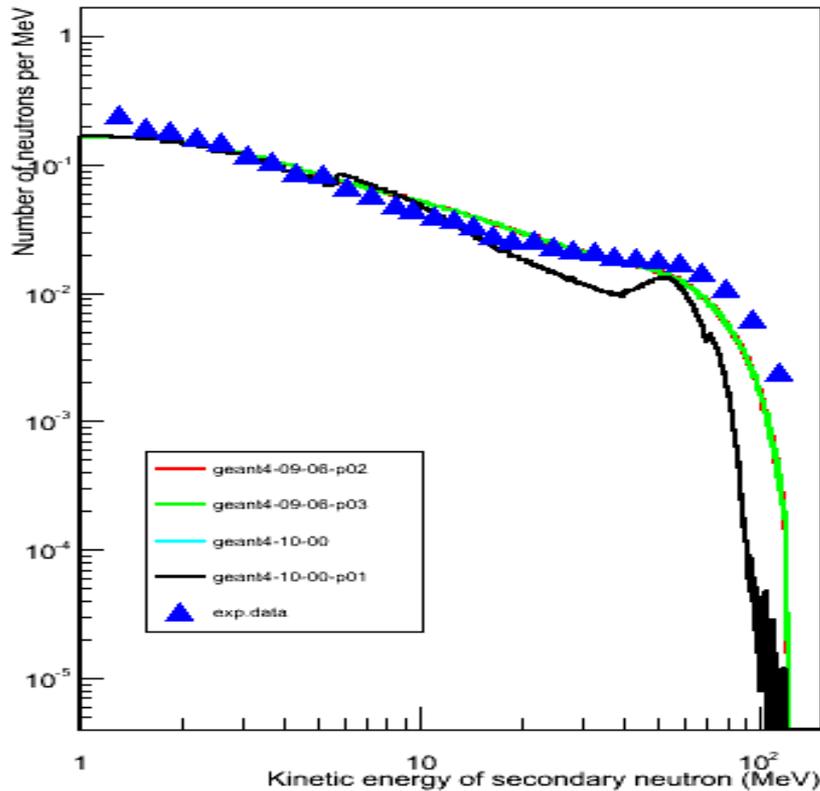


pi- on C, BertiniPreCo

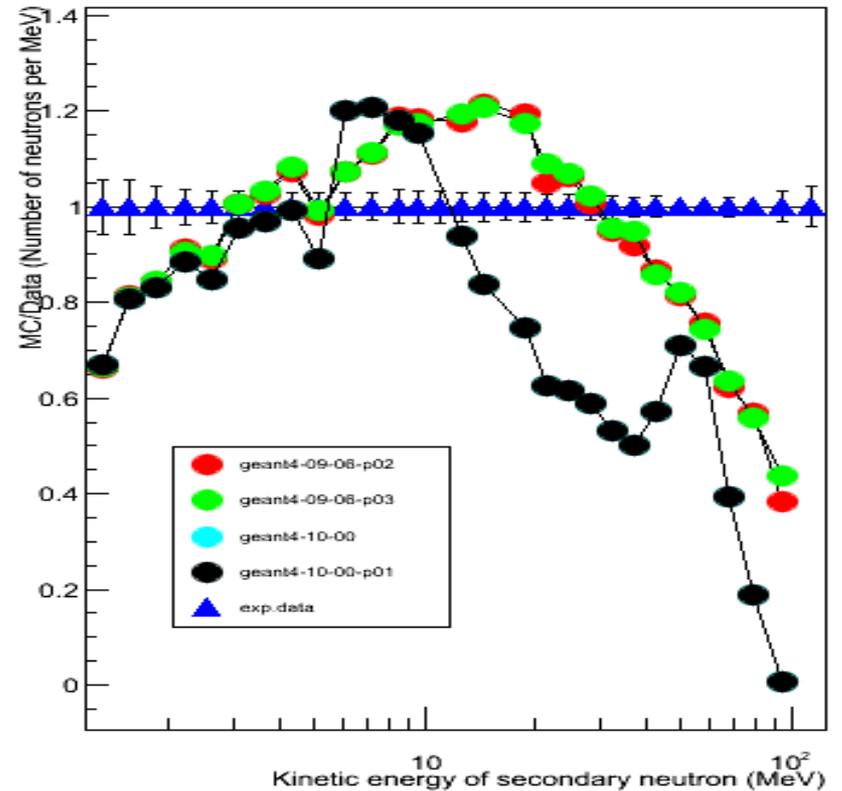


Test48: pi- capture on N -> n + X

pi- on N, BertiniPreCo

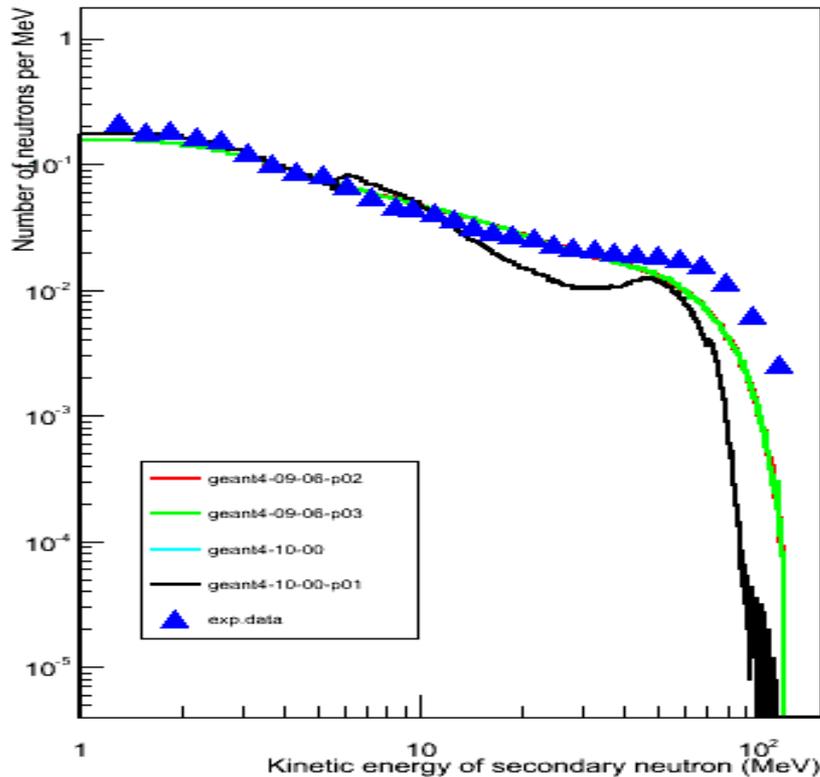


pi- on N, BertiniPreCo

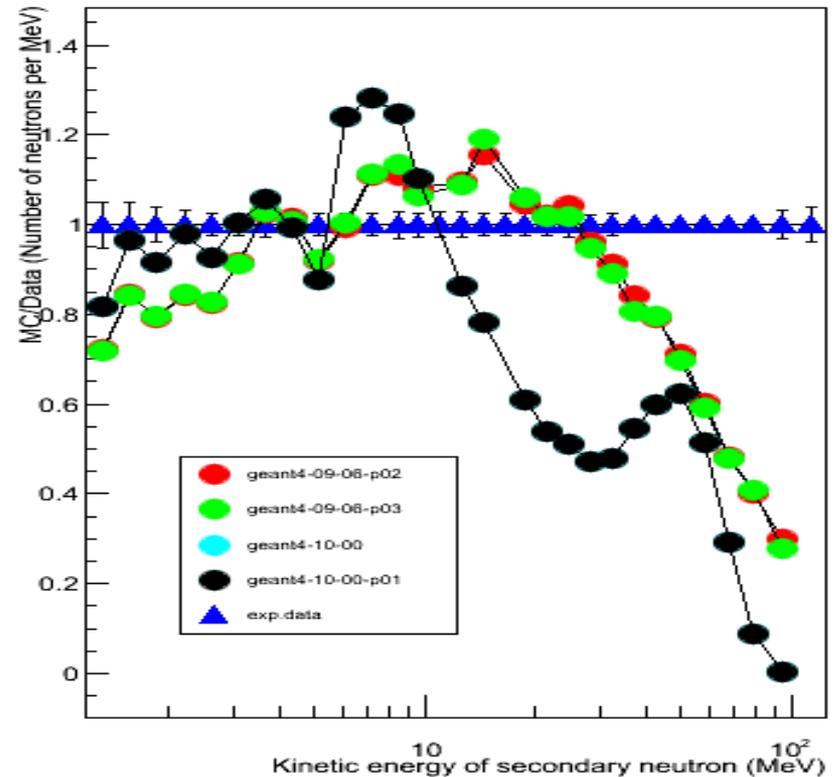


Test48: pi- capture on O -> n + X

pi- on O, BertiniPreCo

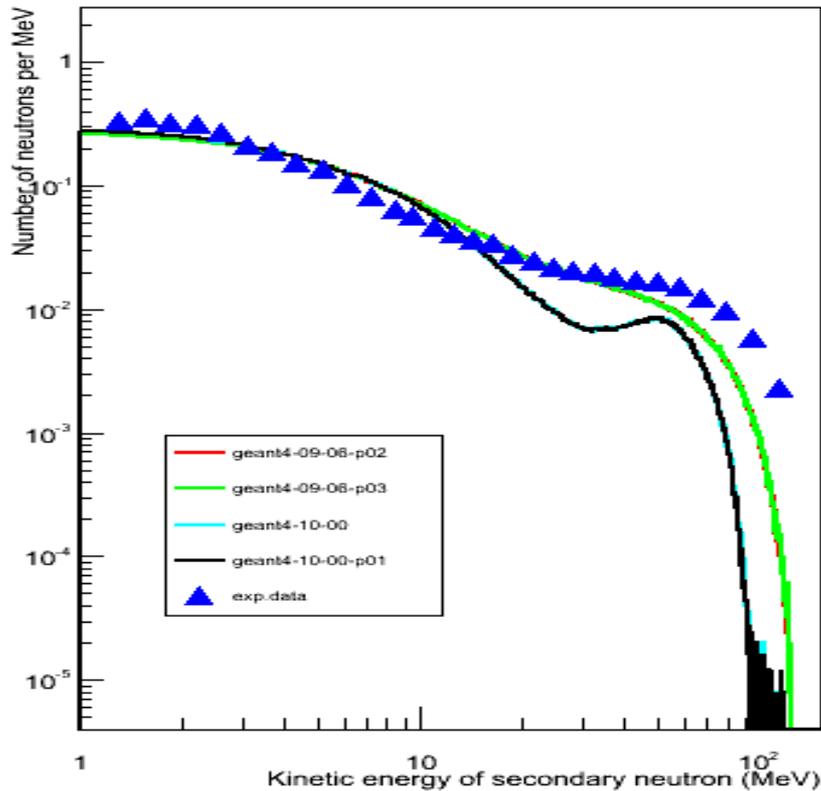


pi- on O, BertiniPreCo

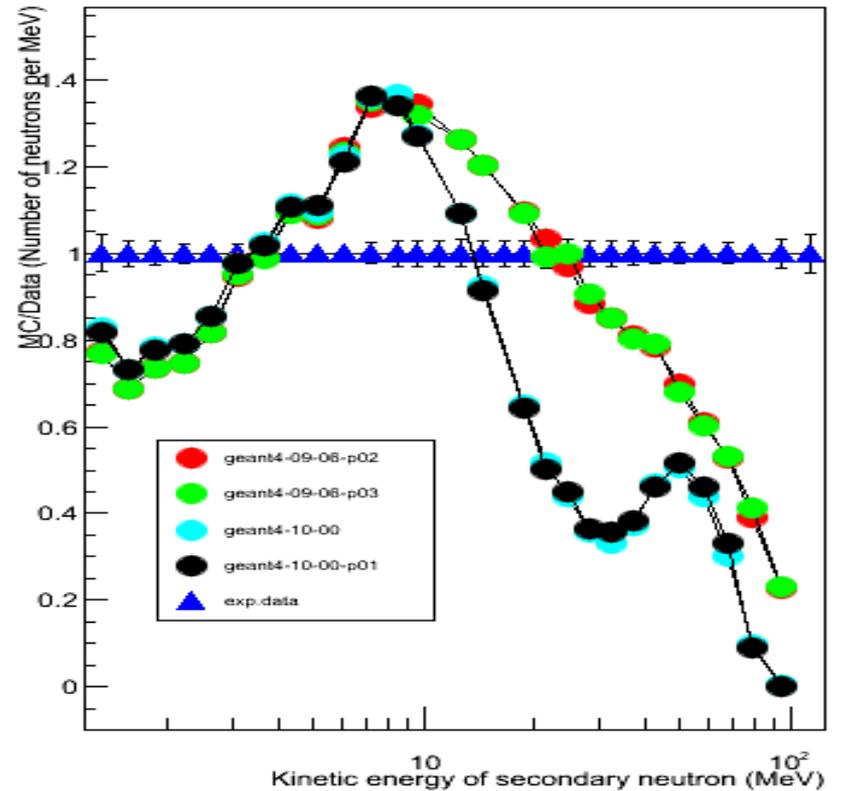


Test48: pi- capture on Al -> n + X

pi- on Al, BertiniPreCo

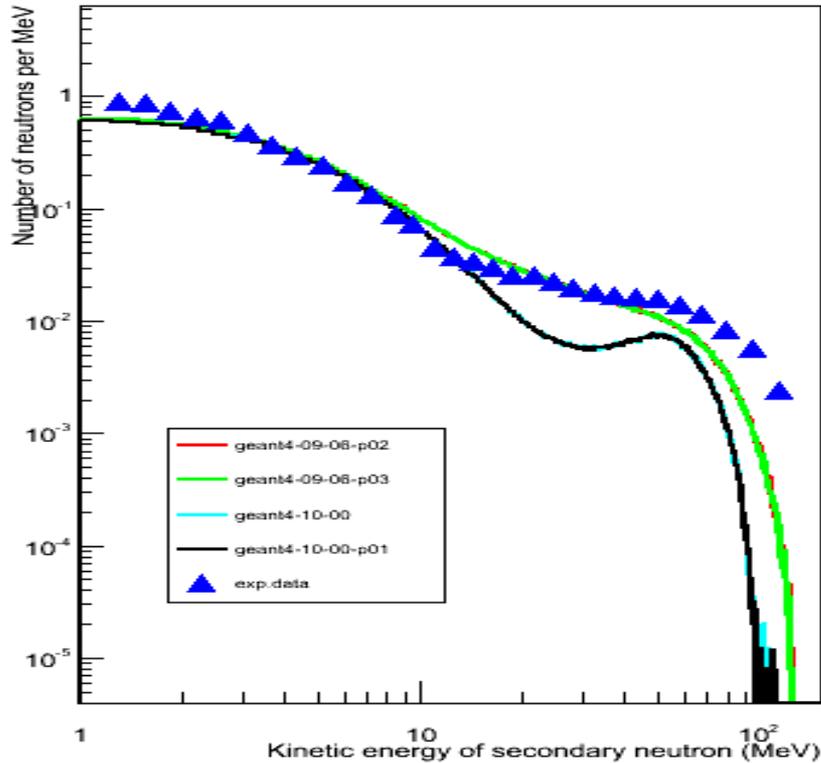


pi- on Al, BertiniPreCo

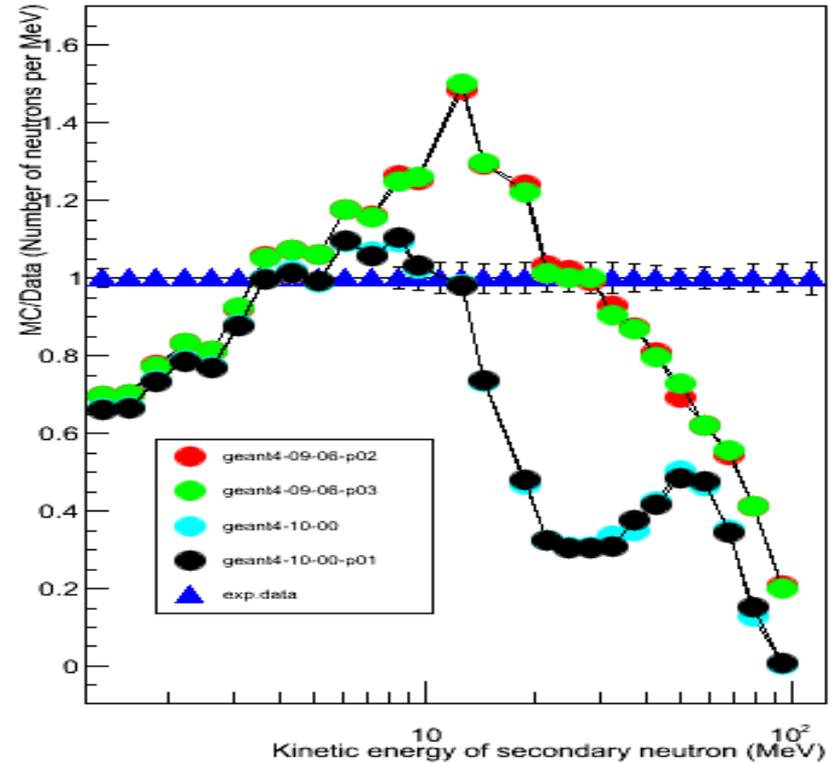


Test48: pi- capture on Cu -> n + X

pi- on Cu, BertiniPreCo

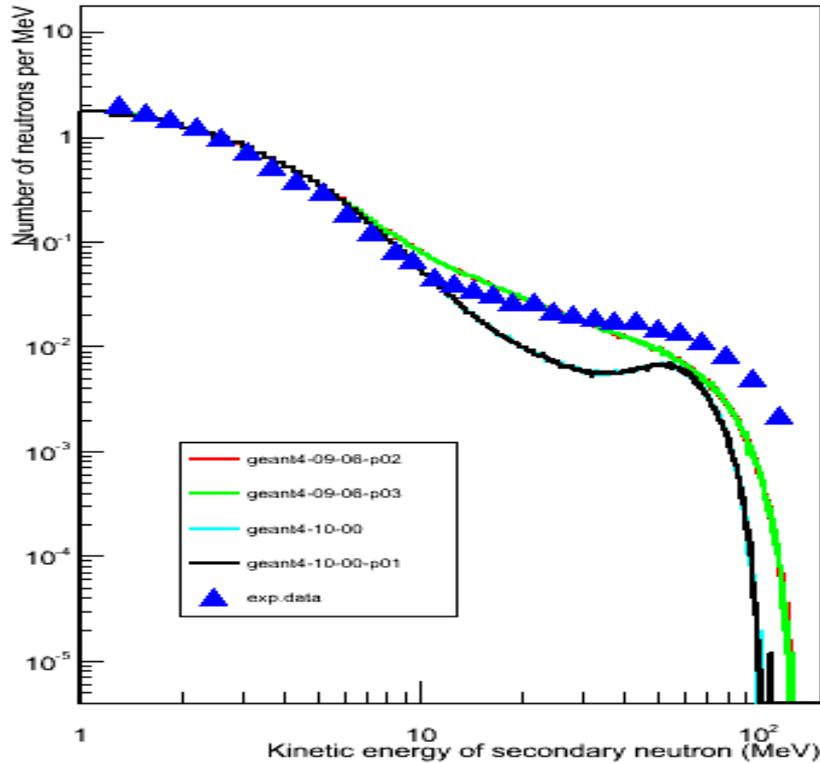


pi- on Cu, BertiniPreCo

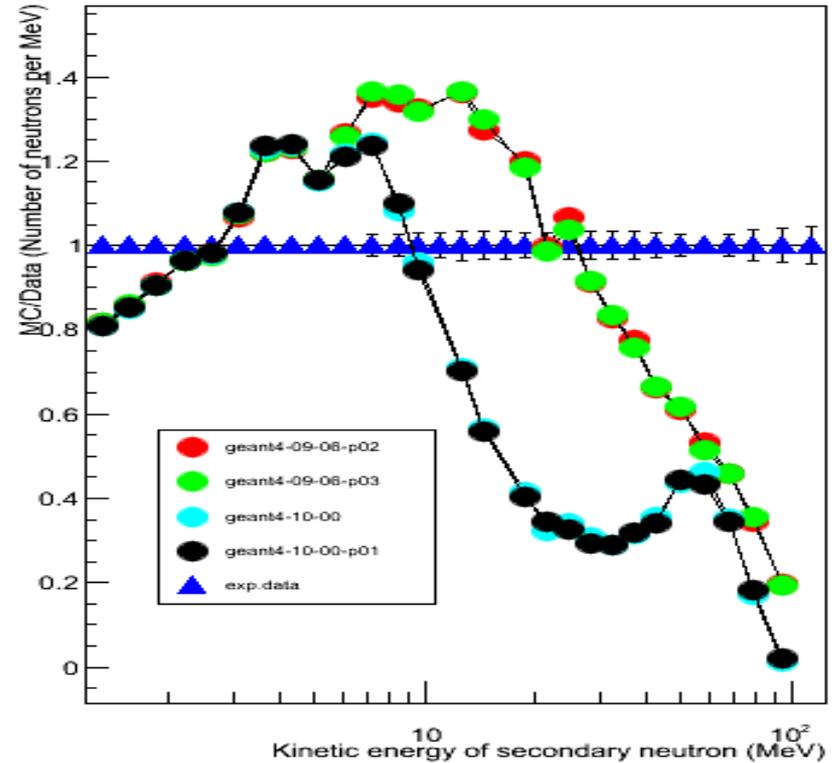


Test48: pi- capture on Ta -> n + X

pi- on Ta, BertiniPreCo

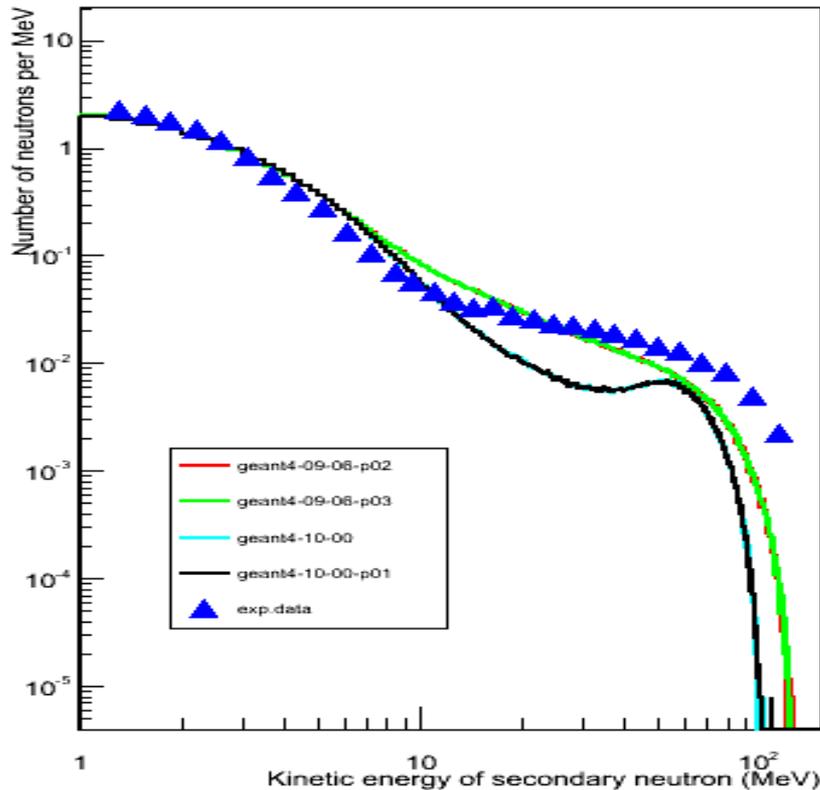


pi- on Ta, BertiniPreCo

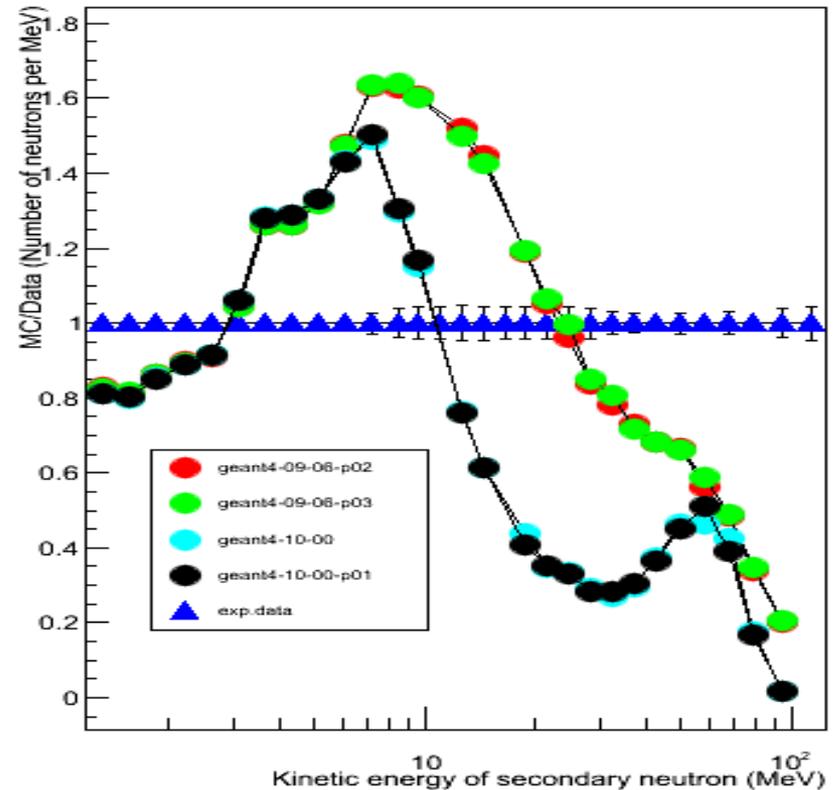


Test48: pi- capture on Pb -> n + X

pi- on Pb, BertiniPreCo



pi- on Pb, BertiniPreCo





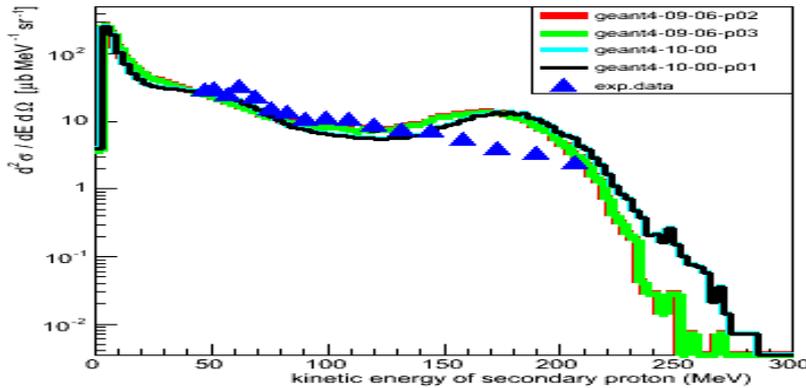
Test75: gamma-N

- No changes between 9.6.p02 and 9.6.p03
- Some changes between 9.6-series and 10.0
- Effect is more prominent for pion production
- See slides 12-14
- Apparently, non-negligible effect is seen by CMS in PbWO4
- No changes for 10.0 through 10.0-ref04 (plots to G4 Val)

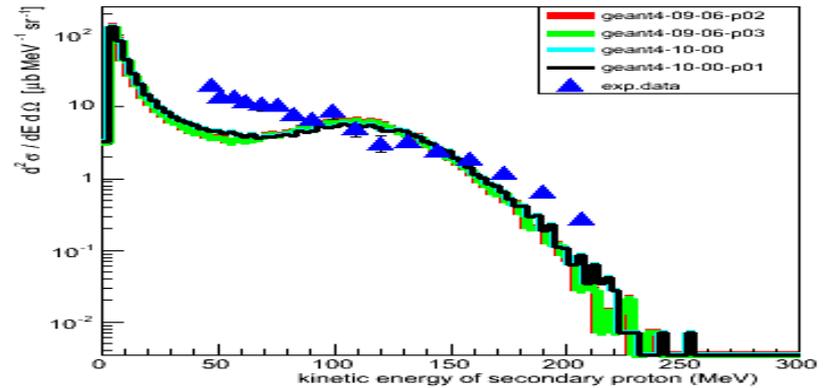


Test75: 300 MeV gamma+Cu -> proton

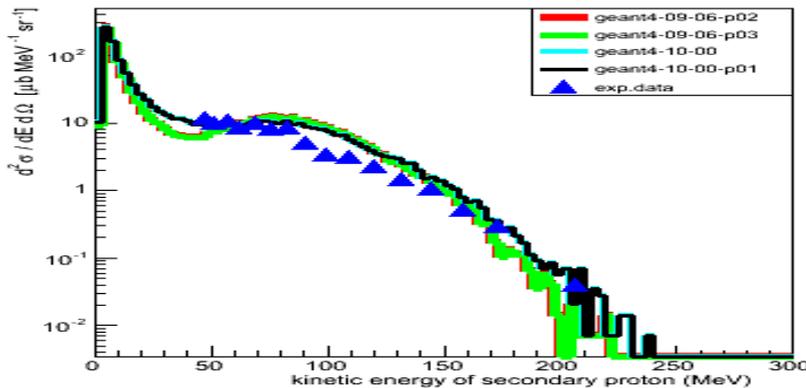
gamma + Cu → X + proton (45deg)



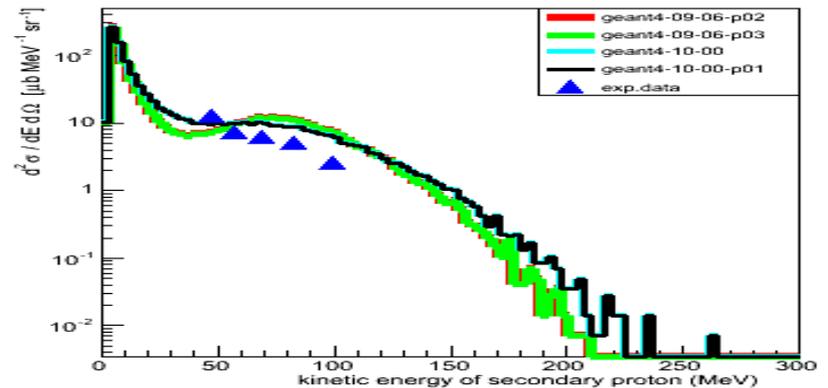
gamma + Cu → X + proton (90deg)



gamma + Cu → X + proton (135deg)

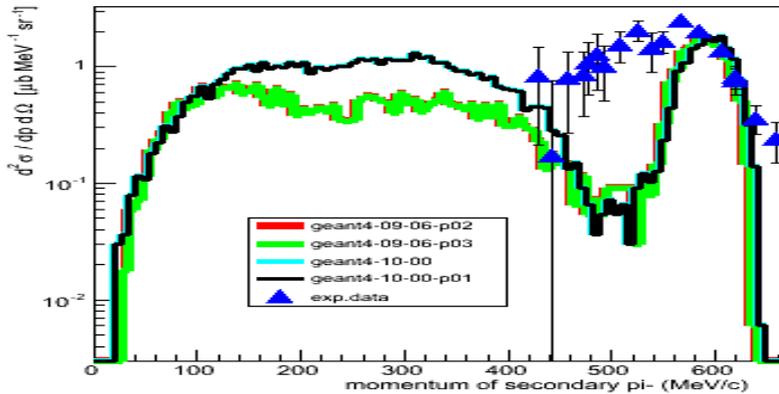


gamma + Cu → X + proton (150deg)

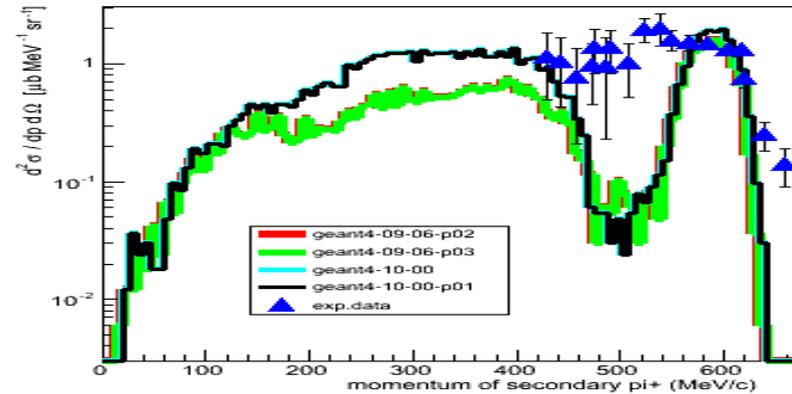


Test75: 668 MeV gamma+Cu -> pi+

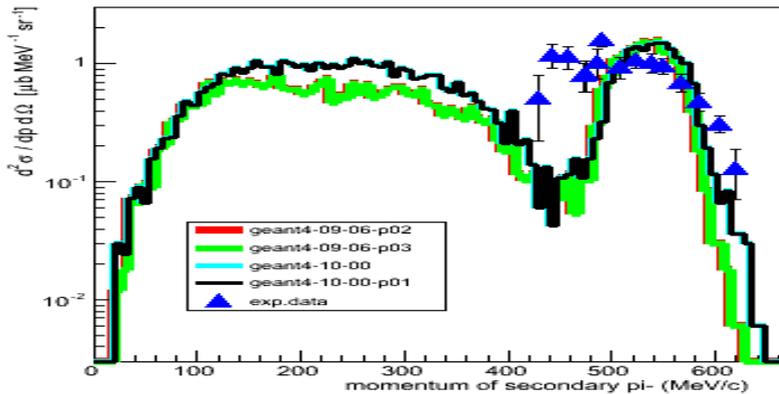
gamma + Cu \rightarrow X + pi- (28deg)



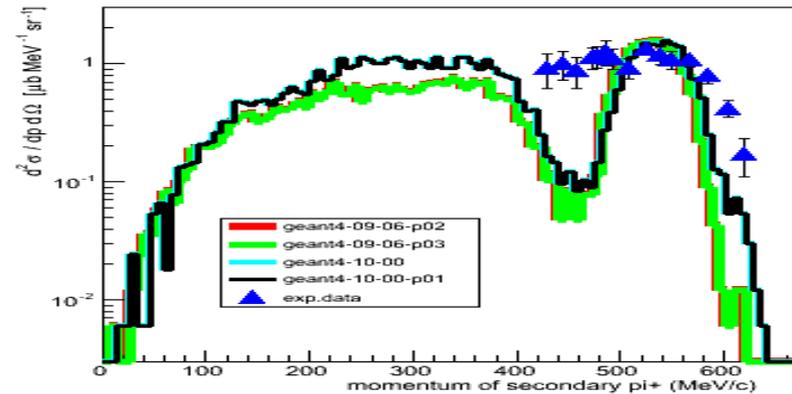
gamma + Cu \rightarrow X + pi+ (28deg)



gamma + Cu \rightarrow X + pi- (44deg)



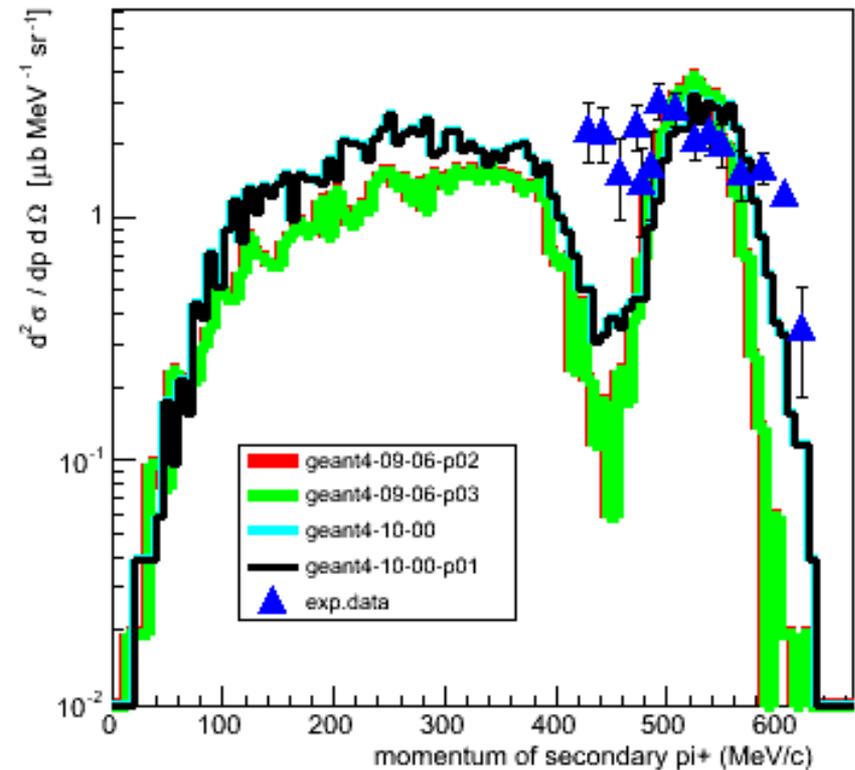
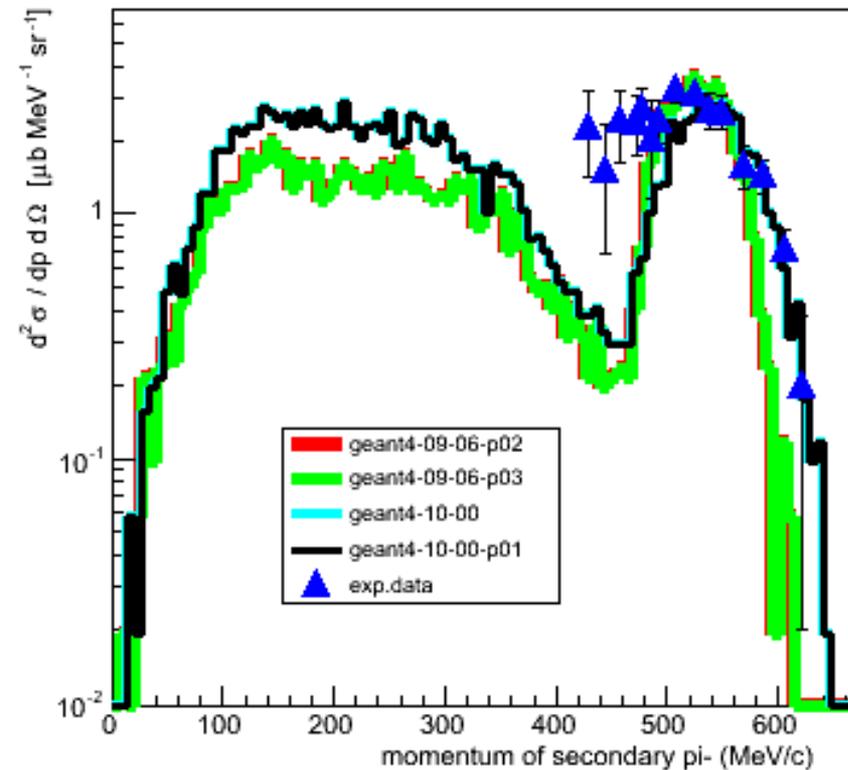
gamma + Cu \rightarrow X + pi+ (44deg)



Test75: 668 MeV gamma+Pb -> pi+

gamma + Pb → X + pi- (44deg)

gamma + Pb → X + pi+ (44deg)





Test47: Intermediate E (up to 7.5GeV/c)

- Proton or pion beam on C or U target, 1.4-7.5GeV/c
- Bertini, Binary, FTF are relatively stable from 9,6.p02 through 10.0-ref04
- There're some variation, but there's no particular trend
- Note: early is 4.9.6-cycle, non-negligible degradations occurred in FTF for this energy range
- Plots to G4 Val

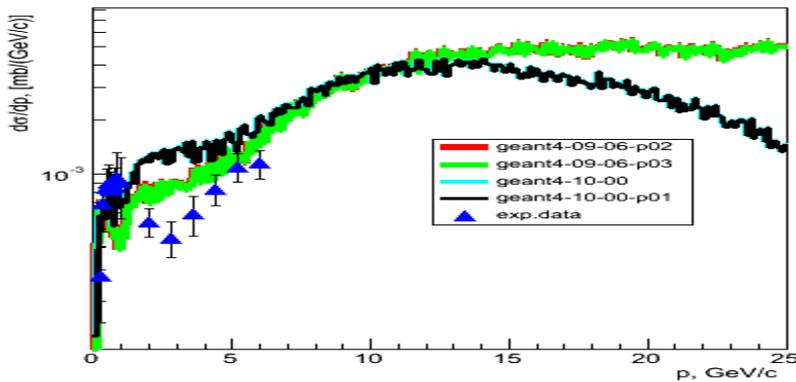


Test19: High E – 31GeV/c(NA61) & 158GeV/c(NA49)

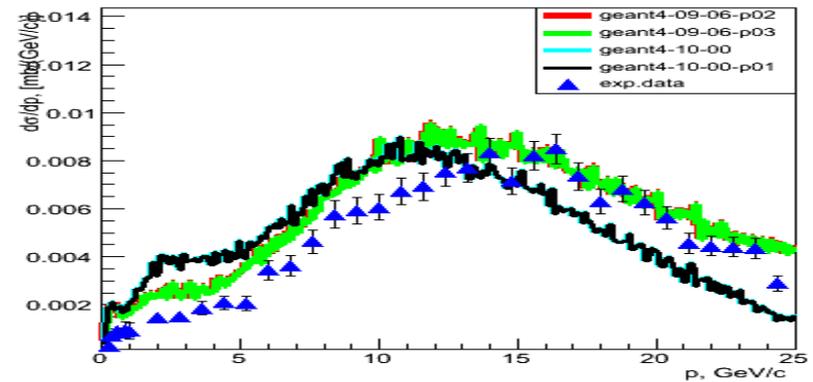
- No changes in QGS(P) (“classical” or outfitted with G4LundStringFragmentation)
Note: QGSP+G4LundStringFragmentation is still the most promising option for modeling highE p+C interactions
- FTF(P) – non-negligible changes between 9.6-cycle and 10.0-cycle
- Observed at at 31GeV/c & 158GeV/c
 - Some of the changes are good, and some are NOT
- See following plots
- No changes for 10.0 through 10.0-ref04
- Plots to G4 Val
- (Another) Note: will add pi+/K+ ratio plots shortly (it's my recollection that there's some degradation in those, too)

Test19: 31 GeV/c p+C -> proton (I) Exp.data: NA61

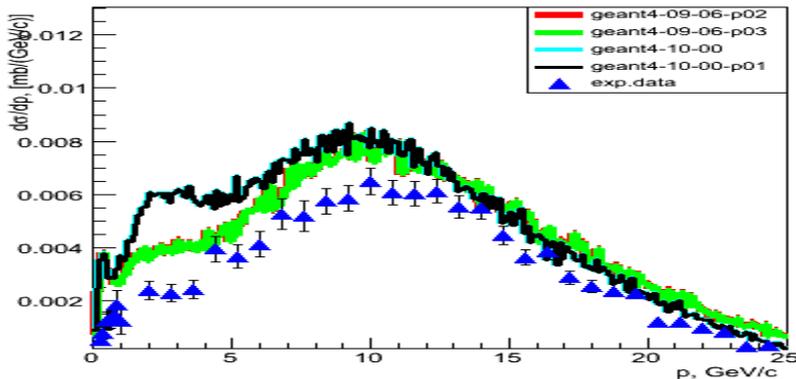
proton + C -> X + proton (0<theta<20 (mrad))



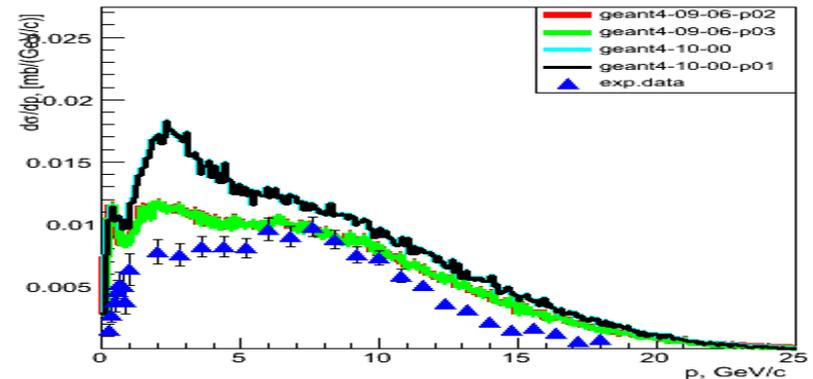
proton + C -> X + proton (20<theta<40 (mrad))



proton + C -> X + proton (40<theta<60 (mrad))

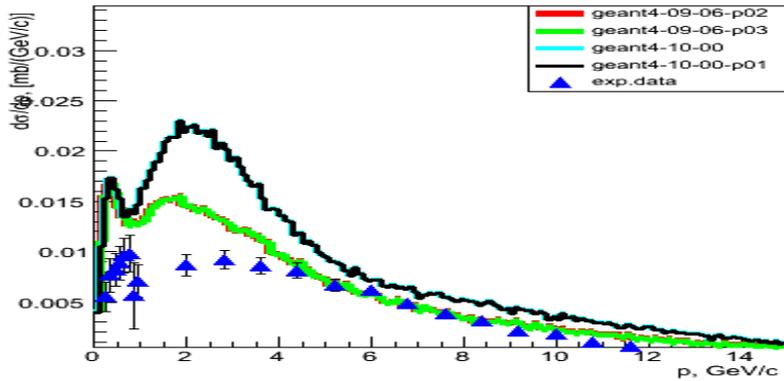


proton + C -> X + proton (60<theta<100 (mrad))

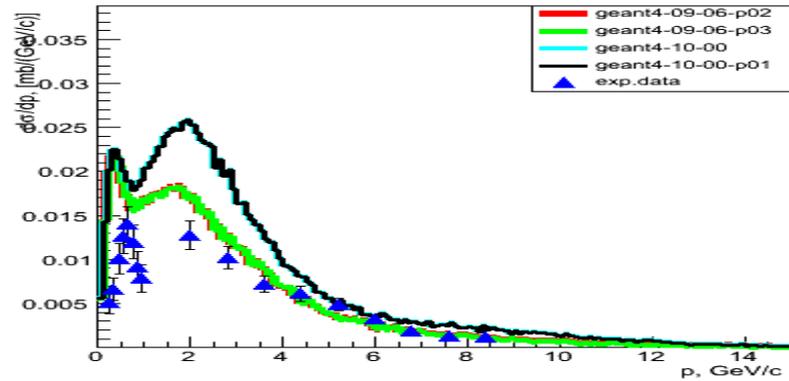


Test19: 31 GeV/c p+C -> proton (II) Exp.data: NA61

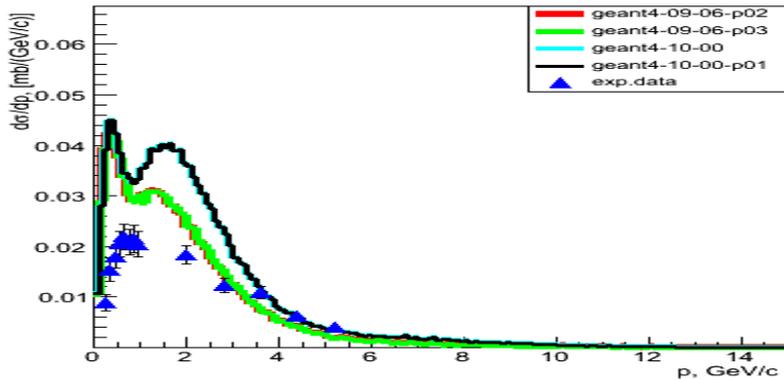
proton + C -> X + proton (100<theta<140 (mrad))



proton + C -> X + proton (140<theta<180 (mrad))

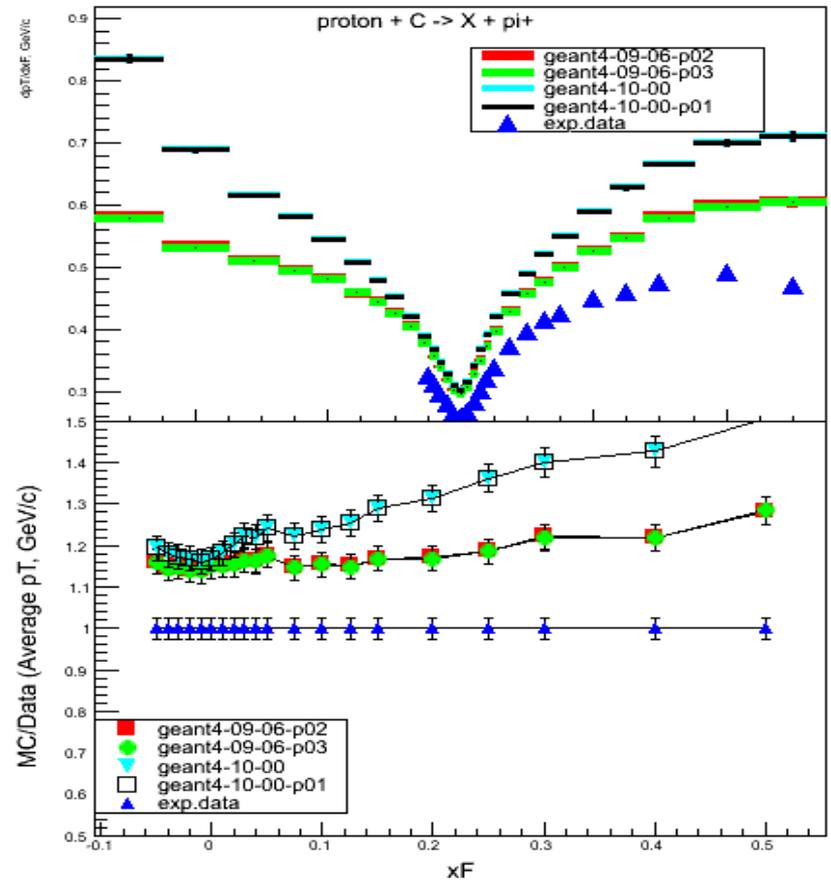
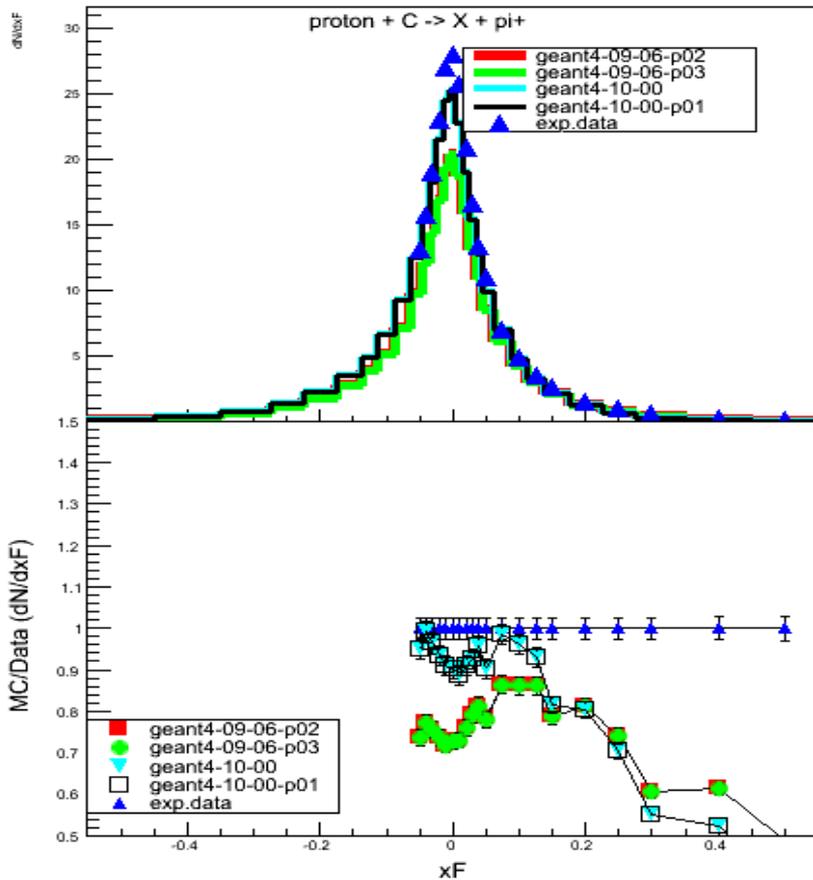


proton + C -> X + proton (180<theta<240 (mrad))



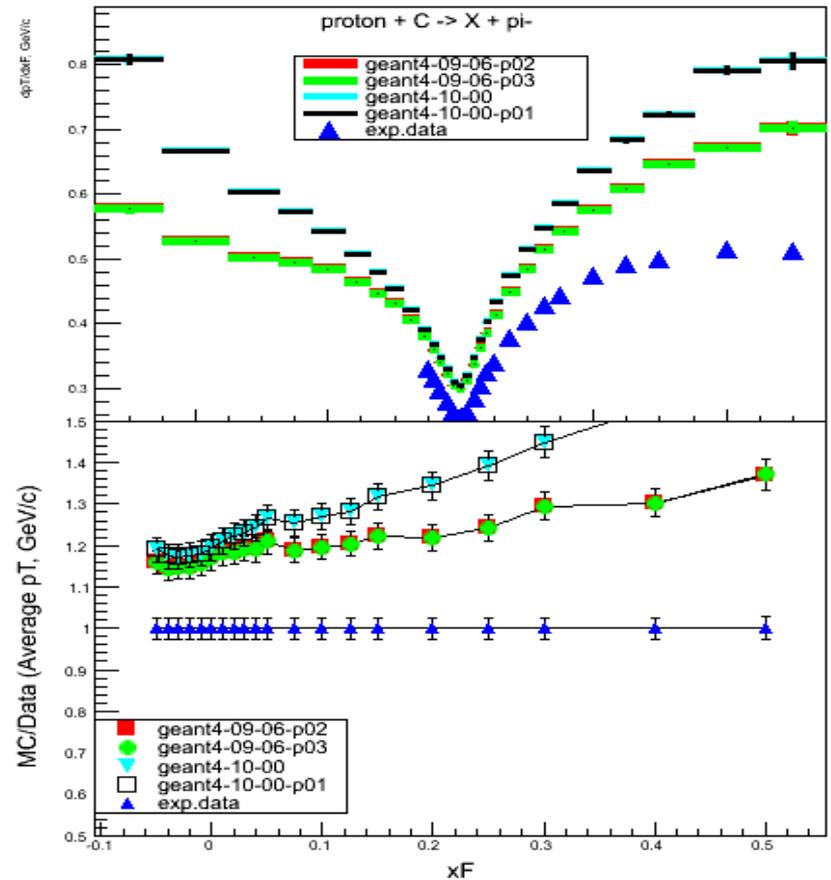
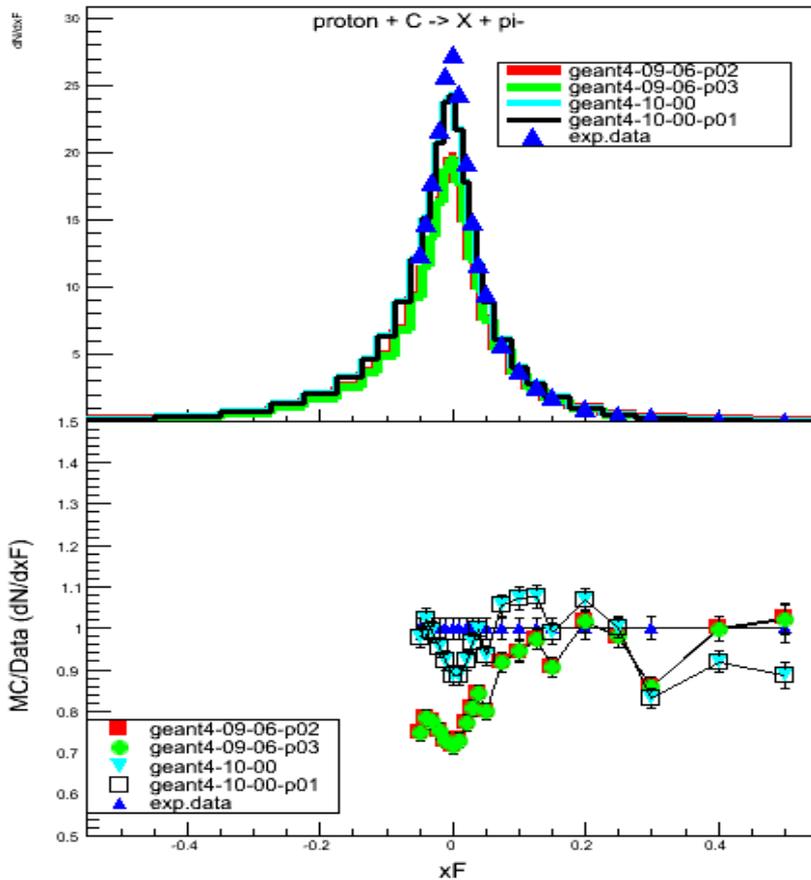
Test19: 158GeV/c p+C -> pi+

Exp.data: NA49



Test19: 158GeV/c p+C -> pi-

Exp.data: NA49





(Instead of) Summary

- Key hadronic models (Bertini, FTF, Binary) are reasonably stable in the intermediate energy range between 9.6.p02 and 10.0-ref04
- Bertini is of concern when modeling pi- capture
- Bertini also shows non-negligible changes for modeling pion production in gamma-N
- FTF shows “mixed news” at higher energies.
Changes in FTF should be taken with caution since FTF is our principal HE model in production physics lists
- No changes in QGS;
Combined with G4LundStringFragmentation can be a good choice for modeling high E p+C