



Geant 4

First Try to Interface FTF with G4HadronicDeveloperParameters

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Geant4 Hadronic Group Meeting

June 21, 2017

Disclaimer

All and any information included in this report is preliminary. Vladimir, Alberto and myself only had a quick email exchange regarding these materials, but we have NOT yet had a detailed discussion, due to the lack of time.

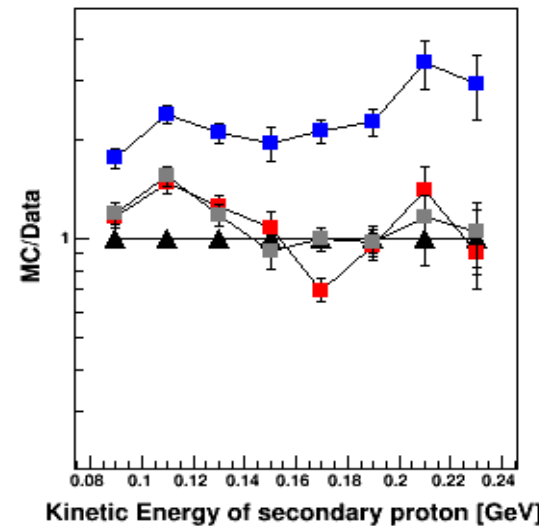
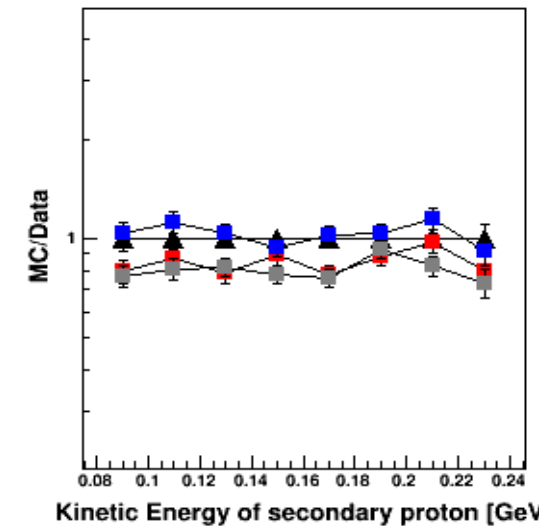
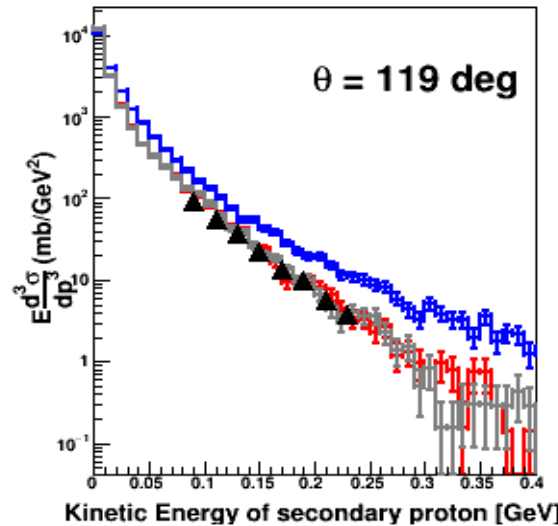
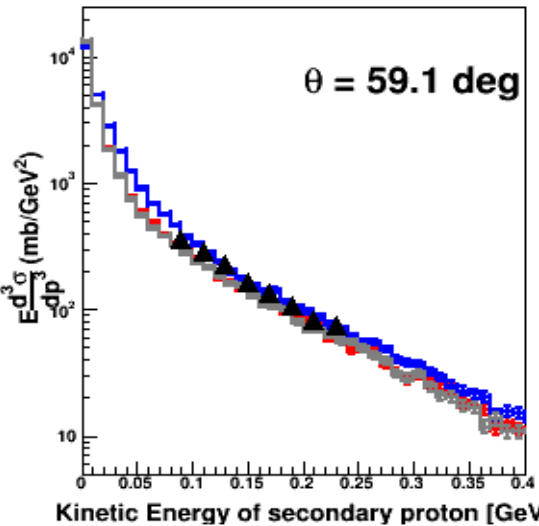
General Information

- Meeting on 12/7/2016 – general strategy towards configurability of Geant4 hadronic models, initial work plans
 - <https://indico.cern.ch/event/591077/>
- Development of the G4HadronicDeveloperParameters (aka HDP) - Tatsumi, Dennis, Andrea, a little bit of myself
 - Initially tested on Bertini

First Try of FTF Configurability

- Documentation - section 3.5.9 of the User's Guide
 - <http://geant4.web.cern.ch/geant4/UserDocumentation/UsersGuides/ForToolkitDeveloper/html/ch03s05.html#sect.ExtdFuncHadPhys.ChangeFTFParam>
- Started with the diffraction part of FTF; did not touch fragmentation part
- In general, there are 3 distinct cases of projectile
 - Baryon
 - Anti-baryon
 - Meson; sometimes there're specific implementations for pions, kaons, etc.
- Lots of hardcoded numbers used in various calculations
- Some of those numbers are common among different projectiles, and some others are case-specific
- Started with the case of baryon projectile
 - Many exp.datasets for proton+A
- Left out the cross sections calculation domain for now
- Concentrated on modeling "elementary processes", including diffractive and non-diffractive interactions and nuclear destruction
- Identified the 1st subset of ~40 parameters and tried interface to HDP
 - It is all based on my common sense; I do not know for sure if all ~40 need to be configurable
- Run initial tests and comparisons vs exp.data – sample plots in the next slides
 - Used geant4.10.3.ref04 because but can/will move to ref05 or later

5GeV/c proton + C → proton + X Data: ITEP771 (Sov.J.Nucl.Phys.42 (1985) p.116)

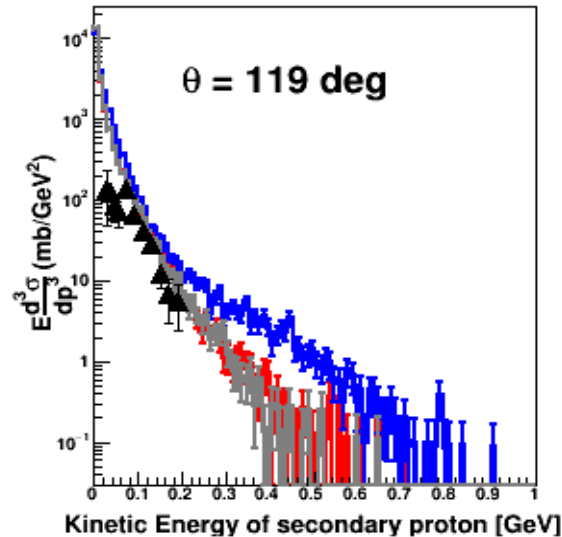
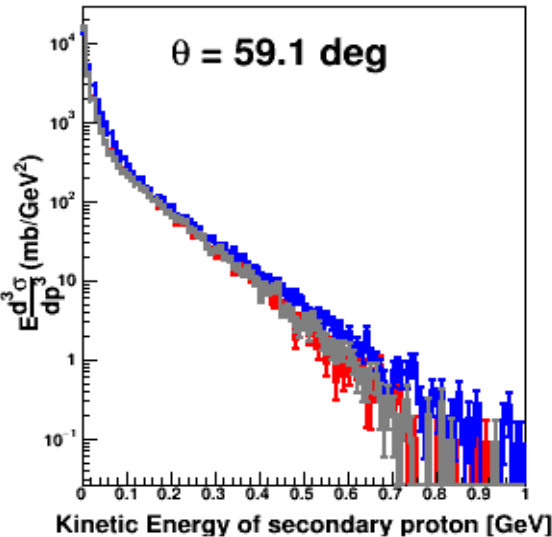


FTF_BARYON_NUCDESTR_P1_TGT:

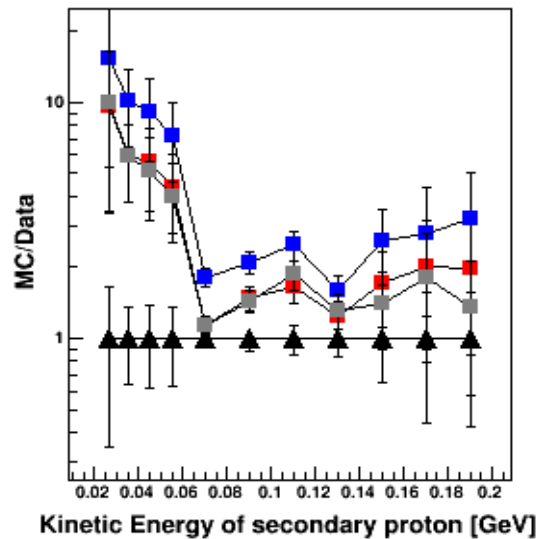
- + as in 10.3.ref04: $0.00481 \cdot A = 0.05772$
- + as in 10.3.p01: 1. (fixed)
- + local test: $0.002 \cdot A$
- ▲ exp.data

Based on 250K events

5GeV/c proton + C → neutron + X Data: ITEP771 (Sov.J.Nucl.Phys.42 (1985),p.116)



Insufficient exp.data

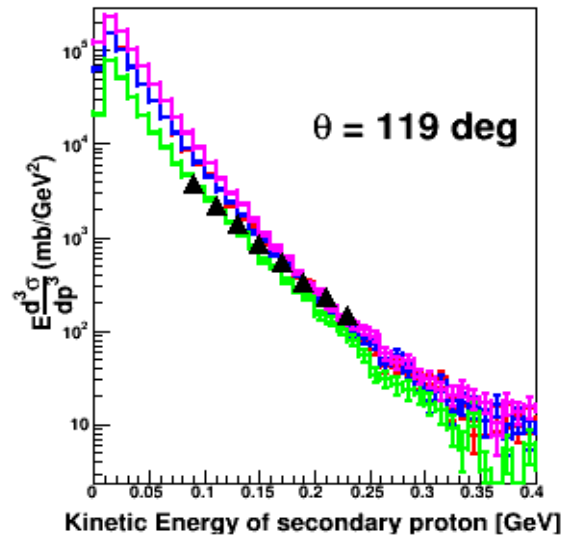
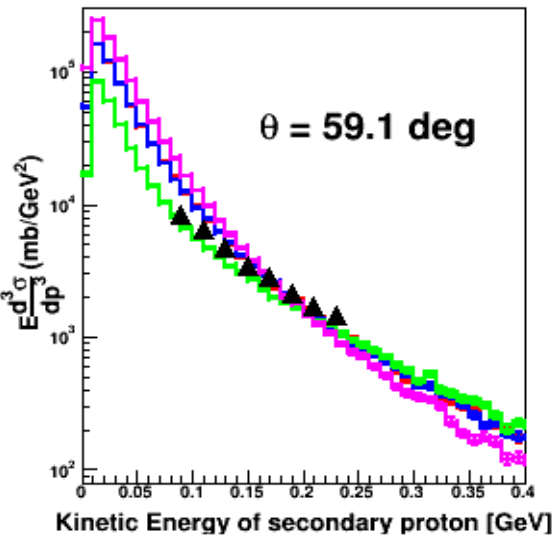


FTF_BARYON_NUCDESTR_P1_TGT:

- \oplus as in 10.3.ref04: $0.00481 \cdot A = 0.05772$
- \oplus as in 10.3.p01: 1. (fixed)
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- \blacktriangle exp.data

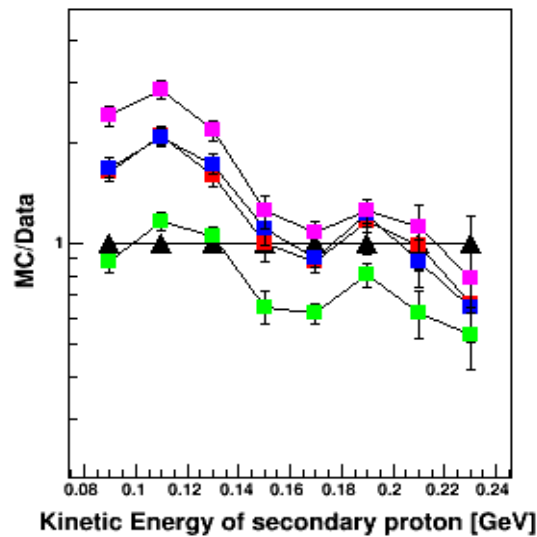
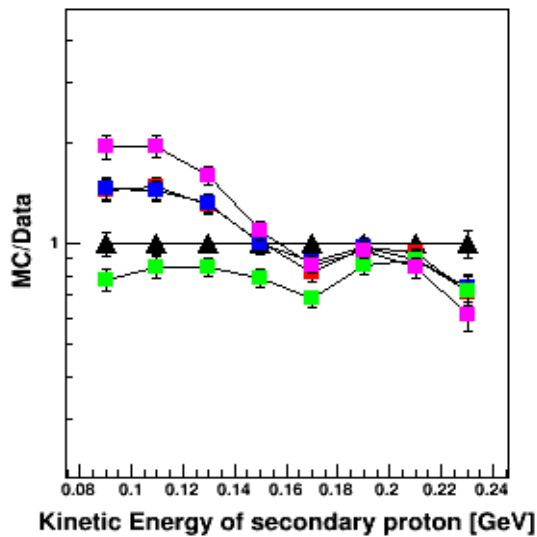
Based on 250K events

5GeV/c proton + Pb → proton + X Data: ITEP771 (Sov.J.Nucl.Phys.42 (1985) p.116)



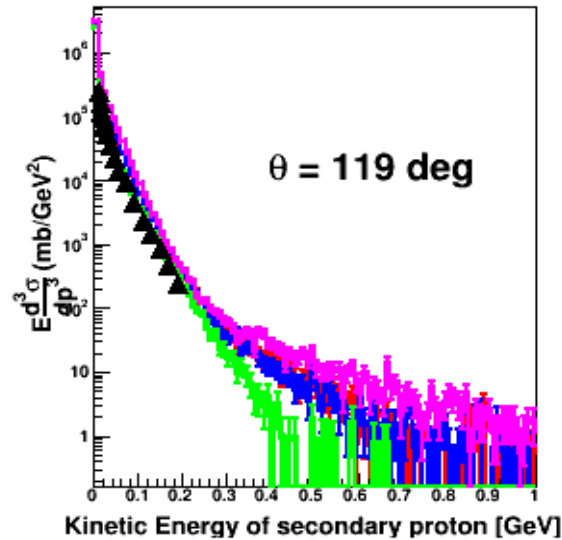
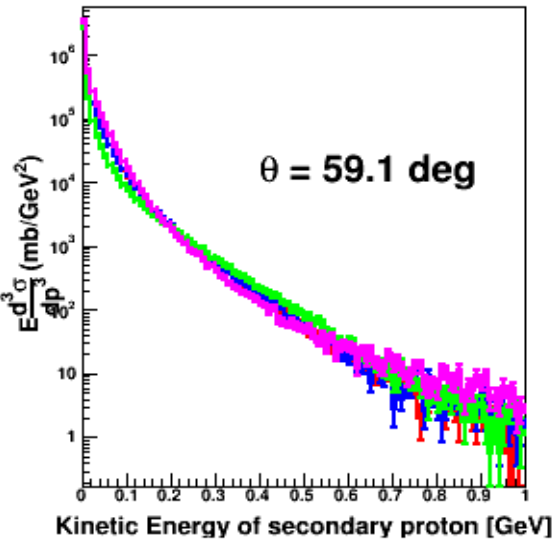
FTF_BARYON_NUCDESTR_P1_TGT:

- + as in 10.3.ref04: 0.00481*A=1.000048
- + as in 10.3.p01: 1. (fixed)
- + local test-1: 0.2 (fixed)
- + local test-2: 5. (fixed)
- ▲ exp.data

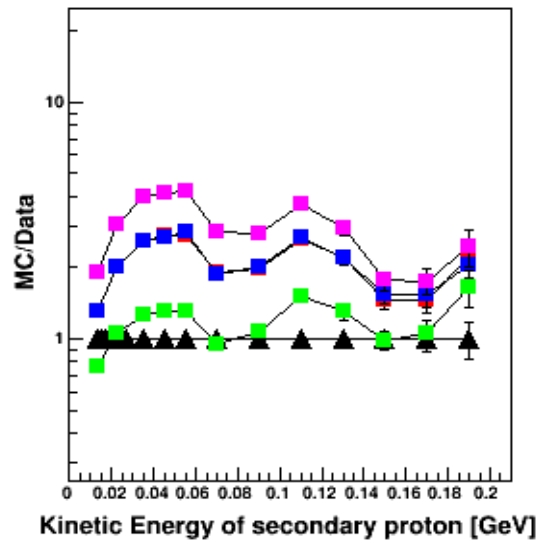


Based on 250K events

5GeV/c proton + Pb → neutron + X Data: ITEP771 (Sov.J.Nucl.Phys.42 (1985),p.116)



Insufficient exp.data

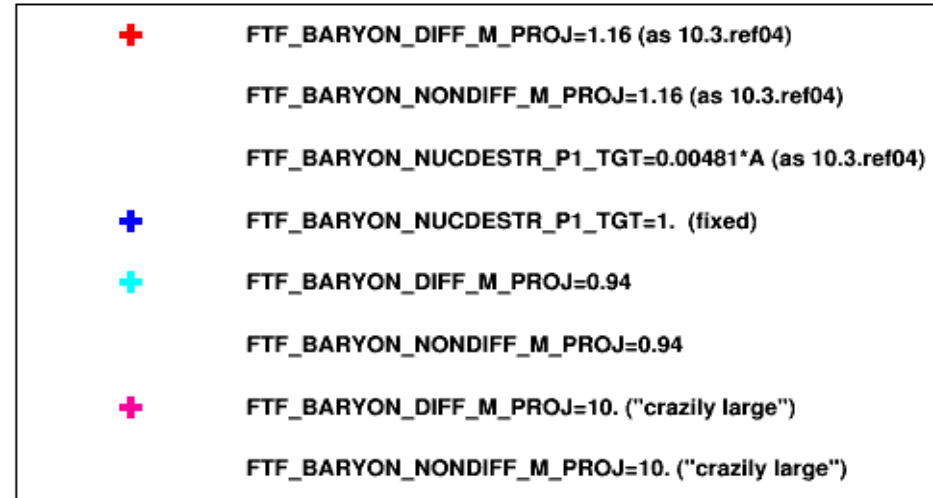
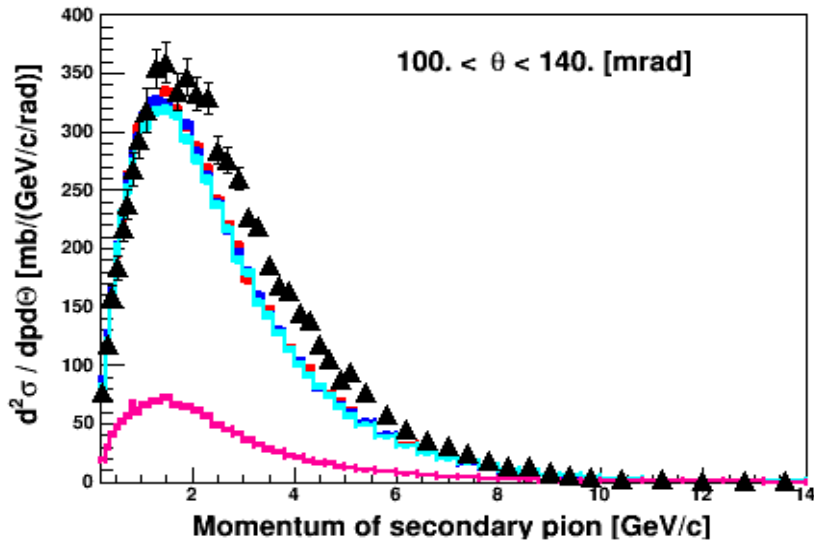
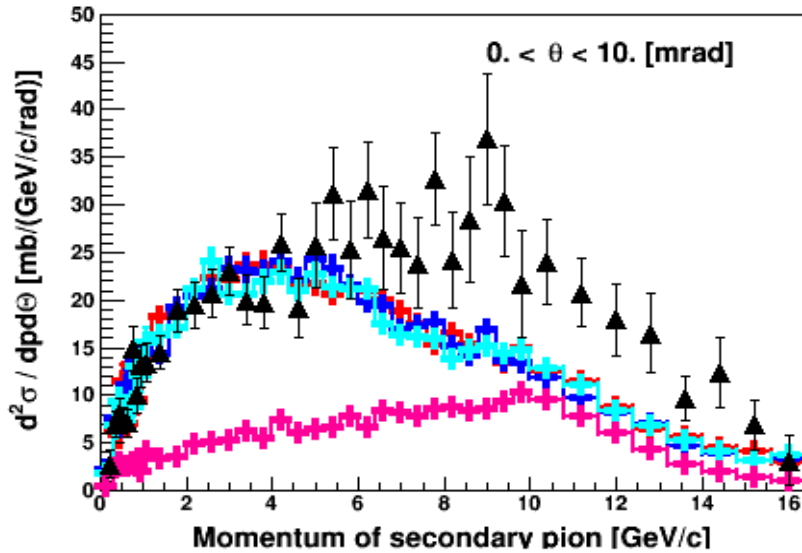


FTF_BARYON_NUCDESTR_P1_TGT:

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- + as in 10.3.p01: 1. (fixed)
- + local test-1: 0.2 (fixed)
- + local test-2: 5. (fixed)
- ▲ exp.data

Based on 250K events

31GeV/c proton + C \rightarrow π^+ + X Data: N.Abgrall et al., Eur.Phys.J.C76 (2016) p 84 (NA61)



Based on 1M events

Other Observations

- FTF does many calculations on the interaction-by-interaction basis
- Those calculations involve parameters (coefficients) in questions
- As said earlier, at present most of those numbers are hardcoded throughout G4FTFParameters
- Direct replacement of such hardcoded numbers by an interface to HDP makes the job dig in the HDP's containers on the interaction-by-interactions basis → unnecessary overhead, inefficiency
 - Plus, tons of warnings in case some parameters are different from default
- I can NOT discuss if the current implementation is “good” or “bad” – any such statement would be beyond my authority

Humble Suggestions

- I think it is feasible to somewhat restructure G4FTFParameters class and make an FTF object to pick up parameters from the central container **only once** (per instance)
- This would be some amount of editorial work, and some non-negligible amount of testing (to make sure that nothing is damaged “in transition”)
- Obviously, consent from Vladimir and Alberto is needed
- If we agree, I think I could work with Vladimir and Alberto and contribute towards such task