Understanding NuWro (11q)

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9-Nov-2015

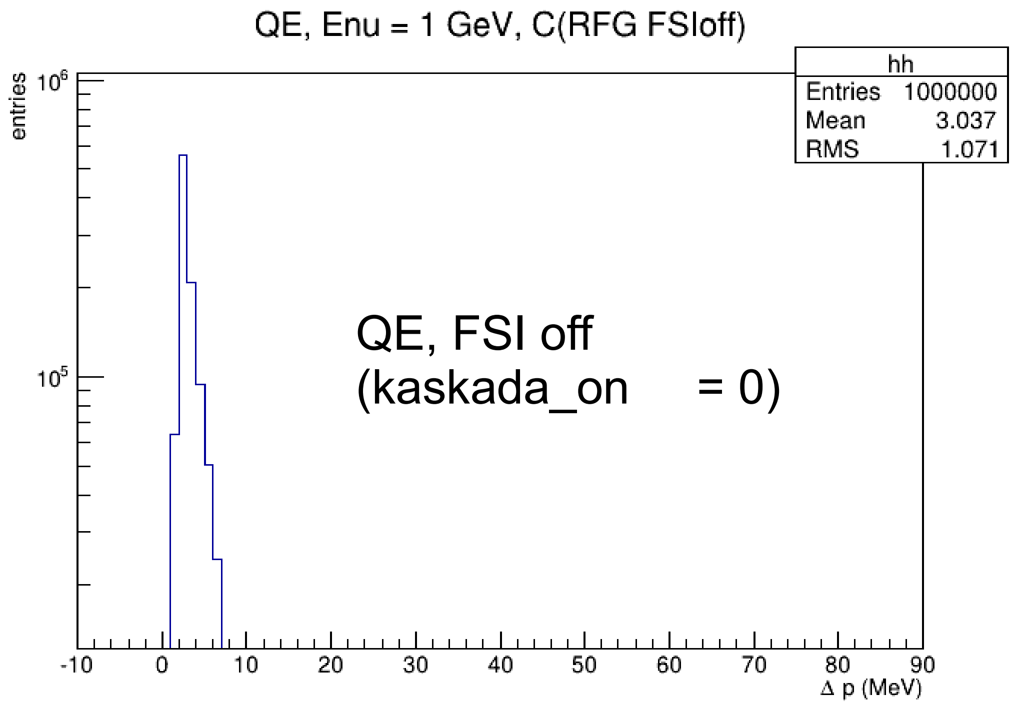
3689

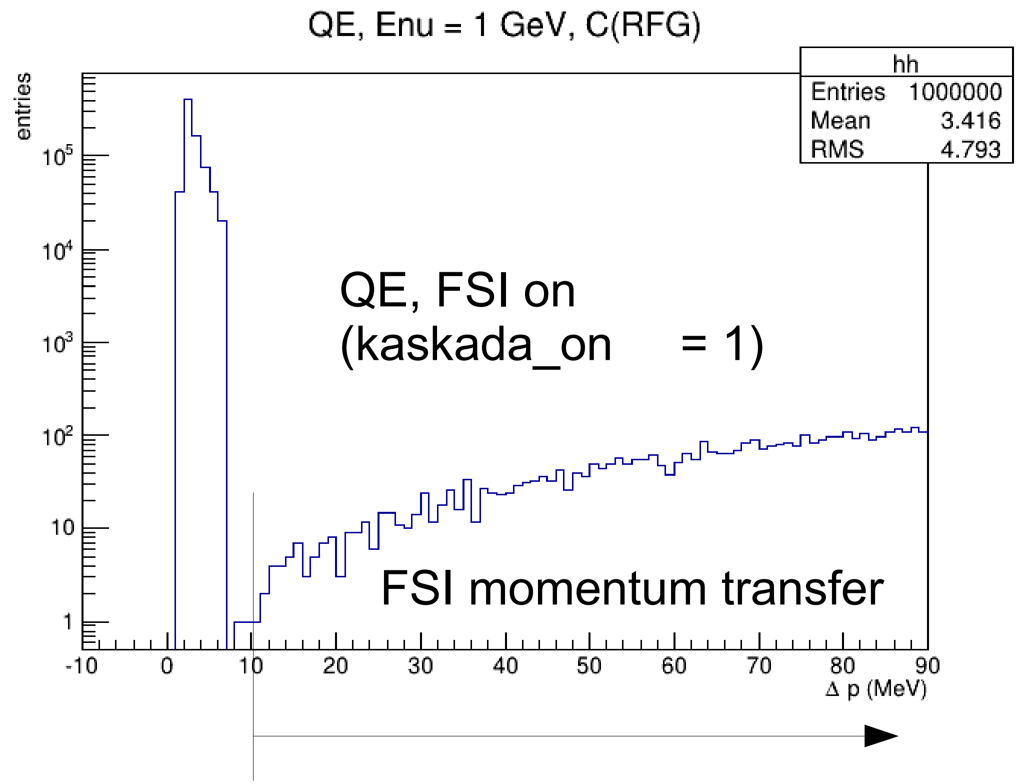
- Momentum conservation
- Resonance FSI with LFG
- Resonance kinematics with FSI

Momentum Conservation

3-momentum deficit in QE: $\Delta p = | p_\nu + p_n - p_\mu - p_p |$

Expected to be 0 in case of no FSI, **but actually has a distribution above 0, < 10 MeV**
→ Tomek: due to the nuclear potential subtraction, which is independent of FSI





In-medium interaction probability τ_f

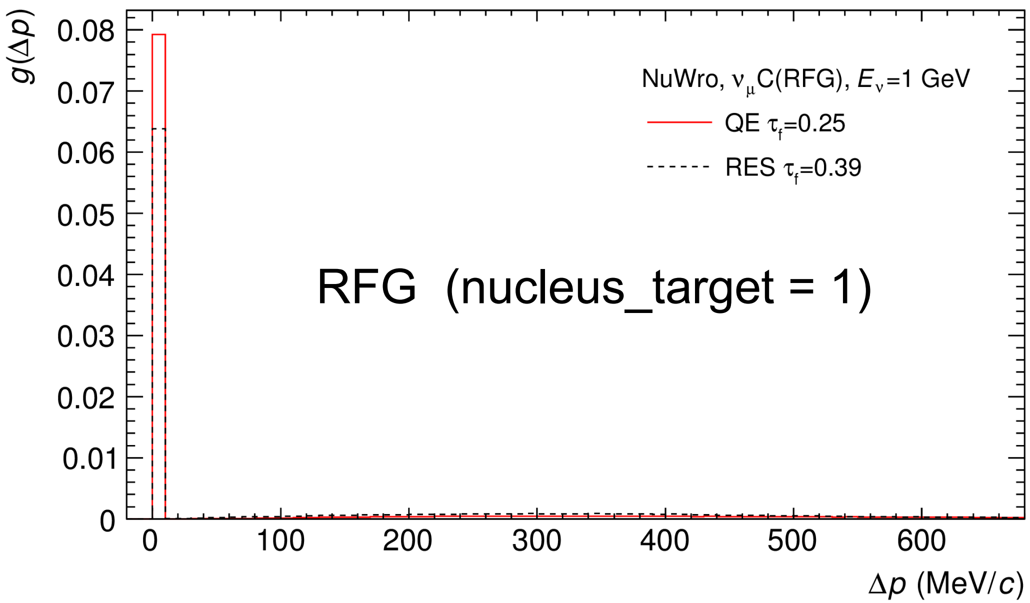
= fraction above Δp > 10 MeV

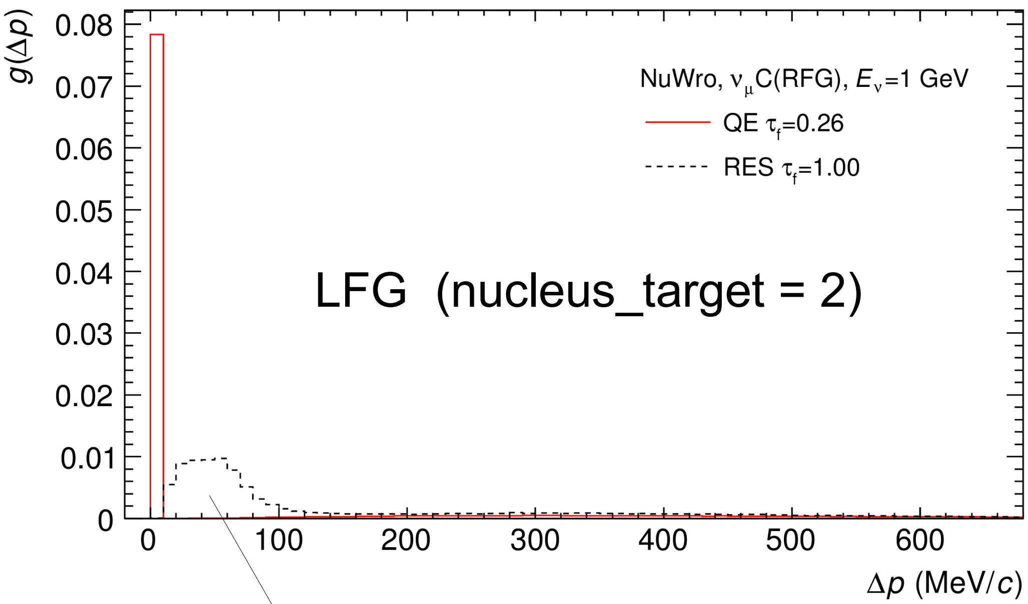
Similar picture also for RES

Resonance FSI with LFG

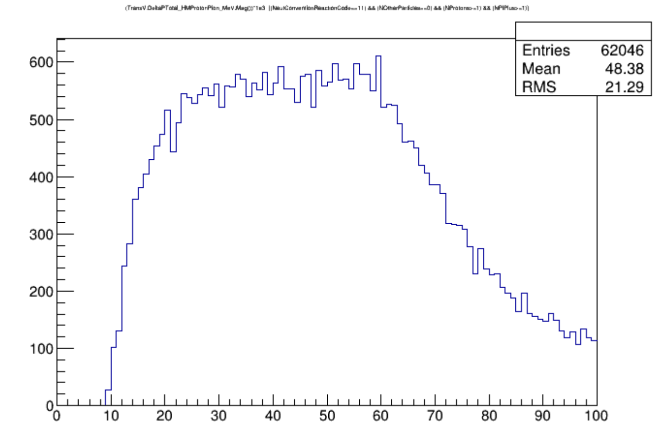
With LFG the Δp distribution is very different

→ Tomek: nuclear potential in LFG is not added to the nucleon energy for RES

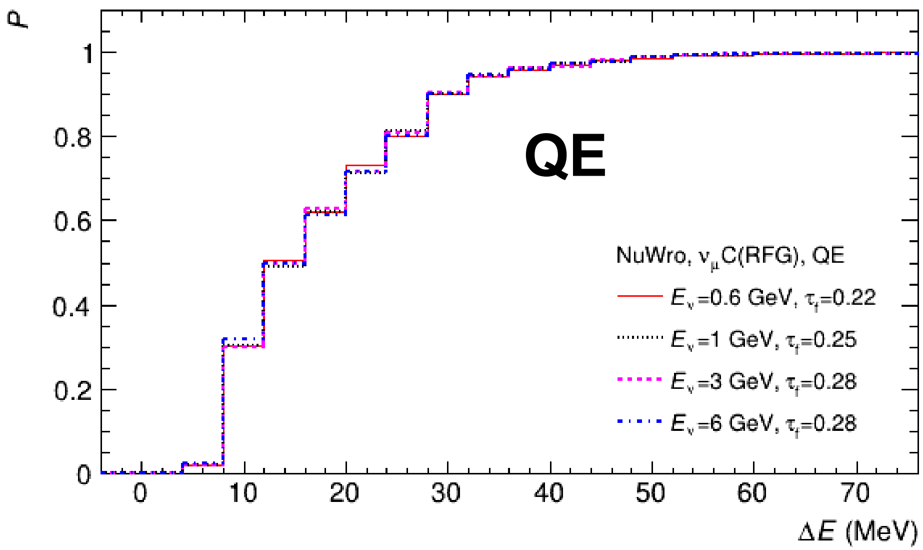


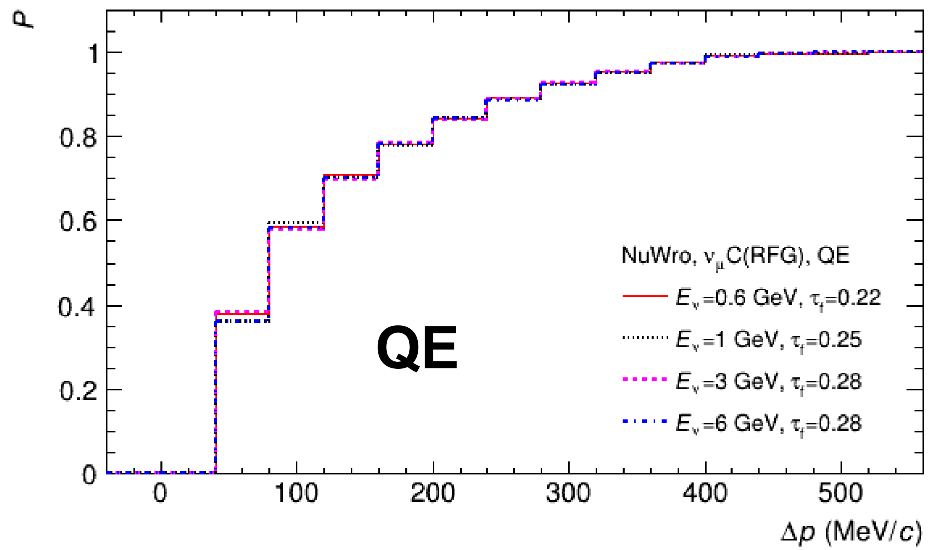


Direct flag for experiencing FSI in Rootracker output format?

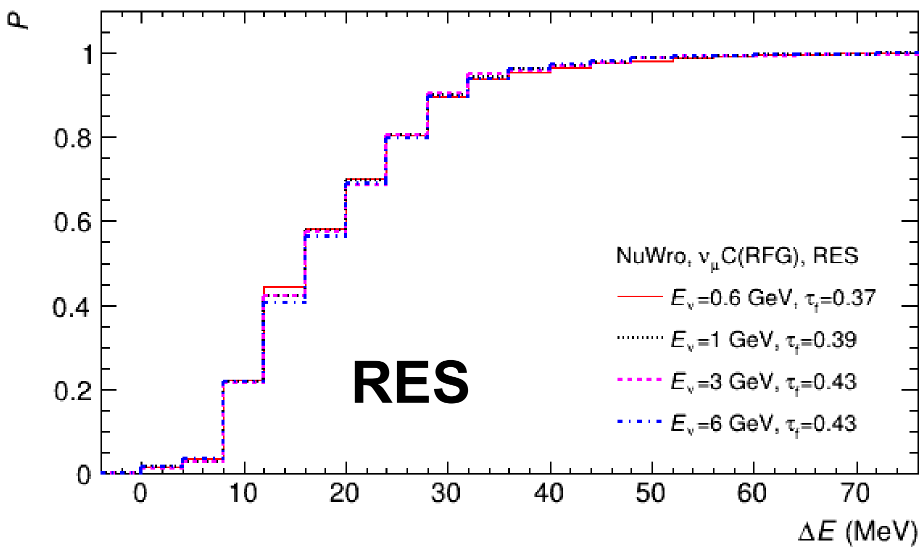


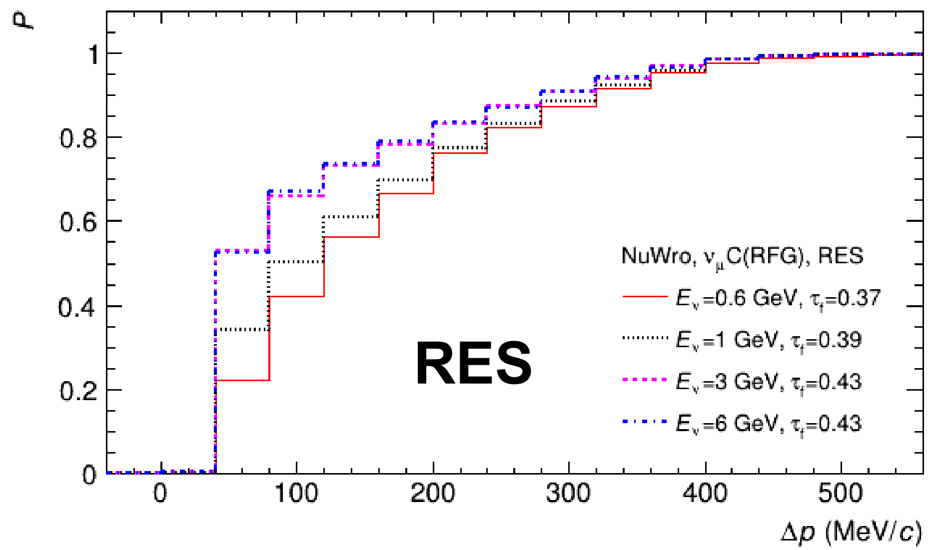
Resonance kinematics with FSI





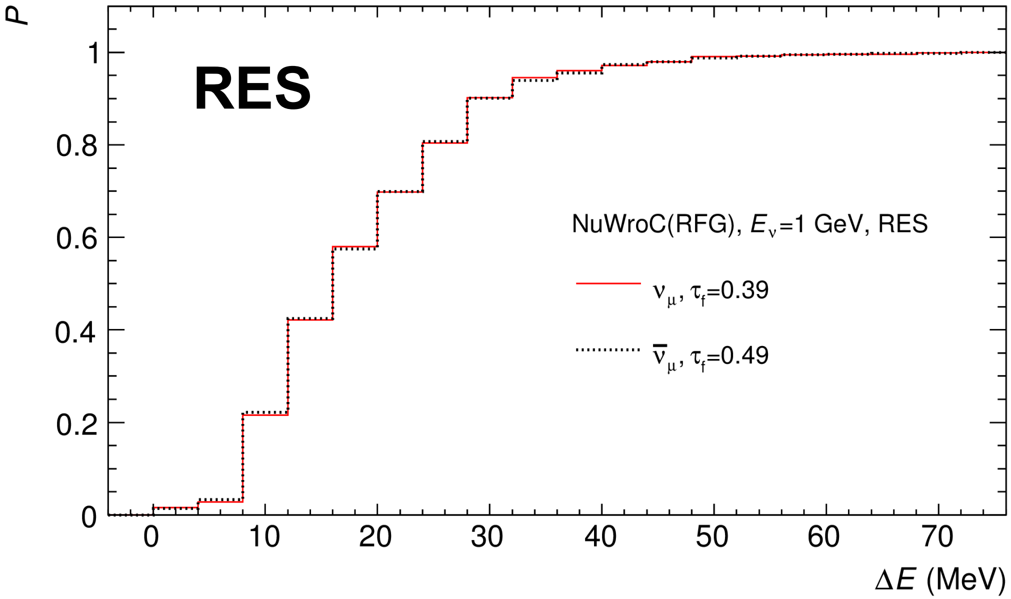
QE: FSI independent of neutrino energy vs. energy transfer and also momentum transfer

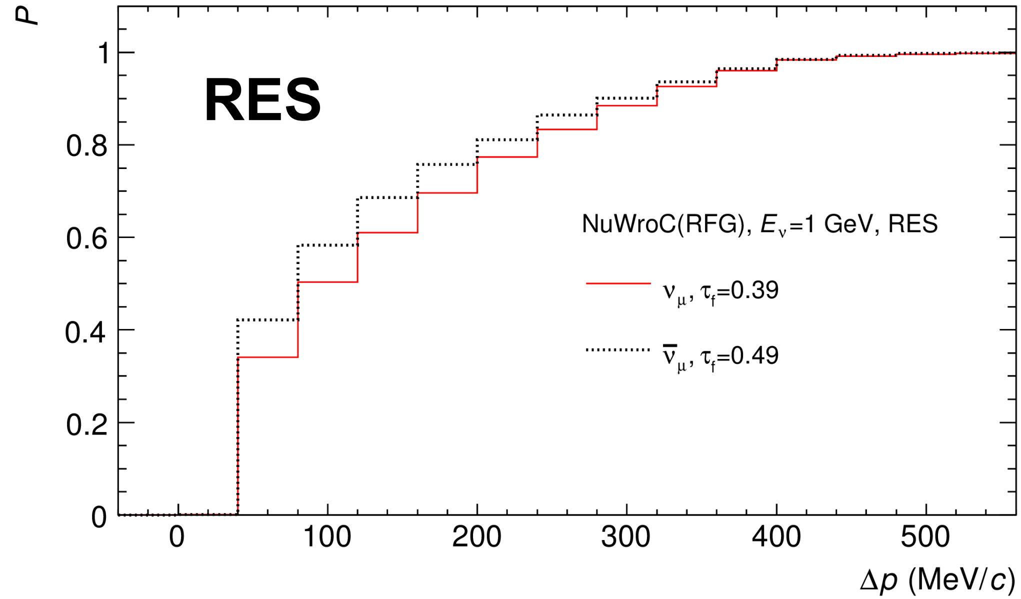




RES: **FSI vs. momentum transfer dependent on neutrino energy**

Resonance kinematics with FSI





Same feature also seen in comparison between nu and antinu.

BACKUP

Technical detail

- 1) Slide 5 is the nuclear emission probability as a function of \Delta E for different neutrino energies.
- a) The nuclear emission probability is the fraction of events which are flagged with kNuclearEmission > 0 (the definition in code is listed below).
- b) \Delta E is the energy difference between (neutrino+initial nucleon) - (lepton+final primary hadron), where the final primary hadron is the highest momentum proton for QE, and (highest momentum proton + highest momentum piplus) for RES. There is a constant shift from 0 due to binding energy in the RFG, which is 32.46 MeV by checking the \Delta E distribution for \Delta P < 10 MeV.
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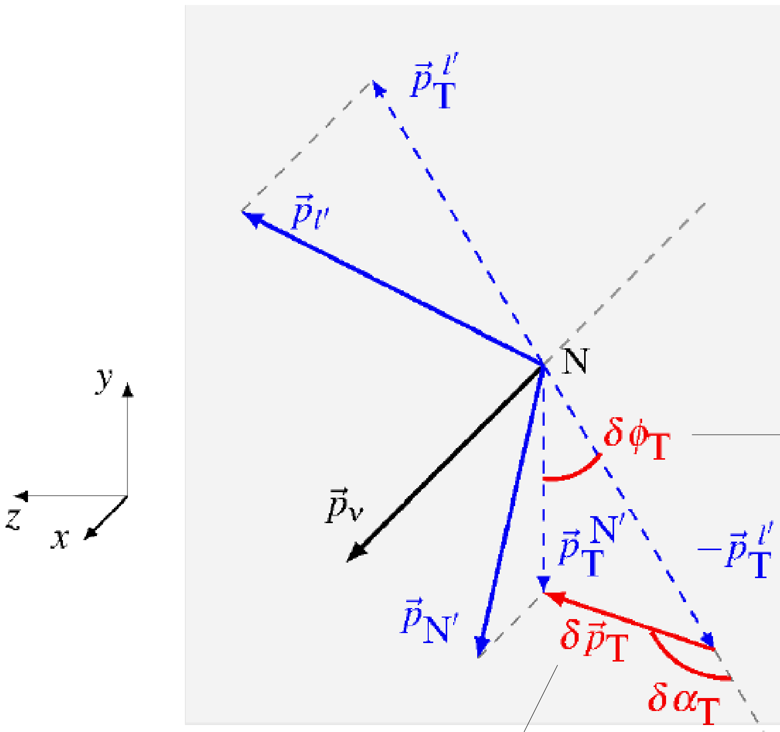
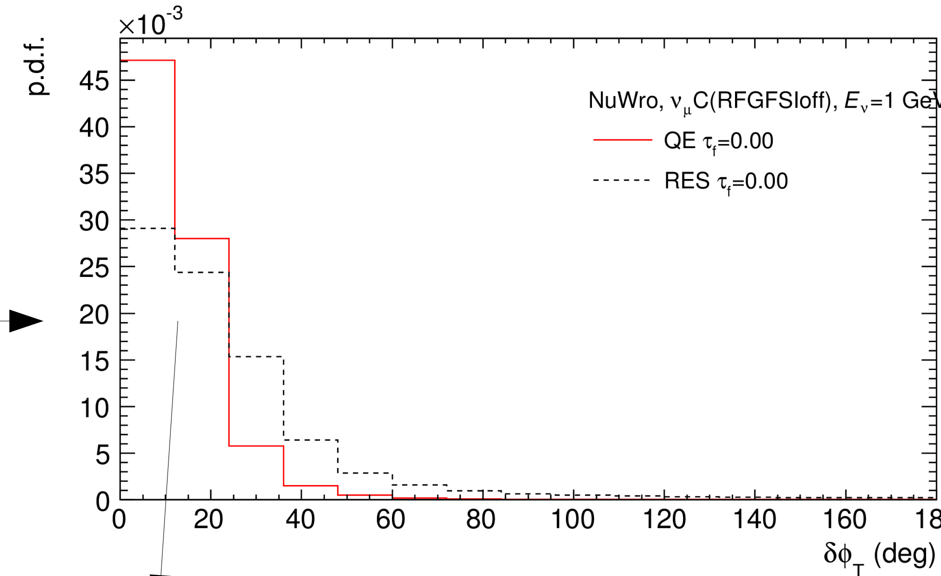
- 3) definition in code
-
- //------------------- resonant production (RES)
- //number of particles beside CC lepton in the final state
- const Int_t nparticle = (nproton + npiplus + nneutron + npiminus + npizero + ngamma + nother);
-
- //flag if this event is RES; in order to have a definition close to experimental selection of topology, require at least 1 proton and at least 1 pi+
- const Bool_t passRES = ((EvtCode == 11) && (nproton>=1) && (npiplus>=1));
-
- //only defined, and should only be called in case passRES = kTRUE; kNuclearEmission = 0 means there is no nuclear emission, otherwise (i.e. >0) means there is nuclear emission
- const Int_t kNuclearEmission = (nparticle-2);
-
- //------------------- quasielastic scattering (QE), similar to RES
- const Bool_t passQE = ((Evtcode ==1) && (nproton>=1));
- const Int_t kNuclearEmission = (nparticle-1);

Resonance kinematics when FSI is switched off

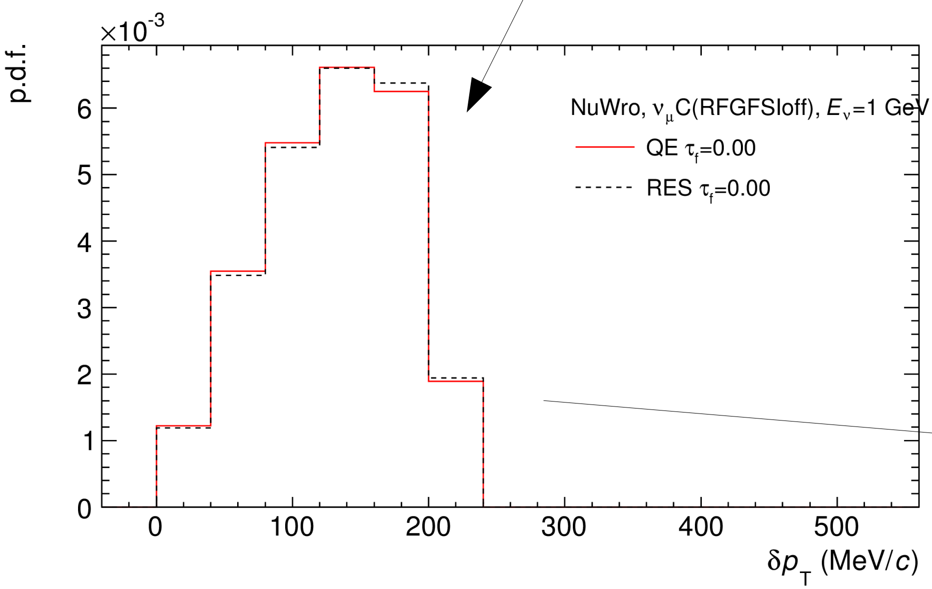


- FSI off (kaskada_on = 0)

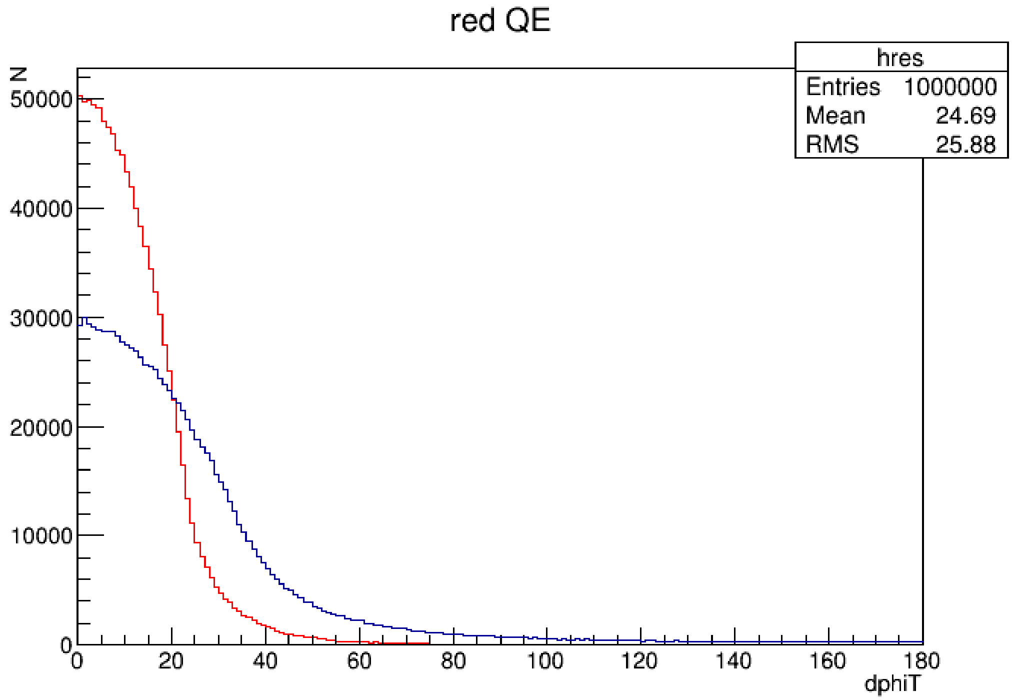


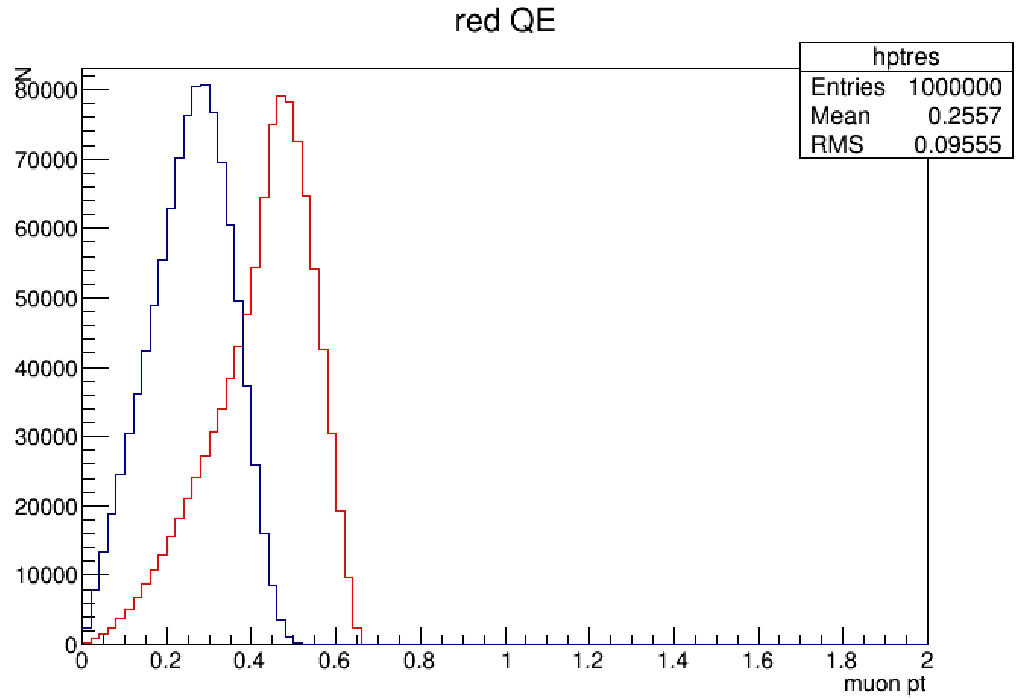
When FSI off, resonance seems to undergo some **residual (elastic) deflection**

→ no. now understood. DphiT ~ 1/muon pt. See next slide.



When FSI off, resonance preserve the initial nucleon momentum, consistent with QE – expected


red QE
hres
Entries 1000000
Mean 24.69
RMS 25.88
N
dphiT
0
10000
20000
30000
40000
50000
0
20
40
60
80
100
120
140
160
180


red QE
hptres
Entries 1000000
Mean 0.2557
RMS 0.09555
N
muon pt
0
10000
20000
30000
40000
50000
60000
70000
80000
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

END