Color Propagation Analysis Updates for Pi Plus

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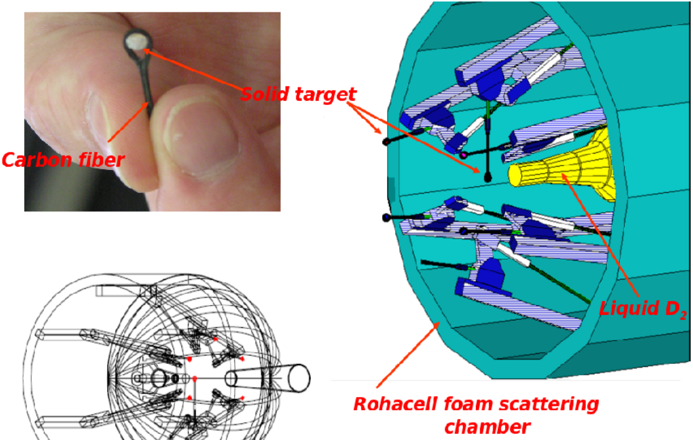
7 de marzo de 2019

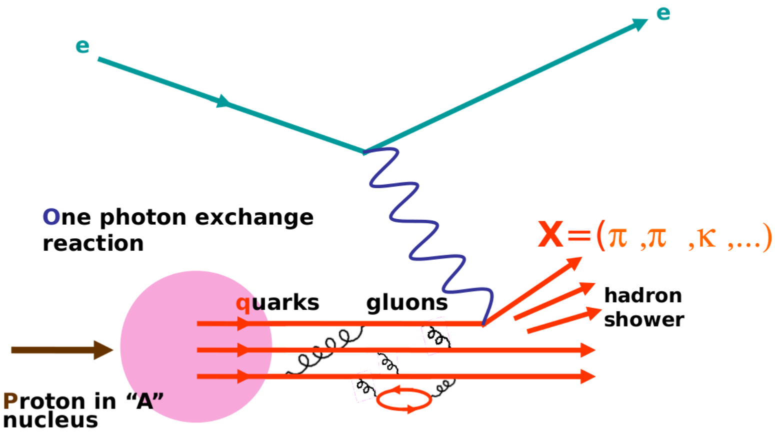
1. Analysis Updates

The Eg2 experiment

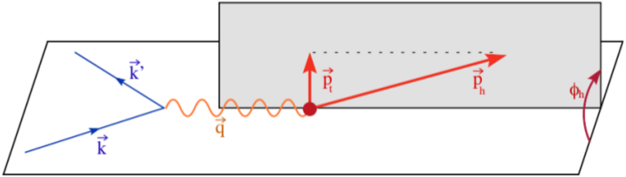


EG2 Experiment target in GEANT3
Solid (C, Al, Fe, Sn, Pb) target
simultaneously with deuterium target

Diagram describing Semi-inclusive Deep Inelastic Scattering of a lepton off a nucleon.



Variables consider in the analysis:



Q2 = -q2 four-momentum transferred by the electron.
ν = E-E' (lab) energy transferred by the electron.
Zh = Eh/ν fraction of initial quark energy carried by hadron.
Pt = hadron momentum transverse to γ* direction.
PhiPQ = angle between leptonic and hadronic planes.
Xb = proton momentum fraction carried by the struck quark.

Situation:

We have two independent analysis , here we call them:

- Santa Maria University analysis (SMU).
- Raphael Dupre Analysis (RD).

which give different final results.

What are the differences between the analysis?

- The selection criteria (Particle Identification).
- The Vertex cuts, for electrons.
- The Set of Simulations.
- The Method of doing the Acceptance Correction.
  - USM $\rightarrow$ Bin by Bin base Correction.
  - RD $\rightarrow$ Event by Event base Correction.
- Number of variables consider in the Acceptance Correction:
  - USM $\rightarrow$ Zh , Q2, P_t^2, Xb and PhiPQ bins (this is called 5D case).
  - RD $\rightarrow$ Zh , Q2, P_t^2 and Xb bins (this is called 4D case).

This study is dedicated to the search of possible sources which produce the discrepancy between final results of two analysis. The following two observables are explored in both cases:

- The European Muon Collaboration effect (EMC effect), which only consider electrons.
- The Hadronic Multiplicity Ratio (MR), for pi plus.

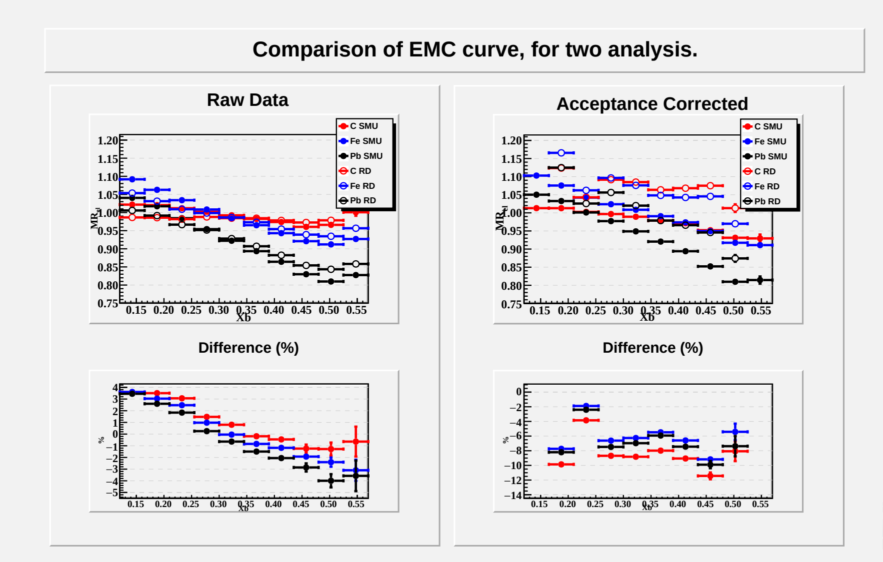
The European Muon Collaboration effect (**EMC effect**).

$$\mathrm{EMC} \equiv \frac{\left(\mathrm{N}_{el^-}^{\mathrm{DIS}}\right)_A}{\left(\mathrm{N}_{el^-}^{\mathrm{DIS}}\right)_D}$$

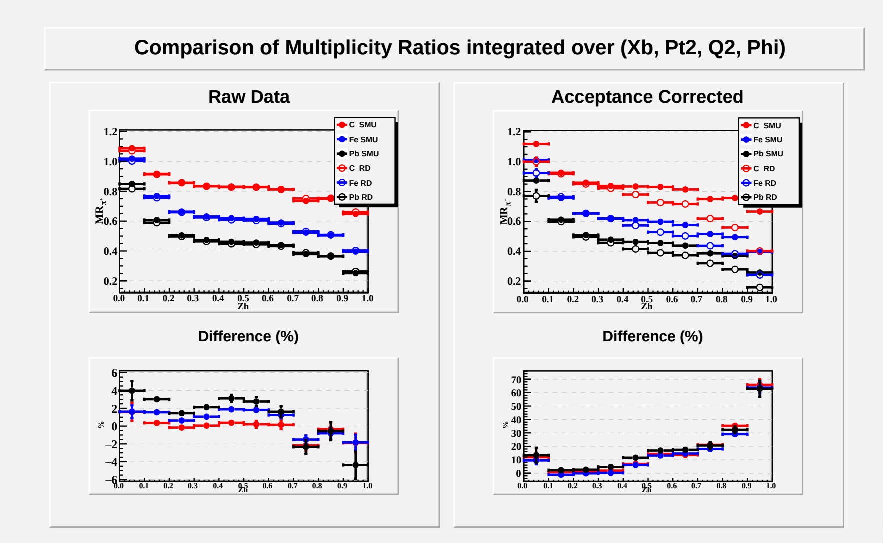
The Hadronic Multiplicity Ratio (**MR**), for π^+, is defined as:

$$\mathrm{MR} \equiv \frac{\left(\frac{\mathrm{N}_{\pi^+}^{\mathrm{DIS}}}{\mathrm{N}_{el^-}^{\mathrm{DIS}}}\right)_A}{\left(\frac{\mathrm{N}_{\pi^+}^{\mathrm{DIS}}}{\mathrm{N}_{el^-}^{\mathrm{DIS}}}\right)_D}$$

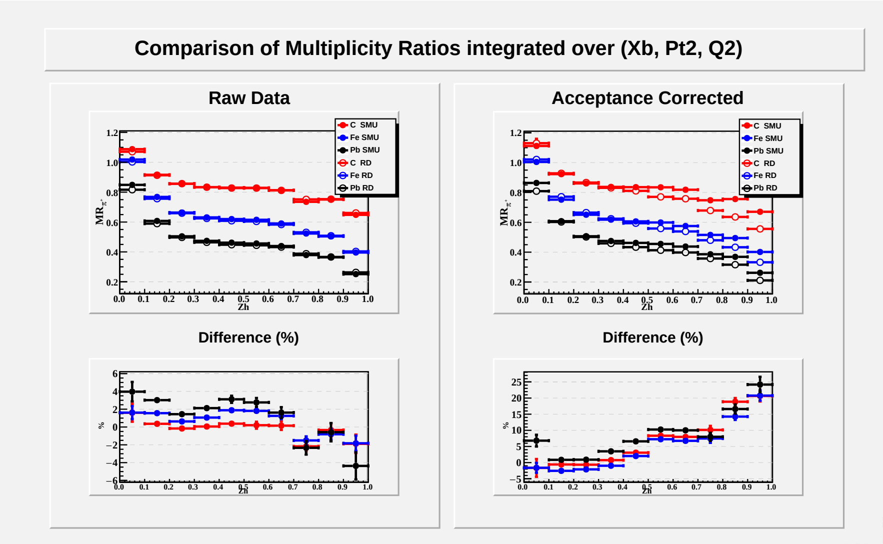
EMC curves as a function of Xb, integrated over Q2. The electron only have two degrees of freedom.



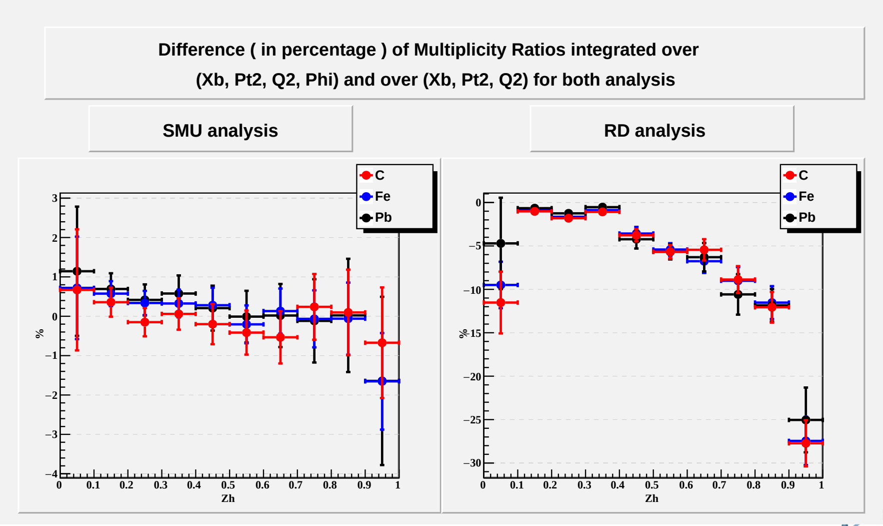
Now, for Pi Plus, we have the MR as a function of Zh. This is the 5D case.



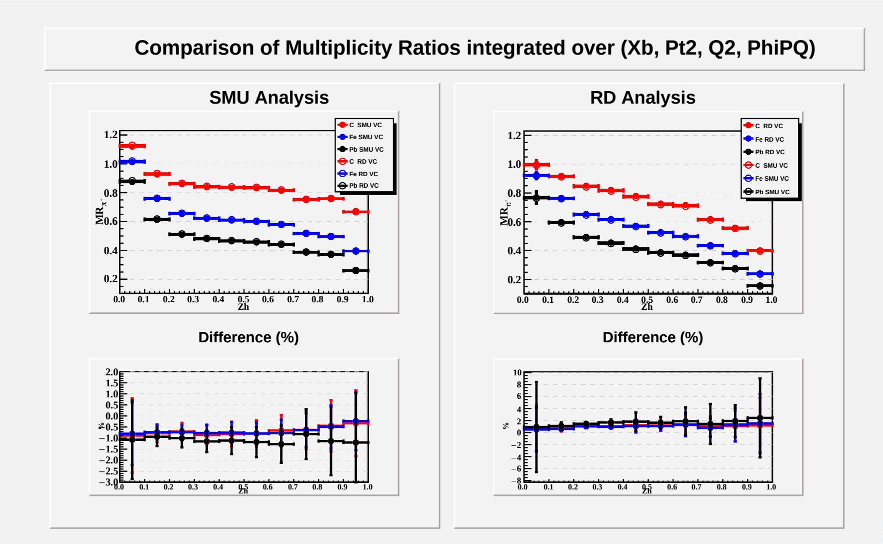
If we don't integrated over PhiPQ, (4D case).



Change in MR curves (%) if PhiPQ is included in the analysis.

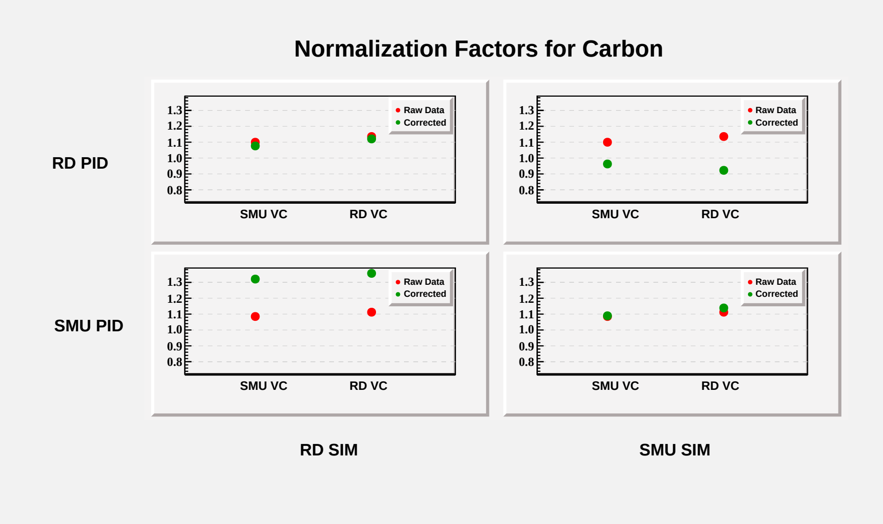


There are two sets of vertex cuts. If we mixed them

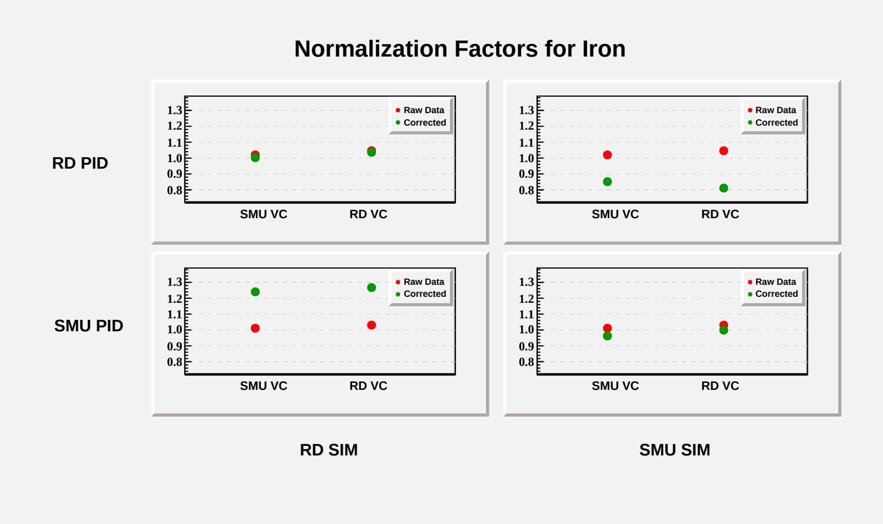


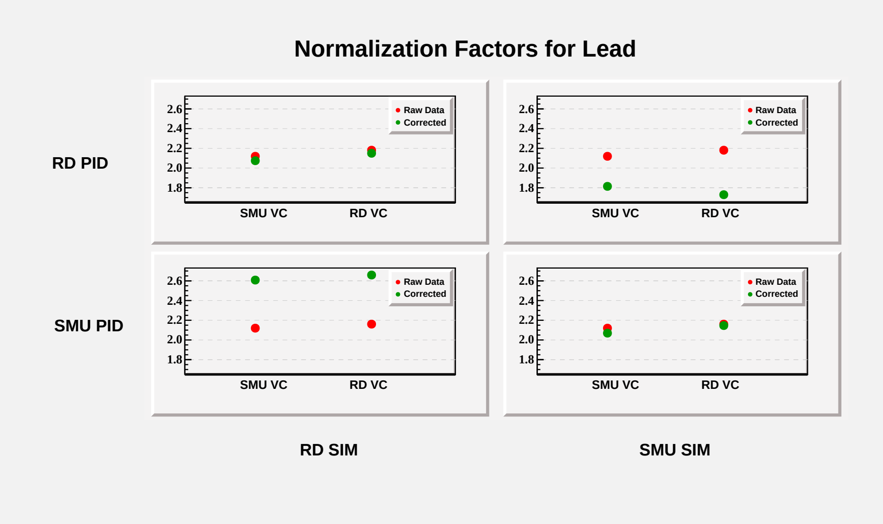
Electron Normalization Factors are calculated using different vertex cuts, different particle identification and different set of simulations.

$$\mathrm{MR} = \frac{\left(\mathrm{N}_{\pi}^{\mathrm{DIS}}\right)_A}{\left(\mathrm{N}_{\pi}^{\mathrm{DIS}}\right)_D} \times \underbrace{\frac{\left(\mathrm{N}_{el}^{\mathrm{DIS}}\right)_D}{\left(\mathrm{N}_{el}^{\mathrm{DIS}}\right)_A}}_{\text{Normalization Factor}}$$

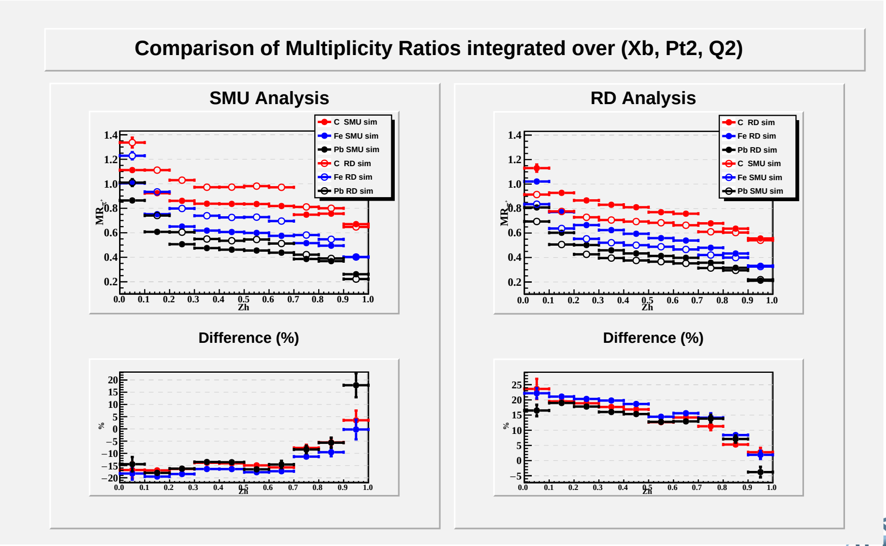


Normalization Factors for Carbon
RD PID
SMU PID
RD SIM
SMU SIM
Raw Data
Corrected
SMU VC
RD VC
1.3
1.2
1.1
1.0
0.9
0.8


Normalization Factors for Iron
RD PID
SMU PID
RD SIM
SMU SIM
Raw Data
Corrected
1.3
1.2
1.1
1.0
0.9
0.8
SMU VC
RD VC


Normalization Factors for Lead
RD PID
SMU PID
RD SIM
SMU SIM
Raw Data
Corrected
SMU VC
RD VC
2.6
2.4
2.2
2.0
1.8

If we only mixed the set of simulations.



Conclusions:

- The set of simulations explains in part the discrepancy between the analysis.
- The method to apply the acceptance Correction factors need to be studied in detail. Further studies are necessary.