Preliminary Monitoring on RG-D data

A preliminary study of current available RG-D data for TMD analysis in SIDIS processes

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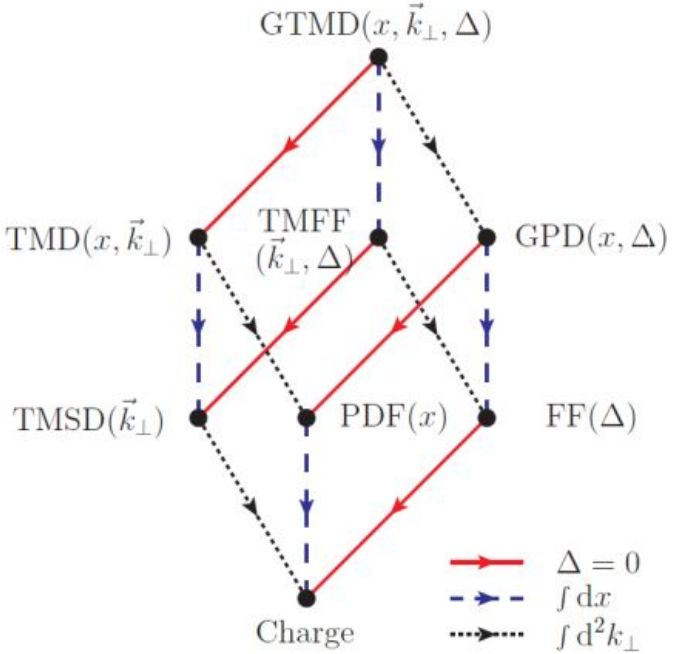
Study of Transverse Momentum Dependent (TMD) functions in RG-D

Understand the structure of nuclei in terms of quarks and gluons through 3D momentum space distribution of hadrons.

This work: Nuclear TMDs

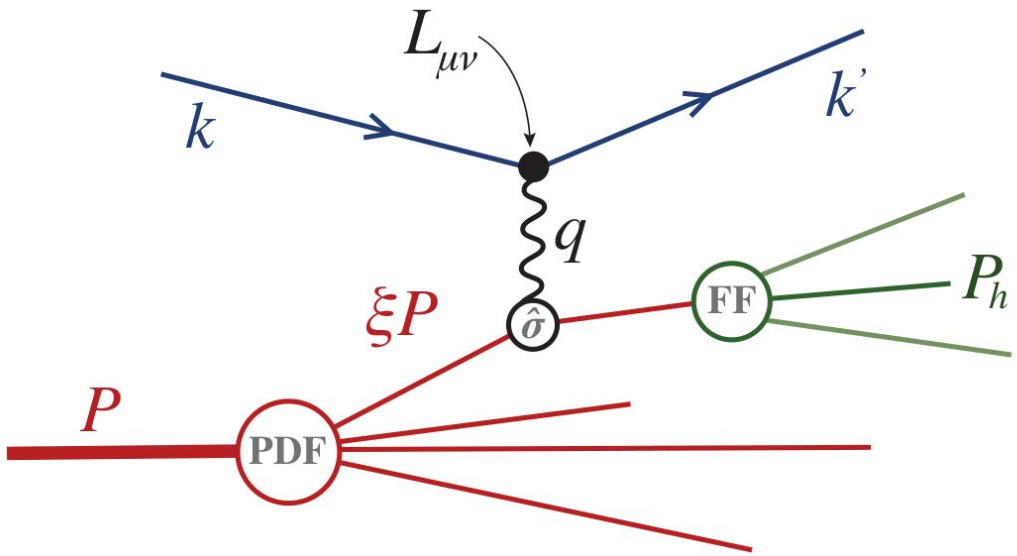
- modification of nucleons in the nuclear medium
- cross section components can be linked to parton level effect
- Study the problem of nucleon modifications in the nuclei (EMC effect)



N/q	U	L	T
U	f_1		$h_1^\perp$
L		g_1	h_{1T}^L
T	$f_{1T}^\perp$	$g_{1T}^\perp$	h_1 $h_{1T}^\perp$

Semi Inclusive Deep Innelastc Scattering (SIDIS)

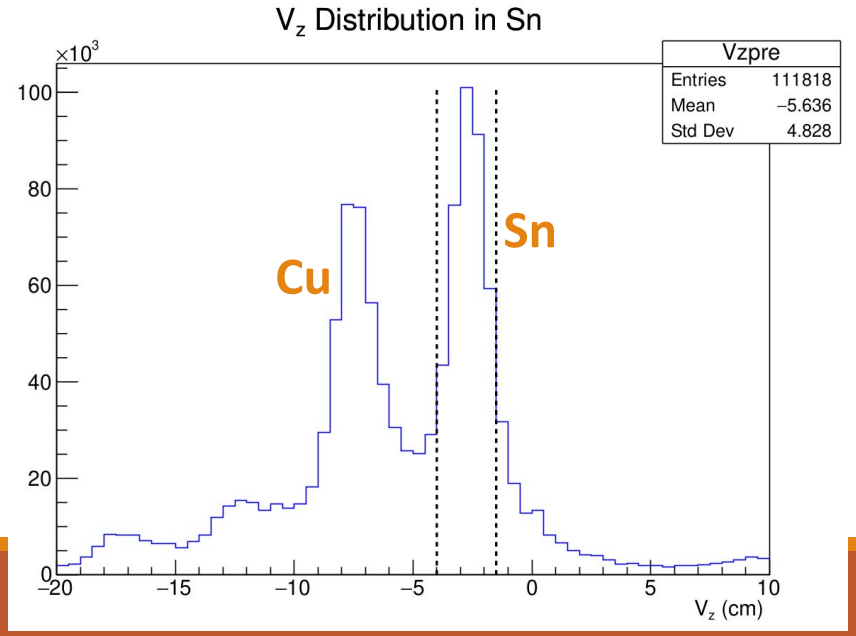
- Hadron production through γ *
  - **e(k) + N(p) -> e(k') + X(p') + h(P_h)**
  - detection of one of the produced hadrons
  - cross section -> convolution of TMD parton distributions and TMD fragmentation functions
- Experimental Observables: Cross section, Beam Spin Asymmetry
- Studied observables: $\cos\phi_h$, $\sin\phi_h$, $\cos 2\phi_h$

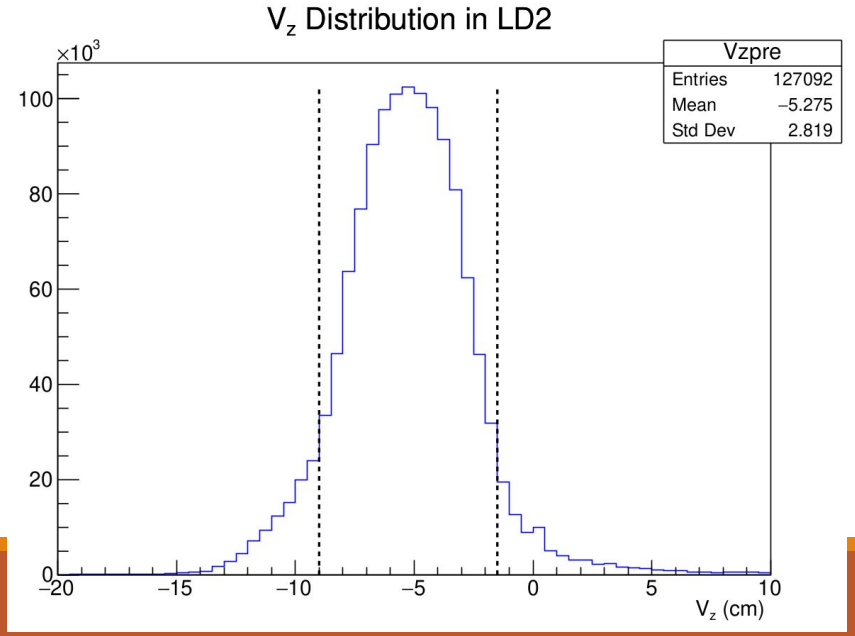


This Work: We use unpolarized nuclear targets where only the cos φ, cos 2φ and sin φ components will contribute in this cross section.

RG-D comparison preliminary analysis

- Comparing Data from simulations and actual available data
- Using runs with **LD2** and **Sn** targets
- Events considered with **π+** production
- Kinematical Variables specific to the hadron for TMDs:
  - z = Fraction of the virtual photon energy carried by the hadron.
  - pt^2 = transverse momentum of hadrons
- Vertex z cuts need to be considered according to target positions

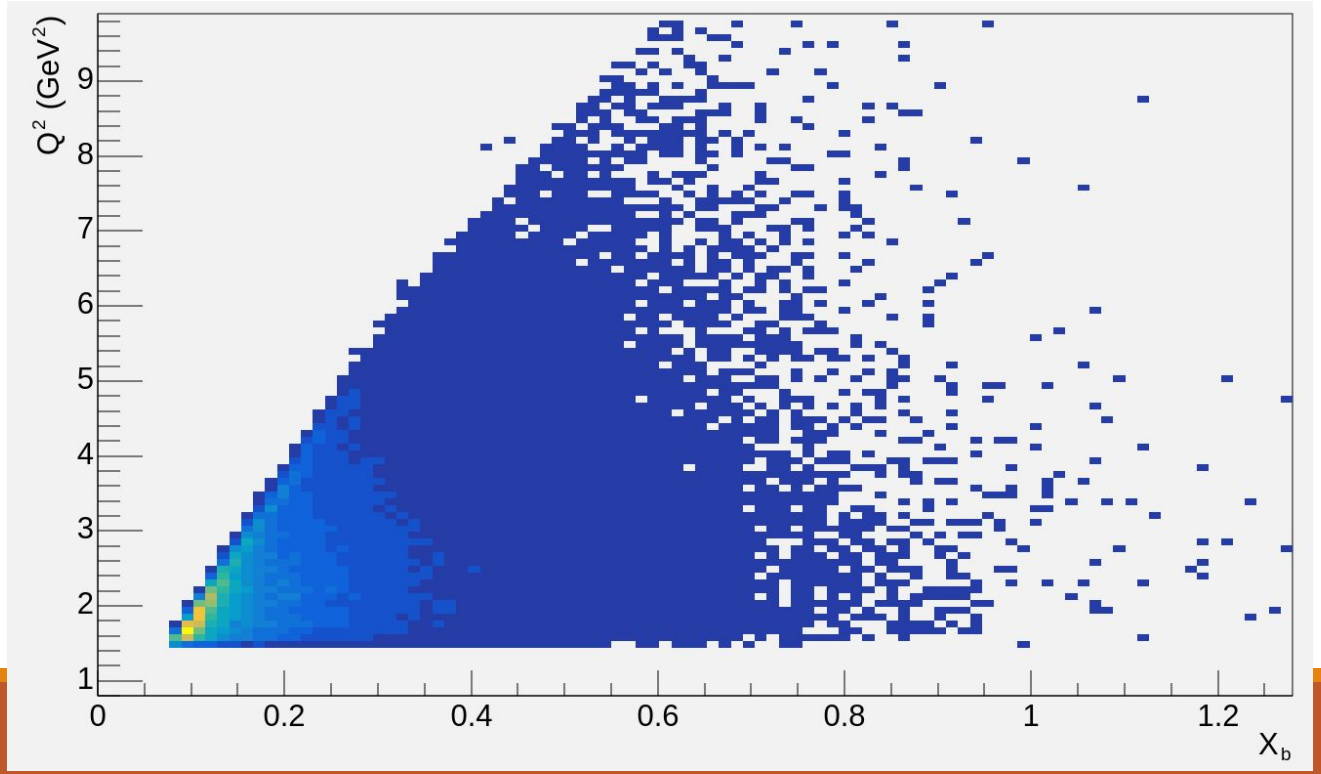




Analysis

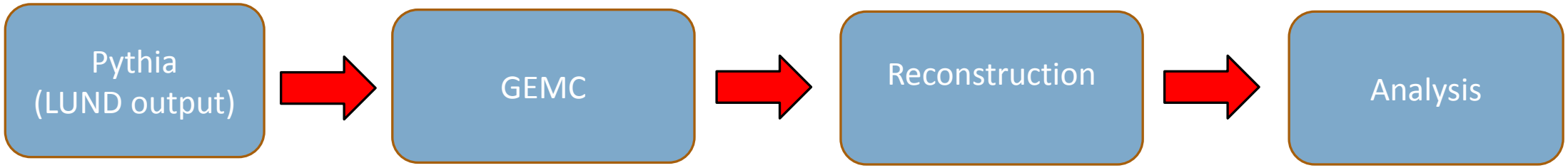
- Coincidences on e- and π+ are considered
- Cuts on electron kinematic variables applied as follows:
  - $Q^2 > 1.5\ GeV^2$
  - $0.25 < y < 0.85$
  - $W > 2$ GeV

Q^2 vs x distribution in LD2



Simulation Procedure

Pythia: Modified version for SIDIS: L.O. event generator on DIS on nucleus with added nuclear effects (nuclear fragmentation not included).
Beam polarization is not considered in the event generation.



Analysis & Comparison

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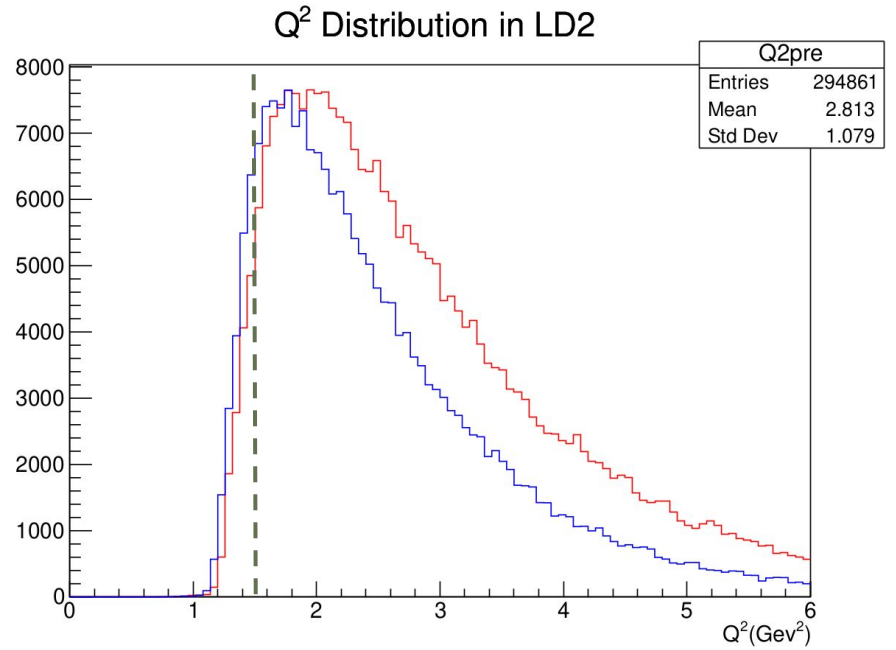

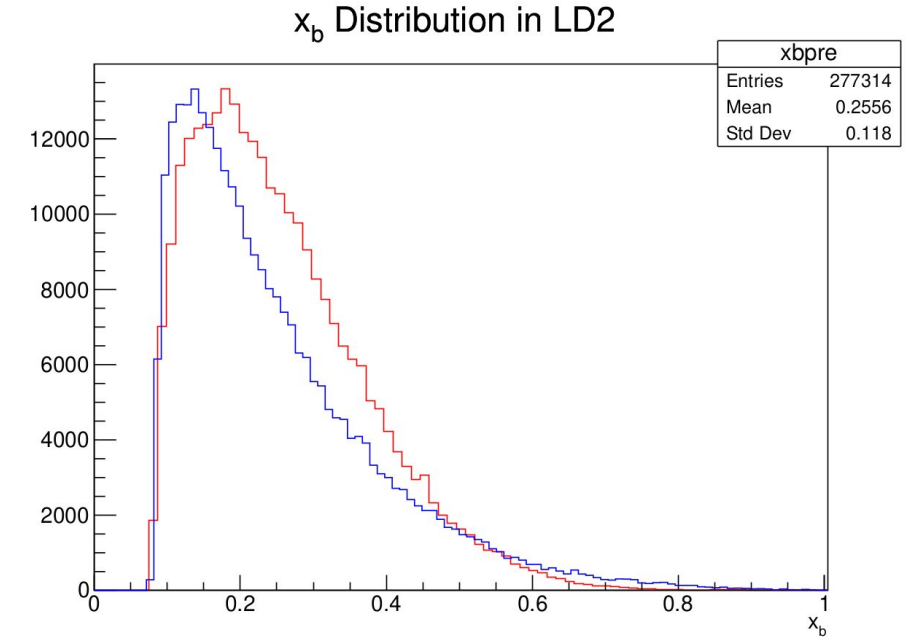

red is simulated data
blue is RG-D data

Analysis & Comparison

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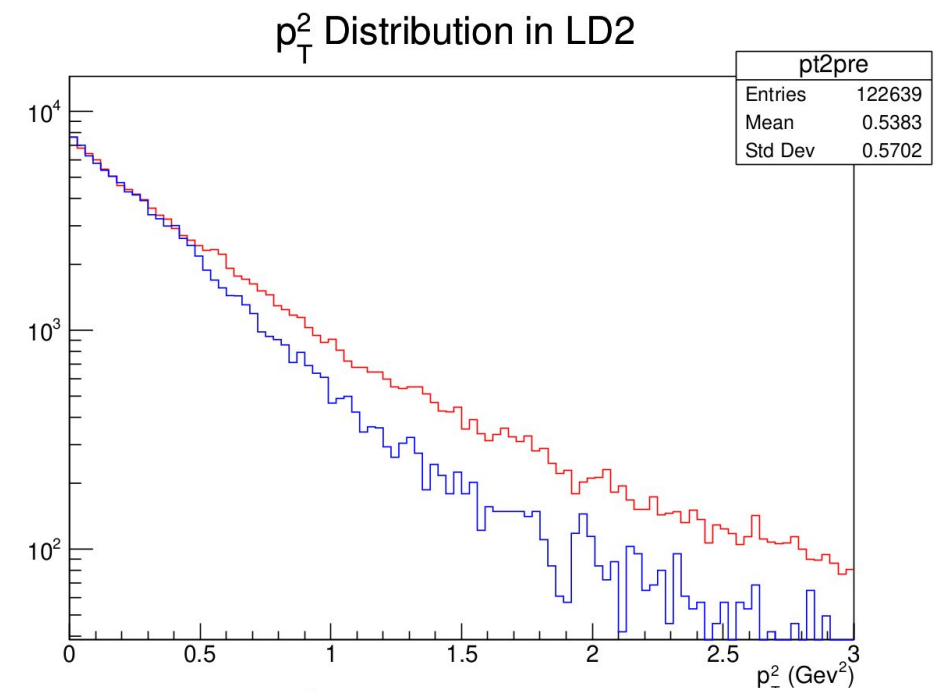
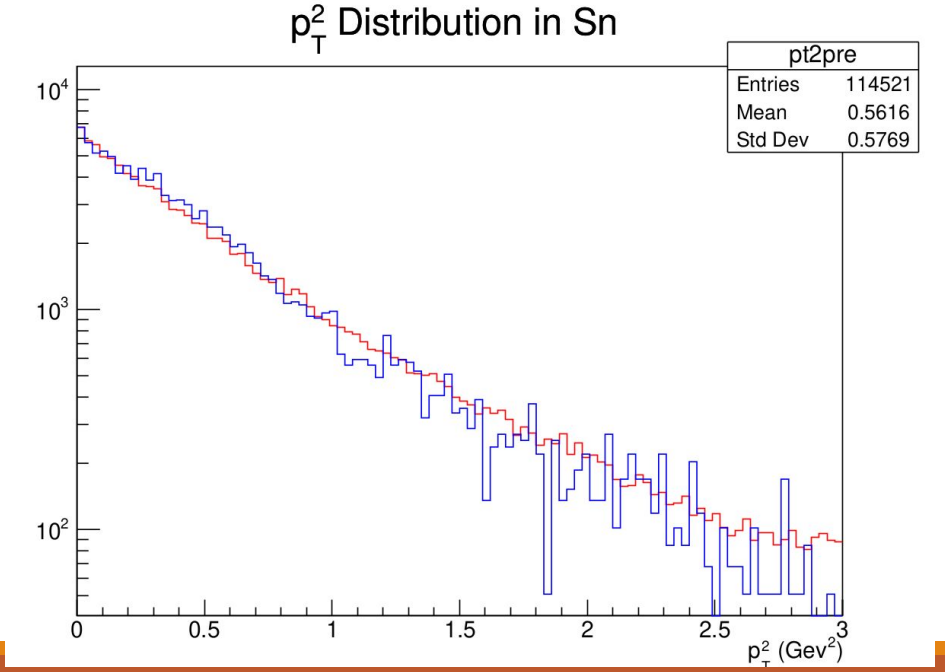
- Cuts on electron kinematic variables applied as follows:
  - $Q^2 > 1.5$ GeV^2
  - $0.25 < y < 0.85$
  - $W > 2$ GeV
- Cuts on Hadron kinematic Variables:
  - $0.3 < z < 0.7$

red is simulated data
blue is RG-D data

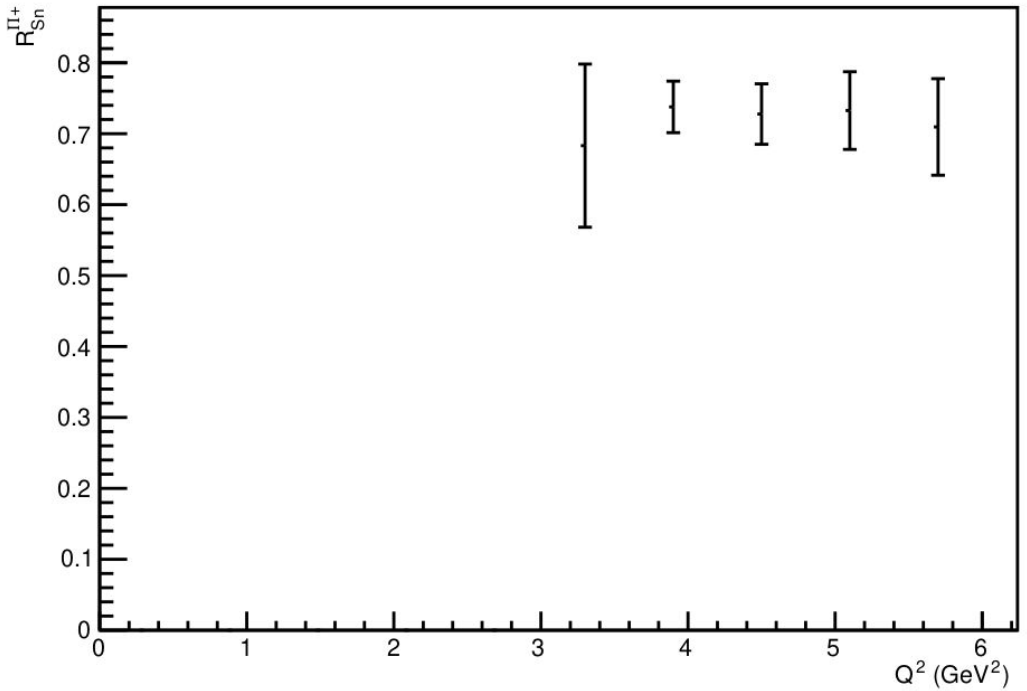


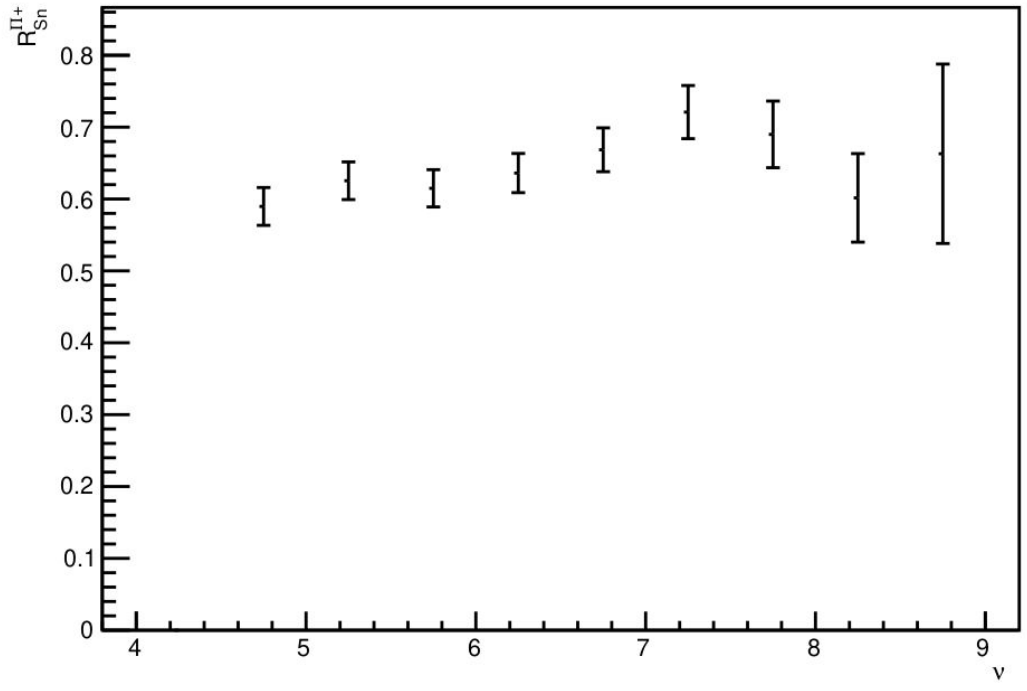


Multiplicity Ratio

$$R_A^{\pi}(Q^2,\nu,z,p_t^2) = \frac{N_{\pi}^{Sn}(Q^2,\nu,z,p_t^2)/N_e^{Sn}(Q^2,\nu)}{N_{\pi}^{De}(Q^2,\nu,z,p_t^2)/N_e^{De}(Q^2,\nu)}$$

- Any deviation indicates nuclear modifications
- Very preliminary plots, no calibration implemented yet





Summary

Implemented work

- Progress on data analysis for a study of TMDs on SIDIS with observables (such as R).
- Modified Pythia version with DIS used for event generation. Simulation applying RG-D experimental conditions.
- Monitoring RG-D available data.

Study of the data

- Very preliminary analysis using a simulation non specific for TMD study and available cooked data

On going work

- Other observables remain to be studied (cosφ, sinφ and Boer Mulders asymmetries)
- Modifications on RG-D simulations remain to be implemented in GEMC geometry
- Other Nuclear targets can be considered.
- Acceptance and Radiative effects.
- Consider beam polarization for eventual BSA
- Training Networks of Luminosity RG-D data using CLAS AI tools (j4np and AI tracking)