Nuclear Physics Working Group Meeting October 31, 2008 A110

Agenda

13:30-13:40 Update on reviews – Jerry Gilfoyle.
13:40-14:05 Update on Modifications to the GENEV event generator – Hyupwoo Lee
14:05-14:30 Coherent pi+ production on 3He – Rakhsha Nasseripour
14:30-14:55 The search for color transparency in rho electroproduction: final update – Kawtar Hafidi
14:55-15:15 Break
15:15-15:40 Update on the K0 hadronization studies – Aji Daniel
15:40-15:55 Statistical uncertainties on Monte-Carlo-based efficiency - Mikhail Osipenko
15:55-16:20 G10 gd->p-pp analysis – Jean-Marc Laget
16:20-16:45 Incorporating systematic uncertainties into an upper limit – Elton Smith

Current and Recent Reviews* - 1

Dan Protopopescu - Multipole Analysis of the Delta0(1232) in 3He
Committee:Kyungseon Joo (Chair), Mike Vineyard, Mike Wood
ongoing

Hovhannes Baghdasaryan - 3He(e,e'pp)n Analysis
Committee:Mike Vineyard (Chair), Dan Protopopescu, Steffen Strauch
ongoing

Rakhsha Nasseripour - Photodisintegration of 4He to p+t
Committee:Dave Ireland (Chair), Yelena Prok, Stephen Bueltmann
approved

Alex Vlasov – CAN: Source size measurements in the eHe -> e'pΛ X reaction.
Committee: Larry Weinstein (chair), Pavel Degtyarenko, Yordanka Ilieva
ongoing

Mikhail Osipenko, G. Ricco, S.Simula, M.Battaglieri, R. DeVita, M. Ripani, M. Taiuti, M. Anghinolfi –
CAN: Moments of the nucleon structure function F2 with CLAS: Part III – nuclear target.
Committee: Mike Dugger (chair), Tony Forest, Rakhsha Nasseripour
ongoing

* If you want to modify this list send email to gilfoyle@jlab.org

Current and Recent Reviews* - 2

M.Wood, R. Nasseripour, D.Weygand, C.Djalali - CAN: Absorption of the Omega and Phi Mesons from the g7a data set.
Committee: Maurik Holtrop (chair), Pawel Nadel-Turonski, Igor Strakovsky.
ongoing

K. Hafidi et al. - CAN:Color Transparency in eg2
Committee: Hovanes Egiyan (chair), Mike Wood, Stepan Stepanyan
just starting

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Other Business

Is there interest in holding the next CLAS Collaboration meeting in Europe (probably Genova)?

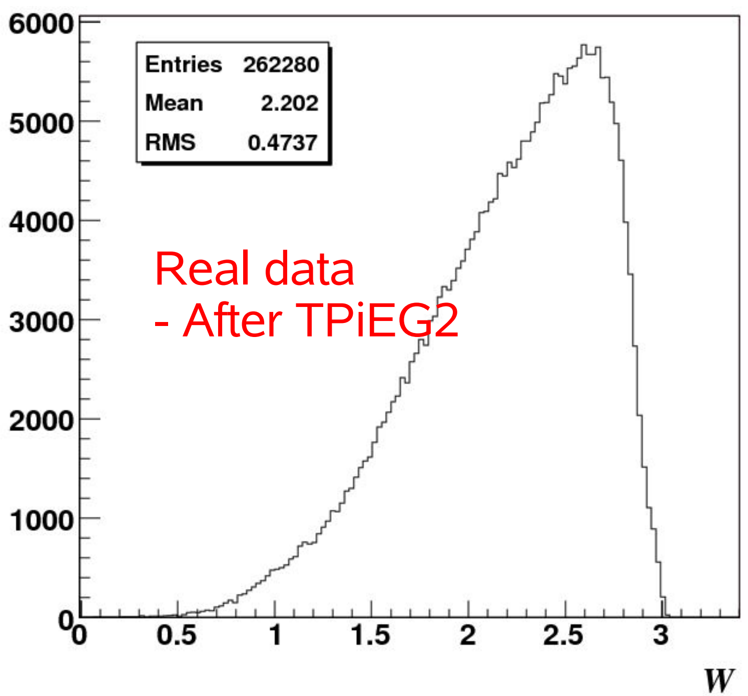
Summary: Analysis of pion production in eA (eg2 data) for ‘neutrino engineering’

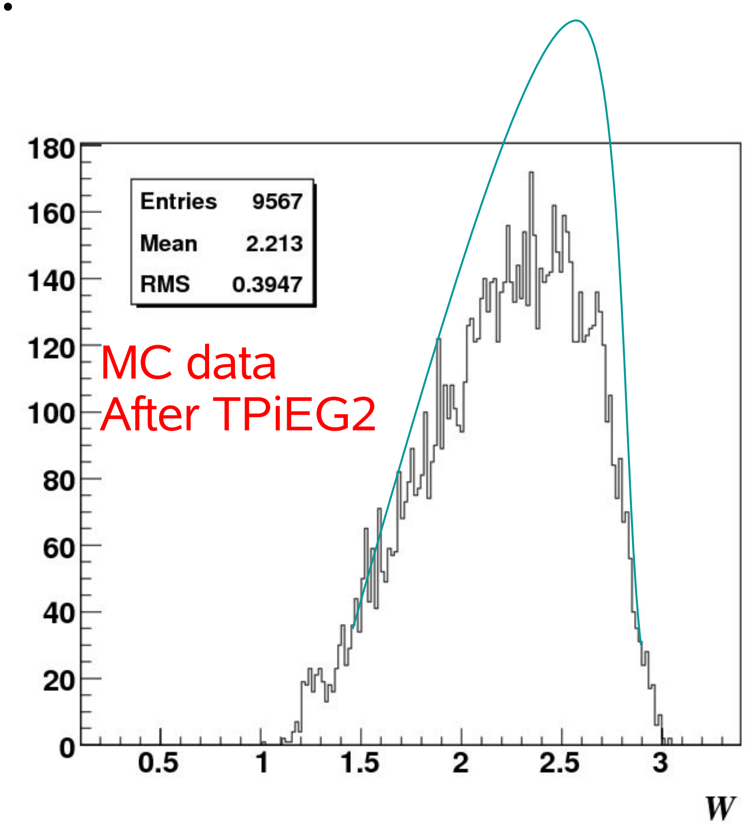
Hyupwoo Lee and Steve Manly, Univ. of Rochester

Main goal of this study: Produce eA data that is useful for tuning MC models used in current and next-generation νA experiments in order to reduce systematic errors in the νA expts.

- Differential cross section of charged pion production on deuterium and carbon targets
- Starting from Holtrop’s TPiEG2 analysis code – analysis chain ~works
- Need MC to get first pass at acceptance and pion model (use for initial radiative corrections, background and yield estimates)
- Starting with GENEV generator (Genova group, Mustapha mods)
- Final pion kinematic distributions from MC analysis chain differ markedly from the distributions coming from data.
- Differences seem to come during processing/analysis of MC.
- Working to make sure all aspects of the data and MC chains are consistent.

An example showing discrepancy in W distributions (carbon target)
… sigh … still much work to do.





- Generate events $1.05 < W < 3.5$, $0.7 < q^2 < 7.0$
- For carbon target
- All 29 channels are generated

  - 1~4 (1-π), 5~10 (Δ), 11~14 (ρ), 15~18 (2-π), 19~20 (ω), 21~24 (3- π), 25~26 (ϕ), 27~29 (4,5-π)

π^+ Coherent Photoproduction on ^{3}He

Rakhsha Nasseripour and Barry Berman, GWU

Measure $A(\gamma,p^+)A'$ where A' has the same mass number as the target.

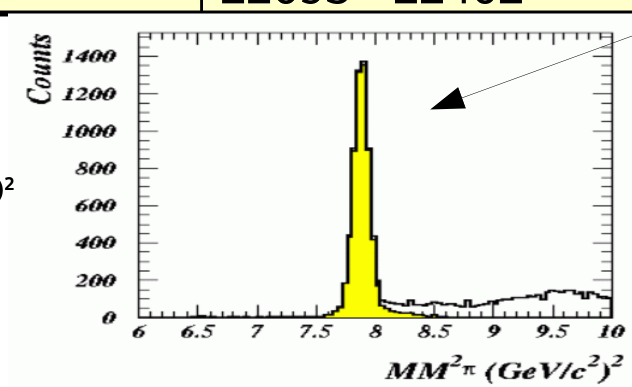
Motivation:
1. Medium modifications
2. Long-range part of NN interaction.
3. Pion cloud and mesonic degrees of freedom.

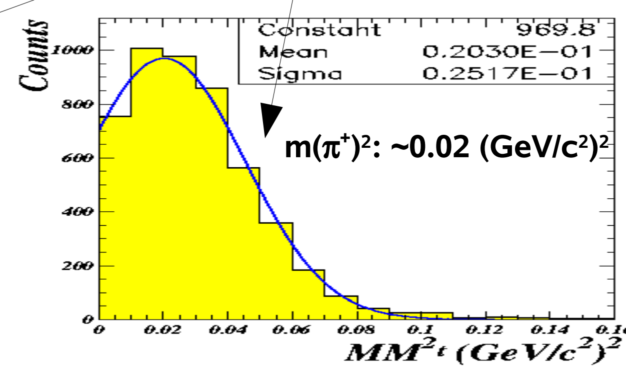
g3a Experiment with CLAS

Electron beam energy	1.645 GeV
Tagged photon beam	0.34 - 1.55 GeV
Target	18-cm liquid ^{3}He target
Target density	0.0675+/-0.0004 gcm^{-3}
Torus field	1920 A
Trigger	L2, Tagger, Start Counter, TOF
Runs	22095 - 22402

- Only one π^+ and one t
- Vertex cuts
- Time cut
- Fiducial cuts
  Energy-loss corrections
- Use of two-body kinematics to select the background-free π^+t channel.

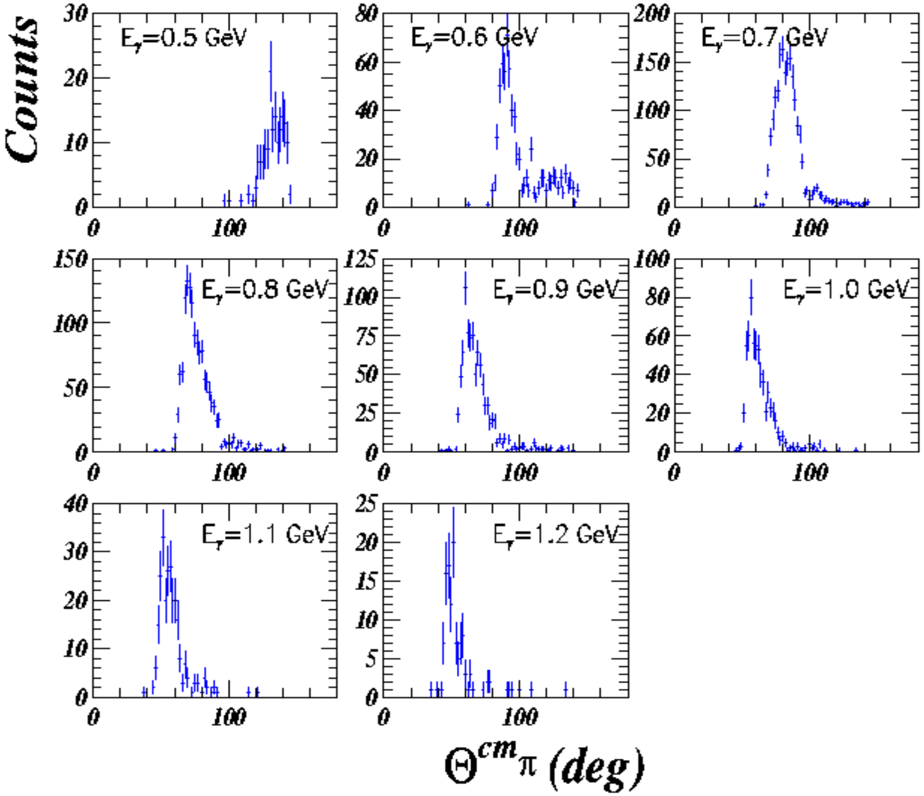
m_t^2: ~7.88 (GeV/c^2)^2



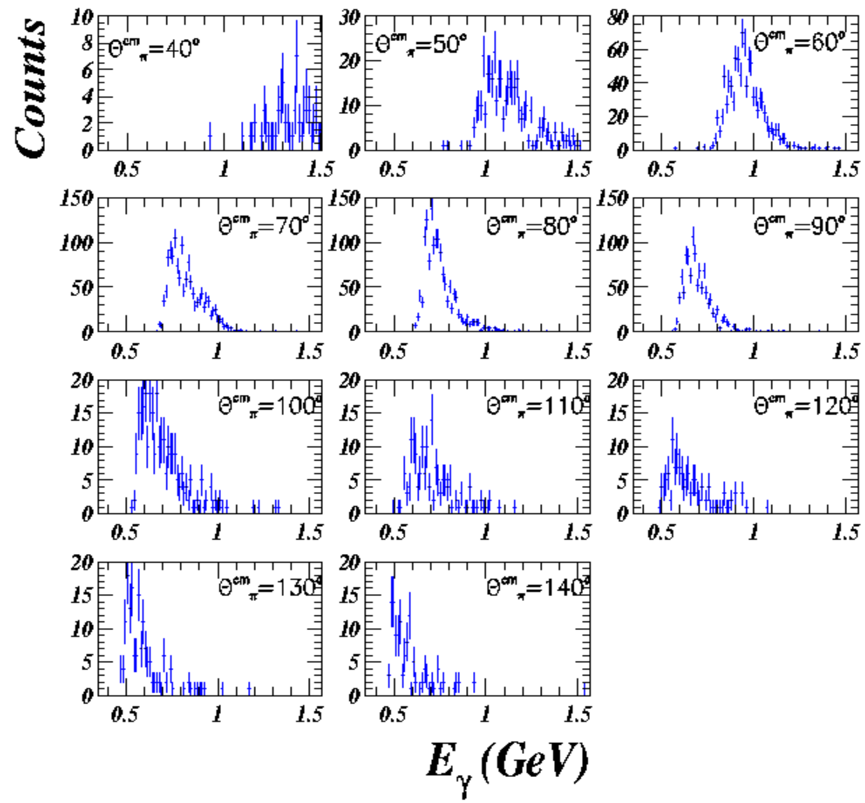


Results

Yields (Angular Dependence)



Yields (Energy Dependence)



On the way -->

- Simulations/Acceptance Corrections
- Extraction of Cross Sections

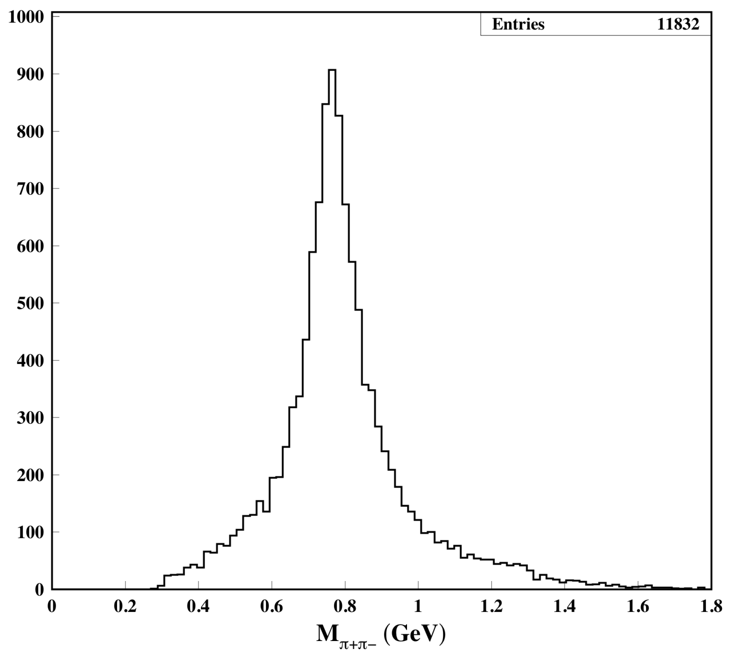
Search for the onset of CT in ρ^0 electroproduction off nuclei at CLAS

L. El Fassi, K. Hafidi, B. Mustapha

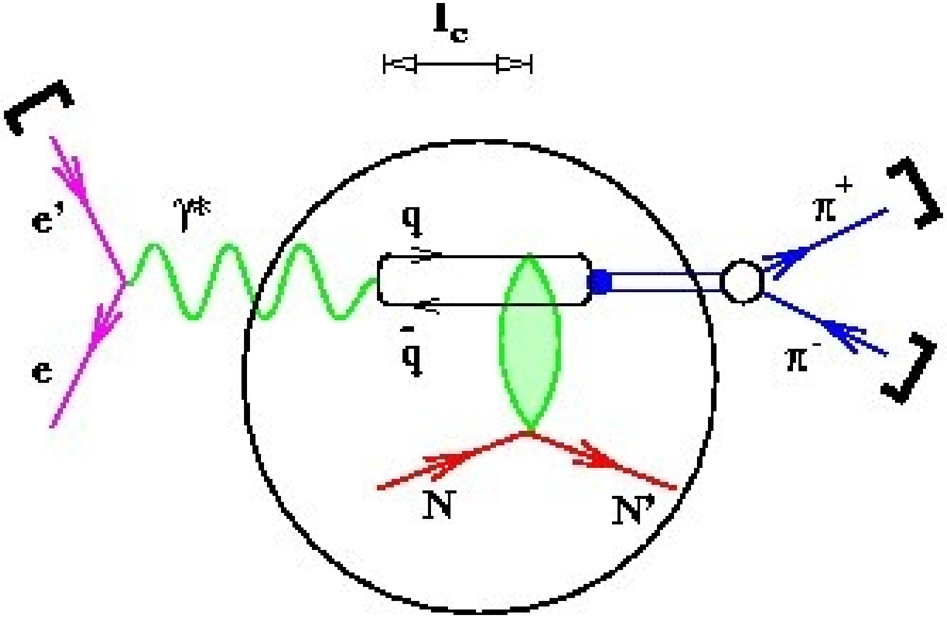
Detected particles are :

scattered electron and the π^+ and π^- from ρ^0 decay

Exclusive diffractive ρ^0 electroproduction Is one of the cleanest processes to directly produce PLC since ρ^0 has the same quantum numbers as the photon

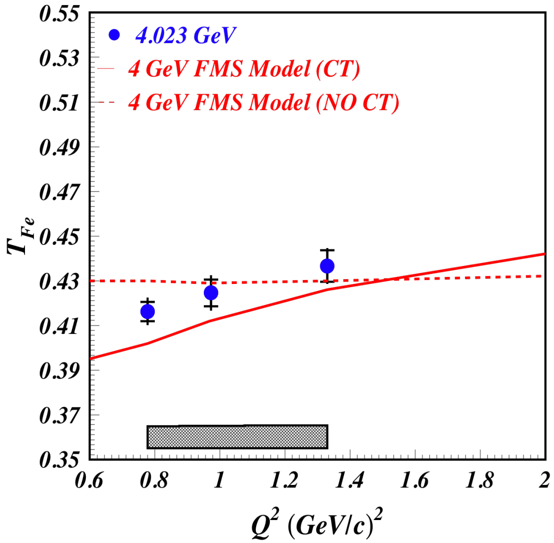


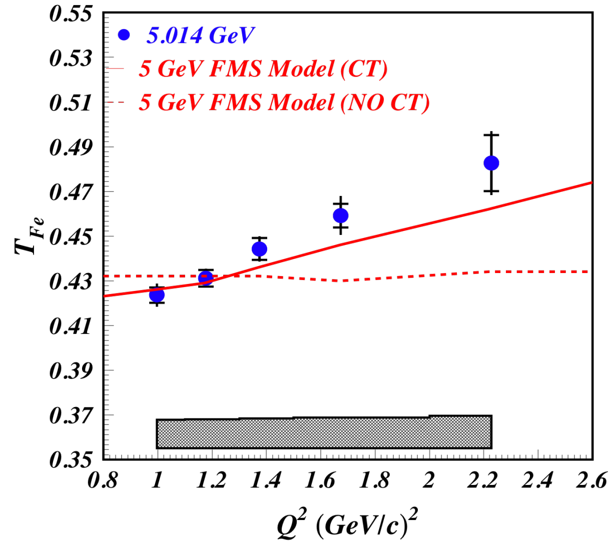
$e + N \rightarrow e' + N + \rho^0$

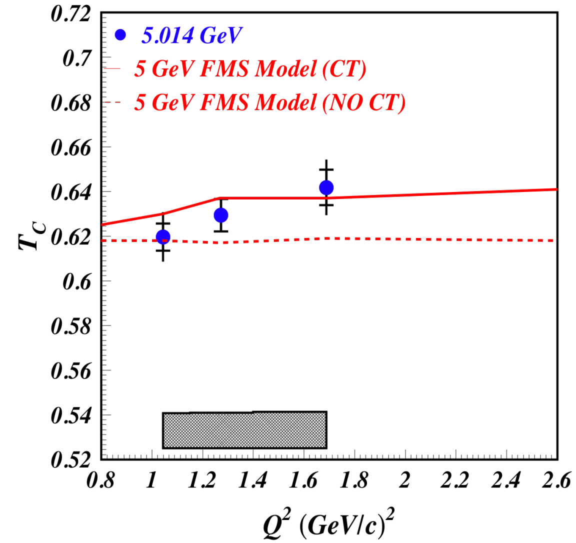


Coherence length $l_c = 2\nu/(M^2 + Q^2)$

M is the mass of the vector meson







L. Frankfurt, G. A. Miller and M. Strikman, Phys. Rev. C78 (2008) 015208

Q^2 slope for C: (0.034 ±0.025)

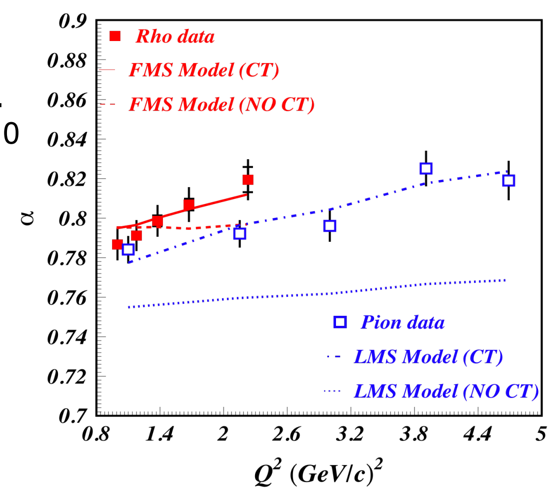
Q^2 slope for N (HERMES) (0.089 ±0.05)

Kopeliovich model N (0.048 GeV^{-2})

Q^2 slope for Fe: 0.043 ±0.008GeV^{-2}

Test of the FMS model consistency !!

$$T \approx \sigma_0 A^{\alpha} / A \sigma_0$$
$$\approx A^{\alpha-1}$$



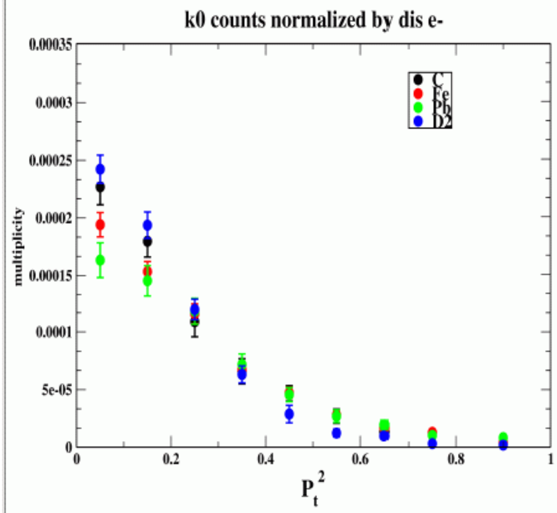
Pion data from Hall C.

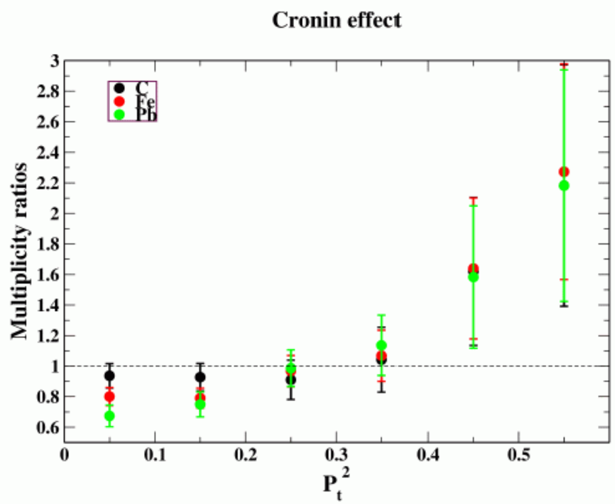
Update on K0 Hadronization Studies
Aji Daniel and Ken Hicks

Experimental Signature ->Transverse momentum broadening
- Component of momentum perpendicular to momentum transfer
- Sensitive to production time; propagation of quark
- No more broadening after pre-hadron forms; inelastics suppressed

Kaon multiplicities and multiplicity ratios

Multiplicities vs Pt2



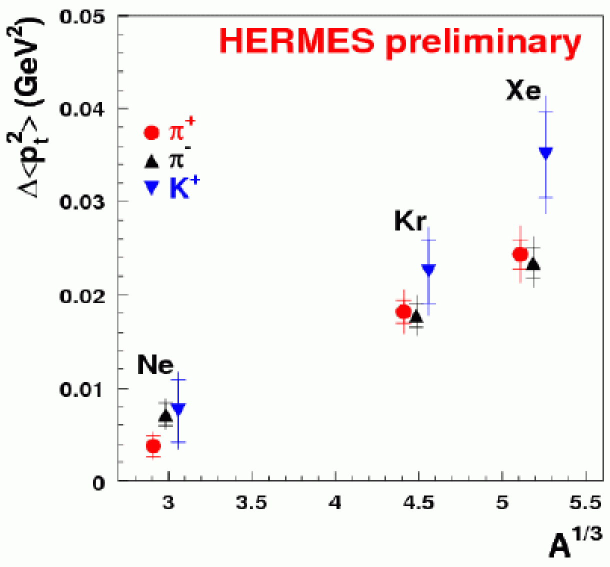


Preliminary results on Cronin effect

Rise at high Pt2 due to broadening of Pt2 distribution. (partonic rescattering, hadronic FSI ...)

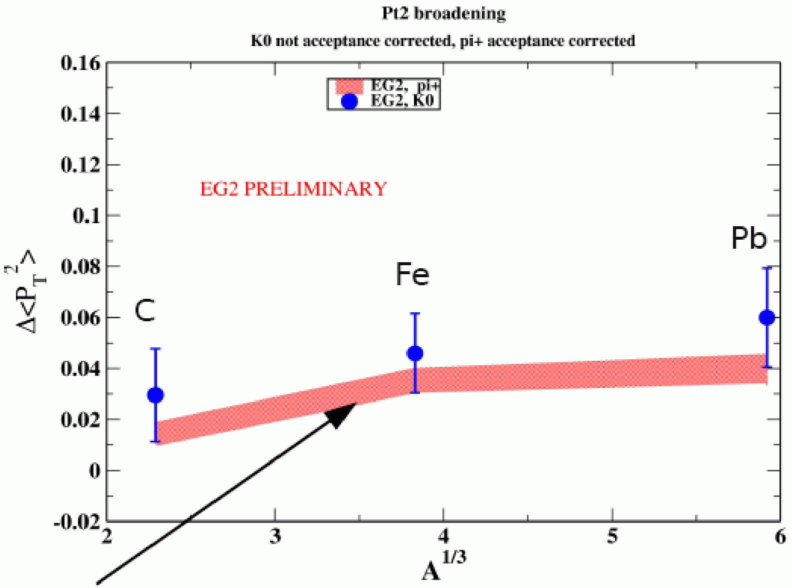
Error bars very large for high Pt2

Preliminary results: Transverse momentum broadening



(Yves Van Haarlem,9th Workshop on Non-Perturbative Quantum Chromodynamics, 2007)

$$\Delta P_T^2 = < P_T^2 >_A^{DIS} - < P_T^2 >_D^{DIS}$$



Shaded region: range of EG2 pi+ results which is acceptance corrected;K0 results are not acceptance corrected

EG2 results very preliminary (only statistical uncertainities)

Though the statistics is limited for K0, data suggests broadening depends on atomic number (raises with atomic radius)

Statistical Uncertainties on Monte Carlo Based Efficiencies

Mikhail Osipenko

Binomial vs. Poisson

- **Binomial** distribution underestimates the statistical uncertainty where bin migrations are significant (over entire kinematics).

$$\Delta A^B \equiv \sqrt{\frac{A(1-A)}{N_{gen}}}$$

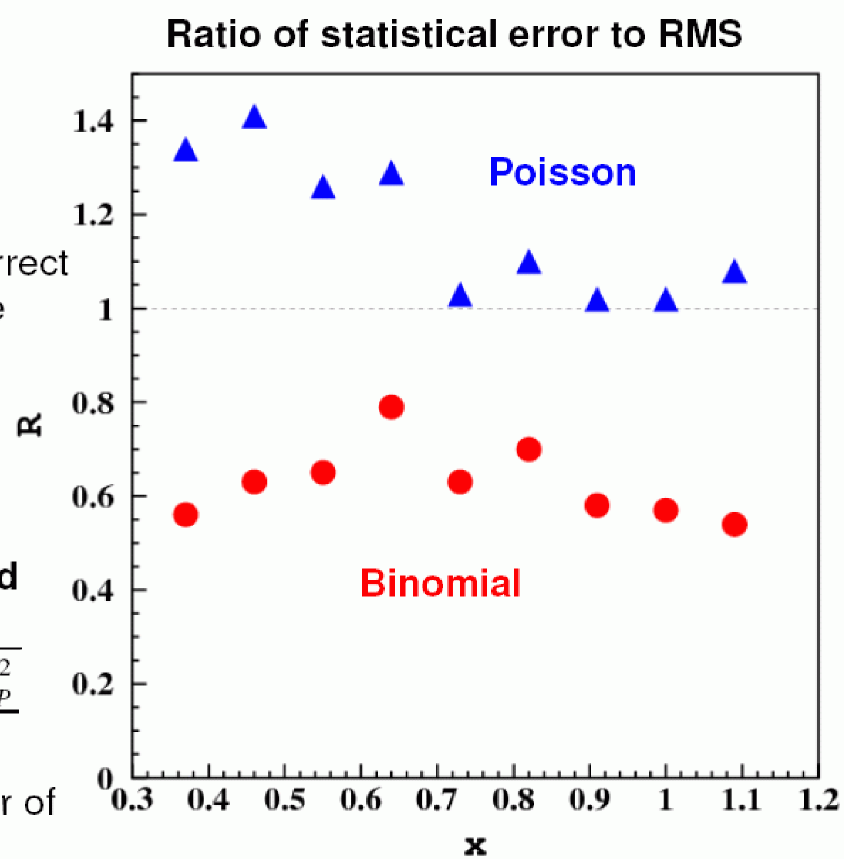
- **Poisson** distribution gives almost correct uncertainties where bin migrations are strong (at large-x).

$$\Delta A^P \equiv \sqrt{\frac{A(1+A)}{N_{gen}}}$$

- Correct uncertainty is approximately given by the **average of Binomial and Poisson** errors.

$$\Delta A \equiv \sqrt{\frac{A}{N_{gen}}} = \sqrt{\frac{\Delta A_B^2 + \Delta A_P^2}{2}}$$

- Use analytic evaluation of the number of generated events!



M. Osipenko, JLab2008

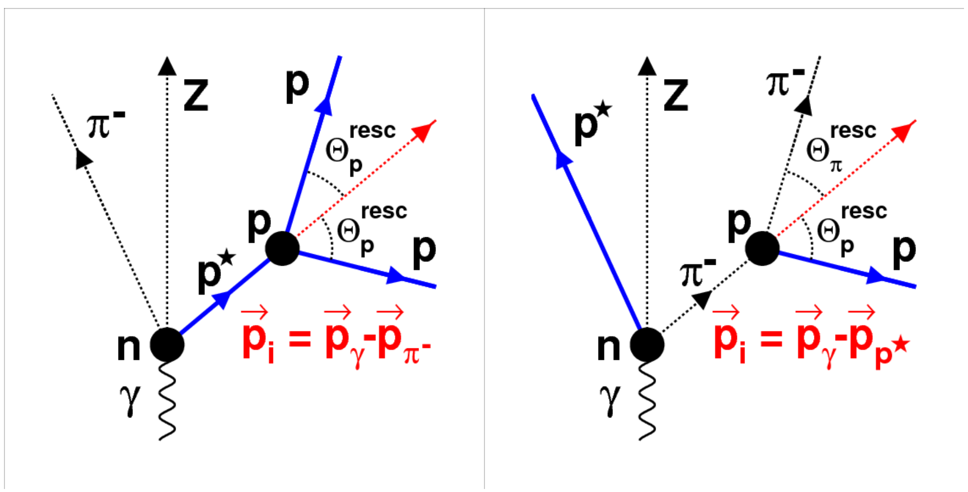
π^- - photoproduction off Deuterium beyond the Quasi-Free region - $\gamma D \to \pi^- p\,(p)$ or $\gamma D \to pp\,(\pi^-)$

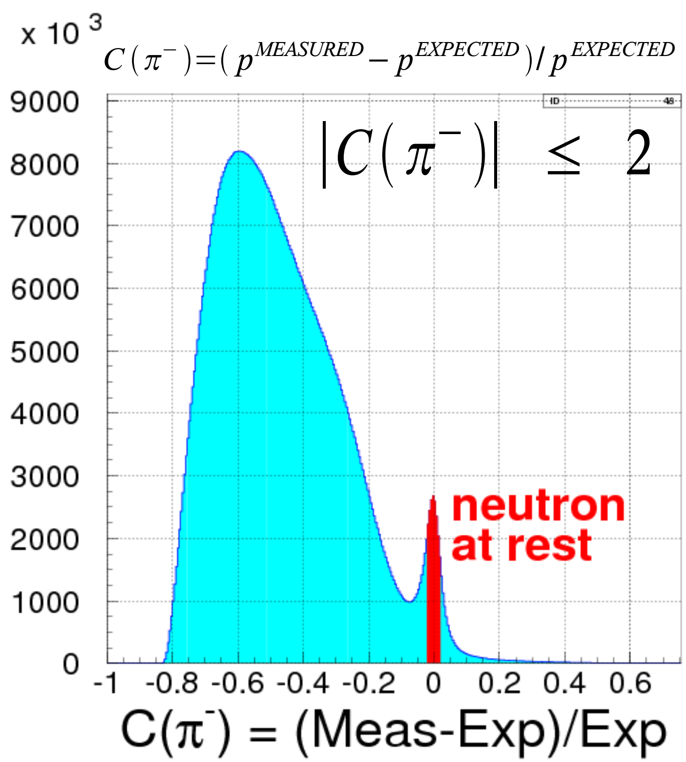
N.Pivnyuk, J.-M. Laget, E.Pasyuk, T.Mibe

- **Search for nuclear transparency using tagged hadrons from pion production vertex.**
- **Study deuteron wave function at short inter-nuclear distances using quasi-coherent kinematics.**

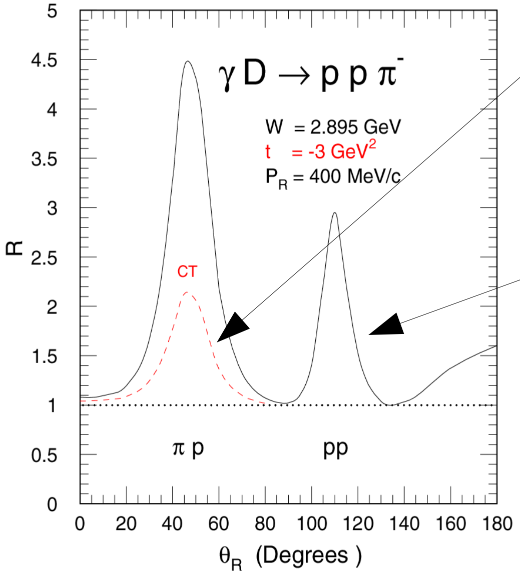
$p_{miss} < 0.2$ GeV/c

$M_{pp} \approx 2m_p$

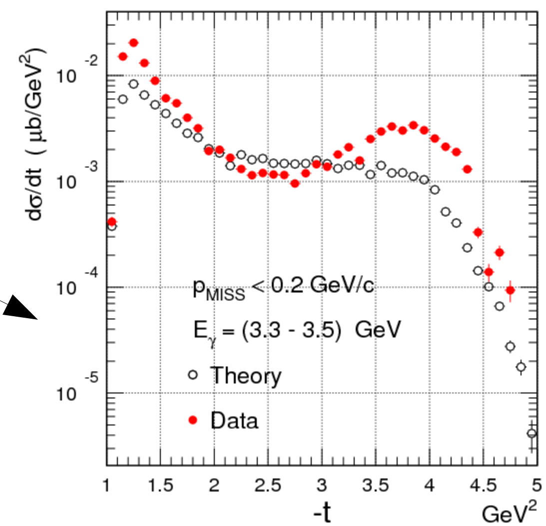


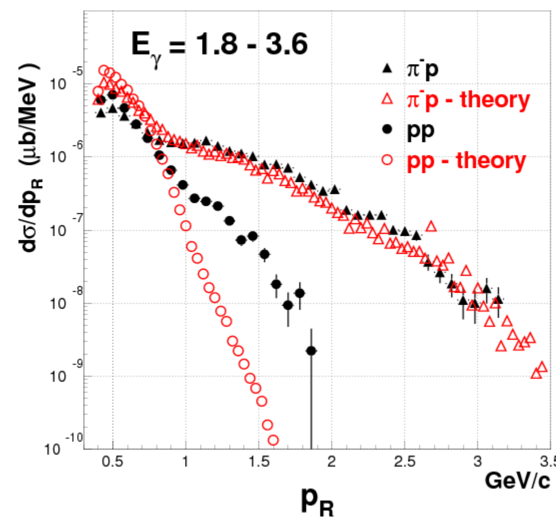


- Large P_R suppresses quasi-free mechanisms
- Unitary peaks determine $\sigma_{\pi N}$ (CT?) or σ_{PP} (calibration)
- CT?: evolution of unitary rescattering peak with *t*
- R= Full / quasi-free; P_R = nucleon recoil momentum



Tests of model

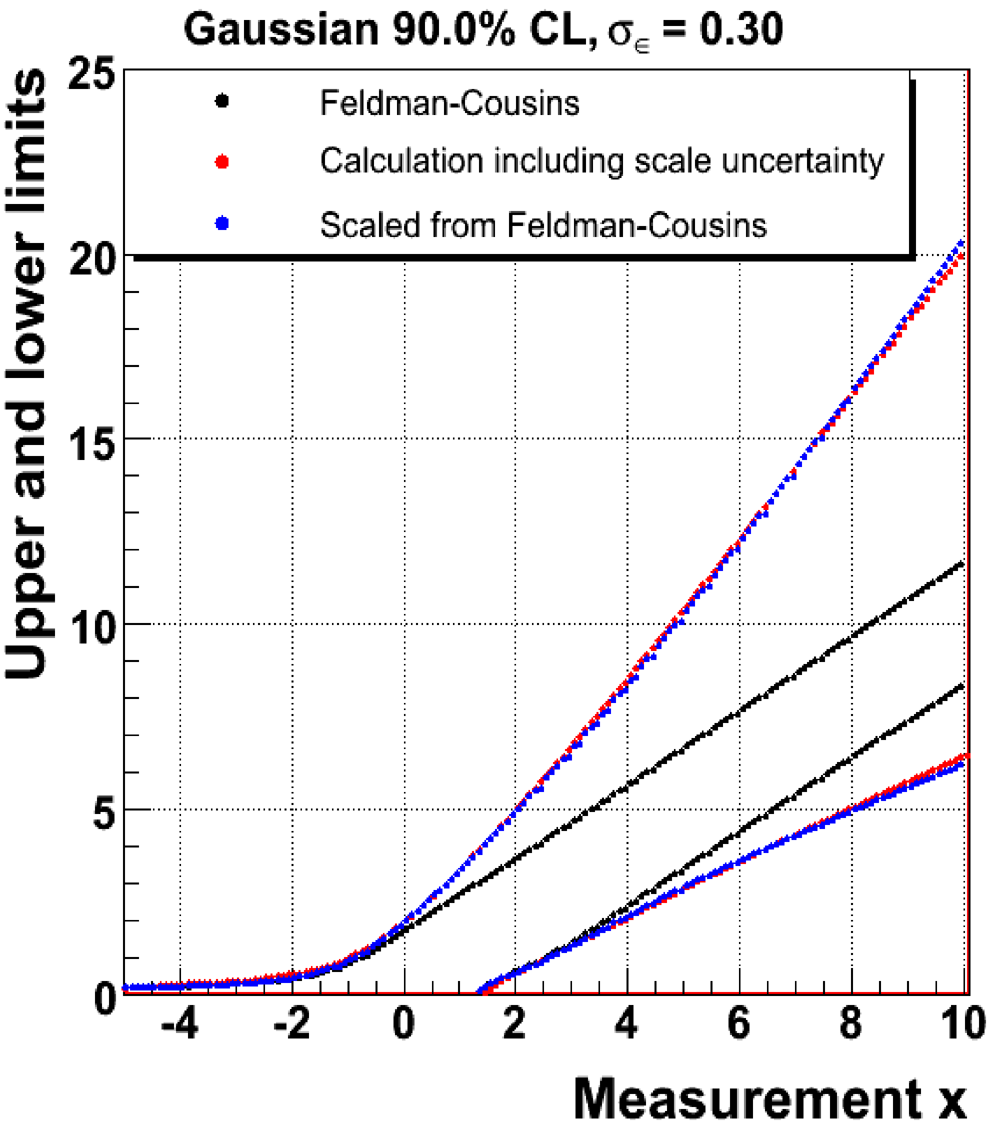




To Do List

- Elementary γN amplitudes
  - Add u-channel exchanges
  - Channel coupling
- Rescattering
  - Beyond diffractive scattering
  - Implement low energy PP phase shifts
  - Implement low energy πN phase shifts

Scaling from nominal FC limits



$$U = U_{FC}\left(1 + \frac{1}{2}\alpha(x)\, U_{FC}\, s_e^2\right)$$

$$\alpha(x) = A\exp(-Bx/2), x^{3}2$$

$$\alpha(x) = A\exp(-B), x < 2$$

$A_U = 2.26$

$B_U = 0.092$

$A_L = -1.34$

$B_L = 0.134$

Simple procedure for scaling FC limits to include systematics

Summary and Conclusions

- We have investigated how uncertainties in the estimation of background and detection efficiency affect the 90% confidence intervals in the unified approach of Feldman and Cousins.
  - Assumption: Gaussian statistics
  - Systematic uncertainties included using Bayesian approach
- Confidence intervals have reasonable limiting behavior
  - depend quadratically on σ_ε
  - can be obtained by scaling the nominal FC intervals
  - have correct coverage

CLAS-NOTE 2007-019 and CLAS-NOTE 2008-20