E01-020 Update

W. Boeglin, E. Voutier,
M.K. Jones

Introduction

- D(e,e'p)n : FSI dominant at many kinematical settings
- new results at high Q^2

Theses completed:

ODU: H. Ibrahim (RLT), December 06

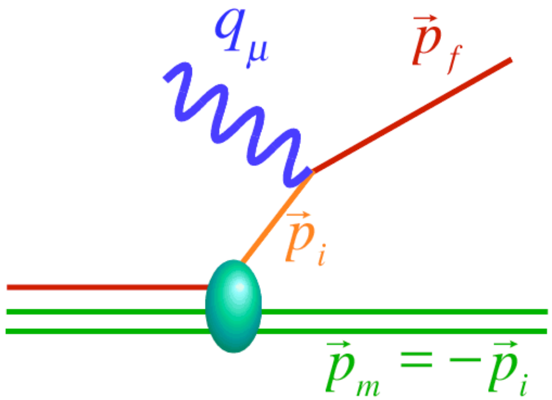
FIU: L. Coman (Angular Distributions), August 07

D(e,e'p)n at JLAB at high Q^2

- test generalized eikonal approximation (Glauber based)
- short distance structure of the deuteron
- relativistic effects: current operator and deuteron structure
- Q^2 dependence of MEC and IC

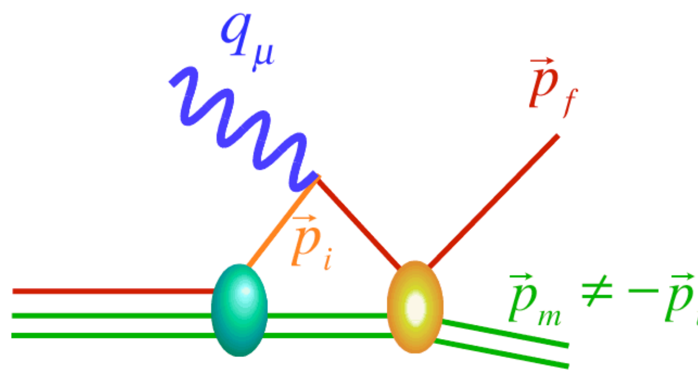
D(e,e'p) Reaction Mechanisms

PWIA



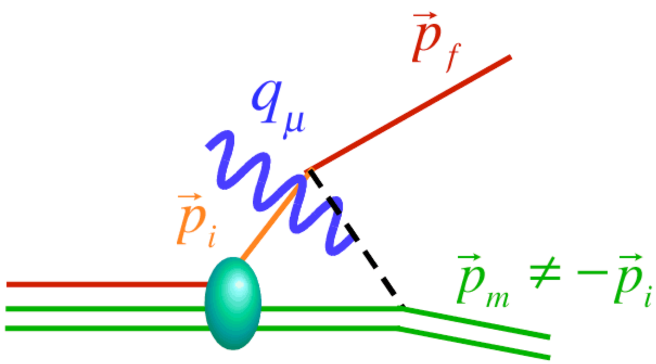
$$\frac{d\sigma}{d\omega d\Omega_e d\Omega_N} = k\sigma_{eN} S(E_m, p_m)$$

FSI

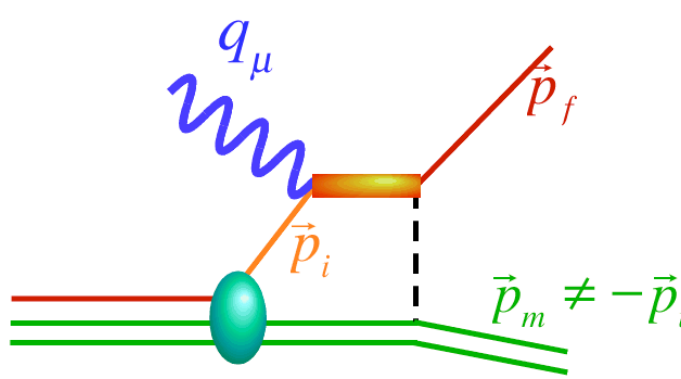


$$\frac{d\sigma}{d\omega d\Omega_e d\Omega_N} = k\sigma_{eN} D(E_m, p_f, p_m)$$

MEC



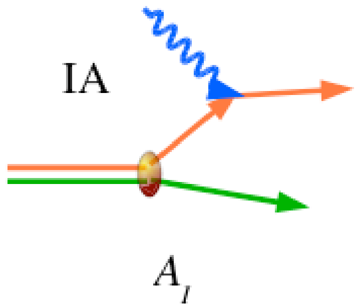
IC

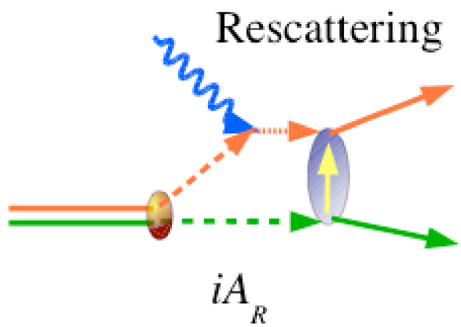


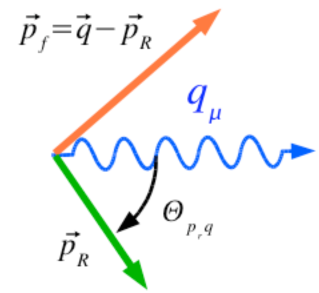
Eikonal Approximation

- FSI described as sequential (soft) scatterings
- successfully used in hadron scattering
- for nucleons at rest $\Rightarrow$ Glauber approximation
- for moving nucleons $\Rightarrow$ Generalized Eikonal Approximation
- angle between q and outgoing nucleon small ($< 10^{o}$)

FSI as Re-Scattering







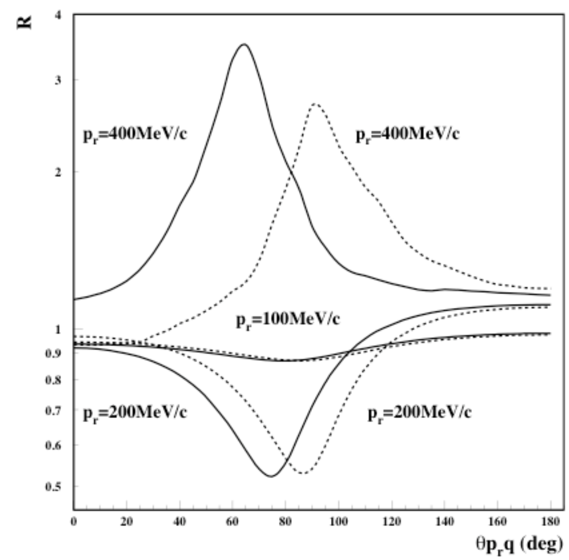
total scattering amplitude: $A = A_I + iA_R$

cross section: $\sigma \sim |A|^2 = |A_I + iA_R|^2$

$$\sigma \sim |A_I|^2 - 2|A_I||A_R| + |A_R|^2$$

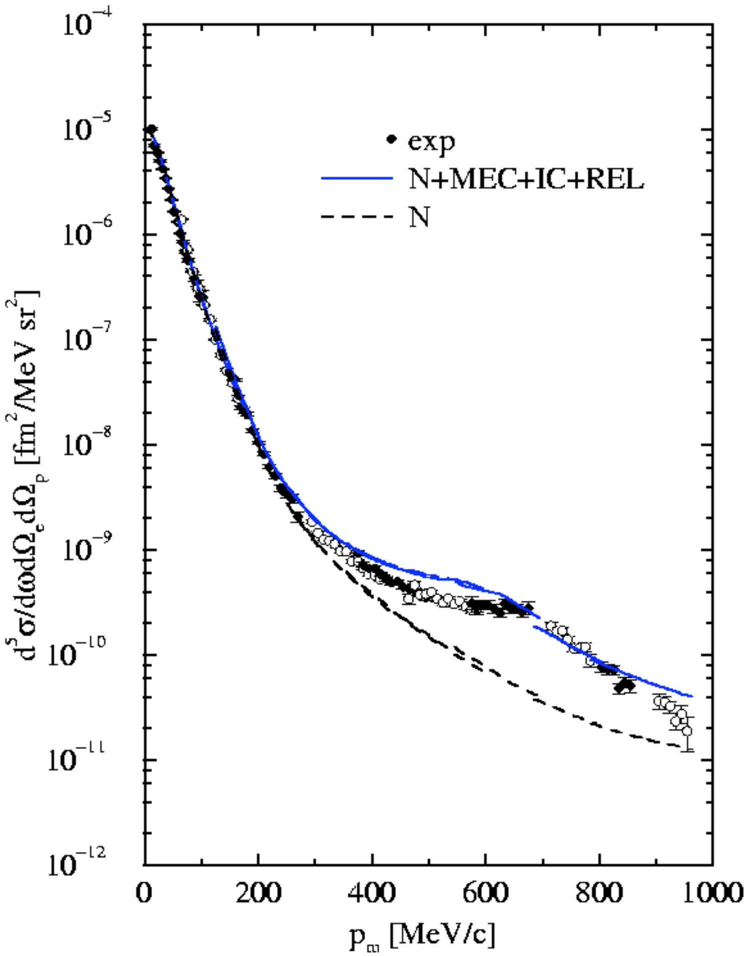
at high energies iA_R is mainly imaginary

$$R = \frac{\sigma}{\sigma_I} = 1 - 2\frac{|A_I||A_R|}{|A_I|^2} + \frac{|A_R|^2}{|A_I|^2}$$

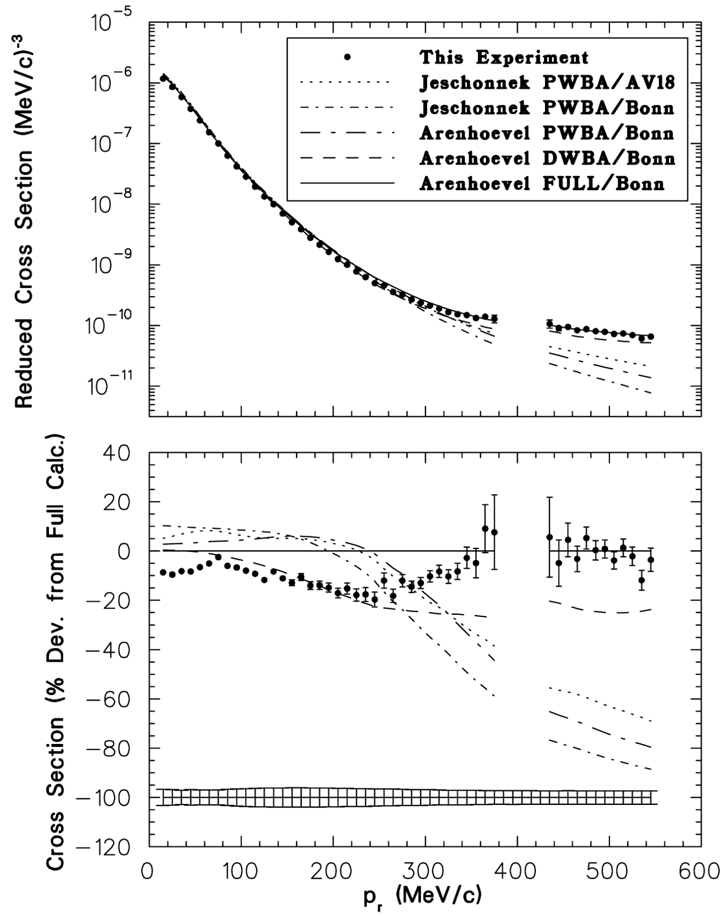


talk: M. Sargsian

Experiments at low(er) Q^2



MAMI $Q^2 = 0.33$ (GeV/c)^2
Blomqvist et al.

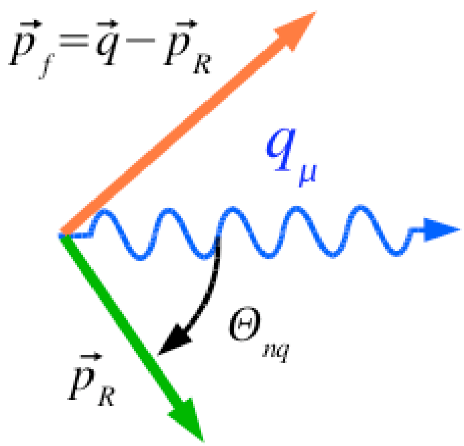


JLAB $Q^2 = 0.67$ (GeV/c)^2
Ulmer et al.

Hall A Experiment

analysis of $Q^2 = 3.5\ (GeV/c)^2$ finished

- $Q^2 = 0.8$, 2.1 and $3.5\ (GeV/c)^2$: constant for each set
- $p_{miss} = 0.2$, 0.4 and 0.5 GeV/c : angular distribution
- $20^o \le \theta_{pq} \le 140^o$

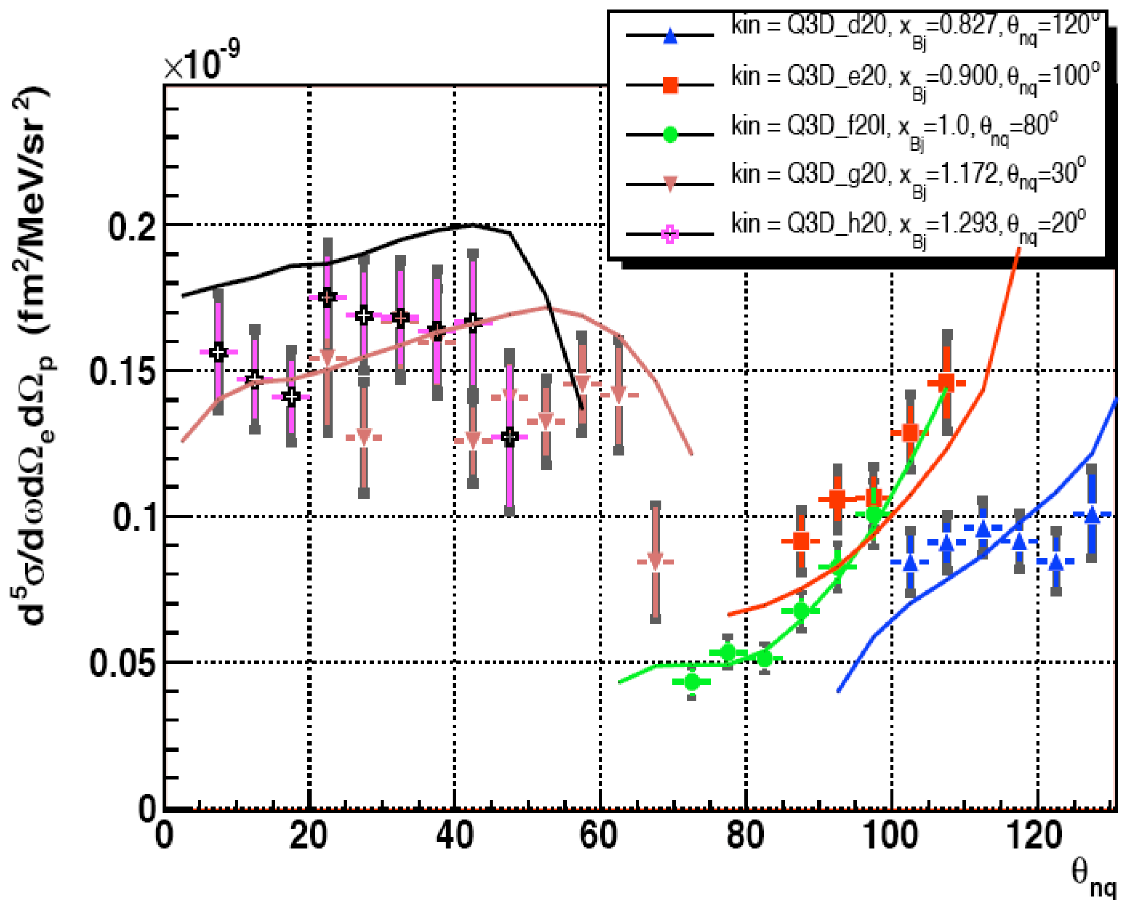


Goals:

- angular distributions
- R_{LT} as a function of Q^2 and p_{miss}

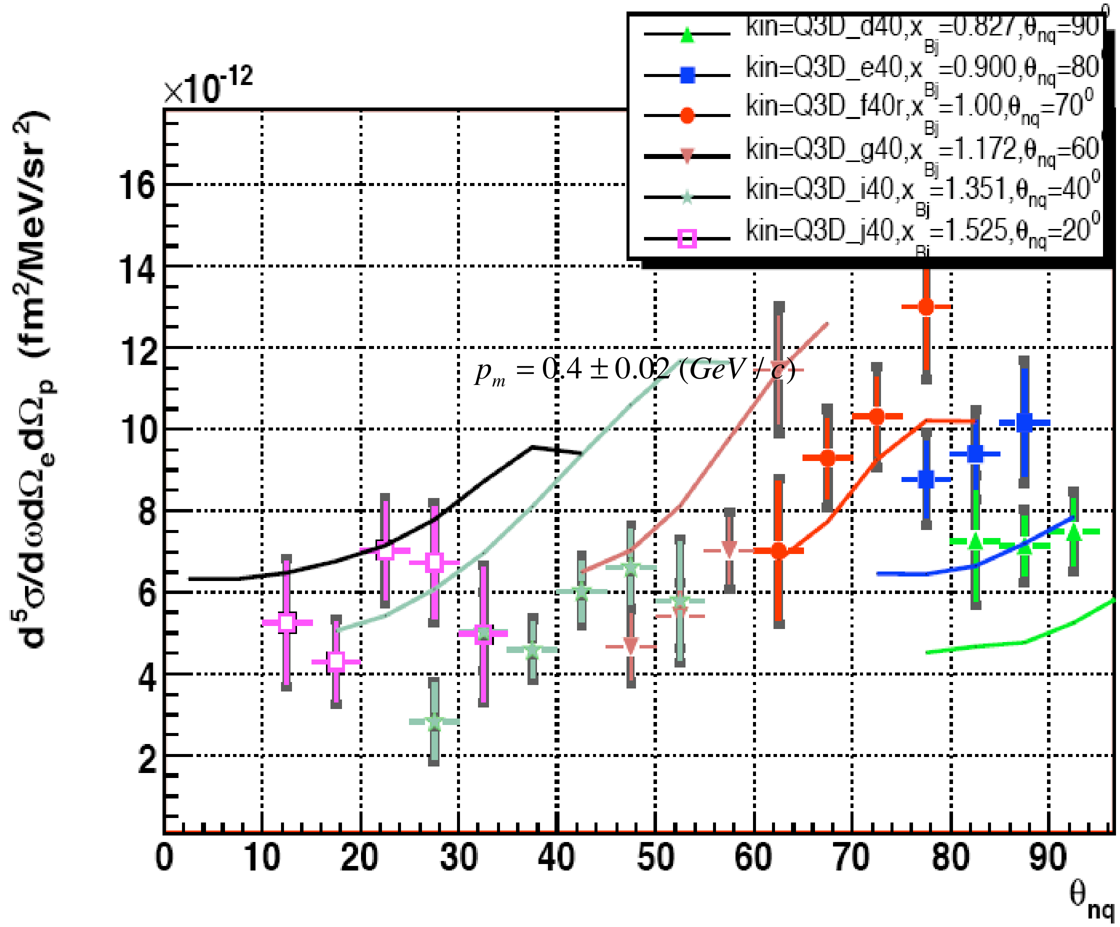
Angular Distribution Results

$$p_m = 0.2 \pm 0.02\ (GeV / c)$$

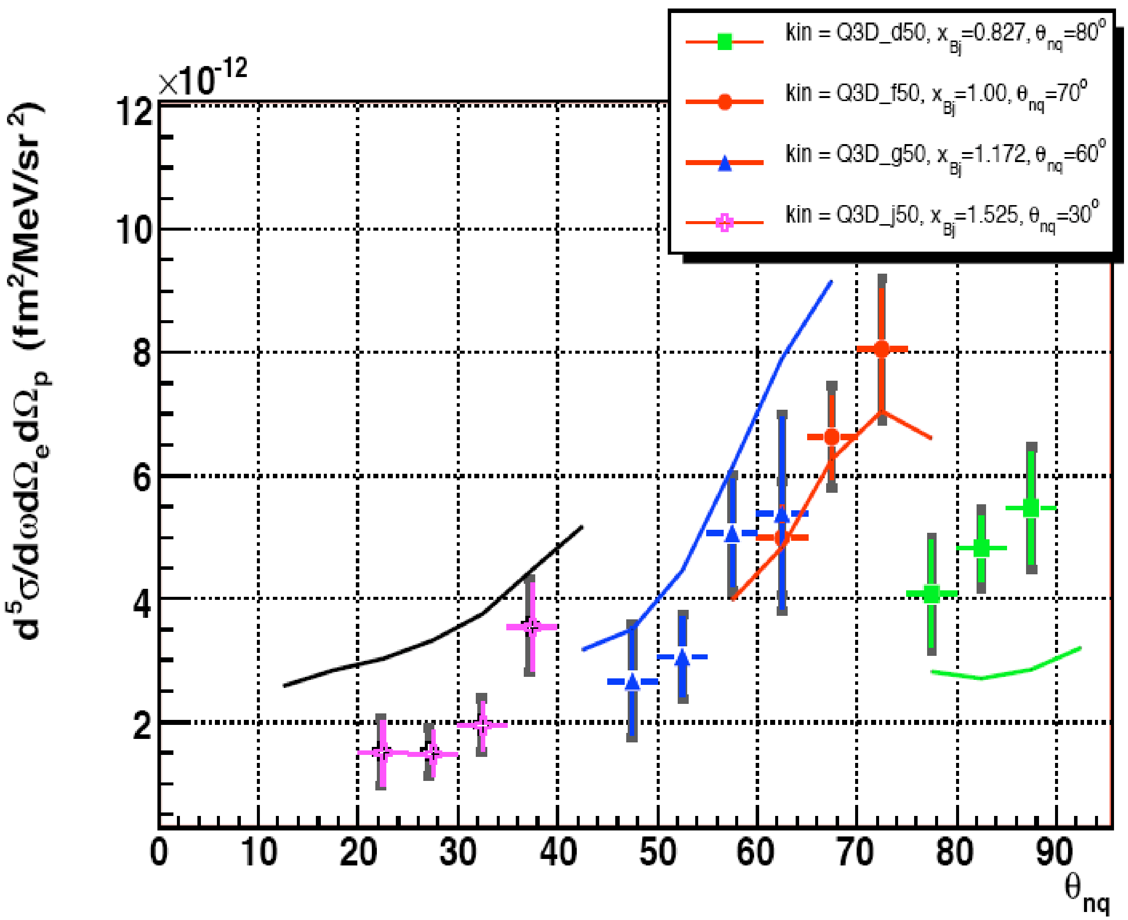


calculation: J.M. Laget

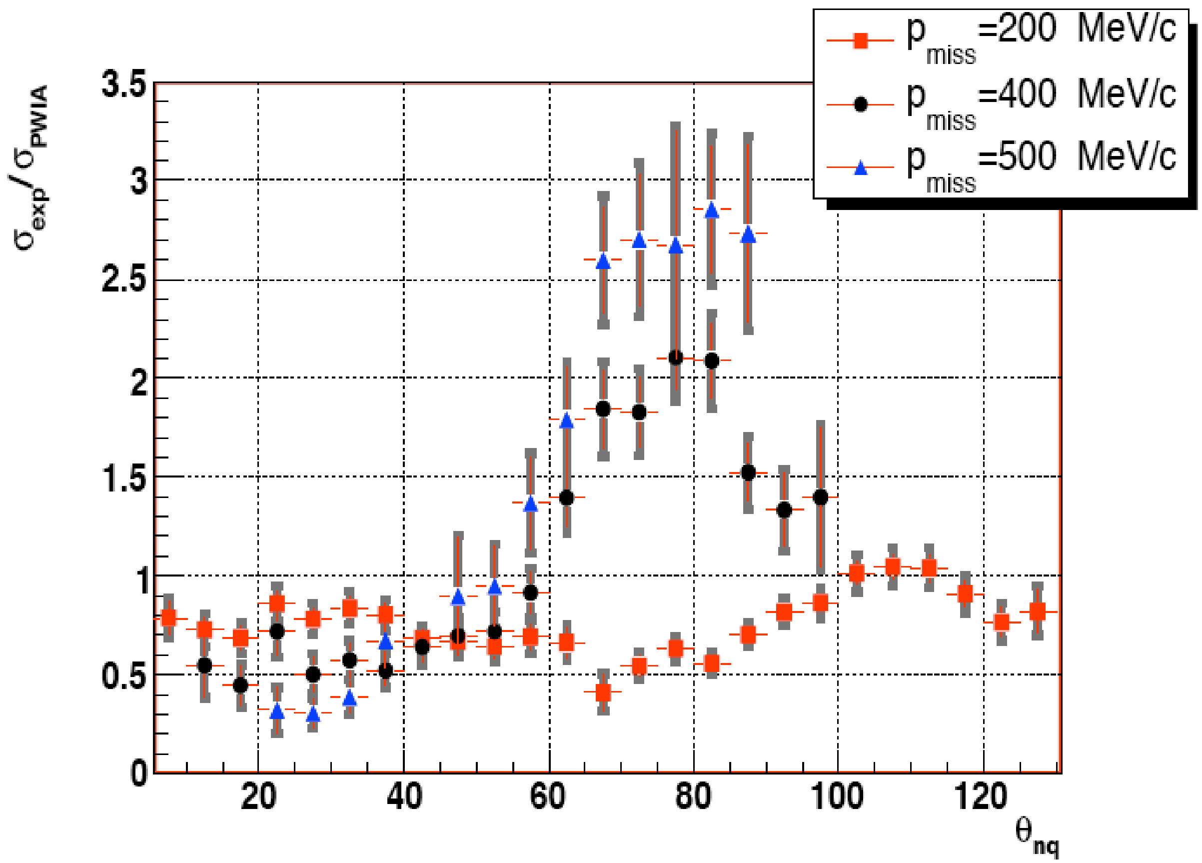
$$p_m = 0.4 \pm 0.02\ (GeV / c)$$



$$p_m = 0.5 \pm 0.02 \ (GeV / c)$$

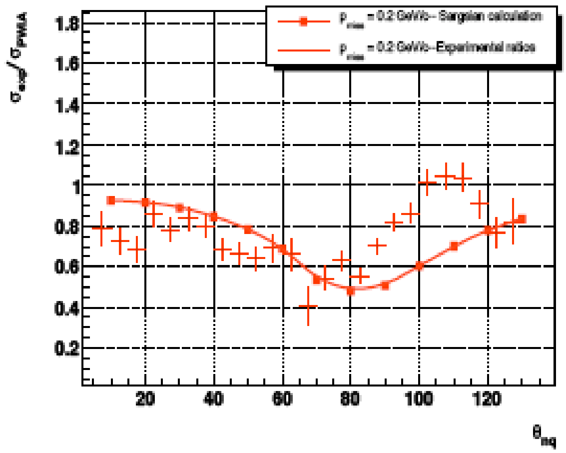


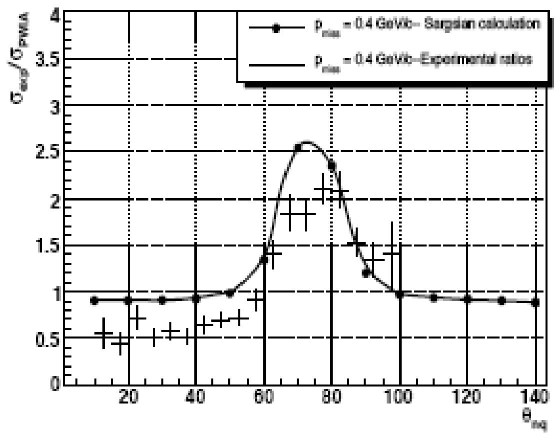
Ratio to PWIA

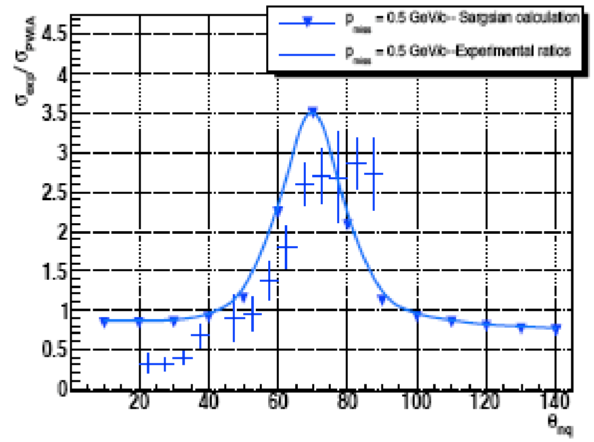


Calculations

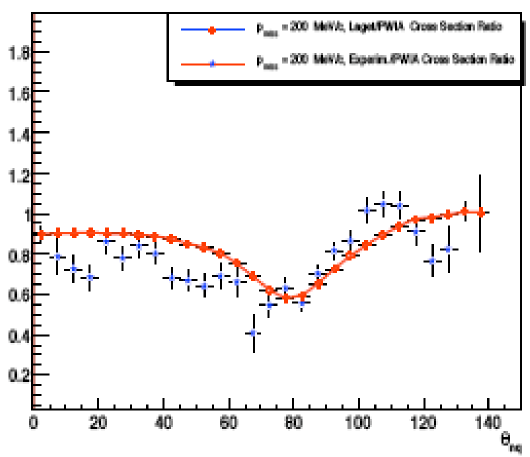
p_m=0.2 GeV/c　　p_m=0.4 GeV/c　　p_m=0.5 GeV/c

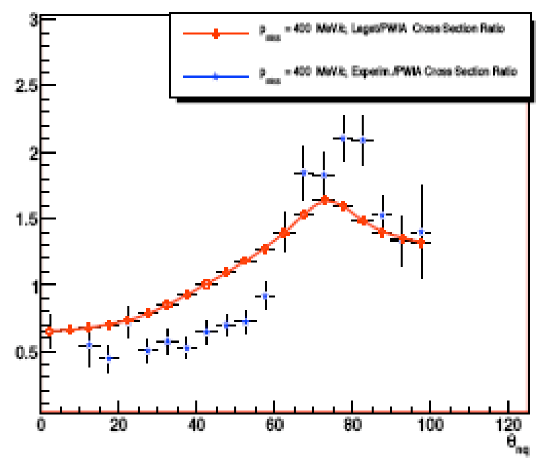


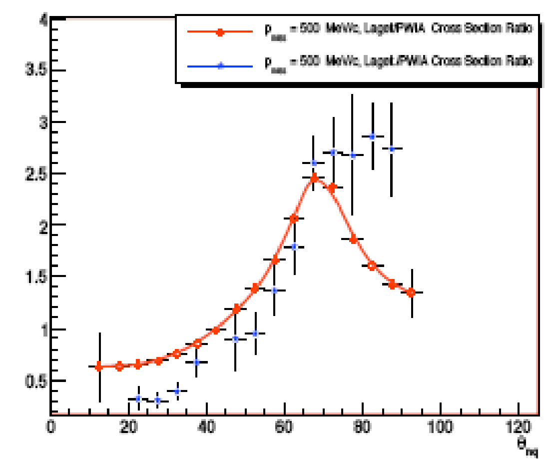




M.Sargsian





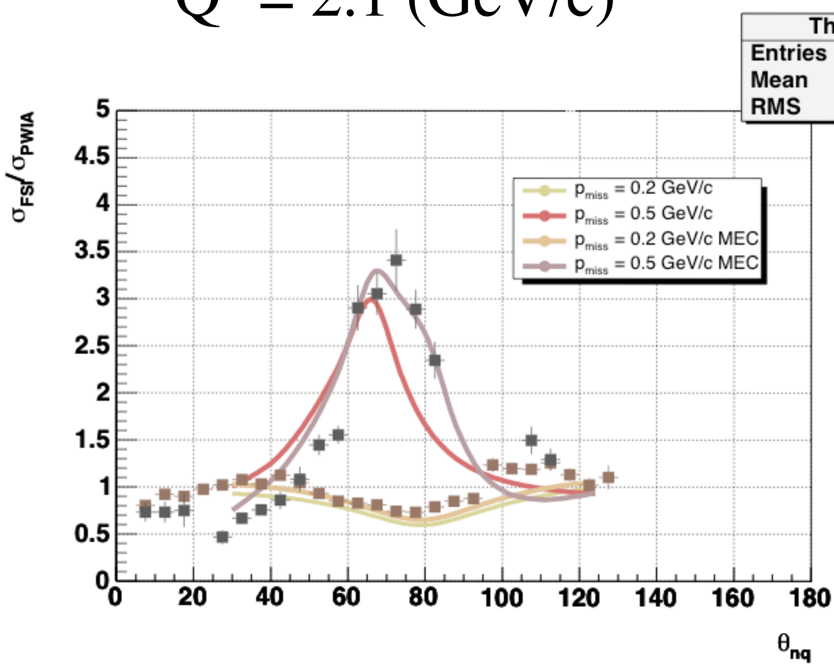


J.M. Laget

Lower Q^2

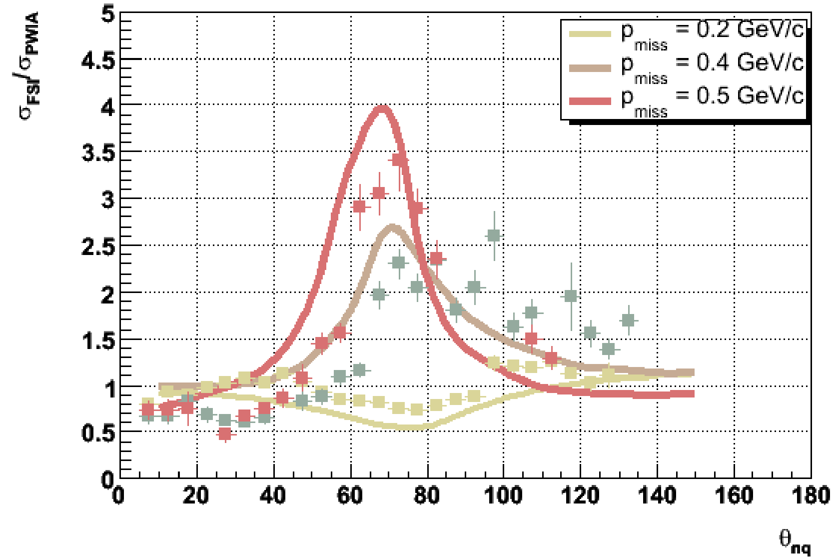
PRELIMINARY

$Q^2 = 2.1\ (GeV/c)^2$



J.M. Laget

$Q^2 = 2.1\ (GeV/c)^2$



M. Sargsian

R_{LT} Determination

Thesis: H. Ibrahim, ODU

Hall A Experiment E01-020

Kinematics:

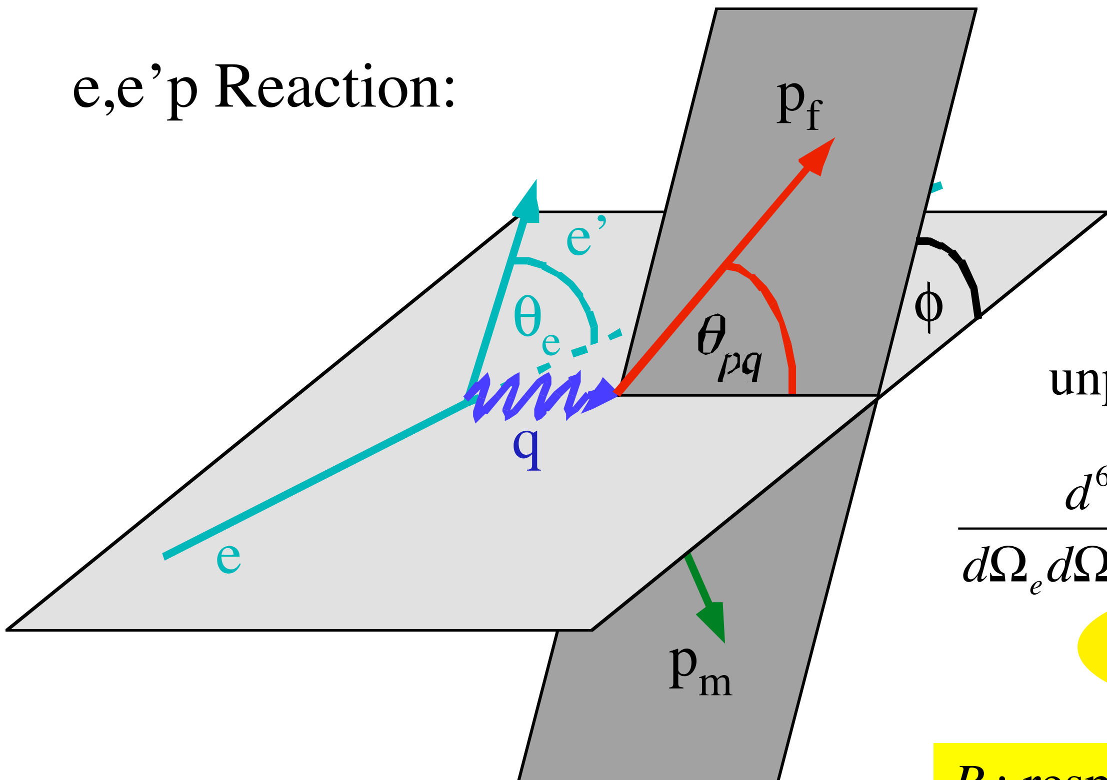
$Q^2 = 3.5\ (GeV/c)^2$

R_{LT} for $p_m \leq 0.5$ GeV/c

$x = 1$

Response Functions

e,e'p Reaction:



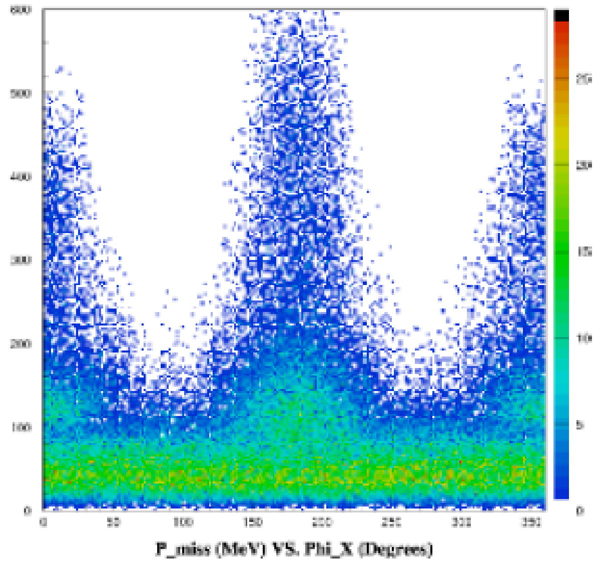
unpolarized cross section:

$$\frac{d^6\sigma}{d\Omega_e d\Omega_p d\omega dp} = \sigma_{Mott} f_{rec} \left(v_L R_L + v_T R_T + v_{LT} R_{LT} \cos(\varphi) + v_{TT} R_{TT} \cos(2\varphi) \right)$$

R_i: response functions

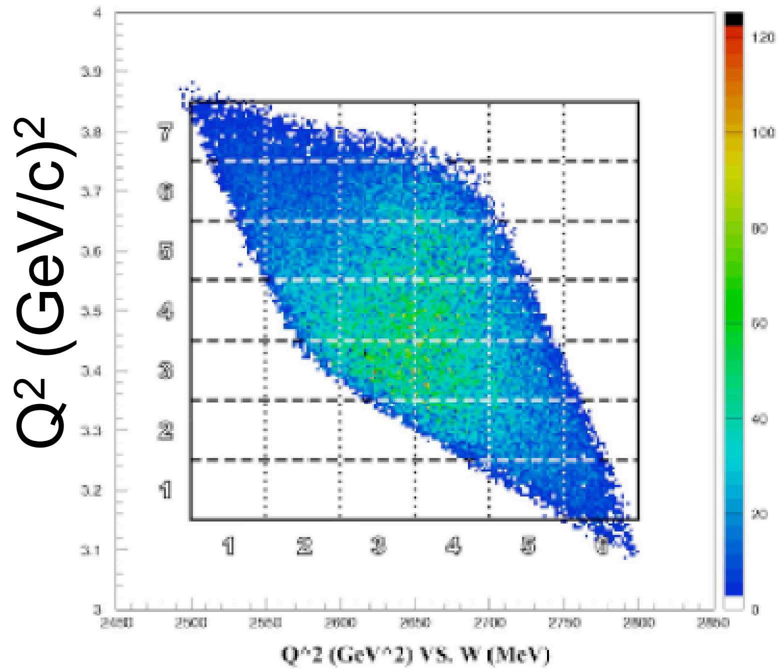
v_i: kinematical factors

Kinematics



$\theta_{nq} = 10^0$

$\theta_{nq} = 0^0$



average cross section (no R_{lt}):

$$\sigma_{ave} = \frac{1}{2}(\sigma_0 + \sigma_{180})$$

$$W^2 = (M_D + \omega)^2 - q^2$$

Determination of R_{lt}

Asymmetry:

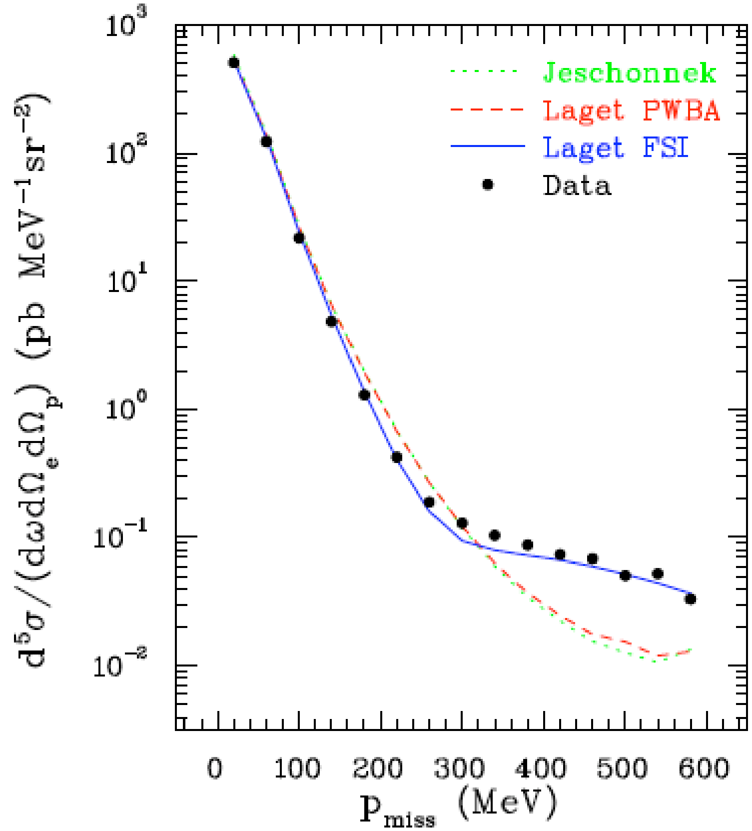
$$A_{LT} = \frac{\sigma_0 - \sigma_{180}}{\sigma_0 + \sigma_{180}}$$

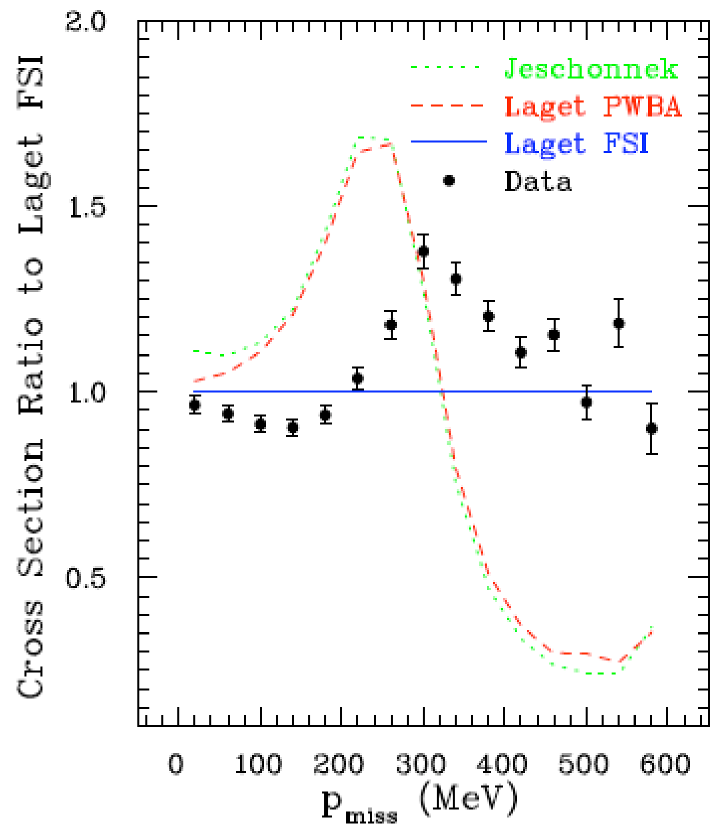
Fit ϕ dependence

$$R_{LT} = \frac{1}{2k\sigma_{Mott}}(\sigma_0 - \sigma_{180})$$

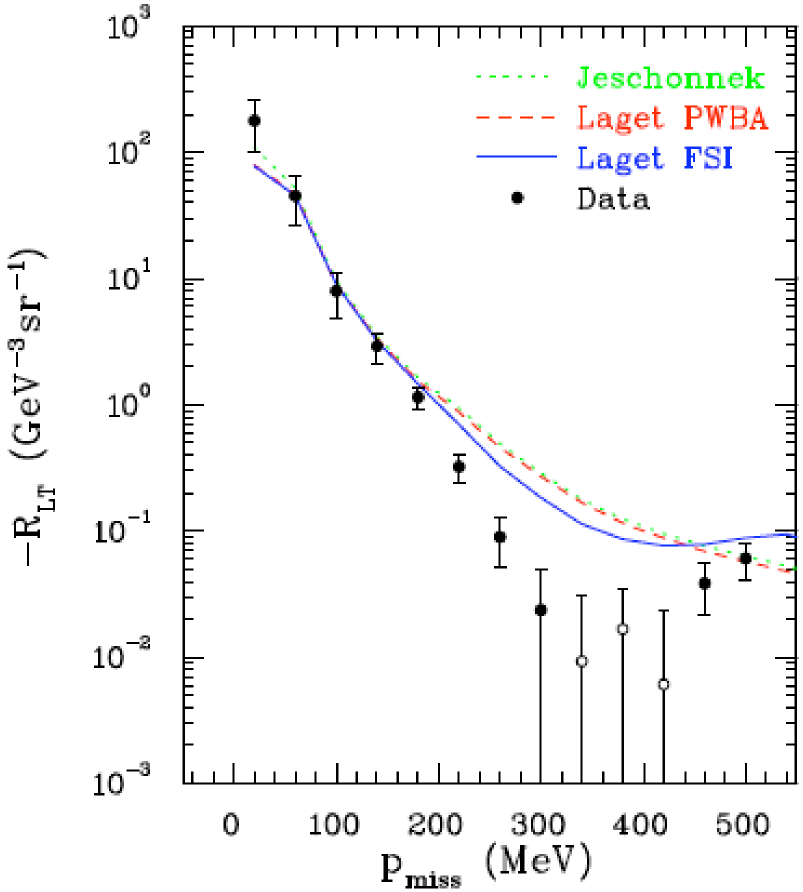
Averaged Cross Section

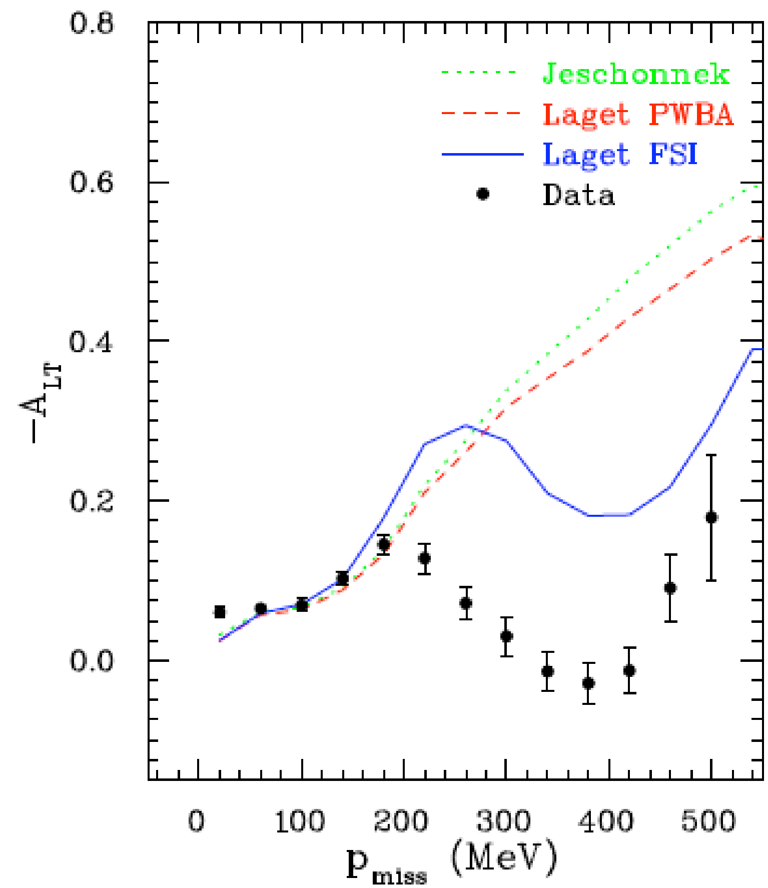
integrated (averaged) over the full Q^2,W acceptance



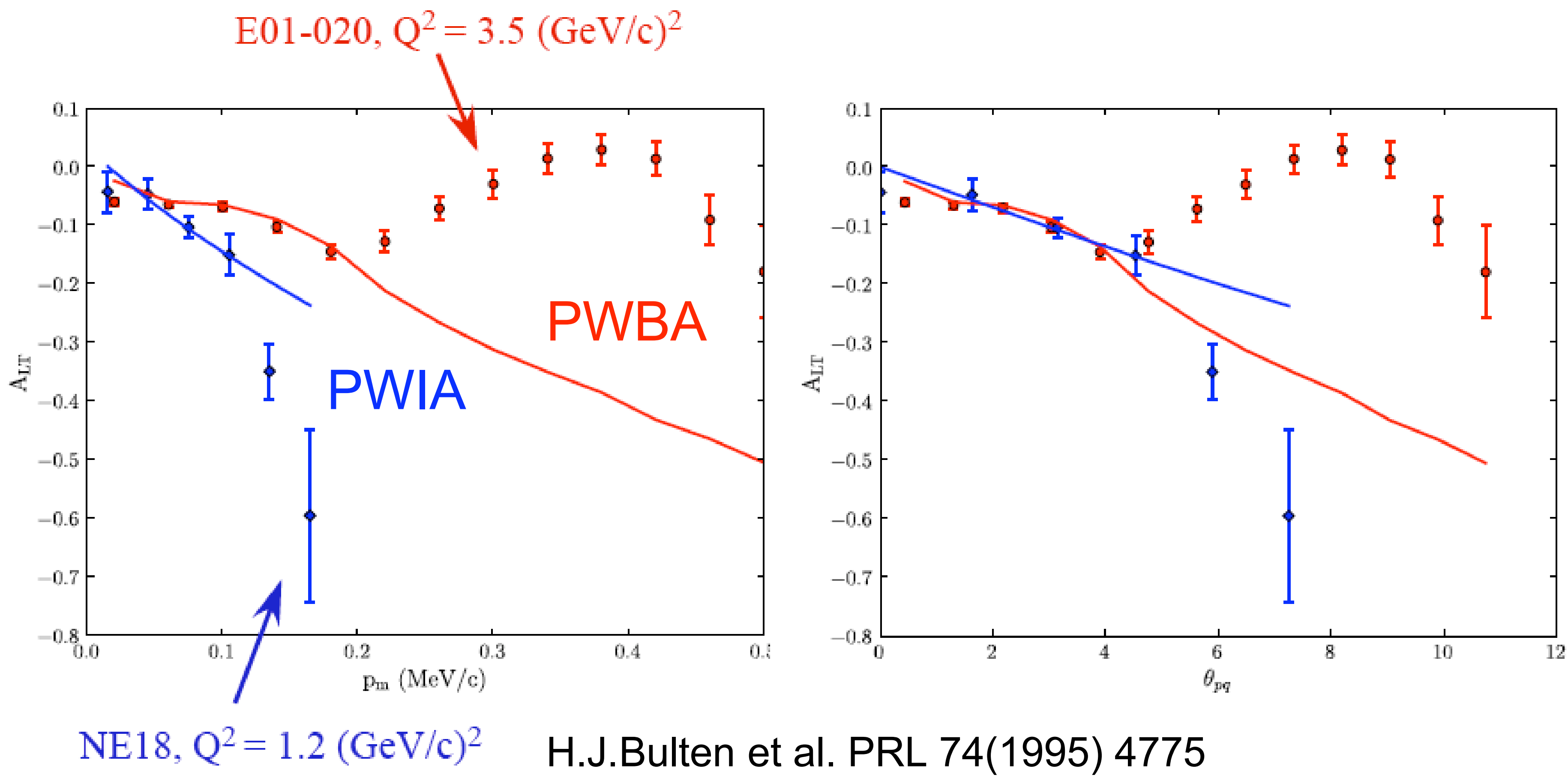


Extracted R_{LT}





comparison to other results



H.J.Bulten et al. PRL 74(1995) 4775

- agree with calculations for small angles (p_m)
- calculations disagree above p_m = 0.2 GeV/c

Summary

✓ Experiment confirms general features of GEA FSI description

✓ But : Considerable differences between experiment and calculation remain

✓ R_{LT} comparison to theory problematic

Projects:

- prepare publication of angular distribution
- further work on bin corrections and average kinematics neede for R_{LT}
- analyze lower Q^2