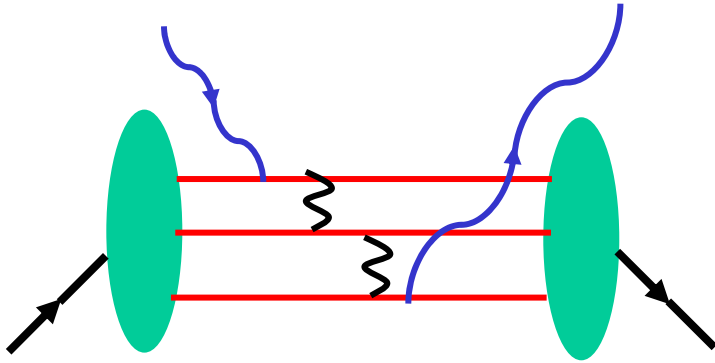


Progress Report on E99-114 (RCS)

- RCS experiment ran in early 2002
 - * Analysis in progress since then
- Outline
 - * Brief theoretical overview
 - * Nearly final results for recoil polarization
 - * Preliminary results for unpolarized cross sections
 - * Summary

How is the Transferred Momentum Shared?

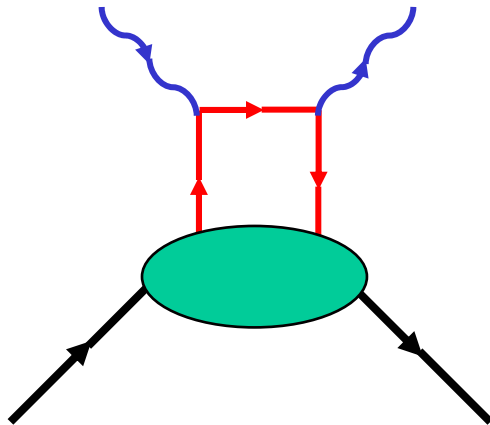


- Asymptotic (pQCD) Mechanism

2 hard gluon exchanges

\Rightarrow scaling at fixed θ_{CM} :

$$d\sigma/dt = f(\theta_{\text{CM}})/s^6$$



- Soft Overlap Mechanism

single quark mechanism

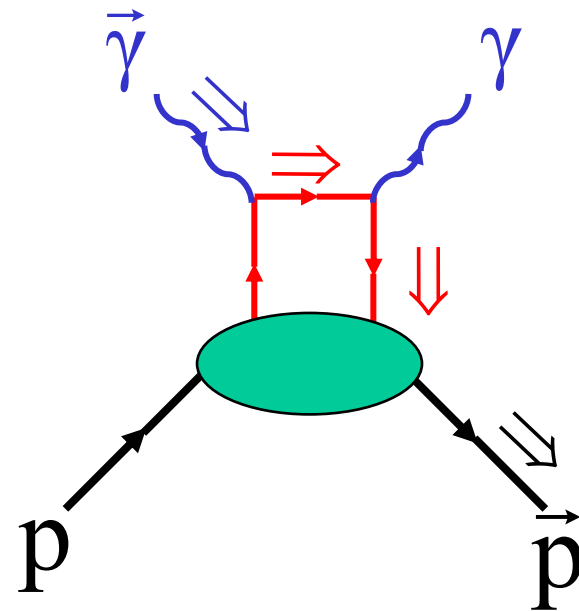
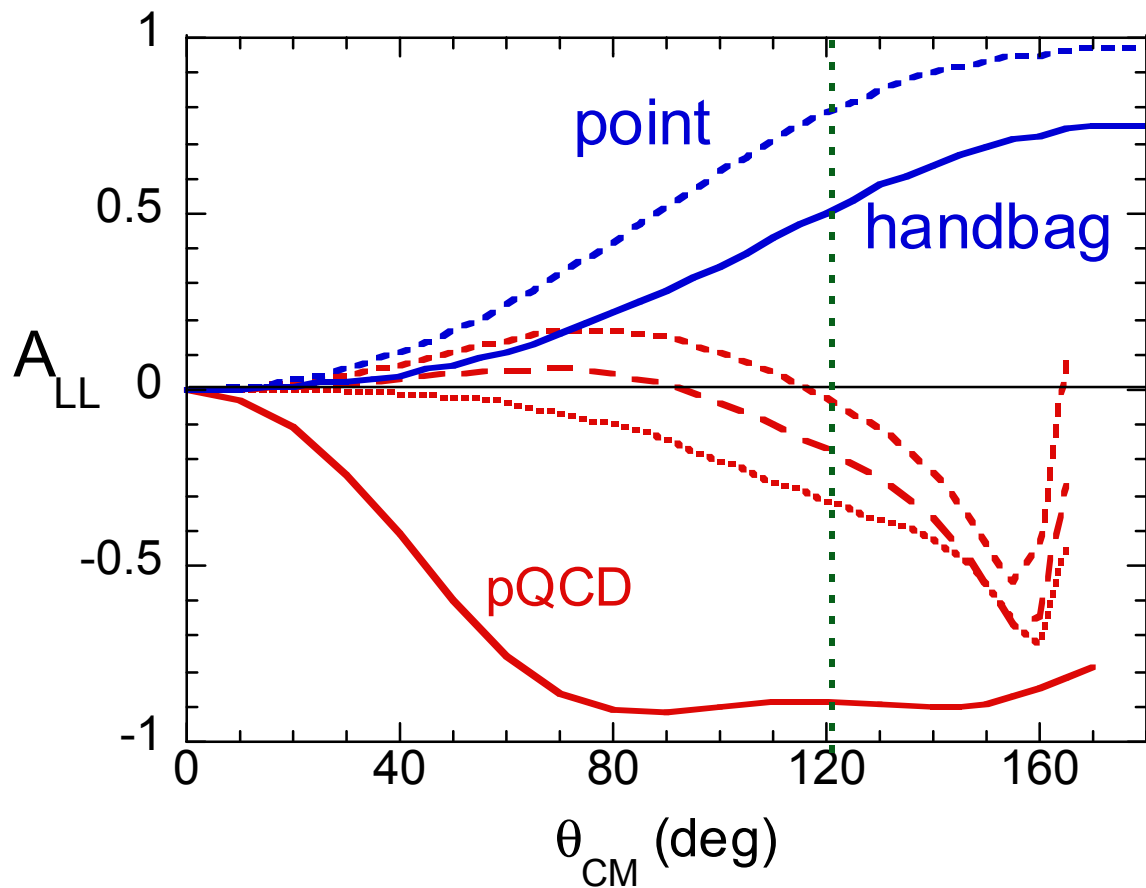
\Rightarrow scaling at fixed t :

$$d\sigma/dt \cong (d\sigma/dt)_{\text{KN}} R_V^2(t)$$

- What Mechanism Dominates at Accessible Energies?
- What Can We Learn About Proton Structure?

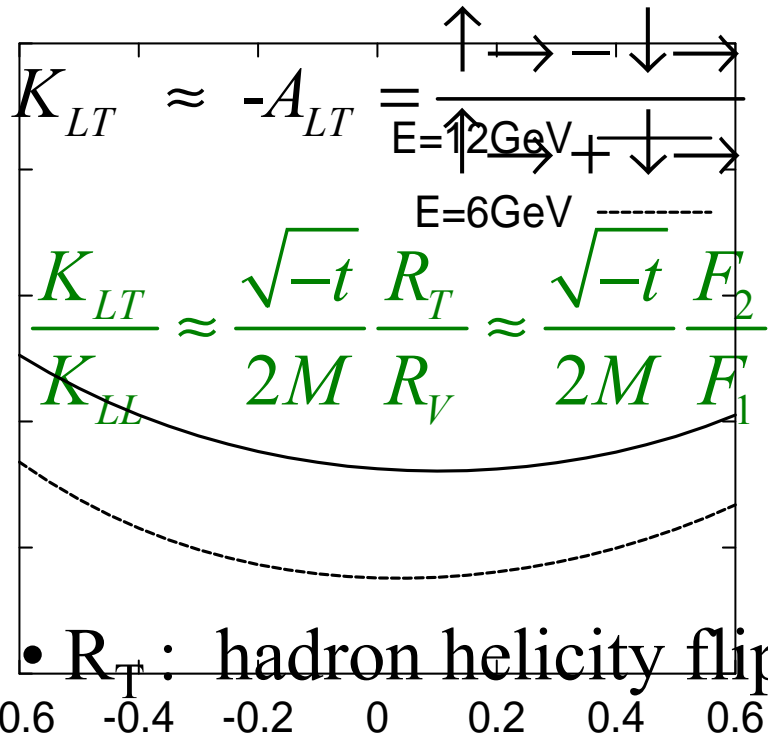
Polarization of Recoil Proton: Longitudinal

$$K_{LL} \approx A_{LL} = \frac{\uparrow\uparrow - \downarrow\uparrow}{\uparrow\uparrow + \downarrow\uparrow} \approx A_{LL}^{point} \frac{R_A}{R_V}$$

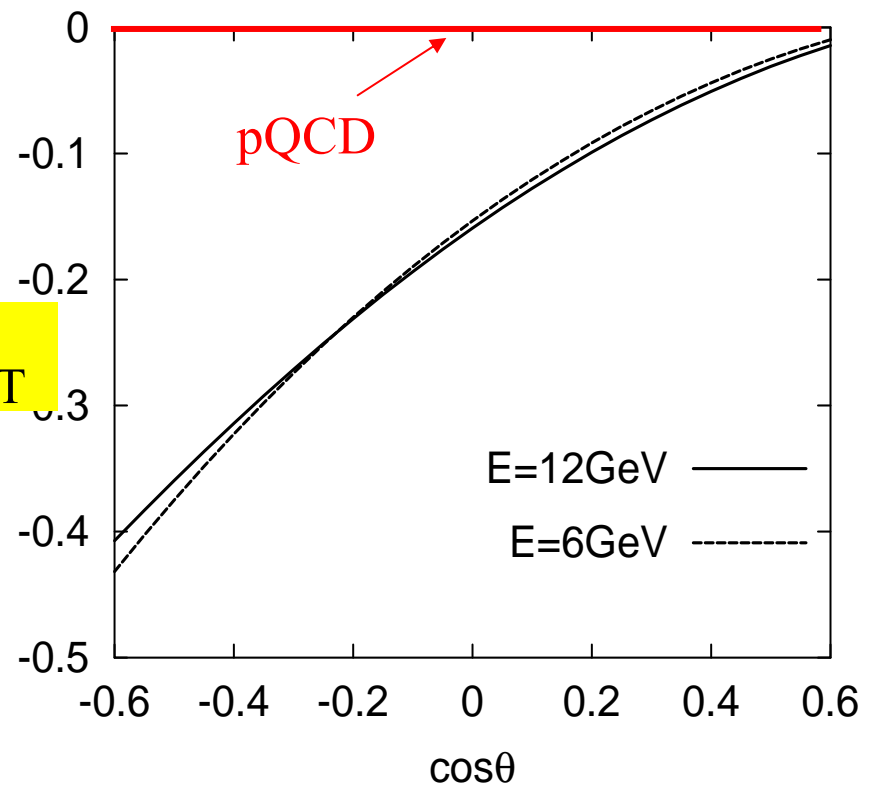


Robust prediction: depends only on ratio of form factors

Polarization of Recoil Proton: Transverse



$-K_{LT}$



- R_T : hadron helicity flip
- pQCD: $\cos\theta$

$-t F_2/F_1 \sim \text{constant}$

- JLab G_{Ep} expt:

$-t^{1/2} F_2/F_1 \sim \text{constant}$

- Does R_T/R_V behave similarly?

Goals of JLab E99-114

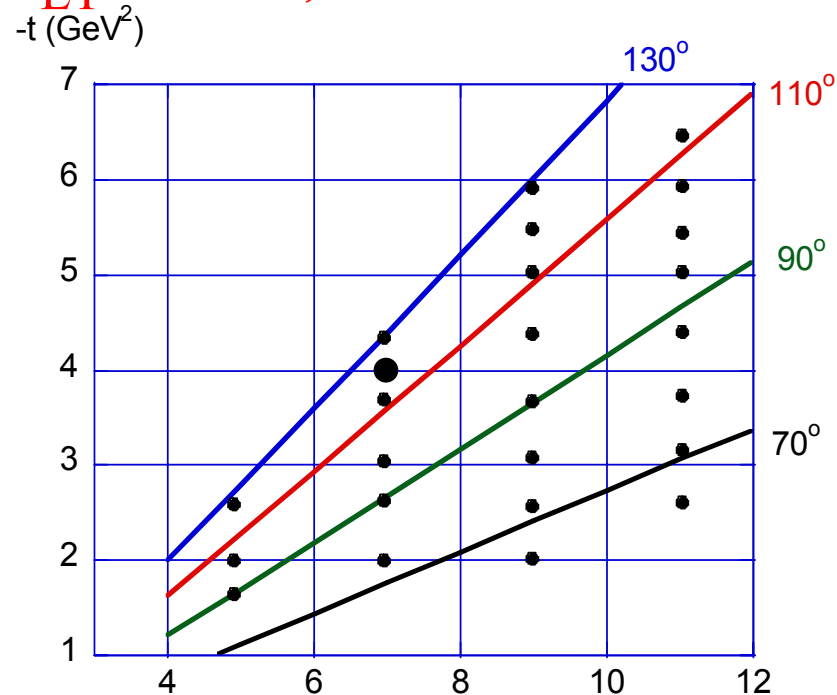
- Measure cross sections to 5% + 5% over broad kinematic range of s, t

-- σ/σ_{KN} vs. s @ fixed t

-- $1/s^n$ @ fixed θ_{cm}

--detailed comparison with handbag

- Measure K_{LL} and K_{LT} at $s=7, -t=4$



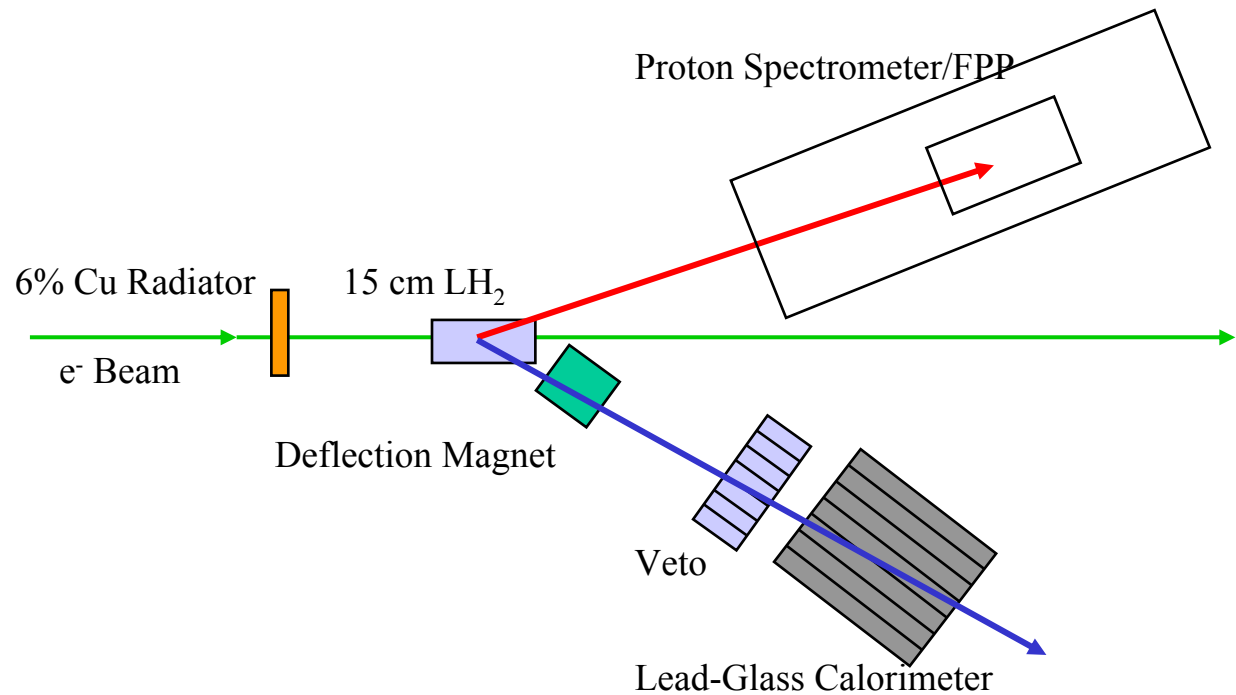
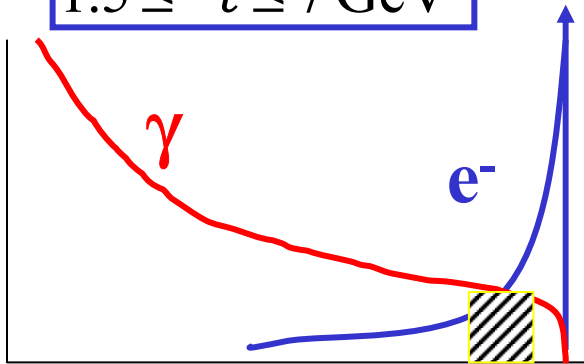
Experimental Setup

Kinematic Range:

$$E \leq 6 \text{ GeV}$$

$$6 \leq s \leq 12 \text{ GeV}^2$$

$$1.5 \leq -t \leq 7 \text{ GeV}^2$$



- mixed e - γ beam
 \Rightarrow background & calibrations
- good angular resolution
- FPP

Experiment ran in Hall A Jan-Feb, 2002

Event Identification

RCS: $p(\gamma, \gamma)p$

ep: $p(e, e)p$

π^0 : $p(\gamma, \pi^0)p$

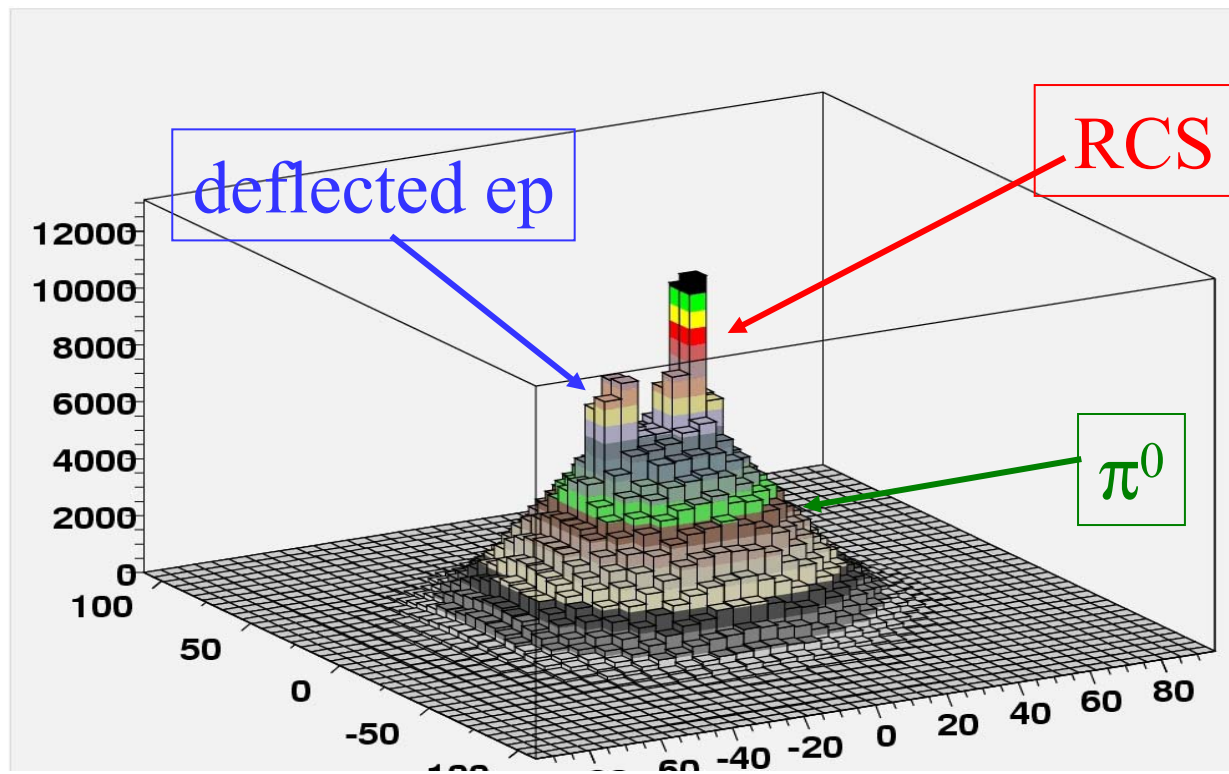
$\gamma\gamma$

e or γ

p

$\theta_{1/2} = m_\pi/E$

γ, e'

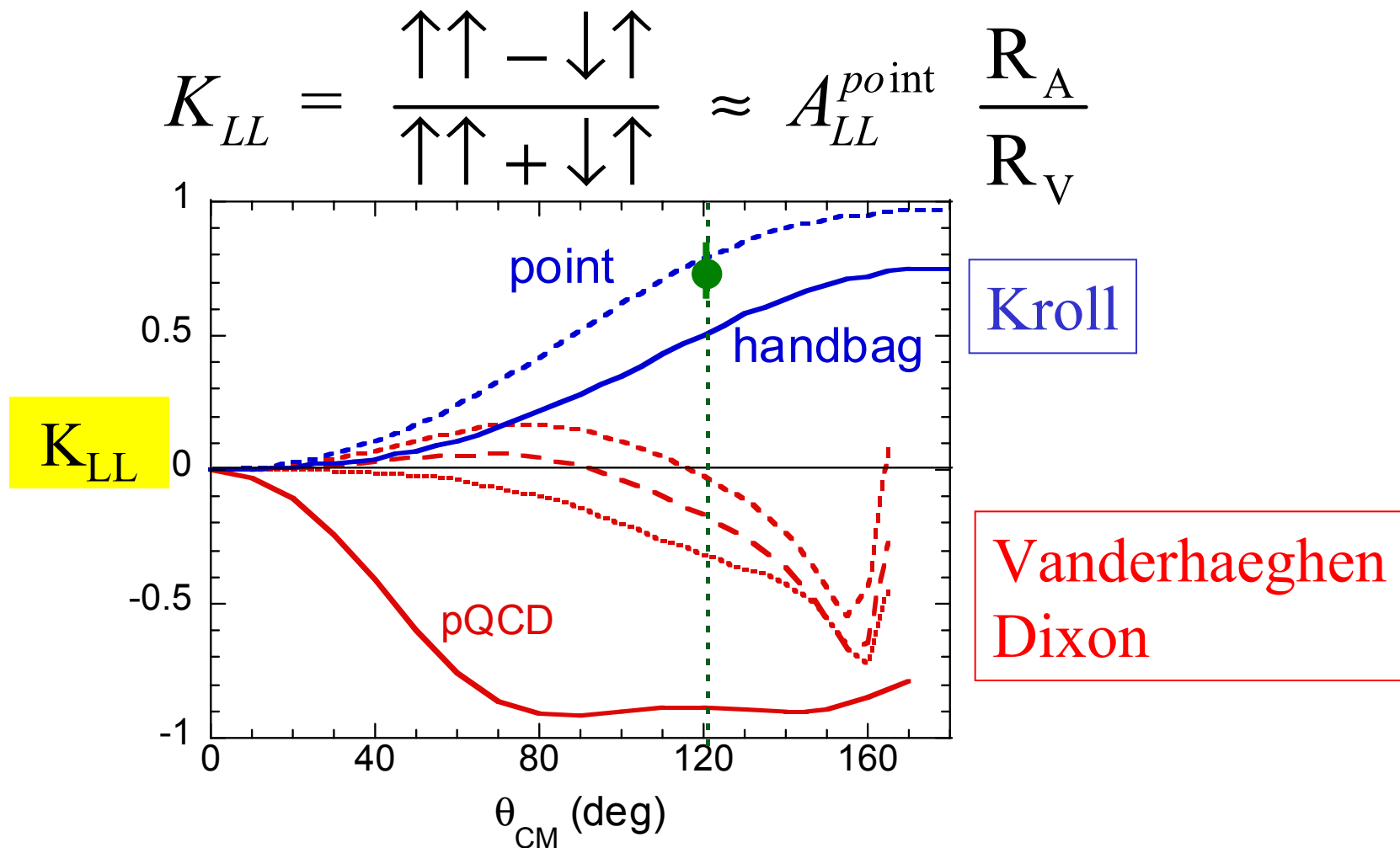


Status Report on Polarization Measurements

- Data analysis in final stages (David Hamilton)
- Results obtained for K_{LL} and K_{LT}
 - * $K_{LL} = 0.68 \pm 0.08$
 - * $K_{LT} = 0.11 \pm 0.08$
- Systematic error still being evaluated
 - * probably < 0.04
- Lots of $p(\gamma, \pi^0)$ polarization to be mined
 - * thesis of Mike Roedelbronn

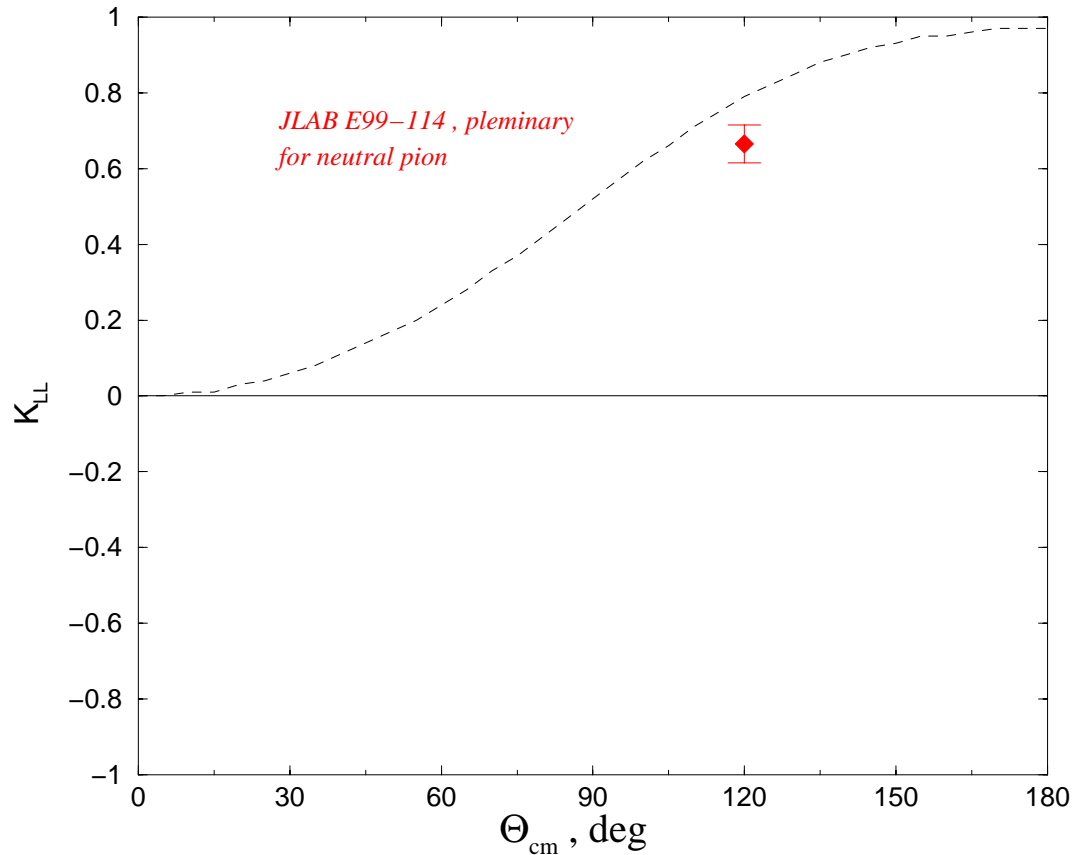
Longitudinal Polarization Transfer:

Preliminary Result from E99-114...final results very soon



K_{LL} consistent with **single-quark mechanism** with active quark carrying proton spin ($R_A \cong R_V$)

Polarization Transfer K_{LL} for γ, π^0



- $K_{LL}^{\pi} \cong K_{LL}^{\text{RCS}} \cong K_{LL}^{\text{KN}}$
- predicted by handbag
- five more points measured but not yet analyzed (75° - 130°)

Transverse Polarization Transfer: Preliminary Result from E99-114

$$K_{LL} = 0.68 \pm 0.08$$

$$K_{LT} = 0.11 \pm 0.08$$

$$\frac{K_{LT}}{K_{LL}} \frac{\sqrt{-t}}{2M} \frac{R_T}{R_V} = 0.16 \pm 0.12$$

$$\Rightarrow R_T/R_V \approx (0.4 \pm 0.3) F_2/F_1$$

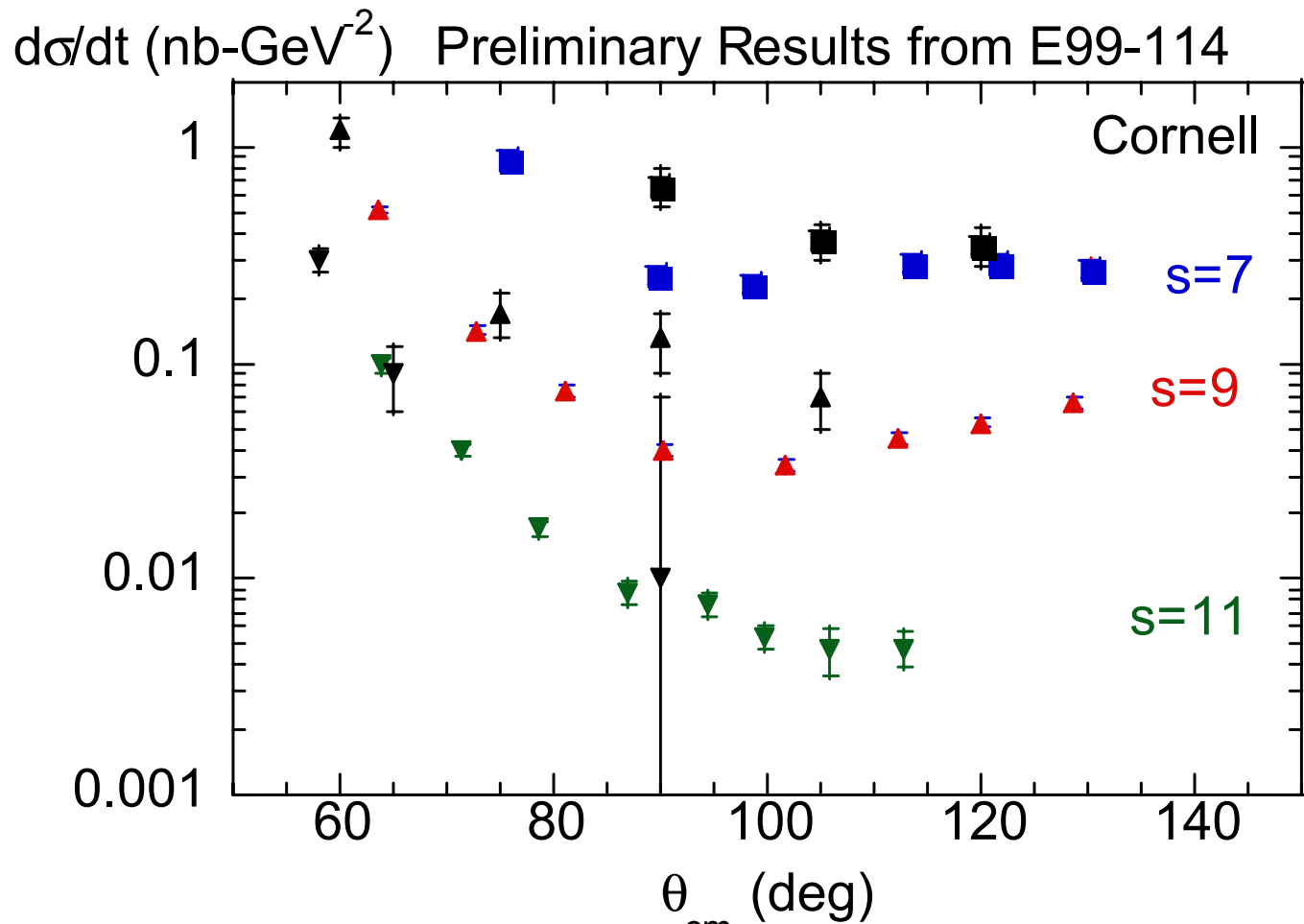
Hard to draw any conclusions with this precision

Status Report on Unpolarized Cross Section

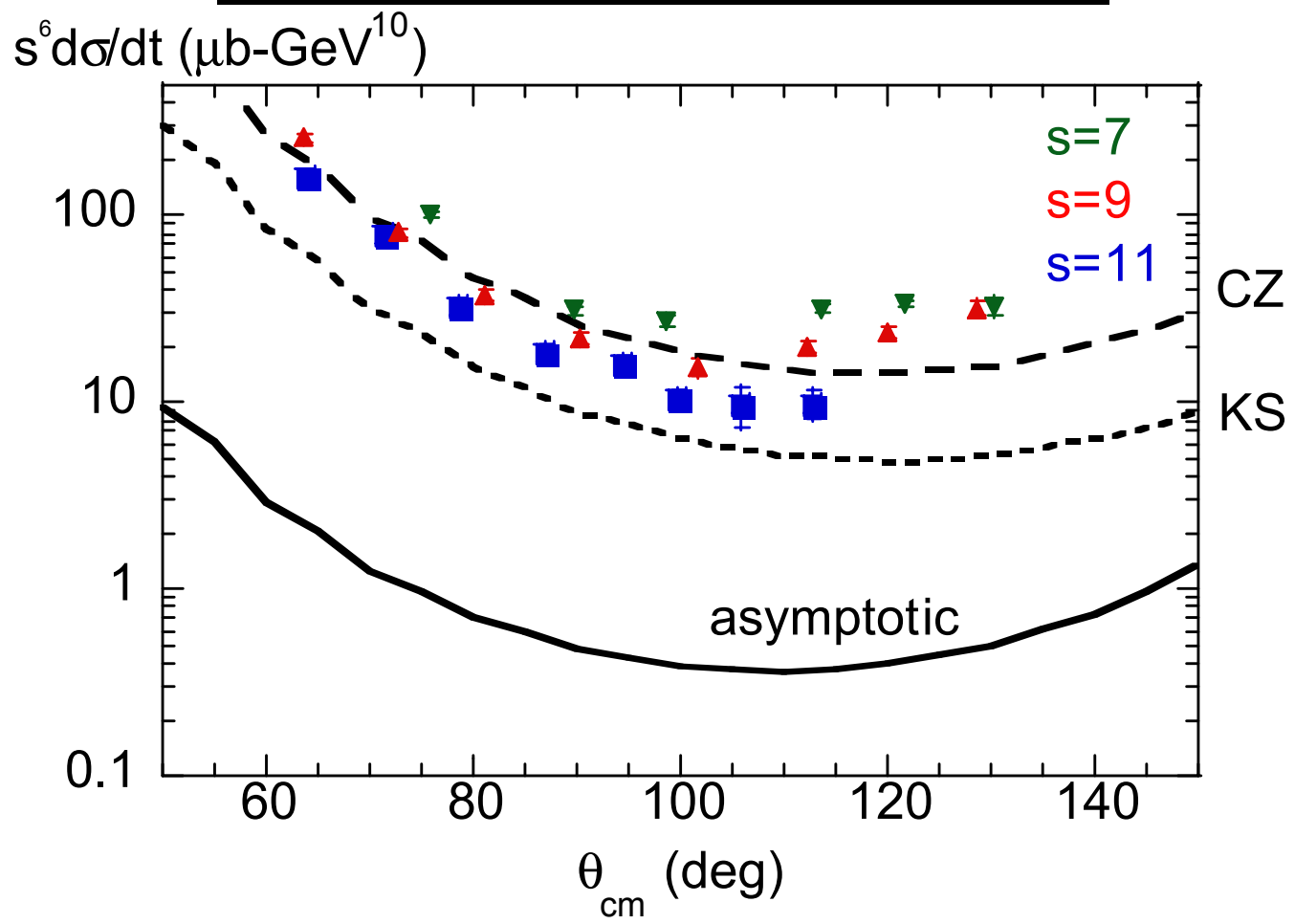
- Preliminary analysis of all kinematics completed June 03
- Final analysis underway
 - * **Mamyan Vahe:** simulation based on GEANT
 - * **Areg Danagoulian:** simulation based on SIMC
- We are still about 1 year away

NOTE:

- this and the next few slides show **preliminary** cross sections
- good to about 20%
- results disagree somewhat with Cornell



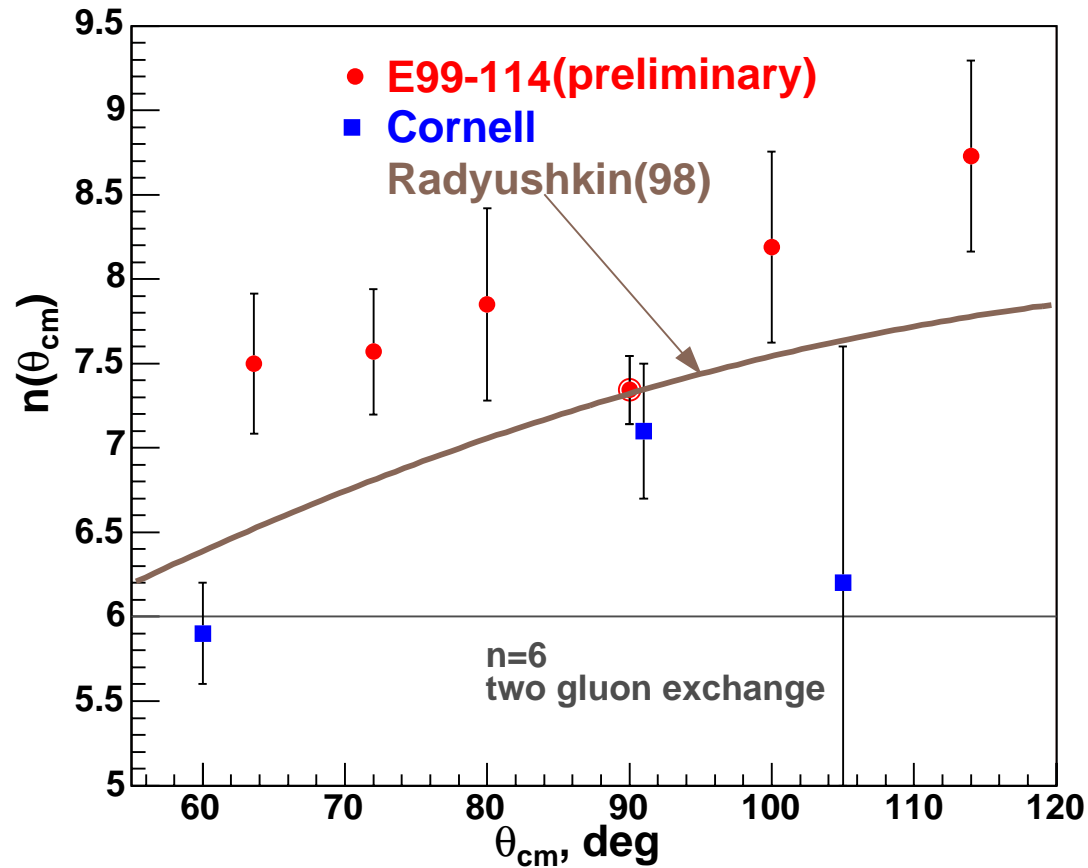
RCS Preliminary Analysis, June03



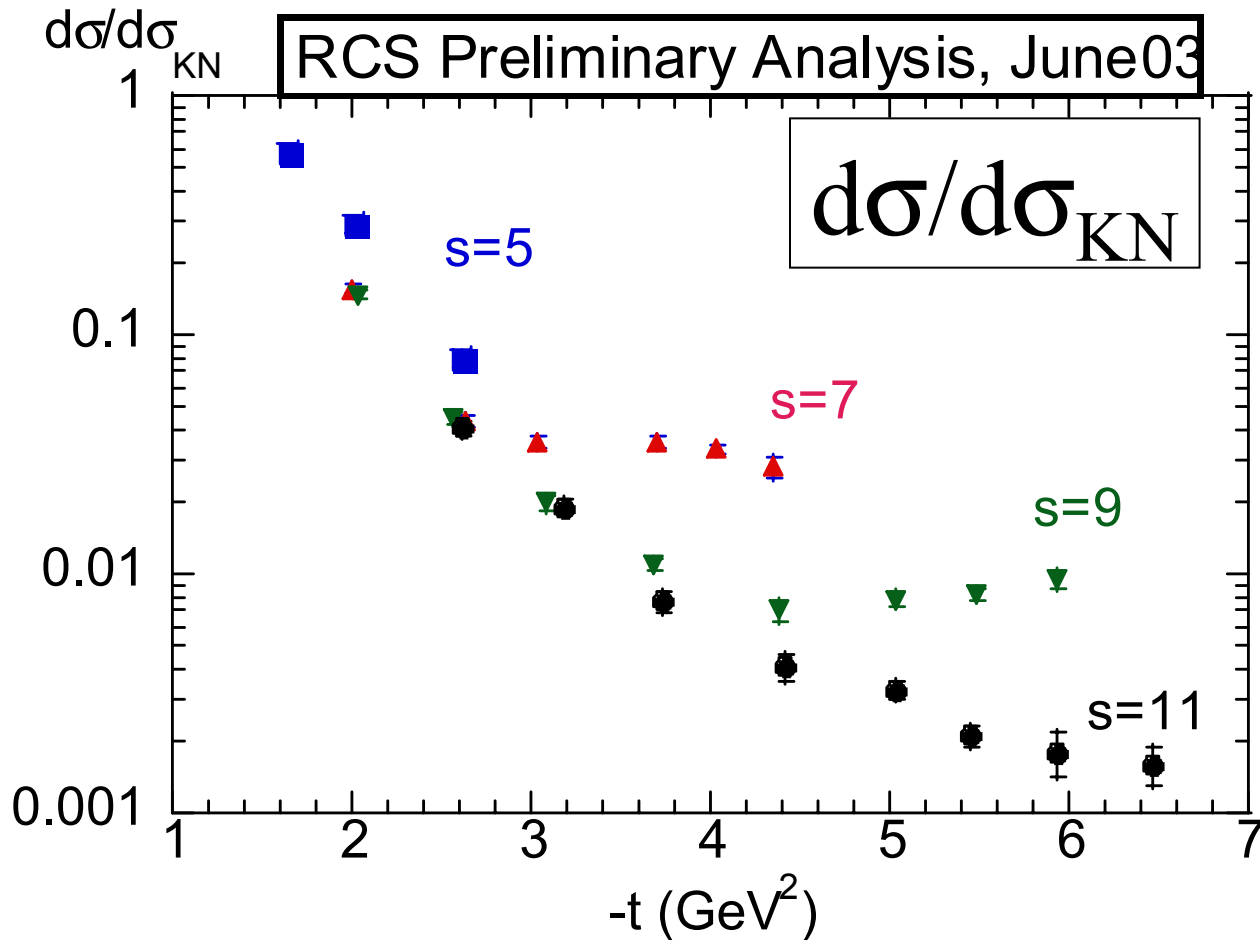
- s^{-6} scaling at fixed θ_{CM} works only approximately
- Leading twist still badly underestimates cross section

$$\frac{d\sigma}{dt} = f(\theta_{CM}) / s^n$$

Scaling parameter

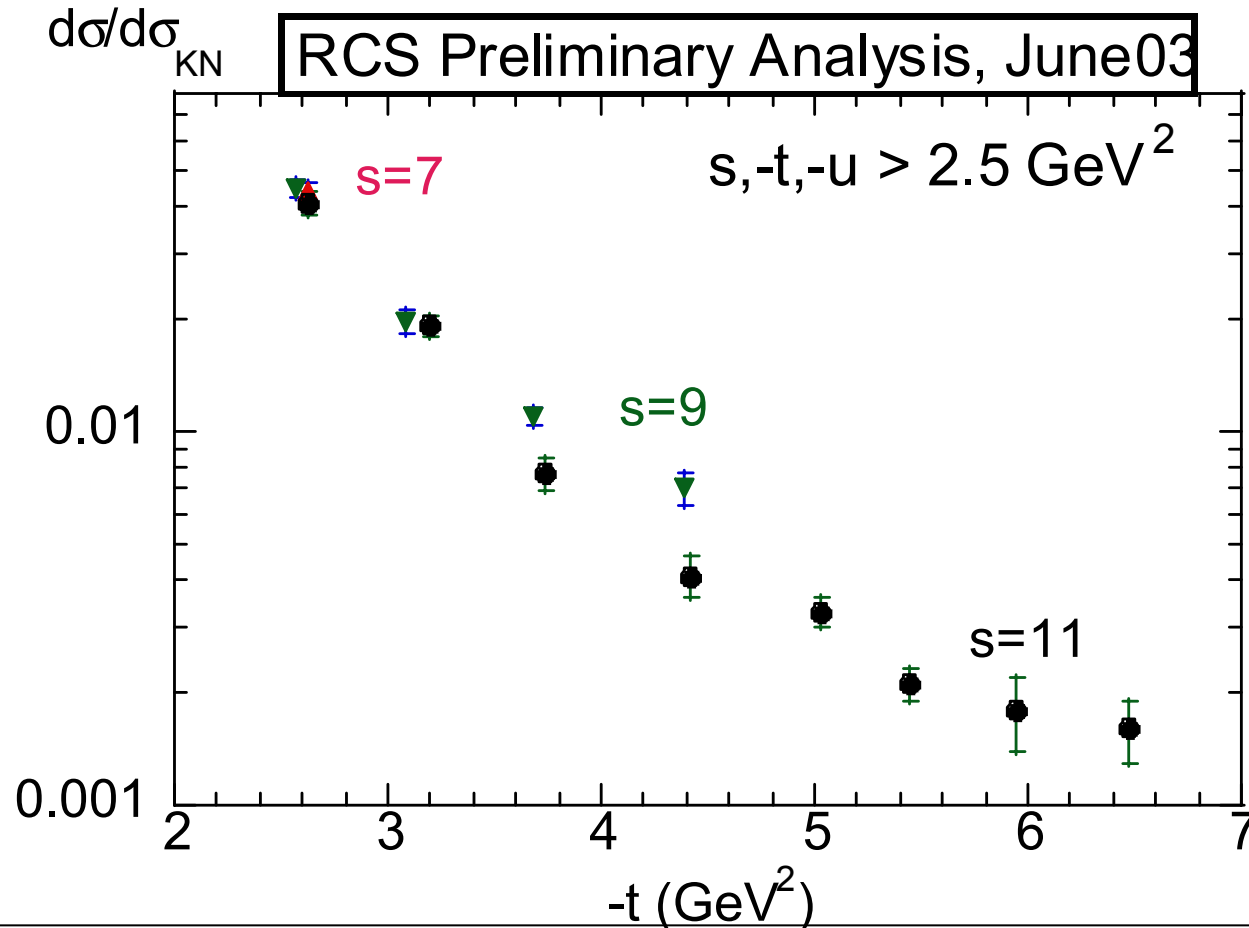


Preliminary Cross Sections



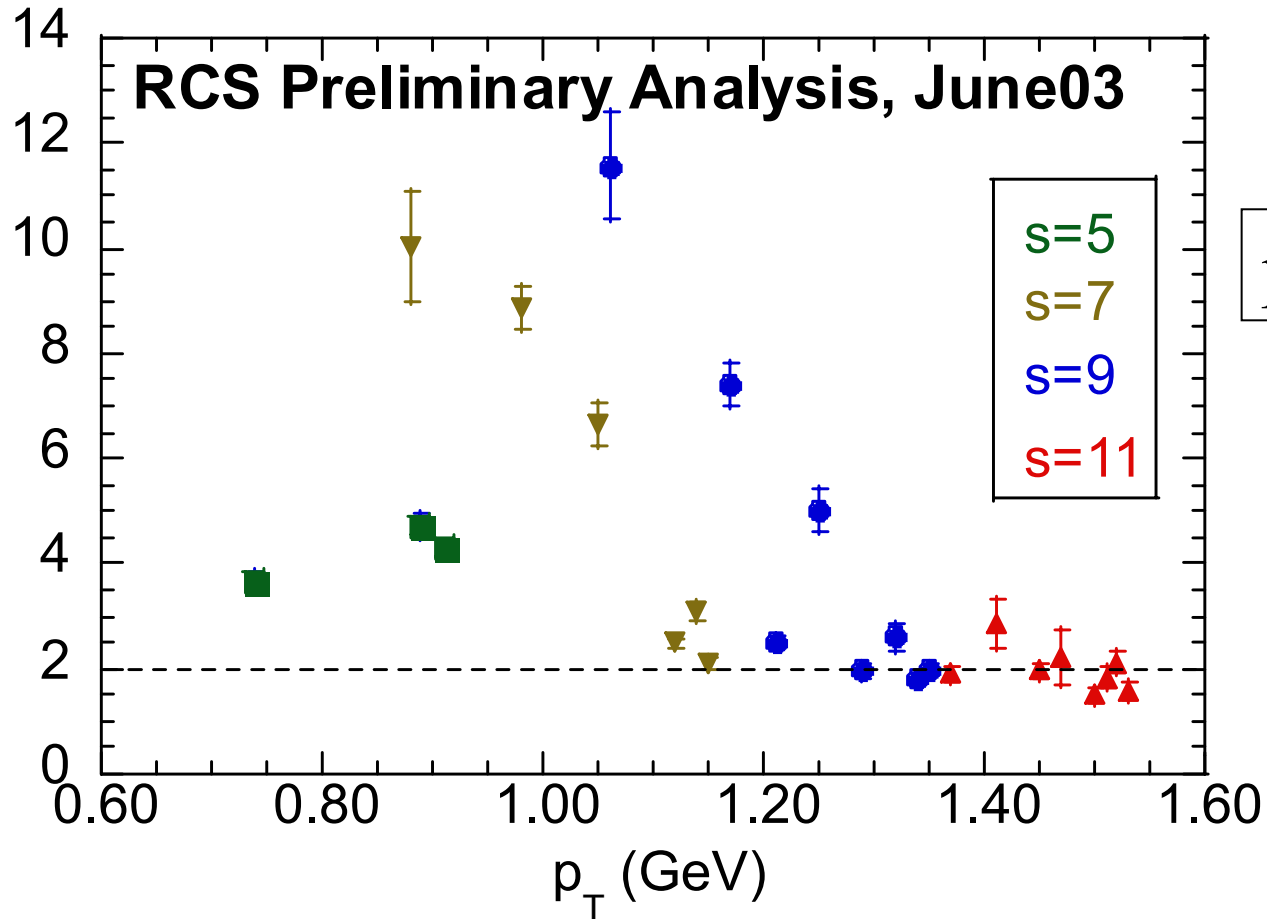
Prediction of s -independence at fixed t not well followed
But...

Preliminary Cross Sections



- Prediction of s -independence at fixed t not well followed
- But...not so bad for data with $s, -t, -u > 2.5 \text{ GeV}^2$
- Higher energy data would be desirable

$t^4 d\sigma/d\sigma_{KN} \text{ (GeV}^8\text{)}$



- For large enough p_T , $d\sigma/d\sigma_{KN} \sim$ scales with $1/t^4$
- In agreement with “spirit” of handbag

Summary and Outlook

- E99-114 successfully completed
 - * K_{LL} and K_{LT} at $s=7$, $-t=4$
 - K_{LL} is “large” and positive
 - Suggestive of single-quark mechanism
 - Similar result for π^0 photoproduction
 - Consistent with handbag prediction
 - K_{LT}/K_{LL} consistent with F_2/F_1 , with poor statistics
 - * $d\sigma/dt$ over broad kinematic range
 - $t^4\sigma/\sigma_{KN}$ roughly constant for $s,-t,-u > 2.5 \text{ GeV}^2$
 - s^{-6} scaling at fixed θ_{CM} works only approximately
 - * Lots of $p(\gamma,\pi^0)$ to be mined
- Higher energy desirable to obtain higher p_T