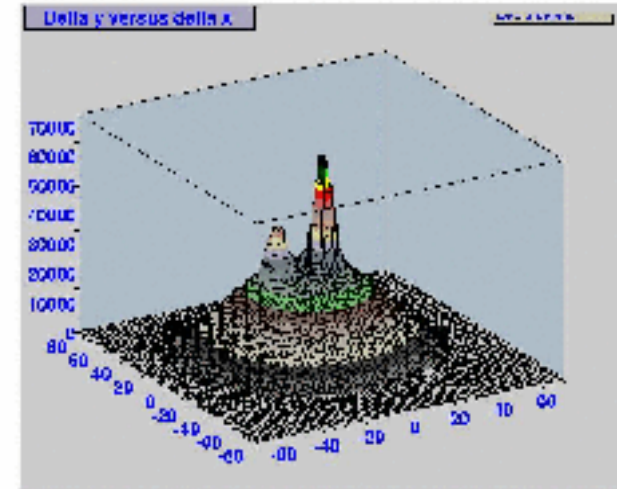


Real Compton Scattering E99-114

Bogdan Wojtsekhowski, TJNAF

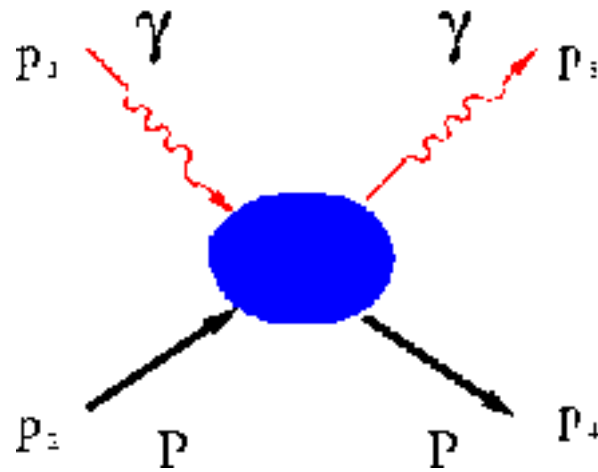


- *Exclusive Real Compton Scattering from Proton – experimental results and next proposed measurements of $d\sigma/dt$, K_{LL} , A_{LL}*

Physics mechanism of hard processes induced by real photons in few GeV energy range – Compton, pion and VM production

Exclusive RCS process: $p \gamma \rightarrow p \gamma$, Jlab E99-114

Hyde-Wright, Nathan, Wojtsekhowski



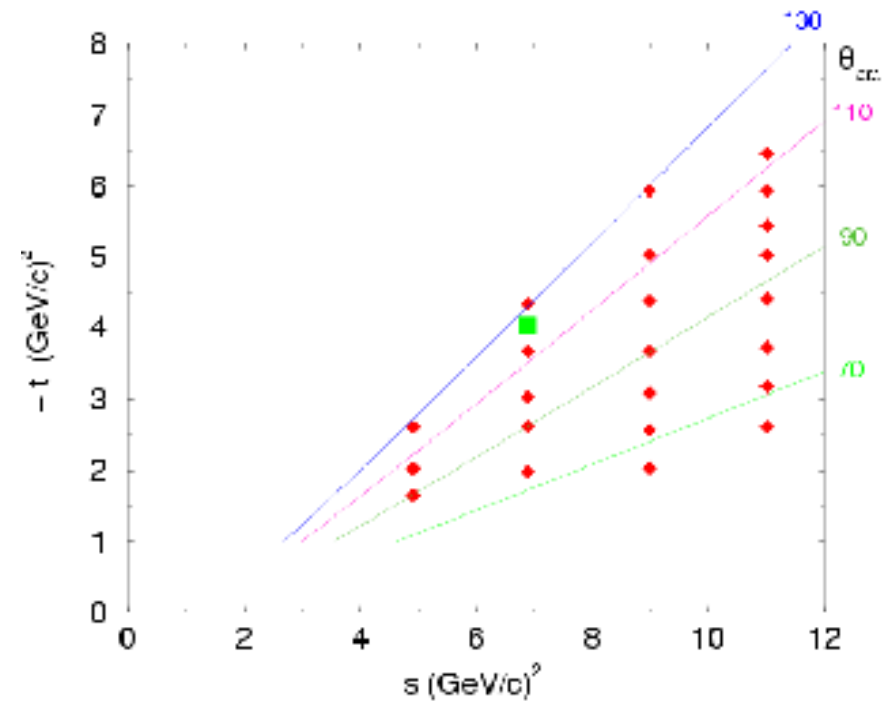
$$s = (p_1 + p_2)^2$$

$$t = (p_1 - p_3)^2$$

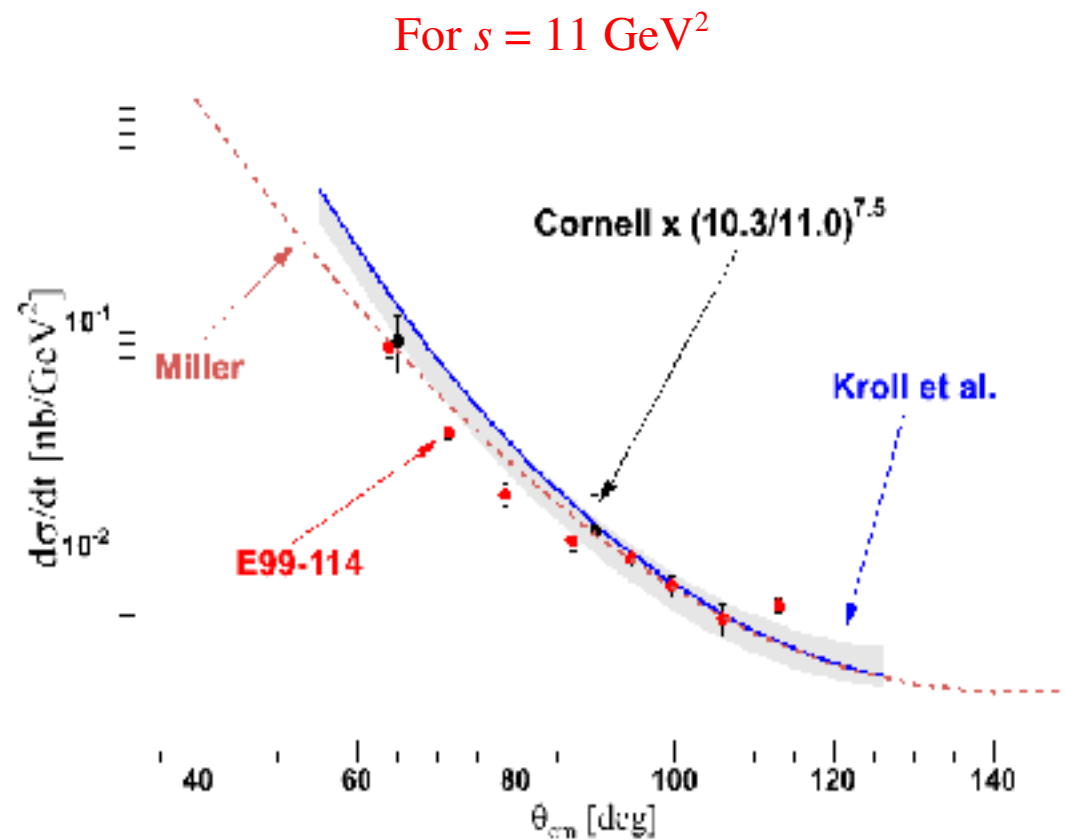
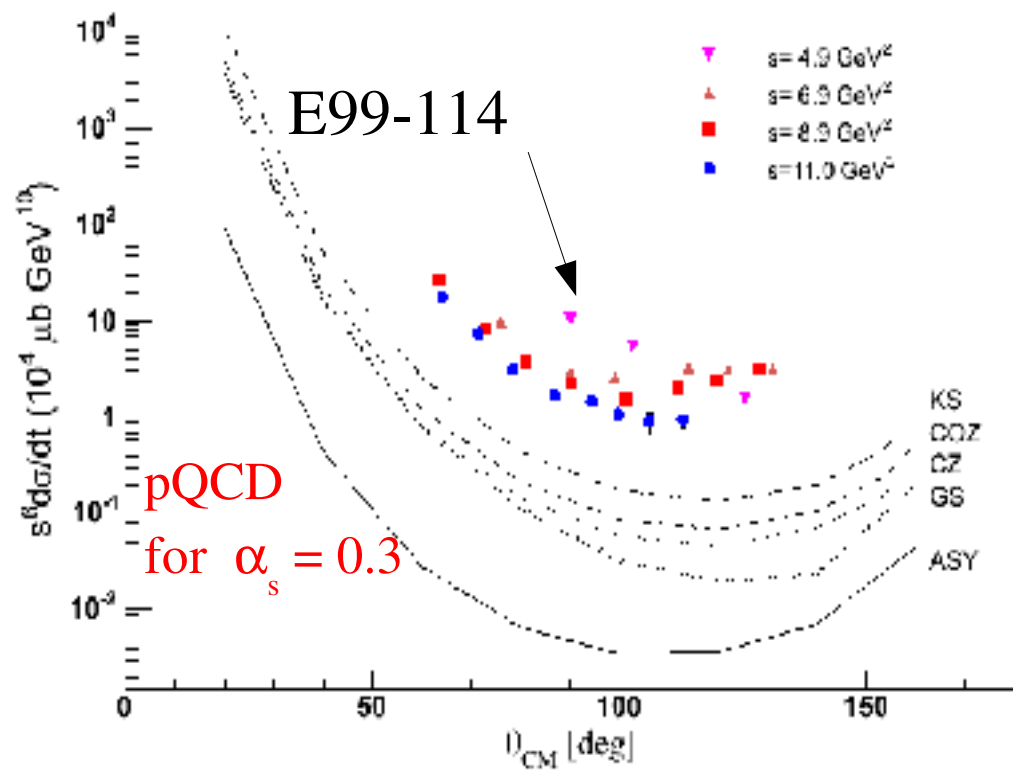
$$u = (p_1 - p_4)^2$$

$$s, t, u > M^2$$

Kinematic range in $s, -t$



Experimental results: cross section



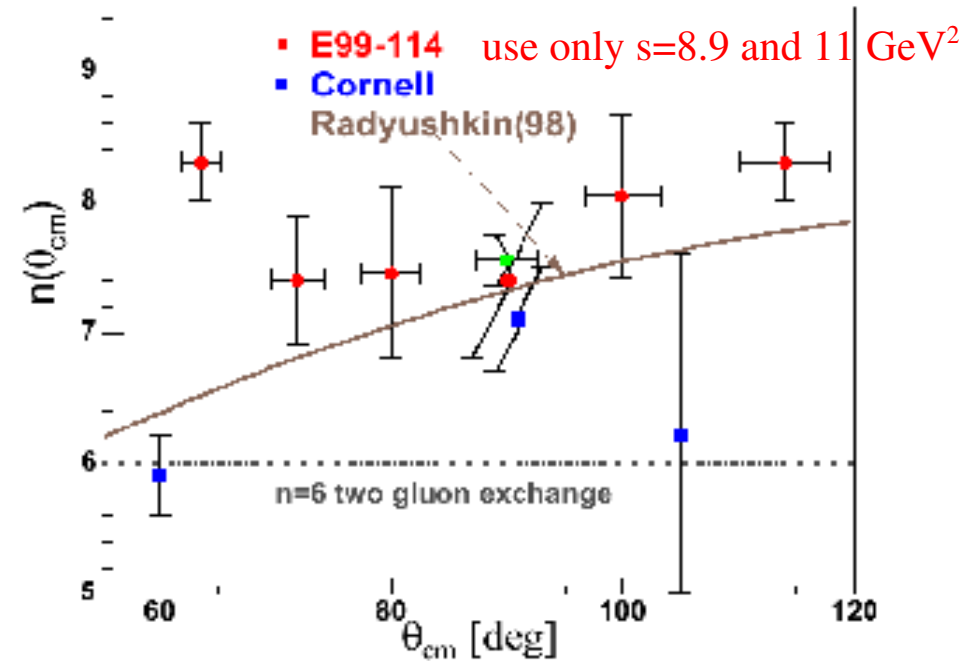
Experimental results: cross section

s scaling for the cross section

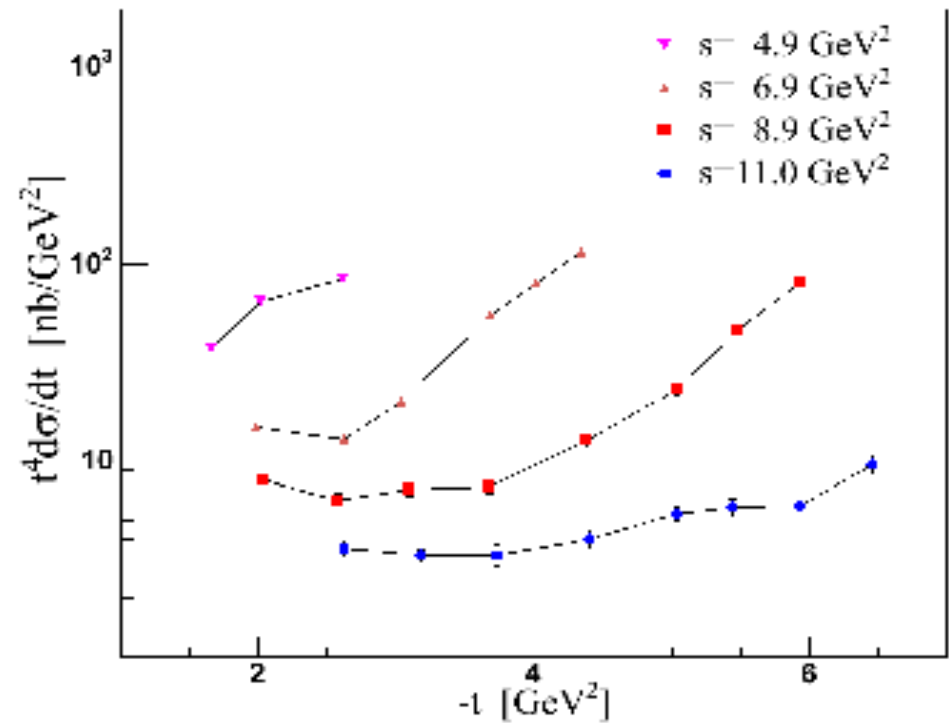
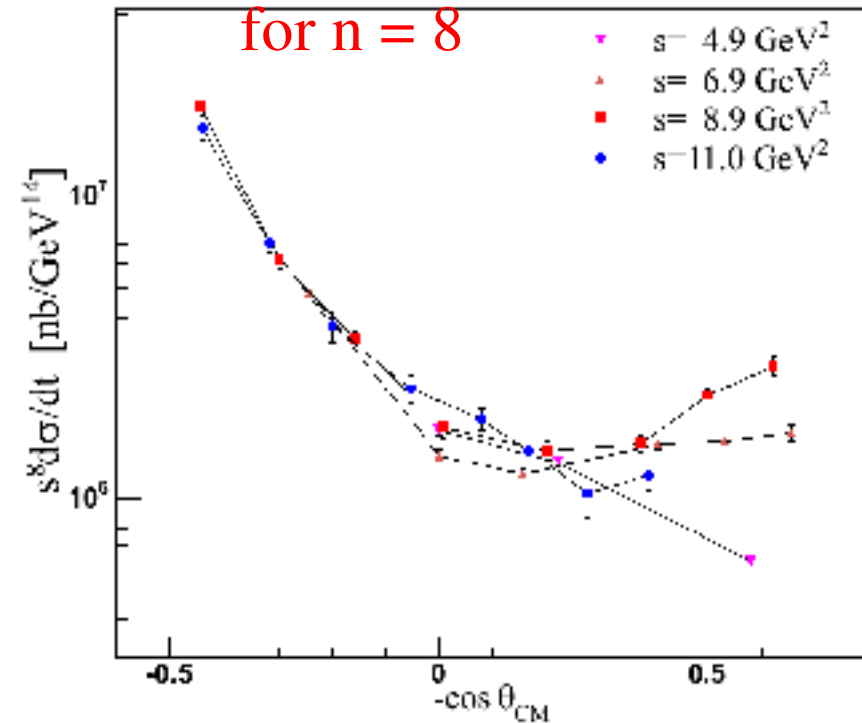
$$d\sigma/dt = f(\theta_{cm}) / s^n$$

pQCD prediction is $n = 6$

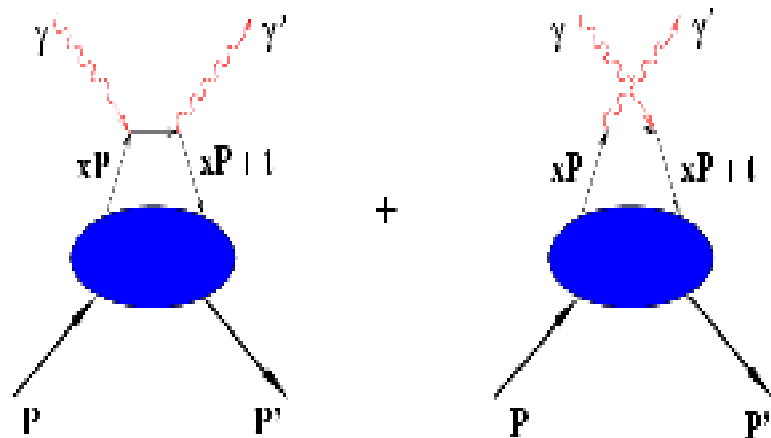
$$d\sigma/dt = C / s^2 t^4$$



for $n = 8$



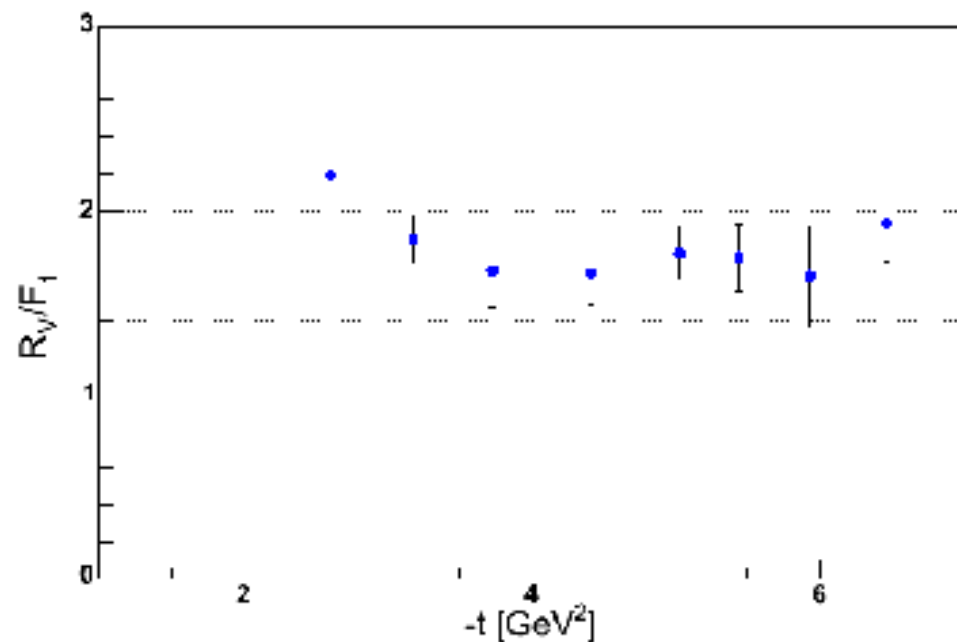
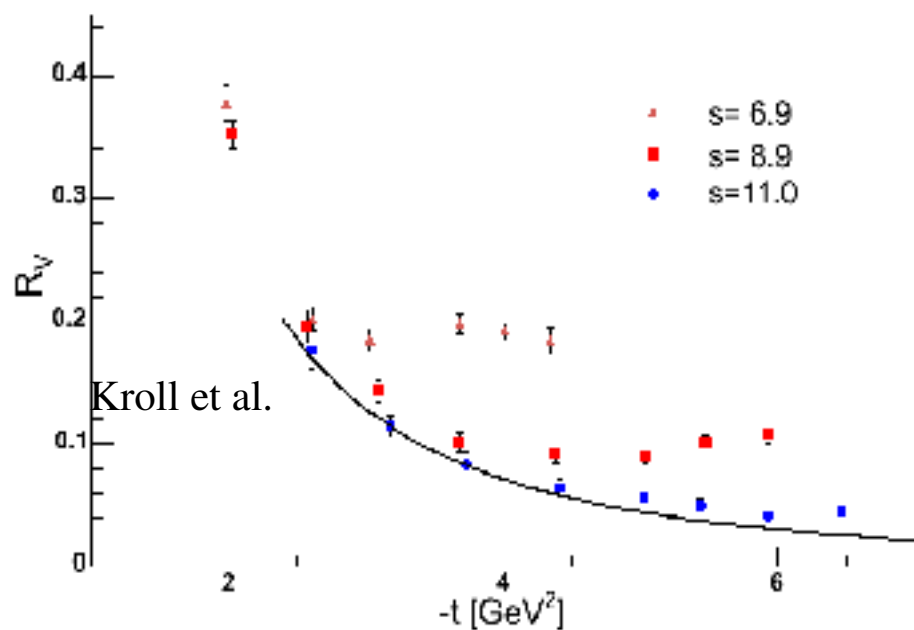
Form factors of RCS and partonic structure of the nucleon



$$\frac{d\sigma_{\text{res}}}{d\sigma_{\text{res}}} = \frac{(\hat{s} - \hat{u})^2}{\hat{s}^2 + \hat{u}^2} R_V^2(t) - \frac{2\hat{s}\hat{u}}{\hat{s}^2 + \hat{u}^2} R_A^2(t)$$

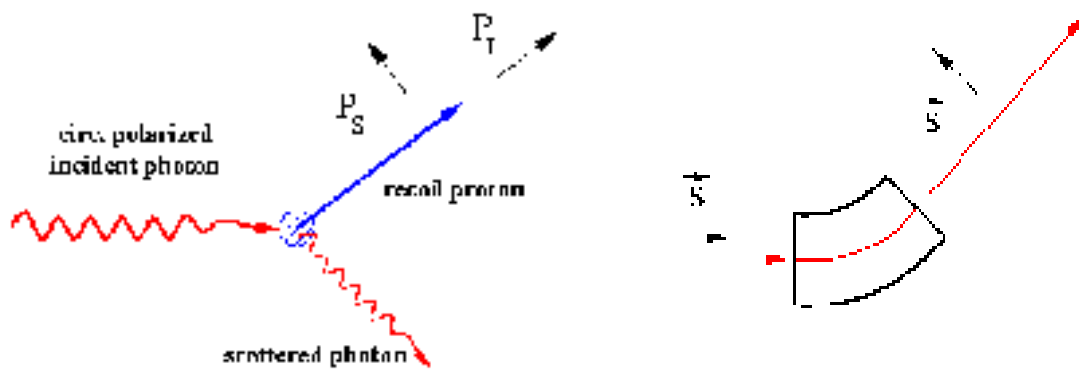
$$R_V(t) = \sum_a e_a^2 \int_{-1}^1 \frac{dx}{x} H^a(x; 0, t), \quad R_A(t) = \sum_a e_a^2 \int_{-1}^1 \frac{dx}{x} \tilde{H}^a(x; 0, t)$$

$$F_1(t) = \sum_a e_a \int_{-1}^1 dx H^a(x, 0, t), \quad F_2(t) = \sum_a e_a \int_{-1}^1 dx E^a(x, 0, t)$$



Experimental results: polarization transfer K_{LL}

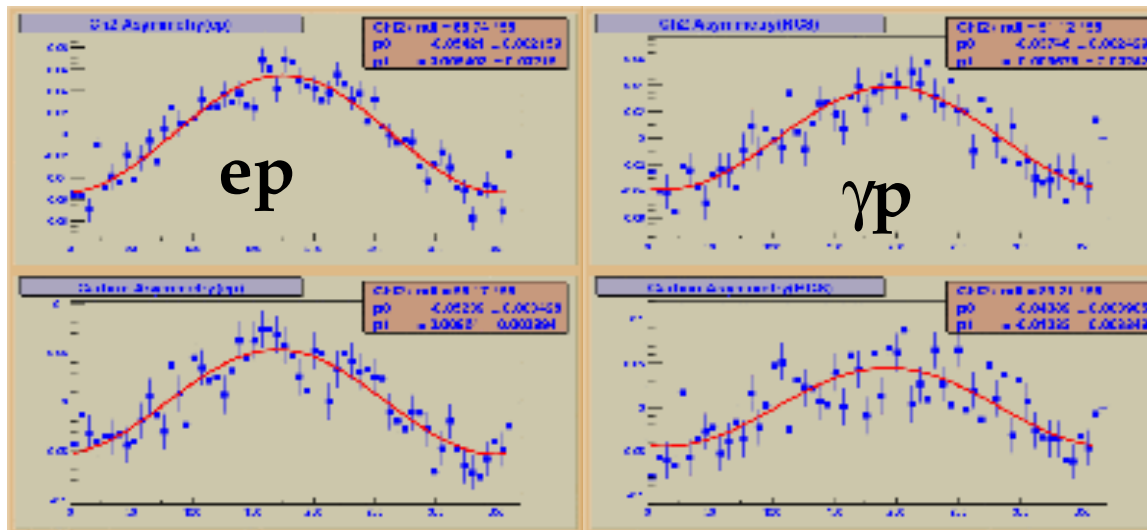
$$E_\gamma = 3.2 \text{ GeV}, \theta_{cm} = 120^\circ \quad (s = 6.9, t = -4 \text{ GeV}^2)$$



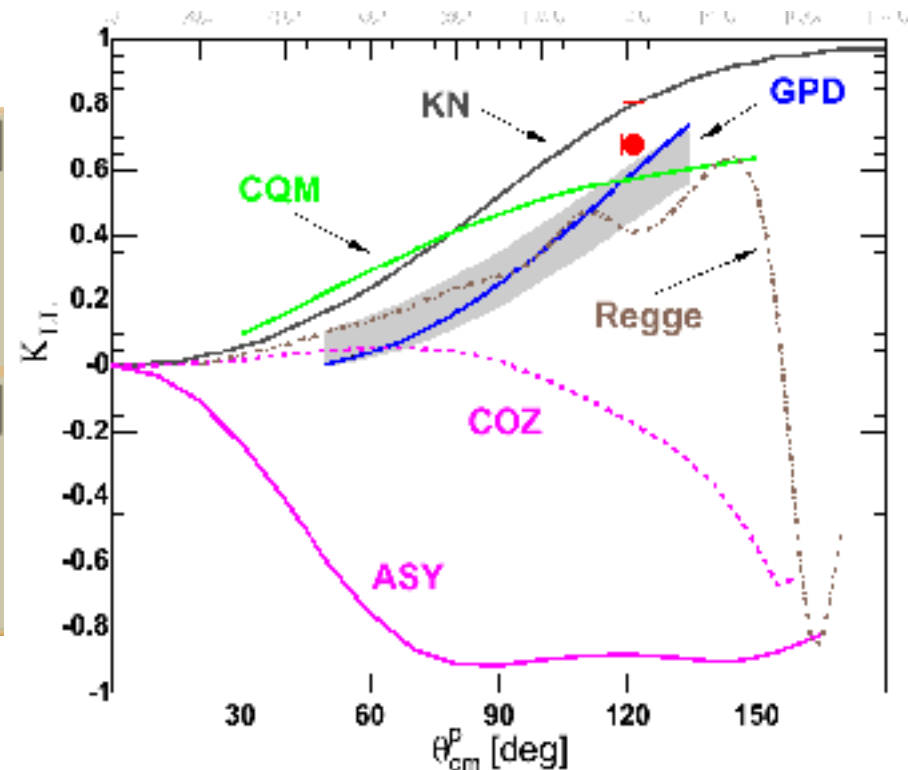
K_{LL} is an average value of the longitudinal proton spin in the γp cm system for 100% circular polarization of incident photon.

$$K_{LL} = \frac{1}{2} \left[\frac{\sigma(-,-) - \sigma(-,+)}{\sigma(+,-) + \sigma(+,+)} - \frac{\sigma(-,-) - \sigma(-,+)}{\sigma(+,-) + \sigma(+,+)} \right]$$

Raw asymmetry for ep and γp events



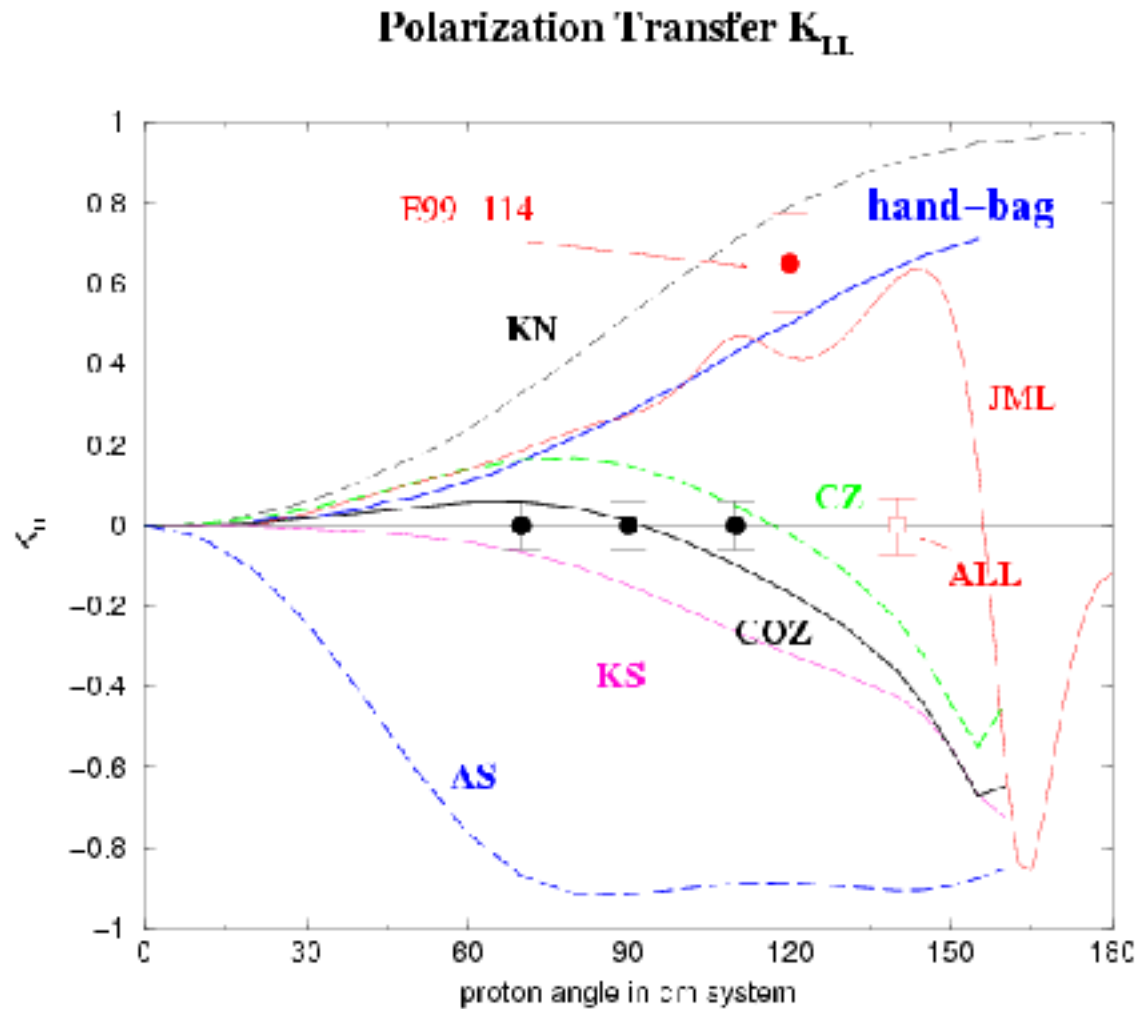
raw asymmetry is of 0.05, systematics is below 10^{-4}



New proposal for polarization transfer K_{LL} : PR 06-001

$$E_{\gamma} = 4.3 \text{ GeV}, \theta_{\text{cm}} = 70, 90, 110^{\circ} \text{ (s = 9, t = -2.4 - 4.9 GeV}^2\text{)}$$

Gilman, Nathan, Wojtsekhowski

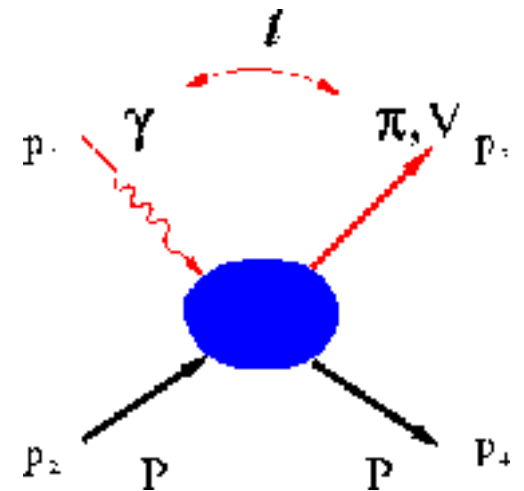
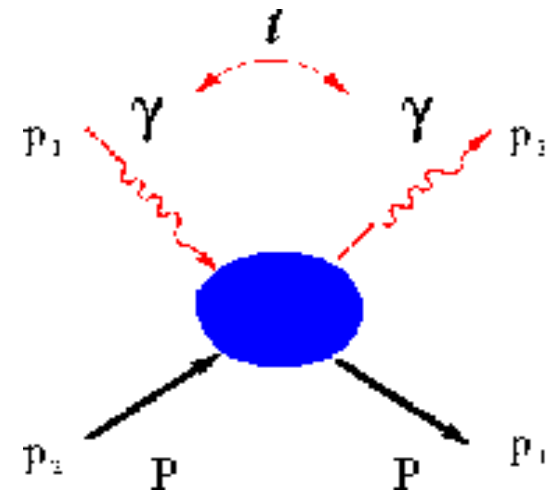


Exclusive processes at momentum transfer of few GeV^2 and a role of two gluon exchange in this regime

Experimental results suggest that hand-bag dominates for RCS in wide angle regime \Rightarrow soft overlap is sufficient to provide correct amplitude of the RCS process up to $s \sim 10 \text{ GeV}^2$, $-t \sim 5 \text{ GeV}^2$

What about exclusive meson photo-production? Presently GPD based calculations are missing experimental cross section by a factor of 100!

Pion w.f. allows even more momentum via soft overlap mechanism \rightarrow It is very unlikely to reach pQCD regime at present JLab 6 GeV energy!



Recent Progress

- Final Analysis of Polarization Data
 - Thesis of David Hamilton, Glasgow, Sept. 2004
 - Publication in PRL, June 2005
- Full and final analysis of cross sections
 - Thesis of Vahe Mamyán, YerPhi, Sept. 2005
 - Thesis of Areg Danagoulian, UIUC, currently writing
 - PRL manuscript in progress
- A_{LL} RCS experiment E05-101 approved to run in Hall C
- Jeopardy proposal submitted for K_{LL} at larger $s, -u, -t$