π^0 electroproduction cross sections at JLab

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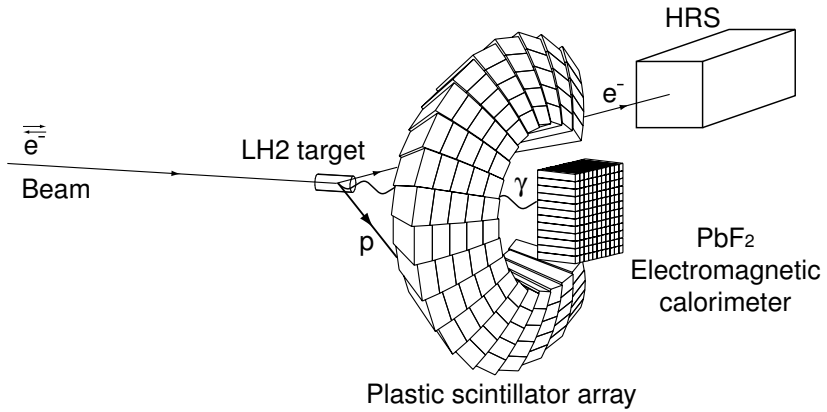
Los Alamos National Laboratory

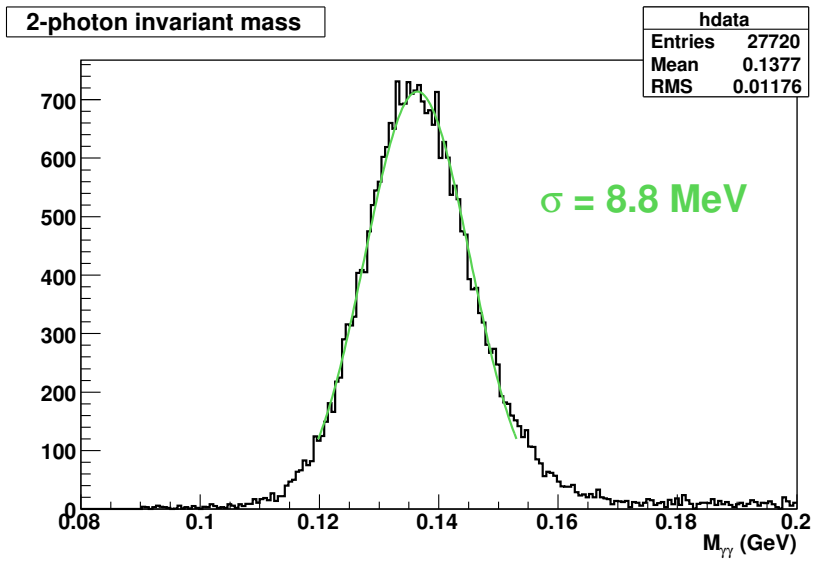
Hard Exclusive Processes at JLab 12 GeV and a Future EIC
Oct 29-30, 2006

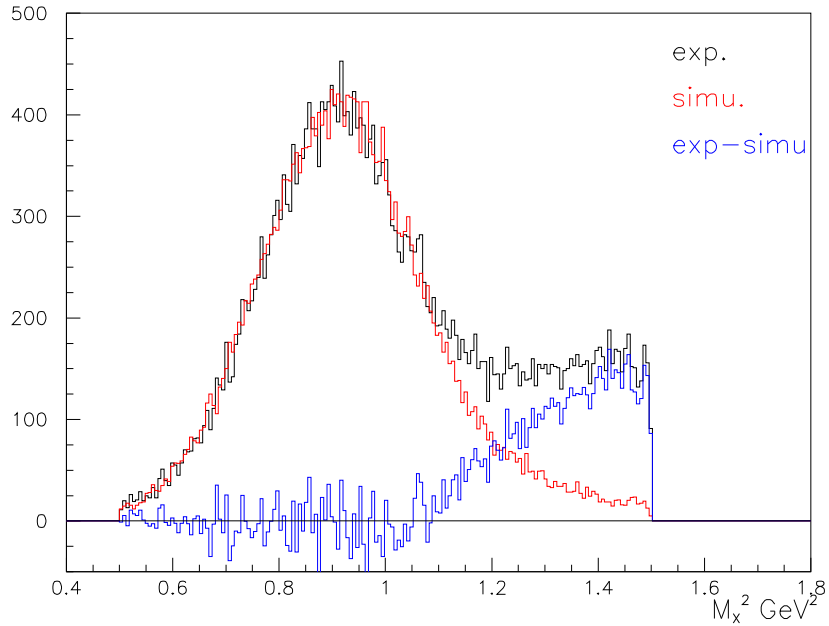
Kinematics and statistics

$\langle Q^2 \rangle = 2.3$ GeV^2, $\langle x_B \rangle = 0.36$, $\langle s \rangle = 4.9$ GeV^2

Data taken concurrently with
E00-110 (Hall A – DVCS)



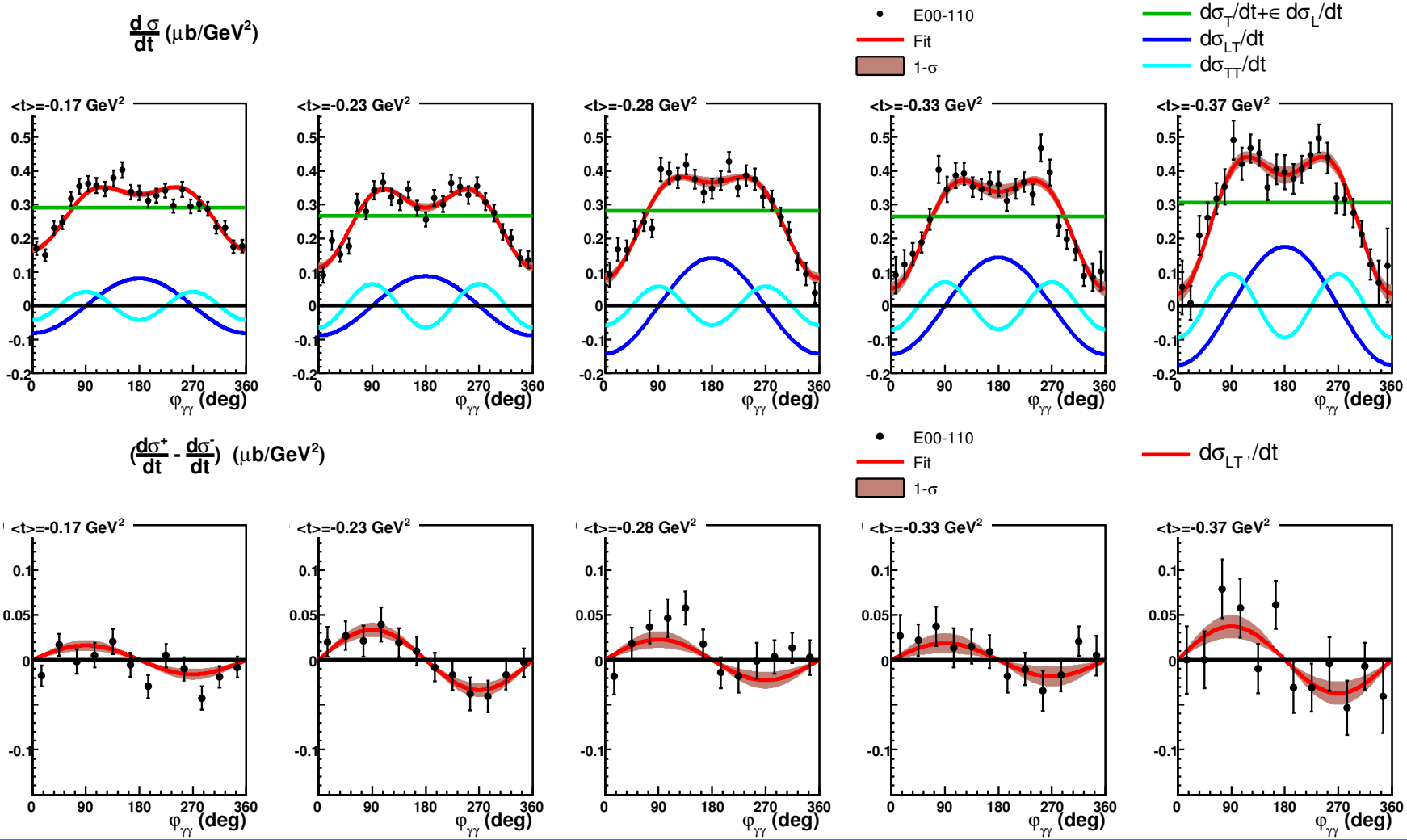




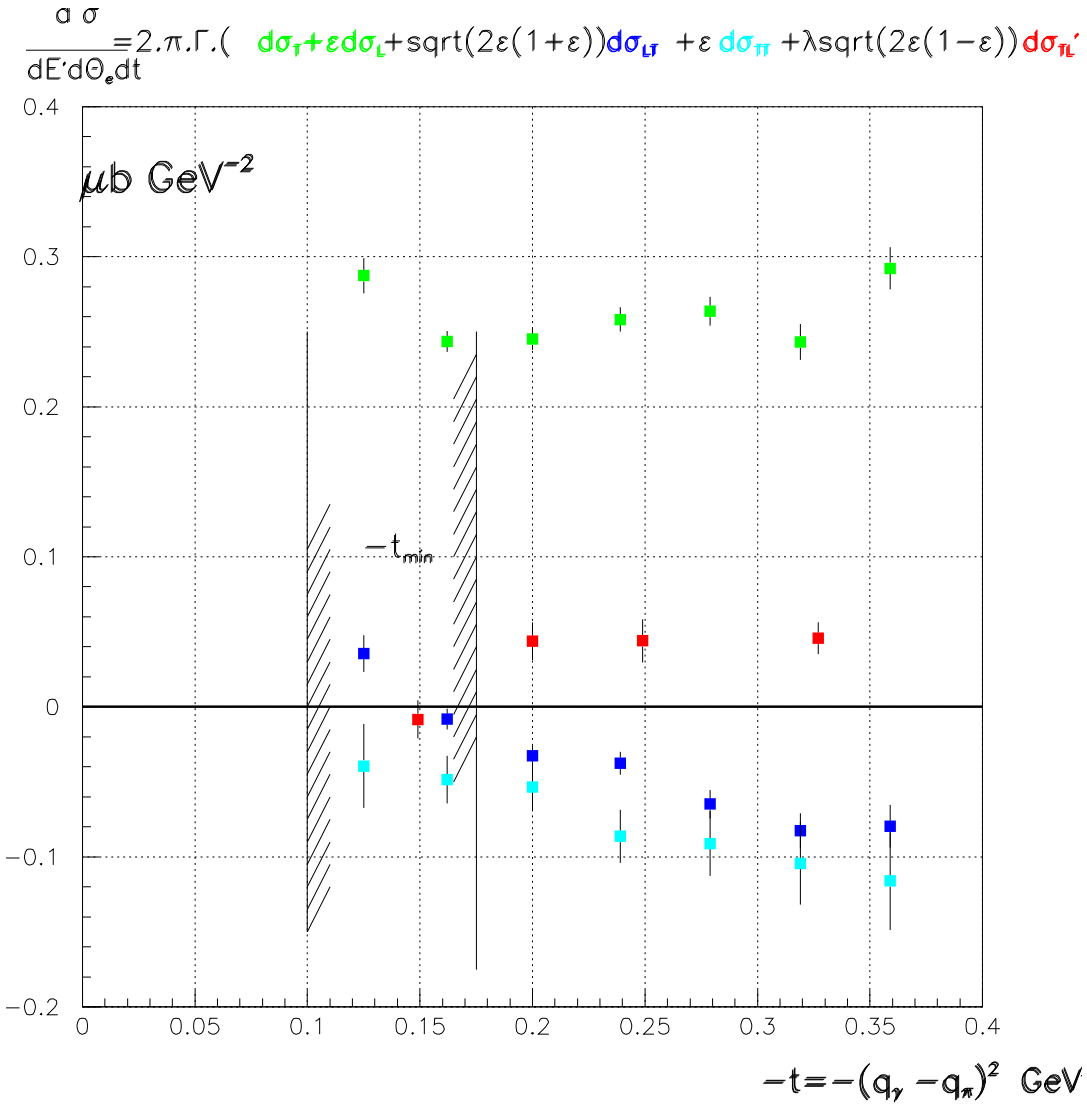
Missing mass squared: $ep \rightarrow e\gamma\gamma X$

π^0 cross sections (preliminary)

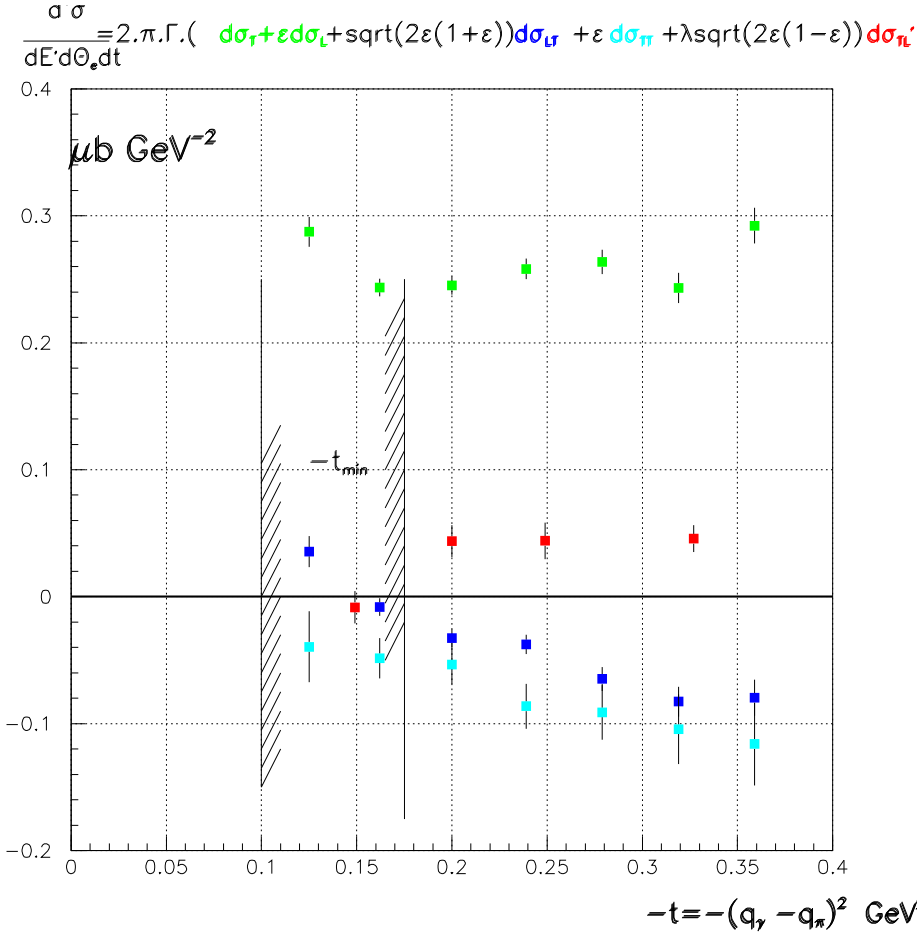
$$\frac{d\sigma}{dt} = \frac{d\sigma_T}{dt} + \epsilon\frac{d\sigma_L}{dt} + \sqrt{2\epsilon(1+\epsilon)}\frac{d\sigma_{LT}}{dt}\cos\phi + \epsilon\frac{d\sigma_{TT}}{dt}\cos 2\phi + h\sqrt{2\epsilon(1-\epsilon)}\frac{d\sigma_{LT'}}{dt}\sin\phi$$

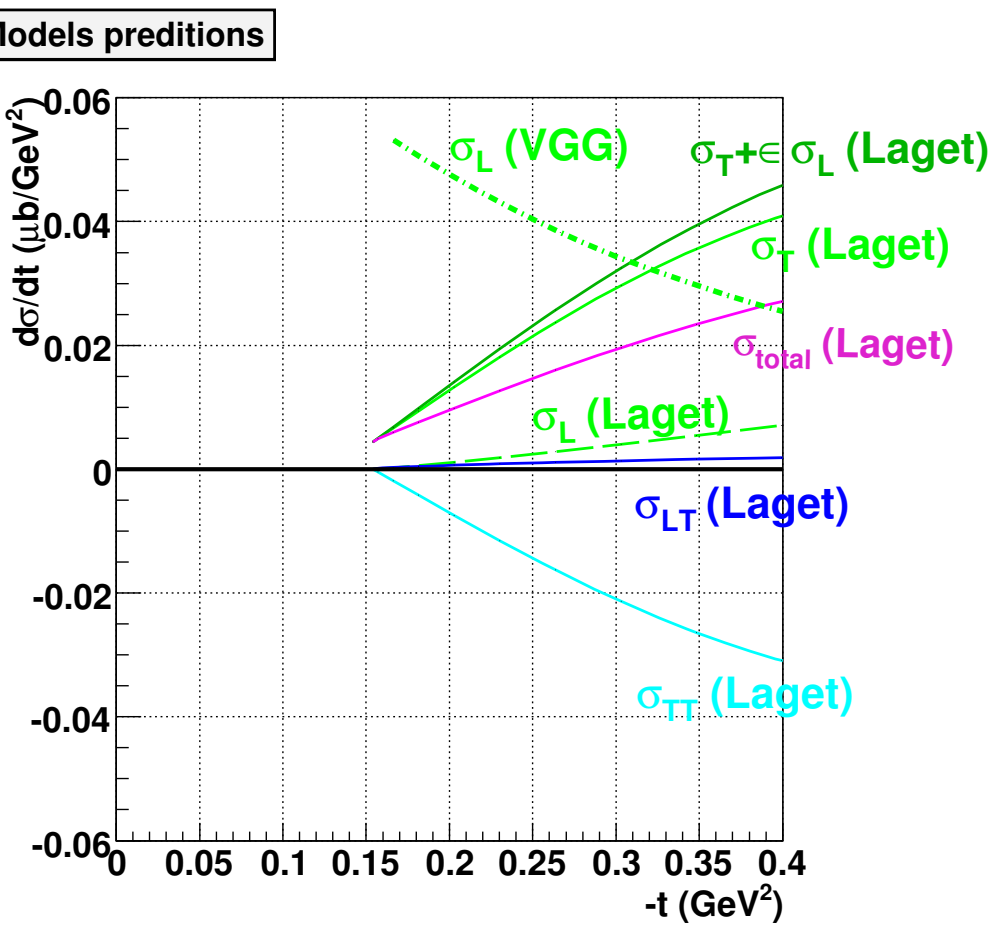


π^0 cross-section results (preliminary)



π^0 cross sections & models (VGG + Laget)





- VGG: σ_L only (GPD based – PR **D60** (1999) 094017)
- Laget: ω, ρ and b_1 meson exchange (work in progress: $\pi^+ \ldots$)

Response functions

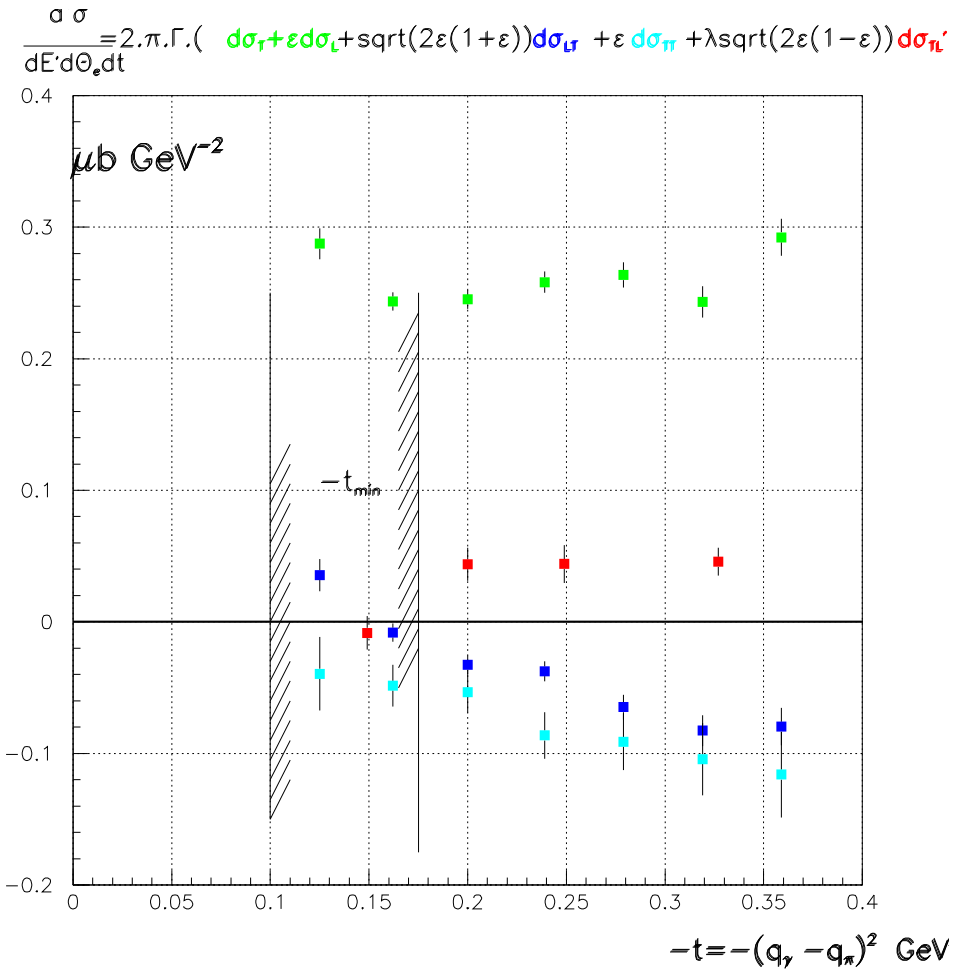
$$\frac{d^2\sigma}{d^2\Omega_{cm}} = \frac{q_\pi}{K_\gamma^{cm}}[R_T + \epsilon R_L + \sqrt{\epsilon(1+\epsilon)}R_{TL}\cos\phi + \epsilon R_{TT}\cos 2\phi + h\sqrt{\epsilon(1-\epsilon)}R_{TL'}\sin\phi$$

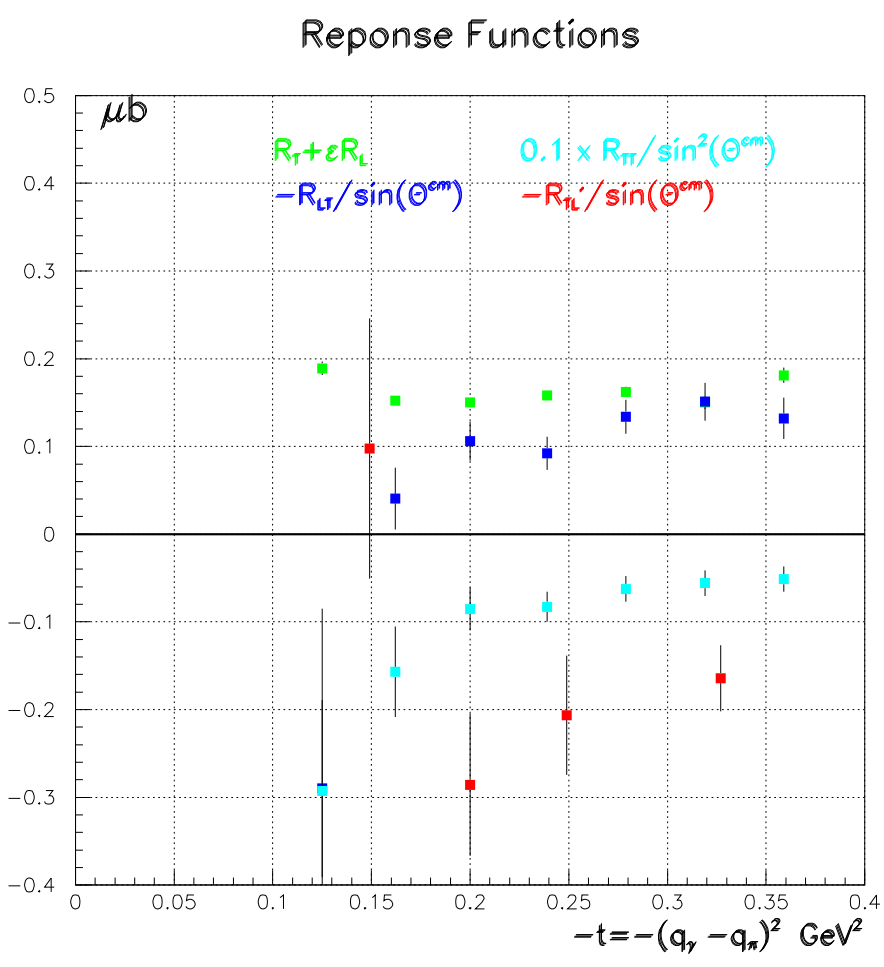
$$\begin{aligned}
R_T &= |F_1|^2 + |F_2|^2 - 2\,\mathcal{R}\mathrm{e}\{F_1^* F_2^*\} + \mathcal{O}(\theta_{cm}^2) \\
R_L &= |F_5|^2 + |F_6|^2 + 2\,\mathcal{R}\mathrm{e}\{F_5^* F_6^*\} + \mathcal{O}(\theta_{cm}^2) \\
R_{TL} &= -\sin\theta_{cm}\ \mathcal{R}\mathrm{e}\{(F_1^* + F_3^* + F_4^*)(F_5 + F_6)\} + \mathcal{O}(\theta_{cm}^3) \\
R_{TT} &= +\sin^2\theta_{cm}[\frac{1}{2}(|F_3|^2 + |F_4|^2) + \mathcal{R}e\{F_1^* F_4 + F_2^* F_3 + F_3^* F_4\}] + \mathcal{O}(\theta_{cm}^3) \\
R_{TL'} &= -\sin\theta_{cm}\ \mathcal{I}\mathrm{m}\{(F_1^* + F_3^* + +F_4^*)(F_5 + F_6)\} + \mathcal{O}(\theta_{cm}^3)
\end{aligned}$$

$$\boxed{\theta_{cm} = \theta_{cm}(t)}$$

$F_1 \ldots F_6$: CGLN amplitudes

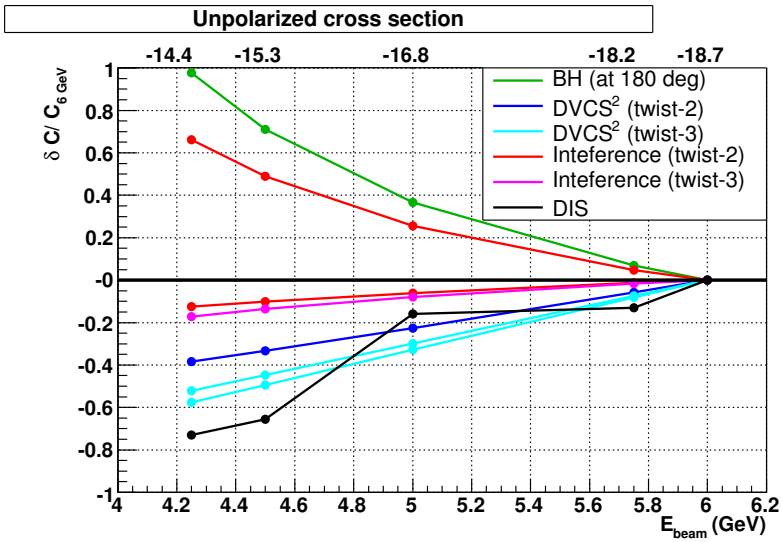
Response functions results (preliminary)

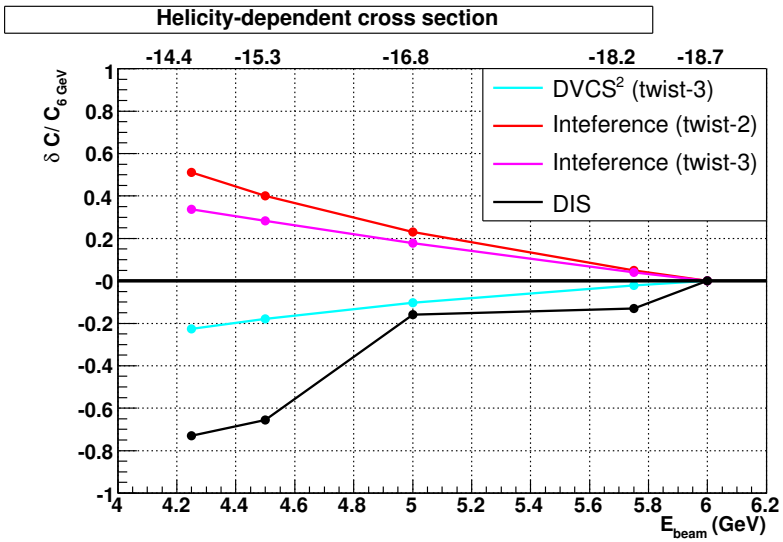


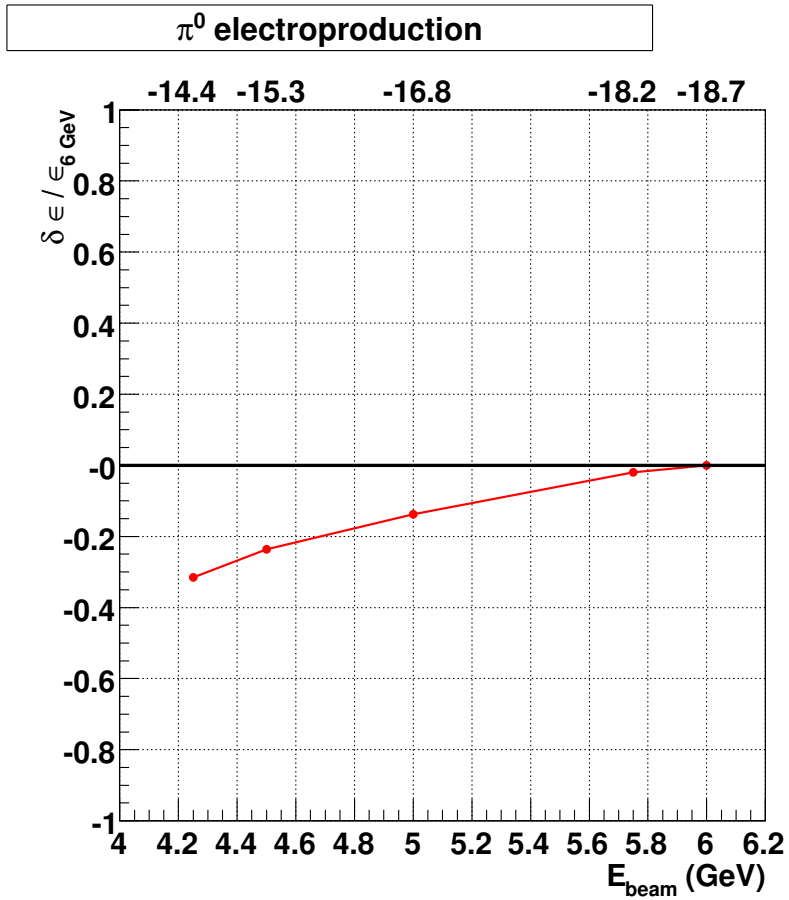


Isolation of σ_L: same kinematics as DVCS^2 separation

$Q^2 = 1.9\,\mathrm{GeV}^2,\ x_B = 0.36,\ s = 4.9\ \mathrm{GeV}^2$







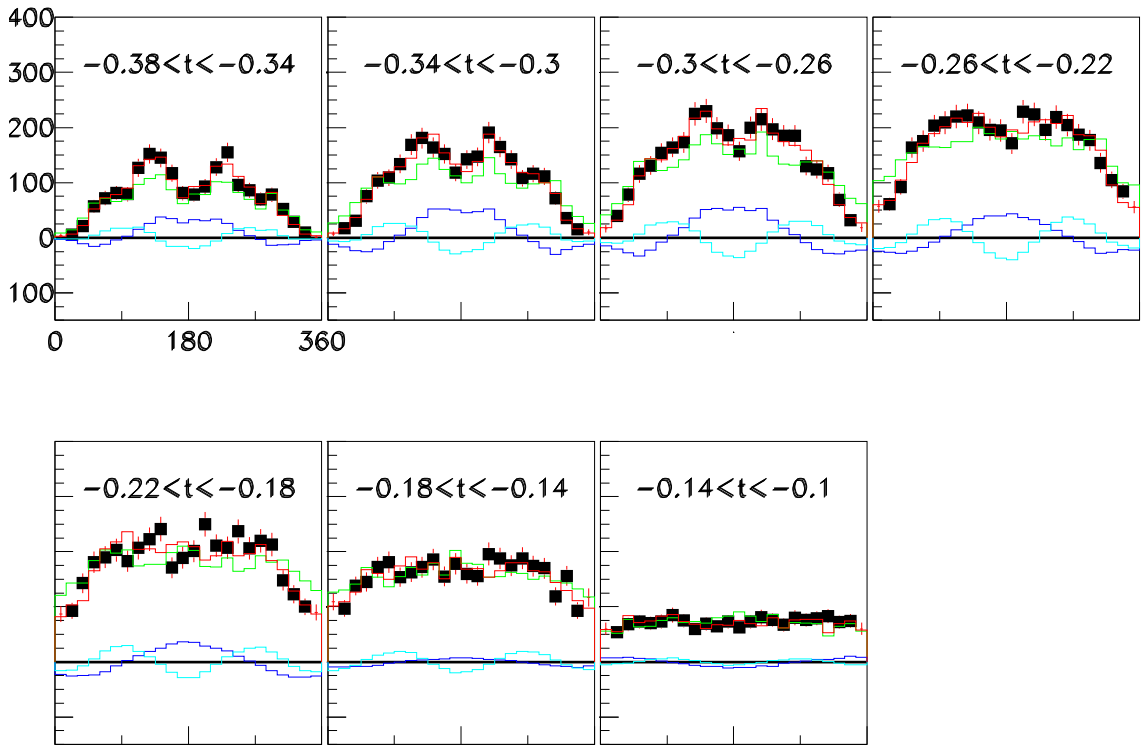
Backup slides

Counts

count = A + B cos(φ) + C .cos(2φ)

χ^2= 0.9218

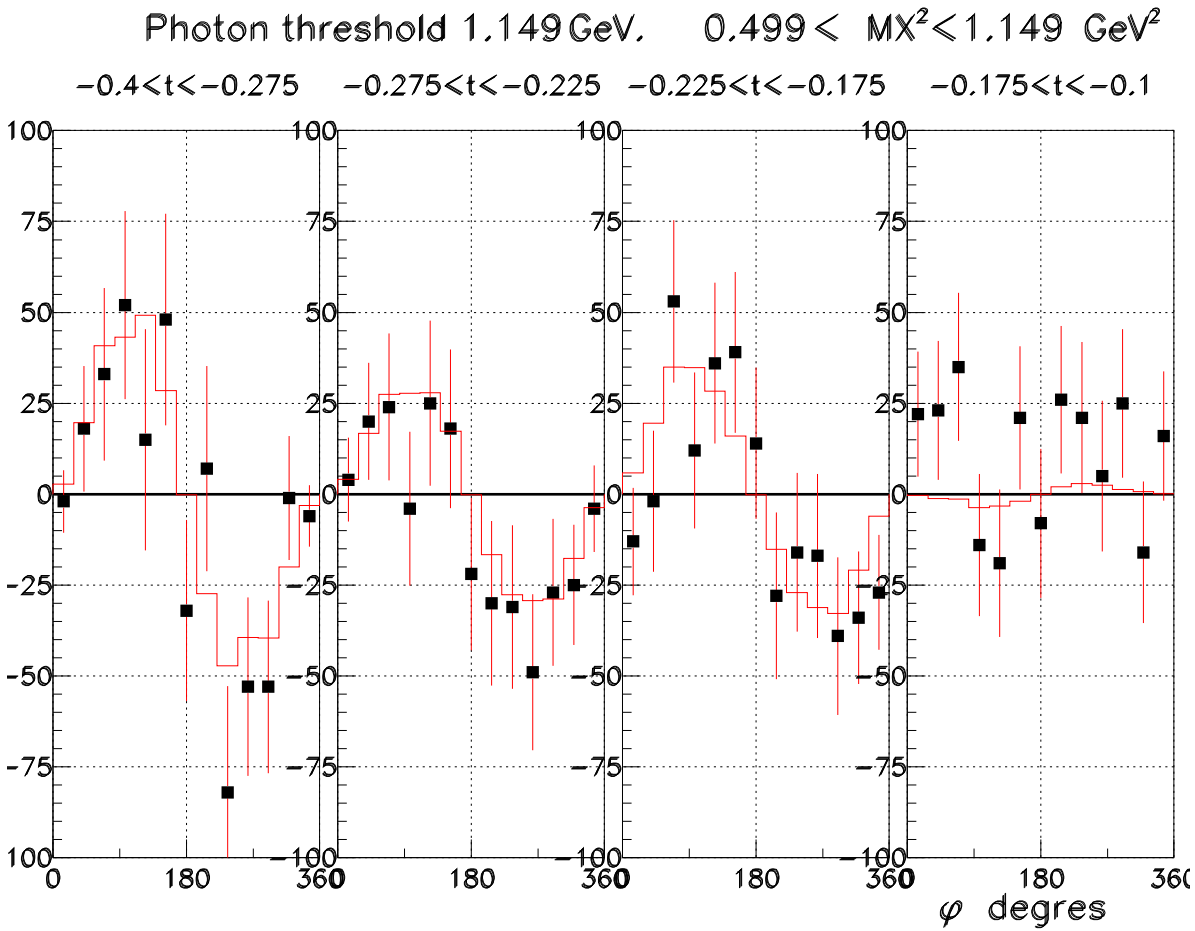
Photon threshold 1.149 GeV. 0.499 < MX^2 < 1.149 GeV^2



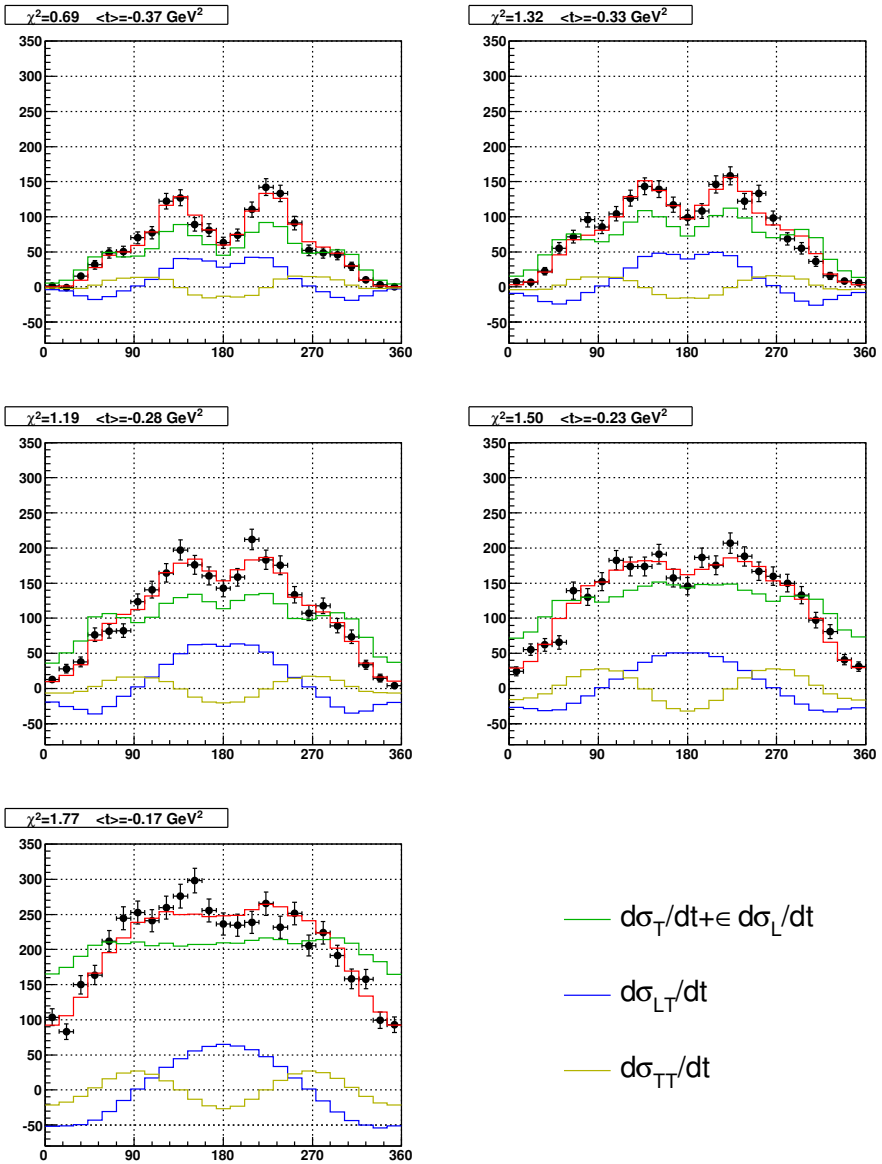
Counts - helicity-dependent

fit $A \sin(\varphi)$ $\chi^2 = 0.79$

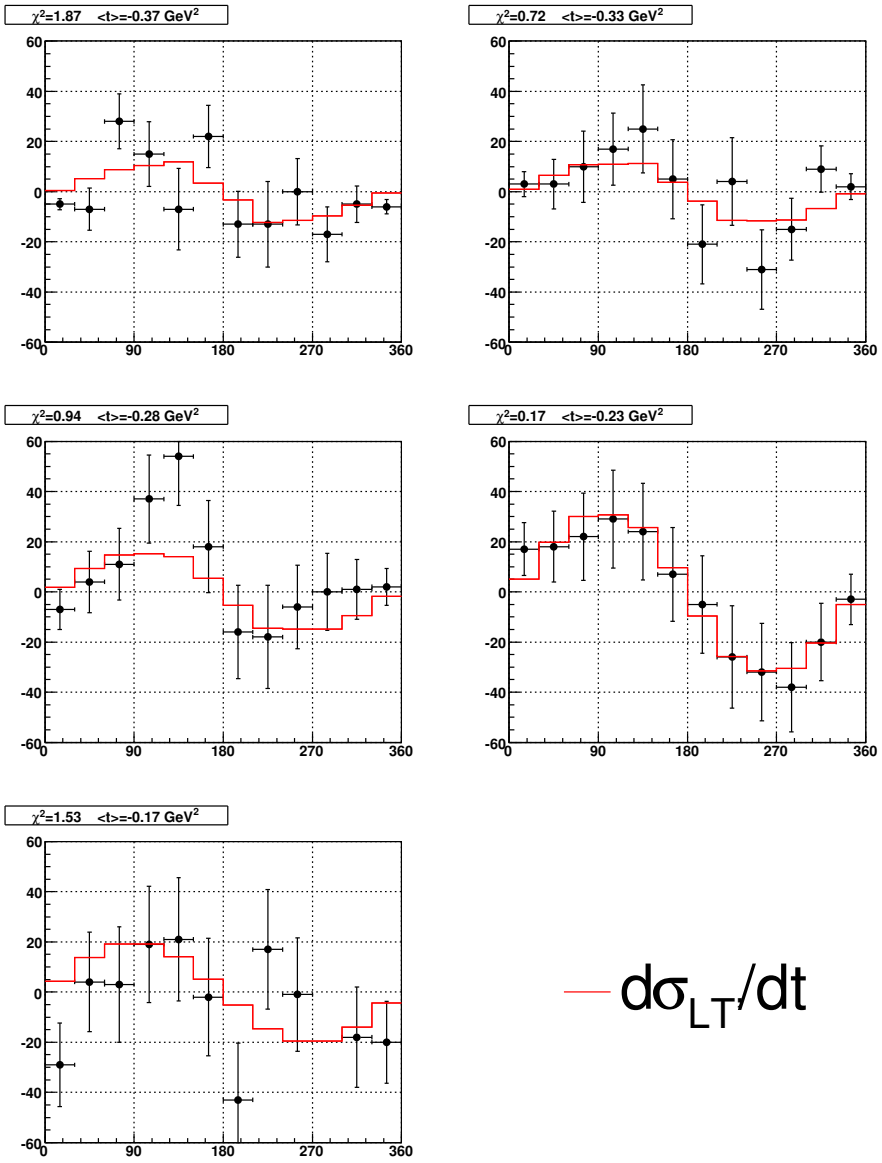
counting $= N^+ - N^-$



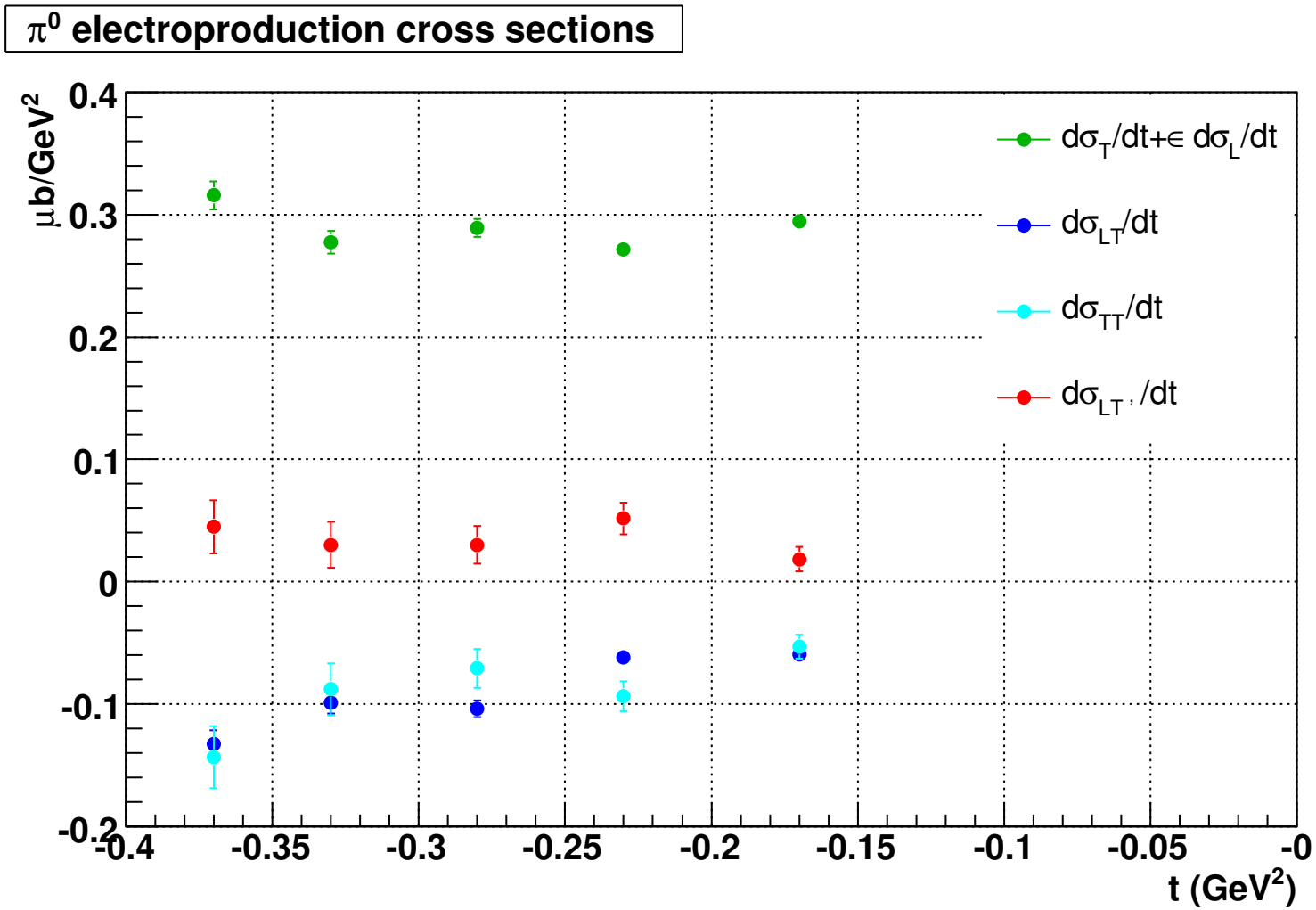
Counts


χ²=0.69 <t>=-0.37 GeV²
χ²=1.32 <t>=-0.33 GeV²
χ²=1.19 <t>=-0.28 GeV²
χ²=1.50 <t>=-0.23 GeV²
χ²=1.77 <t>=-0.17 GeV²
dσT/dt+ϵ dσL/dt
dσLT/dt
dσTT/dt

Counts - helicity-dependent



Results


π^0 electroproduction cross sections
μb/GeV²
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.4
-0.35
-0.3
-0.25
-0.2
-0.15
-0.1
-0.05
-0
t (GeV²)
dσ_T/dt+ϵ dσ_L/dt
dσ_LT/dt
dσ_TT/dt
dσ_LT',/dt