Measurement of Fifth Structure Function In the Exclusive $p(\vec{e}, e'K^+)\Lambda$ Reaction with CLAS

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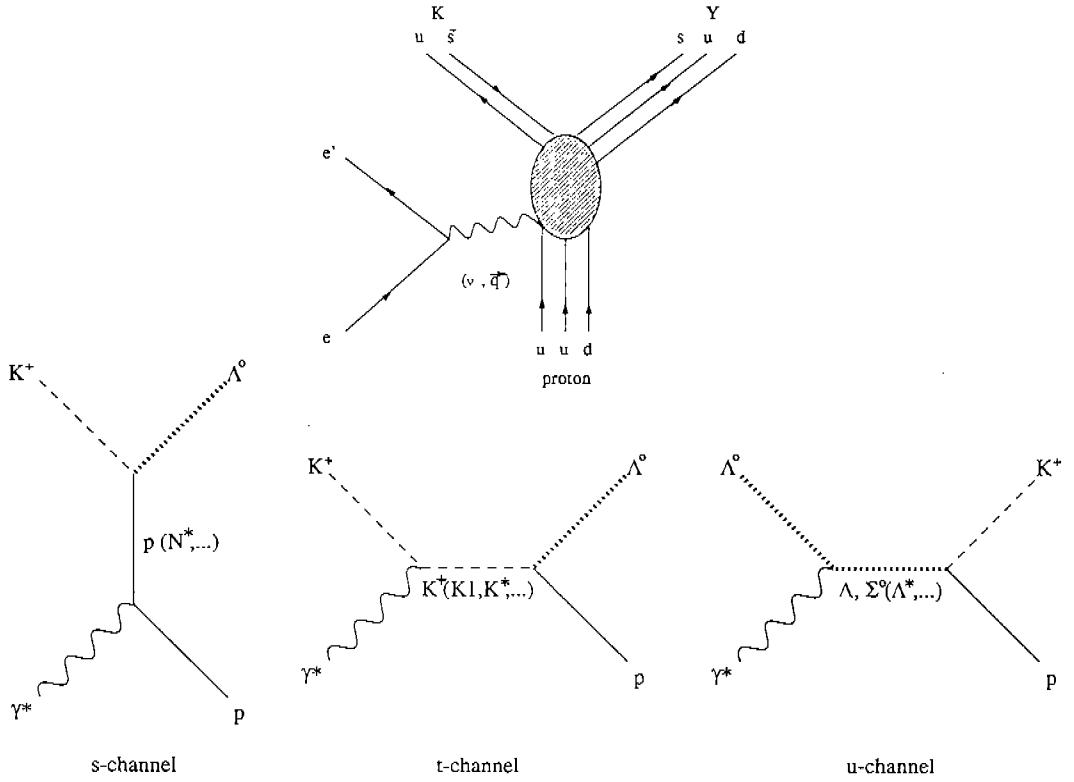
Strangeness Production in $p(\vec{e}, e'K^+)\Lambda$



- Part of N^* program
- The possibility of identifying Non-strange baryons that decay into strange baryon and strange meson, missing resonances.
- Coupling of the baryonic resonance to final states like ΣK, ΛK, ΣK^* and ΛK^*
- Should include all the possible initial and final states such as ηN and ωN
- Previous information mostly from π production

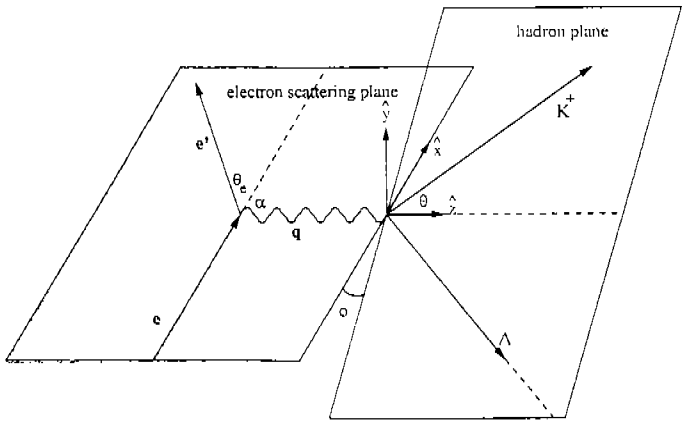
Differential Cross Section for $p(\vec{e}, e'K^+)\Lambda$

$$\frac{d^5\sigma}{d\Omega_{E'} d\Omega_K dE'} = \Gamma \frac{d\sigma_\nu}{d\Omega_K}$$

$$\frac{d\sigma_\nu}{d\Omega_K} = \sigma_0 + h\sqrt{2\epsilon_L(1-\epsilon)}\sigma_{LT'}\sin\phi_K$$

$$\sigma_0 = \sigma_T + \epsilon_L\sigma_L + \sqrt{2\epsilon_L(1+\epsilon)}\sigma_{LT}\cos\phi_K + \epsilon\sigma_{TT}\cos 2\phi_K$$

$$A_{LT'} = \frac{N^+ - N^-}{N^+ + N^-} = \frac{\sqrt{2\epsilon_L(1-\epsilon)}\sigma_{LT'}\sin\phi_K}{\sigma_0}$$

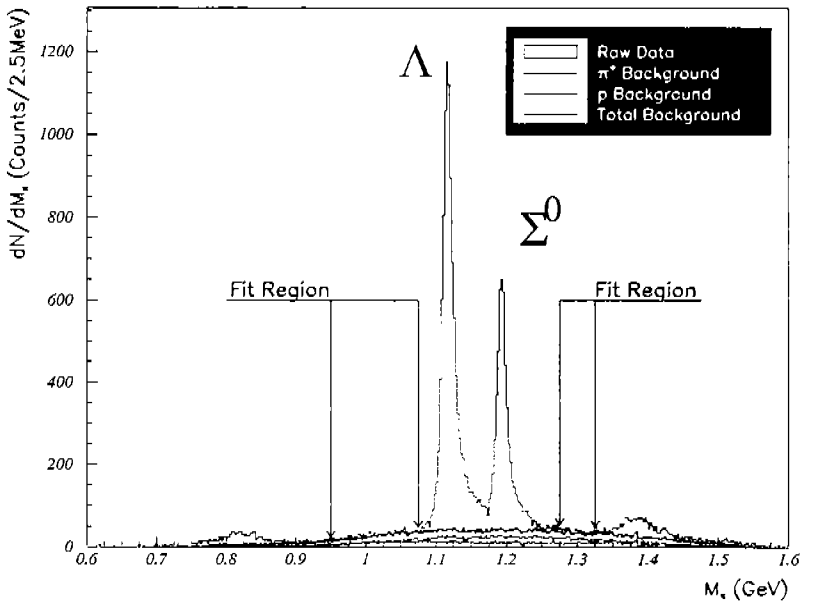


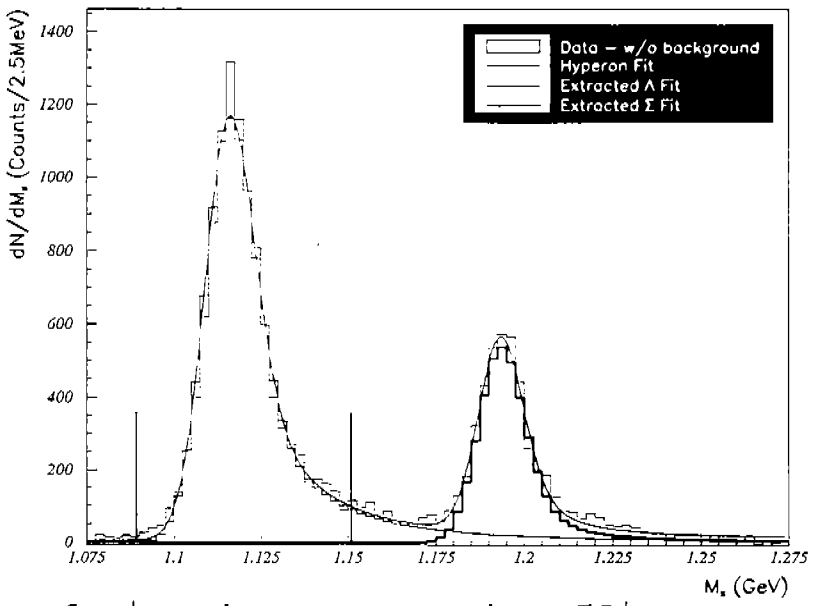
- Extracting the resonance information is not possible unless all trems of the cross section are fully extracted.
- The imaginary part of the LT interference is sensitive to the phase shift of the outgoing wave therfore sensitive to:
  - different resonances
  - interference between resonant and non-resonant background
- CLAS allows measurement of $\sigma_{LT'}$ as a function of kinematic variables.
- First ever measurement.

General Analysis Procedure

- Data Set: 2.567 GeV Polarized Electron Beam on Hydrogen Target
- Standard CLAS Particle ID Procedure:
  - e' And K^+ Detected
  - Hyperon ID, Missing Mass Techniques
- CLAS: Particle Detection Over The Full Angular Range.
- Correction to Measured Helicity Dependent Yields:
  - Radiative Effects
  - CLAS Acceptance
  - Background Effects
- Correction to Measured Asymmetries:
  - Beam Polarization ($\%70$)
  - Beam Charge Asymmetry

Hyperon Missing Mass & Background Model



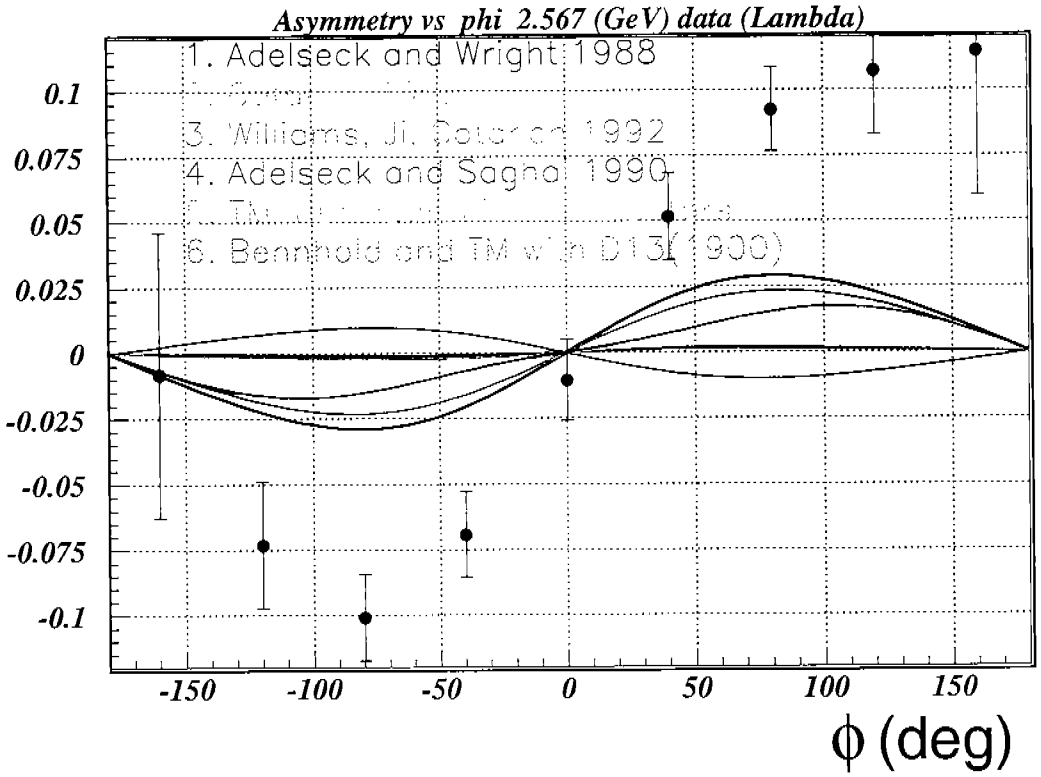


- Samples of π^+ and p are treated as K^+
- Binned max likelihood method used to fit the raw data in the fit regions
- Signal distribution obtained by subtracting the background
- Selecting Λ with a cut on the missing mass spectrum

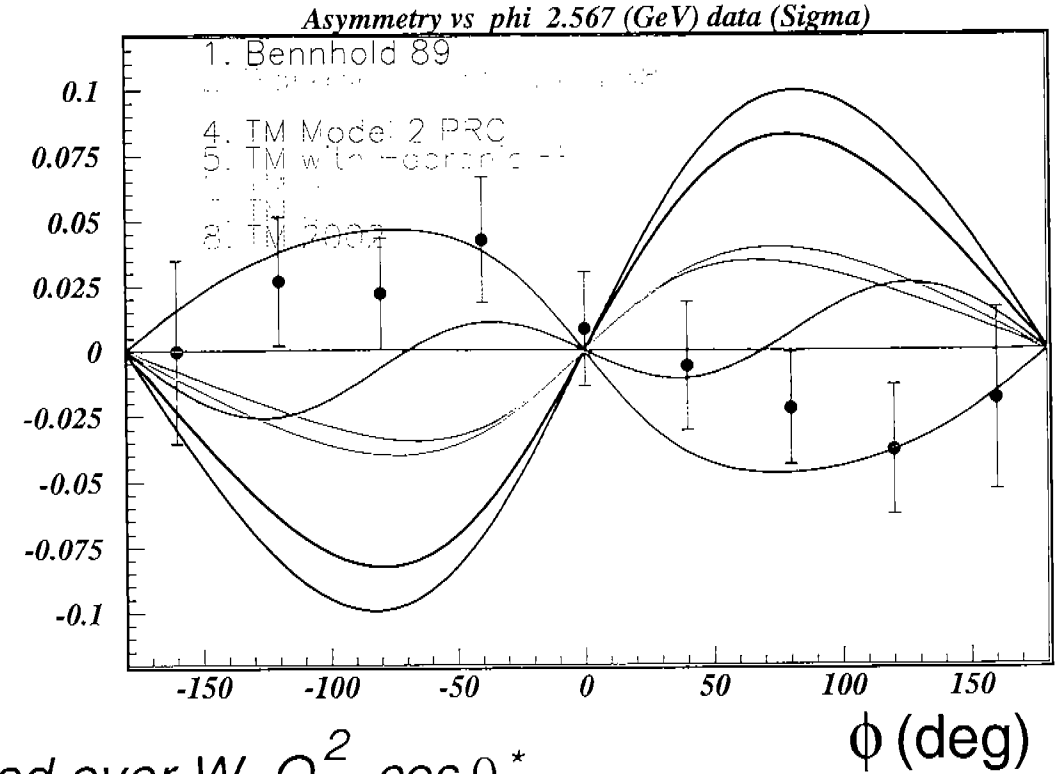
$\vec{e}(p,e'K^+)Y^0$ Single Spin Asymmetry

$$A_{TL'} = \frac{1}{\sigma_0}\sqrt{2\epsilon_L(1-\epsilon)}\sigma_{TL'}\sin\phi = \frac{1}{P_b}\frac{N^+ - N^-}{N^+ + N^-}$$

Λ^0



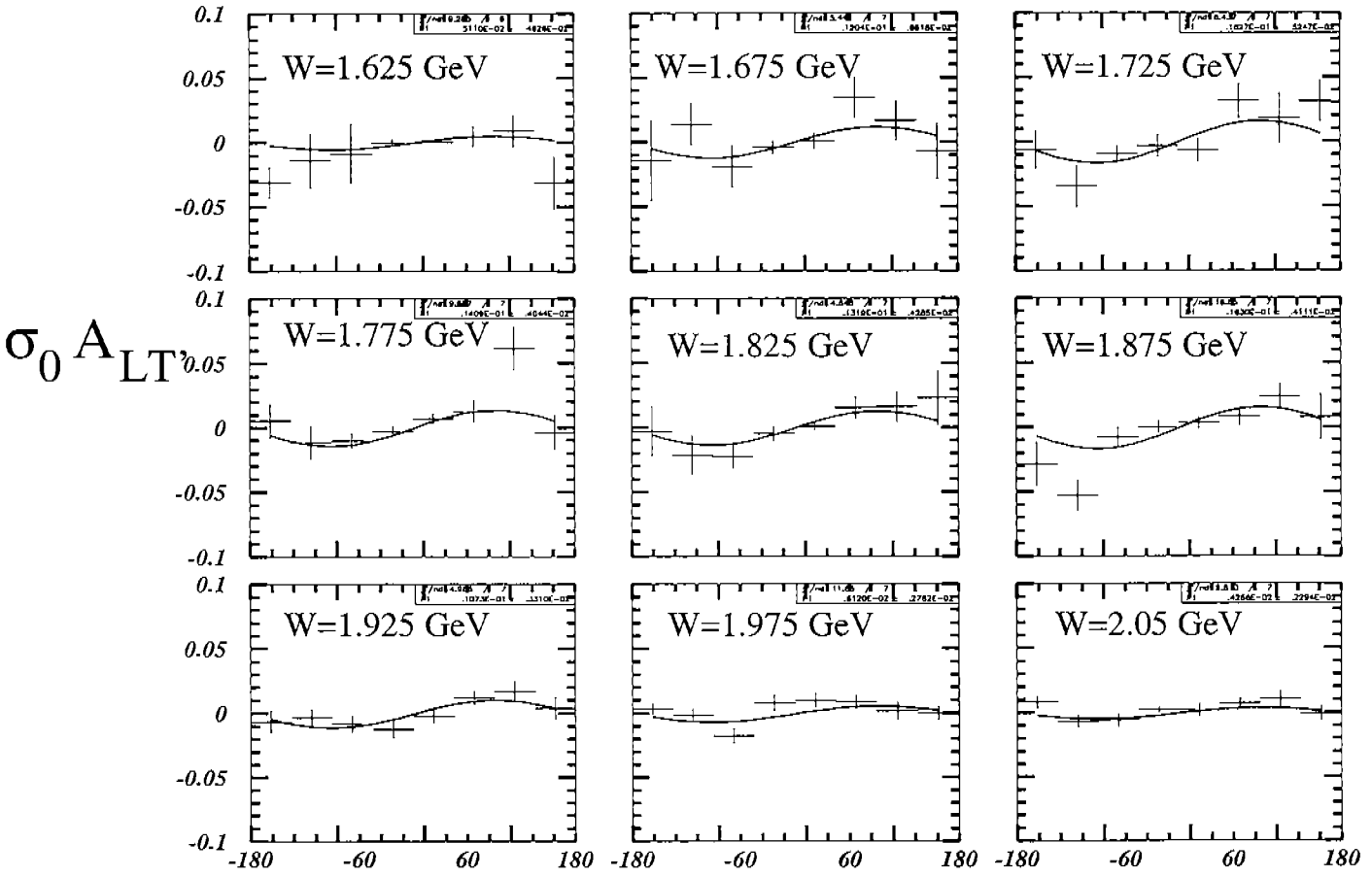
Σ^0



Summed over W, Q^2, $\cos\theta^*_K$

Extraction of $\sigma_{LT'}$ - Sine Fit Method

$Q^2 = 0.7$ (GeV)^2 and $\cos(\theta^*_K) = -0.167$

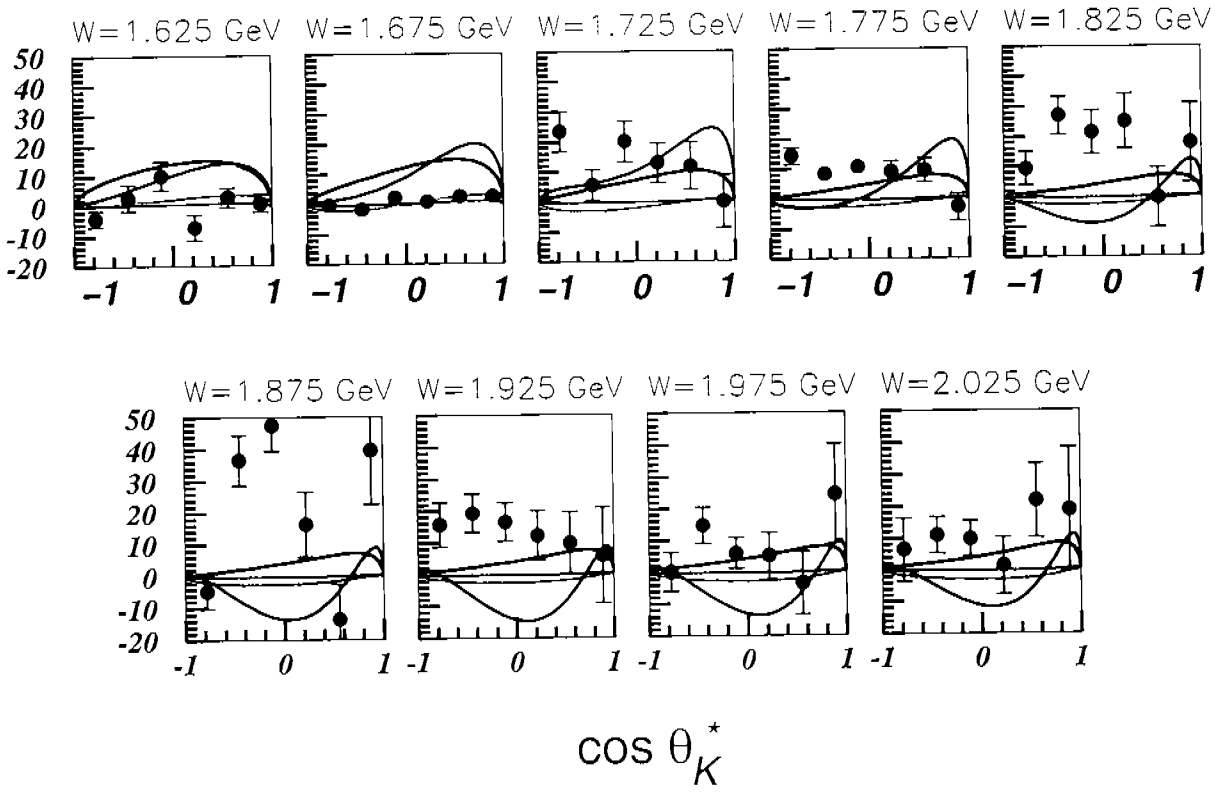


$$\sigma_0 A_{LT'} = \sqrt{2\epsilon_L(1-\epsilon)}\sigma_{LT'}\sin\phi_K$$

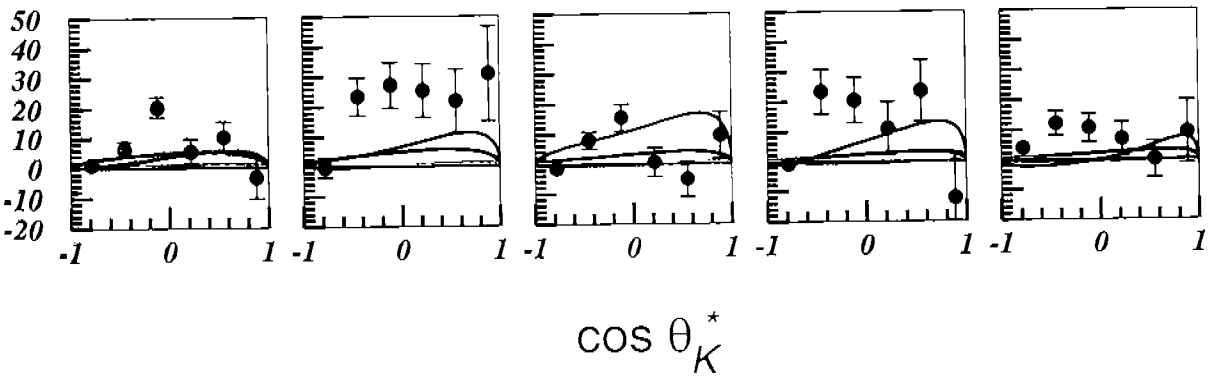
- Unpolarized cross section data from (Exp. 99-030) Robert Feuerbach (Carnegie Mellon University and CLAS colaboration)
- The sine fit parameter gives $\sigma_{LT'}$ times the kinematic factor $\sqrt{2\epsilon_L(1-\epsilon)}$ that is determined from the data.

$\sigma_{LT'}$ for $\vec{e}(p,e'K^+)\Lambda^0$

Q^2=0.7 GeV^2



Q^2=1.1 GeV^2



BM02 — AW88 — WJC92 — BM98

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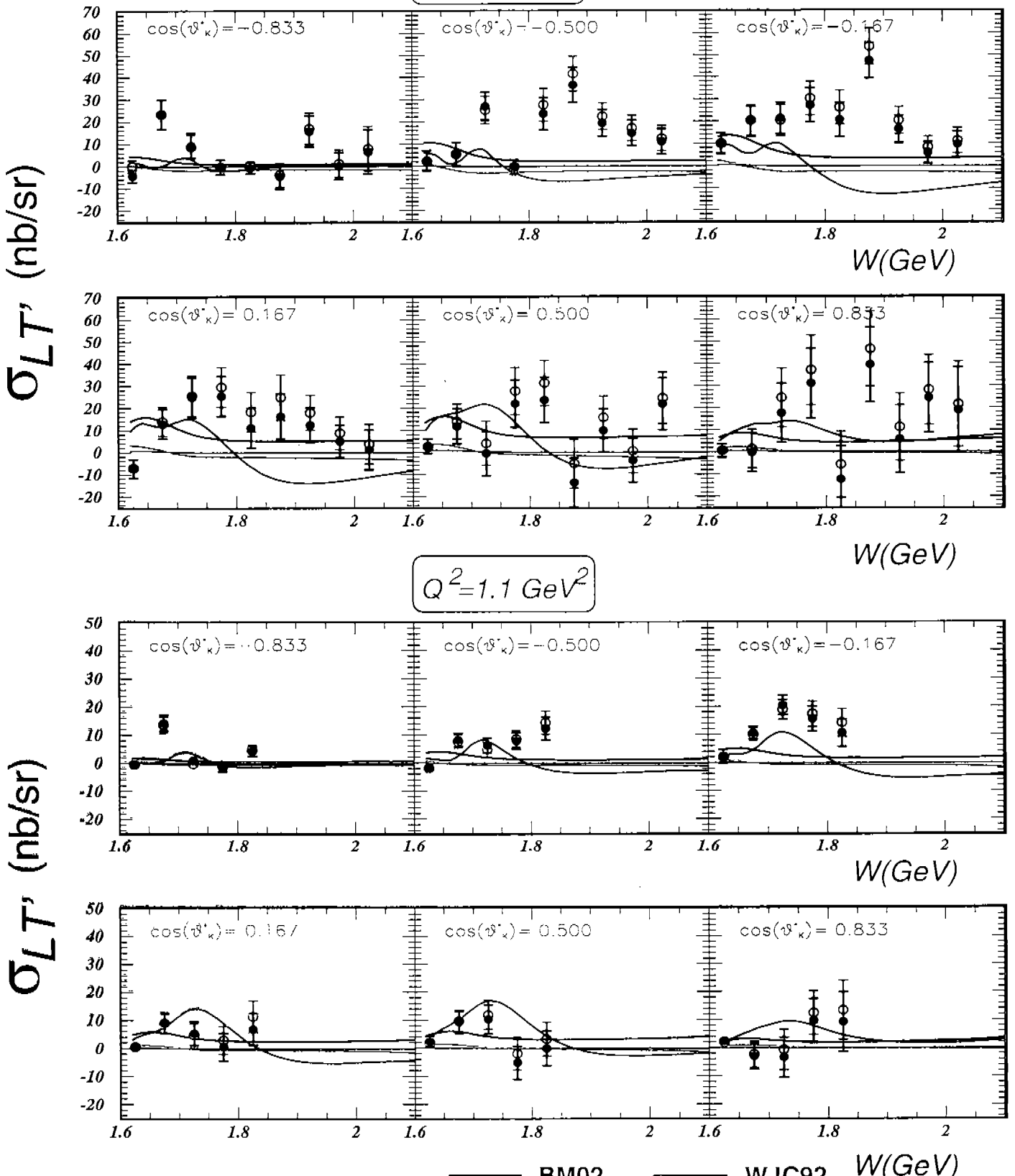
$\sigma_{LT'}$ for $\vec{e}(p,e'K^+)\Lambda^0$



red points: before rad. corr.
black points: after rad. corr.

BM02 — AW88 — WJC92 — BM98

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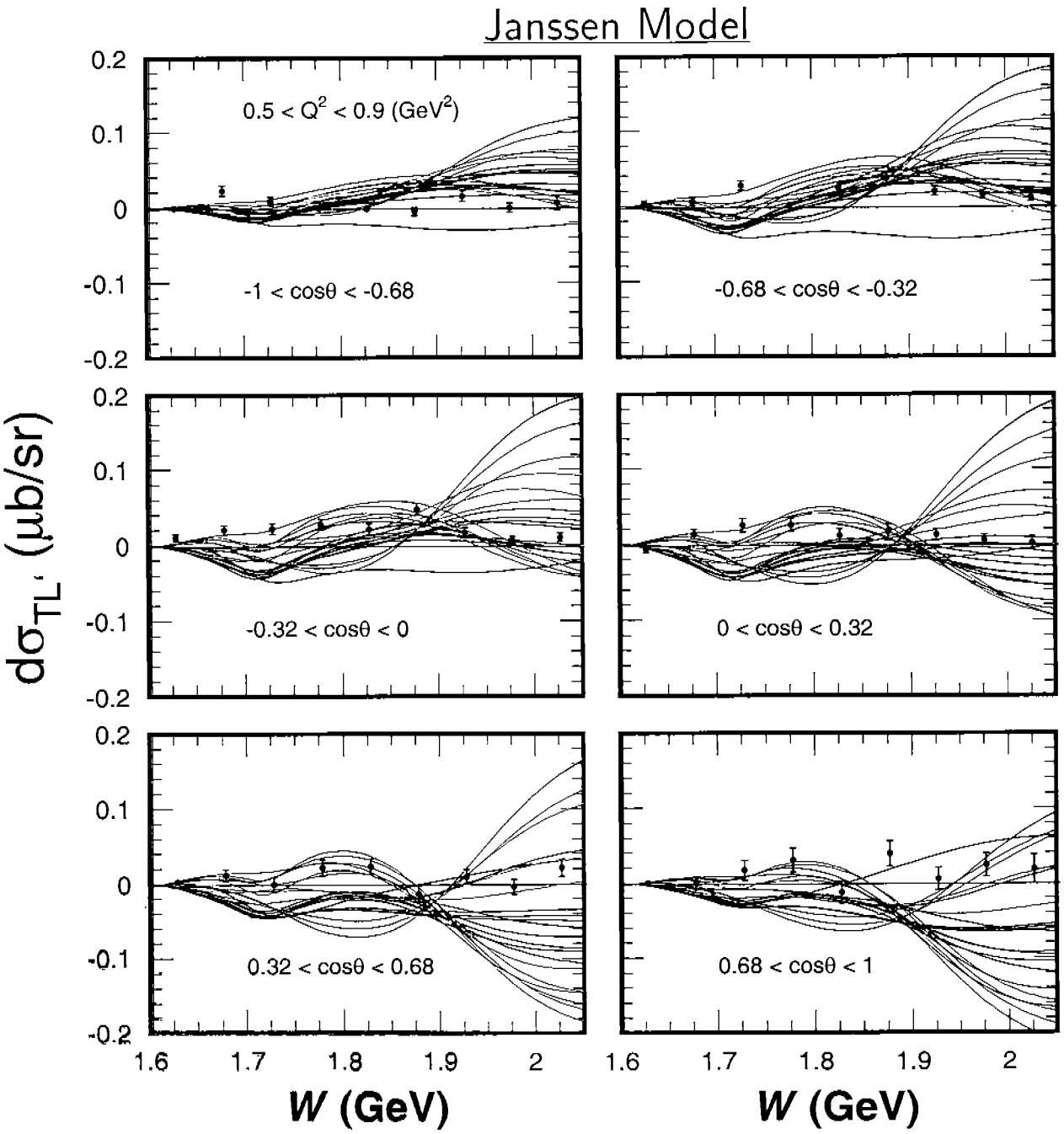

- Black and red curves: Two versions of Janssen's model (Phys. Lett. B 562,51(2003) and Phys. Rev. C 67, 052201(R)(2003))
- Each grounp of curves equally good fits to previous photo and electroproduction data.
- Our data can provide significant additional constraint.

Table of Resonances Included in the Models

State	New TM	Adelseck/Wright	Williams 92	TM had FF	Janssen
Λ	√	√	√	√	√
Σ^0	√	√	√	√	√
Σ	√	√	√	√	√
$Y(1405)$	-	-	-	-	-
$Y(1670)$	-	-	-	-	-
$Y(1800)$	-	-	-	-	√
$Y(1810)$	-	-	-	-	√
$Y(1660)$	-	-	-	-	-
$Y(1750)$	-	√	-	-	-
$N^*(1470)$	-	√	-	-	-
$N^*(1520)$	-	-	-	-	-
$N^*(1535)$	-	-	-	-	-
$N^*(1650)$	√	√	√	√	√
$N^*(1710)$	√	-	√	√	√
$N^*(1720)$	√	√	-	√	√
$\Delta(1620)$	-	-	-	-	-
$\Delta(1900)$	-	-	√	√	-
$\Delta(1910)$	-	-	√	-	-
$D13(1895)$	√	-	-	-	√
$K^*(892)$	√	√	√	√	√
$K_1(1270)$	√	-	√	-	√
$Q1(1280)$	-	√	-	-	-

Some outcomes of our experiment

- Preliminary data show large non-zero $A_{LT'}$ and $\sigma_{LT'}$ that indicate a significant interference between the resonant and none-resonant background.

- $\sigma_{LT'}$ for Λ production shows an interesting W-dependence.

- Our data can provide significant new constraint on basic parameters of the theoretical models, increasing their discriminatory power and allowing for a quantitative measure of whether or not new "missing" resonances might be required to explain these and other hyperon production data.

- Future: It will be interesting to see sensitivity of $\sigma_{LT'}$ to individual resonance within models.