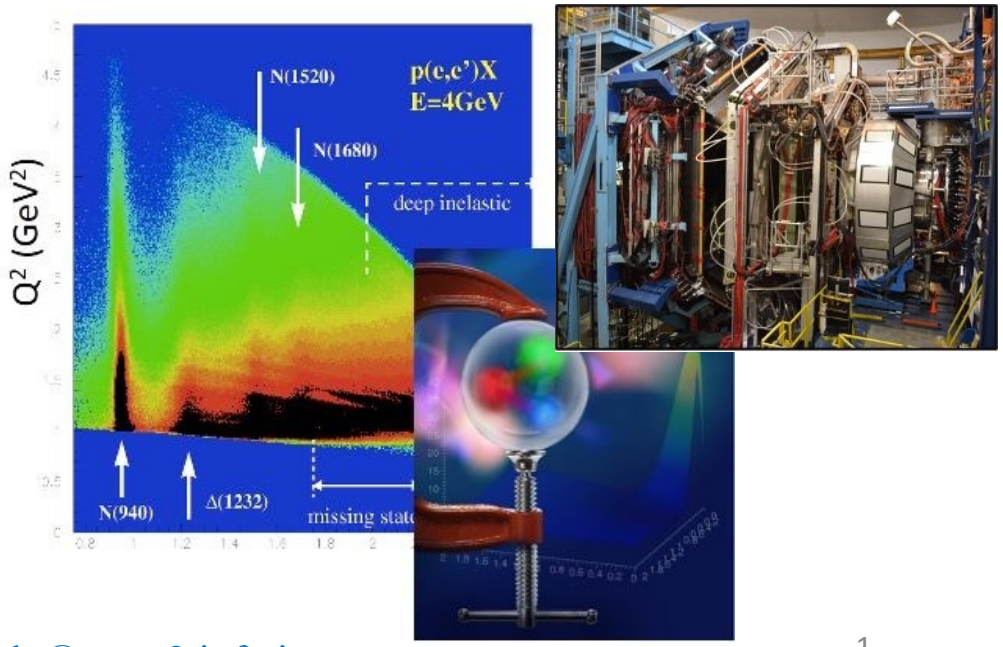
Beam Spin Asymmetry Preliminary Studies on KΛ(1520) Electroproduction at CLAS12



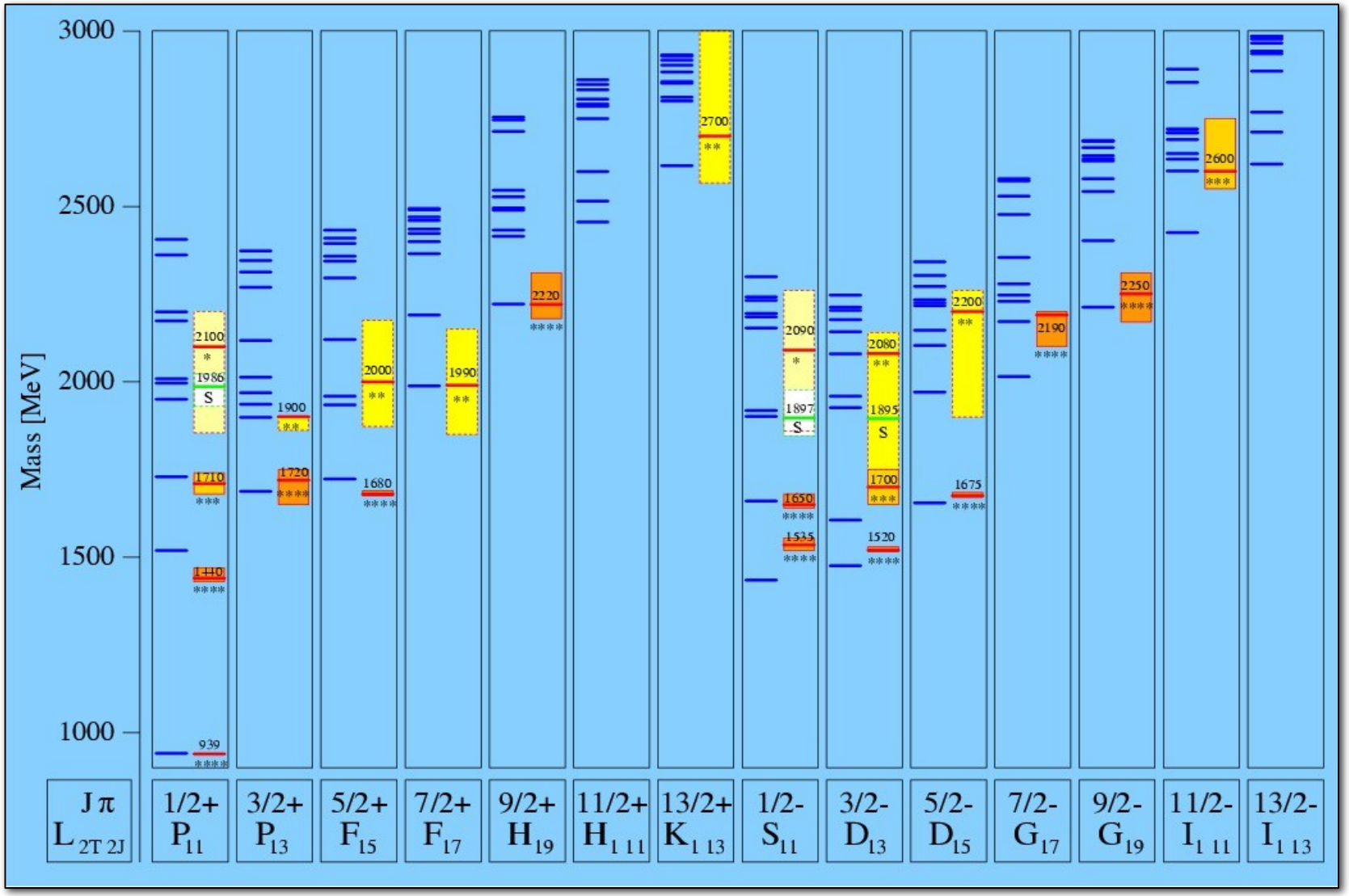
Chiara Ammendola PhD Student
University of Rome Tor Vergata & INFN Rome Tor Vergata
Collaboration Meeting RGK, 18th November 2026

Outline

- Introduction
- Existing $\boldsymbol{\Lambda(1520)}$ photo- and electro-production experimental results
- Preliminary RG-K data analysis on $\mathbf{ep} \rightarrow \boldsymbol{e'K^{+}\Lambda(1520)} \rightarrow \mathbf{e'}\boldsymbol{K^{+}(K^{-})p}$
- Future Goals

Missing Resonances Problem

Constituent Quark Models and LQCD calculations **predict a** significantly **larger number of excited states than those observed**



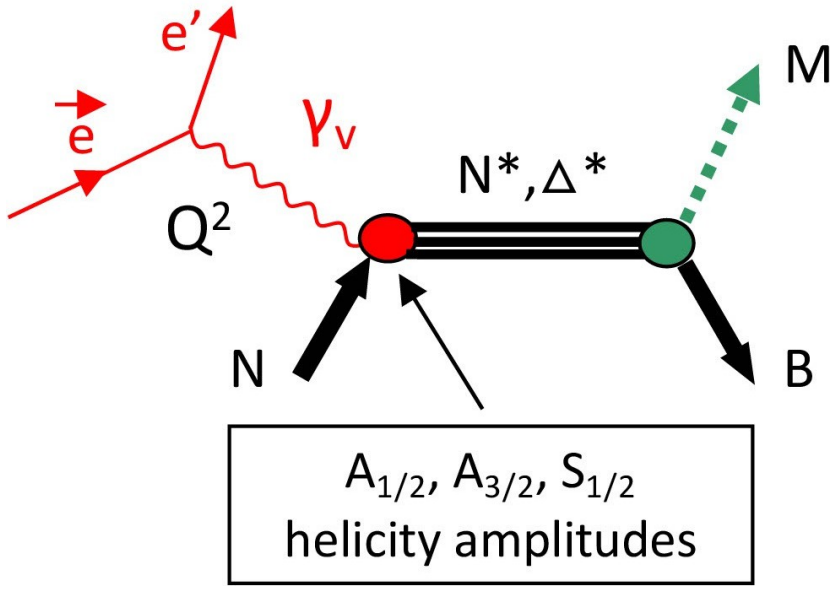
Observed Predicted

Study of Resonance Properties in Electroproduction Reactions

State $N(mass)J^P$	PDG 2010	PDG 2025	πN	$K\Lambda$	$K\Sigma$	γN
$N(1710)1/2^+$	***	****	****	**	*	****
$N(1875)3/2^-$		***	**	*	*	**
$N(1880)1/2^+$		***	*	**	**	**
$N(1895)1/2^-$		****	*	**	**	****
$N(1900)3/2^+$	**	****	**	**	**	****
$N(2000)5/2^+$	*	**	*			**
$N(2060)5/2^-$		***	**	*	*	***
$N(2100)1/2^+$	*	***	***	*		**
$N(2120)3/2^-$		***	**	**	*	***
$\Delta(1600)3/2^+$	***	****	***			****
$\Delta(1900)1/2^-$	**	***	***		**	***
$\Delta(2200)7/2^-$	*	***	**		**	***

Baryon resonances are produced as intermediate states in meson electroproduction processes on proton (and neutron) targets.

New resonances may decay into a KY meson-baryon couple with associate strangeness



***

Confidence level of observed resonances

Why KΛ and KΛ*?

It should be possible to **discover new excited baryons** and confirm the discovery of several others **by analyzing** final states such as :

$$K\Lambda,\ K\Sigma,\ \Lambda K^*,\ K\Sigma^*,\ K\Lambda^*$$

Strange decays of nonstrange baryons

Simon Capstick
Supercomputer Computations Research Institute and Department of Physics, Florida State University, Tallahassee, Florida 32306

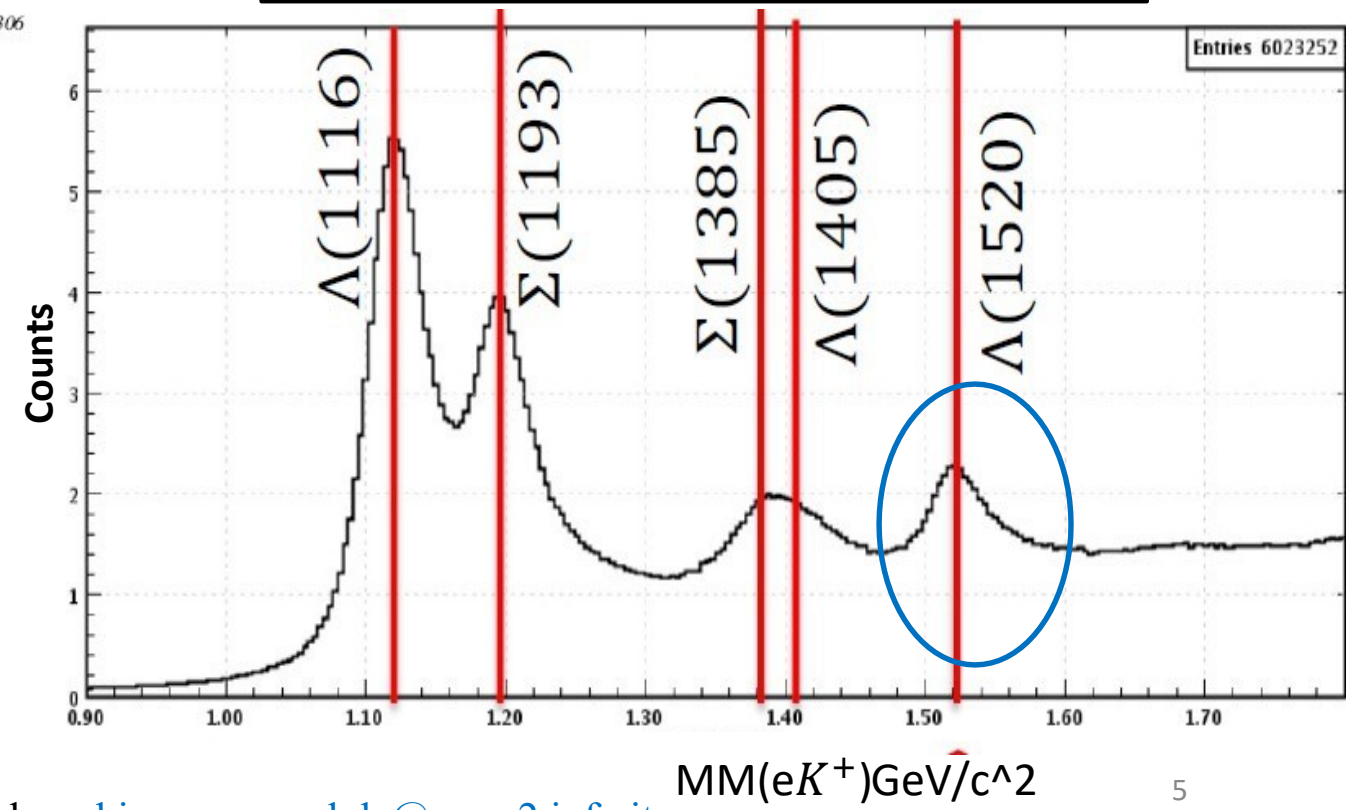
W. Roberts
Department of Physics, Old Dominion University, Norfolk, Virginia 23529
and Thomas Jefferson National Accelerator Facility, 12000 Jefferson Avenue, Newport News, Virginia 23606
(Received 29 April 1998; published 9 September 1998)

S.Capstick and W.Roberts,Phys. Rev. D 58,074011(1998)

Λ(1520) properties

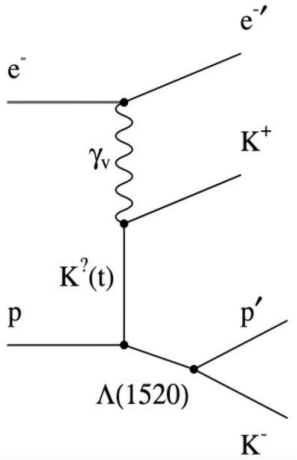
$I(J^P) = 0\left(\frac{3}{2}^-\right)$
M= 1519.42±0.19 *MeV*
$\Gamma = 15.80 \pm 0.32$ MeV
BR: $N\bar{K} = 0.44 \pm 0.01$
$pK^- = (23.4 \pm 1.6)\%$

$$ep \rightarrow e' K^+ \Lambda(1520) \rightarrow e' K^+ (K^-) p$$



Previous results: first KΛ(1520) electro-production at CLAS

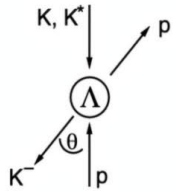
- KΛ(1520) e1 electroproduction at CLAS Phys. Rev. C **64**, 044601(2001)

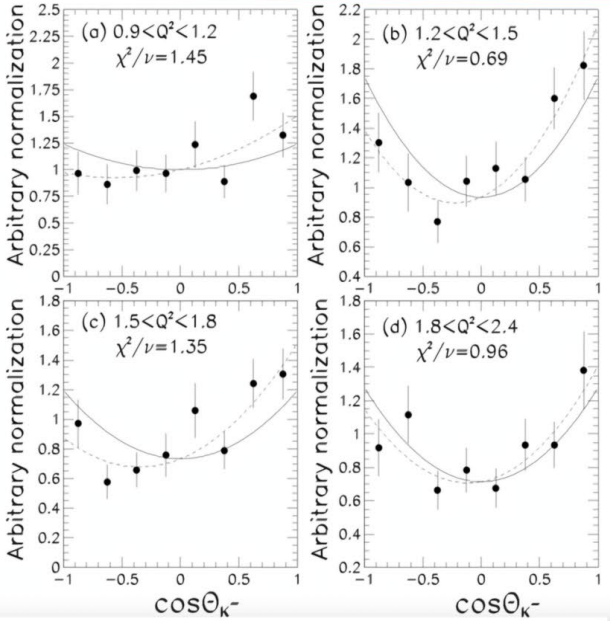


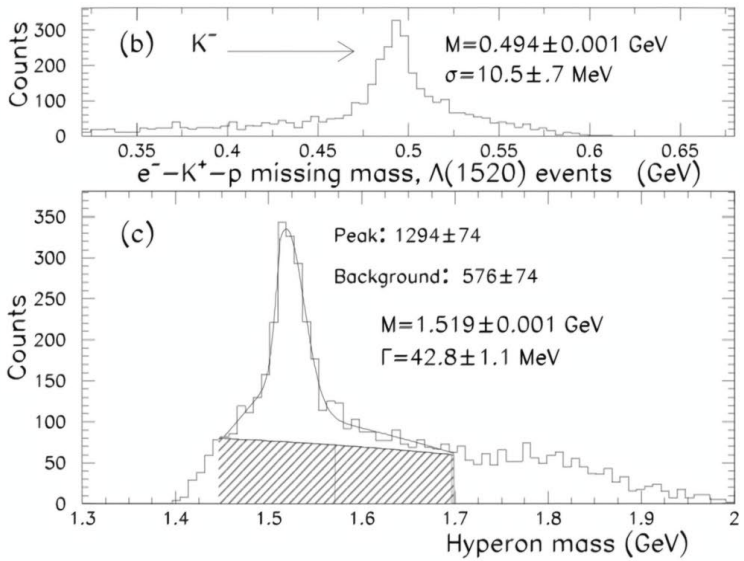
➢ Λ(1520) spin projection distributions from the Λ(1520) decay in the GJ helicity frame were fitted to disentangle J = $\frac{1}{2}$ background from the J = $\frac{3}{2}$ Λ(1520)

$$f(\theta_{K^-}) = \alpha\left(\frac{1}{3} + \cos^2\theta_{K^-}\right) + \beta \sin^2\theta_{K^-} + \gamma\cos\theta_{K^-}$$

$J^P = \frac{1^-}{2}$ $J^P = \frac{3^-}{2}$



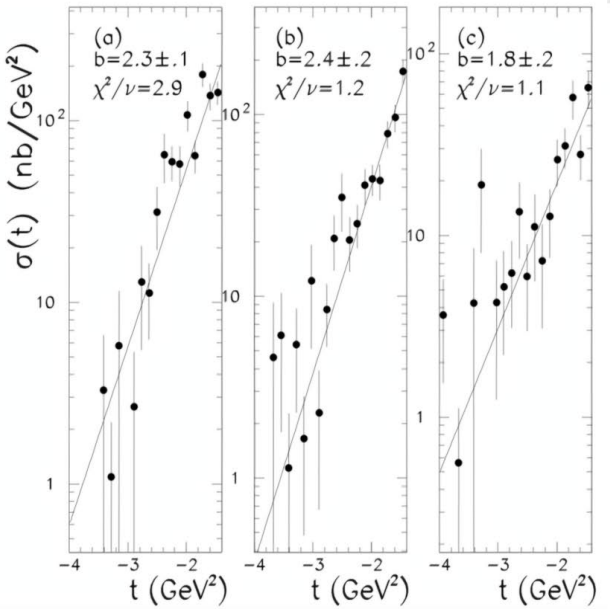




The following observables have been measured:

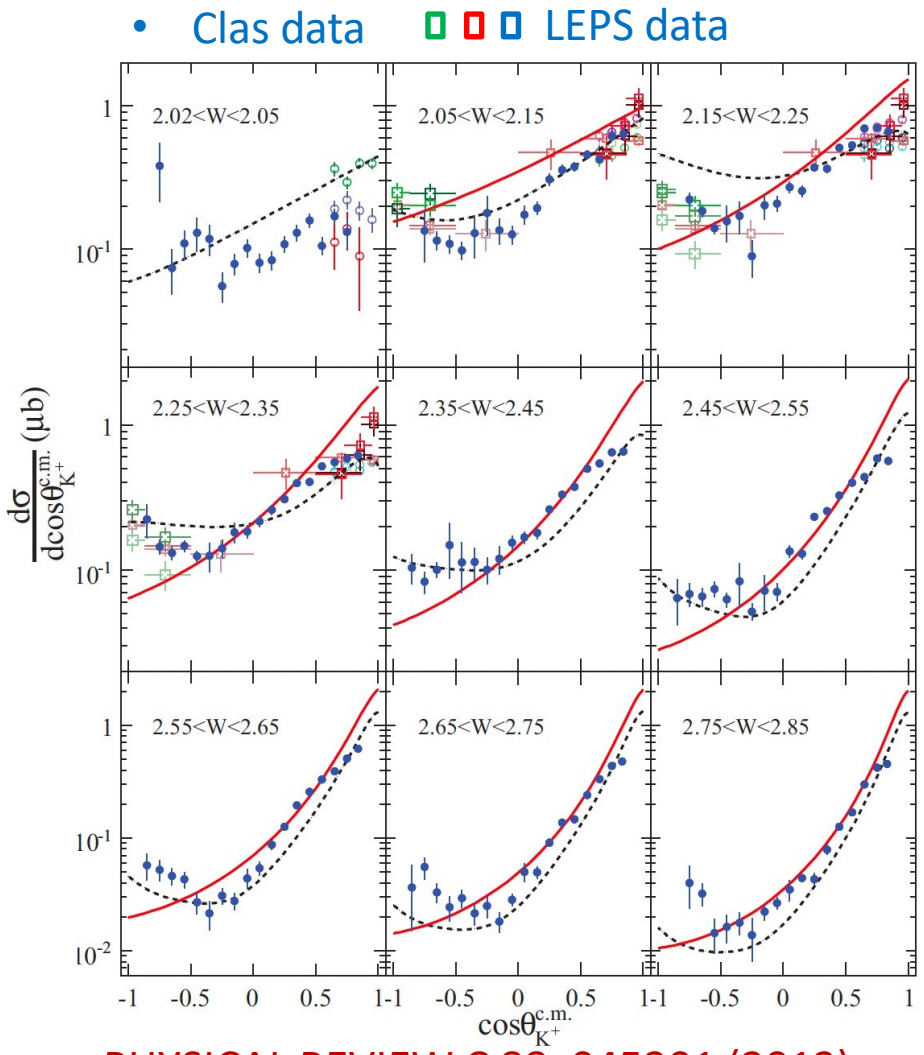
- σ (t)differential cross section
- ϕ_K angular distribution
- σ (W) total cross section
- σ (Q^2) total cross section

The conclusion was that longitudinal t-channel diagrams make significant contributions to electroproduction but not in photoproduction

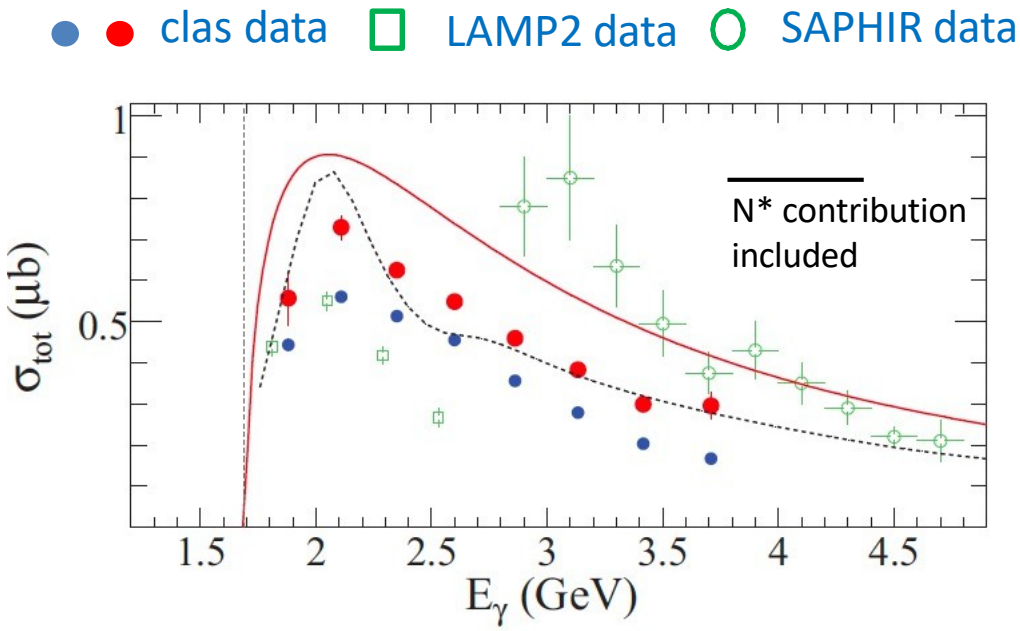


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Previous results: CLAS KΛ(1520) photoproduction



PHYSICAL REVIEW C 88, 045201 (2013)



CLAS data support the model including N* contribution

More observables are needed !

Electroproduction Differential Cross Section

$$\frac{d\sigma}{d\Omega_K^{c.m.}} = \sigma_T + \epsilon\sigma_L + \sqrt{\epsilon(1+\epsilon)}\sigma_{LT}\cos\Phi + \epsilon\sigma_{TT}\cos 2\Phi + h\sqrt{\epsilon(1-\epsilon)}\sigma_{LT'}\sin\Phi$$

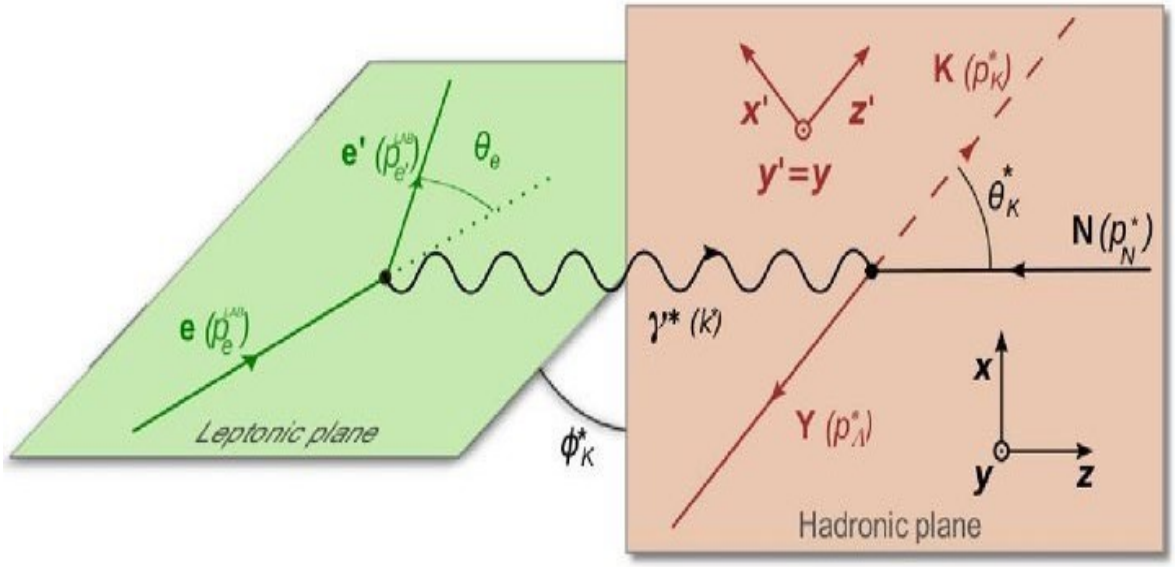
helicity dependent structure function

Electron Helicity Independent Terms (HIT)

- σ_T virtual photon transverse structure function
- σ_L virtual photon longitudinal structure function
- σ_{LT} interference longitudinal - transverse structure function
- σ_{TT} interference transverse - transverse structure functions
- ϵ virtual photon polarization parameter

$$\epsilon = \left[1 + 2\left(1 + \frac{\nu^2}{Q^2}\right)\mathrm{tg}^2\left(\frac{\theta}{2}\right)\right]^{-1}$$

- $\Sigma_{LT'}$ helicity dependent interference longitudinal - transverse structure function



Beam Polarization Observables

RGK Data Taking Conditions:

Longitudinally polarized beam (h=+/-1) on **Unpolarized target**

The simplest accessible polarization observable is the **beam-spin asymmetry**

Helicity dependence of the (virtual) cross section:

$$\frac{d\sigma_v}{d\Omega} = HIT + h\sqrt{\epsilon(1-\epsilon)}\sigma_{LT'}\sin\phi$$

$$\sigma^{\pm} = HIT \pm \sqrt{\epsilon(1-\epsilon)}\sigma_{LT'}\sin\phi$$

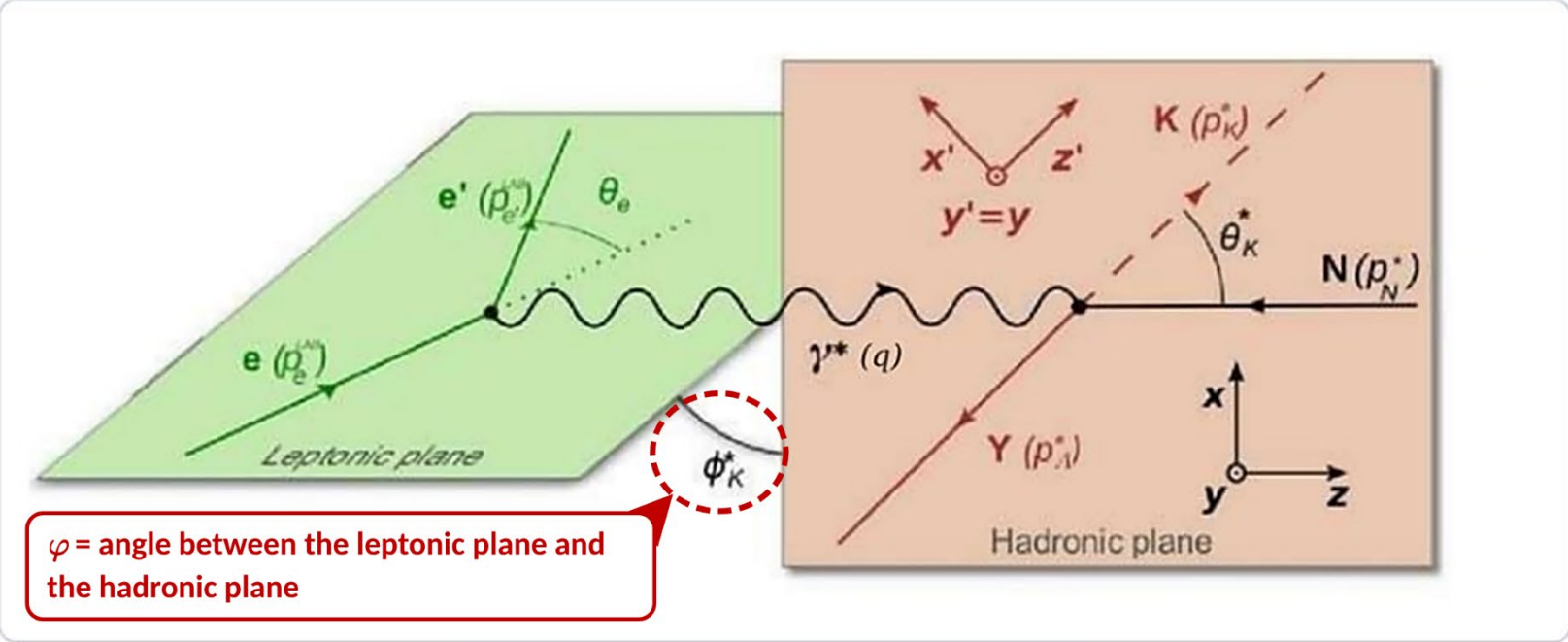
$$A_{LU} = \frac{1}{P_b} \times \frac{\sigma^+ - \sigma^-}{\sigma^+ + \sigma^-} \Rightarrow A_{LU} = \frac{1}{P_b} \times \frac{N^+ - N^-}{N^+ + N^-}$$

The + and – superscripts correspond to beam helicity 1 and -1

$$A_{LT'} = \frac{1}{P_b} \cdot \frac{\sigma^+ - \sigma^-}{\sigma^+ + \sigma^-} = \frac{\sqrt{\epsilon(1-\epsilon)}\sigma_{LT'}\sin\phi}{\sigma_0}$$

$$A_{LU}(\phi) = \frac{1}{P_b} \cdot \frac{N^+ - N^-}{N^+ + N^-} \approx A_{LU}^{\sin\phi}\sin\phi$$

Kinematic Variables



Q^2 Photon virtuality

$$Q^2 = -q^2 = 4\,E_e\,E_{e'}\sin^2\frac{\theta_e}{2}$$

θ_e: angle of the scattered electron relative to the beamline

W^2 Hadronic invariant mass

$$W^2 = (\tilde{p}_{target} + q)^2$$

$q = \tilde{p}_{beam} - \tilde{p}_{e'}$. In the lab frame (proton at rest):

$$W^2 = M_p^2 + 2M_p(E - E') - Q^2$$

E and E' are the initial and final electron energies

MM Missing mass

$$MM^2 = (\tilde{p}_{beam} + \tilde{p}_{target} - \Sigma\,\tilde{p}_{detected})^2$$

RGK CLAS12 Run Conditions

PHYSICS PROGRAM

1. **Search for Hybrid Baryons (qqqg)**
2. **DVCS** — Deeply Virtual Compton Scattering
3. **KY Electroproduction for the N* study**
4. **SIDIS** — Semi-Inclusive Deep Inelastic Scattering

KY electroproduction = this analysis (KΛ(1520))

RUN CONDITIONS

RUN CONDITIONS	
Torus Current	100% (3375 A) - negative out-bending
Solenoid	-100 %
FT	ON @ 7.5 GeV -> OFF @ 6.5 GeV and 8.5 GeV
Beam/Target	Polarized electrons, un-polarized LH_2 target
Luminosity	• ~ 5 10^{34} $cm^{-2}s^{-1}$ @ 7.5 GeV ~ 0.87 10^{34} $cm^{-2}s^{-1}$ @ 6.5 GeV 0.87 10^{35} $cm^{-2}s^{-1}$ @ 6.4 GeV 10^{35} $cm^{-2}s^{-1}$@8.5 GeV FULL LUMINOSITY

BEAM TIME AND ENERGIES

100 days approved by PAC 44 and confirmed by PAC 48 (Jeopardy)
E_b = 6.6 GeV, 50 days – 3 passes
E_b = 8.8 GeV, 50 days – 4 passes

STATISTICS

Fall 2018 – E_b = 6.5 GeV — EVENTS

15.6 G

Spring 2024 – E_b = 6.4 and 8.5 GeV

60 G

×4

Statistics increased by a factor 4

Fall 2018 + Spring 2024 = 50% of the approved days

$\Lambda(1520)$

$$ep \rightarrow e'K^{+}\Lambda(1520) \rightarrow e'K^{+}(K^{-})p$$

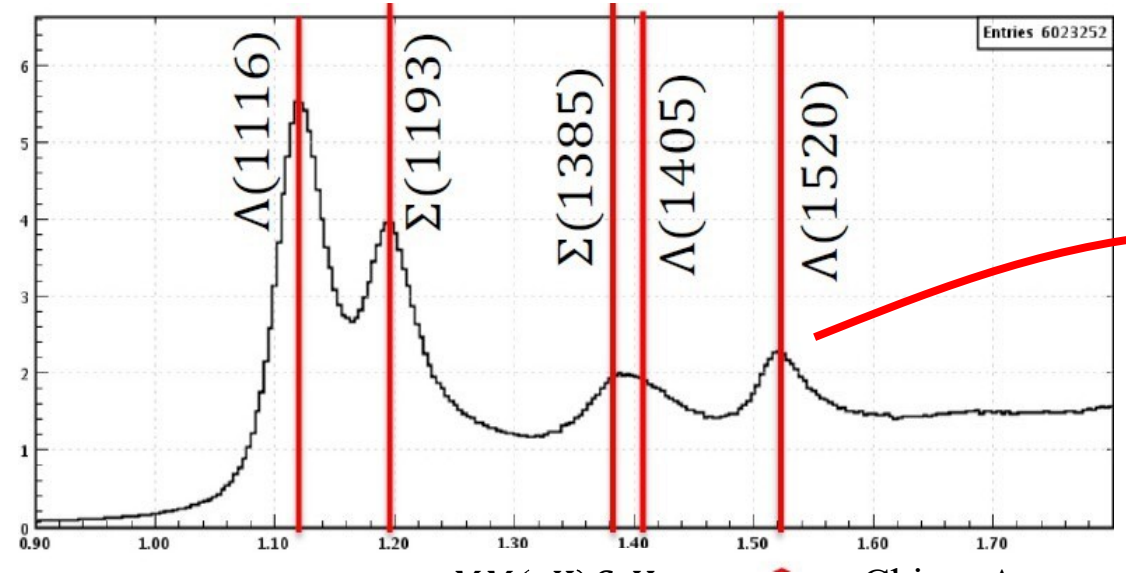
Events Selection Condition

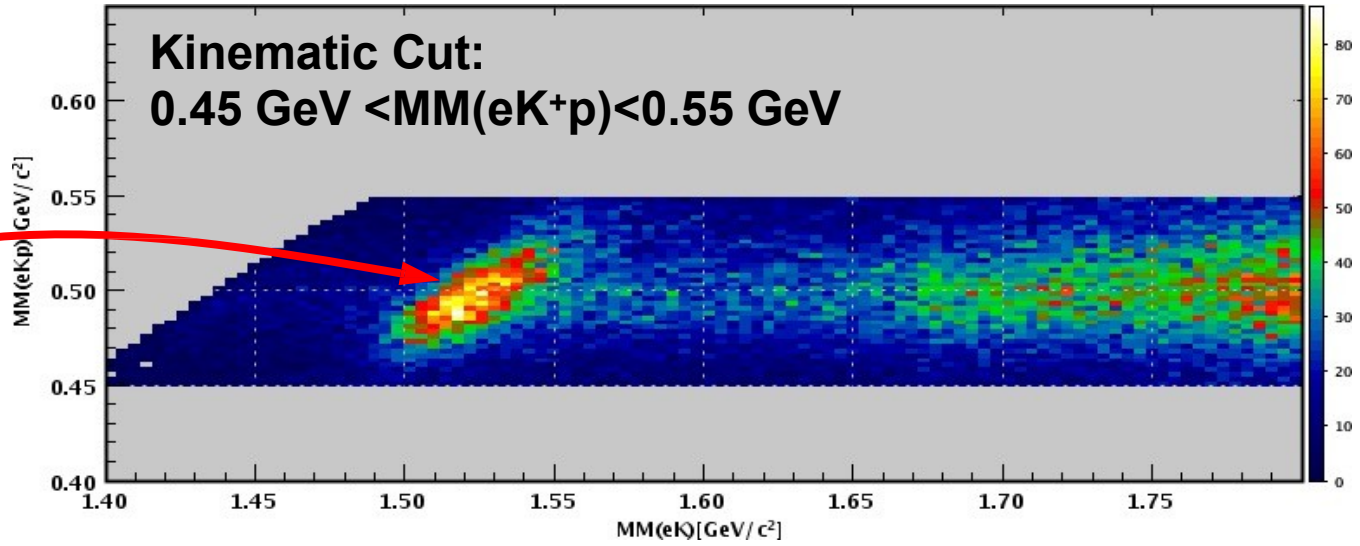
- e Forward Detector
- p Forward/ Central Detector
- K^{+} Forward/ Central Detector
- E_b = 6.5 GeV

Fall 2018 Data Set

$$MM(eK^{+}) = \sqrt{(\mathbf{p}_e + \mathbf{p}_T - \mathbf{p}_{e'} - \mathbf{p}_K)^2}$$

$$MM(eK^{+}p) = \sqrt{(\mathbf{p}_e + \mathbf{p}_T - \mathbf{p}_{e'} - \mathbf{p}_K - \mathbf{p}_p)^2}$$



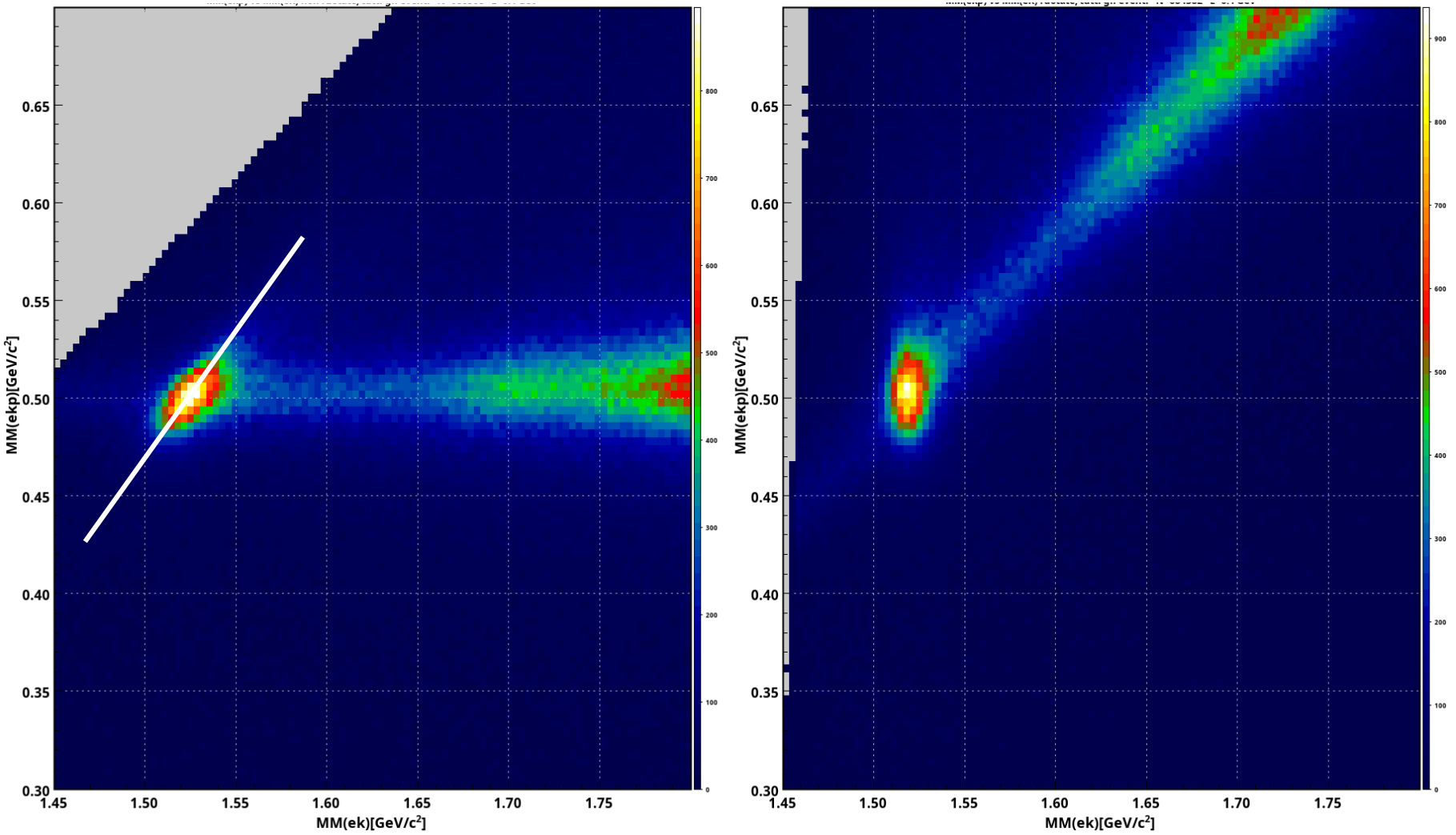


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MM(eK⁺) vs MM(eK⁺p)

E_b= 6.4 GeV Spring 2024

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

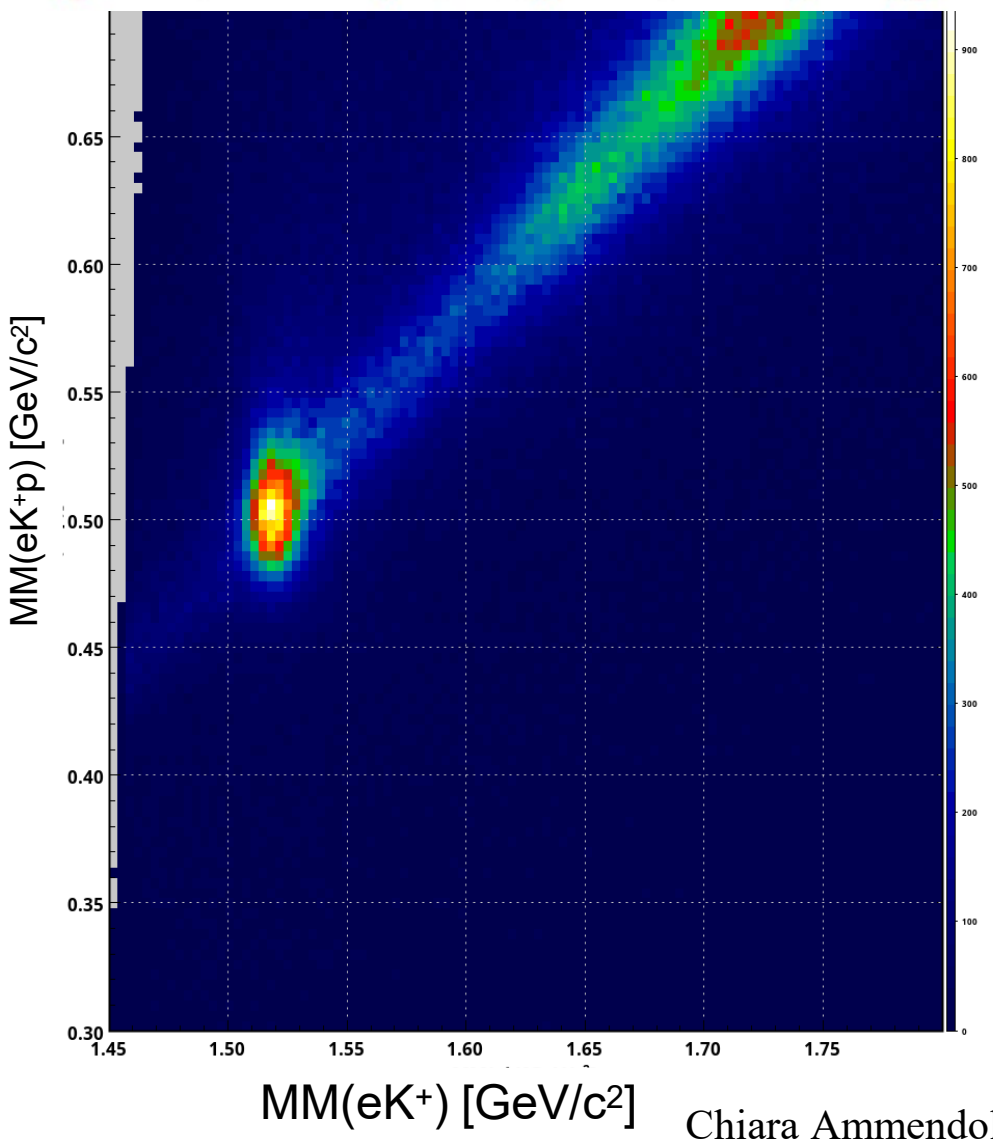


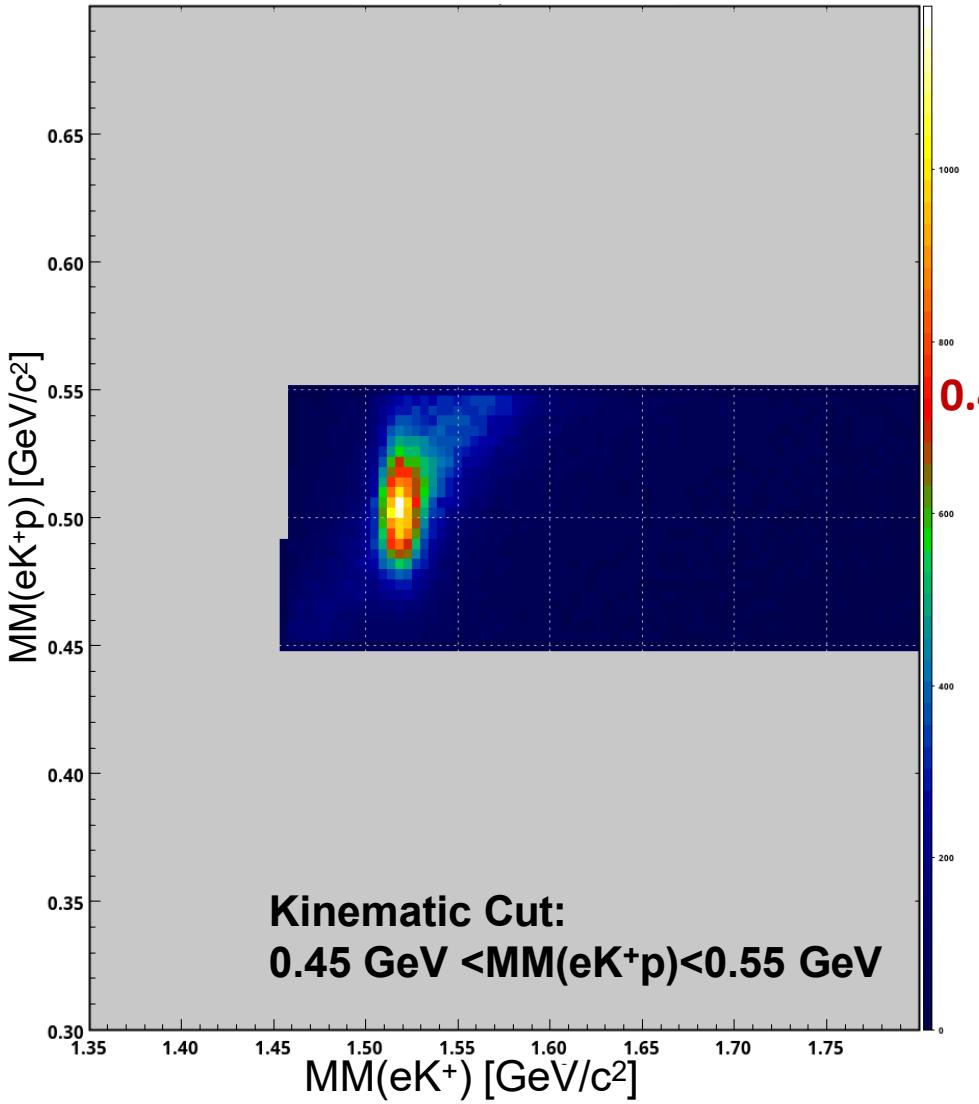
- MM(eK⁺) vs MM(eK⁺p) are kinematically correlated: in the 2D plane, events are distributed along a narrow diagonal band
- A 75° rotation decorrelates the two variables, making the $\Lambda(1520)$ signal narrower

MM(eK⁺) vs MM(eK⁺p)

E_b= 6.4 GeV Spring 2024

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$





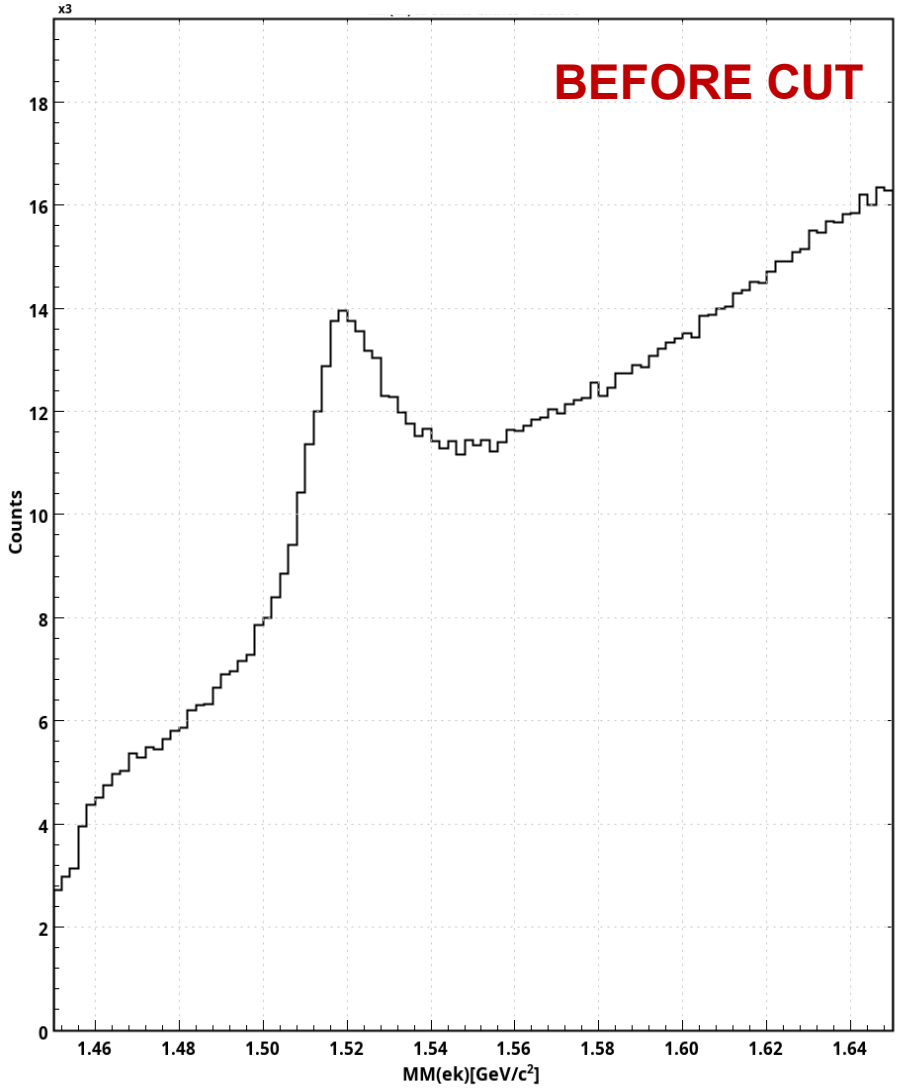
The cut on 0.45 GeV<MM(eK⁺p)<0.55GeV removes the background, improving the signal to background ratio

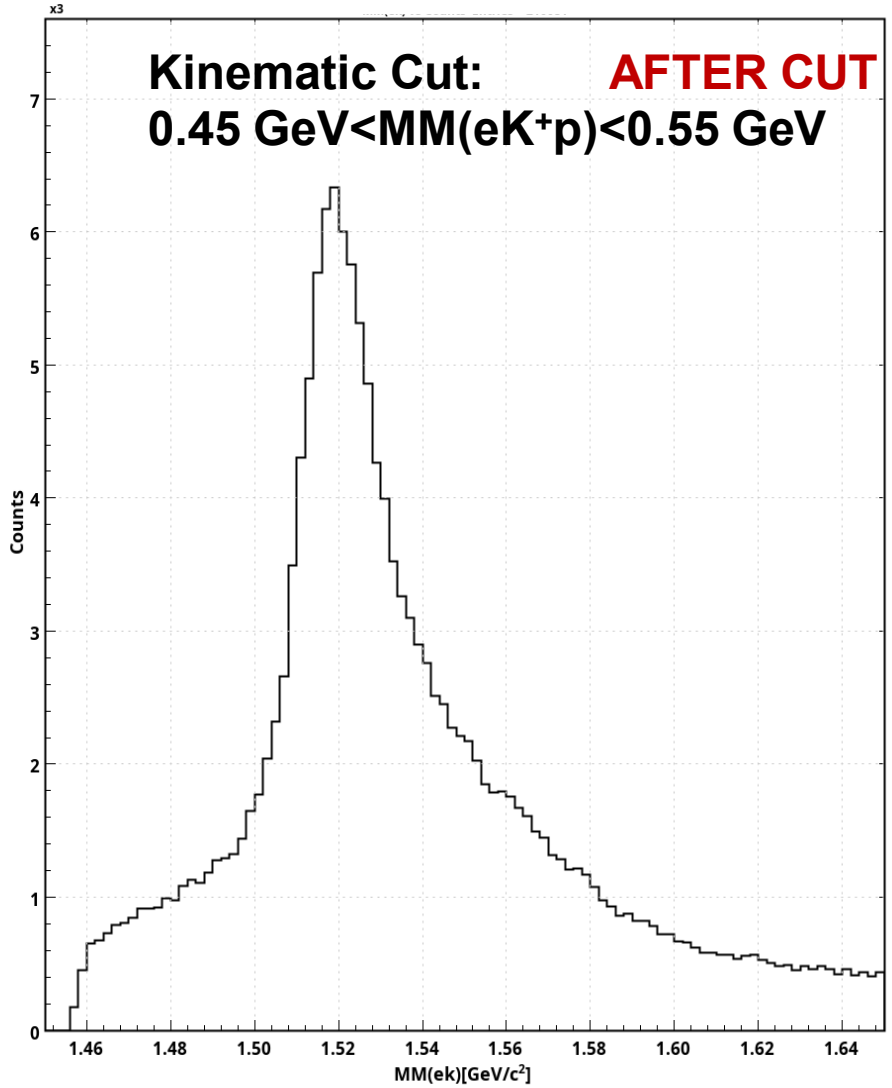
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MM(eK⁺)

E_b= 6.4 GeV Spring 2024

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$





- The MM(eK^+) with rotation profile before the cut shows the Λ(1520) at ~ 1.52 GeV sitting on top of large continuous background
- The MM(e K^+) with rotation profile after the cut shows a narrower and more prominent Λ(1520) peak, the continuous background significantly reduced

The spectrum after the cut is used as input for the fitting procedure

Fitting Procedure (Lorentzian + Radiative Tail)

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

$$f(t) = A\begin{cases} \dfrac{1}{t^2+1} & t \le \alpha \\ \dfrac{B}{(C-t)^n} & t > \alpha \end{cases}$$

$$B = \left(-\frac{n}{2\alpha}\right)^n (\alpha^2+1)^{n-1}$$

$$C = \alpha - n\,\frac{\alpha^2+1}{2\alpha}$$

$$t = \frac{E - E_0}{\frac{\Gamma}{2}}$$

$$f(t) = A\begin{cases} \dfrac{1}{t^2+1} & t \le \alpha \\ \dfrac{\left(-\frac{n}{2\alpha}\right)^n (\alpha^2+1)^{n-1}}{\left(\alpha - n\,\frac{\alpha^2+1}{2\alpha} - t\right)^n} & t > \alpha \end{cases}$$

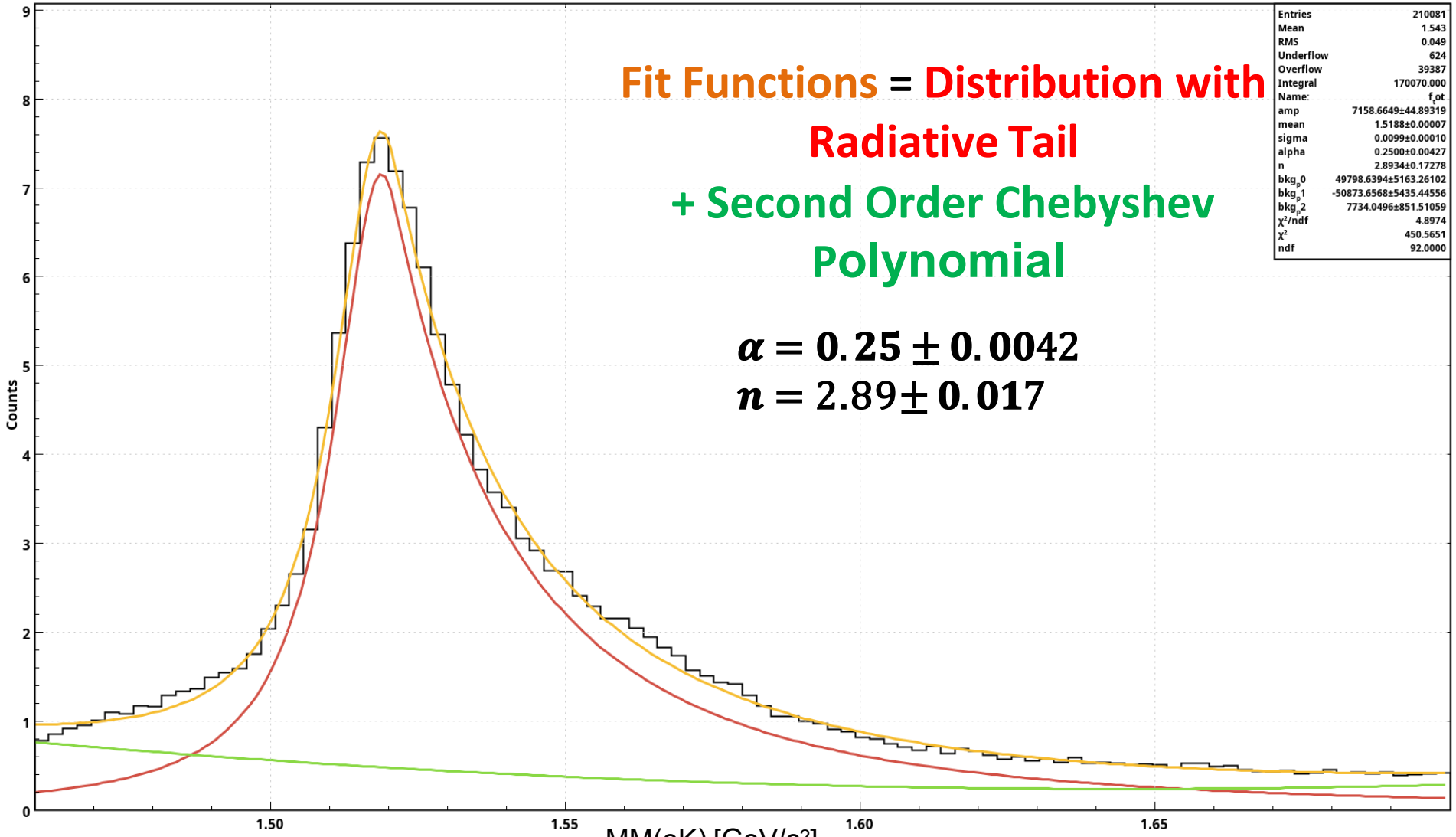
- n is the power of the power -law tail
- α defines the matching point between the Lorentzian core and the power-law tail

Background

$$Bkg = A + Bx + C\left(2x^2 - 1\right)$$

Fitting Procedure (Lorentzian + Radiative Tail) E_b= 6.4 GeV Spring 2024

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$



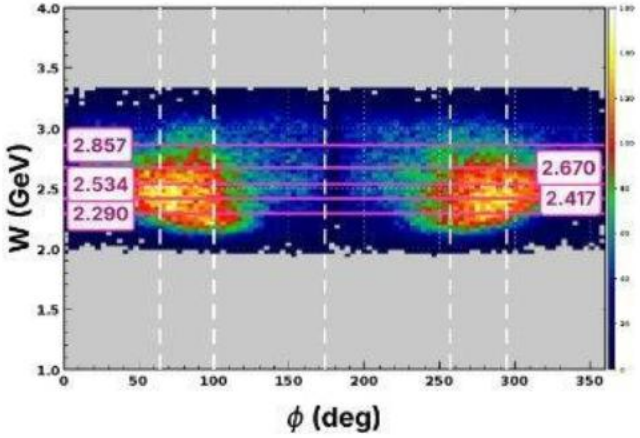
Fit function was optimized on full statistics spectrum without helicity and ϕ separation to fix n and alpha parameters.

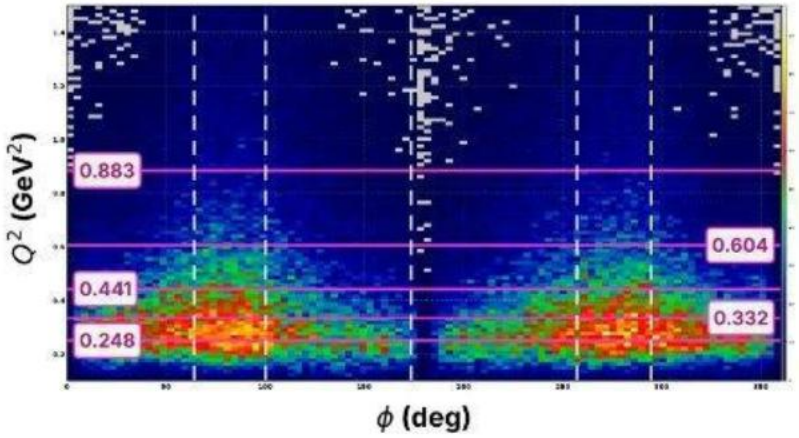
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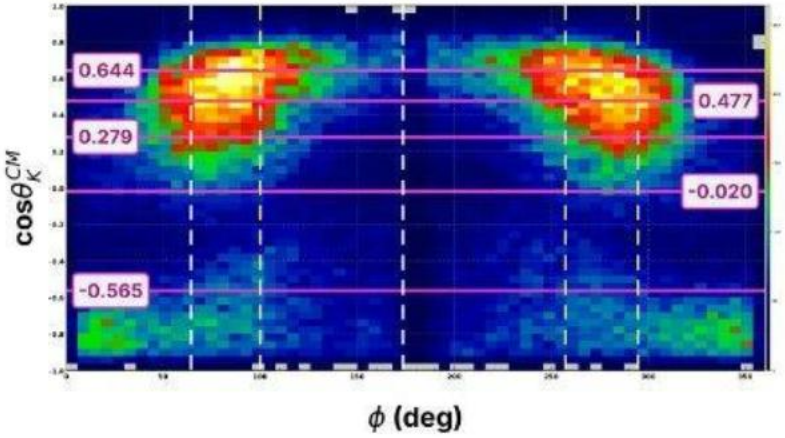
BSA : Integrated vs Binned Analysis Spring 2024

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

Full statistics · 6 φ bins







W	range (GeV)	width	events
1	[2.000, 2.290)	0.290	28152
2	[2.290, 2.417)	0.127	28275
3	[2.417, 2.534)	0.117	28080
4	[2.534, 2.670)	0.136	28247
5	[2.670, 2.857)	0.187	28211
6	[2.857, 3.200]	0.343	28233

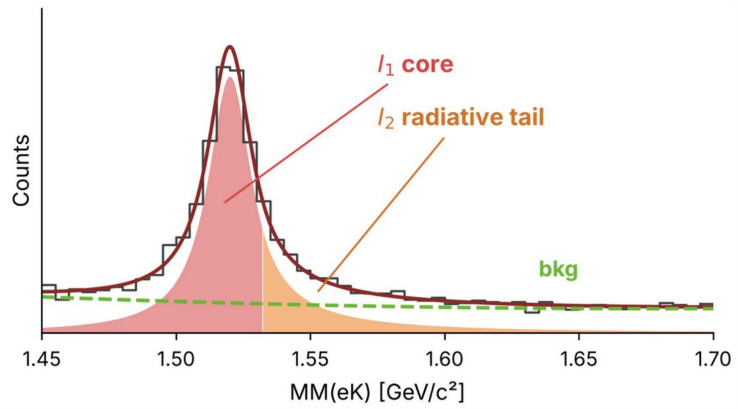
Q^2	range (GeV^2)	width	events
1	[0.000, 0.248)	0.248	25629
2	[0.248, 0.332)	0.084	25335
3	[0.332, 0.441)	0.109	25556
4	[0.441, 0.604)	0.163	25546
5	[0.604, 0.883)	0.279	25491
6	[0.883, 1.500]	0.617	25498

cosθ	range	width	events
1	[−1.000, −0.565)	0.435	28367
2	[−0.565, −0.020)	0.545	28292
3	[−0.020, 0.279)	0.299	28381
4	[0.279, 0.477)	0.198	28333
5	[0.477, 0.644)	0.167	28353
6	[0.644, 1.000]	0.356	28344

E_b=6.4 GeV Spring 2024

Signal Yield Extraction: Three Methods

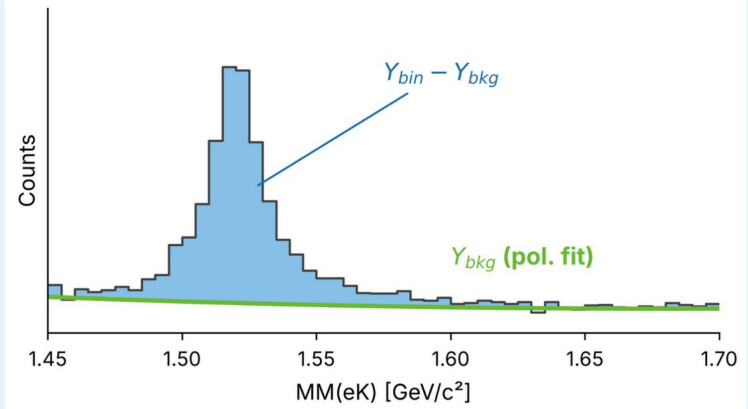
Analytical Integral



$$N_{sig} = (I_1 + I_2) / \Delta x$$

- Fit of MM(eK) in each bin: Lorentzian core + radiative tail + Chebyshev pol. 2 (background)
- I_1: integral of the core; I_2: integral of the radiative tail; Δx: bin width
- Background excluded: only the signal function is integrated

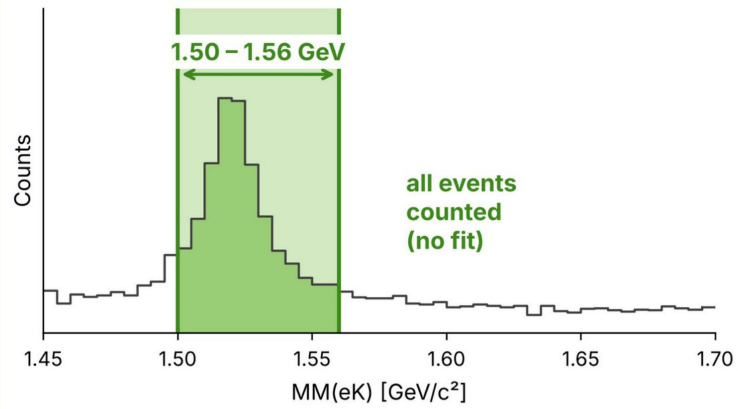
Background Subtraction



$$N_{sig} = \Sigma \left(Y_{bin} - Y_{bkg} \right)$$

- Y_{bin}: histogram bin content (counts)
- $Y_{bkg} = p_0 + p_1 x + p_2(2x^2 - 1)$: background from the fit, evaluated in each bin

Mass Window



$$N_{sig} = \Sigma_{window}\ Y_{bin}$$

- Count the events inside a window around the peak: 1.50 < MM(eK) < 1.56 GeV
- No fit and no background subtraction
- Simplest, model-independent cross-check (residual background included)

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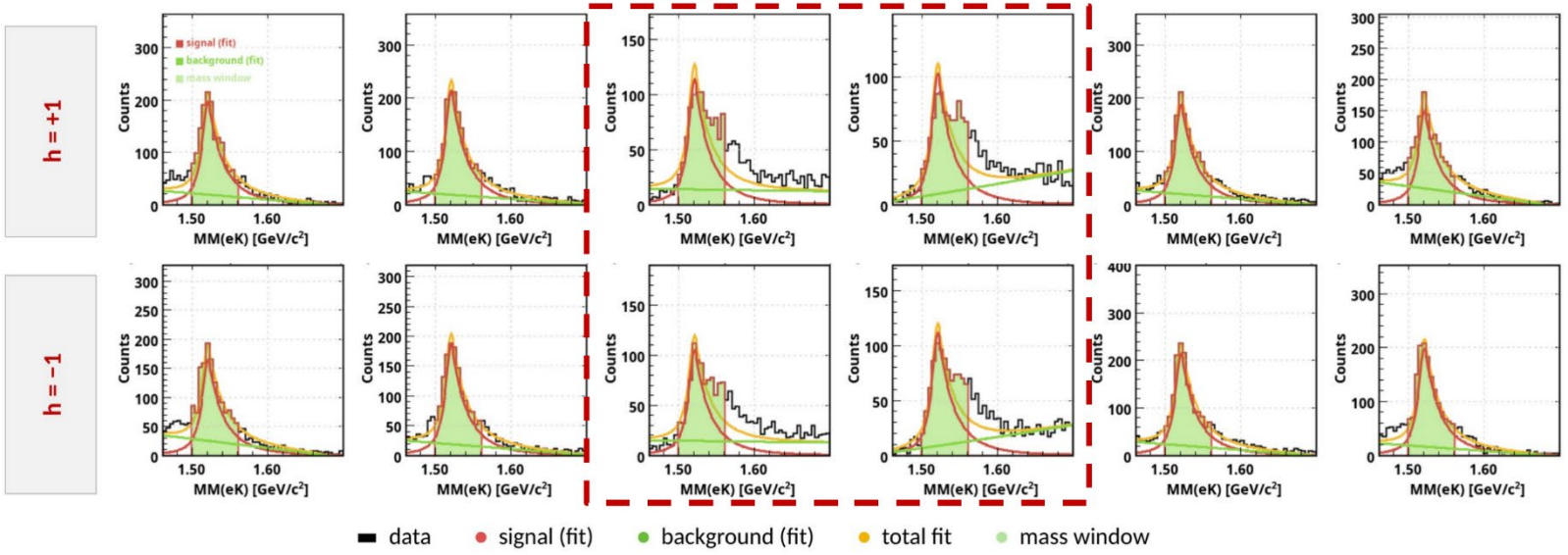
Signal Yield Extraction: Three Methods

Full statistics · 6 φ bins

All three methods on the same plot

2.290 ≤ W < 2.417 GeV

fit does not follow the data



How the three methods work

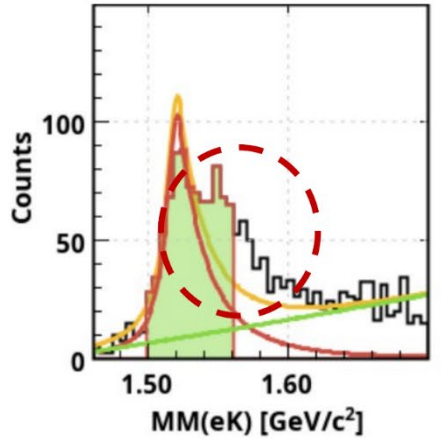
Integral
N = ∫ signal fit dx / Δx (red curve)

Background subtraction
N = Σ (data − background fit) (data − green curve)

Mass window
count events in 1.50–1.56 GeV, no fit (shaded area)

W bin [GeV]: [2.290, 2.417) E_b = 6.4 GeV

Zoom: 4th φ bin, h = +1



Background under study: MM(eK⁺) plots for the central φ bins show lower statistics, which affects the fit quality. Contributions from processes such as φ(1020) → K⁺K⁻ are being investigated to improve the background description.

BSA: $A_{LU}(\varphi)$ in bins of W –Three methods

E_b=6.4 GeV Spring 2024

- Integral
- Mass window
- Background substraction

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

1 Ratio of yields $N^{\pm}$

P_b = 0.85 · $N^{\pm}$ = yields for h = ±1

$$A_{LU} = \frac{1}{P_b} \cdot \frac{N^+ - N^-}{N^+ + N^-}$$

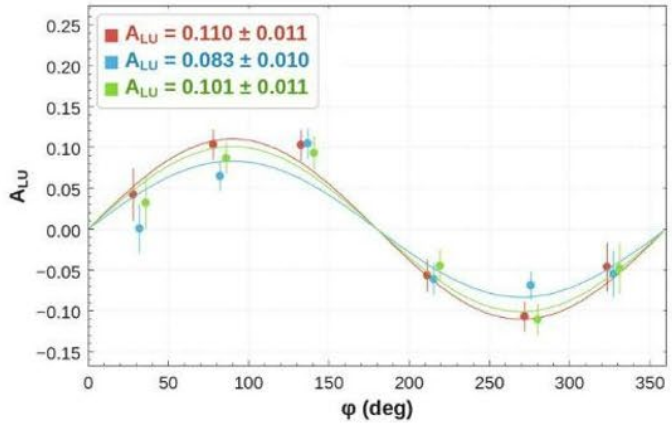
fit

2 Sine moment of the asymmetry

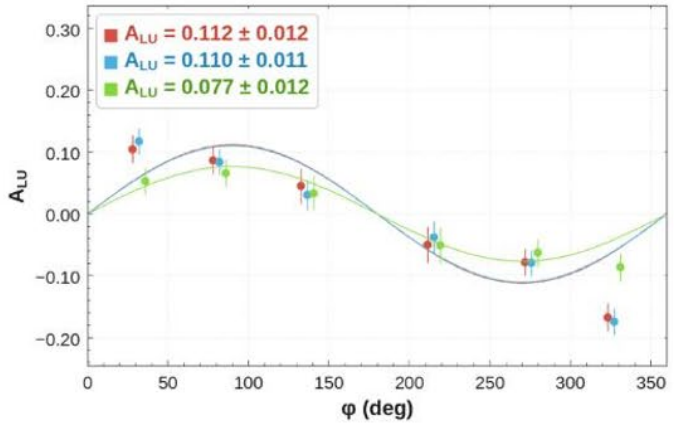
fit $A_{LU}(\varphi)$ per bin → $A_{LU}^{\sin\varphi}$ ± stat. err.

$$A_{LU}(\varphi) \simeq A_{LU}^{\sin\varphi} \cdot \sin\varphi$$

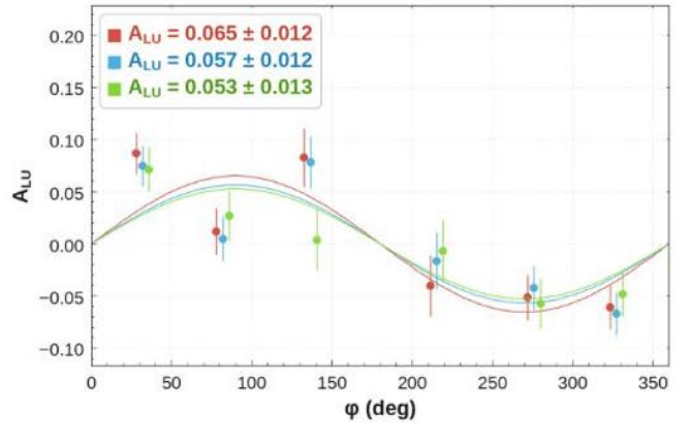
2.000 ≤ W < 2.290 GeV



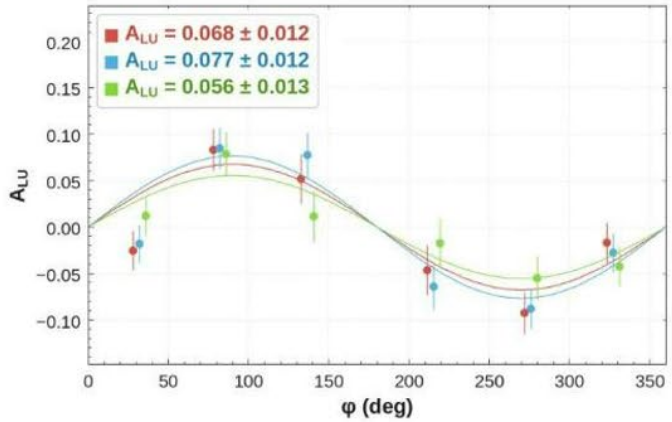
2.290 ≤ W < 2.417 GeV



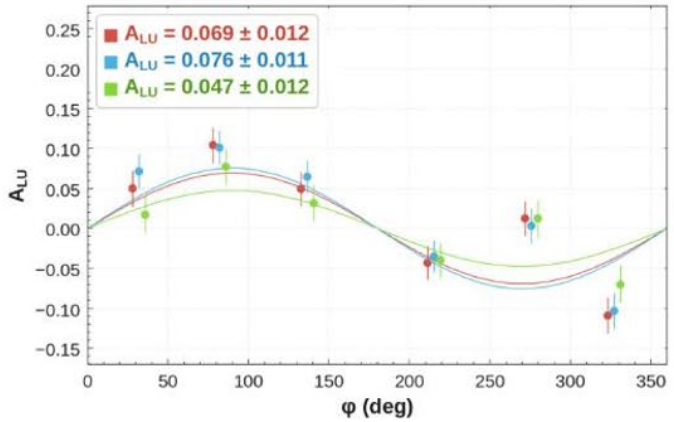
2.417 ≤ W < 2.534 GeV



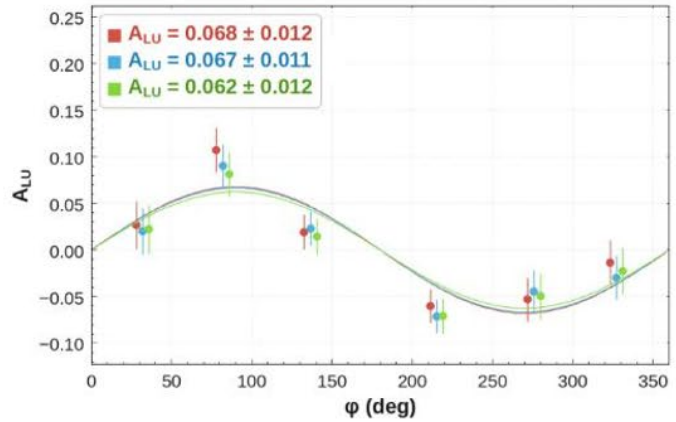
2.534 ≤ W < 2.670 GeV



2.670 ≤ W < 2.857 GeV



2.857 ≤ W ≤ 3.200 GeV



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BSA: $A_{LU}(\varphi)$ in bins of Q^2 –Three methods

E_b=6.4 GeV Spring 2024

- Integral
- Mass window
- Background substraction

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

1 Ratio of yields $N^{\pm}$
$P_b = 0.85 \cdot N^{\pm}$ = yields for h = ±1

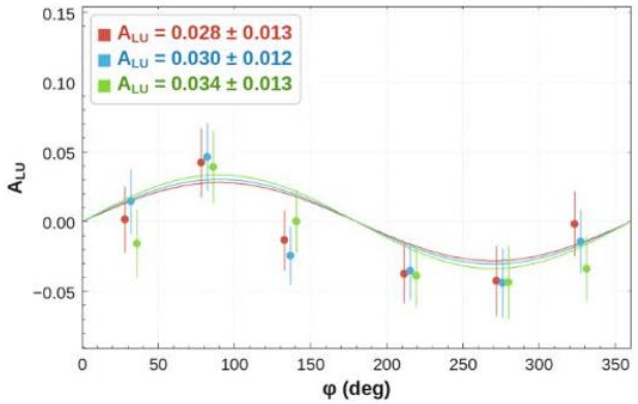
$$A_{LU} = \frac{1}{P_b} \cdot \frac{N^+ - N^-}{N^+ + N^-}$$

fit

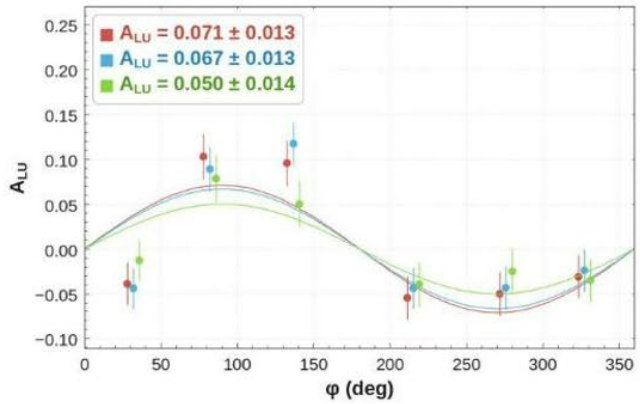
2 Sine moment of the asymmetry
fit $A_{LU}(\varphi)$ per bin → $A_{LU}^{\sin\varphi}$ ± stat. err.

$$A_{LU}(\varphi) \simeq A_{LU}^{\sin\varphi} \cdot \sin\varphi$$

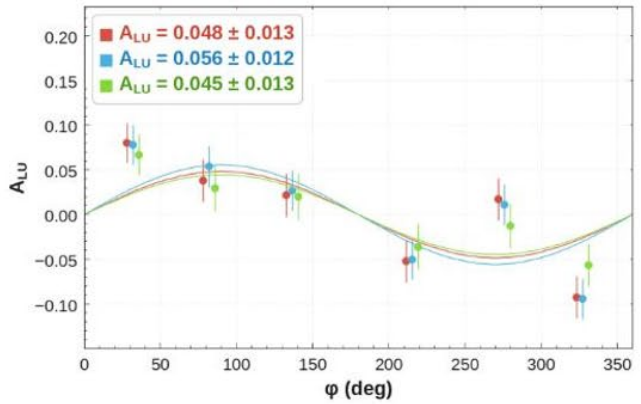
0.000 ≤ Q² < 0.248 GeV²



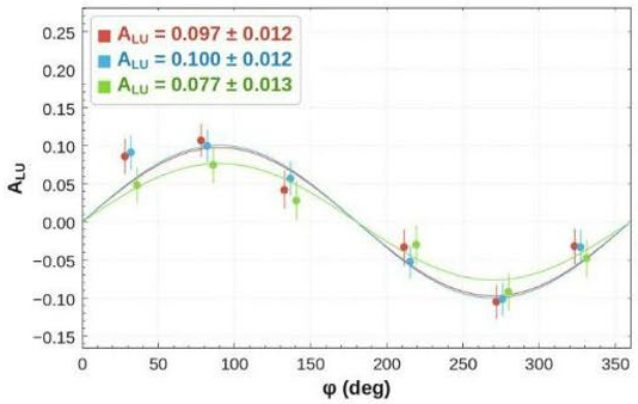
0.248 ≤ Q² < 0.332 GeV²



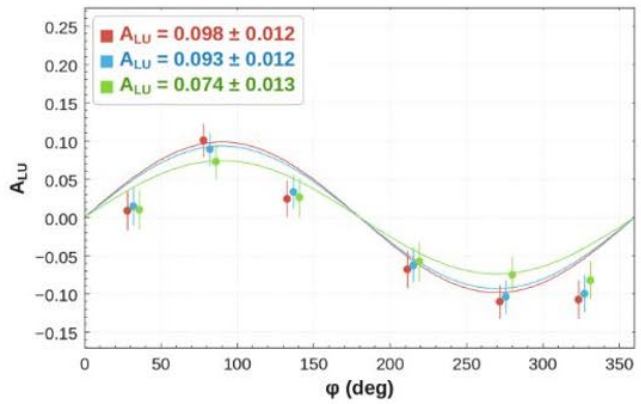
0.332 ≤ Q² < 0.441 GeV²



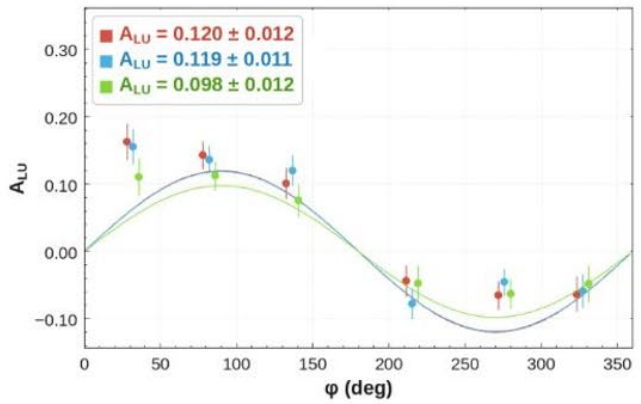
0.441 ≤ Q² < 0.604 GeV²



0.604 ≤ Q² < 0.883 GeV²



0.883 ≤ Q² ≤ 1.500 GeV²



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BSA: $A_{LU}(\varphi)$ in bins of $cos\theta$ –Three methods E_b=6.4 GeV Spring 2024

- Integral
- Mass window
- Background substraction

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

1 Ratio of yields $N^{\pm}$
P_b = 0.85 · $N^{\pm}$ = yields for h = ±1

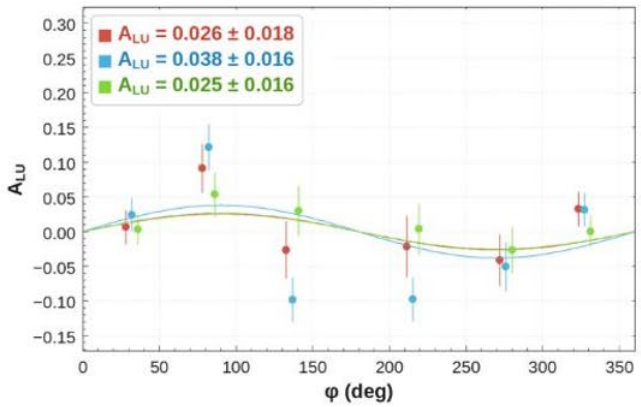
$$A_{LU} = \frac{1}{P_b} \cdot \frac{N^+ - N^-}{N^+ + N^-}$$

fit

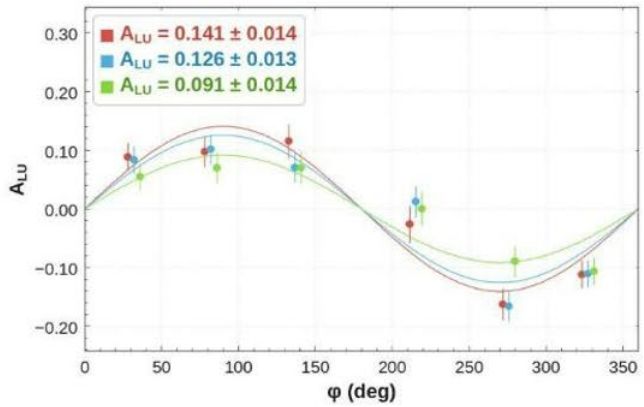
2 Sine moment of the asymmetry
fit $A_{LU}(\varphi)$ per bin → $A_{LU}^{\sin\varphi}$ ± stat. err.

$$A_{LU}(\varphi) \simeq A_{LU}^{\sin\varphi} \cdot \sin\varphi$$

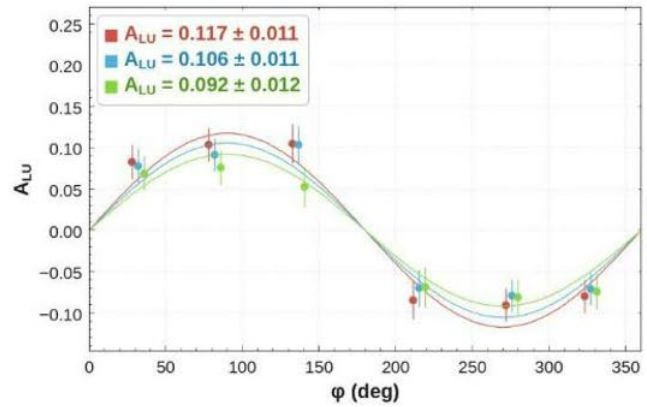
−1.000 ≤ cosθ < −0.565



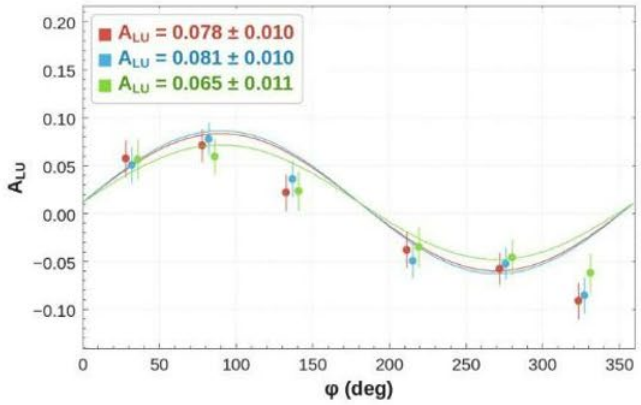
−0.565 ≤ cosθ < −0.020



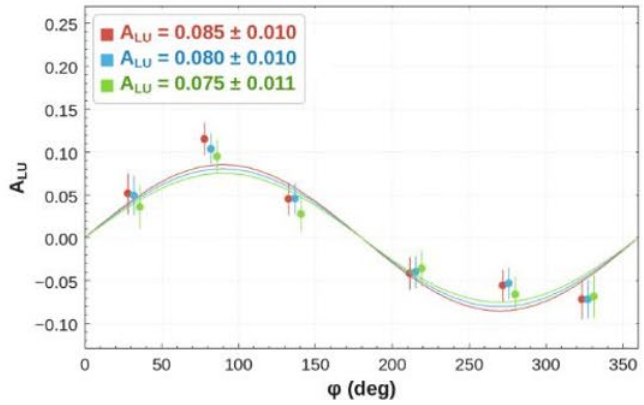
−0.020 ≤ cosθ < 0.279



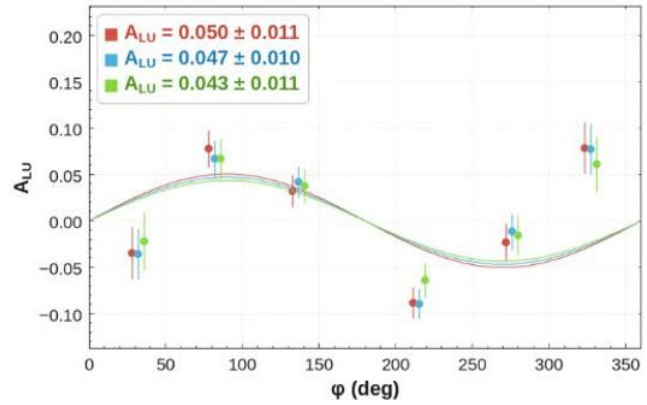
0.279 ≤ cosθ < 0.477



0.477 ≤ cosθ < 0.644



0.644 ≤ cosθ ≤ 1.000



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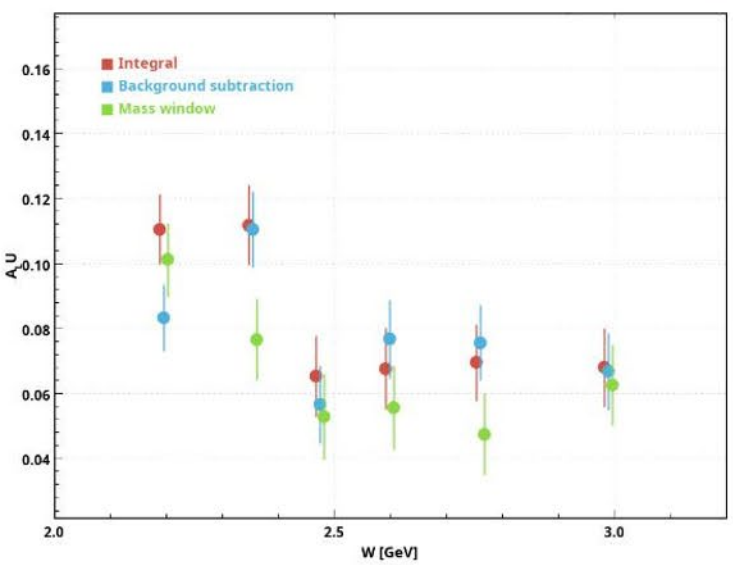
A_{LU} vs W, Q^2 and cosθ

E_b=6.4 GeV Spring 2024

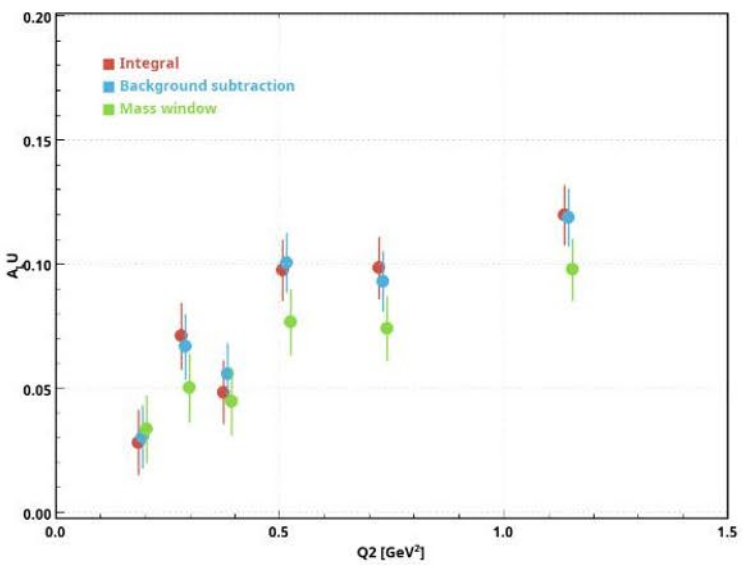
- Integral
- Mass window
- Background substraction

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

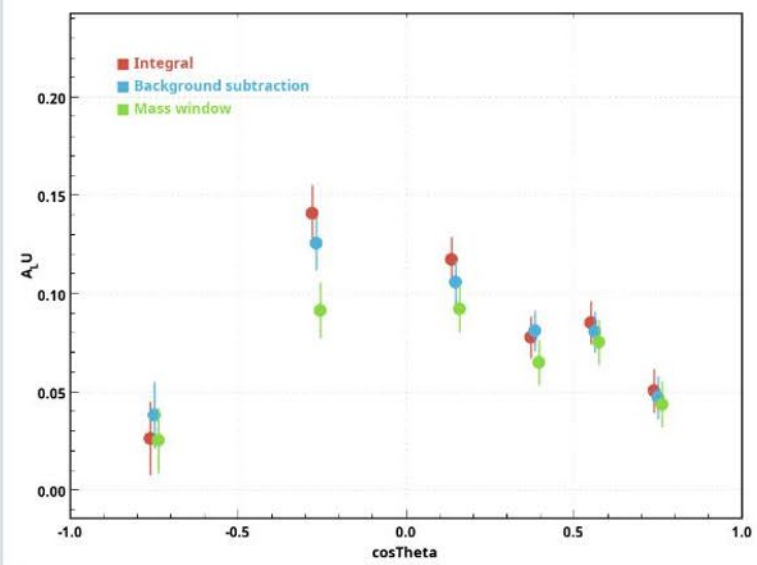
A_{LU} vs W



A_{LU} vs Q^2



A_{LU} vs cosθ



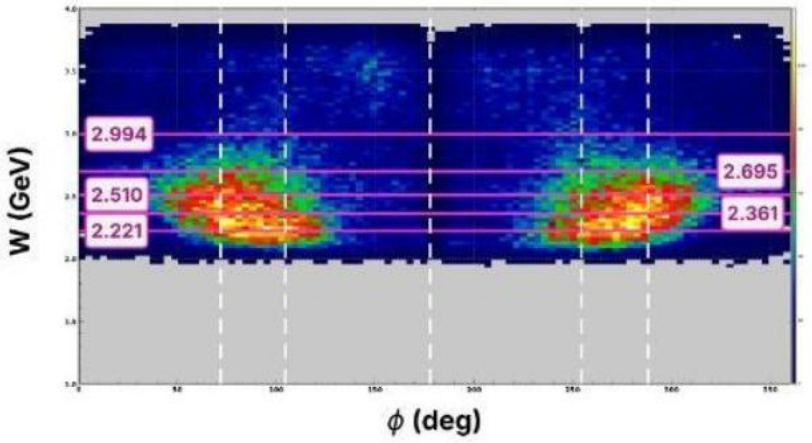
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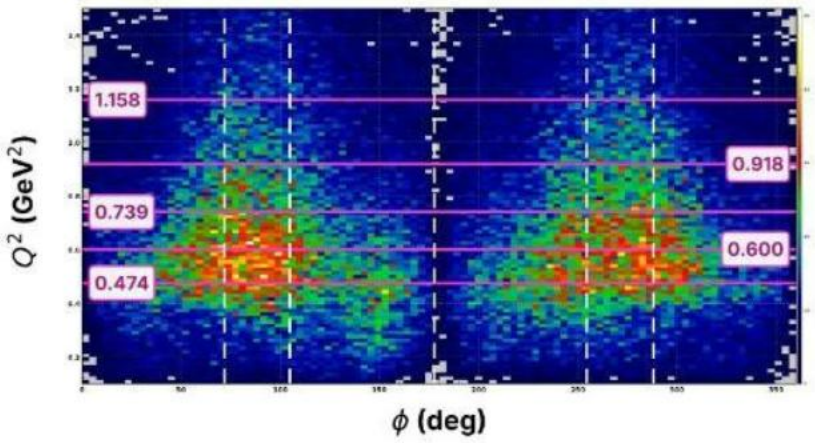
BSA : Integred vs Binned Analysis Spring 2024

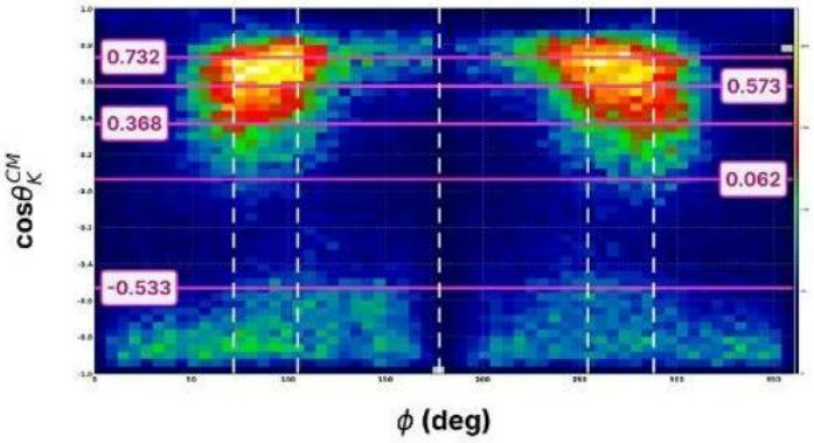
E_b=8.5 GeV Spring 2024

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

Full statistics · 6 φ bins







W	range (GeV)	width	events
1	[2.000, 2.221)	0.221	19630
2	[2.221, 2.361)	0.140	19659
3	[2.361, 2.510)	0.149	19595
4	[2.510, 2.695)	0.185	19609
5	[2.695, 2.994)	0.299	19600
6	[2.994, 3.800]	0.806	19627

Q^2	range (GeV^2)	width	events
1	[0.000, 0.474)	0.474	14067
2	[0.474, 0.600)	0.126	14171
3	[0.600, 0.739)	0.139	14029
4	[0.739, 0.918)	0.179	14175
5	[0.918, 1.158)	0.240	14083
6	[1.158, 1.500]	0.342	14100

cosθ	range	width	events
1	[−1.000, −0.533)	0.467	19673
2	[−0.533, 0.062)	0.595	19663
3	[0.062, 0.368)	0.306	19618
4	[0.368, 0.573)	0.205	19710
5	[0.573, 0.732)	0.159	19596
6	[0.732, 1.000]	0.268	19679

BSA: $A_{LU}(\varphi)$ in bins of W –Three methods

E_b=8.5 GeV Spring 2024

- Integral
- Mass window
- Background substraction

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

1 Ratio of yields $N^{\pm}$
$P_b = 0.85 \cdot N^{\pm}$ = yields for h = ±1

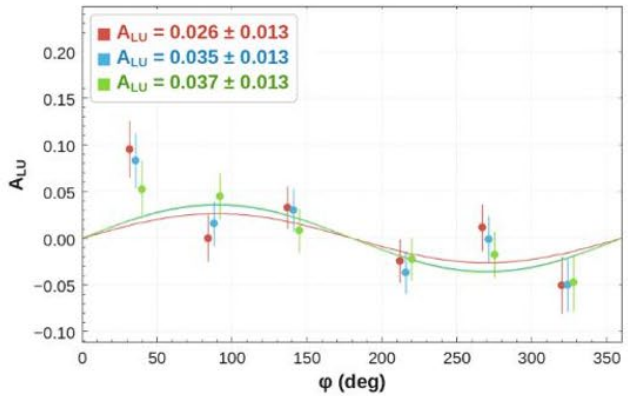
$$A_{LU} = \frac{1}{P_b} \cdot \frac{N^+ - N^-}{N^+ + N^-}$$

fit

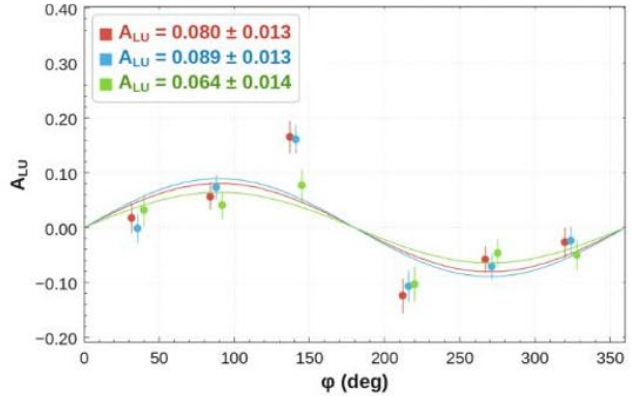
2 Sine moment of the asymmetry
fit $A_{LU}(\varphi)$ per bin → $A_{LU}^{\sin\varphi}$ ± stat. err.

$$A_{LU}(\varphi) \simeq A_{LU}^{\sin\varphi} \cdot \sin\varphi$$

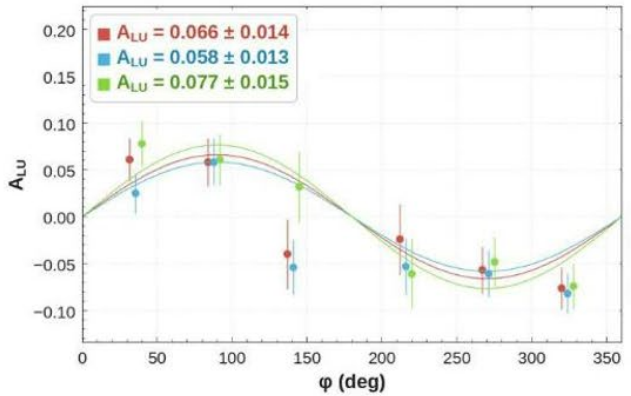
2.000 ≤ W < 2.221 GeV



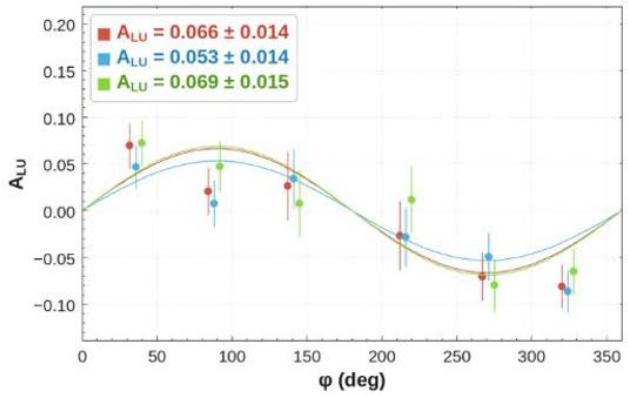
2.221 ≤ W < 2.361 GeV



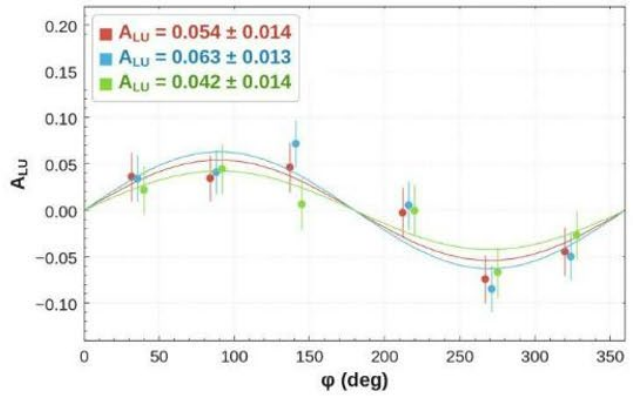
2.361 ≤ W < 2.510 GeV



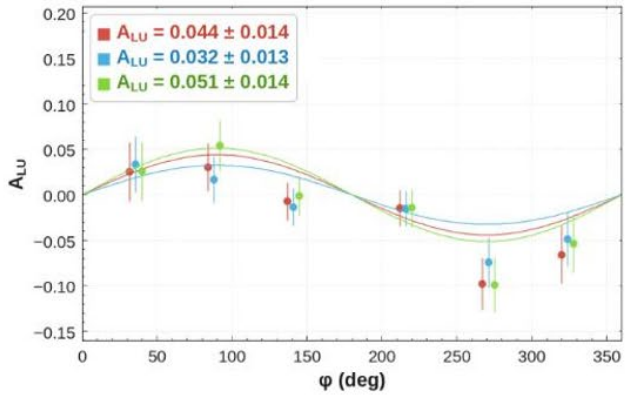
2.510 ≤ W < 2.695 GeV



2.695 ≤ W < 2.994 GeV



2.994 ≤ W ≤ 3.800 GeV



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BSA: $A_{LU}(\varphi)$ in bins of Q^2 –Three methods

E_b=8.5 GeV Spring 2024

- Integral
- Mass window
- Background substraction

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

1 Ratio of yields $N^{\pm}$
P_b = 0.85 · $N^{\pm}$ = yields for h = ±1

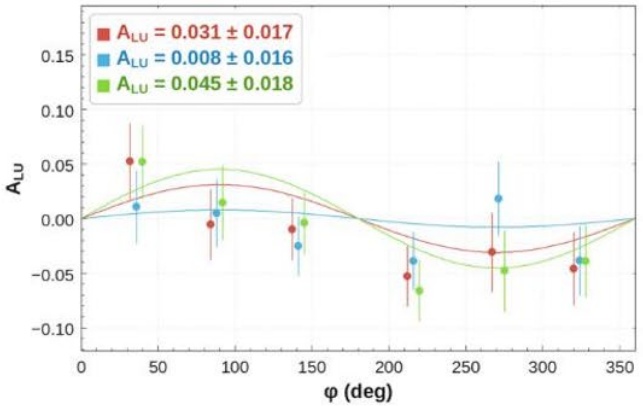
$$A_{LU} = \frac{1}{P_b} \cdot \frac{N^+ - N^-}{N^+ + N^-}$$

fit

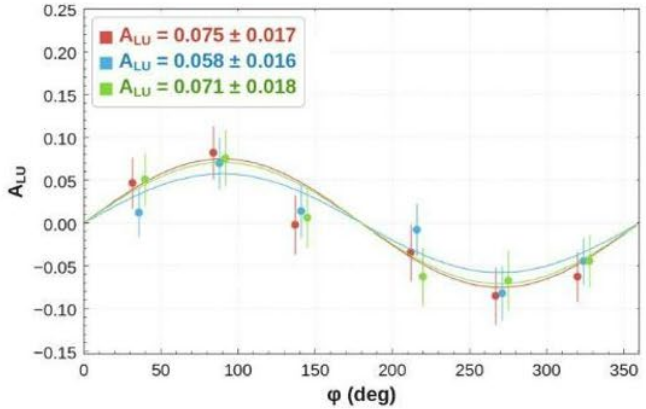
2 Sine moment of the asymmetry
fit $A_{LU}(\varphi)$ per bin → $A_{LU}^{\sin\varphi}$ ± stat. err.

$$A_{LU}(\varphi) \simeq A_{LU}^{\sin\varphi} \cdot \sin\varphi$$

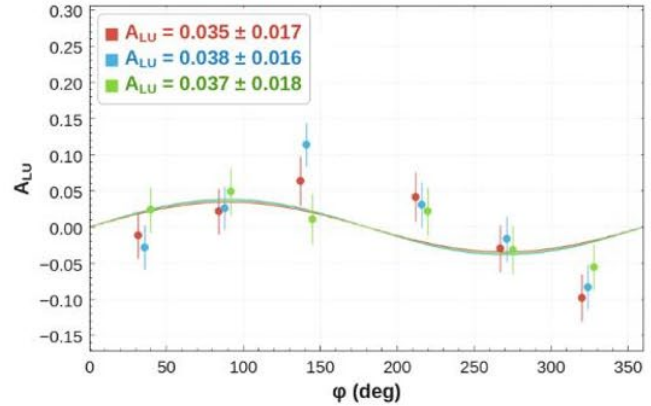
0.000 ≤ Q² < 0.474 GeV²



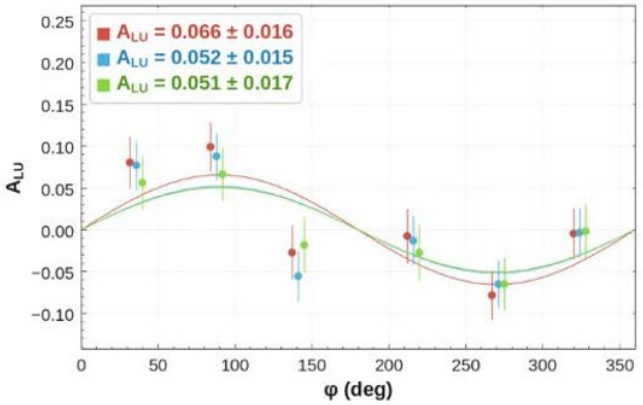
0.474 ≤ Q² < 0.600 GeV²



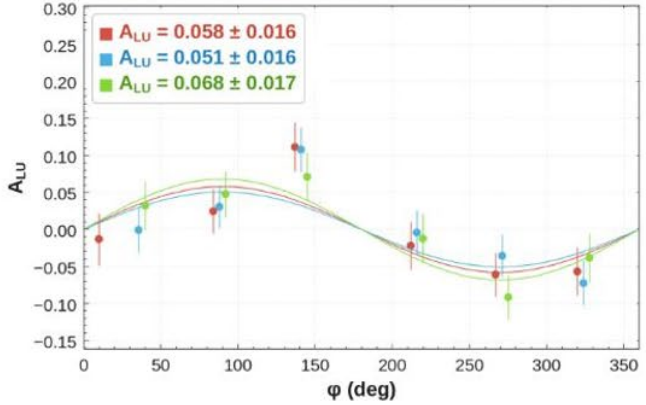
0.600 ≤ Q² < 0.739 GeV²



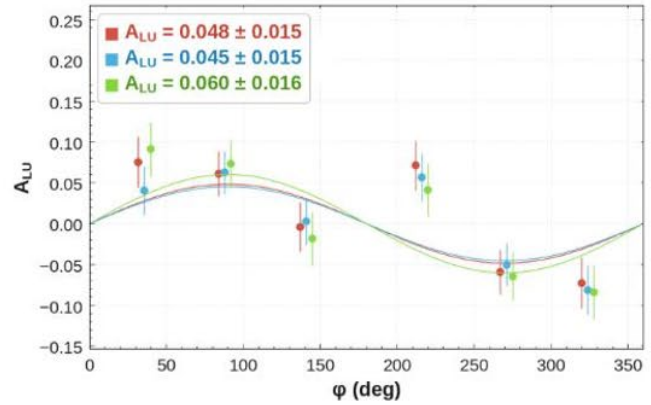
0.739 ≤ Q² < 0.918 GeV²



0.918 ≤ Q² < 1.158 GeV²



1.158 ≤ Q² ≤ 1.500 GeV²



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BSA: $A_{LU}(\varphi)$ in bins of $cos\theta$–Three methods E_b=8.5 GeV Spring 2024

- Integral
- Mass window
- Background substraction

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

1 Ratio of yields $N^{\pm}$
P_b = 0.85 · $N^{\pm}$ = yields for h = ±1

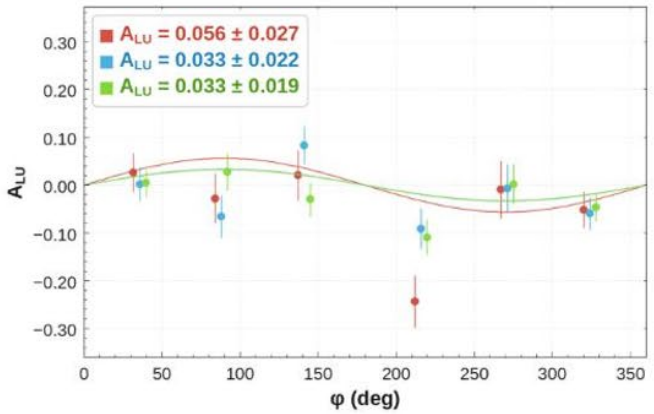
$$A_{LU} = \frac{1}{P_b} \cdot \frac{N^+ - N^-}{N^+ + N^-}$$

fit

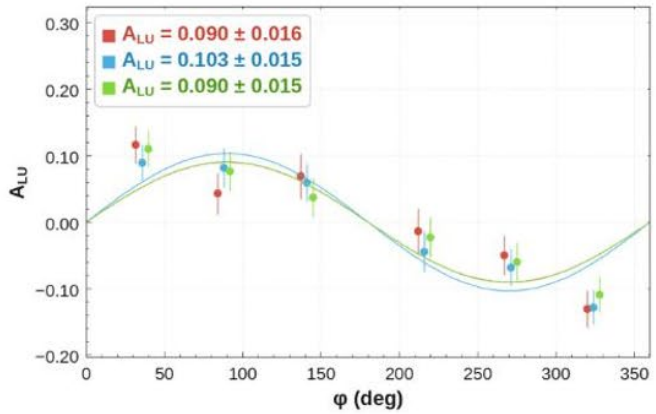
2 Sine moment of the asymmetry
fit $A_{LU}(\varphi)$ per bin → $A_{LU}^{\sin\varphi}$ ± stat. err.

$$A_{LU}(\varphi) \simeq A_{LU}^{\sin\varphi} \cdot \sin\varphi$$

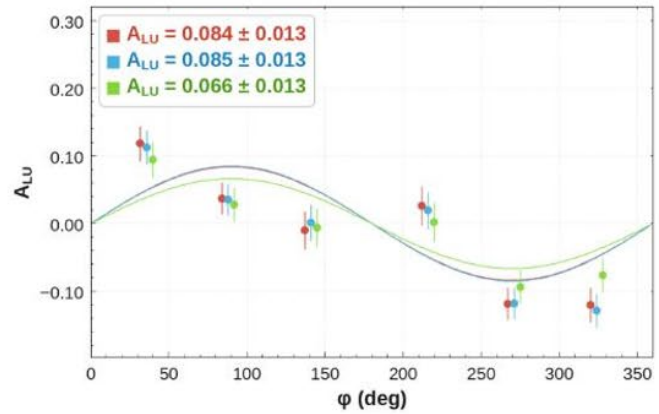
−1.000 ≤ cosθ < −0.533



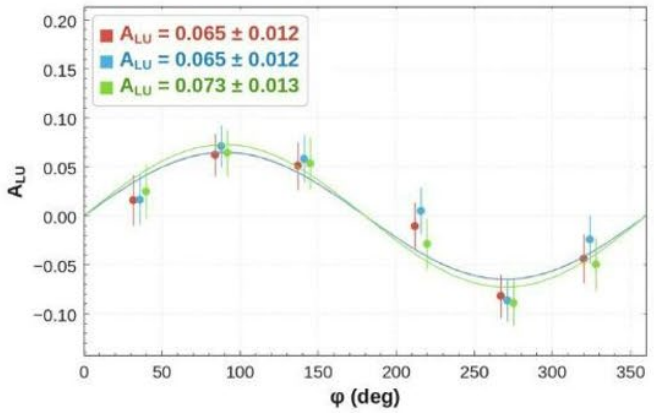
−0.533 ≤ cosθ < 0.062



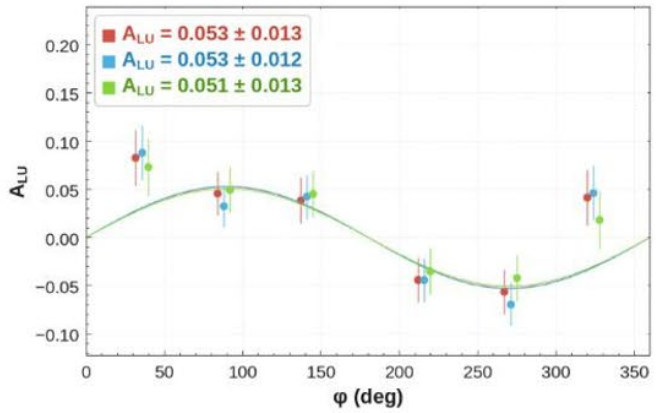
0.062 ≤ cosθ < 0.368



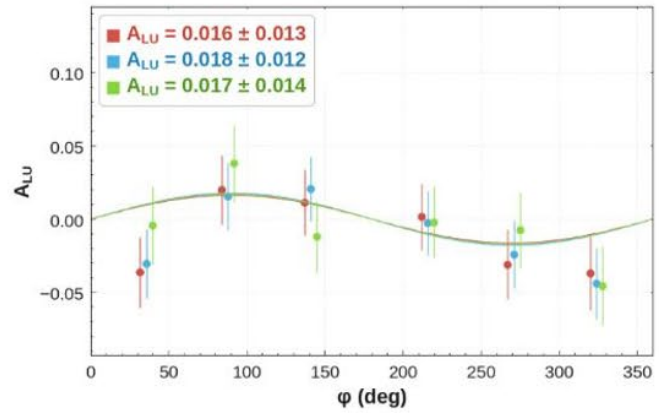
0.368 ≤ cosθ < 0.573



0.573 ≤ cosθ < 0.732



0.732 ≤ cosθ ≤ 1.000



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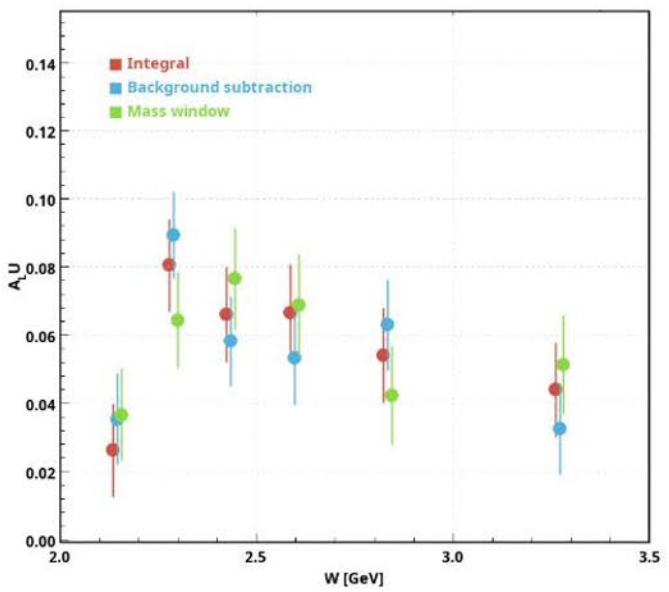
A_{LU} vs W, Q^2 and cosθ

E_b=8.5 GeV Spring 2024

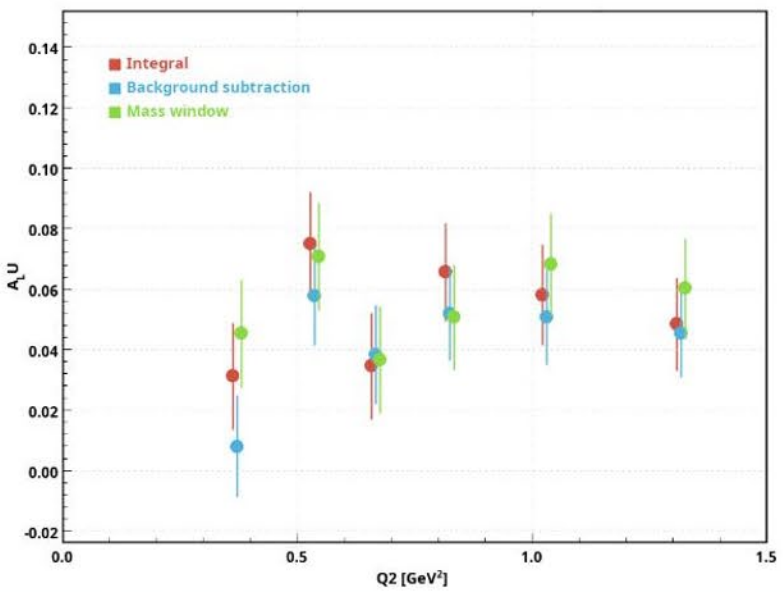
- Integral
- Mass window
- Background substraction

$$ep \rightarrow e'K^+\Lambda(1520) \rightarrow e'K^+(K^-)p$$

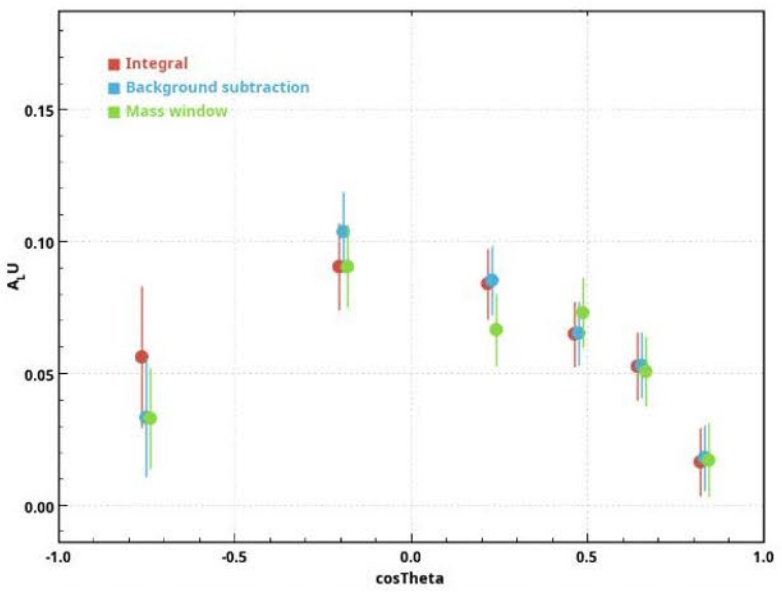
A_{LU} vs W



A_{LU} vs Q^2



A_{LU} vs cosθ



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Summary

- ✓ Preliminary results on Beam Spin Asymmetry amplitude for the reaction $e + p \rightarrow e' K^+ \Lambda(1520)$ have been obtained for :
  - 6.4 GeV and 8.5 GeV datasets (Spring 2024): binned kinematic distributions in W, Q^2 ,cosθ".
- ✓ Results have been obtained using three different events approaches:
  - Signal integral
  - Background subtracted events count
  - Events under the signal peak within a 60 MeV range
- ✓ Low signal statistics bins show discrepancies among the three methods and require better constraints on the signal fit

Future Goals

➢ **Background study:**

evaluate the effect of concurrent processes such as the $\varphi(1020) \rightarrow K^+K^-$ and optimize the fit to fully describe the distributions

➢ **Fit stability:**

improve the stability of the yield fits, which are unreliable in some bins, for the two fit-based methods (integral and background subtraction)

➢ **Theory comparison:**

include theoretical contributions and compare the extracted $A_{LU}^{sin\phi}$ with the experimental data

Thank you for your attention !

Previous results: early KΛ(1520) photoproduction

Evidence of vector meson dominance model

1. KΛ(1520) photoproduction at SLAC - 11 GeV Bremsstrahlung γ beam - Phys. Lett. B 34, 547 (1971).

$$\sigma_{tot}(\Lambda^{o}_{1520}) = (5.4 \pm 1.4)/k^{2}\ \mu b$$

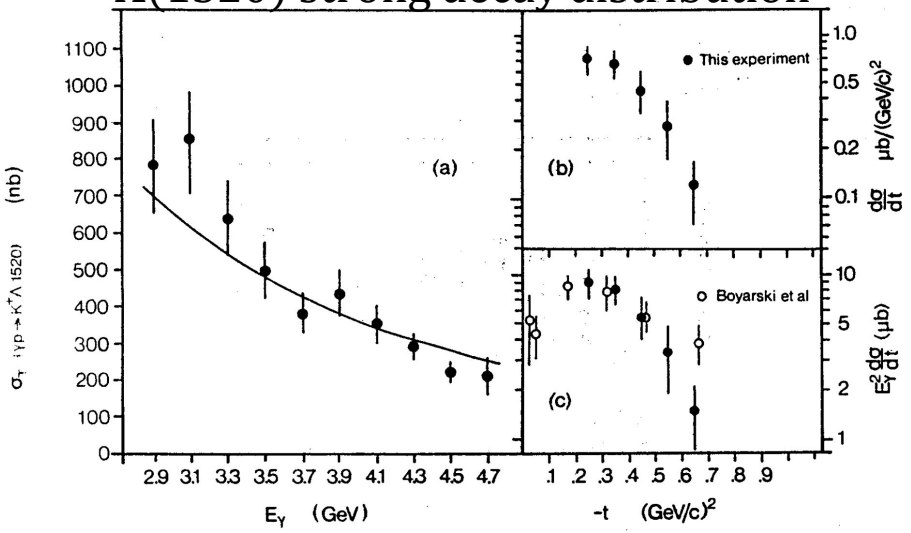
θ_{LAB}	$-t$	Λ_{1520}
0.70	0.025	0.044 ± 0.021
1.03	0.045	0.036 ± 0.011
2.15	0.17	0.071 ± 0.012
2.96	0.32	0.065 ± 0.016
3.57	0.46	0.046 ± 0.010
4.35	0.67	0.032 ± 0.009

- Differential cross section shows a maximum at $t = -m^{2}_{K^{+}}$ and decrease at $t \to 0$

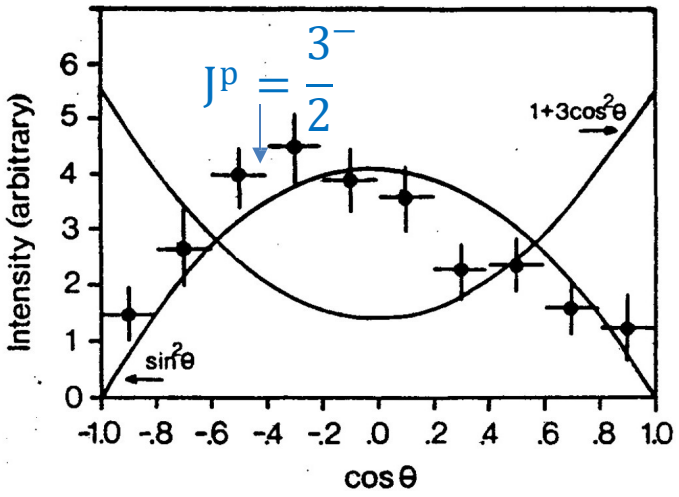
2. KΛ(1520) photoproduction at LAMP2, Daresbury – E_{γ} = 2.8–4.8 GeV - Z. Phys. C: Part. Fields 7, 17 (1980).

- Cross section shows an energy dependence:
  $\sigma = (6.5 \pm 0.7)E_{\gamma}^{-(2.1\pm0.2)}$
- $\sin^{2}\theta$ angular distribution of $\Lambda(1520) \to K^{-}p$ is compatible with $J^{P}=\frac{3^{-}}{2}$
- dominant K*(892) exchange in the t channel
- negligible contribution of K (493) exchange

$\Lambda(1520)$ strong decay distribution

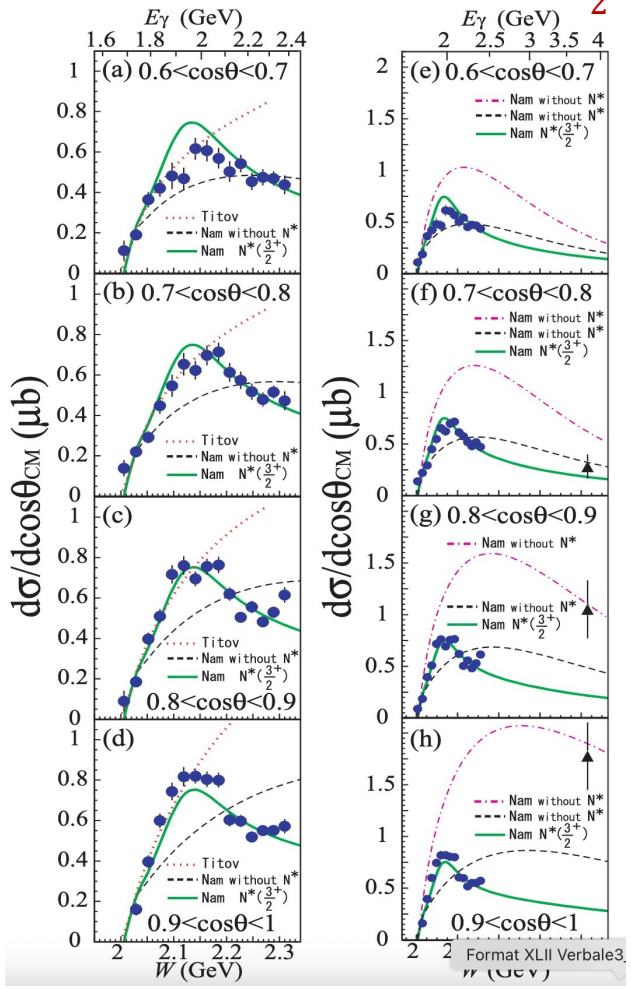


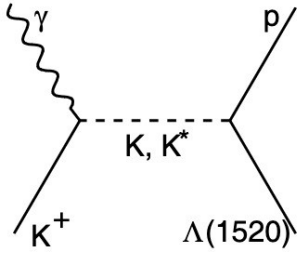
$\Lambda(1520)$ strong decay distribution

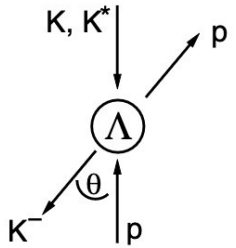


Previous results: more KΛ(1520) photoproduction

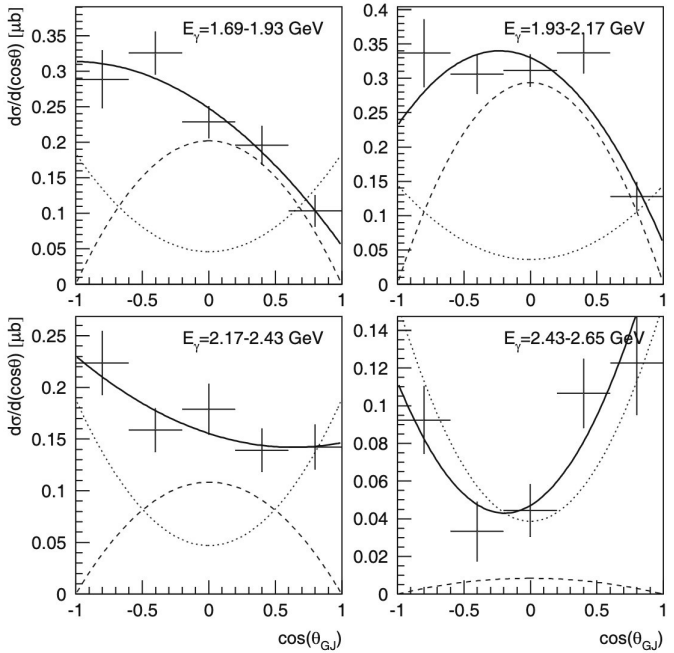
LEPS results for $E_\gamma < 2.4$ GeV are compatible with the production of an intermediate N* $\frac{3}{2}^+$(2100) resonance.







SAPHIR results for $E_\gamma < 2.6$ GeV



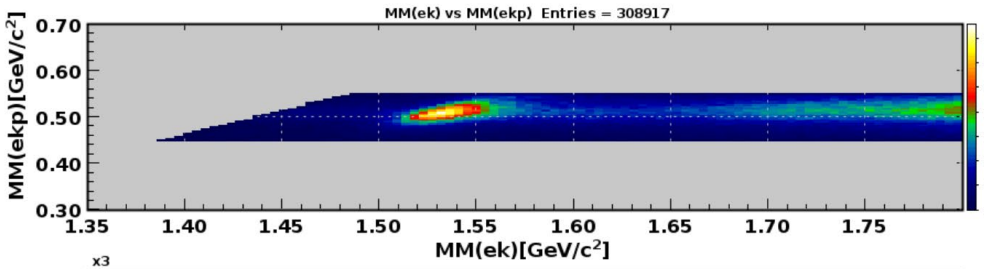
- A $\sin^2\theta_{K^-}$ dominance is observed at low energies.
- For energies above 2.43 GeV a $1 + 3\cos^2\theta_{K^-}$ shape is seen indicating that K exchange is clearly preferred

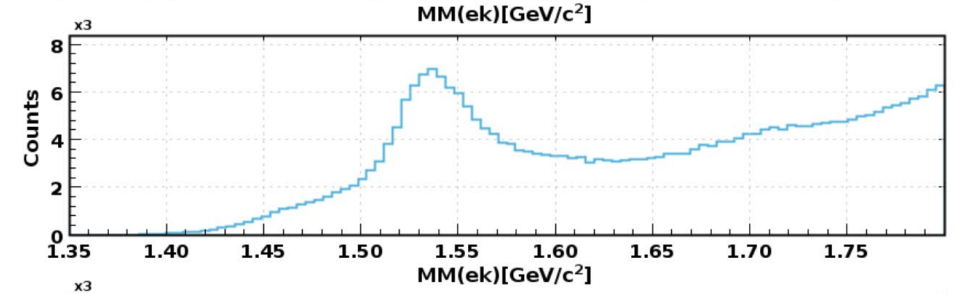
Eur. Phys. J. A 47,47 (2011)

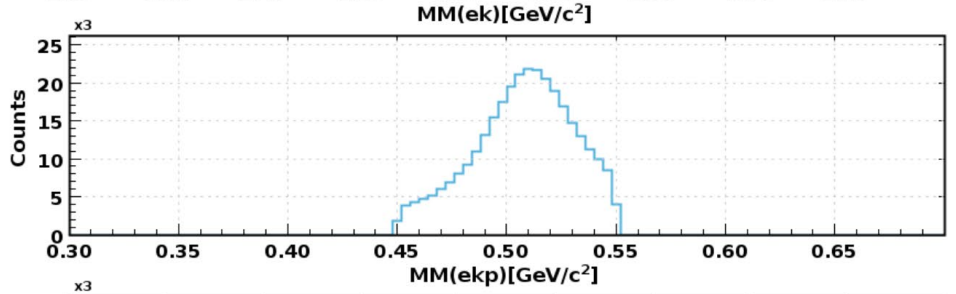
Phys. Rev. Lett. 104,172001 (2010).

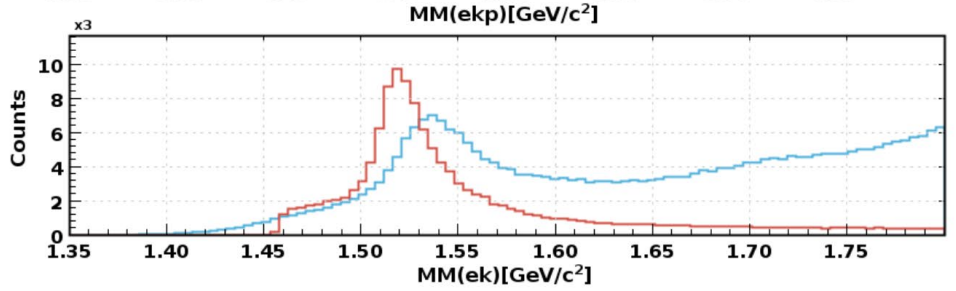
MM(eK$^+$) Without and with Rotation

Without rotation

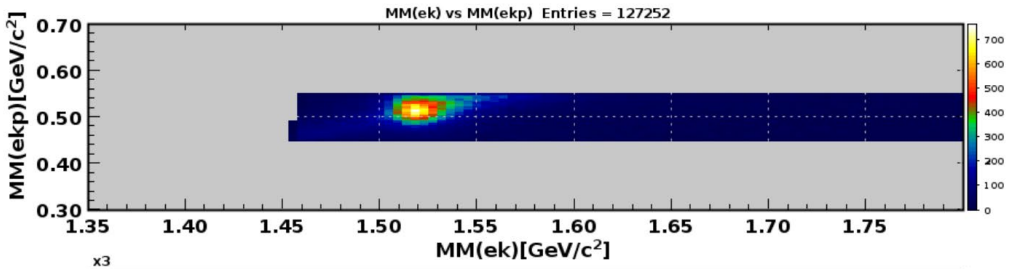


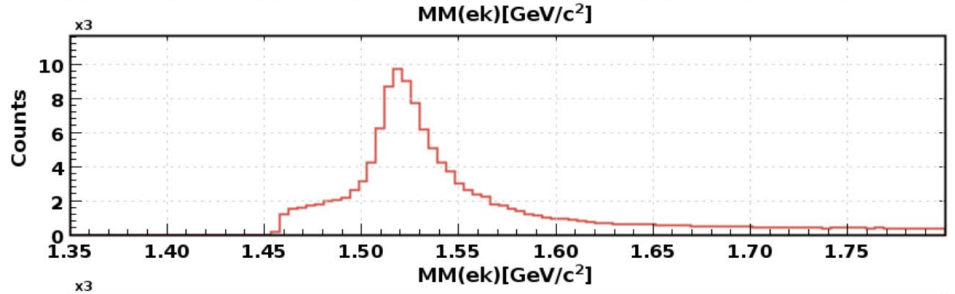


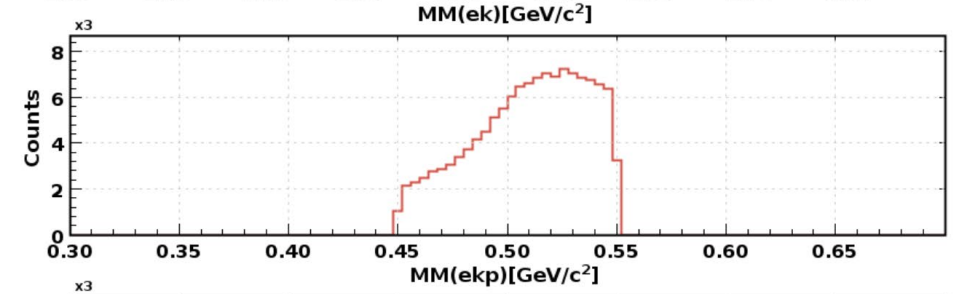


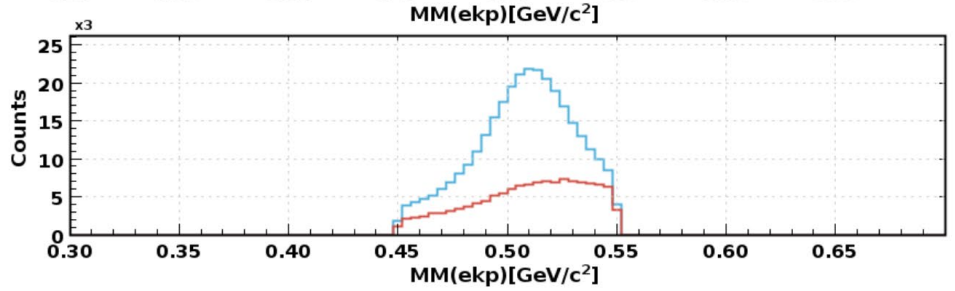


With rotation (θ_{rot} = 75°)









Statistical Uncertainty on the BSA

1 **Yields per helicity**

N^+, N^- *in each (kinematic bin, φ bin)*

2 **Asymmetry and its error**

$$A = (1/P_b) \cdot (N^+ - N^-) / (N^+ + N^-)$$

$$dA = (1/P_b) \cdot 2\sqrt{(N^+N^-)} / (N^+ + N^-)^{3/2}$$

3 **Fit of $A(\varphi) = A_{LU} \cdot \sin\varphi$**

fit weighted with $dA \rightarrow A_{LU} \pm \sigma(A_{LU})$, χ^2/ndf