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Goals:

* Focus on first looks at data in both RG-A and RG-K datasets

* K⁺Y, pπ⁰, nπ⁺, pπ⁺π^{-,} K⁺Y*

Data from reconstruction tag 5.7.4

- Develop analysis codes/procedures
- * Optimize skim conditions and data formats

* Benchmark detector response and systematics

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KY Analysis Overview

Daniel S. Carman, Jefferson Laboratory

Electron ID:

- Cut on tracking status
- EB PID=11 (e⁻ in ECAL)
- 1.5 beam</sub>
- $t_{min} < TOF_e < t_{max}$
- $-10 < v_{ze} < 5 \text{ cm}$
- W² > 0
- 2σ S.F. cut
- UVW ECAL fiducial cut
- $\chi^2 PID cut$
- N_e=1

Hadron ID:

- Cut on tracking status
- q ≠ 0
- p_{min} beam</sub>
- $t_{min} < TOF_h < t_{max}$
- Cut on $\Delta t_{\text{meas-calc}}$
- $-10 < v_{zK} < 5 \text{ cm}$
- Cut about K⁺ mass peak
- χ^2 PID cut
- Separate cuts for fwd and cent hadrons

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Analysis Studies:

- With non-optimized EB PID, develop stringent cuts to isolate KY topologies
- Topologies studied:



• e'K⁺p

K⁺, p, π⁻ fwd or cent

- e'K⁺pπ⁻
 fwd or ce
- e'pπ⁻
- Low-level momentum corrections
- Statistical estimates compared to proposal

Available Data:

- RG-A fall 2018: 4 runs at 10.6 GeV (<1% of sample)
- RG-K winter 2018: 15 runs at 7.5 GeV (10% of sample)
- RG-K winter 2018: 5 runs at 6.5 GeV (5% of sample)

Move beyond EB PID to reduce backgrounds

Data from release 5.7.4

KY Kinematics



Daniel S. Carman

KY Missing Mass Distributions





MM(e'K⁺) Distributions:

- K⁺ in FD vs. CD
 - 6.5 GeV = 5:1
 - 7.5 GeV = 5:1
 - 10.6 GeV = 10:1
- CD has significant particle mis-ID

KY Missing Mass Distributions



e'K⁺p topology

MM(e'K⁺) Distributions:

- Limited statistics at 10.6 GeV
- Yield ratio

 K⁺(FD)p(FD):
 K⁺(FD)p(CD):
 K⁺(CD)p(FD) = 1:¹/₄:¹/₄

E _b (GeV)	$MM_{\Lambda}(GeV)$	σMM_{Λ} (MeV)
6.5	1.1134	16.9
7.5	1.1180	24.7
10.6	1.1183	~45

Direct Λ Detection



e'pπ⁻ topology

$M(p\pi^{-})$ Distributions:

- Λ peak only seen when requiring K*
- π^- acceptance < 1%
- p (FD) π^- (CD) dominant topology
- Invariant mass resolution ~5 MeV

KY Momentum Corrections and "Polarization" Analysis

Next steps:

- Develop "crude" momentum corrections to remove kinematic dependence of MM on p_e, θ_e , and ϕ_e
- Measure transferred Λ polarization once helicity information if available



π^+ n Analysis Overview

Valerii Klimenko, Moscow State University



Objective:

Determine BSA in the resonance region in exclusive π^+n electroproduction off the proton for W < 2 GeV and Q² < 12 GeV²

- Data cooked with tag 5.7.4
- Data runs: 5030, 5036, 5038, 5046, 5117 (400M events)
- E=10.6 GeV, torus/solenoid=-100%/-100%
- Reaction: $ep \rightarrow e'\pi^{+}n$



Selection of π^+ n Exclusive Events

Selection criteria:

- 1. Exactly one pion from EB in event
- 2. Track quality check
- **3**. $p_{\pi} > 0.2 \text{ GeV}$
- 4. Pion should be detected by FD
- 5. No other charged particles except $e'\pi^+$
- 6. W < 2 GeV
- 7. E_{π} calc vs. meas consistency







325183

0.112

Two Pion Electroproduction

E=6.5 GeV outbending



<u>Objective:</u>

Evgeny Golovach, Moscow State University

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Continue ongoing program of two-pion studies to extract electrocoupling amplitudes:

- Precision studies at Q^2 range overlapping existing CLAS data
- Extend studies to Q^2 up to 12 GeV²



Two Pion Electroproduction

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Krishna Neupane, University of South Carolina

Move beyond EB PID to reduce backgrounds

Electron ID:

- Should be first particle in hit list; PID=11
- q = -1
- β > 0.02, p > 0.3 GeV
- 0.0 < Q² < 15 GeV²
- 0.18 < SF < 0.28
- $-10 < v_{ze} < 5$ cm
- -2000 < χ² < 2000
- 2000 < status < 4000
- PCAL fiducial cuts
- DC fiducial cuts under development

Proton ID:

- PID = 2212
- -0.5 < Δt_p < 0.5 ns
- q = +1
- β > 0.02, p > 0.2 GeV
- 0 < Q² < 15 GeV²
- $-2000 < \chi^2 < 2000$
- 2000 < status < 6000

Pion ID:

- PID = ±211
- -0.5 < Δt_{π} < 0.5 ns
- q = ±1
- β > 0.02, p > 0.2 GeV
- 0 < Q² < 15 GeV²
- -2000 < χ² < 2000
- 2000 < status < 6000

Two Pion Electroproduction



KY* Analysis Overview



KY* Analysis Overview



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counts

KY* Analysis Overview

Outbending torus polarity

Entries

Mean x

Mean y

Std Dev x

Std Dev y

3

3.1

p K invariant mass vs thetaKm





p K⁻ invariant mass vs thetaKm

Improved K⁻ acceptance at forward angles

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1.5 1.6 1.7 1.8 1.9 2 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9

thetaKm /deg

80

70

60

50

40 ·

30

20

10

0

1.4

15

Concluding Remarks

- The Hadron Structure Group meets bi-weekly to advance analyses and develop common approaches on a number of different exclusive reaction channels using data sets from RG-A and RG-K.
- With the improved reconstruction code, momentum resolution, alignment, and detector calibrations, progress has been realized in isolating our primary reaction channels in $N\pi$, $N\pi\pi$, KY, and KY* final states.
- Studies will advance and be refined with data cooking that will be getting underway for pass-1 later this summer.

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• Particular focus will turn to data with validated helicity information in the near term.