Differential Cross-Sections and Recoil Polarizations for $\gamma p \rightarrow K^+\Sigma^0$ *from CLAS at Jefferson Lab*

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Outline

Search for "Missing" Baryons in the Strange Sector

- Constituent quark models predict many more nucleon resonances than observed in $N\pi$ partial wave analyses
- Koniuk & Isgur (1980) – "missing" resonances exist, but don't couple to $N\pi$
- Study non-$N\pi$ channels ($N\eta$, $N\omega$, $\Delta\pi$, $K\Lambda$, $K\Sigma, \ldots$)
- Capstick & Roberts (1998) – appreciable strength for several un-observed negative parity baryons decaying into the strange sector
- Experiments at Jefferson Lab (CLAS), Bonn (SAPHIR), Grenoble (GRAAL), Osaka (LEPS) are looking for these "missing" baryons in Kaon electro- and photo-production

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We report new measurements for $\gamma p \rightarrow K^+\Sigma^0$ from CLAS (g11a dataset) at Jefferson Lab

Event Selection Overview

$\gamma p \to K^+\Sigma^0$ event selection utilizes the $\Sigma^0 \to \gamma_{out}\Lambda \to \gamma_{out}p\pi^-$ decay

- Three-track topology: $\gamma p \to K^+ p\pi^-(\gamma)$
  — detect all charged tracks ($K^+ p\pi^-$)
  — γ_{out} from missing momentum (via kinematic fitting)
  — Excellent PID
- Two-track topology: $\gamma p \to K^+ p(\pi^-\gamma)$
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  — Larger Acceptance (esp. in Backward Angles)
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- Timing cuts
- Select Σ's using an *event-based* background separation method

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  $\sim 1.61 million$ events
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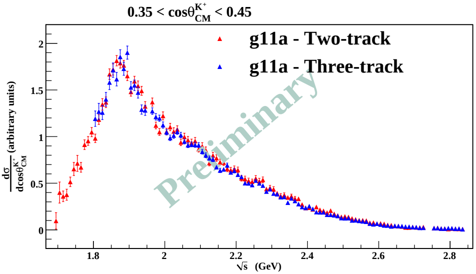
Compare: two- and three-track results

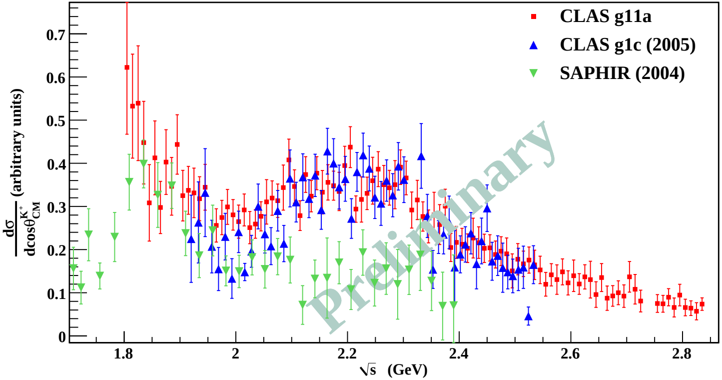
Different event-selection, particle identification, analysis techniques. *No Kinematic Fitting in two-track topology*. Agreement is very satisfactory.



Final *g*11*a* cross-sections: weighted average of two results

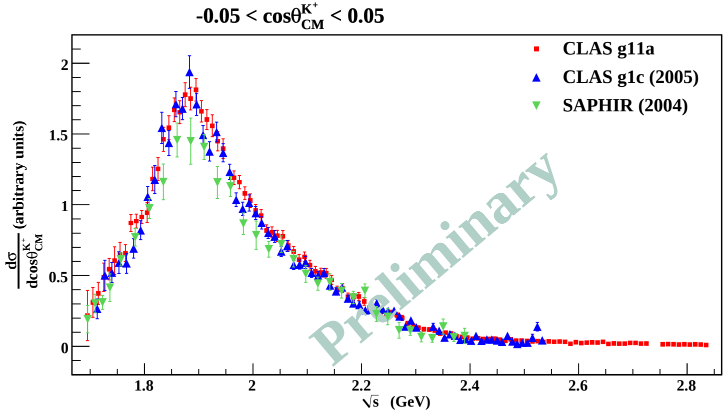
Cross-sections – Backward Angles

$-0.85 < \cos\theta^{K^+}_{CM} < -0.75$



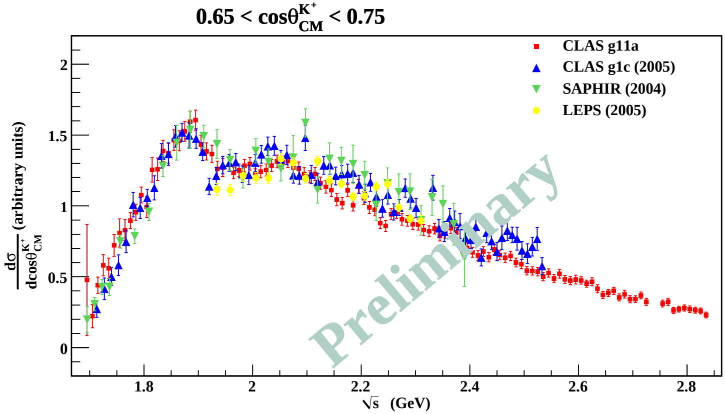
*g*11*a* and *g*1*c* – very good agreement
SAPHIR does not show "hump" at ∼ 2.2 GeV

Cross-sections – Mid Angles



*g*11*a* and *g*1*c* – very good agreement
SAPHIR “slightly” low

Cross-sections – Forward Angles



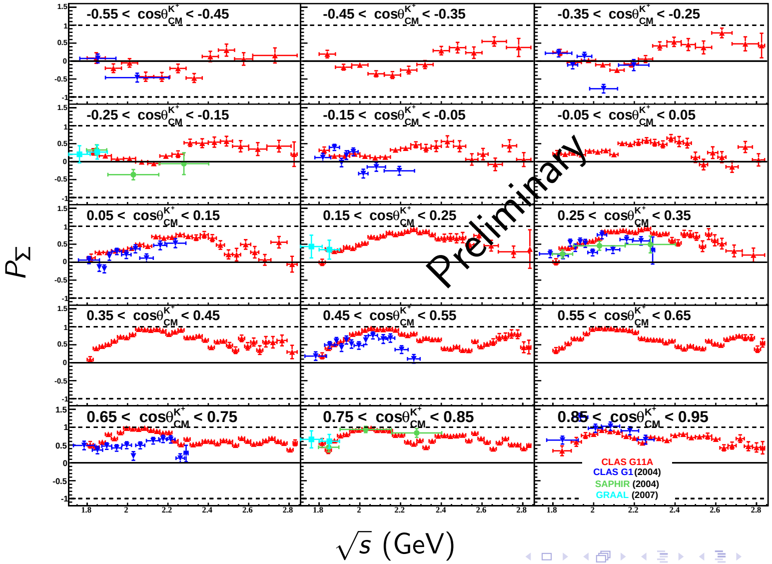
g11a "slightly" lower than both *g1c* and SAPHIR

LEPS doesn't really resolve the discrepancy

Recoil Polarizations

- full characterization of $\gamma p \rightarrow K^+\Sigma^0$ require differential cross sections plus 7 polarization measurements
- polarizations measurable from the self-analysing nature of Σ^0 and Λ decays
- $g11a$ had unpolarized beam and unpolarized target: recoil polarization (P_Σ) only. (others will be available from *FROST*)
- previous P_Σ world data is scarce: present analysis offers wide kinematic coverage and a many fold increase in statistics
- additional precision: Σ^0-Λ spin transfer correlation is preserved in this analysis

Recoil Polarizations



Summary

- $\frac{d\sigma}{\cos\theta_{CM}^{K^+}}$ measured for $\gamma p \rightarrow K^+\Sigma^0$ from threshold till 2.84 GeV with wide angular coverage from the CLAS $g11a$ dataset

- Two-track analysis allows us to confirm structure around $\sim$ 2.2 GeV earlier seen in CLAS $g1c$ at backward angles

- *Slightly* lower than CLAS $g1c$ and SAPHIR in a few mid-forward mid-energy bins

- P_Σ measured for $\sqrt{s}$ from 1.8 to 2.85 GeV and $\cos\theta_{CM}^{K^+} > -0.5$. *Greatly extends* P_Σ world data in both precision and kinematic coverage.

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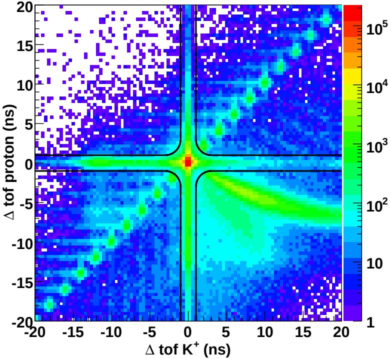
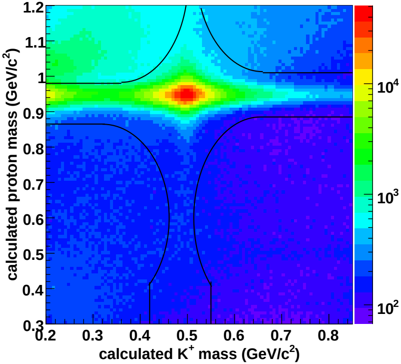
- PWA for missing baryon resonance searches using these measurements is in progress
- Simultaneously, publish present results

Timing Cuts

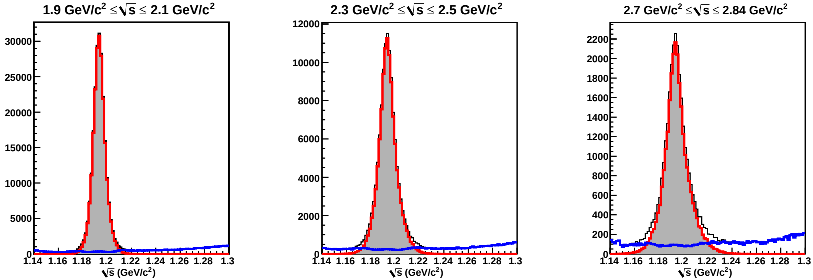




Three-track **Two-track**

Signal-background Separation

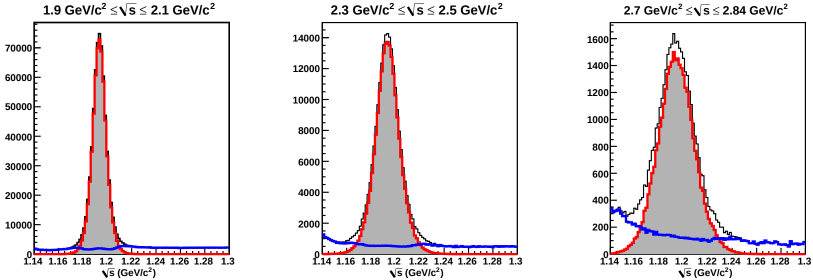
Three-track



Signal Background

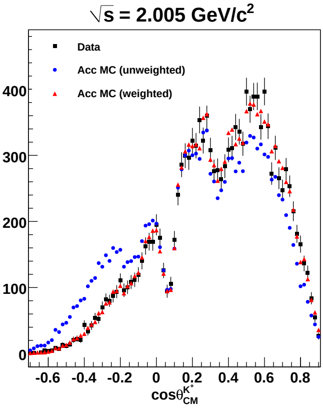
Signal-background Separation

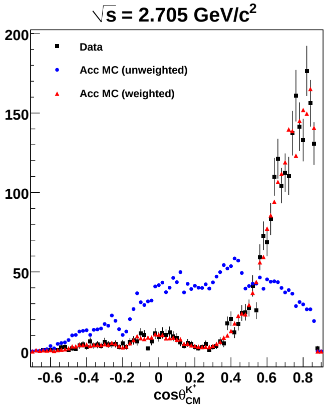
Two-track



Signal Background

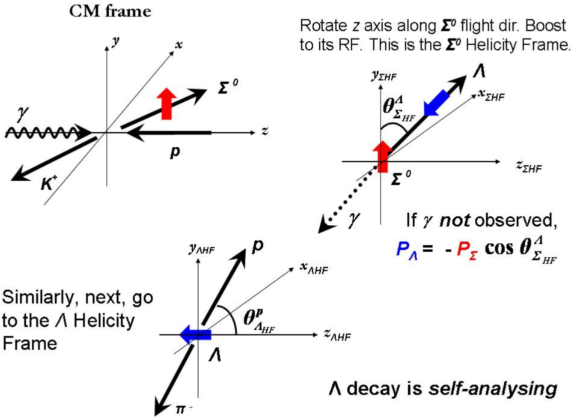
Quality of PWA fits





(Three-track topology *only*)

Extraction of P_Σ



$$\mathcal{I} \propto 1 + \alpha\langle \vec{P}_\Lambda \rangle \cos\theta^p_{\Lambda_{HF}} = 1 + \alpha\left(-\langle \vec{P}_{\Sigma^0}\rangle \cos\theta^\Lambda_{\Sigma_{HF}}\right)\cos\theta^p_{\Lambda_{HF}}$$