Update of Proposal PR-12-12-008 for parallel running with CLAS12 experiment **Run Group A**

Photoproduction of the Very Strangest Baryons on a Proton Target in CLAS12

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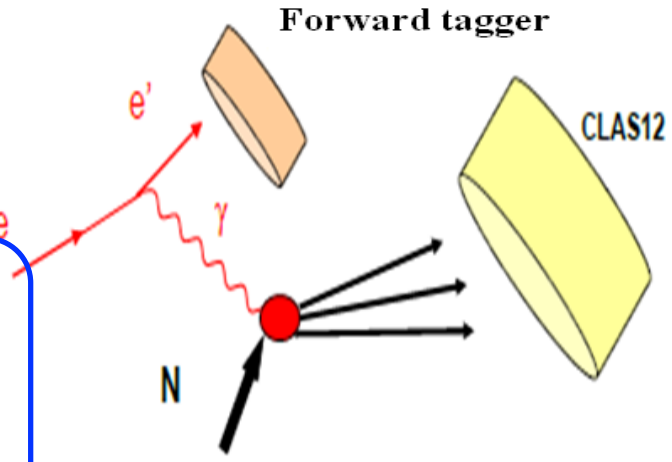
The Status of Excited (PDG12) Ω/Ξ Baryons (half a century later)

State	J^P	M (MeV)	Γ (MeV)
Ω(2250)	? ?	2252	55
Ξ(1530)	$3/2^+$	1531	9.1
Ξ(1690)	$1/2^?$	1690	<30
Ξ(1820)	$3/2^-$	1823	24
Ξ(1950)	??	1950	60
Ξ(2030)	$\geq 5/2^?$	2025	20

- Very few Ω/Ξ baryons have been identified in the last **50** years.
  - Even fewer have their quantum numbers determined.
  - Kaon beam was the primary source for these states discoveries.
  - Photon beam could be a powerful alternative.

PR12-12-008: Motivation

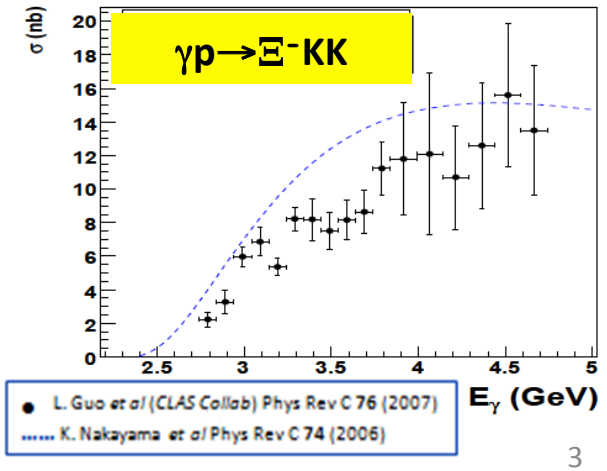


- **Cross section** for $\gamma p \rightarrow \Omega^- K^+ K^+ K^0$ is still unknown.

· Study of a **mechanism** of the Ω^- photoproduction which should be quite specific, since it is the **first baryon** with constituents none of which could come from the target proton.

Further Physics Goals

- Excited cascade resonances (Spin-Parity).
- Polarization measurement of Ξ.
- Mass Splitting measurements for Ξs.
- Expected statistics are several orders of magnitudes higher than existing data

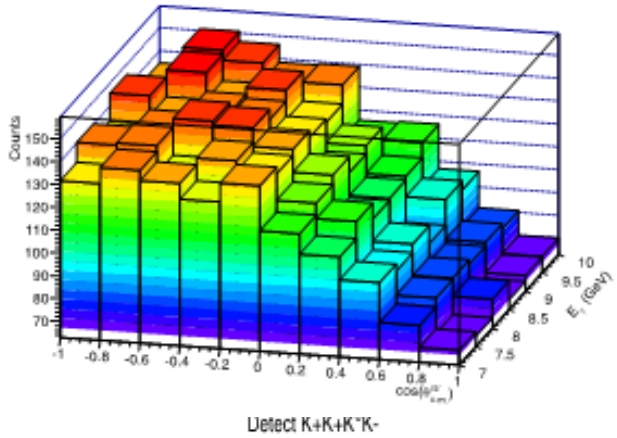


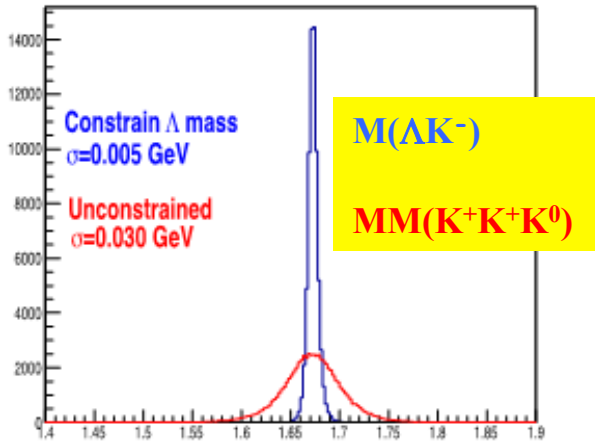
Expected Results

- **Ω^- Measurement:**
  When four kaons detected,
  the spectrum is expected to be background **FREE**

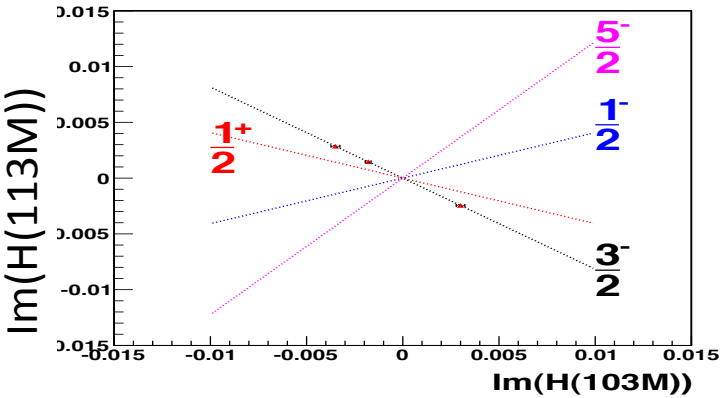
$$\gamma p \rightarrow K^+K^+K^0(\Omega^-)$$

$$\gamma p \rightarrow K^+K^+K^0K^-(\Lambda)$$





- **Expected $\Xi^-(1820)$ double moments (L=3)**



(statistical uncertainty only)

- Constraining the Λ mass improves the resolution.
  Further improvement expected with kinematic fitting.

Beam Time & Expected Particle Rate

State	Detected Particles	Measured decays	Overall Efficiency	Total detected
Ω^-	$K^+K^+K^0(\Omega^-)$		2.28%	4.1k
Ω^-	$K^+K^+K^0K^-(\Lambda)$	Ω^-	0.25%	0.5k
Ξ^-	$K^+K^+\pi^-(\Lambda)$	Ξ^-	9.3%	0.9M
$\Xi^-(1530)$	$K^+K^+\pi^-(\Xi^0)$	$\Xi^-(1530)$	7.4%	270k
$\Xi^-(1820)$	$K^+K^+K^-p(\pi^-)$	$\Xi^-(1820), \Lambda$	0.52%	10k

cross sections used in the estimate are 0.3 nb for Ω^-,
15 nb for Ξ^-,
6 nb for $\Xi^-(1530)$,
3 nb for $\Xi^-(1820)$.

- Approved beam time for CLAS12 Run Group A (**80** full field days + 30 reversed field days) is sufficient for us to achieve most of goals.

PAC39 recommendation and issues

Recommendation: C2:

The motivation of the proposed measurement is sound and it fits very well within the physics interest of the 12 GeV run. The PAC39 recommends C2 approval, contingent on the achievement of more detailed simulations and a more realistic background evaluation.

Issues:

This proposal does not require additional time or equipment with respect to the already approved CLAS12 meson spectroscopy experiment. However the simulations carried out to support the proposal are of insufficient detail to judge its feasibility. In particular the background estimation is based on overly optimistic assumptions about pion and kaon identification.

Progress:

Additional simulations with much higher statistics and more realistic PID and background consideration have been conducted. The updated proposal has been reviewed by a CLAS proposal committee (M. Battaglieri and F. Sabatié) and recommended for approval to run parallel in Run Group A. Subsequently, the CLAS collaboration has endorsed the committee recommendation.

Hall B CLAS12 experiments – run groups

Proposal	Physics	Contact	Rating	Days	Group	New equipment	Energy	Run Group	Target
E12-06-108	Hard exclusive electro-production of π^0, η	Stoler	B	80	139	RICH (1 sector) **Forward tagger**	11	**A** F. Sabatié	liquid H_2
E12-06-112	Proton's quark dynamics in SIDIS pion production	Avakian	A	60					
E12-06-119	Deeply Virtual Compton Scattering	Sabatie	A	80					
E12-09-003	Excitation of nucleon resonances at high Q^2	Gothe	B+	40					
E12-11-005	Hadron spectroscopy with forward tagger	Battaglieri	A-	119					
E12-12-001	Timelike Compton Scatt. & J/ψ production in e+e-	Nadel-Turonski	A-	120					
E12-12-007	Exclusive φ meson electroproduction with CLAS12	Stoler, Weiss	B+	60					
PR12-12-008	**Photoproduction of the very strangest baryon**	**Guo**							
E12-07-104	Neutron magnetic form factor	Gilfoyle	A-	30	90	Neutron detector RICH (1 sector) Forward tagger	11	**B** K. Hafidi	liquid D_2 target
PR12-11-109 (a)	Dihadron DIS production	Avakian							
E12-09-007a	Study of partonic distributions in SIDIS kaon production	Hafidi	A-	56					
E12-09-008	Boer-Mulders asymmetry in K SIDIS w/ H and D targets	Contalbrigo	A-	TBA					
E12-11-003	DVCS on neutron target	Niccolai	A	90					
E12-06-109	Longitudinal Spin Structure of the Nucleon	Kuhn	A	80	170	Polarized target RICH (1 sector) Forward tagger	11	**C** S. Kuhn	NH_3 ND_3
E12-06- 119(b)	DVCS on longitudinally polarized proton target	Sabatie	A	120					
E12-07-107	Spin-Orbit Correl. with Longitudinally polarized target	Avakian	A-	103					
PR12-11-109 (b)	Dihadron studies on long. polarized target	Avakian							
E12-09-007(b)	Study of partonic distributions using SIDIS K production	Hafidi	A-	110					
E12-09-009	Spin-Orbit correlations in K production w/ pol. targets	Avakian	B+	103					
E12-06-106	Color transparency in exclusive vector meson production	Hafidi	B+	60	60		11	**D**	Nuclear
E12-06-117	Quark propagation and hadron formation	Brooks	A-	60	60		11	**E**	Nuclear
E12-10-102	Free Neutron structure at large x	Bueltman	A	40	40	Radial TPC	11	**F**	Gas D_2
TOTAL run time				1411	559				

C1 approved proposals & non-CLAS12

Proposal	Physics	Contact	Rating	Days	Group	Equipment	Energy	Group	Target
C12-11-111	SIDIS on transverse polarized target	Contalbrigo	A	110	110	Transverse target	11	G	HD
C12-12-009	Transversity w/ di-hadron on transvere target	Avakian	A	110					
C12-12-010	DVCS with transverse polarized target in CLAS12	Elouadrhriri	A	110					
All transverse target proposals				330	110				
C12-11-006	Heavy Photon Search at Jefferson Lab (HPS)	Jaros	A	180	180	New setup in alcove	2.2, 6.6	H	Nuclear
E12-11-106	High Precision Measurement of the Proton Charge Radius	Gasparian	A	15	15	Primex	1.1, 2.2	I	H2 gas
TOTAL PAC39 beam time request				**525**	**305**				

One of the approved experiments (PCR) and one C1 conditionally approved experiment (HPS) do not require upgrade equipment. They could run prior to the completion of CLAS12 in Hall B.

1) HPS experiment requires beam energies up to 6 GeV and equipment that is not part of the 12 GeV upgrade project.

2) PCR experiment needs 1.1 and 2.2 GeV beam energy and does not require CLAS12.

Additional Slides

Expected Results (2)

- Ξ^- polarization measurement: (should be E_γ dependent)

$$\gamma p \rightarrow K^+K^+\Xi^- \rightarrow K^+K^+\pi^-(\Lambda)$$

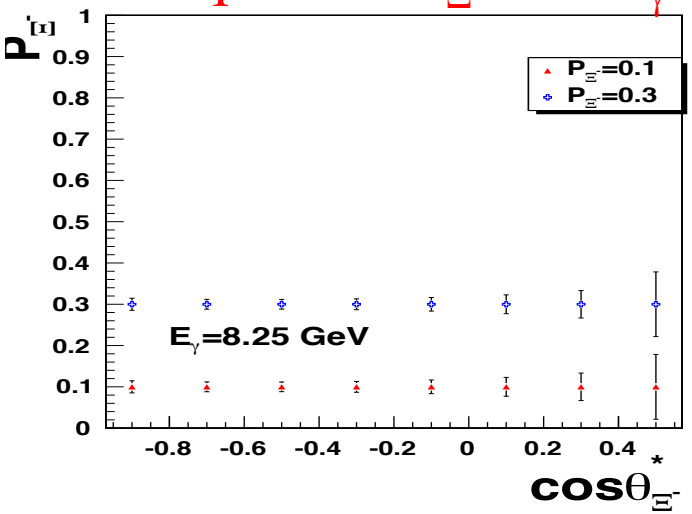
- $\Xi^-(1820)$:

$$\gamma p \rightarrow K^+K^+\Xi^-(1820)$$

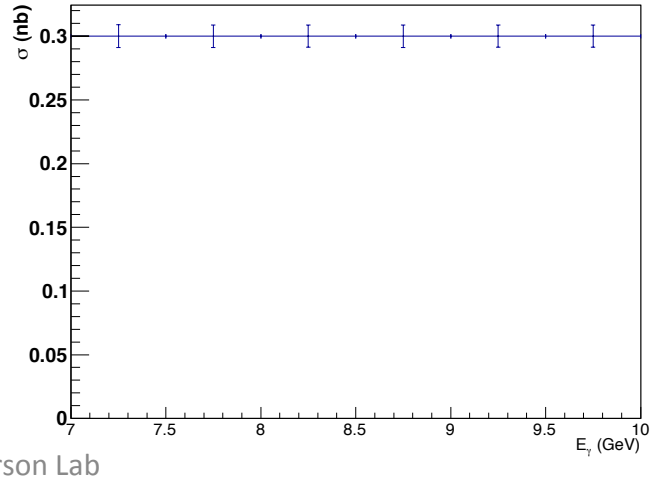
$$\Xi^-(1820) \rightarrow K^-\Lambda$$

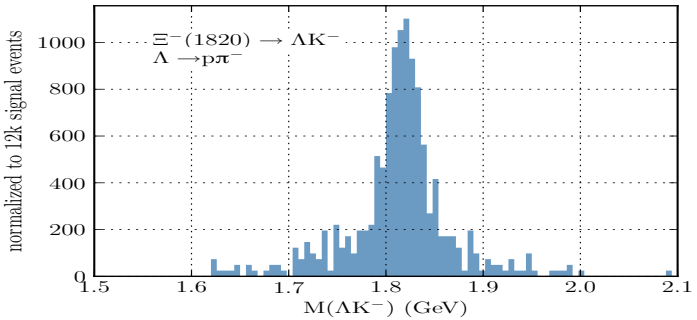
$$\Lambda \rightarrow \pi^- p$$

Expected P_{Ξ^-} VS E_γ



Expected Ω^- Cross section Measurements





Kinematic Fitting

Examples of kinematic fitting from CLAS g11:

Top: The missing mass spectra of the $K^+K^+\pi^-$ system for a proton target. Events corresponding to the Ξ^- signal are selected.

Bottom: The missing mass spectra of the K^+K^+ system for a proton target. Events corresponding to the Λ signal are selected.

The graphs show the nearly background free signal obtained from the kinematic fit.