GlueX at 1 – 4 GeV

Mark M. Dalton

for Farah Afzal, Volker Crede, Peter Hurck, Igal Jaegle, Annika Thiel

and the GlueX Collaboration

GlueX Acknowledgements: gluex.org/thanks

Hall D Beam Opportunity 2026

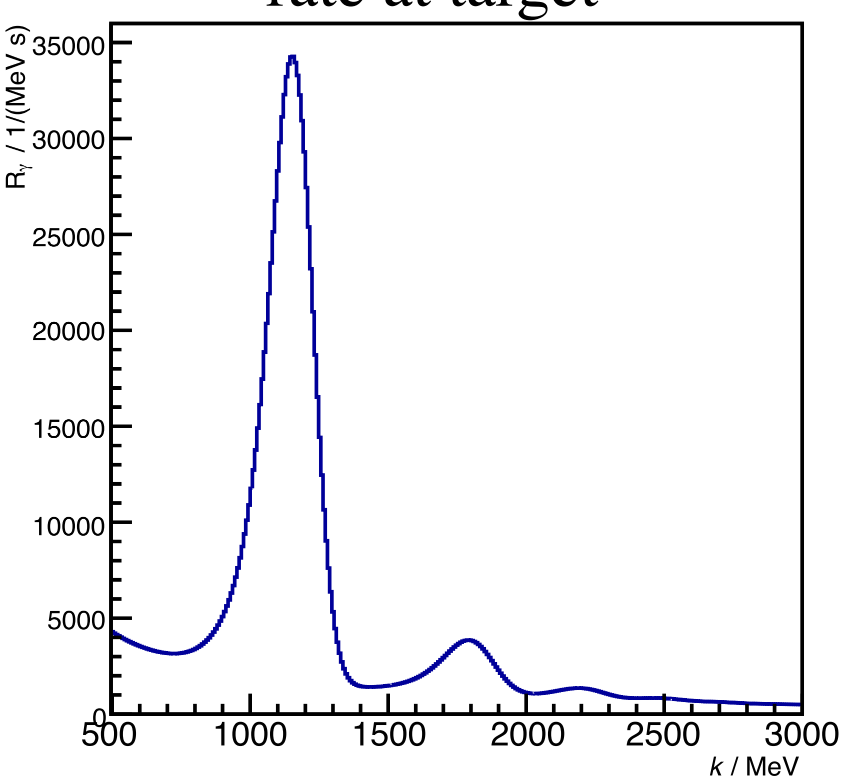
The accelerator is scheduled to run at 690 MeV per pass in 2026 for 55 calendar days.
This would allow a 3833 MeV beam in Hall D with relatively modest additional effort.
(photon beam in the range 956 MeV to 3764 MeV)

We propose to:

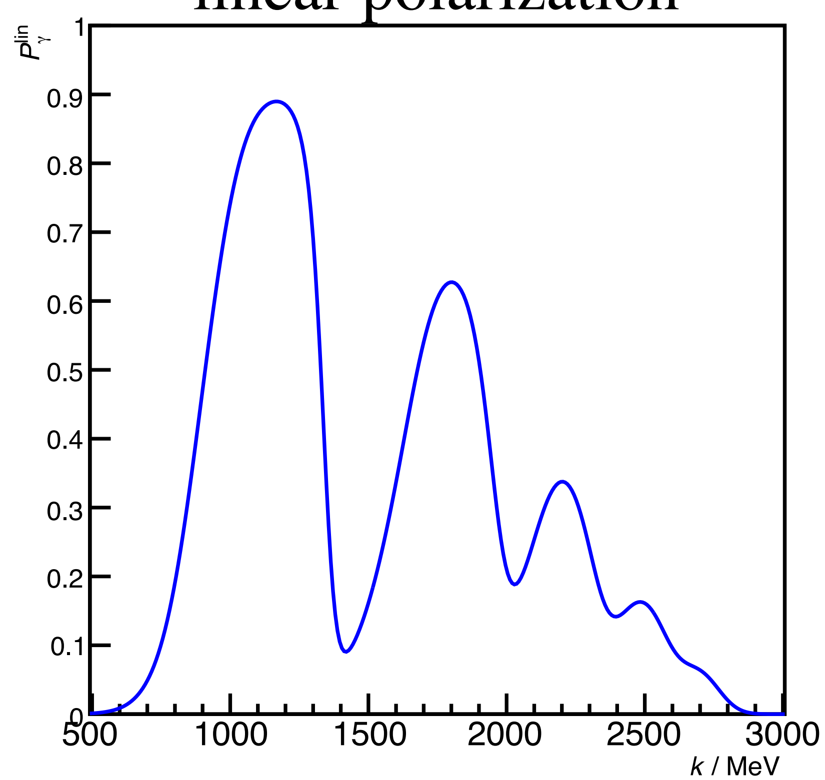
- investigate $N(1685)$ using polarization observables for $K_S^0\Lambda$
- weak-decay constant for $\alpha\_$ for $\Lambda \to p\pi^-$
- measure differential cross sections and perform isospin separation of strong production amplitudes in the transition between resonance and Regge regions

Emphasis on the lowest energy region for both rate and linear polarization.

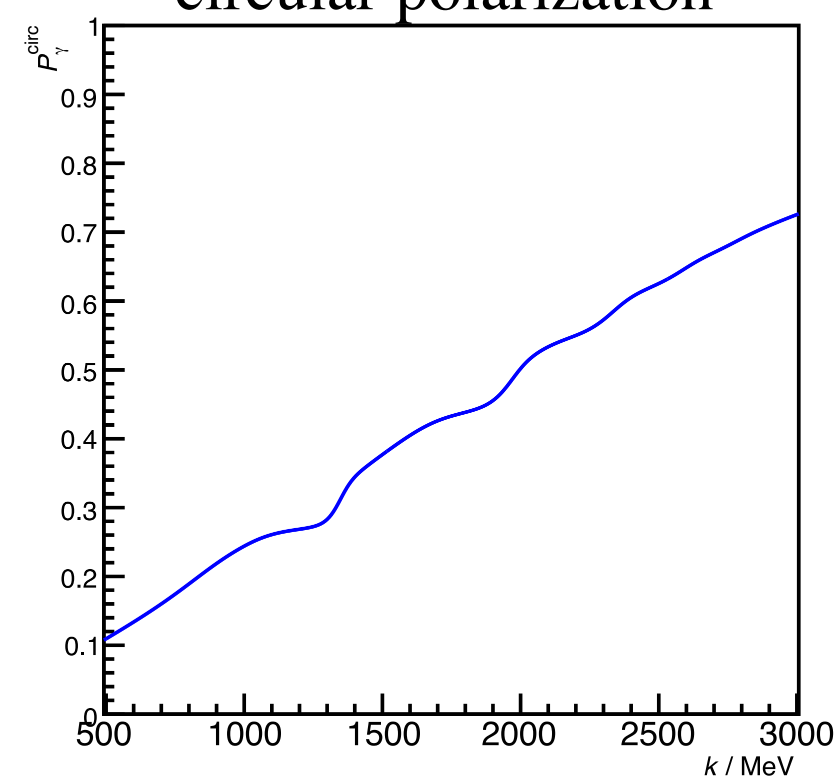
rate at target



linear polarization



circular polarization



Baryon Resonances from Neutrons

Measurements off neutrons are essential for an isospin decomposition of resonances.

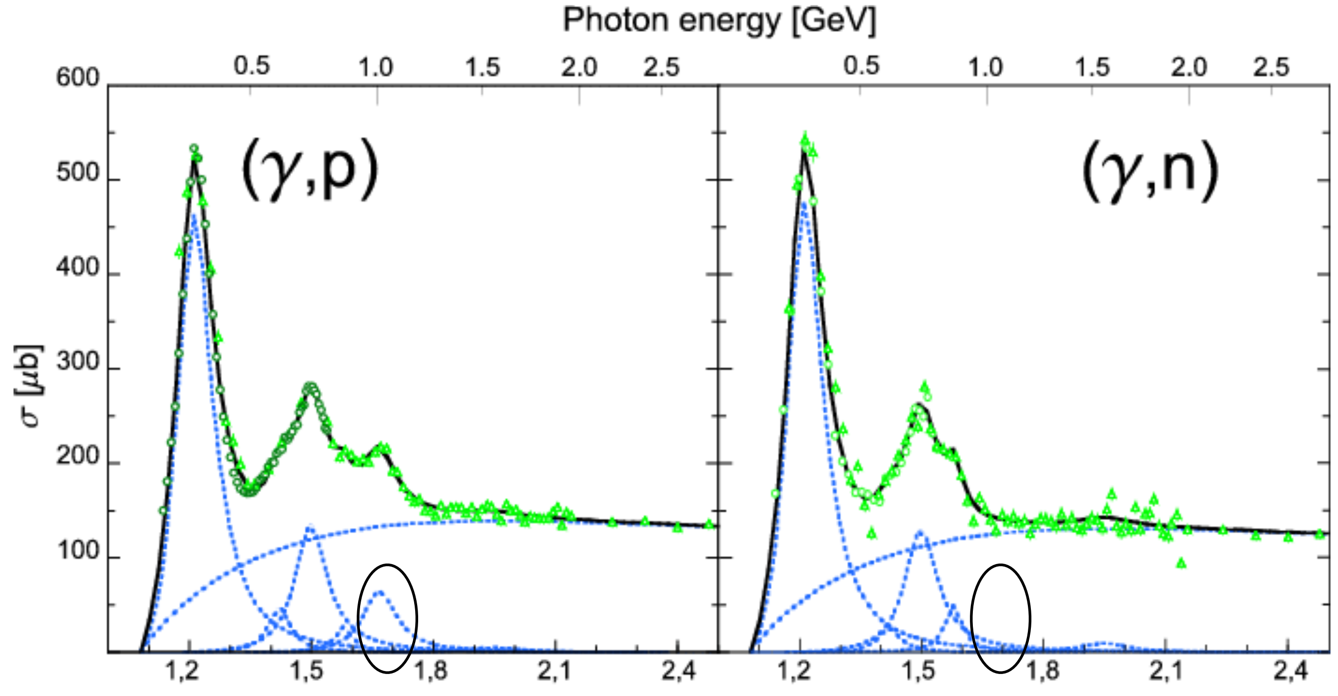
Different resonance contributions are possible from the neutron.

Large increase in proton data over the last decade

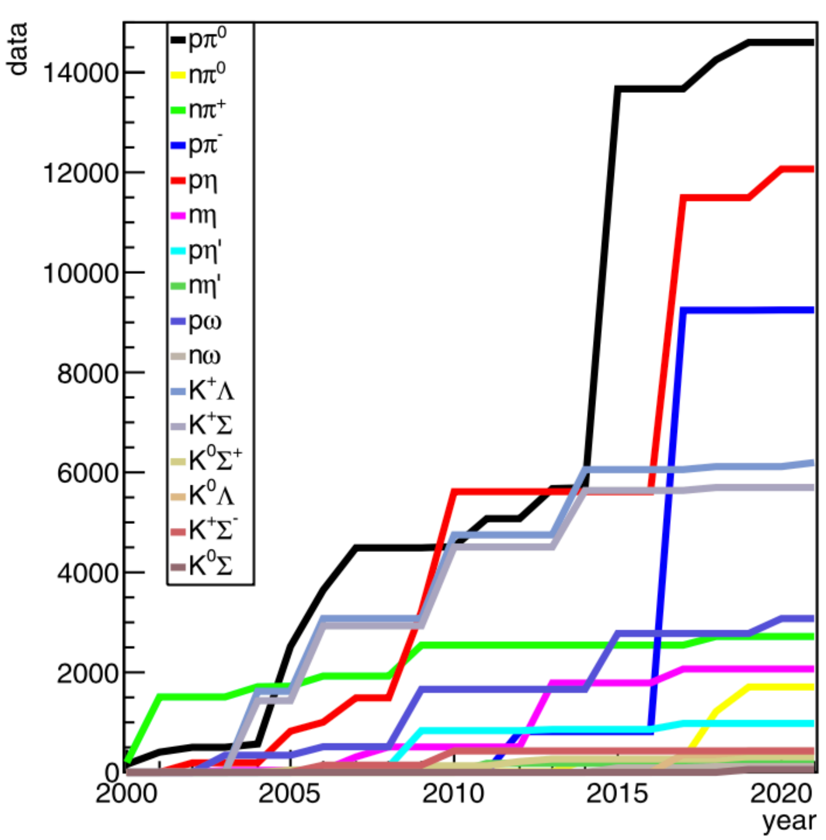
Neutron target is much more rare.

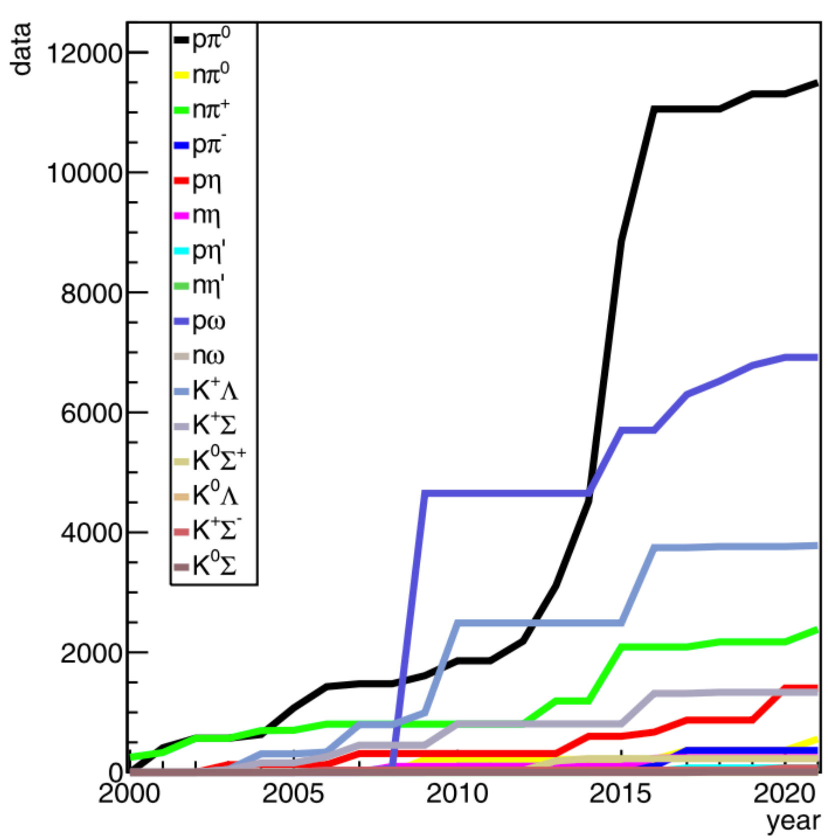
γNN^* and $\gamma N\Delta^*$ couplings may differ strongly for proton and neutron, relatively unexplored, discovery potential due to lack of data.

With a photon beam and deuteron target we have an opportunity to contribute.



$F_{15}(1680)$





What about $N(1685)$?

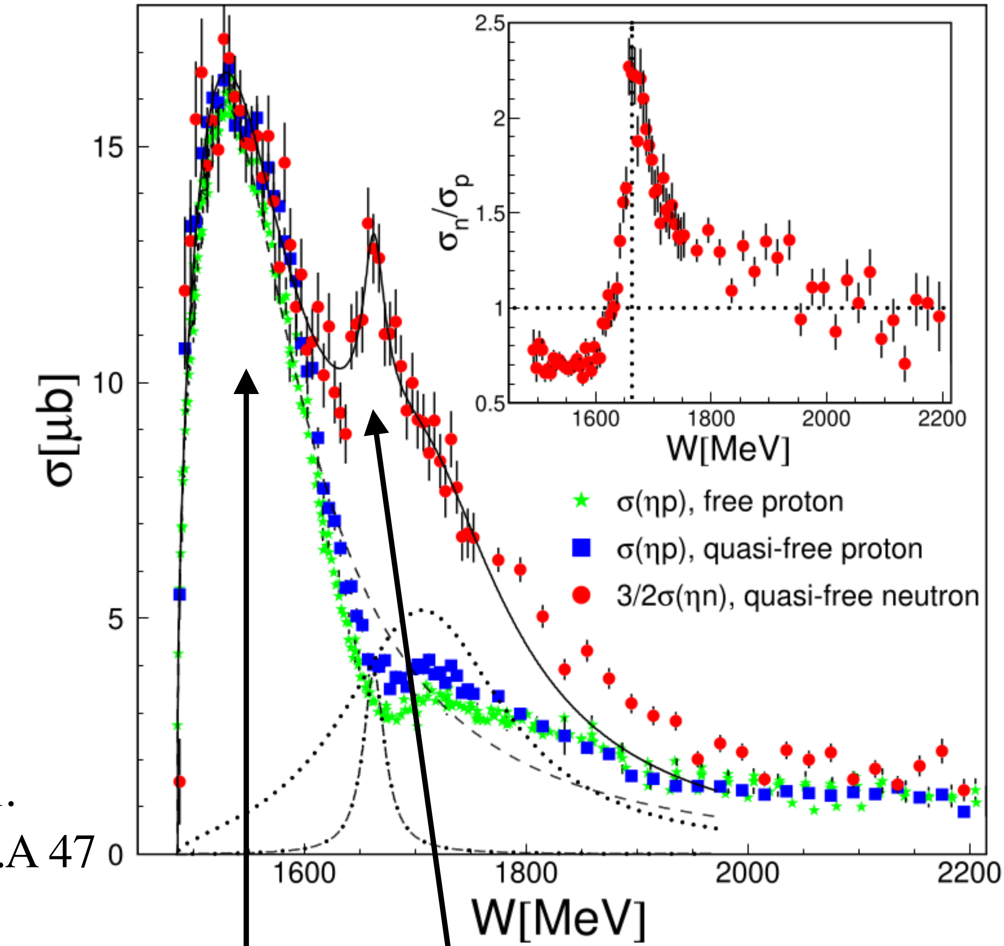
Observation of a narrow peak in cross section data of $\gamma n \to \eta n$ at W = 1685 MeV with $\Gamma \approx 30$ MeV by GRAAL, CBELSA/TAPS, A2, Tohoku group at LNS

Possible explanations:

- Interference term between partial waves?
  Eur. Phys. J. A 51.6 (2015), p. 72,
  Phys. Rev. C 78 (2008), p. 065201
- Opening of a strangeness channel?
  Phys. Lett. B 683 (2010), pp. 145–149
- Coupled channel effects?
  Phys. Lett. B 650 (2007), pp. 172–178
- A narrow resonance?
  Phys. Lett. B 636 (2006), pp. 253–258
  Eur. Phys. J. A 32 (2007), pp. 311–319
  Phys. Rev. D 99.7 (2019), p. 074010

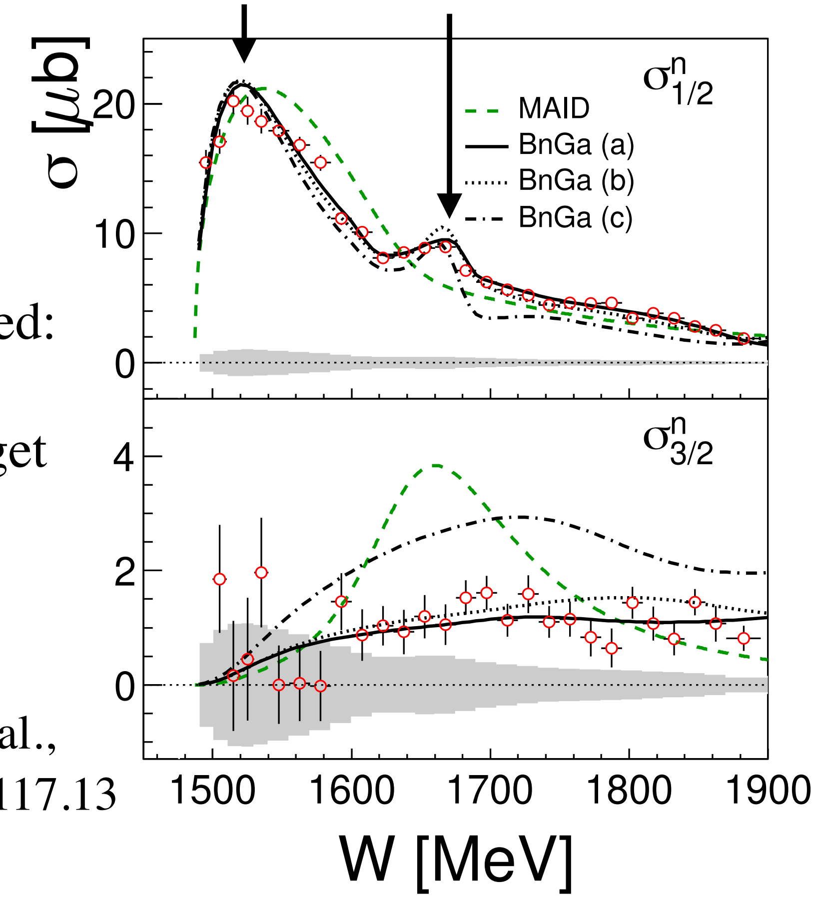
A true resonant structure is expected to decay to $K^0\Lambda$

Jaegle et al.
Eur.Phys.J.A 47
(2011) 89



$N(1535)$ $N(1685)$?

Helicity separated:
Circular beam,
longitudinal target



L. Witthauer et al.,
Phys.Rev.Lett. 117.13
(2016) 132502

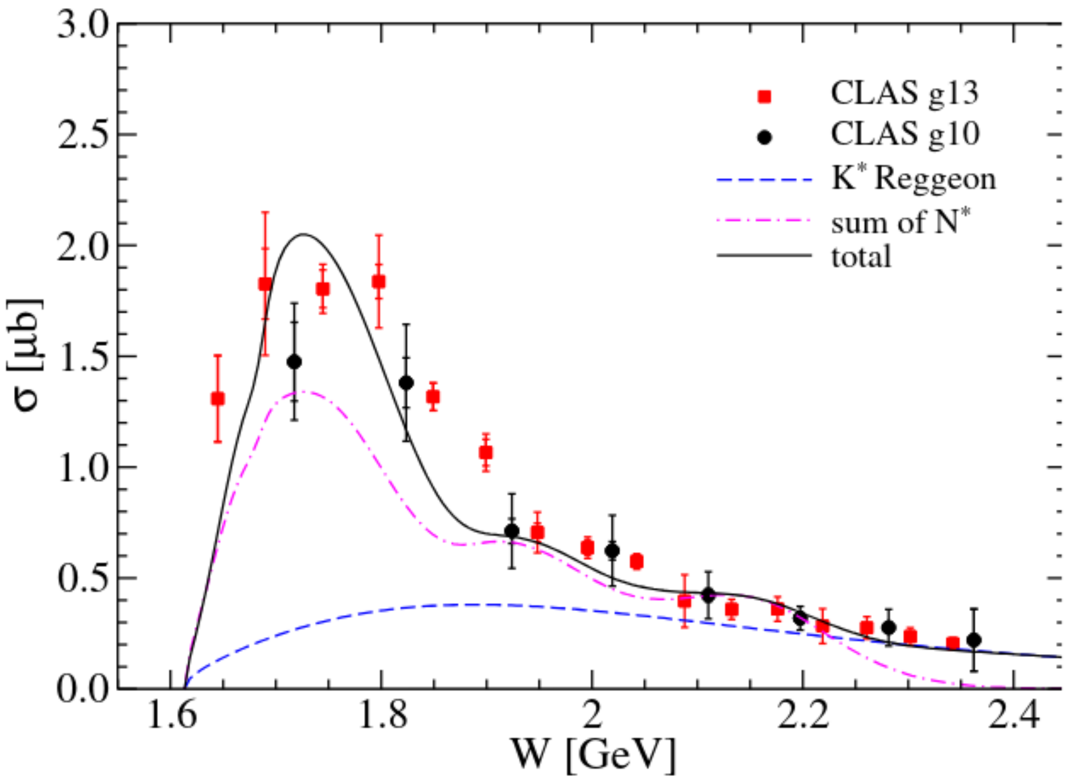
How to investigate the nature of this narrow peak?

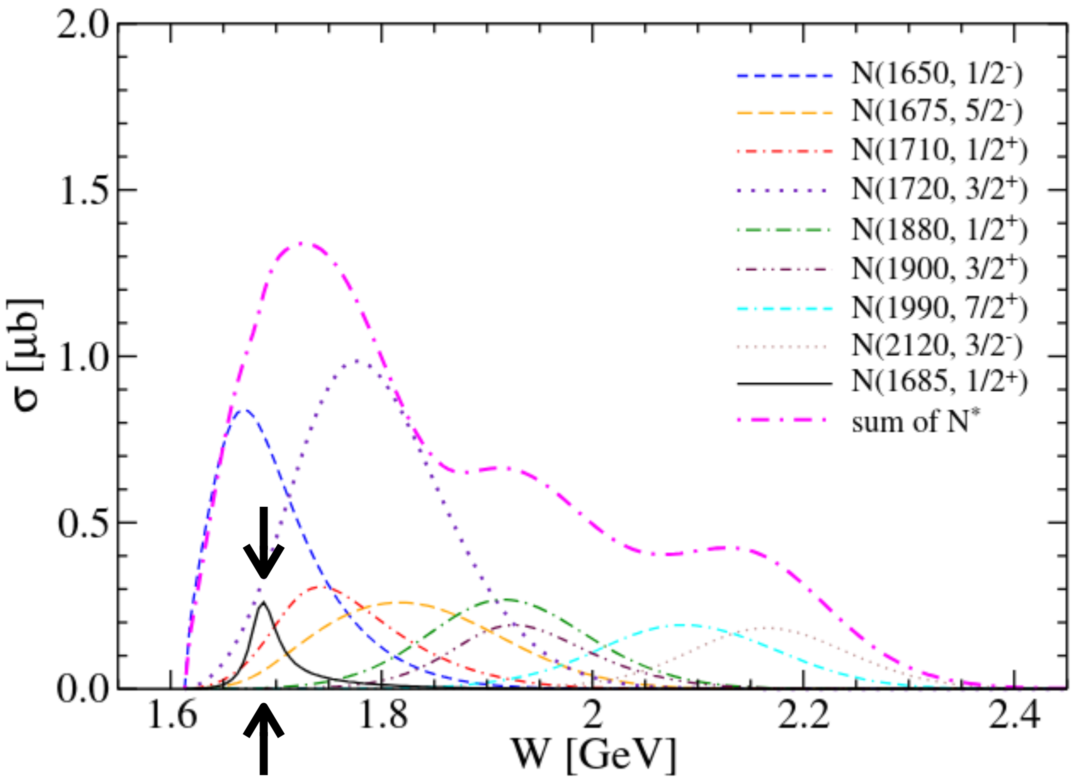
Why $K^0\Lambda$?: accessible from γn initial state
only isospin-½ resonances contribute

Predicted to have strong coupling

$$\frac{Br(N(1685) \to K^0\Lambda)}{Br(N(1685) \to n\eta)} = 0.6$$

Suh et al. Phys. Rev. D 99.7 (2019)





Kim et al., Phys. Lett. B 786 (2018), pp. 156–164

Kim et al.: improved description of differential cross sections when including narrow resonance in cross section.
BnGa: model with interference between $N(1535)$ and $N(1650)$

Either way, cross section is small.

Polarization observables

Polarization observables sensitive to interference of amplitudes
enhances sensitivity to small signals

$\gamma d \to K^0 \Lambda(p)$ off a liquid deuterium target

Linearly and circularly polarized beam
Self-analyzing decay of Λ
7 independent polarization observables accessible

Beam		Target			Recoil		
	-	-	-	-	x'	y'	z'
	-	x	y	z	-	-	-
unpolarized	σ_0		T			P	
linearly pol.	$\boxed{\Sigma}$	H	P	G	$O_{x'}$	T	$O_{z'}$
circularly pol.		F		E	$C_{x'}$		$C_{z'}$

$$\begin{aligned}\frac{d\sigma}{dt} = \frac{d\sigma_0}{dt}[1 &- P_{\rm lin}\Sigma\cos 2\Phi \\ &+ \alpha_-\cos\theta_{x'}(-P_{\rm lin}O_{x'}\sin 2\Phi - P_{\rm circ}C_{x'}) \\ &- \alpha_-\cos\theta_{y'}(-P + P_{\rm lin}T\cos 2\Phi) \\ &- \alpha_-\cos\theta_{z'}(P_{\rm lin}O_{z'}\sin 2\Phi + P_{\rm circ}C_{z'})]\end{aligned}$$

Extraction of the final state

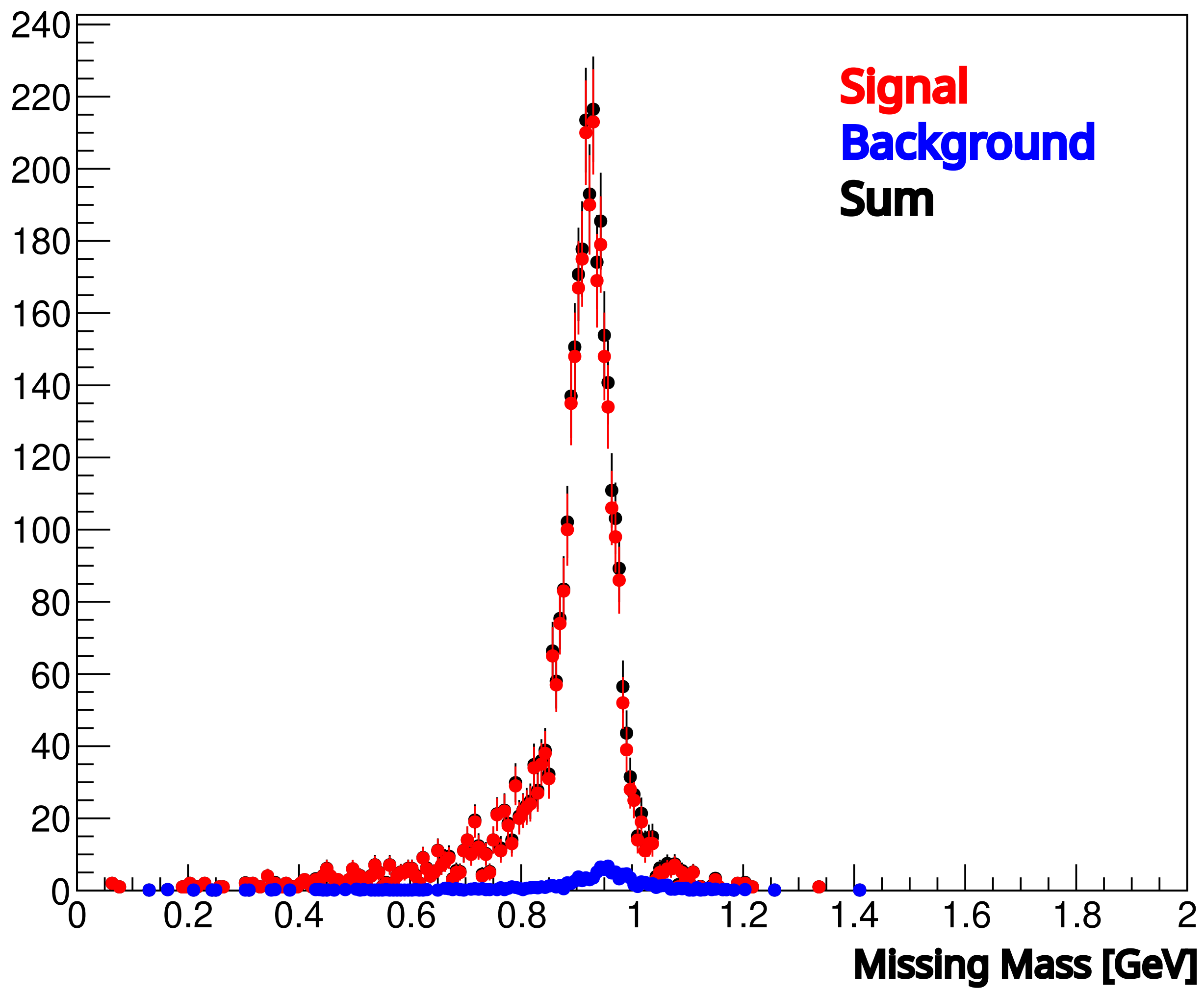
Full simulation and reconstruction done with validated GlueX tools.

- Reconstruct $\gamma d \to K_S^0 \Lambda(p)$ with $K_S^0 \to \pi^+\pi^-$ and $\Lambda \to p\pi^-$
- Proton identified using missing mass

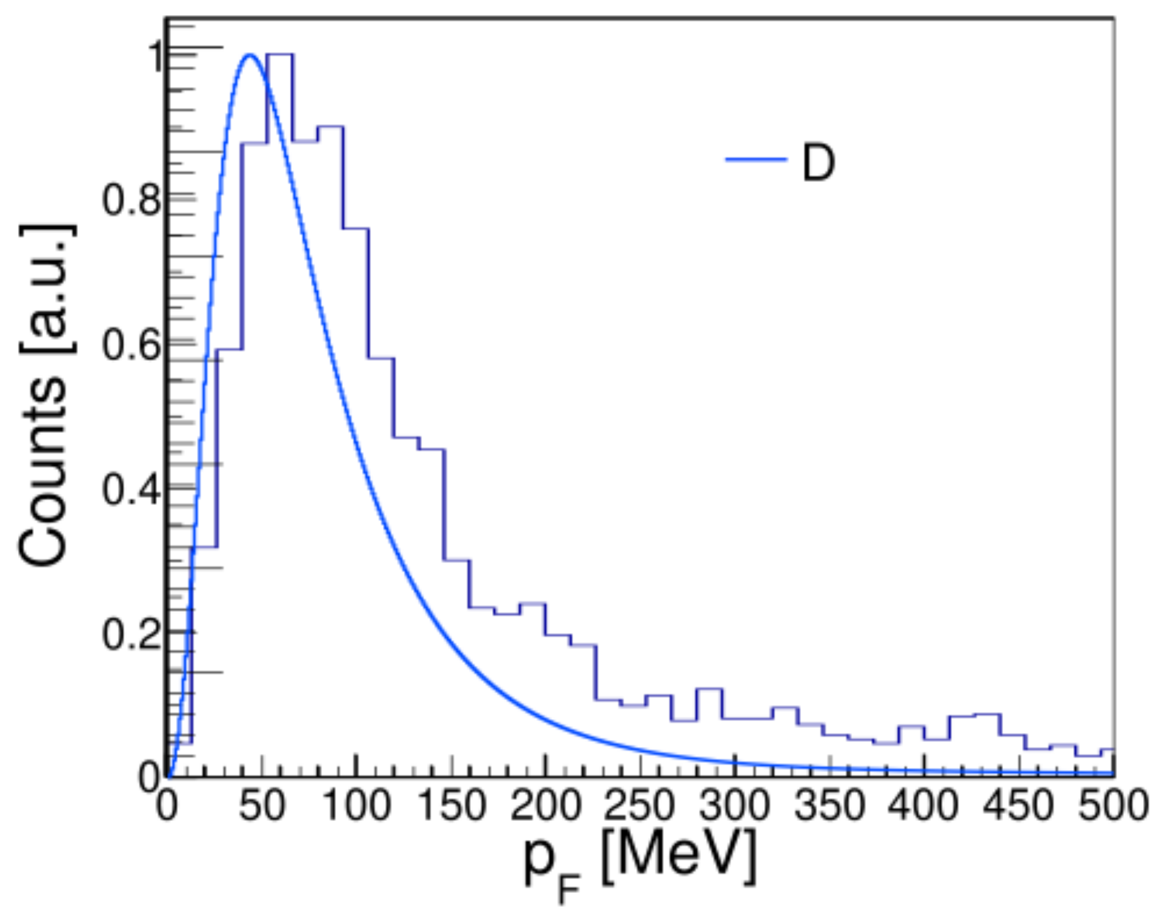
$$p_{\text{missing}} = p_\gamma + p_d - (p_{K_s} + p_\Lambda)$$

- Background from $K_s\Sigma$ with missing photon from Σ decay (~3%)

Participant-Spectator Model:
Fermi momentum of same size but opposite direction for p and n
Proton remains unaffected after the interaction → spectator

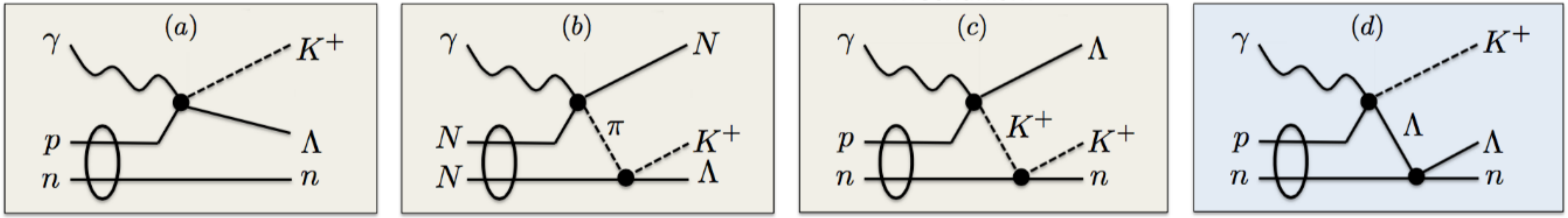


Missing momentum well reconstructed



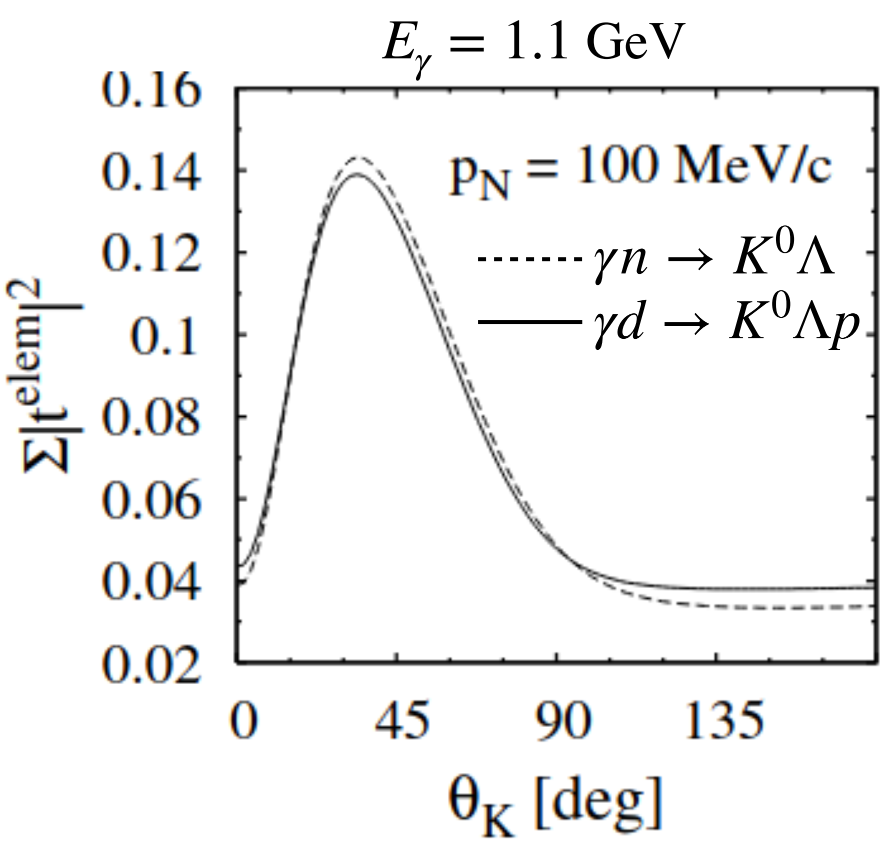
Final State Interaction effects

Examples of possible interactions from proton



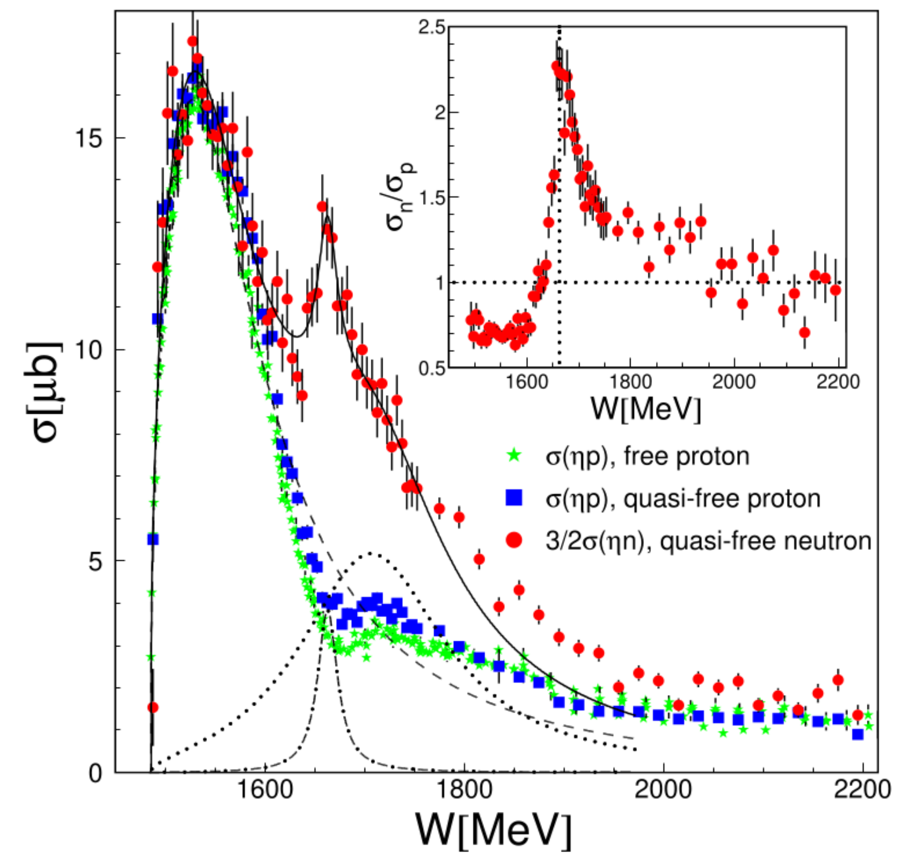
Control missing momentum

FSIs are small for low missing momentum



A. Salam et al., Phys. Rev. C74 (2006), p. 044004

Compare free and quasi-free proton (after Fermi motion correction)

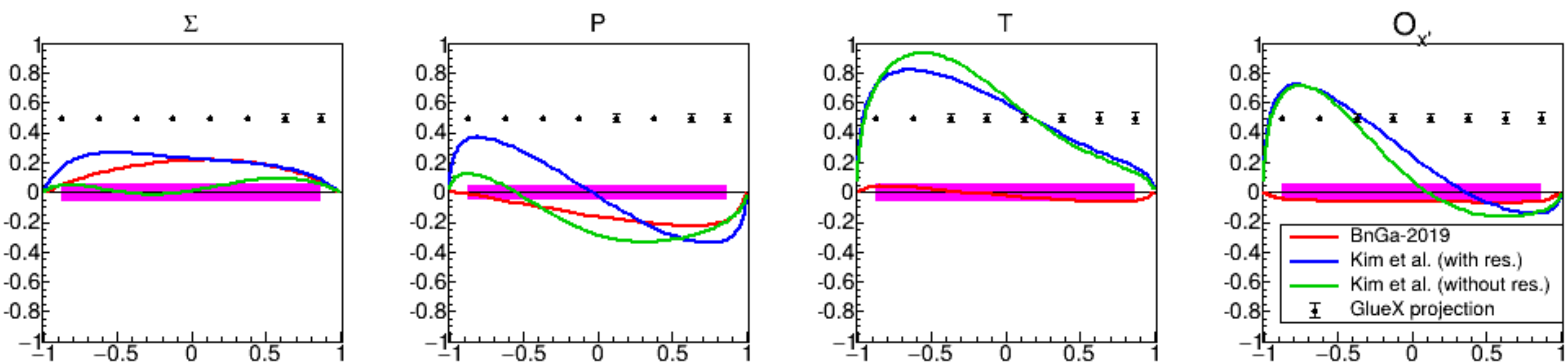


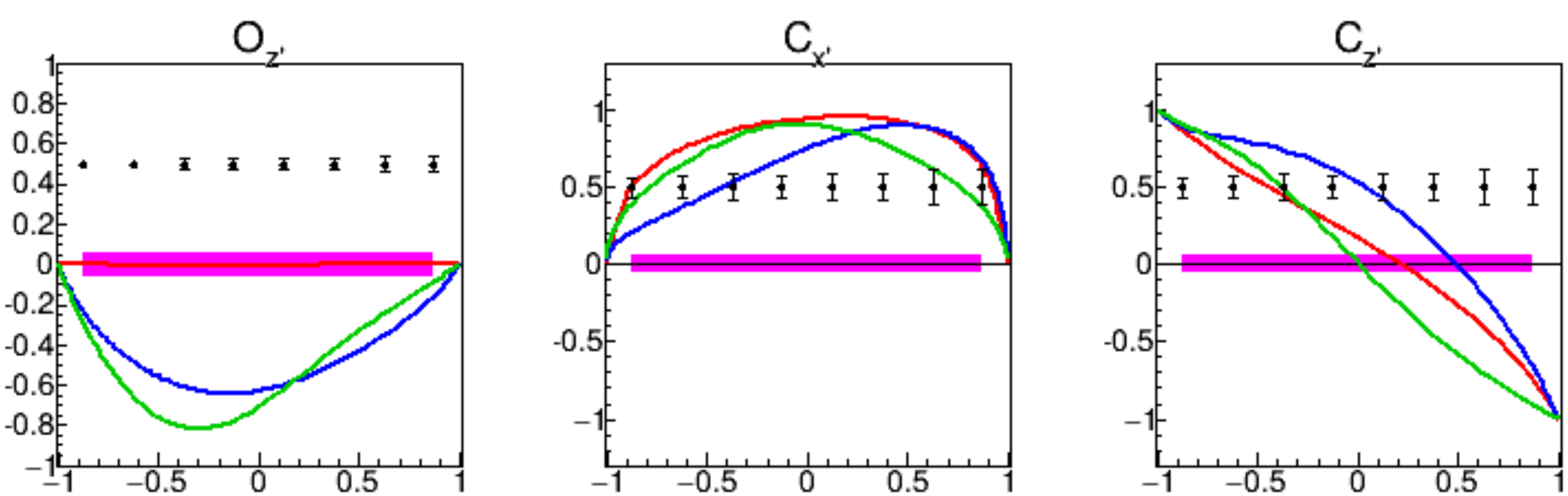
→ FSI effects can be largely controlled!

Projected uncertainties

$$\frac{d\sigma}{dt} = \frac{d\sigma_0}{dt}[1 - P_{\rm lin}\Sigma\cos 2\Phi$$
$$+ \alpha_- \cos\theta_{x'}(-P_{\rm lin}O_{x'}\sin 2\Phi - P_{\rm circ}C_{x'})$$
$$- \alpha_- \cos\theta_{y'}(-P + P_{\rm lin}T\cos 2\Phi)$$
$$- \alpha_- \cos\theta_{z'}(P_{\rm lin}O_{z'}\sin 2\Phi + P_{\rm circ}C_{z'})]$$

Good statistical precision and full CM coverage.
Will be very constraining to models.





Conservative systematic uncertainty:
- Potential FSI contributions (5%)
- Beam polarization (2%)
- Background contribution (2%)
- uncertainty of $\alpha\_$ (1%)

Uncertainties for 17.5 PAC days with standard 5 mm collimator.

The α_- parameter for Λ decay

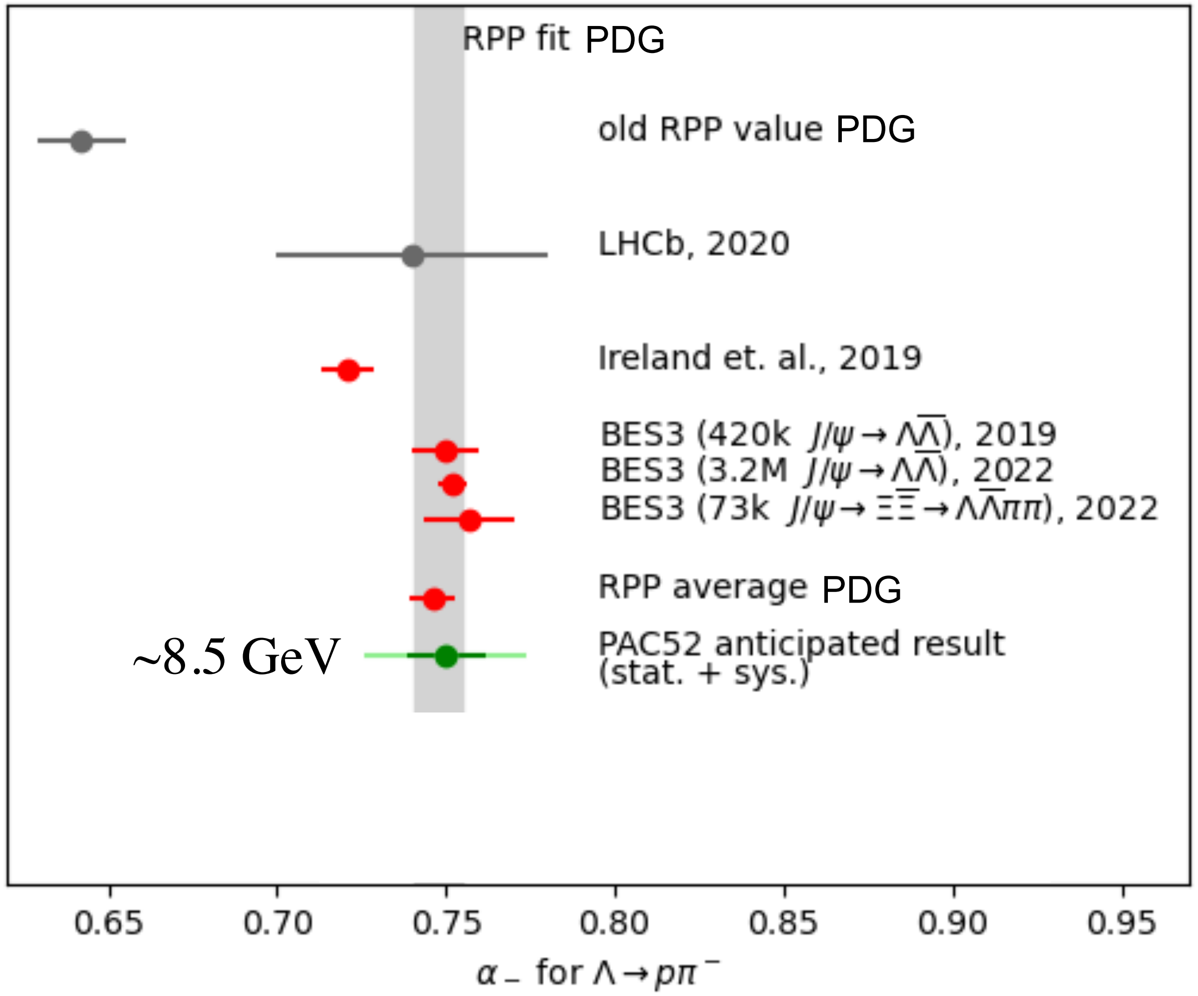
The $\Lambda \rightarrow p\pi^-$ decay is a weak decay and preserves some of the polarization of the Λ

α_- is the parameter that tells us how much of the polarization is transferred from the Λ onto the proton →"Self-analysing" decay.

Significant tension exists between collider and fixed-target extractions.

E12-12-002A **Approved by PAC52** in 2024 as run-group addition to GlueX/JEF. Currently taking data.

Use the same method as Ireland et al. but do it better!



E12-12-002A https://arxiv.org/abs/2405.01288

Main systematic for GlueX:
Photon beam linear polarization due to dominance of amplitudes depending on linear polarization

Method to Extract $\alpha\_$

Measure $P, \Sigma, T, O_x, O_z, C_x, C_z$ all simultaneously for $\gamma p \to K^+\Lambda$

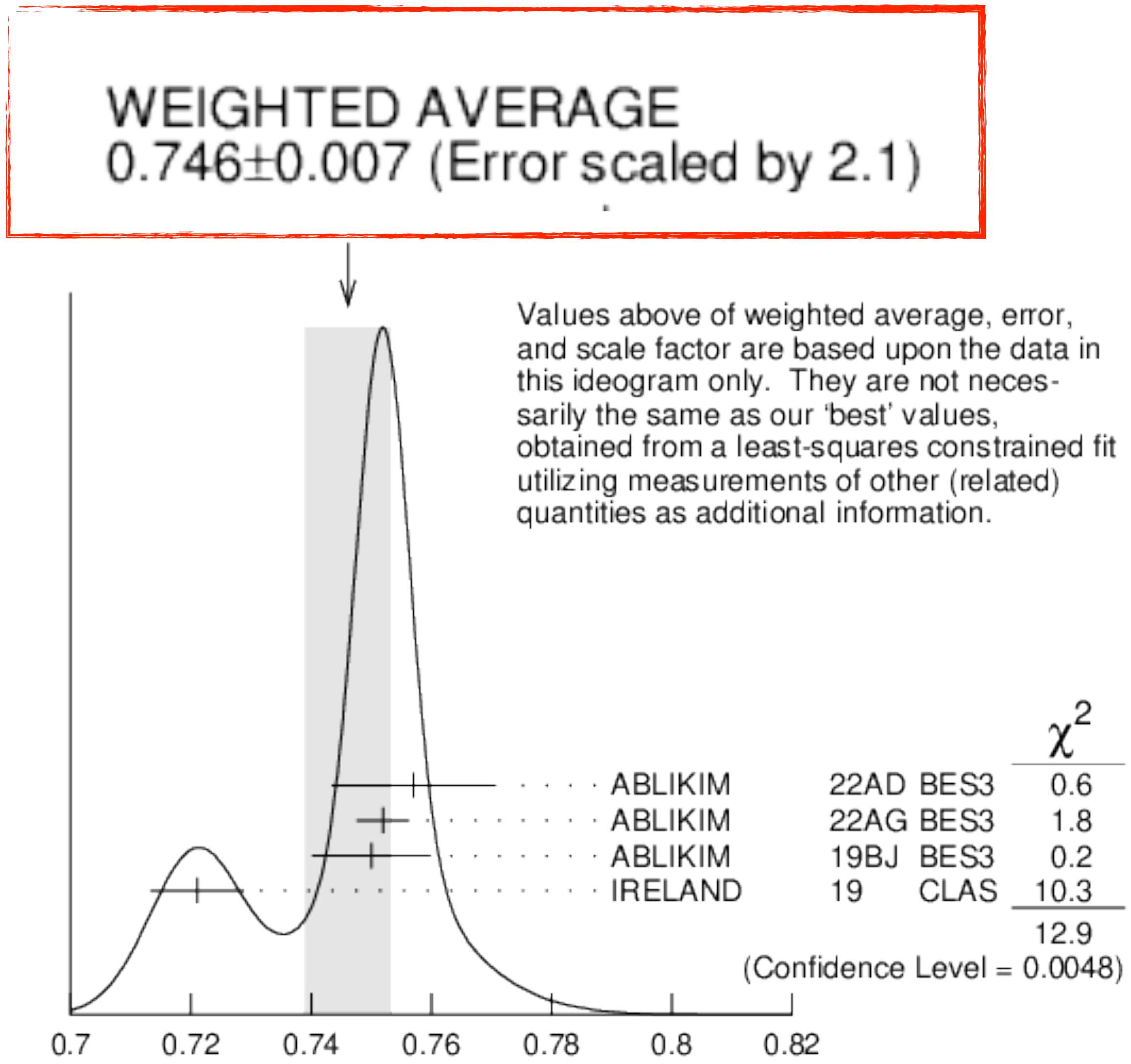
$$I(\Phi, \theta_{x',y',z'}) = 1 + \alpha_- \cos\theta_{y'} P - P_L^\gamma \cos(2\Phi)(\Sigma + \alpha_- \cos\theta_{y'} T)$$
$$- P_L^\gamma \sin(2\Phi)(\alpha_- \cos\theta_{x'} O_{x'} + \alpha_- \cos\theta_{z'} O_{z'})$$
$$- P_C^\gamma (\alpha_- \cos\theta_{x'} C_{x'} + \alpha_- \cos\theta_{z'} C_{z'})$$

Requirement: Linear + circular polarization in Hall D simultaneously (elliptical polarization)

by Fierz identities cause over constrained system: leave $\alpha\_$ as free parameter

$$\Sigma^2 - T^2 + P^2 + C_{x'}^2 + C_{z'}^2 + O_{x'}^2 + O_{z'}^2 = 1$$
$$\Sigma P - T - C_{x'} O_{z'} + C_{z'} O_{x'} = 0$$

In practice: directly fit amplitudes to data instead of constrained polarization observables (automatically constrained)

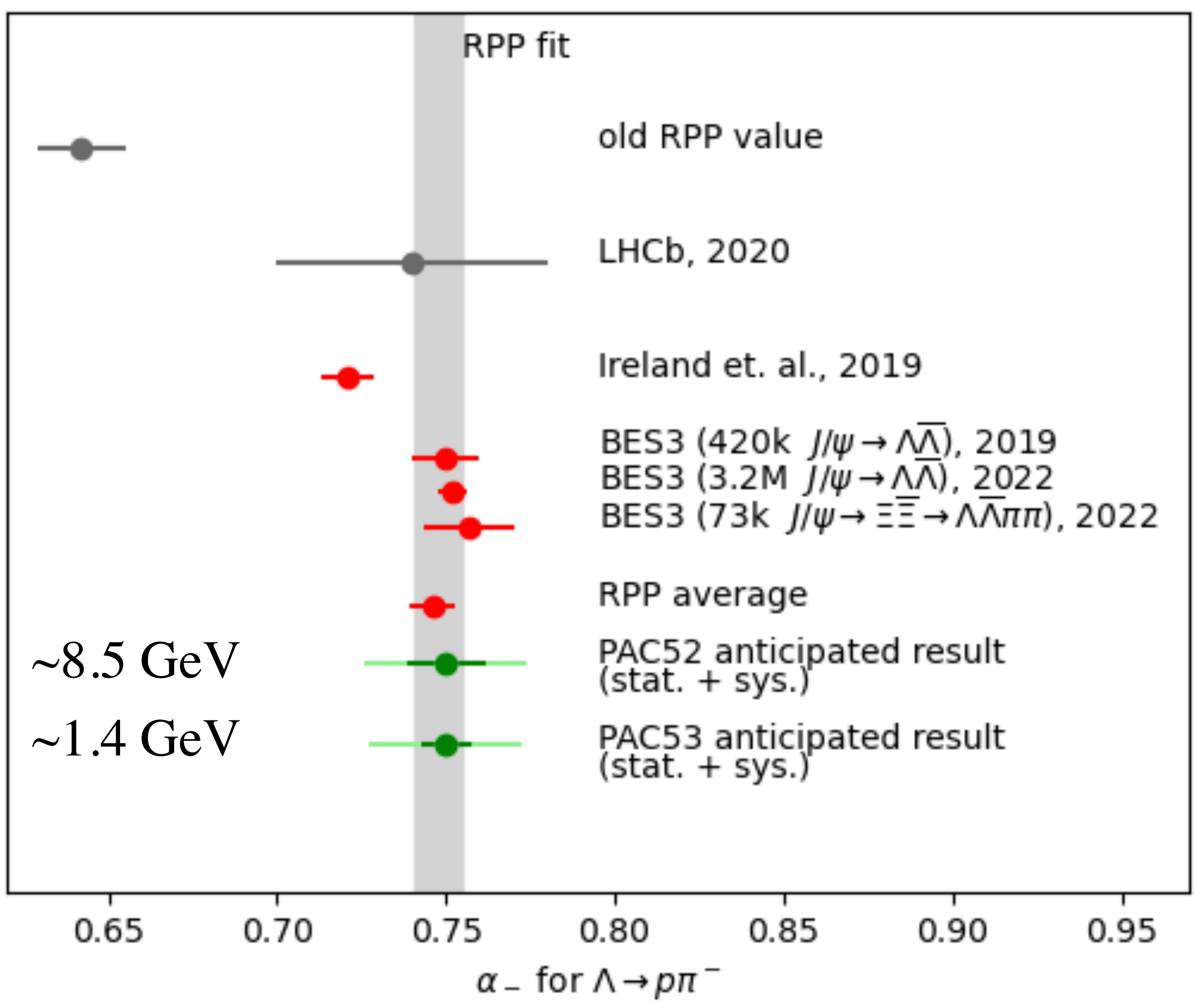


The advantage of lower energies

Statistical precision:

- cross sections about factor 10 greater
  - (SLAC: $\sigma \propto 1/E_\gamma^2$)

Low energy running	% uncertainty	Rel. uncertainty on alpha	Absolute uncertainty
Photon beam circ. pol.	2%	1.9% (<0.2% at 9 GeV)	0.014
Photon beam lin. pol.	<2%	<0.7% (<4% at 9 GeV)	0.005
Acceptance	2%	2%	0.015
Sigma baryon contamination	<2.5%	<0.3%	<0.002
Total		2.9%	0.021



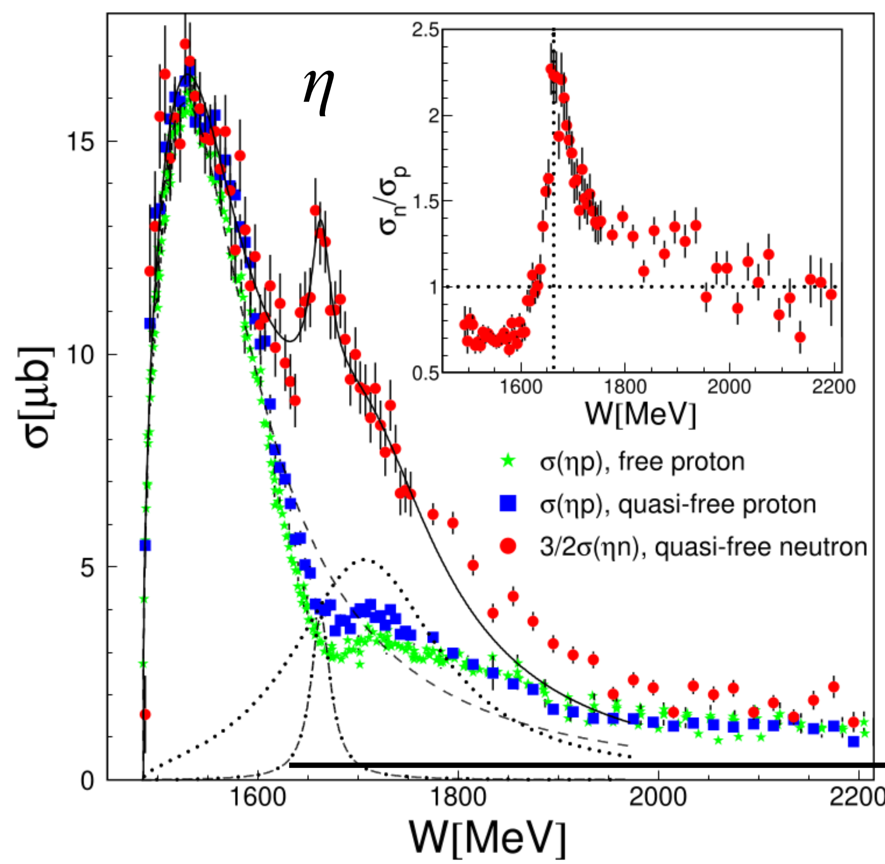
Systematic uncertainty:

- different polarization observables dominate, polarization systematics enter differently
- linear polarization less important
- access to more central events in CM
- partially independent systematic uncertainties
- total uncertainty reduced in combined analysis

Transition Region (Resonance → Regge)

Published world data for π^0, η and η' from deuterium:

$E_\gamma \sim 1.0 - 1.6$ GeV	measured by multiple experiments	$\sim 10\times$
$E_\gamma \sim 1.6 - 2.5$ GeV	measured before	$\sim 100\times$
$E_\gamma \gtrsim 2.5$ GeV	never measured	



expand measurement to
$E_\gamma = 3764$ MeV
$W = 2818$ MeV

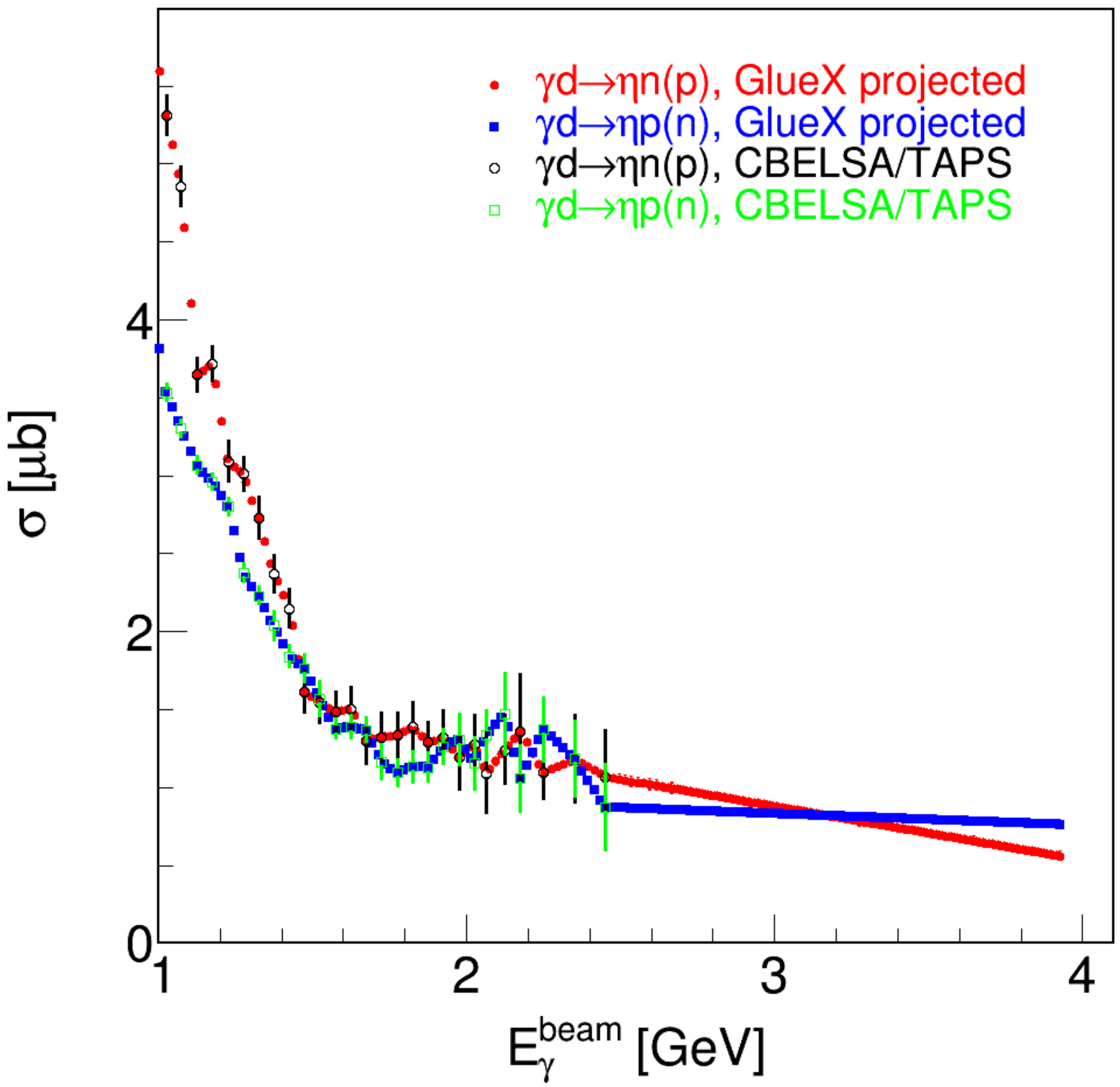
- Disentangle the isospin composition of the elementary strong production amplitudes, particularly to understand the interplay between coherent and incoherent nuclear processes.
- Study nuclear effects by comparing free proton with bound proton.
- Search for (or place upper bound on) the quasi-free Primakoff process.

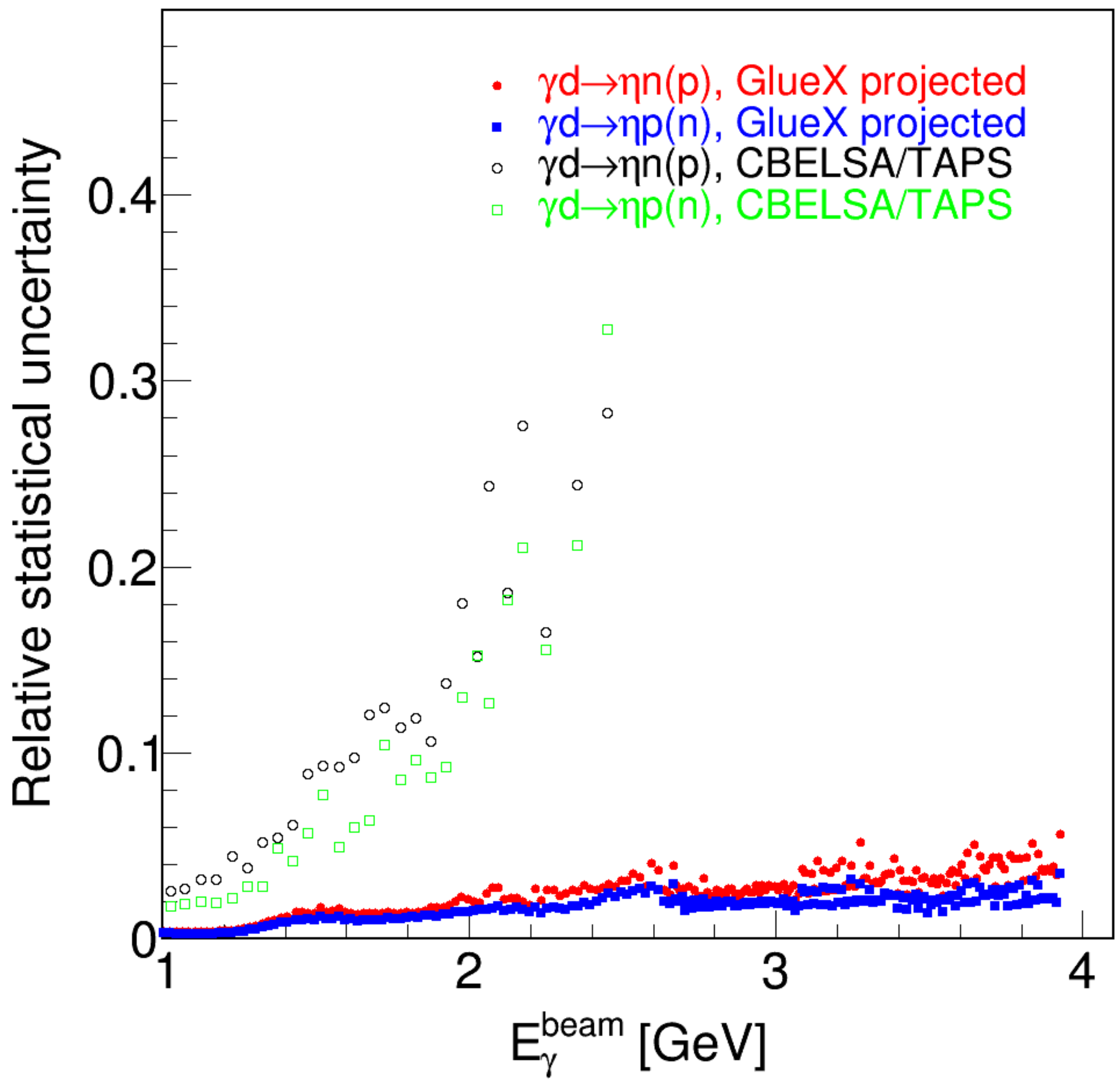
Projected Uncertainties

Measure differential and total cross section.

Huge improvement in uncertainties on cross sections or brand new cross sections over large energy range.

many bins, high statistics





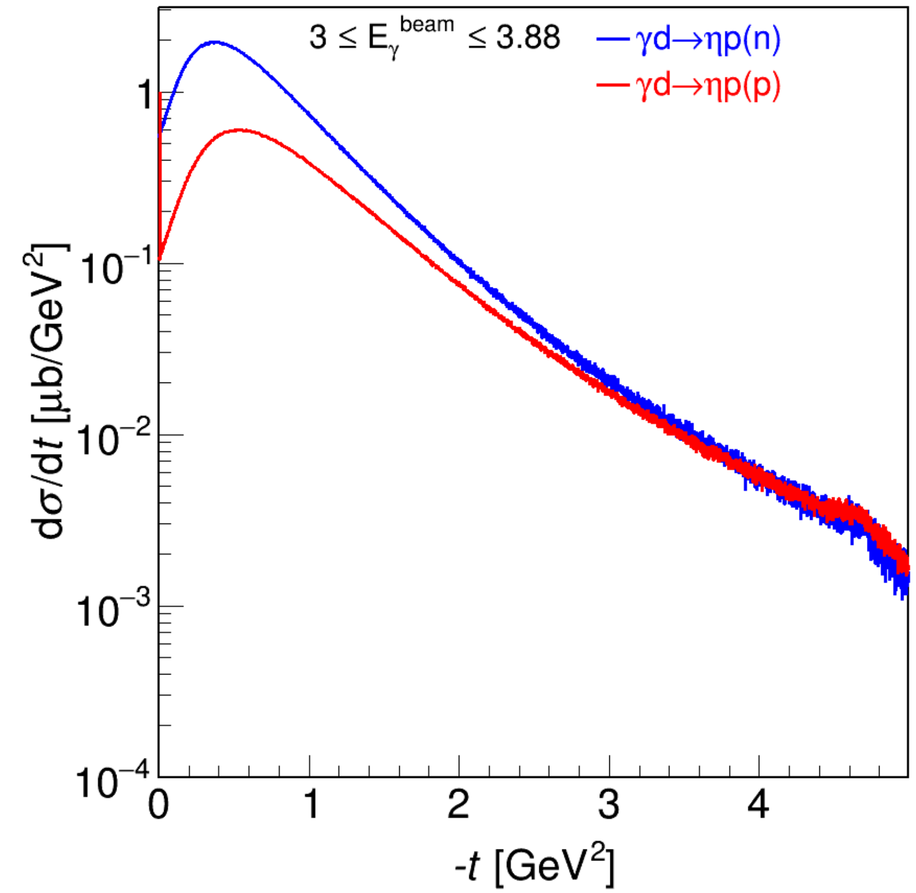
Existing data Jaegle et al. Eur.Phys.J.A 47 (2011) 89

Composition of the amplitude

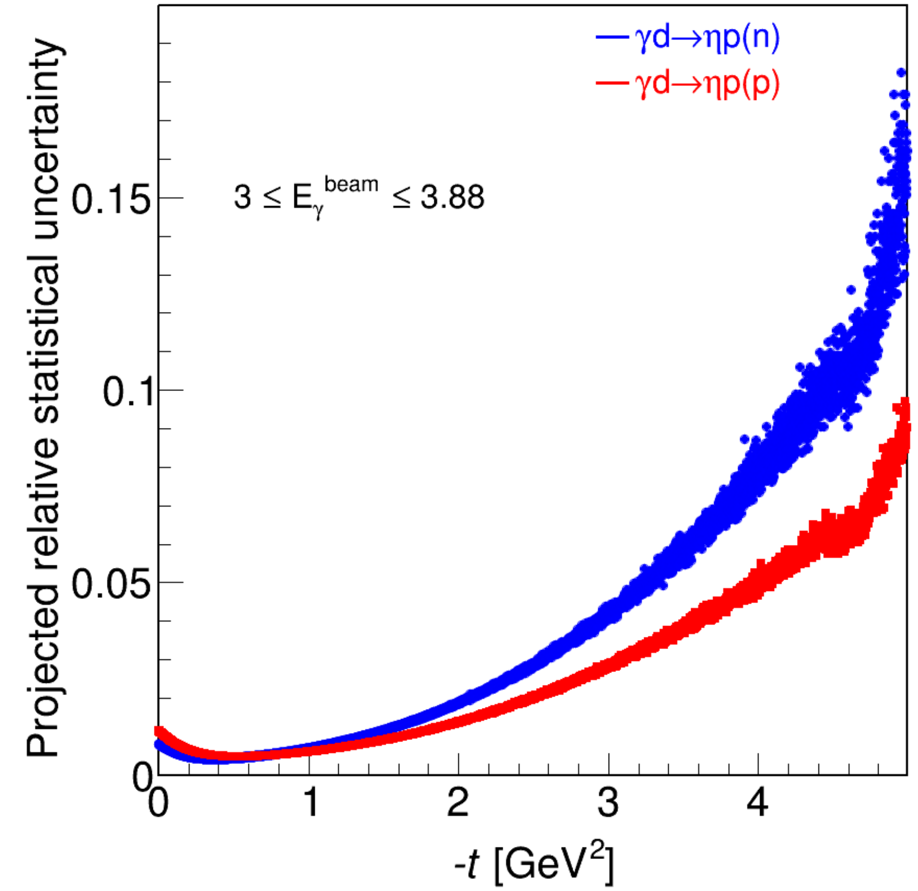
Detecting the pseudo scalar with either n, p
$\rightarrow$ extract Regge trajectories
large range of energies where this was never possible before

Most simple Regge-like model $(\sigma \propto |A|^2)$

$$A(\gamma p \to \pi^0 p) = t_\omega^\pi + t_\rho^\pi$$
$$A(\gamma n \to \pi^0 n) = t_\omega^\pi - t_\rho^\pi$$
$$A(\gamma d \to \pi^0 d) = 2t_\omega^\pi$$
$$A(\gamma p \to \eta^{(\prime)} p) = t_\omega^{\eta^{(\prime)}} + t_\rho^{\eta^{(\prime)}}$$
$$A(\gamma n \to \eta^{(\prime)} n) = t_\omega^{\eta^{(\prime)}} - t_\rho^{\eta^{(\prime)}}$$
$$A(\gamma d \to \eta^{(\prime)} d) = 2t_\omega^{\eta^{(\prime)}}$$



In order to measure absolute cross sections over the full energy range, will normalize against Compton events.

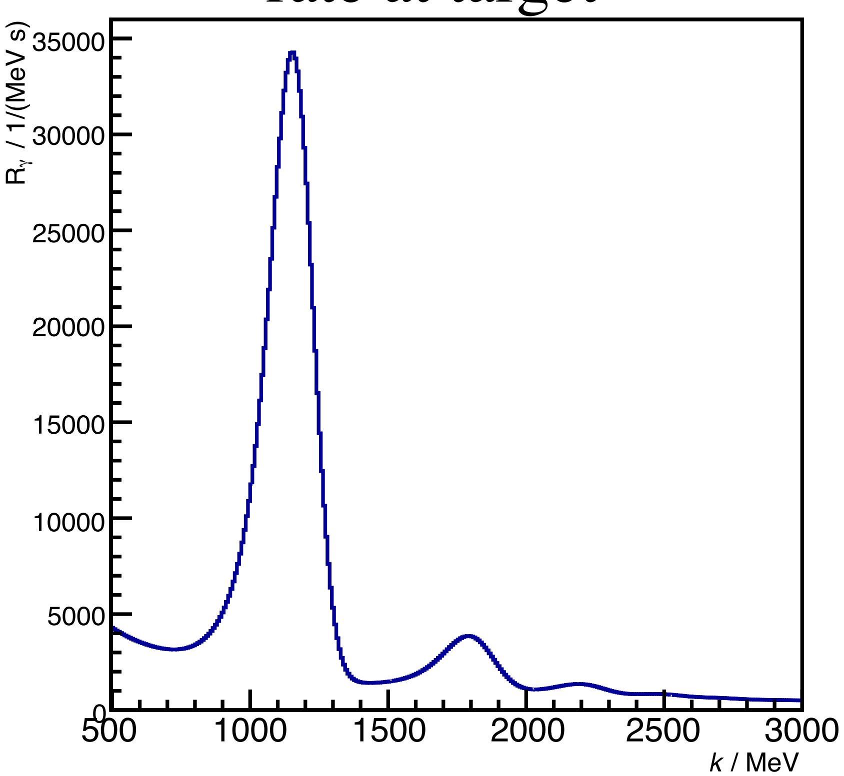


The all neutral final states $\pi^0 n$ and ηn have no tracks and need empty target running to control backgrounds.

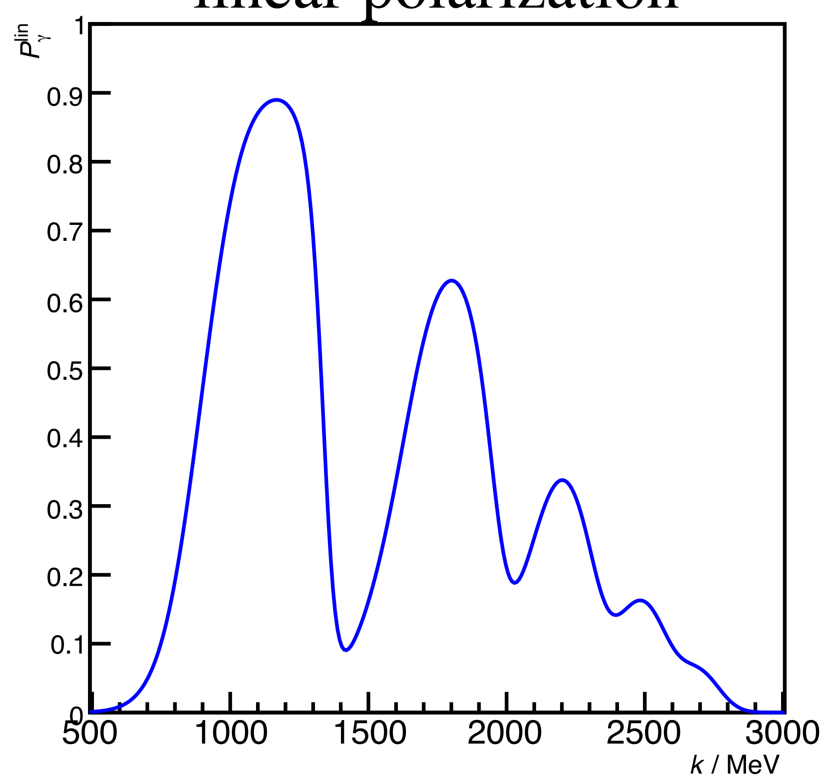
Experiment

- Maximize rate and linear polarization at lowest tagging energies (also gives high linear polarization over a wide range of energies)
- Run at 20-30 nA, not to saturate tagger.
- Modify trigger for lower energy events.
- Widen collimator hole (5 mm → 10 mm) to increase acceptance.

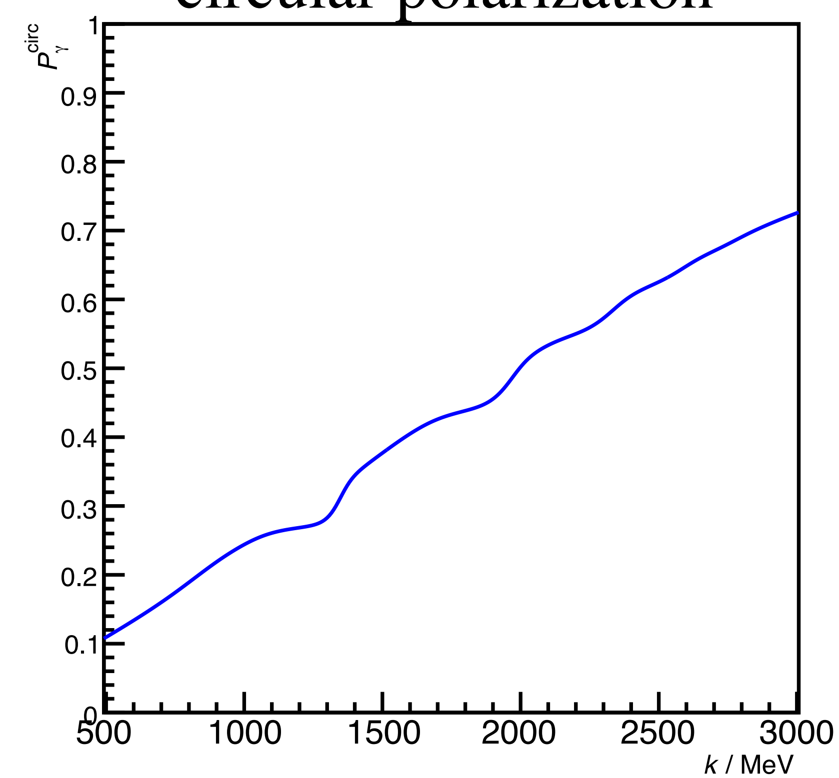
rate at target



linear polarization



circular polarization



GlueX Endorsed: commitment by the GlueX collaboration to operate the detector, staff shifts, calibrate and process the data, as well as provide support for data analysis.

Beamtime Request

	PAC Days	Current	Target	Coherent Edge	Pair Spec.
Commissioning	3	Various configurations			
Luminosity calibration	3	Various configurations			
Hydrogen running	10	30 nA	LH_2	~ 1.4 GeV	$1 < E_\gamma < 1.7$ GeV
	1	30 nA	empty	~ 1.4 GeV	$1 < E_\gamma < 1.7$ GeV
Deuterium running	10	20 nA	LD_2	~ 1.2 GeV	$1 < E_\gamma < 1.7$ GeV
	1	20 nA	empty	~ 1.2 GeV	$1 < E_\gamma < 1.7$ GeV
Total	28				

*Modified from written proposal

Commissioning: setup beamline for low current running, adjust coherent enhancement location, optimize trigger for rate and acceptance,

Luminosity calibration: cross calibrate Compton scattering events with the Pair Spectrometer.

Empty target running: allow the study of beamline backgrounds (necessary for neutral final states and Primakov reactions.)

Polarimetry: requesting the injector group measure the polarization using the Mott polarimeter every 2 weeks to 1.0% statistical precision to help control systematic uncertainties.

Summary

Opportunity to do interesting physics with zero cost in new beam time.

General philosophy of GlueX is to accumulate a general purpose data set useful for multiple different analyses. Accomplish with:

- deuteron and proton targets.
- systematic studies to allow absolute cross sections over full energy range.
- empty target running to facilitate neutral final states and low-t processes.

Unique and timely data set suitable for a range of interesting analyses.

Three dedicated groups ready to analyze the data as soon as it is available.
We expect:

- information on the nature of the feature at 1685 MeV in $\gamma n \rightarrow \eta n$
- measurement of $\alpha\_$ in Λ decay at 1.4 GeV
- first (or improved) differential cross sections from the neutron in the E range 956 MeV to 3764 MeV

GlueX Acknowledgements: gluex.org/thanks

Backup Slides

Modified Beamtime Request

Since the proposal was written the expected time available for the measurement has been shortened to 28 PAC days from 39, a factor of 0.7. We are now planning on using a wider photon beam collimator (from 5 mm to 10 mm), which will increase the beam flux to the experiment by a factor 2.6 at the polarization peak for the Alpha and Baryon parts and by up to 3.8 elsewhere. This will better balance the rates in the spectrometer with the rates in the tagger, but will lower the beam linear-polarization at the peak by about 7% relative. Together these factors should lead to an increase in statistics of about > 1.8, over what was proposed. A modified beam time request from the proposal document is presented here.

	PAC Days	Current	Target	Coherent Edge	Pair Spec.
Commissioning	3	Various configurations			
Luminosity calibration	3	Various configurations			
Hydrogen running	10	30 nA	LH_2	~ 1.4 GeV	$1 < E_\gamma < 1.7$ GeV
	1	30 nA	empty	~ 1.4 GeV	$1 < E_\gamma < 1.7$ GeV
Deuterium running	10	20 nA	LD_2	~ 1.2 GeV	$1 < E_\gamma < 1.7$ GeV
	1	20 nA	empty	~ 1.2 GeV	$1 < E_\gamma < 1.7$ GeV
Total	28				

Prioritization

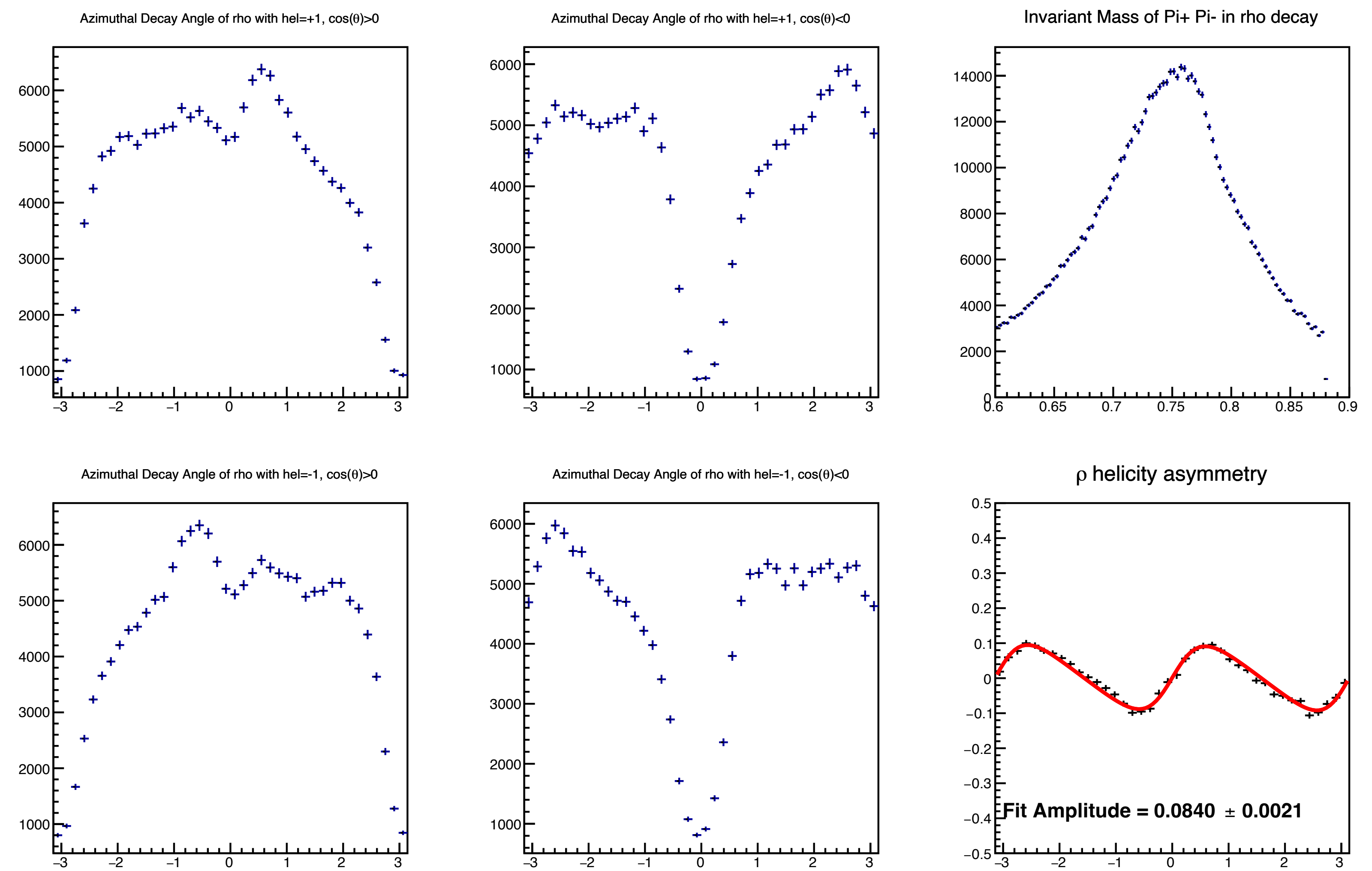
We would like to maintain the general nature of the data set as much as possible.

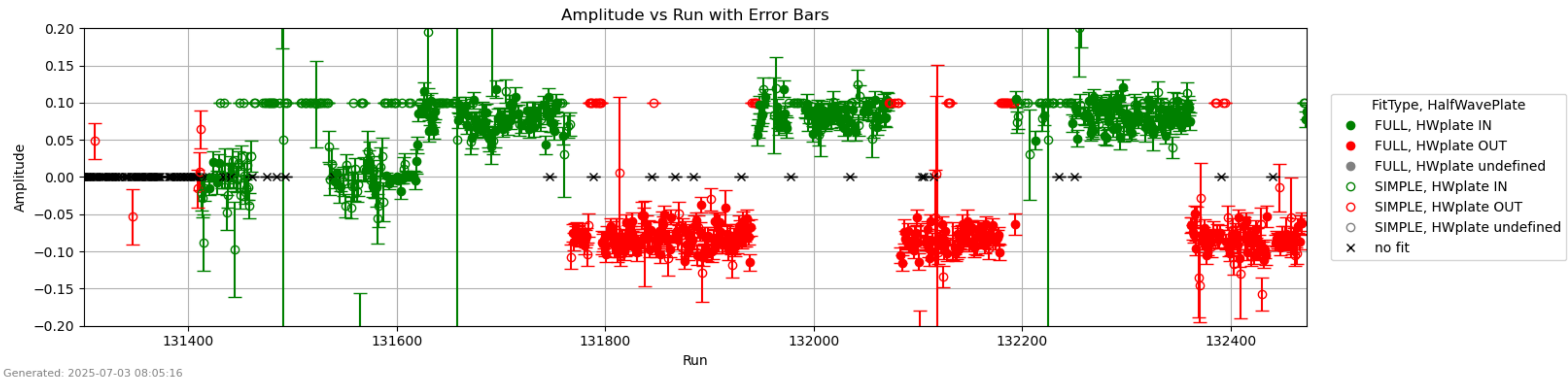
In the event of major loss of beam time:

- Ruthlessly optimize commissioning time
- Remove luminosity calibration running
- Remove empty target running
- Decrease proton running time: $t_p = t_d/\sqrt{2}$
- For example if we have only 12 PAC days we might do the following.

	PAC Days	Current	Target	Coherent Edge	Pair Spec.
Commissioning	2	Various configurations			
Deuterium running	6	20 nA	LD_2	~ 1.2 GeV	$1 < E_\gamma < 1.7$ GeV
Hydrogen running	4	20 nA	LH_2	~ 1.2 GeV	$1 < E_\gamma < 1.7$ GeV
Total	12				

Redundant Polarization Measurement

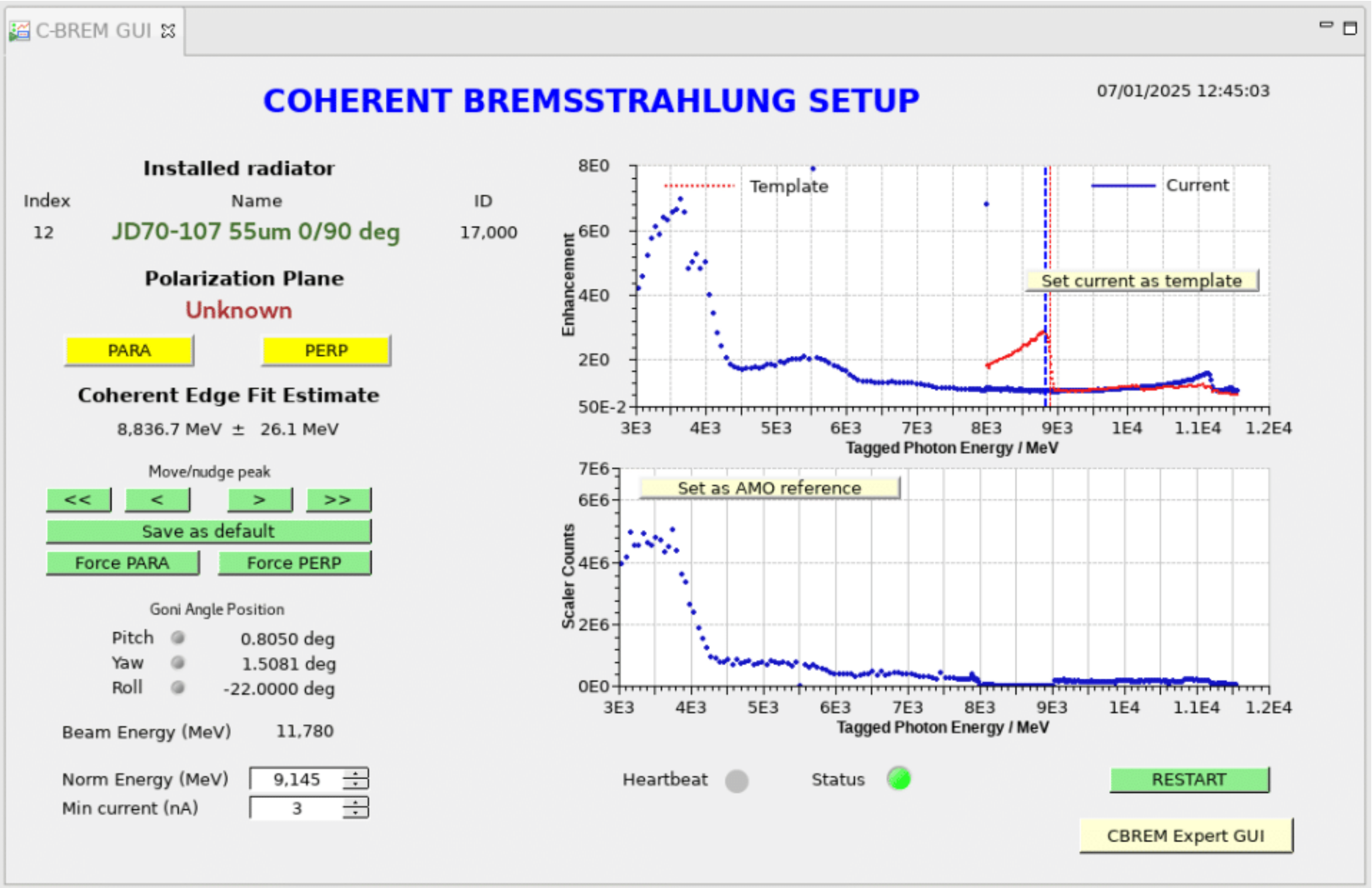




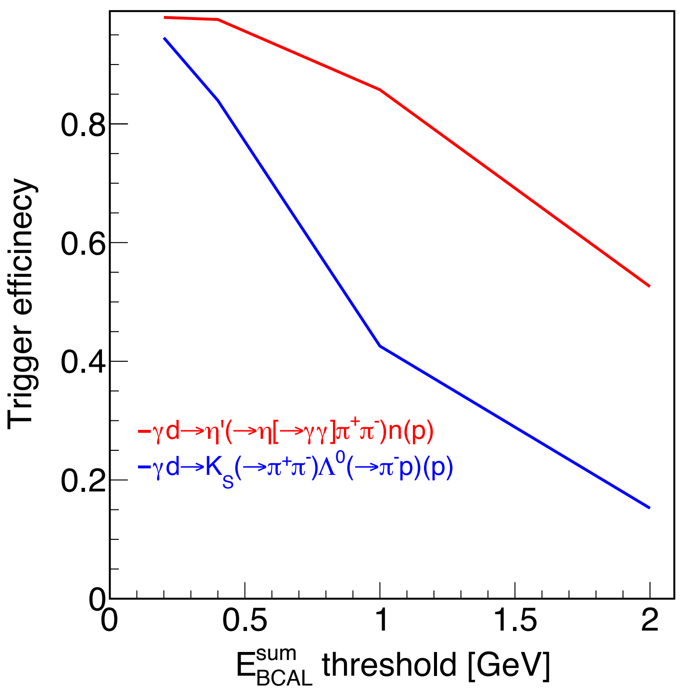
Beam Tests 2025

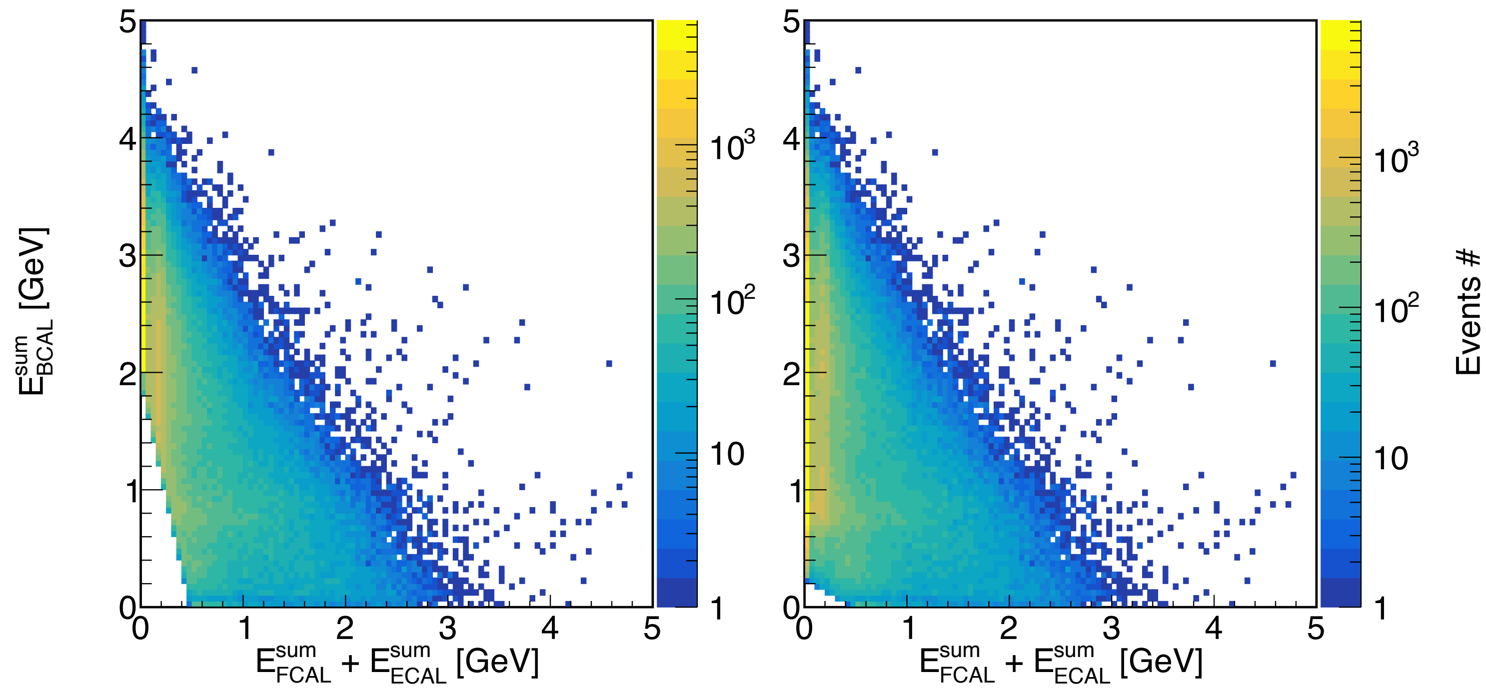
We intend to test the following during the 2025 running.

- Lower the coherent peak to 35\% of the endpoint energy (done)
- Turn on the full tagger, lower the beam current and test the nonoamp BPMs.
- Lower the trigger threshold for the BCAL to 200 MeV and monitor trigger rate.
- Lower the pair spectrometer field to center acceptance at $E_\gamma \approx 32\,\%\,E_e$



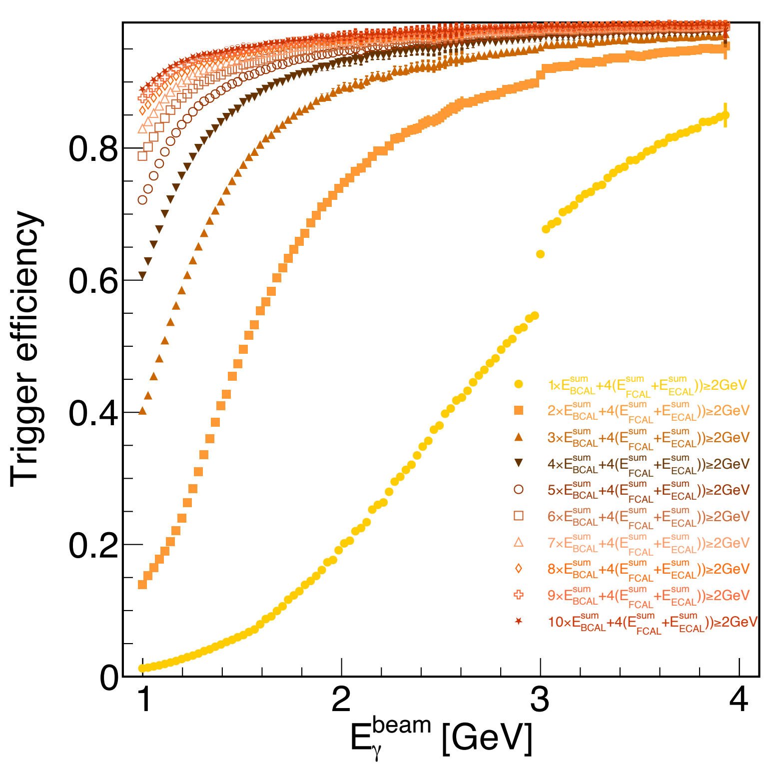
Changes to Trigger

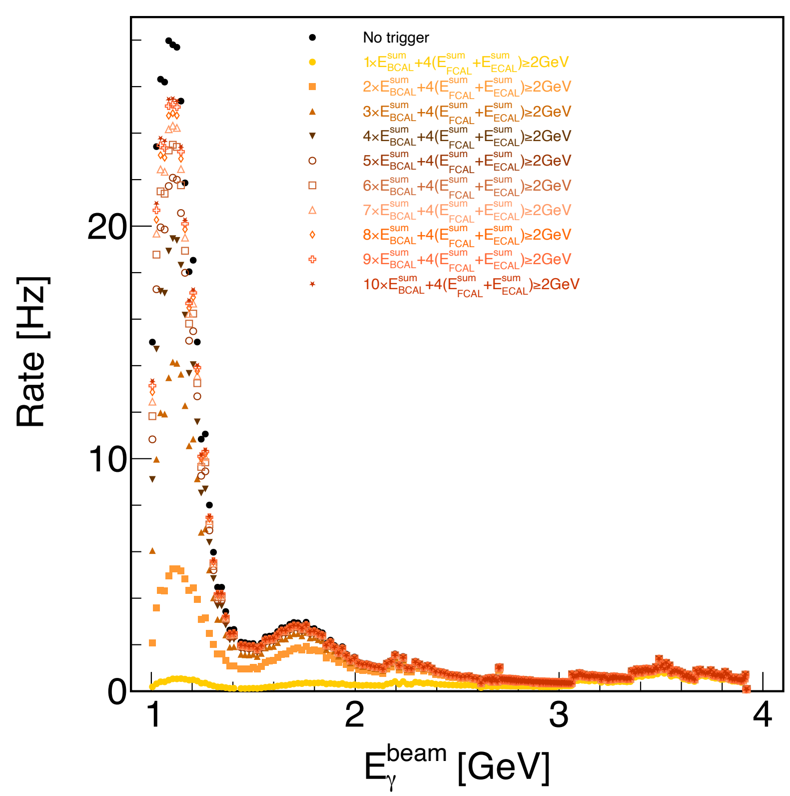


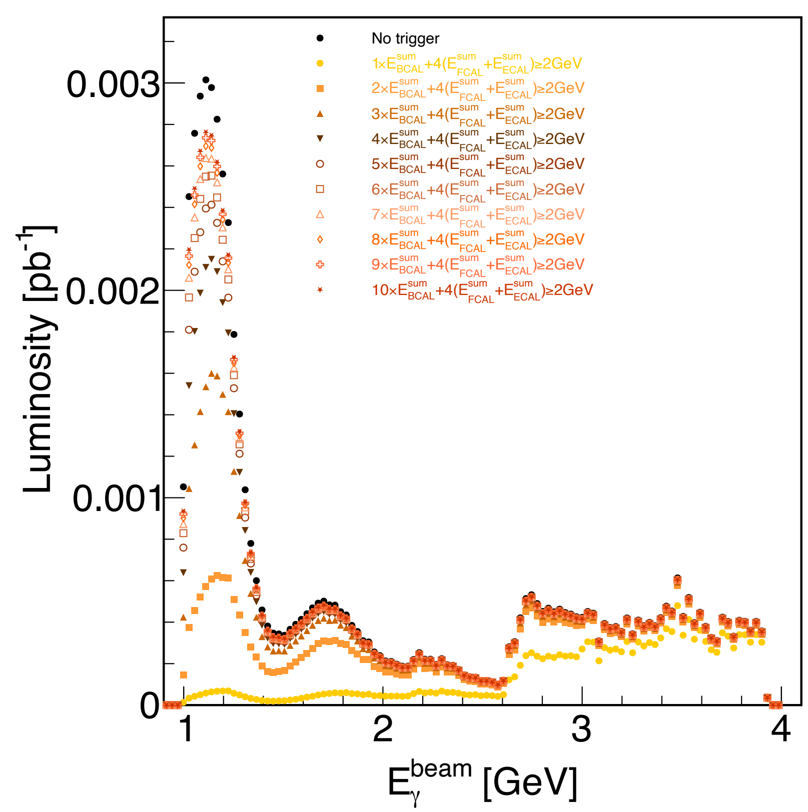


Lower BCAL energy threshold to 200 MeV

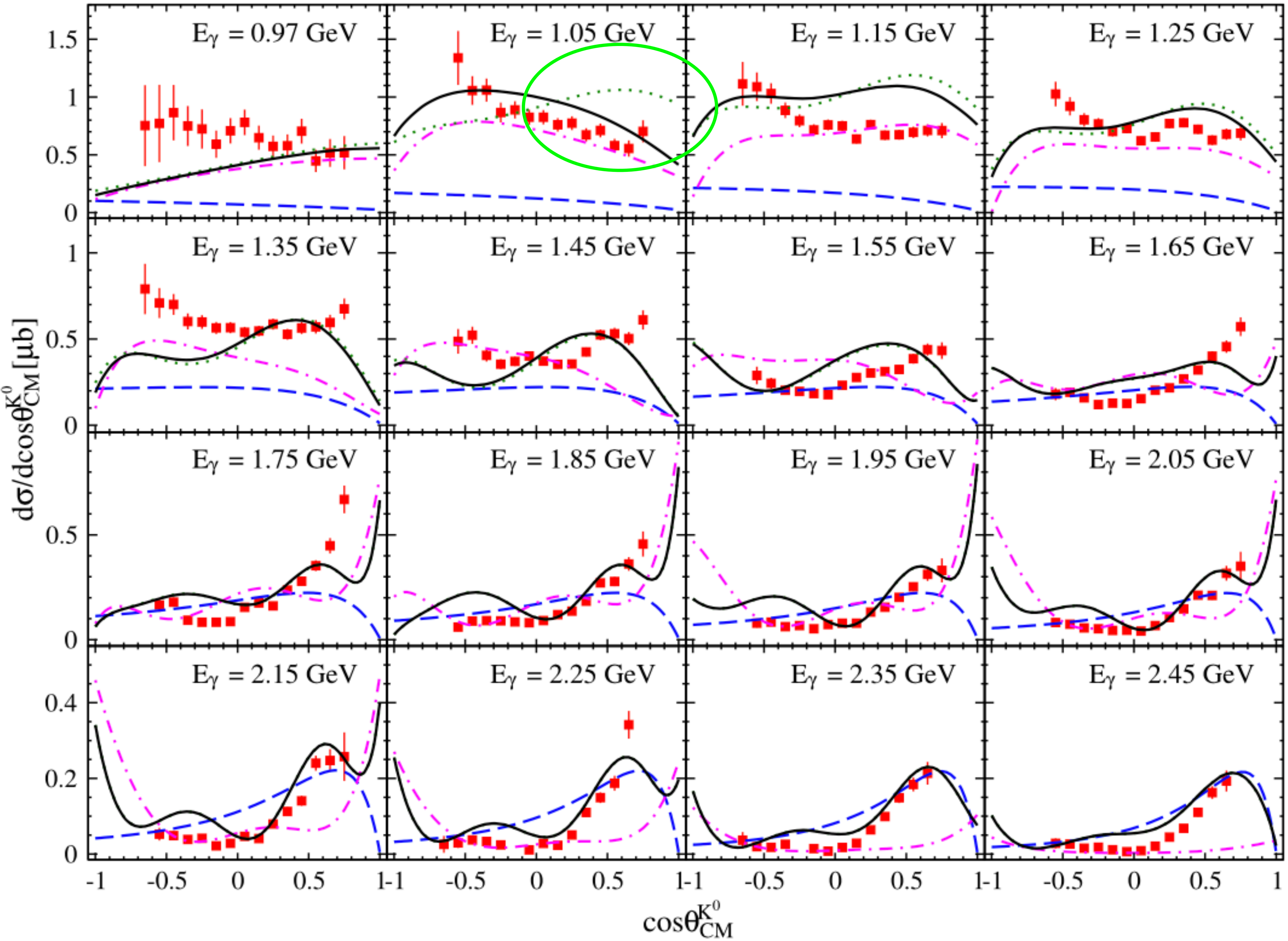
$$\gamma d \to K_S \Lambda^0(p) \to \pi^+\pi^-\pi^- p(p)$$
$$\gamma d \to \eta' n(p) \to \pi^+\pi^-\gamma\gamma n(p)$$







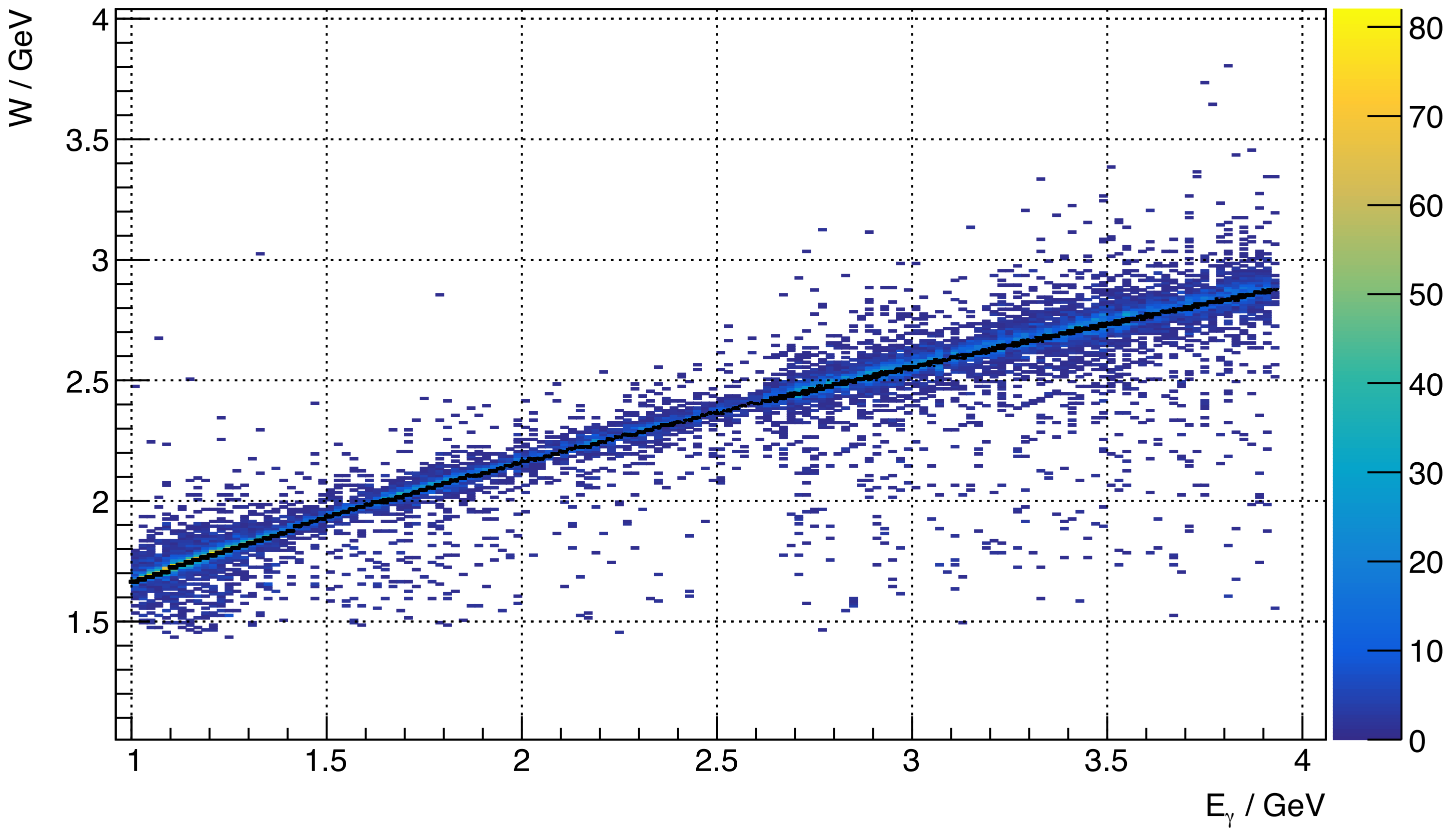
Differential cross section



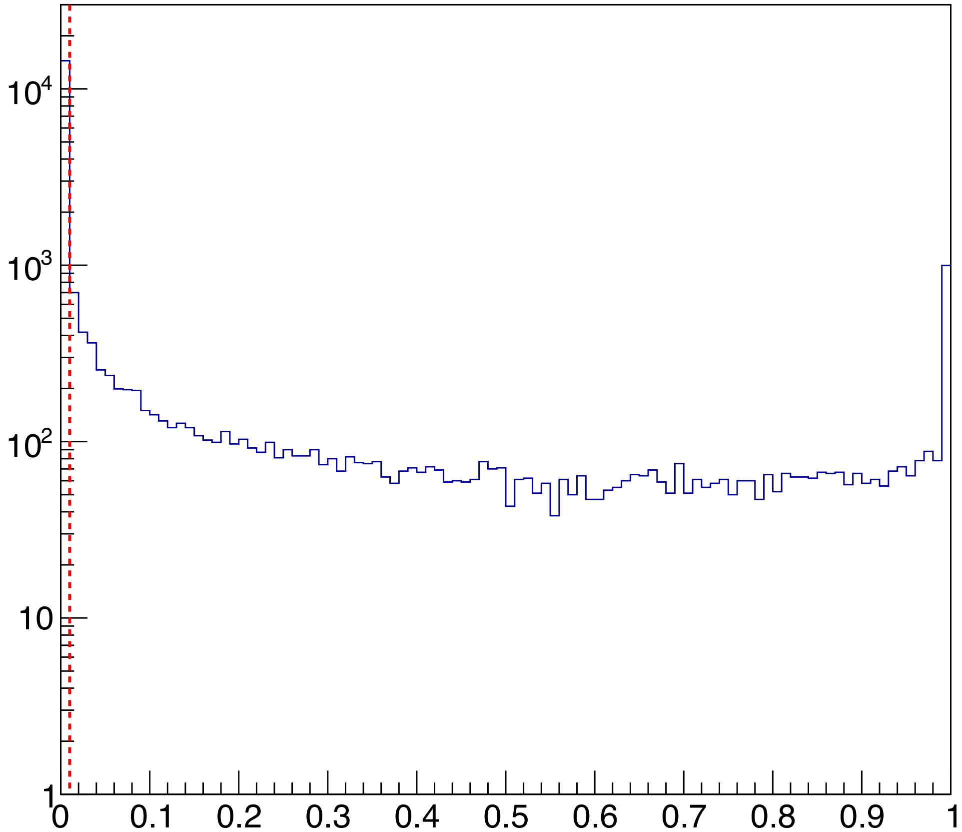
Kim et al., Phys. Lett. B 786 (2018), pp. 156–164

Fig. 4. Differential cross section for the $\gamma n \to K^0\Lambda$ reaction as a function of $\cos\theta^{K^0}_{CM}$ for each beam energy. The dashed (blue), dot-dashed (magenta), and solid (black) curves correspond to the contribution from K^* Reggeon exchange, that from the sum of N^* exchanges, and the total contribution, respectively. The dotted (green) one indicates the total contribution without the effect of the narrow resonance $N(1685, 1/2^+)$. The data are taken from the FOREST experiment [25].

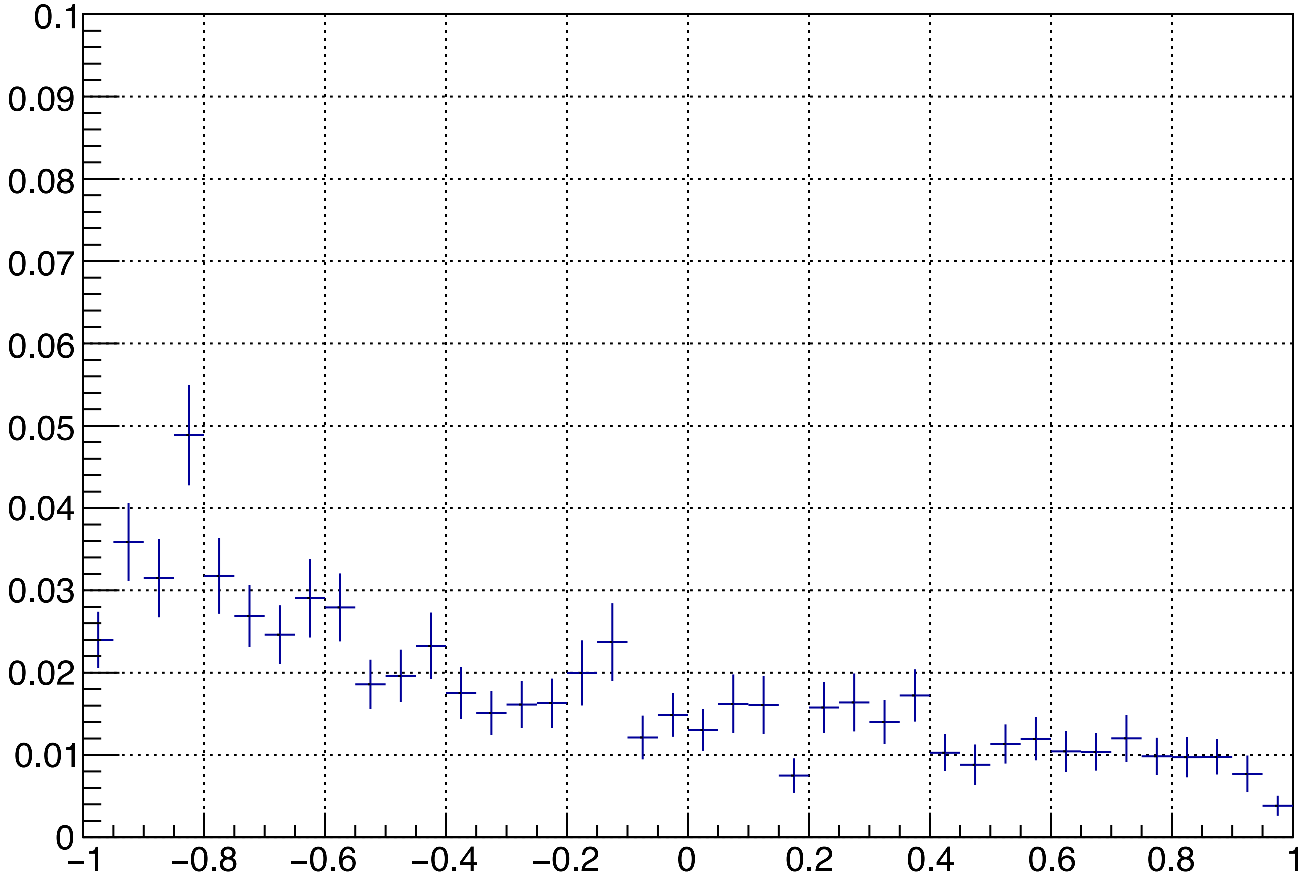
Baryon analysis



confidence level



acceptance



The $\alpha\_$ parameter for Λ decay

Λ BARYONS
$(S = -1, I = 0)$
$\Lambda^0 = uds$

Λ $\quad I(J^P) = 0(\frac{1}{2}^+)$

Mass $m = 1115.683 \pm 0.006$ MeV
$(m_\Lambda - m_{\overline{\Lambda}}) \,/\, m_\Lambda = (-0.1 \pm 1.1) \times 10^{-5}$ (S = 1.6)
Mean life $\tau = (2.632 \pm 0.020) \times 10^{-10}$ s (S = 1.6)
$(\tau_\Lambda - \tau_{\overline{\Lambda}}) \,/\, \tau_\Lambda = -0.001 \pm 0.009$
$c\tau = 7.89$ cm
Magnetic moment $\mu = -0.613 \pm 0.004\ \mu_N$
Electric dipole moment $d < 1.5 \times 10^{-16}$ $e$cm, CL = 95%

Decay parameters **2018**
$p\pi^-$ $\quad \alpha_- = 0.642 \pm 0.013$
$\overline{p}\pi^+$ $\quad \alpha_+ = -0.71 \pm 0.08$

Λ DECAY PARAMETERS

See the "Note on Baryon Decay Parameters" in the neutron Listings. Some early results have been omitted.

α_- FOR $\Lambda \to p\pi^-$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
0.642±0.013 OUR AVERAGE					
0.584±0.046	8500	ASTBURY	75	SPEC	
0.649±0.023	10325	CLELAND	72	OSPK	
0.67 ±0.06	3520	DAUBER	69	HBC	From Ξ decay
0.645±0.017	10130	OVERSETH	67	OSPK	Λ from $\pi^- p$
0.62 ±0.07	1156	CRONIN	63	CNTR	Λ from $\pi^- p$

α_+ FOR $\overline{\Lambda} \to \overline{p}\pi^+$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.71 ±0.08 OUR AVERAGE					
−0.755±0.083±0.063	≈ 8.7k	ABLIKIM	10	BES	$J/\psi \to \Lambda\overline{\Lambda}$
−0.63 ±0.13	770	TIXIER	88	DM2	$J/\psi \to \Lambda\overline{\Lambda}$

M. Tanabashi et al. (Particle Data Group), Phys. Rev. D 98, 030001 (2018)

- The $\Lambda \to p\pi^-$ decay is a weak decay and preserves some of the polarisation of the Λ
- $\alpha\_$ is the parameter that tells us how much of the polarisation is transferred from the Λ onto the proton
  →"Self-analysing" decay
- In 2019 new BESIII result with huge discrepancy

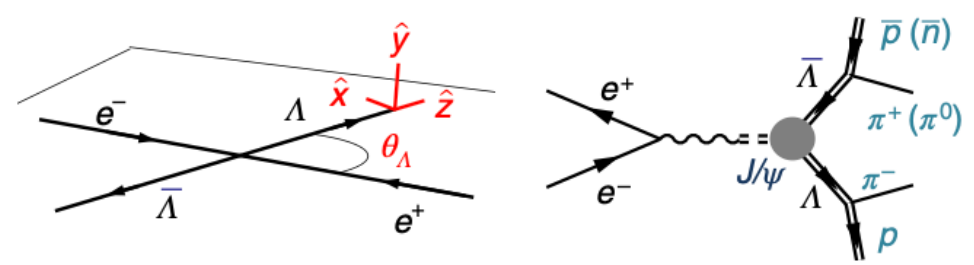
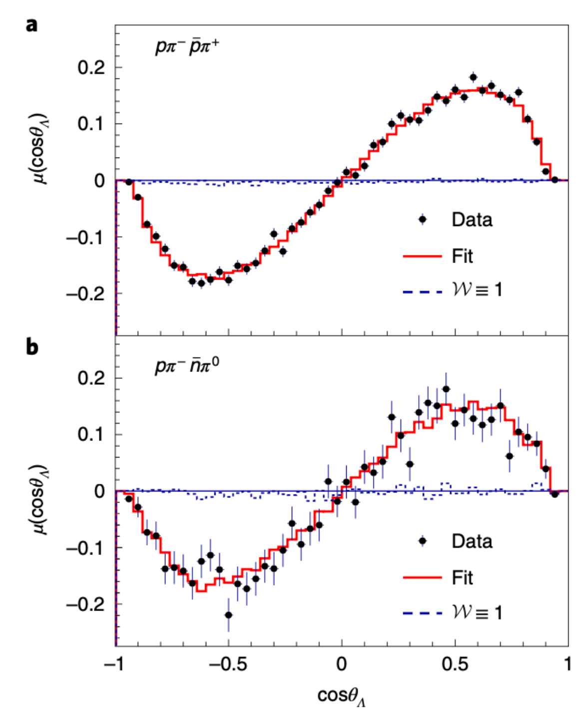


Table 1 | Summary of the results

Parameters	This work	Previous results
α_ψ	0.461±0.006±0.007	0.469±0.027 (ref. [14])
$\Delta\Phi$	42.4±0.6±0.5°	–
α_-	0.750±0.009±0.004	0.642±0.013 (ref. [6])
α_+	−0.758±0.010±0.007	−0.71±0.08 (ref. [6])



2019 - Ireland et al.

D.G. Ireland et al

PHYSICAL REVIEW LETTERS **123,** 182301 (2019)

Kaon Photoproduction and the Λ Decay Parameter α_-

If the photon beam is circularly polarized we have

$$1 + \alpha_- \cos\theta_y P + (\alpha_- \cos\theta_x C_x + \alpha_- \cos\theta_z C_z)\, P_C^\gamma, \quad (2)$$

and if the photon beam is linearly polarized the distribution is

$$1 + \alpha_- \cos\theta_y P - \{\Sigma + \alpha_- \cos\theta_y T\}\, P_L^\gamma \cos 2\phi \\ - \{\alpha_- \cos\theta_x O_x + \alpha_- \cos\theta_z O_z\}\, P_L^\gamma \sin 2\phi. \quad (3)$$

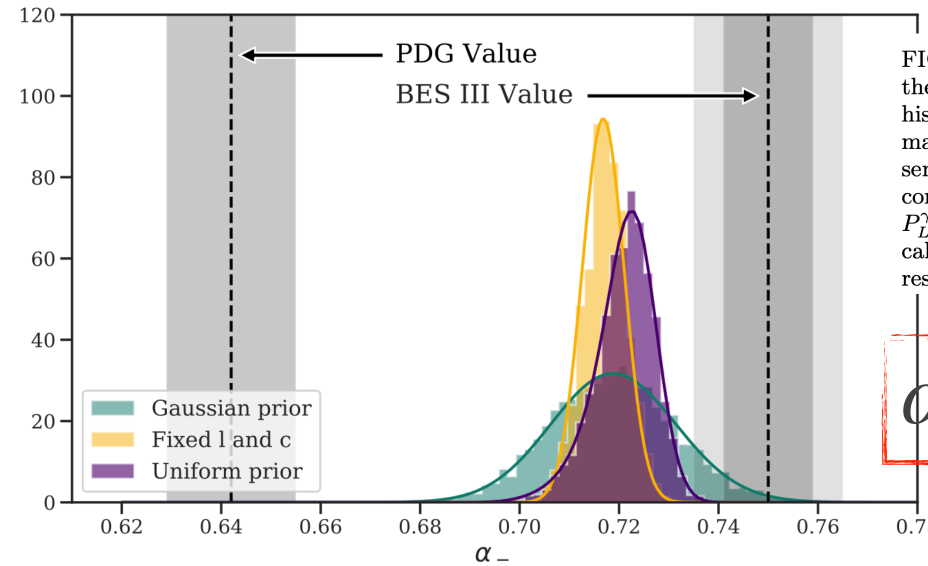
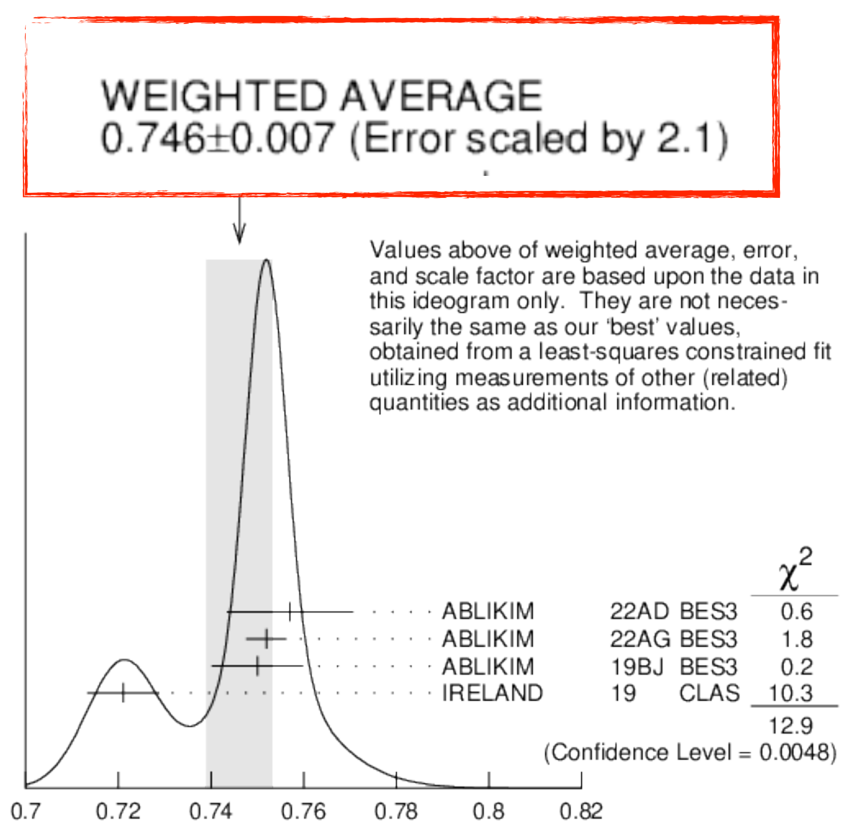


FIG. 1. Posterior densities for α_-, given different priors for the beam polarization calibration constants P_C^γ and P_L^γ. The histograms show the result of the MCMC sampling of the marginalized posterior densities while the solid lines represent a direct scan of the posteriors. For clarity, the results corresponding to the double width uniform priors for P_C^γ and P_L^γ are omitted. Dark grey vertical bands represent statistical uncertainty; the additional light grey bands on the BESIII result represent systematic uncertainty.

$$\boxed{\alpha = 0.721(6)(5)}$$

+ Fierz identities: $O_x^2 + O_z^2 + C_x^2 + C_z^2 + \Sigma^2 - T^2 + P^2 = 1$
$\Sigma P - C_x O_z + C_z O_x - T = 0$

Extract alpha from over-constrained set of equations
Use data from three different publications from different beam times
Extrapolate data to have data set with common kinematics
Since then two more publications by BES3
Old results ignored by PDG but tension between new results

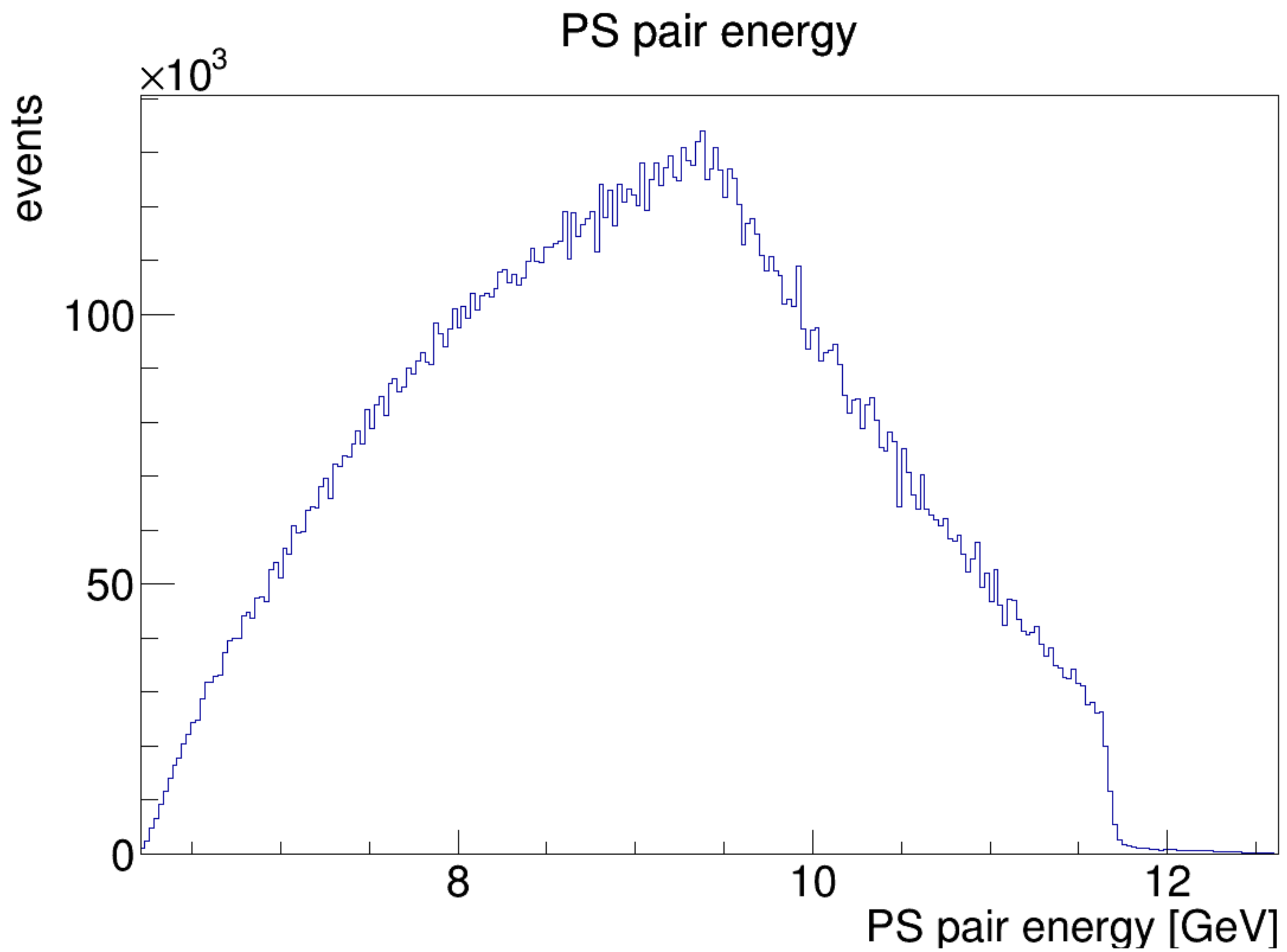


Pair Spectrometer Acceptance

the pair spectrometer has limited energy acceptance $\approx \pm 30\,\%$

$$950 \text{ MeV} < E_\gamma < 1615 \text{ MeV}$$

the remainder of the energy range will be normalized to Compton scattering rate



Relationship between pol. obs. and fitted amplitudes

$$\frac{\mathrm{d}\sigma}{\mathrm{d}t} = |b_1|^2 + |b_2|^2 + |b_3|^2 + |b_4|^2$$

$$\Sigma\frac{\mathrm{d}\sigma}{\mathrm{d}t} = |b_1|^2 + |b_2|^2 - |b_3|^2 - |b_4|^2$$

$$T\frac{\mathrm{d}\sigma}{\mathrm{d}t} = |b_1|^2 - |b_2|^2 - |b_3|^2 + |b_4|^2$$

$$P\frac{\mathrm{d}\sigma}{\mathrm{d}t} = |b_1|^2 - |b_2|^2 + |b_3|^2 - |b_4|^2$$

$$O_{x'}\frac{\mathrm{d}\sigma}{\mathrm{d}t} = -2\,\mathrm{Re}(b_1 b_4^* - b_2 b_3^*)$$

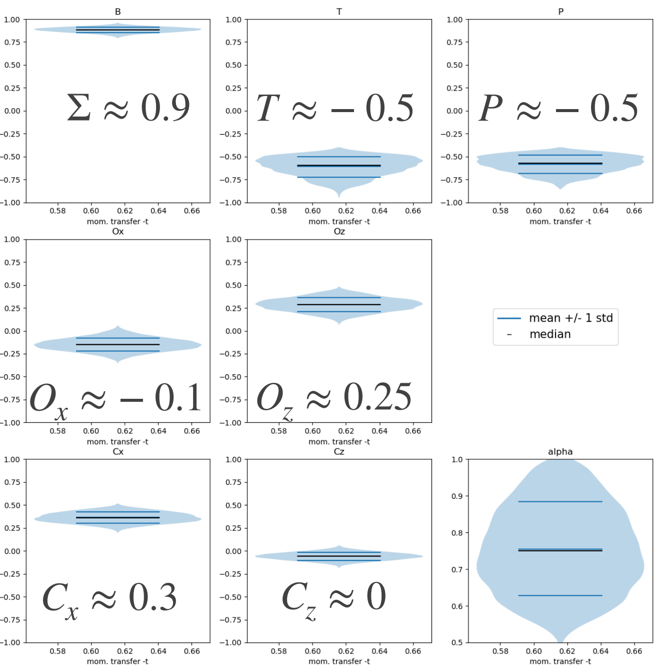
$$O_{z'}\frac{\mathrm{d}\sigma}{\mathrm{d}t} = -2\,\mathrm{Im}(b_1 b_4^* + b_2 b_3^*)$$

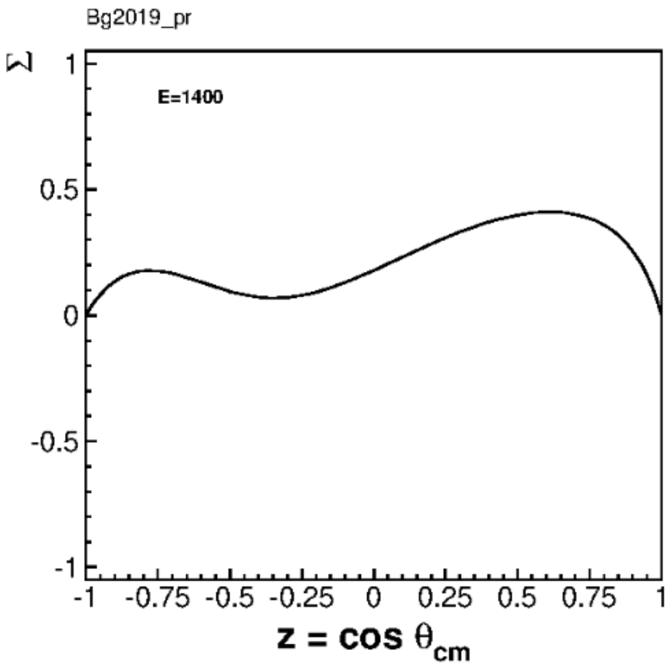
$$C_{x'}\frac{\mathrm{d}\sigma}{\mathrm{d}t} = 2\,\mathrm{Im}(b_1 b_4^* - b_2 b_3^*)$$

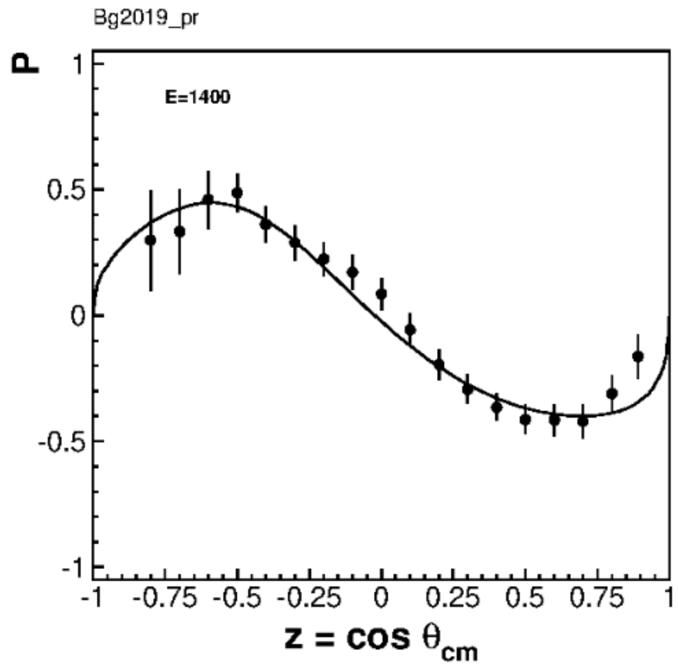
$$C_{z'}\frac{\mathrm{d}\sigma}{\mathrm{d}t} = -2\,\mathrm{Re}(b_1 b_4^* + b_2 b_3^*)$$

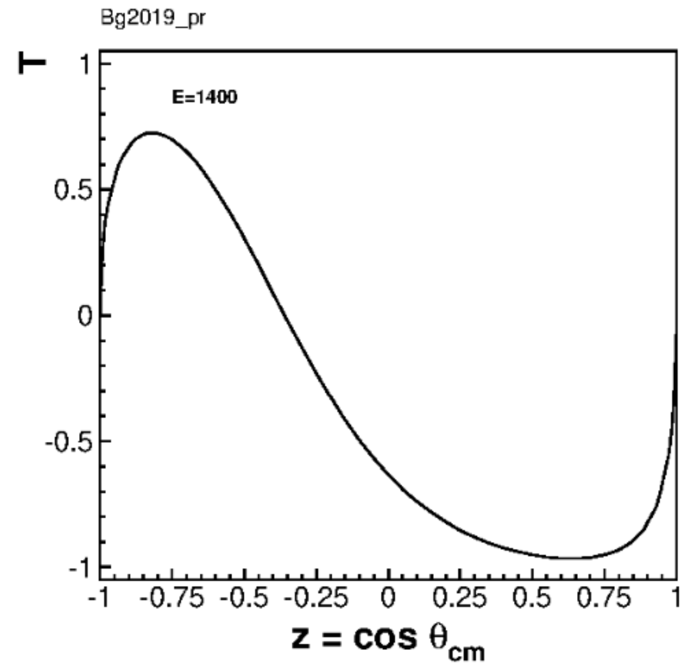
Variation of observables

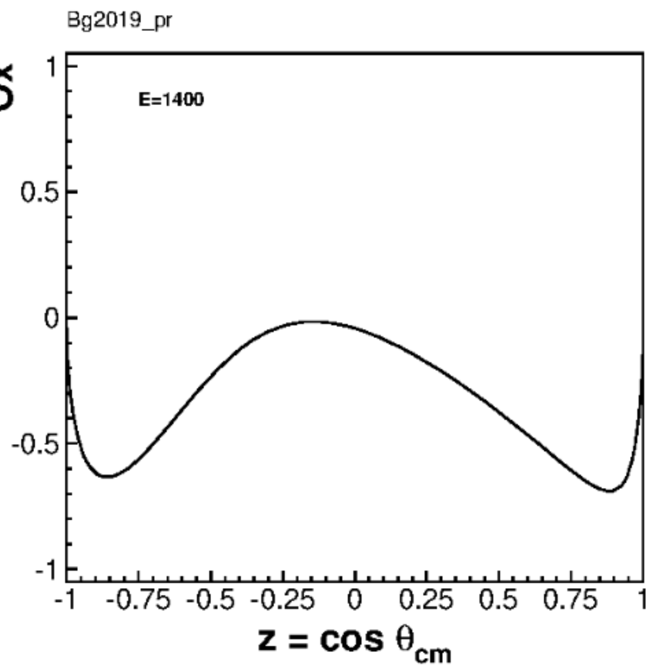
$E_\gamma = 8.0 - 8.6$ GeV

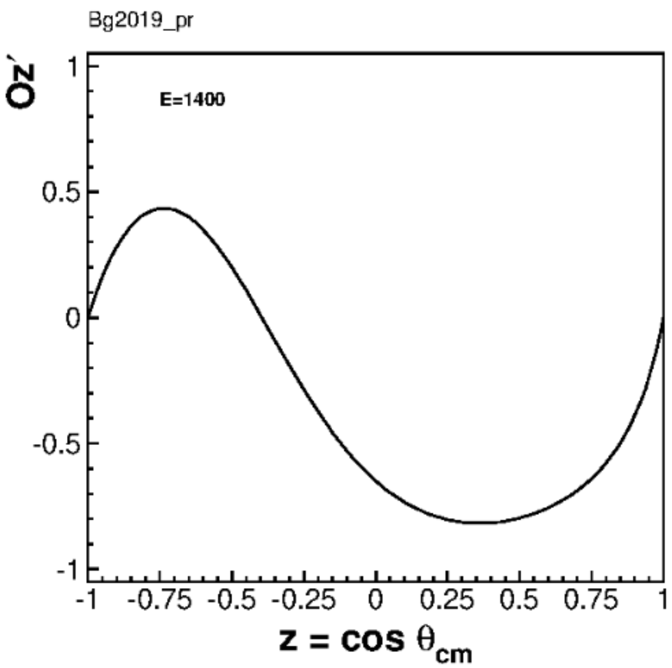












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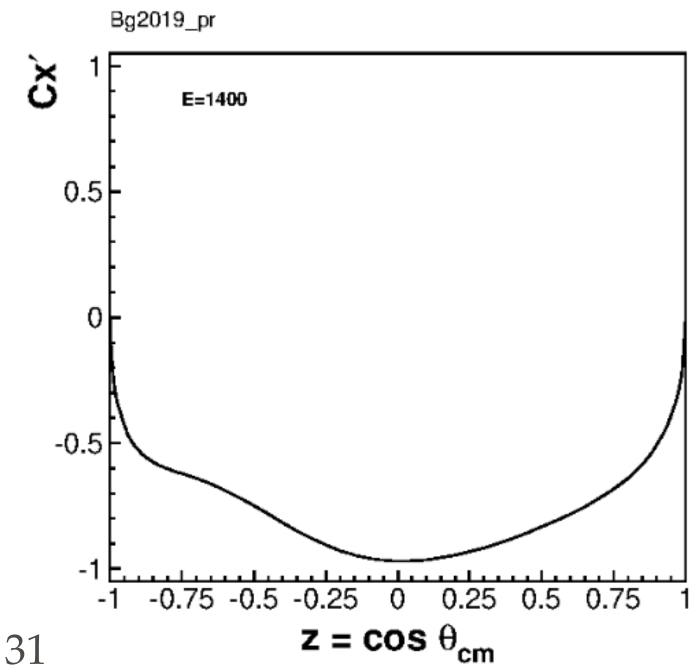
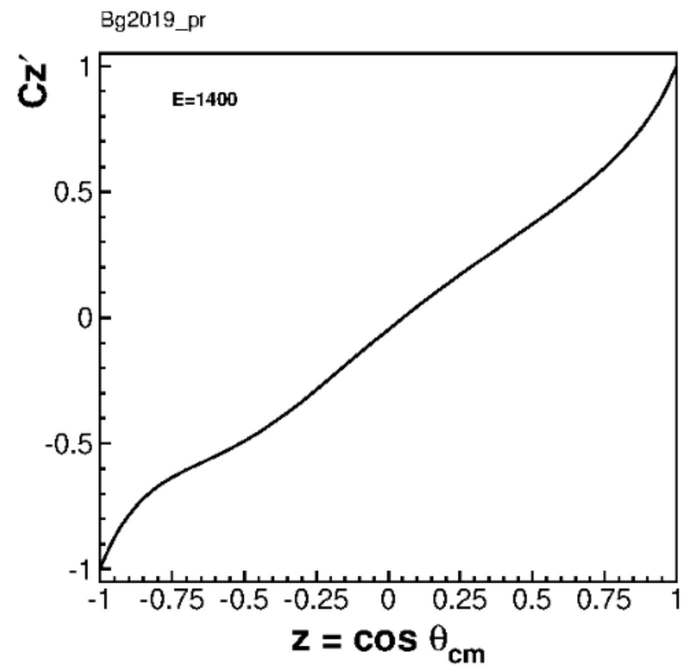
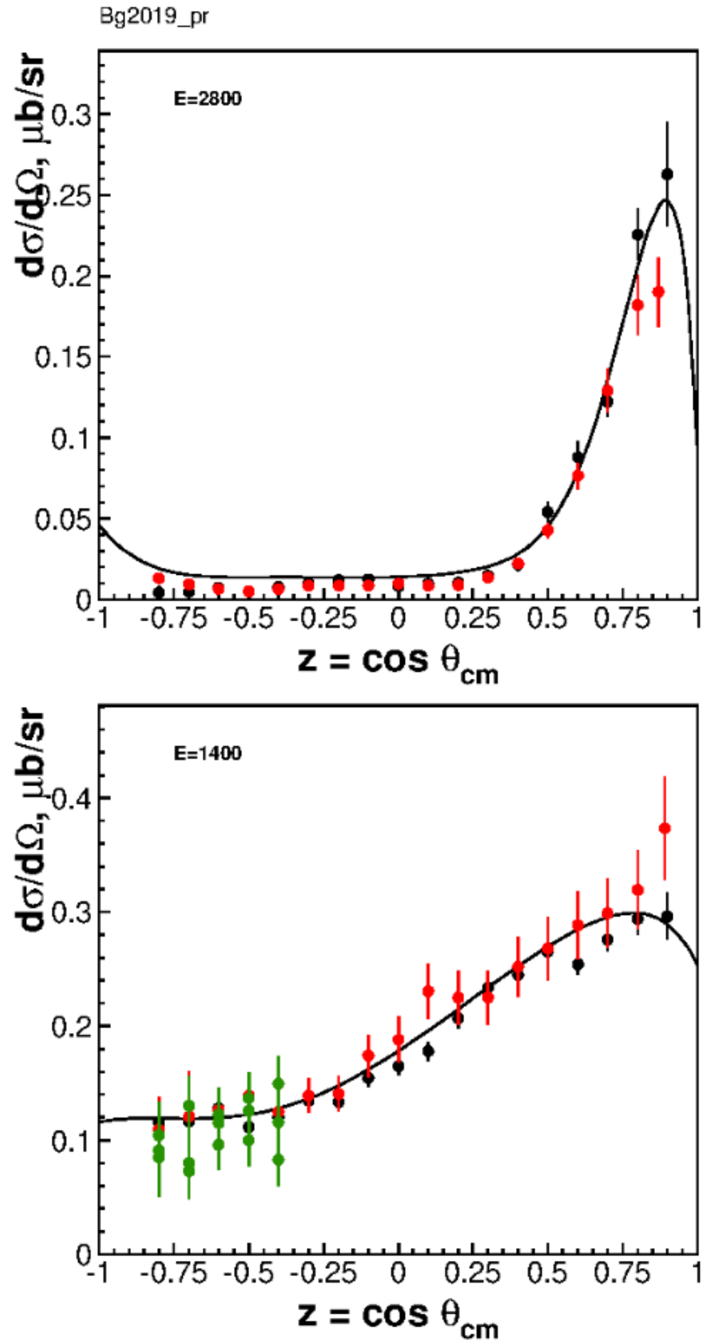




Study parameters

- To determine analysing power (i.e. final statistical precision) and influence of polarisation systematics
- Simulate MC and run the same analysis workflow as for PAC52 proof-of-concept
- Generate 12/13 statistically independent data samples with 500k events each (projected statistics for about 2 PAC of running)
- Use polarisation observables from BnGa PWA at different cos(θ)
- Fit each sample and extract $\alpha\_$
- To study polarisation, fit with value different from generation
    - E.g. generate with $P_L^\gamma = 0.80$, but analyse with $P_L^\gamma = 0.80 + n\sigma$
        - n=1,2,3
        - $\sigma_{L,C} = 0.02 \times P_{L,C}$



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