Hall D Report

Hall D staff: 13 staff scientists, 2+1 postdocs, 2 engineers, 1 designer, 6 technicians
Collaborations: GlueX (150 authors), SRC-CT (70 authors), KLF

1. Experiments in Hall D, accelerator Schedule for 2025-2026
2. Results and publications since PAC52
   - 4 journal publications
   - 2 arXiv publications (+ 1 imminent) , to be sent to journals
   - 3 PhDs awarded
3. Preparations for future experiments

Physics Program in Hall D

Experiment	name	Title	PAC rating	PAC days	data taken
E12-06-102	GlueX-I	Mapping the Spectrum of Light Quark Mesons and Gluonic Excitations with Linearly Polarized Photons	A	120	100%
E12-12-002	GlueX-II	A study of meson and baryon decays to strange final states with GlueX in Hall D	A	220	70%
A	JEF	Eta Decays with Emphasis on Rare Neutral Modes: The JLab Eta Factory(JEF) Experiment	Grp	100	0%
E12-10-011	PrimeX-η	A Precision Measurement of the eta Radiative Decay Width via the Primakoff Effect	A-	79	100%
E12-13-008	CPP/NPP	Measuring the Pion Polarizability in the $\gamma\gamma \to \pi\pi$ Reaction	A-	25	100%
E12-19-003	SRC/CT	Studying Short-Range Correlations with Real Photon Beams at GlueX	B+	15	100%
		Not yet scheduled			
E12-19-001	KLF	Strange Hadron Spectroscopy with Secondary KL Beam in Hall D	A-	200	
E12-20-011	REGGE	Measurement of the high-energy contribution to the Gerasimov-Drell-Hearn sum rule	A-	33	
E12-24-006	GlueX-III	Photoproduction of Charmonia at High Luminosity	A	200	

running

- considerable installation / new equipment required
- finished data taking

- KLF: design ongoing; big overhead: requires about 2 years for installation and >1 year for de-installation
- REGGE: polarized target - technical design not yet started

Physics Program in Hall D

Proposals to PAC53

- Proposal: PR12-25-002 SRC/CT: J/ψ off nuclei; 85 days
- Proposal: PR12-25-005 GlueX: at 1-4 GeV; 39 days
- Proposal: PR12-25-012 GlueX: ϕ off tensor-polarized ^{2}H; 65 days
- Jeopardy: REGGE, KLF

Experiment					
E12-06-102					
E12-12-002					
A					
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Hall D run history https://www.jlab.org/Hall-D/runs.html

Hall D physics runs

Year	Dates	Calendar days	Beam, GeV	ABU[1] + BANU	ABU	Experiment	PDL	Comment	PAC days[3]	PAC days total
2016	Feb, 3 - Mar, 23	49	12.0	?	?	E12-06-102	B.Zihlmann	Engineering run, solenoid at 1200A	3+25	25
2017	Jan, 30 - Mar, 9	40	11.7	58%	51%	E12-06-102	B.Zihlmann	Production	20	45
2018	Jan, 12 - Mar, 5	52	11.7	52%	46%	E12-06-102	B.Zihlmann	Production	26	71
2018	Mar, 29 - May, 6	38	11.7	58%	52%	E12-06-102	B.Zihlmann	Production	19	90
2018	Sep, 21 - Nov, 26	66	11.7	53%	47%	E12-06-102	B.Zihlmann	Production	33	**123**
2018	Nov, 28 - Dec, 9	12	10.3	?	N/A	E12-10-011	L.Pentchev	Commissioning, low energy	N/A	
2018	Dec, 12 - Dec, 18	7	9.0	?	N/A	E12-10-011	L.Pentchev	Commissioning, low energy	N/A	
2019	Feb, 8 - Feb, 21	13	11.6	45%	N/A	E12-12-002	B.Zihlmann	1/2 DIRC Commissioning	6	6
2019	Feb, 21 - Mar, 5	15	11.6	52%	37%	E12-10-011	L.Pentchev	Installation, Production on Be, LHe, FOM=0.97[4]	7.3	7.3
2019	Mar, 8 - Apr, 15	38	11.2	73%	68%	E12-10-011	L.Pentchev	Production on LHe, FOM=0.85[4]	16.1	23.4
2019	Nov, 25 - Dec, 20	25	11.4	34%	32%	E12-12-002	B.Zihlmann	DIRC commissioning, actual start Dec, 3. PAC days = 0.32*25	8	14
2020	Jan, 10 - Mar, 24	75	11.4	62%	56%	E12-12-002	B.Zihlmann	Production with DIRC at high rate. First 2 weeks - lower rate	38	52
2020	Jul, 27 - Sep, 21	56	11.4	46%	38%	E12-12-002	B.Zihlmann	Production with DIRC at high rate	21.5	73.5
2021	Sep, 16 - Nov, 4	50	10.1	51%	45%	E12-10-011	L.Pentchev	Production on LHe, FOM=0.56[4]	14	37.4
2021	Nov, 8 - Dec, 21	43	10.9	70%	60%	E12-19-003	L.Pentchev	Production on LHe, LD, C FOM=0.73[5] PAC=43*0.6*0.73=19	19	**19**
2022	Jun, 8 - Aug, 17	71	11.6	46%	41%	E12-13-008	S.Taylor	CPP/NPP	29	**29**
2022	Aug, 27 - Dec, 18	113	11.6	64%	59%	E12-10-011	L.Pentchev	PrimeX-η Production on LHe, FOM=0.91[4]*0.85(TAGM)	51.6	**89**
2023	Jan, 12 - Mar, 19	67	11.6	48%	42%	E12-12-002	B.Zihlmann	GlueX-II Production. ABU was used to calculate the PAC days	28.1	102
23-25	Mar, 20 - Mar, 25	740		**FCAL2 installation**						
2025	Apr, 6 - Sep, 3	150	11.73			E12-12-002	B.Zihlmann	**GlueX-II + JEF** *Based on the CR budget*	75	177
2026	Feb, 23 - Apr, 19	56	3.8			PR12-25-005	B.Zihlmann	TBD *Tentative*	28	
2026	May, 2 - Jul, 27	86	11.8			E12-12-002	B.Zihlmann	**GlueX-II + JEF** *Many unknowns*	43	**220**

E12-12-002	GlueX-II
E12-10-011	PrimeX-η
E12-19-003	SRC
E12-13-008	CPP/NPP

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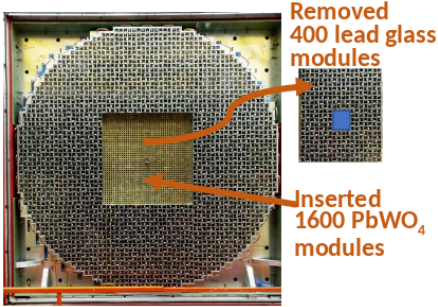
E12-12-002	GlueX-II
E12-10-011	PrimeX-η
E12-19-003	SRC
E12-13-008	CPP/NPP

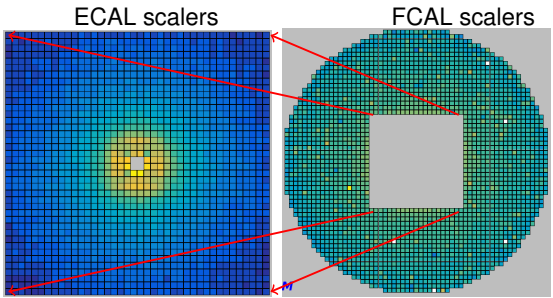
2025 and 2026
GlueX-II total 220 PAC days
GlueX-II 220 PAC days approved

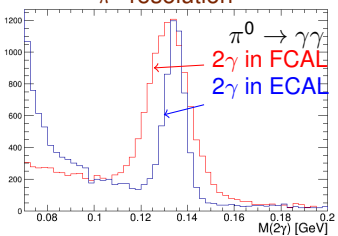
Performance of FCAL2 in running GlueX-III/JEF

FCAL2 $PbWO_4$ insert: Installation

- Replacement of 400 lead glass blocks (out of 2800) with 1600 $PbWO_4$ crystals
- Twice better energy and spacial resolution, much better radiation hardness
- Installation took 2 years







ECAL ($PbWO_4$) performance

Resolution as expected
Lower response to MIPs
$\Rightarrow$ lower trigger efficiency to charged tracks

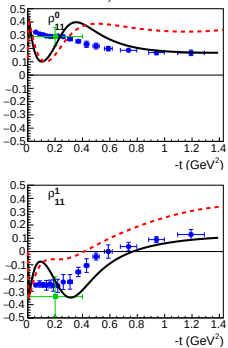
GlueX E12-06-102: Recent publications on SDMEs

PLB 863, 139368 (2025)

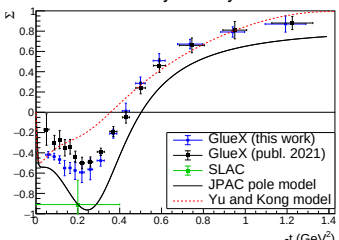
Measurement of SDMEs in $\Delta^{++}(1232)$ photoproduction

$\gamma p \to \pi^- \Delta^{++}(1232), \Delta^{++}(1232) \to p\pi^+$

2 SDMEs, G-J frame



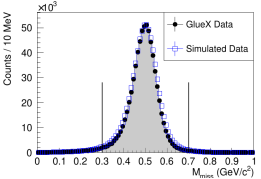
Beam asymmetry Σ

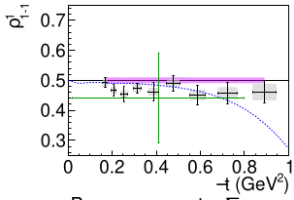


- Supersedes the previous publications
- Comparison with models, helps to tune the models
- Important for understanding of the $\gamma p \to \eta' \pi^- \Delta^{++}$ reaction (search for hybrids)

arXiv 2504.01194 (2025) *submitted to PRC*

Measurement of SDMEs in $\gamma p \to \phi p$, $\phi(1020) \to K^0_S K^0_L$





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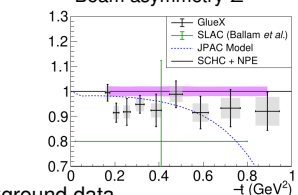


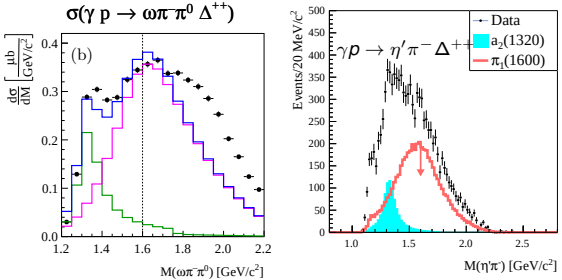
- High statistics, low background data
- Pomeron exchange dominates at $E_\gamma \approx 9$ GeV
- Older data at $E_\gamma < 3$ GeV - deviation from Pomeron exchange; at $E_\gamma > 20$ GeV - Pomeron exchange

GlueX E12-06-102: Recent publications related to hybrids and PWA

PRL 133, 261903 (2024)

An Upper Limit for $\pi_1(1600)$ (1^{-+}) Photoproduction

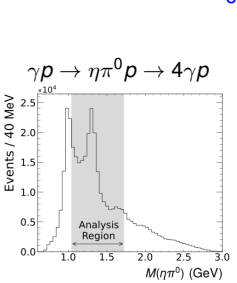
- Using a LQCD prediction: the dominant decay $\pi_1 \to b_1\pi$ ($b_1 \to \omega\pi$); BR$(\eta'\pi)/(b_1\pi)$ is LQCD-evaluated
- For $\gamma p \to \omega\pi\pi p$, $\omega\pi^-\pi^0\Delta^{++}$ $\frac{d\sigma}{dM}$ is measured for $(\omega\pi\pi)_{I=1}$
- Results: $\sigma(\pi_1) \lesssim \sigma(a_2(1320))$, expectations obtained for $\gamma p \to \eta'\pi^0 p$, $\eta'\pi^-\Delta^{++}$

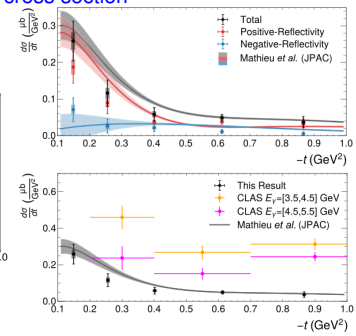


Moment analysis continues on $\gamma p \to \eta'\pi p(\Delta)$ indication of an odd wave

PRC 112, 015204 (2025)

First measurement of $a_2^0(1320)$ polarized photoproduction cross section





- Method: PWA exctracting the D-waves
- Linear polarization of the beam incorporated: separation of natural and unnatural parity exchanges
- Insights on photoproduction mechanisms, critical for the hybrid search, in particular for tensor mesons

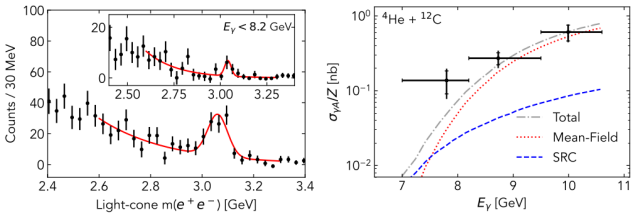
SRC-CT E12-19-003 recent PrimeX-η E12-10-011

PRL 133, 261903 (2024)

First measurement on near-threshold and subthreshold J/ψ photoproduction off nuclei

- Targets: ^{4}He and ^{12}C
- Assumption: production on internal deuterons allows to use kinematic constaints for improving resolution

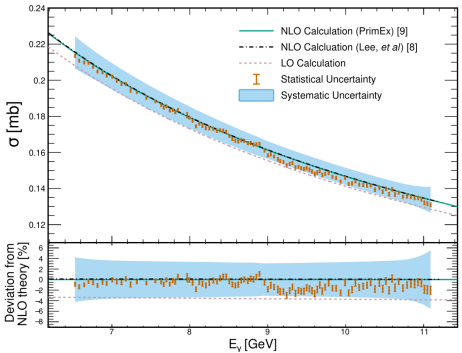
$$\gamma D \to J/\psi p(n), J/\psi \to e^+e^-$$



- Probing gluons in nuclei, or in nucleons at high momenta
- Indication that SRC mechanism is needed to explain the observation close/below threshold
- Proposal to PAC53: PR12-25-002

ArXiv 2505.07994 (2025) *submitted to PLB*

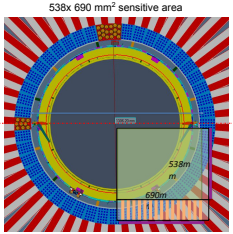
First Measurement of the Total Compton Scattering Cross Section between 6 and 11 GeV

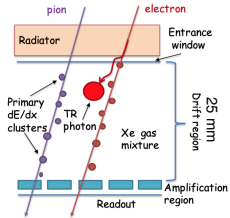


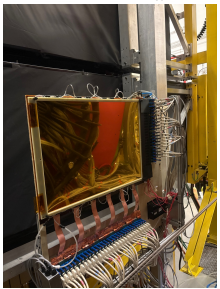
- Comparison with theory at a $\approx$ 3% level
- Important step for the PrimeX-η goals

GEM-TRD development for GlueX-III: improvement of e^+/e^- PID

GEM TRD: prototyping and testing





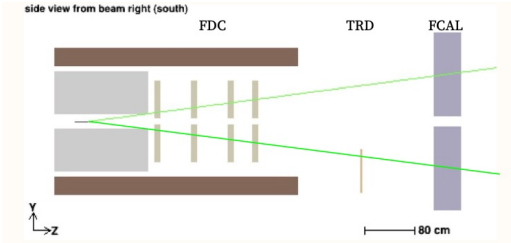


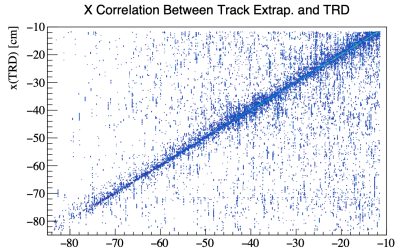
- 1/4 size prototype has been tested in PS with electrons
- Installed in front of DIRC during FCAL2 commissioning, tested with pions in the real GlueX environment
- Efficiency dependence on the flux and gain studied

Positive results: starting the design of the full system

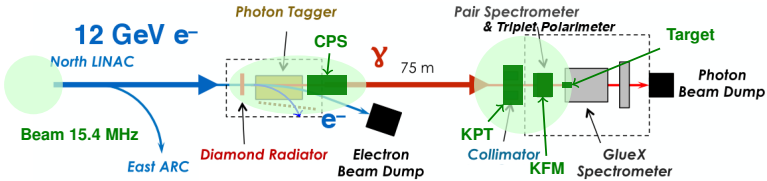
GEM TRD: prototype 1/4 of the full area

Installed for testing during the FCAL2 commissioning in front of the DIRC





KPF(KLONG) experiment: preparations status



KLF installation

1. CPS - Compact Photon Source
2. KPT - Kaon Production Target
3. KFM - Kaon Flux Monitor
4. Target of a larger diameter
5. Injector 4 ns $\rightarrow$ 64 ns

Status of the major components

2025: changes in the radiator and γ absorber, new Start Counter: needed to reduce backround in detectors

- CPS: Engineering design is advanced, magnet procured
- KPT: Engineering design needs changes
- KFM: Detectors from Jülich, to be transported to USA
- Beam duty cycle: compatibility with MOLLER not yet fully tested

Reviews and readiness

- ERR-I (Aug 2, 2023) on the conceptual design Recommendations, all met but one (in progress)
- ERR-II (Aug 29-30, 2024) on data analysis and software
- ERR-III Final readiness review before installation

Compact Photon Source (CPS)