

Hall D staff: 13 staff scientists, 2+1 postdocs, 2 engineers, 1 designer, 6 technicians

Collaborations: GlueX (150 authors), SRC-CT (40 authors), KLF

- 1 Experiments in Hall D, accelerator Schedule for 2024-2026 and outlook
- 2 Results and publications since PAC51
  - 3 journal publications
  - 2 arXiv publications (+ 1 imminent) , to be sent to journals
  - 9 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 A	GlueX-II	A study of meson and baryon decays to strange final states with GlueX in Hall D	A	220	46%
	JEF	Eta Decays with Emphasis on Rare Neutral Modes: The JLab Eta Factory(JEF) Experiment	Grp	100	0%
E12-10-011	PrimeX- $\eta$	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 $\gamma\gamma \rightarrow \pi\pi$ Reaction	A-	25	100%
E12-19-003	SRC/CT	Studying Short-Range Correlations with Real Photon Beams at GlueX	B+	15	100%
<i>Not yet scheduled</i>					
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	

- considerable installation / new equipment required
- finished data taking
- JEF: fully budgeted, FCAL2 installation in progress
- KLF: partly budgeted, engineering design in progress
- REGGE: not yet budgeted

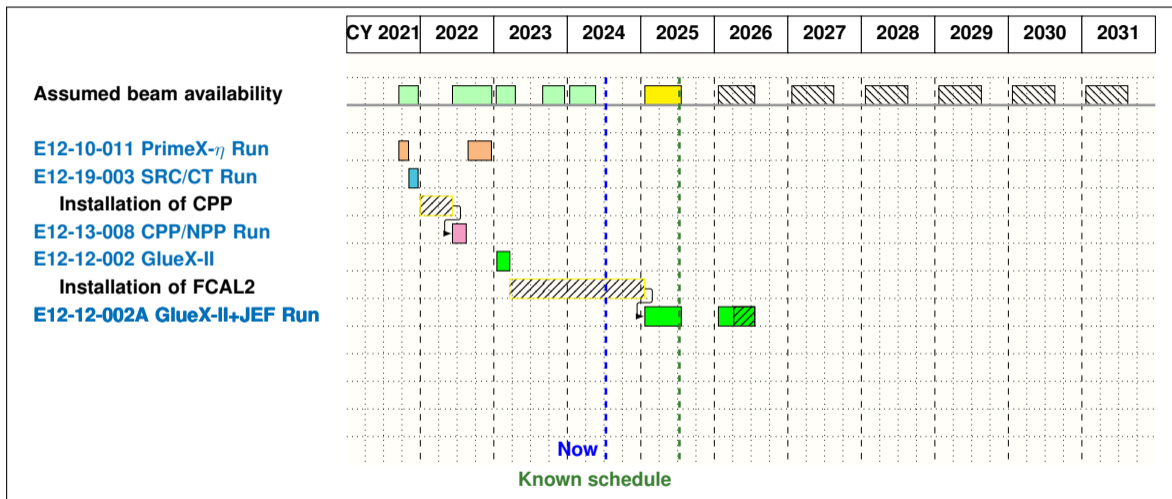
## Proposals/LOI to PAC52

- Proposal: C12-23-009 SRC/CT: conditionally approved C2 by PAC51 100 days
- Proposal: E12-12-002A  $\alpha(\Lambda^0 \rightarrow p\pi^-)$ : a run group proposal with GlueX-II, 0 days
- Proposal: PR12-24-006 GlueX-III: high luminosity production of charmonia, 200 days
- LOI: LOI12-24-001: Spectroscopy with polarized targets

		Eta Factory(JEF) Experiment			
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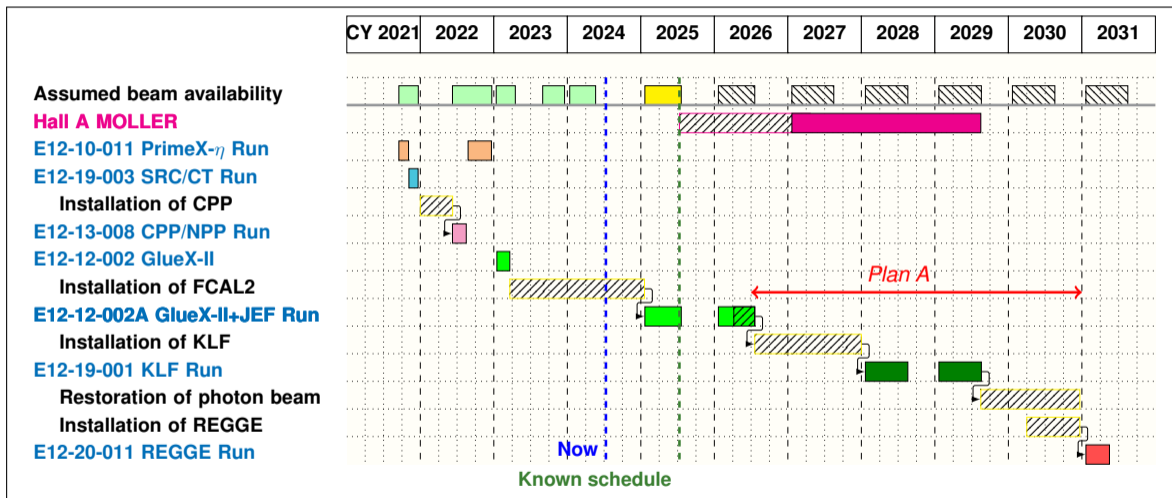
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# Hall D running schedule: outlook



- Assuming 24 weeks/year running in FY25 and FY26 and 30 weeks/year afterwards
- Assuming KLF timely budgeted and pass ERR by mid of 2025
- Assuming KLF compatibility with MOLLER, 64 ns duty cycle is likely OK, 128 ns is uncertain yet

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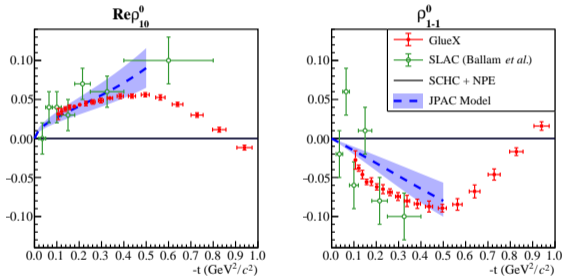
# GlueX E12-06-102: Recent publications on SDMEs

PRC 108, 055204 (2023)

Measurement of SDME in  $\rho(770)$  production by linearly polarized photons at 8.2-8.8 GeV

$$\gamma p \rightarrow \rho^0 p, \rho^0 \rightarrow \pi^+ \pi^-$$

2 SDMEs shown, out of 9



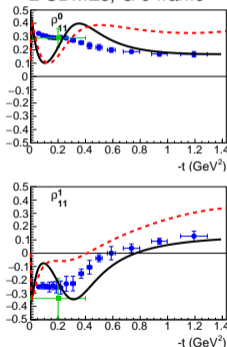
- Greatly supersedes the old data in this energy range
- Good matching of the SDME analysis results and amplitude analysis results: foundation for hybrid meson search
- Enables modeling of production of known resonances

arXiv 2406.12829 (2024) for Phys.Lett.B

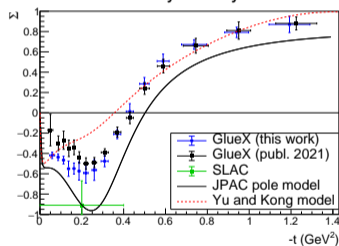
Measurement of SDMEs in  $\Delta^{++}(1232)$  photoproduction

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

2 SDMEs, G-J frame



Beam asymmetry  $\Sigma$



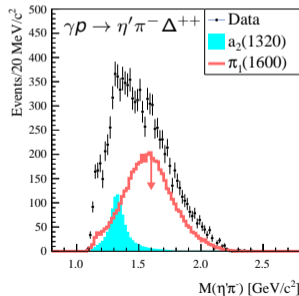
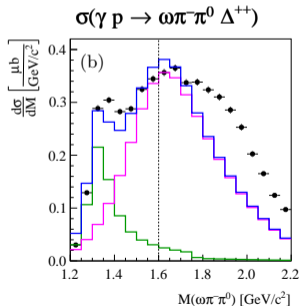
- Supersedes the previous publications
- Comparison with models, helps to tune the models
- Important for understanding of the  $\gamma p \rightarrow \eta' \pi^- \Delta^{++}$  reaction (search for hybrids)

# GlueX E12-06-102: Recent publications

[arXiv 2407.03316 \(2024\)](https://arxiv.org/abs/2407.03316) for PRL

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

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



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

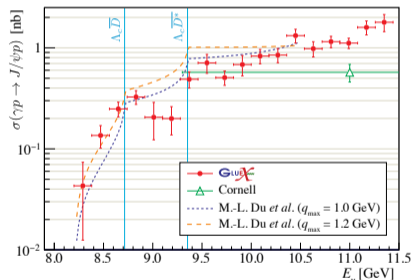
## Photoproduction at threshold $\gamma p \rightarrow J/\psi p$

GlueX

[PRL 123, 072001 \(2019\)](https://arxiv.org/abs/1907.072001)

[PRC 108, 025201 \(2023\)](https://arxiv.org/abs/2302.025201)

} 230 citations



Also: Hall C  $J/\psi$ -007: [Nature 615 \(2023\)](https://arxiv.org/abs/2302.025201)

- Potential relation to gravitational formfactors, nucleon mass radius etc.
- Call for more precision data

# SRC-CT E12-19-003: Recent publications

*Phys.Lett.B 855, 138790 (2024)*

Search for axion-like particle in Primakoff reaction using GlueX detector

Interest in ALP at the  $\Lambda_{QCD}$  mass scale:

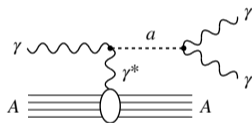
- Solving the CP problem in strong interactions
- Serving a connection to the dark sector

Coupling to photons

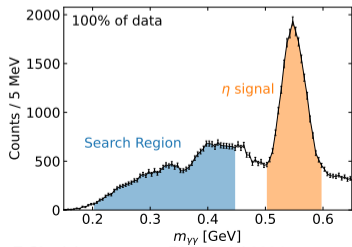
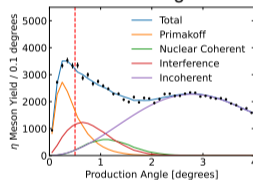
$$\gamma\gamma \rightarrow a$$

$$L_{\text{eff}} \supset \frac{1}{4\Lambda} a F^{\mu\nu} \bar{F}^{\mu\nu}$$

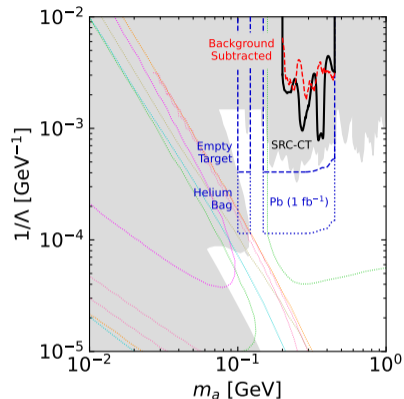
Primakoff reaction



Carbon target



- Primakoff: production at  $\theta < 0.5^\circ$
- Large BG in  $\gamma\gamma$  from beam interaction downstream of the target  
**Needs a considerable empty-target data sample**
- BG in  $\gamma\gamma$  from EM interactions

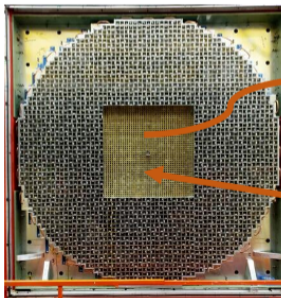




# Ongoing projects: a major upgrade of the Forward Calorimeter FCAL

## FCAL2 PbWO<sub>4</sub> insert: Installation

- Replacement of 400 lead glass blocks (out of 2800) with 1600 PbWO<sub>4</sub> crystals
- Twice better energy and spacial resolution, much better radiation hardness
- Required for the JEF experiment (to run with GlueX-II in 2025-2026)
- Installation is in progress, to be ready by October



Removed  
400 lead glass  
modules



Inserted  
1600 PbWO<sub>4</sub>  
modules

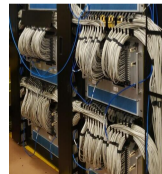
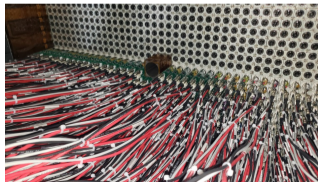
LG cabling done



LMS for crystals

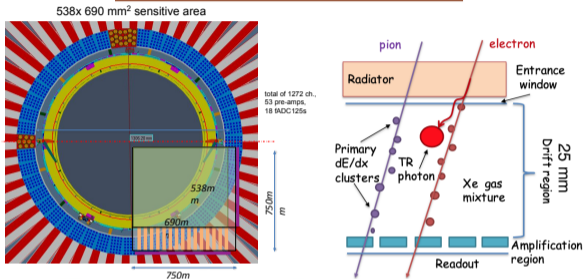


Installation of the bases for crystals and cabling



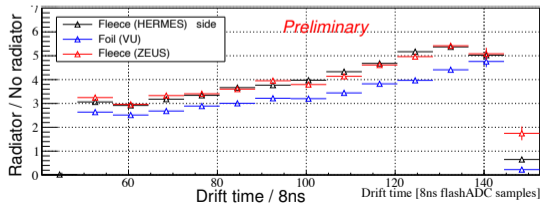
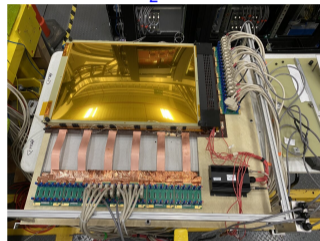
# Ongoing projects: hardware development for future project

## GEM TRD: prototyping and testing



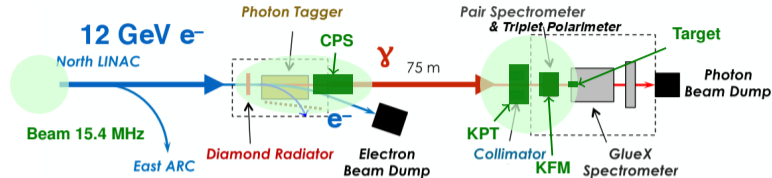
- Goal: additional PID for electrons and positrons, pion suppression  $\sim 10$  at  $\sim 90\%$  electron efficiency  
Acceptance  $\theta < 10^\circ$  - in front of DIRC
- Small prototypes tested with  $e^-$  and  $\pi^\pm$
- Prototype of 25% of area is being tested
- Electronics: for tests using FADC125 MHz spares  
For the full project: VPX-based FADC, PANDA design
- Xe purification system is under development
- **Potential completion: by the end of 2026**

**GEM TRD: prototype 1/4 of the full area**  
Run: Mar 12-15; electrons in Pair Spectrometer  
used 90/10% Kr/CO<sub>2</sub> and different radiators



# BACKUP

# 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

- CPS: Engineering design is advanced
- KPT: Engineering design is complete
- KFM: Detectors from Jülich to be transported to JLab in 2024
- 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) on data analysis and software
- ERR-III (Summer 2025?) Final readiness review

## Compact Photon Source (CPS)

