JLab Hypernuclear Collaboration Meeting, Jefferson Lab, US, May 15–16, 2025

Overview of HES-HKS System and Commissioning Plan

Graduate School of Science, Kyoto University Toshiyuki Gogami May 16, 2025



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(e,e'K⁺) spectroscopy / decay π spectroscopy



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Experimental setup

Engineering → J. Shiflett and S. Lassiter

Beam line + SLI → D. Gaskell

Radiation simulation by FULKA → J. Takahashi

HES-HKS simulations → T. Ishiga, R.Kumaragamage

ENGE → S.Nagao, K. Nishi, K. Nishida

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Kinematic parameters

	Item	Value	
\mathbf{D}_{22}	Energy (/GeV)	2.24	
Beam (e)	(Required) energy spread and drift	1×10^{-4} (FWHM)	
	Central momentum $p_{e'}^{\text{cent.}}$ [/(GeV/c)]	0.74	
PCS + HES (e')	Central angle $\theta_{ee'}^{\text{cent.}}$	8.5°	
	Solid angle acceptance $\Omega_{e'}$ (/msr) (at $p_{e'}^{\text{cent.}}$)	3.4	
	Momentum resolution $\Delta p_{e'}/p_{e'}$	4.4×10^{-4} (FWHM)	Optimal for Λ and Σ^0
PCS + HKS (K^+)	Central momentum $p_{K^+}^{\text{cent.}}$ [/(GeV/c)]	1.20	
	Central angle $\theta_{eK^+}^{\text{cent.}}$	11.5°	
	Solid angle acceptance Ω_{K^+} (/msr) (at $p_{K^+}^{\text{cent.}}$)	7.0	Small Q ²
	Momentum resolution $\Delta p_{K^+}/p_{K^+}$	2.9×10^{-4} (FWHM)	Almost real photon
	$\sqrt{s} = W (/\text{GeV})$	1.912	
$p(e, e'K^+)\Lambda$	$Q^2 [/({ m GeV}/c)^2]$	0.036	
	K^+ scattering angle wrt virtual photon, $\theta_{\gamma^*K^+}$	7.35°	Forward angle
	ϵ	0.59	- Largo cross section
	ϵ_L	0.0096	

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High accuracy measurement by good calibration



\rightarrow Good calibration \mathfrak{S}

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Backward transfer matrix optimization

4 MeV (FWHM)

1.5 MeV (FWHM)



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Experimental target -> D. Meekins

Material	Thickness / (mg/cm ²)	Length in radiation Length	Beam time /hours	Beam current /µA	Remark	
CH ₂	450	10.1×10 ⁻³	144	2	Energy calibration, Raster 2×2 mm ²	
⁶ Li	100	1.40×10 ⁻³	120	50	E12-24-004, Raster 2×2 mm ²	
⁹ Be	100	1.53×10 ⁻³	384	50	E12-24-004	
¹¹ B	100	1.87×10 ⁻³	72	50	E12-24-004, B ₄ C	
¹² C	150	2.34×10 ⁻³	168	50	Energy calibration	
¹² C hole	150	2.34×10 ⁻³	-	10	Beam position check Raster 2×2 mm ²	
²⁷ Al	150	6.24×10 ⁻³	672	50	E12-24-011	
⁴⁰ Ca	150	9.31×10 ⁻³	456	50	E12-15-008/E12-24-013	
⁴⁸ Ca	150	7.76×10 ⁻³	552	50	E12-15-008/E12-24-013	
²⁰⁸ Pb	150	23.5×10 ⁻³	1000	25	E12-20-013/E12-24-003, Raster 2×2 mm ²	

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Particle Detectors

TG et al., NIMA 900, 69—83 (2018) TG et al., NIMA 729, 816—824 (2013) **Cherenkov detectors**

- Aerogel (n=1.05)
- Water (n=1.33) → K. Higashimoto

Κ⁺, π',

TOF walls (Plastic scintillators) **Drift chambers**→ L.Tang

HES HKS

TOF walls (Plastic scintillators)



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The number of channels for detectors

Spectrometer	Detector	FADC (ADC/TDC)	Low resolution TDC	High resolution TDC
ΗКЅ	KDC	-	640 + 640	
	TOF	88	-	88
	AC	42		
	WC	48		
ПСС	EDC	-	1120	-
IILS	TOF	116	-	116
Number of total channels		294	2400	204

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Front-ends



DAQ ➔ A. Camssone

Grouping sim. → T. Iwamoto

Software → S. Park

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