

# Recent activities

## JLab Hypernuclear Experiment

T. Gogami (Kyoto Univ.)

July 13, 2022

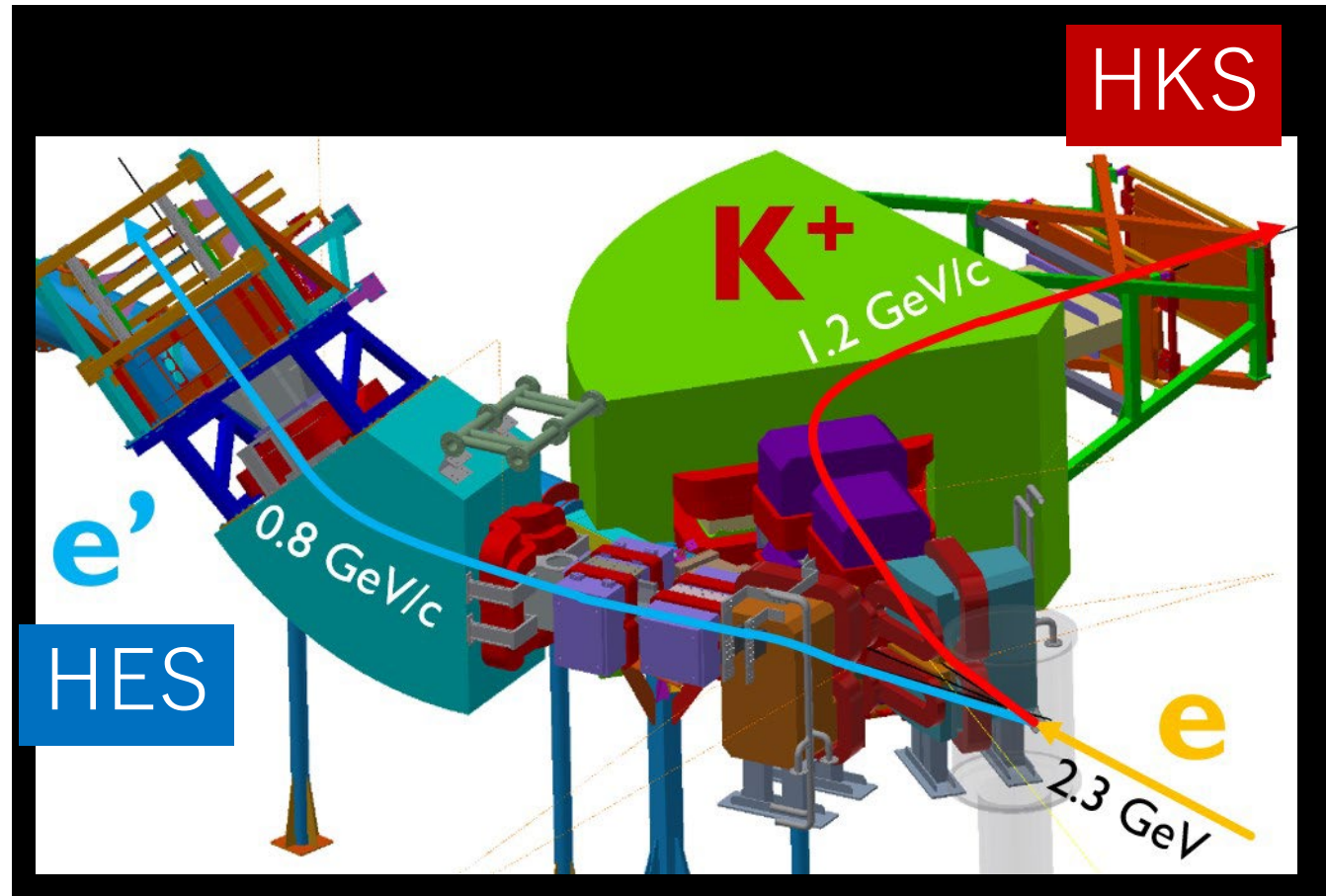


京都大学

KYOTO UNIVERSITY

# Experiments at Hall C

- E12-15-008 ( ${}^{40}_{\Lambda}\text{K}$ ,  ${}^{48}_{\Lambda}\text{K}$ )
- E12-19-002 ( ${}^3_{\Lambda}\text{H}$ ,  ${}^4_{\Lambda}\text{H}$ )
- E12-20-013 ( ${}^{208}_{\Lambda}\text{Tl}$ )



# Meetings (2021, 2022)

## **Regular group Meetings**

- Weekly meeting (Tokyo-Tohoku-Kyoto)
- biweekly meeting (Hampton-Kyoto)

## **JLab Hypernuclear Collaboration meeting**

- Dec 7—9 in 2021 (online):  
[https://wiki.jlab.org/tegwiki/index.php/Hypernuclear\\_CollaborationMeeting\\_2021Dec](https://wiki.jlab.org/tegwiki/index.php/Hypernuclear_CollaborationMeeting_2021Dec)

## **Target Meeting** (Dave + Toshi + etc.)

- 4 meetings in 2021
- 6 meetings in 2022 so far

## **Analysis meeting (tritium experiment: $\Lambda nn$ )**

- >12 meetings in 2021

## **Strategy (spokespeople) meeting**

- Biweekly

# Theses (2021, 2022): 3 Ph.D.'s + 4 Masters

## 2022

- K. Itabashi (Ph.D. thesis, Tohoku Univ. 2022),  
“Study of Lambda quasi-free production in the  ${}^3\text{H}(e,e'\text{K}^+)$  reaction”
- K.N. Suzuki (Ph.D. thesis, Kyoto Univ., 2022),  
"Search for the  $nn\Lambda$  state via the  ${}^3\text{H}(e,e'\text{K}^+)\text{X}$  reaction at JLab“

## 2021

- B. Pandey (Ph.D. thesis, Hampton Univ., 2021) → [web page](#)  
"A Possible Observation of Sigma- $nn$  Continuum Structures and A Bound Sigma- $NN$  State Using the  $(e,e'\text{K}^+)$  Reaction"
- K. Katayama (Master's thesis, Kyoto Univ., 2021) → [PDF](#)  
"Development of HRS-HKS trigger system with FPGA -High precision measurement of hypernuclei at JLab-"
- T. Toyoda (Master's thesis, Kyoto Univ., 2021) → [PDF](#)  
"Basic design of gas target for high accuracy mass measurement of hypertriton at JLab"
- T. Akiyama (Master's thesis, Tohoku Univ., 2021) → [PDF](#)  
"Development of water Cherenkov counter for medium-heavy hypernuclear spectroscopy at JLab"
- K. Okuyama (Master's thesis, Tohoku Univ., 2021) → [PDF](#)  
"Study of the hyperon electroproduction using the  $p(e,e'\text{K}^+)\Lambda/\Sigma^0$  reaction"

# Invited talks (2021, 2022)

- T. Gogami, “Strangeness nuclear physics by electron beam at JLab”, The 15th Asia Pacific Physics Conference (APPC15), Online, Aug 2022.
- S. N. Nakamura, "Future prospects of spectroscopy of Lambda hypernuclei at JLab and J-PARC HIHR", 14th International Conference on Hypernuclear and Strange Particle Physics (HYP2022), Prague, Czech Republic + online, June 2022.
- L. Tang, “Newly completed JLab experiment (E12-17-003): Determine the unknown  $\Lambda n$  interaction by investigating the possible  $\Lambda n n$  resonance”, 14th International Conference on Hypernuclear and Strange Particle Physics (HYP2022), Prague, Czech Republic + online, June 2022.
- T. Gogami, “Hyperons and Hypernuclear Physics”, D12 Mini-Symposium: Strangeness and Hypernuclei, APS April Meeting 2022, New York, U.S. + online, Apr 2022.
- S. N. Nakamura, "Investigation of deep inside of nuclei and neutron stars with electron beams", JPS Co-sponsored Symposium, Online, March, 2022.
- T. Gogami, “Light Lambda Hypernuclear Measurement at JLab”, Strangeness Nuclear Physics Workshop 2021, Online, Dec 2021.
- T. Gogami, “Hypernuclear Physics at Jefferson Lab”, JPS meeting, Online, Sep 2021.
- S. N. Nakamura, "Precise spectroscopy of Lambda hypernuclei with electron and meson beams", Hadron 2021, Mexico/on-line, July, 2021.

# Publications (2021, 2022)

- K. Itabashi et al., being drafted
- B. Pandey et al., “Spectroscopic study of a possible  $\Lambda_{nn}$  resonance and a pair of  $\Sigma NN$  states using the  $(e, e'K^+)$  reaction with a tritium target”, PRC 105, L051001 (2022).
- K. N. Suzuki et al., “The cross-section measurement for the  ${}^3\text{H}(e, e'K^+)nn\Lambda$  reaction”, PTEP 2022, 013D01 (2022).
- K. Itabashi et al., “Study of the  $nn\Lambda$  state and  $\Lambda n$  interaction at Jefferson Lab”, Few-body systems 63, 16 (2022)
- T. Gogami et al., “Spectroscopy of  $A = 9$  hyperlithium with the  $(e, e'K^+)$  reaction”, PRC 103, L041301 (2021).
- T. Gogami et al., “Accurate  $\Lambda$  hypernuclear spectroscopy with electromagnetic probe at Jefferson Lab”, AIP Conf. Proc. 2319, 080019 (2021); <https://doi.org/10.1063/5.0037353>.

2 PRCs, 1 PTEP, 2 proceedings, 1 draft

# Grant-in-aid

## SPIRITS 2020 (Kyoto University)

DONE

- 2020 Apr—2022 Mar
- Project name : Investigation of nuclei with the strangeness degrees of freedom by using tools of real/virtual photons
- Principle investigator (PI) : Toshiyuki Gogami
- Cost: **6,135,000 JPY** (Direct cost)

## Grant-in-Aid for Scientific Research on Innovative Areas (Research in a proposed research area) (JSPS)

- 2018 Apr—2023 Mar
- Project number: 18H05459
- Project name : Investigation of deep inside of nuclei and neutron stars with high energy photons
- PI: S.N. Nakamura
- Cost: **144,100,000 JPY** (Direct cost)

On-going

## Grant-in-Aid for Scientific Research (B) (JSPS)

On-going

- 2018 Apr—2023 Mar
- Project number: 18H01219
- Project name : Solving puzzles in the baryon interaction through electron beam spectroscopy of few-body Lambda hypernuclei
- PI: Toshiyuki Gogami
- Cost: **12,900,000 JPY** (Direct cost)

## Grant-in-Aid for Scientific Research (A) (JSPS)

DONE

- 2017 Apr—2021Mar
- Project number: 17H01121
- Project name : Study of baryonic force through the electromagnetic spectroscopy of Lambda hypernuclei
- PI: S.N. Nakamura
- Cost: **33,500,000 JPY** (Direct cost)

# Experimental preparation

- **Spectrometer base (for vertical bending)**
  - Need support
- **PCS**
  - Has already been transported to ESB from Japan
- **Target + new vacuum chamber**
  - Basic design has been fixed
    - Details design needs to be done by the target group
- **Detectors**
  - Aerogel Cherenkov counters (AC)
    - Cosmic ray test for at ESB (Bishnu works with a support by Brad)
  - Water Cherenkov counters (WC)
    - New containers are being constructed
- **MC simulation**
  - Optimal experimental condition is being investigated



# Schedule

**We are here →** **2022:** Design, detector comm.  
**2023:** ERR, detector comm.  
**2024:** Installation  
**2025:** Experiment