Workshop of Electro- and Photoproduction of Hypernuclei and Related Topics 2024 “Opening”

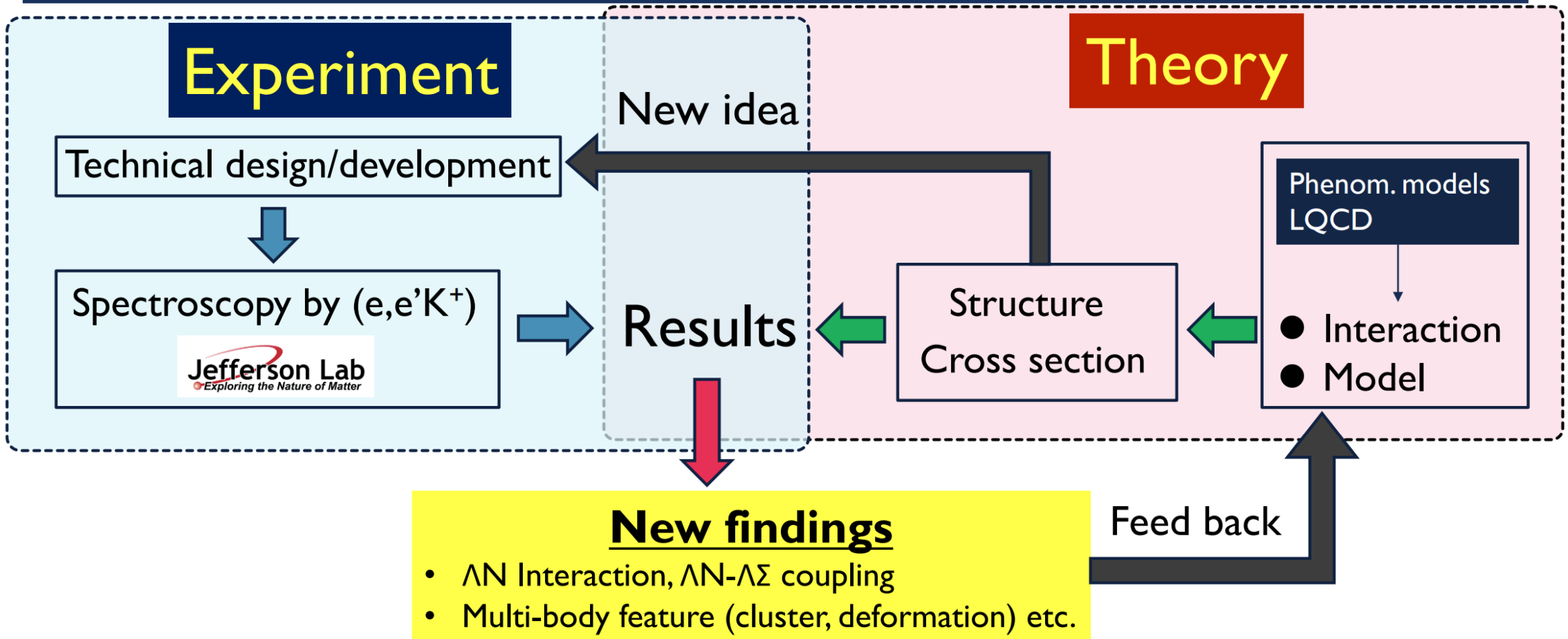
Kyoto University

Toshiyuki Gogami

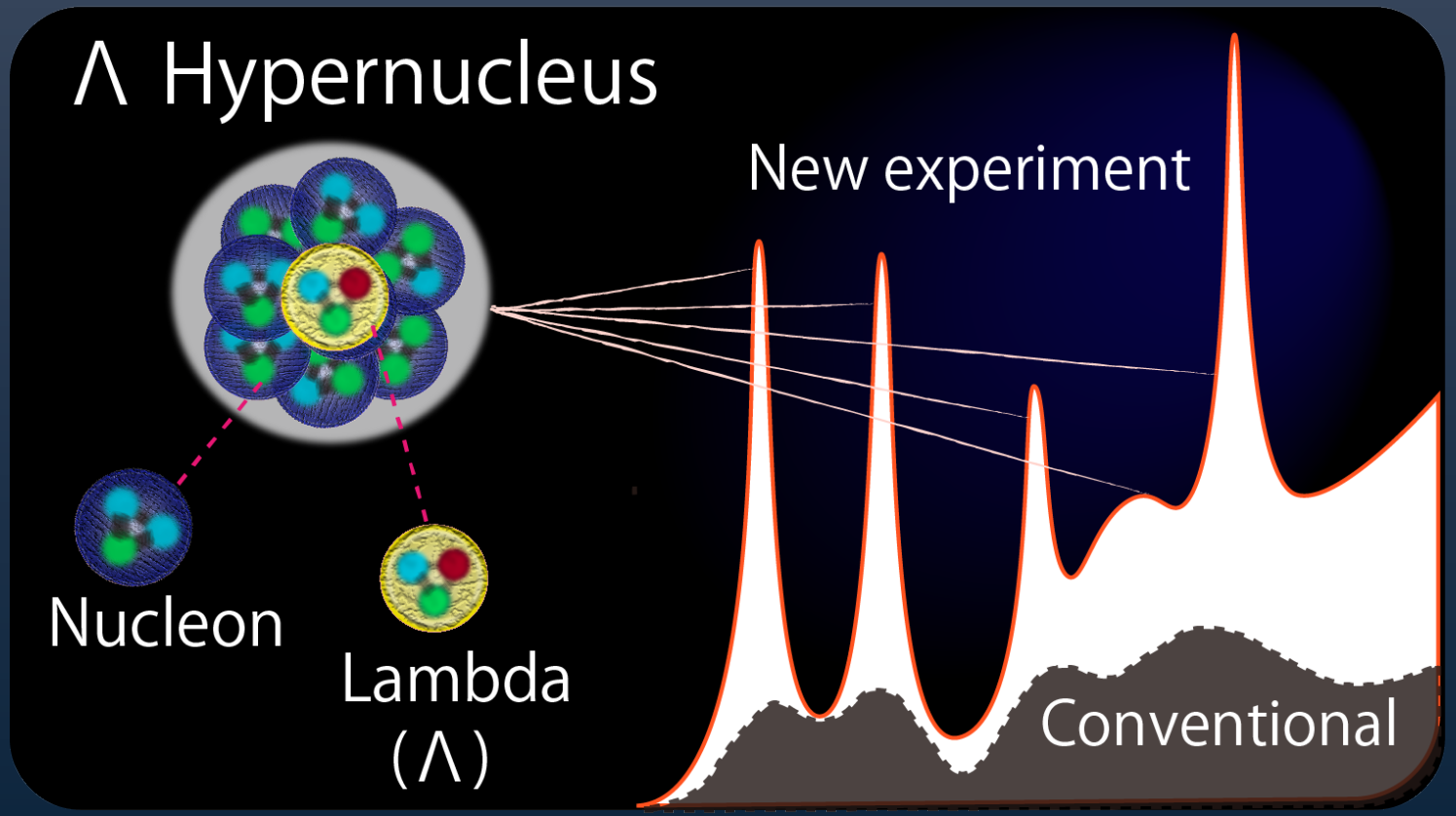
Oct 15, 2024

Slide from HIEI2022 (https://wiki.jlab.org/tegwiki/index.php/HIEI2022_20220316)

COLLABORATION WORK



Hard work for high precision



Precise experimental data are available → will be more in near future!

Precise theoretical calculations (both the energy levels and cross sections) to extract physics information is necessary

New precise data

https://doi.org/10.1051/epjconf/202226201008

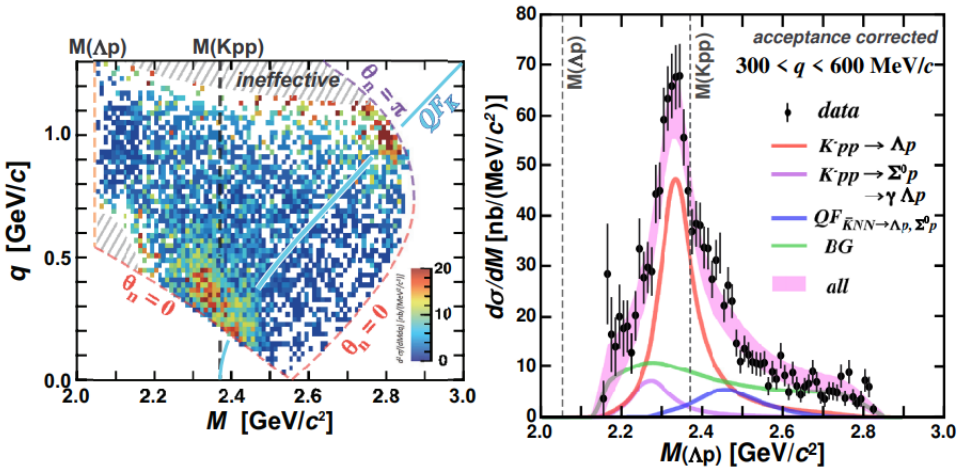
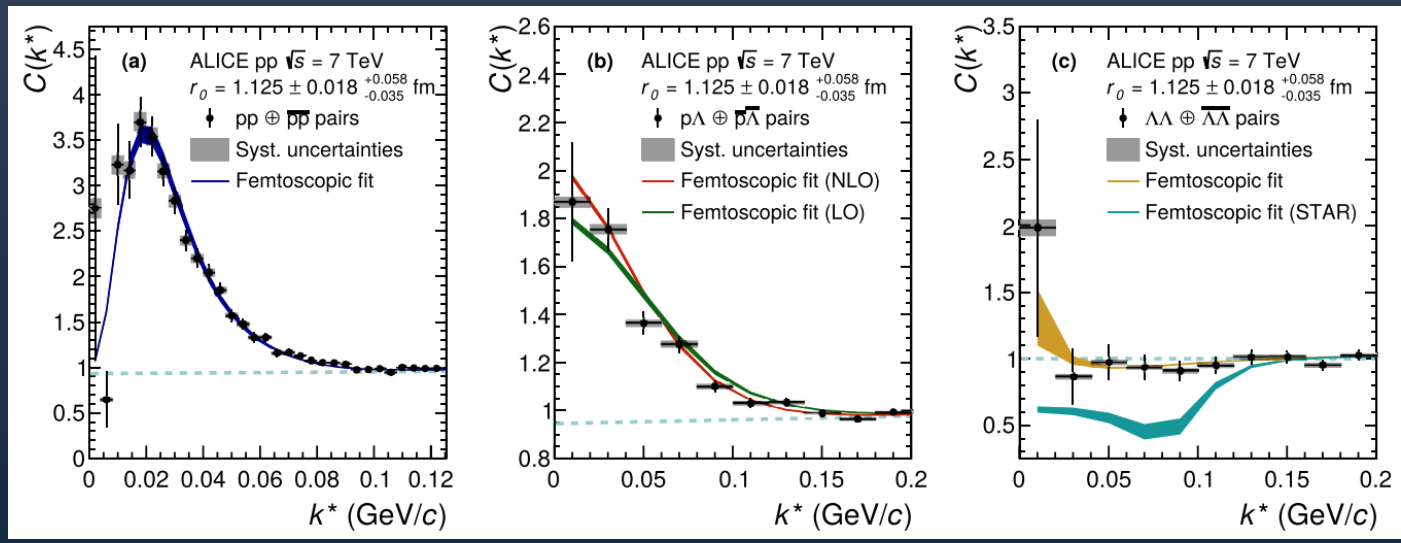


Figure 1. (left) Efficiency and acceptance corrected data over IM (Λp invariant mass) and q (momentum transfer). (right) Λp invariant mass in the region $0.3 < q < 0.6$ MeV/c.

F. Sakuma et al., EPJ Web of Conferences 262, 01008 (2022)

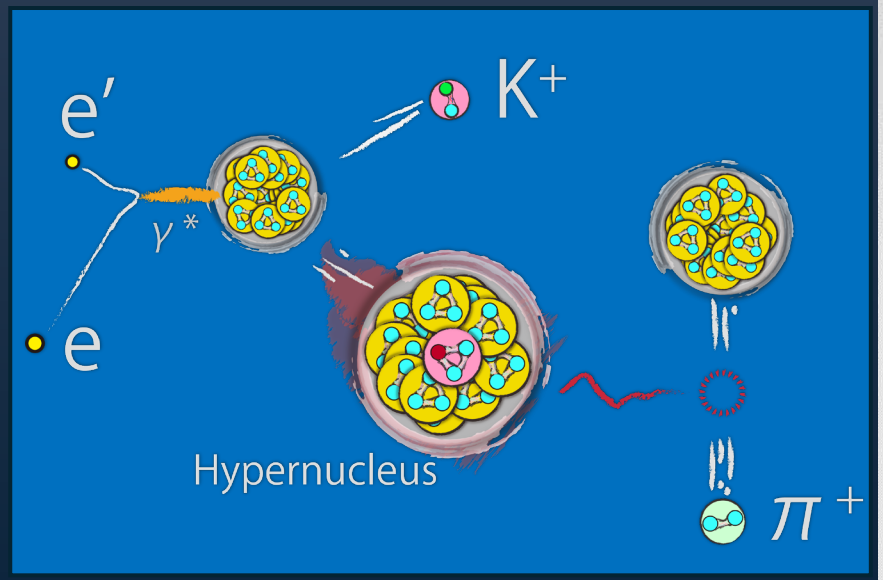
https://doi.org/10.1103/PhysRevC.99.024001



ALICE Collaboration, PRC 99, 024001 (2019)

New experiment at JLab Hall-C (2027～)

- High resolution: 0.6 MeV FWHM
- High accuracy: 0.07 MeV
- Wide mass number: A = 6—208



e': HES

0.7 GeV/c
2×10^5 /sec

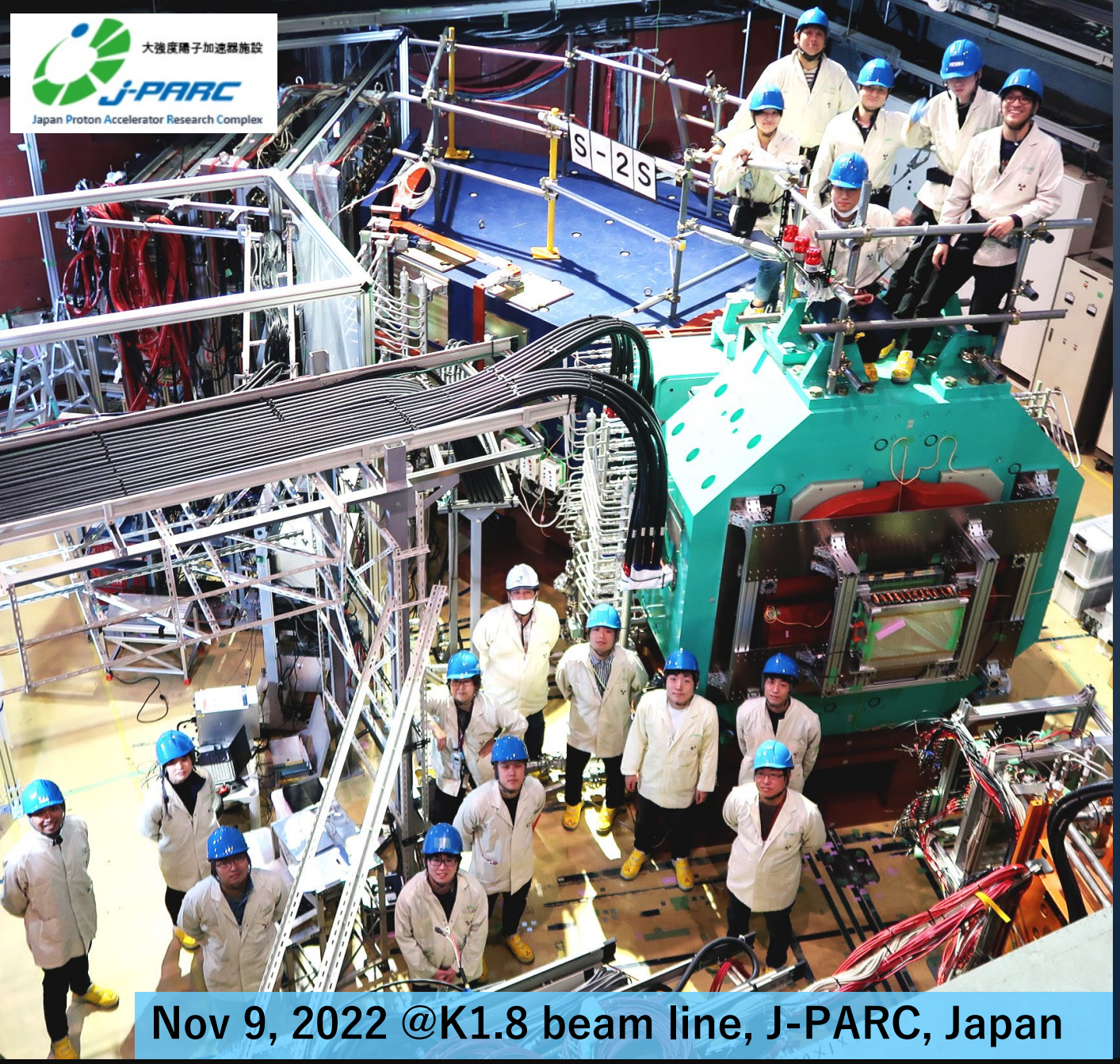
K^+: HKS

1.2 GeV/c
5×10^4 /sec

π^+: ENGE

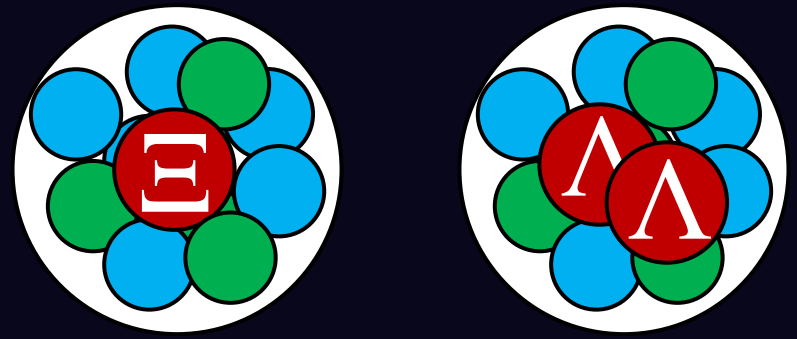
2.2-GeV Electron
50 μA (3×10^{14} /sec)
→ Hypernuclei: 0.003 /sec

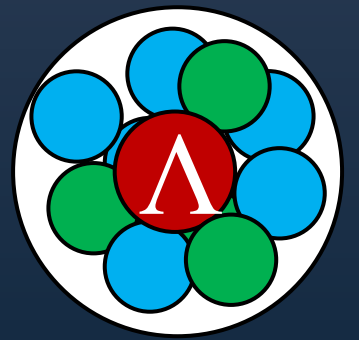
Jefferson Lab
Thomas Jefferson National Accelerator Facility



Nov 9, 2022 @K1.8 beam line, J-PARC, Japan

"S = −2" study will start!





"S = −1"

as well

T. Gogami et al., EPJ Web Conf. 271, 11002 (2022).

New idea?

PHYSICAL REVIEW D **110,** L031502 (2024)

Letter

Possible ${}^{3}_{\phi}$H hypernucleus with the HAL QCD interaction

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[2]*New York City College of Technology, The City University of New York, Brooklyn, New York, USA*
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[4]*Long Island University, Brooklyn, New York, USA*

(Received 27 June 2024; accepted 18 July 2024; published 20 August 2024)

Within the framework of the Faddeev formalism in configuration space, we investigate bound states in the ϕNN system with total isospin $T = 0$ and $T = 1$. The recently proposed lattice HAL QCD ϕN potential in the ${}^4S_{3/2}$ channel does not support either ϕN or ϕNN bound states. The HAL QCD ϕN potential in the ${}^2S_{1/2}$ channel suggests the bound states for ϕN and $\phi NN(S = 0)$ systems. However, the binding energies are highly sensitive to variations of the enhancement factor β, and the ϕNN system is extremely strongly bound in the state $S = 0$. Considering a spin-averaged potential for the state $S = 1$ yields a bound state for the ${}^3_{\phi}$H ($S = 1$) hypernucleus with the binding energy (BE) 14.9 MeV when $\beta = 6.9$. The evaluation of the BE for the $S = 1$, $T = 1$ three-body state results in 5.47 MeV. Additionally, calculations using our approach confirm the bound states for the ϕNN ($S = 2$, $T = 0$ and $S = 1$, $T = 1$) system previously predicted with the Yukawa-type potential motivated by the QCD van der Waals attractive force, mediated by multigluon exchanges.

DOI: 10.1103/PhysRevD.110.L031502

I. Filikhin, R. Ya. Kezerashvili, and B. Vlahovic,
PRD 110, L031502 (2024)

Backup page of TG's presentation file
https://wiki.jlab.org/tegwiki/index.php/HIEI2022_20220316

Isobaric hypernuclei

- ${}^{48}\mathrm{Ti}(e,e'K^+){}^{48}_{\Lambda}\mathrm{Sc}$
  - (Z, N) = ${}^{48}_{\Lambda}$Sc (21, 26) vs. ${}^{48}_{\Lambda}$K (19, 28)
  - → the same mass number, but the different δ
- ${}^{40}\mathrm{Ar}(e,e'K^+){}^{40}_{\Lambda}\mathrm{Cl}$ vs. ${}^{40}\mathrm{Ca}(e,e'K^+){}^{40}_{\Lambda}\mathrm{K}$
- ${}^{46}\mathrm{Ca}(e,e'K^+){}^{46}_{\Lambda}\mathrm{K}$ vs. ${}^{46}\mathrm{Ti}(e,e'K^+){}^{46}_{\Lambda}\mathrm{Sc}$
- ${}^{48}\mathrm{Ca}(e,e'K^+){}^{48}_{\Lambda}\mathrm{K}$ vs. ${}^{48}\mathrm{Ti}(e,e'K^+){}^{48}_{\Lambda}\mathrm{Sc}$
- ${}^{50}\mathrm{Ti}(e,e'K^+){}^{50}_{\Lambda}\mathrm{Sc}$ vs. ${}^{50}\mathrm{V}(e,e'K^+){}^{50}_{\Lambda}\mathrm{Ti}$ vs. ${}^{50}\mathrm{Cr}(e,e'K^+){}^{50}_{\Lambda}\mathrm{V}$
- ${}^{54}\mathrm{Cr}(e,e'K^+){}^{54}_{\Lambda}\mathrm{V}$ vs. ${}^{54}\mathrm{Fe}(e,e'K^+){}^{54}_{\Lambda}\mathrm{Mn}$

58: Fe, Ni
64: Ni, Zn
70: Zn, Ge
74: Ge, Se
76: Ge, Se
78: Se, Kr
… a lot

- ${}^{13}\mathrm{C}(e,e'K^+){}^{13}_{\Lambda}\mathrm{B}$
- ${}^{14}\mathrm{N}(e,e'K^+){}^{14}_{\Lambda}\mathrm{C}$

Workshop series we have been making

① WEPH2020
http://physics.daliborskoupil.cz/workshop2020.html

② WEPH RE:2020
http://physics.daliborskoupil.cz/onlineWS2020

③ WEPH RE:2021 http://physics.daliborskoupil.cz/rezWS2021/

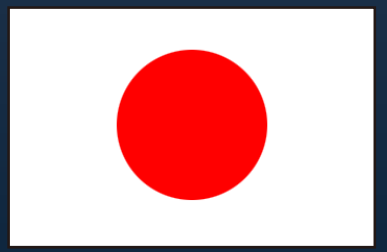
④ HIEI2022
https://wiki.jlab.org/tegwiki/index.php/HIEI2022_20220316

⑤ WEPH RE:2022
https://wiki.jlab.org/tegwiki/index.php/WEPH2022

⑥ BISHOP2023
https://wiki.jlab.org/tegwiki/index.php/Hyper_BISHOP2023

⑦ WEPH RE:2024
https://wiki.jlab.org/tegwiki/index.php/WEPH2024

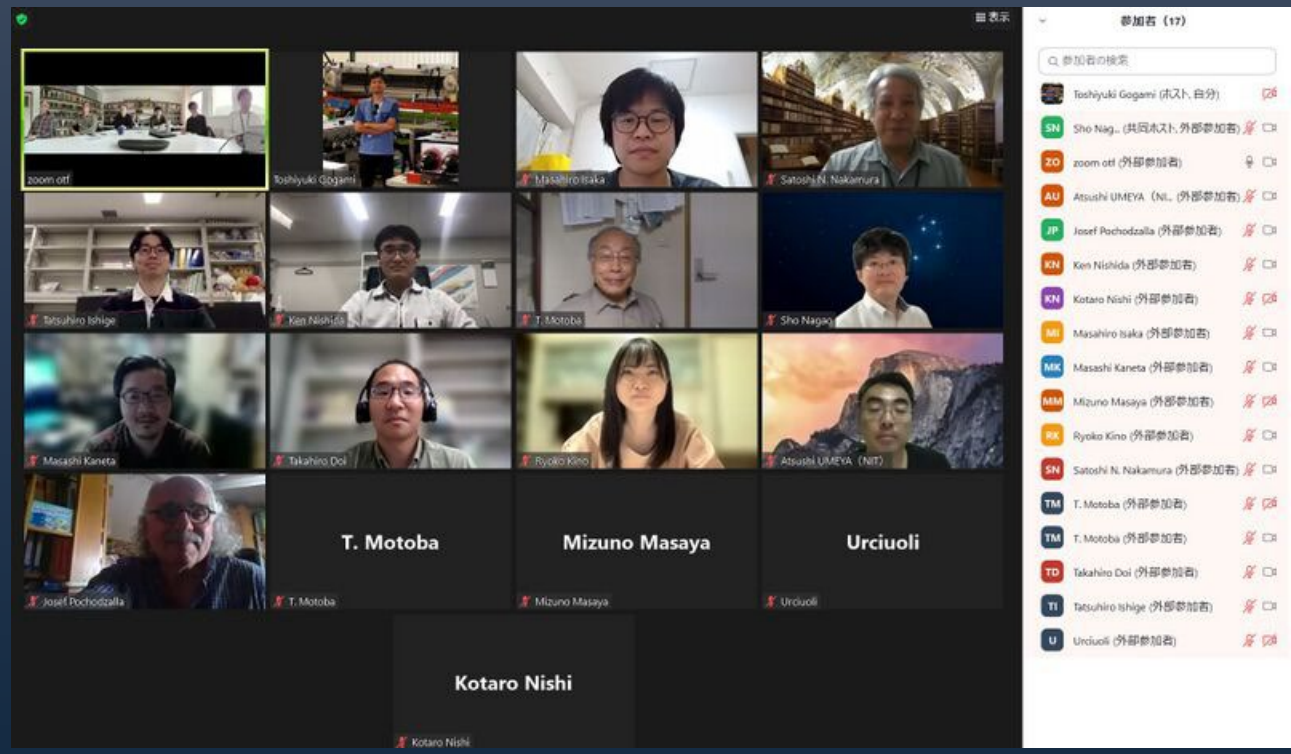
WEPH
Workshop for Electro- and Photoproduction of Hypernuclei and Related Topics 2024



Activity summary document/paper?

Workshop series we have been making

http://physics.daliborskoupil.cz/workshop2020.html



https://wiki.jlab.org/tegwiki/index.php/Hyper_BISHOP2023

Timetable

WEPH
Workshop for Electro- and Photoproduction of Hypernuclei and Related Topics 2024

Oct 15, 2024 (Tue) [edit]

Time table

Time (JST)	Time (ECT)	Speaker	Talk title	File	Chair
17:00-17:10	10:00-10:10	T. Gogami	Opening	PDF	T. Gogami
17:10-18:10	10:10-11:10	P. Bydovsky (CAS)	Hypernuclear production calculation for the electromagnetic process	PDF	
18:10-18:25	11:10-11:25	Coffee Break			
18:25-19:25	11:25-12:25	T. Gogami (Kyoto Univ.)	Hypernuclear experiments at J-PARC by using S-2S	PDF	
19:25-20:25	12:25-13:25	Lunch Break			
20:25-21:25	13:25-14:25	N. Shevchenko	Fine tuning of the KbarNN and KbarNNN calculations	PDF	D. Skoupil
21:25-21:40	14:25-14:40	Coffee Break			
21:40-22:40	14:40-15:40	M. Schafer	Study of hypernuclear Charge Symmetry Breaking effects using Pionless EFT	PDF	
22:40-00:00	15:40-17:00	Discussion			

Oct 16, 2024 (Wed) [edit]

Time table

Time (JST)	Time (ECT)	Speaker	Talk title	File	Chair
17:00-18:00	10:00-11:00	T. Motoba	Hyperon states coupled with nuclear collective motion	PDF	T. Gogami
18:00-19:00	11:00-12:00	Discussion			

Oct 17, 2024 (Thu) [edit]

Time table

Time (JST)	Time (ECT)	Speaker	Talk title	File	Chair
17:00-18:00	10:00-11:00	D. Skoupil	Model selection in kaon photoproduction	PDF	T. Gogami
18:00-18:15	11:00-11:15	Coffee Break			
18:15-18:35	11:15-11:35	D. Watanabe (Tohoku University)	Λ Hypernuclear Spectroscopy to Study P-shell Charge Symmetry Breaking at J-PARC (E94 Experiment)	PDF	
18:35-18:55	11:35-11:55	K. Ebata (Kyoto University)	Light Ξ Hypernuclear Spectroscopy at J-PARC (E75-1 Experiment)	PDF	
18:55-19:15	11:55-12:15	R. Kino (Tohoku University)	Analysis status of decay pion spectroscopy for measurement of hypertriton binding energy at MAMI	PDF	
19:15-20:15	12:15-13:15	Lunch Break			
19:15-20:15	13:15-14:15	R. del Grande	Hadronic interaction studies using femtoscopy	PDF	
20:15-20:30	14:15-14:30	Coffee Break			
20:30-21:00	14:30-15:30	A. Di Donna	Neural Quantum States advancements for Hypernuclear physics	PDF	

Timetable

WEPH
Workshop for Electro- and Photoproduction of Hypernuclei and Related Topics 2024

Oct 18, 2024 (Fri) [edit]

Time table

Time (JST)	Time (ECT)	Speaker	Talk title	File	Chair
17:30-18:30	10:30-11:30	T. Gogami (Kyoto University)	**[Department Seminar]** Strangeness S=-1 and -2 hypernuclear research at JLab and J-PARC	PDF	
18:30-18:40	11:30-11:40	Coffee Break			
18:40-19:10	11:40-12:10	D. Petrellis	Changes in the nuclear shapes in the N=40, 60, 90 regions	PDF	
19:00-20:00	12:00-13:00	Lunch Break			
20:00-21:00	13:00-14:00	P. Vesely	Multi-particle-hole configurations in description of double beta decay	PDF	D. Skoupil
21:00-21:10	14:00-14:10		Closing	PDF	