

International Collaboration Platform for Strangeness Nuclear Physics



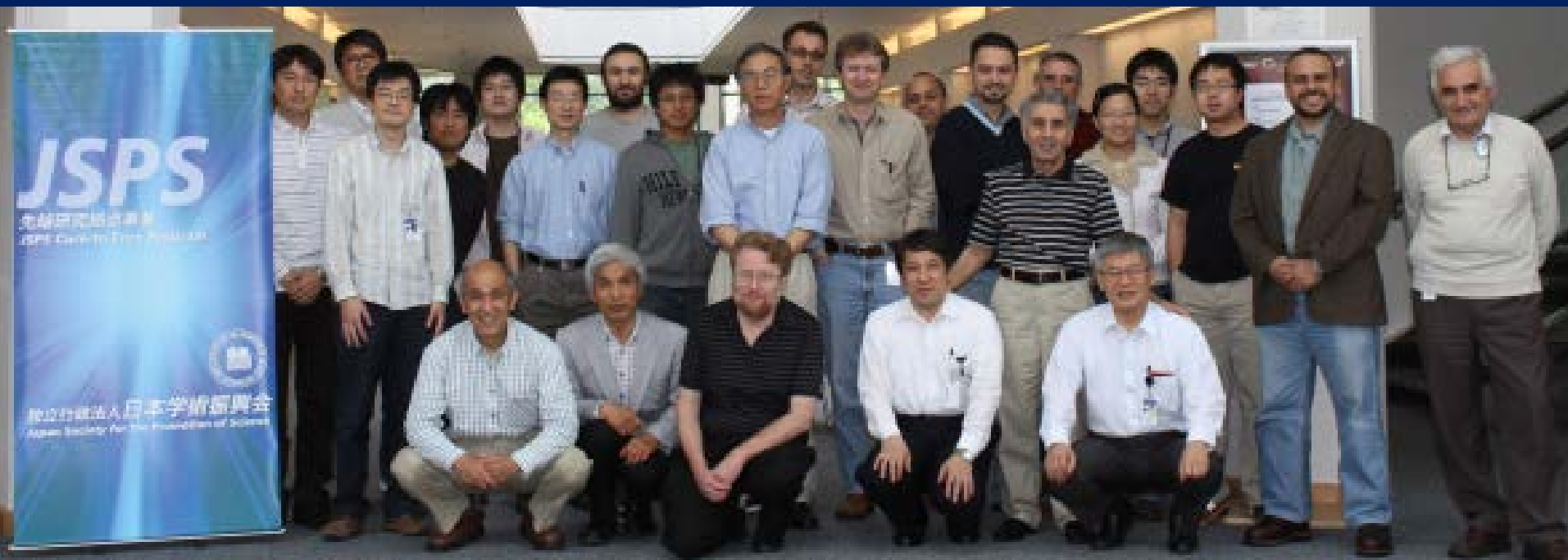
TOHOKU
UNIVERSITY

The 3rd Korea-Japan Workshop on
Nuclear and Hadron Physics at J-PARC
Core-to-core seminar: Internal WS on
Hypernuclear physics at J-PARC, JLab, Mainz and ELPH

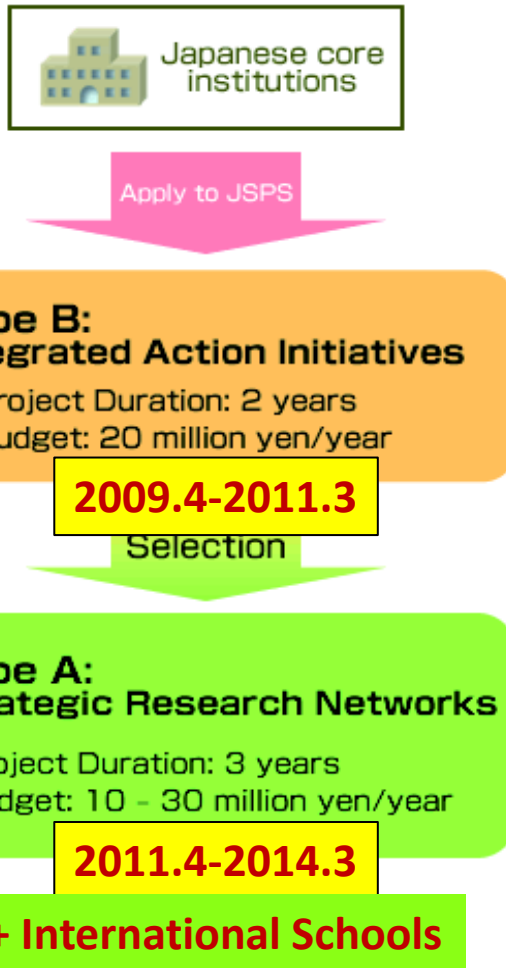
Satoshi N Nakamura

Tohoku University

20, March 2014
Inha Univ. , Korea



JSPS Core-to-Core Program



OBJECTIVE

world-class **research hubs**
foster **young researchers**

It supports

1. Joint research activities
2. Scientific meetings
3. Exchange of researchers

Tohoku U. runs
a core-to-core program
from 2009 to 2014 March.

Establishing an International Collaboration Platform
for **Strangeness Nuclear Physics by Electron beams**

Establishing an International Collaboration Platform for Strangeness Nuclear Physics by Electron beams

Hypernuclear Spectroscopy
Strangeness production

Germany
Core Institution: Mainz Univ.
MAMI-C electron accelerator
Giessen

USA
Core Institution : Jefferson Lab.
CEBAF (Virginia)

Italy
Core Institution:
INFN Rome
Torino
JLab Hall A Exp.

USA
Core Institution:
JLab, Hampton U.
FIU
JLab Hall C Exp.

Czech Republic
Core Institution :
Czech Nuclear Physics Institute
(Prague)

Global network for Strangeness Nuclear Physics

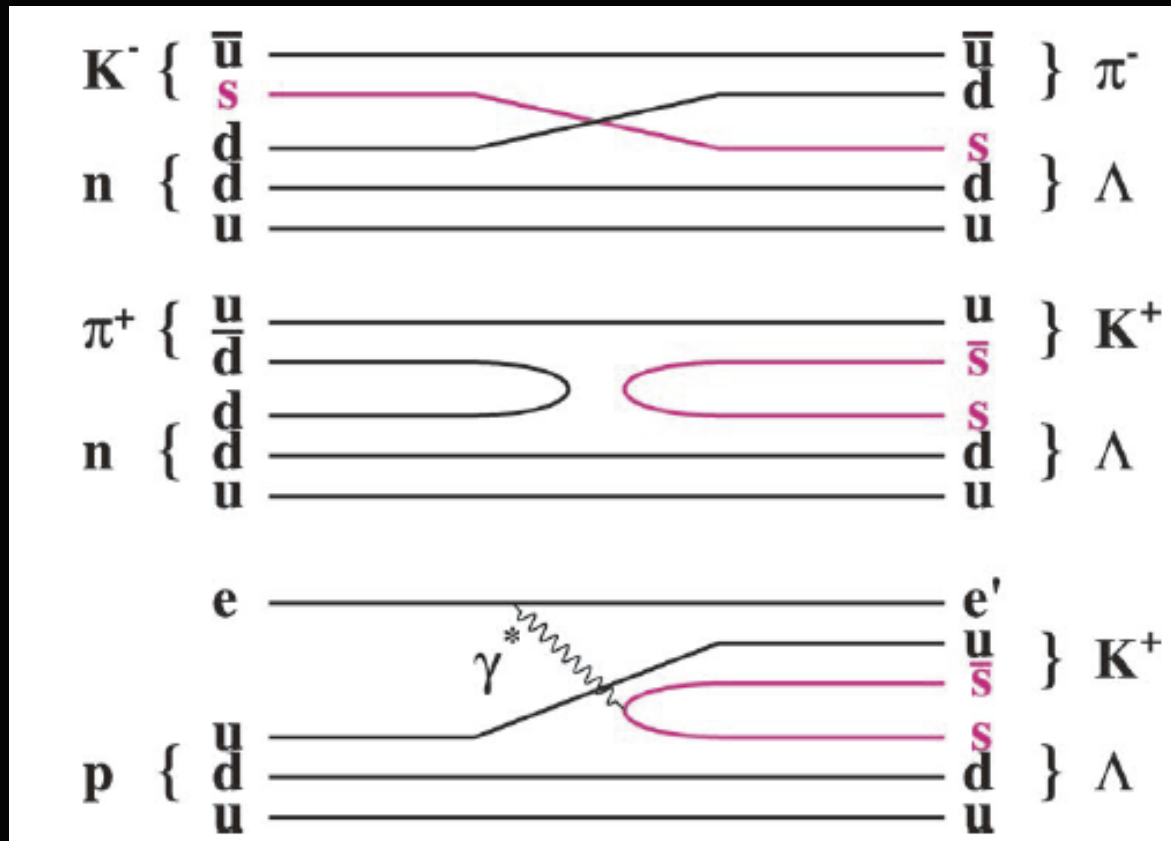
Core Institution Japan :
School of Science, Tohoku University
1.2 GeV electron accelerator
Electron Accelerator Facility, Sendai
KEK, JAEA, RIKEN
Yamagata U., Osaka EC U.

SNP seminar
SNP school
Research exchange

J-PARC
Strangeness Physics by hadron beams

S=-2 hypernuclear spectroscopy
Hypernuclear γ -ray spectroscopy
Etc.

Hypernuclear study with e⁻ beams



- Electromagnetic production
- Convert proton to Lambda :
- High quality primary beam

Challenge of HY Study with e^- beam

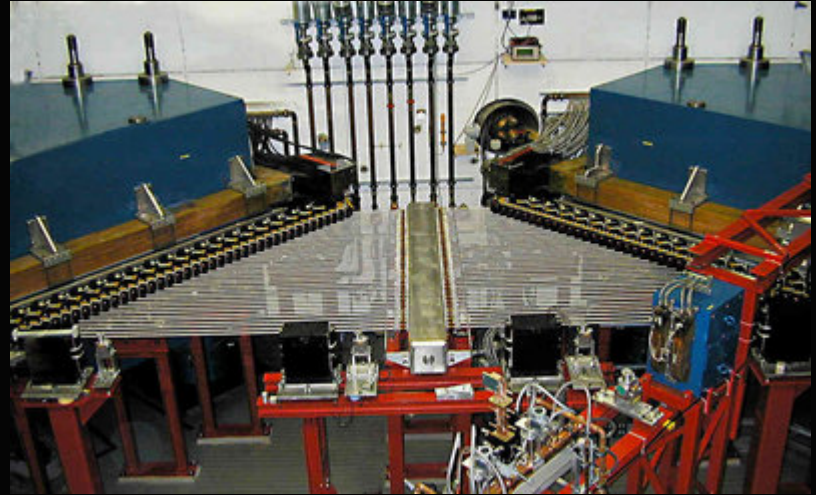
- Huge e' Background (>200 MHz) due to
Bremsstrahlung and Møller scattering
Signal/Noise, Detector
- Less Hypernuclear Cross Section
- Coincidence Measurement (e' , K^+)
Limited Statistics
DC beam is necessary

High Quality Electron Beam is Essential !

Possible sites for Hypernuclear Physics with Electron Beams



CEBAF@Jefferson Lab.



MAMI-C @ Mainz U.

$E_e > 1.5 \text{ GeV}$

Emittance $< 100 \mu\text{m mrad}$

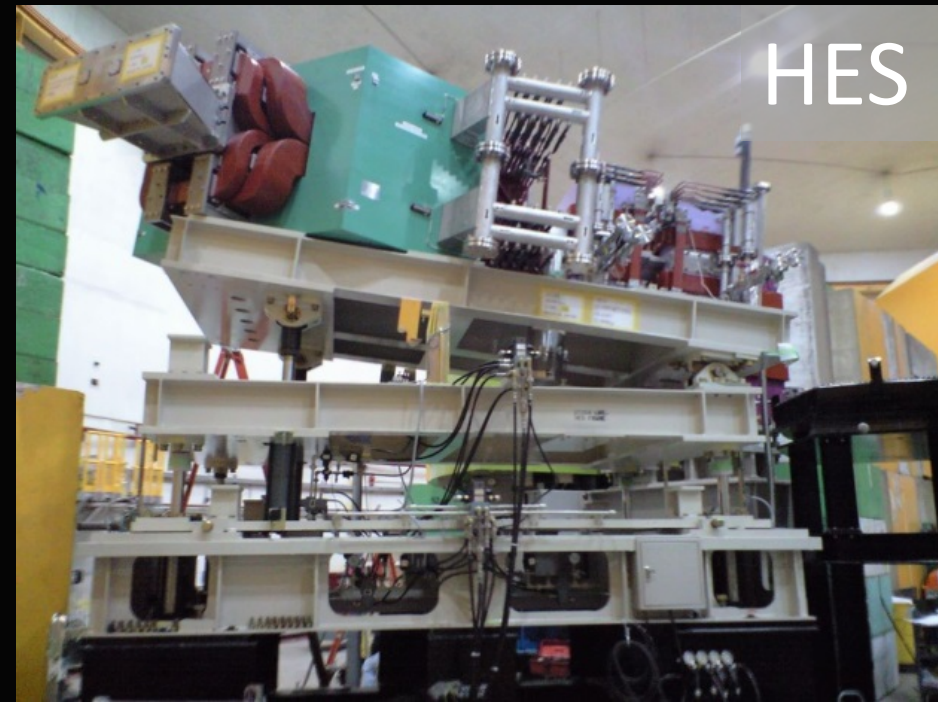
Intensity $> 30 \mu\text{A} = 2 \times 10^{14}/\text{s}$

What we have developed at JLab

High Resolution, Large Solid Angle and Short Orbit Spectrometer



High Resolution Electron Spectrometer

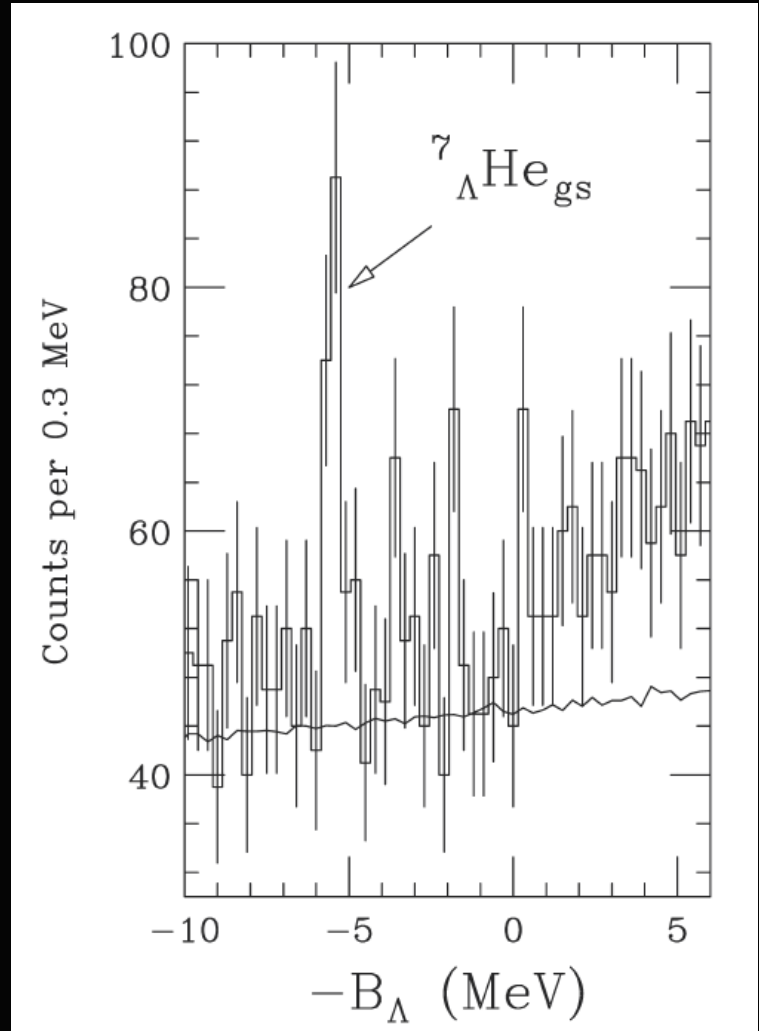
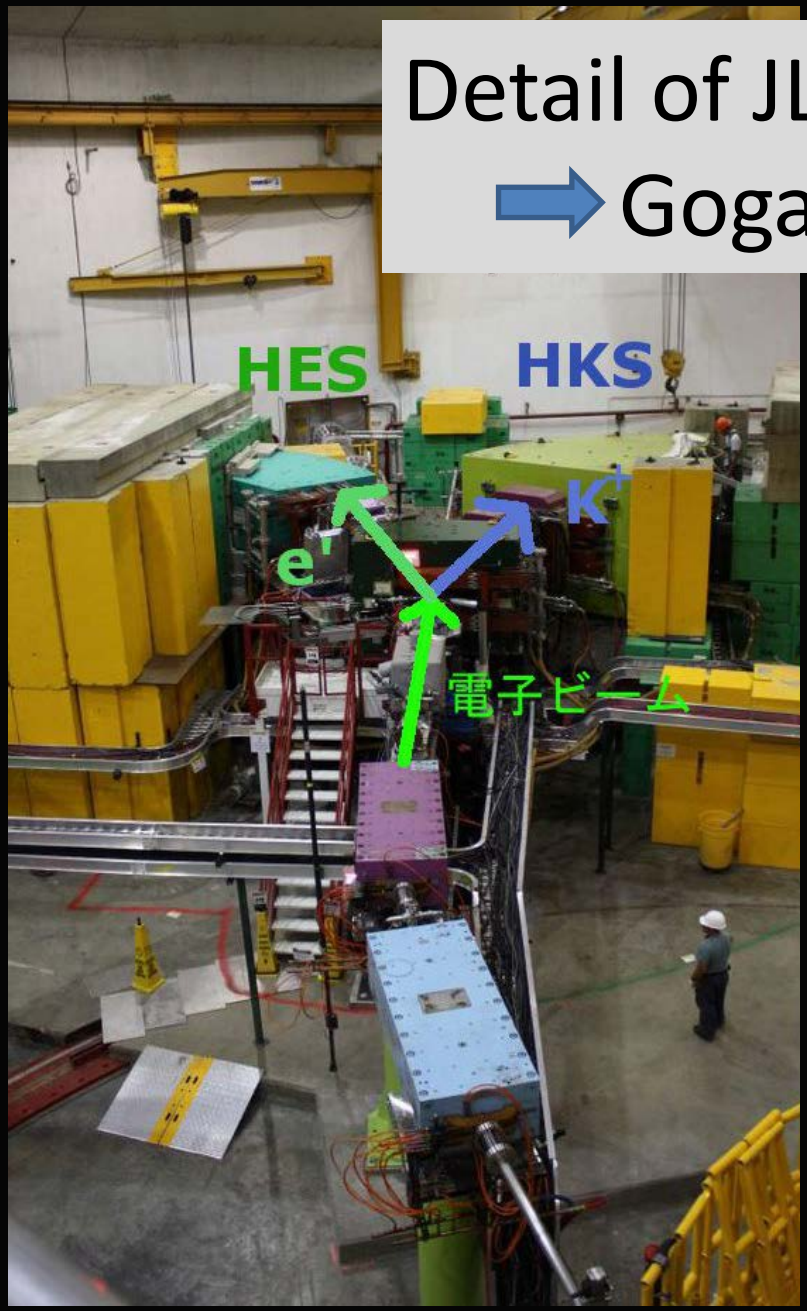


Detail of JLab program:
→ Gogami's talk

1.8 GeV beam

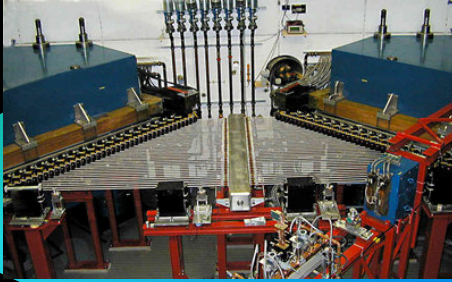
10^{-4}

$\times 10^{14}$ /s



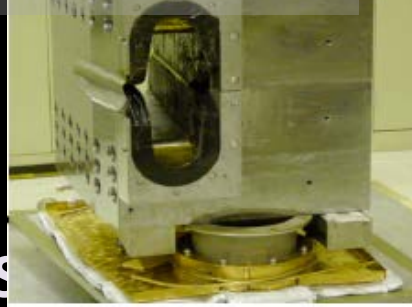
Establishing an International Collaboration for Strangeness Nuclear Physics by

*Hypernuclear Spectroscopy
Strangeness production*



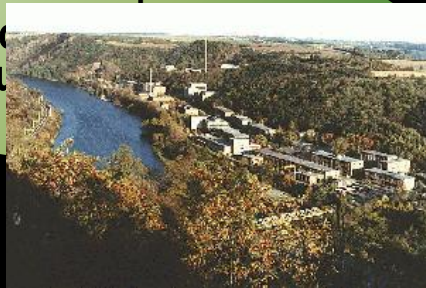
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SC Septum



Czech Republic

Czech Nu



for Strangeness Nuclear Physics

SNP seminar
SNP school
Research exchange

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HES



HKS

J-PARC
Strangeness Physics by hadron beams

*S=-2 hypernuclear spectroscopy
Hypernuclear γ -ray spectroscopy
Etc.*

日本物理学会誌

BUTSURI

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2013 VOL. 68 NO.

9



<http://www.jps.or.jp/>

MAMI-C upgrade



Overall Mainz program:
Tsukada's talk

Detail of decay π exp.:
Nagao's talk

$$B_{\Lambda} (^4_{\Lambda}H)$$

JLab, MAMI-C vs. J-PARC

Primary Electron Beam

Very high intensity, excellent emittance

Secondary Meson Beam

High intensity

$p(e, e'K^+) \Lambda$

Precise $S=-1$ spectroscopy
500 keV (FWHM) res.

Reaction
Spectroscopy

$n(\pi^+, K^+) \Lambda$

$n(K^-, \pi^-) \Lambda$

$pp(\pi^-, K^+) n\Lambda$

$^{12}\text{C}(K^-, K^+) ^{12}_{\Xi}\text{Be}$

π^- spectroscopy

Feasibility Proved

Decay
Spectroscopy

γ -ray spectroscopy

Hyperball-J ready

SNP School 2014, Feb. 2014



Participants 73
Abroad 33

Korea 9

China 5

Indonesia 4

Malaysia 1

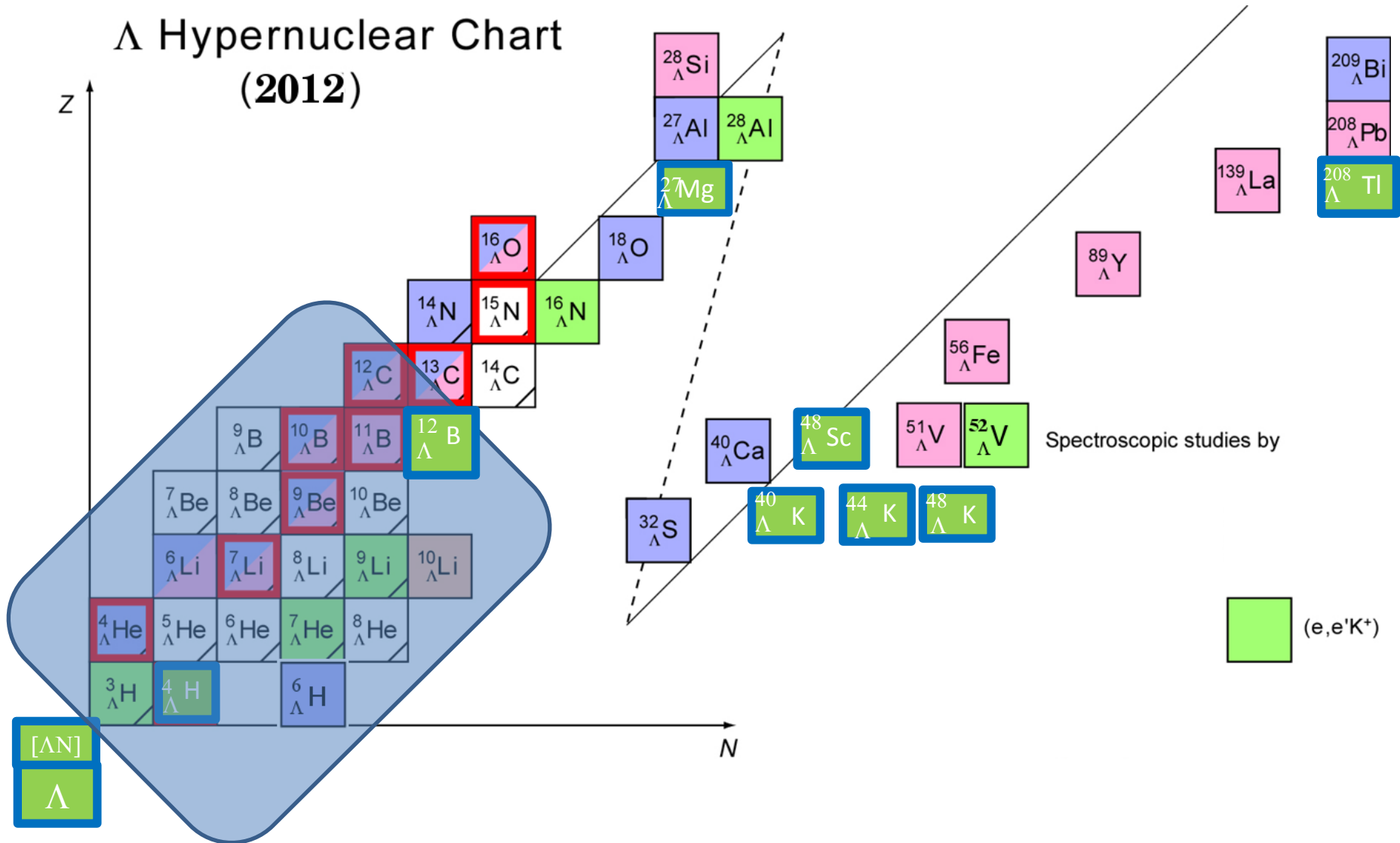
NUFRA2013
Sep-Oct, 2013

GSNP
Research

J-PARC
Strangeness Physics by hadron beams

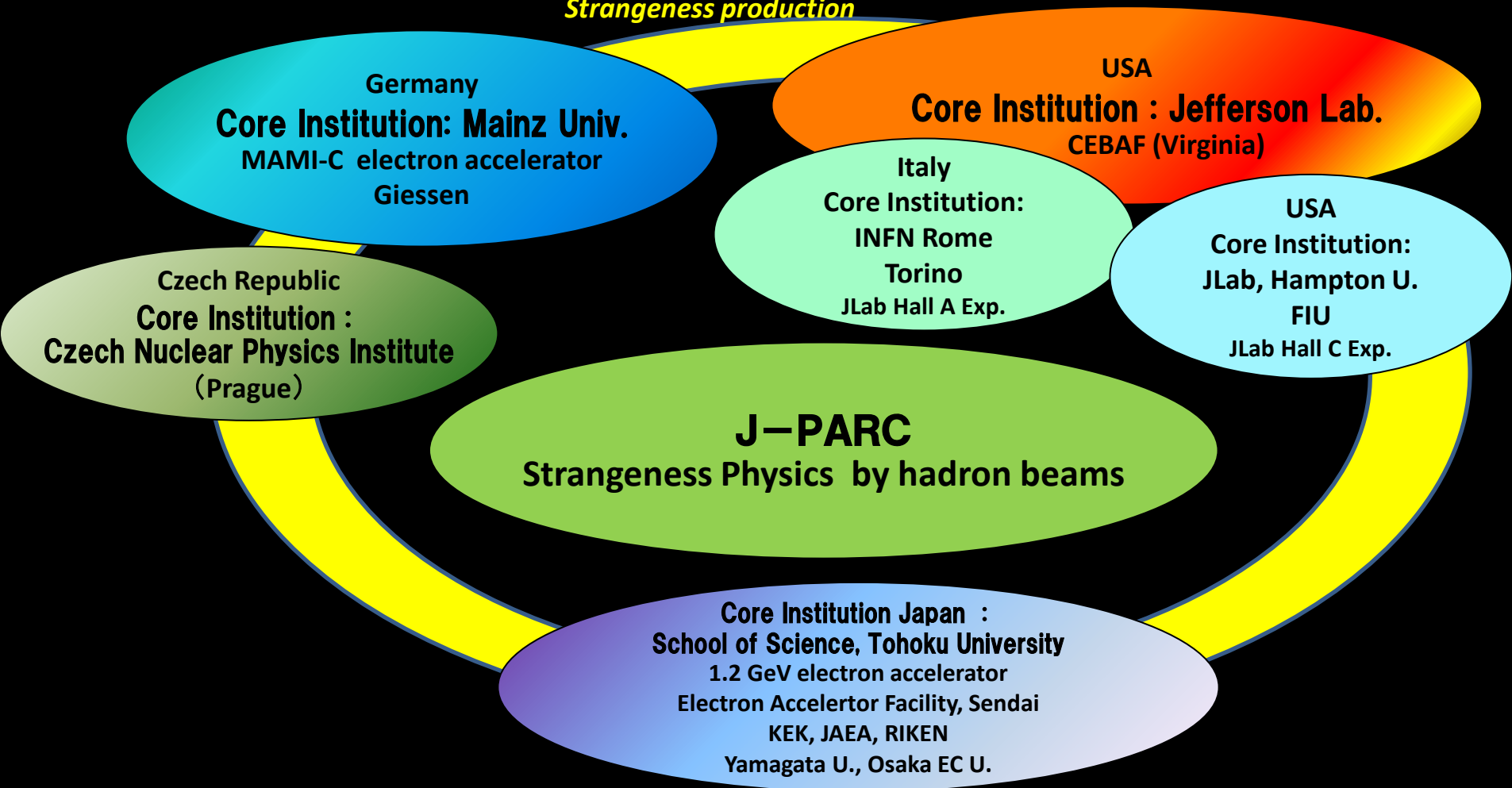
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Hypernuclear Chart



Establishing an International Collaboration Platform for Strangeness Nuclear Physics

Hypernuclear Spectroscopy
Strangeness production



**Global network
for Strangeness Nuclear Physics**

JLab Workshop on hypernuclear physics

“Perspectives of high resolution hypernuclear spectroscopy at Jlab”

May 27-29, 2014

Thomas Jefferson National Accelerator Facility, Newport News

In the workshop, we will discuss the hypernuclear physics experimentally as well as theoretically to explore future prospective:

1. What is necessary to understand of the elementary process of electro-production of strangeness
2. Experimental study of light hypernuclei and YN interaction including Charge Symmetry Breaking (CSB) effect and ΛN - ΣN -coupling.
3. What can be learned from precise determination of Λ binding energies
4. Deformation of core-nucleus and energy levels of Λ hypernuclei
5. Detailed spectroscopy of heavy hypernuclei and potential impacts of measurement to mean-field theory, shell-models and single particle nature of Λ in deep inside of nuclei.
6. Uniqueness of JLab hypernuclear program in contrast to other facilities such as J-PARC, Mainz, future FAIR

The 10th International Conference
on
Hypernuclear and Strange Particle Physics

HYP-X @J-PARC

http://www.confex.jp/2009/09/09HYPERX
September 14 - 18, 2009
Tokai, Ibaraki, Japan

Conference Topics
Spectroscopy of Hypernuclei
Weak Decays of Hypernuclei
 Λ -Systems
Strange Mesons in Nuclei
Baryon-Baryon Interaction
Elementary Strangeness Production on
Nucleic Hadrons
Strangeness in Hadronic Structures
Strangeness in Heavy-Ion Reactions and
in Exotic Matter

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Honorary Chairmen
"The New Generation of Physics"
Japan Society for the Promotion of Science (JSPS)

HYP-X (2009)
J-PARC

XI International Conference on Hypernuclear and Strange Particle Physics

**HYP 2012
BARCELONA**

October 1 - 5, 2012
Barcelona, Spain
<http://www.hyp2012.org>

Conference Topics
Production, structure and decay of hypernuclei
Multistrange systems
Production of strangeness
Interactions of mesons and baryons with strangeness
Strangeness in hadron structure
Kaonic nuclear systems and strange mesons in nuclei
Strangeness in astrophysics and in extreme forms of matter
Hypernuclei, hypernuclei, hypernuclei

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H. Tamura (Osaka)

HYP 2012
Barcelona

Sep. 2015

HYP 2015



Sendai

SNP School 2015 ?

Proceedings of
**Sendai International Workshop
on
the Spectroscopy of Hypernuclei**
January 8-10, 1998
Tohoku University, Sendai, Japan

SENDAI98

SENDAI08

SENDAI03

SENDAI08

JSPS core to core program
SNP school 2012
The First International School for
Strangeness Nuclear Physics
February 12 (Sun) - 18 (Sat), 2012
J-PARC Tokai & Tohoku Univ. Sendai, JAPAN
<http://lambda.phys.tohoku.ac.jp/snpsc2012/>

SNP Sc. 2012

Electroproduction
of
Strangeness
on Nucleons and Nuclei

JSPS core to core program
SNP school 2013
International School for Strangeness
Nuclear Physics
February 14 (Thu) - 20 (Wed), 2013
J-PARC Tokai & Tohoku Univ. Sendai
<http://lambda.phys.tohoku.ac.jp/snpsc2013/>

SNP Sc. 2013

Proceedings of the Sendai International Symposium
**Strangeness
in Nuclear and Hadronic Systems
SENDAI08**

JSPS core to core program
SNP school 2014
International School for Strangeness
Nuclear Physics
February 13 (Thu) - 19 (Wed), 2014
J-PARC Tokai & Tohoku Univ. Sendai
<http://lambda.phys.tohoku.ac.jp/snpsc2014/>

SNP Sc. 2014