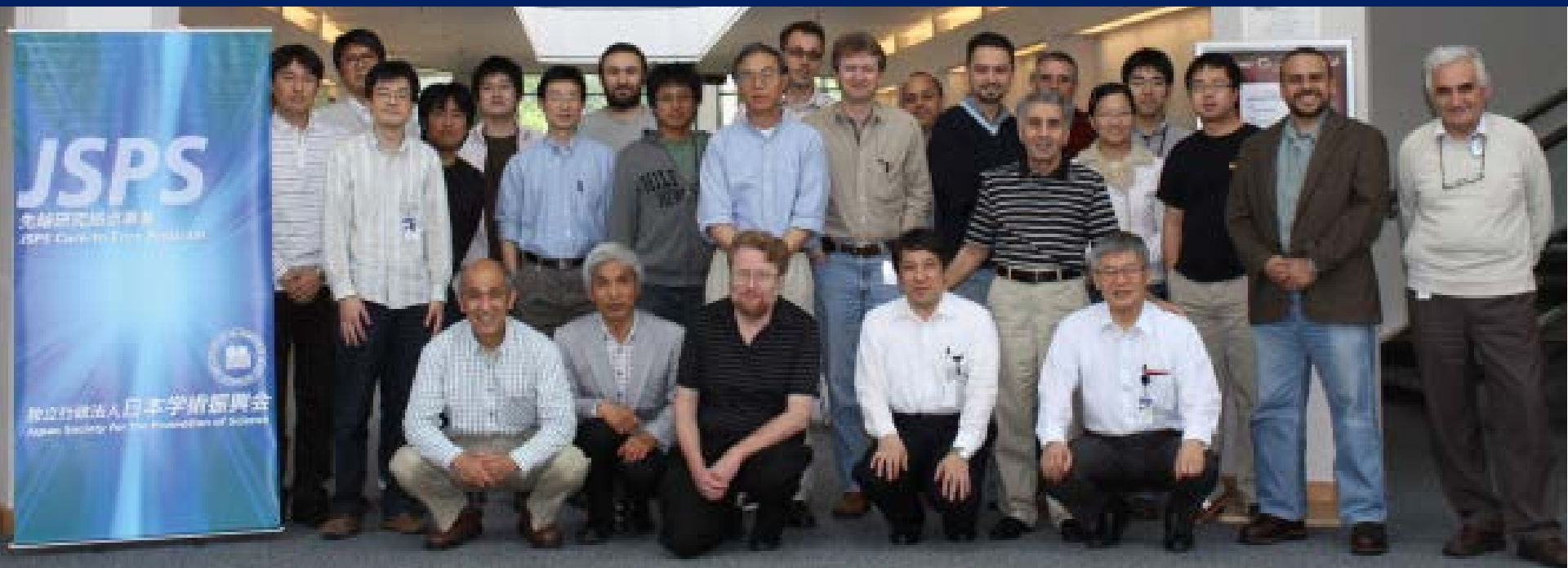
# International Collaboration Platform for Strangeness Nuclear Physics

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

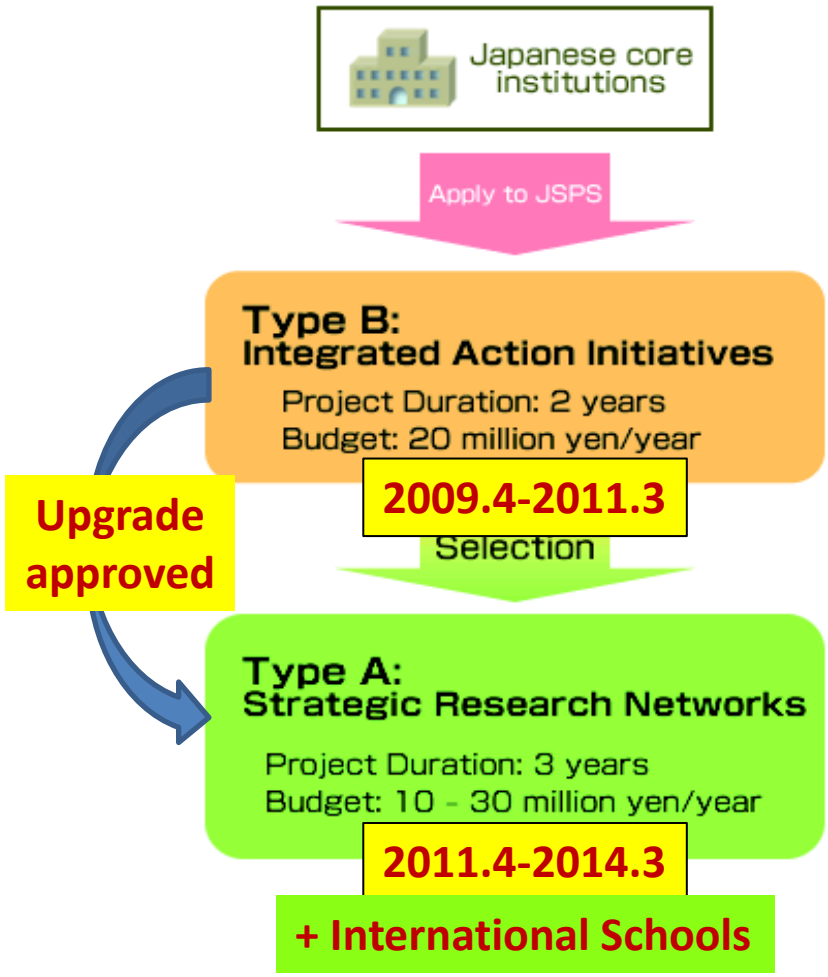

Satoshi N Nakamura

Tohoku University


20, March 2014
Inha Univ. , Korea



# JSPS Core-to-Core Program




**OBJECTIVE**

world-class research hubs

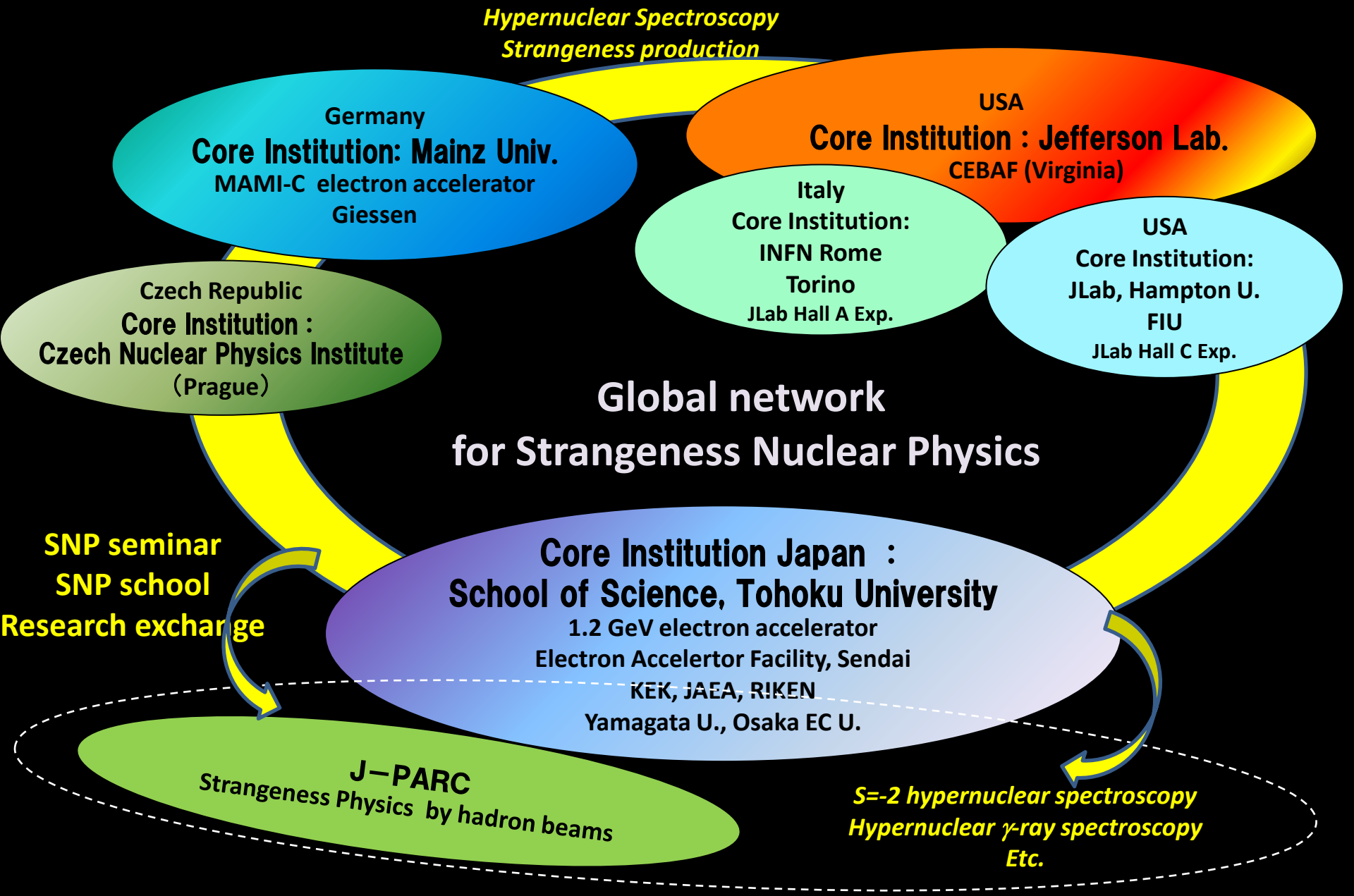
foster young researchers

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

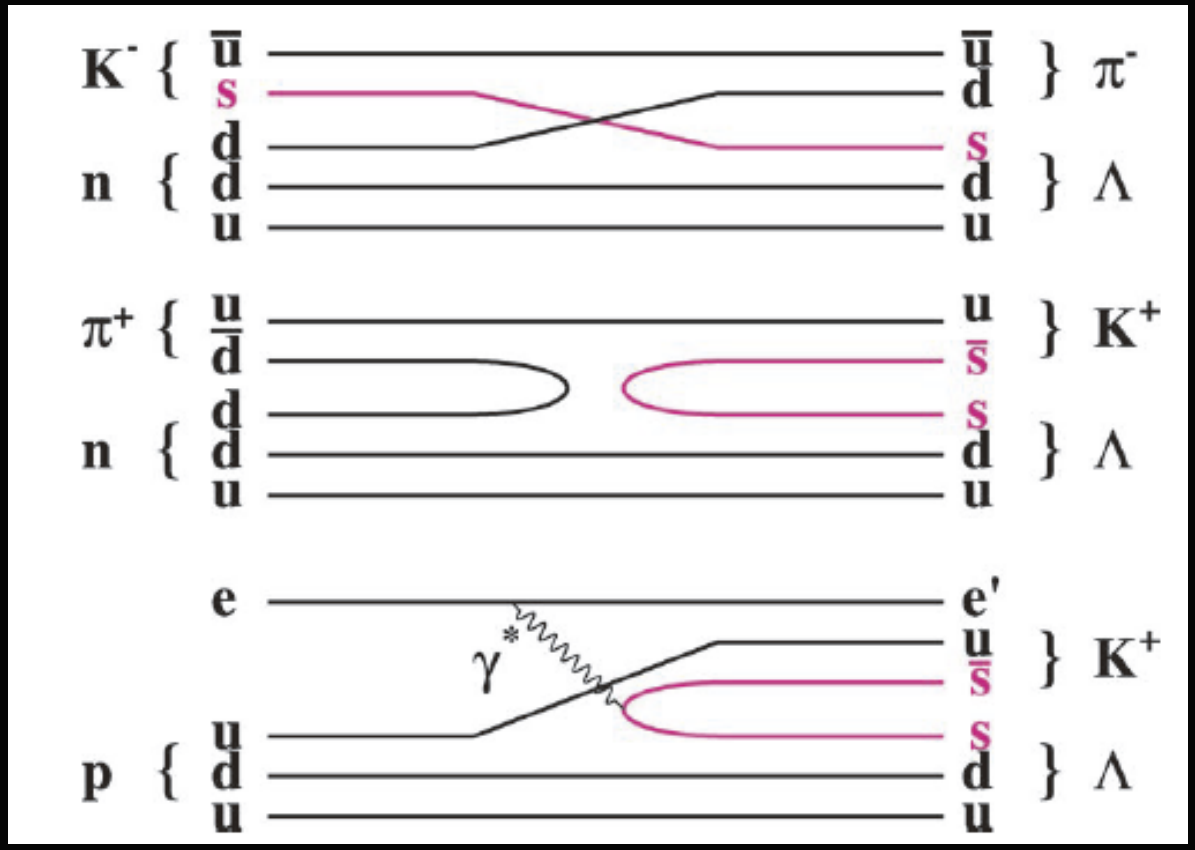
Tohoku U. runs
a core-to-core program
from 2009 to 2014 March.

**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 study with $e^-$ beams




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

# Challenge of HY Study with $e^-$ beam

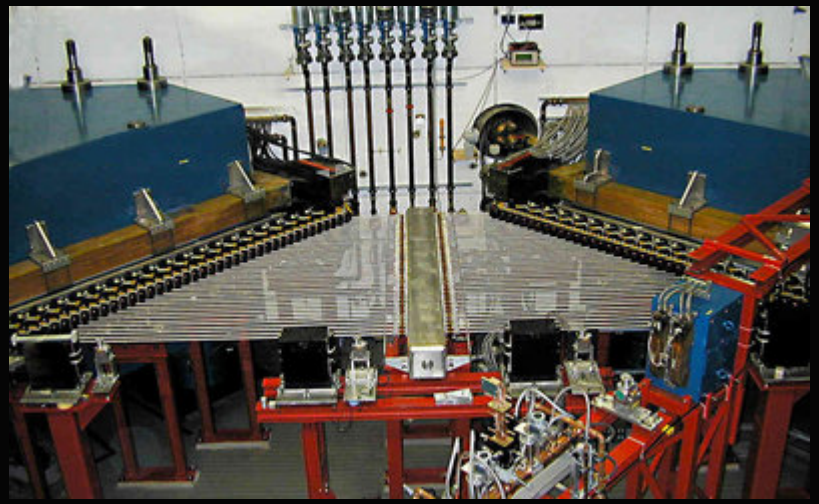
- Huge **e' Background (>200 MHz)** due to
  **Bremsstrahlung** and **Mϕller** scattering
  ***Signal/Noise, Detector***

- **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.

Ee > 1.5 GeV

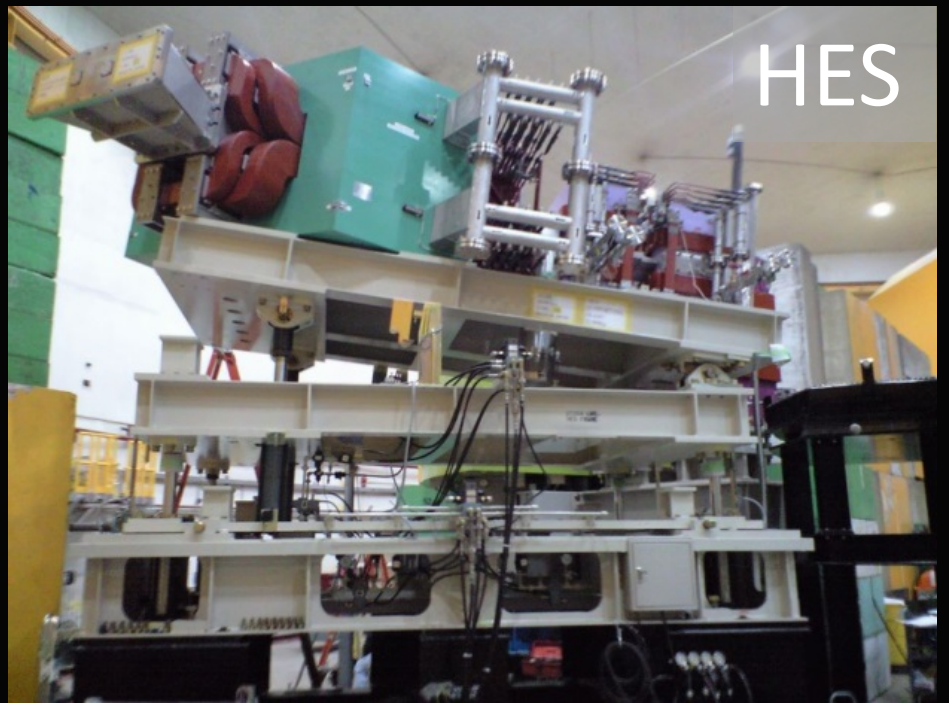
Emittance < 100 μm mrad

Intensity > 30μA = 2 x $10^{14}$/s

# What we have developed at JLab

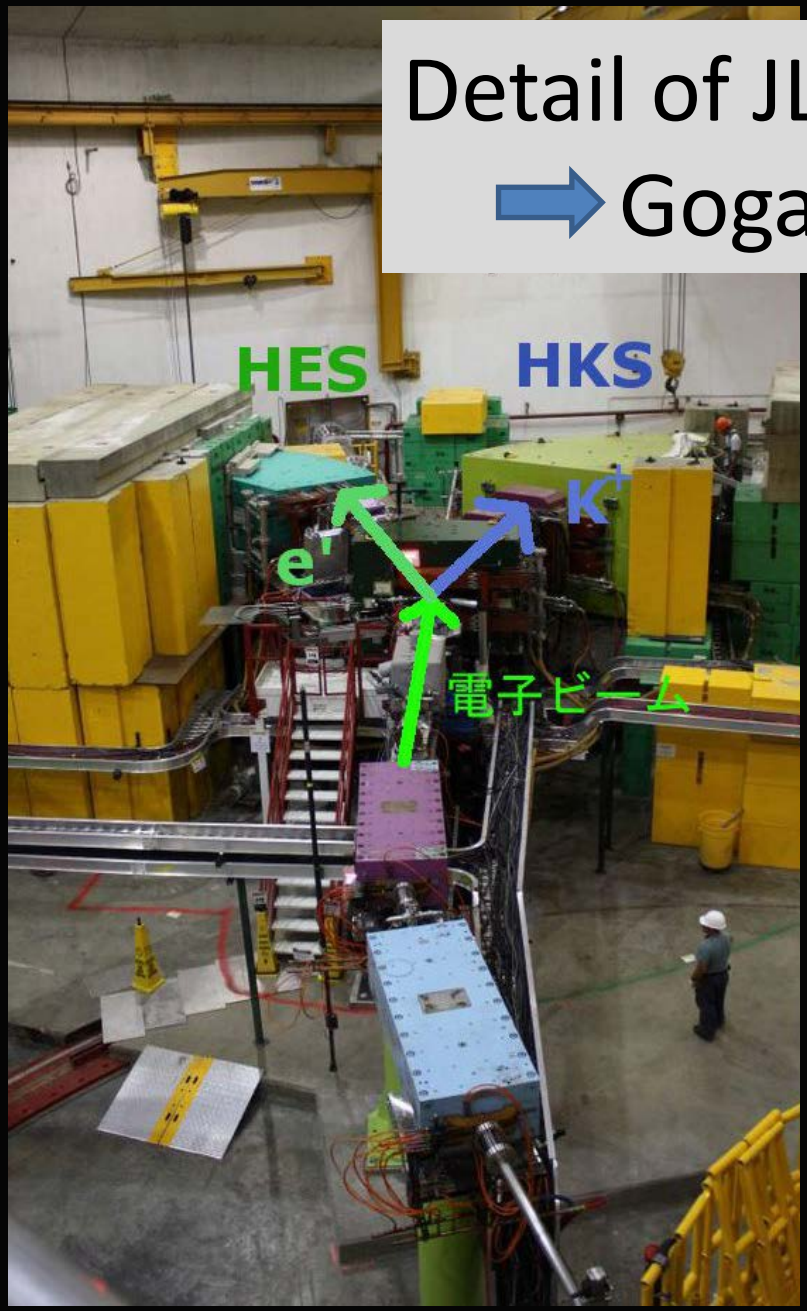
High Resolution, Large Solid Angle and Short Orbit Spectrometer


High Resolution Electron Spectrometer



Detail of JLab program:

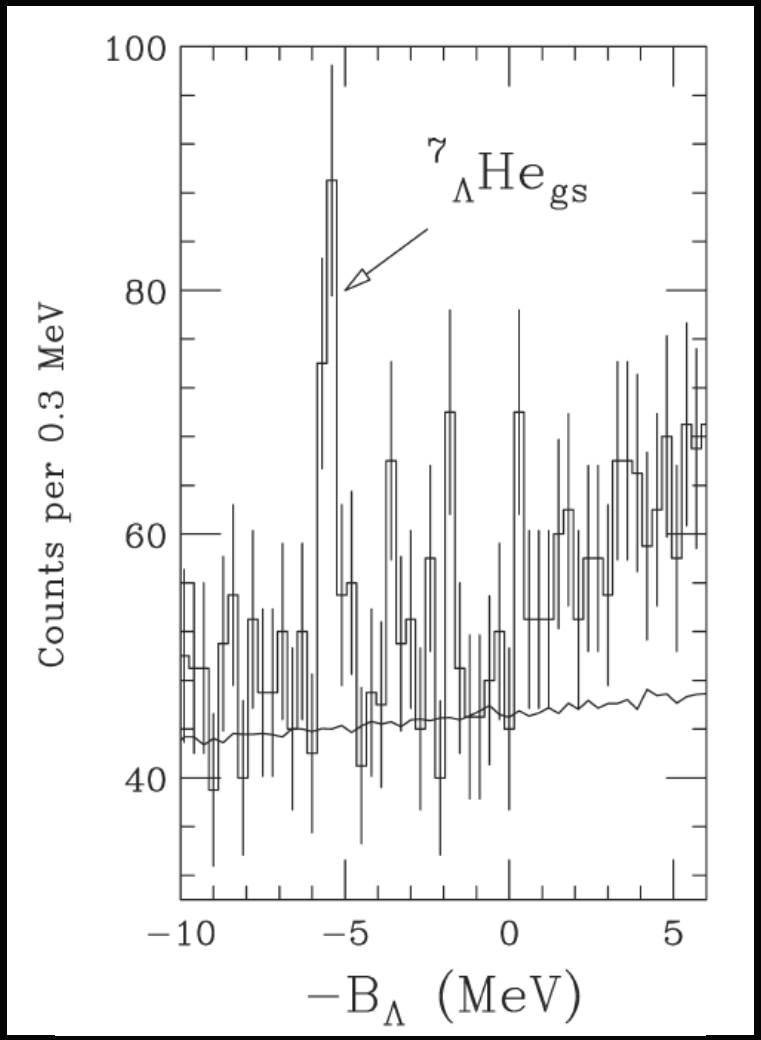
➡ Gogami's talk




1.8 GeV e beam

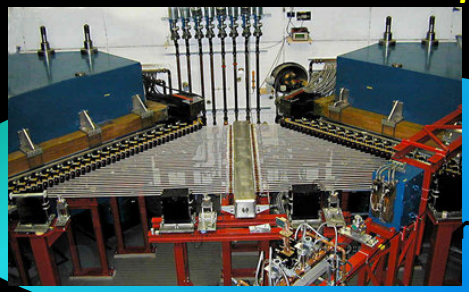
$10^{-4}$

x $10^{14}$ /s



# Establishing an International Collab
# for Strangeness Nuclear Physics by

*Hypernuclear Spectroscopy*
*Strangeness production*



Univ.
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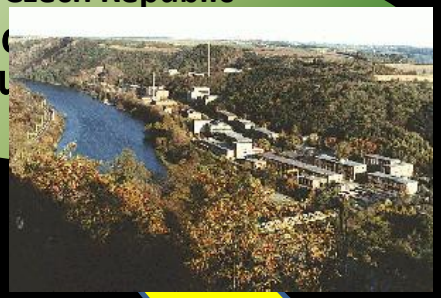


for S clear Physics

SNP seminar
SNP school
Research exchang

Sch

HES

HKS

J−PARC
Strangeness Physics by hadron beams

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


# MAMI-C upgrade

Overall Mainz program:
Tsukada's talk

Detail of decay $\pi$ 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

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

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

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

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

$\pi^-$ spectroscopy

Feasibility Proved

Decay Spectroscopy

$\gamma$-ray spectroscopy

Hyperball-J ready

Trento 2011 Sep-Oct

Praha, Czech

SNP School 2014, Feb. 2014


Participants 73

Abroad **33**

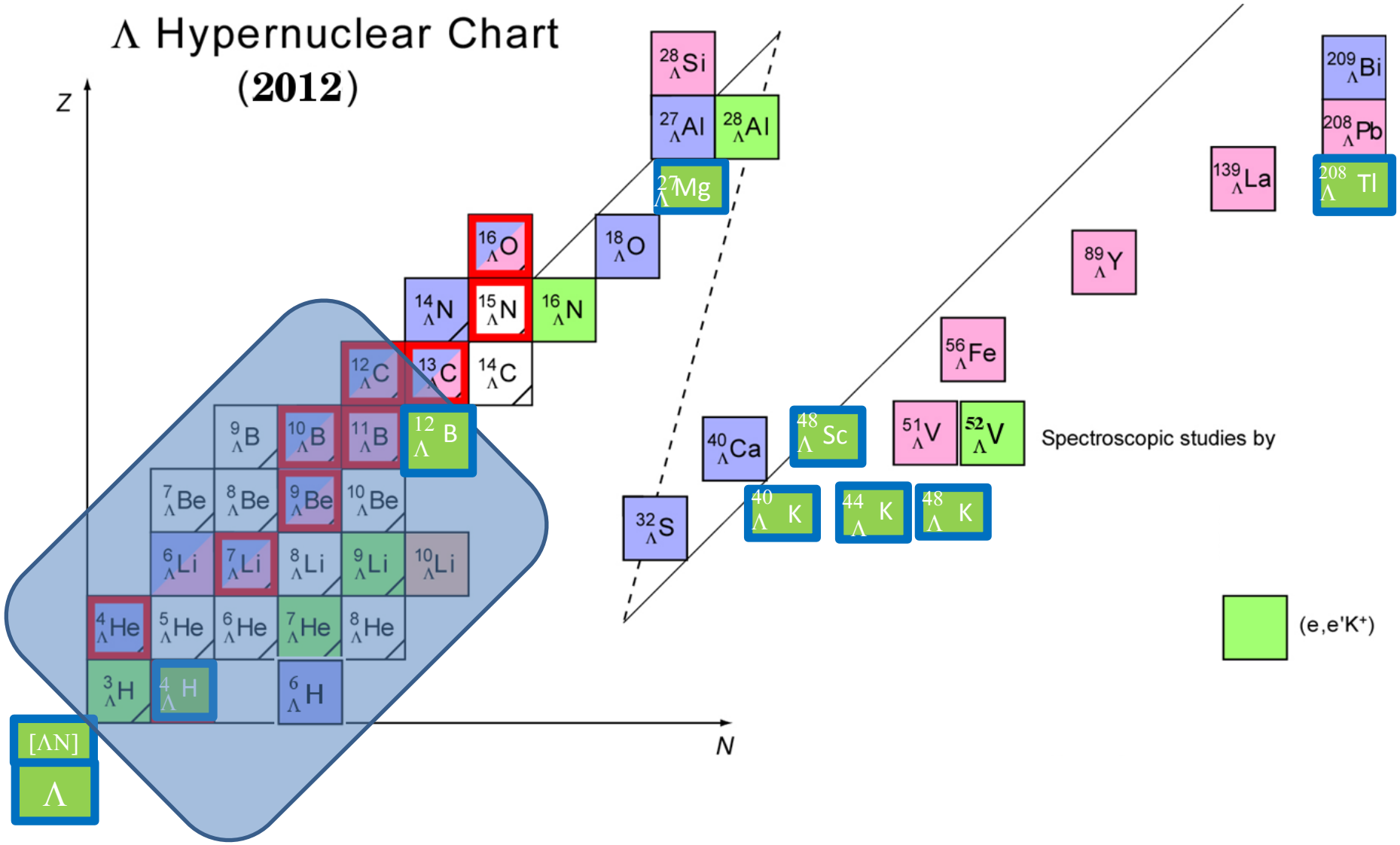
| | |
|---|---|
| **Korea** | **9** |
| China | 5 |
| Indonesia | 4 |
| Malaysia | 1 |

NUFRA2013
Sep-Oct, 201

GSNP
Research

J−PARC
Strangeness Physics by hadron beams

# Hypernuclear Chart



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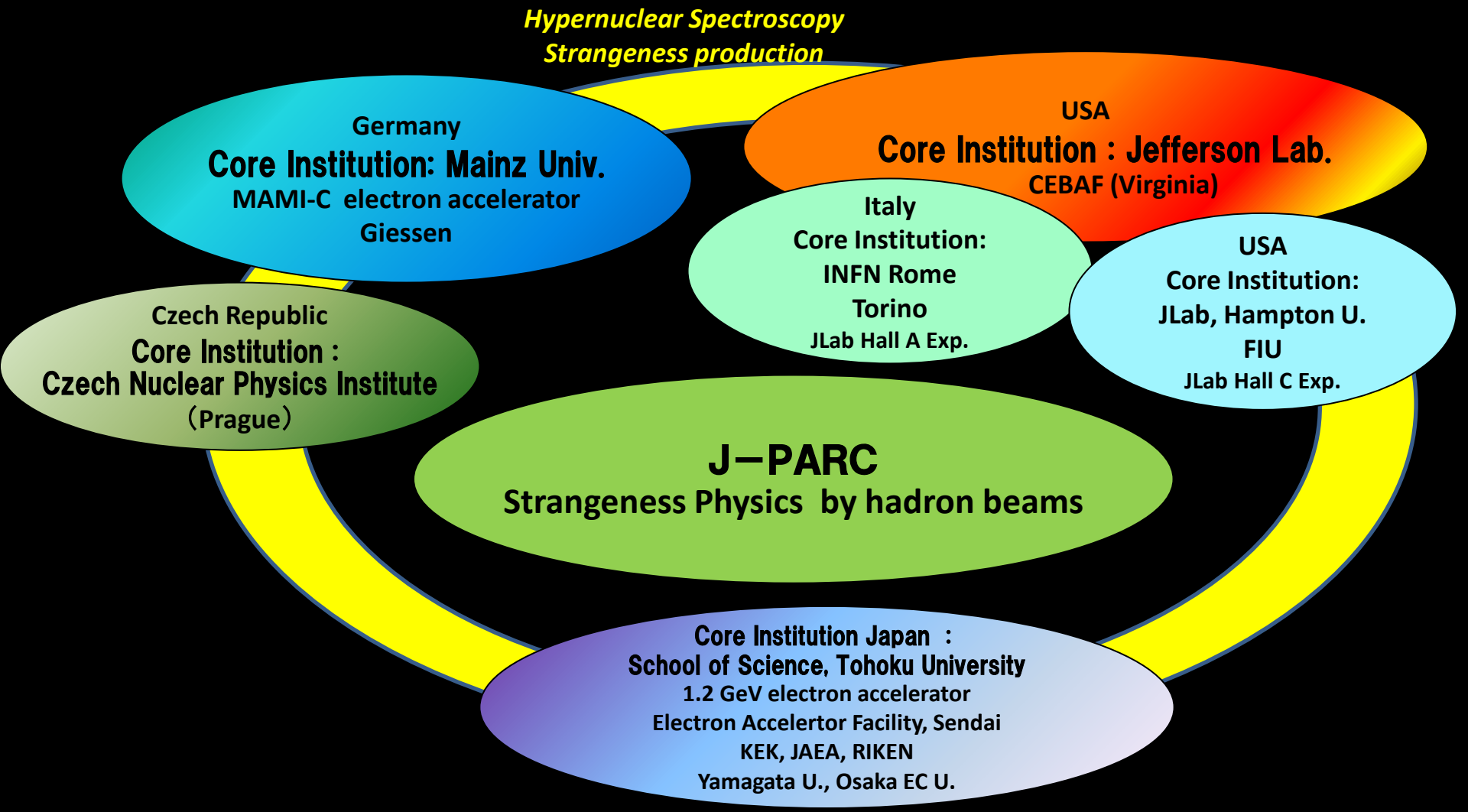



## Global network for Strangeness Nuclear Physics

# JLab Workshop on hypernuclear physics

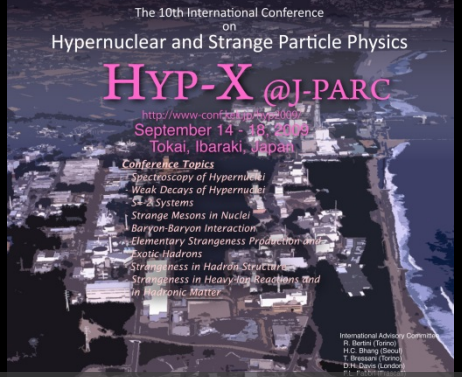
**“Perspectives of high resolution hypernuclear spectroscopy at Jlab”**

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



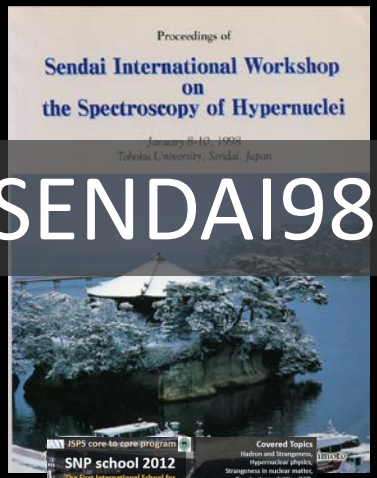

HYP-X (2009)
J-PARC


HYP 2012
Barcelona

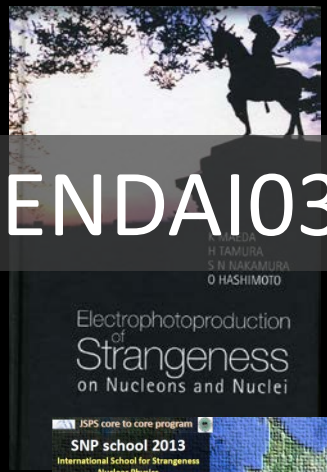
Sep. 2015

HYP 2015

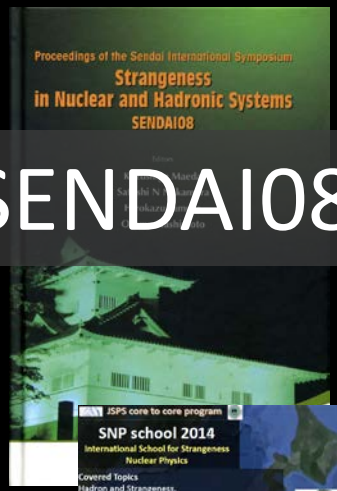
Sendai




SENDAI98



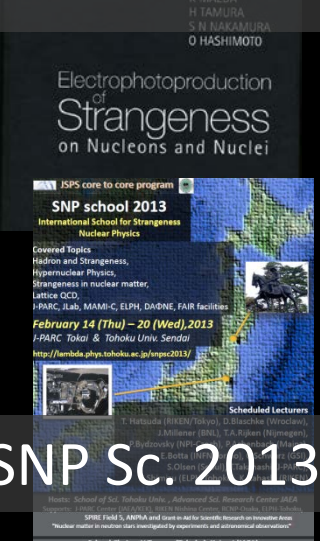
SENDAI03




SENDAI08




SNP Sc. 2012




SNP Sc. 2013




SNP Sc. 2014

SNP School 2015 ?