

**JSPS Core-to-Core Program**  
**FY2012 Implementation Plan (Project No. : 21002)**

Research Theme Establishing an International Collaboration Platform for Strangeness Nuclear Physics by Electron Beams

Duration of Project 2011/4/1 ~2014/3/31 (36 months)

Core Institution in Japan (Co-Chair) Graduate School of Science, Tohoku University  
(Hirokazu TAMURA)

**Implementing Organizations**

○ **Japan**

Japan	Core Institution	Graduate School of Science, Tohoku University	
	Co-Chair (name and title)	Hirokazu TAMURA (Professor)	
	Cooperating Institutions	Research Center for Electron Photon Science, Tohoku University; High-energy Accelerator Research Organization; Yamagata University, Osaka Electro-Communication University, RIKEN Nishina Accelerator Center; Advanced Science Research Center, Japan Atomic Energy Agency	Number of Cooperating Institutions
			6

○ **Partner Countries**

	Core Institution	Thomas Jefferson National Accelerator Facility (JLab)	
	Co-Chair (name and title)	Liguang Tang, Staff Scientist (Professor, Hampton Univ.)	
	Cooperating Institutions	Hampton University, Florida International University, University of Puerto Rico	Number of Cooperating Institutions
			3

	Core Institution	Institute for Nuclear Physics, Mainz University	
	Co-Chair (name and title)	Josef POCHODZALLA (Director, Professor)	
	Cooperating Institutions	Giessen University	Number of Cooperating Institutions
			1

	Core Institution	INFN Rome	
	Co-Chair (name and title)	Franco GARIBALDI (Professor)	
	Cooperating Institutions	INFN Bari, Universita di Torino, INFN Torino	Number of Cooperating Institutions
			3

	Core Institution	Nuclear Physics Institute, Academy of Science of Czech	
	Co-Chair (name and title)	Petr BYDZOVSKY (Staff Scientist)	
	Cooperating Institutions		Number of Cooperating Institutions
		0	

## Objectives of Research Exchange (including the five years after the project finishes)

Based on the international collaboration on the hypernuclear spectroscopy with electron beams, Tohoku University drove two collaborative researches with Jefferson Lab (USA), Mainz University (Germany), INFN Rome (Italy) and theoretical division of NPI (Czech): namely, 1) spectroscopic study of Lambda hypernuclei with electron beams and 2) study of the strangeness nuclear physics with photon and electron beams.

Using analysis results of JLab experiments, a new experiment setup was designed and serious simulation works are undergoing. The collaboration is now preparing a new proposal which will be submitted to JLab PAC in near future to have a beam time in 12GeV era.

During these preparation works for future programs, existing resources at Mainz University are fully utilized. A novel experimental technique, decay pion spectroscopy of electric-produced hypernuclei, was tested at the MAMI-C electron machine at the Mainz University. We are now trying to establish the principle of the experiment. With the upgraded Kaos spectrometer, a study of the electro-production of strangeness with liquid hydrogen target has also started.

With flexible beamtimes at Mainz, feasibility study and pilot experiments will be performed to establish and extend the hypernuclear study with electron beams. At future JLab, with the excellent beam and spectrometers, full potential of these research techniques will be explored.

At ELPH-Tohoku, a research of the photo-production of strangeness is also in progress. The activities are now extended to MAMI-C, Mainz under this core-to-core program. Understanding of the elementary process will help the analysis of Lambda hypernuclear electro-production mechanism. Based on the establishing international research network, new information about the detailed structure of Lambda hypernuclei and Lambda-Nucleon interaction will be obtained and our knowledge about the baryon force will be deepened.

## Results to the present

Year 2011 was really special year for Japan especially for Tohoku district. One of core institutes, Tohoku University, was severely damaged by the Great East Japan Earthquake. However, with strong supports from over-sea core institutes, the above research works were carried out without serious delay. The collaboration has been carrying out the analysis of accumulated data. Recently the binding energy of  ${}^7_{\Lambda}\text{He}$  hypernucleus was measured for the first time and it will provide precious information about the Charge Symmetry Breaking effect of the Lambda-Nucleon interaction. International seminars at ECT\*, Trento and at JLab, Newport News were organized under this program. The first international school for strangeness nuclear physics (SNP school 2012) was successfully performed at Tokai and Sendai, Japan. Based on these activities, a letter of intent for new hypernuclear program in 12GeV era was submitted to JLab. At Mainz, a series of the feasibility study of a novel decay pion spectroscopy of electro-produced hypernuclei was carried out.

Passing away of the ex-coordinator, Prof. Hashimoto on 3<sup>rd</sup> Feb. 2012 was a great loss not only for us but also for the entire strangeness/hypernuclear community. However, the collaboration was strongly supported internationally as well as domestically by this establishing research network and we were able to keep our activities as previous or more.

## Summary of FY 2012 Exchange Plan

### **Joint Research**

Data of hypernuclei in wide mass range accumulated at JLab will be analyzed under the international collaboration. Based on the analysis result, a new proposal will be compiled.

At Mainz Univ., a beam time of the decay pion spectroscopy of hypernuclei is planned in winter 2012. Based on the international collaboration, research condition is now optimized. A study of the elementary strangeness electro-production is also studied at Mainz. When ELPH-Tohoku is recovered from the earthquake's damage, we plan to carry out the experiment on the photo-production of  $K^0\Lambda$ .

### **Seminar**

At Jefferson Lab, the 7<sup>th</sup> JSPS core-to-core seminar (Study of Lambda hypernuclei with Electron Beams) was carried out from 9<sup>th</sup> and 10<sup>th</sup> May. Analysis status of JLab data and future plans were discussed.

Another seminar (Current Status and Future Prospects of Strangeness Nuclear Physics) will be carried out as a satellite meeting of International Conference on Hypernuclear and Strange Particle Physics (HYP2012) at Barcelona.

To encourage young researchers, an international school of strangeness nuclear physics (SNP School 2013) will be carried out at Tokai and Sendai in Feb, 2013. This is the continuation of the successful SNP School 2012 carried out in winter 2012.

### **Researcher Exchanges**

A report on the design of the photon tagger system for the strangeness photo-production study was presented at the international conference on photo detectors (Photodet2012, Orsay, June 2012).

In August, an invited talk on hypernuclear studies with electron beams will be given at the Gordon Research Conference (GRC, photonuclear reactions) Holderness, US.