

JSPS Core-to-Core Program
FY2011 Implementation Plan (Project No. : 21002)

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

Duration of Project April 1, 2011 – March 31, 2014 (36 months)

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

Implementing Organizations

○ **Japan**

Japan	Core Institution	Graduate School of Science, Tohoku University	
	Co-Chair (name and title)	Osamu Hashimoto (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 Japan Atomic Energy Agency, Advanced Science Research Center	Number of Cooperating Institutions 6

○ **Partner Countries**

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

Italy	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

Germany	Core Institution	MAINZ University	
	Co-Chair (name and title)	Josef Pochodzalla (Professor)	
	Cooperating Institutions	Giessen University	Number of Cooperating Institutions
			1

Czech Republic	Core Institution	Institute for Nuclear Physics, Czech Academy of Science	
	Co-Chair (name and title)	Petr Bydzofsky (Staff Scientist)	
	Cooperating Institutions	none	Number of Cooperating Institutions
			0

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

Strangeness nuclear physics aims to reveal the origin and behavior of nuclei and hadrons which contain an s-quark(s) having “strangeness degree of freedom” in addition to u and d quarks that form ordinary nuclei. Such nuclei or hadrons are thought to have played important roles in the beginning of universe.

In the present program, we plan to establish an international collaboration platform for strange nuclear physics by electron beams, strengthening international cooperation with US, Italian and German collaborators.

Prior to this program, the Tohoku University group has made significant achievements in the field of hypernuclear spectroscopy by the $(e,e'K^+)$ reaction at JLab, further extending the successful effort at KE 12 GeV proton synchrotron in Japan. In addition, there has been unique investigation of elementary photo-strangeness production at Laboratory of Nuclear Science, Tohoku University.

In this program, we explore the new paradigm of strangeness nuclear physics at world electron accelerator facilities fully utilizing JLab and MAMI-C electron as well as photon beams at ELPH, Tohoku University. The program also has a role complimentary to those to be carried out at J-PARC which provides high-intensity hadronic beams for strangeness nuclear physics.

It is also our intension to foster young scientists under the international environment and establish the platform that ensures strong international cooperation in the field by organizing international seminars, schools, workshops and collaboration meetings.

Results to the present

Through the experimental collaboration supported by this JSPS program, we have successfully carried out fruitful studies of strangeness nuclear physics at the three electron accelerator facilities.

At JLab, (e,e'K+) reaction precision spectroscopy of light to medium-heavy hypernuclei has been carried out and the intensive and careful data analysis is underway. As an example, the precision mass of ${}^7\Lambda\text{He}$ has been determined taking advantage of the (e,e'K+) reaction. The data is expected to provide a key information on the charge symmetry breaking effect of the Lambda-Nucleon potential in the A=7, T=1 hypernuclear systems.

At MAMI-C, preparation for hypernuclear spectroscopy has been conducted collaborating to Prof. Pochodzalla's group of MAMI. Under the JSPS program, we have newly constructed and installed a time-of-flight Scintillator array as the focal plane detector of the KAOS spectrometer. In addition, a new pre-Chicane system has been installed and is ready for beam. The first beam time for data taking is scheduled in May-June of 2011.

At ELPH, the major data taking was successfully taken in the fall of 2010 using the upgraded NKS2(Neutral Kaon Spectrometer). The reaction, $\gamma + d \rightarrow K^0 + \Lambda$, is of particular interest in the experiment, in which a neutral kaon is detected through the decay to two charged pions. Since no charge contribute at the tree level diagram, it allows us to sort out different contribution of the diagram and clarify the strangeness production processes.

We organized two JSPS core-to-core seminars in 2010, the 3rd one in September at Prague, Czech Republic and the 4th one in February at JLab, following the 1st one in May, 2009 at JLab and the 2nd one in December in Rome, both of which paved a road to establish a global network for the strangeness nuclear physics by electron and photon beams. It was discussed how we establish and strengthen the platform for the international cooperation in the field. It was also well recognized that the strangeness nuclear physics not only with electron and photon beams but also hadronic beams should work closely.

Summary of FY 2011 Exchange Plan

Joint Research

Under the present program in 2011, we will focus on exploring experimental opportunity at MAMI-C, where new chicane beam line and Kaos spectrometer system has become ready for commissioning. In particular, new experiments on elementary electro-production of strangeness, precision hypernuclear spectroscopy by the $(e,e'K^+)$ reaction and decay pion spectroscopy will be developed in the Kaos spectrometer system. The beam time is schedule in May-June and we expect additional one in the fall.

In addition of the experiments at MAMI-C, the analysis of the data taken at JLab in 2009 for hypernuclear spectroscopy in the wide mass range and those at ELPH of Tohoku University in 2010 for the investigation of neutral kaon and Lambda photo-production processes is thoroughly conducted and intensive discussion with theorists in the field will be carried out.

Seminar

We organize two JSPS core to core seminars in 2011. One is held jointly with European center for theoretical physics as ECT* workshop at Trento in Italy, from September 26 to 30, 2011.

The other will be held either at Puerto Rico University or Jefferson National Accelerator Facility (JLab) in winter. The Trento seminar will cover broad strangeness nuclear physics, in which the investigation using electron and photon beams will play key roles. The other one in US is intended more like an experimental collaboration meeting and we plan to concentrate on the intensive discussion on the analysis and physics discussion related to the data taken at JLab under this program in 2009 as well as those to be obtained in the on-going experiments at MAMI-C.

Researcher Exchanges

Major activity of the program this year is the joint research and seminars. Researcher exchanges will be taken place by taking full advantage of opportunities at international conferences and meetings. We plan to send the program members to APS spring meeting, PANIC2011, Asian Few Body Conference etc. in order to present the results of the program activity and stimulate information exchanges in the field of strangeness nuclear physics.

We also organize an international school for strangeness nuclear physics, aiming to foster young researchers in the field bridging research activities utilizing both electron and hadron beam facilities.