

JSPS Core-to-Core Program  
-Strategic Research Networks-  
Research Report

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 (36months)
Core Institution in Japan	Graduate School of Science, Tohoku University

#### Implementing Organizations

Country	Japan
Core Institution	Graduate School of Science, Tohoku University
Co-Chair (name and title)	Hirokazu Tamura (Professor)
Number of Cooperating Institutions	6
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

Country	USA
Core Institution	Thomas Jefferson National Accelerator Facility (JLab)
Co-Chair (name and title)	Liguang Tang, Staff Scientist (Professor, Hamton Univ.)
Number of Cooperating Institutions	3
Cooperating Institutions	Hampton University, Florida International University, University of Puerto Rico
Matching Fund	Selected problems in hypernuclear physics

Country	Germany
Core Institution	Institute for Nuclear Physics, Mainz University
Co-Chair (name and title)	Josef Pochodzalla (Director, Professor)
Number of Cooperating Institutions	1
Cooperating Institutions	Giessen University
Matching Fund	MAMI operating budget; 7th Framework, HADRONPHYSICS2 (SPHERE)

Country	Italy
Core Institution	INFN Rome
Co-Chair (name and title)	Franco Garibaldi (Professor)
Number of Cooperating Institutions	3
Cooperating Institutions	INFN Bari, Università di Torino, INFN Torino
Matching Fund	INFN JLab12

Country	Czech
Core Institution	Nuclear Physics Institute, Academy of Science of Czech
Co-Chair (name and title)	Petr Bydžovský (Staff Scientist)
Number of Cooperating Institutions	0
Cooperating Institutions	
Matching Fund	Hadron and Baryonic systems

## Result of Program Implementation

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. At Mainz, two times of beamtimes were carried out on decay pion spectroscopy of electromagnetically produced hypernuclei and GEM detector test. Analysis of the data obtained at JLab was also in progress. Two international seminars at JLab, USA and Barcelona, Spain were organized under this program. The second international school for strangeness nuclear physics (SNP school 2013) was successfully performed at Tokai and Sendai.

## Achievements in FY2012 (Self Review)

At MAMI-C, we achieved: 1) based on FY2011 result, new lead shielding scheme was implemented for the decay pion spectroscopy from light hypernuclei. Additional aerogel Cherenkov detector was designed and constructed by Tohoku University group and it was installed at the Kaos spectrometer to improve kaon identification ability. 2) With collaboration works between Japan and Germany, a possibility of upgrading of the existing tracking detector of the Kaos spectrometer by a new GEM detector. R&D works were performed based on this international collaboration network. At Jefferson Lab, we observed  ${}^7_{\Lambda}\text{He}$  cleanly by the analysis of Lambda hypernuclei produced by the electron beam and its binding energy was successfully obtained. The result was published in Phys. Rev. Lett. and it triggered discussion about the charge symmetry breaking of  $\Lambda$ -N potential. Based on this result, decay pion program at Mainz becomes more important to have reliable information of  ${}^4_{\Lambda}\text{H}$ . These results were discussed theoretically as well as experimentally at two JSPS seminars. The second international school (SNP school 2013) was successfully performed as the first one.

## Future Plan (Measures toward Achieving Research Objectives)

With full supports from core institutes, international research exchanges, joint researches, international seminars and young researchers' education program were successfully developing. At Mainz, relatively flexible beamtimes allow us timely a feasibility study of new experimental techniques and detectors. At Jefferson Lab, combined hypernuclear collaborations by this JSPS program are now designing a new future experiment and will submit a proposal soon. No optimism is warranted on the recent financial situation in Europe and US, but Japan which is now recovering from the disaster, needs to contribute to the research network with more presence. Now damaged accelerator facilities, J-PARC and ELPH-Tohoku, in Japan got back their original activities and new experimental results will be obtained in near future. Using this core-to-core program, we will strengthen our collaboration to explore the potential of electro-photo reactions in the strangeness nuclear physics.