

E442

PROPOSAL FOR EXPERIMENT AT RCNP

July 17, 2014

TITLE:**Study of three nucleon force effects in $p+^3\text{He}$ elastic scattering at 65 MeV****SPOKESPERSON:**

Name	Kimiko Sekiguchi
Institution	Department of Physics, Tohoku University, Japan
Title or Position	Associate Professor
Phone number	+81-22-795-5737
FAX number	+81-22-795-6455
E-mail	kimiko@lambda.phys.tohoku.ac.jp

EXPERIMENTAL GROUP:

Name	Institution	Title or Position
Y. Wada	Department of Physics, Tohoku University	D1
Y. Shiokawa	Department of Physics, Tohoku University	M2
D. Eto	Department of Physics, Tohoku University	M1
A. Watanabe	Department of Physics, Tohoku University	M1
M. Itoh	CYIRIC, Tohoku University	RA
T. Wakui	CYIRIC, Tohoku University	RA
K. Hatanaka	RCNP, Osaka University	P
A. Tamii	RCNP, Osaka University	AP
C. Iwamoto	RCNP, Osaka University	PD
T. L. Tang	RCNP, Osaka University	PD
T. Itoh	RCNP, Osaka University	D3
T. Wakasa	Kyushu University	AP
Y. Shindo	Kyushu University	M1
K. Tabata	Kyushu University	M1
A. Ohkura	Kyushu University	M1
Y. Maeda	Miyazaki University	AP
Y. Kanaya	Miyazaki University	M2
S. Gotanda	Miyazaki University	M2
S. Kawakami	Miyazaki University	M1
H. Sakai	RIKEN Nishina Center	P
K. Miki	GSI	PD
A.C. Fonseca	Centro de Fisica Nuclear da Universidade de Lisboa, Portugal	P
A. Deltuva	Centro de Fisica Nuclear da Universidade de Lisboa, Portugal	PD
M. Viviani	Istituto Nazionale di Fisica Nucleare Sezione di Pisa Italy	P

RUNNING TIME: Installation time without beam 3 days
Data runs 4 days

BEAM LINE: WS course

BEAM REQUIREMENTS: Type of particle polarized p
Beam energy 65 MeV
Beam intensity 5–10 nA
Other requirements energy resolution ≤ 200 keV
halo-free, small emittance

BUDGET: Experimental expenses 1,950,000 JPY
Traveling expenses : 16 people should be supported by RCNP.

SAFETY CONTROLLED ITEMS:

- a H₂ gaseous target at 1 atom with liquid-nitrogen temperature

TITLE:**Study of three nucleon force effects in $p+{}^3\text{He}$ elastic scattering at 65 MeV****SPOKESPERSON:** Kimiko Sekiguchi**SUMMARY OF THE PROPOSAL**

Study of three nucleon forces (3NFs) is essentially important in clarifying various nuclear phenomena. Few-nucleon scattering offers good opportunities to investigate dynamical aspects of these forces, such as momentum, spin, and iso-spin dependencies. First indication of the 3NFs in the scattering system was pointed out in the cross section minimum for nucleon–deuteron elastic scattering at intermediate energies ($E/A \gtrsim 60$ MeV). Since then nucleon–deuteron elastic scattering at incident energies of up to ≈ 300 MeV have been extensively performed both experimentally and theoretically.

The nucleon–deuteron scattering has provided an solid basis to nail down detailed properties of 3NFs, however, the total isospin channel of the 3NFs is limited to $T = 1/2$. Recently importance of the iso-spin dependence study of 3NFs have been pronounced for understanding of nuclear system with larger-isospin asymmetry, e.g. neutron-rich nuclei, neutron matter, and neutron stars. The $p+{}^3\text{He}$ scattering is an attractive probe since this system is the simplest one where the 3NFs in the channels of total isospin $T = 3/2$ can be studied. Together with this rigorous numerical calculations for four-nucleon scattering are becoming possible even above four-nucleon breakup threshold energies, which opens up new possibilities for the study of 3NFs. The calculations of the cross section for $p+{}^3\text{He}$ elastic scattering indicate that the effects of 3NFs can be enhanced in the cross section minimum region with increasing an incident energy as is similar to the nucleon–deuteron elastic scattering.

We consider it is the time to promote the study of $p+{}^3\text{He}$ scattering at intermediate energies. As the first step we propose the measurement of the cross section and proton analyzing power for $p+{}^3\text{He}$ elastic scattering at 10° – 170° in the center of mass system with a proton beam at 65 MeV.