E375

RCNP EXPERIMENT E

PROPOSAL FOR EXPERIMENT AT RCNP

11 July 2011

TITLE:

Study of density distributions of light nuclei and nuclaer equation of state by measuring elastic scattering of protons from ^{12,13,14}C at E_p = 200 and 300 MeV.

SPOKESPERSON:

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EXPERIMENTAL GROUP:

Full Name	Institution	Title or Position
H. Sakaguchi	RCNP, Osaka University	Guest Researcher
A. Tamii	RCNP, Osaka University	Associate Professor
H.J. Ong	RCNP, Osaka University	Assistant Professor
Y. Yasuda	RCNP, Osaka University	Researcher
J. Tanaka	RCNP, Osaka University	M1
S. Terashima	Beihai University, China	Assistant Professor
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K. Takahashi	Department of Physics, Tohoku University	M1
K. Miyazaki	Department of Physics, Tohoku University	M1
T. Mashiko	Department of Physics, Tohoku University	M1
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H. Miyasako	Department of Applied Physics, University of Miyazaki	M2
T. Kawabata	Department of Physics, Kyoto University	Associate Professor
T. Murakami	Department of Physics, Kyoto University	Assistant Professor
N. Yokota	Department of Physics, Kyoto University	M2

RUNNING TIME:

Installation time without beam	3 days (^{12,13}C), 3 days (^{14}C)
Beam tuning	4 days (total)
Data runs	4 days (^{12,13}C),7 days (^{14}C)
The other runs	1.5 days (200 MeV p), 1 day (100 MeV/A^{12}C)

BEAM LINE: Ring : WS course

BEAM REQUIREMENTS:

Type of particle	polarized p, $^{12}C^{6+}$
Beam energy	200, 300 MeV (p), and 100 MeV/A ($^{12}C^{6+}$)
Beam intensity	faint beam and $\leq$ 400 nA
Energy resolution	$\leq$ 200 keV, $\leq$ 60 keV (^{14}C(p,p),$\leq$ 15 nA)
	halo-free, small emittance

BUDGET: Experimental expenses 2,800,000 yen

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Study of density distributions of light nuclei and nuclear equation of state by measuring elastic scattering of protons from ^{12,13,14}C at E_p = 200 and 300 MeV.

SPOKESPERSON: Y.Matsuda

SUMMARY OF THE PROPOSAL

Proton elastic scattering at intermediate energies ($\sim$ 300 MeV) is one of the suitable tools to deduce the density distributions. Recently we have succeeded in extracting neutron density distributions of tin and lead isotopes from the polarized proton elastic scattering.

Carbon isotopes are characteristic light nuclei which have many isotopes from mass number 9 to 22 and the skin/halo structures. As a point of view of the nuclear equation of state, the optical potentials also show characteristic and interesting shapes. The systematic quantitative investigation will help us to understand not only the nuclear structures but also the isospin dependence of the equation of state. In this research, we propose to measure elastically scattered protons from ^{12,13,14}C at 200 and 300 MeV. Since we have already measured ^{9,10,11}C at NIRS-HIMAC, we are going to obtain systematic data set up to p sub-shell closure. At RIKEN-RIBF, we are going to measure ^{16,18}C.

The measurement of unstable nucleus ^{14}C is meaningful in particular because the spin observables as well as the cross sections are obtained up to a high momentum transfer region with high statistics. It is quite difficult to accomplish such an experiment in inverse kinematics. ^{14}C is the most neutron-rich isotope the density distribution of which can be determined precisely.

In order to deduce the density distributions, it is important to find out a suitable effective interaction. In this research, the effective interaction will be calibrated with data of ^{12}C. Unfortunately, previous data of ^{12}C include significant experimental uncertainties. These were too large to determine the effective interaction. Therefore, we need to measure ^{12}C precisely again.

In addition, we will develop a new technique to extract proton and neutron density distributions simultaneously by using large difference of the optical potentials between 200 and 300 MeV. This technique will be very useful to study unstable nuclei because it is very difficult to obtain the charge density distributions. Therefore, the measurements at two incident energies are indispensable.