E366

RCNP EXPERIMENT E

PROPOSAL FOR EXPERIMENT AT RCNP

7 February, 2011

TITLE:

Precision measurement of proton elastic scattering at E_p = 200 and 300 MeV, and study for simultaneous extraction of proton and neutron density distributions of ^{90,92,94,96}Zr

SPOKESPERSON:

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EXPERIMENTAL GROUP:

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T. Murakami	Department of Physics, Kyoto University	Assistant Professor
N. Yokota	Department of Physics, Kyoto University	M1

RUNNING TIME:	Installation time without beam		1.0 days(for each beam time)
	beam tuning		0.5 days(for each beam time)
	Data runs		9.0 (4.0+4.0+1.0) days
BEAM LINE:			Ring : WS course
BEAM REQUIREMENTS:		Type of particle	polarized p, $^{12}C^{6+}$
		Beam energy	200 MeV, 300 MeV (p), and 100 MeV/A (^{12}C)
		Beam intensity	faint beam and $\leq$ 400 nA
		Energy resolution	$\leq$ 100 keV (p) and 300 keV (^{12}C)
			halo-free, small emittance
BUDGET:	Experimental expenses		4,000,000 yen

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Precision measurement of proton elastic scattering at E_p = 200 and 300 MeV, and study for simultaneous extraction of proton and neutron density distributions of ^{90,92,94,96}Zr

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SUMMARY OF THE PROPOSAL

Proton elastic scattering at intermediate energy ($\sim$ 300 MeV) is a good probe to extract the information about the nuclear matter distributions. We explain the scattering observables for medium-heavy stable very well using the effective nucleon-nucleon interaction with density-dependent correction parameters. Recently we have succeeded in extracting the neutron density distributions of tin and lead isotopes precisely within the framework of relativistic impulse approximation.

In addition, it has been found that more precise measurement of proton elastic scattering with small systematic uncertainties leads to not only more precise extraction of neutron density distributions, but also simultaneous extraction of both proton and neutron density distributions due to the effect of unique behavior of the optical potentials and the Coulomb potentials by nuclear charge distributions around the intermediate energy of 200–300 MeV. This new study is very important especially for the unstable nuclei since there are little information about the charge radii or densities of unstable nuclei while for the stable nuclei nuclear charge or proton density distributions are well known from many measurements using electromagnetic probes.

We propose the precise measurement of ^{90,92,94,96}Zr($\overrightarrow{p}$, p) elastic scattering at different energies of E_p = 200 and 300 MeV. This experiment aims to establish the applicability of our analysis method to lighter nuclei than tin or lead isotopes, and to extract both the proton and neutron density distributions of Zr isotopes simultaneously.