

## PROPOSAL FOR EXPERIMENT AT RCNP

22 July 2003

**TITLE:****Three-nucleon force effects in the  $\vec{d} + p \rightarrow (pn)_{1S_0} + p$  reaction at 200 MeV****SPOKESPERSON:**

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**EXPERIMENTAL GROUP:**

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Y. Shimizu	RCNP Osaka University	D2
K. Fujita	RCNP Osaka University	M2
Y. Tameshige	RCNP Osaka University	M2
H. Sakai	Department of Physics, U. of Tokyo	P
K. Yako	Department of Physics, U. of Tokyo	RA
Y. Maeda	Department of Physics, U. of Tokyo	D3
K. Sekiguchi	RIKEN	Research Fellow
K. Sagara	Kyushu University	P
T. Wakasa	Kyushu University	AP
T. Kudoh	Kyushu University	M2
H. Ohira	Kyushu University	M1
M. Tomiyama	Kyushu University	M1
H. Witala	Jagiellonian University	Professor

**RUNNING TIME:**

Beam energy	200 MeV	
Beam intensity	1 - 10 nA	
Beam time	Total	12 days
	1 day	Installation with beam
	2 day	Development of the polarized deuterons in the horizontal plane
	3 days	Measurements of $A_{yy}$
	3 days	Measurements of $A_{xx}$
	3 days	Measurements of $A_{xz}$

**BEAM LINE:****BEAM REQUIREMENTS:**

Type of particle	WS course + LAS polarized deuteron
Beam energy	200 MeV
Beam intensity	1-10 nA
Energy resolution	< 0.2 MeV (FWHM)
Beam polarization	> 0.7 (in vertical & horizontal plan)

**BUDGET:**

Experimental expenses	250,000 yen
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**TITLE:****Three-nucleon force effects in the  $\vec{d} + p \rightarrow (pn)_{1S_0} + p$  reaction at 200 MeV****SPOKESPERSON:** Kichiji Hatanaka**SUMMARY OF THE PROPOSAL**

Three-nucleon scattering based on modern NN forces has matured in recent years, and computationally accurate solutions of the three-nucleon (3N) Faddeev equation can be achieved. In addition to the first signal on 3NF effects resulting from discrete states [?], strong 3NF effects were observed in a study of the minima of the  $Nd$  elastic scattering cross section at incoming nucleon energies higher than about 60 MeV. This discrepancy between the data and predictions based exclusively on NN forces could be largely removed by including the  $2\pi$ -exchange TM 3NF, properly adjusted to reproduce the  ${}^3\text{H}$  binding energy in the 3N Hamiltonian. A recent study at RIKEN shows that the inclusion of the 3NF does not always improve the description of precise data taken at intermediate deuteron energies. In the E146 at RCNP, we measured the angular distributions of the cross section, the proton analyzing power and all proton polarization transfer (PT) coefficients of  $\vec{p}d$  elastic scattering at 250 MeV. Experimental data were compared with rigorous Faddeev calculations. Overall, these results clearly indicate that the spin structure of 3NF is not properly described by present day models.

It is necessary to investigate 3NF effects on other observables with various combinations of spin and isospin in outgoing channels. In this proposal, we measure the tensor analyzing power  $A_{yy}$  of the following reaction:  $\vec{d} + p \rightarrow (pn) + p$  at 200 MeV. This process is a supplementary process at almost the same kinematics as the  $Nd$  elastic scattering but with a different relative role of 2N and 3NF. Large 3NF effects are predicted by a rigorous Faddeev calculation for  $A_{yy}$ . We also measure the tensor analyzing powers  $A_{xx}$  and  $A_{xz}$  for which according to theoretical predictions 3NF gives negligible effects.