# E367

# PROPOSAL FOR EXPERIMENT AT RCNP

07/02/2011

**TITLE:**

Study of nuclear medium effects on $D_{NN}$ for $1s_{1/2}$ knockout $(\vec{p}, \vec{n}p)$ reactions.

**SPOKESPERSON:**


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**EXPERIMENTAL GROUP:**


| | | | | | |
|---|---|---|---|---|---|
| T. Noro | Kyushu Univ. | P | K. Sagara | Kyushu Univ. | P |
| K. Ishibashi | Kyushu Univ. | M | S. Kimura | Kyushu Univ. | M |
| S. Tanaka | Kyushu Univ. | M | K. Hatanaka | RCNP | P |
| A. Tamii | RCNP | AP | K. Sekiguchi | Tohoku | AP |
| J. Miyazaki | Tohoku | M | Y. Maeda | Miyazaki | RA |
| H. Miyasako | Miyazaki | M | Y. Sakemi | CYRIC | P |
| H. P. Yoshida | CYRIC | R | S. Sakaguchi | RNC | R |
| M. Dozono | CNS | R | | | |


**RUNNING TIME:**

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|---|---|
| Development for neutron polarization measurement | 3.0 days |
| Calibration of NPOL3 | 2.0 days |
| Measurement of $\sigma$ and $A_y$ | 0.5 days |
| Measurement of $D_{NN}$ | 10.5 days |
| Total | 16.0 days |

**BEAM LINE:** WS (NPOL3 + LAS)

**BEAM REQUIREMENTS:**

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|---|---|
| Type of particle | Polarized Protons |
| Beam energy | 346 MeV |
| Beam intensity | $\lesssim$ 100 nA |
| Time resolution | $\lesssim$ 500 ps (FWHM) |
| Beam polarization | $\gtrsim$ 0.6 |

**BUDGET:**

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|---|---|
| Experimental expenses | 3,500,000 |
| Travel expenses | 1,200,000 |
| Total | 4,700,000 |

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## SUMMARY OF THE PROPOSAL

In the RCNP-E59 and E131 experiments, differential cross sections and a complete set of polarization observables have been measured for the quasielastic $(\vec{p},\vec{n})$ reaction on $^{12}$C at $T_p$ = 346 MeV and $\theta_{\rm lab} = 22^\circ$ ($q \simeq 1.7\,{\rm fm}^{-1}$). In this momentum transfer region, the isovector spin-longitudinal interaction is attractive where the one-pion exchange is dominant. The spin-longitudinal $ID_q$ and two spin-transverse, $ID_p$ and $ID_n$, polarized cross sections have been deduced. The theoretically expected enhancement in the spin-longitudinal mode is observed, and the observed enhancement is reasonably reproduced by the distorted wave impulse approximation (DWIA) calculations employing random phase approximation (RPA) response functions. On the other hand, the theoretically predicted quenching in the spin-transverse mode is not observed. The observed $ID_p$ and $ID_n$ are not quenched, but rather enhanced relative to the DWIA+RPA predictions. The small enhancement in $ID_p$ might be resolved by considering the short-range tensor correlations. However, the large enhancement in $ID_n$ could not be resolved.

Since the relevant nucleon-nucleon ($NN$) $t$-matrix component is different between $ID_p$ and $ID_n$, a possible explanation is that the $NN$ interaction is modified in the nuclear medium, and thus the $t$-matrix component relevant to $ID_n$ ($B$-term in the KMT representation) is enhanced compared with the free-space value. Recently, in the E313 experiment at RCNP, the cross section for the exclusive $1s_{1/2}$ knockout $^{12}$C$(p,np)$ reaction was measured, and the data has been compared with the cross section for the exclusive $1s_{1/2}$ knockout $^{12}$C$(p,2p)$ reaction. The result suggests that the $n(p,n)p$ cross section in the nuclear medium is enhanced compared with the free space value.

The enhancement observed in the exclusive $(p,np)$ reaction would responsible for the "unexpected" enhancement in $ID_n$ for the inclusive $(p,n)$ reaction. In order to investigate the medium effects on each term of the $NN$ $t$-matrix, a complete set of $D_{ij}$ should be measured. For the first measurement, we propose to measure the polarization transfer $D_{NN}$ for the $1s_{1/2}$ knockout $(\vec{p},\vec{n}p)$ reaction since the significant discrepancy is observed in $D_{NN}$ for the inclusive $^{12}$C$(\vec{p},\vec{n})$ reaction whereas the other $D_{ij}$ are reasonably reproduced by the calculations. Thus it is very interesting to investigate whether the $D_{NN}$ for the exclusive $(\vec{p},\vec{n}p)$ in the nuclear field is different from that in the free space or not. Furthermore, the measurement of $D_{NN}$ does not require the use of a special magnet for the neutron spin rotation. Thus the measurement of $D_{NN}$ is suitable for the first measurement investigating nuclear medium effects on $D_{ij}$.