RCNP EXPERIMENT E351

PROPOSAL FOR EXPERIMENT AT RCNP

25/01/2010

TITLE:

Study of the spin-dipole quenching factors via ^{208}Pb(p, n) polarization transfer measurements

SPOKESPERSON:

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EXPERIMENTAL GROUP:

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T. Noro	Kyushu Univ.	P	K. Sagara	Kyushu Univ.	P
S. Kuroita	Kyushu Univ.	D	T. Yabe	Kyushu Univ.	M
K. Hatanaka	RCNP	P	Y. Maeda	Miyazaki	RA
T. Saito	Miyazaki	M	H. Miyasako	Miyazaki	M
Y. Sakemi	CYRIC	P	T. Hayamizu	CYRIC	M
A. Oikawa	CYRIC	M	K. Yako	Tokyo	RA

RUNNING TIME:

Beam tuning for N, S, and L-type beams	1.0 days
Calibration of NPOL3	1.5 days
Measurement of σ and A_y	0.5 days
Measurement of D_{ij}	4.0 days
Total	7.0 days

BEAM LINE: N0 (N0 + NPOL3)

BEAM REQUIREMENTS:

Type of particle	Polarized Protons
Beam energy	300 MeV
Beam intensity	$>$ 500 nA on target before pulse selection
Time resolution	$<$ 500 ps (FWHM)
Beam polarization	$>$ 0.6
Injection Mode	High Current Mode
Pulse selection	1/9 or 1/1

BUDGET:

Summary of budget request	3,000,000
Experimental expenses	2,200,000
Travel plan	800,000

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SUMMARY OF THE PROPOSAL

The quenching of the total $\Delta L = 0$ Gamow–Teller (GT) strength from the GT sum rule (Ikeda's sum rule) value $3(N - Z)$ has prompted theoretical studies of possible mechanisms, ranging from conventional configuration mixing to admixture of the Δ-hole (Δ-h) states. Experimental investigations for the (p,n) and (n,p) reactions on ^{90}Zr performed at RCNP have revealed that the configuration mixing such as the coupling to 2-particle–2-hole ($2p$-$2h$) excitations plays an important role for the GT quenching, whereas Δ-h coupling plays a minor role. In contrast to the GT strength, whether there is also a quenching of the $\Delta L = 1$ spin-dipole (SD) strength has not been established. Brockstedt *et al.* have claimed that the observed SD strength via the $(^3\mathrm{He}, t)$ reaction is about 30% lower than the calculation and this might be interpreted as a quenching of the SD strength. However, it should be noted that the quasielastic contribution is phenomenologically subtracted in their analysis, and thus part of the missing SD strength might be contained in this subtracted component.

We performed the multipole decomposition analysis (MDA) for the ^{208}Pb(p,n) data taken at RCNP in order to obtain the SD strength distributions in the cross section spectra. Our preliminary result suggests that the quenching factor for the total SD strength is about 0.9 whereas the result by Brockstedt *et al.* is about 0.7. Note that our result is similar to that for the GT strength. Our result also suggests that the SD quenching factors depend on J^π: the 2^- strength is fully exhausted whereas the 0^- strength is quenched by about 60%. However, unfortunately, these results have significant systematic uncertainties since the ΔJ^π separation has been performed by using the D_{NN} data only, and thus it is difficult to draw strong conclusion for the spin dependence of the SD quenching factors.

The purpose of this proposal is to study the spin dependence of the SD quenching factors quantitatively. We propose to measure complete sets of polarization transfer observables for the ^{208}Pb(p,n) reaction in the SD resonance

region in order to reduce the systematic uncertainties. The measured complete polarization transfer observables are used to separate the cross section into spin-longitudinal ID_q and spin-transverse ID_p polarized cross sections. These polarized cross sections enable us to separate the $\Delta L = 1$ SD cross section into the 0^-, 1^-, and 2^- components in the MDA. The results obtained in the present measurements would provide unique and important information for deepening our understanding of the nuclear spin–isospin responses and for the spin-dependence of the quenching mechanism.