RCNP EXPERIMENT E207

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE:

Weak isoscalar response of ^{11}B

SPOKESPERSON:

Full Name	Kawabata Takahiro
Institution	Center for Nuclear Study (CNS), Graduate School of Science, University of Tokyo
Title or Position	Research Associate
Address	2-1 Hirosawa, Wako, Saitama 351-0198
Phone number	+81-48-464-4156
FAX number	+81-48-464-4554
E-mail	kawabata@cns.s.u-tokyo.ac.jp

EXPERIMENTAL GROUP:

Full Name	Institution	Title or Position
K. Hatanaka	RCNP, Osaka University	P
M. Fujiwara	RCNP, Osaka University	AP
T. Wakasa	RCNP, Osaka University	RA
M. Itoh	RCNP, Osaka University	Res. Fell.
H. Fujita	RCNP, Osaka University	Res. Fell.
H.P. Yoshida	RCNP, Osaka University	D3
K. Hara	RCNP, Osaka University	D3
H. Sakaguchi	Department of Physics, Kyoto University	AP
M. Yosoi	Department of Physics, Kyoto University	RA
H. Takeda	Department of Physics, Kyoto University	Res. Fell.
M. Uchida	Department of Physics, Kyoto University	D3
Y. Yasuda	Department of Physics, Kyoto University	D2
H. Akimune	Department of Physics, Konan University	AP
K. Yamasaki	Department of Physics, Konan University	D3
A. Tamii	Department of Physics, University of Tokyo	RA
T. Uesaka	CNS, University of Tokyo	L
Y. Fujita	Department of Physics, Osaka University	AP
Y. Shimbara	Department of Physics, Osaka University	D3

RUNNING TIME:	Installation time without beam	1.0 day
	Setup and test running time	1.5 day
	Data runs	3.5 days
BEAM LINE:		Ring : WS course
BEAM REQUIREMENTS:	Type of particle	d
	Beam energy	200 MeV
	Beam intensity	$\leq$ 10 nA
		Energy resolution $\leq$ 200 keV
		halo-free, small emittance
BUDGET:	Experimental expenses	0 yen

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SUMMARY OF THE PROPOSAL

It is revealed from the recent studies that the isoscalar part of the neutral axial-vector current plays a significant role in weak-interaction processes, while the isovector part is only taken into account in usual calculations for the neutrino-nucleus reactions. Since the ^{11}B nucleus, which has been examined as a possible neutrino detector to solve the solar-neutrino problem, has different numbers of protons and neutrons, M1 excitations in ^{11}B are induced by both the isoscalar and isovector parts of the weak neutral-currents interaction. As pointed out by Bernabéu *et al.*, the $^{11}\mathrm{B}(\nu,\nu')$ cross section changes by 30-40% if the isoscalar part is taken into account. It is, therefore, important to investigate the weak isoscalar response of ^{11}B, which is still unclear.
Since the cross section of hadronic reactions provides a good measure for the weak interaction response, we recently measured the $^{11}\mathrm{B}(^3\mathrm{He},t)$ and $^{11}\mathrm{B}(p,p')$ reactions to study the weak interaction response of ^{11}B, and compared the obtained transition strength with the shell model prediction. As a result, it was found that the isoscalar M1 transition strengths for the $1/2^-_1$ and $3/2^-_2$ states are extremely quenched. This quenching of the isoscalar M1 transition strength is not predicted by the shell model calculation. Our result for the isoscalar strength from the (p,p') experiment has a large systematic uncertainty because the proton scattering amplitude in the M1 transition is dominated by the isovector components due to the large $|V_{\sigma\tau}/V_\sigma|$ value in the effective interaction. Thus, we propose the precise measurement of the isoscalar M1 transition strength in ^{11}B by using a deuteron beam as a probe. Because the deuteron inelastic scattering has a selectivity for the isoscalar transition, the precise measurement of the isoscalar transition becomes possible. This experiment will be the first measurement of the $^{11}\mathrm{B}(d,d')$ reaction at intermediate energy. Since the inaccuracy of the theoretical description for the isoscalar M1 transitions is caused by the lack of experimental data, the precise measurement of isoscalar strength is important not only from the view of neutrino astrophysics but also from nuclear physics.