RCNP EXPERIMENT E249

PROPOSAL FOR EXPERIMENT AT RCNP

6-July-2004

TITLE:

High-resolution study of $M1$ strengths and their distribution

SPOKESPERSONS:

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EXPERIMENTAL GROUP:

Name	Institution	Title or Position
K. Hatanaka	RCNP, Osaka Univ.	Professor
Y. Sakemi	RCNP, Osaka Univ.	Assoc. Professor
M. Itoh	RCNP, Osaka Univ.	Researcher
Y. Shimbara	RCNP, Osaka Univ.	Researcher
Y. Shimizu	RCNP, Osaka Univ.	D3
K. Nakanishi	RCNP, Osaka Univ.	D2
K. Fujita	RCNP, Osaka Univ.	D2
Y. Tameshige	RCNP, Osaka Univ.	D1
T. Adachi	Dep. of Physics, Osaka Univ.	D3
H. Sakaguchi	Dep. of Physics, Kyoto Univ.	Assoc. Professor
M. Yosoi	Dep. of Physics, Kyoto Univ.	Assist. Professor
J. Zenihiro	Dep. of Physics, Kyoto Univ.	M2
T. Kawabata	CNS, Univ. of Tokyo	Assist. Professor
J. Carter	Univ. of Witwatersrand, Johannesburg	Professor
F.D. Smit	iThembaLABs, Somerset West	Senior Scientist
H. Fujita	iThembaLABs, Somerset West	Researcher

RUNNING TIME:

14 days

BEAM LINE:

Ring : WS course

BEAM REQUIREMENTS:

Type of particle:	p at 300 MeV
Beam intensity:	$\geq$5 nA
Other requirements:	High-resolution halo-free beam with small emittance

Type of particle:	$\vec{p}$ at 300 MeV
Beam intensity:	20 nA
Other requirements:	High-resolution beam

BUDGET:

Experimental expenses	0 yen
Travel planes	0 yen

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TITLE:
High-resolution study of $M1$ strengths and their distribution

SPOKESPERSONS: Atsushi Tamii and Yoshitaka Fujita

SUMMARY OF THE PROPOSAL

Systematic study of $M1$ strengths and their distribution is of much interest. ¿From the study of Gamow-Teller strengths by (p, n) reactions, it was claimed that the observed strengths are systematically small compared to the sum rule value, *i.e.* quenching. Recent sophisticated measurements and analyses of (p, n) reactions shown that a large fraction of the missing strength was located in the continuum of up to 50 MeV. As for the $M1$ strengths, systematic measurements of (p, p') reactions have been performed at forward angles. They reported that quenching phenomena also occur for both isoscalar and isovector $M1$ strengths of ^{28}Si, and later that almost no quenching was observed in sd shell nuclei. However, the cross sections at zero degrees could not be measured and the data suffered large background events. Therefore the systematic errors were as much as 20% and the results were not satisfactory nor conclusive.

Another concern is fragmentation and distribution of the $M1$ strengths. The $M1$ strength of ^{48}Ca is considered to have a simple shell model structure. Actually most of the $M1$ strength is believed to be concentrating on a state at 10.22 MeV. Recently the study of (e, e') and (p, p') reactions suggested that a small fraction of the strength is fragmenting into many tiny states around 10.22 MeV. Such fragmentation of the $M1$ strength is not easily explained by any usual structure theories, like shell-model or second-RPA calculations, and may need more exotic explanations. Therefore the detailed study of the fragmented strengths provides a good test ground for various shell model and other theoretical calculations.

¿From the development of high-resolution halo-free beams in E214, we have shown that clean and high-resolution measurements of (p, p') reactions at very forward angles including zero degrees are already feasible at the RCNP. We propose to do systematic measurements of cross sections and angular distributions of $M1$ states for several sd and fp shell nuclei at forward angles including zero degrees for studying the strength and fragmentation of the $M1$ strengths.