PROPOSAL FOR EXPERIMENT AT RCNP

6 July 2004

TITLE:
Investigation of the Molecular States in ^{11}B and ^{13}C

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
T. Uesaka	Center for Nuclear Study, University of Tokyo	L
T. Wakui	Center for Nuclear Study, University of Tokyo	RA
K. Suda	Center for Nuclear Study, University of Tokyo	PD
Y. Maeda	Center for Nuclear Study, University of Tokyo	PD
S. Sakaguchi	Center for Nuclear Study, University of Tokyo	M1
Y. Sasamoto	Center for Nuclear Study, University of Tokyo	M1
K. Itoh	Department of Physics, Saitama University	D1
K. Hatanaka	RCNP, Osaka University	P
M. Fujiwara	RCNP, Osaka University	AP
A. Tamii	RCNP, Osaka University	AP
M. Itoh	RCNP, Osaka University	PD
H.P. Yoshida	RCNP, Osaka University	PD
M. Uchida	RCNP, Osaka University	PD
Y. Shimizu	RCNP, Osaka University	D3
K. Nakanishi	RCNP, Osaka University	D2
K. Kawase	RCNP, Osaka University	D2
H. Hashimoto	RCNP, Osaka University	D1
Y. Tameshige	RCNP, Osaka University	D1
S. Okumura	RCNP, Osaka University	M2

RUNNING TIME:	Installation time without beam	3.0 days
	Setup and beam tuning time	1.0 day
	Data runs	5.0 days
BEAM LINE:		Ring : WS course
BEAM REQUIREMENTS:	Type of particle	^{4}He^{++}
	Beam energy	400 MeV
	Beam intensity	$\leq$ 10 pnA
		Energy resolution $\leq$ 150 keV
		halo-free, small emittance
BUDGET:	Experimental expenses	500,000 yen
	Travel plans - 8 participants should be supported by RCNP	

TITLE:
Investigation of the Molecular States in ^{11}B and ^{13}C

SPOKESPERSON: Kawabata Takahiro

SUMMARY OF THE PROPOSAL

It is well known that many light nuclei possess a prominent cluster structure and the α particle plays an important role as a constituent of the cluster state. For example, it has been suggested that the 7.65-MeV 0_2^+ state in ^{12}C has an 3α-like molecular configuration. Recently, the cluster models have been applied to the neutron-rich nuclei, and the molecular structures where the excess neutrons act as the covalent particles have been discussed.

Miline and Oertzen pointed out that the $1/2_2^-$ state at $E_x = 8.86$ MeV and the $1/2_2^+$ state at $E_x = 10.996$ MeV in ^{13}C are considered to have a neutron in the $p_{1/2}$ and $2s_{1/2}$ orbits, respectively, coupled to the 0_2^+ state in ^{12}C. These two states may have the triangular three α-particle structure. In these states, the valence neutron may play a role to stabilize the three α-particle structure to a triangular shape.

On the other hand, an analogous cluster state to the 0_2^+ state in ^{12}C has been observed in ^{11}B as well as ^{13}C. The $3/2_3^-$ state at $E_x = 8.56$ MeV, which is not predicted by the shell-model calculation, is considered to be a cluster state with a proton hole in the $p_{3/2}$ orbit coupled to the 0_2^+ state in ^{12}C.

We propose to study the molecular cluster states by measuring the inelastic alpha scattering on ^{13}C, ^{12}C, and ^{11}B at forward angles including 0°. A comparison of the cluster states in ^{13}C, ^{12}C, and ^{11}B is expected to provide an insight into the molecular structure in light nuclei. We are also aiming to search for another group of the molecular states in which a valence neutron or a proton hole is coupled to the 10.3-MeV state in the continuum spectra by the multipole decomposition analysis.