PROPOSAL FOR EXPERIMENT AT RCNP

12 July 2007

TITLE:
Search for α-condensed state in ^{24}Mg

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	AP
Y. Shimizu	Center for Nuclear Study, University of Tokyo	PD
S. Sakaguchi	Center for Nuclear Study, University of Tokyo	D2
Y. Sasamoto	Center for Nuclear Study, University of Tokyo	D2
K. Itoh	Department of Physics, Saitama University	D3
K. Hatanaka	RCNP, Osaka University	P
M. Fujiwara	RCNP, Osaka University	AP
A. Tamii	RCNP, Osaka University	AP
K. Suda	RCNP, Osaka University	PD
H. Hashimoto	RCNP, Osaka University	D3
Y. Tameshige	RCNP, Osaka University	D3
H. Matsubara	RCNP, Osaka University	D2
M. Itoh	Cyclotron and Radioisotope Center, Tohoku University	RA
M. Uchida	Department of Physics, Tokyo Institute of Technology	RA
Y. Maeda	Department of Phsyics, Kyushu University	RA
S. Terashima	RIKEN (The Institute of Physical and Chemical Research)	PD
N. Itagaki	Department of Physics, University of Tokyo	AP
M. Ito	RIKEN (The Institute of Physical and Chemical Research)	PD

RUNNING TIME:

Installation time without beam	3.0 days
Setup and beam tuning time	2.0 days
Data runs	4.0 days

BEAM LINE: Ring : WS course

BEAM REQUIREMENTS:

Type of particle	$^4He^{++}$
Beam energy	400 MeV
Beam intensity	$\leq$ 10 pnA
Energy resolution	$\leq$ 50 keV
Dispersive beam transport, halo-free, small emittance	

BUDGET:

Experimental expenses	2,500,000 yen

Travel plans - 10 participants should be supported by RCNP

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SUMMARY OF THE PROPOSAL

Alpha particle clustering is an important phenomenon in nuclear physics for light nuclei. On the basis of the Ikeda diagram, the α cluster structure is expected to emerge near the α-decay threshold energy. For example, it was suggested that the 7.65-MeV 0_2^+ state in ^{12}C, which locates at an excitation energy higher than the 3α-decay threshold by 0.39 MeV, has an 3α cluster structure. Recently, it was proposed that this 0_2^+ state is theoretically described by introducing a novel concept of the nuclear structure, i.e., this state is an α-condensed state where three α particles are weakly interacting and are condensed into the lowest s-orbit. The next natural question addressed is whether such an α-condensed state exists in the heavier self-conjugate $N = 4n$ nuclei or not.

Based on a microscopic α-cluster model, N. Itagaki *et al.* demonstrated a possible answer to the question that an α-condensed state around a strongly bound core of ^{16}O may appear near the $2\alpha + ^{16}$O decay threshold energy in ^{24}Mg.

We propose to search for the α-condensed state in ^{24}Mg by a high-resolution measurement of the inelastic alpha scattering at forward angles including 0°. To achieve the highest energy resolution, the dispersion matching technique should be used. In addition, the decaying particles from the excited states should be measured, since the decay branches from the excited states are expected to provide an insight into the cluster structure.