RCNP EXPERIMENT E 339

PROPOSAL FOR EXPERIMENT AT RCNP

September 16, 2009

TITLE:
Test Experiment: (^{3}He,^{3}He') Reaction at 175 MeV/nucleon
- for the precise study of $E1$ response of nuclei -

SPOKESPERSONS:

Full Name	Institution	Title or Position
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EXPERIMENTAL GROUP:

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J. Thies	Muenster University	Ph.D. Student
Y. Yasuda	RCNP, Osaka University	Researcher

RUNNING TIME: total 3 days

Beam tuning for the background reduction and dispersion matching	2 days
Study of the properties of the (^{3}He, ^{3}He') reaction	1 day

BEAM LINE: Ring : WS course

BEAM REQUIREMENTS:

Type of particle	^{3}He
Beam energy	525 MeV (175 MeV/nucleon)
Beam intensity	$\leq$ 20 nA
Beam transportation	dispersive mode of the WS beam line
Other requirements	energy resolution $\leq$ 100 keV halo-free, small emittance

BUDGET: No special budget is required.

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Spokespersons: Y. Fujita, A. Tamii and H. Fujita

Summary of the Proposal

The largest concentration of the isovector $E1$ strength in nuclei, i.e., the Isovector Giant Dipole Resonance (IVGDR), has been observed systematically at the excitation energy $E_x = 31.2A^{-1/3} + 20.6A^{-1/6}$ MeV ($E_x = 15 - 23$ MeV) as a broad bump-like structure. The $E1$ strengths in the IVGDRs situated above the neutron separation energy S_n were studied by the (γ, n) reaction. On the other hand, (γ, γ') reactions [nuclear resonance fluorescence (NRF) method] or $(\alpha, \alpha'\gamma)$ coincidence experiments have been used for the study of the $E1$ responses in the region below the S_n energy, where $E1$ states are observed as discrete states. In order to obtain the whole $E1$ response of a nucleus, these two methods should be combined. The largest difficulty, however, was that the connection was not always smooth.

Here we propose the ^{3}He inelastic scattering reaction [(^{3}He,^{3}He$'$) reaction] at an incoming energy of 525 MeV (175 MeV/nucleon) as a potentially good tool to study the overall view of the $E1$ responses in nuclei, not affected by the S_n energy. Due to this high energy of the ^{3}He beam available at RCNP, it is expected that the $E1$ states excited by the Coulomb interaction become pronounced in a measurement at 0°. In addition, the high energy-resolution of the measurement that will be achieved by the realization of beam matching techniques will reveal the fine structures of the $E1$ response in nuclei.

The Grand Raiden spectrometer and the standard VDC focal plane detector system will be used for the analysis and detection of outgoing ^{3}He particles. We request a good quality single-turn extracted 175 MeV/nucleon ^{3}He beam of up to 10 nA. We seek to realize the complete beam matching conditions to achieve a high energy-resolution of about 30 keV. In addition, an appropriate condition of the vertical off-focus mode will be studied to realize an effective background subtraction. For such purposes, we plan to do (^{3}He,^{3}He$'$) measurements on ^{26}Mg, ^{56}Fe and ^{58}Ni targets, and also on a heavier mass target such as Sn isotopes. It is expected that the obtained results will show the overall view of the $E1$ strengths, and they are compared with the existing (γ, γ') and $(\alpha, \alpha'\gamma)$ data and also the (γ, n) results showing the $E1$ response in the energy region below and above S_n, respectively.