RCNP EXPERIMENT E158

PROPOSAL FOR EXPERIMENT AT RCNP

28/08/2000

TITLE:

Study of Isospin Structure by the Comparison of (^{3}He,t) and (p,p') Reactions
Update Proposal E113

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REQUEST TIME:

Request Time for Data Runs 6 days

BEAM REQUIREMENTS:

Type of particle	$(^3\mathrm{He}, \mathrm{t})$
Beam energy	405 MeV
Beam intensity	$\approx$ 10 nA on Target
Injection mode	High Resolution Mode
WS transport mode	Dispersive Modes

BUDGET:

Summary of budget request	1.3 Million yen.
For the preparation of targets	1.0 Million yen.
For the travel expense	0.3 Million yen.

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Summary of Experiment

We study the isospin symmetry structure i.e. the symmetry structure in z components of isospin T, and physics quantities being obtained based on the isospin symmetry structure for $T = 0$, $T = 1/2$, $T = 1$ and $T = 3/2$ nuclei. The possibility of studying $T > 2$ nuclei are also sought. The isospin symmetry structure is studied based on the fact that energies and strengths of Gamow-Teller (GT) transitions of β_+ and β_- types and also of $M1$ transitions are all similar, if the transitions are analogous, i.e. if the initial or the final states are the same or analogous. These transitions are of the lowest multipole with $\Delta L = 0$, $\Delta S = 1$, and $\Delta T = 1$ and are dominantly caused by the $\sigma\tau$ type operator.

In obtaining GT transition strengths B(GT), (p, n) reaction has been established to be useful owing to the good proportionality between the cross-section at 0° and the B(GT). It could overcome the decay window limitation inherent to the β decay and the B(GT) distributions were studied up to high excitation. High-resolution (^{3}He, t) reaction at an intermediate incident energy is a new spectroscopic tool. With an expected resolution of well less than 50 keV, it is possible to study the detailed B(GT) distribution up to highly excited region.

By comparing energies and strengths of individual Gamow-Teller transitions available from the high resolution (^{3}He, t) reaction with those from β decay and (n, p) type reactions as well as with those of $M1$ transitions from $M1$ γ decay, (e, e') and (p, p') reactions, analogous states are identified, and then isospin symmetry structure is studied.

The identification of analogous states is based on the "level-by-level" base. A high resolution, therefore, is indispensable. Up to now (^{3}He, t) data has been obtained with 70-150 keV resolutions by using the old WN course. With the use of new WS course, a resolution well less than 50 keV is expected.

The relative cross section for the (^{3}He, t) reactions from several medium mass targets will be measured over the angular range from 0°–2.0° with the Grand Raiden spectrometer at 135 MeV/nucleon incident ^{3}He energy. The excitation energy range will cover up to $E_x \leq 30$MeV. The WS course and the Ring Cyclotron will be tuned so as to realize the *dispersion matching mode* in order to attain the theoretical resolution of around 20-30 keV for the total system combined with the spectrometer. A good angular resolution of 4-6 mrad is expected even under the condition of *dispersion matching* owing to the it angular dispersion matching being realized by the use of newly constructed WS course. The angular distribution thus obtained permit us to distinguish between $L = 0$ and $L = 1$ transitions.

More difficult high-resolution 0° (p, p$'$) measurements should be realized in combination with the *dispersion matching*. By using the WS course, we expect an experiment realizing simultaneously less background condition, better resolution and good angular resolution. We will perform developments to realize low background and high-resolution 0° (p, p$'$) measurements under the condition of *dispersion matching*, in which beam is rather wide on target.