

PROPOSAL FOR EXPERIMENT AT RCNP

28/08/2000

TITLE:

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

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EXPERIMENTAL GROUP:

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REQUEST TIME:

Request Time for Data Runs 6 days

BEAM REQUIREMENTS:

Type of particle	(³ He, t)
Beam energy	405 MeV
Beam intensity	≈ 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 $B(\text{GT})$, (p, n) reaction has been established to be useful owing to the good proportionality between the cross-section at 0° and the $B(\text{GT})$. It could overcome the decay window limitation inherent to the β decay and the $B(\text{GT})$ distributions were studied up to high excitation. High-resolution ($^3\text{He}, t$) 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 $B(\text{GT})$ distribution up to highly excited region.

By comparing energies and strengths of individual Gamow-Teller transitions available from the high resolution ($^3\text{He}, t$) 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 ($^3\text{He}, t$) 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 ($^3\text{He}, t$) 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 ^3He energy. The excitation energy range will cover up to $E_x \leq 30\text{MeV}$. 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.