RCNP EXPERIMENT E197

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE: # Detailed Study of Gamow-Teller Strengths in $T=1$ fp Shell Nuclei

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EXPERIMENTAL GROUP:

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RUNNING TIME:

	Beam tuning time	1.5 days
	Set up time of the matching conditions	0.5 days
	Data runs	4 days
	Mesuremente time for calibration targets	0.5 days
BEAM LINE:		Ring : WS course
BEAM REQUIREMENTS:	Type of particle	^{3}He
	Beam energy	420 MeV
	Beam intensity	$\sim$ 30 nA
	Energy resolution	$\Delta E \leq 100$ keV (Achromatic mode), small emittance
BUDGET:	For the preparation of targets	1.5 Millon yen

TITLE: **Detailed Study of Gamow-Teller Strengths in $T=1$ fp Shell Nuclei**

SPOKESPERSON: Tatsuya Adachi

SUMMARY OF THE PROPOSAL

We propose to study the Gamow-Teller (GT) excitations in fp-shell nuclei ^{54}Co, ^{50}Mn, ^{46}V, and ^{42}Sc with the $(^3\mathrm{He}, t)$ charge-exchange (CE) reactions on target nuclei ^{54}Fe, ^{50}Cr, ^{46}Ti, and ^{42}Ca, respectively. Target nuclei have ground-state (g.s) isospin $T=1$ and final nuclei have isospin $T=0$.

The low-lying excitation energy (E_x) region of these odd-odd $N=Z$ nuclei are particularly interesting, since strong $T=0$, GT excitations with $J^\pi = 1^+$ and a $T=1$, Fermi excitation with $J^\pi = 0^+$ exist in the same region. It looks as if they form a quasi-deutron. Therefore, they are suited for the study of isovector ($T=1$) and isoscalar ($T=0$) channels of the proton-neutron interaction.

A high-resolution $(^3\mathrm{He}, t)$ experiment on $T=1$ fp-shell nuclei was first performed on a ^{58}Ni target at RCNP by the present group. In the final nucleus ^{58}Cu, discrete GT states are identified up to high E_x region of about $E_x = 14$ MeV. The isospin value T of each state was identified in comparison with the results of a (p, p') experiment, and thus the GT strength distribution was obtained for $T=0,\ 1$ and 2 states. How well these GT strength distributions and the fine structures can be determined has been one of the most active areas of experimental and theoretical structure studies. Therefore, studying GT transitions up to highly excited region for fp-shell nuclei itself is very important. In addition, these GT transitions are also of astrophysics interest.

For this study, a 140 MeV/nucleon ^{3}He beam from the RCNP Ring Cyclotron will be used to excite the target nuclei. The out going tritons are momentum analyzed by the spectrometer Grand Raiden at 0°. In these experiments a high energy resolution of less than 40 keV is very important, which has been achieved only at RCNP for intermediate energy CE reactions. Also important is the good angle resolution of the scattering angle around 0° and the capability of reconstructing the angle. The ion-optical conditions *dispersion matching* and *angular dispersion matching* will be realized between the spectrometer and the the newly constructed WS beam line to achieve a high resolution and good angle resolution, respectively. The over-focus mode of the spectrometer is essential in realizing good angle resolution in vertical direction and also in correcting kinematic aberrations.

In the $(^3\mathrm{He}, t)$ reaction at 140 MeV/nucleon, it has been established that there is a "specific" proportionality, i.e., a proportionality between the cross sections at 0° and the transition strengths $B(\mathrm{GT})$ in one specific nucleus. Unfortunately there is not enough data to discuss "the universal" proportionality. In order to answer this question, we plan to study a few nuclei, like ^{30}Si, ^{42}Ca or ^{62}Ni, in which $(^3\mathrm{He}, t)$ results can be directly calibrated with the β-decay results.