E424

RCNP EXPERIMENT E***

PROPOSAL FOR EXPERIMENT AT RCNP

February 11, 2014

TITLE:
High-resolution study of Gamow-Teller transitions in odd-A high S_p nuclei

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RUNNING TIME:

Measurements for ^{51}V, ^{55}Mn, ^{59}Co target nuclei at 0° and 2.5°	3.0 days
Measurements for calibration and reference targets	0.5 days
Beam preparation, dispersion matching, sieve slit runs	1.5 days

BEAM LINE:

Ring : WS course, high resolution mode

BEAM REQUIREMENTS:

Type of particle	^{3}He
Beam energy	420 MeV
Beam intensity (max.)	25 nA
Energy resolution	$\Delta E \leq 100$ keV, small emittance

BUDGET:

Material ^{51}V, ^{55}Mn, ^{59}Co :	50k yen

SCHEDULE:

We request the beam time in November, December, 2014.

1 Summary of Experiment

• Summary of proposal and experiment:

Our present proposal is to study β^--type Gamow-Teller (GT^-) transitions starting from ^{51}V, ^{55}Mn, and ^{59}Co target nuclei in high energy-resolution (^{3}He, t) experiments. In addition, we have a future plan to make a γ-coincidence experiment using the CAGRA HPGe sphere detector array to be constructed at RCNP.

It has been well established that (^{3}He, t) reactions at 0° and intermediate incident energies are good tools to study GT transitions. Under these conditions, GT states (states excited by GT transitions) are selectively excited. With the increase of the resolution in the (^{3}He, t) measurement using the dispersion matching techniques, a resolution $\approx$ 30 keV is regularly obtained at an incident ^{3}He energy of 140 MeV/nucleon. With this resolution, highly fragmented structures of GT states have been observed at the Grand-Raiden spectrometer up to a few to several MeV above the proton separation energy S_p. Above this energy, the decay widths start to smear the spectrum. It was found that fragmented structures are very common for nuclei up to pf-shell region.

The odd-A isotopes ^{51}V, ^{55}Mn, and ^{59}Co are odd Z and even N nuclei with $T_z = +5/2$. The final nuclei after the (^{3}He, t) reaction on these proposed target nuclei are ^{51}Cr, ^{55}Fe, and ^{59}Ni, respectively. Therefore, relatively high level densities of GT states are expected in the highly excited energy region of the so-called Gamow-Teller Resonance (GTR) region ($\approx 6 - 13$ MeV) of the final nuclei; even with the high resolution of $\approx$ 30 keV, we expect that it is rather difficult to fully separate densely populated GT states. However, we note that these even-Z and odd-N final nuclei have rather large S_p values; their S_p values are as high as $\approx$ 9 MeV. Such S_p values are very high among final nuclei that can be reached by the β^--type (^{3}He, t) reaction on stable target nuclei in the pf-shell region. The γ decay, in principle, can be studied for the states up to the lowest particle separation energy. Therefore, by taking a coincidence of outgoing tritons with decay γ rays, a factor of 3 to 4 better resolutions ($\approx 5 - 7$ keV) can be achieved in the identification of GT states.

In the measurements proposed here, we intend to study the strength distributions of GT states in the final nuclei ^{51}Cr, ^{55}Fe, and ^{59}Ni. Among these isotopes, we will select the best target nucleus for the coincidence experiment, which we plan to propose as the second step.

• Apparatus and beam properties:

The spectrometer Grand Raiden and the standard VDC focal plane detector system will be used for the analysis and detection of outgoing tritons. We request $\approx$ 25 nA of good quality single-turn extracted 420 MeV ^{3}He beam. In order to realize various matching conditions, including the dispersion and angular dispersion matching conditions, full capabilities of the WS course will be utilized.

• Beam time request:

Measurement for ^{51}V, ^{55}Mn, and ^{59}Co targets at 0° and 2.5°: 3.0 days
Measurements for calibration and reference targets
(for example, mylar, CH_2, ^{13}C, ^{nat}Mg ...) : 0.5 days
Beam preparation, dispersion matching, sieve slit runs : 1.5 days

• Schedule:

We request the beam time in November or December, 2014.