E356

RCNP EXPERIMENT E***

PROPOSAL FOR EXPERIMENT AT RCNP

July 12, 2010

TITLE:

High-resolution study of Gamow-Teller transitions starting from ^{20}Ne and ^{22}Ne

SPOKESPERSON(s):

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RUNNING TIME:

^{20}Ne and ^{22}Ne, and natural Ne gas data taking runs	1.0 day
Measurements for calibration runs	0.5 day

BEAM LINE:

Ring : WS course, high resolution mode

BEAM REQUIREMENTS:

Type of particle	^{3}He
Beam energy	420 MeV
Beam intensity (max.)	10 nA
Energy resolution	$\Delta E \leq 100$ keV, small emittance

BUDGET:

Enriched target gas ^{20}Ne and ^{22}Ne:	300k yen
Target gas cell for dispersion matched beam:	50k yen

SCHEDULE: We request the beam time in December, 2010.

1 Summary of Experiment

• Summary of proposal and experiment:

Our aim is to study β^--type Gamow-Teller (GT^-) transitions starting from ^{20}Ne and ^{22}Ne target nuclei in the high energy-resolution (^{3}He, t) experiments. It is suggested that $T_z = 0$ nucleus ^{20}Ne is well deformed. Assuming a Nilsson's deformed shell-model, we find that ^{20}Ne will behave as if it were a "doubly magic" nucleus as for the GT^- transitions are concerned. It is intriguing whether we can see the hindrance of GT transitions associated with the doubly-magic nature.

On the other hand, the nucleus ^{22}Ne, has $T_z = 1$, among other *sd*-shell nuclei ^{18}O, ^{26}Mg, and so forth. Thus, $J^\pi = 1^+$, GT states with $T = 0$ are expected in the low-lying region of ^{22}Na and $T = 1$ and 2 GT states in the higher excited region. However, the GT^- transition strength from ^{18}O is concentrated in only one low-lying $T = 0$ state and that from ^{26}Mg is distributed among three different T states. Our concern here is whether we see "transitional" behavior for the GT transition from ^{22}Ne.

It is known that (^{3}He, t) experiments at forward angles including 0° and a beam energy of 140 MeV/nucleon are a unique tool to study GT^- transition strength. Because of the simplicity of reaction mechanism, and also the dominance of the $\sigma\tau$ interaction at 0°, the B(GT) values that are proportional to the square of the transition matrix element can be derived accurately.

In the (^{3}He, t) experiment, a high energy resolution of less than 30 keV is important in order to separate GT (and Fermi) states and also to determine the widths of states. Also important is the good angular resolution and the capability of reconstructing the scattering angle. The ion-optical conditions *dispersion matching* and *angular dispersion matching* will be realized between the spectrometer and the WS beam line to achieve a high energy-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. A gas target system developed at RCNP will be used.

• 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 $\approx$ 10 nA of good quality single-turn extracted 420 MeV ^{3}He beam. In order to realize various matching conditions, including the dispersion matching condition, full capabilities of the WS course will be utilized.

• Beam time request:

Measurement of ^{20}Ne, ^{22}Ne and natural Ne gas targets : 1.0 day
Sieve-slit run, measurement of $^{\rm nat}$Mg, for calibration purposes and the empty cell run without gas for the back ground subtraction : 0.5 day
The total requested beam time : 1.5 days
(Note : for the beam tuning and the achievement of the dispersion matching, we need additional 2 days.)

• Schedule:

We request the beam time in November or December, 2010. We request that the present beam time will be performed as a part of the campaign of high energy-resolution (^{3}He, t) measurements using the gas target system.