RCNP EXPERIMENT E322

PROPOSAL FOR EXPERIMENT AT RCNP

May 19, 2009

TITLE:
High resolution study of the ^{71,69}Ga(^{3}He,t) reactions at 0.42 GeV and GT neutrino responses for ^{71,69}Ga

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R. Zegers	MSU/NSCL, East Lansing, Michigan, USA	Assistant Professor

RUNNING TIME:

^{130}Te data taking runs	18 shifts
Measurement time with calibration	3 shifts
Beam tuning and beam preparation time	3 shifts
Total	24 shifts

BEAM LINE: Ring : WS course

BEAM REQUIREMENTS:

Type of particle	^{3}He
Beam energy	420 MeV
Beam intensity	20 nA
Energy resolution	$\Delta E \leq 30$ keV, small emittance

BUDGET: Support for PhD students and Postdocs (Muenster and Bratislava) during their stay in Japan. Local support for non-RCNP participants.
Local travel support for participants coming far from Osaka.

SCHEDULE: The beam time preferentially in the period from the end of 2009 to the middle of 2010.

RCNP EXPERIMENT E327

TITLE:
High resolution study of the ^{71,69}Ga(^{3}He,t) reactions at 0.42 GeV and GT neutrino responses for ^{71,69}Ga

SPOKESPERSON: H. Akimune, H. Ejiri, D. Frekers, R. Zegers

SUMMARY OF THE PROPOSAL

1. Proposed experiment:
   The GT-strength distribution in the reactions ^{71}Ga(^{3}He, t)^{71}Ge and ^{69}Ga(^{3}He, t)^{69}Ge with highest possible energy-resolution.

2. Motivation and objective
   High energy-resolution studies are made on the ^{69,71}Ga(^{3}He, t)^{69,71}Ge reactions to study the GT strengths relevant to the solar neutrino capture rates for 71Ga. The neutrino capture rates have been calibrated by using the low-energy neutrinos from ^{51}Cr and ^{37}Ar. The GT strengths for low-lying states are crucial for these neutrino studies.

   The present experiment aims at studying the (^{3}He, t) reaction mechanism and the GT strengths for the low-lying 1/2-, 5/2-, 3/2-, and other states in ^{71}Ge by the (^{3}He, t) reaction. Contributions from the l=2 transition and the tensor interaction to the weak GT states are studied by observing the angular distributions. The ^{69}Ga(^{3}He,t)^{69}GaGe reaction with known ft value for the 5/2- state is studied to investigate the (3He, t) reaction mechanism and to deduce the GT strengths from the (^{3}He, t) cross sections.

3. Apparatus and beam properties
   The proposal asks for a 140 MeV/nucleon ^{3}He beam from the RCNP Ring Cyclotron. The Grand RAIDEN spectrometer and the standard focal plane detection system will be used for the detection of outgoing tritons. The momentum and angular dispersion matching technique will be employed to achieve a high momentum and high angle resolution. The over-focus mode of the spectrometer is essential for good angular resolution in vertical direction and, moreover, for correcting kinematic aberrations. We have seen in the E220 experiment on ^{48}Ca and in the E294 experiment on ^{76}Ge, ^{96}Zr and ^{100}Mo that an angular distribution up to 4° can be obtained by measuring at two angle settings, one at 0° and one at 2.5°. This may be sufficient to identify œ*B*œ(Bl = 0 GT transitions. We perform a measurement at a third angle in order to discriminate tensor and GT

transitions, where the former shows a much less steep decrease of the angular distribution. We request $\approx$ 20 nA single-turn extracted 3He beam of good quality. In order to realize various matching conditions, the capabilities of the WS course will be employed.

4. Target

   High-resolution (^{3}He, t) measurements demand that the effect of energy spread in the target be minimized. The energy spread in the target is mainly caused by the energy losses of ^{3}He and t particles, and thus, a sufficiently small target thickness is important. Thin ^{71}Ga and ^{69}Ga targets of about 1 mg/cm^2 will be made available by the Muenster group. The relevant expertise is locally available in Muenster. The targets will either be self-supporting or sandwiched between two thin carbon foils and transported to Japan in a special cool-box to avoid liquifaction (melting temperature of Ga:Tm = 29.8° C).