The test experiment for nuclear responses for double beta neutrinos and double spin isospin resonances

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Double beta decays ($\beta\beta$) are of current interest in view of particle, astro and nuclear physics[1-5]. Neutrino-less double beta decays ($0\nu\beta\beta$), which require the neutrino helicity mixing, are sensitive to the Majorana masses of light and heavy neutrinos(ν), right-left mixings of weak currents, and to SUSY-neutrino couplings, and others beyond the standard theory. Finite ν-masses give contributions to non-baryonic hot dark matters in the universe.

Nucleon (quark) sectors of double beta decays include mainly double isospin-flip and double isospin flip nuclear weak responses. The nuclear spin-isospin operator $\sigma\tau$ results in the broad GTR (Gamow Teller resonance) and double GT ones(DGTR). Recently, $\beta\beta-\nu$ responses have been analyzed in terms of couplings of single particle-hole GT states and GTR. Here DGTR play crucial roles for the $\beta\beta-\nu$ responses.

Double giant resonances are of great interest to see resonance features at high excitation energy regions[6-14]. DGTR standing on the GTR, however, have not well studied.

It is shown that nuclear weak responses relevant to the isospin and isospin-spin mode are investigated by studying strong processes of charge-exchange(isospin-flip) spin-flip nuclear reaction. Actually, charge-exchange (^{3}He,t) reactions with E(^{3}He) = 450MeV are used to study isospin spin responses for $\beta\beta$-nuclei. The charge-exchange reactions at the intermediate energy excite preferentially the isospin spin modes.

This proposal aims at studies of double spin-isospin responses in view of the $\beta\beta-\nu$ decays. The double isospin spin giant resonances are investigated by means of double charge-exchange nuclear reactions. E115 has been proposed by H.Ejiri, et. al. in 1997 to study double GT strengths and nuclear responses for $\beta\beta-\nu$'s by means of the (^{11}B,^{11}Li) reactions at RCNP. It was approved in 1997. Since then, the ^{11}B beam adequate for the experiment has not been available, and thus the experiment has not been carried out.

At the present, ^{11}B(E=751MeV) and 5nA beam by RING-cyclotron was available[15]. The spectrometer Grand Raiden will be set at 0 degree with equal horizontal and vertical opening angles of 30 mr each. The full solid angle is 1.6 msr which will be divided later on by software cuts. The $^{11}B^{5+}$ beam enters the spectrometer at this angle but will be deflected because of its lower magnetic rigidity into an internal Faraday cup in the first dipole (D1) magnet of the Grand Raiden spectrometer. The thin foil was attached to reduce the ($^{11}B^{5+}$,$^{11}B^{3+}$) reaction.

At this test experiment(E177), the (^{11}B,^{11}Li) double charge exchange reaction was carried out by using of ^{11}B(E=751MeV) beam by RING-cyclotron about 2 days. We can clearly identify the scattered ^{11}Li particle by using the drift time and energy loss technique. Therefore, the (^{11}B,^{11}Li) double charge exchange reaction have been shown possible. The pleliminary result of the ^{56}Fe(^{11}B,^{11}Li) double charge exchange reaction is shown in Figure 1. This experiment is based on the proposal E115.

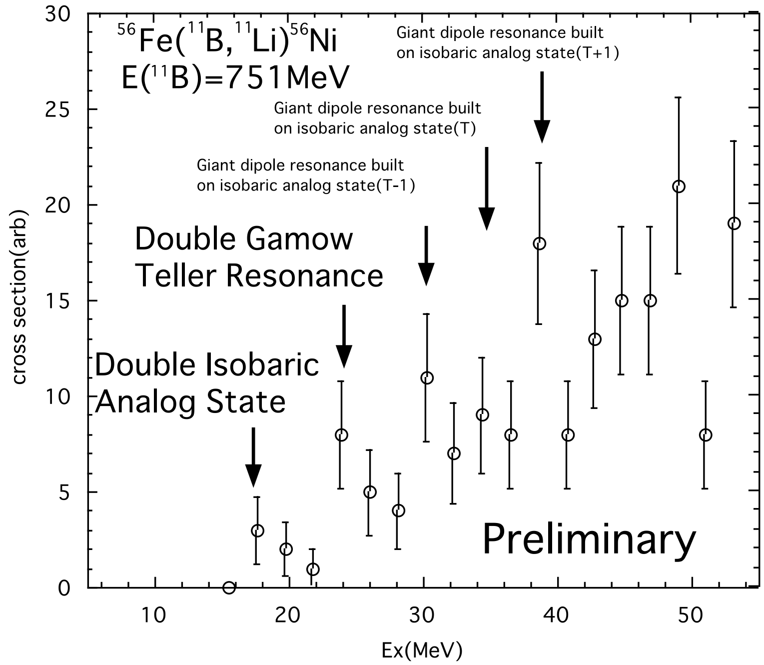

Figure 1: The pleliminary result of the ^{56}Fe(^{11}B,^{11}Li) double charge exchange reaction

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