First Evidence of Double Spin Isospin Excitation

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Double beta decays (ββ) are of current interest in view of particle, astro and nuclear physics. Nucleon (quark) sectors of double beta decays include mainly double spin-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).

Double giant resonances are of great interest to see resonance features at high excitation energy regions. 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 are used to study isospin spin responses for ββ-nuclei. The charge-exchange reactions at the intermediate energy excite preferentially the isospin spin modes. In the case of the (π^+,π^-) double charge exchange reaction, pion has zero spin, therefore pion could not excite the spin flip DGTR excitations.

The (^{11}B,^{11}Li) reaction is one of the most lightest heavy ion double charge exchange reaction.. The (^{11}B,^{11}Li) double charge exchange reaction was carried out by using of ^{11}B (*Ei* = 758 **MeV**) beam by RING-cyclotron. The spectrometer Grand Raiden will be set at 0 degree with equal horizontal and vertical opening angles of 30 **mr** each. We can clearly identify the scattered ^{11}Li particle by using the drift time and energy loss technique.. We have measured the ^{13}C(^{11}B,^{11}Li)^{13}O reaction. The sharp peak of ^{13}O ground state has clearly seen. The energy calibration of the spectrometer has made by this peak. The experimental data of ^{56}Fe(π^+,π^-) (**ΔT**=2,**ΔS**=0) reaction existed. In this reaction, DIAS and GDR*IAS were observed. Meanwhile, ^{56}Fe(^{11}B,^{11}Li) (**ΔT**=2,**ΔS**=2) reaction is possible to excite not only DIAS and GDR*IAS ,but also DGTR. The preliminary result of the ^{56}Fe(^{11}B,^{11}Li) reaction was shown the similar spectrum of ^{56}Fe(π^+,π^-) reaction in the DIAS and GDR*IAS region. The DGTR region of ^{56}Fe(^{11}B,^{11}Li)^{58}Ni shows the forward angle peak.

We have established the (^{11}B,^{11}Li) reaction. The DGTR region of ^{56}Fe(^{11}B,^{11}Li)^{58}Ni shows the forward angle peak. Compare to the (π^+,π^-)reaction, we can see not only the DIAS and GDR*IAS but also other component such as DGTR. From these facts we conclude that the (^{11}B,^{11}Li) reaction at 70 **MeV**/nucleon is a good spectroscopic tool. We believe that the reaction can be well applied to the study of pure spin-flip nuclear responses in higher-excited regions including DGTR and higher **ΔL** excitations. The setup enables us to get information on the double spin isospin exchange response about double beta decay nuclei.