Title:

Double Gamow–Teller transition studied by double charge exchange reaction of (^{12}C, ^{12}Be(0^+_2)) at 250 MeV/nucleon

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Abstract:

Double Gamow–Teller (DGT) transition is a nuclear process in which both of the spin and isospin are flipped twice without a change in the orbital angular momentum. Giant resonance in DGT transition, DGT giant resonance (DGTGR), is expected to exist, but there is no established observation so far. The observables of the DGTGR will provide information on the collective excitation in the spin-dependent domain. In addition to that, it is suggested that the observables of the DGTGR will constrain the nuclear matrix element of the neutrino-less double beta decay.

We are aiming to observe the DGTGR using the double charge exchange reaction of (^{12}C, ^{12}Be(0^+_2)). The final state of this reaction, ^{12}Be(0^+_2), decays into ground state with emitting electron-positron pair. We utilize this feature to identify the reaction channel by detecting 511 keV gamma-ray deriving from ^{12}Be(0^+_2).

We performed the first experiment at RI Beam Factory (RIBF) using (^{12}C, ^{12}Be(0^+_2)) for ^{48}Ca target with the primary beam of ^{12}C with the energy of 250 MeV/nucleon. The measurement was performed with the energy resolution of 1.5 MeV and the angular resolution of 0.2˚, and we observed forward peaking structure around 20 MeV in the excitation energy of ^{48}Ti. This is the candidate for the DGTGR. The cross section at the forward angular region was evaluated as 1.33±0.12 μb/sr below 34 MeV.

The DGT transition strength B(DGT) was evaluated from the observed cross section by performing the multipole decomposed analysis based on the distorted-wave Born approximation. The centroid energy and the width of the B(DGT) below 34 MeV are E_c=23±3 MeV and Γ=6±1 MeV, respectively. Though this first result could not constrain the NME, the future high-statistics experiment will give more information. The future plan will also be provided in the talk.