SEARCH FOR DOUBLE GAMOW-TELLER RESONANCE VIA HEAVY-ION DOUBLE CHARGE EXCHANGE REACTION

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Among all two-phonon excitation modes, a Double Gamow-Teller Resonance (DGTR) is a missing piece for better understanding of two-phonon states in terms of the nuclear spin-dependent correlations. Possible existence of the DGTR was first proposed by Auerbach, Zamick, and Zheng in 1989 [1]. A basic question concerning the DGTR is that if the DGTR is a simple superposition of GTRs. According to conclusive results of pion double charge exchange reaction studies, double isobaric analogue resonances and double giant dipole resonances are the simple superposition [2]. However, the nuclear response can be anharmonic and we can expect occurrence of anharmonicity, especially when the spin-degrees of freedom play a role. Therefore, the experimental observation of the DGTR provides us with a unique opportunity to investigate the effect.

Heavy-ion double-charge exchange (HIDCX) reactions are the most promising spectroscopic tools for DGTRs. It can induce two-phonon excitations with spin and isospin transfer by two units [3]. In spite of the potential of HIDCX reactions as probes to DGTRs, there have not been many experiments with the reactions. The reason is that it is difficult to find a reaction with significant DGT strengths and a clear event identification capability. We have succeeded in inventing a new experimental method based on the (^{12}C,^{12}Be(0^+)) reaction that is free from the difficulties. The idea has been conceived through our previous double charge exchange studies with the ^{12}C(^{18}O,^{18}Ne)^{12}Be reaction. In the experiment, we found that this reaction has relatively large cross section for the second 0^+ state of ^{12}Be at 0 degree. This is because the ^{12}Be(0^+_2) state in the final state is dominated by $0\hbar\omega$ configuration as well as the initial ^{12}C($0^+_{g.s.}$) and intermediate ^{12}B($1^+_{g.s.}$) states. Furthermore, this reaction bears an additional strong point: identification of the final state in the ejectile (^{12}Be) is possible by detecting the delayed γ-ray emitted from the ^{12}Be(0^+_2) state. The ^{12}Be(0^+_2) state is a long-life isomer state and has a lifetime of 331 ns [4].

To investigate the DGTR in ^{48}Ti, we performed the ^{48}Ca(^{12}C,^{12}Be(0^+_2)) reaction experiment at Research Center for Nuclear Study (RCNP), Osaka University. The 100A MeV ^{12}C beam bombarded a ^{48}Ca-enriched target with the areal density of 10 mg/cm^2. The outgoing particles were momentum-analyzed with the high-resolution magnetic spectrometer Grand Raiden. Excitation energies of residual nuclei were measured with a missing mass method. The momentum-analyzed ^{12}Be was stopped in one plastic scintillator at a focal plane and detected γ-rays from ^{12}Be(0^+_2) state with NaI scintillators.

At present, we succeed in identifications of the outgoing ^{12}Be particles and its characteristic γ-rays. Excitaion energy spectra of ^{48}Ti is going to be obtained. In the conference, the results of the ^{12}C(^{18}O,^{18}Ne)^{12}Be reaction and the DGTR search experiments will be reported.

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