Charge-exchange reactions induced by radioactive heavy-ions have potentiality for studies of a variety of spin-isospin responses due to their unique reaction kinematics and selectivities.

Among them the \(^{12}\text{N},^{12}\text{C}\) reaction has peculiar features: This reaction can be exothermic \((Q>0)\) owing to the large mass difference of about 17MeV between the \(^{12}\text{N}\) projectile and the \(^{12}\text{C}\) ejectile, and accordingly it can realize small momentum transfer even for highly-excited states. Moreover, since the final state in the \(^{12}\text{C}\) ejectile can be identified by detecting the de-excitation gamma rays, the excitation modes with the transferred quantum numbers \((S=1, T=1)\) and \((S=0, T=1)\) can be selected. These features make this reaction suitable for the study of yet-to-be-discovered states such as the isovector spin-isospin monopole resonance (IVSMR).

We performed for the first time an experiment of this exothermic charge-exchange \((^{12}\text{N},^{12}\text{C})\) reaction on a \(^{90}\text{Zr}\) target at an incident energy of 175MeV/u. The experiment was carried out at the RIB Beam Factory (RIBF) at RIKEN using the magnetic spectrometer SHARAQ and the gamma-ray detector array DALI2. The double differential cross sections were measured at the excitation energy of 0–70MeV and at the scattering angles of 0–3 degrees for both of the \((S=1, T=1)\) and \((S=0, T=1)\) modes. In the former mode, peaks for the Gamow-Teller giant resonance (GTGR) and the isovector spin monopole resonance (IVSMR) were clearly observed at \(\sim 10\) MeV and \(\sim 30\) MeV, respectively. In the latter mode, a peak for the isobaric analog state was also clearly observed at \(\sim 5\) MeV. Furthermore, we obtained the cross section of the GTGR per Gamow-Teller transition strengths of the target-residual and projectile-ejectile systems and that of the IAS per Fermi transition strengths, and found that their ratio was enhanced compared with the \((p,n)\) reaction.

In this talk, I will present the details of the experiment and discuss the results.