

Exothermic charge-exchange reactions by unstable beams with the magnetic spectrometer SHARAQ

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An unstable beam is very attractive as a reaction probe, since it has an excess mass. The excess mass can be transferred to the target nucleus as a form of an excitation energy, which leads to an exothermic reaction. The exothermic charge-exchange reaction is particularly interesting since it allows us to access unexplored spin-isospin responses of nucleus. This is because the exothermic heavy-ion charge-exchange reaction having a large positive reaction Q-value is possible to realize the condition of $\omega > q$ (time-like region) including $q = 0$ in nucleus. Here ω is the excitation energy and q is the momentum transfer. The $q \sim 0$ condition is essential to study the spin-isospin responses such as the isovector-spin monopole giant resonance (IVSM), or the double GT giant resonance (DGTGR). It should be noted that the reaction kinematics with stable beam is such that the excitation of nucleus is always associated with the finite momentum transfer ($\omega < q$ (space-like region)).

At RIKEN the Radio-Isotope Beam Factory (RIBF) has started working. It provides various unstable nuclei for the experiments. The energy range of 100-300 MeV/A provided by RIBF is most suited for the study of spin-isospin responses. The University of Tokyo has taken an initiative to construct the magnetic spectrometer called 'SHARAQ' dedicated to the high energy-resolution measurements in the experimental hall of RIBF under the Isospin-spin responses in CHarge-exchange exOthermic Reactions (ICHOR) program. SHARAQ is designed exclusively for the unstable beam experiments having a capability of full dispersion matching with an unstable-beam production beam line. Commissioning of SHARAQ is being planned to start at March 2009.

The first test experiment on the exothermic reaction of ($^{12}\text{B}, ^{12}\text{C}$) with $Q_{gg} = +15.1$ MeV was carried out using the A1900+S800 system at National Superconducting Cyclotron Laboratory (NSCL), which revealed various difficulties associated with the exothermic reactions.

In this talk, the magnetic spectrometer SHARAQ together with some planned experiments is introduced and the first test experiment at NSCL will be reviewed.