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Measurement of charge-changing cross sections of 38-43Ca/38-43Ca の荷電変化断面積測定

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The charge radius of an atomic nucleus is an important physical quantity representing its size. By considering the charge distribution of nucleons, it can be converted into the radii of the proton density distribution within the nucleus. Charged radii have been derived from measurements of electron scattering and isotope shifts; however, due to experimental limitations, the measurable nuclides are restricted to stable nuclei and some unstable nuclei. Since charge change in nuclear reactions involves a change in proton number before and after the reaction, the charge-changing cross section is known to be sensitive to the proton density distribution of the incident nucleus. In principle, the charge-changing cross section can be measured for any nucleus, provided the beam intensity is experimentally feasible, making it applicable to many unstable nuclei.
This study focused on Ca isotopes and measured the charge-changing cross section around stable nuclei, including regions with proton excess. Since charge-changing cross sections for Ca isotopes in the neutron-rich region ($^{42-51}$Ca) have been measured previously [1], this study systematically discusses charge-changing cross sections including the proton-rich region. The experiments were conducted at RIKEN RIBF as part of the TRIP project. A ^{70}Zn beam with an energy of 345 MeV/u was irradiated onto a Be production target to produce unstable nuclei via the incident nucleus spallation reaction. The unstable nuclei separated by the RI beam separation production apparatus BigRIPS and irradiated onto a carbon target (1.5g/cm^2). The average incident energy of Ca isotopes is 180–230 MeV/u. To obtain charge-changing cross sections, we counted the number of incident particles and the number of Ca isotopes (Z=20) downstream of a carbon target with a transmission method.
In this study, we measured the charge-changing cross sections of $^{38-43}$Ca on a carbon target. In this presentation, we will describe the experimental details and analysis methods, and discuss the systematics of charge-changing cross sections of Ca isotopes.

References
[1] M. Tanaka *et al.*,"Charge-changing cross sections for $^{42-51}$Ca and effect of charged-particle evaporation induced byneutron-removal reactions"Phys. Rev. C 106, 014617 (2022).

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