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Study of proton distribution of neutron-rich nitrogen isotopes through charge-changing cross section measurements

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Abstract

With large neutron-to-proton ratios far from the line of stability, nuclei develop exotic structures such as neutron skin and halo. Charge radius which is a fundamental nuclear ground-state property, seems to be changing with the increase of valence neutrons. As an example, the charge radius of ^{11}Li, where there are two valence neutrons in addition to the core ^{9}Li nucleus, is larger than that of ^{9}Li [1]. Therefore, to understand the structure of neutron-rich nuclei, it is important to know how the proton distribution of a nucleus is affected with large neutron-to-proton ratios. A new tool to determine the point-proton root-mean-square radii in exotic nuclei is to measure the charge-changing cross section. Charge-changing cross section is the sum of all interactions of the protons in the projectile due to the collision with the nucleons of the target nucleus that changes the proton number of the projectile. Thus it can be used as a probe to measure the extent of the proton distribution in exotic nuclei through Glauber model analysis of the reaction. Measurements to determine the charge-changing cross section have been done for neutron-rich $^{8-11}$Li [2], $^{9-14}$Be [3], ^{15,16}C [4], and $^{10-17}$B [5] isotopes. Here, we focus on similar systematic studies for neutron-rich nitrogen isotopes. Charge-changing cross sections of stable ^{14,15}N isotopes and unstable $^{16-22}$N isotopes on a carbon target at relativistic beam energy of around 900 MeV/u have been measured precisely using the FRS fragment separator at GSI. In this presentation, the first preliminary observations for $^{14-16}$N will be discussed.

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