Nuclear Radius Systematics around N=Z Kr Isotopes Studied via their Interaction Cross-Sections at Relativistic Energies

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Precision measurements of the interaction cross-sections ($\sigma_{\rm I}$) at relativistic energies $\sim$1 *A*GeV allow us to derive nuclear matter radii [1]. Since nuclear matter radii are directly related to the density distributions, the measurements of $\sigma_{\rm I}$ are a good probe to search for unusual nuclear structures. Neutron-deficient Kr isotopes close to the $N = Z$ line attract a particular interest in their structures. Recent γ-ray measurements have shown up that large deformations and even shape coexistence appear in this region [2]. The proton dripline nuclei in the mass range $60 < A < 100$ play an important role to determine the astrophysical rapid proton capture process path [3].

We have performed the precision measurements of the interaction cross-sections for neutron-deficient even-mass Kr isotopes using the fragment separator FRS at GSI. We have so far succeeded several experiments to determine nuclear matter radii of light nuclei ($A \leq 40$) [4-6]. The measurements for Kr isotopes are an effort to extend a series of successful experiments to heavier nuclei ($A \sim 80$).To identify the particles unambiguously we have developed the ultra-fast timing plastic scintillation counters with the timing resolution of 13 ps (σ) for ^{80}Kr beam at 1.05 *A*GeV.

The result of the interaction cross-sections of Kr isotopes clearly shows that the radii increase as the mass number decreases. This is clearly different from our early observations in the light region [6]. A systematics of the radius changes in the medium mass region around the $N = Z$ line is discussed together with the results of indirect measurements recently performed at GANIL [7]. Since the charge radii of Kr isotopes are available from the isotope-shift measurements at ISOLDE [8], the proton and the neutron radius can be extracted separately. The proton skin thickness for the neutron-deficient Kr isotopes is for the first time compared with that observed in the light nuclei.

The present experiment extended the database of the production cross-sections for exotic nuclei by studying the fragmentation of ^{80}Kr. A systematics of the production cross-sections and the charge pickup channels is compared with the reaction models such as abrasion-ablation model [9].

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