International Nuclear Physics Conference INPC2013: 2-7 June 2013, Firenze, Italy

Charge Changing Interactions Probe Point-Proton Radii of Nuclei

T. Yamaguchi[1], J. Kouno[1], T. Suzuki[1], S. Yamaki[1], and SIGMA collaboration

[1] *Department of Physics, Saitama University, Saitama 338-8570, Japan*

Contact email: *yamaguti@ribf.riken.jp*

Neutron skins of exotic nuclei are a key observation to study the equation of state (EOS) of nuclear matter [1]. The density-derivative coefficient in the EOS would be clearly defined by the precise neutron skin thicknesses of extremely neutron-rich nuclei such as ^{78}Ni.

A new approach to probe the point-proton (charge) distributions of exotic nuclei close to the drip line is currently being developed. The charge-changing cross sections σ_{cc} of stable and unstable nuclei ($^{9-11}$Be, $^{14-16}$C, $^{16-18}$O) on a carbon target were investigated at an intermediate energy, 300 MeV/nucleon. A phenomenological Glauber-type model analysis of σ_{cc} for nuclei with known charge radii indicates an approximate, but universal, scaling of σ_{cc} over a wide range of A/Z [2]. This allows the determination of the density distributions of protons bound in the neutron-rich nuclei. An application to the one-neutron halo nucleus ^{15}C and ^{16}C, where laser spectroscopy has technical difficulty, indicates a systematic evolution of proton root-mean-square radii. Combined with the matter radii obtained from the interaction cross sections [3], the present study has revealed for the first time a neutron skin effect in carbon isotopes [2].

As an extension, to examine the applicability of the present method to the whole over the chart of nuclides, the charge-changing cross sections of medium-mass nuclei ranging from $Z = 18$ to 32 (84 nuclides in total) were measured systematically. The results show a significant correlation between the measured cross sections and known charge radii. Being complementary to isotope-shift and electron-scattering experiments, the present study suggests a potential capability to explore the structures of exotic nuclei far from the stability. We will present the methodology developed with the experimental data, the results obtained, and the future physics case of Ni isotopes.

[1] M. Centelles et al., Phys. Rev. Lett. 102,122502 (2009).
[2] T. Yamaguchi et al., Phys. Rev. Lett. 107, 032502 (2011).
[3] A. Ozawa, T. Suzuki, I. Tanihata, Nucl. Phys. A 693, 32 (2001).