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Probing Neutron-Proton Correlation and 3N-force in 12C

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Direct observation of neutron-proton (np) correlations and 3N-froce in nuclei is the long-sought goal in nuclear physics. Two-nucleon knockout reactions offer a powerful tool as the reaction cross section is a direct probe of nucleon correlations. The experimental data of 12C on a carbon target reveal that the inclusive cross sections of residues from np removal channel (10B) is approximately 6-8 times greater than those for nn pair (to 10C) and pp pair (to 10Be) [1,2], already in excess of the 16/6 ≈ 2.7 ratio from simple pair counting in 12C. Such enhancement however could not be described by the calculations using eikonal reaction dynamics and microscopic structure from the effective-interaction shell model and the no-core shell model with chiral NN+3N interactions [3].

To further investigate the nature of nucleon correlations and the origin of discrepancy between the observations and theories, we have performed the first final-state exclusive np-removal cross section measurements using DALI2 gamma-detection array and SAMURAI spectrometer at RIKEN. By the gamma-residue coincidence measurement, the partial cross sections to 10B and 10Be T=0 and T=1 final sates following np and pp removal from 12C at 200 MeV/u were extracted. The experimental results indicate the insufficient treatment of T=0 np-correlations and 3N-force in the current microscopic structure models. In this talk, the experimental setup and the physics results will be discussed.

References:
[1] D. L. Olson et al., Phys. Rev. C. 28, 1602 (1983)
[2] J. M. Kidd et al., Phys. Rev. C. 37, 6 (1988)
[3] E. Simpson P. Navrátil, R. Roth, and J. A. Tostevin, Phys. Rev. C 86, 054609 (2012).

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