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Experimental study of the knockout reaction mechanism using ^{14}O at 60 MeV/nucleon

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Knockout reactions, together with the associated reaction models for deducing spectroscopic factors are the powerful tool to probe the single-particle structure and nucleon correlation in exotic nuclei. For the deeply-bound nucleon removal using C or Be target, a strong reduction in the spectroscopic factor deduced using Glauber-based reaction model from experiment relative to the shell-model calculations is found [1]. Such large disagreement has not been explained and is inconsistent with results from systematic studies of transfer reactions [2,3]. The recently observed asymmetric parallel momentum distribution of the knockout residue indicates the significant dissipative core-target interaction in the knockout reaction with a composite target [4].

To investigate the one-nucleon knockout mechanism, we have performed the fully exclusive measurement of ^{14}O using ^{12}C target at 60 MeV/nucleon at RCNP in Osaka University. Coincidence measurement of the knockout residues and the associated decay protons was achieved, which allows us to probe the core-excitation strength quantitatively via the invariant mass method. The upper limits of the cross section for one-neutron removal from ^{14}O followed by proton evaporation is obtained. The data provide the first constraint on the role of core excitation and evaporation processes in the deeply-bound nucleon removal from very asymmetric nuclei. The experimental results are consistent with the prediction of Intra-nuclear Cascade (INC), shedding light on the long-standing intriguing puzzle of the discrepancy between measurements and eikonal-model predictions for knockout reaction. In this talk, the experimental setup and the physics results will be discussed.

[1] A. Gade et al., Phys. Rev. Lett. 93, 042501 (2004).

[2] J. Lee et al., Phys. Rev. Lett. 104, 112701 (2010).

[3] F. Flavigny et al., Phys. Rev. Lett. 110, 122503 (2013).

[4] F. Flavigny et al., Phys. Rev. Lett. 108, 252501 (2012).

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