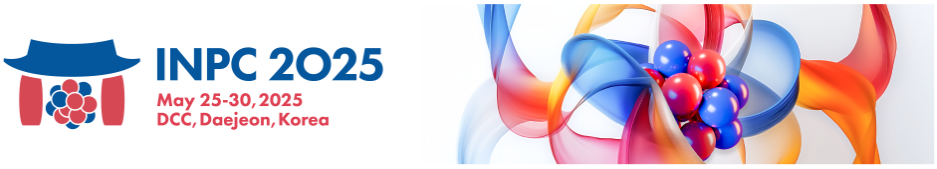

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Probing alpha clusters in the ground state of 12C via alpha-knockout reactions

Monday, 26 May 2025 14:25 (15 minutes)

Alpha clusters in light nuclei are known to play a significant role in nucleosynthesis. Among them, the Hoyle state with a three-alpha cluster structure is crucial for the synthesis of ^{12}C via the triple-alpha-fusion reaction. An ab initio no-core Monte Carlo Shell Model calculations predicted that alpha clusters present not only in the Hoyle state, but also in the ground state of ^{12}C [1]. It is thus interesting to experimentally measure the alpha cluster component in the ground state of ^{12}C and compare it with the ab initio and cluster model predictions. It could help to understand the coexistence and competition of the cluster and shell-model-like components in nuclei. Recent studies show that the alpha knockout reaction is a promising tool for probing the strength of alpha clusters in the ground state [2].
At the RCNP Cyclotron Facility, we conducted measurements of the alpha knockout reaction ^{12}C(p,pα). A 400 MeV proton beam was accelerated and irradiated onto a natural carbon target. By measuring the proton and alpha particles in coincidence using a double-arm spectrometer, we successfully obtained the alpha separation energy spectrum of ^{12}C. From the reaction yield, the differential cross-section will be determined, enabling us to extract the strength of alpha clusters in the ground state of ^{12}C.
In this presentation, we will provide a detailed introduction of the experiment and discuss the results.

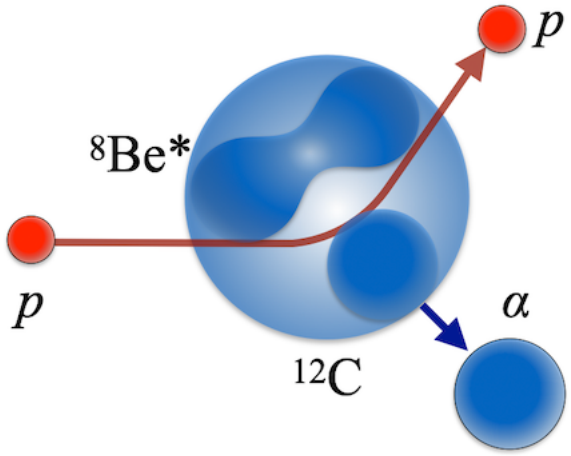

Figure 1: Illustration of alpha knockout reaction

[1] T. Otsuka, T. Abe et. al, Nat Commun 13, 2234 (2022).
[2] J. Tanaka, Z.H. Yang et. al, Science 371, 260-264 (2021).

Primary author: CHEN, Fengyi (Osaka University)

Co-authors: Mr BIAN, Jiawei (Peking University); TANAKA, Junki (RCNP, Osaka University); YANG, Zaihong (Peking University); ONOKORO COLLABORATION

Presenter: CHEN, Fengyi (Osaka University)

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