Exploration of cluster structure on neutron rich nuclei ^{16}C with SAMURAI magnetic spectrometer

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The highly excited states in weakly bound unstable nuclei have been attracting considerable interest recently. In particular, an important question is whether alpha-cluster degree of freedom emerges near the threshold in unstable nuclei as in stable nuclei. For stable nuclei, the Ikeda diagram predicts such threshold cluster states, and many experimental evidences have been reported[1]. However, this threshold-rule has not been examined for unstable nuclei.

The present study is aimed at searching cluster states in the neutron-rich nucleus ^{16}C through α inelastic scattering at incident energy of 200 MeV/nucleon. Such a technique has been successfully applied on various stable isotopes[2].

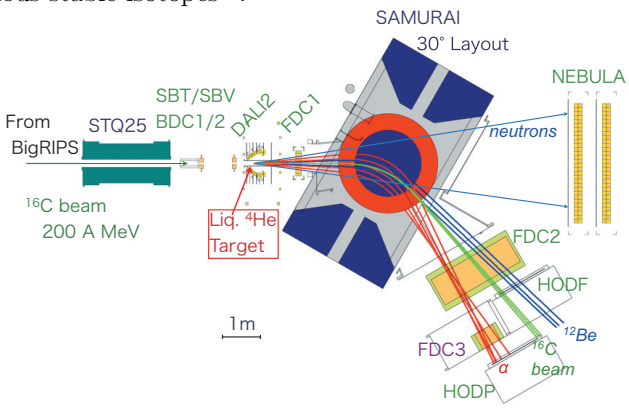

Fig. 1. Experimental setup. Detectors on the SAMURAI focal plane are arranged for α + residual particle detection.

A secondary beam of ^{16}C at 200 MeV/u and an intensity of 2×10^5 Hz is impinged on a 7 mm thick cryogenic liquid ^{4}He target[3]. The experiment was performed by using the SAMURAI spectrometer[4]. The large momentum acceptance property enables us to detect A/Z=3 particle and A/Z=2 particle including α simultaneously. The experimental setup is shown in Fig.1. The setup is similar to that used for the SAMURAI Day–one experiments[5]. The A/Z=2 particles were detected using A/Z=2 arm consisting of FDC3 and HODP. The A/Z=3 particles were detected using FDC2 and HODF (A/Z=3 arm). The correlation between ΔE and detector ID of HOD gated by the α particle in the A/Z=2 arm is shown in Fig.2, where ^{11,12}Be arising from the breakup of ^{16}C can be clearly identified.

From the measured four momenta of α particle and the corresponding Be isotopes, the invariant mass of ^{16}C* will be reconstructed. For such a purpose, multiple track reconstruction techniques on drift chambers have been developed[6]. The analyses of the data are in progress.

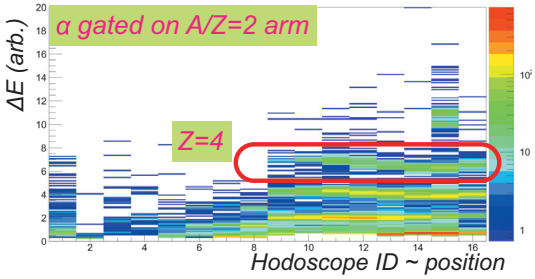

Fig. 2. Particle identification on SAMURAI focal plane. $Z=4$ particles are identified on A/Z=3 arm in coincidence with α particles, which are gated on the A/Z=2 arm.

In summary, we first measured the α dissociation channel on excited ^{16}C using the SAMURAI spectrometer. Our future scope will focus on *sd* shell neutron rich nuclei such as $^{26-30}$Ne.

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