Study of nuclear structure in proton-rich carbon isotopes

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The structures of the proton-rich carbon isotopes ^{8}C and ^{9}C were studied by the neutron transfer ^{10}C(p,t) and ^{10}C(p,d) reactions, respectively. The experiment was aimed at measuring the unknown excited states in ^{8}C, which had not been achieved in the previous studies[1–4] and identifying the decay property of the unbound first excited state in ^{9}C.

The experiment was performed in 2013 at the RIKEN RIPS facility[5]. A ^{10}C secondary beam at 51 *A*MeV was impinged on the hydrogen gas target system (CRYPTA)[6,7]. Recoiled tritons and deuterons were identified by using the ΔE-E method, with the help of the Dubna telescope consisting of an annular double-sided strip silicon detector and 16 CsI(Tl) scintillators. The reaction residues were identified by the ΔE-E method using a four-plastic-scintillator array at 0 degree[8].

The excitation energy spectrum of ^{8}C after subtracting the background is shown in Fig. 1. The ground state of ^{8}C was observed. The deduced mass excess of the ^{8}C nucleus was 34.9(1.1) MeV, which is consistent with the values reported in previous works[1–4]. The differential cross-section of the ^{10}C$(p,t)^8$C$_{\rm g.s.}$ reaction will be analyzed in order to deduce the transferred angular momentum in the reaction.

The background-subtracted excitation energy spectrum of ^{9}C is shown in Fig. 2. The known ground and first excited states in ^{9}C were observed. The deduced excitation energy of the first excited state in ^{9}C was 2.4(5) MeV, which is consistent with the value obtained in the previous experiment[9]. By tagging the residual nucleus separated by the detectors at 0 degree, the decay paths of the first excited states in ^{9}C will be determined.

In summary, the ground state of ^{8}C and the ground and first excited states of ^{9}C were observed by using the ^{10}C(p,t) and ^{10}C(p,d) reactions, respectively. Their excitation energies were consistent with the previous results. In future studies, observation of the excited states in ^{8}C with higher statistics, better energy resolution, and higher S/N ratio is expected.

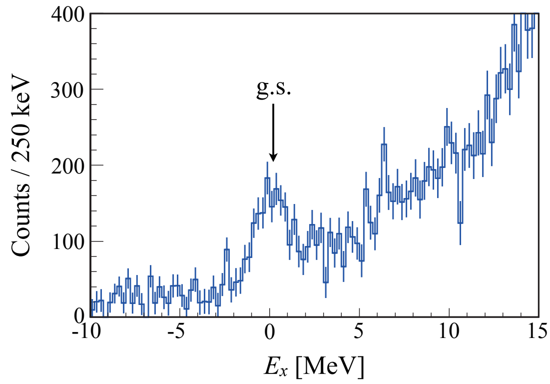

Fig. 1. The excitation energy spectrum of ^{8}C.

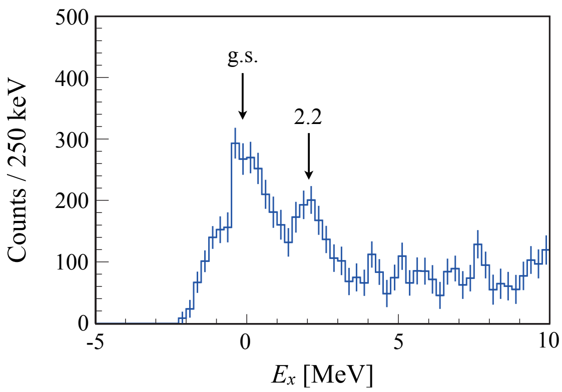

Fig. 2. The excitation energy spectrum of ^{9}C.

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