Study of the ^{9}C proton breakup reaction

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The ^{9}C proton breakup reaction was studied during the SAMURAI29 experiment at RIKEN. The reaction was studied by two methods: Coulomb dissociation and nuclear breakup. The physics goal of the experiment was to evaluate the astrophysical S_{18}-factor of the inverse process, the ^{8}B$(p,\gamma)^{9}$C, at energies relevant for astrophysics.

The SAMURAI29 experiment is the first performed among a series of 4 experiments with proton-rich secondary beams and was carried out with a 160-MeV/nucleon ^{9}C beam produced from an ^{18}O primary beam, at the F13 focal plane using the SAMURAI magnetic spectrometer. The whole experimental setup is detailed in Ref. 1) and in Ref. 2). The detection system was prepared to ensure the inclusive and exclusive measurements of the ^{9}C breakup reaction. Therefore, a silicon GLAST-type detector system and a set of two new drift chambers (PDC1 and PDC2) were used to detect the protons produced in the breakup. Both systems were used for the first time during the experiment.

The silicon detectors, the signals of which were processed using a combination of HINP16 electronics and the new Dual-Gain Preamplifiers developed by the RIKEN-ATOMKI collaboration,[3)] enabled the simultaneous detection of the proton and ^{8}B from the reaction. Therefore, they cover a large dynamic energy range, as shown in Fig. 1. Having these tracking detectors together with other SAMURAI standard detectors enabled

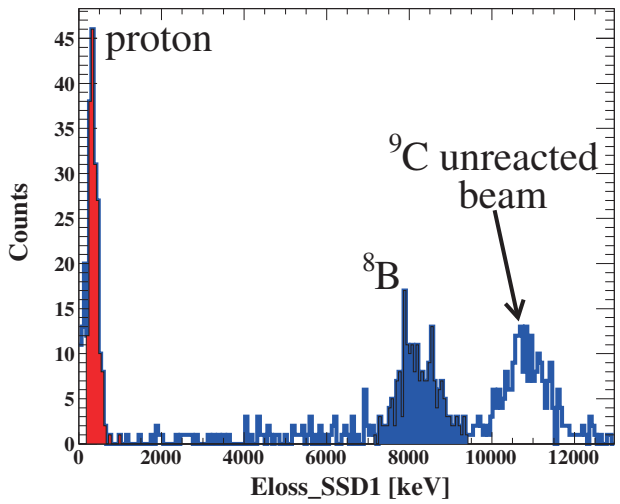

Fig. 1. Energy deposited by the proton and ^{8}B recorded simultaneously in the first layer of the silicon detector.

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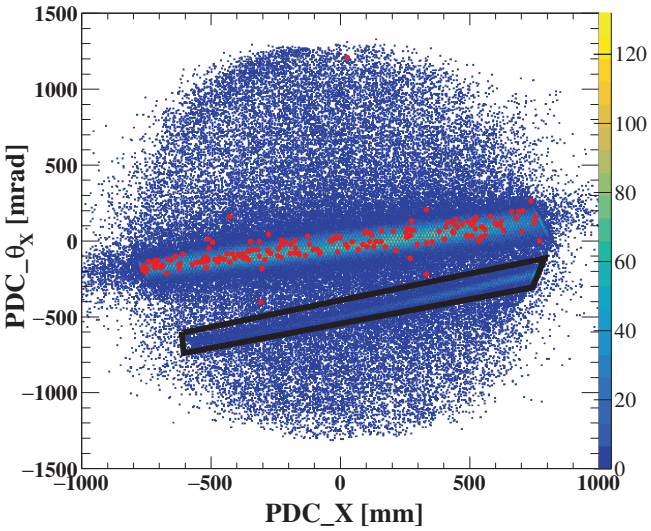

Fig. 2. Protons tracked in the proton drift chambers (PDCs).

the reconstruction of the proton momentum distribution, which provides information on the shell occupied by the removed proton in ^{9}C.

A serious complication in the analysis is the background from the interaction of the beam particles with the experimental detectors, which must be excluded from the events. One example is the protons produced in the plastic scintillator bars of the HODF, which were detected in the PDCs. In Fig. 2, the red dots indicate the protons produced in the target with the condition of coincident proton signals in the silicon detectors, whereas the events marked with the black box area in the figure are protons produced in the HODF detector.

The following steps have been achieved so far in the data analysis.

(1) The one-proton removal channel from ^{9}C nucleus is clearly separated in the data.
(2) With the tracked positions in the silicon detectors placed after the target, it was possible to reconstruct the reaction vertex.
(3) The proton and ^{8}B momentum distributions were determined.
(4) The Coulomb dissociation yield of the ^{9}C breakup as a function of the relative energy between the proton and ^{8}B was obtained.

Further analysis of the experimental data is in progress.

References

1) A. I. Chilug *et al.*, RIKEN Accel. Prog. Rep. **52**, 27 (2019).
2) A. I. Chilug *et al.*, AIP. Conf. Proc. **2076**, 060001 (2019).
3) V. Panin *et al.*, RIKEN Accel. Prog. Rep. **51**, 148 (2018).