Overview of the experimental setup of SAMURAI30 to measure the ^{11}Li(p,n) reaction in inverse kinematics

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In this report, we provide an overview of the setup used in the SAMURAI30 experiment performed at the RI Beam Factory (RIBF) of RIKEN Nishina Center in the spring of 2018.

The experiment was performed to measure the (p,n) reaction on ^{11}Li[1] and ^{14}Be.[2] A secondary cocktail beam was produced via the fragmentation reaction of a 230 MeV/nucleon ^{18}O primary beam on a 14 mm-thick ^{9}Be target installed at the F0 focal plane of the BigRIPS separator. The secondary cocktail beam consisted of ^{11}Li at 182 MeV/nucleon and ^{14}Be at 198 MeV/nucleon with purities of 48% and 19%, respectively. The total beam intensity was 5×10^5 particle/s.

The SAMURAI spectrometer[3] was used as the key device to tag the (p,n) reaction channel through particle idenfication of beam residual nuclei.[4] The large acceptance by the SAMURAI spectrometer was crucial to detect a wide range of residual nuclei with different mass and proton numbers in the same setup.

Figure 1 shows a schematic view of the experimental setup around the SAMURAI spectrometer. Two 1-mm-thick plastic scintillators (SBT1, 2) were installed downstream of STQ25 for the detection of beam particles. Two multi-wire drift chambers were installed (BDC1, 2) to tune the beam focus. The secondary beam was transported onto a liquid hydrogen (LH) target with a thickness and diameter of 10 and 60 mm, respectively[5,6] (rotated by 45°) at the secondary target position of SAMURAI (F13).

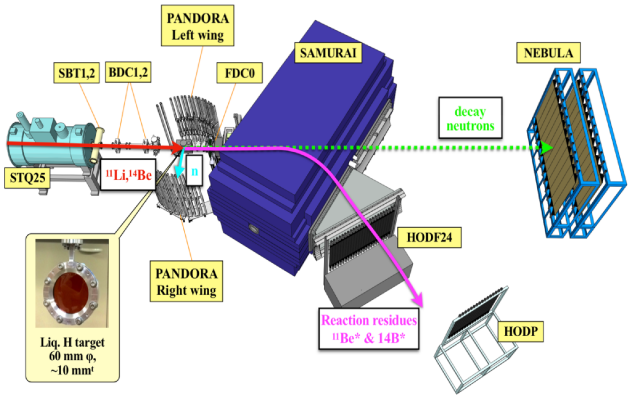

Fig. 1. The schematic view of the experimental setup around the SAMURAI spectrometer.

The PANDORA neutron detector setup consisted of 40 plastic scintillators and was placed on the left and right sides of the LH target. The neutron-gamma pulse-shape discrimination (PSD) capability of PANDORA in combination with a new DAQ system based on digitizers[7] enables the reduction of the gamma-ray background originating from the enviroment as well as from the beam.[8] PANDORA was optimized to detect neutrons with a kinetic energy of 0.1–5 MeV. The reaction residues entered SAMURAI after passing through the forward drift chamber, FDC0. The magnetic field of the spectrometer was set to 2.75 T. At the focal plane of SAMURAI, walls consisting of 24 and 16 plastic scintillator bars, HODF24 and HODP, were installed to momentum analyze the reaction residues. NEBULA was used to detect the fast decay neutrons of the reaction products (decays by $1n$ and $2n$ emissions).

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