Overview of the experimental setup of SAMURAI11 to measure the ^{48}Cr(p,n) and ^{64}Ge(p,n) reactions in inverse kinematics

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In this report, we provide an overview of the setup used in the SAMURAI11 experiment performed at the RI Beam Factory (RIBF) of RIKEN Nishina Center in the spring of 2019.

The experiment was performed to measure the (p,n) reaction on ^{48}Cr and ^{64}Ge. For each of ^{48}Cr and ^{64}Ge, a secondary cocktail beam was produced via the fragmentation reaction of a 345 MeV/nucleon ^{78}Kr primary beam on a 3 mm-thick ^{9}Be target installed at the F0 focal plane of the BigRIPS separator. The purity of ^{48}Cr (^{64}Ge) was 75.9% (58.3%) for a total beam intensity of 1.5×10^5 (1.4×10^5) particle/s.

The SAMURAI spectrometer[1)] was used as the key device to tag the (p,n) reaction channel through the particle idenfication of residual beam nuclei. The large acceptance of the SAMURAI spectrometer was crucial to detect a wide range of residual nuclei with different masses and proton numbers in the same setup.

Figure 1 shows a schematic view of the experimental setup around the SAMURAI spectrometer. Two thin 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 (Liq. H) target with a thickness and diameter of 10 and 60 mm, respectively, at the secondary target position of SAMURAI (F13).

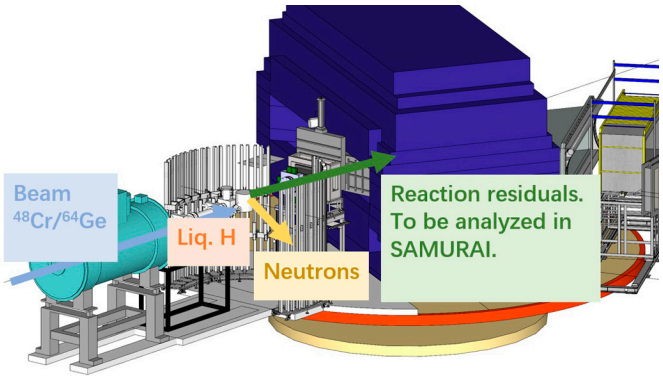

Fig. 1. Schematic view of the experimental setup around the SAMURAI spectrometer.

The PANDORA neutron detector setup consisted of 37 plastic scintillators and was placed on the left and right sides of the Liq. H target. The neutron-gamma pulse-shape discrimination (PSD) capability of PANDORA in combination with a new DAQ system based on digitizers enables the reduction of the gamma-ray background originating from the enviroment as well as from the beam.[2)] 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 chambers, FDC0 and FDC1. The magnetic field of the spectrometer was set to 1.45 (1.36) T for the ^{48}Cr (^{64}Ge) beam. At the focal plane of SAMURAI, the beam residue particles were tracked by FDC2K/3K drift chambers, followed by plastic scintillator walls HODS. In this experiment, a high rate of accepted triggers of approximately 5 kHz was achieved by employing a new method.[3)]

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References

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