Measurement of the ^{132}Sn(p,n) reaction at 270 MeV/nucleon

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Among the collective modes[1)], the Gamow-Teller (GT) giant resonance is an interesting excitation mode. It is a $0\hbar\omega$ excitation characterized by the quantum-number changes of orbital angular momentum ($\Delta L = 0$), spin ($\Delta S = 1$), and isospin ($\Delta T = 1$), and induced by the transition operator $\sigma\tau$. In the stable nuclei in medium or heavier mass regions ($A > 50$), the collectivity in this mode exhibits the GT giant resonance (GTGR), which gives information that is critically important for understanding the isovector part of the effective nucleon-nucleon interaction[2)] and the symmetry potential of the equation of the state[3)].

The goal of the NP1306-SAMURAI17 experiment performed in Spring 2014 was to extract the GT and spin-dipole (SD) transition strengths over a wide excitation range covering their giant resonances on the key doubly magic nucleus ^{132}Sn via the charge-exchange (p,n) reaction at 270 MeV/nucleon in inverse kinematics. This is an essential step toward establishing comprehensive theoretical models for nuclei situated between ^{78}Ni and ^{208}Pb; at the same time, this is a milestone for extending the research on various phenomena in stable nuclei such as GT quenching, and nuclear weak processes of astrophysical interest, to the neutron-rich region far from the beta stability. An experimental technique based on the missing mass spectrocopy[4,5)] was employed to reconstruct the excitation energy spectra for the reaction.

In the experiment, a secondary beam of ^{132}Sn at 270 MeV/nucleon was produced through an abrasion-fission reaction with a 345 MeV/nucleon primary beam of ^{238}U. The resulting cocktail beam had a total intensity of 1.4×10^4 pps, containing ^{132}Sn with a purity of 45%. The particle identification (PID) was performed on an event-by-event basis by measuring the energy loss in the ionization chamber at the F7 focal plane, and the magnetic rigidity and the time of flight of the beam particles in the BigRIPS spectrometer.

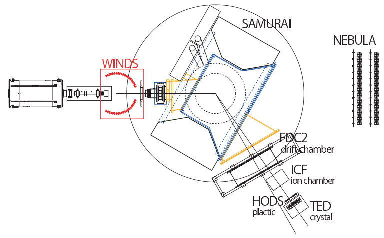

Fig. 1. Top view of the experimental setup around the SAMURAI spectrometer.

Figure 1 shows a top view of the experimental setup around the SAMURAI spectrometer[6)]. The secondary beam was impinged on a liquid hydrogen target[7)] before the entrance of the SAMURAI magnet. The recoil neutrons were detected by using the Wide-angle Inverse-kinematics Neutron Detectors for SHARAQ (WINDS) surrounding the target. The PID of the reaction residues was performed with the SAMURAI spectrometer and the decay neutrons from the residues were detected with the NEBULA. Detailed reports on the WINDS setup, the PID analysis in the SAMURAI spectrometer, and the NEBULA DAQ based on a fast clear mode are given in other reports in the current volume of the APR. The analysis is in progress. In preliminary results, the kinetic curves corresponding to the (p,n) reaction are clearly observed; this indicates that the experiment worked as planned.

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