Spin-dipole response of ^{4}He by exothermic charge exchange (^{8}He,^{8}Li*(1$^+$))

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The spin dipole (SD) ($\Delta S = \Delta L = 1$) is one of the spin-isospin responses. On a double-closed nucleus, the SD excitation contribution is large because of the nucleon configuration. ^{4}He is leghtest of the double-closed nucleus, and has a simple configuration. It is easy to understand the SD response. This is important for the study of supernova nucleosynthesis with the neutrino-nucleus reaction[1)].

We conducted the exothermic charge-exchange (CE) reaction ^{4}He(^{8}He, ^{8}Li*(1$^+$))^{4}H. CE reactions are used as a powerful probe to study the spin-isospin responses. The exothermic reaction enables targets to excite at low momentum transfer due to the high reaction Q-value. The kinematics of this reaction are closed of the neutrino-nucleus reaction, in contrast to the case in previous experiments. In this article, the angular distribution of the reaction is reported.

The reaction was measured with the BigRIPS[3)], the high-Resolution beamline[4)], and the SHARAQ spectrometer[5)] at RIKEN RIBF. The liquid-^{4}He[6)] was installed at the target position of the SHARAQ. The secondary ^{8}He beam irradiated the target at an intensity of about 2 MHz. In order to determine the missing mass energy and scattering angle, the trajectory and momenta of ^{8}He and ^{8}Li were measured by using LP-MWDCs[7)] and CRDCs[8)] in the beamline and SHARAQ. The detail experimental setup is discribed in another report[9)].

Figure 1 shows the cross section angular distribution obtained from the (^{8}He,^{8}Li*(1$^+$)). The vertical and horizontal axes are the differential cross section and scattering angle in the center-of-mass frame, respectively. The closed circles were reduced from the experimental data. The cross sections were summed over the excitation energy in the range from 0 MeV to 30 MeV for the continuum state of ^{4}H. The experimental data were compared with the DWBA calculation with FOLD[10)]. The lines show the calculated cross sections on the angular momentum transfer of $\Delta L = 0, 1, 2, 3$. The experimental data qualitatively indicated SD transition.

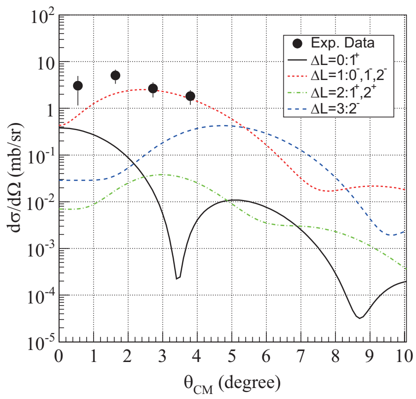

Fig. 1. Cross section angular distribution obtained from the (^{8}He,^{8}Li*(1$^+$)) reaction. Closed circles donate the experimental data. The lines show the DWBA calculation on the angular momentum transfer of $\Delta L = 0, 1, 2, 3$.

Comparison between the experimental data and the theoretical calculation of the isovector type SD response of ^{4}He is now in progress.

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