High Resolution Study of Gamow-Teller and Fermi Excitations in ^{56}Co via the (^{3}He,t) Reaction at 140 MeV/u

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The isospin mixing between the IAS (0^+) at 3.599 MeV and neighboring 0^+ state at 3.527 MeV was reported using the (^{3}He,t) [1] and (p,n) [2] reactions on ^{56}Fe. However, in order to resolve these 0^+ states, lower incident energy beams were used, where contributions of multi-step reactions are not negligible. The high resolution (^{3}He,t) measurement facility at RCNP allows us to disentangle these states even at higher energies. In addition, the information of the GT strength distribution in the iron-mass region is astrophysically very important, since in a supernova explosion process, these core nuclei collapse by electron capture and emit neutrinos, which are dominated by GT_+ transitions [3].

For these reasons, a ^{56}Fe(^{3}He,t)^{56}Co experiment was performed at RCNP at 140 MeV/nucleon. The areal density of the ^{56}Fe target was 1.05 mg/cm^2. In order to achieve high energy and horizontal scattering angle resolutions, lateral and angular dispersion matching were realized [4] applying the faint beam method [5]. To achieve good angle resolution in the vertical direction, the over-focus mode [7] was applied. Outgoing tritons were momentum analyzed by the Grand Raiden magnetic spectrometer [6] set at 0°, 2.5°, and 4°. The tritons were detected by the standard focal plane detector system consisting of two multi-wire drift-chambers and two ΔE plastic scintillation detectors. It should be noted that the achieved energy resolution of 23 keV (FWHM) is the best resolution yet at this energy and can be ascribed to the update of the injector cyclotron.

In Fig. 1 (a), a preliminary ^{56}Fe(^{3}He,t) spectrum at 0° is shown. As shown in the enlarged spectrum, four peaks around 3.5 MeV including the two 0^+ states were clearly resolved. From the angular distribution, J^π values of these states will be identified. During the same beamtime, data was also taken using some lower mass targets. These data will be used to test the proportionality between the cross sections at 0° and the B(GT) values, which was in question from the comparisons with the (p,n) spectra [8]. In Fig. 1 (b), the ^{34}S spectrum is shown. The analysis of these data is now in progress.

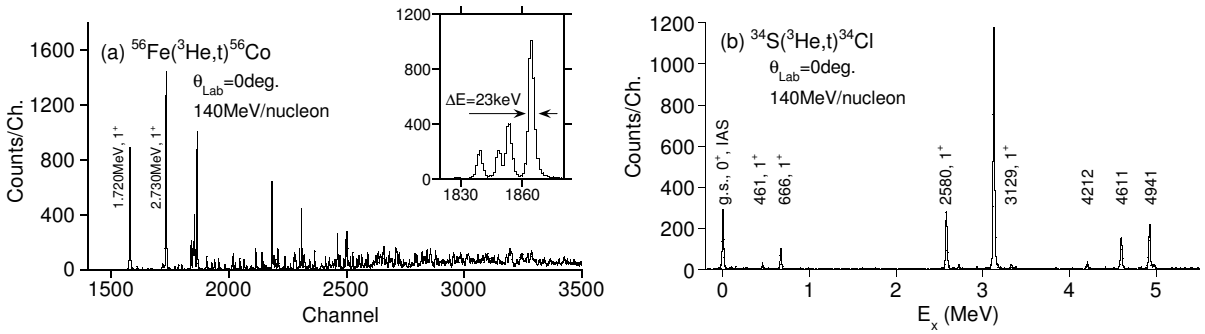

Figure 1: The preliminary (^{3}He,t) spectra using the ^{56}Fe and ^{34}S target at 0°. Energy resolution of 23 keV was realized in the ^{56}Fe spectrum.

References

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