Measurement of the ^{116}Sn(n,p) reaction at 293 MeV

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The double β decay with two neutrinos in the final state ($2\nu\beta\beta$ decay) is an allowed second-order weak process which has been observed for a number of nuclei. The nuclear matrix element of $2\nu\beta\beta$ decay consists of the energy denominator, the Gamow-Teller (GT) matrix elements from the mother nucleus to the states in the intermediate nucleus, and those from the intermediate states to the daughter nucleus. Since the nuclear matrix element depends on the detailed wave functions, it is difficult to predict the the half lives theoretically so far. Experimentally, GT strength (B(GT)) distributions can be studied by the charge exchange reactions and they provide constraints on the inputs of the theoretical calculation, such as effective interactions. For ^{116}Cd nucleus, the B(GT) distributions in the low lying states in ^{116}In were studied by the ^{116}Cd(^{3}He, t)^{116}In [1] and ^{116}Sn(d, ^{2}He)^{116}In [2] reactions. However, the B(GT) distributions in and above the giant resonance regions are also important to give a thorough constraint on the calculations. Therefore, we measured the double different cross sections for the ^{116}Sn(n,p) reaction at 293 MeV to obtain a reliable B(GT) distribution up to high excitation energy region of $\sim$ 50 MeV.

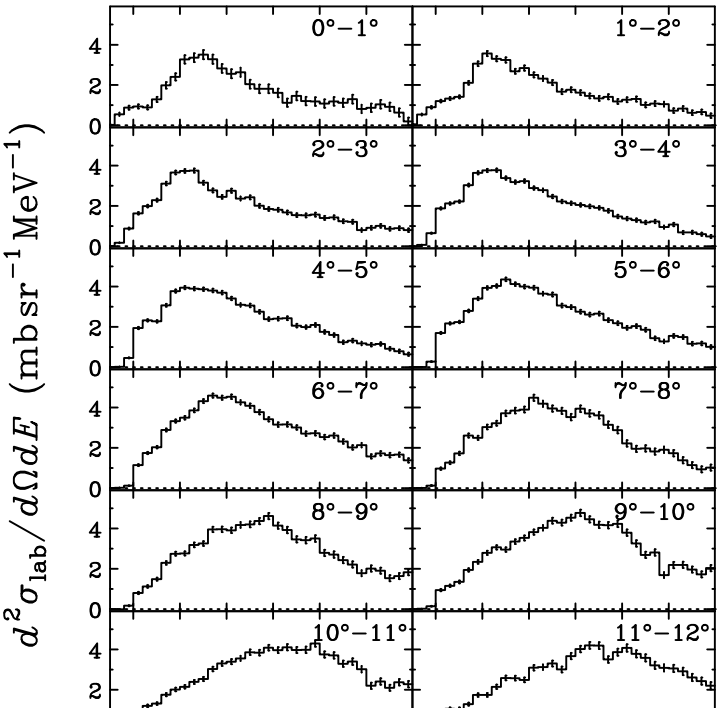

Figure 1: Double differential cross sections for the ^{116}Sn$(n,p)^{116}$In reaction at 293 MeV.

The measurement was carried out by using the (n,p) facility [3]. A nearly monoenergetic neutron beam was produced by the ^{7}Li reaction at 295 MeV. The typical beam intensity was 300 nA and the thickness of the ^{7}Li target was 320 mg/cm^2. Three ^{116}Sn targets with thicknesses of 406, 338, and 419 mg/cm^2 and a polyethylene (CH_2) target with a thickness of 46 mg/cm^2 were mounted in the (n,p) target box located 95 cm down stream from the ^{7}Li target. The (n,p) targets were separated from one another by a multiwire drift chamber plane. The number of ^{1}H(n,p) events from the CH_2 target was used for normalization of the neutron flux.

We have obtained the double differential cross sections up to 60 MeV excitation energy over an angular range of 0°–12° in the laboratory frame. The ^{116}Sn$(n,p)^{116}$In spectra obtained by analysis of 10% of all the data are shown in Fig. 1. The overall energy resolution estimated from the target thicknesses is 1.2 MeV. The multipole decomposition analysis will be performed to identify the GT component of the cross in the continuum.

References

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