Shell-model study of Gamow-Teller transition from ^{100}Sn

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In the previous report[1)], we presented the results of shell-model calculations with an effective interaction determined for the use around ^{100}Sn. We adopted the model space consisting of four orbits $1p_{1/2}$, $0g_{9/2}$, $1d_{5/2}$ and $0g_{7/2}$ assuming a hypothetical "core" $^{76}_{38}$Sr$_{38}$. Starting with a G-matrix interaction,[2)] the Hamiltonian parameters were modified by iterative fits to experimental energy data. The shell-model results reasonably described the systematics of energy levels and electromagnetic transitions for nuclei around ^{100}Sn.

As a next step, we report on the Gamow-Teller (GT) transition from ^{100}Sn using the same shell-model framework. Since ^{100}Sn is a doubly-magic, jj-closed $N = Z$ nucleus, some similarity to ^{56}Ni is expected. In the case of ^{56}Ni, the GT transition is dominated by the $\pi f_{7/2} \rightarrow \nu f_{5/2}$ excitation, and in the extreme single-particle picture the final state is described by a 1p-1h configuration on top of the closed ^{56}Ni core. However, according to the realistic shell-model calculations, the GT strengths are distributed over many states due to the configuration mixing. We have reported[3)] that the "double-peak" structure in the strength distribution becomes significant after including 4p-4h components. Therefore it is interesting to examine whether the similar structure could be seen in the case of ^{100}Sn.

Since the GT transition from ^{100}Sn should be dominated by the $\pi g_{9/2} \rightarrow \nu g_{7/2}$ excitation, we can expect a reasonable description in the present model space. At the price of the lack of some (possibly minor) components such as the $\pi d_{5/2} \rightarrow \nu d_{3/2}$, the present model space allows us to take into account the effects of sufficiently many np-nh configurations. The calculated GT strength distribution is shown in Fig.1. Although we don't see clear "double-peak" structure in this case even at the t=5 truncation level, the splitting of the strength becomes significant as more and more particle-hole configurations are included.

In the recent β-decay experiment of ^{100}Sn[4)], a possible "superallowed" GT transition corresponding to B(GT)=$7.6^{+2.2}_{-2.5}$ was observed. The analysis was made under the assumption that the GT decay goes into the single final 1^+ state of ^{100}In. This assumption was supported by large-scale shell-model calculations in the gds model space, which predict the concentration of a large part (69%) of the GT strengths on the lowest 1^+ state. In the present calculation, the GT decay goes mainly into the lowest three states, and the 1^+_3 state carries the largest strength as shown in Fig.1 (B(GT)=2.8 including the standard quenching factor of 0.74). Further analysis is desired for clarifying the GT strength distribution and the corresponding closed-core structure.

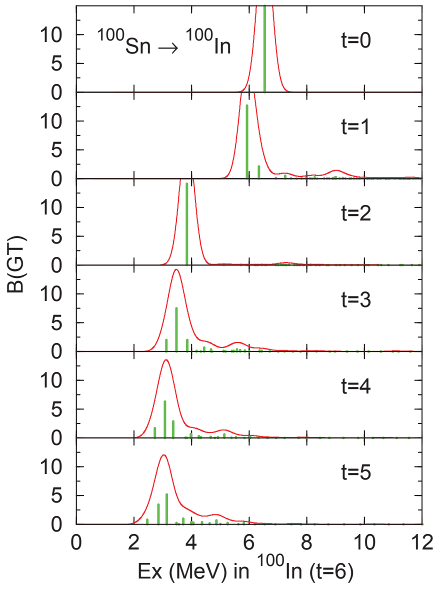

Fig. 1. The GT transition strength from ^{100}Sn calculated by the shell model varying the truncation order t, which stands for the number of nucleons allowed to excite from the lower orbits ($p_{1/2}$, $g_{9/2}$) to the higher orbits ($d_{5/2}$, $g_{7/2}$). The discrete strengths indicated by thick vertical bars are obtained by the prescription in Ref.[5)] through 100 Lanczos iterations, and they are folded by Gaussian of σ=0.5MeV as shown with a smooth curve. No quenching factor is considered for the purpose of comparison. The shell-model results are obtained by using the efficient code MSHELL64[6)].

References

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