Coulomb breakup reactions of ^{11}Li in the coupled-channel ^{9}Li + n + n model

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The ^{11}Li nucleus is known to have two-neutron halo structure owing to the breaking of the $N = 8$ magic number and the large s-wave mixing in the ground state. Those exotic structures observed in the ^{11}Li ground state can be reproduced nicely by using the coupled-channel ^{9}Li + n + n model including the tensor and pairing correlations in the ^{9}Li core [1]. It is interesting to examine the excitation mechanism of ^{11}Li in terms of the Coulomb breakup reactions, which is dominated by the $E1$ transition, into the ^{9}Li + n + n states.

We show the Coulomb breakup cross section into the ^{9}Li + n + n final states in Fig. 1. It is found that the results shows good agreement with the experiment for shape and magnitude over whole energy region. The low-lying enhancement is confirmed at around 0.25 MeV.

To see the effect of the large s-wave mixing on the Coulomb breakup strength of ^{11}Li, we compare the $E1$ strength distributions assuming different wave functions of ^{11}Li, a case of the small $(s_{1/2})^2$ component as 21.0 % in the ground state. The distributions are shown in Fig. 2. The distribution with the small s-wave mixing shows a relatively small strength at the peak energy, the magnitude of which is about a half of the original one with a large s-wave mixing. The result indicates that the s-wave mixing in the ^{11}Li ground state plays a significant role in reproducing the low-lying enhancement in the breakup strength.

To clarify the effect of the excitation of the ^{9}Li core on the $E1$ strength distribution of ^{11}Li, we also compare our coupled-channel calculation with that of the simple ^{9}Li + n + n model assuming an inert ^{9}Li core [3], which gives the small the $(s_{1/2})^2$ component as 20.6 %. In two kinds of results having small s-wave mixing, there exists the large difference of the strengths . This is due to the fact that about 15 % of the integrated strength in our calculation escapes to the highly excited ^{11}Li states having the excited components of the ^{9}Li core. This result indicates the importance of the core-excitation in ^{11}Li not only for the ground state but also for the excited continuum states.

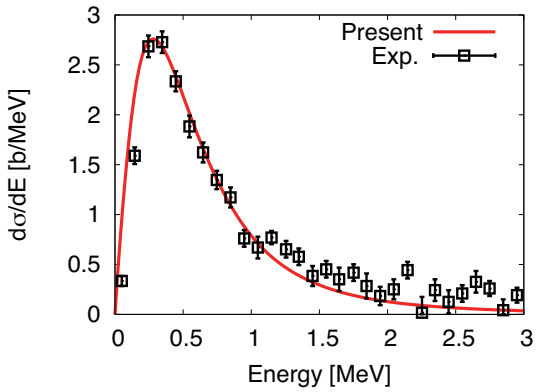

Figure 1: Coulomb breakup cross section of ^{11}Li, measured from the ^{9}Li + n + n breakup threshold. The red (solid) line represents the calculated cross section. The experimental data are taken from Ref. [2], shown as open squares with error bars.

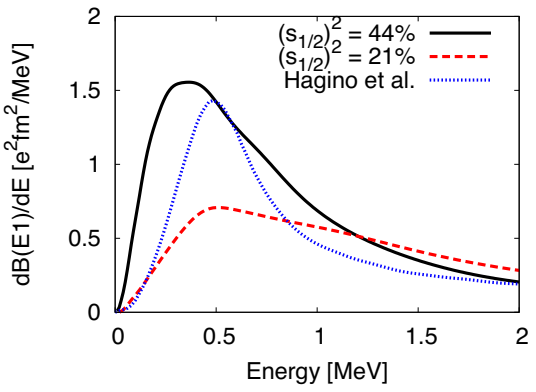

Figure 2: Comparison between the $E1$ strength distributions. The black (solid) line represents the result used in FIG. 1, and the red (dashed) one is the result using the wave function with $(s_{1/2})^2 = 21$ %. The blue (dotted) line is the result taken from Ref. [3].

References

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