Photodisintegration cross section of ^{9}Be up to 16 MeV in the $\alpha + \alpha + n$ three-body model

Y. Kikuchi[1,2], M. Odsuren[3], T. Myo[4], and K. Katō[5]

[1] *Department of Physics, Osaka City University, Osaka 558-8585. Japan*

[2] *RIKEN Nishina Center, Wako 351-0198, Japan*

[3] *Nuclear Research Center, National University of Mongolia, Ulaanbaatar 210646, Mongolia*

[4] *Research Center for Nuclear Physics (RCNP), Osaka University, Ibaraki, Osaka 567-0047, Japan*

[5] *Nuclear Reaction Data Centre, Faculty of Science, Hokkaido University, Sapporo 060-0810, Japan*

The photodisintegration cross section of ^{9}Be shows various characters in different energy regions. In the energy region higher than $E_\gamma = 6$ MeV, the recent measurement [1] reports the photodisintegration cross section of ^{9}Be up tp $E_\gamma = 16$ MeV, and the cross section shows a significant electric dipole strength below the giant dipole resonance (GDR). In the recent measurement [1], Utsunomiya *et al.* discussed that the enhanced dipole strength in ^{9}Be at the excitation energy of ~ 8 MeV exhausts 10 % of Thomas-Reiche-Kuhn sum rule and almost all the cluster dipole sum rule [1]. It is desired to understand the low-lying dipole strength below the GDR comprehensively from a viewpoint of the cluster structure of $\alpha + \alpha + n$ in ^{9}Be.

The purpose of this work is to elucidate the mechanism of the enhanced dipole transition in ^{9}Be below the GDR observed by the recent experiment [1]. In the present calculation [2], we employ the $\alpha + \alpha + n$ three-body model with complex-range Gaussian basis functions. We calculate the photodisintegration cross section applying the complex scaling method with Green's function to the $\alpha + \alpha + n$ three-body model, and discuss the mechanism of the photodisintegration of ^{9}Be.

In Fig. 1, we show the calculated photodisintegration cross section up to $E_\gamma = 16$ MeV in comparison with the experimental data. From the result in Fig. 1, we see that calculated cross section has a broad peak at $E_\gamma \sim 8$ MeV as similar to the experimental data. To investigate the origin of the peak at $E_\gamma \sim 8$ MeV, we also calculate the contribution of each spin-parity final state. The results show that the peak is dominated by the $E1$ transitions into $3/2^+$ and $5/2^+$. In the present calculation, we do not find any isolated resonances corresponding to the peak. Therefore, the peak at $E_\gamma \sim 8$ MeV is understood to be described by the $E1$ transition from the ground state into the non-resonant continuum states of $3/2^+$ and $5/2^+$.

We calculated the energy-integrated cross section by integrating σ_{E1} over the energy interval of $4 \le E_\gamma \le 16$ MeV. We obtain the energy-integrated cross section as 12.1 mb MeV for this energy interval, and the result is consistent with the experimental value (11.3 mb MeV). On the other hand, we also obtain the energy-integrated cross sections for $E_\gamma < 4$ MeV and $E_\gamma > 16$ MeV as 0.954 and 8.40 mb MeV, respectively. Our result suggests that the cluster dipole sum rule does not concentrate on the strength for $4 \le E_\gamma \le 16$ MeV and the strength for higher energy region would have a sizable contribution to the energy-weighted cluster dipole sum rule.

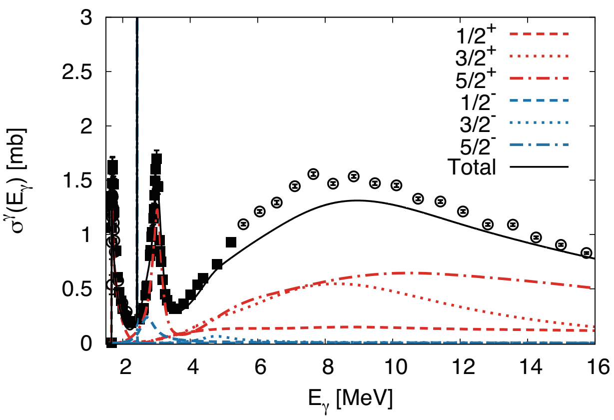

Figure 1: Photodisintegration cross section of ^{9}Be in comparison with the experimental data. The open circles and solid squares represent the data taken from Refs. [1] and [3], respectively.

References

[1] H. Utsunomiya *et al.*, Phys. Rev. C **92**, 064323 (2015).

[2] Y. Kikuchi, M. Odsuren, T. Myo, and K. Katō, Phys. Rev. C **93**, 054605 (2016).

[3] C. W. Arnold *et al.*, Phys. Rev. C **85**, 044605 (2012).