Exotic electromagnetic transitions of neutron-rich Carbon isotopes studied with extended antisymmetrized molecular dynamics

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The recent experiments using radioactive isotope beams have revealed many exotic features in neutron-rich Carbon isotopes, such as the formation of one-neutron halo structure in $^{19}$C, breaking of N=14 subshell closure in $^{20}$C, and small B(E2) values in $^{16,18}$C, which may be related to each other. In even Carbon isotopes, the small B(E2) values attracted much attention, and the ground and the first excited state have been extensively studied. However, the investigation of non-yраст excited states is still insufficient, but considered to be important to pin down exotic properties of Carbon isotopes. For example, whether the $K^\pi=2^+$ side band exist or not in $^{16}$C is important to know the deformation shape of this nucleus, and related to the small B(E2;2$_1^+\rightarrow0^+$) value of $^{16}$C [1].

In this study, we have investigated detailed structures of the low-lying excited states of $^{16,18,20}$C, using the extended framed work of antisymmetrized molecular dynamics (AMD) [2]. In the present framework, the 2$^+$ excitation energies of $^{16,18,20}$C, and B(E2;2$_1^+\rightarrow0^+$) values of $^{16,18}$C are reproduced well. We have found $K^\pi=2^+$ side band with strong E2 transition between the ground band, which originate from the triaxial shape of $^{16}$C, as pointed out by Y. Kanada-En’yo [1]. However, $^{18}$C does not have 2$_2^+$ state that has strong B(E2) transition between the ground state in the present calculation, since the deformation shape of this nucleus is close to the oblate. We have also obtained 0$_2^+$ state with the neutron excitation in $^{16,18}$C. The valence neutrons of the ground states are spatially extended compared to 0$_2^+$ state, which indicate that the dominance of ($\nu\,1s_{1/2}$)$^2$ and ($\nu\,0d_{5/2}$)$^2$ configurations in 0$_1^+$ and 0$_2^+$ state, respectively.