

## Radiative $\alpha$ capture on $^{12}\text{C}$ in cluster effective field theory

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Radiative  $\alpha$  capture on  $^{12}\text{C}$ ,  $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$ , is studied within the framework of cluster effective field theory (EFT). We constructed a low energy EFT for the  $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$  reaction and studied the related reactions to fix the parameters of the reaction amplitudes and estimate the astrophysical  $S$  factors of  $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$  at the Gamow-peak energy,  $E_G = 0.3\text{-MeV}$ ; it is known that  $E1$  and  $E2$  transitions of  $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$  are dominant because of the sub-threshold  $1_1^-$  and  $2_1^+$  states of  $^{16}\text{O}$ . The theory was applied to the studies of elastic  $\alpha$ - $^{12}\text{C}$  scattering at low energy,  $\beta$  delayed  $\alpha$  emission from  $^{16}\text{N}$ , and the  $E1$  transition of  $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$  in which the  $S_{E1}$  factor was deduced at  $E_G$ . We report the study of  $E2$  transition of  $^{12}\text{C}(\alpha,\gamma)^{16}\text{O}$  to estimate the  $S_{E2}$  factor at  $E_G$  and discuss the uncertainties of estimate of the  $S$  factors at  $E_G$  in the cluster EFT.

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