$^{12}C+^{12}C$ cluster states in sub-Coulomb barrier region

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The $^{12}C+^{12}C$ fusion reaction rate is of astrophysical interest since it has big impact on carbon-burning process in star. Recently the enhancement of the astrophysical S-factor of $^{12}C+^{12}C$ fusion reaction and the existence of the resonances below $E_{c.m.}$ = 3 MeV in p- and α-decay channels were reported in Torojan-Horse method (THM). However, A. Mukhamedzhanov et al. argued that THM result is not correct since the assumptions in the THM are not appropriate. Although there are many theoretical predictions based on cluster models, they cannot provide the information on the p-decay width. Therefore, theoretical prediction based on the reliable microscopic model is desired.

In this contribution, we will demonstrate that the $^{12}C+^{12}C$ cluster states appear above the $^{12}C+^{12}C$ decay threshold energy on the basis of antisymmetrized molecular dynamics (AMD) calculation results, which can enhance the $^{12}C+-^{12}C$ reaction rate. The spectra of ^{24}Mg calculated with AMD are shown in Fig. 1. We found that the states having large reduced ^{12}C-decay width θ_C^2 appear from $E_{cm} \sim 0$ MeV. We will discuss the reduced p-, α- and ^{12}C-decay widths of the excited states of ^{24}Mg in detail to reveal the decay modes of the $^{12}C+^{12}C$ cluster states.

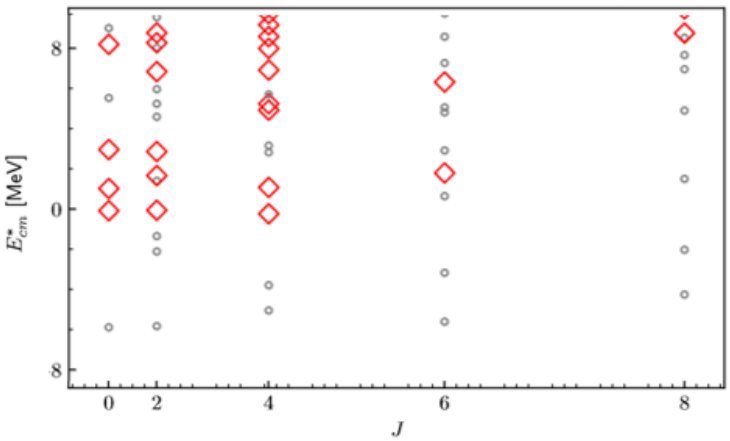

Fig. 1: Energy spectra of the positive parity state of ^{24}Mg as function of total angular momentum J around E_{cm} = 0 MeV. The states having the reduced ^{12}C-decay width θ_C^2 larger than 0.01 are indicated by open red diamonds.

[1] A. Tsumino et. al. Nature 557, 687 (2018)
[2] A. Mukhamedzhanov et al, arxiv:1806.05921