Neutron capture reaction in oxygen nuclei
near threshold energy regions

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We investigate the neutron capture reaction near threshold energies in light nuclei. For the investigation of the stellar evolution in terms of the element abundance, there are two important ingredients: the stellar model and the nuclear reaction data at astrophysical energies.

In general, the nuclear data at astrophysical energy regions involves uncertainties due to experimental errors and to the ambiguity originating in the compilation including the extrapolation process. The uncertainty in the rate of a specific reaction can affect decisively on the path to produce heavier elements in the stellar nucleosynthesis. We call it the key reaction in this synthesis process. The precise theoretical estimation for the key reaction is necessary, especially when we have no experimental data for that reaction. For the s-process nucleosynthesis of the helium shell flash model in metal-poor stars\textsuperscript{[1]}, we found the importance of the reaction $^{17}\text{O}(n, \gamma)^{18}\text{O}$ and $^{17}\text{O}(n, \alpha)^{14}\text{C}$ as the key reactions \textsuperscript{[2]}.

In the present work, we discuss the neutron capture reaction for the nuclides $^{16}\text{O}$ and $^{17}\text{O}$. In particular, the reaction $^{17}\text{O}(n, \gamma)^{18}\text{O}$ should be estimated precisely since this is the key reaction and we have no experimental data so far.

For the calculation of the reaction cross sections, we use the wave function taken account of the nuclear structure described by the Cluster Orbital Shell model\textsuperscript{[3]}. The Complex Scaling Method is used to treat the unbound and resonance states accurately\textsuperscript{[3]}. The reproduction of the energy levels of the final nucleus and the proper treatment of the long range tail of the scattering state are necessary for obtaining the accurate estimation of the reaction rate near threshold energies. The cross section for the key reaction $^{17}\text{O}(n, \gamma)^{18}\text{O}$ will be presented and will be compared with the available nuclear data compilations.

References