EFFECTS OF TRIPLE-ALPHA REACTIONS ON THE SUPERNOVA NUCLEOSYNTHESIS

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Ogata, Kan and Kamimura (2009)[1] evaluated directly nonresonant triple-alpha reaction rate by solving the Schrödinger equation of the three-body system. The scattering wave function is obtained by the continuum discretized coupled-channels method (CDCC). The CDCC results drastically differ from that of NACRE[2] at the low temperature. Effect of this triple-alpha reaction rate (OKK rate) on the *s*-process during the evolution of a massive star has been investigated for the first time, because the *s*-process in massive stars are considered to be established with only minor change permitted.

We calculate the massive star evolution of $15M_{\odot}$◎M◎$40M_{\odot}$ from He core burning phase. In particular for 25 $M_{\odot}$ star, we investigate nucleosynthesis of the s-process and calculate 1 dimensional supernova explosion to estimate ejected elements. We find that the *s*-process with use of OKK rate during the core helium burning is very inefficient compared to the case with the previous rate. However, the difference in the overproduction is found to be largely compensated during the subsequent carbon burning. Moreover, *p*-process nuclei which have been produced during silicon burning remain before the explosion. In case of OKK rate, $4M_{\odot}$ He core model (ZAMS $15M_{\odot}$) ignites helium at the off-center. The stars with M ◎ 13 $M_{\odot}$ could undergo non-degenerate burning to form an iron core. As the result, OKK rate will change the final fate of the stellar evolution in massive stars.

[1]K. Ogata, M. Kan and M. Kamimura, Prog. Theor. Phys. 122, 1055 (2009).
[2]C. Angulo et al. Nucl. Phys. A 656, 3 (1999).