THEORETICAL REACTION RATES OF THE $^{12}C(\alpha,\gamma)^{16}O$ REACTION FROM THE POTENTIAL MODEL

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The $^{12}C(\alpha,\gamma)^{16}O$ reaction is considered as the key reaction for the carbon-oxygen ratio in the universe [1]. The knowledge of $^{12}C(\alpha,\gamma)^{16}O$, however, has not been established yet, because the energy corresponding to He-burning temperatures is too low to measure the cross section at the present laboratories. ($E_{c.m.}$ = 0.3 MeV) To cope with the experimental difficulty, the theoretical calculation from the potential model [2] is reported in this presentation.

To investigate the α+^{12}C continuum state, we first show the result of elastic scattering [3,4]. To obtain the appropriate strength of the internuclear potential, we refer to nuclear rainbow at high energies [5]. For the bound states the potential is adjusted so as to reproduce the separation energy. This is the same as a textbook method in direct reaction models [6]. It gives appropriate wavefunctions in the peripheral region that are sensitive to nuclear reactions, and it leads to a doorway making fused nuclei from the continuum state. The spectroscopic factors and ANCs can be obtained phenomenologically. The contribution from the narrow resonances is also considered.

The resulting E1 and E2 S-factors at low energies seem to be concordant with the experimental data [7]. The S-factors are $S_{E1} \approx 3$ keV b and $S_{E2} \approx 150$ keV b at $E_{c.m.}$ = 0.3 MeV. The S-factors are found to be dominated by E2 transition to the ^{16}O ground state. The derived reaction rates are consistent with the results from [8,9].

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