Reexamination of the astrophysical S factor for the $\alpha+d\to{}^6$Li$+\gamma$ reaction

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Recently a new measurement of the ^{6}Li(A 150 MeV) dissociation in the field of ^{208}Pb has been reported in [1] to study the radiative capture $\alpha+d$ ^{6}Li$+\gamma$ process. However, the dominance of the nuclear breakup over the Coulomb one prevented from obtaining the information about the $\alpha+d\to{}^6$Li$+\gamma$ process from the breakup data. The astrophysical $S_{24}(E)$ factor has been calculated within the α-d two-body potential model with potentials determined from the fits to the α-d elastic scattering phase shifts. However, the scattering phase shift itself, according to the theorem of the inverse scattering problem, doesn't provide a unique α-d bound state potential, which is the most crucial input when calculating the $S_{24}(E)$ astrophysical factor at astrophysical energies. In this work we emphasize an important role of the asymptotic normalization coefficient (ANC) for ^{6}Li$\to$α+d which controls the overall normalization of the peripheral $\alpha+d\to{}^6$Li$+\gamma$ process and is determined by the adopted α-d bound state potential. Since the potential determined from the elastic scattering data fit is not unique, the same is true for the ANC generated by the adopted potential. However, a unique ANC can be found directly from the elastic scattering phase shift, without invoking intermediate potential, by extrapolation the scattering phase shift to the bound state pole [2].

We demonstrate that the ANC previously determined from the α-d elastic scattering s-wave phase shift in [2] and confirmed by the abinitio calculations [3], gives $S_{24}(E)$, which is at low energies about 38% lower than the one reported in [1]. We recalculate also the reaction rates, which are also lower than those obtained in [1]. This paper has been published in Phys. Rev. C.

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