# Reexamination of the astrophysical *S* factor for the $\alpha+d\rightarrow{}^6\mathrm{Li}+\gamma$ reaction

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Recently, a new measurement of the $^6$Li (150 A MeV) dissociation in the field of $^{208}$Pb has been reported [1] to study the radiative capture $\alpha+d\rightarrow{}^6\mathrm{Li}+\gamma$ process. However, the dominance of the nuclear breakup over the Coulomb one prevented the information about the $\alpha+d\rightarrow{}^6\mathrm{Li}+\gamma$ process from being obtained from the breakup data. The astrophysical $S_{24}(E)$ factor has been calculated within the $\alpha$-$d$ two-body potential model with potentials determined from the fits to the $\alpha$-$d$ elastic scattering phase shifts. However, the scattering phase shift, according to the theorem of the inverse scattering problem, does not provide a unique $\alpha$-$d$ 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 the important role of the asymptotic normalization coefficient (ANC) for $^6\mathrm{Li}\rightarrow\alpha+d$, which controls the overall normalization of the peripheral $\alpha+d\rightarrow{}^6\mathrm{Li}+\gamma$ process and is determined by the adopted $\alpha$-$d$ 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 $\alpha$-$d$ elastic scattering *s*-wave phase shift [2], confirmed by *ab initio* calculations, gives $S_{24}(E)$, which at low energies is about 38% less than the other one reported [1]. We recalculate also the reaction rates, which are lower than those obtained in that same study [1]. The paper has been published in Phys. Rev. C **83**, 055805 (2011).

[1] Hammache *et al.*, Phys. Rev. C **82** 065803 (2010).
[2] Blokhintsev *et al.*, Phys. Rev. C **48** 2390 (1993).