Low-energy R-matrix fit for the ^{6}L(d,α)^{4}He S factor

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Information about the ^{6}L(d,α)^{4}He reaction rates of astrophysical interest can be obtained by extrapolating direct data to lower energies, or by indirect methods. The indirect Trojan Horse method, as well as various R-matrix and polynomial fits to direct data, estimate electron screening energies much larger than the adiabatic limit. The astrophysical *S* factor for the low energy ^{6}L(d,α)^{4}He reaction dominated by broad subthreshold resonances has been analyzed using the single, two and three level R-matrix fits. For the low energy R matrix we use the s-wave approximation for the deuteron. The resulting ambiguity due to the choice of channel radii is large in a single-level fit as well as in the fit that considers three subthreshold resonances. Our goal is to check possibility of determination of the electron screening potential from the low energy astrophysical *S* factors. We find that parameters depend on the number of the subthreshold states involved in the fitting. We consider the fit with three subthreshold states as the most reliable. We find that the extracted screening potential depends on the used procedure. If we first fit the *S* factor varying all the parameters at energies above 60 keV, at which the electron screening potential can be neglected, and then fixing all the parameters and varying only U_e to fit the astrophysical factor at energies below 1 MeV, we obtain $U_e = 71.4$ eV. However, if we fit the *S* factor at energies below 1 MeV varying all the parameters simultaneously including U_e, we get $U_e = 149.5$ eV. Thus, the result strongly depends on the fitting procedure. We may conclude that the assumption that electron screening effects are negligible at energies above 50 keV is not valid and our recommended value is $U_e = 149.5$ eV. Note, that other obtained fitting parameters are also sensitive to the fitting procedure.

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