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# $^{6}$Li as a three-particle system in the (p,$^{3}$He) reaction at astrophysical energies

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We present a theoretical study of the $^{6}$Li + p $\rightarrow$ $^{3}$He + $\alpha$ direct transfer reaction at collision energies from few keV to around the Coulomb barrier ($\sim$ 1.5 MeV in the center of mass). This lithium-depleting process is of interest from the astrophysical point of view [1], and is also important in relation to the so-called "electron screening problem", regarding different discrepancies observed between experimental and theoretical estimations of the role of atomic electrons in nuclear reactions at low energies [2]. It has been suggested that the issue might be connected to nuclear structure features of the involved nuclei [2], calling for more advanced studies.

Here, the $^{6}$Li nucleus is described as a quantum-mechanical $\alpha$+p+n system, making use of both past [3] and more recent calculations. We compare several structure configurations for the system ground state, displaying various degrees of deuteron clutering, which is sensitive to the interference of components in which the pair of transferred nucleons within $^{6}$Li lies in different shells. The impact of the structure on the transfer reaction cross section is then evaluated within the first- and second-order Distorted-Wave Born Approximation. We find that effects connected to the $^{6}$Li ground-state static deformation tend to cancel out at low energies, while configurations exhibiting stronger clustering consistently yield greater transfer cross sections [4].

[1] L. Lamia et al., The Astrophysical Journal 768 (2013), p. 65

[2] C. Spitaleri et al., Physics Letters B 755 (2016), p. 275

[3] J. Bang and C. Gignoux, Nuclear Physics A 313 (1979), p. 119

[4] S. S. Perrotta, PhD Thesis, University of Catania and University of Seville (2022)

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