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Double ionization of helium by electron and proton impact. A Generalized Sturmian Functions Approach.

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In this contribution we explore the double ionization of helium by fast electrons and protons. A first-Born framework is considered for the projectile-target interaction, while all the intra-target ones are considered to all orders. This reduces the number of active components from four particles to three, and the resulting three-body problem can be tackled with todays computational resources [1-3]. We apply the Generalized Sturmian Functions method to obtain the scattering wavefunction, and from its asymptotic part we extract the transition amplitudes. We present theoretical fully differential cross sections calculated for a wide variety of energy and momentum transfer regimes. A general good agreement is observed when they are compared with experimental data [4-7]. For electronic projectiles, for given momentum transfer values, higher order effects are appreciable in the measured cross sections, and some differences with first Born calculations are noticeable [5]. However, in the case of protonic projectiles we observe that a first Born treatment is enough to reproduce the features of the available experiments [6,7]. Analyzing the different energy and momentum transfer regimes, we are able to distinguish which collisional mechanisms are more preeminent in each regime [7]. This work was done in collaboration with Dr. Daro Mitnik, Prof. Lorenzo Ugo Ancarani, Dr. Gustavo Gasaneo, Antonio Gmez and Enzo Gaggioli. [1] J. Berakdar et al., Phys. Rep. 374, 91 (2003). [2] I. Bray et al., Phys. Rep. 520, 135 (2012). [3] G. Gasaneo et al., Adv. Quantum Chem. 67, 153 (2013). [4] M. J. Ambrosio et al.,J. Phys. B 48, 055204 (2015). [5] M. J. Ambrosio et al., Phys. Rev. A 93, 032705 (2016). [6] M. J. Ambrosio et al., Phys. Rev. A 92, 042704 (2015). [7] M. J. Ambrosio et al., Eur. Phys. J. D 71, 127 (2017).