Dirac bubble potential for He–He and inadequacies in the continuum: Comparing an analytic model with elastic collision experiments

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Résumé en anglais	We focus on the long-pending issue of the inadequacy of the Dirac bubble potential model in the description of He–He interactions in the continuum [L. L. Lohr and S. M. Blinder, Int. J. Quantum Chem. 53, 413 (1995)]. We attribute this failure to the lack of a potential wall to mimic the onset of the repulsive interaction at close range separations. This observation offers the explanation to why this excessively simple model proves incapable of quantitatively reproducing previous experimental findings of glory scattering in He–He, although being notorious for its capability of reproducing several distinctive features of the atomic and isotopic helium dimers and trimers [L. L. Lohr and S. M. Blinder, Int. J. Quantum Chem. 90, 419 (2002)]. Here, we show that an infinitely high, energy-dependent potential wall of properly calculated thickness rc(E) taken as a supplement to the Dirac bubble potential suffices for agreement with variable-energy elastic collision cross section experiments for 4He–4He, 3He–4He, and 3He–3He [R. Feltgen et al., J. Chem. Phys. 76, 2360 (1982)]. In the very low energy regime, consistency is found between the Dirac bubble potential (to which our extended model is shown to reduce) and cold collision experiments [J. C. Mester et al., Phys. Rev. Lett. 71, 1343 (1993)]; this consistency, which in this regime lends credence to the Dirac bubble potential, was never noticed by its authors. The revised model being still analytic is of high didactical value while expected to increase in predictive power relative to other appraisals.
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