

Elastic scattering of positronium: Application of the confined variational method

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Abstract. We demonstrate that the phase shift in elastic S-wave positronium (Ps)-atom scattering can be precisely determined by the confined variational method, in spite of the fact that the Hamiltonian includes an unphysical confining potential acting on the center-of-mass of the positron and one of the atomic electrons. The calculated phase shifts are precise mainly because the unphysical effect of the potential can be eliminated by adjusting the confining potential. Using the stochastic variational method, explicitly correlated Gaussian-type basis functions are optimized and the energies of confined Ps-atom systems are determined. Then the discrete energies are taken as a reference for tuning auxiliary one-dimensional potentials. The phase shifts calculated for the one-dimensional potential scattering are the same as the phase shifts of the Ps-atom scattering. For the Ps-hydrogen scattering, the present calculations are in very good agreement with the Kohn variational calculations. Therefore, the 2~4% discrepancy between the Kohn variational and R-matrix calculations is resolved. For Ps-helium scattering, our calculations achieve a higher precision than reported in any previous publication.