Resonance tunneling of a cluster composed by identical particles through repulsive barriers*

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Abstract

A model for quantum tunnelling of a cluster comprised of A identical particles, interacting via oscillator-type potential, through short-range repulsive barrier potentials is introduced for the first time in symmetrized-coordinate representation (SCR) and studied in the s-wave approximation. A constructive method for symmetrizing or antisymmetrizing the (A-1)-dimensional harmonic oscillator basis functions in the new symmetrized coordinates with respect to permutations of coordinates of A-identical particles is described. It was shown that the transformations of (A-1)-dimensional oscillator basis functions from the symmetrized coordinates to the Jacobi coordinates, reducible to permutations of coordinates and (A-1)-dimensional finite rotation, are implemented by means of the (A-1)-dimensional oscillator Wigner functions while reduction of the SCR in the Cartesian coordinates to the hyperspherical ones are given by means of the Clebsch-Gordan coefficients of the interbasis expansions. One can use the above transformations to recalculate the SCR: A-1-harmonic oscillator functions of symmetric or antisymmetric type with respect to permutations of Cartesian coordinates of A-identical particles, in desirable sets of Jacobi and/or hyperspherical coordinates. The effect of quantum transparency, manifesting itself in nonmonotonic resonance-type dependence of the transmission coefficient upon the energy of the particles, of their number A=2,3,4 and of the type of their symmetry, is analyzed. It is shown that the total transmission coefficient demonstrates the resonance behavior due to the existence of barrier quasistationary states, imbedded in the continuum.

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