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Co-spherical electronic configuration of the helium-like atomic systems. (English)
Zbl 1483.81162

Summary: The properties of a special configuration of a helium-like atomic system, when both electrons are on the surface of a sphere of radius \( r \), and angle \( \theta \) characterizes their positions on sphere, are investigated. Unlike the previous studies, \( r \) is considered as a quantum mechanical variable but not a parameter. It is important that the “co-spherical” and the “collinear” configuration are coincident in two points. For \( \theta = 0 \) one obtains the state of the electron-electron coalescence, whereas the angle \( \theta = \pi \) characterizes the e-n-e configuration when the electrons are located at the ends of the diameter of sphere with the nucleus at its center. The Pekeris-like method representing a fully three-body variational technique is used for the expedient calculations. Some interesting features of the expectation values representing the basic characteristics of the “co-spherical” electronic configuration are studied. The unusual properties of the expectation values of the operators associated with the kinetic and potential energy of the two-electron atom/ion possessing the “co-spherical” configuration are found. Refined formulas for calculations of the two-electron Fock expansion by the Green’s function approach are presented. The model wave functions of high accuracy describing the “co-spherical” electronic configuration are obtained. All results are illustrated in tables and figures.

MSC:
81V45 Atomic physics
35P05 General topics in linear spectral theory for PDEs
81V10 Electromagnetic interaction; quantum electrodynamics
81Q05 Closed and approximate solutions to the Schrödinger, Dirac, Klein-Gordon and other equations of quantum mechanics
30H20 Bergman spaces and Fock spaces
35J08 Green’s functions for elliptic equations
70M20 Orbital mechanics

Keywords:
two-electron atom/ion; co-spherical configuration; Fock expansion; ground state; wave function

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References:


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