Adiabatic representation for a hydrogen like atom photoionization in a magnetic field

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A new effective method of calculating wave functions of discrete and continuous spectra of a hydrogen atom in a strong uniform magnetic field is developed based on the adiabatic approach, known in mathematics as the Kantorovich method, to parametric boundary problems in spherical coordinates [1, 2, 3]. The two-dimensional boundary problems for the Schrödinger equation at a fixed magnetic quantum number and a spatial parity is reduced to a spectral parametric problem for a one-dimensional equation by the angular variable for the angular oblate spheroidal functions and to boundary problems for a finite set of the ordinary second-order differential equations by the radial variable with effective potentials. All needed asymptotics of set of adaptive basis functions, matrix elements of radial coupling and radial solutions in analytic form to reduce interval of integration of the corresponded boundary problems are calculated to achieve economy of computer resources. The rate of convergence is investigated firstly numerically and is illustrated with a number of typical examples. The method is applied to calculations of the photo-ionization cross-sections of a hydrogen atom in the magnetic field that will be provide a true threshold behavior. Further applications of the method to the photo-ionization and -recombination of a hydrogen-like atom in the magnetic field [4], and channeling of atoms or ions in a confinement potential [5] are briefly discussed.

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