

Dirac equation: Calculation and analysis

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As a relativistic wave equation, the Dirac equation provides naturally a description of an elementary spin-1/2 particle and plays a key role in relativistic quantum mechanics. In this talk, we will present and discuss recent progress on the Dirac equation made in my research group. The talk falls into three parts. In the first part, we discuss basic structures of relativistic wave functions of many-body Dirac equation, and then derive the relativistic electron-electron coalescence conditions. In the second part, we introduce an efficient iterative method to solve the eigenvalue problem associated with the Dirac equation. In the third part, we will focus on the nonlinear generalization of the Dirac equation in which the multi-hump structure of the solitary wave solutions and its possible relation to the stability are investigated theoretically as well as numerically by a newly developed operator splitting scheme.

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