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Study of Simulation Method of Time Evolution in Rigged QED

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We discuss how we formulate time evolution of physical quantities in the framework of the Rigged QED (Quantum Electrodynamics). The Rigged QED is a theory which has been proposed to treat dynamics of electrons, photons and atomic nuclei in atomic and molecular systems in a quantum field theoretic way. To solve the dynamics in the Rigged QED, we need different techniques from those developed for the conventional QED. As a first step toward this issue, we propose a procedure to expand the Dirac field operator, which represents electrons, by the electron annihilation/creation operators and solutions of the Dirac equation for electrons in nuclear potential. Similarly, the Schrodinger field operators, which represent atomic nuclei, are expanded by nucleus annihilation/creation operators. Then we derive time evolution equations for these annihilation and creation operators and discuss how time evolution of the operators for physical quantities can be calculated. In the end, we propose a method to approximate the evolution equations of the operators by the evolution equations for the density matrices of electrons and atomic nuclei. Under this approximation, we carry out numerical simulation of the time evolution of electron charge density of a hydrogen atom.

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