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Quantum information processing, quantum communication and quantum Artificial Intelligence in semiconductor quantum computer

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場所 ： 本館 1 階 155B 理学院セミナー室

ご来聴を歓迎いたします。

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概 要

Implementation scheme for electrostatic quantum computer is given with reference to recent cryogenic single-electron(s) CMOS technologies [1-4]. Analytical solutions describing quantum swap, Hadamard and CNOT gates are provided with a use of tight-binding approximation, Hubbard model and Schroedinger formalism [5-8]. The implementation scheme for quantum networks is given in the framework of CMOS technology as well as in reference of interface between quantum semiconductor and quantum superconducting computer [3, 6, 8]. Decoherence effects occurring in electrostatic quantum gates are described analytically for two interacting electrons confined by local potentials with a use of tight-binding simplistic model and in Schrödinger formalism with an omission of spin degree-of-freedom [8]. The obtained results can be generalized for the case of N electrostatically interacting quantum bodies confined by local potentials (N-qubit system) representing any electrostatic quantum gate with N1/N-N1 inputs/outputs [8]. A mathematical structure of a system evolution with time is given by analytic formulas and by numerical simulations [8]. The concept of CMOS programmable quantum matter with built-in quantum sensors is discussed. Potential usage for quantum chemistry algorithms is specified. The strategy of construction of electrostatic quantum neural networks is specified. At very end the concept of quantum AI and quantum Artificial Life is introduced with particular attention focused on programmable quantum neural network. The perspective of usage of quantum chips for quantum sensing in CERN experiments is given. Finally the theory of quantum reconfigurable graphs [6] is presented with reference to NP hard problems. The framework development for semiconductor QISKIT like software (with reference to IBM Quantum Experience software) is specified. Various types of fundamental experiments inducing phase transitions among interacting electrons, inducing topological quantum phase transitions or time crystals are drawn so the connection between fundamental and applied science is underlined [5]. The strategy of future research is presented.

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