

Information about the department

Department: Institute of Physics and Quantum Engineering, Department of Theoretical Physics and Quantum Technologies (TPQT).

Head: Mukhin Sergey Ivanovich, D.Sc. (Physics and Mathematics), Professor, Head of the TPQT Department, <https://misis.ru/science/community/scientists/3505/>

Field of science: Physical and technical sciences and quantum information science, physics of strongly correlated macroscopic quantum systems

Topic and content of Research Project No. 1

Title: Collective quantum states in a system of superconducting qubits interacting with a quantized microwave electromagnetic field.

Head of Research Project: Fistul M.V., Ph.D. (Physics and Mathematics), leading researcher at the Laboratory of Superconducting Quantum Technologies.

Field of Science: Physical and Engineering Sciences and Quantum Information Science, Physics of Strongly Correlated Macroscopic Quantum Systems

Working Languages: Russian/English

Goals and Objectives of the Research Project: The goal of the project is a quantitative analysis of possible equilibrium and nonequilibrium collective quantum states and quantum phase transitions between them arising in macroscopic systems of superconducting qubits interacting with microwave photons of a low-dissipative resonator (an extended Dicke model). The role of the inevitably present dissipation and external pumping by the microwave electromagnetic field will be theoretically studied. The obtained results will be used within the framework of the strategic technological project "Quantum Internet".

Description of Scientific Approaches and Methods: For a quantitative description of the quantum dynamics of strongly interacting large-scale systems in the presence of dissipation and external pumping, analytical methods of perturbation theory, semiclassical methods and the "mean field" method, as well as numerical methods for diagonalizing Hamiltonians in systems with a small number of qubits will be used.

Job Description:

Tasks and functions in the Research Project: mathematical description of the model, development of methods for quantitative analysis of equilibrium and nonequilibrium collective states in a system of superconductor qubits interacting with microwave photons of a low-dissipative resonator, i.e., a quantized microwave photon field; comparison with experiments.

Salary, position, contract term: 0.5-1.0 rate; senior research fellow; 1 year.

Salary: based on interview results.

Postdoc requirements: Knowledge and work experience (publications) in the field of Nonrelativistic Quantum Mechanics, Statistical Physics with application to quantum systems, Physics of strongly correlated quantum systems. Fundamentals of quantum information science and quantum technologies (basic level).

Expected results for the postdoc: development of a quantitative and qualitative description of possible collective states in a system of interacting qubits, study of the dependencies of these states on the physical parameters of the system.