

KIRILL SHULGA

Postdoctoral Researcher
in Quantum Computation

- Tokyo, Japan
- shulga@icepp.s.u-tokyo.ac.jp
- 4kq6UmcAAAAJ

Summary

Quantum physicist with 10 years of practical experience in cryogenic physics experiments focused on the use of superconducting circuits and electrons on helium.

I have been involved in numerous projects with quantum systems on diverse topics in various environments. I studied the individual and collective properties of superconducting qubits and resonators, cQED systems (metamaterials, quantum simulators, in particular time crystals) based on them. I am also interested in fundamental physics, which I seek to verify by experiment. I also apply my knowledge to practical problems in other quantum systems, such as electrons on helium.

My experience convinced me that impactful, applied problems fused with rigorous research are the best way to advance quantum technologies and have a positive impact on society.

Research Interests

- superconducting qubits
- metamaterials
- electrons on helium
- quantum phenomena
- time crystals
- theory of time
- quantum information

Skills

- Dilution refrigerator operation
- EDA software, chip design
- FEM software (Sonnet, HFSS)
- Pulse|CW qubit devices measurement
- Scientific Python
- Clean room operation

Professional Experience

Project Researcher

The University of Tokyo
International Center for Elementary Particle Physics

2023 - present
Tokyo, Japan

- Investigation of the effects of relativistic quantum information, and in particular Hawking radiation in superconducting quantum metamaterials

Postdoctoral Researcher

Okinawa Institute of Science and Technology
Quantum Dynamics Unit led by Dr. Denis Konstantinov

2021 - 2023
Okinawa, Japan

- Explored cavity quantum electrodynamics with electrons on helium
- Researched quantum computation with electron spins
- Explored the potential of squeezed spin states of the electron Rydberg states and squeezed Landau levels parametric pumping

Postdoctoral Researcher

Center for Emergent Matter Science (CEMS), RIKEN
Design and development of experiments with superconducting qubits, research led by Prof. Dr. Yasunobu Nakamura

2017 - 2020

Wako, Saitama, Japan

- Researched a single photon detector based on superconducting circuit technology
- Experimented with unconventional photon blockade in cQED systems
- Created time crystals based on superconducting qubits

Research Fellow

Russian Quantum Center
Superconducting qubits and quantum circuits group led by Prof. Dr. Alexey Ustinov

2013 - 2017
Moscow, Russia

- Participated in the construction of the RQC laboratory in Moscow
- Investigated the arrays of superconducting qubits and quantum superconducting metamaterials
- Studied flux π -qubits with SFS-Josephson junctions

Junior Researcher

Moscow Institute of Steel and Alloys
The lab of superconducting metamaterials led by Prof. Dr. Alexey Ustinov

2012 - 2017
Moscow, Russia

- Created cryogenic setup for continuous wave and pulse microwave measurements
- Measured the first superconducting qubits in Russia
- Studied the Abrikosov vortex dynamics in thin superconducting structures
- Explored arrays superconductive qubits embedded into the transmission line and resonators
- Investigated new types of superconducting qubits (twin flux qubits) and unusual properties of metamaterials based on such qubits

Education

Ph.D. in Condensed Matter Physics

Institute of Solid State Physics, Russian Academy of Science
Thesis: *Microwave investigation of superconducting coherent systems and quantum metamaterials.* Supervisors: Prof. Dr. Valery Ryazanov, Prof. Dr. Alexey Ustinov

2013 - 2017

Moscow, Russia

Master of Applied Mathematics and Physics

Moscow Institute of Physics and Technology
Thesis: *Investigation of superconducting qubits with SFS Josephson junctions.* Supervisor: Prof. Dr. Valery Ryazanov

2011 - 2013

Moscow, Russia

Bachelor of Applied Mathematics and Physics

Moscow Institute of Physics and Technology

2007 - 2011
Moscow, Russia

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Scientific Python

Clean room operation

Scholarships and Research Visits

Karlsruhe Institute of Technology

Alexey Ustinov group

Scholarship to study the operation of the dilution refrigerator, cryogenic and microwave equipment, basic experiments with superconducting qubits

2012-2013

Karlsruhe, Germany

The University of Queensland,

Arkady Fedorov group

Study of the quantum contextuality phenomenon using the pulse measurement of a three-level transmon qubit

2015

Brisbane, Australia

Special Fellowship of the Russian Quantum Center

2013

Research Grants

FY2022 KAKENHI for Early Career Researchers ~ 30K USD

2022

Title: *Dispersive readout of the electrons on Helium Rydberg state with the Landau levels*

Invited Talks

- Walther-Meissner-Institute for Low Temperature Research, Munich, Germany – 19/09/2019
- Adam Mickiewicz University (UAM), Poznan, Poland – 11/09/2019
- Center for Axion and Precision Physics, IBS/CAPP, Korea – 19/05/2018
- Center for the Theoretical Physics of Complex Systems, Institute of Basic Science, Korea – 17/05/2018
- Landau Institute for Theoretical Physics of Russian Academy of Sciences, Russia – 12/01/2017
- Laboratory of Artificial Quantum Systems, Russia – 04/06/2015

Publications

- Broadband sample holder for microwave spectroscopy of superconducting qubits,
A. S. Averkin, A. Karpov, **K. Shulga**, E. Glushkov, N. Abramov, U. Huebner, E. Il'ichev, and A. V. Ustinov, *Rev. Sci. Instr.* **85**, 104702, (2014).
- Fabrication and measurements of hybrid Nb/Al Josephson junctions and flux qubits with π -shifters
A. V. Shcherbakova, K. G. Fedorov, **K. V. Shulga**, V. V. Ryazanov, V. V. Bolginov, V. A. Oboznov, S. V. Egorov, V. O. Shkolnikov, M. J. Wolf, D. Beckmann and A. V. Ustinov, *Supercond. Sci. Technol.* **28**, 025009, (2015).
- Observation of a Collective Mode of an Array of Transmon Qubits
K. V. Shulga, Y. Ping, G. P. Fedorov, M. V. Fistul, M. Waides and A. V. Ustinov. *JETP Letters* **105**, 38, (2017).
- Magnetically induced transparency of a quantum metamaterial composed of twin flux qubits
K. V. Shulga, M. V. Fistul, I. S. Besedin, S. Butz, O. V. Astafiev, U. Hübner, E. Il'ichev, and A. V. Ustinov. *Nature Communications*, **9**, Art. Nr. 150, (2018).
- Time molecules with periodically driven interacting qubits
K. V. Shulga, I. Vakulchyk, Y. Nakamura, S. Flach, and M. V. Fistul, *Quantum Science and Technology*, **6(3)**, 035012, (2021).
- Dissipative Stability and Dynamical Phase Transition in Two Driven Interacting Qubits
K. V. Shulga, *arXiv:2312.10609v1*, (2023).

Teaching Experience

Supervisory support of two bachelor and one master dissertation projects.