# Ilia Luchnikov, PhD

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## EXPERIENCE

### Leading research fellow

**Russian Quantum Center**

01/2021 - Ongoing Moscow, Russia

Laboratory of Quantum Information Technologies

- I have developed a novel state-of-the-art method for the data-driven identification of non-Markovian quantum dynamics. The code is available via the link. The overall work is currently being reviewed at one of the top physics research journals. An outdated version of the paper is available via the link.
- I have developed a method for many-body quantum dynamics optimal control. The code is available via the link (The code and the research paper are still under development).
- I have developed a new type of emulator of quantum circuits based on the Multi-scale Entanglement Renormalization Ansatz. The draft of the research paper is available via the link.
- I am a co-advisor of one Master student and one PhD student who are developing new tensor networks based data processing and modeling techniques for quantum technologies.
- Tech stack: Python 3, Jax, Chex, PyTest, TensorFlow, NumPy, SciPy
- In my research at RQC, I use various tensor networks architectures, Riemannian and Convex optimization, various machine learning methods, and model order reduction techniques from data-driven engineering, Bayesian Deep Learning, some Deep Learning architectures from NLP (such as Transformer) to approximate many-body quantum states.

### Master student -> PhD student -> Research scientist

**Moscow institute of physics and technology**

01/2015 - 01/2022 Moscow, Russia

Laboratory of Quantum Information Theory

- I have developed a TensorFlow-based framework for Riemannian optimization in quantum technologies. The framework has wide range of possible applications including quantum tomography of states and channels, tensor networks optimization, quantum control, non-Markovian dynamics identification, etc. We have published two papers (SciPost Phys and NJP) and made code of the framework available via the link.
- We have developed a novel data-driven method of non-Markovian quantum dynamics identification capable of external control response prediction. The paper is published in Physical Review Letters.
- We have developed a theoretical framework for open quantum dynamics complexity estimation. The paper is published in Physical Review Letters.
- I have developed a novel method for many-body quantum states reconstruction based on Variational autoencoder. The corresponding paper is available via the link. The paper has been featured by the journal.
- We have investigated a new type of quantum dynamics induced by repeated projective measurements. The corresponding paper is published in Physics Review A.
- I was teaching Bachelor and Master students to quantum information theory, the theory of open quantum systems and tensor networks for 1.5 years in the role of Teaching Assistant.
- I was organizing research/educational seminars on a regular basis in our research group.
- Tech stack: Python 3, TensorFlow, NumPy, SciPy.

### PhD student

**Skoltech**

2017 - 2021 Moscow, Russia

Energy Systems center

- I was developing new approaches to demand response based on statistical mechanics.
- I was teaching Master students to non-equilibrium processes in engineering for two terms in the role of Teaching Assistant.
- Tech stack: Python 3, TensorFlow, NumPy, Scipy.
- Two papers were published as the result of my research activity in top physics/engineering journals.

# EXPERIENCE

## Bachelor student -> Junior research scientist

**Russian quantum center**

01/2014 - 01/2017 Moscow, Russia

Laboratory of Quantum Simulators and Integrated Photonics

- I was supporting an experimental setup by coding different modules for experiment control, e.g., evaporative cooling schedule, online data-processing module, GUI for a team of experimentalists. I am a co-author of the number of papers made in this laboratory.
- Tech stack: LabView, Wolfram Mathematica.

# EDUCATION

## PhD in Theoretical physics

**Moscow Institute of Physics and Technology**

09/2017 - 09/2020

## MSc in Applied mathematics and physics

**Moscow Institute of Physics and Technology**

09/2015 - 09/2017

## BSc in Applied mathematics and physics

**Moscow Institute of Physics and Technology**

09/2011 - 09/2015

# LANGUAGES

**English** Advanced **Russian** Native

# SKILLS

**Python** **TensorFlow 1.x/2.x** **Jax** **PyTorch** **numpy / scipy** **Tensor networks**

**Open quantum systems** **Machine Learning** **Deep Learning** **Bayesian methods** **C/C++**

**Riemannian optimization** **Convex optimization** **Automatic differentiation** **Rust**

# STRENGTHS

## Programming skills

Even though all my working experience lies in the research field, I endeavor to use the best programming practices in my research and write concise, maintainable code.

## Full-stack research

I am used to doing full-stack research, starting from generating ideas and prototyping and finishing with polishing papers and getting them published in top research journals.

# STRENGTHS

### Many innovative ideas

I have a lot of innovative ideas in mind that are enough to proceed with research for many years

### Technical writing skills

Even though English is not my native language and I do not have full professional proficiency, I can write coherent and easy-to-read technical text explaining complex ideas.

# PUBLICATIONS

## Machine learning non-Markovian quantum dynamics

**Physical Review Letters**

*Luchnikov I. A., Vintskevich S. V., Grigoriev D. A., Filippov S. N.*

2020 https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.124.140502

## Simulation complexity of open quantum dynamics: Connection with tensor networks

**Physical Review Letters**

*Luchnikov I. A., Vintskevich S. V., Ouerdane H., Filippov S. N.*

2019 https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.122.160401

## QGOpt: Riemannian optimization for quantum technologies

**SciPost Phys**

*Luchnikov I. A., Krechetov M. E., Filippov S. N.*

2021 https://scipost.org/SciPostPhys.10.3.079

## Riemannian geometry and automatic differentiation for optimization problems of quantum physics and quantum technologies

**New Journal of Physics**

*Ilia A Luchnikov, Mikhail E Krechetov and Sergey N Filippov*

2021 https://iopscience.iop.org/article/10.1088/1367-2630/ac0b02

## Variational autoencoder reconstruction of complex many-body physics

**Entropy**

*Luchnikov I. A., Ryzhov A., Stas P. J., Filippov S. N., Ouerdane H.*

2019 https://www.mdpi.com/1099-4300/21/11/1091

## Quantum evolution in the stroboscopic limit of repeated measurements

**Physics Review A**

*I. A. Luchnikov and S. N. Filippov*

2017 https://journals.aps.org/pra/abstract/10.1103/PhysRevA.95.022113

# PUBLICATIONS

## Super-relaxation of space–time-quantized ensemble of energy loads to curtail their synchronization after demand response perturbation

**Applied Energy**

*Luchnikov I , Metivier D., Ouerdane H., Chertkov M.*

2021

https://www.sciencedirect.com/science/article/pii/S0306261920317827?casa_token=BE6Bnq5jX-wAAAAA:xeP_sUpxfHsAvSYHSUsQwnXDEdE669C59xP-lfcuRkuPlc_6A5eFDZa6VLQGfJ3iKohC-j4JxRo

## Light-assisted collisions in ultracold Tm atoms

**Physical Review A**

*Cojocaru I. S., Pyatchenkov S. V., Snigirev S. A., Luchnikov I. A., et al.*

2017 https://journals.aps.org/pra/abstract/10.1103/PhysRevA.95.012706

## Polarized cold cloud of thulium atom

**Journal of Physics B: Atomic, Molecular and Optical Physics**

*Tsyganok V. V., Khlebnikov V. A., Kalganova E. S., Pershin D. A., Davletov E. T., Cojocaru I. S., Luchnikov I. A., et al.*

2018

https://iopscience.iop.org/article/10.1088/1361-6455/aad445/pdf?casa_token=fEGQbz0tGSYAAAAA:_PIH49cXh43WUqtcZJXsdhsREqBTB0eKHyrqcstYOjIM6H3lPmbtN9mKCKB5eYdmGHMRVX6RCL2QYRc

## Power of ensemble Diversity and Randomization for energy Aggregation

**Scientific reports**

*Metivier D., Luchnikov I., Chertkov M.*

2019 https://www.nature.com/articles/s41598-019-41515-4

## Probing non-Markovian quantum dynamics with data-driven analysis: Beyond" black-box" machine learning models

**arXiv preprint**

*Luchnikov, I. A., Kiktenko, E. O., Gavreev, M. A., Ouerdane, H., Filippov, S. N. and Fedorov, A. K.*

2021 https://arxiv.org/abs/2103.14490

## Simulating quantum circuits using the multi-scale entanglement renormalization ansatz

**arXiv preprint**

*Luchnikov, I. A., A. V. Berezutskii, and A. K. Fedorov.*

2021 https://arxiv.org/abs/2112.14046

## Collisional open quantum dynamics with a generally correlated environment: Exact solvability in tensor networks

**arXiv preprint**

*Sergey N. Filippov, Ilia A. Luchnikov*

2022 https://arxiv.org/abs/2202.04697

## FIND ME ONLINE

**Google scholar**
https://scholar.google.com/citations?user=5wB0-tkAAAAJ&hl=en

**Research gate**
https://www.researchgate.net/profile/Ilya-Luchnikov

**GitHub**
https://github.com/LuchnikovI

## OPEN SOURCE PROJECT

### QGOpt: the library for Riemannian optimization in quantum technologies

2021 Russia, Moscow

GitHub link: https://github.com/LuchnikovI/QGOpt.