

Bakhrom Oripov

Boulder, CO 80305, USA • bakhromtjk@gmail.com
bakhromtjk.com • [linkedin.com/in/bakhromtjk](https://www.linkedin.com/in/bakhromtjk) • ORCID 0000-0002-6626-2076

SUMMARY

- Research scientist specializing in superconducting quantum hardware and large-scale detector systems, with 10+ years of experience spanning nanofabrication, cryogenic systems, and device physics.
- Led development of state-of-the-art superconducting nanowire single-photon detector (SNSPD) systems, including a 400k+ pixel imager, achieving orders of magnitude scaling over prior technologies.
- Combines physics, modeling, and machine learning to build scalable hardware-aware solutions, including neuromorphic training algorithms with reduced computational complexity.

EXPERIENCE

Applied Physics Division, National Institute of Standards and Technology

Department of Physics, University of Colorado

Research Associate

Feb 2021 – Present

- Developed and optimized nanofabrication processes for 10-layer superconducting devices, achieving reliable and reproducible performance. Designed and characterized test structures to validate each fabrication step, and maintained process stability through regular tool calibration.
- Designed, fabricated, and characterized arrays of superconducting nanowire single-photon detectors (SNSPDs). Improved fabrication yield by introducing advanced lithography techniques at the Boulder Microfabrication Facility.
- Upgraded cryogenic testing infrastructure to enable rapid characterization and iterative prototyping of SNSPD arrays, significantly reducing experimental turnaround time.
- Demonstrated an 800×500 pixel SNSPD imager, representing a two orders of magnitude increase in pixel count over prior state-of-the-art systems.
- **Machine Learning:** developed scalable training methods for neuromorphic hardware, reducing computational complexity from $\mathcal{O}(n^2)$ to $\mathcal{O}(n)$.

Quantum Materials Center, University of Maryland

Research Assistant

Jun 2014 – Aug 2020

- Developed a scanning probe microscopy (SPM) based near-field magnetic microwave microscope, a novel surface material defect characterization tool.
- Developed numerical models to extract key parameters from large experimental datasets, demonstrating that nonlinear response signatures originate from Josephson junction-like defects on cavity surfaces.
- Performed vortex dynamics simulations using the time-dependent Ginzburg–Landau model in COMSOL Multiphysics, elucidating mechanisms of vortex nucleation in SRF cavities. Modeled surface current distributions using Ansys HFSS finite-element simulations.
- Built a low-temperature superconducting RF cavity testing facility operating down to 50 mK, including design of mechanical support and thermalization, implementation of a phase-locked loop (PLL) measurement feedback circuit, development of low-cost magnetic shielding with attenuation > 5000 , and integration of a liquid nitrogen pre-cooling system to enable rapid cooldown.
- Characterized thin-film superconductors using a parallel-plate resonator technique, extracting surface resistance and London penetration depth from temperature-dependent resonance frequency $f(T)$ and quality factor $Q(T)$ measurements.
- Mentored three undergraduate students and two first-year graduate students, including training a direct successor.

Institute for Research in Electronics and Applied Physics, University of Maryland

Research Assistant

Jan 2014 – Jun 2014

- Built a frequency-resolved optical gating (FROG) device for femtosecond laser pulse characterization; designed custom holders in SolidWorks and machined them on a 3-axis mill.

SELECTED PUBLICATIONS

- K. M. Parzuchowski *et al.*, **B. G. Oripov**, “Reaching the intrinsic performance limits of superconducting nanowire single-photon detectors up to 0.1 mm wide”, **Optica** **13**, 1649–1657 (2026)
- **B. G. Oripov** *et al.*, “A superconducting-nanowire single-photon camera with 400,000 pixels”, **Nature** **622**, 730–734 (2023)
- **B. G. Oripov**, A. Dienstfrey, A. McCaughan, S. M. Buckley, “Scaling of hardware-compatible perturbative training algorithms”, **APL Machine Learning** **3**, 026107 (2025)
- **B. G. Oripov**, S. M. Anlage, “Time-dependent Ginzburg–Landau treatment of rf magnetic vortices in superconductors”, **Physical Review E** **101**, 033306 (2020)

EDUCATION

University of Maryland, College Park, Maryland, USA

Ph.D. in Physics

Aug 2013 – Aug 2020

- Thesis: *Superconducting RF Materials Science through Near-Field Magnetic Microscopy*. Adviser: Prof. Steven M. Anlage.

The Data Incubator, Washington, DC, USA

Data Science Scholar

Sep 2020 – Dec 2020

- Intensive data science fellowship with a 3% admission rate. Capstone: processed 4.6 million rows of T-cell repertoire data using PySpark, clustering unique TCR sequences by Levenshtein distance with interactive Altair visualizations.

Boğaziçi University, Istanbul, Turkey

B.Sc. in Physics (Honors List)

Aug 2008 – Jul 2012

SKILLS AND QUALIFICATIONS

- **Superconducting devices:** SNSPDs, SRF cavities, thin-film resonators, nanocryotrons, cryogenic device physics.
- **Nanofabrication & process engineering:** e-beam lithography, photolithography, thin film deposition (sputtering, evaporation, PECVD), reactive ion etching.
- **Cryogenics:** dilution refrigerators (~50 mK), sorption refrigerators (~1 K), probe stations, magnetic shielding.
- **RF & microwave instrumentation:** network analyzers, spectrum analyzers, lock-in amplifiers.
- **Modeling & simulation:** COMSOL (TDGL, multiphysics), Ansys HFSS, electromagnetic modeling, LTspice.
- **Machine learning & neuromorphic systems:** hardware-aware training, complexity reduction, device modeling, JAX, high-performance computing.
- **Software & automation:** Python, data pipelines, measurement automation, scientific computing.
- **Languages:** English, Russian, Turkish, Tajik, Persian.

AWARDS & SCHOLARSHIPS

- NIST PEAR Technical Accolade Award

Sep 2024

- Bronze Medal, 39th International Physics Olympiad (IPhO), Vietnam Jul 2008
- Bronze Medal, 9th Asian Physics Olympiad (APhO), Mongolia Apr 2008
- Gold Medal, Tajikistan Nationwide Physics Olympiad Mar 2008

SERVICE

- Reviewer for NSF ENG/EFMA Panel
- Reviewer for Applied Physics Letters (AIP)
- Reviewer for Review of Scientific Instruments (AIP)
- Reviewer for Advanced Photonics (SPIE)
- Reviewer for Nanoscale (Royal Society of Chemistry)

PUBLICATIONS

- [20] K. M. Parzuchowski, E. Mueller, **B. G. Oripov**, B. Hampel, R. A. Chowdhury, S. Patel, D. Kuznesof, E. Batson, R. Morgenstern, R. H. Hadfield, V. B. Verma, M. D. Shaw, J. P. Allmaras, M. Stevens, A. Gurevich, A. N. McCaughan, “Reaching the intrinsic performance limits of superconducting nanowire single-photon detectors up to 0.1 mm wide”, *Optica* 13 (8), 1649–1657 (2026). doi:10.1364/optica.599984
- [19] R. O’Loughlin, **B. G. Oripov**, N. Skuda, N. Chongsiriwatana, I. Whitehouse, S. M. Buckley, A. N. McCaughan, “Multiplexed gradient descent: perturbative learning with astrocytes”, *Neuro Inspired Computational Elements (NICE)* 1–9 (2026).
- [18] K. M. Parzuchowski, E. Mueller, R. A. Chowdhury, **B. G. Oripov**, D. V. Reddy, A. N. McCaughan, “Superconducting single-photon detectors for next-generation quantum sensing”, *SPIE Quantum Effects and Measurement Techniques in Biology and Biophotonics III* (2026).
- [17] **B. G. Oripov**, A. Dienstfrey, A. N. McCaughan, S. M. Buckley, “Scaling of hardware-compatible perturbative training algorithms”, *APL Machine Learning* 3 (2), 026107 (2025). doi:10.1063/5.0258271
- [16] N. Otrooshi, R. Morgenstern, **B. G. Oripov**, A. N. McCaughan, N. Nader, M. J. Collins, R. P. Mirin, A. E. Lita, S. W. Nam, “Alignment and packaging of a 1D-array of optical transition edge sensors to an optical fiber array”, *Optics Express* 33 (24), 51108–51115 (2025). doi:10.1364/oe.567354
- [15] R. O’Loughlin, N. Skuda, **B. G. Oripov**, B. Hayes, A. N. McCaughan, S. M. Buckley, “Model-free multiplexed gradient descent: neuromorphic learning in recurrent networks”, *International Conference on Neuromorphic Systems (ICONS)* 104–111 (2025).
- [14] D. Brunner, B. J. Shastri, **B. G. Oripov**, et al., “Roadmap on neuromorphic photonics”, *arXiv:2501.07917* (2025). doi:10.48550/arXiv.2501.07917
- [13] J. Hutchins, S. Alam, D. S. Rampini, **B. G. Oripov**, A. N. McCaughan, A. Aziz, “Machine learning-powered compact modeling of stochastic electronic devices using mixture density networks”, *Scientific Reports* 14, 6383 (2024). doi:10.1038/s41598-024-56779-8
- [12] D. S. Rampini, C. S. Yung, **B. G. Oripov**, S. Woods, J. Lehman, S. W. Nam, A. N. McCaughan, “Integration of vertically-aligned carbon nanotubes with superconducting nanowire single photon detectors”, *Superconductor Science and Technology* 37 (1), 015005 (2024). doi:10.1088/1361-6668/ad0db3
- [11] **B. G. Oripov**, D. S. Rampini, J. P. Allmaras, M. D. Shaw, S. W. Nam, B. Korzh, A. N. McCaughan, “A superconducting-nanowire single-photon camera with 400,000 pixels”, *Nature* 622 (7984), 730–734 (2023). doi:10.1038/s41586-023-06550-2
- [10] **B. G. Oripov**, A. N. McCaughan, “Large-scale nanowire camera with a single-photon sensitivity”, *Nature Research Briefing* (2023). doi:10.1038/d41586-023-02797-x
- [9] A. N. McCaughan, **B. G. Oripov**, N. Ganesh, S. W. Nam, A. Dienstfrey, S. M. Buckley, “Multiplexed gradient descent: fast online training of modern datasets on hardware neural networks without backpropagation”, *APL Machine Learning* 1 (2), 026118 (2023). *Journal*

cover, Editor's Pick. doi:10.1063/5.0157645

- [8] S. Alam, D. S. Rampini, **B. G. Oripov**, A. N. McCaughan, A. Aziz, "Cryogenic reconfigurable logic with superconducting heater cryotron: enhancing area efficiency and enabling camouflaged processors", *Applied Physics Letters* 123 (15), 152603 (2023). doi:10.1063/5.0170187
- [7] A. N. McCaughan, **B. G. Oripov**, D. S. Rampini, B. Korzh, J. P. Allmaras, S. W. Nam, "Development of a 60,000 pixel superconducting-nanowire single photon imager", *SPIE Advanced Photon Counting Techniques XVII* PC1251203 (2023).
- [6] R. P. Mirin, B. Hampel, A. E. Lita, A. N. McCaughan, **B. G. Oripov**, D. V. Reddy, et al., "High-efficiency, superconducting nanowire single-photon detectors from ultraviolet to infrared", *IEEE Photonics Conference (IPC)* 1–2 (2023).
- [5] A. N. McCaughan, Y. Zhai, B. Korzh, J. P. Allmaras, **B. G. Oripov**, M. D. Shaw, S. W. Nam, "The thermally coupled imager: a scalable readout architecture for superconducting nanowire single photon detectors", *Applied Physics Letters* 121 (10), 102602 (2022). Journal cover, Editor's Pick. doi:10.1063/5.0102154
- [4] **B. G. Oripov**, D. Kumar, C. Garcia, P. Hemmer, T. Venkatesan, M. S. R. Rao, S. M. Anlage, "Large microwave inductance of granular boron-doped diamond superconducting films", *Applied Physics Letters* 118 (24), 242601 (2021). doi:10.1063/5.0051227
- [3] **B. G. Oripov**, S. M. Anlage, "Time-dependent Ginzburg–Landau treatment of rf magnetic vortices in superconductors: vortex semiloops in a spatially nonuniform magnetic field", *Physical Review E* 101 (3), 033306 (2020). doi:10.1103/PhysRevE.101.033306
- [2] **B. G. Oripov**, "Superconducting radio frequency materials science through near-field magnetic microscopy", *Ph.D. thesis, University of Maryland, College Park* (2020).
- [1] **B. G. Oripov**, T. Bieler, G. Ciovati, S. Calatroni, P. Dhakal, T. Junginger, O. B. Malyshev, G. Terenziani, A.-M. Valente-Feliciano, R. Valizadeh, S. Wilde, S. M. Anlage, "High-frequency nonlinear response of superconducting cavity-grade Nb surfaces", *Physical Review Applied* 11 (6), 064030 (2019). doi:10.1103/PhysRevApplied.11.064030