Oles Shtanko

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Research Scientist at IBM Quantum (IBM Thomas J. Watson Research Center, NY) with 12+ years of experience in quantum information and many-body theory, including 5+ years in quantum computing industry. Author of 26 publications (h-index 13, 746 citations) in leading journals including Nature Physics, PRL, PRX Quantum, and PNAS (Google Scholar).

Research Interests

Quantum algorithms for early fault-tolerance · Thermal Gibbs state preparation for physics and optimization · Quantum machine learning and applications · Quantum complexity of noisy systems

Education

Ph.D. in Physics, Massachusetts Institute of Technology 2013 – 2019
Thesis: *Boundaries, Disorder and Noise in Quantum-Coherent Systems*
Advisors: Prof. Seth Lloyd, Prof. Leonid Levitov (co-advisor)

M.Sc. & B.Sc. in Physics, Taras Shevchenko National University, Ukraine 2011 – 2013
Thesis: *Theory Behind the Observation of Neutral Modes in QHE* $\nu = 2/3$
Advisor: Prof. Vadim Cheianov (jointly w/ Lancaster University, UK)

Professional Experience

Research Scientist, IBM Quantum 2021 – Present
Quantum Algorithms for Near-Term and Early Fault-Tolerance team
Key contributions: designed and execution of quantum experiments on up to 156 qubits [1,2], efficient quantum thermal state preparation [19, 21], improved Hamiltonian simulation [5], quantum machine learning [20], proved computational universality of local noisy quantum circuits [3]

Postdoctoral Fellow, QuICS and JQI, University of Maryland College Park 2019 – 2021
Established theoretical bounds on autonomous quantum error correction [4];
developed complexity results for dissipative systems [10, 11];
explored power of machine learning for physics [22]

Research Intern, IBM Quantum 2018, 2019
Random matrix theory for quantum many-body systems [12, 14]

Honours & Awards

MIT-IBM Research Externship 2018, 2019
Funded winter research at IBM Quantum

ExxonMobil-MIT Energy Initiative Fellowship 2017
Support for outstanding PhD research

Bronze Medal, International Physics Olympiad, Iran 2007

Technical Skills

Quantum Computing: Qiskit, Cirq; algorithm design, error correction, circuit optimization
Scientific Computing: Python, Julia, C++; PyTorch, TensorFlow/JAX; CUDA/GPU; MPI/OpenMP
Many-Body Simulation: tensor networks (DMRG/MPS/PEPS), ITensor, TeNPy, Quimb
Theory: quantum information, quantum field theory, condensed matter, random matrix theory, free probability
Infrastructure: Linux, Git, Slurm/PBS, HPC cluster management

Professional Service

Co-organizer, QSim 2025 conference at IBM Quantum
Large-scale demonstration committee, IBM Quantum (2024–2025)
Mentored 6 research interns at IBM Quantum (2021–2025) resulting in 4 publications [2, 7, 19, 20]
Referee for *Nature Physics*, *Physical Review X*, *PRX Quantum*, *Phys. Rev. Lett.*, *Phys. Rev. B*, *Phys. Rev. E*, *Quantum*

Selected Talks

- Noise-robust quantum dynamics and quantum refrigerators, KITP, UCSB (2025)
- Criteria for stable quantum memories protected by engineered dissipation, QSim 2024, URI (2024) [Video]
- Uncovering local integrability in quantum many-body dynamics, Qiskit Seminar Series, IBM (2023) [Video]
- Gibbs state samplers with noiseless and noisy random quantum circuits, BIRS, Banff (2022) [Video]

Selected Publications

[S1] **O. Shtanko**, D.S. Wang, H. Zhang, N. Harle, A. Seif, R. Movassagh, Z. Minev, *"Uncovering local integrability in quantum many-body dynamics,"* Nature Communications **16**(1), 2552 (2025).

[S2] **O. Shtanko**, K. Sharma, *"Complexity of local quantum circuits under nonunital noise,"* PRX Quantum **6**(3), 030347 (2025).

[S3] N. Harle, **O. Shtanko**, R. Movassagh, *"Observing and braiding topological Majorana modes on programmable quantum simulators,"* Nature Communications **14**(1), 2286 (2023).

[S4] **O. Shtanko**, R. Movassagh, *"Unitary subharmonic response and Floquet Majorana modes,"* Physical Review Letters **125**, 086804 (2020).

[S5] **O. Shtanko**, L. Levitov, *"Robustness and universality of surface states in Dirac materials,"* PNAS **115**(23), 5908–5913 (2018).

[S6] M.T. Allen, **O. Shtanko** *et al.*, *"Spatially resolved edge currents and guided-wave electronic states in graphene,"* Nature Physics **12**(2), 128 (2016).

Peer-Reviewed Publications

[1] E.D. Switzer, N.F. Robertson, N. Keenan, Á. Rodríguez-Alcaraz, A. D'Urbano, **O. Shtanko** *et al.*, *"Realization of two-dimensional discrete time crystals with anisotropic Heisenberg coupling,"* Nature Communications **17**(1), 605 (2026). [DOI]

[2] **O. Shtanko**, D.S. Wang, H. Zhang, N. Harle, A. Seif, R. Movassagh, Z. Minev, *"Uncovering local integrability in quantum many-body dynamics,"* Nature Communications **16**(1), 2552 (2025). [arXiv]

[3] **O. Shtanko**, K. Sharma, *"Complexity of local quantum circuits under nonunital noise,"* PRX Quantum **6**(3), 030347 (2025). [DOI]

[4] **O. Shtanko**, Y.J. Liu, S. Lieu, A.V. Gorshkov, V.V. Albert, *"Bounds on autonomous quantum error correction,"* Quantum **9**, 1804 (2025). [arXiv]

[5] N.F. Robertson, B. Pokharel, B. Fuller, E. Switzer, **O. Shtanko**, M. Amico *et al.*, *"Tensor network enhanced dynamic multiproduct formulas,"* PRX Quantum **6**(2), 020360 (2025). [DOI]

[6] A. Kolchinsky, I. Marvian, C. Gokler, Z.W. Liu, P. Shor, **O. Shtanko** *et al.*, *"Maximizing free energy gain,"* Entropy **27**(1), 91 (2025). [arXiv]

[7] N. Harle, **O. Shtanko**, R. Movassagh, *"Observing and braiding topological Majorana modes on programmable quantum simulators,"* Nature Communications **14**(1), 2286 (2023). [DOI]

[8] M. Van Regemortel, **O. Shtanko**, L.P. García-Pintos, A. Deshpande, H. Dehghani, A.V. Gorshkov, M. Hafezi, *"Monitoring-induced entanglement entropy and sampling complexity,"* Physical Review Research **4**(3), L032021 (2022). [DOI]

[9] S. Lieu, M. McGinley, **O. Shtanko**, N.R. Cooper, A.V. Gorshkov, *"Kramers' degeneracy for open systems in thermal equilibrium,"* Physical Review B **105**(12), L121104 (2022). [DOI]

[10] A. Deshpande, B. Fefferman, A.V. Gorshkov, M.J. Gullans, P. Niroula, **O. Shtanko**, *"Tight bounds on the convergence of noisy random circuits to the uniform distribution,"* PRX Quantum **3**(4), 040329 (2022). [DOI]

[11] **O. Shtanko**, A. Deshpande, P.S. Julienne, A.V. Gorshkov, *"Complexity of fermionic dissipative interactions and applications to quantum computing,"* PRX Quantum **2**, 030350 (2021). [DOI]

[12] **O. Shtanko**, R. Movassagh, *"Unitary subharmonic response and Floquet Majorana modes,"* Physical Review Letters **125**, 086804 (2020). [DOI]

[13] K.X. Wei, P. Peng, **O. Shtanko**, I. Marvian, S. Lloyd, C. Ramanathan, P. Cappellaro, *"Emergent prethermalization signatures in out-of-time ordered correlations,"* Physical Review Letters **123**(9), 090605 (2019). [DOI]

[14] **O. Shtanko**, R. Movassagh, *"Stability of disordered Floquet topological phases,"* Physical Review Letters **121**, 126803 (2018). [DOI]

[15] **O. Shtanko**, L. Levitov, *"Robustness and universality of surface states in Dirac materials,"* PNAS **115**(23), 5908–5913 (2018). [DOI]

[16] M.T. Allen, **O. Shtanko**, I.C. Fulga, J.I-J. Wang, D. Nurgaliev, K. Watanabe, T. Taniguchi, A. Akhmerov, P. Jarillo-Herrero, L. Levitov, A. Yacoby, *"Observation of electron coherence and Fabry–Pérot standing waves at a graphene edge,"* Nano Letters **17**(12), 7380–7386 (2017). [DOI]

[17] M.T. Allen, **O. Shtanko**, I.C. Fulga, J.I-J. Wang, D. Nurgaliev, K. Watanabe, T. Taniguchi, A.R. Akhmerov, P. Jarillo-Herrero, L. Levitov, A. Yacoby, *"Spatially resolved edge currents and guided-wave electronic states*

in graphene," Nature Physics **12**(2), 128 (2016). [DOI]

[18] **O. Shtanko**, K. Snizhko, V. Cheianov, *"Nonequilibrium noise in transport across a tunneling contact between $\nu = 2/3$ fractional quantum Hall edges,"* Physical Review B **89**(12), 125104 (2014). [DOI]

Preprints and working papers

[19] D. Hahn, R. Sweke, A. Deshpande, **O. Shtanko**, *"Efficient quantum Gibbs sampling with local circuits,"* arXiv:2506.04321 (2025). [arXiv]

[20] W. Zhong, **O. Shtanko**, R. Movassagh, *"Advantage of quantum neural networks as quantum information decoders,"* arXiv:2401.06300 (2024). [arXiv]

[21] **O. Shtanko**, R. Movassagh, *"Preparing thermal states on noiseless and noisy programmable quantum processors,"* arXiv:2112.14688 (2021). [arXiv]

[22] Y. Kharkov, **O. Shtanko**, A. Seif, P. Bienias, M. Van Regemortel, M. Hafezi, A.V. Gorshkov, *"Discovering hydrodynamic equations of many-body quantum systems,"* arXiv:2111.02385 (2021). [arXiv]

[23] **O. Shtanko**, Y.A. Kharkov, L.P. García-Pintos, A.V. Gorshkov, *"Classical models of entanglement in monitored random circuits,"* arXiv:2004.06736 (2020). [arXiv]

[24] **O. Shtanko**, S. Lloyd, *"Hydrodynamic behavior of non-interacting quantum particles in presence of dephasing,"* arXiv:1807.07087 (2018). [arXiv]

[25] C. Gokler, A. Kolchinsky, Z.W. Liu, I. Marvian, P. Shor, **O. Shtanko**, K. Thompson, D. Wolpert, S. Lloyd, *"When is a bit worth much more than $kT \ln 2$?"* arXiv:1705.09598 (2017). [arXiv]

[26] K. Akkaravarawong, **O. Shtanko**, L. Levitov, *"Ballistic guided electron states in graphene,"* arXiv:1512.04185 (2015). [arXiv]