QWORLD

QUANTUM SCIENCE DAYS

The third scientific meeting organized by QWorld

May 29-31, 2023, Online

Program & List of Talks

All aspects of quantum information science and technology

Version: July 20, 2023

Welcome to the QWorld Quantum Science Days 2023! We are excited to launch the third edition of this yearly flagship event, bringing researchers across the quantum domain and the world together to network and present their work. The three-day event is sponsored by **Unitary Fund** and **Classiq**, and supported by the **Latvian Quantum Initiative**. We present a lineup of **9 invited speakers**, who will share their perspectives on quantum simulation, quantum and society, circuit design and beyond. Aligning with QWorld's mission to educate globally and build an open quantum ecosystem, we premiere the thematic session **Building an Open Quantum Ecosystem** with speakers from diverse global and national initiatives to democratize quantum education and resources. Moreover, we received many excellent submissions, and have selected a diverse and stimulating **program of 31 contributed talks over three days**. We invite you to network with researchers all over the world and welcome you to an engaging environment to help you advance your research.

We are thankful to all authors for submitting their work to the third edition of Quantum Science Days. We extend our thanks and appreciation to our invited speakers for sharing their inspiring work: **Özlem Salehi** (QWorld & Institute of Theoretical and Applied Informatics, Polish Academy of Sciences), **Yanzhu Chen** (Virginia Tech), **Volodymyr Tkachuk** (Ivan Franko National University of Lviv, Ukraine), **Igor Dotsenko** (Collège de France), **Rayssa Bruzaca de Andrade** (Denmark Technical University), **Julia Cramer** (Leiden University), **Monika Aidelsburger** (Ludwig-Maximilians-Universität München), **Eden Schirman** (Classiq for Academia), and **Christopher Bishop** (Improvising Careers).

This event would not have been possible without the program committee:
James Robin Wootton (IBM Research, Zurich), **Alessandra Di Pierro** (University of Verona, Italy), **Marlou Slot**, co-chair (NIST & Womanium, USA), **Radha Pyari Sandhir** (IBM Quantum), **Laura Piispanen** (Aalto University, Finland), **Orsolya Kalman** (QHungary & Wigner Research Centre for Physics, Hungary), **Jibran Rashid** (QWorld & Institute of Business Administration, Karachi, Pakistan), **Taha Rouabah** (CQTech & University of Constantine 1, Algeria), **Katarzyna Rycerz** (AGH University of Science and Technology, Poland), **Andrii Semenov** (Bogolyubov Institute for Theoretical Physics, Ukraine), **Abuzer Yakaryilmaz**, co-chair (QWorld & University of Latvia).

We thank the organizing committee members **Agnieszka Wolska** (QWorld Marketing Lead), **Engin Baç** (QWorld), **Shantanu Misra** (QWorld), and **Jibran Rashid** (QWorld) for making the event possible with their excellent work.

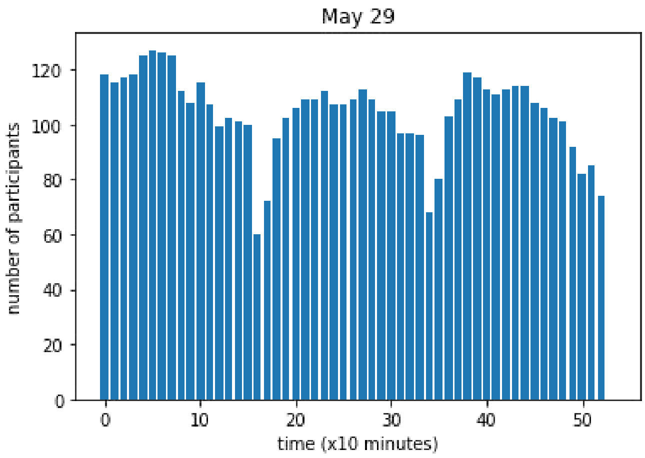
We are very happy to bring more than **500 people** together for three days of quantum.

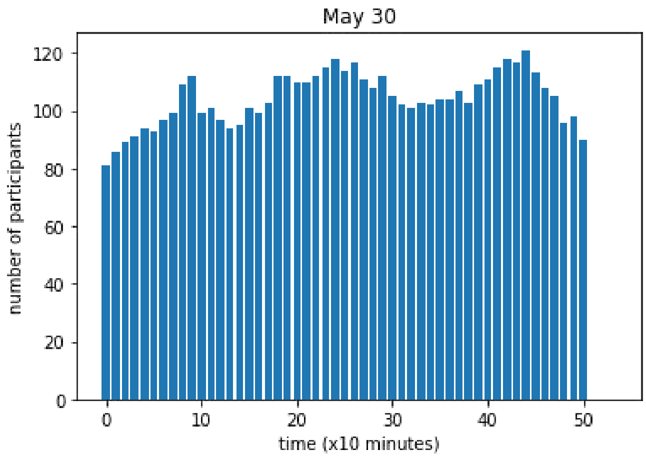
Marlou Slot
Co-chair of the program committee

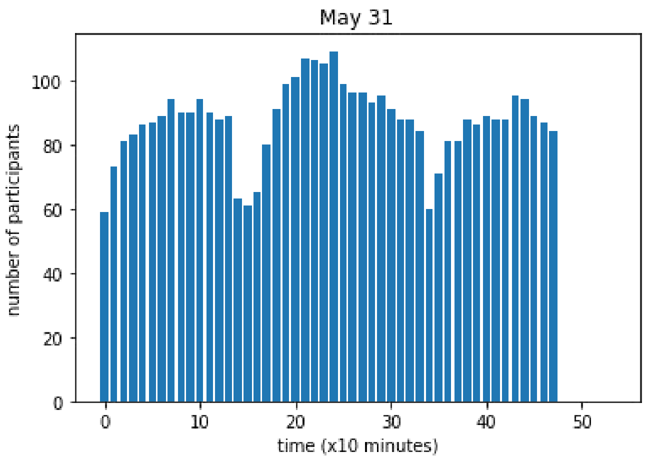
Abuzer Yakaryilmaz
Co-chair of the program committee
Co-chair of the organizing committee

Our statistics

Over 500 people from 69 different countries registered for our event. We hosted over 300 unique participants during the zoom sessions. We had around 100 participants on average in each session.







At the same time, 230 participants joined our dedicated Discord server.

Researcher/student	%
Researcher	22,0
Graduate student	38,0
Undergrad student	26,0
High school student	3,0
Industry	11,0

Working on/researching some quantum topics	%
Yes	60,0
No, but I plan to involve with some quantum topics	21,0
No, but I am interested in learning some quantum topics	15,0
No, but I am happy to learn about new stuffs	4,0

They talk about us

We collected more than 50 feedback responses. Here are some anonymous quotes about QSD2023:

Love what QWorld has been doing, been a part of this community for about two years now

I am really eager to attend this event. I am looking for a job in the area of quantum computing and I am pretty sure that this event helps me a lot.

Many thanks to all of you for such a great effort to make the quantum world accessible to everyone.

Good luck, and hopefully next year I will be a speaker in this amazing event!

Thank you very much for organizing QWorld!! You are doing fantastic work and greatly needed!!

Thank you for this opportunity, and all your events during the year

I'm looking forward to Quantum Science Days! I've been fascinated by quantum physics, quantum computers and their applications, especially quantum simulations. I can't wait to learn more about all of them. Thank you!

I thank the QWorld community for the numerous opportunities they provide at educating young students.

Thanks for allowing us to join for free, I really appreciate it because our university does not have this kind of research budget.

QWorld's efforts in the quantum technological domain are truly commendable.
I frequently share the updates from them with my friends and colleagues.

QWorld is a great platform for beginners and researchers to learn more about Quantum Technology.

This was my first time attending a live session, and it was great.
I would love to attend these types of online activities in the future. QWorld is a great opportunity.

Great diversity in terms of the underlying subject of the talk.

Monday, May 29 | Program

Session 1 Jarosław Adam Miszczak, 10:00 (UTC)

- **Rayssa Bruzaca de Andrade: Probing biological samples with quantum light**
- Shubhayan Sarkar: Self-testing composite measurements and bound entangled state in a unified framework
- Muhammad Shuraim: Generation, Stabilization and Manipulation of Kerr Cat States in Superconducting Resonators
- Alex Stephane Piedjou Komnang: Single microwave Photon detection based Josephson junction
- Carlos Javier Valdez: Effective study of the quantum damped harmonic oscillator

12:20 – 13:00 | Break (40 min.)

Session 2 Marlou Slot, 13:00 (UTC)

- **Volodymyr Tkachuk: Studies of spin systems on a quantum computer**
- Kh. P. Gnatenko: Entangling capability of multi-qubit parameterized quantum circuits and its calculation with quantum programming
- Aritra Sarkar: Visualizing Quantum Circuit Probability
- Radu Marginean: Uranium – a visual quantum computing platform
- Yun Shang: Faster quantum sampling of Markov chains in nonregular graphs with fewer qubits
- Aby Philip: Quantum Steering Algorithm for Estimating Fidelity of Separability

15:30 – 16:00 | Break (30 min.)

Session 3 Abuzer Yakaryilmaz, 16:00 (UTC)

Thematic session "Building an Open Quantum Ecosystem"

- Paweł Gora: The QCousins Program – Building a Global Network of Quantum Computing Groups
- Claudia Zendejas-Morales: Year-long Open QCourse on Quantum Computing & Programming
- Will Zeng: Let's have more open source quantum tech projects!
- Marlou Slot: Womanium Quantum – Igniting the Quantum Leaders of Tomorrow
- Jen Dodd: QHack, The One-of-a-kind Quantum Hackathon
- Brian Ingmanson: Qiskit Fall Fest: Building a Quantum Community With a Student-First Approach
- Radha Pyari Sandhir: Quantum Explorers: A Game-based Approach to Quantum Education
- Yasser Omar: The World Quantum Day – 14 April
- Andris Ambainis: Latvian Quantum Initiative – Building Quantum Technologies in a Small Country
- Garazi Muguruza: Women in Quantum Development (WIQD)

Tuesday, May 30 | Program

Session 4 Zeki Seskir & Jibran Rashid, 10:00 (UTC)

- **Julia Cramer: Let's talk about Quantum; Societal readiness through science communication research**
- Anastasija Nikiforova: Framework for understanding quantum computing use cases from a multidisciplinary perspective and future research directions
- Zeki C. Seskir: Democratization of quantum technologies
- Zeki C. Seskir: Global innovation and competition in quantum technology, viewed through the lens of patents
- Luca M. Possati: Is it rational to connect quantum computers?
- Mansur Ziiatdinov: QJudge: Automated Testing of Students Solutions for Quantum Algorithms Courses

12:30 – 13:00 | Break (30 min.)

Session 5 Taha Rouabah, 13:00 (UTC)

- **Igor Dotsenko: Circular Rydberg atoms for quantum simulations**
- Gabriela Wojtowicz: Tensor network techniques for quantum transport beyond weak coupling
- Abdellah Tounsi: Systematic Braid Matrix Generation for Topological Quantum Computing
- Nacer Eddine Belaloui: TQSim: An Open-Source Package for Topological Quantum Computing with Anyons
- Utkarsh Azad: Surface code design for asymmetric error channels
- Elijah Pelofske: Mapping state transition susceptibility in quantum annealing

15:30 – 16:00 | Break (30 min.)

Session 6 Taha Rouabah & Abuzer Yakaryilmaz, 16:00 (UTC)

- **Monika Aidelsburger: Quantum simulation – Engineering & understanding quantum systems atom-by-atom**
- Massimiliano Incudini & Francesco Di Marcantonio: Quantum Advantage Seeker with Kernels (QuASK): a software framework to speed up the research in quantum machine learning
- **Eden Schirman: Pioneering End-to-End Quantum Software Development with Classiq**

Wednesday, May 31 | Program

Session 7 Aurél Gábris, 10:00 (UTC)

- **Özlem Salehi: Near-optimal circuit design for variational quantum optimization**
- Shaurya Agrawal: A Novel Multi-Stage Cancer Workflow using Quantum and Classical Machine Learning & microRNA signatures
- Tooba Bibi: Quantum carpets: efficiently probing fractional revivals in position-dependent mass systems
- Seyed Navid Elyasi: Investigation of open quantum batteries and using IBM quantum computers as a versatile platform to simulate them

12:30 – 13:00 | Break (30 min.)

Session 8 Kh. P. Gnatenko, 13:00 (UTC)

- **Christopher Bishop: The secrets to working in quantum**
- R. Dharmaraj: A Riemannian Genuine Measure of Entanglement for Pure States
- Shrobona Bagchi: Tighter And Stronger Quantum Speed Limits For General Quantum States
- Guillermo Lugilde: Phase estimation with functional quantum abstract detecting systems
- Areej Ilyas: Nonlocality Distillation With Non-Trivial Marginals
- Manal Khawasik: A Secured Half-Duplex Bidirectional Quantum Key Distribution Protocol against Collective Attacks

15:30 – 16:00 | Break (30 min.)

Session 9 Aritra Sarkar, 16:00 (UTC)

- Ankit Khandelwal & Handy Kurniawan: Multiple-control Toffoli Circuit Classification and Transformation
- Nihar Gargava: Quantum gate synthesis and Ramanujan
- Shrobona Bagchi: Remote Creation of Quantum Coherence via Indefinite Causal Order
- **Yanzhu Chen: Improving variational quantum algorithms with an adaptive technique**

Invited speakers

Monika Aidelsburger (LMU/MCQST München)

Quantum simulation – Engineering & understanding quantum systems atom-by-atom

Abstract:

The computational resources required to describe the full state of a quantum many-body system scale exponentially with the number of constituents. This severely limits our ability to explore and understand the fascinating phenomena of quantum systems using classical algorithms. Quantum simulation offers a potential route to overcome these limitations. The idea is to build a well-controlled quantum system in the lab, which represents the problem of interest and whose properties can be studied by performing measurements. In this talk I will introduce quantum simulators based on neutral atoms that are confined in optical arrays using laser beams. State-of-the-art experiments now generate arrays of several thousand particles, while maintaining control on the level of single atoms. I will show how these systems can be used to study the properties of topological phases of matter. In the end I will provide a brief outlook on new directions in the field based on the unique properties of alkaline-earth(-like) atoms.

Monika Aidelsburger

is a professor and group leader at Ludwig Maximilian University of Munich (LMU), Germany. Her research group focuses on analog quantum simulations of many-body physics with ultracold atoms in optical lattices, aiming to simulate lattice gauge theories coupled to fermionic matter using ultracold Yb atoms. Aidelsburger completed her PhD on artificial gauge fields with ultracold atoms in optical lattices with Prof. Immanuel Bloch at LMU, which was published by Springer Nature as part of their Outstanding PhD thesis series. After a postdoctoral position at Collège de France in Paris, where she worked alongside Prof. Jean Dalibard on out-of-equilibrium phenomena with uniform Bose gasses, she returned to LMU as a group leader. Aidelsburger is currently a tenure-track professor for Synthetic Quantum matter at LMU and holds a joint position at the Max Planck Institute of Quantum Optics. In recognition of her work, she has received several grants and awards, including the ERC Starting Grant, Alfried-Krupp-Förderpreis and Klung Wilhelmy Science Award.

See the recording of the talk on YouTube >>

Invited speakers

Julia Cramer
(Leiden University, Science Communication and Society & Leiden Institute of Physics)

Let's talk about Quantum; Societal readiness through science communication research

Abstract:
The current 'second quantum revolution' promises dramatic technological changes for society. While there is clearly an international push to quantum research and development, it also comes with societal responsibility. Now is the time to involve society. We live in a time of science skepticism. We know from climate debates and vaccine discussions that our current society does not just 'believe' in science. This is a very different cultural atmosphere than the times in which the classical computer entered society and people set foot on the moon. Therefore, we think that research on the impact of quantum technology on society is highly relevant. Understanding the concerns, questions and acceptance within societal groups will help to increase the societal relevance of quantum technology, as we will know in an early stage what specific groups in society need and expect.

The ambition of our research group Quantum and Society at Leiden University is that social engagement, both of the quantum community towards society, and of society towards quantum technology, can be increased in a well-considered way in the coming years. Studies on the impact of communication by experts and media, the attitudes of social groups, empirical research on interventions such as popular science events and dialogues between scientists and society will contribute to improving and advising on the societal implementation of the promising quantum technology.

In this talk I will discuss the urge for and implications of research on quantum and society. I will discuss some of the research findings of our research group, such as the result of a framing-study on TEDx talks about quantum. We found that quantum is often framed as 'spooky' and enigmatic, that a majority of quantum experts explains a quantum concept such as superposition and that benefits of quantum technology are more often discussed than the risks.

Julia Cramer

is an assistant professor at Science Communication and Society, IBL, and the Leiden Institute of Physics, LION. Julia's research is focused on the impact of quantum science and technology on society from a science communication perspective. Cramer studied Applied Physics at Delft University of Technology and ETH Zurich. She obtained her PhD (funded by the Casimir Prize) in 2016 on 'Quantum Error Correction with Spins in Diamond' at QuTech at Delft University of Technology. During her PhD she was one of the Faces of Science of the KNAW and she participated in the theater show Science Battle. She is fascinated about communicating science to the (non-obvious) public. During her PhD in quantum science, Julia Cramer realized a great challenge and opportunity to connect to society at an early stage. She is involved in National and European groups focusing on the impact of quantum technology on society.

See the recording of the talk on YouTube >>

Invited speakers

Özlem Salehi (QWorld & Institute of Theoretical and Applied Informatics, Poland)

Near-optimal circuit design for variational quantum optimization

Abstract:
Quantum Approximate Optimization Algorithm (QAOA) is one of the leading quantum optimization algorithms and a candidate for showing near-term quantum advantage. In this talk, I will first talk about the state-of-the-art method for implementing QAOA, which often results in redundancy and increased usage of resources. Next, I will introduce Functional QAOA, an alternative approach for implementing QAOA which results in near-optimal circuits with respect to all relevant cost measures (e.g., number of qubits, gates, circuit depth) for optimization tasks like Travelling Salesman Problem and Max-K-Cut.

References:
B Bakó, A Glos, Ö Salehi, Z Zimborás, "Near-optimal circuit design for variational quantum optimization.", arXiv preprint arXiv:2209.03386, 2022
E. Farhi, J. Goldstone, and S. Gutmann, "A quantum approximate optimization algorithm," Tech. Rep. MIT-CTP/4610, 2014.
S. Hadfield, Z. Wang, B. O'Gorman, E. G. Rieffel, D. Venturelli, and R. Biswas, "From the quantum approximate optimization algorithm to a quantum alternating operator ansatz," Algorithms, vol. 12, no. 2, p. 34, 2019.
A. Glos, A. Krawiec, and Z. Zimbor´as, "Space-efficient binary optimization for variational quantum computing," npj Quantum Information, vol. 8, no. 1, pp. 1–8, 2022.

Özlem Salehi

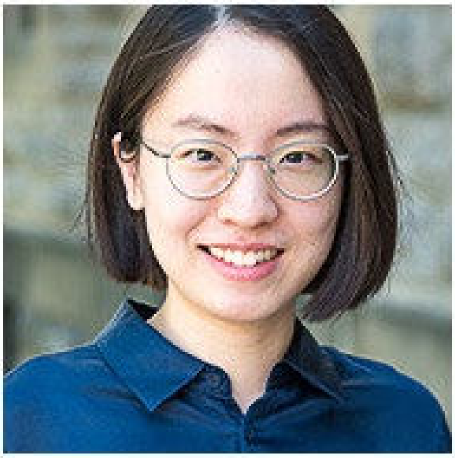
is a postdoctoral researcher at the Institute of Theoretical and Applied Informatics of the Polish Academy of Sciences. She obtained her Ph.D. degree in the field of theoretical computer science in 2019 from Boğaziçi University, İstanbul, Turkey. Her research area focuses on quantum optimization. In particular, she has been recently working on modeling and solving combinatorial optimization problems using quantum annealing and QAOA. She is one of the coordinators of the QEducation Department under QWorld. She has organized and instructed quantum programming workshops and developed open-source educational materials to promote quantum computing.

See the recording of the talk on YouTube >>

Invited speakers

Yanzhu Chen (Virginia Tech)

Improving variational quantum algorithms with an adaptive technique



Abstract:
Variational quantum algorithms show promise in providing advantage over purely classical computing by using shallow quantum circuits. The quality of the variational ansatz plays a crucial role in the performance of the algorithm. Balancing the ansatz expressivity and the information about the target problem, Adaptive Derivative-Assembled Problem-Tailored Variational Quantum Eigensolver (ADAPT-VQE) utilizes an adaptive ansatz to reach the desired accuracy with shallower circuits than conventional approaches. In this talk, I will introduce TETRIS-ADAPT-VQE, a modified version of ADAPT-VQE which produces even more compact circuits. Other than simulating quantum systems, variational algorithms have the potential of solving many classical optimization problems that can be mapped to finding the ground state of a Hamiltonian. A prototypical algorithm is the Quantum Approximate Optimization Algorithm (QAOA). I will review ADAPT-QAOA, which improves the convergence rate by applying the adaptive technique. Then I will discuss the entanglement generated during its execution, which exhibits different behavior from the standard QAOA.

References:
[1] TETRIS-ADAPT-VQE: an adaptive algorithm that yields shallower, denser ansatze. P. G. Anastasiou, YC, N. J. Mayhall, E. Barnes, S. E. Economou. arXiv:2209.10562
[2] Adaptive quantum approximate optimization algorithm for solving combinatorial problems on a quantum computer. L. Zhu, H. L. Tang, G. S. Barron, F. A. Calderon-Vargas, N. J. Mayhall, E. Barnes, S. E. Economou. Phys. Rev. Research 4, 033029
[3] How Much Entanglement Do Quantum Optimization Algorithms Require? YC, L. Zhu, C. Liu, N. J. Mayhall, E. Barnes, S. E. Economou. arXiv:2205.12283

Yanzhu Chen

is a postdoc in the Physics Department and Center for Quantum Information Science and Engineering at Virginia Tech. She is interested in quantum algorithms, noise in quantum computing, measurement based quantum computing, and quantum control. Her current works focus on properties and improvements of adaptive variational quantum algorithms and protocols of mitigating errors in quantum information processing. Yanzhu received her PhD from Stony Brook University, supervised by Tzu-Chieh Wei, and joined Virginia Tech in 2021, working with Sophia Economou and Edwin Barnes.

See the recording of the talk on YouTube >>

Invited speakers

Igor Dotsenko
(Laboratoire Kastler Brossel, Collège de France)

Circular Rydberg atoms for quantum simulations

Abstract:

A full understanding of many-body quantum systems is of paramount importance, first for the advancement of fundamental quantum science, but also for the development of radically new materials with fully engineered properties. However, the exact computation of relatively small many-body quantum systems of e.g. 40 spin-1/2 (or qubits) is already at the edge of the grasp of modern supercomputers. This limitation can be overcome by implementing quantum simulators. They transcribe the dynamics of the system of interest into another one, in which all parameters are adjustable and all relevant observables accessible. A quantum simulator based on a few tens of qubits would already outperform any foreseeable classical machine. Our experimental group has proposed to use arrays of laser-trapped circular Rydberg atoms to build a quantum simulator [1]. Its realization requires the ability to prepare arbitrary arrays of Rydberg atoms and to provide long atomic lifetime. These requirements are reflected in the two main experiments of our group: spatial manipulation of Rydberg atoms with ponderomotive force and inhibition of atomic spontaneous emission by placing atoms inside a conducting capacitor. In my presentation I first present our latest results on manipulating individual atoms in 2D arrays with optical tweezers. Then, I discuss the main challenges in realizing the emission inhibition, the current status of the project and the perspectives it opens.

References:
[1] T. L. Nguyen et al., Phys. Rev. X 8, 011032 (2018)

Igor Dotsenko

is associate professor at Collège de France and is a member at the Kastler-Brossel Laboratory in Paris. He received his PhD from the University of Bonn, Germany. His main research area is experimental quantum physics with individual quantum systems, e.g. with Rydberg atoms and trapped photons. He is interested in quantum optics, atomic physics, quantum thermodynamics, quantum simulations, etc.

See the recording of the talk on YouTube >>

Invited speakers

Volodymyr Tkachuk
(Ivan Franko National University of Lviv, Ukraine)

Studies of spin systems on a quantum computer

Abstract:

In this talk I will mainly present the results published in [1-4]. We propose a method and the corresponding quantum protocol for determining energy levels of spin systems on a quantum computer. The method is based on studies of the evolution of the mean value of operator anticommuting with Hamiltonian. In this case the evolution of the mean value of the corresponding physical quantity is related with the energy levels of a quantum system. It is in the contrast to the general case when time dependence of the mean value of a physical quantity is related to the transition energies of a quantum system. Therefore proposed method allows us to nd just energy levels on a quantum computer [1]. It is interesting to note that the structure of energy spectrum in this case is related to the supersymmetric properties of the system. Note that this method is restricted to the Hamiltonians for which anticommuting operators exist and the corresponding energy spectrum is symmetric with respect to inversion of the energy. We generalize this method to the case of an arbitrary spin system by adding to the system one probe (ancilla) spin [2]. Studies of the probe spin evolution allow us to determine energy levels of the system. The energy levels of various spin systems are found on IBM's quantum computer. The results of quantum calculations are in good agreement with the theoretical ones.

The proposed method is applied to studies of the single spin-1 tunneling on IBM's quantum computer, ibmq-bogota [3]. The spin-1 is realized with two spins-1/2 [3,4]. On the basis of studies of the time dependence of the mean value of z-component of spin-1 on the quantum device we detect oscillations of spin-1 between the states |1> and |-1> in the result of tunneling. The eigenvalues of Hamiltonian which describe the spin tunneling and the energy level splitting are observed on the IBM's quantum computer.

References:
[1] Kh. P. Gnatenko, H. P. Laba, V. M. Tkachuk, Phys. Lett. A 424, 127843 (2022).
[2] Kh. P. Gnatenko, H. P. Laba, V. M. Tkachuk, Eur. Phys. J. Plus 137, 522 (2022).
[3] K. P. Gnatenko, V. M. Tkachuk, Observation of spin-1 tunneling on a quantum computer, arXiv preprint arXiv:2201.08872 (2022), (to be published in Eur. Phys. J. Plus).
[4] A. R. Kuzmak, V. M. Tkachuk, Probing mean values and correlations of high-spin systems on a quantum computer, arXiv preprint arXiv:2205.10800 (2022).

Volodymyr Tkachuk

chairman of the Department for Theoretical Physics, Ivan Franko National University of Lviv. Theoretical physicist, PhD (Thermodynamic functions and dynamics of structurally disordered systems, 1990), DSc (Supersymmetry and exactly solvable problems in quantum mechanics, 2005). Since 2006 Professor of the Department for Theoretical Physics. One of the developers of the educational program "Quantum computers and quantum programming" at the Ivan Franko National University of Lviv. Research interests are quantum information and quantum computers, quantum graph states, fundamental problems of quantum mechanics, theory of quantum space, zeros of the partition function, supersymmetry in quantum mechanics.

Home page *https://physics.lnu.edu.ua/en/employee/volodymyr-tkachuk*

See the recording of the talk on YouTube >>

Invited speakers

Rayssa Bruzaca de Andrade
(Womanium & NKT Photonics)

Probing biological samples with quantum light

Abstract:
Quantum-enhanced measurements using squeezed states of light enable, for instance, improvements in the sensitivity of spectroscopy, imaging, and interferometric techniques beyond the shot-noise limit. In this presentation, we discuss the use of squeezed states in Stimulated Raman Spectroscopy. We also present absorption measurements using biological samples as the loss medium, showing sub-shot-noise imaging using a transmission raster scan microscope. Overall, we will highlight how squeezed states can provide benefits for quantum imaging and spectroscopy due to the reduced quadrature fluctuations.

Rayssa Bruzaca
works as an R&D optical engineer at NKT Photonics in the quantum solutions group. In addition, at the Womanium Foundation, she led the Quantum Hardware team. She has a Ph.D. in physics from the University of São Paulo. During her postdoctoral research at the Technical University of Denmark, she worked with quantum sensing using squeezed states of light for probing biological samples.

See the recording of the talk on YouTube >>

Invited speakers

Eden Schirman (Classiq for Academia)

Pioneering End-to-End Quantum Software Development with Classiq

Abstract:

Classiq is a leading quantum software company that enables end-to-end quantum software development. From devising your novel quantum algorithm, through generating an optimal quantum circuit, to executing your algorithm on all available quantum computers, Classiq is the one-stop solution for that.

Join us for a hands-on workshop where you will easily design and optimize new complicated quantum algorithms. Through an intuitive user interface, participants will have the unique opportunity to execute their algorithms seamlessly on real hardware, all with the simplicity of just three clicks. By attending, you will uncover the power of Classiq's comprehensive software suite, revolutionizing the quantum software development process and empowering researchers and developers alike. Feel free to start exploring Classiq even before the workshop by registering at *platform.classiq.io*

Eden Schirman

is the manager of Classiq for academia, where he leads the academic activities of Classiq. Before joining Classiq, Eden completed his masters in quantum dynamics at Imperial College London, where he developed quantum algorithms for attacking the post-quantum cryptography. At Imperial, Eden co-founded and was the president of the Imperial Quantum Technology Society.

See the recording of the talk on YouTube >>

Invited speakers

Christopher Bishop (Improvising Careers)

The secrets to working in quantum

Abstract:
How do we prepare students to participate in the emerging quantum workplace? What are the opportunities offered by quantum information science? We need to focus more broadly on how this technology is going to evolve and the range of skills that will be needed to support it. And from a learner's perspective, this represents a range of career opportunities that are going to grow and morph and evolve across many disciplines.

Christopher Bishop

is a technology futurist, TEDx speaker and former IBMer. He has performed the role of emcee and led panels for numerous Inside Quantum Technology conferences as well as for The Economist's "Commercialising quantum" events, both in London and Silicon Valley. Chris hosts the Quantum Tech Pod series, interviewing C-suite executives at leading quantum companies. In addition, he is a member of the Quantum Economic Development Consortium (QED-C) contributing to the Workforce Technology Advisory Committee and managing the Office Hours initiative connecting quantum students with mentors.

See the recording of the talk on YouTube >>

Thematic session "Building an Open Quantum Ecosystem"

Invited speakers

Paweł Gora
(QWorld, QPoland, Quantum AI Foundation)

The QCousins Program – Building a Global Network of Quantum Computing Groups

Abstract:
In this talk, I will introduce one of QWorld's programs: QCousins. Its idea is to create active groups on a global scale willing to popularize quantum technologies and to involve more people in the field by working locally and/or internationally (e.g., by organizing workshops, courses, preparing educational materials). I will outline the past, current and future projects of the QCousins program, and explain how to join us and create new QCousin groups.

Paweł Gora
board member of QWorld and Coordinator of its QCousins Department and QPoland's group. Founder and CEO of the Quantum AI Foundation.

See the recording of the talk on YouTube >>

Thematic session "Building an Open Quantum Ecosystem"

Invited speakers

Claudia Zendejas-Morales
(QWorld)

Year-long Open QCourse on Quantum Computing & Programming

Abstract:
Since having an open-access global ecosystem for quantum technologies and quantum software is the goal of QWorld, a new course is being created: the Year-long Open QCourse on Quantum Computing & Programming. With this QCourse edition, we will cover the necessary bases to start studying Quantum Computing, from the essential mathematics, an introduction to Python programming, and an introduction to quantum mechanics, going through the concepts of a classical probabilistic system to give way to the quantum counterpart and to reach the study of various quantum algorithms. It will be a course that covers several chapters to achieve the objective, starting September 2023 and projecting completion in May 2024; it will be an entirely online course with homework and exams to complete an evaluation of the students, who will have lectures, lab sessions, as well as the opportunity to consult mentors so that they can solve their doubts as they arise. At the end, the students will have chances to examine self-study modules on different quantum topics such as quantum hardware, quantum annealing, quantum key distribution, quantum error correction. The whole course materials will be open-sourced and freely available.

Claudia Zendejas-Morales
is a Computer Engineer and Physicist. She's been an instructor and mentor leader in multiple qcourses from QWorld, some in collaboration with University of Latvia. She is also part of the Qiskit Advocate program and collaborates as a mentor in events organized by IBM; she is part of the core team of the localization project. She is a research intern at Perimeter Institute (Waterloo, Canada). Her primary interest is Quantum Computing and Quantum Machine Learning.

See the recording of the talk on YouTube >>

Thematic session “Building an Open Quantum Ecosystem”

Invited speakers

Will Zeng
(Unitary Fund)

Let’s have more open source quantum tech projects!

Abstract:
Open source is an effective way to build ecosystems in new technologies. This talk will review the programs that Unitary Fund is using to support work in open quantum technologies as well as highlight funding areas of interest for new projects.

Will Zeng
Founder and President, Unitary Fund

See the recording of the talk on YouTube >>

Thematic session "Building an Open Quantum Ecosystem"

Invited speakers

Marlou Slot
(Womanium)

Womanium Quantum – Igniting the Quantum Leaders of Tomorrow

Abstract:
How to lead and to leap in quantum? How to become a quantum creator and leader? To build the quantum workforce of tomorrow, Womanium launched the Global Quantum Program and trained 1200+ people (45% women) from 70+ countries in its first year. During a full summer, the program takes quantum from the lab to the real world – How does quantum sensing revolutionize imaging the brain, earth and space? How to program quantum algorithms that help finance, healthcare and energy applications? What are the advantages of different qubit modalities? And how to start and fund your own startup? With virtual lab tours, hardware lectures, software bootcamps, investor and founder panels, a career fair and industry projects in collaboration with 60+ partners from industry, government and academia.

Dr. Marlou Slot
is a quantum materials physicist at NIST and heads the quantum team at Womanium. Womanium works with leading US government agencies, labs and companies to create future scientific leaders and advance women in STEM+E. To train the global quantum workforce, Womanium organizes flagship programs in Quantum Computing, Sensing and Applications, bringing together CEOs, scientists and industry leaders from the quantum field to train young talent.

See the recording of the talk on YouTube >>

Thematic session “Building an Open Quantum Ecosystem”

Invited speakers

Jen Dodd
(Xanadu)

QHack, The One-of-a-kind Quantum Hackathon

Abstract:
Call it a fan expo, hackathon or scientific conference, QHack is a one-of-a-kind event that has been bringing people together for four years to celebrate all things quantum. In this talk I will talk about the advantages and disadvantages of being an online event, how we've massively increased the rate of active engagement in QHack, and why Coding Challenges are the best thing since sliced bread.

Jen Dodd
is the Quantum Computing Community Lead at Xanadu (Toronto, Canada) where our mission is to make quantum computers that are useful and available to people everywhere. She holds a PhD in Physics from The University of Queensland in Australia, focusing on theoretical quantum computing. She has spent most of her career building communities around big ideas in science and technology.

See the recording of the talk on YouTube >>

Thematic session "Building an Open Quantum Ecosystem"

Invited speakers

Brian Ingmanson
(IBM Quantum)

Qiskit Fall Fest: Building a Quantum Community With a Student-First Approach

Abstract:
The Qiskit Fall Fest is a collection of student-led events focused on quantum computing engagement and education. Powered by IBM Quantum but designed by the students themselves, these events have reached more than 6000 students with hands-on activities and challenges. Brian Ingmanson of IBM Quantum will discuss the goals, successes, and lessons learned from the program.

Brian Ingmanson
is the Education Engagement Lead for the IBM Quantum Community Team. He works with students and educators around the world to host engaging events and create new learning pathways into the field of quantum computing. Brian left his classroom after 6 years of public education and joined IBM Quantum in 2019. He holds a Bachelor's and Master's in Education from the University of Connecticut. Brian frequently presents on stage for adults and students, and sometimes plays the drums. Occasionally he's known to do both at the same time.

See the recording of the talk on YouTube >>

Thematic session "Building an Open Quantum Ecosystem"

Invited speakers

Radha Pyari Sandhir
(IBM Quantum)

Quantum Explorers: A Game-based Approach to Quantum Education

Abstract:
Quantum Explorers is a self-paced educational program at IBM Quantum that uses gamification to bring cohorts of students through various learning paths. Learners work towards unlocking space exploration themed achievements by tackling quantum labs, completing assessments, participating in community events, and more. This game-based approach to learning quantum computing has the potential to cater to a variety of learner types, boost learner engagement, and improve information processing and retention, among other perks. This talk will cover the lessons learned from the inaugural cohort of the Quantum Explorers, and future plans.

Radha Pyari Sandhir
India Community Lead and Quantum Explorers program lead at IBM Quantum.

See the recording of the talk on YouTube >>

Thematic session “Building an Open Quantum Ecosystem”

Invited speakers

Yasser Omar (PQI – Portuguese Quantum Institute & IST, University of Lisbon)

The World Quantum Day – 14 April

Abstract:

The World Quantum Day (*worldquantumday.org*), celebrated on 14 April and in the days and weeks around that date, is an initiative from quantum scientists from 65+ countries. It is a decentralized and bottom-up initiative, inviting all scientists, engineers, educators, etc., and their organisations, to develop their own activities, such as outreach talks, exhibitions, lab tours, panel discussions, interviews, artistic creations, etc., to celebrate quantum science and technology around the World. It is also a unique opportunity to establish global collaboration links at a global scale for research, education, and outreach.

See the recording of the talk on YouTube >>

Thematic session "Building an Open Quantum Ecosystem"

Invited speakers

Andris Ambainis
(University of Latvia)

Latvian Quantum Initiative – Building Quantum Technologies in a Small Country

Abstract:
In this talk, I describe how we developed the Latvian Quantum Initiative – a technology project that started in February 2023. In contrast to all-encompassing Quantum Initiatives in larger countries, we focused on selected areas of quantum technologies which are important to Latvia either because of existing research strength (for example, in quantum software) or because of practical importance in near-term future (for example, the development of European Quantum Communication Infrastructure). At the same time, we aimed to include both research and education and to expand the excellence to new research areas (for example, by building infrastructure for experimental research at very low temperatures). This conceptual approach may be useful for developing Quantum Initiatives in other smaller countries.

Andris Ambainis

is a quantum computer scientist known for quantum walks, quantum query lower bounds and other developments in quantum algorithms and complexity. He received an ERC Advanced Grant in 2012 and is now leading the Latvian Quantum Initiative.

See the recording of the talk on YouTube >>

Thematic session "Building an Open Quantum Ecosystem"

Invited speakers

Garazi Muguruza
(QuSoft & MNS, University of Amsterdam)

Women in Quantum Development (WIQD)

Abstract:

In this talk I will introduce WIQD's initiative to tackle the lack of gender diversity in the quantum network. WIQD is a professional network in the quantum sector in the Netherlands including industry, academia and policy. I will explain our organization's structure, mission, activities we organize and future plans.

Garazi Muguruza

is a PhD candidate in Quantum Networks, with interest in Quantum Cryptography and Quantum Information Theory, at QuSoft. She has been an organizing committee member of WIQD since the start of her PhD.

See the recording of the talk on YouTube >>

List of Talks

[In their submitted order]

1. A Secured Half-Duplex Bidirectional Quantum Key Distribution Protocol against Collective Attacks

See the recording >>

Manal Khawasik, Wagdy Gomaa El-Sayed, M. Z. Rashad, Ahmed Younes
(Alexandria University, Egypt; Mansoura University, Egypt; University of Birmingham, UK)

Quantum Key Distribution is a secure method that implements cryptographic protocols. The applications of quantum key distribution technology have an important role: to enhance the security in communication systems. It is originally inspired by the physical concepts associated with quantum mechanics. It aims to enable a secure exchange of cryptographic keys between two parties through an unsecured quantum communication channel. This work proposes a secure half-duplex bidirectional quantum key distribution protocol. The security of the proposed protocol is proved against collective attacks by estimating the interception of any eavesdropper with high probability in both directions under the control of the two parties. A two-qubit state encodes two pieces of information; the first qubit represents the transmitted bit and the second qubit represents the basis used for measurement. The partial diffusion operator is used to encrypt the transmitted qubit state as an extra layer of security. The predefined symmetry transformations induced by unitary in conjunction with the asymmetrical two-qubit teleportation scheme retain the protocol's secrecy. Compared to the previous protocols, the proposed protocol has better performance on qubit efficiency.

DOI: *https://doi.org/10.3390/sym14122481*

2. Framework for understanding quantum computing use cases from a multidisciplinary perspective and future research directions

See the recording >>

Anastasija Nikiforova, Dandison Ukpabi, Heikki Karjaluoto, Astrid Bötticher, Dragoş Petrescu, Paulina Schindler, Visvaldis Valtenbergs, Lennard Lehmann, Abuzer Yakaryilmaz (University of Tartu, Estonia; University of Jyväskylä, Finland; Friedrich-Schiller-University Jena, Germany; University of Bucharest, Romania; University of Latvia; QWorld Association)

Recently, there has been increasing awareness of the tremendous opportunities inherent in quantum computing (QC). Specifically, the speed and efficiency of QC will significantly impact the Internet of Things, cryptography, finance, and marketing. Accordingly, there has been increased QC research funding from national and regional governments and private firms. However, critical concerns regarding legal, political, and business-related policies germane to QC adoption exist. Since this is an emerging and highly technical domain, most of the existing studies focus heavily on the technical aspects of QC, but our study highlights its practical and social uses cases,

which are needed for the increased interest of governments. Thus, this study offers a multidisciplinary review of QC, drawing on the expertise of scholars from a wide range of disciplines whose insights coalesce into a framework that simplifies the understanding of QC, identifies possible areas of market disruption and offer empirically based recommendations that are critical for forecasting, planning, and strategically positioning QCs for accelerated diffusion.
arXiv: *https://arxiv.org/abs/2212.13909*

3. Self-testing composite measurements and bound entangled state in a unified framework

See the recording >>

Shubhayan Sarkar, Chandan Datta, Saronath Halder, Remigiusz Augusiak
(Universite Libre De Bruxelles, Belgium; Polish Academy of Sciences; University of Warsaw, Poland)

Within the quantum networks scenario we introduce a single scheme allowing to certify three different types of composite projective measurements acting on a three-qubit Hilbert space: one constructed from genuinely entangled GHZ-like states, one constructed from fully product vectors that exhibit the phenomenon of nonlocality without entanglement (NLWE), and a hybrid measurement obtained from an unextendible product basis (UPB). Noticeably, we certify a basis exhibiting NLWE in the smallest dimension capable of supporting this phenomenon. On the other hand, the possibility of certification of a measurement obtained from a UPB has an interesting implication that one can also self-test a bound entangled state in the considered quantum network. Such a possibility does not seem to exist in the standard Bell scenario.
arXiv: *https://arxiv.org/abs/2301.11409*

4. Democratization of quantum technologies

See the recording >>

Zeki C. Seskir, Steven Umbrello, Christopher Coenen, Pieter E Vermaas
(KIT-ITAS, Germany; Delft University of Technology, Netherlands)

As quantum technologies (QT) advance, their potential impact on and relation with society has been developing into an important issue for exploration. In this paper, we investigate the topic of democratization in the context of QT, particularly quantum computing. The paper contains three main sections. First, we briefly introduce different theories of democracy (participatory, representative, and deliberative) and how the concept of democratization can be formulated with respect to whether democracy is taken as an intrinsic or instrumental value. Second, we give an overview of how the concept of democratization is used in the QT field. Democratization is mainly adopted by companies working on quantum computing and used in a very narrow understanding of the concept. Third, we explore various narratives and counter-narratives concerning democratization in QT. Finally, we explore the general efforts of democratization in QT such as different forms of access, formation of grassroot communities and special interest groups, the emerging culture of manifesto writing, and how these can be located within the different theories of democracy. In conclusion, we argue that although the

ongoing efforts in the democratization of QT are necessary steps towards the democratization of this set of emerging technologies, they should not be accepted as sufficient to argue that QT is a democratized field. We argue that more reflexivity and responsiveness regarding the narratives and actions adopted by the actors in the QT field and making the underlying assumptions of ongoing efforts on democratization of QT explicit, can result in a better technology for society.
DOI: *https://doi.org/10.1088/2058-9565/acb6ae*

5. Global innovation and competition in quantum technology, viewed through the lens of patents

See the recording >>

Zeki C. Seskir, Kelvin W. Willoughby
(KIT-ITAS, Germany; HHL Leipzig Graduate School of Management, Germany)

In this work we elucidate international trends in the field of quantum technology (QT) by analysing a global patent database built from an operational definition of QT that was generated through the curated application of artificial intelligence (AI). In doing so, we demonstrate how the sophisticated use of intellectual property information, enhanced by the artful deployment of AI techniques, may produce more reliable and useful revelations for policymakers and managers about global innovation in emerging fields of technology than is possible through conventional methods of data collection and analysis. We also demonstrate the utility of this approach for reliably characterising the evolving constituent sub-fields of QT. By adopting a hybrid human-AI approach to both the definition and the analysis of QT, we have produced some novel insights about global innovation and national organisational profiles in the QT field, particularly concerning dynamic competition between the USA and China.
DOI: *https://doi.org/10.1504/IJIPM.2023.129076*

6. Quantum gate synthesis and Ramanujan

See the recording >>

Nihar Gargava (EPFL, Switzerland)

After nearly a century, Hardy's apology is rendered premature yet again as Ramanujan's research finds novel applications in making fault tolerant quantum computers. In this talk, I will outline how as a number theorist I forayed into the quantum computing world to explore an amazing connection of Ramanujan graphs and decomposing an arbitrary unitary matrix in terms of some special gates sets (for example Clifford+T). In particular, I will talk about current progress from number theorists and what lies ahead. This is based on my internship work at Quantinuum in Fall 2022 and the Rust library generated there.

7. A Riemannian Genuine Measure of Entanglement for Pure States

See the recording >>

R. Dharmaraj, Radhika Vathsan (Birla Institute Of Technology And Science, India)

We define a new geometric measure for multipartite pure state entanglement using the geodesic distance on the space of quantum states. This measure not only satisfies all the desirable properties for a genuine entanglement measure but is also easy to compute. Comparison with existing entanglement measures shows similar behaviour as a function of entanglement parameters. Further, it exhibits better smoothness and discriminance, in variation with respect to parameters in the states, as compared to some of the existing GME's.

arXiv: *https://arxiv.org/abs/2211.06309*

8. Visualizing Quantum Circuit Probability

See the recording >>

Aritra Sarkar, Bao Gia Bach, Akash Kundu, Tamal Acharya (Delft University of Technology, Netherland; Ho Chi Minh City University of Technolog, Vietnam; Silesian University of Technology, Poland; Polish Academy of Sciences; QuTech)

This research applies concepts from algorithmic probability to Boolean and quantum combinatorial logic circuits. Various notions of the complexity of states are presented. Thereafter, the probability of states in the circuit model of computation is defined. Classical and quantum gate sets are compared to select some characteristic sets. The reachability and expressibility in a space-time-bounded setting for these gate sets are enumerated and visualized. These results are studied in terms of computational resources, universality and quantum behavior. The article suggests how applications like geometric quantum machine learning, novel quantum algorithm synthesis and quantum artificial general intelligence can benefit by studying circuit probabilities.

arXiv: *https://arxiv.org/abs/2304.02358*

9. Tighter And Stronger Quantum Speed Limits For General Quantum States

See the recording >>

Shrobona Bagchi, Abhay Srivastav, Arun Kumar Pati (Korea Institute of Science and Technologies; Harish-Chandra Research Institute, India)

We derive various quantum speed limits for unitary evolution for the case of general quantum states using the stronger uncertainty relation for mixed quantum states and tighter uncertainty relation for general quantum states. These bounds are proved to be stronger and tighter than many earlier bounds in the literature, which renders them useful in the arena of quantum metrology and potential applications in quantum information processing tasks. In the process we also generalize the tiger uncertainty relation for pure quantum states to that of mixed quantum states and prove its better performance theoretically. It is then shown that these bounds can be

optimized over different choices of operators for obtaining even better bounds. We illustrate these with many examples and show their better performance with respect to at least three existing bounds for general quantum states and many different choices of Hamiltonians that are useful in different quantum information processing tasks.
arXiv: *https://arxiv.org/abs/2211.14561*

10. Remote Creation of Quantum Coherence via Indefinite Causal Order

See the recording >>

Shrobona Bagchi, Jasleen Kaur, Arun K. Pati (Raymond and Beverly Sackler School of Physics and Astronomy, Israel; Amity Institute of Applied Sciences, India; Harish-Chandra Research Institute, India, Homi Bhabha National Institute, India)

Quantum coherence is a prime resource in quantum computing and quantum communication. Quantum coherence of an arbitrary qubit state can be created at a remote location using maximally entangled state, local operation and classical communication. However, if there is a noisy channel acting on one side of the shared resource, then, it is not possible to create perfect quantum coherence remotely. Here, we present a method for the creation of quantum coherence at a remote location via the use of entangled state and indefinite causal order. We show this specifically for the superposition of two completely depolarizing channels, two partially depolarizing channels and one completely depolarizing channel along with a unitary operator. We find that when the indefinite causal order of channels act on one-half of the entangled pair, then the shared state looses entanglement, but can retain non-zero quantum discord. This finding may have some interesting applications on its own where discord can be consumed as a resource. Our results suggest that the indefinite causal order along with a tiny amount of quantum discord can act as a resource in creating non-zero quantum coherence in the absence of entanglement.
DOI: *https://doi.org/10.1007/s11128-022-03708-1*
arXiv: *https://arxiv.org/abs/2103.04894*

11. Uranium – a visual quantum computing platform

See the recording >>

Radu Marginean (Transilvania Quantum)

Uranium is an open-source, visual, quantum computing platform. At its core, it comprises an extremely powerful circuit editor and a high performance simulator that can run in your browser or offline. It features a large collection of predefined gates, many of which are not available elsewhere. The editor is easy to use, productive, and supports exporting to external formats. Using our platform, in a manner of minutes, you can create and simulate advanced quantum circuits.

12. Phase estimation with functional quantum abstract detecting systems

See the recording >>

Guillermo Lugilde, Elías F. Combarro, Ignacio F. Rúa (University of Oviedo)

Quantum abstract detecting systems (QADS) provide a common framework to address detection problems in quantum computers. A particular QADS family, that of combinatorial QADS, has been proved to be useful for decision problems on eigenvalues or phase estimation methods. In this paper, we consider functional QADS, which not only have interesting theoretical properties (intrinsic detection ability, relation to the QFT), but also yield improved decision and phase estimation methods, as compared to combinatorial QADS.

13. Investigation of open quantum batteries and using IBM quantum computers as a versatile platform to simulate them

See the recording >>

Seyed Navid Elyasi (University of Kurdistan, Iran)

In the past decades, the field of quantum technologies has grown significantly, and many studies have been conducted in an attempt to operationalize theoretical research. In this regard, quantum batteries can be considered one of these technologies. Our daily lives involve the use of a variety of batteries to provide the energy required by electronic devices. These batteries use electrochemical processes to be charged and discharged. In essence, quantum batteries are microscopic devices that store energy and are capable of extracting it when needed. Originally, quantum batteries were considered to be closed systems in research studies on this topic. We are, however, confronted with natural systems that interact with their environment. For this reason, it is best to study these devices in the form of an open quantum system in order to bring this problem into reality and to examine them more closely. In order to investigate the evolution of open quantum systems, there are two types of approaches, Markovian and non-Markovian. Markov evolution requires using Born-Markov approximations, making it difficult to describe some systems accurately. Hence, it is more precise to analyze systems in a non-Markovian regime. This thesis presents a model that illustrates the evolution of quantum batteries as open systems. As an integral part of conventional batteries as well as quantum batteries, self-discharge has also been investigated. As a final point, we have operated and analyzed a quantum battery based on the qubits used in IBM quantum computers.

14. Entangling capability of multi-qubit parameterized quantum circuits and its calculation with quantum programming

See the recording >>

Kh. P. Gnatenko (Ivan Franko National University of Lviv & SoftServe Inc., Ukraine)

We study the geometric measure of entanglement of the multi-qubit quantum states generated by parameterized circuits on the basis of analytical calculations and with programming on quantum devices of IBM, and Riggetti [1,2]. Quantum states generated by the rotational gates (RY gate) and two-qubit controlled phase gates (CP gate) are examined [3]. The states can be associated with graphs with the vertices corresponding to qubits and edges representing the action of two-qubit gates. Also, we study the entanglement of quantum graph states prepared with parameterized quantum circuits with rotational gates (RY, RZ gates) and two-qubit RXX gates. We find analytically an expression for the geometric measure of entanglement of the states corresponding to the arbitrary graph structure [3,4]. We show that the measure of entanglement of a qubit in a graph state is related to the degree of vertex representing it in a graph and analyze the dependencies of the entanglement on the circuit's parameters. Also, the average geometric measure of entanglement of the graph states is calculated and analyzed.

In addition, we examine the geometric measure of entanglement of Generative Adversarial Network states [5] and their generalization (states prepared with a circuit with a layer formed by the rotational gates and two-qubit controlled phase gates) [6].

Quantum protocols for studies of the entanglement of the states on quantum devices are constructed. To detect the entanglement we use its relation with the mean spin obtained in [7]. Protocols are realized on IBM's and Riggetti's quantum computers. The results of quantum calculations are in agreement with the theoretical ones.

arXiv: *https://arxiv.org/abs/2301.03885*

[1] IBM Q experience. https://quantum-computing.ibm.com/
[2] Rigetti Computing: Quantum Computing https://www.rigetti.com/
[3] Gnatenko, Kh. P. Susulovska, N. A.: Geometric measure of entanglement of multi-qubit graph states and its detection on a quantum computer. EPL (Europhys. Lett.) 136, 40003 (2021).
[4] Gnatenko, Kh. P. Tkachuk, V. M.: Entanglement of graph states of spin system with Ising interaction and its quantifying on IBM's quantum computer. Phys. Lett. A. 396, 127248 (2021).
[5] Zoufal, Ch. Lucchi, A. Woerner, S.: Quantum Generative Adversarial Networks for learning and loading random distribution. npj Quantum Information 5, 103 (2019).
[6] Gnatenko, Kh. P.: Evaluation of variational quantum states entanglement on a quantum computer by the mean value of spin, arXiv:2301.03885 (2023).
[7] Frydryszak, A. M. Samar, M. I. Tkachuk, V. M.: Quantifying geometric measure of entanglement by mean value of spin and spin correlations with application to physical systems. Eur. Phys. J. D 71, 233 (2017).

15. Multiple-control Toffoli Circuit Classification and Transformation

See the recording >>

Ankit Khandelwal, Handy Kurniawan, Shraddha Aangiras, Adam Glos, Ozlem Salehi
(Tata Consultancy Services, India; University of Tartu, Estonia, Polish Academy of Sciences; Algorithmiq Ltd, Finland)

Efficient decompositions are critical for quantum computing irrespective of whether NISQ or fault-tolerant architectures are used. In particular the multi-controlled NOT is a core example of a multi-qubit gate for which various decompositions were provided depending on the available qubit resources. The decompositions differ in the way the auxiliary qubit systems are used. In this work, we provide a classification based on the auxiliary qubit systems and analyze the dependency among each class. Such classification applies not only to multi-controlled NOT gates but also to arbitrary permutation unitaries and can be used for transforming a given quantum circuit into a representative of a more general class and consequently reduces the number of gates or depth.

16. Is it rational to connect quantum computers?

See the recording >>

Luca M. Possati, Pieter Vermaas (Delft University of Technology, Netherland)

This contribution investigates the rationality of connecting quantum computers. The central questions are as follows: What are scenarios in which it is ethically advantageous to connect quantum computers? Does connecting quantum computers offer a competitive advantage over other opposing players? These are crucial questions given the growing development of quantum computing and its applications that promise to have disruptive effects from an ethical and social point of view. We describe three possible scenarios: non-connection, blind connection and governed connection of quantum computers. These scenarios will be evaluated using five criteria: quantum advantage, collaboration gain, equality, transparency, and autonomy. We then analyze the results of this evaluation from an ethical point of view. Some cases in which it is ethically advantageous to choose a governed connection between quantum computers, and some others in which a blind connection is preferable are described.

17. Quantum Advantage Seeker with Kernels (QuASK): a software framework to speed up the research in quantum machine learning

See the recording >>

Massimiliano Incudini, Francesco Di Marcantonio, Davide Tezza, Michele Grossi
(University of Verona, Italy; CERN; University of Trento, Italy)

QuASK is a quantum machine learning software written in Python that supports researchers in designing, experimenting, and assessing different quantum and classical kernels performance. This software is package agnostic and can be integrated with all major quantum software packages (e.g. IBM Qiskit, Xanadu's Pennylane, Amazon Braket). QuASK guides the user through a simple preprocessing of input data, definition and calculation of quantum and classical kernels, either custom or pre-defined ones. From this evaluation the package provides an assessment about potential quantum advantage and prediction bounds on generalization error. Moreover, it allows for the generation of parametric quantum kernels that can be trained using gradient-descent-based optimization, grid search, or genetic algorithms. Projected quantum kernels, an effective solution to mitigate the curse of dimensionality induced by the exponential scaling dimension of large Hilbert spaces, are also calculated. QuASK can furthermore generate the observable values of a quantum model and use them to study the prediction capabilities of the quantum and classical kernels.

DOI: https://doi.org/10.1007/s42484-023-00107-2

18. Generation, Stabilization and Manipulation of Kerr Cat States in Superconducting Resonators

See the recording >>

Muhammad Shuraim (Pakistan Institute of Engineering and Applied Sciences)

Exploiting the non-linearity (Kerr effect) in superconducting qubits when coupled with microwave resonators showed promising results: thus, creating out-of-phase superpositions of coherent states, commonly called Schrödinger cat states. These cat states are widely used in quantum information processing because of their exponential suppression against bit-flip errors, albeit linear increment in phase-flip errors against the amplitude of the coherent state. However, high-fidelity generation, stabilization, and manipulation of these cat states is a challenging task. In this project, we computationally studied the evolution of the cavity state of the resonator to cat states under the Kerr nonlinear resonator (KNR) with an additional two-photon drive using the QuTiP package. We demonstrate that this method can generate stabilized cat states that are robust against single-photon loss. This can also cancel out the unwanted phase evolution induced by the Kerr effect and dephasing effects due to single-photon loss. Furthermore, we have presented how adiabatic and high-fidelity non-adiabatic initialization of cat states is possible. We found that the cat state preparation using the qcMAP protocol suffers deformation, but using a two-photon drive can obviate these deformations and thus generate a high-fidelity cat state. Finally, we manipulated those engineered subspaces of KNR to use as a resource for quantum logic (X gate, Z gate, and Entangling gate) and realized high fidelities of the proposed method and the operations. We have also presented a possible experimental realization of KNR with a two-photon drive.

19. Quantum carpets: efficiently probing fractional revivals in position-dependent mass systems

See the recording >>

Tooba Bibi, Sunia Javed, Shahid Iqbal
(National University of Sciences and Technology, Pakistan)

Position-dependent-mass systems are of great importance in many physical situations, such as the transport of charge carriers in semiconductors with non-uniform composition and in the theory of many-body interactions in condensed matter. Here we investigate, numerically and analytically, the phenomenon of fractional revivals in such systems, which is a generic characteristic manifested by the wave-packet evolution in bounded Hamiltonian systems. Identifying the fractional revivals using specific probes is an important task in the theory of quantum measurement and sensing. We numerically simulate the temporal evolution of probability density and information entropy density, which manifest self-similarly recurring interference patterns, namely, quantum carpets. Our numerical results show that the quantum carpets not only serve as an effective probe for recognizing the fractional revivals of various order but they efficiently describe the effect of spatially-varying mass on the structure of fractional revivals, which is manifested as a symmetry breaking in their designs.

DOI: https://doi.org/10.1088/1572-9494/ac9f0d

20. Surface code design for asymmetric error channels

See the recording >>

Utkarsh Azad, Aleksandra Lipińska, Shilpa Mahato, Rijul Sachdeva,
Debasmita Bhoumik, Ritajit Majumdar (Xanadu Quantum Technologies;
International Institute of Information Technology, India; ; Jagiellonian University, Poland;
IndianInstituteof Technology Dhanbad; Jülich Supercomputing Center, Germany; Indian Statistical Institute)

Surface codes are quantum error correcting codes normally defined on 2D arrays of qubits. In this paper, we introduce a surface code design based on the fact that the severity of bit flip and phase flip errors in the physical quantum systems is asymmetric. For our proposed surface code design for asymmetric error channels, we present pseudo-threshold and threshold values in the presence of various degrees of asymmetry of Pauli $\hat{X}$, $\hat{Y}$, and $\hat{Z}$ errors in a depolarization channel. We show that, compared to symmetric surface codes, our asymmetric surface codes can provide almost double the pseudo-threshold rates while requiring less than half the number of physical qubits in the presence of increasing asymmetry in the error channel. We also demonstrate that as the asymmetry of the surface code increases, the advantage in the pseudo-threshold rates begins to saturate for any degree of asymmetry in the channel.
DOI: *https://doi.org/10.1049/qtc2.12042*
arXiv: *https://arxiv.org/abs/2111.01486*

21. Quantum Steering Algorithm for Estimating Fidelity of Separability

See the recording >>

Aby Philip, Soorya Rethinasamy, Vincent Russo, Mark M. Wilde
(Cornell University, USA; Unitary Fund)

Quantifying entanglement is an important task by which the resourcefulness of a state can be measured. Here we develop a quantum algorithm that tests for and quantifies the separability of a general bipartite state, by making use of the quantum steering effect. Our first separability test consists of a distributed quantum computation involving two parties: a computationally limited client, who prepares a purification of the state of interest, and a computationally unbounded server, who tries to steer the reduced systems to a probabilistic ensemble of pure product states. To design a practical algorithm, we replace the role of the server by a combination of parameterized unitary circuits and classical optimization techniques to perform the necessary computation. The result is a variational quantum steering algorithm (VQSA), which is our second separability test that is better suited for the capabilities of quantum computers available today. This VQSA has an additional interpretation as a distributed variational quantum algorithm (VQA) that can be executed over a quantum network, in which each node is equipped with classical and quantum computers capable of executing VQA. We then simulate our VQSA on noisy quantum simulators and find favorable convergence properties on the examples tested. We also develop semidefinite programs, executable on classical computers, that benchmark the results obtained from our VQSA. Our findings here thus provide a meaningful connection between steering, entanglement, quantum algorithms, and quantum computational complexity theory. They also demonstrate the value of a parameterized mid-circuit measurement in a VQSA and represent a first-of-its-kind application for a distributed VQA. Finally, the whole framework generalizes to the case of multipartite states and entanglement.
arXiv: *https://arxiv.org/abs/2303.07911*

22. Effective Study Of The Quantum Damped Harmonic Oscillator

Carlos Javier Valdez (Universidad Autonoma de Chihuahua, Mexico)

See the recording >>

An analysis of the quantization of the damped harmonic oscillator is presented. To this end, we study three approaches: the Feshbach--Tikonchinsky quantization of the Bateman Hamiltonian, the solution given by the employment of the Lindblad master equation, and the effective description of the quantum damped harmonic oscillator based on the Bateman Hamiltonian given by the momentous quantum mechanics. From the Feshbach-Tikochinsky method, we observed that despite its sophistication, the energy eigenvalues obtained are complex, and the uncertainty relation evolution decays to zero. The solution given by the Lindblad master equation, on the other hand, provides a description that holds the Heisenberg uncertainty and shows how the energy of the quantum damped harmonic oscillator decays to the energy levels given by the environment.

By using the momentous quantum mechanics, we observe quantum corrections that Bateman's dual Hamiltonian undergoes when it is quantized. This allowed us to propose a framework, under which the effective method allows the conservation of the classical symplectic structure, at the same time it is possible to test the consequences of promoting to operators the physical and not the canonical momenta. From this, we are able to show and compare under which conditions the solution obtained by this method is similar to the one given by the Lindblad master equation. Obtaining that the evolution given by the momentous quantum mechanics is similar to the case in the Lindblad approach, when the system of interest is isolated from the environment. We discuss the problems present in the quantization of the Bateman Hamiltonian, and how the semiclassical formulation overcomes these shortcomings.

23. Nonlocality Distillation With Non-Trivial Marginals

Areej Ilyas, Jibran Rashid (Institute of Business Administration, Pakistan)

See the recording >>

PARITY is known to be optimal for nonlocality distillation using non-adaptive protocols. The nonlocal correlation source considered for these cases assumes trivial local marginals. We prove that other protocols, such as OR, can perform better nonlocality distillation when the local marginals are non-trivial.

24. Faster quantum sampling of Markov chains in nonregular graphs with fewer qubits

Yun Shang, Xinying Li (Chinese Academy of Sciences)

See the recording >>

Sampling from the stationary distribution is one of the fundamental tasks of Markov-chain-based algorithms and has important applications in machine learning, combinatorial optimization, and network science. For the quantum case, quantum sampling from Markov chains corresponds to preparing quantum states with amplitudes arbitrarily close to the square root of a stationary distribution instead of classical sampling from a stationary distribution. A different quantum sampling algorithm for all reversible Markov chains is constructed by discrete time quantum walks. We build a quantum sampling algorithm that not only accelerates nonregular graphs, but also keeps the speed up of existing quantum algorithms for regular graphs. In nonregular graphs, the invocation of the quantum fast-forwarding algorithm accelerates previous state-of-the-art quantum sampling algorithms for both discrete-time and continuous-time cases, especially on sparse graphs. Compared to existing algorithms, we decrease the runtime by a factor of log n, where n is the number of graph vertices. In regular graphs, our results match other quantum algorithms and the reliance on the gap of Markov chains achieves quadratic speedup compared with classical cases. For both cases, we reduce the number of ancilla qubits required compared with the existing results. In some widely used graphs and a series of sparse graphs where stationary distributions are difficult to reach quickly, our algorithm achieves complete quadratic acceleration (without log factor) over the classical case without any limit. In addition, we construct a different reflection around the stationary state with fewer ancilla qubits and believe it may have an independent application.

DOI: *https://doi.org/10.1103/PhysRevA.107.022432*
arXiv: *https://arxiv.org/abs/2205.06099*

25. QJudge: Automated Testing of Students Solutions for Quantum Algorithms Courses

See the recording >>

Mansur Ziiatdinov (Kazan Federal University)

We describe QJudge, an automated testing system tailored for problems with quantum circuit solutions. QJudge allows you to prepare problems and accept solutions in the form of quantum circuits. It can be conveniently used in introductory quantum programming courses when students do not have sufficient knowledge of quantum programming libraries. The paper compares QJudge with other testing systems and describes the types of problems available in QJudge. We discuss the architecture of the system as well as the experience of using QJudge to teach a course on quantum algorithms.

26. TQSim: An Open-Source Package for Topological Quantum Computing with Anyons

See the recording >>

Nacer Eddine Belaloui, Abdellah Tounsi, Mohamed Messaoud Louamri, Mohamed Taha Rouabah (CQTech & University of Constantine 1, Algeria)

Topological quantum computation (TQC) is a theoretical framework that offers a clever mean of executing fault-tolerant quantum computation. This framework is based on the statistical properties of anyon particles, which are governed by the braid group operations. Nonetheless, the present challenges in developing and studying algorithms for such platforms are attributed to the considerable domain-specific knowledge required in the field of anyon models and topological quantum systems. To address this issue and extend the field to more researchers, we have developed the TQSim, an open-source software library, written purely in Python and licensed under Apache 2.0. Its main aim is to facilitate the simulation of topological quantum circuits with braiding anyons. Although it was initially designed for educational purposes, TQSim has since proven useful in our research. Its primary functions include computing the matrix representation of braid generators, simulating braid sequences on specific sets of identical anyons, visualizing the braids, and providing analysis tools for quantum circuit measurement. In this talk, we are going to dive into the world of TQC using a user-friendly software package. In addition, we are going to identify the main functionalities and the structure of this open-source package.

27. Systematic Braid Matrix Generation for Topological Quantum Computing

See the recording >>

Abdellah Tounsi, Nacer Eddine Belaloui, Mohamed Messaoud Louamri,
Achour Benslama, Mohamed Taha Rouabah (CQTech & University Constantine 1, Algeria)

Topological quantum computing is a theoretical framework that enables unitary operations to be performed without introducing errors due to the system's dynamics. This framework relies on the statistical properties of anyon particles, which are governed by the braid group. However, computing the anyonic braid matrices for topological quantum computing is considered challenging. In this study, we propose a systematic method for computing such braid matrices for quantum circuit-based anyonic states. This method can serve as the foundation for a general topological quantum computing simulator, facilitating the study of complex topological quantum circuits in the context of any anyon model. In this presentation, we aim to provide a comprehensive review of the foundational principles of anyon model theory. Specifically, we describe the methodology for constructing qubits/qudits based on anyonic states. Furthermore, we present a generalized formula for systematically computing the matrix components of the braid operations, which we validate through algebraic techniques. Moreover, we reproduce well-known quantum gates from previous studies to demonstrate the validity of our method.

28. Mapping state transition susceptibility in quantum annealing

See the recording >>

Elijah Pelofske (Los Alamos National Laboratory)

Quantum annealing is a novel type of analog computation that aims to use quantum-mechanical fluctuations to search for optimal solutions for Ising problems. Quantum annealing in the transverse field Ising model, implemented on D-Wave devices, works by applying a time-dependent transverse field, which puts all qubits into a uniform state of superposition, and then applying a Hamiltonian over time, which describes a user-programed Ising problem. We present a method that utilizes two control features of D-Wave quantum annealers, namely reverse annealing and an h-gain schedule, to quantify the susceptibility, or the distance, between two classical states of an Ising problem. The starting state is encoded using reverse annealing, and the second state is encoded on the linear terms of a problem Hamiltonian. An h-gain schedule is specified, which incrementally increases the strength of the linear terms, thus allowing a quantification of the h-gain strength required to transition the anneal into a specific state at the final measurement. Because of the nature of quantum annealing, the state tends towards global minima, and therefore we restrict the second classical state to a minimum solution of the given Ising problem. This susceptibility mapping, when enumerated across all initial states, shows in detail the behavior of the quantum annealer during reverse annealing. The procedure is experimentally demonstrated on three small test Ising models which were embedded in parallel on the D-Wave Advantage_system4.1. Analysis of the state transition mapping shows detailed characteristics of the reverse annealing process, including intermediate state transition paths, which are visually represented as state transition networks.

DOI: *https://doi.org/10.1103/PhysRevResearch.5.013224*
arXiv: *https://arxiv.org/abs/2210.16513*

29. Tensor network techniques for quantum transport beyond weak coupling

See the recording >>

Gabriela Wojtowicz, Justin E. Elenewski, Marek M. Rams, Michael Zwolak, Bitan De, Jakub Zakrzewski (Jagiellonian University, Poland; National Institute of Standards and Technology, USA; University of Maryland, USA)

Recent progress in experimental techniques allows for studying quantum phenomena directly. Among many, there are out—of—equilibrium quantum systems that can answer fundamental questions about dynamics in quantum systems and realize some theoretical concepts for quantum-based devices.
Quantum transport is a paradigm example of a non—equilibrium process induced by the environment. It is, however, extremely difficult to study both analytically and numerically. Efficient research of quantum transport requires effective numerical approximations.
Extended reservoirs enable addressing strong coupling and non-linear response for non—Markovian environments. It provides a framework for capturing macroscopic environments, such as metallic electrodes, which drive a current through a finite lattice.
In my presentation, I will give an overview of this topic including my original research. I will present it in the context of tensor network methods for open systems.

30. A Novel Multi-Stage Cancer Workflow using Quantum and Classical Machine Learning & microRNA signatures

See the recording >>

Shaurya Agrawal (Adlai E. Stevenson High School, Illinois, USA; Womanium)

The first attempt to sequence the human genome, known as the Human Genome Project, cost $2 billion and 10 years, while today the same process requires a few hours and $1000. This has prompted a rise in "Big Data" for bioinformatics, though widespread clinical usage of this data is still limited as computational tools are unable to accurately utilize this high-dimensional and sparse omics data for effective treatment planning of cancer, generalizing it to several cancers, and getting interpretable clinical results. Also, omics data is often collected with invasive methods and is based on in-vitro models making it inefficient. Thus this project aims to use a non-invasive biomarker, miRNA, to predict full end-to-end treatment planning using novel computational tools. miRNAs are non-coding DNA sequences often partnered with the DROSHA complex for post-transcriptional RNA processing, and often they are released into the bloodstream allowing for these circulating miRNAs to provide crucial genetic information through blood tests. This project has three parts: diagnosis, staging, and multi-drug treatment plan prediction. For each part, the data is cleaned and feature selected, then highly expressed genes were extracted as potential oncogenes, or driver genes specific to each problem. The signatures extracted for each problem were trained on individual Support Vector Classifiers. A Quantum SVM was chosen for the prediction of multi-drug treatment courses immune to resistance due to its effectiveness with high-dimensional data. The diagnosis and robust treatment plan prediction models had high accuracy and generalizability. The features and coefficient analysis were representative of established oncogenes and driver genes and provided novel ones as well. The Quantum SVM provided better accuracy than the classical model. The model for staging had a modest accuracy and depicted less generalizability providing preliminary proof that miRNA genes have minimal correlation with the staging of cancer already corroborated by literature. The integrated workflow, therefore, provided effective and efficient treatment planning for various cancers and drug types with higher clinical applicability using novel computational tools that provided better results along with higher clinical interpretability to allow for better clinical decisions.

31. Single microwave Photon detection based Josephson junction

See the recording >>

Alex Stephane Piedjou Komnang, Claudio Guarcello, Carlo Barone, Alessio Rettaroli, Claudio Gatti, Sergio Pagano, Giovanni Filatrella (University of Salerno, Italy; INFN Gruppo Collegato di Salerno, Italy; Laboratori Nazionali di Frascati, Italy; University of Roma Tre, Italy; University of Sannio, Italy)

In the past two decades, the development of nanotechnologies and superconducting materials has led to the possibility to design ultrasensitive sensors for very weak signals, even close to the quantum limit. Among the superconducting elements, Josephson junctions (JJs) stand as a promising candidate to detect weak microwave signals, or even single microwave photons . The detection in this range of frequencies, that is below the terahertz band, is challenging, for the energy of a photon is comparable to thermal energy. JJs are promising for they operate in the range of microwave region and being superconducting elements can be cooled as much as cryogenics allow, In a suitable configuration for photon detection, a JJ is exposed to a microwave field that induces the appearance of a volta ge, as the perturbation induces a switch from the superconducting to the resistive state. In this set up, the confounding thermal induced transitions are to be kept at bay lowering the operating temperature, for they produce spurious events that corrupt the detection process.

In this talk I show how to carefully plan Josephson based experiments devised to decide about the existence of a weak electromagnetic signal in a thermal noise background, and to achieve the best conditions to reveal the photon field in the frame of signal detection.

The analysis considers a JJ prepared in the superconducting state, and proposes to collect the waiting times of the device prior to a switch towards the finite voltage state. The employed methodology consists in comparing the switching probabilities of a junction exposed to a train of current pulses, which mimics a weak photon field, with that of the same device in absence of pulses. The investigation of the unbalance in the number of switching events in the two cases, gives an estimate of the efficiency of the detection. The optimization of the detection probability will give a guide to select the J J parameters that best suit to reveal weak microwave signals.

DOI: *https://doi.org/10.1103/PhysRevApplied.16.054015*
arXiv: *https://arxiv.org/abs/2108.00976*

Meet Our Sponsors & Supporter

Unitary Fund is a 501(c)(3) non-profit whose mission is to create a quantum technology ecosystem that benefits the most people. We believe that expanding the pool of people working on quantum technologies is a way to ensure that the benefits of these tools are widely, swiftly, and equitably distributed. We work to create a more inclusive quantum, open source community by supporting new and innovative projects, while also researching and developing tools to further accelerate a quantum technology ecosystem for all.

WE DO THREE MAIN THINGS:

- We run an open microgrant program to fund explorers across the world to work on quantum technologies.
- We do our own research to help grow the ecosystem as a whole.
- We host an open source quantum tech community that runs hackathons and events on our Discord.

For more information or to check out our *website*.

Classiq Technologies is revolutionizing the development of quantum algorithms. Our software technology helps teams model, synthesize, and analyze quantum circuits that were previously impossible to create. Our user-friendly platform enables both beginner and expert designers to rapidly generate, analyze, and execute quantum circuits.

Whether your circuit needs 10 or 10,000 qubits, the Classiq quantum software platform lets you develop optimized circuits in a fraction of the time gate-level modeling would require. At Classiq, we believe that quantum algorithms should be limited only by ingenuity and imagination, not by laborious gate-level design. That's why we built a software platform that helps quantum teams automate the process of converting high-level functional models into optimized quantum circuits.

With our revolutionary Quantum Algorithm Design platform, quantum teams can create quantum algorithms that were impossible to create otherwise. Upgrade from gate-level design into a quantum world limited only by your imagination.

Classiq is launching the Classiq for academia program bringing the leading quantum computing software to campuses worldwide. For now, access is free of charge! By leveraging the Classiq Platform's revolutionary automatic circuit synthesis you can design, analyze, and optimize quantum circuits effortlessly. Learning quantum computing is now much more seamless with our platform as a quantum computing training tool.

The Classiq software platform allows you to focus on functions and modeling and then transforms your high-level functional models into concrete optimized quantum circuits. You can then connect to quantum hardware directly for execution. Don't miss out on this opportunity to accelerate your quantum computing learning and research.

Latvian Quantum Initiative

The initiative brings together Latvia's leading scientists and teaching staff in the field of quantum technologies with the aim of supporting knowledge, skills, technologies and ideas related to practical applications of quantum physics. This initiative is a part of European and global effort to develop and apply a range of technologies based on quantum phenomena that will bring revolutionary changes in computing, communications and sensor technologies.

The Latvian Quantum Initiative supports global and national efforts in the creation and application of quantum technologies, and serves as a framework for the effective development of quantum technologies. The quantum technology industry is growing rapidly, and we can participate in it with highly skilled staff in high-tech companies, as well as by developing quantum technology start-ups.

The development of quantum technologies is a challenge for humanity, in the overcoming of which every country must be involved. This initiative is the way Latvia is involved in this challenge. In order for Latvian scientists and specialists to keep pace with Europe and the world, it is necessary to coordinate cooperation so that the activities carried out are unified and effective. In order to overcome obstacles, it is necessary to create unique and goal-oriented collaborations between scientists, involving companies and state institutions.

The Latvian Quantum Initiative will monitor and coordinate activities related to quantum technologies in Latvia, participating in the European quantum technology cooperation networks, as well as following the needs of Latvian industry and representing its interests in the development of quantum technologies.

Program committee

James Robin Wootton (IBM Research, Zurich)
Alessandra Di Pierro (University of Verona, Italy)
Marlou Slot, co-chair (Womanium & NIST, USA)
Radha Pyari Sandhir (IBM Quantum)
Laura Piispanen (Aalto University, Finland)
Orsolya Kalman (QHungary & Wigner Research Centre for Physics, Hungary)
Jibran Rashid (QWorld & Institute of Business Administration, Karachi, Pakistan)
Taha Rouabah (CQTech & University of Constantine 1, Algeria)
Katarzyna Rycerz (AGH University of Science and Technology, Poland)
Andrii Semenov (Bogolyubov Institute for Theoretical Physics, Ukraine)
Abuzer Yakaryilmaz, co-chair (QWorld & University of Latvia)

Organizing committee

Abuzer Yakaryilmaz, chair (QWorld & Latvian Quantum Initiative)
Engin Baç (QWorld)
Shantanu Misra (QWorld)
Jibran Rashid (QWorld)
Marlou Slot (Womanium & NIST)
Agnieszka Wolska (QWorld Marketing Lead)

Contact:

qsd@qworld.net

We invite you to follow us on Facebook, LinkedIn and Twitter, where you can find the latest information about QWorld's events. To chat directly with our members, join the Discord platform. On our YouTube channel, you will discover great talks on the most recent topics in quantum technologies. To receive direct messages from us, subscribe to QWorld's newsletter. **Stay updated with QWorld!**

linkedin.com/company/qworld19/
QWorld19
QWorld19
qworld.net/newsletter-subscription/
youtube.com/QWorld19
discord.qworld.net/