

2023
Conference
Program

17-22 SEPT 2023
BELLEVUE, WASHINGTON, USA
CONFERENCE & EXPO

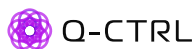
IEEE QUANTUM WEEK

IEEE International Conference on Quantum
Computing and Engineering (QCE23)

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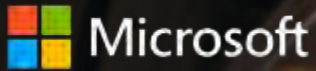
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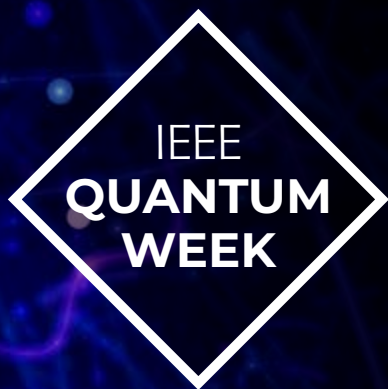
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**IEEE International
Conference on
Quantum Computing
and Engineering
(QCE23)**

**Access Online
Schedule →**



Exhibit Hours

Mon, 18 Sept: 18:30–20:30
with Reception
Tues, 19 Sept: 9:30–17:00
Weds, 20 Sept: 9:30–17:00
Thurs, 21 Sept: 9:00–16:00

Registration Hours

Sat, 16 Sept, 15:00–18:00
Sun, 17 Sept, 9:00–16:30
Mon, 18 Sept, 7:00–18:30
Tues, 19 Sept, 7:00–19:00
Weds, 20 Sept, 7:30–16:30
Thurs, 21 Sept, 7:30–17:00
Fri, 22 Sept, 7:30–10:30

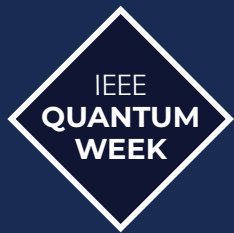
Welcome!

IEEE Quantum Week is a multidisciplinary quantum computing and engineering venue where attendees have the unique opportunity to discuss challenges and opportunities with quantum researchers, scientists, engineers, entrepreneurs, developers, students, practitioners, educators, programmers, and newcomers.

**Have a great week at
IEEE Quantum Week 2023!**

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Chairs' Message

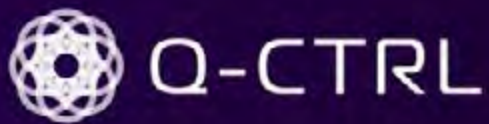
Hausi Müller, Yuri Alexev,
Andrea Delgado, and Greg Byrd

It is our distinct pleasure and honor to welcome you all to the Fourth IEEE International Conference on Quantum Computing and Engineering (QCE23), also known as IEEE Quantum Week 2023. With your outstanding contributions and participation, QCE23 offers valuable opportunities to interact with experts in a full range of quantum technologies, from quantum device engineering to quantum computing and applications.

From its beginning, IEEE Quantum Week has worked on enabling a meaningful exchange of ideas to broaden the quantum community through networking with peers and exploring partnerships among industry, government, and academia. With participants from across the globe, we are confident that the insights shared and discussions held will lead to groundbreaking advancements and foster meaningful connections among peers.

We are pleased to hold IEEE Quantum Week 2023 as an in-person conference with the option of remote participation. We have therefore arranged for almost all 2023 IEEE Quantum Week events to be offered using the RD Mobile virtual platform. This platform allows virtual attendees from around the world to participate in real-time, interacting with on-site attendees and presenters. In addition, all streamed content will be recorded and will be available as QCE23 on-demand to all registered attendees through the end of 2023.





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Throughout the program, you will have the privilege to engage with distinguished keynote speakers, quantum experts, and thought leaders who will share their deep understanding, insights, and perspectives. Additionally, a diverse array of workshops, panel discussions, and paper presentations will showcase cutting-edge research and initiatives, empowering you with new viewpoints and ideas.

QCE23 features 14–15 parallel tracks per day over six days, including 9 keynotes by world-class speakers, 32 community-building workshops, 30 workforce-building tutorials, 153 technical papers, 13 stimulating panels, 93 innovative posters, and 4 thought-provoking Birds of Feather (BoF) sessions.

One of the pillars of IEEE Quantum Week 2023 is the Exhibits. You have the chance to engage with Exhibitors and Poster presenters who showcase a diverse representation of the worldwide quantum landscape. Our 40+ exhibitors, sponsors,

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IBM Quantum is bringing useful quantum computing to the world and making the world quantum safe.

IBM Quantum builds the hardware, software, and services users will need to solve useful problems with quantum computers, while securing enterprises for the quantum future. Industry leaders are exploring challenging problems in healthcare, materials science, machine learning, and more with IBM Quantum technology.

Today, our utility-scale quantum computers can run computations that are competitive with leading classical methods. And soon, our IBM Quantum System Two will let us scale to larger system sizes than ever before, with the goal to build a 100,000-qubit system by 2033. Our IBM Quantum Safe technology offers a comprehensive set of tools, capabilities, and approaches for securing your enterprise for the quantum future.

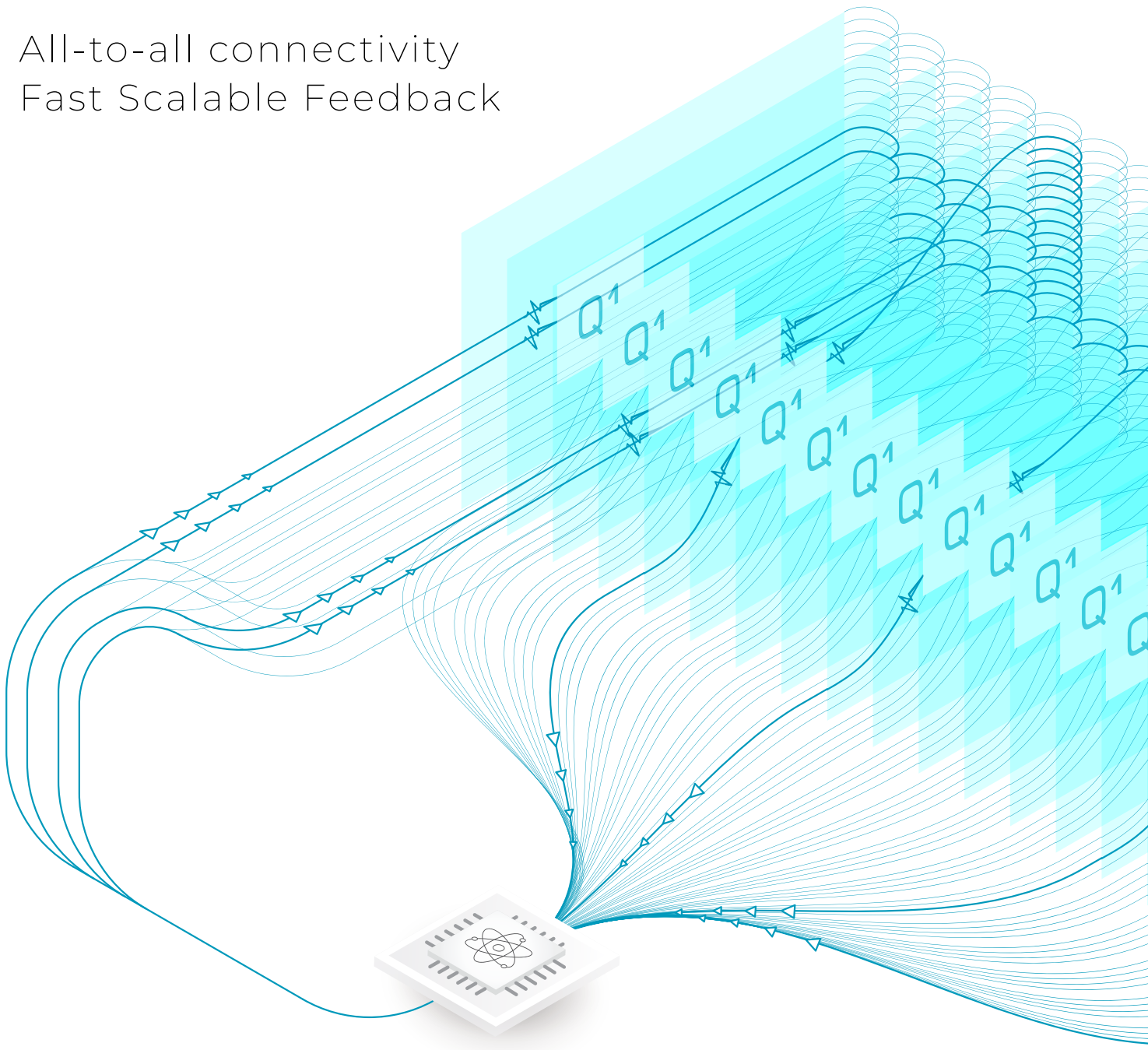
To learn more about what quantum computing can do for your organization, please visit ibm.com/quantum.



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and supporters reach across academia, industry, and government research. For the first time this year, QCE will also feature a Quantum Career Fair.

Our keynote program features nine outstanding speakers from industry, academia, and research labs. The plenary keynote sessions in the morning and evening frame the rigorous daily program agendas, offering insights into the latest progress and potential for quantum technologies and applications.

The technical papers program is organized into five tracks: (1) Quantum Applications (QAPP), (2) Quantum Algorithms (QALG), (3) Quantum Systems Software (QSYS), (4) Quantum Networking and Communications (QNET), and (5) Quantum Computing Hardware Engineering (QTEM). QCE23 received 293 technical paper submissions—a 100% increase over 2022. More than 45% of the submitted papers had at least one



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The advertisement features a dark background with a glowing green 'CLASSIQ' logo at the top. Below the logo, five icons in hexagonal frames represent different software capabilities: a circuit diagram for high-level modeling, a quantum circuit for hardware-specific optimization, a circular flow diagram for interactive visualization, a circuit diagram with a double-headed arrow for unmatched circuit efficiency, and a stack of coins for free for education and research. On the right, a laptop displays the CLASSIQ software interface. At the bottom, a QR code is positioned next to a green button with a left-pointing arrow and the text 'SIGN UP FOR FREE'.

author from industry or government laboratories. Papers were submitted by authors from 25 countries—attesting to the international reach of the conference and the quantum research community. Each paper track had its own program committee, managed by two track co-chairs. Each paper received at least three reviews from 151 international program committee members. Based on the reviews and further discussion, 153 papers were selected for presentation.

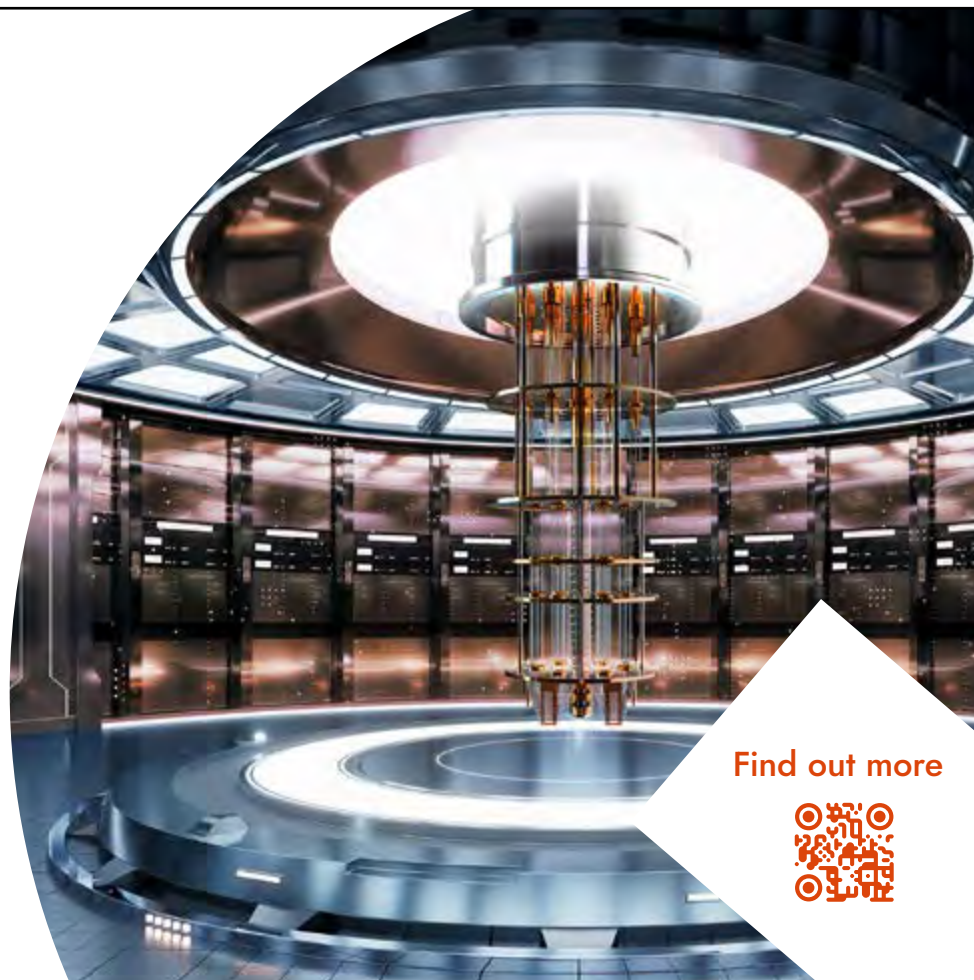
If you are new to the quantum experience, we are delighted to have you onboard. The Tutorials Program offers newcomers different entry points to the quantum realm and, at the same time provides introductions to different technologies across the quantum stack and quantum applications.

The community-building workshops are a fundamental pillar of IEEE Quantum Week. In the past four years, unique communities have formed from the QCE workshops,



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maintaining collaborations even between Quantum Week events. Out of the 32 workshops, seven workshops had a paper track which accepted a total of 47 papers.

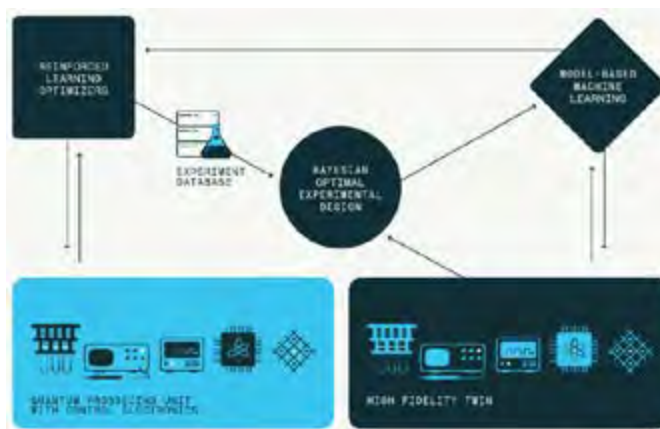
Our expert panels provide attendees with the unique opportunity to hear insights and perspectives directly from industry leaders and seasoned professionals. Not only does it offer a deeper understanding of nuanced topics, but it also sparks engaging discussions, stimulates new ideas, and presents a rare chance to interact with and pose questions to some of the brightest minds in the field.

QCE23 received a record number of 116 Poster submissions, including several from high school students. The Posters program committee selected 93 Posters for presentation in the Exhibits space at IEEE Quantum Week 2023. Posters will be featured in the proceedings with 2-page abstracts.

Machine Learning will impact most fields in the coming decade and experimental physics is no exception. Qruise is implementing and packaging the relevant ML techniques, so that they can be used as everyday tools in labs everywhere, thereby accelerating scientific research and development. Our mission at Qruise is to build a Machine Learning Physicist, to work alongside experimentalists in the lab, helping them to achieve better results faster, and to gain a more in-depth understanding of what is going right, what can be improved, and how to get there.

Our solution is not just fully platform agnostic when it comes to quantum technology development, but also extremely versatile. The same methodology is applicable to quantum sensing, NMR, silicon photonics and many other fields. Our background is in quantum control, with over 280 peer-reviewed publications and more than 34,000 citations (see qruise.com/science). At Qruise, we are distilling our collective experience into the software.

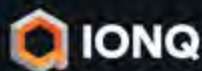
We've created a toolset that is maximally useful for you, the experimental scientist and engineer – in order to make your job as easy as possible, to allow the development of your device to proceed as quickly as possible, and to ensure the final outcome is as good as possible. Therefore, with our software, you are always in the driver's seat – deciding how the development should proceed. We simply provide Qruise control, reducing the effort required.



IEEE Quantum Week also features the 2nd Quantum Science and Engineering Education Conference (QSEEC). In this two-day colocated event, education researchers and practitioners come together to discuss methodologies for quantum curriculum and tool development for instruction and teaching.

One of the QCE23 highlights is the Panel entitled “Quantum Leap—Ideas into Practice: Conversations with IEEE Computer Society Major Award Recipients.” It is a distinct honor for IEEE Quantum Week to have been selected as the host for the 2023 IEEE Computer Society Major Awards Gala.

QCE23 received submissions from 40 countries. 286 program track committee members conducted more than 1,800 reviews. The QCE23 Proceedings have been arranged into three volumes this year. Volume 1 contains the contributions from the five technical paper tracks. Volume 2 includes



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- Wednesday, September 27, 9:40 AM, EST
- Livestreamed from Quantum World Congress

Join us live as we reveal our next generation of quantum computers, an update to our technology roadmap and discuss how we are delivering quantum value to our customers at our keynote during Quantum World Congress.

Register at ionq.com/livestream



the workshop papers, the 2-page poster papers, as well as keynote, panel, tutorial, and workshop abstracts. Volume 3 comprises the contributions of the 2nd Quantum Science and Engineering Education Conference (QSEEC).

Diversity and Inclusion (D&I) are central to the goals of the IEEE International Conference on Quantum Computing & Engineering (QCE) and its activities. Equity at its heart is about removing barriers, biases, and obstacles that impede equal access and opportunity to succeed. Diversity is fundamentally about valuing human differences and recognizing diverse talents. Inclusion is the active engagement of Diversity and Equity.

IEEE Quantum Week adheres to IEEE's Diversity Statement. IEEE's mission to foster technological innovation and excellence to benefit humanity requires the talents and perspectives of people with different personal, cultural, and disciplinary backgrounds. IEEE is committed to advancing diversity in the technical profession, and to promoting an inclusive and equitable culture in its activities and programs that welcomes, engages and rewards those who contribute to the field without regard to race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression.

QCE follows and implements the D&I Best Practices advocated by the IEEE Computer Society. The IEEE Computer Society is committed to Diversity and Inclusion (D&I) across all its sponsored activities, including conferences. IEEE Computer Society encourages all conference organizers to promote and facilitate greater diversity and inclusion in their activities.

We are deeply indebted to many people for their help and support in orchestrating QCE23. First, we would like to thank all the contributors—the keynote speakers, the technical paper and poster authors, the workshop organizers, the tutorial presenters, the panel organizers and panelists, and

the BoF orchestrators. We especially would like to thank the exhibitors—the Diamond, Platinum, Gold, Silver, Bronze sponsors and patrons, and the supporters for their financial, technical, and in-kind contributions.

Second, we would like to thank all attendees who registered for QCE23. Your enthusiasm and

appreciation of the speakers and the program make it all worthwhile. After two years of meeting each other virtually, it was a wonderful experience to finally interact in-person in Broomfield, Colorado. We will have a record attendance at the Hyatt Regency Bellevue on Seattle's Eastside this year. We are already working on QCE24, which will be held in Montréal, Québec, Canada. Please continue to provide feedback on how you are enjoying IEEE Quantum Week, as well as your ideas on how to improve the conference in the future.

Third, we thank all technical program track chairs and committee members, who conducted the review process under the leadership of the Technical Program Board Co-Chairs Yuri Alexev and Andrea Delgado. We also thank the co-chairs and reviewers of the workshop, tutorial, poster, and panel tracks for their dedication and innovative ideas in soliciting proposals. We thank publications chair the Scott Koziol for liaising with Computer Society Conference Publications Services team for the proceedings. The track co-chairs and committee members are enumerated and recognized on the QCE23 Committee pages below in detail. Finally, we are indebted to the union of the IEEE Quantum Week Steering Committee and the IEEE Quantum Initiative Steering Committee for their extensive contributions, feedback, and support in the weekly conference calls over the past twelve months. These folks greatly shaped the structure and format of IEEE Quantum Week.

We are deeply indebted to all the IEEE staff who worked tirelessly over the last year (and more!) in bringing IEEE

Quantum Week 2023 to fruition. First, we thank Kathy Grise, Terence Martinez, Andrea Sadlowski, and Bill Tonti, IEEE Quantum and IEEE Future Directions, for their dedicated support. Kathy, Terence, and Andrea orchestrated our weekly conference calls, and liaised with all the IEEE Societies and organizational units sponsoring IEEE Quantum Week. We thank all the staff at IEEE, IEEE Future Directions, and the different sponsoring societies, councils, and organizational units for promoting IEEE Quantum Week in their respective channels.

We especially commend the staff of IEEE Computer Society, the official QCE23 Conference Management Organization, for their superb help and support throughout the entire journey of IEEE Quantum Week. First, we would like to thank our outstanding meeting planner, Carmen Saliba, for her outstanding project management skills, her attention to details, and for looking after IEEE Quantum Week and its volunteers. She conducted all our contract negotiations with the hotel, registration services, and many more. She was the perfect interface to IEEE Computer Society staff and services. We also would like to thank Silvia Ceballos for her support and vision of IEEE Quantum Week. We especially thank the outstanding exhibits team that exceeded all our exhibits sales expectations—Regan Pickett, Amir Draquez, and Michelle Tubb. Marketing is critical for a growing conference—we are deeply indebted to Katherine Mansfield and Michelle Tubb for leading this activity. We especially thank Steve Woods for his outstanding technical support, his outstanding support for the RD Mobile platform, and the orchestration of the student mentorship session. We thank Lisa O'Conner and Patrick Kellenberger for their outstanding Conference Publications Services (CPS) for creating three volumes of the QCE23 proceedings. We are deeply indebted to Marie Trinh, Priscilla An, and Tricia Yamaguchi for their excellent Registration Services through Cvent. Finally, we would like to thank Anne Marie Kelly, Melissa Russel, and Nita Patel for bringing the prestigious IEEE Computer Society Awards to IEEE Quantum Week 2023.

September is a perfect time to experience true nature in the majestic beauty of the Pacific Northwest. Explore Mount Rainier National Park, the towering pinnacle of the Cascade Range, hike trails at Mount Baker, or visit Mount St. Helens to understand the impact of the monumental 1980 eruption. Discover the ancient waterways of Puget Sound, sculpted beautifully by glaciers that receded 14,000 years ago. The Olympic Peninsula National Park is an experience to spark your senses and immerse you in its raw beauty.

Whether you attend IEEE Quantum Week 2023 in-person or online, we hope that you will find the program and the events to be a terrific experience. We want you to enjoy the conference this week, meet new colleagues, and find plenty of time in the weeks to come to explore the many outstanding contributions from the international quantum community.



Hausi Muller, University of Victoria
QCE23 General Chair



Yuri Alexev, Argonne National Laboratory
QCE23 Program Co-Chair



Andrea Delgado, Oak Ridge National Laboratory
QCE23 Program Co-Chair



Greg Byrd, NC State University
QCE23 Finance Chair

Thank You to Our Sponsors!

With your support, we are pleased to present the IEEE International Conference on Quantum Computing and Engineering (QCE23), a multidisciplinary event focusing on quantum technology, research, development, and training.

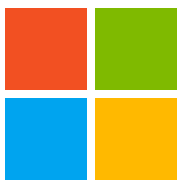
We are grateful to our amazing lineup of sponsors for being a part of Quantum Week.

Exhibit Location: Evergreen Ballroom

Exhibit Hours: Monday, 18 September: 18:30–20:30 with Reception

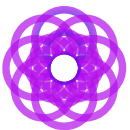
Tuesday, 19 September–Thursday, 21 September: 9:30–15:00

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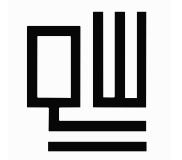


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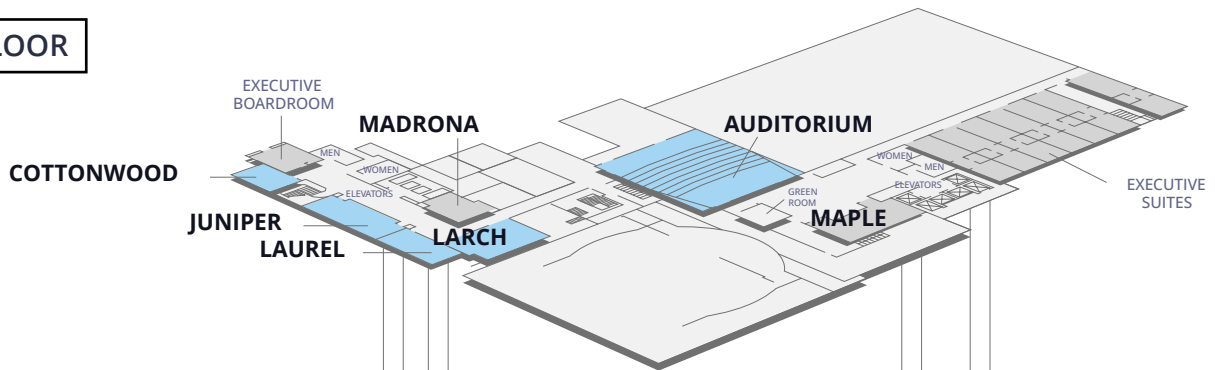




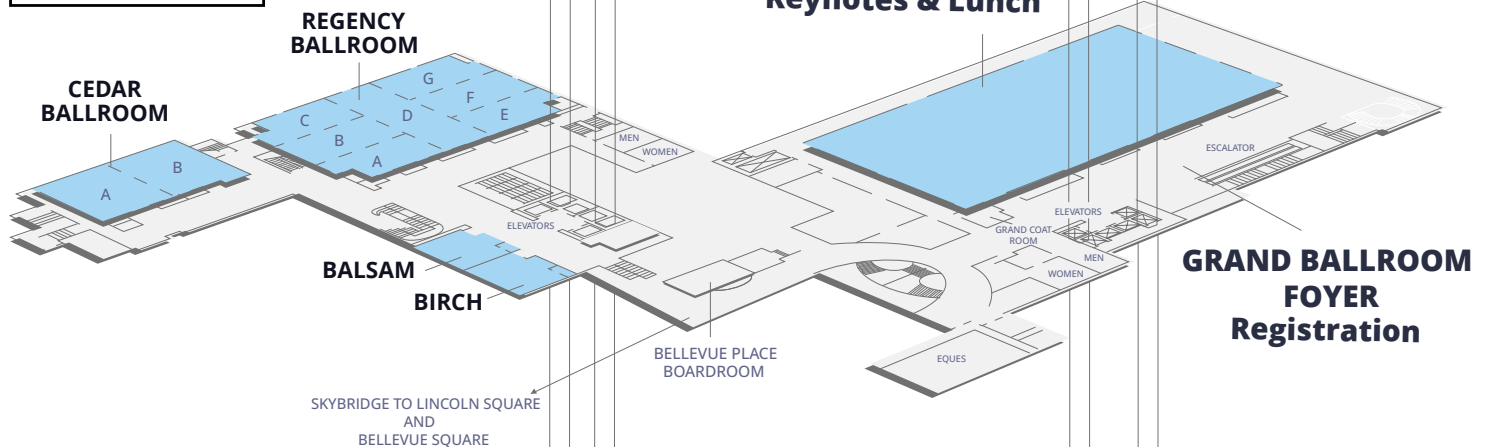
Conference Maps

HYATT REGENCY BELLEVUE
BELLEVUE, WASHINGTON, USA

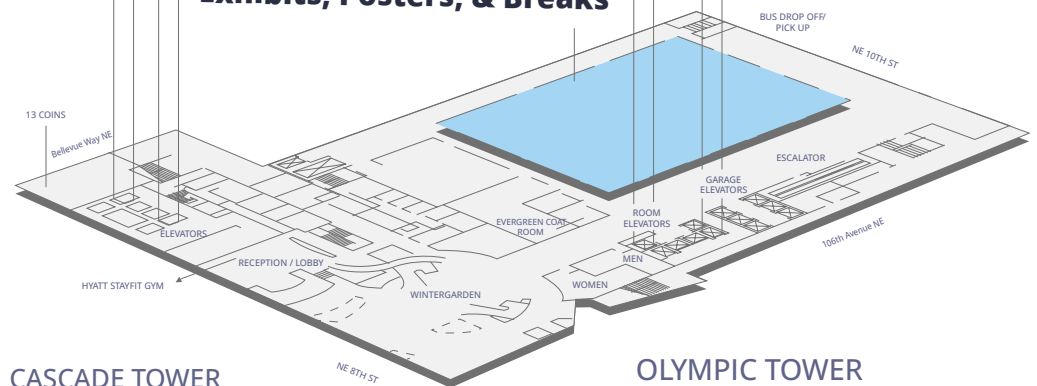
THIRD FLOOR



SECOND FLOOR



LOBBY LEVEL



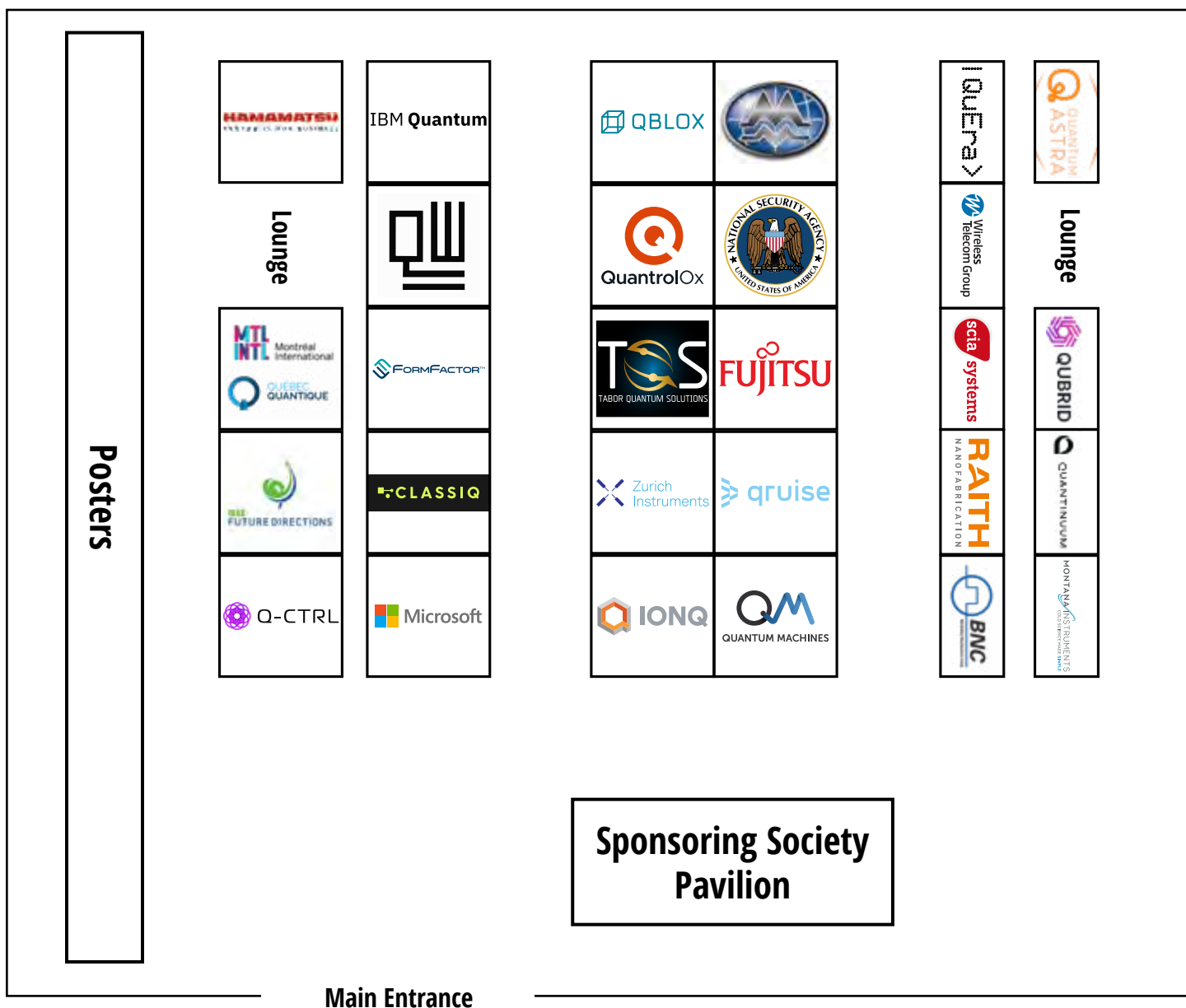
Exhibitor Map

Evergreen Ballroom

Monday, 18 Sept: 18:30–20:30 with Reception

Tuesday, 19 Sept–Wednesday, 20 Sept: 9:30–17:00

Thursday, 21 Sept: 9:00–15:00





General Conference Information

In-Person and Virtual: Logistics for IEEE Quantum Week 2023

We have planned IEEE Quantum Week 2023 as primarily an in-person event with virtual components. As we realize that some may not be able to travel for many reasons, we have arranged for almost all Quantum Week events to be offered using the RD Mobile virtual platform. This will allow virtual attendees from around the world to participate in real-time, interacting with on-site attendees. **In addition, all streamed content will be recorded and will be available on-demand to all registered participants.**

The following types of sessions will be streamed and recorded: keynotes, workshops, tutorials, technical paper sessions, panels, and Birds-of-a-Feather (BoF) sessions. All of these sessions will use hosted Zoom rooms through the RD Mobile virtual platform, allowing for engagement with the online attendees. All presentations will be live, and pre-recorded presentations will not be supported. The Session Chair for each session will be in person so that the interaction between speakers and attendees is driven from the room.

The following activities will not be available to virtual attendees: poster sessions, breaks, receptions, banquet, and access to the exhibit space. In addition, there will be opportunities for online attendees to meet with corporate sponsors. To be a truly international conference, our goal is that physical distance should not be an impediment to participation—we hope that both in-person and remote attendees will take full advantage of the extensive program.

QUICK LINKS

[QCE Registration](#)

[Online Schedule](#)

Thank you very much for your patience and support in working through the in-person and virtual logistics for IEEE Quantum Week 2023.



[Access Online
Schedule →](#)

Program Legend

Keynotes
Panels
Exhibits and Networking
Tutorials
Workshops
Technical Paper Tracks
Posters
Birds of a Feather (BoF)
QSEEC
Meals and Breaks

Exhibit Hours

Mon, 18 Sept: 18:30–20:30 with Reception

Tues, 19 Sept: 9:30–17:00

Weds, 20 Sept: 9:30–17:00

Thurs, 21 Sept: 9:00–16:00

Registration Hours

Sat, 16 Sept, 15:00–18:00

Sun, 17 Sept, 9:00–16:30

Mon, 18 Sept, 7:00–18:30

Tues, 19 Sept, 7:00–19:00

Weds, 20 Sept, 7:30–16:30

Thurs, 21 Sept, 7:30–17:00

Fri, 22 Sept, 7:30–10:30

Fujitsu Quantum

Activities in Fujitsu Quantum Computing

Fujitsu is engaged in the research and development of quantum computing as a next generation computing technology.

It covers all technical areas, from quantum devices to platform software and applications, in the quantum gate system, which is expected to expand the applications. While focusing on software technologies such as error correction and quantum simulators, we are promoting research and development with a structure that pursues a wide range of possibilities in quantum computing while globally collaborating with world-leading research institutions on hardware.

What problems will be solved by quantum computing?

The problems expected to be solved using quantum computing are problems requiring enormous number of calculations with classical computers, such as the ones related to quantum chemistry and complex financial systems. For example, we should know the energy states of materials accurately using quantum mechanics in order to predict properties of new materials. Such precise calculations using quantum mechanical principles are difficult with classical computers. Quantum computing is expected to solve such problems. Prediction of prices of financial products is also difficult in general. New algorithms for such a problem using quantum computing have recently been developed and demonstrated.

Furthermore, by simulating complex quantum-based systems using quantum computing, novel phenomena and/or principles may be discovered.



QCE23 Program — Sun, 17 Sept

Pacific Time	Session Type	Session Room	Sunday Sessions
9:00–16:30 Registration			
9:30–10:00	Break		
10:00–16:30	Workshop	Regency A	Advanced Simulations of Quantum Computations — Part 1 (Break and Lunch Included)
	Workshop	Regency B	Quantum Algorithms for Combinatorial Optimization (Break and Lunch Included)
	Workshop	Regency C	Practical Quantum Error Correction and Faulttolerant Quantum Computing: a Full-stack Approach (Break and Lunch Included)
	Workshop	Regency E	Advances in Numerical Quantum Optimal Control and Characterization Methods (Break and Lunch Included)
	Workshop	Juniper	Demystifying the Quantum Enigmas: A Hands-on Introduction to Quantum Computing (Break and Lunch Included)
	Workshop	Laurel	Quantum Machine Learning: From Foundations to Applications (Break and Lunch Included)
10:00–14:30	Tutorial	Regency F	Hardware Architecture for Quantum Networks (Break and Lunch Included)
	Tutorial	Regency G	Quantum Noise Characterization and Mitigation Techniques (Break and Lunch Included)
	Tutorial	Birch	Compiling Resource-Efficient Programs with Numerical Instantiation (Break and Lunch Included)
	Tutorial	Balsam	Quantum Instrumentation Control Kit (Break and Lunch Included)
	Tutorial	Auditorium	Introduction to Quantum Computing — Part 1 (Break and Lunch Included)



[Access Online Schedule →](#)

Pacific Time	Session Type	Session Room	Sunday Sessions
10:00–14:30	Tutorial	Larch	Security of Quantum Computing Systems (Break and Lunch Included)
10:00–18:30	QSEEC	Cedar A/B	Quantum Science and Engineering Education Conference — Papers, Talks, Posters (Break and Lunch Included)



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QCE23 Program — Mon, 18 Sept

Pacific Time	Session Type	Session Room	Monday Sessions
7:00–18:30 Registration			
8:00–9:30	Keynote	Grand Ballroom	David Awschalom, University of Chicago & Q-NEXT
09:30–10:00	Break		
10:00–11:00	Mentorship	Cedar A/B	Student Mentorship Program (Pre-registration Required)
10:00–11:30	Workshop	Regency A	Advanced Simulations of Quantum Computations — Part 2
	Workshop	Regency B	Chemical Applications of Quantum Computing
	Workshop	Larch	Progress and Challenges in Quantum Intermediate Representations (QIR)
	Workshop	Laurel	Quantum Algorithms for Differential Equations
	Workshop	Cottonwood	Developing Responsible and Ethical Quantum Computing for Societal Benefit
	QSEEC	Regency C	Quantum Science and Engineering Education Conference — Papers, Talks, Posters
	Technical Papers	Regency E	QALG01—Circuit Optimization - I Paper IDs: 62, 95, 108
	Technical Papers	Regency F	QAPP02—Applications to Life Sciences Paper IDs: 126, 284, 324
	Technical Papers	Regency G	QTEM01—Quantum Controls - I Paper IDs: 315, 321, 438
	BoF	Birch	Exploring the Link Between Quantum Science and AI: Pathways for Collaboration
	Tutorial	Balsam	Algorithmic Approaches for Finding Better QUBO Formulations
	Tutorial	Auditorium	Introduction to Quantum Computing — Part 2
	Panel	Juniper	What's in your Photonics for Quantum Toolbox?



[Access Online
Schedule →](#)

Pacific Time	Session Type	Session Room	Monday Sessions
11:30–13:00	Lunch		
13:00–17:30	Career Fair	Cedar A/B	Career Fair
13:00–14:30	Workshop	Regency A	Advanced Simulations of Quantum Computations — Part 2
	Workshop	Regency B	Chemical Applications of Quantum Computing
	Workshop	Larch	Progress and Challenges in Quantum Intermediate Representations (QIR)

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Pacific Time	Session Type	Session Room	Monday Sessions
13:00–14:30	Workshop	Laurel	Quantum Algorithms for Differential Equations
	Workshop	Cottonwood	Developing Responsible and Ethical Quantum Computing for Societal Benefit
	QSEEC	Regency C	Quantum Science and Engineering Education Conference — Papers, Talks, Posters
	Technical Papers	Regency E	QALG02—Circuit Optimization - II Paper IDs: 339, 362, 365
	Technical Papers	Regency F	QAPP01—Applications for Physical Sciences Paper IDs: 220, 385, 119
	Technical Papers	Regency G	QTEM02—Quantum Controls - II Paper IDs: 79, 329, 377
	Tutorial	Birch	Deep-dive into Mitiq, a Software Package for Error Mitigation on Noisy Quantum Computers
	Tutorial	Balsam	Algorithmic Approaches for Finding Better QUBO Formulations
	Tutorial	Auditorium	Introduction to Quantum Computing — Part 2
	Tutorial	Juniper	Circuit Cutting with Quantum Serverless
14:30–15:00	Break		
15:00–16:30	Workshop	Regency A	Advanced Simulations of Quantum Computations — Part 2
	Workshop	Regency B	Chemical Applications of Quantum Computing
	Workshop	Larch	Progress and Challenges in Quantum Intermediate Representations (QIR)
	Workshop	Laurel	Quantum Algorithms for Differential Equations
	Workshop	Cottonwood	Developing Responsible and Ethical Quantum Computing for Societal Benefit
	QSEEC	Regency C	Quantum Science and Engineering Education Conference — Papers, Talks, Posters



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Pacific Time	Session Type	Session Room	Monday Sessions
15:00–16:30	Technical Papers	Regency E	QALG07—Optimization Paper IDs: 127, 218, 304
	Technical Papers	Regency F	QAPP06—NISQ Benchmarks Paper IDs: 222, 241, 431
	Technical Papers	Regency G	QTEM06—Tomography Paper IDs: 151, 275, 332
	Tutorial	Birch	Deep-dive into Mitiq, a Software Package for Error Mitigation on Noisy Quantum Computers
	BoF	Balsam	Building the software stack for fault-tolerant quantum error correction
	Panel	Auditorium	Munich, Chicago, Riken, Delft: Software Stacks in Big Quantum Computing Initiatives Road Map
	Tutorial	Juniper	Circuit Cutting with Quantum Serverless
16:30–17:00	Break		
17:00–18:30	Keynote	Grand Ballroom	Shruti Puri, Yale University
18:30–20:30	Reception	Evergreen Ballroom	Reception sponsored by AWS
	Exhibits		
	Posters	Evergreen Ballroom	

QCE23 Program — Tue, 19 Sept

Pacific Time	Session Type	Session Room	Tuesday Sessions
7:00–19:00 Registration			
8:00–9:30	Keynote	Grand Ballroom	Sarah Sheldon, IBM Quantum
09:30–10:00	Break		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:30–17:00
	Posters		
10:00–11:30	Workshop	Regency A	Quantum Artificial Intelligence
	Workshop	Regency B	Quantum Computing Market Success Requires an Application-level Programming Model that Delivers Performance
	Workshop	Cedar A	Empowering Quantum Educators & Researchers with IBM Quantum Tools
	Workshop	Cedar B	Algorithm Grand Challenge: How to Make Better Use of NISQ Devices to Enable Algorithms for Practical Applications
	Workshop	Larch	Quantum Computing Entrepreneurship
	Workshop	Cottonwood	Modular Quantum Computing Architectures: Bridging the Quantum Networks and Quantum Computing Communities
	Technical Papers	Regency C	QALG03—Error Correction and Mitigation - I Paper IDs: 121, 104, 169
	Technical Papers	Regency E	QAPP11—Quantum Machine Learning Paper IDs: 388, 418, 262
	Technical Papers	Regency F	QSYS03—Compilation - I Paper IDs: 145, 196, 397
	Technical Papers	Regency G	QTEM03—Quantum Hardware - I Paper IDs: 138, 206, 256
	Tutorial	Birch	Quantum Circuit Compilation and Classical Control with TKET
	Tutorial	Auditorium	Hybrid Quantum-Classical Algorithms and Analog Hamiltonian Simulation on Amazon Braket



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Pacific Time	Session Type	Session Room	Tuesday Sessions
10:00–11:30	Tutorial	Laurel	QubiC: An Open-Source FPGA-based Quantum Controller
	Panel	Juniper	Quantum Error Correction with Superconducting Circuits: Experimental Challenges and Control Requirements
11:30–13:00	Lunch		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:30–17:00
	Posters		



The Quantum Algorithms Institute is a collaboration between government, the academic community, and Canada’s growing sector of quantum companies.

QAI works with companies across industries to help them build experience applying quantum solutions.

Pacific Time	Session Type	Session Room	Tuesday Sessions
13:00–14:30	Workshop	Regency A	Quantum Artificial Intelligence
	Workshop	Regency B	Quantum Computing Market Success Requires an Application-level Programming Model that Delivers Performance
	Workshop	Cedar A	Empowering Quantum Educators & Researchers with IBM Quantum Tools
	Workshop	Cedar B	Algorithm Grand Challenge: How to Make Better Use of NISQ Devices to Enable Algorithms for Practical Applications
	Workshop	Larch	Quantum Computing Entrepreneurship
	Workshop	Cottonwood	Modular Quantum Computing Architectures: Bridging the Quantum Networks and Quantum Computing Communities
	Technical Papers	Regency C	QALG04—Error Correction and Mitigation - II Paper IDs: 393, 214, 456
	Technical Papers	Regency E	QAPP10—Quantum Deep Learning Paper IDs: 307, 429, 159
	Technical Papers	Regency F	QSYS04—Compilation - II Paper IDs: 148,274,258
	Technical Papers	Regency G	QTEM04—Quantum Hardware - II Paper IDs: 171, 447, 464
	Tutorial	Birch	Quantum Circuit Compilation and Classical Control with TKET
	Tutorial	Balsam	Playing with cats! What are cat qubits? How can they serve as a the basis for Fault Tolerant Quantum Computing?
	Tutorial	Auditorium	Hybrid Quantum-Classical Algorithms and Analog Hamiltonian Simulation on Amazon Braket
	Tutorial	Juniper	Practical Quantum Machine Learning: Time Series Analysis with PennyLane and Covalent
	Tutorial	Laurel	QubiC: An Open-Source FPGA-based Quantum Controller



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Pacific Time	Session Type	Session Room	Tuesday Sessions
14:30–15:00	Break		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:30–17:00
	Posters		
15:00–16:30	Workshop	Regency A	Quantum Artificial Intelligence
	Workshop	Regency B	Quantum Computing Market Success Requires an Application-level Programming Model that Delivers Performance
	Workshop	Cedar A	Empowering Quantum Educators & Researchers with IBM Quantum Tools

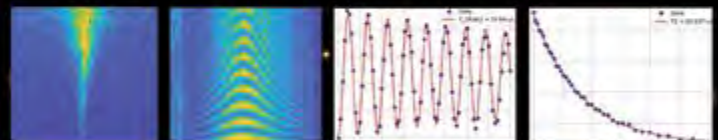


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-  Open Source FPGA Architecture
-  Nuclear Spectroscopy



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Pacific Time	Session Type	Session Room	Tuesday Sessions
15:00–16:30	Workshop	Cedar B	Algorithm Grand Challenge: How to Make Better Use of NISQ Devices to Enable Algorithms for Practical Applications
	Workshop	Larch	Quantum Computing Entrepreneurship
	Workshop	Cottonwood	Modular Quantum Computing Architectures: Bridging the Quantum Networks and Quantum Computing Communities
	Technical Papers	Regency C	QALG11—Simulation Paper IDs: 172, 756, 408
	Technical Papers	Regency E	QAPP05—Gradient Descent Training Paper IDs: 346, 371, 396
	Technical Papers	Regency F	QSYS05—Compilation - III Paper IDs: 277, 113, 67
	Technical Papers	Regency G	QTEM05—Surface Codes Paper IDs: 161, 205, 330
	BoF	Birch	IEEE Quantum-HPC Working Group
	Tutorial	Balsam	Playing with cats! What are cat qubits? How can they serve as a the basis for Fault Tolerant Quantum Computing?
	Tutorial	Juniper	Practical Quantum Machine Learning: Time Series Analysis with PennyLane and Covalent
	Awards	Auditorium	IEEE Computer Society Awards Panel
	Panel	Laurel	Academic Quantum Devices and their Vertical Stacks: Status Quo and Future
16:30–17:00	Break		
	Exhibits	Evergreen Ballroom	
	Posters		
17:00–18:30	Keynote	Grand Ballroom	Itamar Sivan & Yonatan Cohen, Quantum Machines



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QCE23 Program — Wed, 20 Sept

Pacific Time	Session Type	Session Room	Wednesday Sessions
7:30–16:30 Registration			
8:00–9:30	Keynote	Grand Ballroom	Laura Schulz, Leibniz Supercomputing Centre (LRZ)
09:30–10:00	Break		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:30–17:00
	Posters		

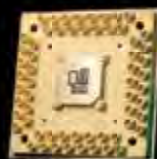


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Pacific Time	Session Type	Session Room	Wednesday Sessions
10:00–11:30	Workshop	Regency A	Classical Control Systems for Quantum Computing
	Workshop	Regency B	Workshop on Quantum Computing Opportunities in Renewable Energy and Climate Change
	Workshop	Regency C	Quantum Computing for Natural Sciences: Technology and Applications
	Workshop	Auditorium	Third International Workshop on Integrating High-Performance Computing with Quantum Computing (WIHPQC 2023)
	Workshop	Juniper	3rd International Workshop on Quantum Software Engineering and Technology
	Workshop	Cottonwood	Towards Controlling Fault-Tolerant Quantum Computers
	Technical Papers	Regency E	QALG05—General - I Paper IDs: 427, 13, 401
	Technical Papers	Regency F	QAPP07—Optimization - I Paper IDs: 356, 434, 260
	Technical Papers	Regency G	QSYS06—Error Correction and Mitigation - I Paper IDs: 211, 416, 268
	Tutorial	Cedar A	Introduction to Intel Quantum SDK Version 1.0
	Tutorial	Balsam	SimuQ: A Domain-Specific Language for Quantum Simulation with Analog Compilation
	Tutorial	Laurel	Quantum Ethics in Action
	Panel	Cedar B	Quantum Industry Associations: Formation, Development, and Future Directions
	Panel	Birch	Progress and Perspectives on NISQ Applications
	Panel	Larch	Quantum-Classical Processing to Push the Quantum Computing Limits
11:30–13:00	Lunch		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:30–17:00
	Posters		



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Pacific Time	Session Type	Session Room	Wednesday Sessions
13:00–14:30	Workshop	Regency A	Classical Control Systems for Quantum Computing
	Workshop	Regency B	Workshop on Quantum Computing Opportunities in Renewable Energy and Climate Change
	Workshop	Regency C	Quantum Computing for Natural Sciences: Technology and Applications
	Workshop	Auditorium	Third International Workshop on Integrating High-Performance Computing with Quantum Computing (WIHPQC 2023)



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Pacific Time	Session Type	Session Room	Wednesday Sessions
13:00–14:30	Workshop	Juniper	3rd International Workshop on Quantum Software Engineering and Technology
	Workshop	Cottonwood	Towards Controlling Fault-Tolerant Quantum Computers
	Technical Papers	Regency E	QALG06—General - II Paper IDs: 386, 204, 320
	Technical Papers	Regency F	QAPP08—Optimization - II Paper IDs: 111, 270, 378
	Technical Papers	Regency G	QSYS07—Error Correction and Mitigation - II Paper IDs: 72, 234, 299
	Tutorial	Cedar A	Introduction to Intel Quantum SDK Version 1.0
	Tutorial	Cedar B	Tangelo: Enabling Quantum Chemistry Workflows for Current and Future Quantum Computers
	Tutorial	Birch	Parameterized Quantum Pulse Circuit and its Application
	Tutorial	Balsam	SimuQ: A Domain-Specific Language for Quantum Simulation with Analog Compilation
	Tutorial	Larch	Quantum Pictures in Practice
	Tutorial	Laurel	Quantum Ethics in Action
14:30–15:00	Break		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:30–17:00
	Posters		
15:00–16:30	Workshop	Regency A	Classical Control Systems for Quantum Computing
	Workshop	Regency B	Workshop on Quantum Computing Opportunities in Renewable Energy and Climate Change
	Workshop	Regency C	Quantum Computing for Natural Sciences: Technology and Applications
	Workshop	Auditorium	Third International Workshop on Integrating High-Performance Computing with Quantum Computing (WIHPQC 2023)
	Workshop	Juniper	3rd International Workshop on Quantum Software Engineering and Technology



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Pacific Time	Session Type	Session Room	Wednesday Sessions
15:00–16:30	Workshop	Cottonwood	Towards Controlling Fault-Tolerant Quantum Computers
	Technical Papers	Regency E	QALG12—Variational Algorithms Paper IDs: 228, 472, 134
	Technical Papers	Regency F	QAPP04—Benchmarking Quantum Annealers and Variational Algorithms Paper IDs: 94, 201, 208
	Technical Papers	Regency G	QSYS08—Error Correction and Mitigation - III Paper IDs: 156, 267, 263
	Panel	Cedar A	From the Capitol to the Laboratory: How Industry and Academia can Leverage
	Tutorial	Cedar B	Tangelo: Enabling Quantum Chemistry Workflows for Current and Future Quantum Computers
	Tutorial	Birch	Parameterized Quantum Pulse Circuit and its Application
	Tutorial	Larch	Quantum Pictures in Practice
16:30–17:00	Break		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:30–17:00
	Posters		
17:00–18:30	Keynote	Grand Ballroom	Stefan Leichenauer, SandboxAQ
18:30–20:20	QCE Steering Committee Meeting	Regency A	QCE Steering Committee Meeting



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QCE23 Program — Thu, 21 Sept

Pacific Time	Session Type	Session Room	Thursday Sessions
7:30–17:00 Registration			
8:00–9:30	Keynote	Grand Ballroom	Krysta Svore, Microsoft
09:30–10:00	Break		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:00–16:00
	Posters		
10:00–11:30	Workshop	Regency A	Workshop on Quantum in Consumer Technology
	Workshop	Regency B	Workshop on Software Architecture Concerns for Quantum (WOSAQ)
	Workshop	Regency C	Emerging Technologies for Scaling Trapped-ion Quantum Systems
	Workshop	Auditorium	Quantum Resource Estimation
	Workshop	Larch	Cryogenic Electronics for Quantum Systems
	Technical Papers	Regency E	QALG08—Quantum Machine Learning: Classification Paper IDs: 253, 3, 200
	Technical Papers	Regency F	QSYS09—Simulation - I Paper IDs: 442, 254, 251
	Technical Papers	Regency G	QNET05—Quantum Network Theory and Cryptography - I Paper IDs: 68, 69, 194
	Tutorial	Cedar A	Using Qiskit Runtime Primitives with Error Suppression and Error Mitigation
	Tutorial	Birch	Quantum plus High-Performance Computing for Natural Language Processing
	Tutorial	Laurel	Speeding up Calibrations and Algorithm Execution through Agile Real-time Control



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Pacific Time	Session Type	Session Room	Thursday Sessions
10:00–11:30	Panel	Cedar B	Challenges Related to Adoption of Quantum Computing in an Enterprise
	Panel	Juniper	Scaling to Usefulness: Unifying Quantum and Classical Computers
	BoF	Balsam	Advancing Quantum Workforce Development Initiatives: Strategies, Challenges and Opportunities
11:30–13:00	Lunch		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:00–16:00
	Posters		
13:00–14:30	Workshop	Regency A	Workshop on Quantum in Consumer Technology
	Workshop	Regency B	Workshop on Software Architecture Concerns for Quantum (WOSAQ)
	Workshop	Regency C	Emerging Technologies for Scaling Trapped-ion Quantum Systems
	Workshop	Auditorium	Quantum Resource Estimation
	Workshop	Larch	Cryogenic Electronics for Quantum Systems
	Technical Papers	Regency E	QALG09—Quantum Machine Learning: Deep Learning Paper IDs: 421, 223, 240
	Technical Papers	Regency F	QSYS10—Simulation - II Paper IDs: 257, 414, 403
	Technical Papers	Regency G	QNET06—Quantum Network Theory and Cryptography - II Paper IDs: 209, 273, 301
	Tutorial	Cedar A	Using Qiskit Runtime Primitives with Error Suppression and Error Mitigation
	Tutorial	Cedar B	Tutorial: Introduction to Quantum Computing: From Algorithm to Hardware
	Tutorial	Birch	Quantum plus High-Performance Computing for Natural Language Processing

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Pacific Time	Session Type	Session Room	Thursday Sessions
13:00–14:30	Tutorial	Balsam	Cloud Quantum Computing with Neutral Atoms
	Tutorial	Juniper	Deep Dive into Classical Simulation of Quantum Circuits with QX-Simulator
	Tutorial	Laurel	Speeding up Calibrations and Algorithm Execution through Agile Real-time Control
14:30–15:00	Break		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:00–15:00
	Posters		
15:00–16:30	Workshop	Regency A	Workshop on Quantum in Consumer Technology
	Workshop	Regency B	Workshop on Software Architecture Concerns for Quantum (WOSAQ)
	Workshop	Regency C	Emerging Technologies for Scaling Trapped-ion Quantum Systems
	Workshop	Auditorium	Quantum Resource Estimation
	Workshop	Larch	Cryogenic Electronics for Quantum Systems
	Technical Papers	Regency E	QALG10—Quantum Machine Learning: Novel Techniques Paper IDs: 199, 475, 457
	Technical Papers	Regency F	QSYS13—Variational Quantum Algorithms Paper IDs: 178, 2, 463
	Technical Papers	Regency G	QNET01—Entanglement Management and Network Design - I Paper IDs: 101, 233, 183
	Panel	Cedar A	Real-Time Decoding in the Fault-Tolerant Era
	Panel	Laurel	Quantum Standards: Progress, Plans and Challenges
	Tutorial	Cedar B	Tutorial: Introduction to Quantum Computing: From Algorithm to Hardware



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Pacific Time	Session Type	Session Room	Thursday Sessions
15:00–16:30	Tutorial	Balsam	Cloud Quantum Computing with Neutral Atoms
	Tutorial	Juniper	Deep Dive into Classical Simulation of Quantum Circuits with QX-Simulator
16:30–17:00	Break		
	Exhibits	Evergreen Ballroom	Exhibit Hours: 9:00–15:00
	Posters		
17:00–18:30	Keynote	Grand Ballroom	Helmut Katzgraber, AWS
18:30–20:30	Banquet	Grand Ballroom	Banquet

QCE23 Program — Fri, 22 Sept

Pacific Time	Session Type	Session Room	Friday Sessions
7:30–10:30 Registration			
8:00–9:30	Keynote	Grand Ballroom	Marco Pistoia, JPMorgan Chase
09:30–10:00	Break		
10:00–11:30	Workshop	Regency A	Technology Roadmapping for Quantum Computing
	Workshop	Auditorium	Quantum Algorithms for Financial Applications
	Workshop	Juniper	Quantum System Stability and Reproducibility Workshop
	Workshop	Larch	Quantum Algorithm Design Automation

Pacific Time	Session Type	Session Room	Friday Sessions
10:00–11:30	Workshop	Laurel	Quantum Characterization, Verification, and Validation (QCVV) for Fault Tolerance
	Technical Papers	Regency C	QAPP12—Resource Optimization - I Paper IDs: 425, 411, 160
	Technical Papers	Regency E	QSYS11—Software - I Paper IDs: 116, 106, 122
	Technical Papers	Regency F	QNET02—Entanglement Management and Network Design - II Paper IDs: 282, 297, 298
	Technical Papers	Regency G	QAPP04—General Paper IDs: 469, 422, 430
	Tutorial	Cedar A	Benchmarking and Calibrating Quantum Devices with Qiskit Experiments
	Tutorial	Cedar B	Solving Partial Differential Equations (PDEs) with Quantum Computers
	Tutorial	Birch	Introduction to SeQUeNCe, a Customizable Discrete-Event Simulator of Quantum Networks
	Tutorial	Balsam	qBraid: The Quantum Ecosystem All in One Place
	Panel	Regency B	Fostering DEIA Culture and Environment in Industry
11:30–13:00	Lunch		
13:00–14:30	Workshop	Regency A	Technology Roadmapping for Quantum Computing
	Workshop	Auditorium	Quantum Algorithms for Financial Applications
	Workshop	Juniper	Quantum System Stability and Reproducibility Workshop
	Workshop	Larch	Quantum Algorithm Design Automation
	Workshop	Laurel	Quantum Characterization, Verification, and Validation (QCVV) for Fault Tolerance
	Technical Papers	Regency C	QAPP13—Resource Optimization - II Paper IDs: 168, 186, 360
	Technical Papers	Regency E	QSYS12—Software - II Paper IDs: 367, 426, 326



Access Online
Schedule →

Pacific Time	Session Type	Session Room	Friday Sessions
13:00–14:30	Technical Papers	Regency F	QNET03—Quantum Network Modeling and Simulation - I Paper IDs: 5, 158, 175
	Technical Papers	Regency G	QSYS02—Circuit Optimization Paper IDs: 150, 423, 453
	Tutorial	Cedar A	Benchmarking and Calibrating Quantum Devices with Qiskit Experiments
	Tutorial	Cedar B	Solving Partial Differential Equations (PDEs) with Quantum Computers
	Tutorial	Birch	Introduction to SeQUeNCe, a Customizable Discrete-Event Simulator of Quantum Networks
	Tutorial	Balsam	qBraid: The Quantum Ecosystem All in One Place
14:30–15:00	Break		
15:00–16:30	Workshop	Regency A	Technology Roadmapping for Quantum Computing
	Workshop	Auditorium	Quantum Algorithms for Financial Applications
	Workshop	Juniper	Quantum System Stability and Reproducibility Workshop
	Workshop	Larch	Quantum Algorithm Design Automation
	Workshop	Laurel	Quantum Characterization, Verification, and Validation (QCVV) for Fault Tolerance
	Technical Papers	Regency C	QAPP09—Quantum Amplitude Estimation Paper IDs: 247, 302, 409
	Technical Papers	Regency E	QSYS01—Benchmarks Paper IDs: 80, 337, 363
	Technical Papers	Regency F	QNET04—Quantum Network Modeling and Simulation - II Paper IDs: 252, 289, 314
	Technical Papers	Regency G	QSYS14—Security Paper IDs: 155, 165, 290

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