



2025 Quantum Computing User Forum

Day 1: Monday, July 21st - Morning

8:30am – Workshop

Presenter: IonQ

Title: Exploring the IonQ Quantum Cloud and Systems: From Hello World to Hybrid Applications

In this hands-on workshop, we'll cover the basics of IonQ's hardware and software, demonstrate different ways to use our systems, and share how our team is leveraging these capabilities to develop new quantum applications. During the first section, we'll review IonQ's trapped-ion hardware and how you can submit circuits to our QPUs and simulators via our quantum cloud platform and supported SDKs. Next, we'll cover some features, techniques, and workflows supported by our platform, including error mitigation with debiasing, submission using our native gates, and leveraging our hosted hybrid service for more complex quantum-classical workflows. Finally, we'll demonstrate how all of these capabilities come together and highlight some of IonQ's recent progress in quantum algorithms and applications. Participants will have the opportunity to follow along and submit jobs to IonQ's hardware and simulators throughout the workshop.

8:30am Overview of IonQ's trapped-ion quantum computers and the IonQ Quantum Cloud

9:30am Coffee break

9:45am Advanced features of the IonQ Quantum Cloud: Error mitigation, native gates, hosted hybrid service, and more

10:45am Coffee break

11:00am Putting the pieces together: Hybrid quantum-classical applications

12:00pm – Working Lunch

12:30pm Introduction: Travis Humble and Ashley Barker

12:40pm The Quantum Computing User Program: Claire Marvinney and Josh Cunningham

Day 1: Monday, July 21st - Afternoon

Moderator: Peter Groszkowski

1:00pm – Keynote

Presenter: Martin Roetteler (IonQ)

Title: Toward quantum commercial advantage with enterprise-grade quantum computers

2:00pm –

Presenter: In-Saeng Suh (ORNL)

Title: Distributed QAOA on the superconducting and trapped-ion quantum computers

2:30pm–

Presenter: Alejandro Montanez-Barrera (Forschungszentrum Jülich)

Title: Evaluating the performance of quantum process units at large width and depth

3:00pm – BREAK

Moderator: Elaine Wong

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3:30pm –

Presenter: Suman Debnath, Phani Marthi (Oak Ridge National Laboratory)

Title: Applications of Quantum Computing in Power Grid/Energy System - Some Examples

4:00pm –

Presenter: Chao Lu (Oak Ridge National Laboratory)

Title: Optimizing Quantum Linear Solvers: Benchmarking the HHL Algorithm with an Enhanced QPE Framework

4:30pm –

Presenter: Seongmin Kim (ORNL)

Title: Many-qubit is All We Need for Optimization Challenges

5:00pm – Event Close

Day 2: Tuesday, July 22nd - Morning

8:30am – Workshop

Presenter: Quantinuum

Title: Quantinuum Workshop

Join us for an in-depth workshop designed to introduce the capabilities and latest advancements of Quantinuum Systems, including Helios, which is slated for launch later this year. The workshop will cover the core features and functionalities of Helios; introduce our newly released programming language, Guppy; provide an overview of Nexus and its integration with Helios to enhance system performance; and discuss the capabilities of Selene emulators. We will discuss how to maximize the use of these tools and explore various use cases, providing an in-depth look at quantum error correction workflows and the dynamic behaviors and applications of quantum systems. The workshop will conclude with Q&A, providing an opportunity to clarify concepts and discuss further applications. This session is ideal for researchers, developers, and enthusiasts looking to deepen their knowledge and leverage the power of quantum computing in their work.

8:30am Helios Introduction (60 min): Current-Stack and Next-Gen Introduction, Current Hardware, Quantinuum Helios

9:30am Coffee break

9:40am Software: Guppy, Selene, Nexus

10:40am Coffee break

10:50am Application: Quantum Error Correction (Repeat until Success), Quantum Dynamics (Toric Code)

12:00pm – Working Lunch

12:40pm Introduction: Claire Marvinney

12:45pm Quantum Computing for the Benefit of Humanity: Catherine Lefebvre

Day 2: Tuesday, July 22nd – Afternoon

Moderator: Antonio Coello Perez

1:00pm – Keynote

Presenter: Justin Bohnet (Quantinuum)

Title: Helios: A new dimension for Quantinuum systems

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2:00pm –

Presenter: Ammar Ahmad Kirmani (Los Alamos National Laboratory)

Title: Variational Quantum Simulations of a Two-Dimensional Frustrated Transverse-Field Ising Model on a Trapped-Ion Quantum Computer**2:30pm–**

Presenter: Adrian Harkness (Lehigh University)

Title: Improved Implementation of Quantum Linear Systems Algorithms on a Trapped-Ion Quantum Processor**3:00pm – BREAK**

Moderator: Andrea Delgado

3:30pm –

Presenter: Gregory Quiroz (Johns Hopkins University Applied Physics Laboratory)

Title: Sparse Non-Markovian Noise Modeling of Transmon-Based Multi-Qubit Operations**4:00pm –**

Presenter: Herschel Chawdhry (Florida State University)

Title: Quantum simulation of color in high-energy Quantum Chromodynamics**4:30pm –**

Presenter: Ermal Rrapaj (NERSC, Lawrence Berkeley Laboratory)

Title: Collective Neutrino Oscillations in Three Flavors on Qubit and Qutrit Processors**5:00pm – Announcements + Group Photo****5:15-7:00pm – Poster Session****Day 3: Wednesday, July 23rd****8:30am – Workshop**

Presenter: IBM

Title: IBM Quantum Workshop

IBM has been at the forefront of advancing the state-of-the-art in quantum computing — from 100+ qubit devices and cutting-edge error mitigation strategies to novel low-density and resource-efficient error correction schemes, algorithms, and application development. This includes pioneering work in quantum-centric supercomputing and the exploration of practical use cases across disciplines. We actively facilitate working groups focused on high-impact domains where quantum advantage is most promising, such as materials science, high energy physics, and optimization. To support this ecosystem, IBM has invested heavily in enabling both internal and external researchers through our Quantum Algorithm Engineering (QAE) team — a group of domain experts dedicated to the scalability of emerging quantum applications and algorithms. Their work spans experiment and workflow optimization, demonstration of novel techniques on hardware, and the development of benchmarking methods that allow rigorous comparisons between quantum and classical approaches to assess true quantum advantage. This workshop will highlight IBM's latest developments, services, and capabilities — with an emphasis on how the quantum community can collectively achieve quantum advantage within the next two years. Topics will include recent hardware advancements, experimental optimization techniques for IBM devices, and how quantum-classical HPC integration can unlock computational capabilities previously out of reach. By showcasing results from internal efforts, joint research collaborations, and technical working groups, we aim to demonstrate how IBM continues to lead the way in quantum computing.

8:30am Session 1 - Quantum Computing at IBM

9:25am Coffee break

9:45am Impactful work using IBM technology

10:40am Coffee break

11:00am *Driving towards advantage and beyond*

12:00pm – Working Lunch

12:40pm *Introduction: Josh Cunningham*

12:45pm *Supporting Exascale Science at ORNL: A Brief Overview of the OLCF: Verónica Vergara*

Day 3: Wednesday, July 23rd – Afternoon

Moderator: Alessandro Baroni

1:00pm – Keynote

Presenter: Sarah Sheldon (IBM)

Title: From Algorithms to Applications: The path to Quantum Advantage

2:00pm –

Presenter: Arnab Banerjee (Purdue University)

Title: Bypassing Optimization: Magnetism and dynamics using quantum hardware

2:30pm –

Presenter: Yuqi Zhang (Kent State University)

Title: Protein Structure Prediction in Drug Discovery on Utility-Level Quantum Processors

3:00pm – BREAK

Moderator: Vicente Leyton-Ortega

3:30pm –

Presenter: Esam El-Araby (The University of Kansas (KU))

Title: Utilizing Quantum Computing for Solving Multidimensional Partial Differential Equations

4:00pm –

Presenter: Hisham Amer (Virginia Tech)

Title: Utility scale implementation and benchmarking of Dynamically Corrected Gates at the coherence limit of IBM devices

4:30pm –

Presenter: Ji Liu (Argonne National Laboratory)

Title: Pauli Check Extrapolation for Quantum Error Mitigation

5:00pm –

Presenter: Muqing Zheng (Pacific Northwest National Laboratory)

Title: Bypassing Optimization: Generator-Coordinate-Inspired Methods for Quantum Chemistry

5:00pm – Event Close

Day 4: Thursday, July 24th

8:30am – Workshop

Presenter: IQM

Title: Getting started with hybrid quantum-classical algorithms

As quantum computing advances, its role is increasingly conceived as a powerful complement to traditional high-performance computing (HPC). Hybrid quantum-classical workflows have demonstrated early promise in domains such as quantum chemistry, materials science, and optimization.

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However, realizing the full potential of hybrid quantum-classical systems requires collaboration across disciplines. This workshop provides participants with an opportunity for a hands-on exploration of hybrid quantum algorithms. Iterative and sequential hybrid workflows will be explored, with example problems spanning application domains from chemistry simulations to optimization problems.

8:30am Intros

8:45am Intro to the Munich ecosystem, Experience of real HPC+QC integration at LRZ , Software stack

10:00am Coffee break

10:30am Quantum Chemistry with IQM

11:00am Q&A

12:00pm – Working Lunch

12:40pm Introduction: Claire Marvinney

12:45pm Virtual QPUs: Bridging the Gap Between Simulation and Hardware Performance: Andreas Sawadsky

Day 4: Thursday, July 24th – Afternoon

Moderator: Ryan Landfield

1:00pm – Keynote

Presenter: Kristine Rezai

Title: Supercharging HPC with IQM: A vision for hybrid computing

2:00pm –

Presenter: Chenxu Liu (PNNL)

Title: STQS: A Unified System Architecture for Spatial Temporal Quantum Sensing

2:30pm –

Presenter: Kalyana Chakravarthi Gottiparthi (Oak Ridge National Laboratory)

Title: Quantum Linear Solvers for Computational Fluid Dynamics

3:00pm – BREAK

Moderator: Anshumitra Baul

3:30pm –

Presenter: Jan Balewski (NERSC/LBNL)

Title: EHAnds: Quantum Protocol for Polynomial Computation on Real-Valued Encoded States

4:00pm –

Presenter: Amir Shehata (Oak Ridge National Laboratory)

Title: Bridging Paradigms: Designing for HPC-Quantum Convergence

4:30pm –

Presenter: Andreas Sawadsky (Quantum Brilliance)

Title: Unlocking Quantum Potential: From Mobile Accelerators to Scalable Parallel Clusters

5:00pm – Event close

Abstracts for each talk can be found [here](#).

The QCUF concludes on Thursday, July 24th. The [QQSSw](#) event to be hosted on Friday, July 25th.