

Scholarship Virtual Conference

Conference Booklet





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Our Mission



The SandboxAQ Scholarship Conference aims to create a vibrant space where emerging researchers can share their work, connect with peers, and practice communicating complex ideas in AI and quantum science with clarity and creativity. We believe the future of these fields relies not only on excellent research but also on the ability to collaborate across disciplines and articulate science effectively. This conference is dedicated to celebrating the achievements of our scholars, fostering mutual learning, and strengthening our growing community.



Janet Faakye & Kayla Quinnes
Conference Organisers & Co-Hosts



Jack Hidary, CEO - SandboxAQ
Keynote Speaker



Key Outcomes

01

Provide a platform for scholarship recipients to present their research to a broad, interdisciplinary audience.

03

Deepen the scholars' sense of community and commitment to the SandboxAQ mission.

02

Foster meaningful networking, mentorship, and collaboration between scholars, SandboxAQ staff, alumni, and external partners.

Day 1

March 26th

9:00 AM - 2:00 PM
EST

SoWork Virtual Workspace

9:00 AM

Opening Remarks

9:15 AM

Scholar Talks: Session 1

Bariana Bowman, Diego Ibarra Hoyos,
Isaac Leonardo Huidobro Meezs, Jasvith Raj Basani

10:30 AM

Coffee Break

10:45 AM

Scholar Talks: Session 2

Kabir Dubey, Michael Rose, Mostafa Atallah,
Pablo Rodriguez-Grasa

12:00 PM

Lunch Break

1:00PM

Scholar Talks : Session 3

Theodoros Trochatos, Tarek Hamid,
Claire Yuqian, Naixu Guo

2:00 PM

Announcements & Social
Hour

Day 2

March 27th

Times in EST

9:00 AM

9:30 AM

10:00 AM

11:30 AM

1:30PM

2:30PM -
3:30PM

SoWork & Google Meet

Keynote Address

Jack Hidary - CEO, SandboxAQ

Final Scholar Talk

María Gragera Garcés

Science Showcase Viewing

Lunch Break & Optional
Socialization

Career Development Panel

Closing Remarks & Award
Ceremony

Conference space remains open till 7pm

Keynote Address will be Hosted on Google Meet



Talk Titles and Abstracts

Bariana Bowman

University of Florida

Title: Advancing BEE-NET for Physics-Informed Quantum Materials Discovery

Abstract: The integration of physics-informed descriptors into graph neural networks (GNNs) has emerged as a powerful strategy for accelerating materials discovery. Building on the recently developed Bootstrapped Ensemble of Equivariant Graph Neural Networks (BEE-NET), which predicts superconducting properties from crystal structures with high fidelity, we introduce an extended architecture that explicitly incorporates three-body interactions and symmetry-aware geometric features. Building on the original BEE-NET framework trained to predict the Eliashberg spectral function $\alpha^2F(\omega)$, we extend the model into a multi-purpose architecture capable of simultaneously learning superconducting, geometric, and symmetry-derived descriptors. This unified design enables interpretable, high-throughput screening of superconducting behavior and provides a scalable foundation for multi-task learning across diverse classes of crystalline materials.

The resulting workflow integrates dataset curation, model development, and large-scale screening into an open-source, AI-enabled platform for accelerating superconductor discovery. While the primary focus is on superconductivity, the underlying framework is broadly applicable to other quantum materials classes, enabling efficient exploration of chemical and structural spaces that remain computationally inaccessible to conventional first-principles approaches.

Claire Yuqian Huo

Rice University

Title: Anchor: Reducing Temporal and Spatial Output Performance Variability on Quantum Computers.

Abstract : Quantum computing, which has the power to accelerate many computing applications, is currently a technology under development. As a result, the existing noisy intermediate-scale quantum (NISQ) computers suffer from different hardware noise effects, which cause errors in the output of quantum programs. These errors cause a high degree of variability in the performance (i.e., output fidelity) of quantum programs, which varies from one computer to another and from one day to another. Consequently, users are unable to get consistent results even when running the same program multiple times. Current solutions, while focusing on reducing the errors faced by quantum programs, do not address the variability challenge. To address this challenge, we propose Anchor, a first-of-its-kind technique that leverages linear programming to reduce the performance variability by 73% on average over the state-of-the-art implementation focused on error reduction.

Diego Ibarra Hoyos

University of Virginia

Title: Quantum AI for Materials Discovery

Abstract: This talk presents a quantum-assisted machine-learning (QaML) framework for accelerating materials discovery in data-scarce regimes. By formulating feature selection and neural-network pruning as QUBO optimization problems solvable via quantum annealing, the approach improves model generalization while addressing combinatorial optimization challenges that often limit classical methods. Applied to high-entropy alloys, the framework uses predictive models for ductility and strength together with physics-based constraints on density, cost, phase stability, and corrosion resistance to guide alloy discovery. This pipeline identified the alloy Al₈Cr₃₈Fe₅₀Mn₂Ti₂ (at.%), which was experimentally synthesized and validated, exhibiting a 0.2% yield strength of ~568 MPa, >40% compressive strain without fracture, and significantly improved corrosion resistance relative to 304 stainless steel. These results highlight how quantum optimization can move beyond algorithm development toward practical materials discovery workflows.

Isaac Leonardo Huidobro Meezs

Mcmaster University, Canada

Title: Discrete Flow-Based Generative Methods for Quantum Computing

Abstract: Achieving chemical accuracy in quantum simulation is often limited by the measurement bottleneck. In particular, evaluating molecular energies requires estimating large numbers of Hamiltonian terms with high precision, leading to substantial measurement costs. In this talk, I will first discuss a discrete flow-based generative approach to measurement optimization, where GFlowNets are used to generate high-quality groupings of molecular Hamiltonians. By sampling commuting groups according to rewards that encode trade-offs among measurement cost, circuit depth, and two-qubit gate count, this framework explores a richer combinatorial space than standard heuristics, reducing measurement costs and improving overlapping-grouping methods.

I will then introduce the Generative Derandomized Classical Shadows method, a complementary approach for the simultaneous estimation of multiple expectation values. Leveraging the sampling structure of Classical Shadow Tomography, GFlowNets learn adaptive circuit distributions that replace randomized measurement choices, reducing estimator variance and measurement overhead. Extension to derandomized shallow-shadow settings under circuit-depth constraints will be discussed.

Jasvith Raj Basani

University of Maryland

Title: Speedup in Generative Learning of Quantum System Dynamics

Abstract: Learning and reproducing non-classical probability distributions lie at the heart of demonstrating quantum advantage and remains a computationally challenging task. Inspired by the recent success of generative learning models, we propose a quantum generative learning architecture that overcomes the limitations of traditional quantum machine learning approaches. Our framework employs an adversarial learning paradigm implemented directly on quantum hardware, where a variationally trained generator reconstructs the system's dynamics while the discriminator guides the generator's optimization. Unlike heuristic machine learning models that suffer from "barren plateaus", which are regions where gradients vanish and learning becomes exponentially harder, numerical simulations show that our framework maintains stable, system-size-independent gradients, enabling efficient optimization at scale. Furthermore, by incorporating shared entanglement between the generator and the target system, we enhance the sensitivity of the learning process and significantly reduce the sample complexity, offering a clear advantage over conventional tomographic methods. The framework is platform-independent but will be experimentally realized on a quantum photonic processor using a mesh of programmable interferometers. Together, these features establish a scalable route for the characterization and verification of noisy quantum devices, marking a significant step toward generative quantum models with quantum advantage in learning efficiency.

Kabir Dubey

Northwestern University

Title: Vectorized Quantum Signal Processing using Parallel Memory Queries

Abstract: The theory of quantum signal processing (QSP) enables quantum computers to implement a generic class of scalar polynomials by encoding them as unitary transformations on a single qubit. We introduce a protocol that extends QSP by configuring the signal operator which encodes the input to the polynomial with QCrack, a quantum read-only memory (QROM) primitive for parallel access to real numbers. When given a QSP-achievable polynomial and vector of scalars, our protocol evaluates the polynomial at each component of the vector to additive precision ϵ in $O(1/\epsilon^2)$ measurement shots. We compare vectorized QSP over a length n vector with executing n independent scalar QSP circuits and analyze the costs incurred in circuit width and entangling gate count. This is joint work with Jan Balewski and Daan Camps from LBNL, supported by NERSC.

Maria Gragera Garces
University of Edinburgh, UK

Title: Distributed Quantum computing, the path towards scalability

Abstract: Distributed quantum computing is emerging as the route toward scalable quantum advantage, as single devices remain limited in size, connectivity, and noise.

This talk will provide a brief overview of the state of the art in distributing quantum computations across networked quantum processors, including approaches such as circuit cutting, modular architectures, and entanglement-enabled communication.

I will then focus on my own work developing a model-agnostic framework that captures both quantum and classical dependencies to guide compiler-level distribution across heterogeneous quantum clusters.

Michael Rose
University of Chicago

Title: Many-Body Time Evolution from a Correlation-Efficient Quantum Algorithm

Abstract: We introduce the correlation-efficient time-evolution (CETE) algorithm for simulating quantum many-body dynamics. CETE recasts each step of time evolution as a time-independent correlation problem: the ansatz begins from a mean-field single Slater determinant and is then correlated to capture the true time-evolved state.

We derive this exact ansatz from a contraction of the time-dependent Schrödinger equation onto the space of two electrons. Unlike conventional evolution by sequential short-time propagators, which must both correlate and decorrelate the state as the degree of correlation fluctuates in time, CETE correlates only once. This substantially reduces circuit depth, extending accessible simulation times on near-term quantum devices. We demonstrate the approach by simulating the electronic time evolution of the hydrogen molecule and the helium hydride ion, highlighting the potential for the CETE algorithm to simulate strongly correlated systems on near-term devices.

The talk will highlight key challenges, current progress, and open directions on the path toward scalable and useful quantum computing.



Mostafa Atallah
University of Tennessee

Title: Layer-wise QUBO-Based Training of CNN Classifiers for Quantum Annealing

Abstract: We propose an iterative Quadratic Unconstrained Binary Optimization (QUBO) framework for training convolutional neural network (CNN) classifiers for quantum annealing, avoiding barren plateaus of variational quantum circuits and quadratic data scaling of quantum kernel methods. Following the Extreme Learning Machine paradigm, convolutional filters are frozen and only the fully connected layer is trained. At each iteration, a convex quadratic surrogate derived from the feature Gram matrix replaces the cross-entropy loss. A per-output decomposition splits the C-class problem into C independent QUBOs, each with $(d+1)K$ binary variables, so that problem size scales with model and bit precision rather than dataset size. Experiments on five benchmarks show that accuracy improves monotonically with bit resolution, with 10 bits as a practical minimum. The 15-bit formulation fits within D-Wave Advantage hardware limits, and the 20-bit formulation matches or exceeds stochastic gradient descent on MNIST, Fashion-MNIST, and EMNIST while remaining competitive on CIFAR-10 and KMNIST.

Naixu Guo
National University of Singapore

Title: Towards quantum accelerated AI model inference

Abstract: Recent advances in quantum computing suggest a concrete pathway toward accelerating large-scale AI model inference. In this talk, I explore quantum implementations of core neural-network primitives, focusing on transformer and deep residual architectures. Leveraging and developing new quantum linear-algebra techniques, we show how key components of AI models can be executed coherently with provable complexity advantages under suitable data-access models. Complementary results establish end-to-end quantum inference frameworks for multilayer networks, carefully analyzing resource requirements and identifying regimes that admit quadratic to higher-order speedups over classical methods. Together, these works move beyond abstract asymptotic and toward architecturally meaningful quantum acceleration, outlining the algorithmic structure, data assumptions, and fault-tolerant requirements necessary to integrate quantum processors into future AI inference pipelines.

Pablo Rodriguez-Grasa

University of Basque Country, Spain

Title: Understanding generalization in quantum machine learning

Abstract: Generalization, the ability of a model to perform well on new, unseen data, is a central question in machine learning.. In quantum machine learning (QML), understanding generalization is especially important as models grow in size and complexity, yet theoretical tools to assess their reliability remain limited. Most existing error bounds are uniform: they depend only on the overall capacity of the model and often fail to capture what happens during training or explain empirical performance.

In this talk, I discuss recent progress toward more informative generalization guarantees for quantum models. In particular, we derive new error bounds that depend explicitly on the learned network parameters, rather than only on global complexity measures. These bounds provide a more refined, solution-dependent perspective and show good agreement with empirical observations, helping bridge the gap between theory and practice in QML.

Theodoros Trochatos

Yale University

Title: Fortifying Quantum Clouds: Securing Information in the Quantum Era

Abstract: Quantum computers promise to solve problems that are impossible for today's machines. But most people will not own a quantum computer. Instead, they will access them through the cloud, sending their quantum programs to powerful machines owned by companies. This creates a new security challenge. Quantum programs can represent years of research, valuable intellectual property, or sensitive data. Today, when users send these programs to a cloud quantum computer, the provider can potentially see everything inside them, including the algorithms and the data they contain. In other words, using a quantum computer may require revealing your most valuable ideas. My research tackles this problem by designing the first hardware architecture that allows quantum computers to run user programs without exposing them to the cloud provider. By building security directly into the hardware, the system helps protect both the algorithm and the user's data, even from insiders operating the machine. This work helps make cloud quantum computing not only powerful, but also trustworthy, so that researchers, companies, and governments can safely use the next generation of computing technology.



Tarek Hamid
University of Virginia

Title: Improving Medical Sensing by Measuring and Quantifying Skin Characteristics

Abstract: Across medical and wearable sensing technologies, measurements are often distorted by biological confounders that are not directly quantified. In optical sensing, such as those found in smartwatches, light must travel through skin and tissue before reaching blood and other physiological targets. Variations in pigmentation, scattering, and tissue composition systematically alter these signals, yet these effects are typically treated as noise rather than measured and modeled explicitly.

In this work, we present a wearable optical sensing framework that directly quantifies tissue optical properties alongside physiological signals. By separating tissue-driven variability from the underlying measurement target, we demonstrate how sensing systems can be made more accurate, more generalizable, and less population-dependent. This approach reframes bias in medical sensing systems not as a calibration problem, but as a missing-variable problem in the sensing pipeline. More broadly, the work highlights a general principle for biosensing: robust measurement requires measuring the medium itself.

Innovation at the intersection of AI and Quantum

The Scholarship Team

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March 26th & 27th