Headline Sponsor:

unitaryCON 2023 - November 15-17, Rome, Italy

All talks take place at: Tecnopolo Tiburtino, Casale 5, Via Ardito Desio, 60, 00131 Roma RM
https://maps.app.goo.gl/jjZs4Dvh8GU266kR7

unitaryCON Program

Time	Tue Nov 14	Wed Nov 15	Thu Nov 16	Fri Nov 17
8:30		Shuttle from Hotel	Shuttle from Hotel	Shuttle from Hotel
9:00 - 9:30		Registration	Luciano Bello – IBM Quantum	Xiuzhe (Roger) Luo – Perimeter Institute
9:30 - 09:45		Welcome by Will Zeng – Unitary Fund		
9:50-10:35		Nathan Shammah – Unitary Fund	Nathan Killoran – Xanadu	Eduardo Maschio – Pasqal
10:35 - 11:05		Coffee Break		
11:05 - 11:50		Peter Groszkowski – Oak Ridge Natl. Laboratory	Ecosystem Gaps Discussion	UF Closing remarks (15')
11:55 - 12:30		Jordan Sullivan – Amazon Braket at AWS		
12:30 - 14:00		Lunch	Lunch	Lunch
14:00 - 15:00		UF projects lightning talks (every grant awardee can sign up to give a 6' talk!)	Free Pitches - 3' each (coding hacks, open problems, crazy ideas, etc.)	End of event
15:05 - 15:35	Welcome & Hotel check in (Hotel Gran Duca D'Este)	Survey Discussion	Matt Lourens – Stellenbosch University	
15:35 - 16:20		Free discussions + Coffee	Free discussions + Coffee	
16:25 - 17:45		Projects Office Hours	Projects Office Hours	
17:45 - 18:00		Shuttle to Hotel	Shuttle to Hotel	
19:00 - 20:30	Social Dinner	Free evening	Dinner out	

Headline Sponsor: Quantum ITALIA

Speakers' List and Talk Titles:

Wed Nov 15

- Nathan Shammah, Unitary Fund, *"Welcome Unitary Fund!"*
- Peter Groszkowski, Oak Ridge Lab, *"Simulating superconducting circuits with scqubits"*
- Jordan Sullivan, AWS, *"Amazon Braket"*

Thu Nov 16

- Luciano Bello, IBM Quantum, *"Qiskit: Transformative impact on quantum research and community development"*
- Nathan Killoran, Xanadu, *"PennyLane & Catalyst: envisioning the future of quantum software"*
- Matt Lourens, Stellenbosch University, *"Hierarchical quantum circuit representations"*

Fri Nov 17

- Xiuzhe (Roger) Luo, Perimeter Institute, *"The Julia programming language in the quantum community"*
- Eduardo Maschio, PASQAL, *"Qadence: a differentiable interface for digital-analog programs"*

Speakers' List, Talk Titles with Abstracts:

Wed Nov 15

Nathan Shammah, Unitary Fund
Title: "Welcome Unitary Fund!"
Abstract: In this talk I'll provide an overview of Unitary Fund activities and ecosystem growth. Unitary Fund activities can be broadly divided into three groups: (1) Microgrants; (2) community activities; (3) research. I will provide an overview of 89+ microgrants awarded to date with some spotlights and stats. Community activities include the Unitary Fund Discord server (with many community calls and Quantum Wednesdays), the Quantum Open Source Survey, unitaryHACK and more. The Unitary Fund tech staff is performing research enabling open source projects in error mitigation (Mitiq) and benchmarks of quantum computer metrics (Metriq.info).

Peter Groszkowski, Oak Ridge National Laboratory
Title: "Simulating superconducting circuits with scqubits"
Abstract: In recent years, open source software development has played a crucial role in fueling technological advances across a broad range of disciplines, including ones related to quantum information science (QIS). One important area of QIS research involves building software tools that allow for accurate modeling and simulations of early quantum computing devices. In this talk, besides giving a brief overview of the current landscape of such tools, I will discuss scqubits[1]: an open-source Python package for simulating and analyzing superconducting circuits - arguably one of the leading approaches to building early quantum computers. I will outline its core functionality, features, as well as limitations. I will also briefly present recently added facilities for arbitrary circuits analysis, and talk about our ongoing efforts related to performance enhancements as well as building tooling required to take advantage of GPU-based computing. Finally, I will discuss more broader efforts and challenges related to open source quantum software development at the Oak Ridge National Laboratory, and give an overview of programs that provide classical and quantum computing access to researchers and developers from around the world [2].
[1] https://github.com/scqubits/scqubits, [2] https://www.olcf.ornl.gov/

Jordan Sullivan, AWS
Title: **"Amazon Braket"**

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Thu Nov 16

Luciano Bello, IBM Quantum

Title: "Qiskit: transformative impact on quantum research and community development"

Abstract: Qiskit, a highly popular open-source framework for Quantum Computing, has significantly influenced the research landscape in this field. First released in 2017, Qiskit is an open-source SDK for quantum computers, enabling developers to work with these powerful machines using a familiar Python interface. Qiskit has become the most popular package for quantum computing, with a thriving open-source community. As Qiskit has grown and changed, so has our approach to nurturing our community. Additionally, we highlight the collaborative nature of the development community and its interaction with IBM Quantum, its main developer, emphasizing the values of openness and transparency. Join us to discover the transformative impact of Qiskit on quantum research and the dynamic community shaping its future. This talk will share important lessons we've learned over the years, including practical tips you can apply to your own open-source projects.

Nathan Killoran, Xanadu

Title: "PennyLane & Catalyst: envisioning the future of quantum software"

Abstract: To be most useful, quantum software needs to span the gap between quantum programmers and quantum computing hardware. On one hand, software users benefit from high-level interfaces and abstractions—often exposed in Python—which let them think in ways best suited to their problem domain. On the other hand, finer details related to quantum hardware, accelerators, or compilation are necessary to make algorithms run efficiently. How can we cross this gap between high-level abstractions and low-level implementation details? In this talk, I will share how the PennyLane team is exploring this critical question via an approach originally developed in machine learning, specifically the Multi-Level Intermediate Representation (MLIR), bringing the best of both worlds to users.

Matt Lourens, Stellenbosch University

Title: "Hierarchical quantum circuit representations"

Abstract: Quantum circuit algorithms often require architectural design choices analogous to those made in constructing neural and tensor networks. These tend to be hierarchical, modular and exhibit repeating patterns. Neural Architecture Search (NAS) attempts to automate neural network design through learning network architecture and achieves state-of-the-art performance. We propose a framework for representing quantum circuit architectures using techniques from NAS, which enables search space design and architecture search. We use this framework to justify the importance of circuit architecture in quantum machine learning by generating a family of Quantum Convolutional Neural Networks (QCNNs) and evaluating them on a music genre classification dataset, GTZAN. Furthermore, we employ a genetic algorithm to perform Quantum Phase Recognition (QPR) as an example of architecture search with our representation. Finally, we implement the framework as an open-source Python package to enable dynamic circuit creation and facilitate circuit search space design for NAS.

Xiuzhe (Roger) Luo, Perimeter Institute

Title: "The Julia programming language in the quantum community"

Abstract: The Julia programming language has been deeply entrenched in the realm of scientific computing since its inception. Notably, the past five years have witnessed a consistent and rapid surge in the adoption of Julia for quantum science. In this presentation, I will commence with a comprehensive introduction to the Julia programming language, highlighting its advantages and limitations within the quantum science domain. Subsequently, I will provide an extensive overview of the key contributors and packages that form the backbone of the Julia community. To conclude, I will touch upon our previous endeavors and future prospects in employing Julia for quantum computing, emulation, and tensor networks, emphasizing packages such as Yao, Bloqade, and OMEinsum.

Eduardo Maschio, PASQAL

Title: **"Qadence: a differentiable interface for digital-analog programs"**

Abstract: In this talk we present Qadence, a Python package focused on building digital-analog quantum programs through a flexible and extensible block system and PyTorch integrated differentiation on quantum circuits for neutral atom devices. It produces an easy-to-work framework that can be used on Quantum Machine Learning algorithms with parametric quantum programs and can be either solved using automatic differentiability or parameter shift rules

approaches on digital, digital-analog or analog circuits. After showing the basics of Qadence, an interactive hands-on session is held.

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