Open Quantum: Democratizing Access to Quantum Computing Resources

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Abstract

Open Quantum is a platform designed to provide researchers and developers with easy access to quantum processing units (QPUs) and high-performance computing (HPC) quantum simulations, enabling seamless execution of quantum circuits through a unified API. Created by Quantum Rings—a team best known for making quantum algorithm research and development more accessible through their high-speed, scalable quantum simulator—Open Quantum removes many barriers that prevent a broad set of users from accessing quantum hardware through a simple-to-use platform that integrates directly with popular quantum frameworks. Quantum Rings is furthering this commitment to accessible quantum computing through a partnership with qBitTensor Labs—a company specializing in quantum solutions through the Bittensor ecosystem—which will provide Open Quantum users with opportunities for free runtime on physical quantum hardware. This paper introduces the platform's architecture, key features, and strategic goals, highlighting its role in bridging the gap between emerging quantum technologies and practical applications.

1 Introduction

Quantum computing represents a paradigm shift in computational capabilities, promising to solve complex problems in optimization, cryptography, and simulation that are intractable for classical computers. However, the high cost and limited availability of quantum processing units (QPUs) and the costly classical hardware requirements needed to run large-scale quantum simulators have restricted access to a select few institutions and corporations. Furthermore, accessing QPUs and simulators from new providers often requires learning entirely new systems and frameworks, and migrating algorithms. These limitations have inhibited the growth of the quantum industry as a whole.

Quantum Rings has been tackling the simulator side of this problem since 2023 through their development of the Quantum Rings SDK, which allows users to execute hundreds of logical qubits and millions of gate operations with high fidelity all on consumer-grade classical hardware [1]. They first demonstrated their expertise in quantum simulation by simulating Google's 2019 quantum supremacy circuits on a classical computer with 32 GB of memory, achieving a record-breaking linear cross-entropy benchmarking (XEB) score of 0.622 [2]. They later revisited this experiment, running the same simulation on a single NVIDIA A100 GPU in 1:15:36, representing a 6.95×10^7 speedup compared to Google's original classical prediction [3].

Quantum Rings is now extending their reach to quantum hardware, developing Open Quantum to solve similar access issues. Open Quantum addresses these barriers by providing access to QPUs from leading providers through a unified API with user-friendly tools that integrate directly into developer frameworks like Qiskit, PennyLane, and Cirq.

Through a partnership with qBitTensor Labs, the leading entity for quantum solutions on

the blockchain-based Bittensor network, Quantum Rings leverages decentralized incentives to provide users with opportunities for free and subsidized runtime on quantum hardware [4]. This white paper outlines the platform's core functionalities, its integration with advanced networks, and its vision for empowering a global community of quantum innovators.

2 Overview of Open Quantum

Open Quantum is a comprehensive platform that enables users to run quantum circuits on QPUs or GPUs via a single, intuitive API, eliminating the complexities of multi-vendor integrations [5]. Key features include:

- **Public Tier: Free and Subsidized Access**: Without requiring any payment from users, they can execute quantum circuits on physical QPUs and HPC simulations. **Public tier users are required to cite this paper in any publications resulting from their work on the platform**. Additionally, by using the public tier, users contribute their anonymized, aggregated data (circuits, results, and metadata) to a common data repository maintained by Open Quantum. This repository will be used to drive insights and advancements that will accelerate the quantum industry.
- **Private Tier: Secure Access**: For users wishing to keep their quantum circuits confidential, the Private Tier allows for circuit execution while maintaining all data in strict isolation, without contributing anything to the common data repository.
- **Unified Interface**: Users can submit Open QASM files through a web-browser or pip-installable Python SDK. Plugins for quantum frameworks like Qiskit are also available for seamless integration into existing workflows, with upcoming support for Cirq, and PennyLane.
- **Scalable Simulations**: In addition to executing on QPUs, Open Quantum has announced the upcoming support for managed quantum simulations that leverage GPUs for large-scale quantum workloads, approximating real QPU behavior for development and testing.

The platform connects users to backends from providers such as Rigetti, IonQ, IQM, and more, removing the complexities of engaging with multiple companies and APIs to interface with the diverse set of quantum computers available. Target audiences span both traditional users such as quantum researchers, academics, software developers, and enterprises, but also extends to students, enthusiasts, and outside innovators from adjacent fields, making quantum experimentation accessible without prohibitive costs.

3 Integration with Decentralized Quantum Networks

The innovation that initially drives Open Quantum's ability to provide free quantum compute access lies in its synergy with the Bittensor ecosystem, a decentralized innovation ecosystem powered by the TAO token [6]. Through small communities known as subnets, Bittensor uses blockchain-based incentives to drive innovations and solve challenges defined by each subnet owner.

The public tier of Open Quantum is powered by the Quantum Compute subnet (SN48), which is operated by qBitTensor Labs. SN48 creates an open marketplace for real quantum circuit execution on physical QPUs and HPC simulators. Launched in Fall 2025, users submit circuits via Open Quantum's API, which routes them to miners equipped with hardware or simulation capabilities. Validators perform spot checks to verify that the miners have properly executed the circuits on the appropriate target QPU, while TAO-based incentives promote sustainability by allowing miners to cover the cost of the underlying quantum computing resources. This two-sided market model connects demand from end-users with supply from resource providers, allowing for a dynamic and sustainable marketplace that enables researchers to drive innovation in the field of quantum.

For organizations that have made large capital purchases of QPUs that are underutilized, Open Quantum offers services to integrate those systems,

allowing Open Quantum users to consume the spare capacity, while creating substantial revenue streams for the QPU operator. This model allows owners to directly monetize idle capacity while providing their researchers with seamless integration into favorite tools like Qiskit, Cirq, and PennyLane, along with priority access for any market purchases.

4 Goals and Aims

Open Quantum's mission is to democratize quantum computing. Strategic aims include:

- **Ensuring Access**: Make quantum compute and simulation resources available to large corporations and individuals alike while minimizing the learning curve required to access them, allowing the brightest minds from all backgrounds to contribute to quantum research.
- **Building Sustainability**: Through Bittensor's incentive mechanisms, create a self-sustaining economy where contributions to quantum tasks yield fair rewards, reducing reliance on centralized funding.
- **Empowering Innovation**: Enable diverse minds from traditional researchers to unconventional thinkers to collaborate on bold quantum ideas, accelerating discoveries in AI, materials science, cryptography, and other critical fields.

Ultimately, Open Quantum envisions a future where quantum computing is as accessible as cloud services today, sparking widespread adoption and transformative applications.

5 Conclusion

Open Quantum stands at the forefront of quantum democratization, combining easy and low-cost resource access with decentralized intelligence to unlock quantum potential for all. By addressing accessibility challenges through innovative integrations and community incentives, the platform paves the way for groundbreaking advancements. As Quantum Rings and partners like qBitTensor Labs continue to evolve this ecosystem, Open Quantum invites the world to begin building practical quantum applications today.

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