Xanadu and Oak Ridge National Laboratory push the boundaries of large-scale quantum programming on the Frontier supercomputer

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TORONTO, April 29, 2026 /PRNewswire/ - Xanadu Quantum Technologies Ltd. ("Xanadu") (NASDAQ: XNDU) (TSX: XNDU), a leading photonic quantum computing company, and the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL), one of the largest scientific research centers in the United States, have collaborated to enable cutting-edge research in quantum computing by leveraging Xanadu's open-source quantum software library, PennyLane, on the Frontier supercomputer, one of the most advanced computing systems in the world.

Users of Frontier and the broader Oak Ridge Leadership Facility (OLCF) community can now utilize PennyLane to write and execute quantum programs directly on the Frontier supercomputer using PennyLane's high-performance Lightning simulator. This collaboration pushes the limits of quantum computing simulation by merging Frontier's exascale capabilities, powered by AMD's CPUs and GPUs, with PennyLane's accessible programming interface.

In order to prototype, test, and validate larger quantum programs and algorithms, researchers often need supercomputing resources to simulate a large number of qubits. With the ability to run PennyLane on Frontier, researchers can now explore complex problems and identify performance bottlenecks that are not present within smaller simulations. Researchers have a new, powerful set of tools to advance the field of quantum applications development, with fault-tolerant quantum computing on the horizon.

Xanadu has further advanced this work by integrating Message Passing Interface (MPI) with Lightning. MPI introduces the ability to communicate across multiple computational nodes and is a foundational tool for massively-parallelized classical high-performance computing. This integrated feature enables users to cut down on total runtimes and explore novel approaches for distributed computation by coupling Lightning with MPI for quantum simulation. Researchers are now able to easily leverage world-class parallel computing capabilities of AMD-powered hardware at the Frontier supercomputing facility for their quantum computing research.

Xanadu also supported the OLCF community through a comprehensive hands-on workshop. The goal of this workshop was to provide participants with the knowledge to start using PennyLane for quantum programming. In addition to general onboarding, the workshop also taught how PennyLane's high-performance capabilities could be leveraged with the supercomputing capabilities of Frontier.

"We're thrilled that PennyLane is now ready for researchers using Frontier to push the limits of quantum computing simulation. PennyLane was designed to provide an accessible user interface, support hybrid classical-quantum programs, and integrate with high-performance simulators - all features that complement Frontier's classical supercomputer," said Dr. Christian Weedbrook, Founder and Chief Executive Officer of Xanadu.

"By leveraging the exascale performance of Frontier's AMD-powered systems with Xanadu's accessible PennyLane software framework, we are enabling the OLCF user community to simulate quantum programs at scale. This capability supports benchmarking of algorithms, investigation of hardware constraints, and preparation for future fault-tolerant quantum applications," said Michael Sandoval, a high-performance engineer at OLCF and organizer of the PennyLane on Frontier workshop.

As the field of quantum computing continues to accelerate, collaborations between industry and national laboratories are poised to unlock new discoveries in quantum computing and beyond. Xanadu and ORNL stand ready to support the world-class researchers pushing the limits of the field.

About Xanadu: Xanadu is a Canadian quantum computing company with the mission to build quantum computers that are useful and available to people everywhere. Founded in 2016, Xanadu has become one of the world's leading quantum hardware and software companies. The company also leads the development of PennyLane, an open-source software library for quantum computing and application development. Visit xanadu.ai or follow us on X @XanaduAI.

About PennyLane & Catalyst: PennyLane is an open-source software framework for quantum machine learning, quantum chemistry, and quantum computing with the ability to run on all hardware. Catalyst is a package that enables just-in-time (JIT) compilation of PennyLane programs and allows for an efficient quantum-classical hybrid workflow. To find out more, visit the PennyLane website (pennylane.ai), or check out the PennyLane demos, a gallery of hands-on quantum computing content (https://pennylane.ai/demonstrations). To find out more about Catalyst or to contribute to its development, visit: https://docs.pennylane.ai/projects/catalyst/en/stable/.

About ORNL

Oak Ridge National Laboratory delivers scientific discoveries and technical breakthroughs to accelerate the development and deployment of solutions in clean energy and global security, and in doing so create economic opportunity for the nation. ORNL is managed by UT-Battelle for DOE's Office of Science.

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