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2023 캐나다 양자기술 R&D 사절단

Canadian Quantum Technology R&D
delegation to South Korea 2023

Délégation canadienne de R&D sur les
technologies quantiques en Corée du Sud 2023

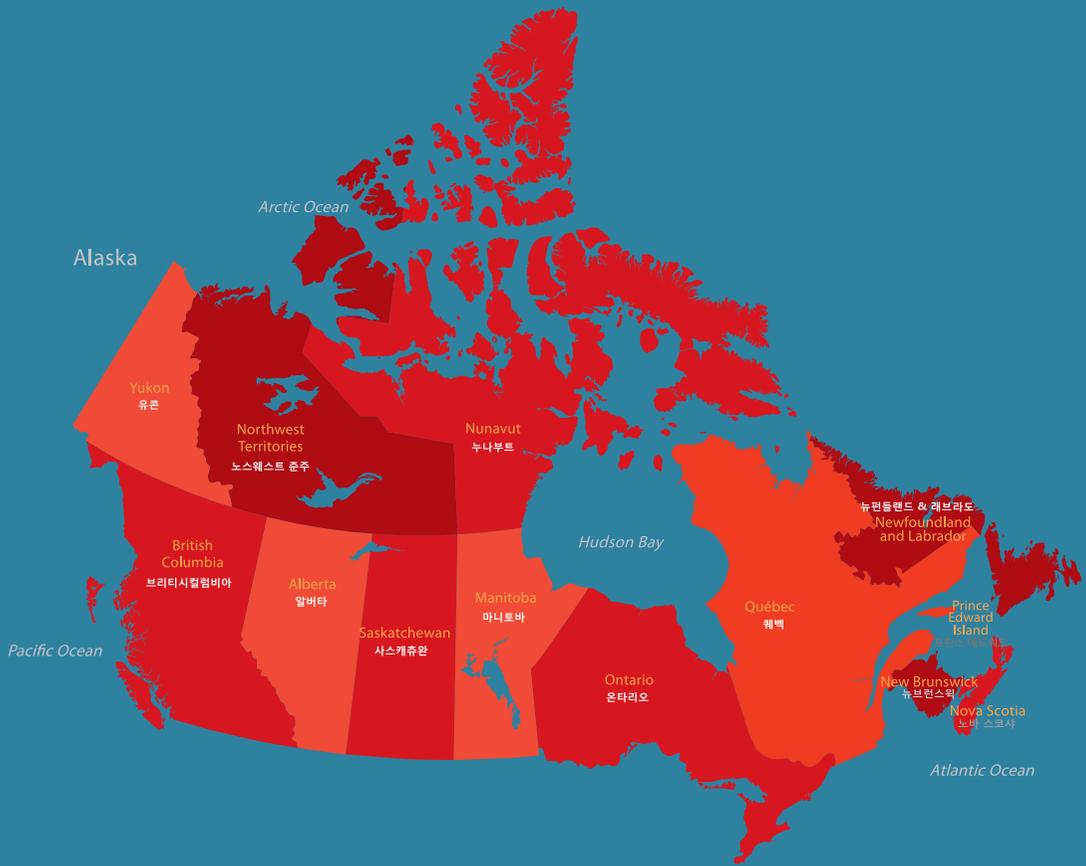
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문의.

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참가 기업 PARTICIPANTS

1QBit	Quantum Computing Hardware, Quantum Computing Software	4
Agnostiq	Quantum Computing Software	5
Anyon Systems Inc.	Quantum Computing Hardware, Quantum Computing Software, Quantum Algorithm	6
Applied Quantum Materials Inc.	Quantum Materials	7
BTQ Technologies	Quantum Communications/Security	8
Good Chemistry	Quantum Algorithm	9
OTI Lumionics Inc.	Quantum Algorithm, Quantum Material	10
Quantum Valley Ideas Laboratories (QVIL)	Quantum Sensing, Non-for-profit	11
Québec Quantique	Non-for-profit	12
Xanadu	Quantum Computing Hardware, Quantum Computing Software, Quantum Algorithm	13

1QBit leverages its deep expertise in quantum computing and machine learning to develop novel computing hardware that will enable the next generation of artificial intelligence and fault-tolerant quantum computing technologies.

VALUE PROPOSITION

1QBit develops next-generation computing technologies to address key challenges in quantum computing (QC) and artificial intelligence (AI). Our main areas of focus are fault-tolerant quantum computing (FTQC) and novel processors for AI. 1QBit's FTQC efforts include (i) decoders and controllers that will be able to operate at cryogenic temperatures and using extremely low amounts of power to address key limitations faced by many QC systems and (ii) software tools to assist in designing and estimating the performance of FTQC hardware. 1QBit also is developing opto-electronic processors that harness quantum mechanical phenomena to drastically improve the efficiency of next-generation AI methods.

HIGHLIGHTS

- 1QBit is developing components of the QC stack that will be required for any paradigm (superconducting, trapped-ion, photonic, etc.).
- 1QBit's quantum resource estimation tool optimizes the space-time cost needed for a quantum system to execute a quantum algorithm.
- 1QBit's opto-electric processor will use around 0.1% of the energy required by classical processors for various AI workloads.

OBJECTIVES

We are seeking to work with QC hardware companies to collaborate on the development of and to validate our decoder and controller processors. We'd also like to collaborate on the design of their hardware utilizing our resource estimation tool, which outlines the resources required for executing a user-defined quantum circuit within an upper bound for the accumulated error rates and produces the approximated circuit in the Clifford + T basis, the algorithmic and magic state factory layout maps, and more. We would also like to work with chip manufactures on the development, scaling up, and fabrication of our opto-electric chip.

REPRESENTATIVES



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Agnostiq is the company behind Covalent, an Advanced Computing as a Service platform that enables users to manage and execute tasks on heterogeneous compute resources including CPUs, GPUs and quantum computers, across all major clouds, hardware architectures, and in any configuration including cloud, on-premises and hybrid combinations.

VALUE PROPOSITION

Covalent Cloud is a novel Advanced Computing as a Service platform designed to provide a unified interface for all of the advanced computing resources available on the market, including but not limited to GPUs and TPUs, quantum and quantum-inspired hardware, and other ASIC devices. Covalent enables users to create virtual classical & quantum clusters, schedule jobs, manage workflows and more, while offering the flexibility of a multi-cloud solution. Covalent frees teams from managing infrastructure and operations, enabling them to instead focus on their business objectives. Open source Covalent was launched in January 2022 and has been downloaded over 70,000 times.

HIGHLIGHTS

- **Ease of Use:** Covalent is a Python-based tool that lowers the barrier to adoption for high performance and quantum computing resources.
- **Multi-cloud support:** Covalent supports multi-cloud job scheduling across all major public cloud platforms.
- **Quantum ready:** Covalent provides a powerful and easy-to-use tool for advanced computing, yet future-proofed, supporting quantum algorithms as hardware matures.

OBJECTIVES

Agnostiq welcomes partners including:

- Users of quantum computers in industry, academia and government needing a portal to the broader quantum computing ecosystem both hardware and software, and a powerful tool to handle operational tasks
- Quantum and quantum-inspired hardware providers keen to directly integrate with Covalent Cloud to provide access to their resources, either to a restricted set of partners or a global audience, without needing to build out and maintain such capabilities on their own
- Supercomputing or quantum computing centers seeking a user-friendly framework to unify and to simplify access to all types of hardware including quantum

REPRESENTATIVE



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Github repo

github.com/agnostiqHQ/covalent

Covalent Slack

covalentworkflows.slack.com

Anyon Systems is a vertically integrated provider of superconducting universal quantum computers (custom QPU, electronics and cryogenics) that has delivered one unit to the Canadian Defense Forces and sold a second unit to a high-performance computing center.

VALUE PROPOSITION

Anyon Systems is a leading provider of fully-integrated superconducting universal quantum computers. We have developed unique technologies involving the full vertical hardware stack of a quantum computer, from quantum processing units (QPUs) to quantum control electronics and ultra-low temperature cryogenics systems which host the QPUs. We already deliver near-term intermediate-scale quantum computers to early adopters who wish to get started with their quantum R&D program and stay ahead of the competition. Our technology was developed to scale-up rapidly and deliver industry-leading performance.

HIGHLIGHTS

- Our on-premises quantum computers can embed directly into the fabric of HPC centers.
- We design and manufacture in-house most of the major components of the quantum computer.
- We sold and delivered a first quantum computer to the Canadian Department of National Defense and a second quantum computer will be delivered to an HPC center in Canada in early 2024.

OBJECTIVES

We are seeking to connect with early adopters of quantum technologies looking to develop and test initial applications on near-term intermediate-scale quantum computers. Ideal partners include government agencies, high performance computing centers, universities, and leading technology companies. We're open to investors to help with our R&D efforts and to talent to join our amazing team.

REPRESENTATIVE



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Applied Quantum Materials Inc.

Edmonton, Alberta

A global leader in silicon nanomaterials and silicon quantum dots.

VALUE PROPOSITION

Applied Quantum Materials (AQM) is a global leader in the design, synthesis, and manufacturing of silicon nanomaterials. We work with over 300 customers at major universities, national labs in the U.S., Japan, Spain, France, Italy, Australia and the U.K., start-up quantum computing and multinational companies. We are the first company globally to commercialize bio-compatible silicon quantum dots for sensing, photonics, displays, security, nanocomposite polymers, solar films, and biomedical applications. AQM's new class of silicon quantum dots were developed as an alternative safe and environmentally friendly nanomaterial to address the issues of toxicity and heavy metals from other quantum dot technologies.

HIGHLIGHTS

- AQM is a global manufacturer of high-performance photo resists for semiconductor applications (electron beam, ion beam, nanoimprint, EUV lithography and conformal coatings) for sub 5 nm features.
- We have developed a nano-catalyst that is capable of producing on-demand hydrogen from any type of water at room temperatures without the need for electricity or light.
- We also provide silicon quantum dots for medical imaging, and magnetic nanoparticles for medical diagnostics – nucleic acid selection, extraction, and manipulation.

OBJECTIVES

To build awareness of AQM's advanced material products, technologies, and capabilities. We are interested in expanding and developing new business partnerships with end users and OEM customers for the integration of innovative technologies, co-development, distribution of products and direct sales of nanomaterials. We are looking for strategic partners for our electronic, magnetic and hydrogen producing materials.

REPRESENTATIVE



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BTQ

Vancouver, British Columbia

BTQ builds post-quantum infrastructure to secure mission critical networks.

VALUE PROPOSITION

BTQ builds post-quantum cybersecurity solutions across both software and hardware. Our technologies enable post-quantum compliance in applications like blockchain, CBDCs, aggregate signatures, zero-knowledge proofs, and IoT.

HIGHLIGHTS

Our Preon algorithm was recently selected by NIST in the additional round for digital signatures (in collaboration with Foxconn).

<https://www.btq.com/blog/introducing-preon-a-zk-snark-based-post-quantum-signature-scheme>

OBJECTIVES

Explore collaborations around PQC (post-quantum cryptography) in Korea and engage in Korean cryptography standards efforts + PQC semiconductor community.

REPRESENTATIVE



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Good Chemistry is a software company combining quantum computing and artificial intelligence on the cloud to design new advanced materials and chemicals faster.

VALUE PROPOSITION

- Good Chemistry's cloud-based virtual chemistry lab called QEMIST Cloud screens the entire chemical space of synthesizable molecules at a scale and accuracy that was never imaginable before.
- QEMIST Cloud's Machine learning models that are trained on high accuracy quantum chemistry data generate new materials and synthesis pathways (chemical IP) at least 10 times faster than traditional techniques.
- Our technology accelerates design and synthesis of new and more sustainable chemicals for applications in advanced materials, consumer electronics, energy and petrochemical, battery and automotive, and pharma industries.

HIGHLIGHTS

- Good Chemistry has successfully served Fortune 100 companies like Dow, Accenture, Mercedes Benz, Biogen as well as well-established materials companies in Asia Pacific like DIC corporation, and AGC
- In a landmark collaboration with AWS, Accenture and Intel, we scaled QEMIST Cloud to more than one million Intel CPUs on the cloud to accurately model the breaking of Forever Chemicals (i.e., PFAS molecules) for the first time in the history of computational chemistry.
- In collaboration with Dow and IonQ, we successfully simulated the largest strongly-correlated molecule on a hybrid of quantum and classical computers. This pioneering accomplishment was published in Nature Communication Physics.
- We use our unfair advantage in generating quantum chemistry data at scale to train machine learning models capable of predicting molecular properties and chemical reactions 10000X faster than traditional techniques.

OBJECTIVES

- Partnering with South Korean companies on joint materials discovery pilot projects
- GC already has a strong presence in Japan, looking forward to expanding our client base in South Korea
- Learn about the SK market and audience

REPRESENTATIVES



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OTI Lumionics Inc.

Mississauga, Ontario

OTI Lumionics develops advanced production ready materials for electronics industry using advanced computational and quantum techniques.

VALUE PROPOSITION

OTI Lumionics has proprietary algorithms for accurately simulating materials for the electronic industry. This enables chemists to have more confidence in the simulation results and thus can either develop accurate AI algorithms with significantly fewer data points or use the data to infer desired chemical properties.

HIGHLIGHTS

- We have achieved the largest quantum chemistry simulation on a quantum emulator to date (>200 logical qubits)
- High accuracy simulations for simulating chemical properties such as phosphorescent spectra and chemical reactions
- We have demonstrated the accuracy and speed of our algorithm in partnership with Microsoft and Amazon.

OBJECTIVES

OTI is looking to partner with companies that are interested in using the Quantum Simulation for materials design of battery, semiconductor, high spin magnetic materials and so on

REPRESENTATIVES



Jackie Ha

Vice President of
Business Development



Scott Genin

Vice President of
Materials Discovery

Company site otilumionics.com

Quantum Valley Ideas Laboratories (QVIL) is an independent quantum technology research lab, developing Quantum sensing technologies from idea to prototype and creating companies to commercialize our innovations.

VALUE PROPOSITION

QVIL is a unique Canadian advanced technology research lab, investing in the people and infrastructure to progress novel Quantum sensing ideas towards commercialization, developing the IP and know how required to productize those innovations via spin-out companies for key market opportunities.

QVIL is a recognized leader in the development of Quantum Radio Frequency (RF) sensing using Rydberg Atom vapour cells and has developed prototypes across a range of RF use cases and markets. We have a portfolio of 40 patents covering the core vapour cell engineering and fabrication, laser control system and applications in telecom, electronics and radar.

HIGHLIGHTS

- Application driven quantum sensing research and commercialization
- Recognized leader (participant in US DARPA programs) in Rydberg Atom radio frequency (RF) research and applications. (Test and measurement, 5G communications, radar)
- Portfolio of research expertise (quantum optics, MEMS, vapour cells, signal processing, RF) and 40 patents across a broad range of quantum technologies and applications.

OBJECTIVES

QVIL is seeking research and commercialization partnerships with technology companies, telcos or research labs in the radio frequency (RF) test and measurement, 5G communications, and radar markets. Potential collaboration partners would have a vision to integrate quantum RF sensor-based technology into their product development roadmap.

REPRESENTATIVE



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Enabling the Quebec Quantum Ecosystem

VALUE PROPOSITION

Fostering collaboration and driving innovation, we unite Quebec's local stakeholders to drive transformative projects. Elevating Quebec's influence globally, we put together talent, companies, and investments, while simplifying external engagement. As a facilitator, we streamline inquiries from beyond Quebec, catalyzing growth. Our commitment extends to tracking opportunities, promoting awareness, and strategizing economic advancement.

Québec Quantique brings together Quebec players in the field of quantum science and technology and is working to ensure that Quebec is recognized as one of the world's major developers of quantum technologies and that these technologies are adopted by major industrial sectors in Quebec by 2030.

HIGHLIGHTS

- We are the best way to connect with the Québec quantum ecosystem
- We can help facilitate connections to companies, investment opportunities and the government.
- Quebec has a rich quantum ecosystem: 60+ companies, 50+ support organizations, 30,000 enrolled STEM students, \$200M CAD in local government direct investment towards the field.

OBJECTIVES

Our objective is to create stronger relationships with South Korea and their main actors. We also want to understand the current state of development of the sector in South Korea. The usual collaborators for us would be universities, economic development agencies, companies interested in industrial R&D partners in Quebec or interested in opening a branch in Quebec.

REPRESENTATIVE



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Xanadu is a Canadian quantum computing company with the mission to build quantum computers that are useful and available to people everywhere.

VALUE PROPOSITION

Xanadu is a full-stack quantum computing company that leverages photonic technology. The company was founded in 2016 since then it 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. To date, Xanadu has 180+ employees and raised \$275M USD from leading investors like Porsche Automobil Holding SE, Bessemer Venture Partners, and Georgian.

HIGHLIGHTS

- Xanadu achieved quantum computational advantage with its latest quantum computer, Borealis. For a specific calculation it took Borealis 2 minutes to compute, whereas it would have taken 7M years to execute on the fastest supercomputer in the world, Fugaku. (Nature publication)
- PennyLane (PL) is a leading software framework for quantum computing. PennyLane is fully hardware agnostic, and PL has an active community of thousands of developers with more than 20,000 downloads per month.
- Xanadu is currently working with industry partners to co-develop novel quantum algorithms and software for simulating materials of next-generation battery systems and other use-cases. The industry partners include Volkswagen, BMW, Rolls-Royce, and others. (publications with Volkswagen: [1], [2])

OBJECTIVES

The key objective of this PDA is to establish connections with vital stakeholders in South Korea. Xanadu collaborates various global hardware partners to develop error-corrected fault-tolerant quantum computers. Through the PDA, we seek to engage with South Korean semiconductor manufacturers like Samsung Electronics and SK Hynix. Additionally, our efforts extend to collaborative research projects with industry players, investigating how quantum computing can address industrial challenges efficiently. Noteworthy South Korean companies such as Samsung, LG, SK, Hyundai, and POSCO are actively investing in quantum computing R&D, and we aim to strengthen our involvement with them.

REPRESENTATIVES



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1QBit

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ANYON



BTQ



OTI

Quantum Valley
Ideas Lab

QUÉBEC
QUANTIQUE

XANADU

Canada