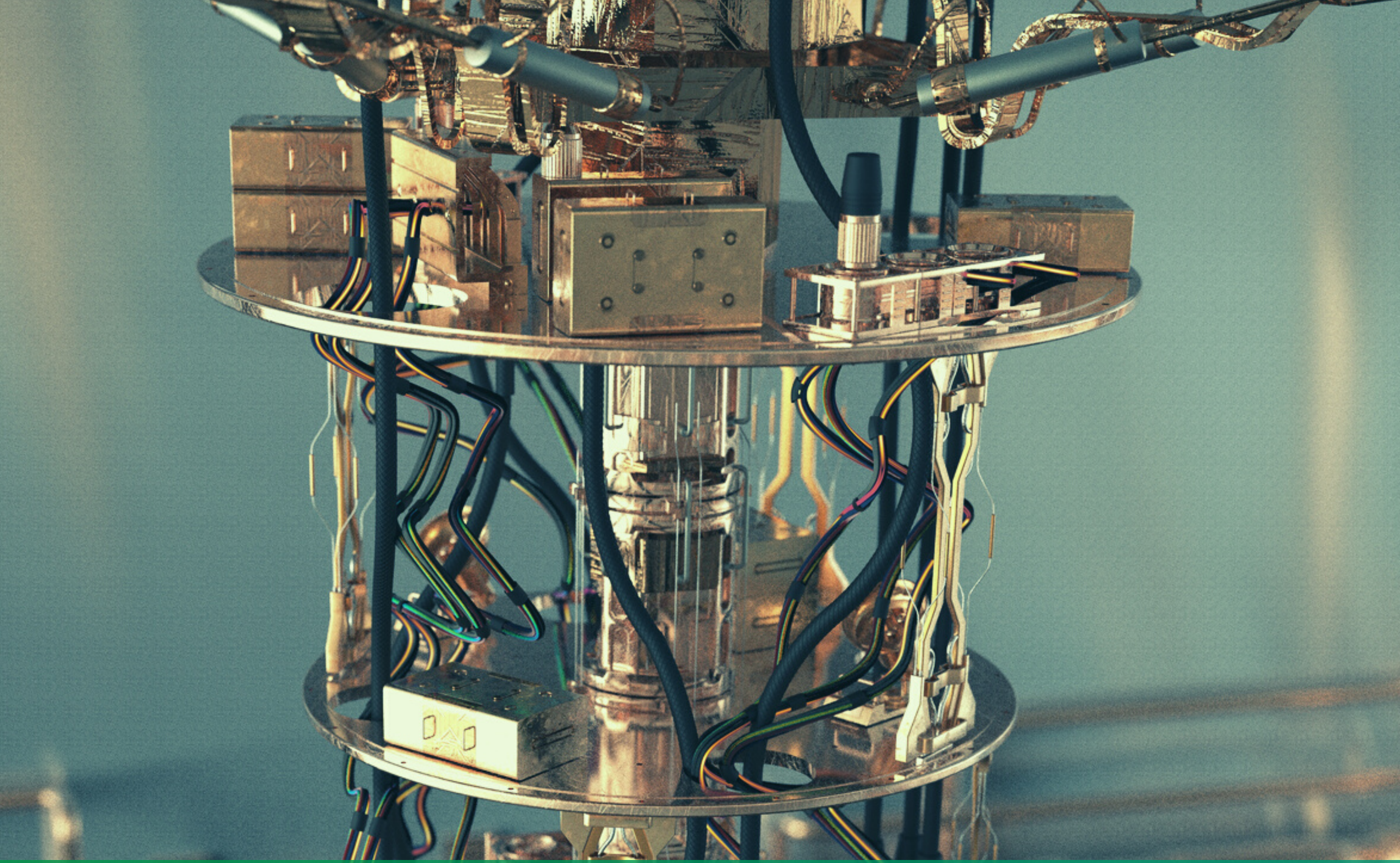
CURIEUX QUANTIQUES

INSTITUT QUANTIQUE UdS



BACKGROUND

Recent technical and scientific advances are bringing about the advent of quantum computing as well as key developments in quantum sensors, encrypted communications and materials. Several countries, including Canada, are already investing in quantum. According to the *Boston Consulting Group*, the annual market could reach over 50 billion $ US in the next decade.

For companies, research centers and education institutions interested in exploring the potential of quantum computing, the required expertise, infrastructure, and technology tranfer are daunting challenges.

It is estimated that only a few thousand scientists worldwide have the required expertise in quantum to develop concrete applications.

APPLICATIONS IN QUANTUM COMPUTING

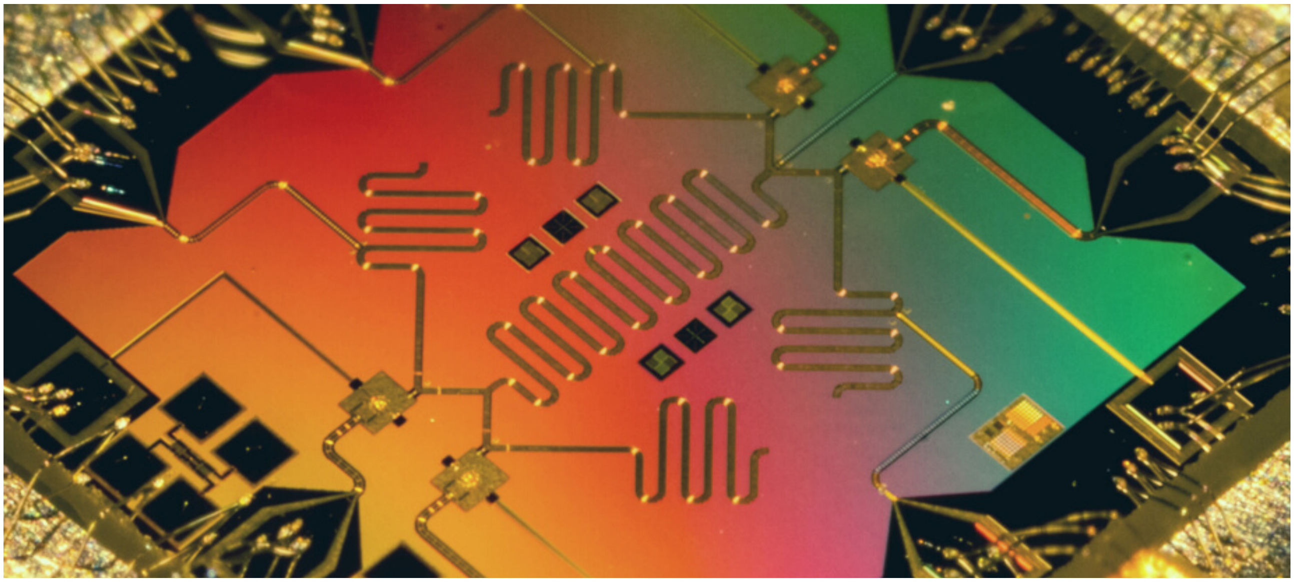
Optimization	Risk analysis Logistics Planning
Apprentissage automatique	Data analysis Imaging Forecasting models
Quantum Modelling	Materials Molecular simulations Particule physics

OTHER APPLICATIONS

Quantum cryptography	Secured communications Random number generation
Quantum sensors	Magnetometers Gravitometers

INTRODUCTION TO QUANTUM

Quantum mechanics is the theory that best describes the natural phenomena that take place at the atomic and subatomic scale. In recent years, the precision of this theory as well as advances in technology, have allowed researchers to reach an unparalleled level of control over different quantum phenomena.

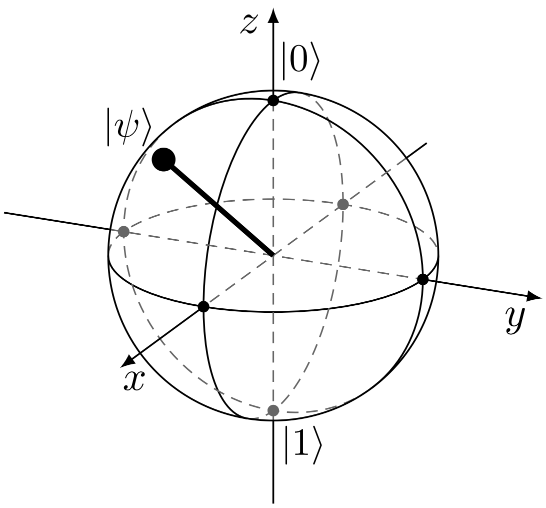


Although quantum physics has already had an impact on our everyday lives through inventions like the cell phone or the microprocessor, the coming years will be bring even more discoveries and the development of new technologies.

Among recent scientific developments, the quantum computer strikes the imagination with its potential to solve problems that are intractable on a classical computer.

Quantum science does not reveal its secrets easily however. One of the challenges in developing the quantum computer is to maintain a system's quantum state as long as possible while limiting the result errors to improve the computation accuracy.

A FEW QUANTUM NOTIONS



Quantum computing is based on properties and concepts that seem astonishing.

First, a quantum computer uses a unit of information encoding, the qubit, which can have a value of 0, 1 or both at the same time. This is called a superposition. In the Bloch sphere illustration above, we can see the representation of the qubit in a state superposition of 0 and 1.

Another important concept is entanglement. When two qubits are entangled, their respective states are linked: it is possible to influence one of the qubits by acting on the other, regardless of the distance between them.

The quantum computer's power is based in part on its ability to superimpose and intricate qubits. This makes the information encoded in a quantum circuit evolve.

The system can then explore all result possibilities simultaneously. This is referred to as quantum parallelism, which gives the quantum computer its exceptional processing power.

In order to bring quantum information back to a classical state, one must perform a measurement of the quantum system by putting it in contact with the outside world. The quantum properties of superposition and entanglement are then lost. This is referred to as the quantum system's collapse, which allows us to observe only one of the possible states, and subsenquently interpret the results of the quantum computation.

INSTITUT QUANTIQUE UdS

The Université de Sherbrooke's Institut quantique (IQ) is at the heart of an ecosystem that is well established in the Estrie region, with key partners, state-of-the-art infrastructure and qualified technical teams.

Technology platforms including the Quantum FabLab and the Quantum AlgoLab are a testament to the exceptional research environment as well as the spirit of scientific and industrial collaboration at IQ.

Our 350 members include world-renowened scientists and a student community who are working to accelerate the transition from science to quantum technologies.

CURIEUX QUANTIQUES

The Curieux quantiques initiative is a growing community of people who want to learn more about quantum science and its applications. Whether you are an educational institution, a government agency or a company, we have several events, workshops, learning resources and a newsletter for you.

Workshops

- Introduction to quantum computing
- Linear algebra transforms qubits
- Introduction to variational quantum algorithms
- Quantum optimization using Qiskit
- Introduction to quantum cryptography
- Quantum machine learning using Qiskit

Events and workshops in quantum

Quarterly newsletter

Podcasts, quantum experiments, lexicon and other resources
Scan the QR code to see all of our pedagogical tools

Are you curious? curieuxquantiques@usherbrooke.ca

Avec la participation financière de :
Québec

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YOUR QUANTUM ADVANTAGE STARTS HERE.