

Alquor®

Why Alquor®?

Quantum Computing

Quantum computing is a new computing paradigm that promises to solve problems that are practically unsolvable for classical computers. It is therefore expected to have a dramatic impact on various fields, including cryptography, optimization, materials science and chemistry. Moreover, quantum computing opens up new possibilities in machine learning and artificial intelligence.

Alquor is a universal multimode tunable interferometer that can implement any desired linear optical transformation. It enables the miniaturization and scalability of photonic quantum computers, by integrating all optical components on a single chip, reducing size and complexity while improving stability and performance. This enables the development of more powerful and practical photonic quantum computers. So far, Alquor can be used for fundamental quantum optics research, quantum random walks, boson sampling, and to realize small-scale near-term quantum computers (up to 10 qubits). Soon, with the addition of fast-feed-forward capabilities, universal quantum computing will be possible, with measurement-based QC running natively and gate-based QC via a compiler.

Quantum Cryptography

The best-known example of quantum cryptography is Quantum Key Distribution (QKD), which provides an information-theoretically secure solution to the key exchange problem. The security of QKD is based on the laws of quantum mechanics and makes it resistant to all kinds of attacks, even attacks from quantum computers. Unlike post-quantum cryptography, QKD is not based on the supposed difficulty of certain mathematical problems but is inherently secure.



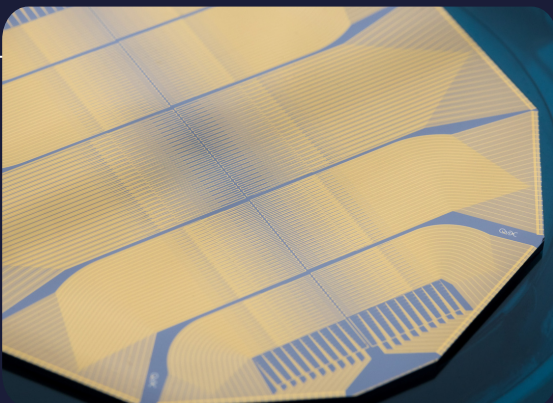
Alquor® is our award-winning, market-leading photonic integrated technology, distinguished by ability to operate at room temperature, along with lowest losses and complete programmability. This is our core technology used for our quantum computers.

What is Alquor®?

Alquor is the Quantum Photonic Processor pioneered by QuiX Quantum since 2020. It is the core element of quantum computers based on photonics, providing a wide range of functionalities to precisely control, manipulate and entangle quantum light. Thanks to real-time reconfiguration and fine-tuning Alquor provides great flexibility and outstanding performances.

How does it work?

Alquor works as an integrated multiport linear optical interferometer built on the highly customizable TriPleX™ silicon nitride (Si₃N₄) platform, fully programmable and reconfigurable via its dedicated control software that allows for seamless integration of the device into your process. Providing both high transformation fidelity (>95%) and the lowest losses on the market, Alquor is the key-enabling solution for your quantum applications.



Why Photonics?

Light is a superior information carrier, especially when it comes to quantum applications. Information encoded in photons, the quantum particles of light, is immune to electromagnetic noise (known as decoherence) and allows for an all-to-all connectivity between the different photon qubits. Photon-based systems bring also the advantage of working at room temperature, making their deployment easier.

Photonic Integrated Circuits (PICs) are becoming the key enabling technology of the modern information society. Bulk optical solutions are not scalable in any aspect (practical, economic), and on-chip integration paves the way for widespread adoption of photonic solutions, just as electronic integration did in the past.

PICs are the only way to achieve field-deployable, key-switch, and scalable solutions for photonic use cases, that are also affordable through mass production. Some use cases for Alquor are outlined below, but the possibilities are unlimited!

The path to miniaturized quantum communication systems of increasing complexity and enhanced functionality is paved by photonic integration. Alquor is a field-deployable solution that, when combined with integrated quantum light sources and photodetectors, can serve as a stand-alone QKD system.

Quantum Sensing

Quantum sensors utilize the unique properties of quantum mechanical systems, such as entanglement, to interact with their environment in ways that classical sensors cannot. This opens the door to a wide range of applications, from ultra-precise navigation and timekeeping to the development of new medical diagnostics.

Miniaturized sensors for practical applications are realized based on PICs. Alquor offers a mature platform for quantum sensors that allows precise control of the signal used for initialization, manipulation, and readout of the sensor. Real-time reconfiguration and tuning of light signals paired with spot-sized converters (SSC) for light coupling enables quantum sensors with the highest precision.

Quantum Random Number Generation

True random numbers play an important role in many applications, for example cryptography and simulation. Since quantum mechanics is fundamentally and inherently non-deterministic (i.e., probabilistic), Quantum Random Number Generation (QRNG) is the only known method for generating true randomness.

Alquor exploits the probabilistic nature of quantum mechanics and can serve as a robust, stable, and flexible entropy source for QRNG. It provides an unparalleled level of security by generating true random numbers that are fundamentally impossible to predict or replicate.

Optical Network Switching

As the demand for data transmission continues to grow exponentially, there is an increasing need for high-speed and low-latency optical interconnects in data centers, HPC environments, and telecommunication networks.

When used as an optical circuit switch (OCS), Alquor provides high bandwidth, minimal latency, and extremely low loss. In addition, Alquor's large transparency window makes it an excellent choice for switching both classical and quantum data in optical networks.

Optical Power Grid Distribution

The ability of distributing an incoming optical signal in a reconfigurable manner across multiple output channels, with the ability to control the power distribution profile and the time delays between the outputs is a crucial feature for other quantum computing technologies.

Being an integrated multiport interferometer, Alquor provides a high-quality control over the coherent superposition of all the optical signals with an all-to-all connectivity, with the advantage of compactness and room-temperature operation.

About QuiX Quantum

QuiX Quantum is the European market leader for quantum computing hardware based on photonics. They are building the first universal photonic quantum computer in Europe, with the first sale to the German Aerospace Center (DLR). The core technology for their universal quantum computers is award-winning and commercially available. QuiX Quantum has 4 offices in Europe and customers worldwide.



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