ROADMAP 2024–2030

QUANDELA

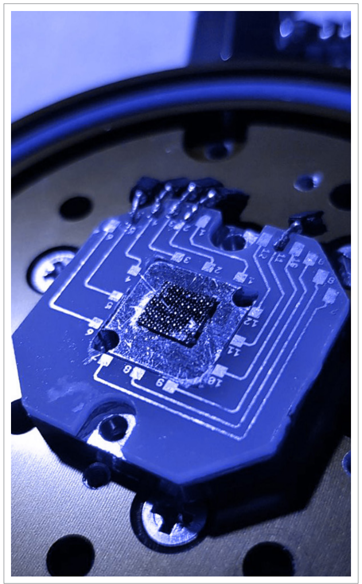
QUANDELA'S ROADMAP

Leading the way towards the fault tolerant era

2016
First photonic qubits

2023
Data-center ready

2028
Towards large scale quantum computers



Photons at the Heart of Quantum Transformation

Founded in 2017, Quandela is a world leader in full-stack photonic quantum computing. We develop hardware, middleware, and software for a range of industrial applications, including energy, cybersecurity, and finance, showcasing the versatility of our unique technology.

At the heart of our innovations lies eDelight, our cutting-edge solid-state single-photon source that effectively eliminates barriers to the scalable manipulation of single-photon qubits.

Featuring a modular, scalable, upgradeable, and energy efficient architecture, Quandela's mission is to deliver the first useful quantum computer to drive quantum transformation to industry and society.

Shaping the Quantum Future With a Pragmatic Approach

Developing Fault-Tolerant Quantum Devices:

We are building error-corrected quantum computer systems enabled by our industry-grade architecture. Quandela's unique technology is modular, interconnected, and compatible with state-of-the-art error-correcting codes. Our proprietary **Spin-Optical Quantum Computing** architecture empowers us to execute error correction protocols with highly efficient use of qubits. We leverage spin-mediated qubit devices, a unique innovation that enables us to generate deterministic entanglement links between qubits as they are created.

Manufacturing Quantum Computers with Value from Today:

We have a proven track record of delivering industry-grade solutions and high-end products to customers. Our long-term partnerships with world-class research laboratories fuels our ongoing technology innovations. Our QPU manufacturability is guaranteed by high-quality foundry-produced photonic integrated circuits and in-house factory assembly.

Industrializing Quantum Technologies:

In our path to quantum utility, we have optimized the assembly and testing of quantum computers, creating a pilot line for our novel spin-mediated qubit devices. Our architecture ensures scalability and manufacturability via industrial processes.

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Constantly Achieving Timed Roadmap With First-Of-A-Kind Milestones

		2017-2018 ✓	2019 ✓
		Launched the world's best quantum light emitter technology	**Commercialization of top-class quantum technologies for research labs**
Given value for our customers	FOR QUANTUM COMPUTER DEVELOPERS	Single photon devices with state-of-the-art performance available on the market.	
	FOR APPLICATION DEVELOPERS		
Innovation	SOFTWARE & ALGORITHMS		
	MANUFACTURABILITY	Achieved reproducible top performance of source devices.	Assembled opto-electronic modules.

PHOTON EMITTER DEVICES

REPRODUCIBLE AND STABLE SOURCE-DEVICES FABRICATION PROCESS

2020 ✓	2021 ✓	2022 ✓
Modular system for integration into quantum computing system prototypes	**Industry-grade, stand-alone quantum emitters**	**Photonic Quantum Computing user-experience**
Launched • DMX-6: state-of-the-art active demultiplexer for single-photons, • Pigtailed single-photon source device.	Launched Prometheus: the first stand-alone single-photon device on the market.	Integration of Achernar: the first cloud accessible single-photon based QPU that runs quantum certified random number generator.
MODULE INTEGRATION		MIDDLEWARE INTEGRATION
		Launched **Perceval**, Quandela's open-source programming framework with emulators' backend.
	Started full-stack approach, offering software interface for device testing and characterization.	Created LOv-calculus: The user-friendly graphical language for linear-optics.
Increased production to 10 opto-electronic modules per year.	Produced #200+ source devices per year.	Produced #350+ source devices per year.

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Scaling Up Towards Error Corrected and Networked Useful Quantum Computers

		2023 ✓ Integration and long-term operability	2024 Boosting gate fidelity via error mitigation
Given value for our customers	QUANTUM PROCESSORS	**Ascella:** QOPS*=144 Physical qubits=6	**Altair:** QOPS*=400Physical qubits=10 **Belenos:** QOPS*=576 CNOT error rate=1x10-3Physical qubits=12
		SINGLE PHOTONS	
	FOR APPLICATION DEVELOPERS	Provided Quantum Machine Learning and Variational Quantum Eigensolver algorithm to end customers.	Released **Cloud 2.0** introducing the "Toolbox": A set of solvers to tackle a variety of use cases.
		DISCOVERY	UTILITY
Innovation	SOFTWARE & ALGORITHM	Introduced full software developer kit and REST APIs for cloud-connected Quantum Processor Units.	Launched Variational Quantum Eigensolver algorithms for graph-based problems.
		FULL-STACK INTEGRATION	UTILITY
	MANUFACTURABILITY & INDUSTRIALIZATION	Launched the Paris (FR) quantum computer factory. Industry-grade semiconductor devices production: over #500 devices per year.	Expanded the Paris (FR) quantum computer factory. **QUANTUM COMPUTER FACTORY** Launched Quandela's semiconductor devices pilot line (pre-industrial fabrication facility).
		QUANTUM COMPUTER FACTORY	SEMICONDUCTOR QUANTUM DEVICE

*QOPS: Quantum Operations Per Second.

**Cluster photons: several entangled photons.

*** Logical qubit: An error-corrected qubit composed of multiple physical qubits, designed to maintain coherence and provide reliable quantum information processing.

2025	2027	> 2028
Quantum computing utility	**Quantum computing scaling via modularity**	**Quantum computing scaling via quantum networking**
Canopus: QOPS*=2k Physical qubits=24	**Diadem:** QOPS*=10k CNOT error rate=1x10-4 Physical qubits=100	
CLUSTER PHOTON DEVICES** Logical qubits***: implementation	**Andromeda:** QOPS*=50k Logical qubits***=10	**Draco:** QOPS*= 10^6 Logical qubits***=50
LOGICAL QUBITS		
Cloud Incorporation: Heuristic algorithms in quantum machine learning.	Cloud incorporation: • Vertical integration of specialized algorithms, • Cluster state computing framework.	Launching Quandela's general purpose quantum computing libraries.
	ADVANTAGE	GENERAL PURPOSE
• Quantum utility via QPU-GPU hybridization and quantum AI, • Logical qubits' resource estimate.	Developing dedicated error correction compilers and decoders.	Integrating distributed quantum computing full-stack midlewere and software.
	ERROR CORRECTIONS	
Assembly capacity: 4 quantum computers a year.	Launching a second quantum computer factory.	Assembling large-scale, error-corrected quantum computers.
Expansion of the pilot-line to reach fabrication of several thousands' device per year.	Scaling of hardware modules production and performance.	
: FABRICATION FACILITY	MULTI-SITE, LARGE-SCALE PRODUCTION	QUANTUM-CENTRIC DATA CENTER

Relevant Scientific Publications

1. Maring, N., et al. (2024). A versatile single-photon-based quantum computing platform. Nature Photonics, 18(6), 603–609. https://doi.org/10.1038/s41566-024-01403-4

2. De Gliniasty, G., et al. (2024). A Spin-Optical Quantum Computing Architecture. Quantum, 8, 1423. https://doi.org/10.22331/q-2024-07-24-1423

3. Fyrillas, A., et al. (2024). Certified randomness in tight space. PRX Quantum, 5(2). https://doi.org/10.1103/prxquantum.5.020348.

4. Coste, N., et al. (2023). High-rate entanglement between a semiconductor spin and indistinguishable photons. Nature Photonics, 17(7), 582–587. https://doi.org/10.1038/s41566-023-01186-0

5. Heurtel, N., et al. (2023). Perceval: a software platform for discrete variable photonic quantum computing. Quantum, 7, 931. https://doi.org/10.22331/q-2023-02-21-931
Heurtel, N., et al. (2023). Strong simulation of linear optical processes. Computer Physics Communications, 291, 108848. https://doi.org/10.1016/j.cpc.2023.108848

6. Maring, N., et al. One Nine Availability of a Photonic Quantum Computer on the Cloud Toward HPC Integration. in 2023 IEEE International Conference on Quantum Computing and Engineering (QCE), pp. 112-116. Bellevue, WA, USA, (2023). doi: 10.1109/QCE57702.2023.10193

7. Thomas, S. E., et al. (2021). Bright polarized Single-Photon source based on a linear dipole. Physical Review Letters, 126(23). https://doi.org/10.1103/physrevlett.126.233601

8. Istrati, D., et al. (2020). Sequential generation of linear cluster states from a single photon emitter. Nature Communications, 11(1). https://doi.org/10.1038/s41467-020-19341-4

9. Anton, C., et al. (2019). Interfacing scalable photonic platforms: solid-state based multi-photon interference in a reconfigurable glass chip. Optica, 6(12), 1471. https://doi.org/10.1364/optica.6.001471

10. Senellart, P., et al. (2017). High-performance semiconductor quantum-dot single-photon sources. Nature Nanotechnology, 12(11), 1026–1039. https://doi.org/10.1038/nnano.2017.218

11. Somaschi, N., et al. (2016). Near-optimal single-photon sources in the solid state. Nature Photonics, 10(5), 340–345. https://doi.org/10.1038/nphoton.2016.23

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Driven by Quantum, Empowered by Quandela

Building on the well-established semiconductor industry, Quandela has pioneered groundbreaking synergies between photonic and quantum technologies.

Our innovative modular and interconnected technology offers the most reliable and powerful path to truly scalable quantum computing solutions. We deployed the first quantum processing units on the cloud in January 2023, and soon after delivered our quantum computers to datacenters in France and in Canada.

Quandela's technical roadmap delivers useful near-term products that fit into our recently patented modular architecture for fault-tolerant universal quantum computing together with industrial processes to scale.

From enhancing data security and optimizing computational capabilities to revolutionizing medical imagine and environmental monitoring, the potential applications of quantum technologies are limitless, and Quandela leads the way.

Join Us to Shape the Future
Of Technology and Usher
In A New Era of Innovation.

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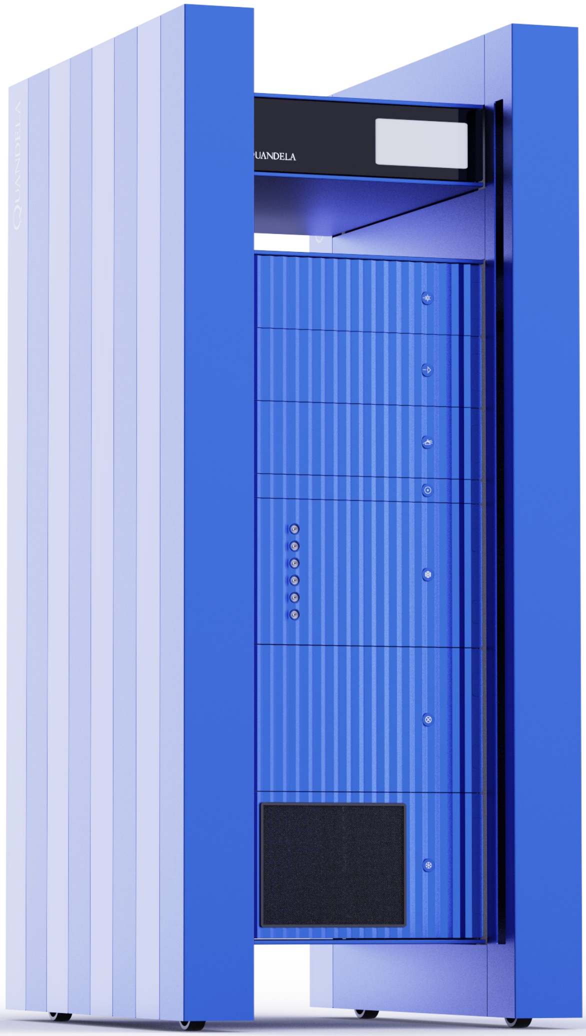

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Quantum Technologies
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