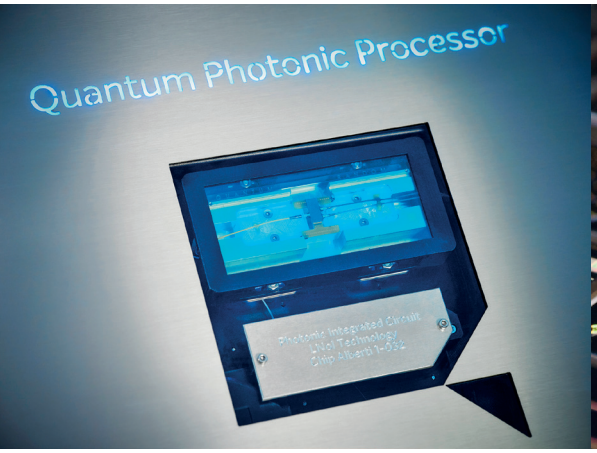
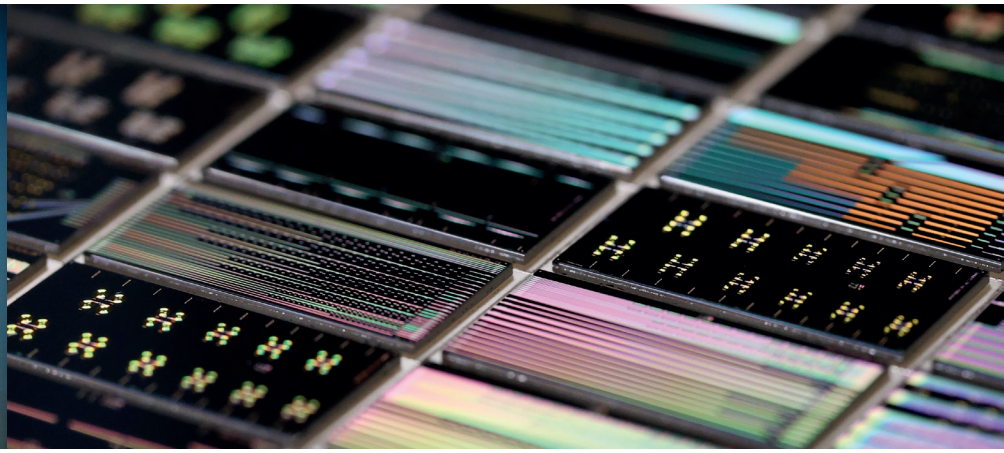
QUANTUM PHOTONIC PROCESSOR





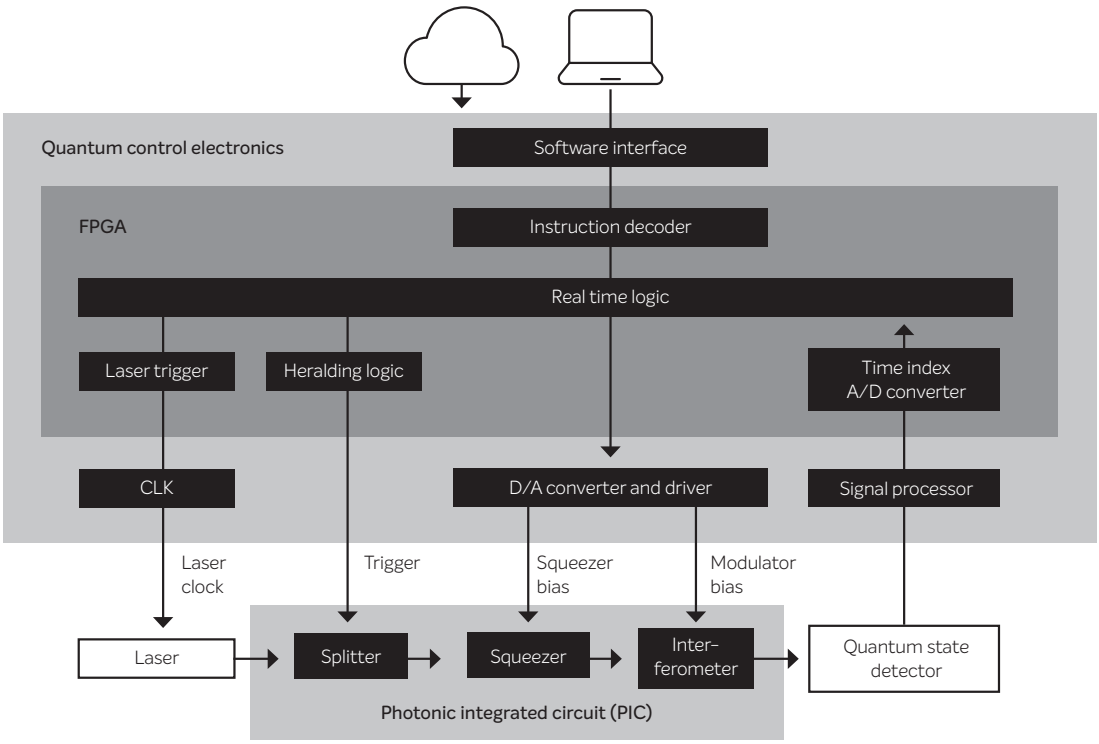
The heart of Q.ANT´s Quantum Photonic Processors are interferometer chips based on lithium niobate on insulator (LNOI). Lithium niobate offers three main advantages compared to other optical materials for photonic integrated circuits (PICs):

1. No thermal crosstalk between optical modulators. Q.ANT uses electrical fields instead of heat to change the refractive index in its waveguides. This allows easier control of the Mach-Zehnder interferometers and smaller structures compared to other optical materials.

2. Faster modulation and switching speeds. The electro-optical modulation allows modulation speeds in the MHz range at sufficiently low losses for photonic quantum computing. For applications which are more tolerant to losses, switching cycles can even reach GHz.

3. Direct and lossless integration of efficient quantum light sources and Mach-Zehnder interferometers onto a single chip. Other material platforms use external quantum light sources that are connected via optical fibers to the Mach-Zehnder interferometers.

Q.ANT offers the full Quantum Computing stack



Gaussian Boson Sampling (GBS)

Photonic quantum computers that implement Gaussian Boson Samplers (GBS) can be used to solve QUBO type problems. Gaussian Boson Sampling (GBS) consists of squeezed vacuum states, a universal linear optical interferometer and photon-number resolvant detectors or threshold detectors.

Quantum algorithm	Quantum application/ Use-case	Status	Complexity	Insight
Gaussian Boson Sampling Quantum sampling according to transition probabilities	Vibronic spectra	Not promising regarding quantum speedup	Experimentally feasible case: Polynomial with number of vibrational modes (=number GBS modes) Experimentally infeasible case: Exponential in number of vibrational modes	The unitary and squeezing gates in GBS performs the transformation from the initial to the final (excited) vibrational states. Just the transformation from ground to excited states, does not use "Perfect matching property".
GBS-enhanced heuristics for finding dense subgraphs GBS-enhanced heuristics for solving maximum clique type problems	Social network analysis Data mining Finance Molecular docking	Analysis show an advantage of using GBS	NP-hard problem	High robustness to noise and hardware imperfections. Quantum-inspired algorithms may have similar performance
Variational Quantum Eigen-solver without sampling Train the GBS ansatz for solving QUBO/PUBO type problems	It includes: Job-Shop-Scheduling Problem Flight-Gate Assignment Problem (Mixed) Graph Coloring Problem	Currently under investigation	Exact solving (chromatic number): NP-hard approximability: n/polylog(n) Inapproximability: n1-a	The training is done classically (no need to sample)
Further algorithms are under investigation				

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