Q.ANT

The Power of Photonic Quantum Computing for HPC

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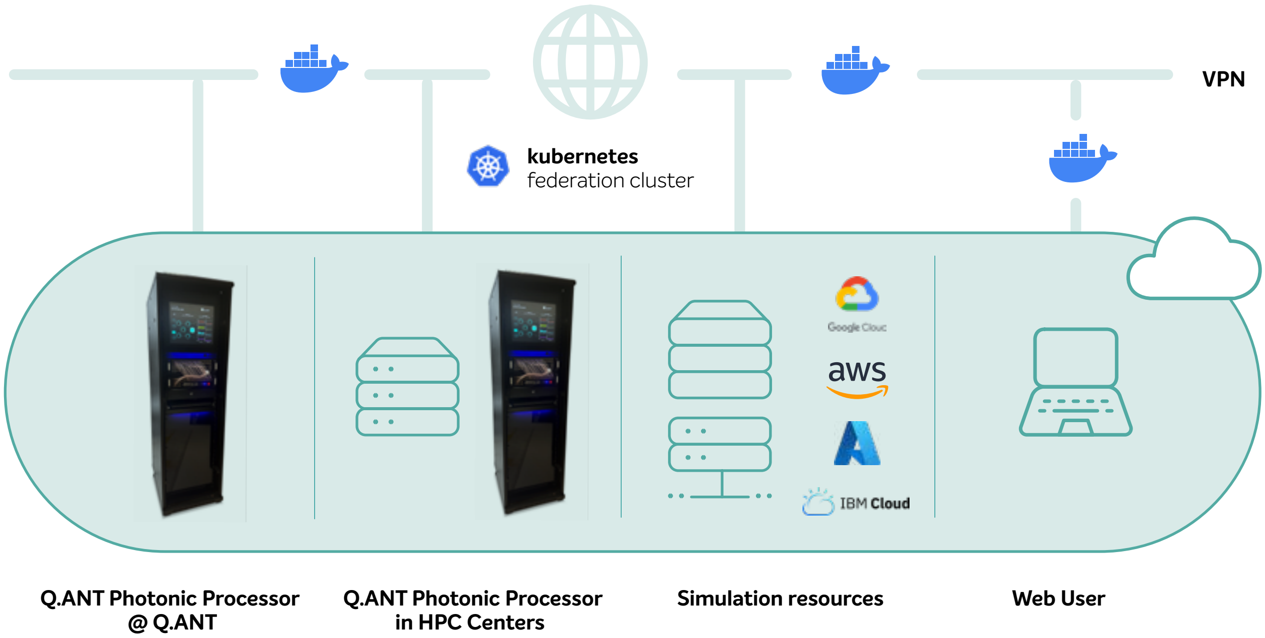
Unlocking the Power of Photonic Quantum Computing for HPC

The landscape of high-performance computing is undergoing a seismic shift. Quantum computing enters as the game-changer that holds the potential to reshape the way we process data to analyze and solve complex problems. Quantum computing transcends the limitations of classical computing systems, opening up new horizons for discovery and innovation in various fields such as science, engineering, artificial intelligence, finance, and healthcare. Photonic chips and processors from Q.ANT easily and securely integrate to HPC architectures and data processing centers for hybrid computing. Embark on our quantum-powered adventure into the future of high-performance computing! Let's dive in and unlock the quantum advantage.

The Q.ANT one-stop-shop from chip to application

- Accelerates data processing
- Reduces energy consumption
- Custom-fit soft- and hardware
- Seamless integration in HPC infrastructure
- Scales easily
- Next level of hybrid computing

Q.ANT‘s photonic processors integrate seamlessly into federation clusters by kubernetes



We empower users to discover optimal abstractions, high-performance algorithms and photonic processor architectures for complex challenges

	Photonic quantum processor	Photonic processor	Photonic processor
Application	Molecular docking	Flight gate assignment problem	Maschine learning and AI
Abstraction	Max-Clique	QUBO	Vector-matrix multiplication
Algorithm	Gaussian Boson Sampling	All-optical coherent Ising machine	MZI matrix Core
Processor Architecture	20 mode GBS processor	20 mode interferometer with feedback	4 mode interferometer

Q.ANT‘s algorithms and photonic processors are accessible through the cloud

JANUARY 2024	JUNE 2024	DECEMBER 2024
• QUBO/PUBO problems, e.g. flight-gate assignment, scheduling problems • Quantum-classical hybrids (variational algorithms) • Gaussian Boson Sampling	**Includes all previous solutions** + Quantum-enhanced classical heuristics for graph problems, e.g. molecular docking via max. weighted clique + QUBOs via Coherent Ising Machine	**Includes all previous solutions** + Photonic matrix-vector multiplication for machine learning and AI + Quantum-enhanced Monte Carlo, e.g. chemical reaction pathways and properties of materials

+

Q.ANT PHOTONIC PROCESSOR
- *photonic hardware performance*

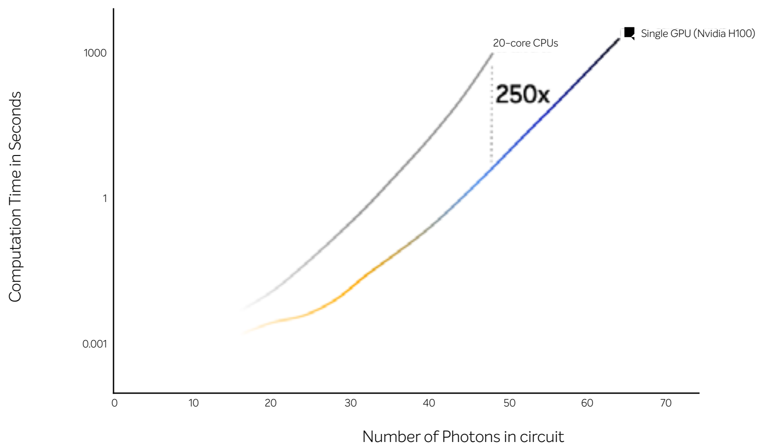
+

GPU/HPC
- *optimized for performance*
- *scaling to larger problem sizes*

LAPTOP/CPU
- *gain experience with Q.ANT solutions*
- *easy to access and implement*

The Q.ANT Blackcat Simulator accelerates Hafnian computation by factor 250

Hafnian calculation performance of Blackcat vs. 20 core CPU



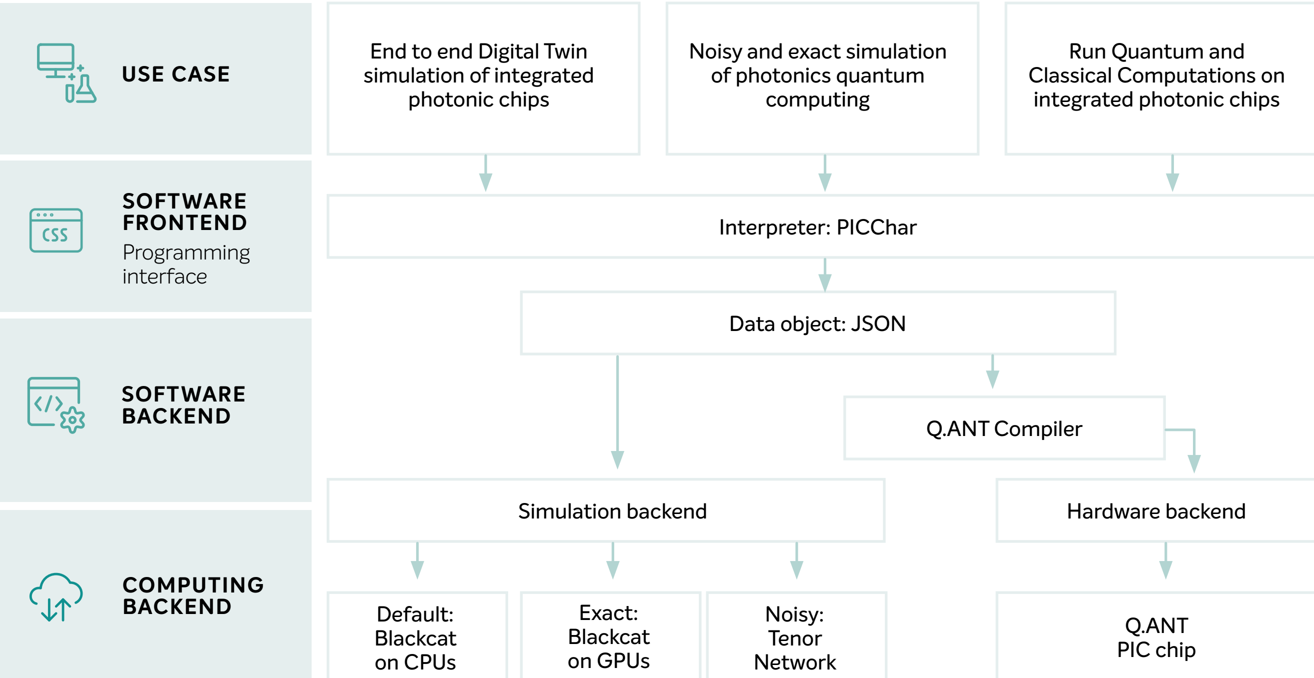
Blackcat is the Q.ANT library to calculate Hafnians on a GPU

It benefits from the massive degree of parallelization of simple calculation units in GPUs

It is a backend to Strawberry Fields from Xanadu

PICChar is Q.ANT's software framework for developing photonic processors and applications

It provides a collection of tools, libraries, and APIs that enable developers to experiment with photonic processors from Q.ANT, develop algorithms, and build applications.



Integrated squeezed photon sources will revolutionize photonic quantum processing performance by more than one order of magnitude

		Q.ANT squeezed-photons architecture	**Single-photon architecture I**	**Single-photon architecture II**	**Squeezed-photons architecture**
	Reference	Target 2024	A general-purpose single-photon-based quantum computing platform (2023)	20 Mode Universal Quantum Photonic Processor (2023)	Quantum circuits with many photons on a programmable nanophotonic chip (2021)
QUANTUM SOURCE	**Type**	On-chip squeezing (SPDC in microresonators) Q > 1,000,000, SPDC 1550 nm, Squeezing: 10 dB	External single-photon source InGaAs quantum dot, 5K, 928 nm	External photon-pair source (PDC) TiSapph + PPKTP (type II), 1562 nm, Schmidt number 1.1	On-chip squeezing (FWM in microresonators) Q = 700,000, FWM 1550nm, Squeezing: 8 dB
	Generation rate	1 MHz	80 MHz		100 kHz
	Detection rate	2-photon : 550 kHz 4-photon: 200 kHz 6-photon : 81 kHz 10-photon : 15 kHz 12-photon : 6 kHz	2-photon : 80 kHz 4-photon: 0,7 kHz 6-photon : 0,004 kHz 12-photon : 200 nHz (calc.)		4-photon: 10 kHz 10-photon: 0,3 kHz
PHOTONIC INTEGRATED CIRCUIT	**Material**	LNOI	Si_3N_4	Si_3N_4	Si_3N_4
	Number of modes	4	12 (max 6 occupied)	20 (max 2 occupied)	2x4 (max 8 occupied)
	Beamsplitter	electro-optic	thermo-optic	thermo-optic	thermo-optic
EFFICIENCY	**Total efficiency**	40 %	8 %	48 %	15%
	SM fiber-chip couppling	85 %	70 %	81 %	
	Chip transmission	50 %	45 %	77 % (0.07 dB/cm)	50 % (0.2 dB/cm)
	Cooling power	< 1 W		200 W available	1 W required for unitary transformation

Quantum Photonic Processor

Technical Data Sheet System Specifications

System specifications	2023	2024
Clock frequency	500 kHz	1 MHz
PIC operation temperature	22°C stabilized @ <0,1°C	22°C stabilized @ <0,1°C
System operating temperature	Room temperature +10°C ≤ T ≤ +40°C	Room temperature +10°C ≤ T ≤ +40°C
System dimensions	Control 1x3U 19“ Rack Mount	Control 2x5U 19“ Rack Mount
System power consumption	40 W @ 240V	< 1kW @ 240V

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