



Quarterly Highlights – Q4 2024

February 2025



Kipu Quantum provides application- and hardware-specific algorithms for early industrial usefulness within the next 12 to 18 months

Kipu Quantum – We stand at the forefront of quantum computing algorithms

We are specializing in application- and hardware-specific quantum computing solutions that drastically reduce the requirements for solving industry use cases.

These solutions enable even the currently small and noisy quantum processors to yield significantly improved results, while approaching industrial usefulness.

Commercial Quantum Advantage Era – With Kipu!

Tackling major industry challenges with quantum computers requires algorithms that use over 70 qubits. Despite having processors with over 100 noisy qubits, this remains out of reach. Current qubit specifications and gates are inadequate for greedy quantum algorithms.

However, we anticipate overcoming this limitation in the next 12-18 months with advancements in quantum computing paradigms and hardware. This is particularly promising for optimization problems.

Kipu's Tech Edge – Our algorithmic compression achieves a massive reduction in the required circuit depth

We outperform competing state-of-the-art quantum algorithms through our digital, analog and digital-analog compression techniques, dramatically reducing the necessary circuit depth by orders of magnitude.

Our technology seamlessly integrates with leading hardware concepts such as superconducting circuits, ion traps, and neutral atoms.

Presenting our Quarterly Highlights!

Kipu Quantum constantly moves the needle on our path to making quantum computers useful. In the third quarter of 2024, we realized several breakthroughs, which we briefly discuss in this document.

Please reach out if you would like to learn more!



In Q4, KIPU achieved several innovative milestones on our journey towards early industrial usefulness at the quantum-advantage level



Towards quantum advantage for feature extraction: 1,000x fewer training parameters using Kipu's new algorithm on D-Wave hardware



We proved that our digital-analog encoding enables a radical reduction of algorithm runtime at improved quality for HUBO optimization problems



Improved chem-informatics based on molecular screening – on the PLANQK platform

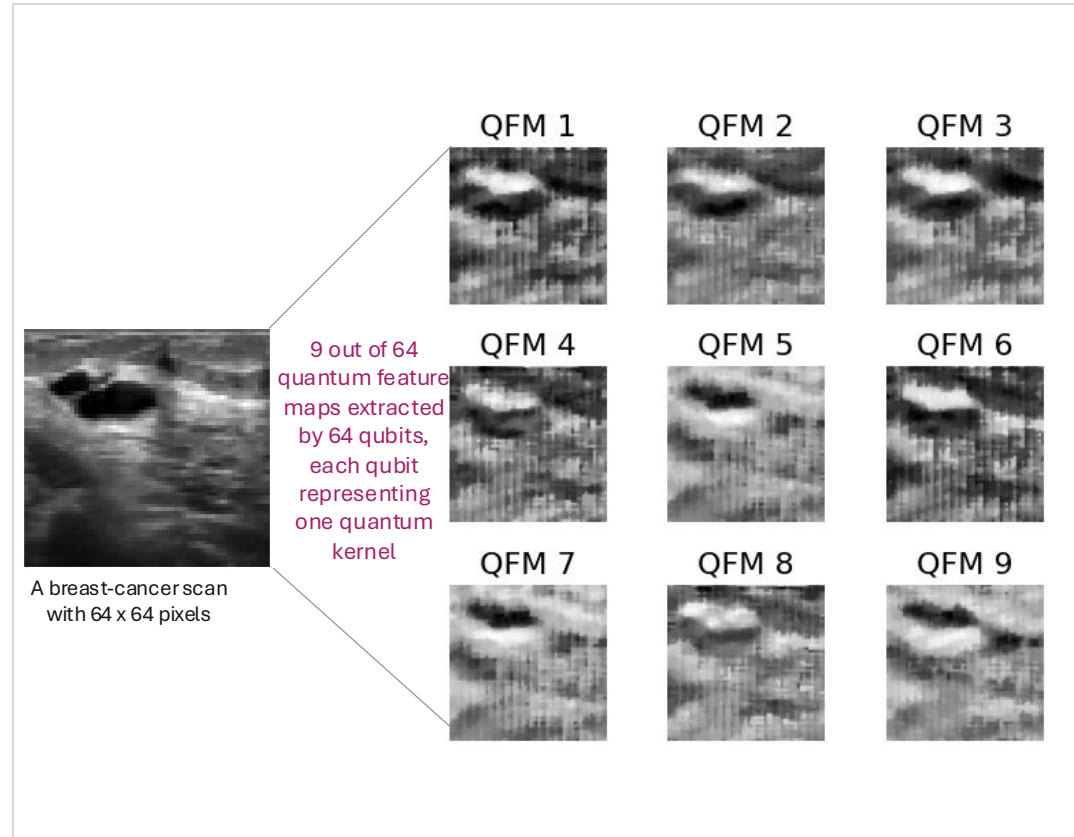


Ultra-fast quantum simulation on 156 IBM qubits on IBM pave the way for advancements in materials science



Underlying tech – see our [whitepaper LINK](#)

Towards quantum advantage for feature extraction: 1,000x fewer training parameters using Kipu's new algorithm on D-Wave hardware



- Image classification is a relevant task in healthcare diagnostics, quality control in manufacturing. Yet, complex datasets challenge traditional methods like CNNs¹, make them **costly and ineffective**
- Kipu's analog algorithm² uses up to **1,000x fewer training parameters** vs. models like ResNet-18, enabling faster training
- We've demonstrated feature extraction **using D-Wave quantum processors**³, aiming for quantum-advantage in image classification

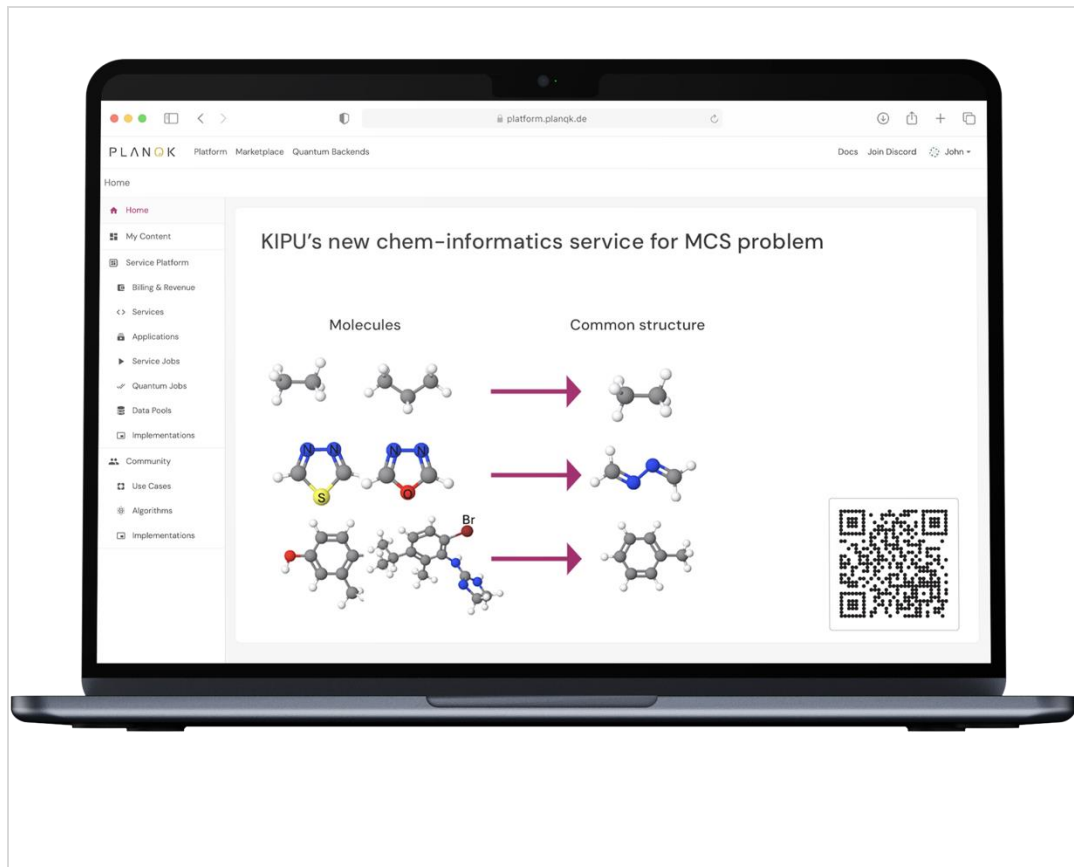
Quantum-boosted CNNs uncover features and relationships that classical methods can't reach – this leads to drastic performance improvements in quality at reduced resources!

1) CNNs: convolutional neural networks

2) AQCNN, analog Quantum Convolutional Neural Network (AQCNN).

3) Details: annealing time is 20 ns within coherence time; # of shots: 6,000, D-Wave Advantage 2 with 1,200 qubits

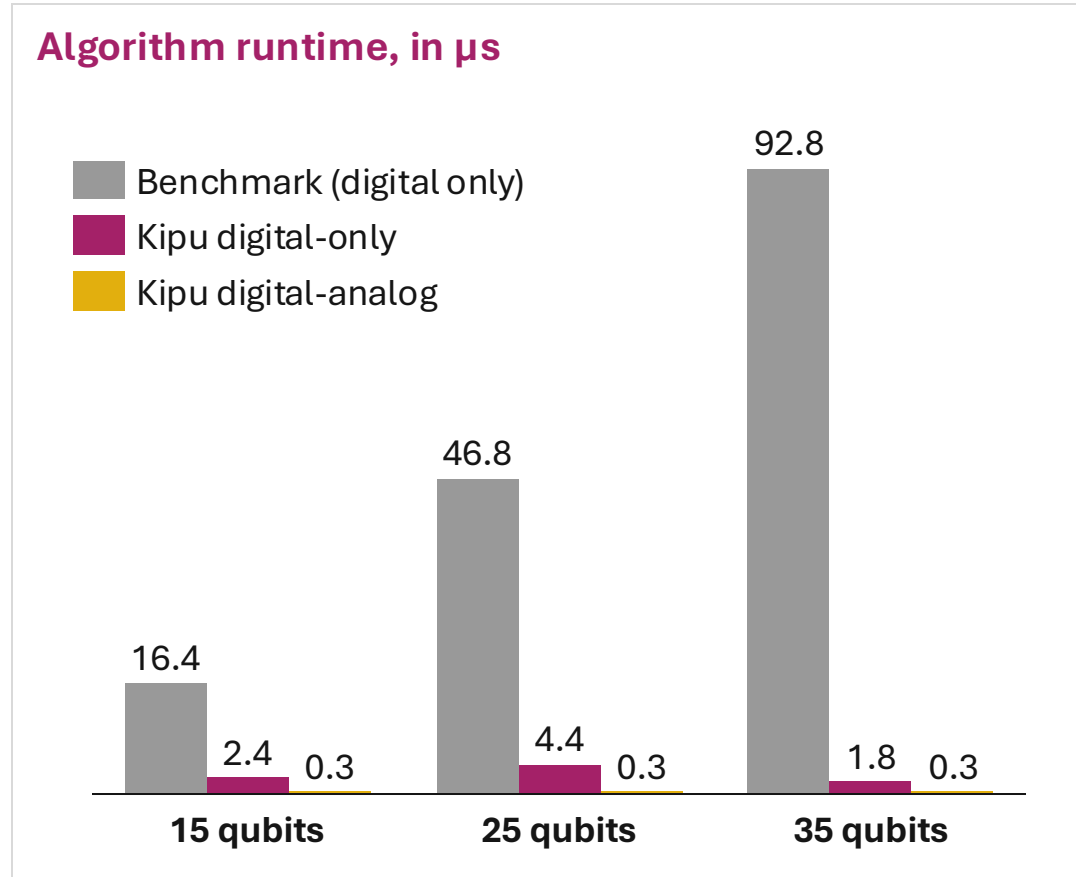
Improved chem-informatics based on molecular screening – now on the PLANQK platform



- **Molecular screening is highly relevant in pharma R&D.** Classical algorithms struggle with solving the underlying maximum common substructure problems **for more than two molecules**, making these computations impossible for large and complex molecules
- Kipu's quantum computing approach is making significant advancements in this area and is paving the way for further developments.

The early-version of the service is now available on PLANQK for selected customers.

We proved that our digital-analog encoding enables a radical reduction of algorithm runtime at improved quality for HUBO optimization problems



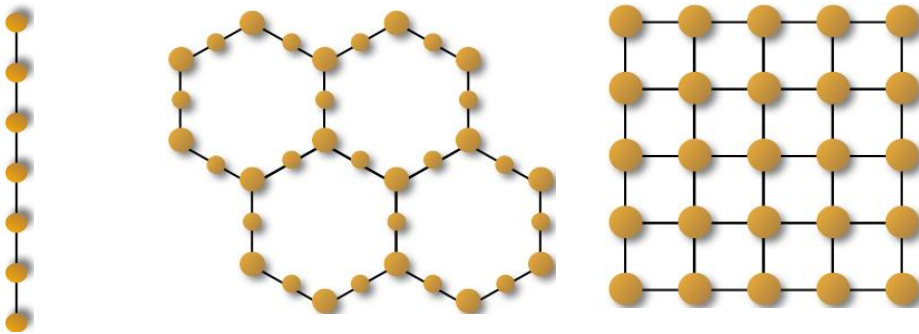
- HUBO¹ problems are vital for complex industrial challenges, such as LABS². However, classical computers struggle with **over 66 variables**.⁴
- Kipu's digital-analog encoding and constant depth quantum algorithms ensure runtime doesn't grow with system size for HUBO and QUBO³ problems.
- On top of slashing down the algorithmic runtime, our digital and analog techniques improved solution quality by 2.5 times.

This tech can solve HUBO problems at the quantum-advantage level – providing a speed advantage.

1) HUBO: Higher-Ordinary Unconstrained Binary Optimization; 2) LABS: Low Autocorrelation Binary Sequence problem, its mathematical formulation has 4-order interactions between variables; 3) QUBO: Quadratic Unconstrained Binary Optimization 4) <https://arxiv.org/pdf/2106.03377>: Classical computers using exhaustive search techniques can solve LABS problem for sequence sizes up to 66 in practical time frames

Beyond optimization: Ultra-fast quantum simulation on 156 qubits on IBM paves the way for advancements in materials science

Reduced defect density by up to 48% of the benchmark value



We studied different geometries of the dynamic systems: 1D chain, heavy-hexagonal lattice, and 2D square lattice – defects were reduced by 48%.

- Quantum simulations provide insights into complex phenomena that **classical computers struggle to study**
- Kipu’s algorithm **runs large-scale simulations** on IBM's Heron chip, achieving up to 156 qubits
- Our algorithm reduces defect density by **up to 48%¹**, leading to more reliable simulations
- This technology enables accurate quantum state preparation, advancing materials science and quantum chemistry

For the first time, Kipu pushes large-scale quantum simulation beyond 156 qubits which would otherwise take weeks.

1) <https://arxiv.org/abs/2502.15100>

Contact our customer team and start a quantum journey with us

Ways to engage with us:



Enter the discussion regarding your use cases, value, and strategy



Test our quantum solutions on PLAQNK platform



Transform ideas into actionable pilots and bring real-world results to your business



Embark on a 12 – 18 months journey to demonstrate first usefulness



Matthias Kaiser
Account Executive



David Niehaus
Head of Commercialization





Many thanks!