



# Quantum Advantage, ChatQPT, and Agentic Quantum Computing

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# A functioning, high-performing quantum computer will drastically change our society

QC WILL PUSH BACK  
THE BOUNDARIES  
OF TECHNOLOGY ...

... AND CHANGE THE  
WAY WE LIVE  
AND DO BUSINESS



Simulation of physics  
and chemistry whose  
equations explode in  
complexity



Combinatorial  
optimization that  
cannot be with classical  
brute-force testing



AI and ML use  
cases that suffer  
when data is sparse



Exploding energy  
consumption of our  
digital tools

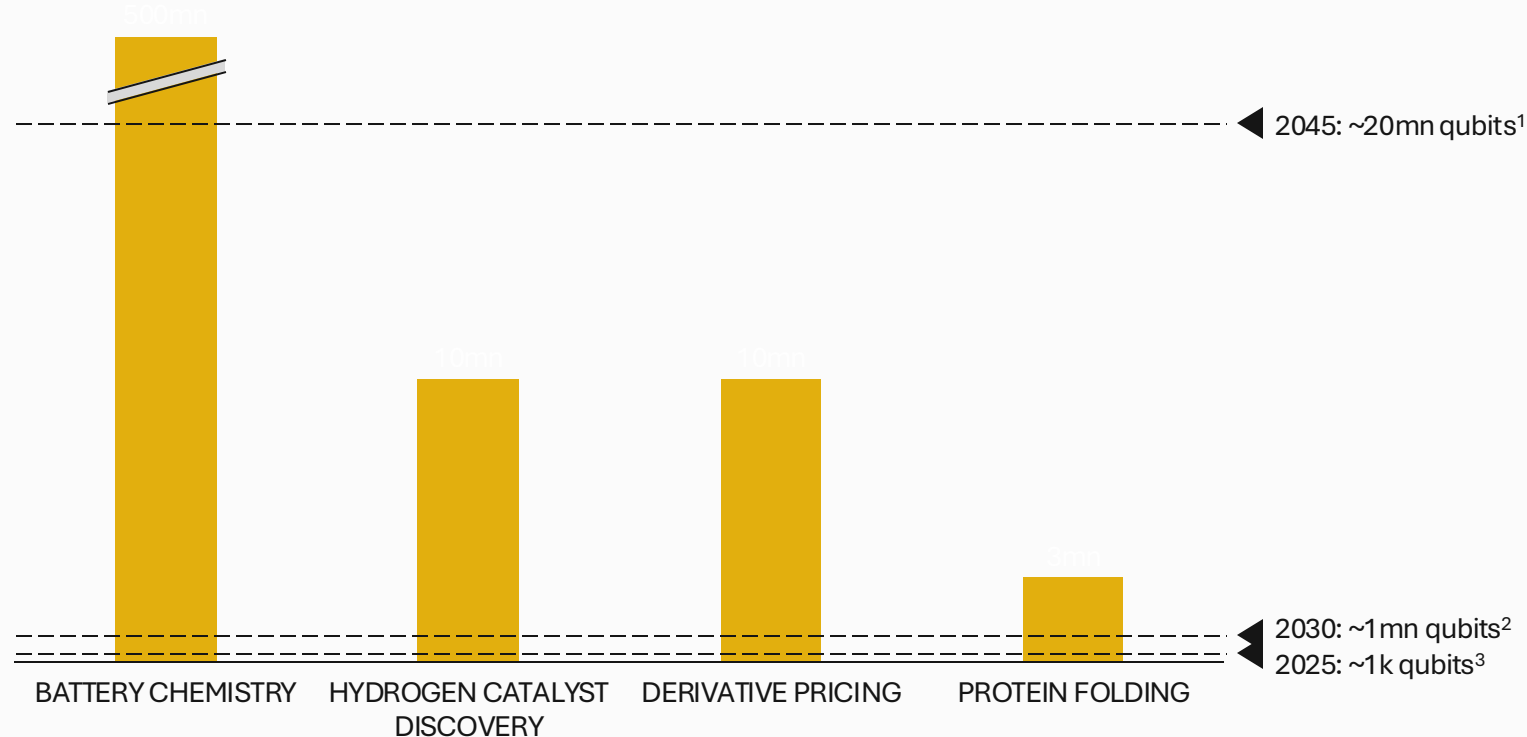
- **Break the foundation of today's encryption:** Since using encryption keys based on factorization do not withstand the fundamental laws of physics
- Help to cure cancer by increasing the **understanding of fundamental biochemical processes** and **reinventing** the way in which **pharmaceuticals company do research**
- Create long-range electric vehicles using **newly designed materials**
- Help with our energy issues by **developing clean energy sources, better process catalysts**, and by **reinventing** the way in which **natural resources are explored**



# Without KIPU, quantum will stay useless due to a massive mismatch between available quantum processors & the needs of competing algorithms

## REQUIRED VS. AVAILABLE NUMBER OF PHYSICAL QUBITS FOR INDUSTRY USE CASES

assuming standard algorithms like Shor, Grover, quantum phase estimation



## REALITY CHECK

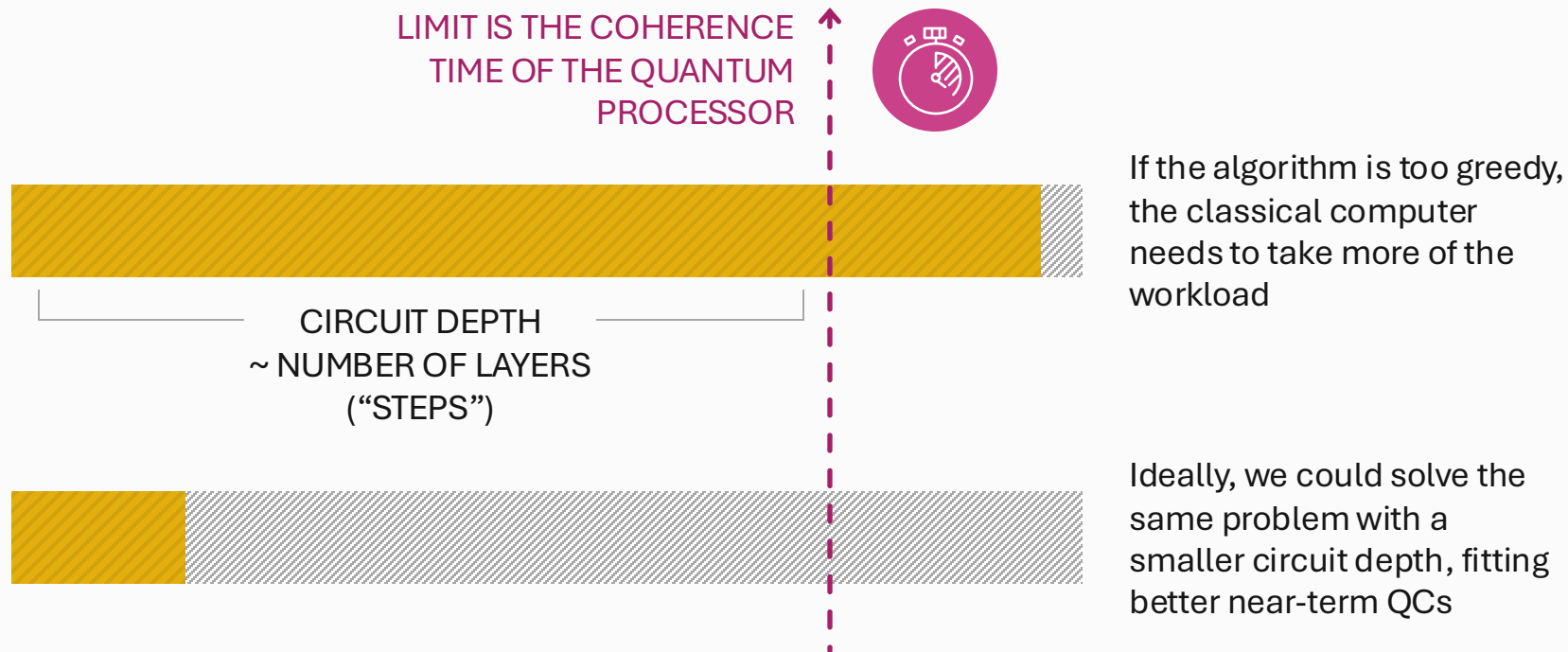
- ⚠ Quantum is unable to solve any industry problems based on current or even near-term hardware
- ⚠ The reason is a mismatch between what today's processors can deliver, and the huge overhead required by standard algorithms
- ⚠ Standard algorithms such as Shor's and Grover's were created decades ago, for QC specs that may only exist in the far future
- ⚠ Alternative algorithms like VQE<sup>4</sup> and QAOA<sup>5</sup> have been proven to be commercially useless and not scalable

1 Assuming yearly doubling of qubit count | 2 Source: Google roadmap | 3 Source: IBM roadmap, 7x156 qubits

3 4 Variational Quantum Eigensolver | 5 Quantum approximate optimization algorithm



# How we do it: Kipu creates algorithms that require lower circuit depth by orders of magnitude

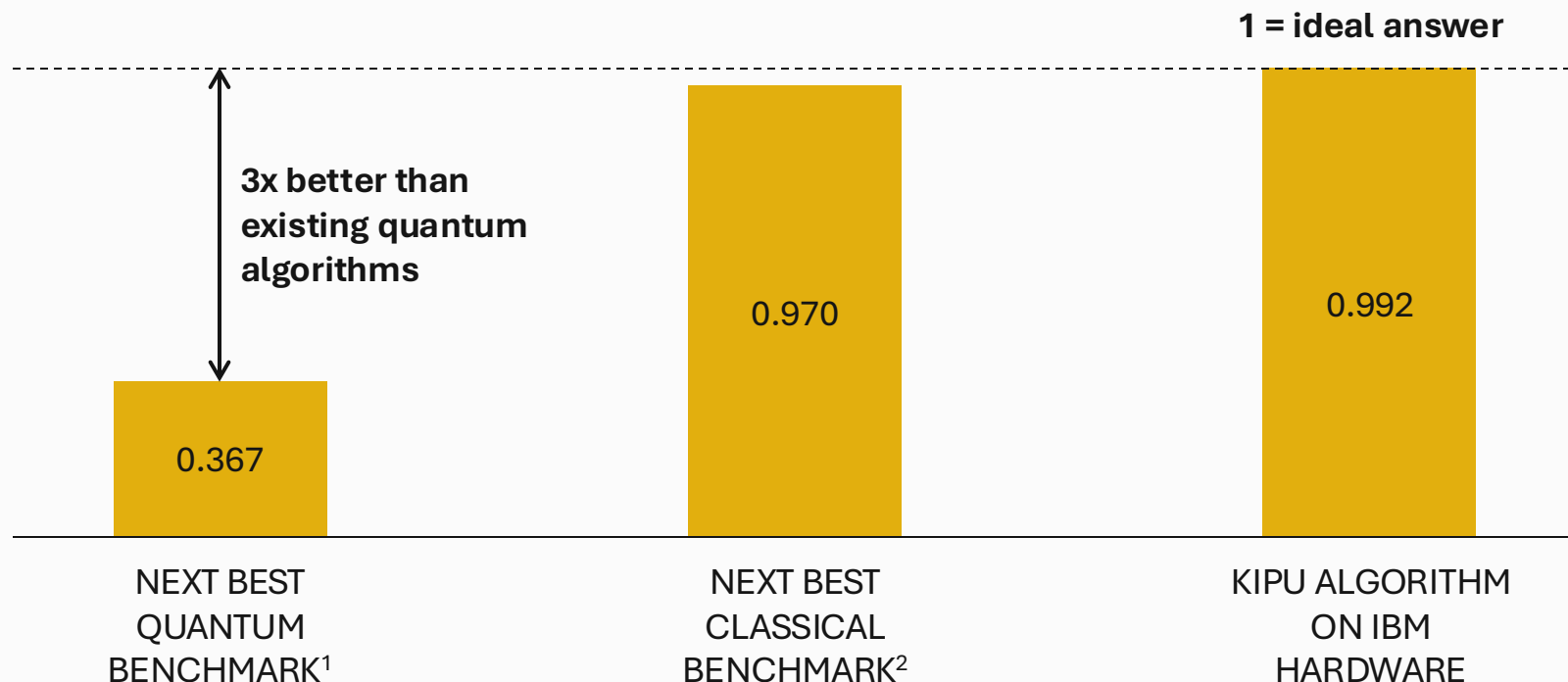


OUR ALGORITHMS  
REQUIRE 10-100X  
LESS CIRCUIT DEPTH  
COMPARED TO  
COMPETING  
ALGORITHMS



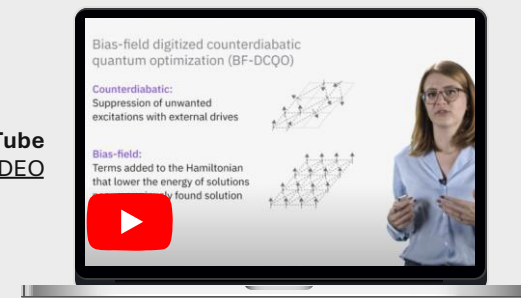
# Our technology beats competing quantum algorithms and outperforms leading classical solvers at quantum-advantage level for real use cases

BEATING CLASSICAL APPROACHES FOR REAL-WORLD OPTIMIZATION USE CASES WITH IBM QPU



- ✓ We beat CPUs in the quality of the answers – relevant in cases where precision matters, like protein folding
- ✓ Validated by scientific papers, paying customers, and hardware partners
- ⌚ Soon, we will also beat classical CPUs in multiple dimensions, like time to solution

IBMs YouTube  
[WATCH VIDEO](#)



<sup>1</sup> Standard QAOQ on 156Q IBM Heron | <sup>2</sup> Simulated annealing, we also beat Tabu search (0,971) | <sup>3</sup> HUBO: Higher order unconstrained binary optimization problem – applicable for protein folding, financial and mixed-integer optimization in logistics, telco and manufacturing. See our paper:

<https://arxiv.org/pdf/2409.04477>



# Our performance has been validated on existing quantum hardware, confirmed by paying customers

MORE SPECIFIC ALGORITHMS = LOWER HARDWARE REQUIREMENTS = EARLIER USEFULNESS = HUGE ADDRESSABLE MARKET

## Benefits on noisy hardware<sup>1</sup>:

**x500**

Shorter time-to-solution

**x600**

Increased success probability

**x100**

Better results

## Use cases:



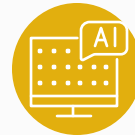
Combinatorial  
optimization for  
logistics



Network resilience  
modeling for  
telecommunications



Boosted neural  
networks for images  
and tabular data



Feature selection for  
financial forecasts



Finance portfolio  
modeling



Chemistry modeling  
and simulation

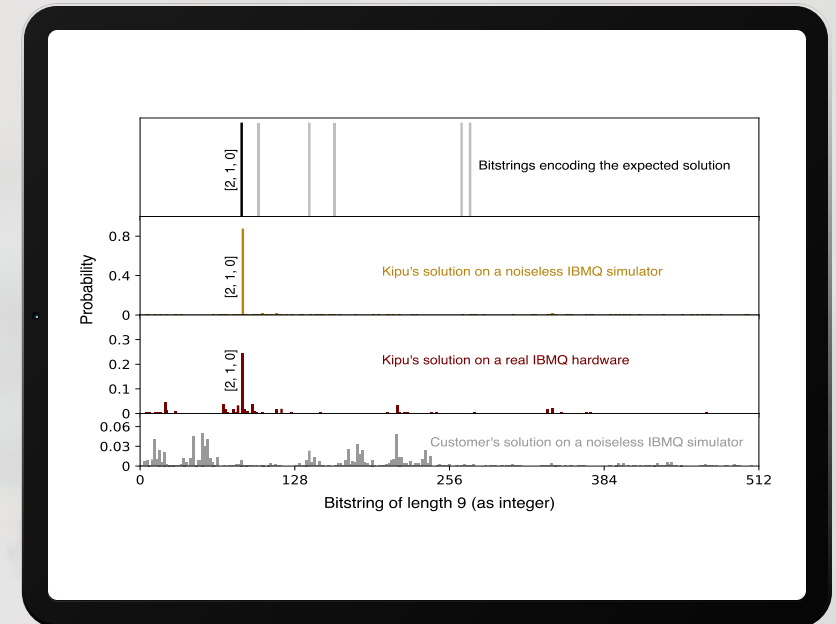


In a project with BASF's quantum team, we beat standard quantum algos for small-sized optimization problems in robotics and logistics by 600x



**600x better than other quantum algorithms<sup>1</sup>**

Toy-sized problem, but much better than other quantum algorithms



1) Metric was success probability in noiseless simulation, i.e., apple-for-apples likelihood to find the correct answer in a single shot on quantum hardware



Spanish telco player MasMovil worked with us to optimize network resilience, already solving 10% of the full problem with just 140 qubits

Telco optimization on QuEra's hardware:

- 256 qubits in 2023
- 3,000 qubits in 2025
- 10,000 qubits in 2026



**Clear trajectory to run real world problems very soon**

GRUPO  
**MASMOVIL**



# Kipu set a record – we solved the largest optimization problem using all 156 qubits on IBM, and a HUBO mapping

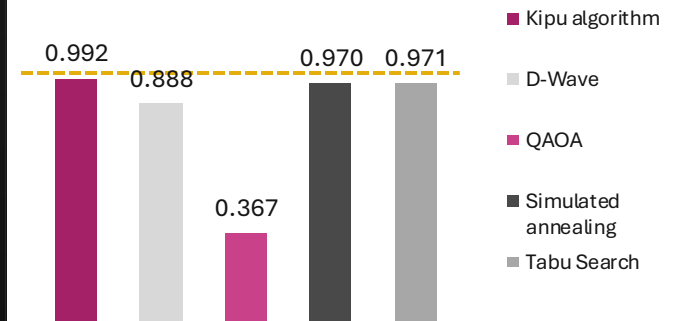


## Proof that we can run relevant problems beyond 100 qubits

HUBO<sup>1</sup> is more difficult but more practically relevant than QUBO mapping

Great for protein folding, scheduling, financial modeling, mixed integer optimization

Achieved closeness to solution (1 = optimum)



1) HUBO: Higher order unconstrained binary optimization problem; QUBO: quadratic unconstrained binary optimization problem

SOURCE: <https://arxiv.org/pdf/2409.04477>



# Combining quantum and AI creates powerful solutions to detect breast cancer in scans – using 1000x fewer parameter to train the model



**Usefulness  
within reach**

Quantum AND convolutional neural network work in tandem<sup>1</sup>

Got better predictions with much less training data vs. standard ML

1) Demonstrated in quantum-inspired mode on classical hardware, using 4-6 simulated qubits for small images; real hardware expected to yield an advantage at ~100 qubits

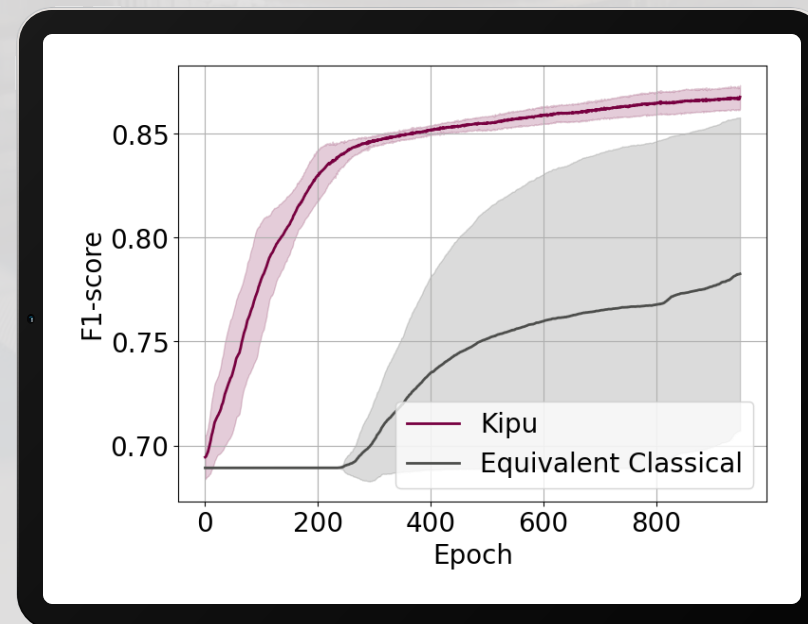


# Improving loan default prediction with 1,000 fewer data input for tabular data sets – faster and more efficient risk decision-making



**Achieving accuracy with reduced data input**

Kipu's algorithm improves loan default prediction accuracy by 8%<sup>1</sup> using around 1,000 fewer training data



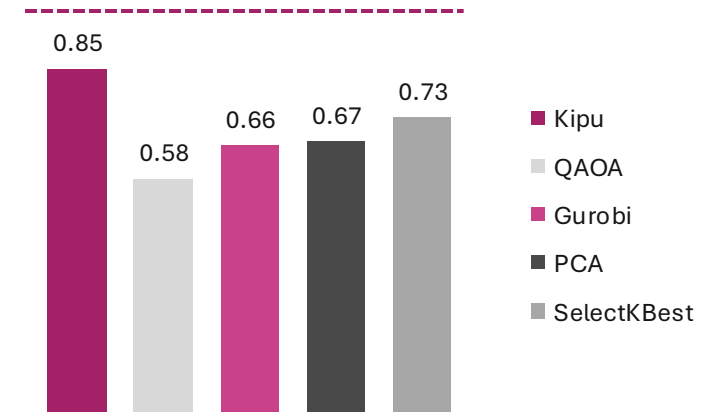
We enhance AI by outperforming traditional feature selection algorithms by 47%  
- this is a potential game-changer in forecasting



**Reduced computational overhead for large data set**

By selecting only 63% of the features, Kipu's solution surpasses benchmarked quantum and classical methods by up to 47%.

**Churned customer prediction performance of F1-score<sup>1</sup> (1 = optimum when using all features)**

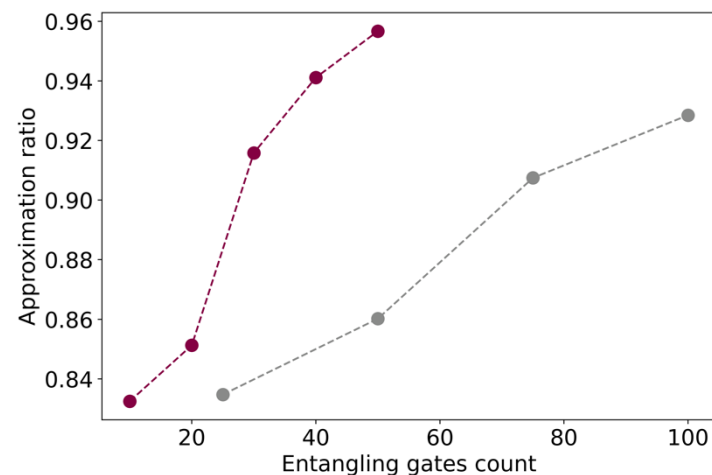


# Boosting the return in portfolio by 10% vs. J.P. Morgan's benchmark – billions in value at scale



**Quality improvement while  
slicing the required time in half**

A 40x less greedy algorithm was developed

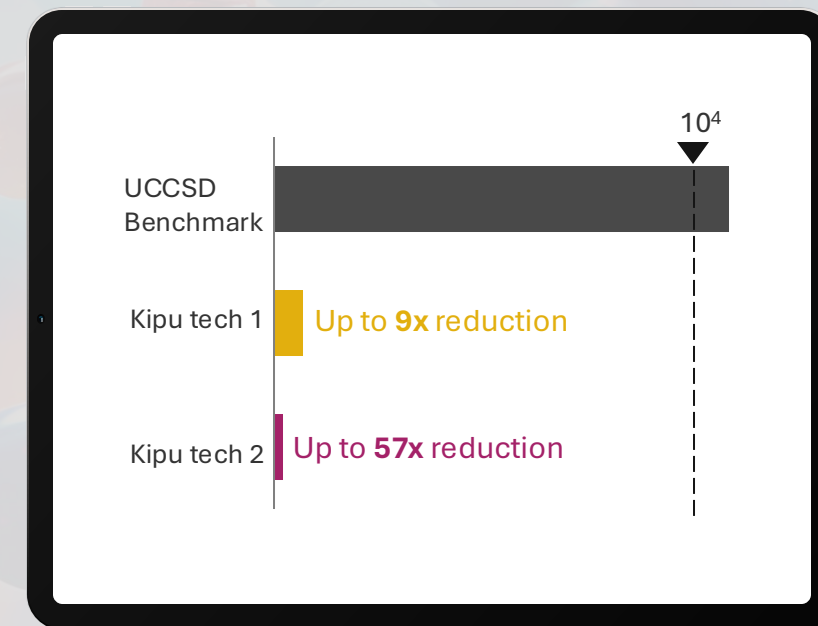


# Accurately simulating chemical systems is the key to curing diseases & making our economy sustainable



**Making chemistry modeling  
feasible on real hardware**

High-accuracy simulation of catalysts,  
batteries and drug interaction – 50x  
faster

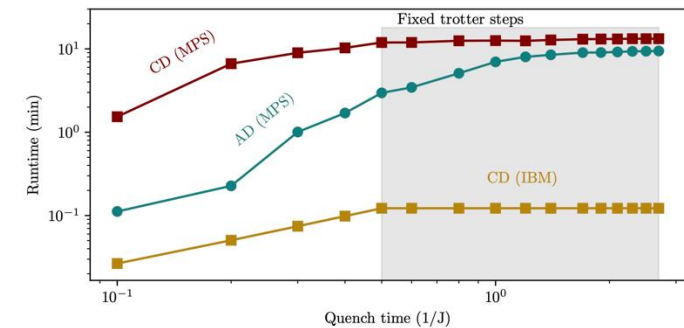


# Beating „quantum inspired” classical benchmark 5x in time to solution in quantum simulation



On the edge of solving quantum dynamics problems that are out of reach for classical computers

Huge industrial impact for material design in battery systems, spintronics and superconductors.





# KIPU will start the quantum revolution, unlocking trillions of dollars of economic value

FULL VALUE POTENTIAL<sup>1</sup>

**USD**  
**1 trillion**



## EXEMPLARY AREAS OF DISRUPTION

### CHEMISTRY SOLUTIONS TO COMBAT CLIMATE CHANGE

Solve sustainability challenges with new chemistries, like improved batteries for electric vehicles and catalysts for hydrogen generation.



### ENERGY EFFICIENT COMPUTING

Move workflows from conventional computers to quantum, to slash the overall energy demand of AI applications.



### DECISION MAKING IN FINANCE

Transform financial decision-making by enhancing dynamic portfolio optimization, market simulations, and risk management.



### HUMAN HEALTH

Revolutionize drug discovery and patient care through better diagnostics based on accelerated drug development, and enabling precision medicine.



### RESOURCE OPTIMIZATION

Efficient use of physical and human resources, in logistic networks, manufacturing workflows, telecommunication nodes, and aerospace routes.



### DATA-EFFICIENT ARTIFICIAL INTELLIGENCE

Scalable & data-efficient AI systems with increased training efficiency and enriched datasets with quantum models.

## KIPU'S PROVEN BENEFITS

**5,000X LESS ENERGY<sup>2</sup>**  
when moving classical HPC workload to quantum

**AI IN ABSENCE OF DATA<sup>3</sup>**  
by training AI models with quantum-simulated data

**1,000X LESS DATA<sup>4</sup>**  
to train neural networks, while improving performance

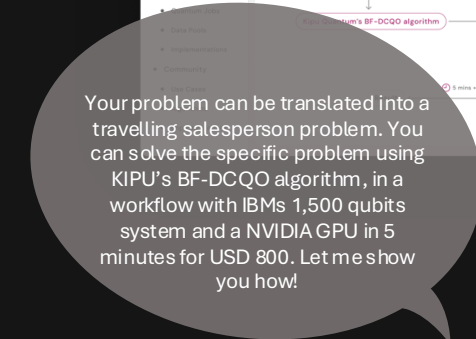
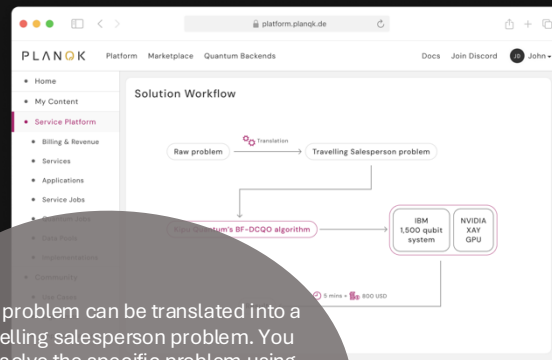


# The next stage of value creation after quantum advantage will involve co-designed, error-corrected solutions, boosted by AI: **AGENTIC QC**

## WHAT CUSTOMERS WILL SEE

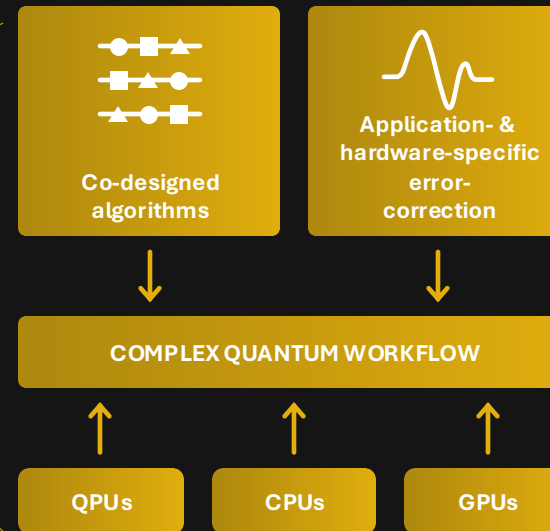


CUSTOMER



ACCESS THROUGH AGENT

## BELOW THE HOOD



TAILORED KIPU WORKFLOW IS CREATED USING REASONING

## OUR VIEW ON THE NEXT 5 YEARS IN QUANTUM

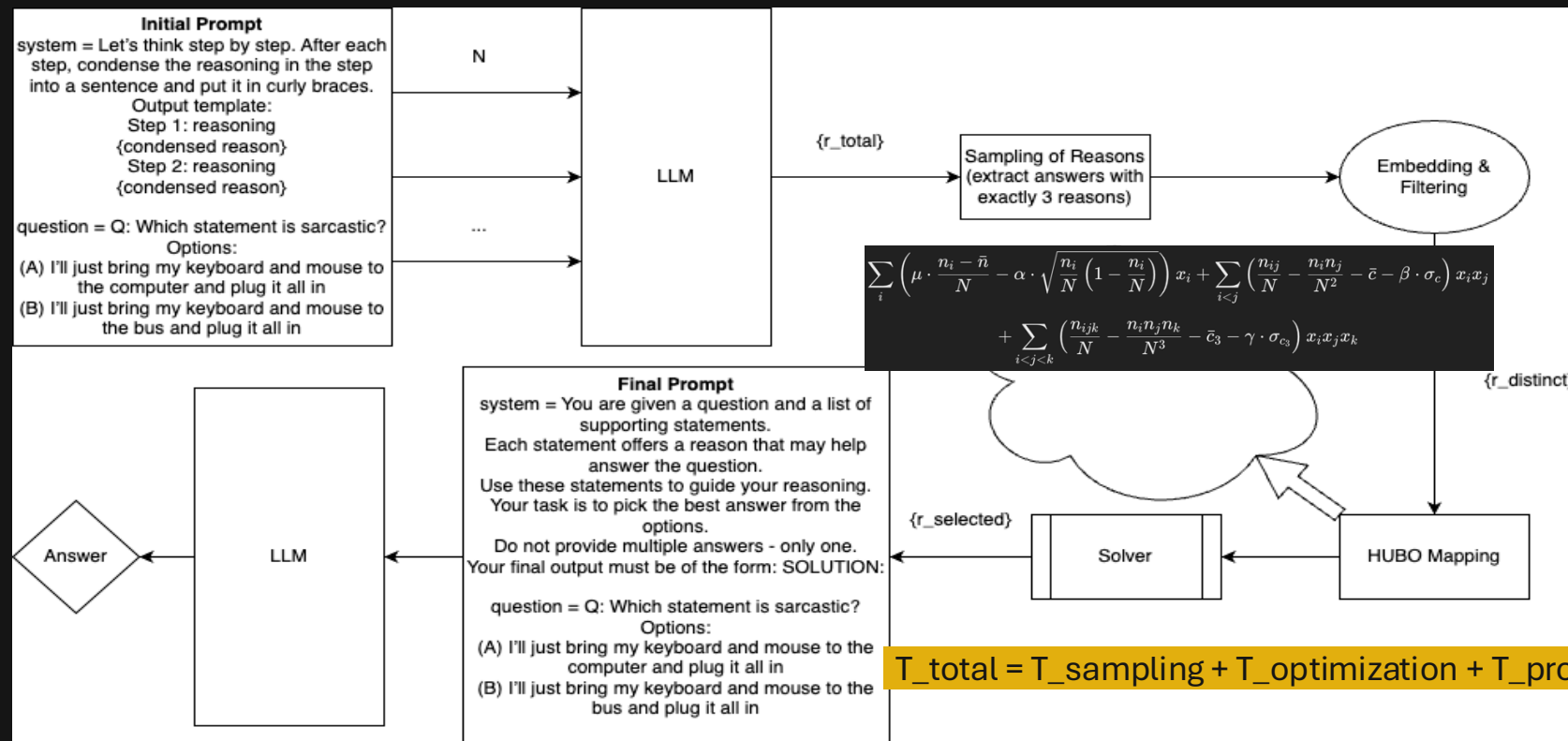
- ✓ We expect a coexistence of different hardware modalities, as well as physical and logical qubits
- ✓ Unless millions of qubits come online, co-designed solutions will be a necessity – this includes application- & hardware-specific error correction
- ✓ The next big question: How to get valuable answers from quantum-boosted workflows, combining CPUs, GPUs and different QPUs depending on the application?



# Chat QPT

## ENHANCING AI USING QUANTUM: FROM CLASSICAL TO QUANTUM SUPERINTELLIGENCE?

Combinatorial Reasoning HUBO (CRH): A Fully-Automated Prompting Method Designed for tasks that require reasoning through multiple layers of consequences, and powered by quantum optimization at the quantum-advantage level?





# PLANQK platform provides easy access to Kipu's quantum solutions in a SaaS model



## EUROPE'S LARGEST QUANTUM PLATFORM:

600 users from 120 European organizations



## KIPU ALGORITHMS ACCESSIBLE AS SCALABLE SERVICES, INTEGRATED IN WORKFLOWS & APPLICATIONS:

PoC and consulting delivering tailored quantum solutions directly through the platform



## ACCESS TO DIVERSE BACKENDS TO OFFER A ONE-STOP-SHOP FOR INDUSTRY:

Ensuring that the best available backends are used for each specific task, optimizing performance and results

