Quantum Machine Learning in the finance industry

International Biometric Congress 2018

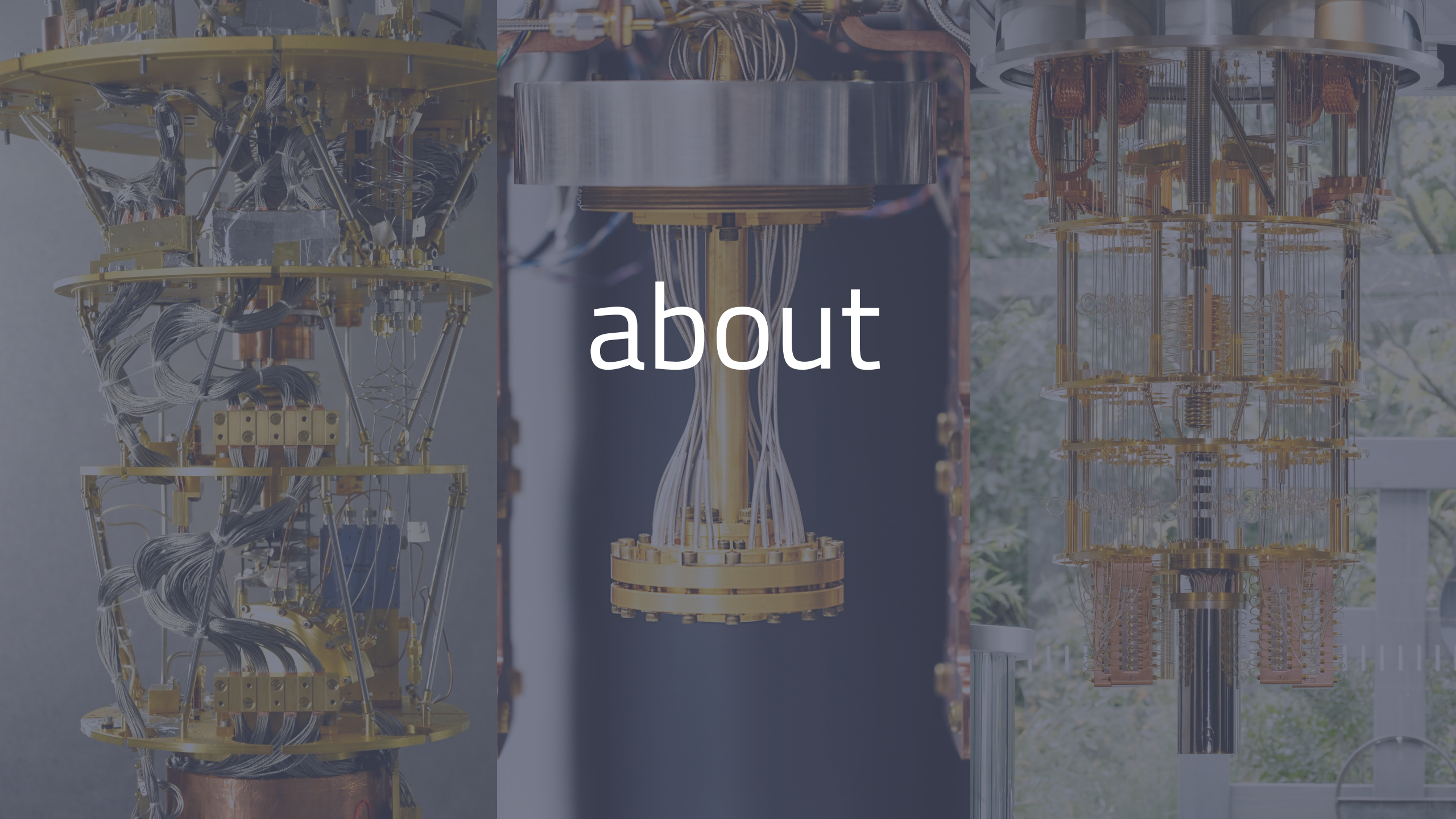
October 3rd 2018


wk@bohr.technology


witoldkowalczyk/

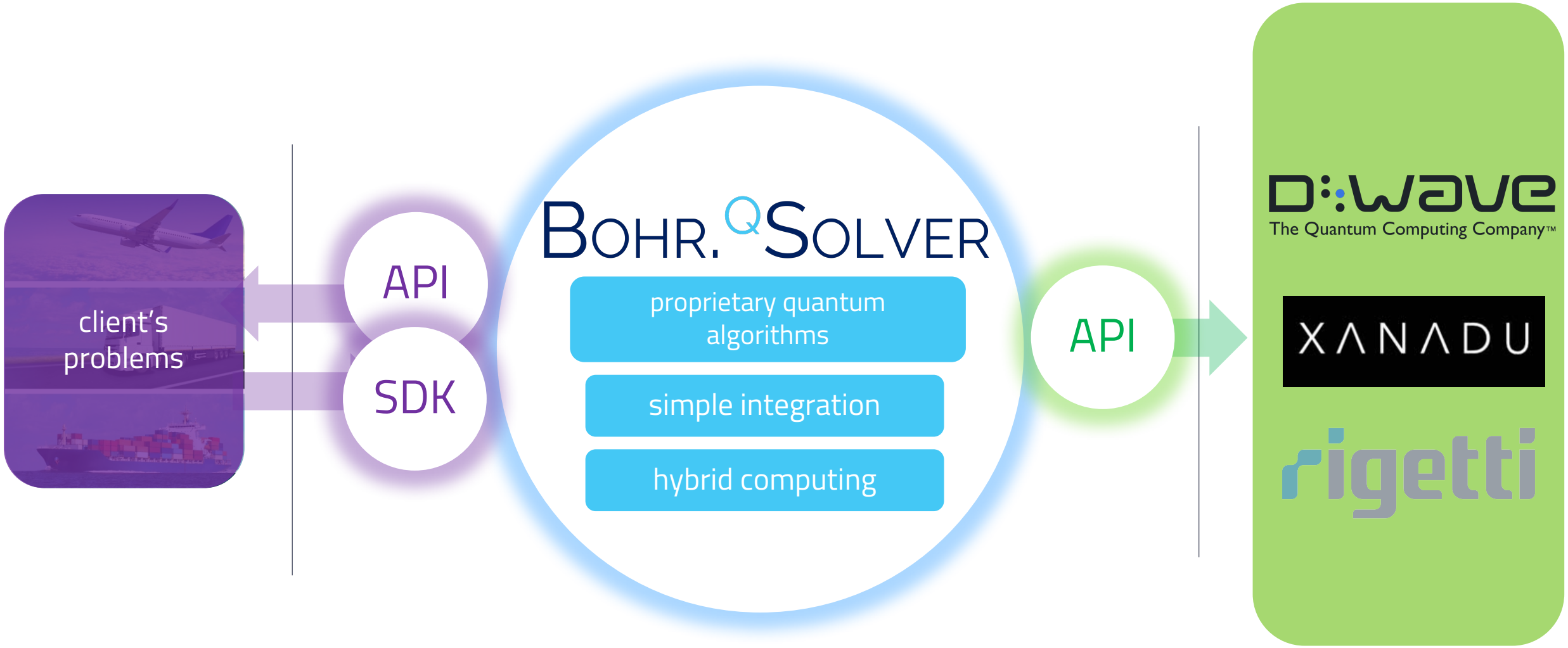
Witold Kowalczyk

CEO, Bohr Technology Inc.



about

Our quantum optimization platform:



client system

quantum cloud platform

quantum hardware

Current clients...

Poczta Polska

Investors...

Bloomberg BETA

S28 CAPITAL

DC VC

Data Collective

Business partnerships...

BMW Foundation Herbert Quandt

CREATIVE DESTRUCTION LAB

Technological partnerships...

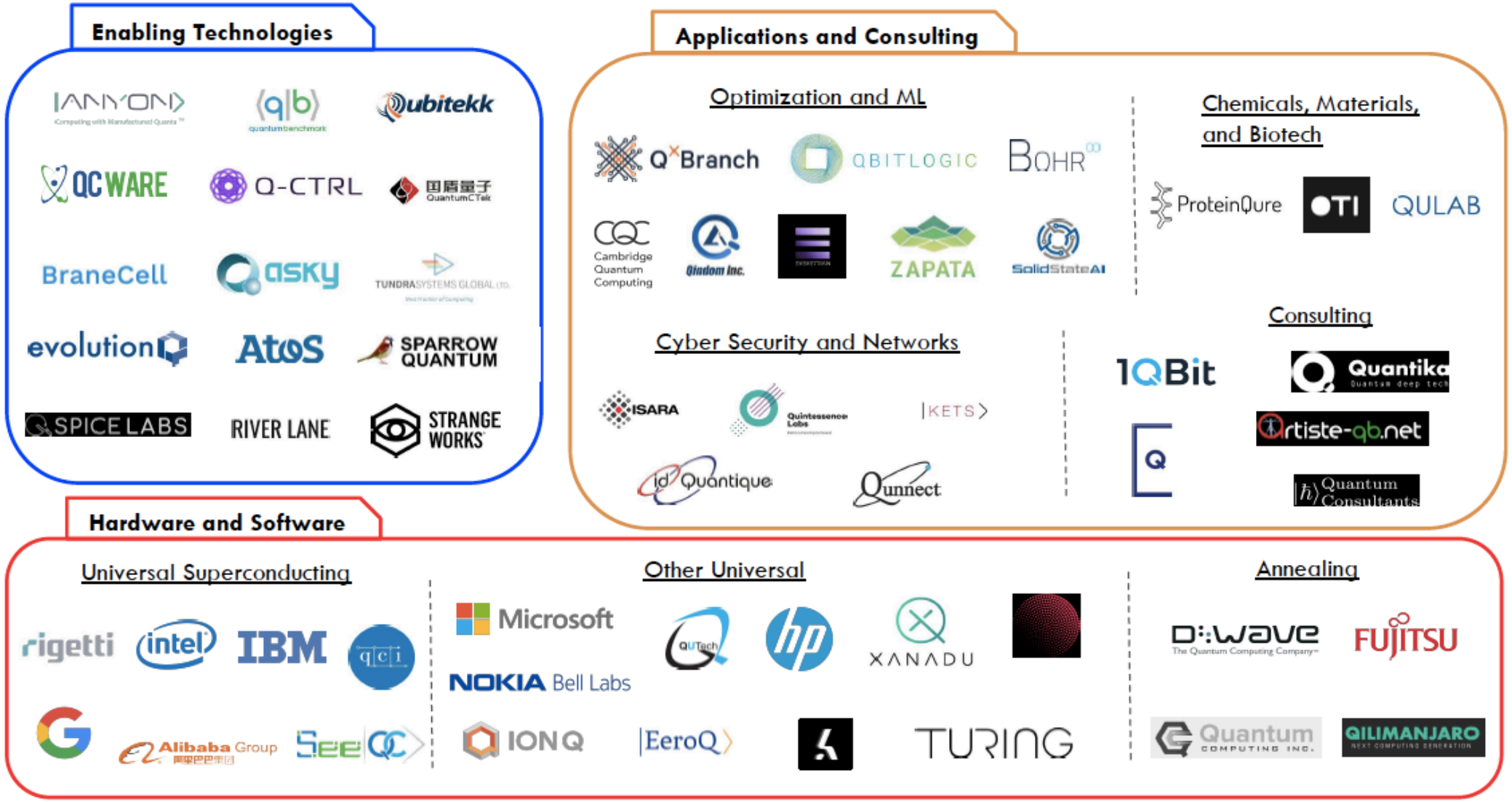
D-Wave The Quantum Computing Company™

rigetti

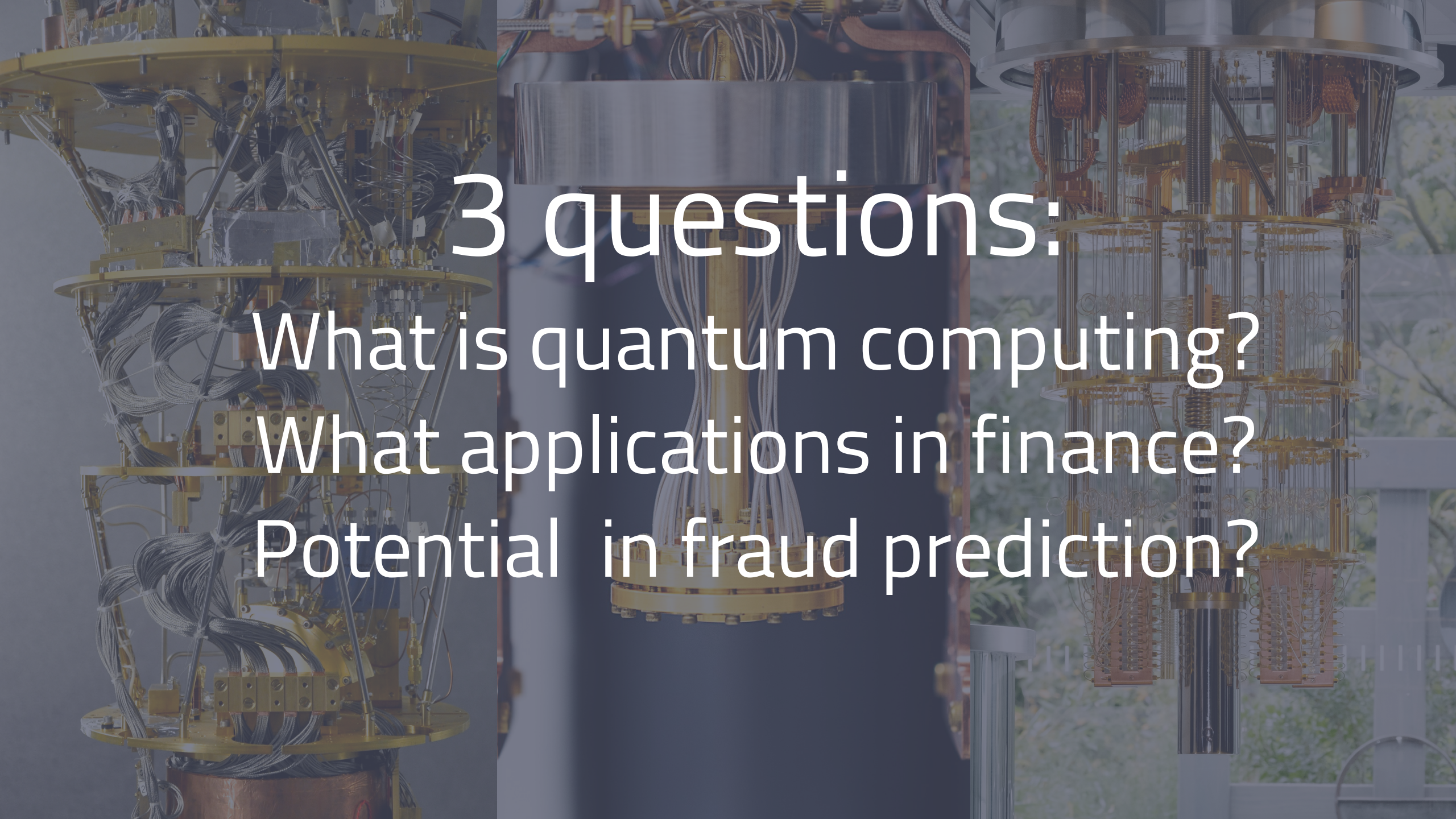
XANADU

Forbes 30 UNDER 30

Current quantum landscape…



SOURCE: Creative Destruction Lab



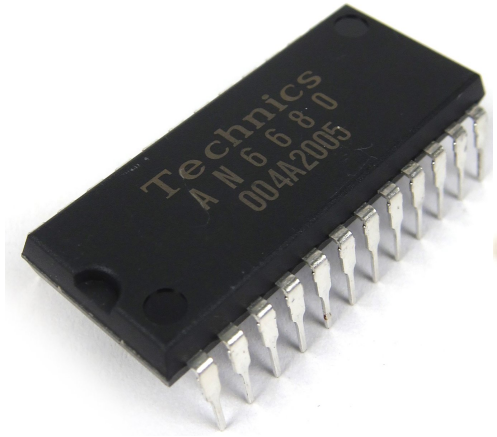
3 questions:

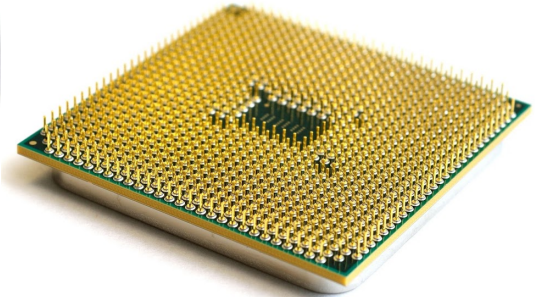
What is quantum computing?

What applications in finance?

Potential in fraud prediction?


quantum computer?





First Generation

(1940 – 1956)

Vacuum tubes

Second Generation

(1956 – 1964)

Transistors

Third Generation

(1964 – 1971)

Integrated circuits

Fourth Generation

(1971 – present)

Microprocessors

New Generation

(present – future)

Quantum computers

Bell Labs, 1956

O

0

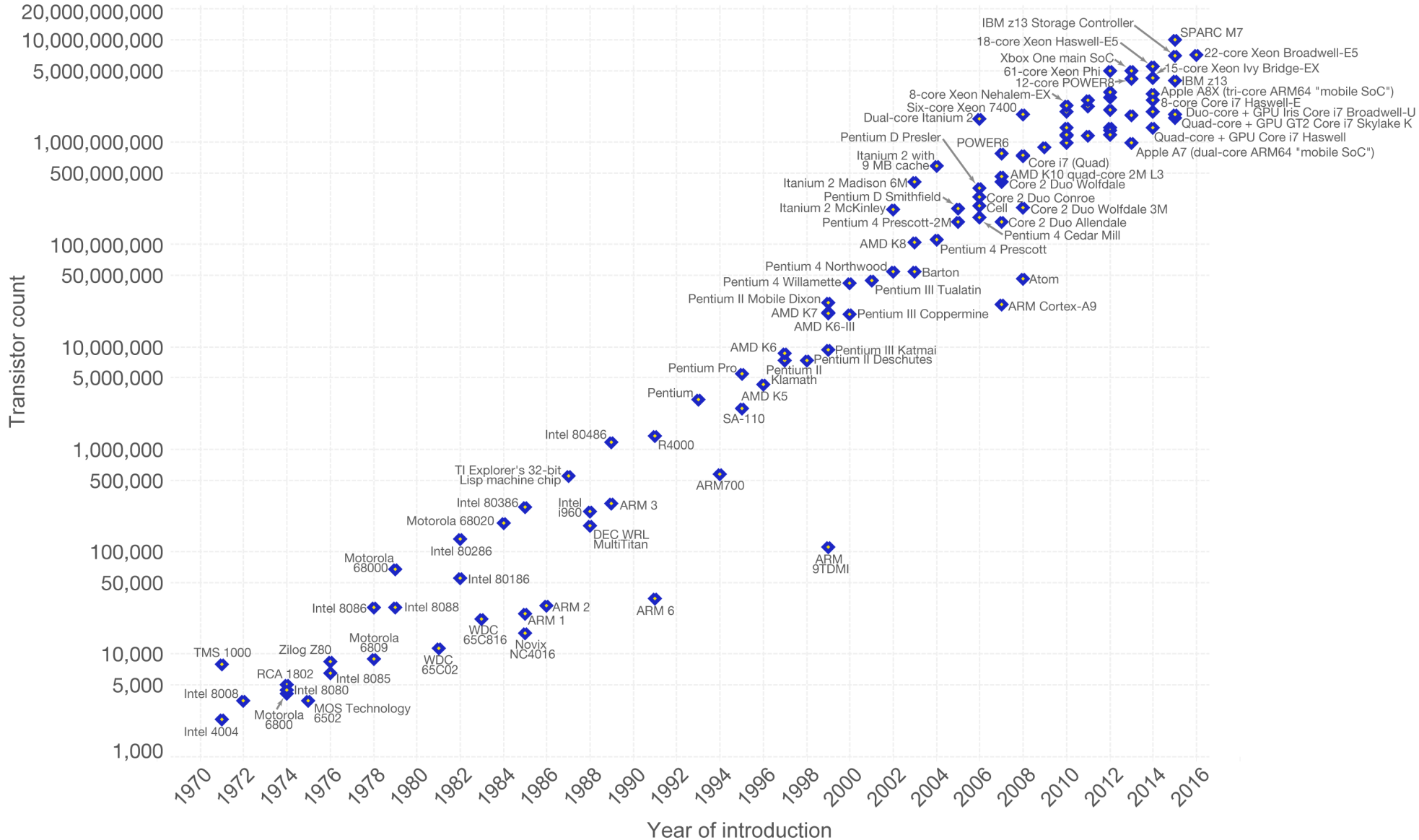
1


Titan supercomputer
177 trillion transistors

Moore's Law – The number of transistors on integrated circuit chips (1971-2016)

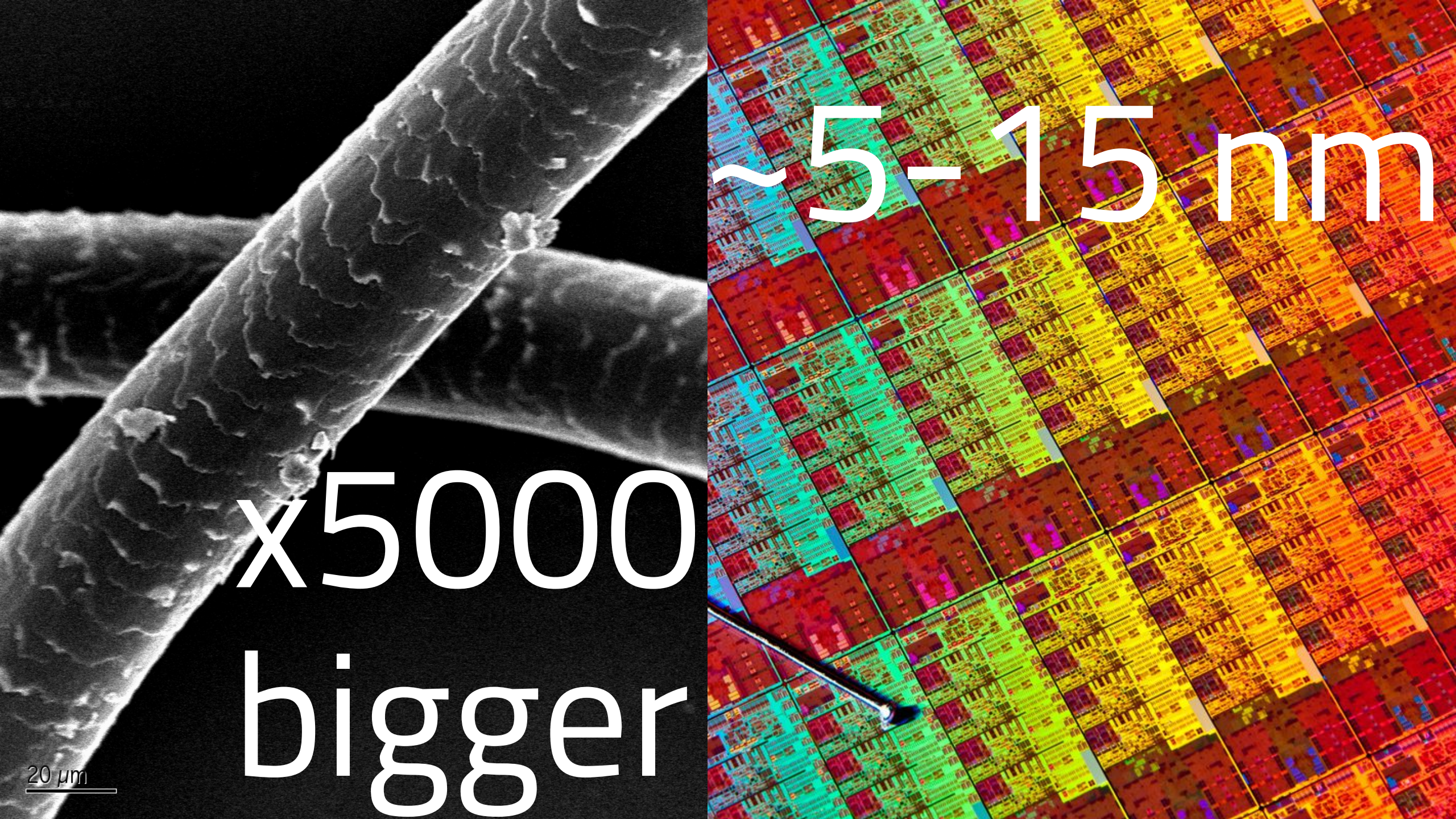
Our World in Data

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important as other aspects of technological progress – such as processing speed or the price of electronic products – are strongly linked to Moore's law.



Data source: Wikipedia (https://en.wikipedia.org/wiki/Transistor_count)

The data visualization is available at OurWorldinData.org. There you find more visualizations and research on this topic.


~5-15 nm
x5000
bigger
20 µm

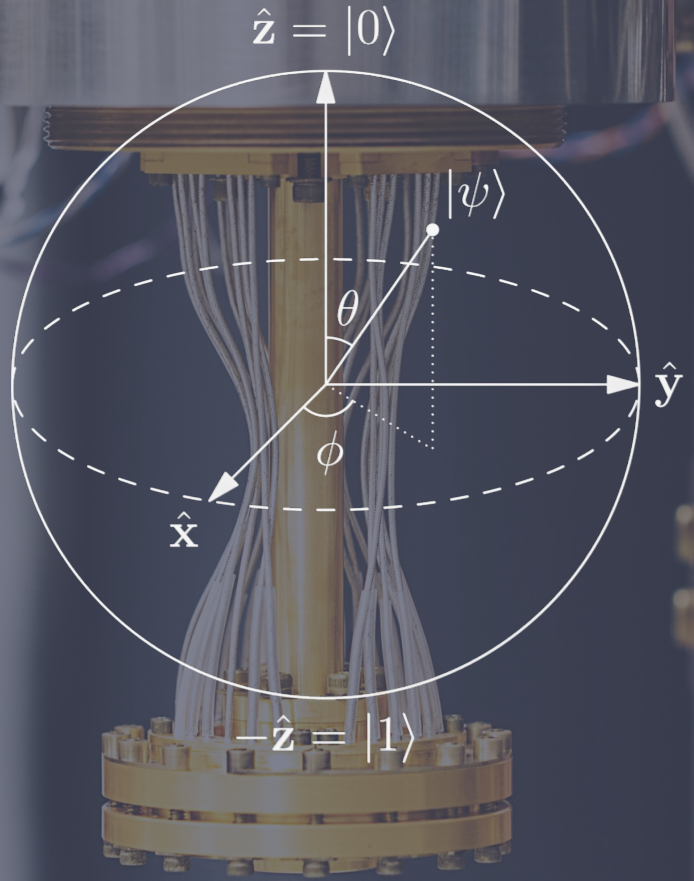
Chip Makers Admit Transistors Are About to Stop Shrinking

In the next five years, it will be too expensive to further miniaturize—but chip makers will innovate in different ways.

by Jamie Condliffe July 25, 2016

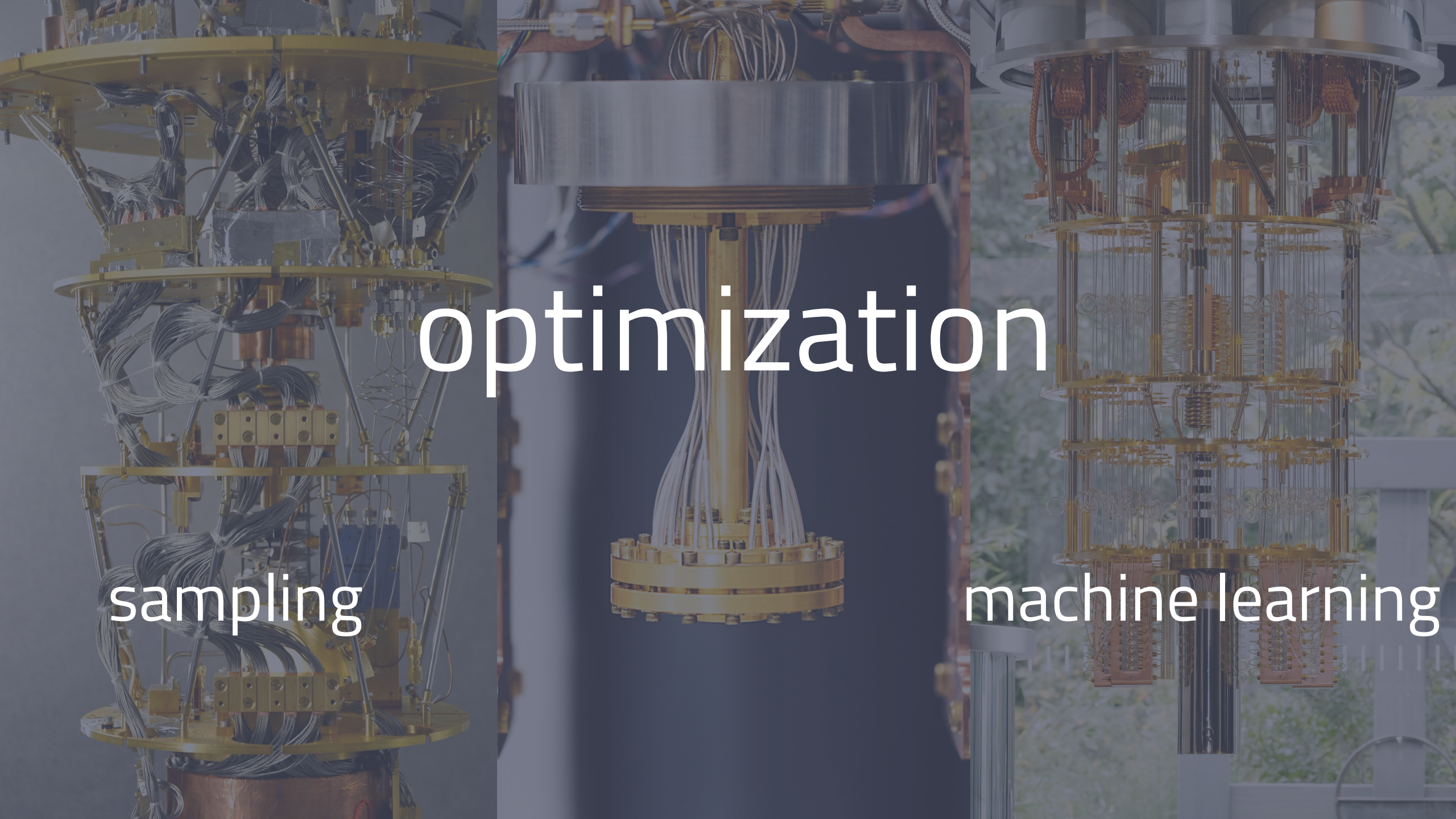
Moore's Law has been slowing for a while. But the U.S. industry that exploits it has finally recognized that it is about to die.

superposition &
entanglement



qubits

probabilistic

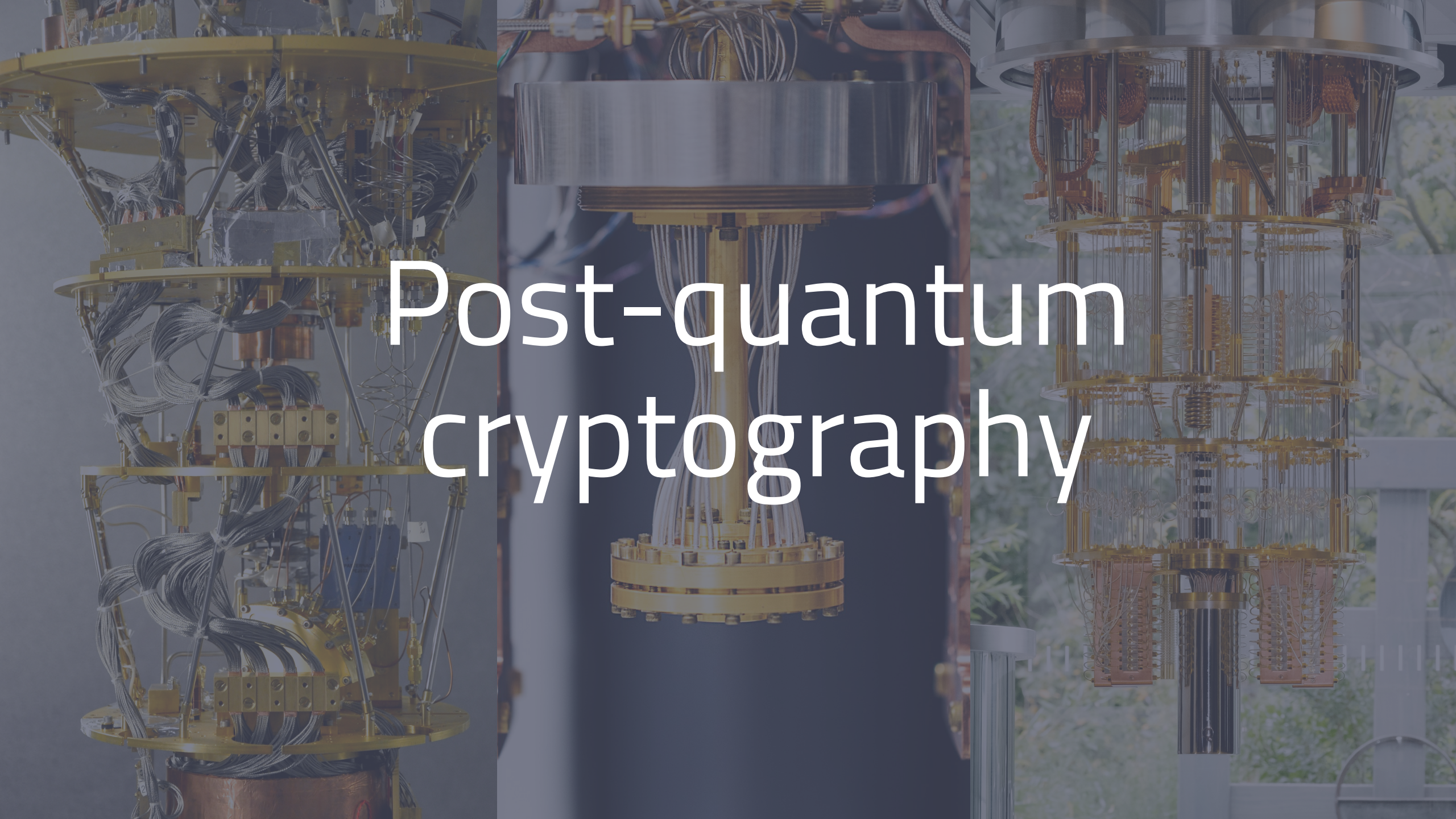

optimization
sampling
machine learning

applications in finance?

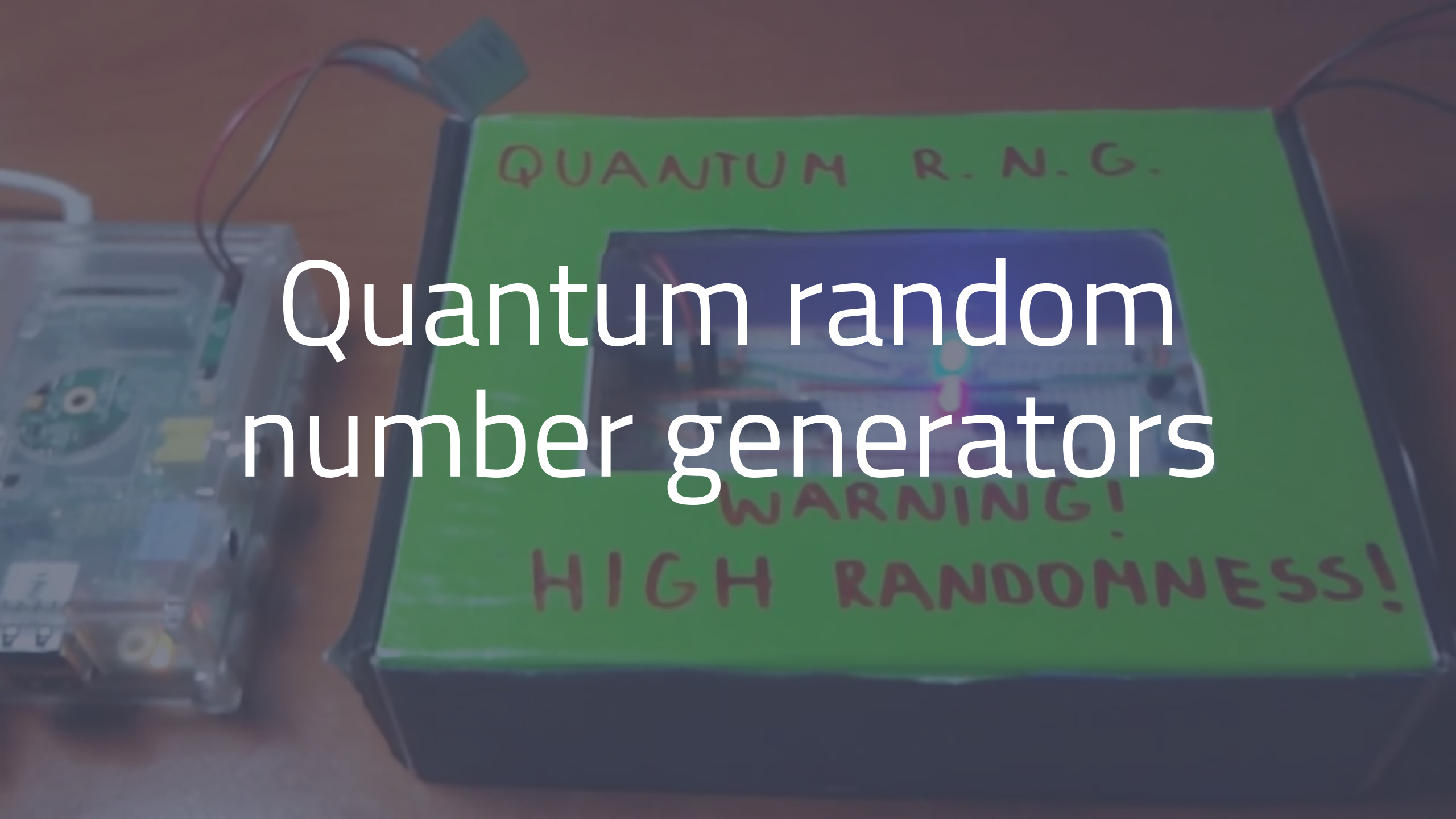
IBM warns of instant breaking of encryption by quantum computers: 'Move your data today'

Welcome to the future transparency of today as quantum computers reveal all currently encrypted secrets -- a viable scenario within just a few years.

By Tom Foremski for Tom Foremski: IMHO | May 18, 2018 -- 18:24 GMT (19:24 BST) | Topic: Security



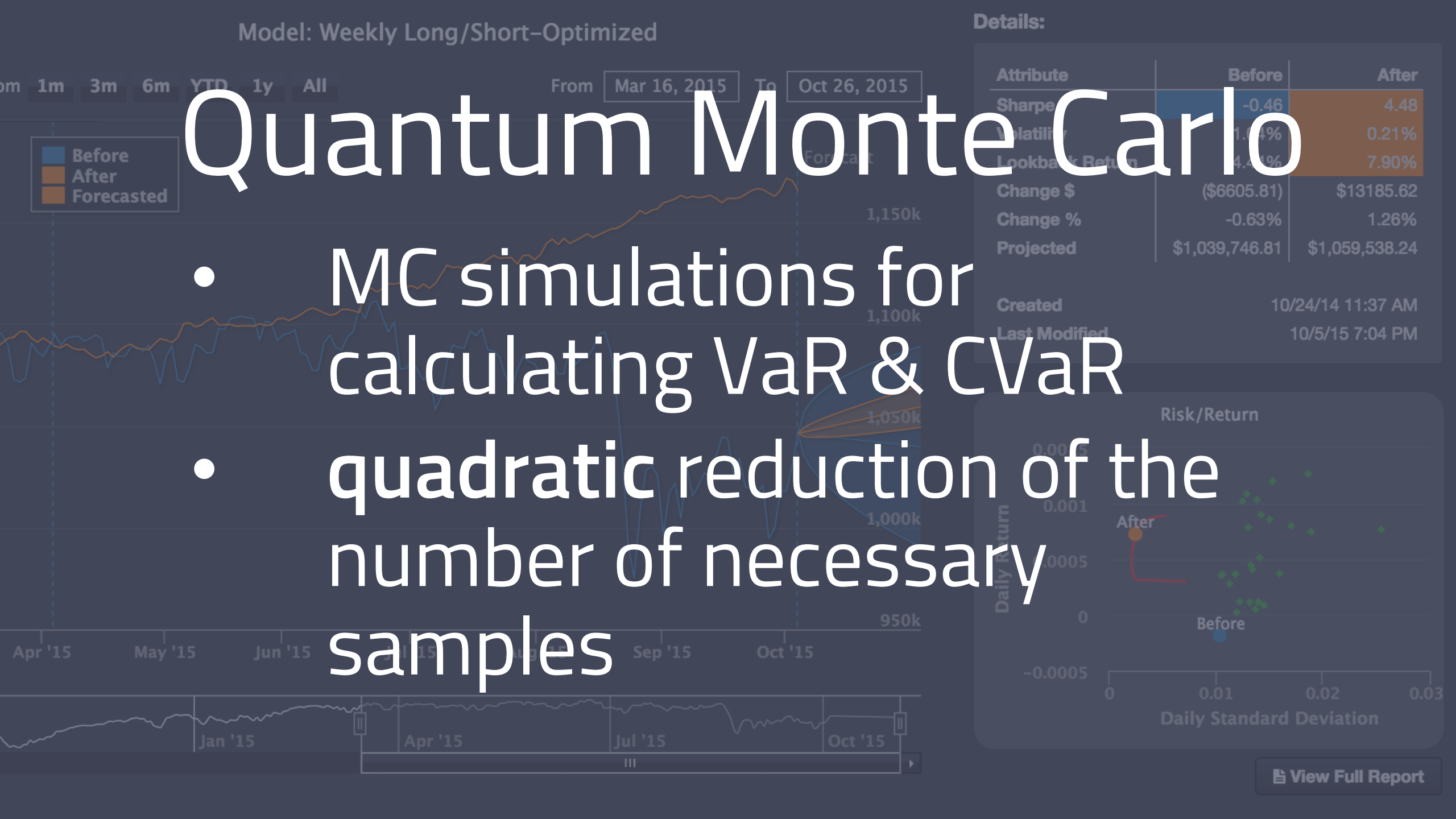
Post-quantum cryptography



Quantum random number generators

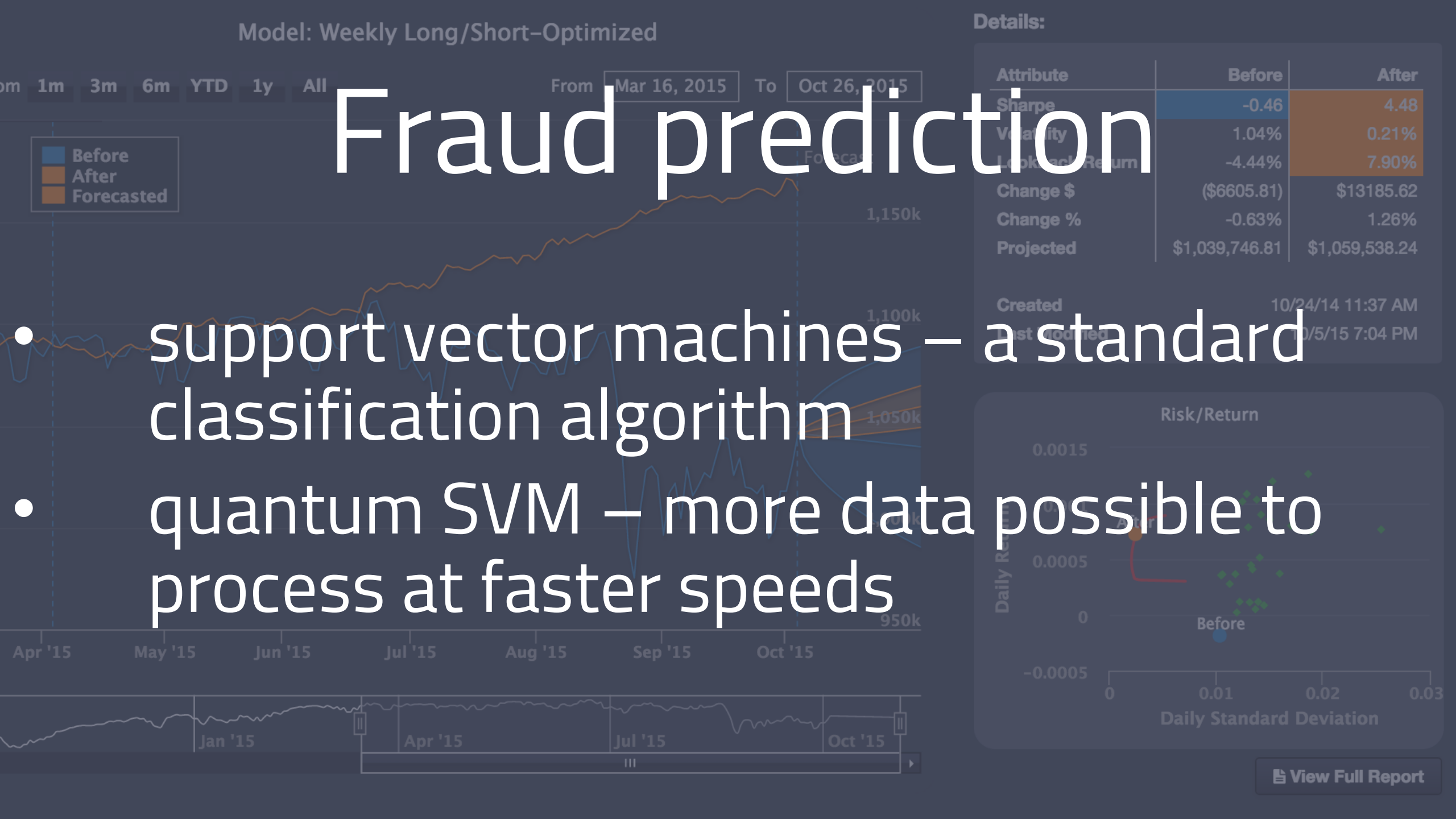
portfolio optimization

- optimal trading trajectory
- Hierarchical risk parity
- Real-time optimization



Quantum Monte Carlo

- MC simulations for calculating VaR & CVaR
- **quadratic** reduction of the number of necessary samples



Fraud prediction

- support vector machines – a standard classification algorithm
- quantum SVM – more data possible to process at faster speeds

Quantum support vector machine for big data classification

Patrick Rebentrost,[1,*] Masoud Mohseni,[2] and Seth Lloyd[3,†]

[1]*Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, MA 02139*
[2]*Google Research, Venice, CA 90291*
[3]*Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139*

Supervised machine learning is the classification of new data based on already classified training examples. In this work, we show that the support vector machine, an optimized binary classifier, can be implemented on a quantum computer, with complexity logarithmic in the size of the vectors and the number of training examples. In cases when classical sampling algorithms require polynomial time, an exponential speed-up is obtained. At the core of this quantum big data algorithm is a non-sparse matrix exponentiation technique for efficiently performing a matrix inversion of the training data inner-product (kernel) matrix.


Challenges?

Contact for cooperation!

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