

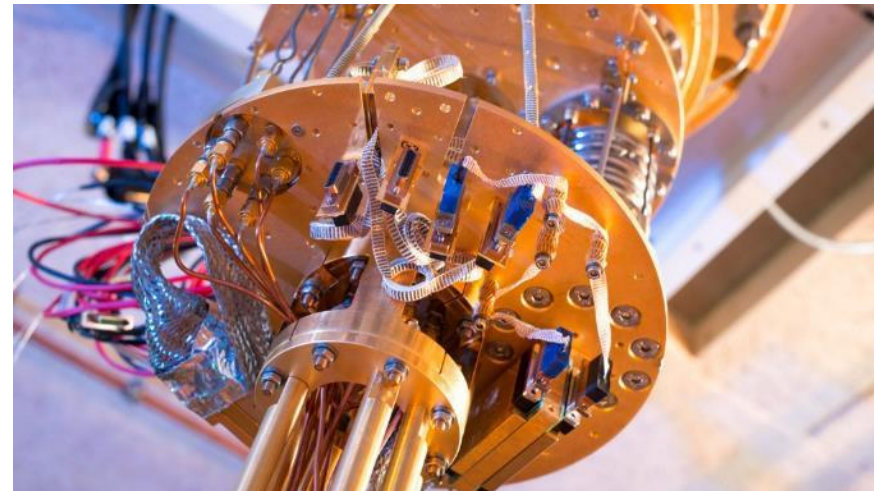
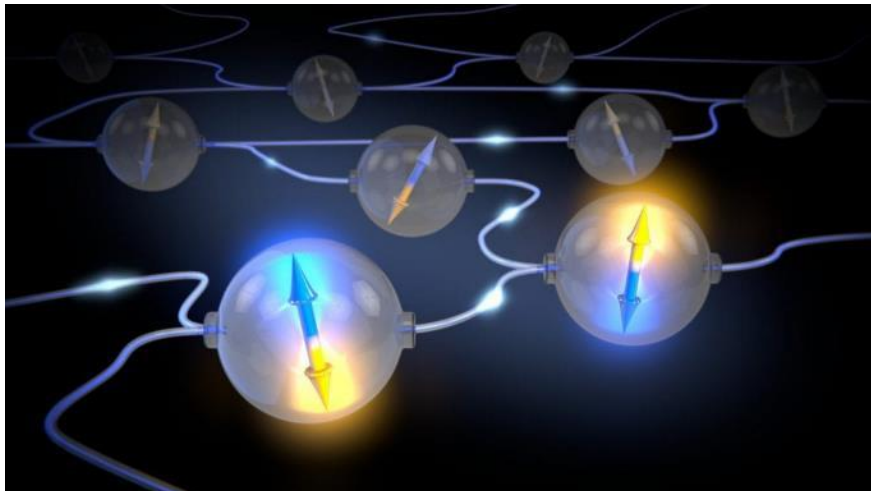


Quantum Security

Quantum Technology: introductie en toepassingen

Ingrid Romijn

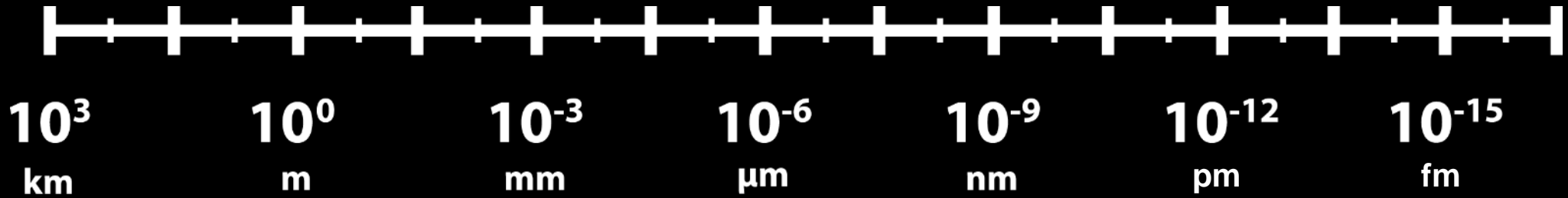
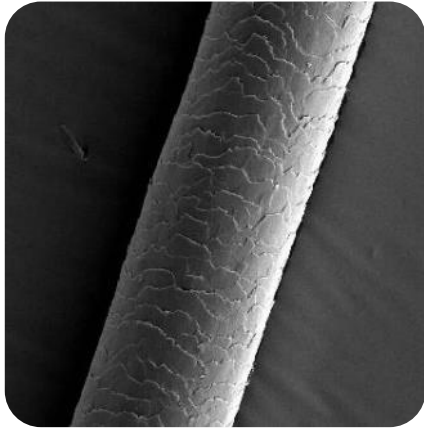
Quantum Technology: De digitale infrastructuur van de toekomst



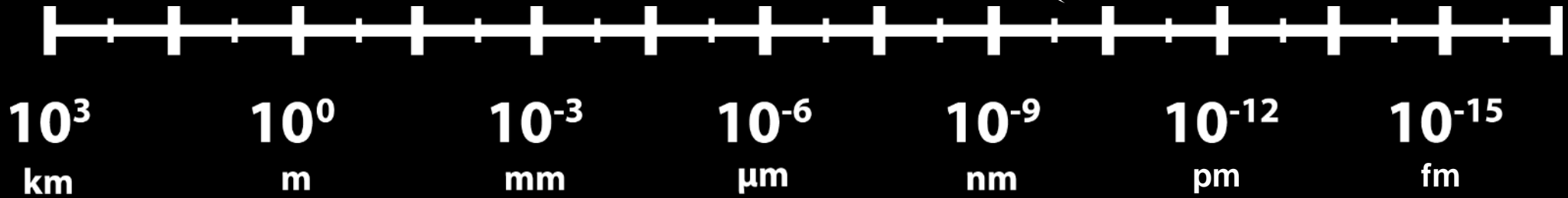
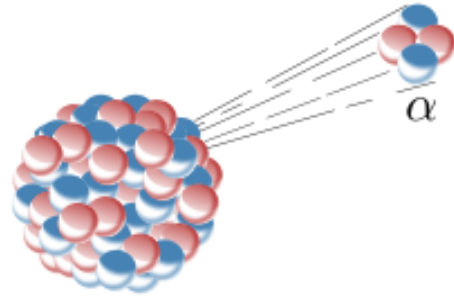
Quantum Wat?



Haar

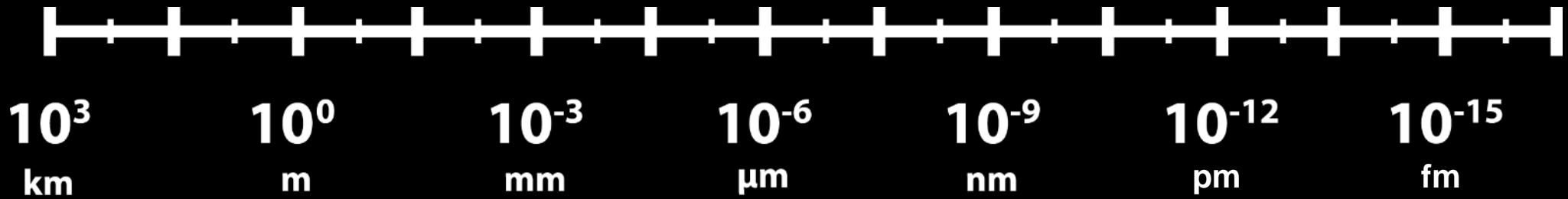
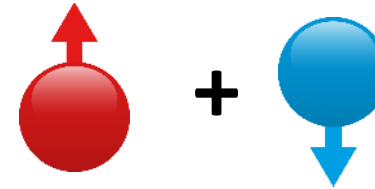


Atom



Elektron

Quantum Fysica !



Principes van quantum mechanica

“Op twee plekken tegelijkertijd”

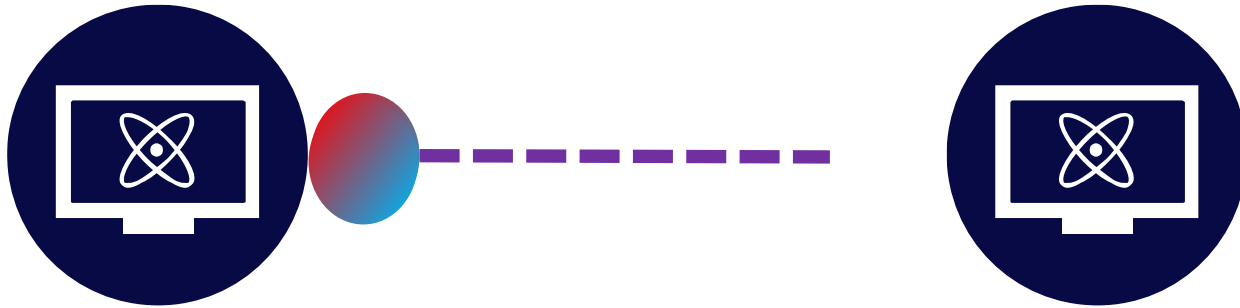
Superposition

“Instantane verbinding op afstand”

Entanglement



Quantum Communicatie



- Elke meting beïnvloedt de toestand van de qubit
- Quantum toestanden kunnen gedeeld worden

→ Nieuw communicatie paradigma!

Klassiek



Quantum





NOBELPRISET I FYSIK 2022 THE NOBEL PRIZE IN PHYSICS 2022



KUNGL.
VETENSKAPS-
AKADEMIEN

THE ROYAL SWEDISH ACADEMY OF SCIENCES



Photo: Royal Society

Alain Aspect

Université Paris-Saclay &
École Polytechnique, France

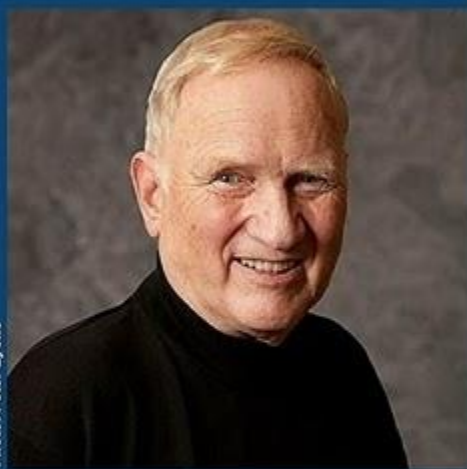


Photo: Peter Lyons

John F. Clauser

J.F. Clauser & Assoc.,
USA

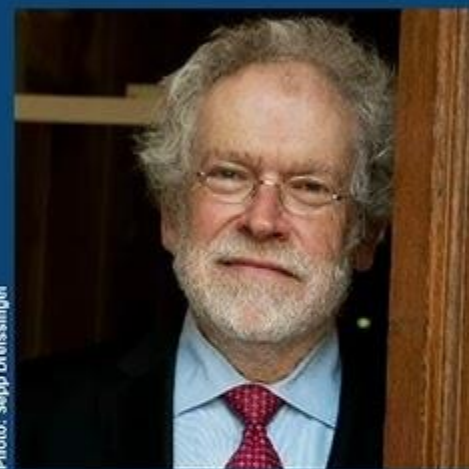


Photo: Sepp Dreissinger

Anton Zeilinger

University of Vienna,
Austria

”för experiment med sammanflätade fotoner som påvisat brott mot Bell-olikheter och banat väg för kvantinformationsvetenskap”

“for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science”

#nobelprize

THE
NOBEL
PRIZE

Quantum Entanglement in Delft



- 2015: Entanglement irrefutable proven for the first time
- 2018: Worlds first entanglement “on demand”
- 2021: Worlds first 3-node quantum network in the lab
- 2022: Teleportation of quantum information



Quantum, hoe kunnen we het gebruiken?



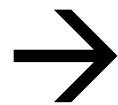
De eerste quantum revolutie



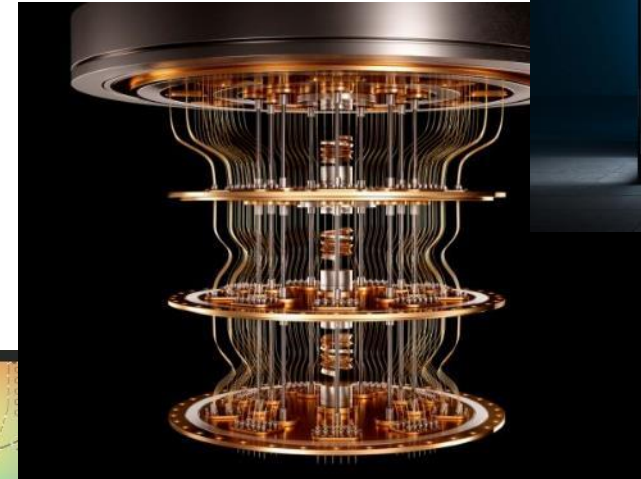
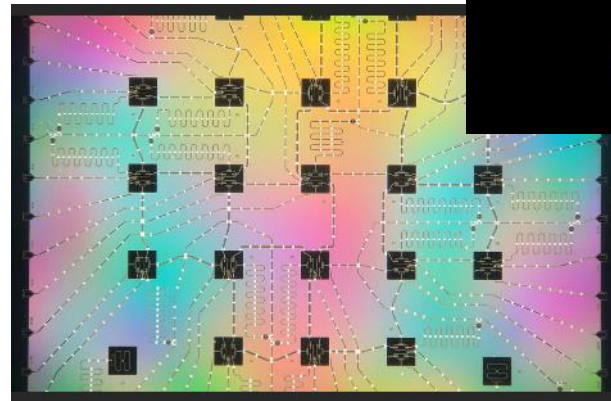
De tweede quantum revolutie

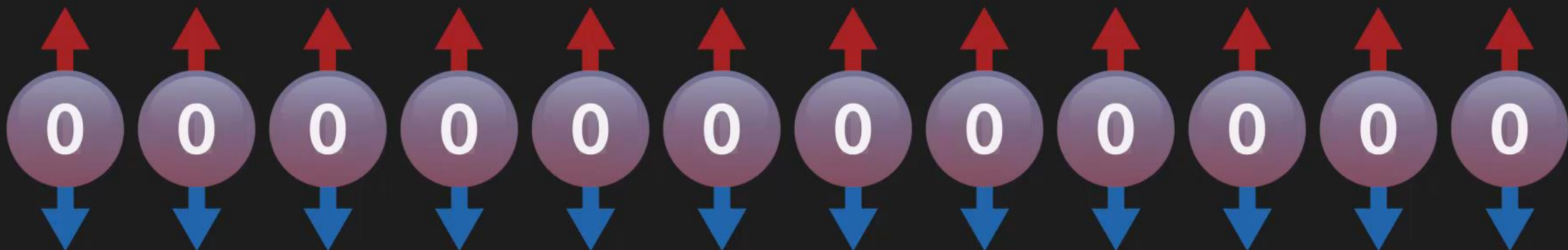
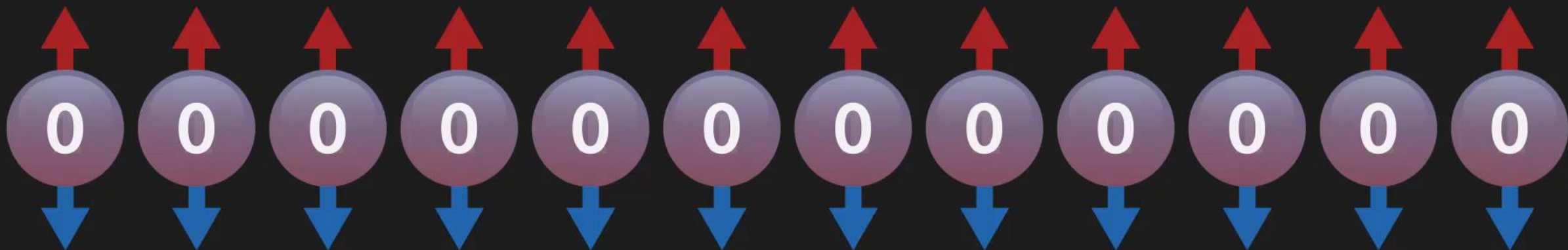
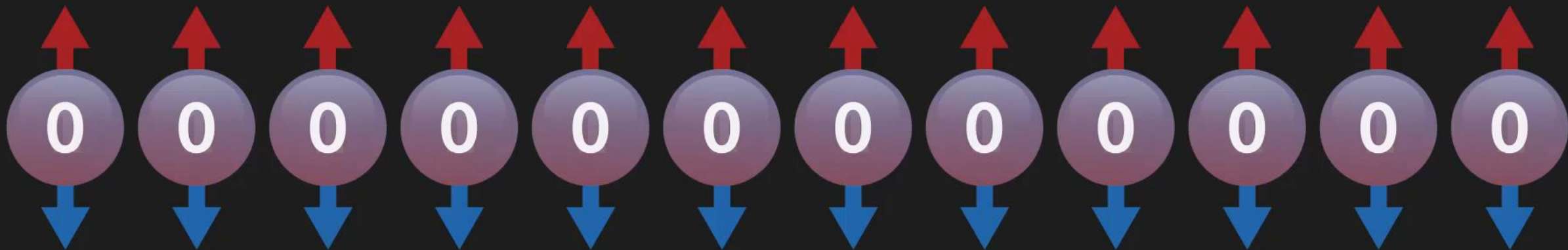


Bits

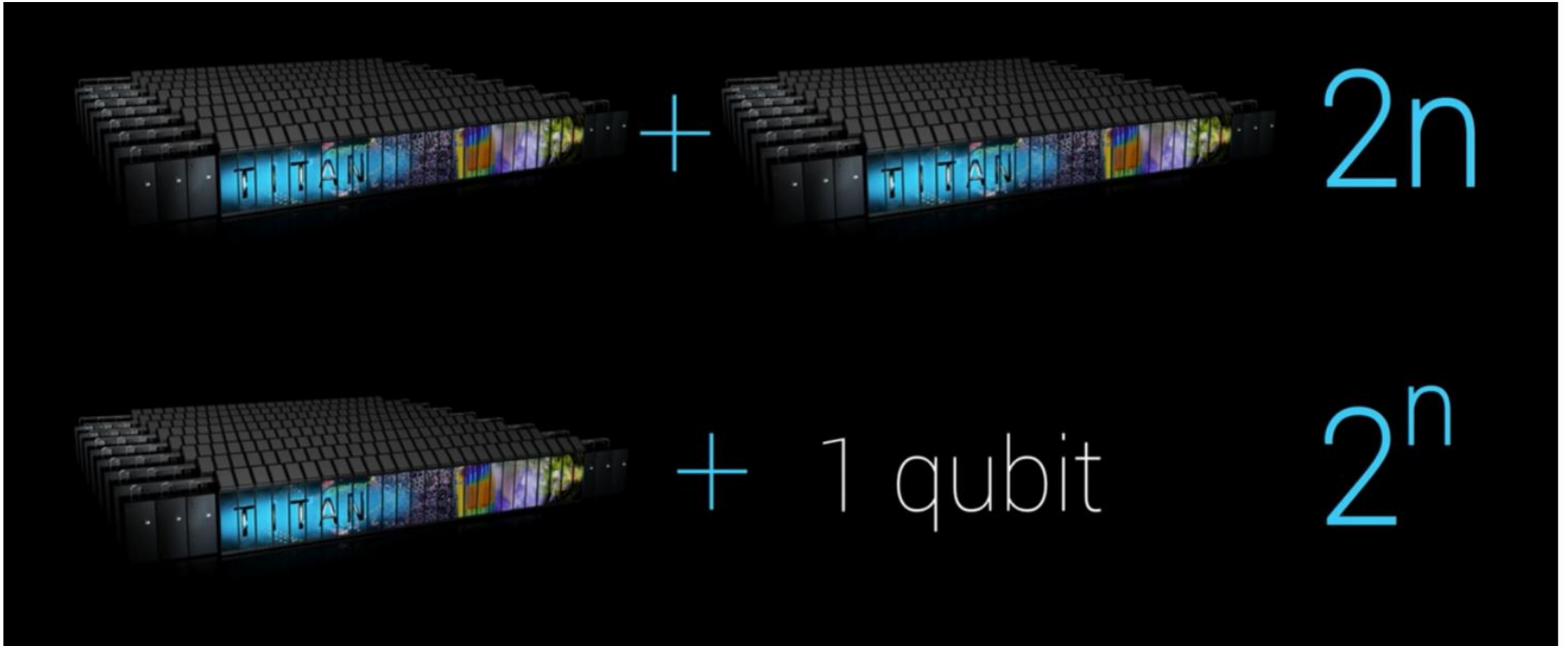


Qubits

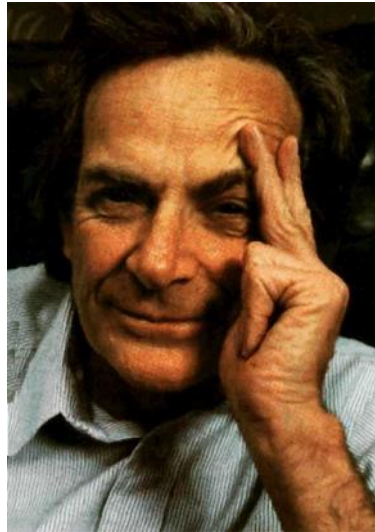




Enorme rekenkracht



Quantum simulaties



NATURE ISN'T CLASSICAL, DAMMIT, AND IF YOU WANT TO MAKE A SIMULATION OF NATURE, YOU'D BETTER MAKE IT QUANTUM MECHANICAL, AND BY GOLLY IT'S A WONDERFUL PROBLEM, BECAUSE IT DOESN'T LOOK SO EASY.

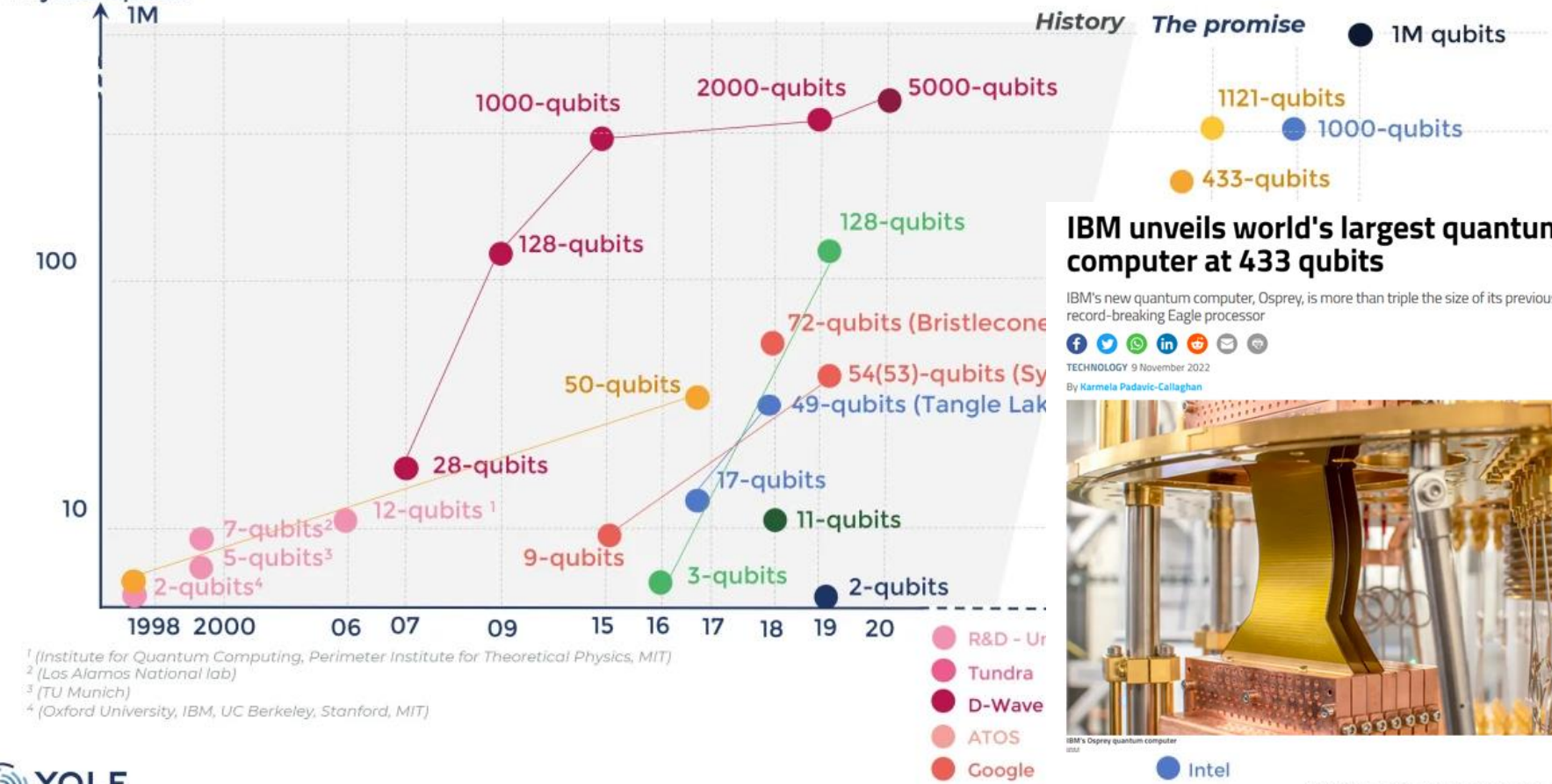
- RICHARD FEYNMAN -

1982

PHYSICAL QUBIT ROADMAP FOR QUANTUM COMPUTER – HISTORY AND FUTURE

Source: Quantum Technologies report, Yole Développement, 2021

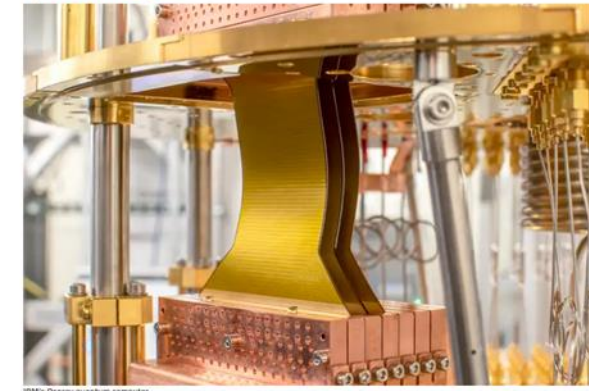
Graph below shows physical qubit roadmap (Note: for a quantum computer, 50 logical qubits minimum are required → it means 50 000 physical qubits)



IBM unveils world's largest quantum computer at 433 qubits

IBM's new quantum computer, Osprey, is more than triple the size of its previous record-breaking Eagle processor

TECHNOLOGY 9 November 2022
By Karmela Padavic-Callaghan



IBM's Osprey quantum computer

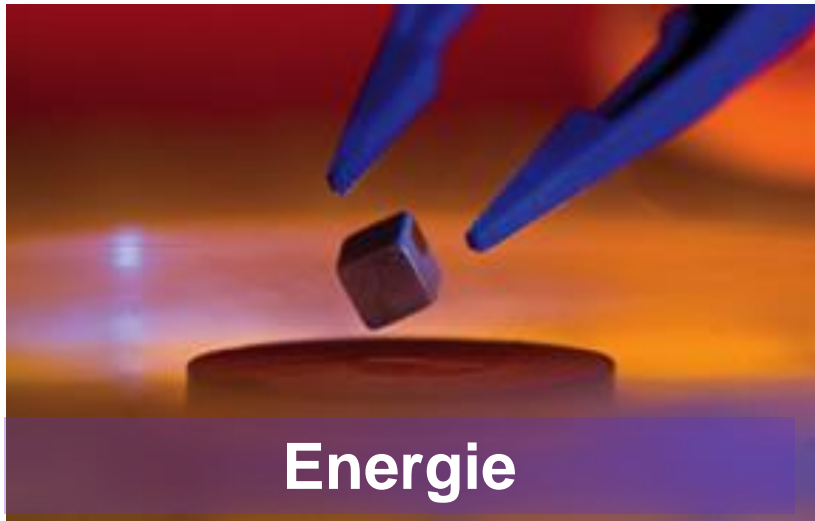
Uitdagingen:

- Stabiliteit, kwaliteit
- Error correctie

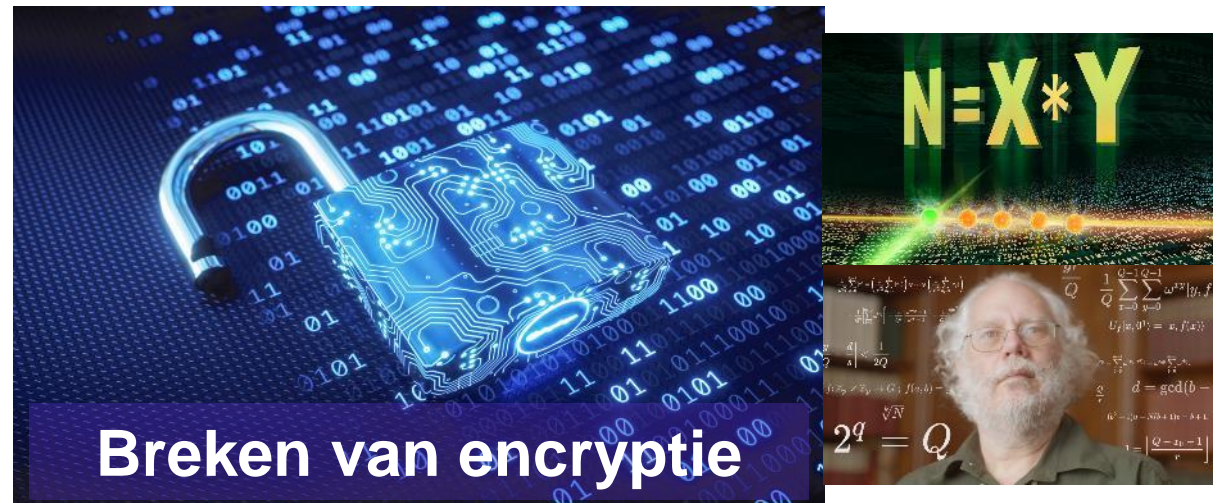
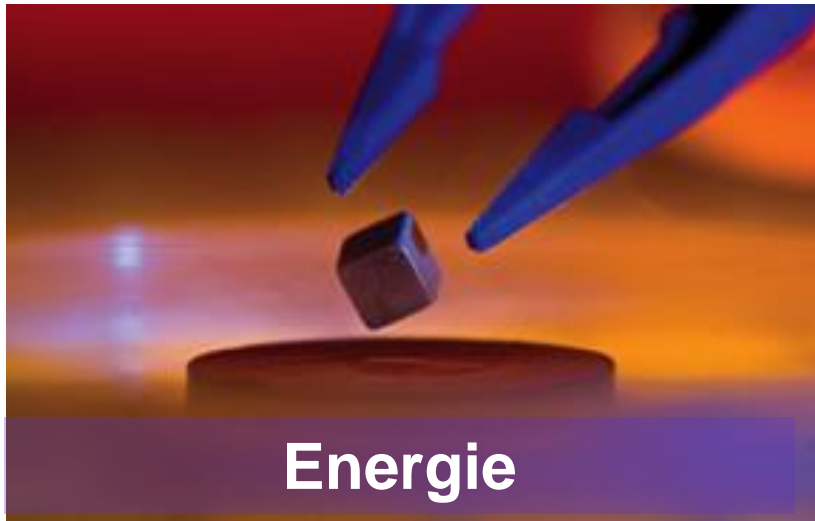
Fault tolerant QC:
→ Logical qubits (1000 fysieke qubits)



De belofte van de 2^e quantum revolutie



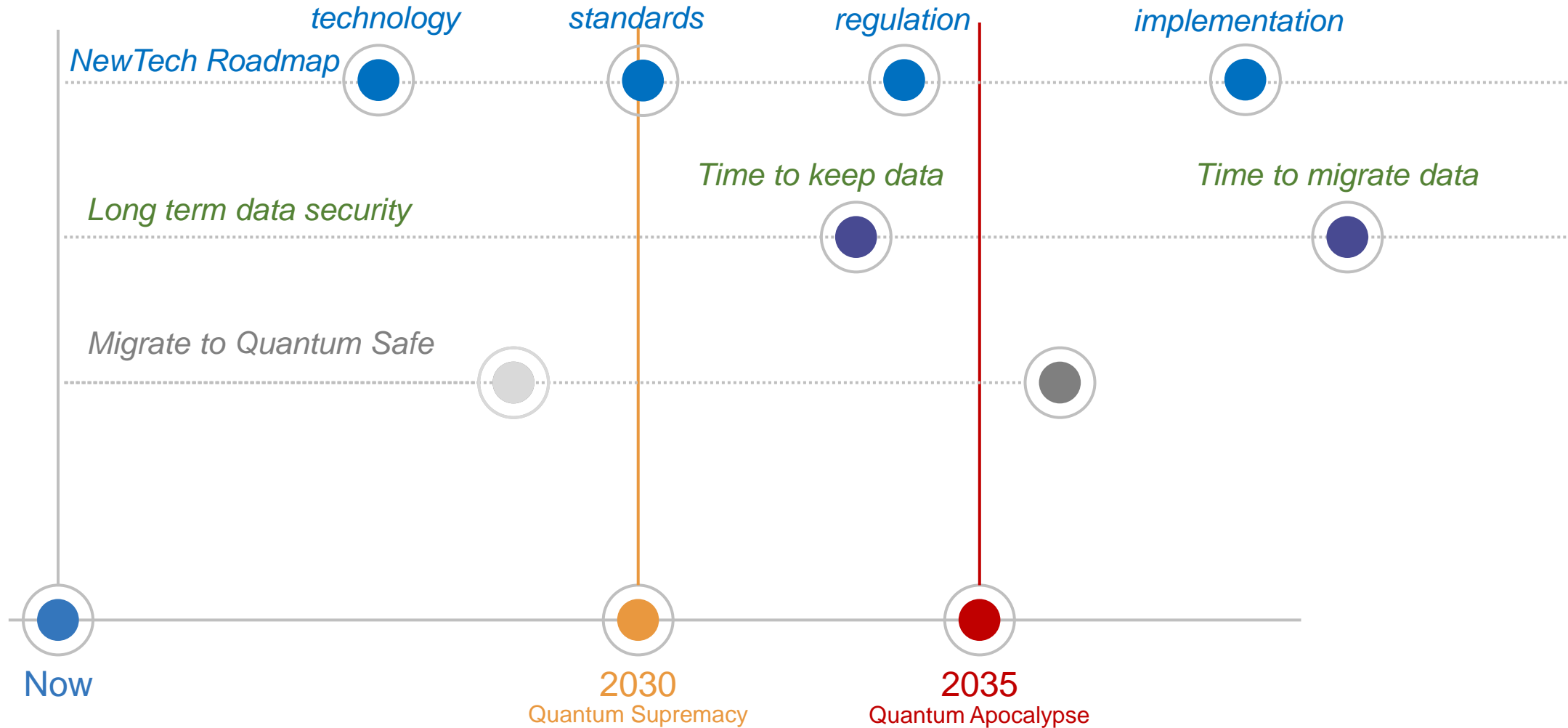
De belofte / dreiging van de 2^e quantum revolutie



THE QUANTUM APOCALYPSE

2035

De dreiging



~~NEXT WEEK~~

~~TOMORROW~~

~~OTHER DAY~~

NOW

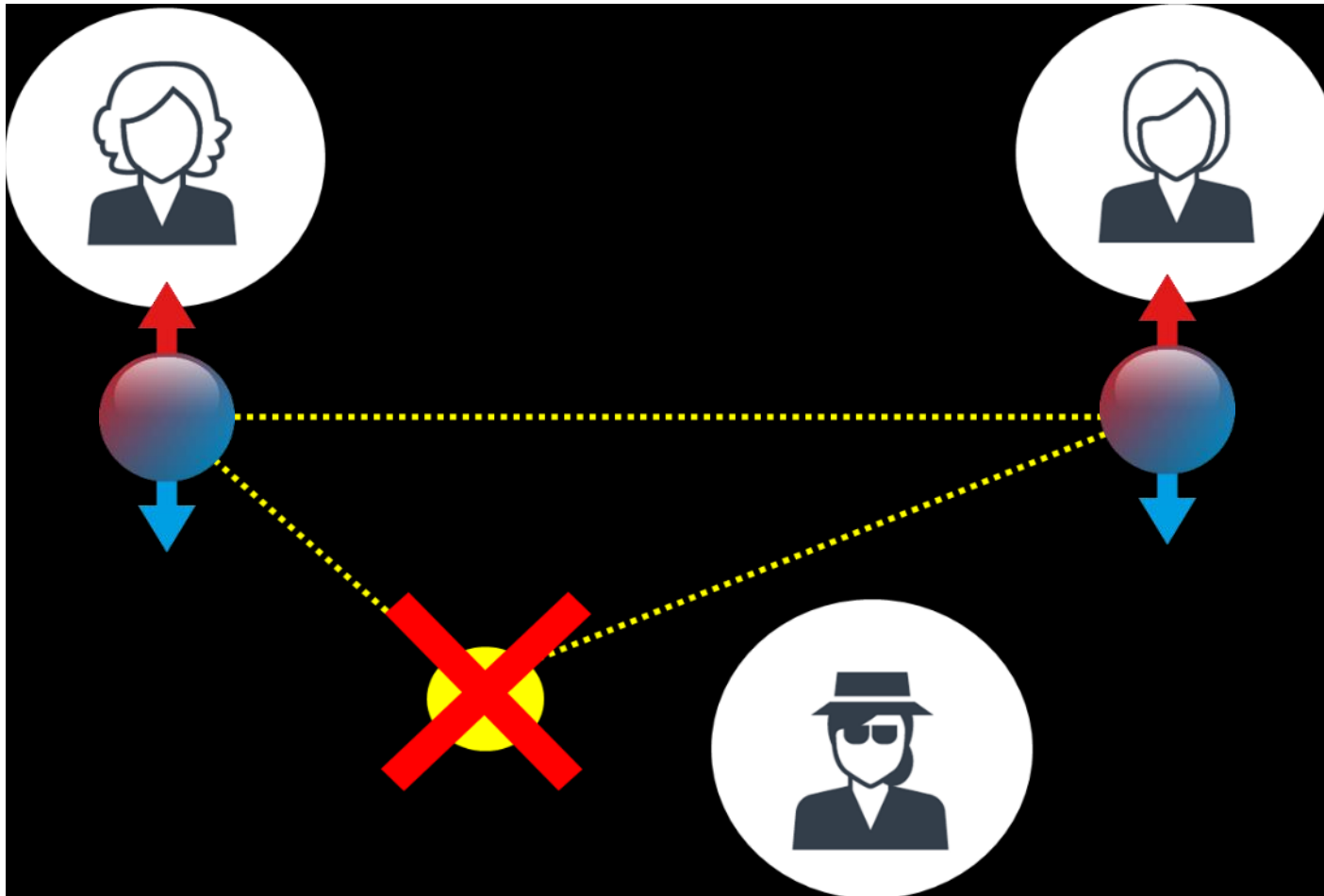
~~NEXT YEAR~~

~~SOMEDAY~~

~~IN THE FUTURE~~

~~LATER~~

Quantum Communicatie



Kunnen we dit gebruiken?



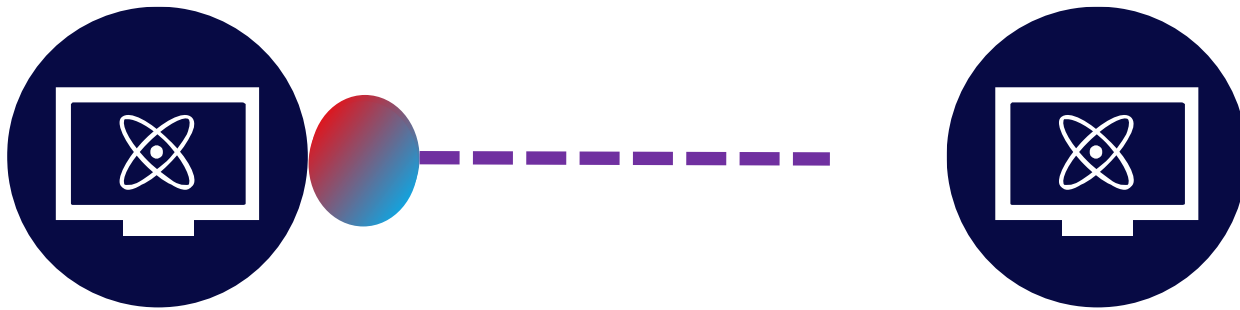
The background features a smooth gradient from a deep blue on the left to a bright green on the right. Overlaid on this are several thin, white, curved lines that flow across the frame, creating a sense of motion and depth. The lines are most concentrated in the upper half of the image, where they form a series of overlapping, wave-like patterns.

Pauze / vragen

Quantum Security against the quantum threat



Quantum Communicatie



- Elke meting beïnvloedt de toestand van de qubit
- Quantum toestanden kunnen gedeeld worden

→ Nieuw communicatie paradigma!

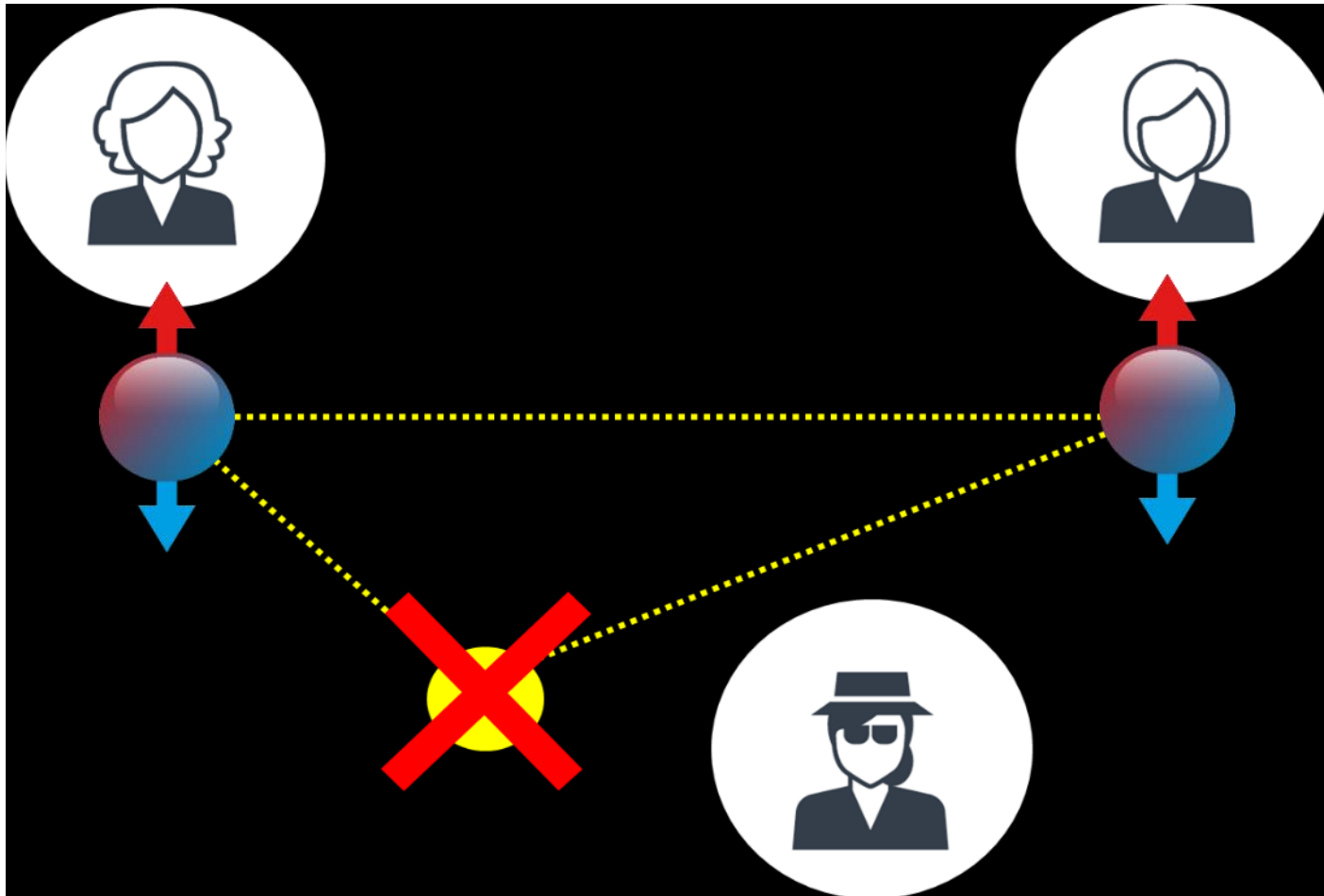
Klassiek



Quantum



Quantum Communication = Secure Communication

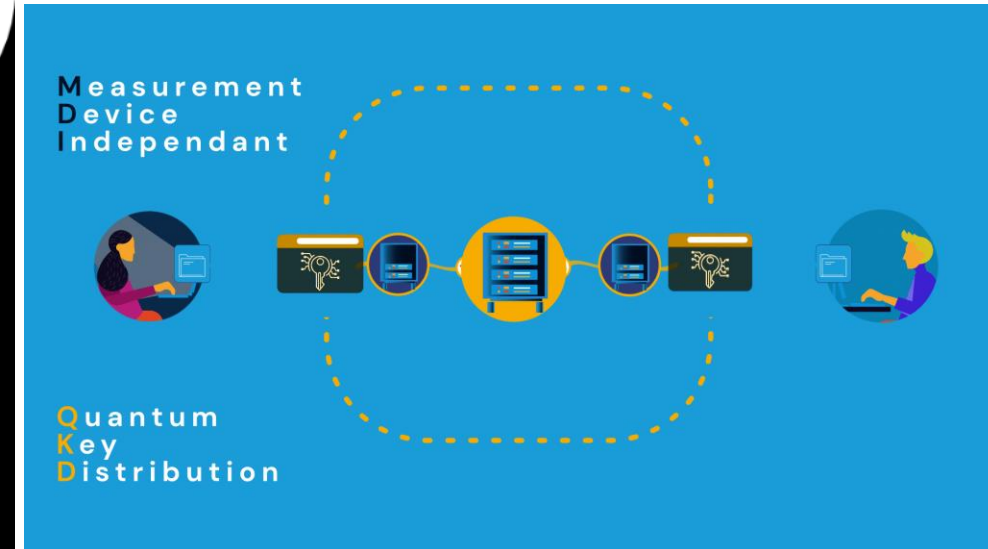
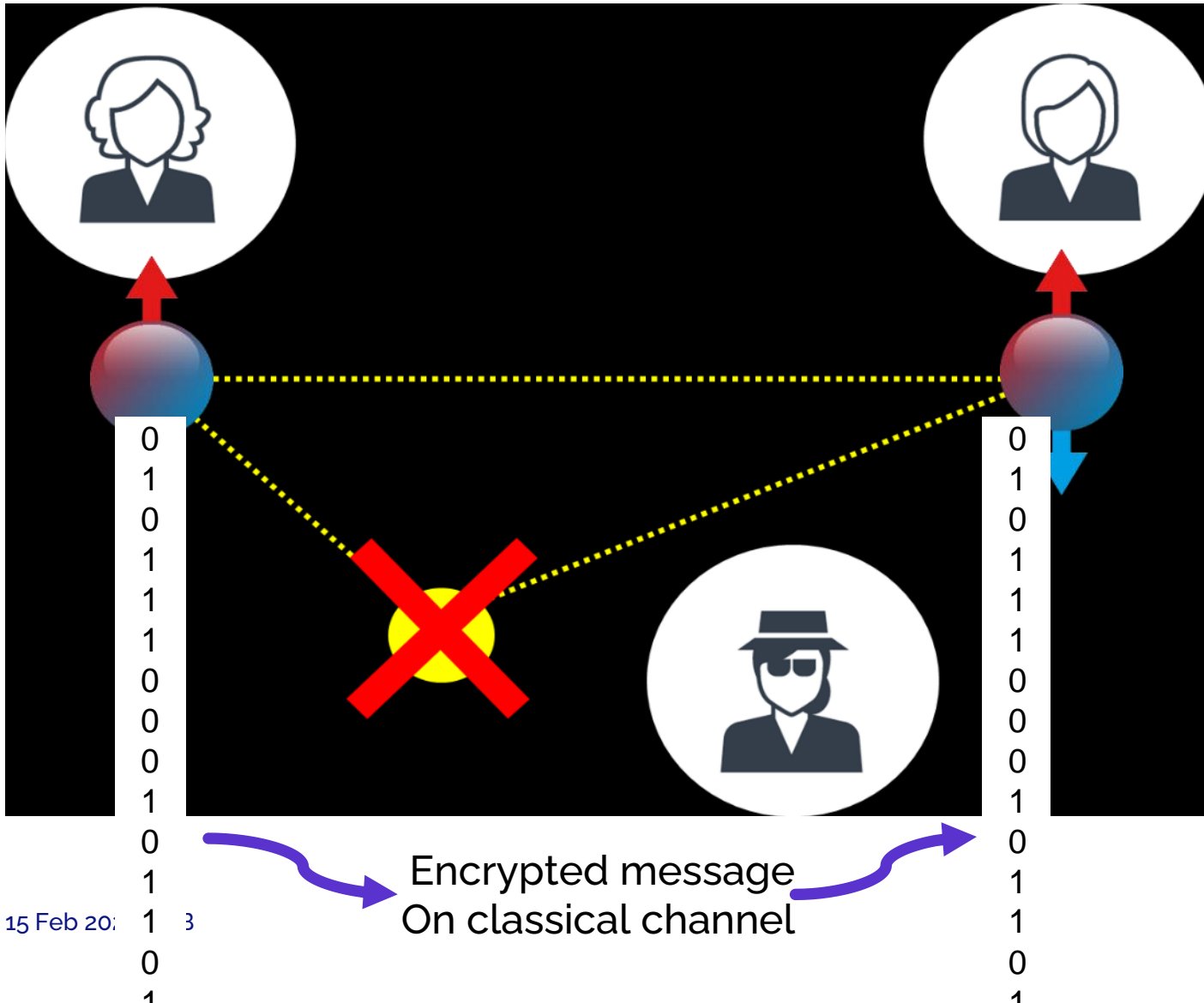


Quantum
Cryptography
uses the
fundamentals of nature

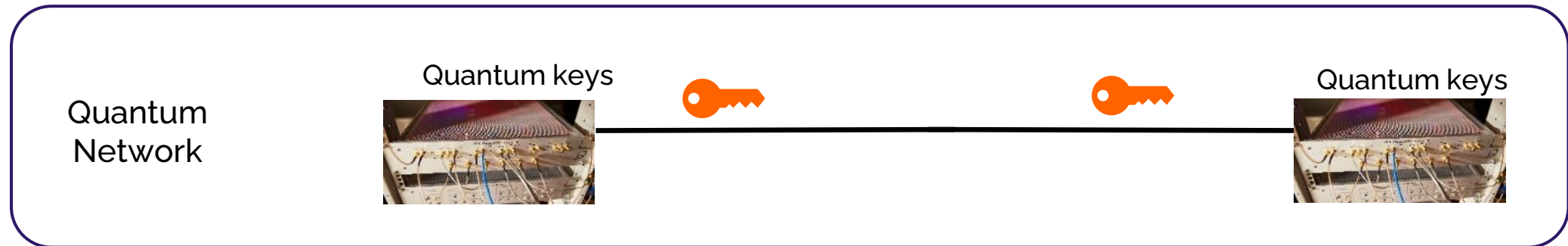
to protect our
communications –
even against an
attack by a future
quantum computer!



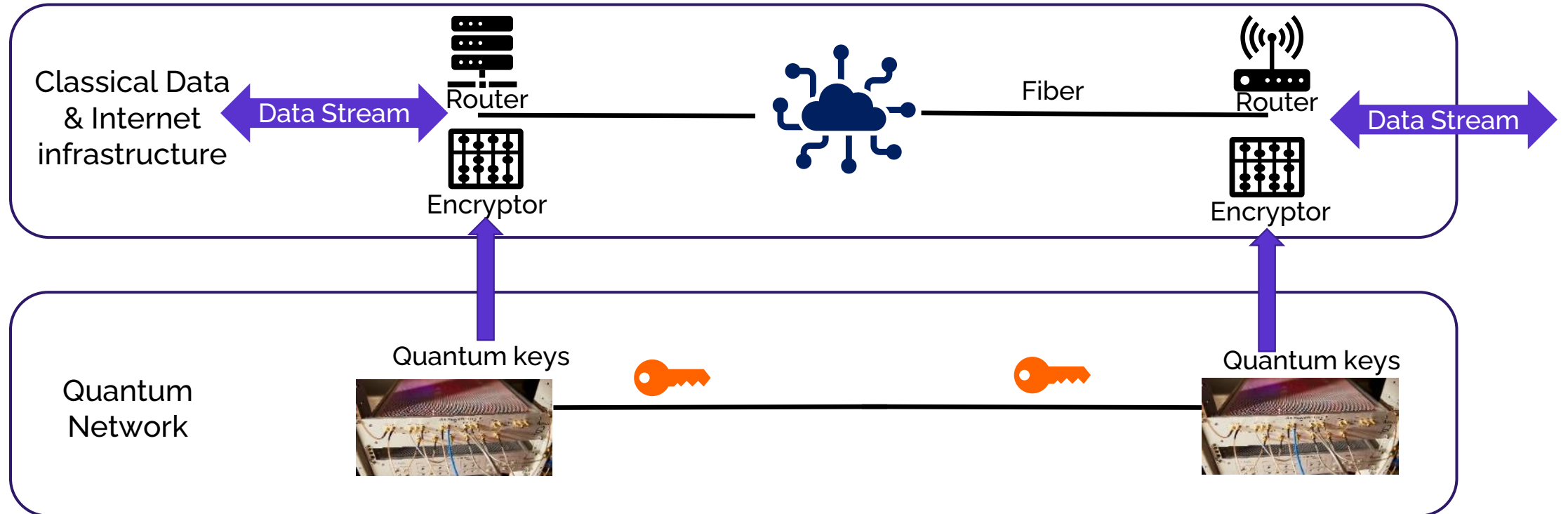
Quantum Communication = Secure Communication



Use quantum to protect our data infrastructure

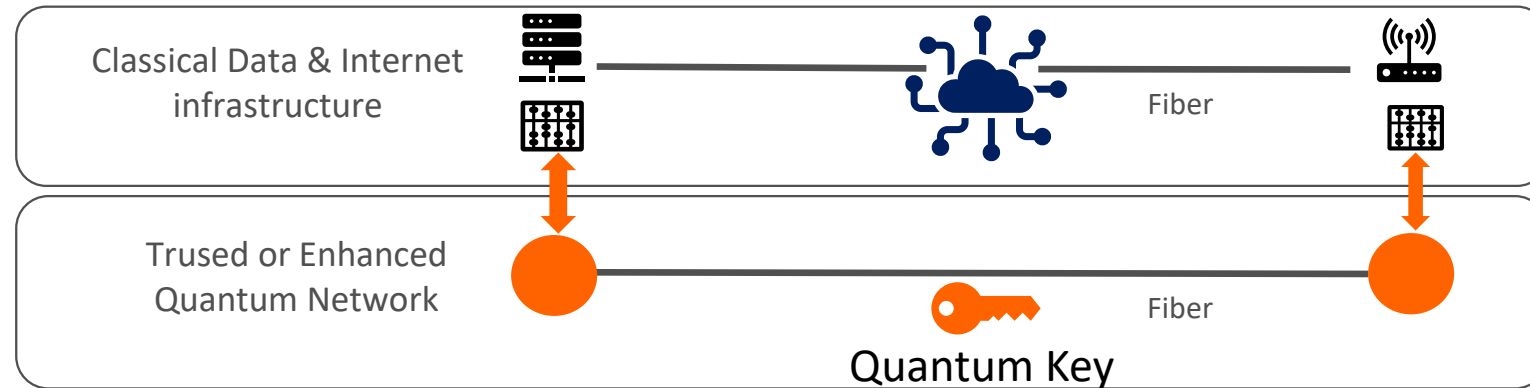


Protect classical data & internet networks

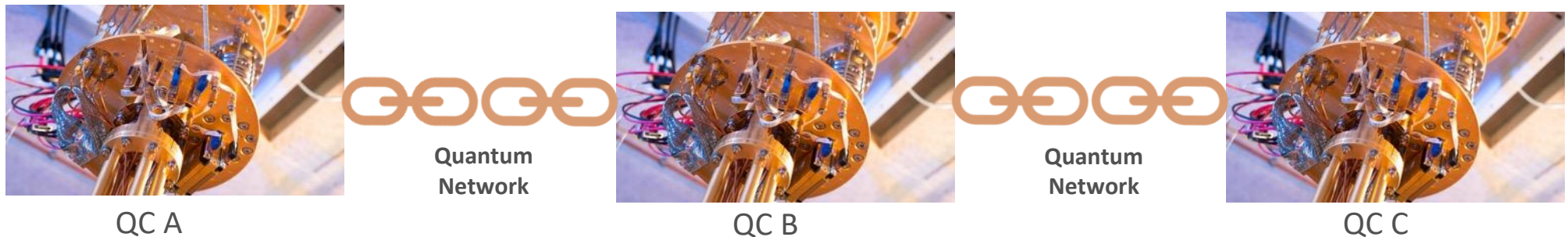


First and future generation quantum networks

1 Protect Classical Data & Internet



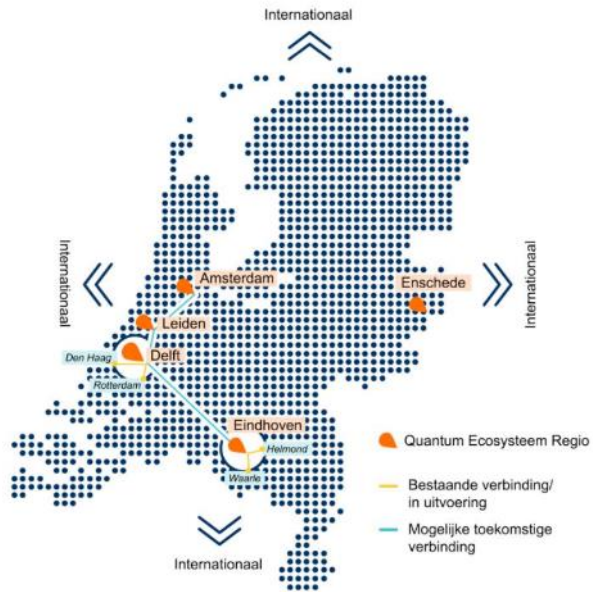
2 Connecting (Distributed) Quantum Computers



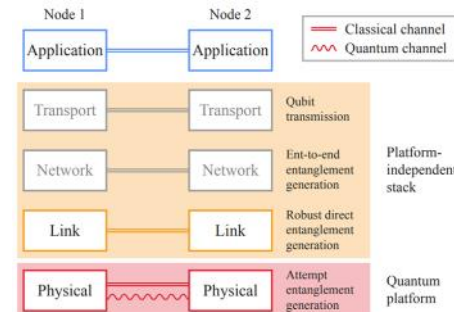
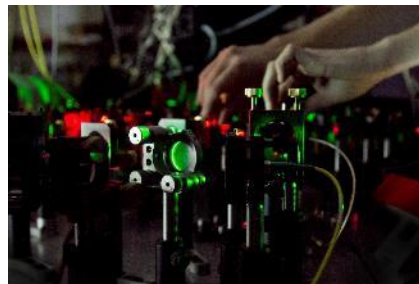
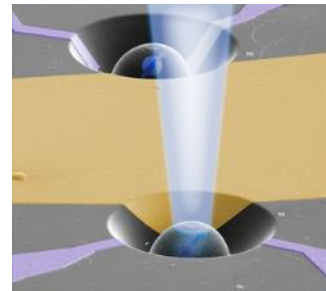
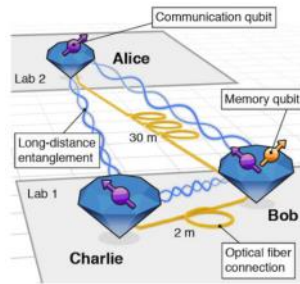
Building quantum networks



National quantum network
EU and national projects to
deploy quantum networks



Research & develop the building
blocks for a future quantum
internet



Commercialize quantum network
equipment, field tested quantum key
distribution devices



We are not the only one....

Newsroom > BT and Toshiba to build world's first commercial quantum-secured metro network across London
05 OCTOBER 2021

BT and Toshiba to build world's first commercial quantum-secured metro network across London



News Analysis Qanalysis
Another Metropolitan Quantum Network Being Set Up in the Washington DC Area

Numana announces the launch of the world's first open quantum telecommunication network

21 June 2022

Canada /Quebec region

Worldwide Quantum Network Being Set Up in the Washington DC Area

Research and Markets
Thu, 7 July 2022 at 11:18 am · 8-min read

Company Logo

RESEARCHANDMARKETS
THE WORLD'S LARGEST MARKET RESEARCH STORE

Dublin, July 07, 2022 (GLOBE NEWSWIRE) -- The "Opportunities in Quantum Networks: 2022 to 2031" report has been added to ResearchAndMarkets.com's offering.

DECLARATION ON A QUANTUM COMMUNICATION INFRASTRUCTURE FOR THE EU

All 27 EU Member States

have signed a declaration agreeing to work together to explore how to build a quantum communication infrastructure (QCI) across Europe, boosting European capabilities in quantum technologies, cybersecurity and industrial competitiveness.

@FutureTechEU #EuroQCI



Quantum Network Industry to 2031 - Players Include

Compact QKD System Paves The Way To Cost-Effective Satellite-Based Quantum Networks

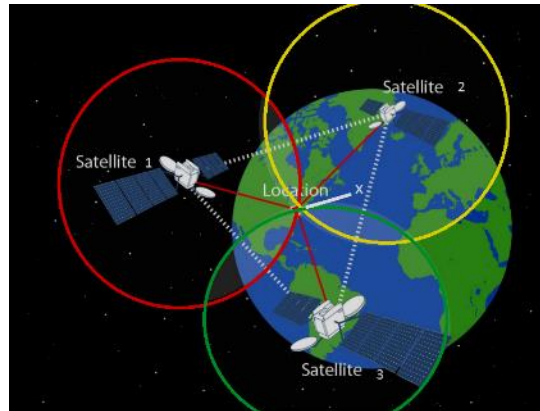


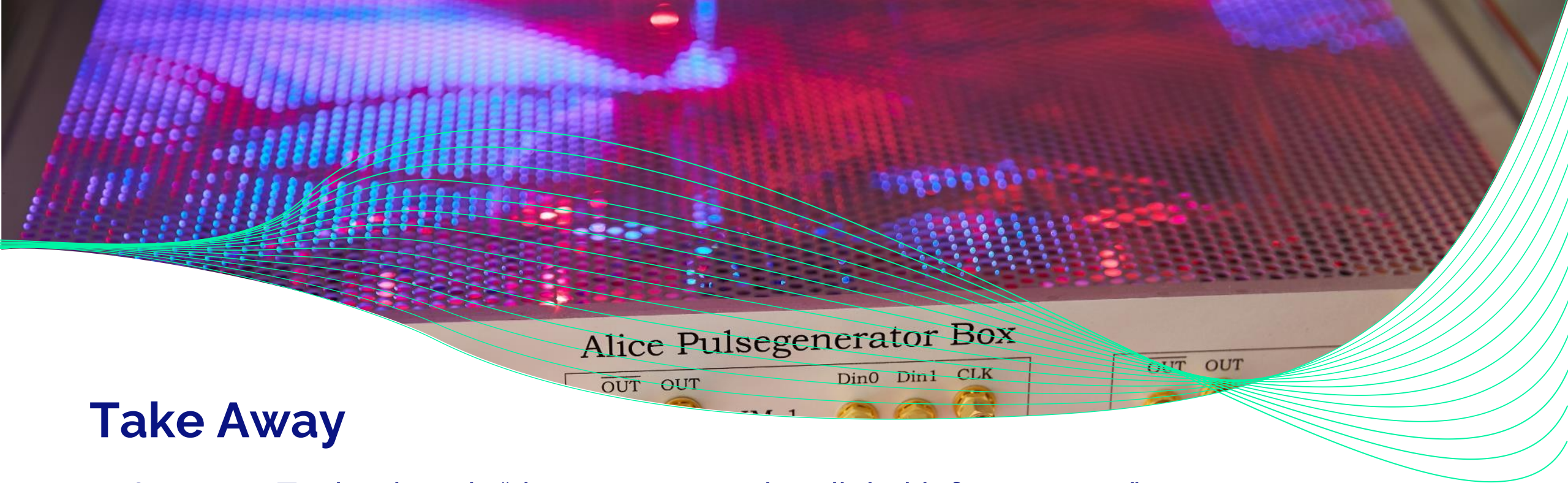
China

Impact on society

Societal impact & contribution to the SDG's

- Digital sovereignty & Strong institutions
- Protection of critical infrastructures
- Linking quantum sensors, connecting future quantum computers





Take Away

- ✦ Quantum Technology is “the next generation digital infrastructure”
- ✦ Quantum Technology: een **fundamenteel andere manier** van computation & communication
- ✦ **NU** is het moment om na te denken over **de impact** van quantum technology!



Thank you!

ingrid@q-bird.nl

www.q-bird.nl