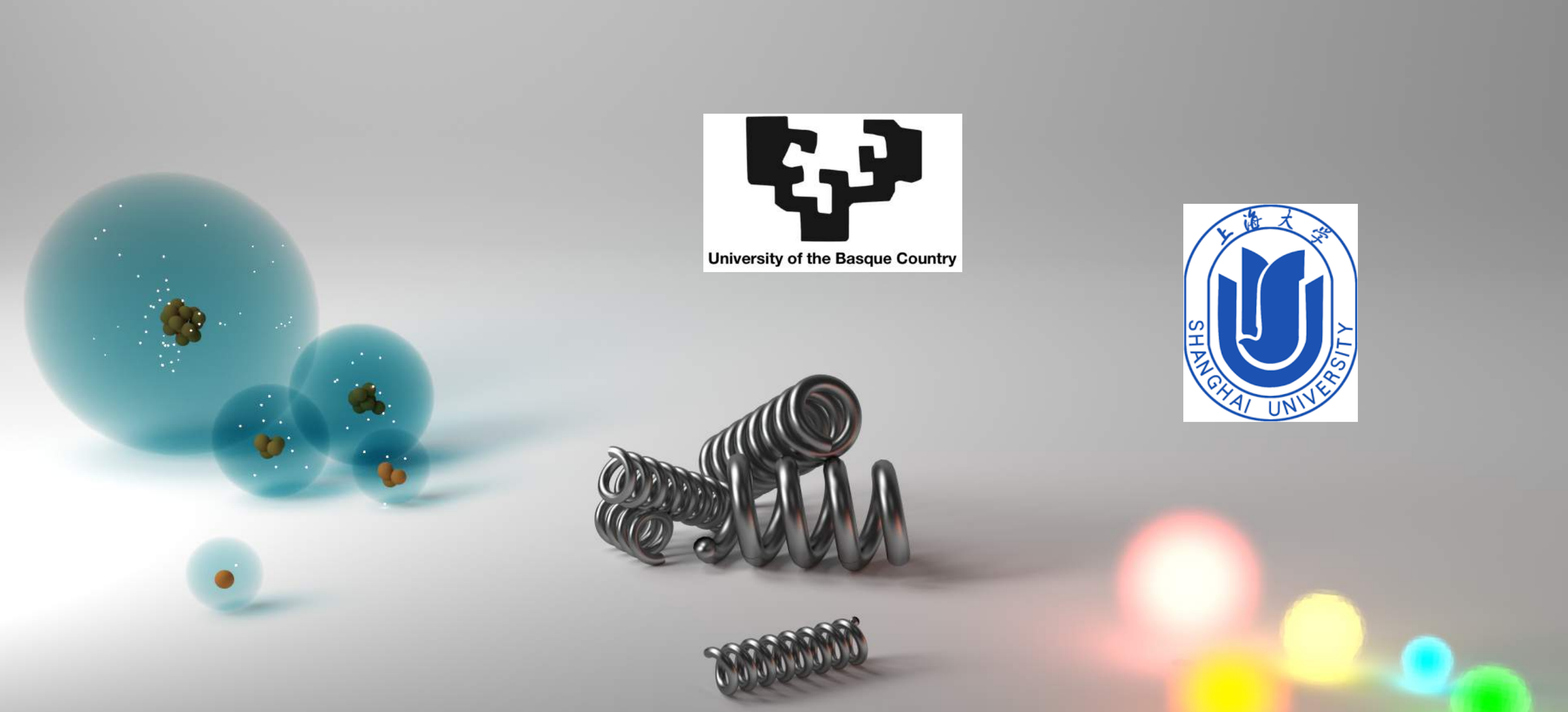


Quantum computers & industrial applications

E. Solano

University of the Basque Country & Shanghai University

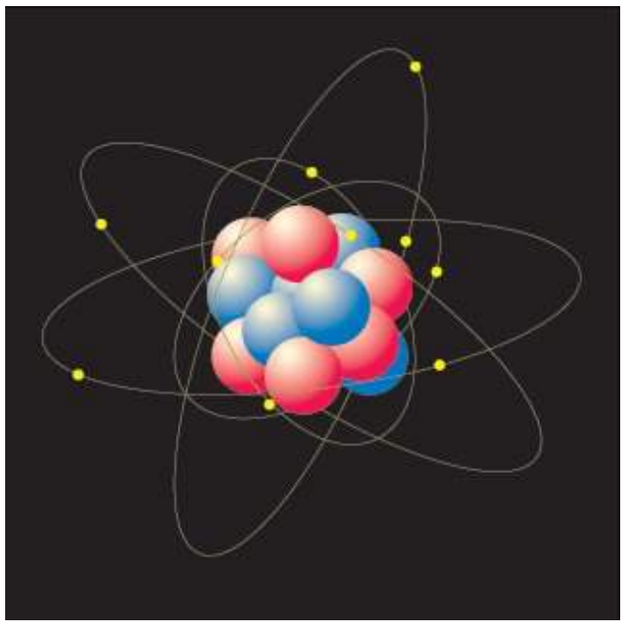
SECPhO Workshop, Madrid, May 2019

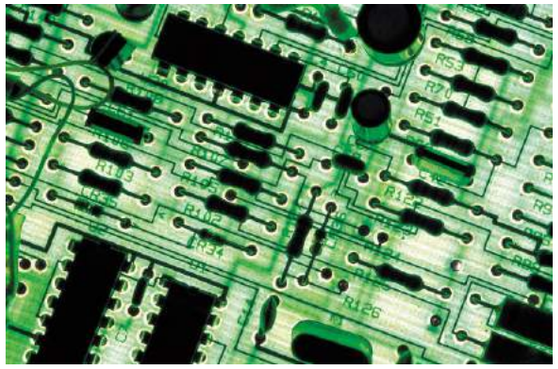
What is so mysterious in quantum physics?

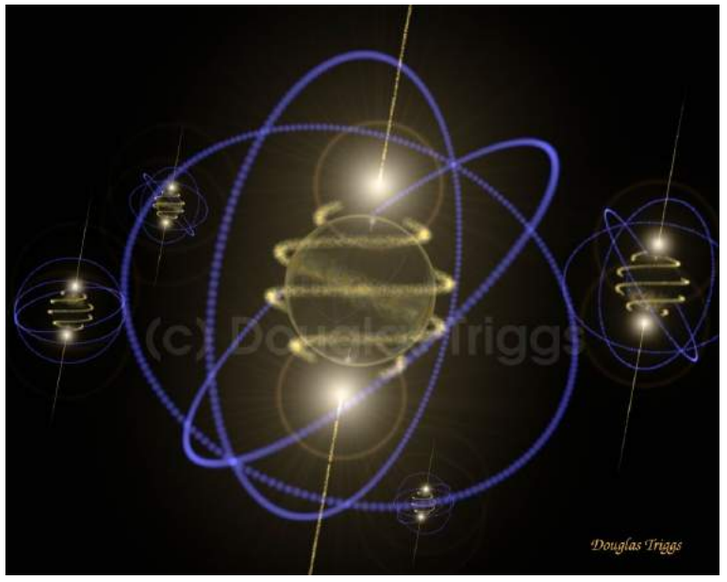
A particle or an atom can be in two states or two places at the same time

Excited and deexcited

Quantum bit or Qubit







Quantum computers use quantum parallelism

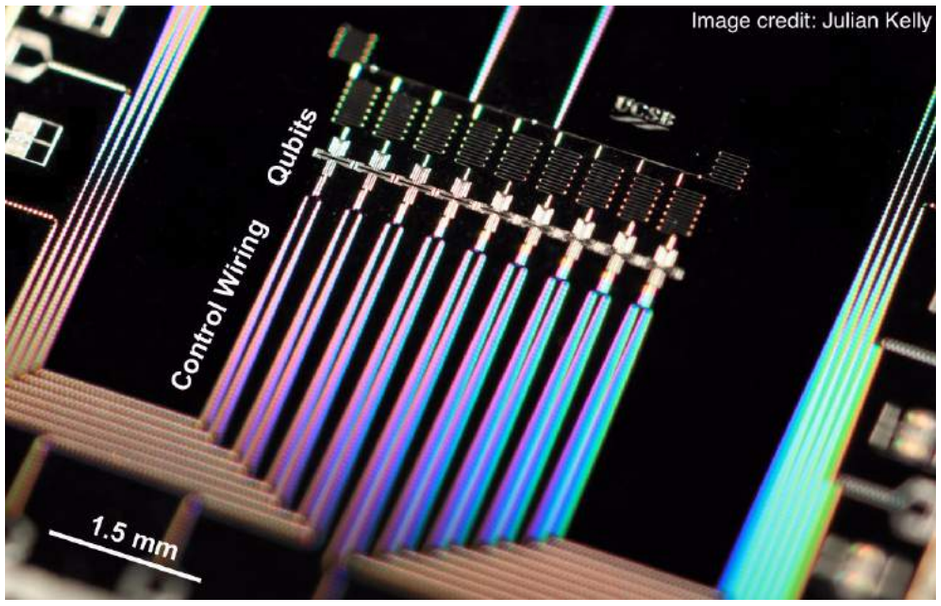
$00 \rightarrow 00$

$01 \rightarrow 01$

$10 \rightarrow 11$

$11 \rightarrow 10$

Classical controlled-NOT gate

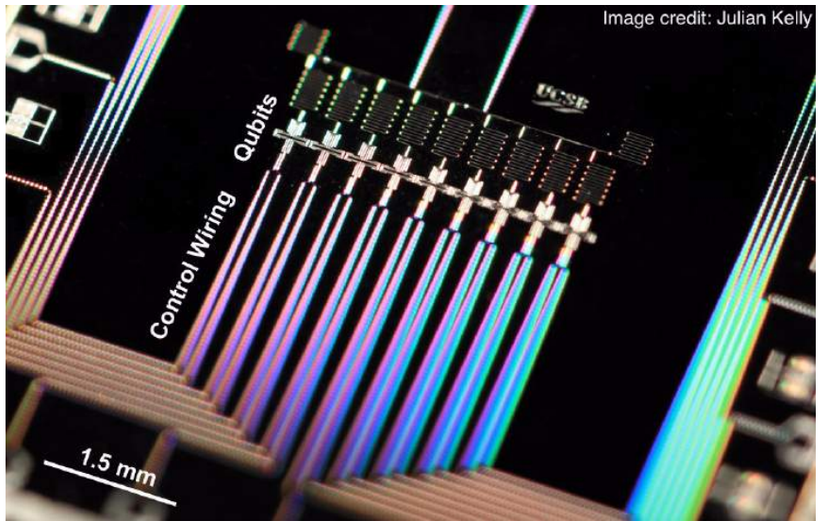


$$U_{CNOT}\left(c_{00}|00\rangle + c_{01}|01\rangle + c_{10}|10\rangle + c_{11}|11\rangle\right) =$$

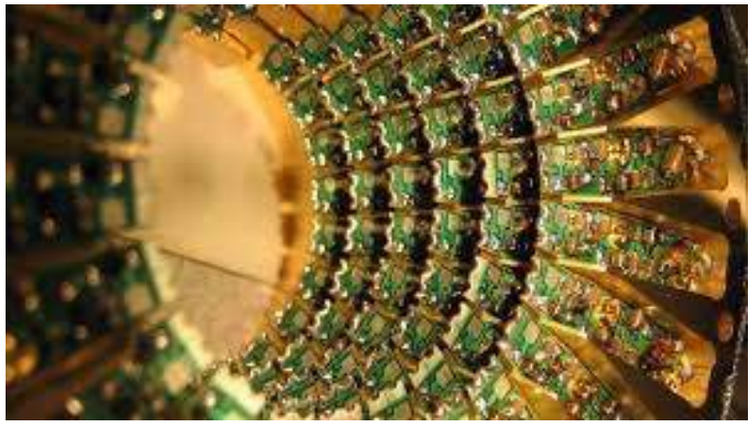
$$= c_{00}|00\rangle + c_{01}|01\rangle + c_{10}|11\rangle + c_{11}|10\rangle$$

Quantum controlled-NOT gate

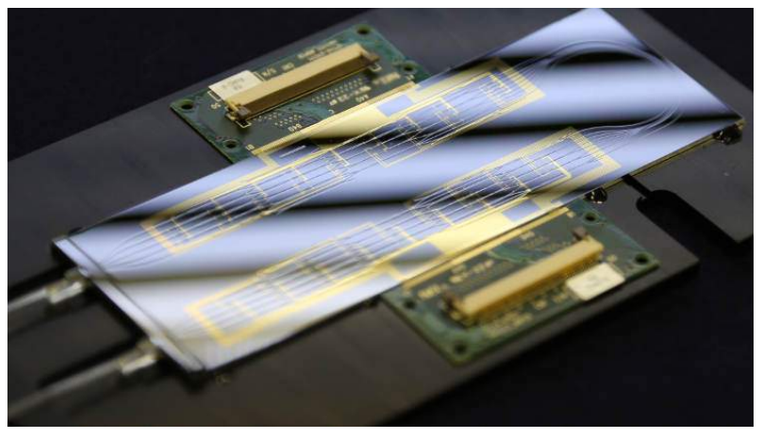
Quantum computers & Quantum supremacy



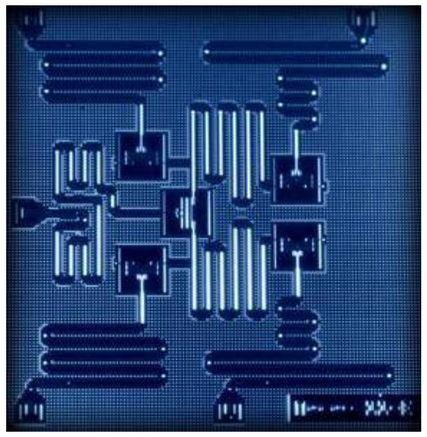
Google Quantum Computer



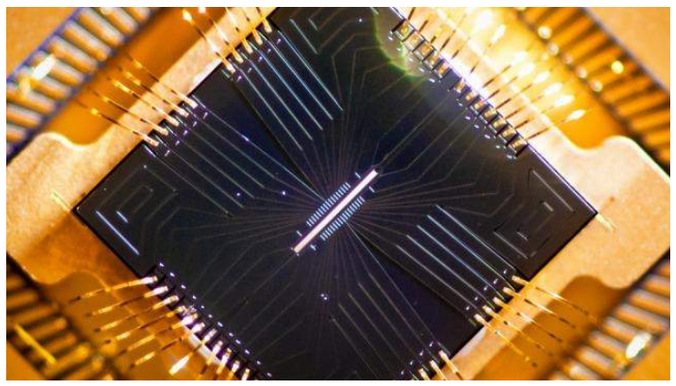
D-Wave Quantum computer



Photonic Quantum Computer



IBM Quantum Computer

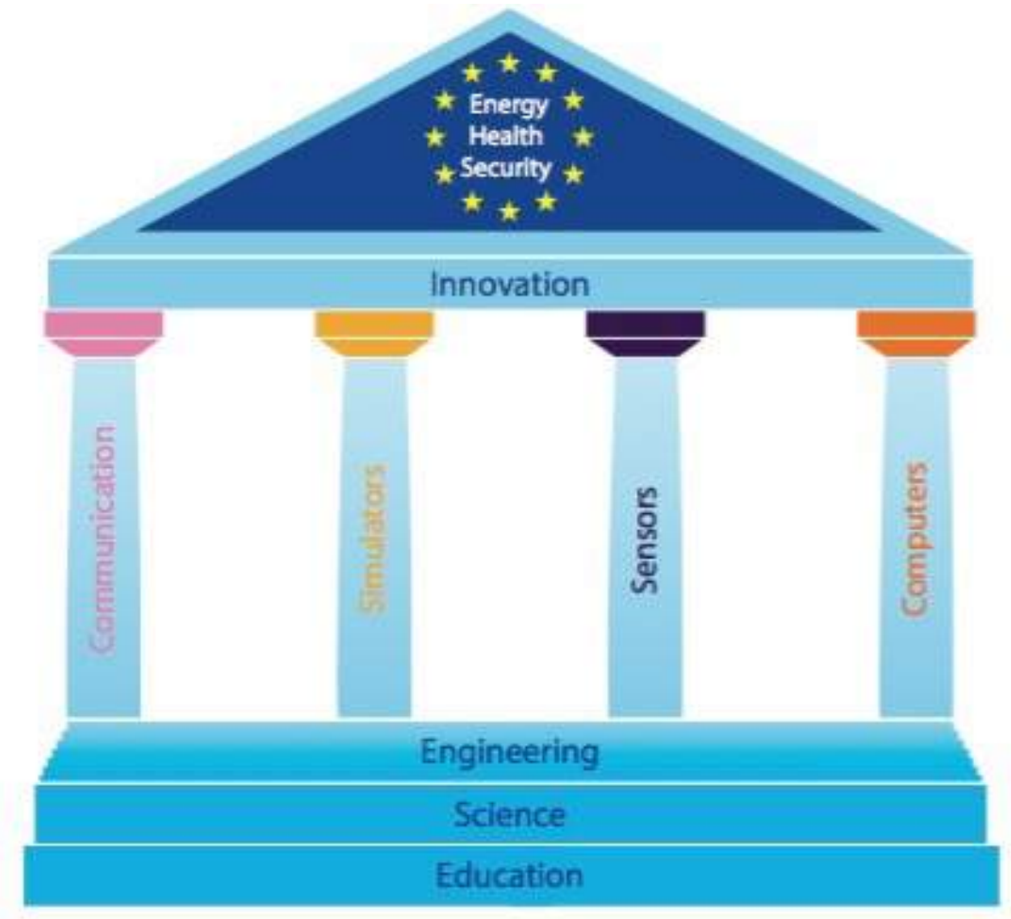


Ion Trap Quantum Computer

Will we ever have a quantum computer that outperforms classical computers?

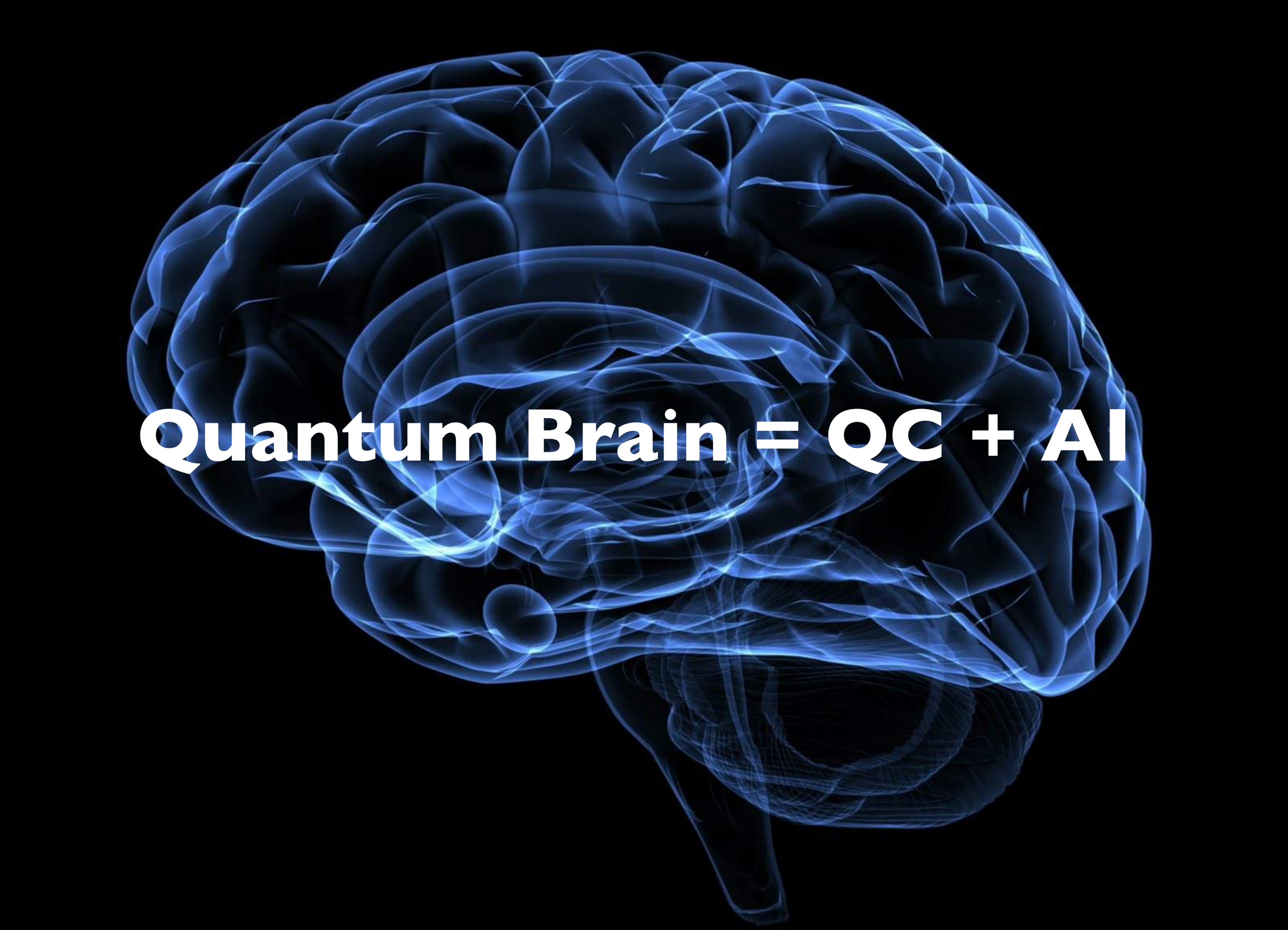
Quantum technologies

- Quantum Computing, Quantum Simulation, Quantum Communication, Quantum Sensing



Elements of a European programme in quantum technologies.

- In quantum technologies there is room for arts, science, technology, and entrepreneurship



Quantum Brain = QC + AI

Bilbao-Shanghai Quantum Roadmap

Digital steps provide versatility

Digital-Analog Quantum Simulation

DAQS

Analog blocks provide complexity

Digital steps provide versatility

Digital-Adiabatic quantum computing

DAQC

Adiabatic blocks provide complexity

DQS + AQS+AQC

Complexity Simulating/Computing Complexity

Embedding Quantum Simulators

EQS

Optimal Quantum Control

OQC

Biomimetic Quantum Technologies

(NQT)

Quantum Machine Learning

QML

Quantum Artificial Intelligence

QAI

Quantum memristors provide complexity

Prof. Enrique Solano

QUTIS Research

Quantum optics
Quantum information
Superconducting circuits
Quantum biomimetics

Íñigo Galindo-Leandro
Asier Galicia
Álvaro Gil-Muñoz
Jon Pérez-Visaires
Borja Ramón-Gómez
Asier Izquierdo
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B. Sc. Bruno Candelas

M. Sc. Ana Martín-Fernández
M. Sc. Tasio Gonzáles-Raya
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M. Sc. Adrián Parra-Rodríguez
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