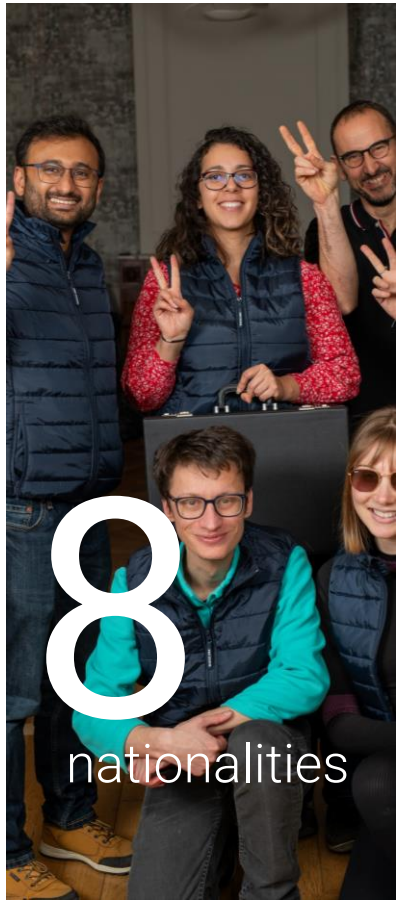
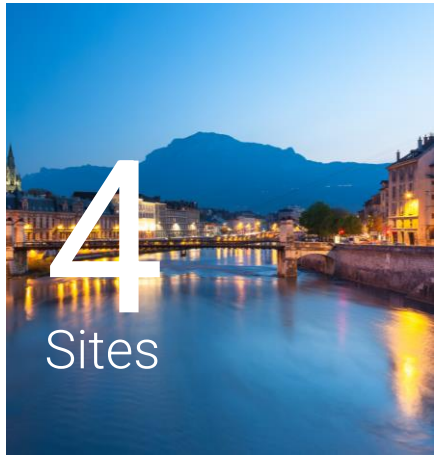
quobly

Quantum world congress 2024

Unlocking the Future:
Quobly's Path to Scalable Quantum Computing

Quobly was launched in November 2022.





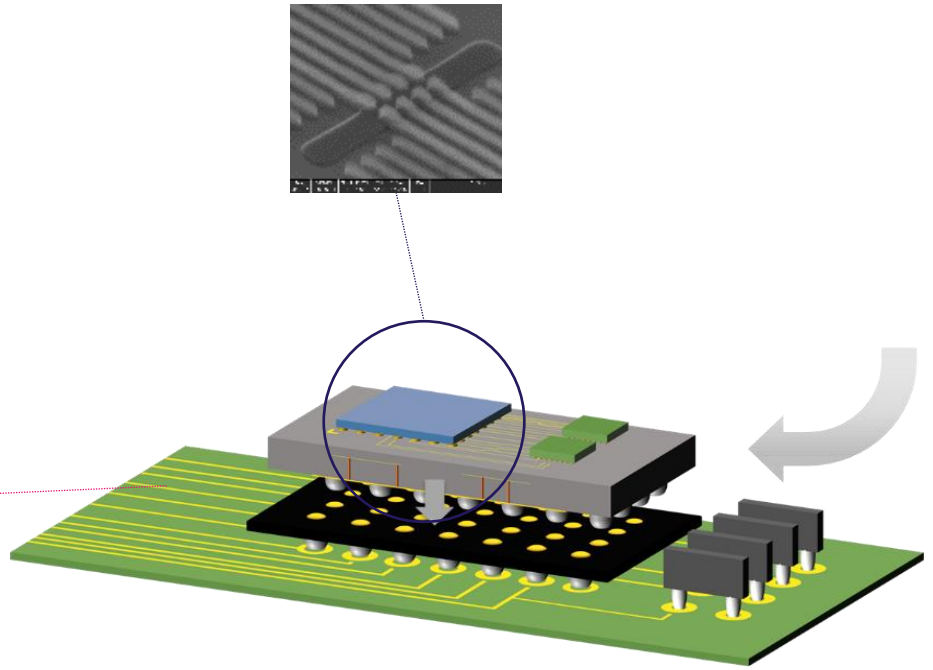
Our networks

IEC ISO MINALOGIC EIC ScalingClub Selected Club Member le lab quantique UIC QuantAlps #QEI the quantum energy initiative QUANTUM FLAGSHIP FRANCE 2030 LES MAISONS DU QUANTIQUE FRANCE DEEPTECH CREATIVE DESTRUCTION LAB Le HUB Quantique

Our future product

A universal quantum server

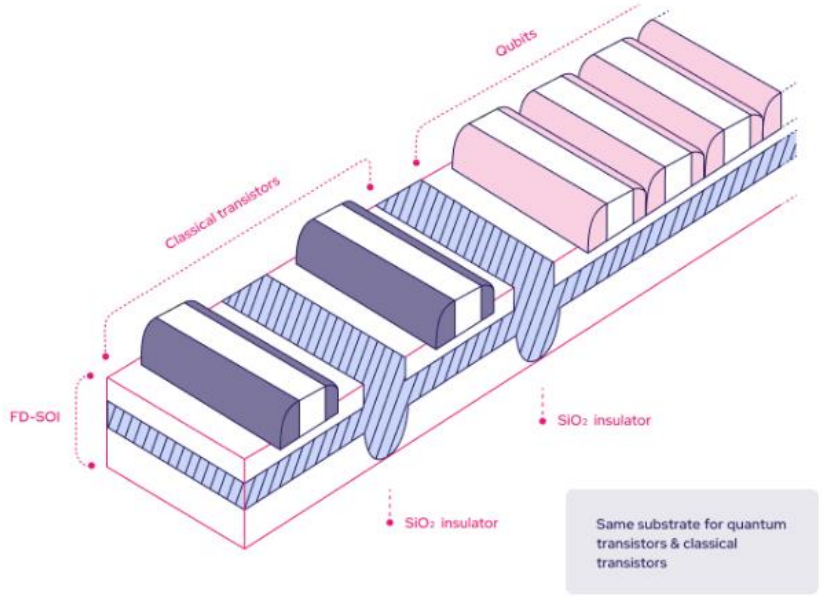
QUANTUM CORE



With quantum µprocessor (QPU) based on FDSOI

To leverage the semiconductor industry's 60+ years of experience, we have a fabless approach using commercial FD-SOI technologies.

It's the fastest and most cost-effective path.



Quantum integrated circuit in cryogenic enviroment

Protected by **40+** patents

Technology Roadmap

Control electronics

1D array

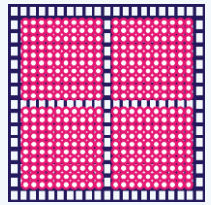
System in package (SiP)

1D multicore

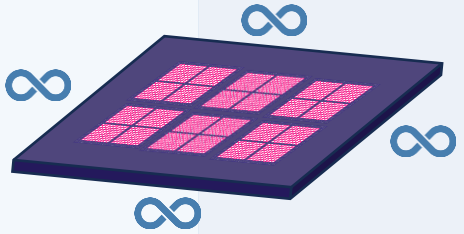
1D System on Chip (SoC)

2D array

2D multicore



2D multicore SoC with quantum links



= quantum links

Noisy quantum systems | Quantum advantage PoV | LSQ

2023 | 2025 | 2027 | 2029 | 2031 | 2033 | 2035+

Emulator

Remote access

Series A deliverables

Scalability demonstration

100 physical qubit chip
& cryoelectronics on chip

Gen 1 QPU servers

Series B deliverable

First QC computer with QEC PoC
GtM demonstrated

100 logical qubit chip

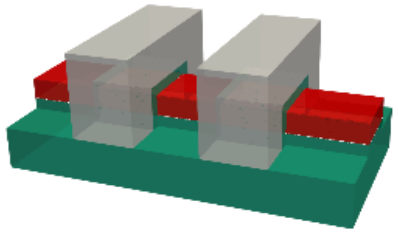
Gen 2 QPUs

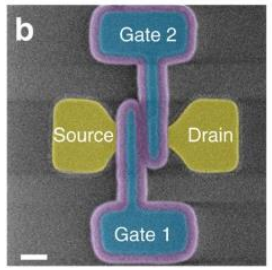
On-premise QaaS

Product Roadmap

Evolution of our devices

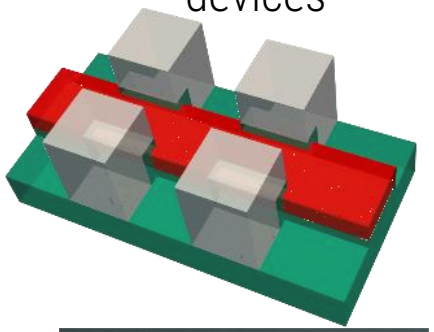
Nanowire devices with series gates

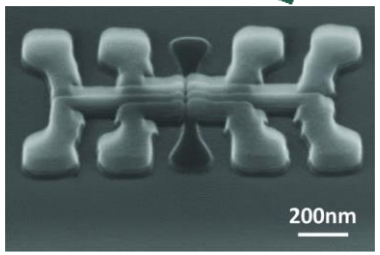




S. De Franceschi, *IEDM* 2016

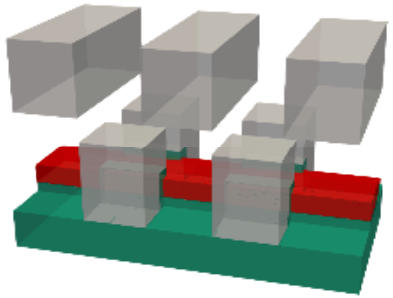
Face-to-Face (FF) devices

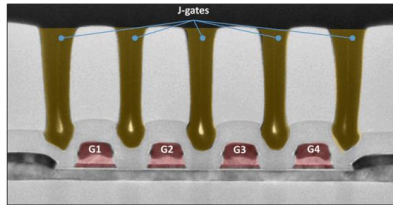




L. Hutin, *IEDM* 2018

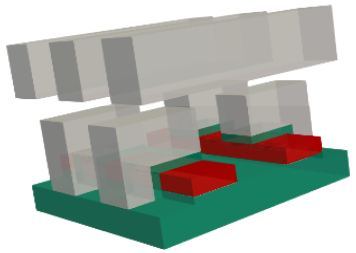
FF with J-gates

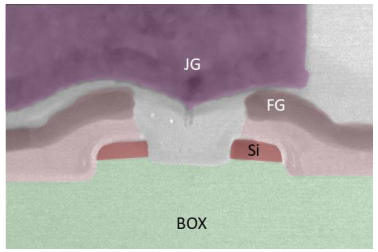




T. Bédécarrats, *IEDM* 2021

FF with J-gates and trench cut





B. Bertrand, *IEDM* 2023

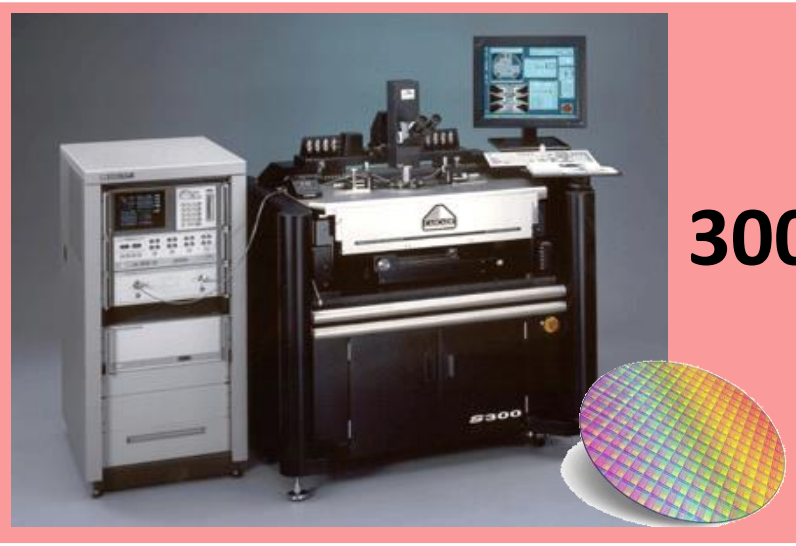
Time

2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

Gen. 1 Gen. 2 Gen. 3 Gen. 4

Experimental test setups

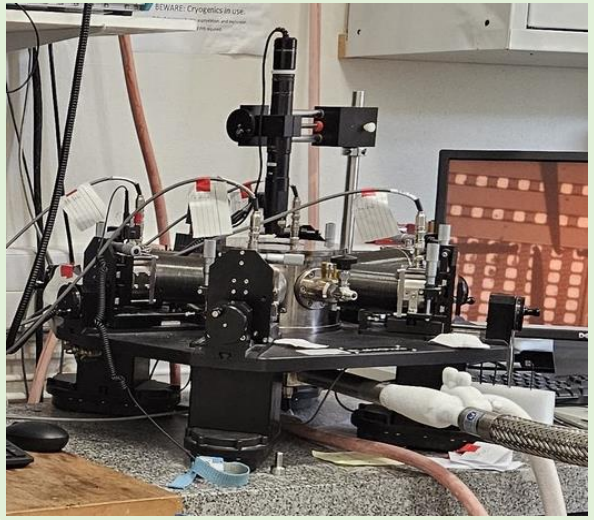
High-throughput



300K

2K

Device-level



4K

mK

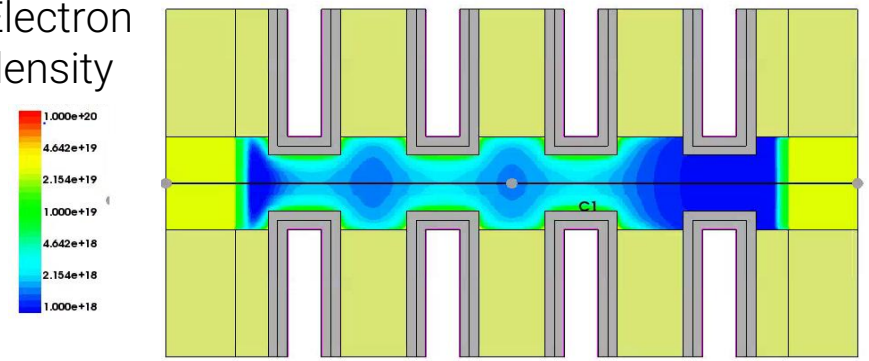
Simulation Methodologies

Room temperature :

- Sentaurus software
- Leader in TCAD solutions for the microelectronic industry

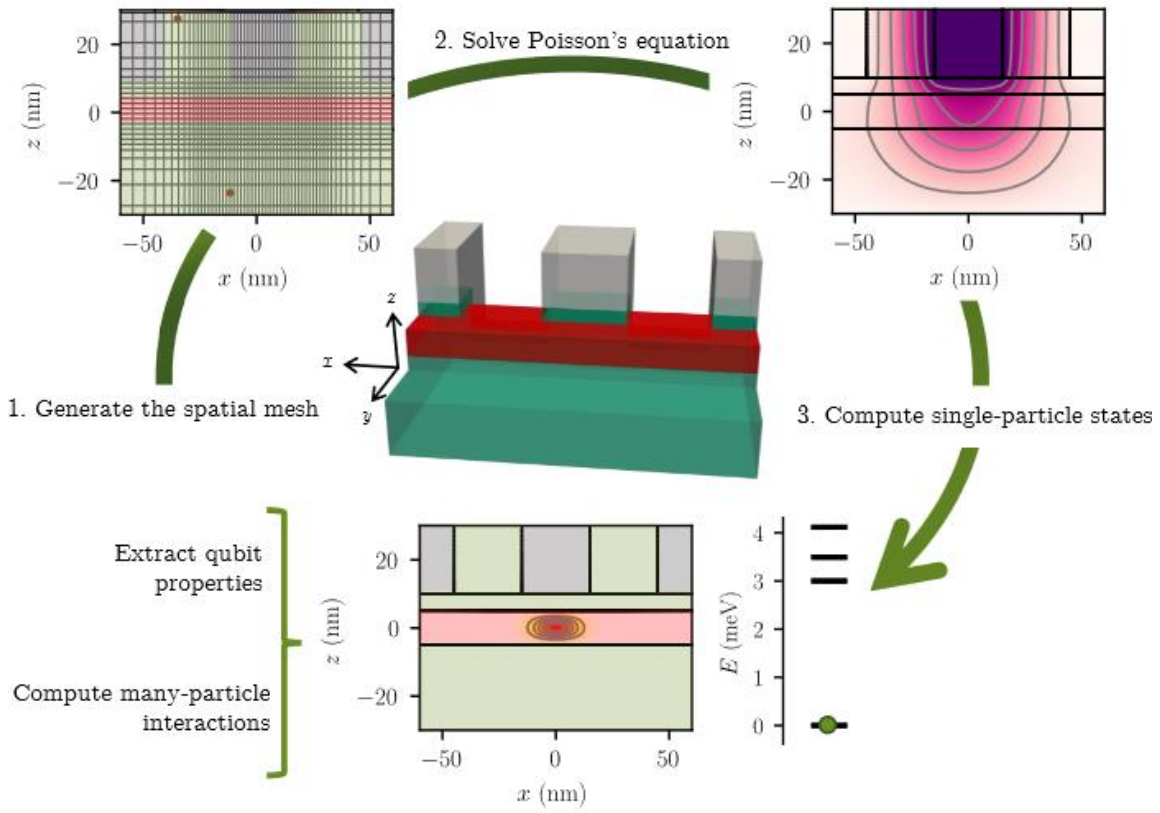
SYNOPSYS®

Electron density



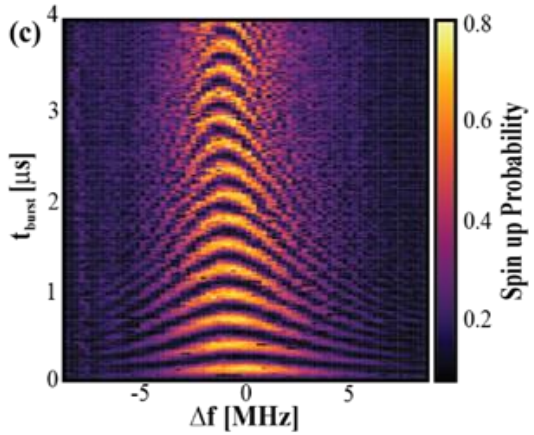
Low temperature Few electrons :

TB-Sim, QTCAD



Individual qubit demonstrations

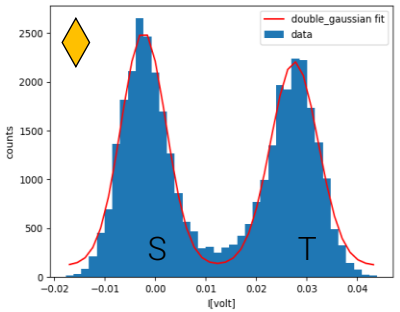
One qubit gate showing excellent performance



A. Crippa et al., Nature Com 2019
N. Piot et al., Nature Nano 2022
B. Klemt et al., Nature QI (2023)
B. Paz et al, IEDM 2024

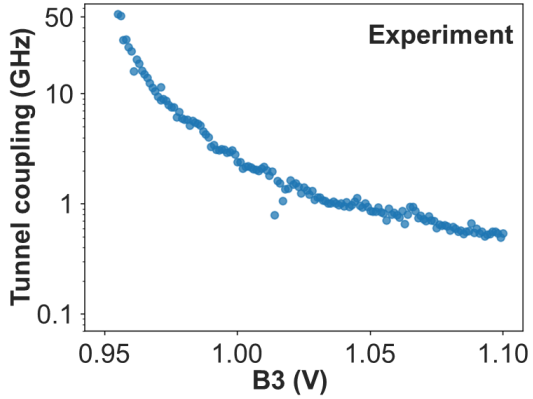
Excellent results: over 98% single shot spin read-out

B=50mT, shot rep. 50µs



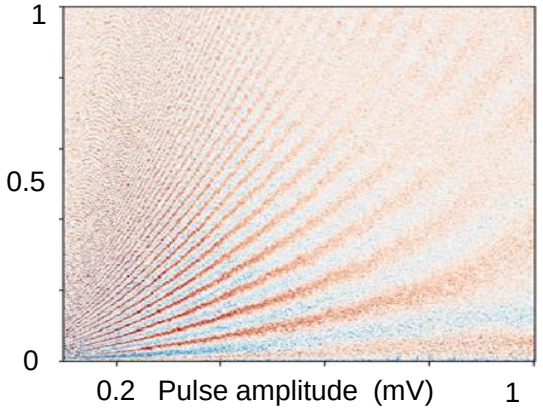
Urdampilleta et al., Nature Nano 2019
A. Crippa et al., Nature Com 2019
T. Lundberg et al., PRX 2020
D. Niegeman et al., PRX Quantum (2022)
V. El Homsy et al., Arxiv (2023)

Tunnel-coupling – highly promising results



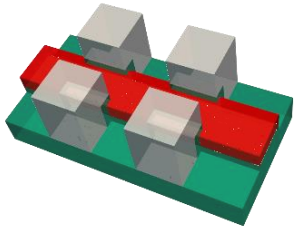
B. Paz, SIQEW 2024
B. Paz et al, IEDM 2024

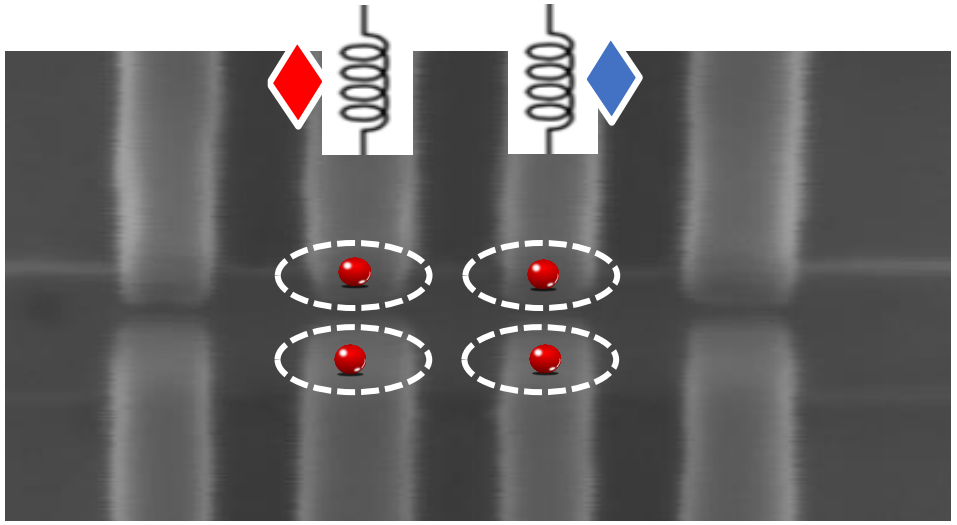
Achievement of a two qubit gate



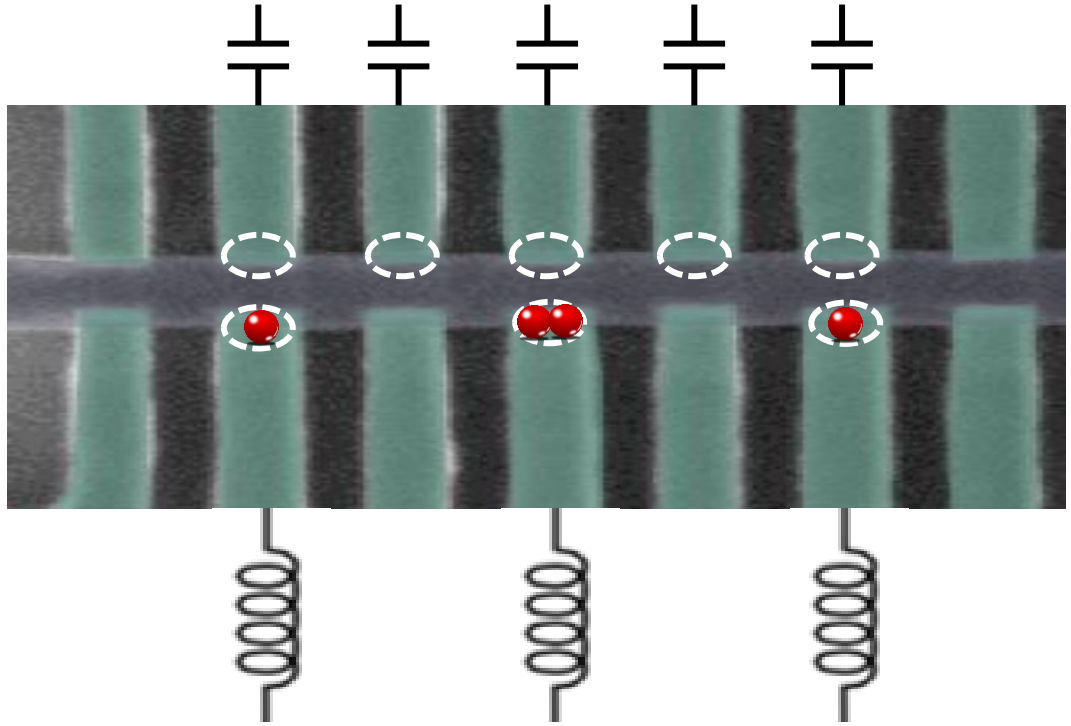
P. Hamonic et al, submitted 2024
P. Hamonic et al, in preparation
B. Paz et al, IEDM 2024

Up to 5x2 array of electron spins





2x2 array of electron spins

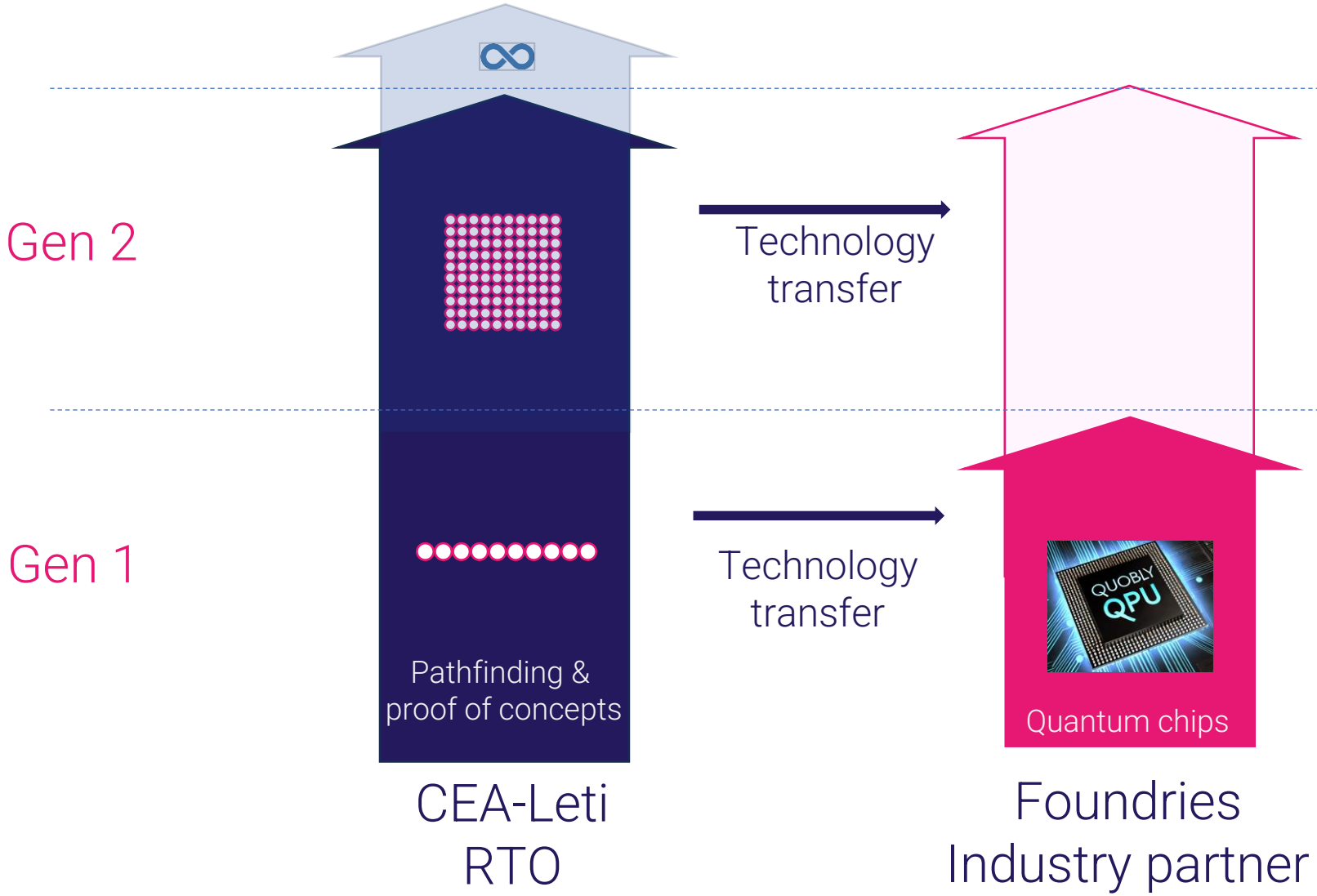


5x2 quantum dot array of electron spins

Two-qubit gate dynamics in 2x2 array

P. Hamonic et al, in preparation

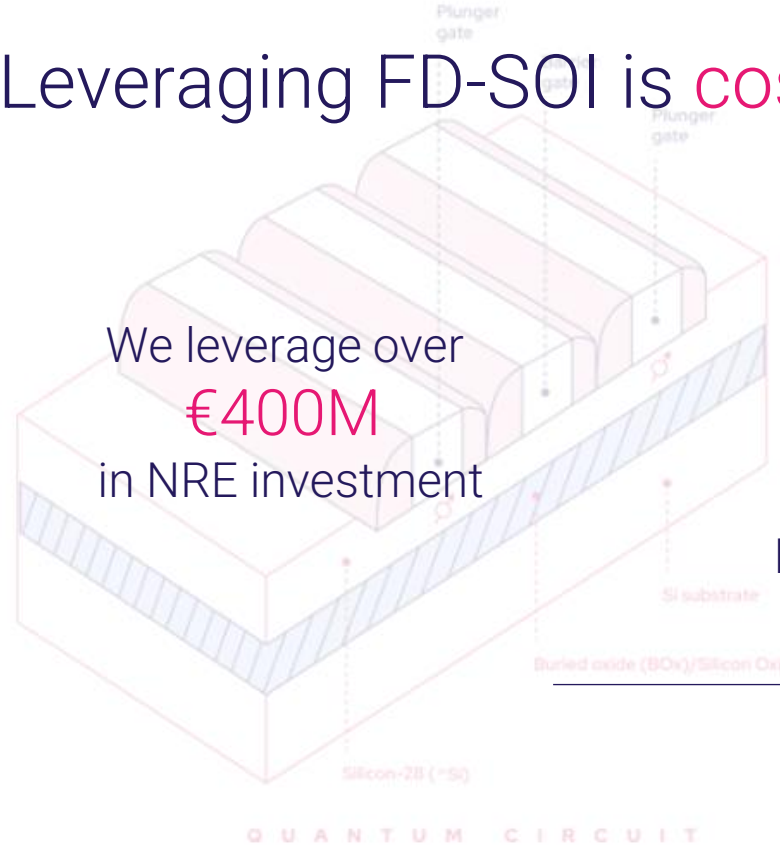
From RTO to Industry



HW and enabling partnerships

Si-28 substrate	orano, soitec, Air Liquide, life.augmented
EDA, simulation & modeling	cadence, SYNOPSYS, NANOACADEMIC TECHNOLOGIES, SIEMENS
Equipment	BLUEFORS, KEYSIGHT TECHNOLOGIES, FormFactor, Radiall
Foundries	life.augmented, GlobalFoundries
R&D labs	cea leti, NÉEL institut

Leveraging FD-SOI is cost efficient.



We leverage over
€400M
in NRE investment

We add qubits while respecting the stringent fabrication guidelines of FD-SOI

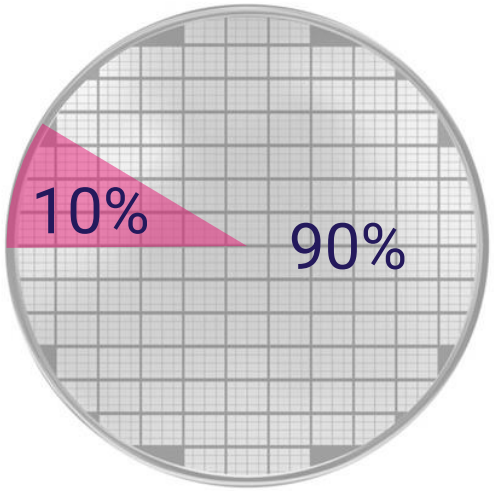
Ensures short qualification

This makes our qubits:

- Cost efficient
- Large-scale production-compatible

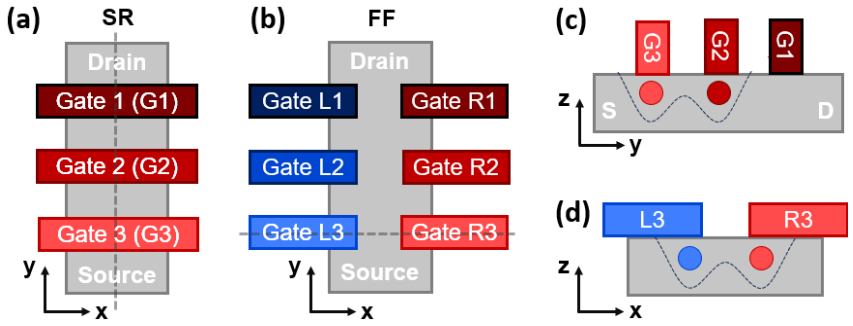
We modify 10% of fab processes.

90% follow standard semiconductor processes & use standard EDA tools



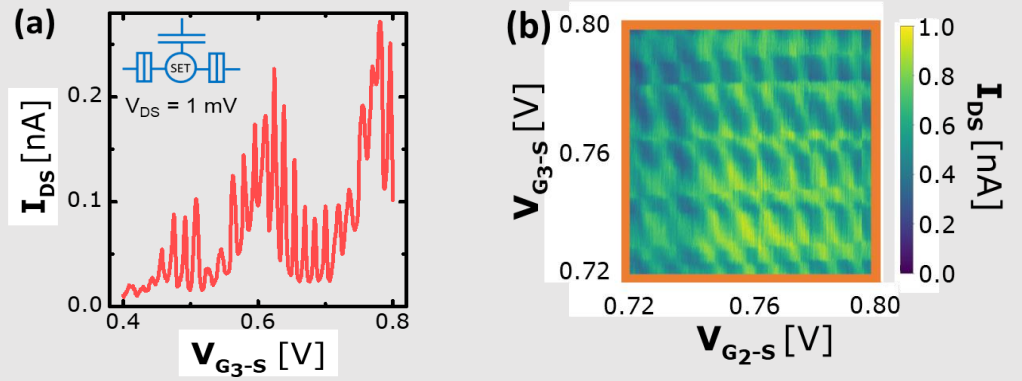
Successful formation of coupled quantum dots in 22FDX® qubit devices

Quobly: G. Elbaz et al - SiQeW 2024

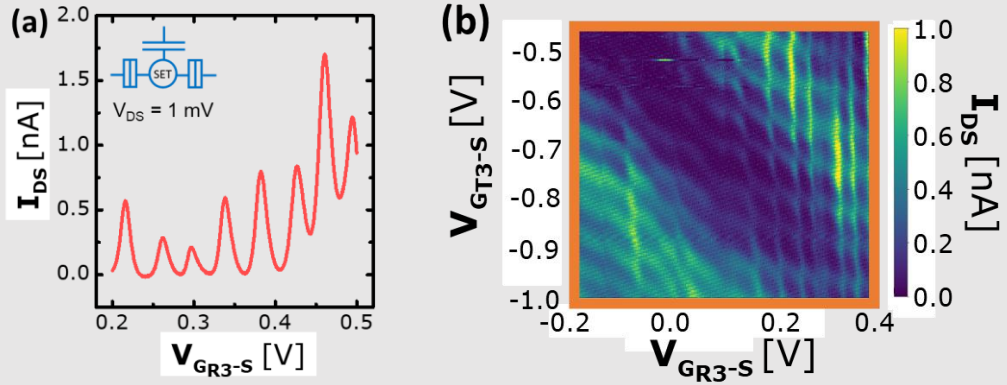


Using the commercial 22FDX® platform, we successfully show that we can form coupled quantum dots in devices expressly designed for spin qubits

QuDot and QuDot coupling in a SR device (G3/G2)

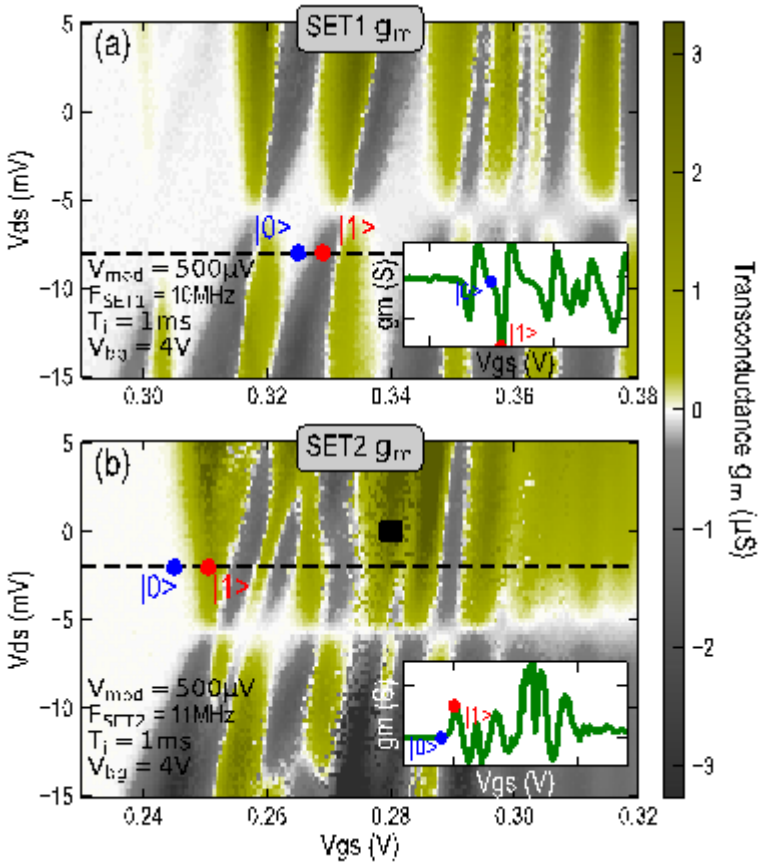


QuDot and QuDot coupling in a FF device (L3/R3)



Compact frequency multiplexed readout of silicon quantum dots in monolithic FDSOI 28nm technology

Leti: Quentin Schmidt, Quobly: T. Meunier et al - ESSERC 2024



This paper demonstrates the first on-chip frequency multiplexed readout of two co-integrated single-electron transistors without the need for bulky resonators.

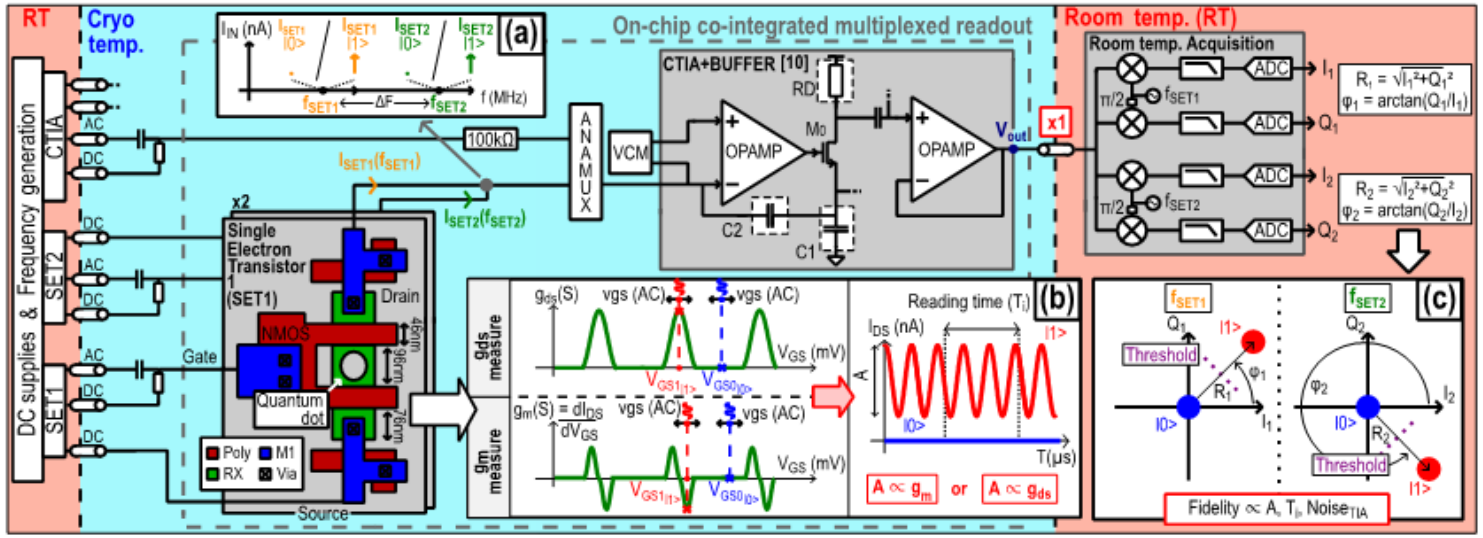


Fig. 2. Single electron transistors (SETs) geometry and block diagram of the proposed frequency multiplexed TIA-based readout. (a) Input signal frequency representation. (b) Illustration of the different measurable parameters. (c) Depiction of the thresholding algorithm for I/Q signals.

Take-away

- Quobly has the knowledge to deliver good qubits from a FD-SOI technology
- Quobly has an ecosystem to develop a scalable, industry-compatible version of its technology
- Having demonstrated qudot coupling in 22FDX and co-integration (CMOS and qudots) in FD-SOI 28nm, we have demonstrated critical milestones on the path to large-scale, fault-tolerant quantum computing

An ambitious vision for quantum computing.

A VIABLE PLAN FOR BRINGING IT TO LIFE.

Thank you!

www.quobly.io | Quobly