



From Semiconductors to Quantum: Infineon's Multi-Technology Approach

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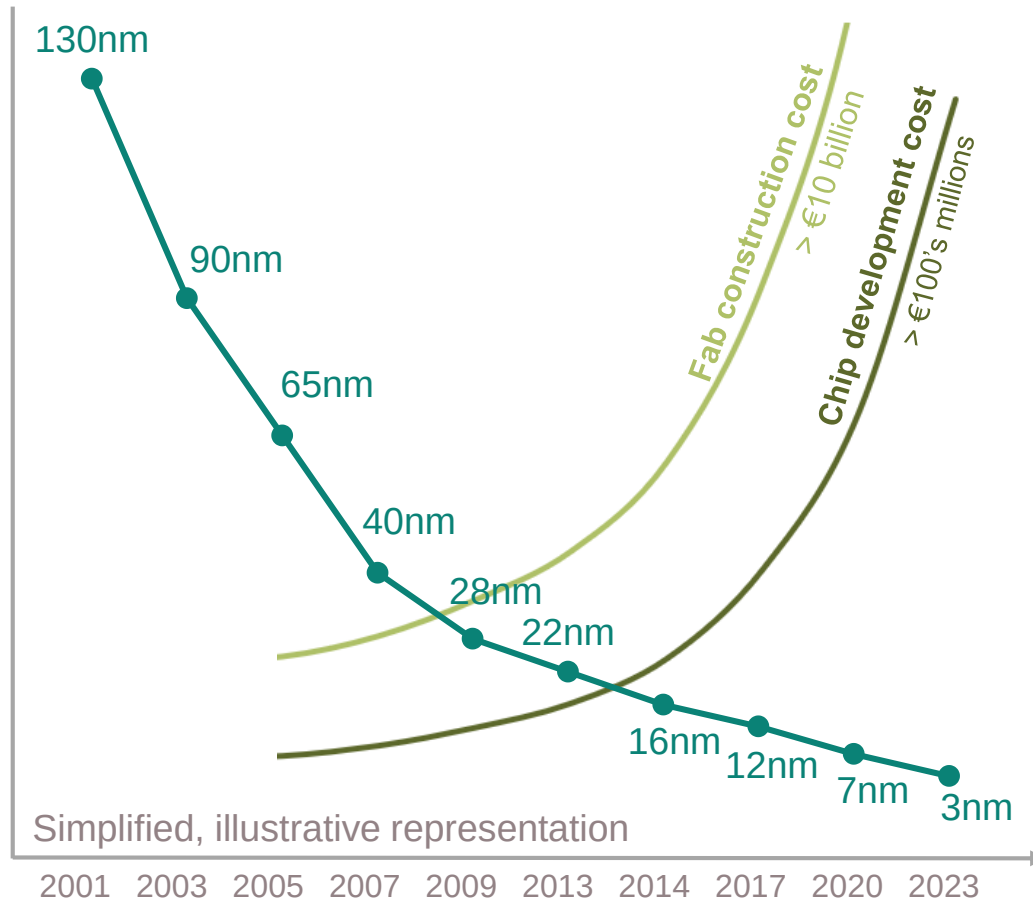
Nov 19th, 2025



Costs for advanced nodes are exploding: Development costs per chip > €100's millions, construction of a fab > €10 billion

Evolution of node sizes (year of leading edge)

Feature Size ("Node")



(Image: AZ Central)



The increasing effort for smaller nodes drives the development of alternative concepts

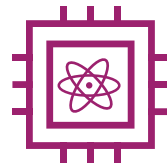
- It is becoming increasingly demanding to increase computing power
- Energy consumption for AI data centers is increasing drastically, imposing a challenge to carbon footprint
- New computing concepts, architectures and platforms could push the boundaries of modern data processing
- Amongst others:



Optical
Computing



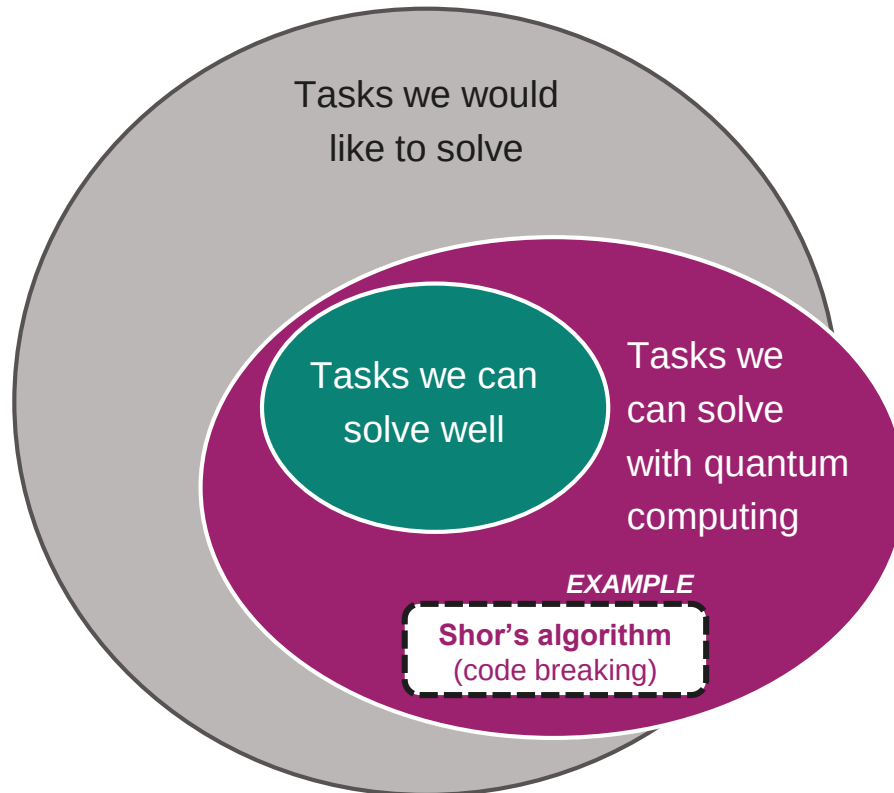
Neuromorphic
Computing



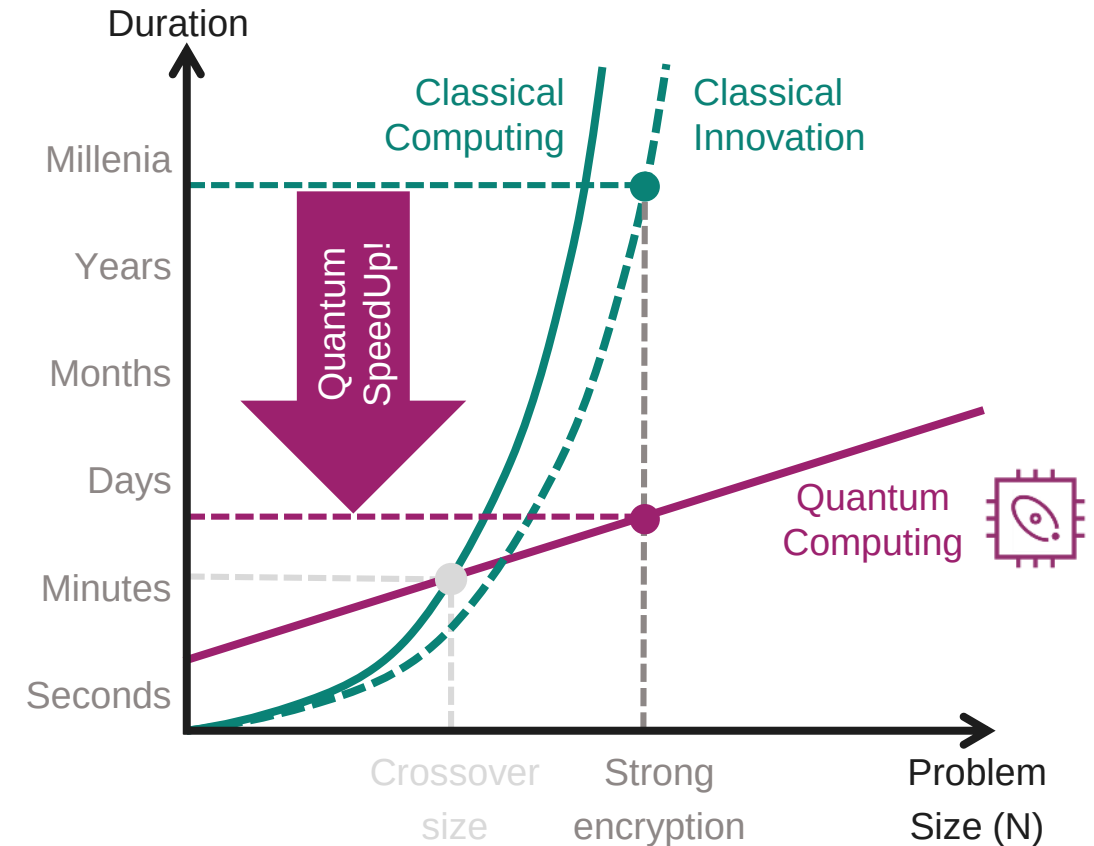
Quantum
Computing

Future quantum computers will open up a new solution space to complex problems such as encryption breaking

Powerful quantum computers will allow us to address certain tasks which we cannot solve well with classical quantum computers



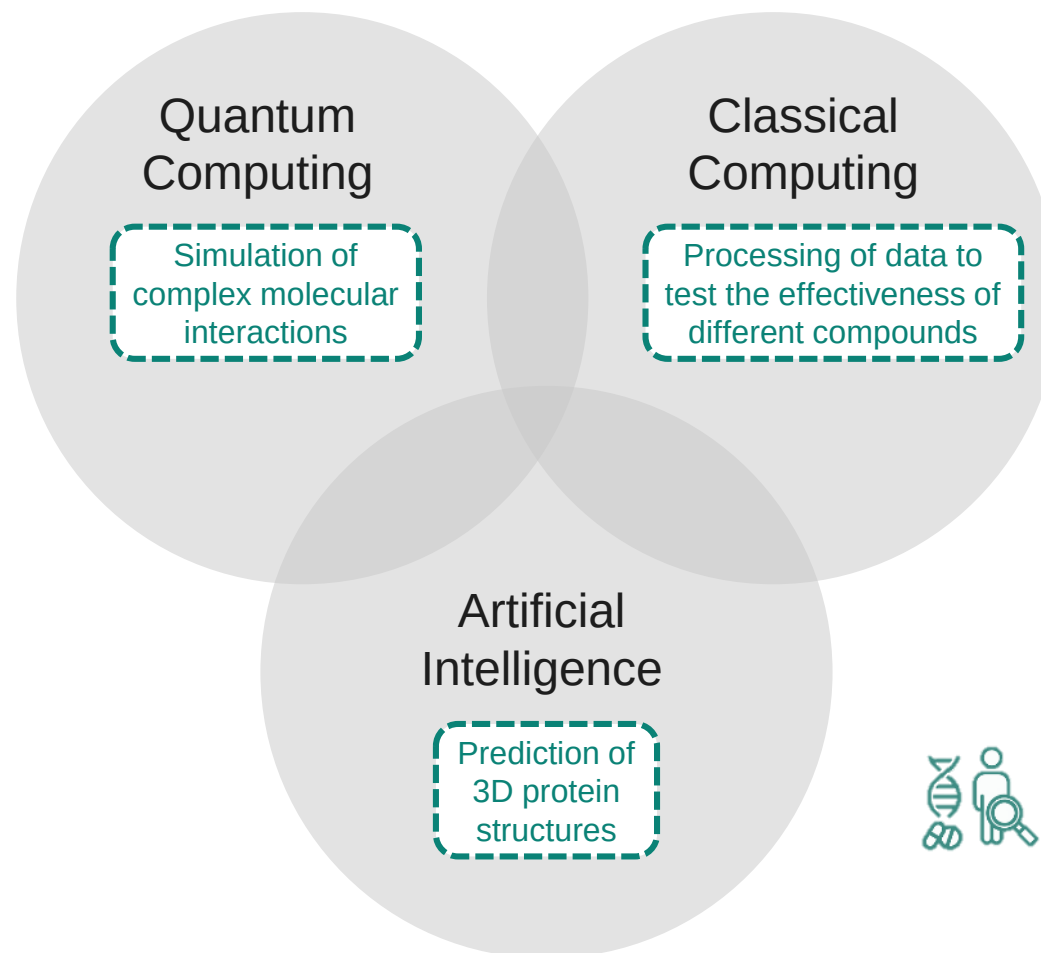
Quantum computers are exponentially faster than classical computers – for certain types of complex problems





Quantum Computing

Quantum Computers will complement
(not replace) Classical Computers and AI



Example:
Drug Discovery

Courtesy of F. Schmidt

Let's join forces with German industry giants to evaluate the quantum computing potential in relevant applications



QUTAC, founded in June 2021, unites a broad cross-section of German industry focuses on raising quantum computing to the level of large-scale industrial application



Quantum computers can help develop **new and better catalysts** for fertilizer production and thus contribute to a **significant reduction in global energy consumption.**



Quantum computers could contribute to an **improved inventory forecasting**, a **more robust supply chain** and thus a **more stable economy.**

www.qutac.de



Guiding questions

Which will be the first economically relevant application that gives us a benefit over conventional computers?



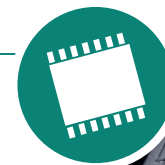
Chemistry
Simulation

Logistics
Optimization

Portfolio
Management

Generated by DALL·E 3, September 20th, 2024

Which type of hardware will be best suited to run this application and when will the hardware be available?



Semi-
conductors

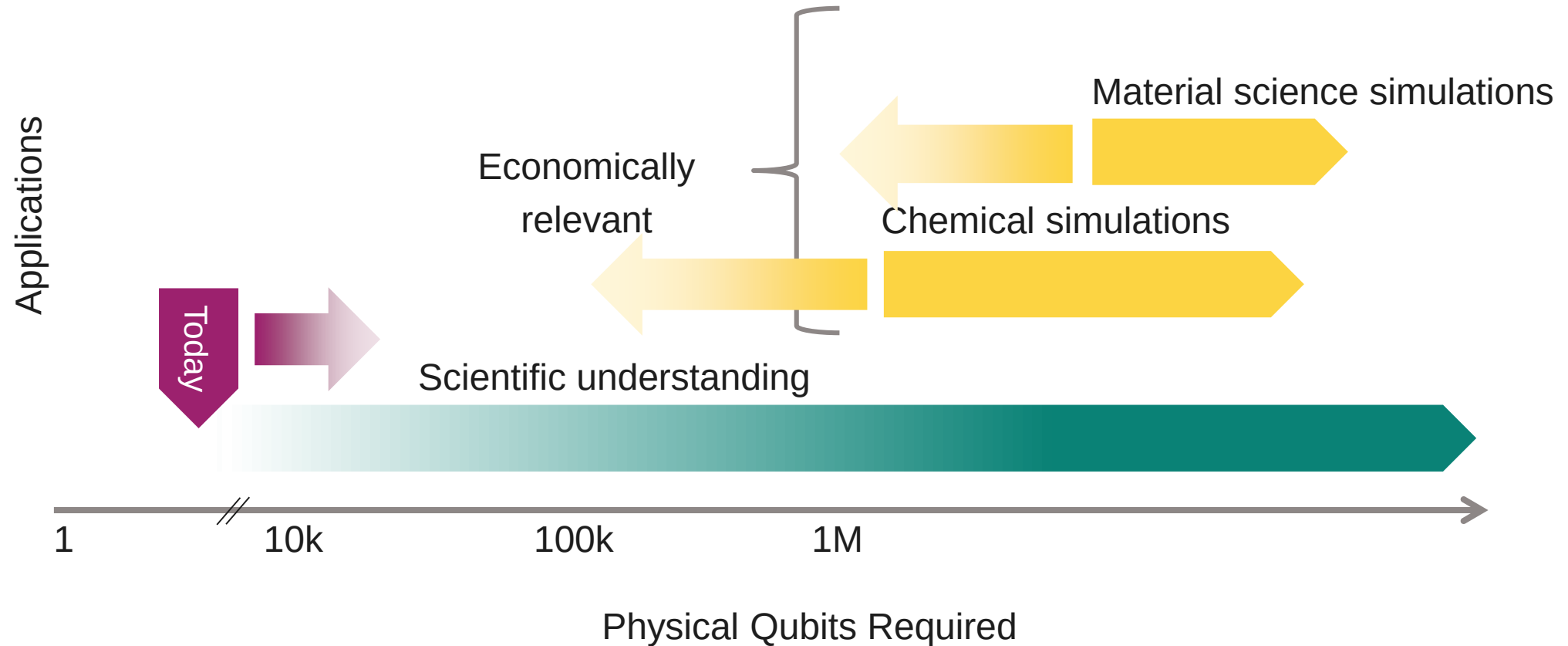
Super-
conductors

Neutral Atoms
/ Ions

Generated by DALL·E 3, - September 20th, 2024

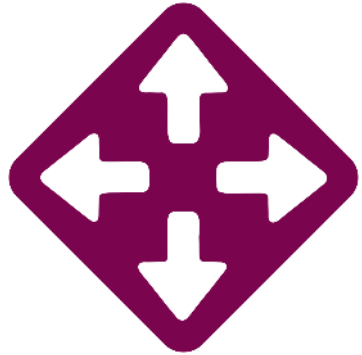
Need for scale, speed & performance

Impactful applications require significant improvements

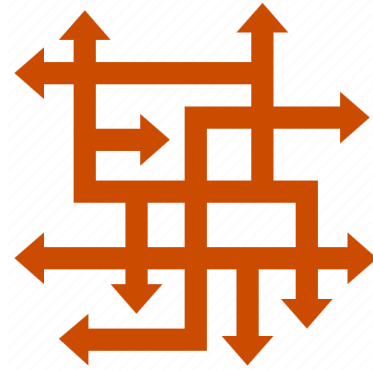


Adapted from presentation of H. Sirtl, Microsoft Deutschland GmbH, 2023

Quantum computing hardware performance is much more than just the number of Qubits



Addressable problem **size**
is determined by the
number of qubits



Addressable problem **complexity**
is determined by qubit quality,
error rates, life times...



Solution **time**
is determined by gate operation
speed, connectivity, instruction set, ...



Performance comparison between leading platforms for selected parameters



	Ions	Atoms	Superconductors	Semiconductors
 No of Qubits*	56 (512)	256 (6100) 	133 (1121)	2 (12)
 Coherence (T2)*	>1000s 	>40s	>1ms	>3ms
 2-Qubit Error*	2E-3 ... 1E-4 	5E-2 ... 5E-3	~2E-3	~2E-3
 2-Qubit Gate Speed*	2- 35µs (<1µs in Rydberg scheme)	~400ns	~20-60ns 	~40-70ns 

T. Harty, et al., PRL 2014
A. Leu, et al., PRL 2023
C.R. Clark, et al., PRL 2021
C. Löschnauer, et al. arxiv 2024
V. Schäfer, et al., Nature 2018
C. Zhang, et al., Nature 2020
Quantinuum H2 Data Sheet, 2024

T.M. Graham, et al., Nature 2022
D. Bluvstein, et al., Nature 2022
H. Levine, et al., Phys Rev A, 2022
S.J. Evered, et al., arxiv 2023

S.B. Kjaergaard, Annu. Rev. Cond. Mat. Phys, 2019
Zhiyuan Li, et al., Nature 2023
D.B. Sung, et al., Phys Rev X 2021
IBM Heron R1 Data Sheet, 2024

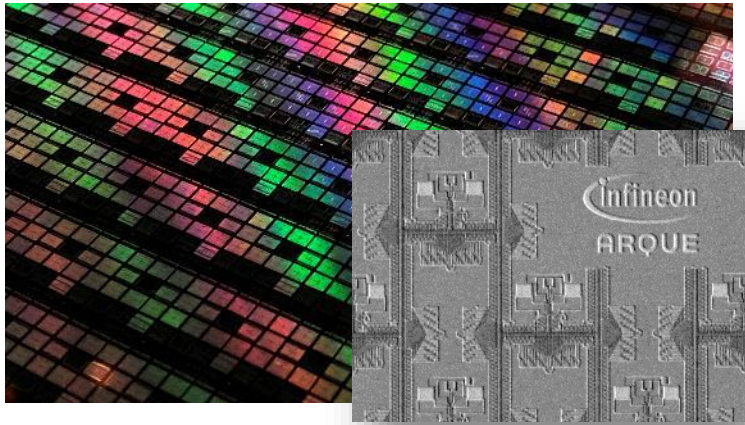
A.R. Mills, et al., Science Advances 2022
S.G.J. Phillips, et al., Nature 2022
QuTech 2024

*Some of the shown values are usually not achieved in commercial quantum computers yet!
Especially T2 coherence times are typically 10-1000x shorter depending on the platform, and expected to be further impacted by scaling challenges.

Infiniteon has the broadest technology portfolio in quantum computing based on unique competencies

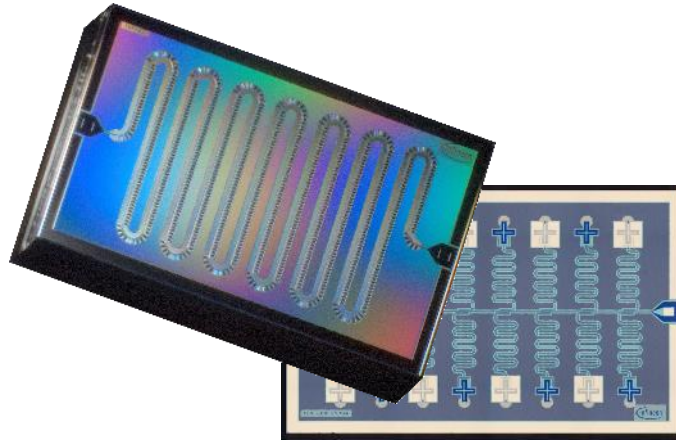


Quantum dots in SiGe



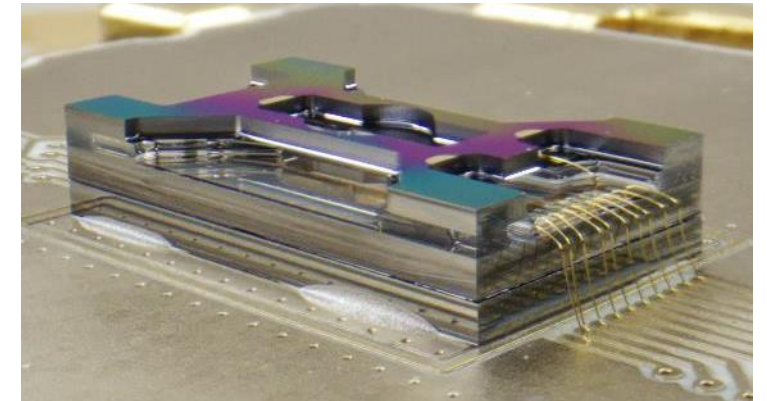
CMOS-compatible process in silicon enables scalable quantum processing units

Superconducting circuits



Our superconducting technology is ideally suited to build quantum devices with high process control

Trapped ions

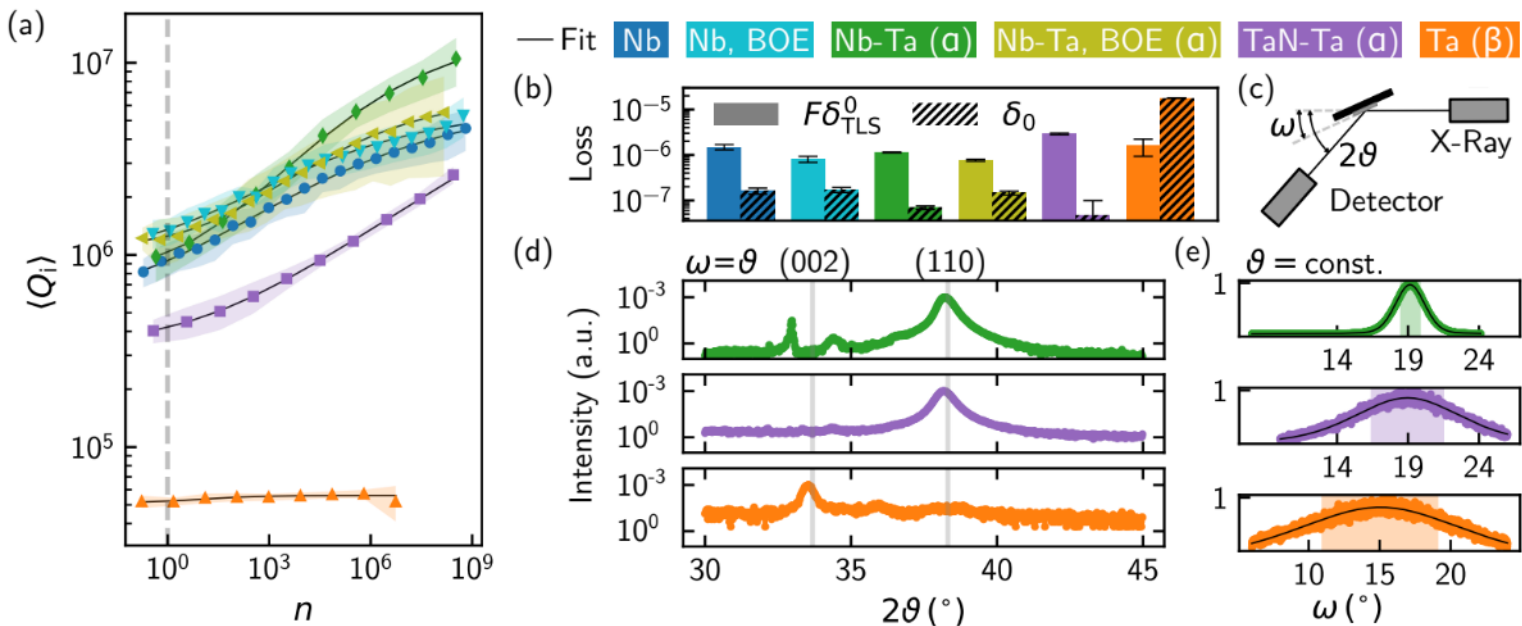
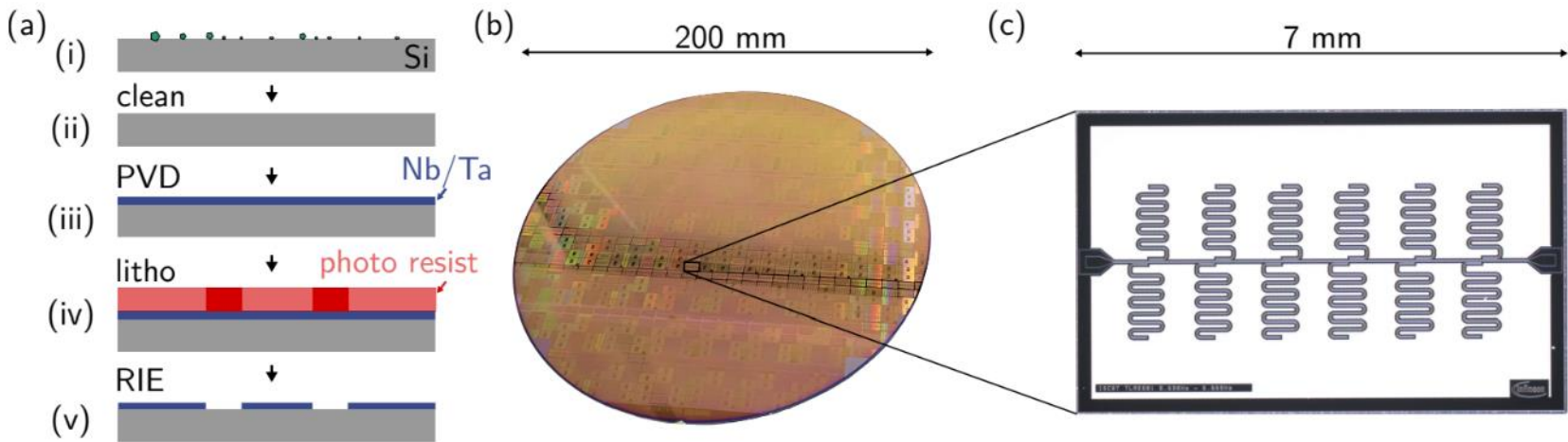


Three-dimensional structures for the world's first industry-scale manufacturable 3D ion trap

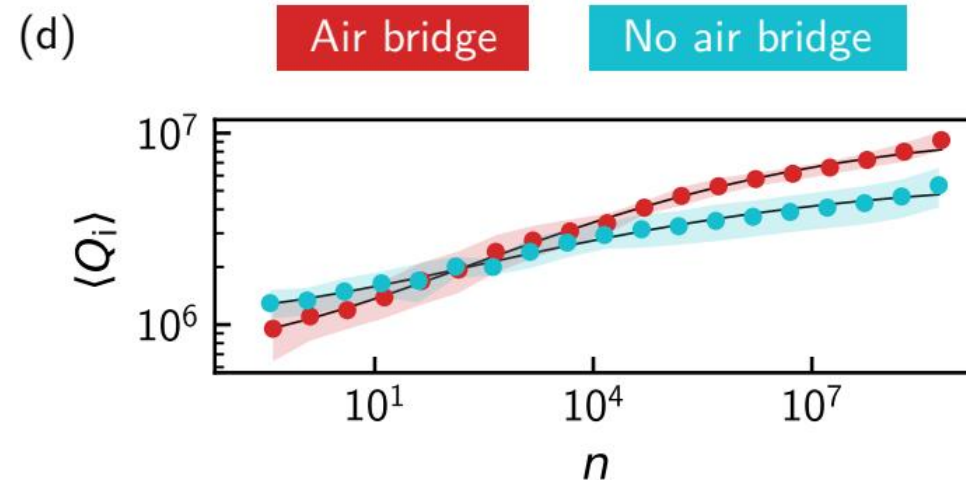
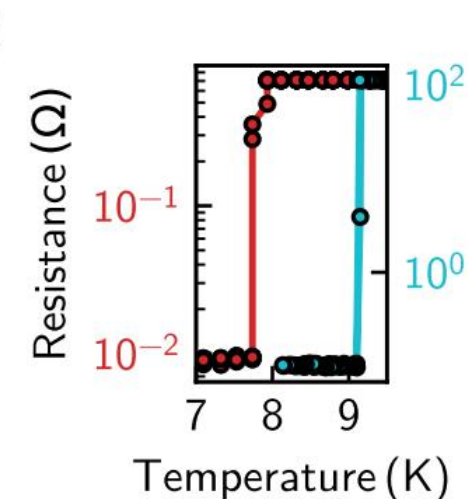
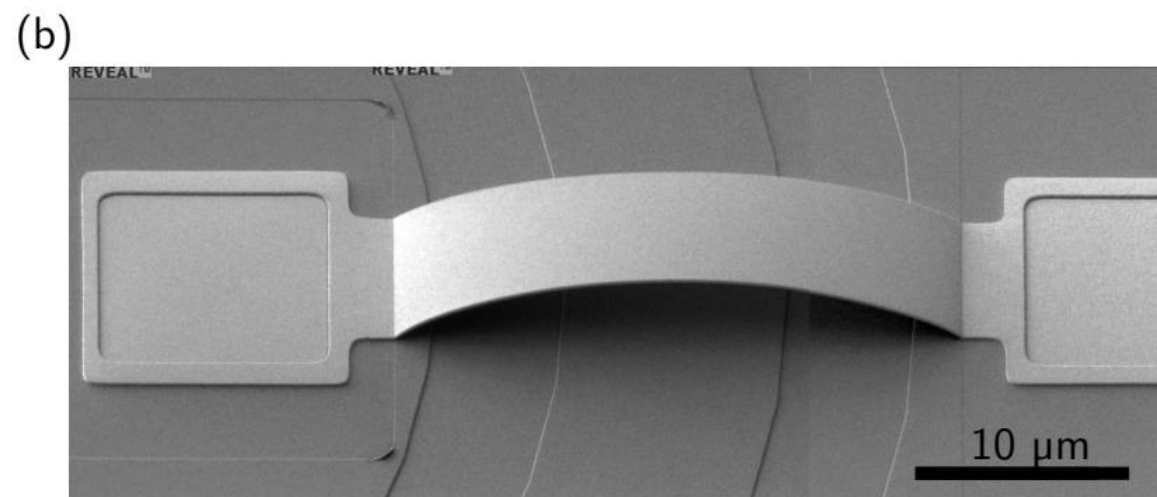
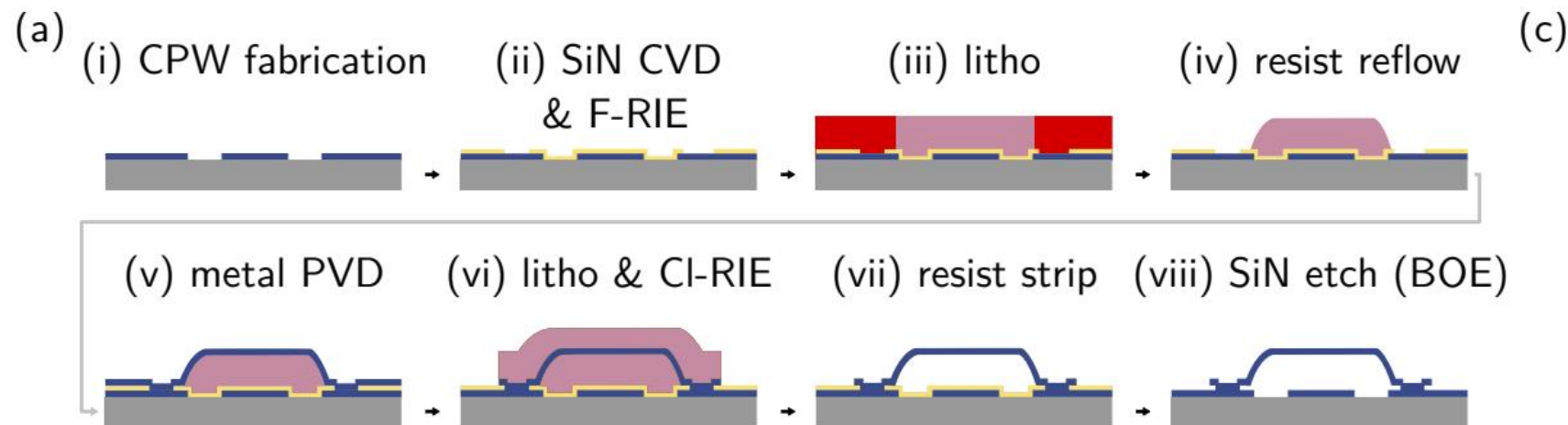


For all three platforms, we offer quantum processing units (QPUs) and control & readout electronics. E.g. quantum limited amplifiers (QLAs), RF signal generators, cryogenic electronics (Cryo-CMOS), ...

High-Q superconducting resonators as first building block for a superconductor technology



Air bridges complement the tool set

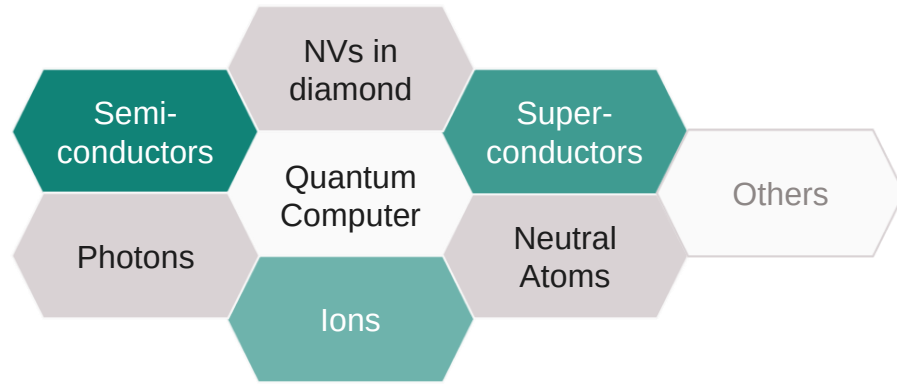


N. Arlt et al.,
arXiv:2508.09577

Infiniteon is shaping the quantum future with secure encryption, provision of components and application of quantum computers



We Enable



...quantum computing with superior components relying on unique technology and engineering expertise for three leading technological approaches

www.infineon.com/quantumcomputing

We Apply



...quantum computers to optimization problems within supply chain & beyond

www.qutac.de

We Prepare



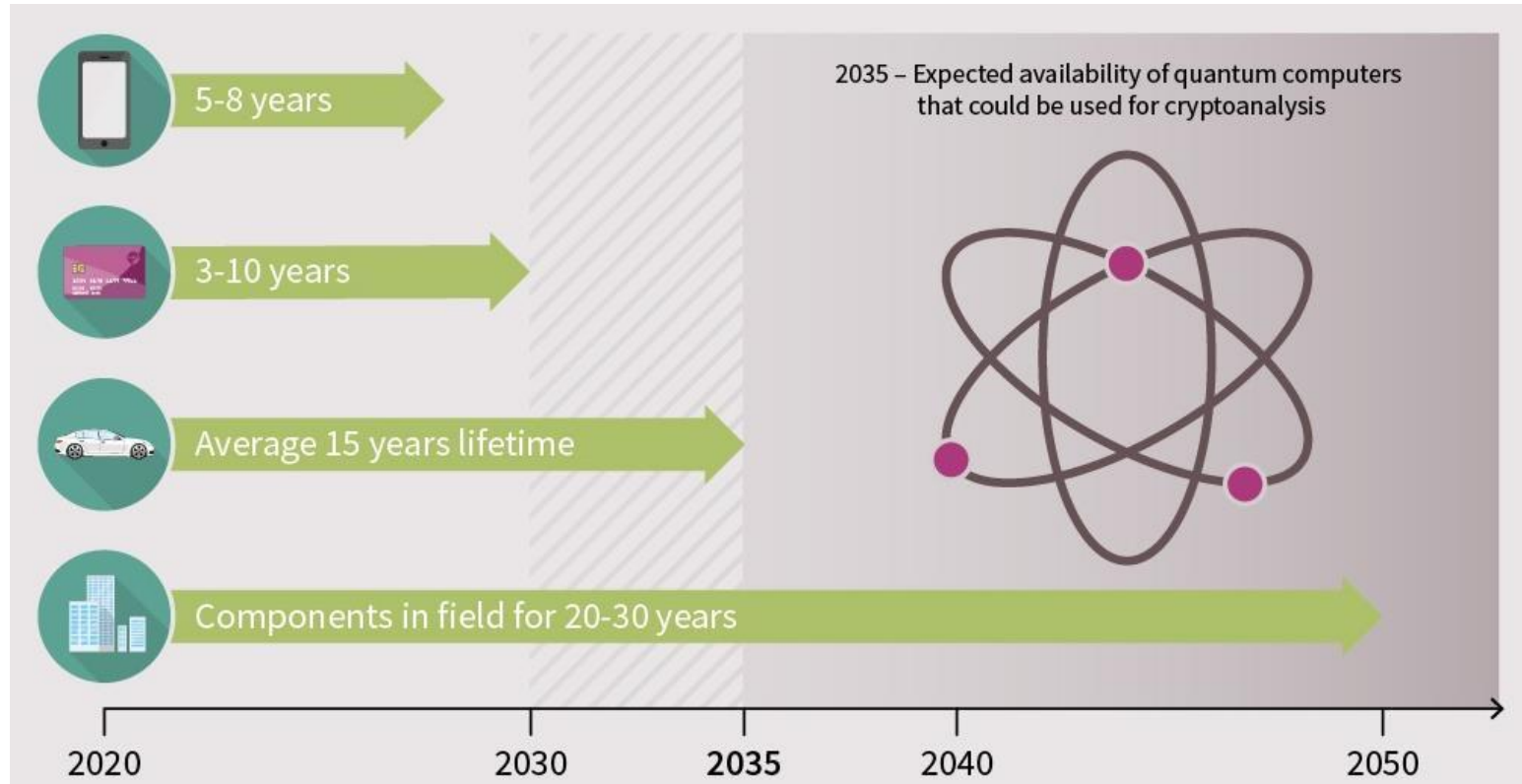
...for the quantum computing age with pioneering work on Post-quantum cryptography (PQC)

www.infineon.com/PQC

Infineon – a leader in Post-Quantum Cryptography (PQC) for quantum secure communication



Quantum Computers are expected to break critical cryptographic algorithms within 10-15 years, triggering a scramble to move to Post Quantum Cryptography (PQC)



Milestones

2017: First demo of PQC on a smart card



2022: NIST selects four PQC algorithms

2022: Analyzed PQC in AURIX for Automotive

2022: First PQC in a security certified product (TPM)



2022: First demo of PQC in electronic passport



2025: World's first EAL6 Certification for PQC algorithm on a security controller

Quantum computers have the potential to solve certain complex problems exponentially faster

Prospects and Challenges

- Today's quantum computers still have limited performance. Scaling up to larger systems while reducing error rates is a significant challenge.
- No hardware platform is excelling in all parameters, hence, it remains an open race.
- Integrating quantum computers with classical systems and infrastructure is essential for practical applications.
- Solving the challenges above, quantum computing will have significant implications for industries such as finance, healthcare, and materials science.



