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A Day as Superconducting Qubit Integration Engineer

Shana Massar
R&D Engineer

At the beginning



<https://www.pinterest.com/pin/759701030884004209/>

imec

Leuven

Louvain-la-Neuve

UCLouvain

- Bachelor
 - Applied chemistry and physics
 - Electricity
- Double Master's degree: Functional Advanced Materials Engineering

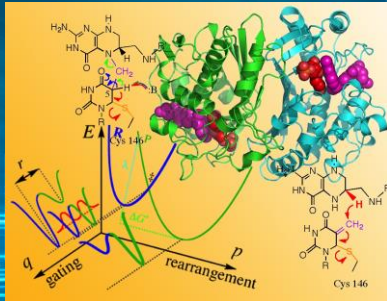
Augsburg

Uia
Universität
Augsburg
University



The promise of Quantum Computing

Materials science,
Drug discovery



NP-hard problems:

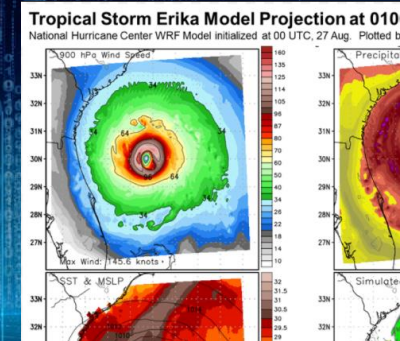
Financial market prediction,
traffic management, ...



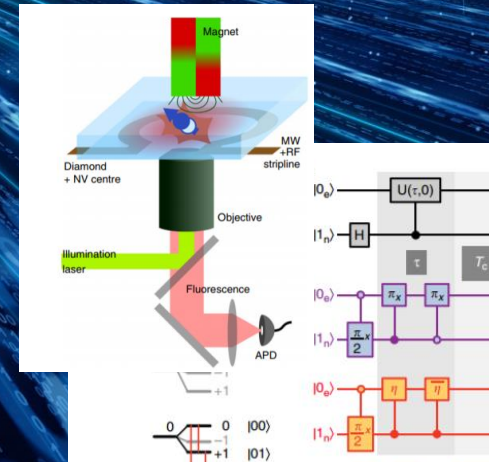
Cryptography/Data security



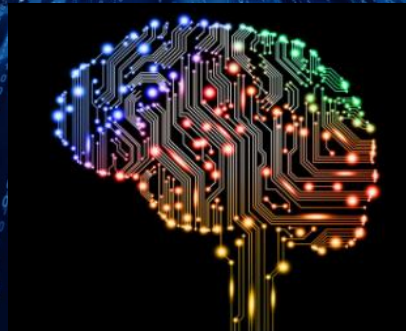
Weather forecast &
climate change



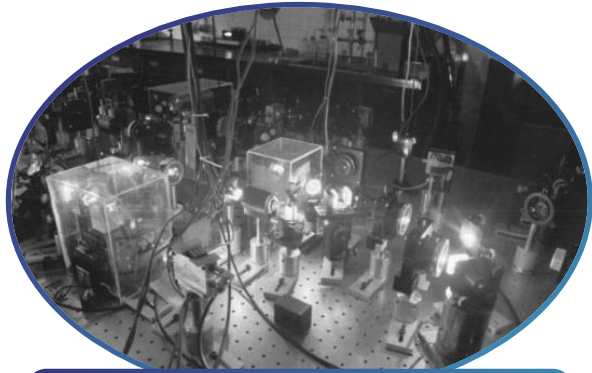
Metrology/Quantum sensing



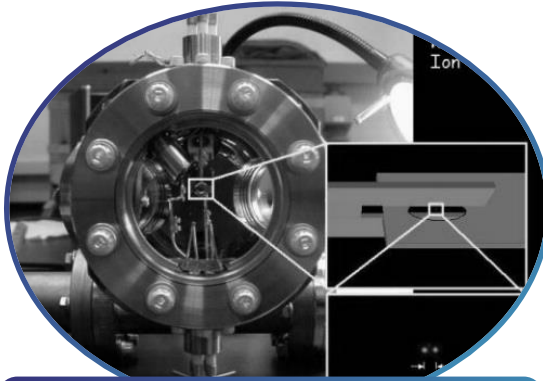
Machine learning



Physical implementation of qubits



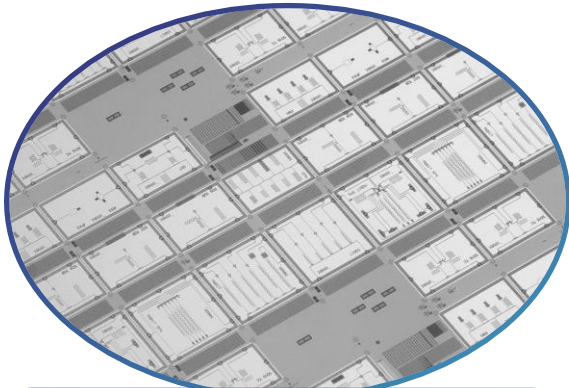
quantum optics



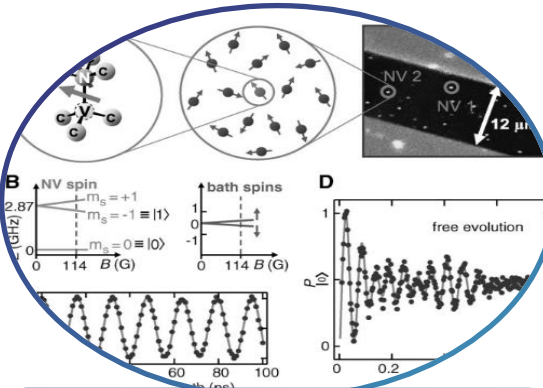
trapped ions



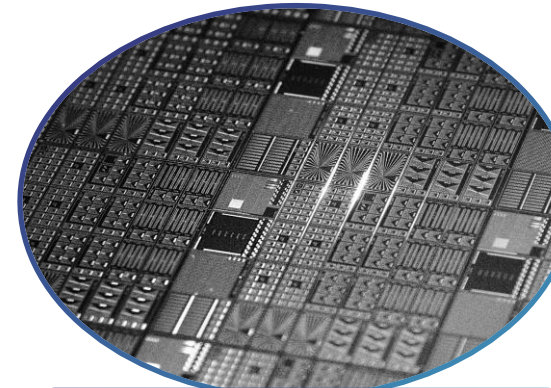
NMR



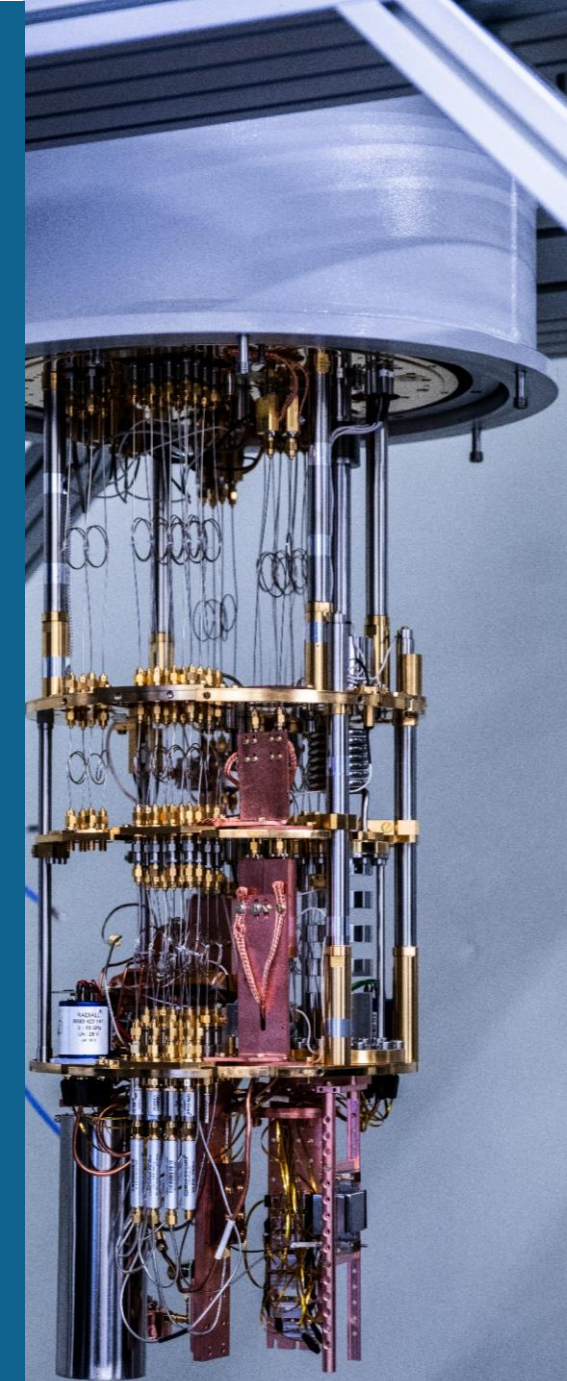
superconducting
devices



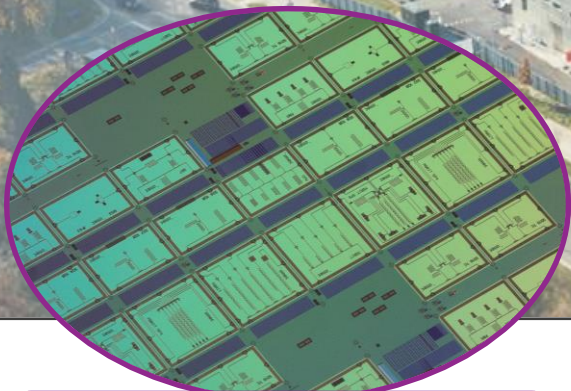
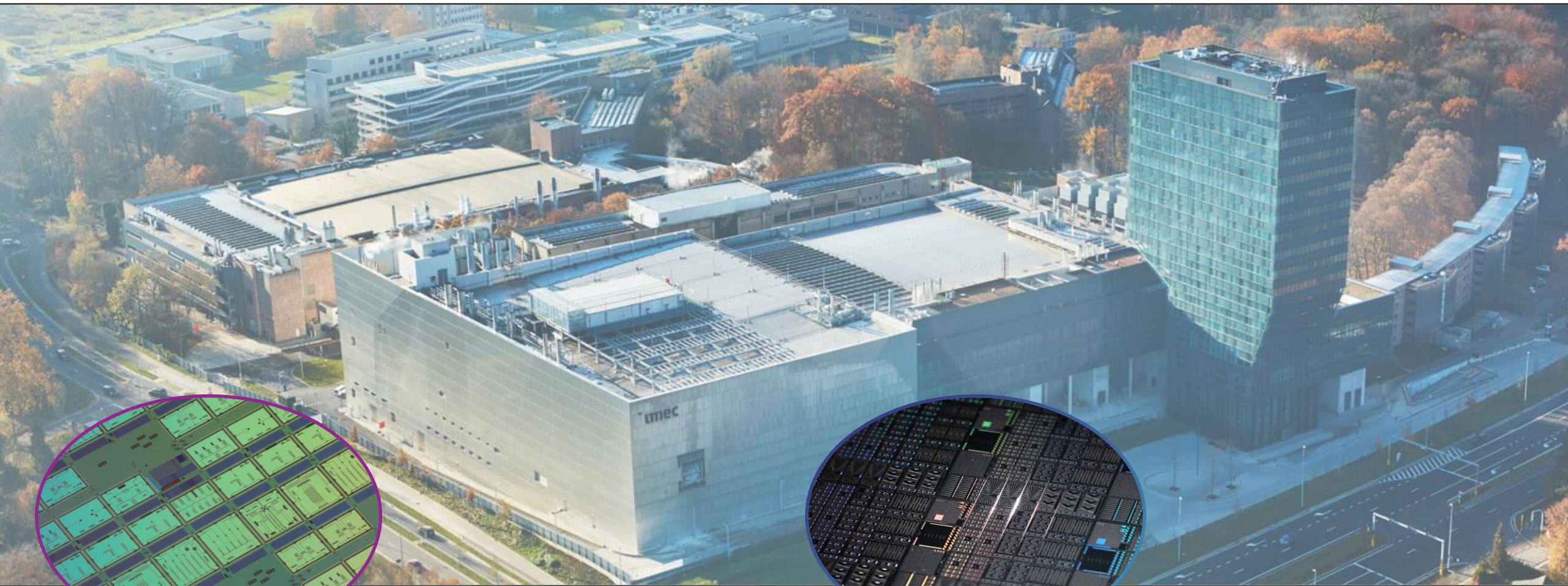
N vacancies in
diamond



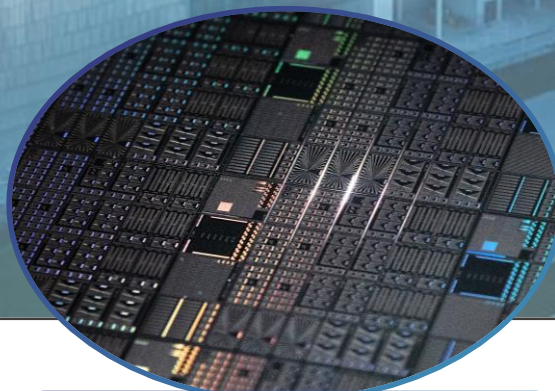
semiconductor
quantum dots



Qubits at Imec

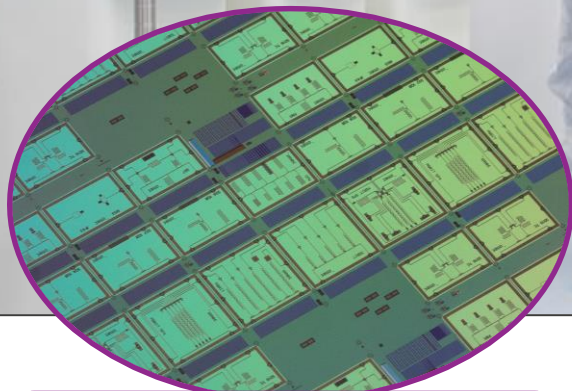


**superconducting
devices**

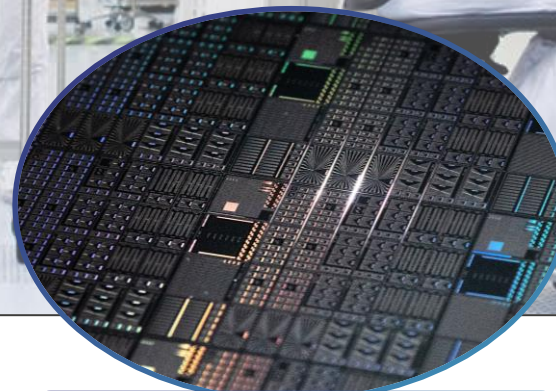


**semiconductor
quantum dots**

Qubits at Imec



superconducting
devices

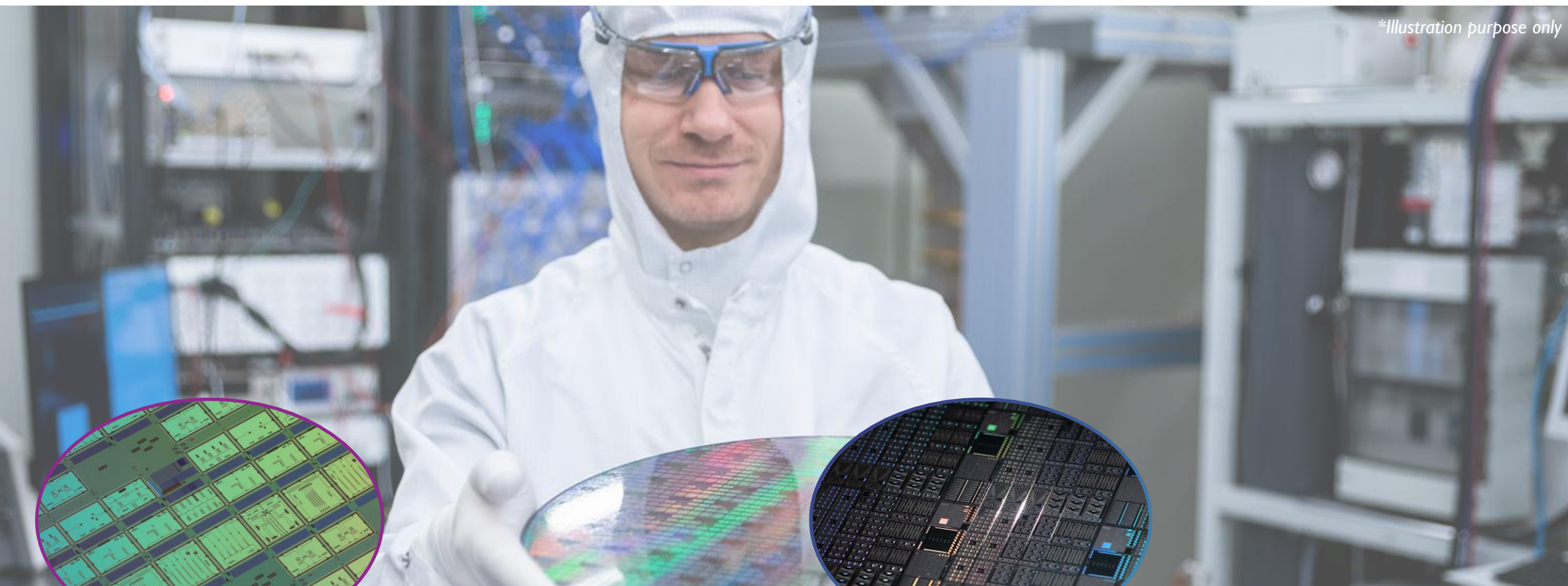


semiconductor
quantum dots

1st experience as support
integration engineer:
Mix of integration and
metrology support **within
the fab**

Qubits at Imec

**Illustration purpose only*

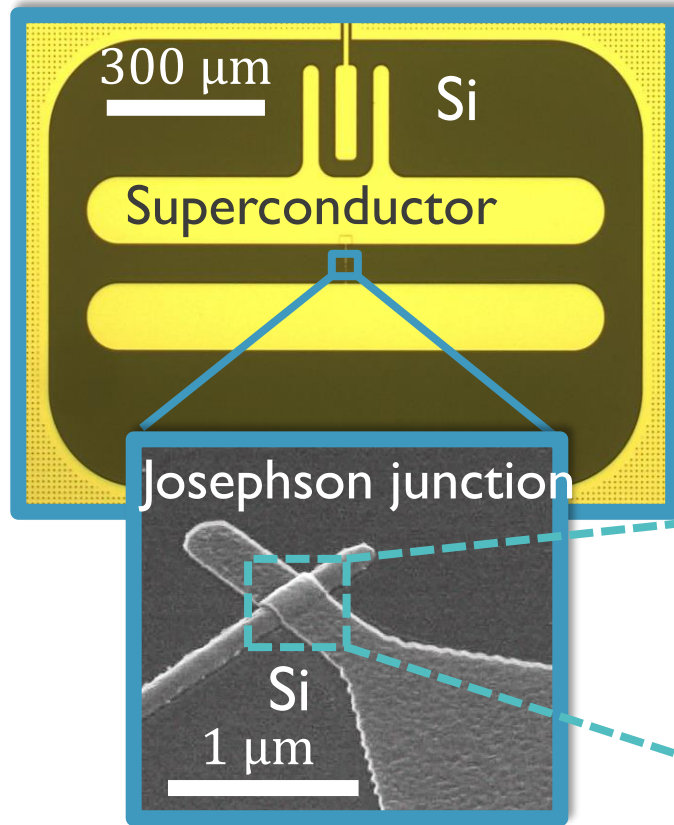


**superconducting
devices**

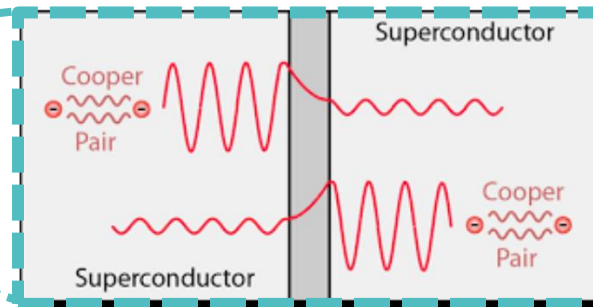
Current position
as integration
engineer

**semiconductor
quantum dots**

Superconducting qubit & Josephson junction



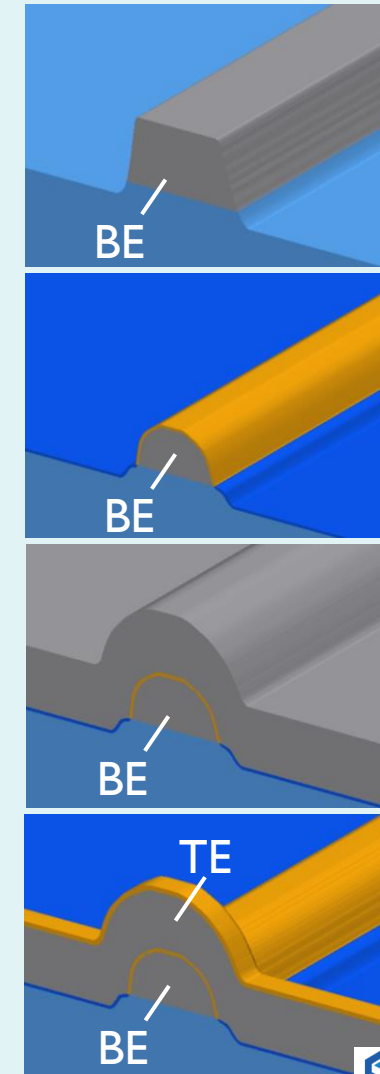
Josephson junction
 $S - I - S$



The superconducting qubit consists of:

- A superconducting island
- Josephson Junction (JJ)

300mm fab compatible
“Overlap” fabrication approach



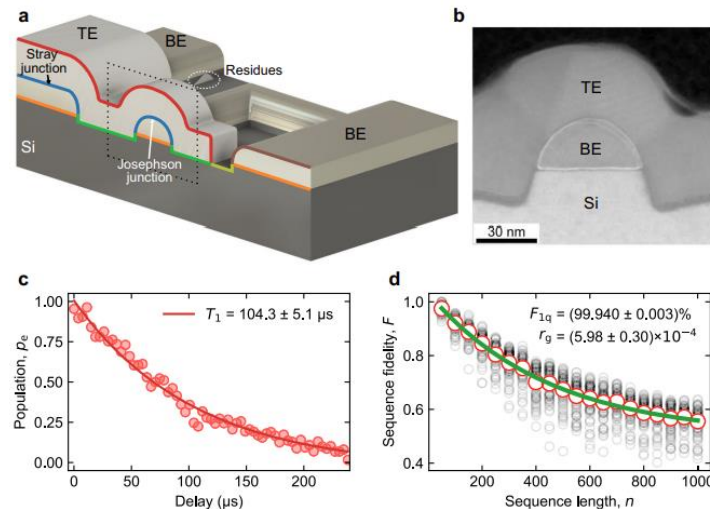
COVENTOR
A Lam Research Company

Overlap qubits fabrication: the “lab to fab” approach

ARTICLE OPEN

Path toward manufacturable superconducting qubits with relaxation times exceeding 0.1 ms

J. Verjauw^{1,2}, R. Acharya^{1,3}, J. Van Damme^{1,3}, Ts. Ivanov¹, D. Perez Lozano^{1,3}, F. A. Mohiyaddin¹, D. Wan¹, J. Jussot¹, A. M. Vadiraj¹, M. Mongillo¹, M. Heyns^{1,2}, I. Radu¹, B. Govoreanu¹ and A. Potočník¹✉



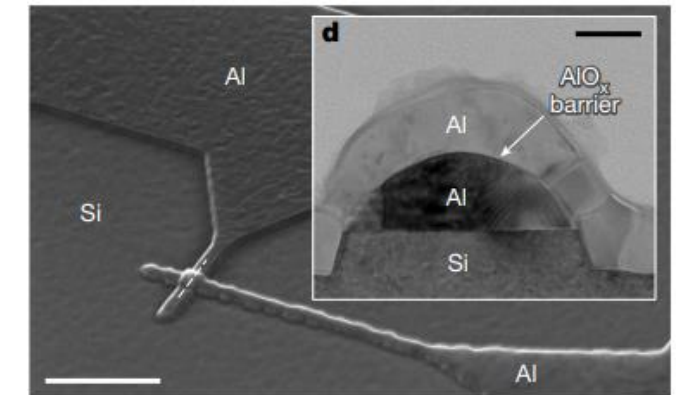
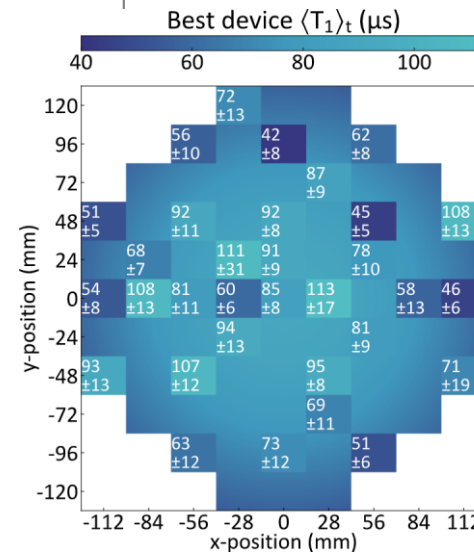
Verjauw, et al. *npj Quantum information* 2022

Lab-made devices with fab-compatible process flow

Article

Advanced CMOS manufacturing of superconducting qubits on 300 mm wafers

J. Van Damme^{1,2}, S. Massar¹, R. Acharya¹, Ts. Ivanov¹, D. Perez Lozano¹, Y. Canvel¹, M. Demarets^{1,2}, D. Vangoidsenhoven¹, Y. Hermans¹, J. G. Lai¹, A. M. Vadiraj¹, M. Mongillo¹, D. Wan¹, J. De Boeck^{1,2}, A. Potočník¹✉ & K. De Greve^{1,2}

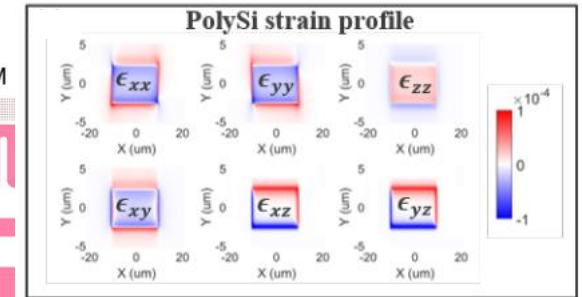
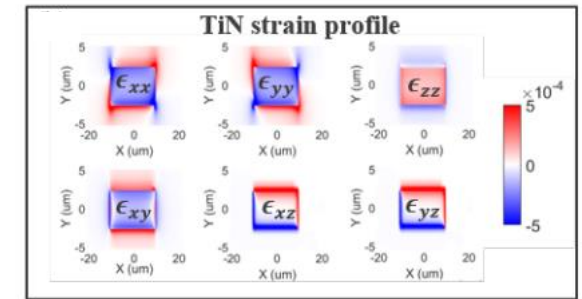
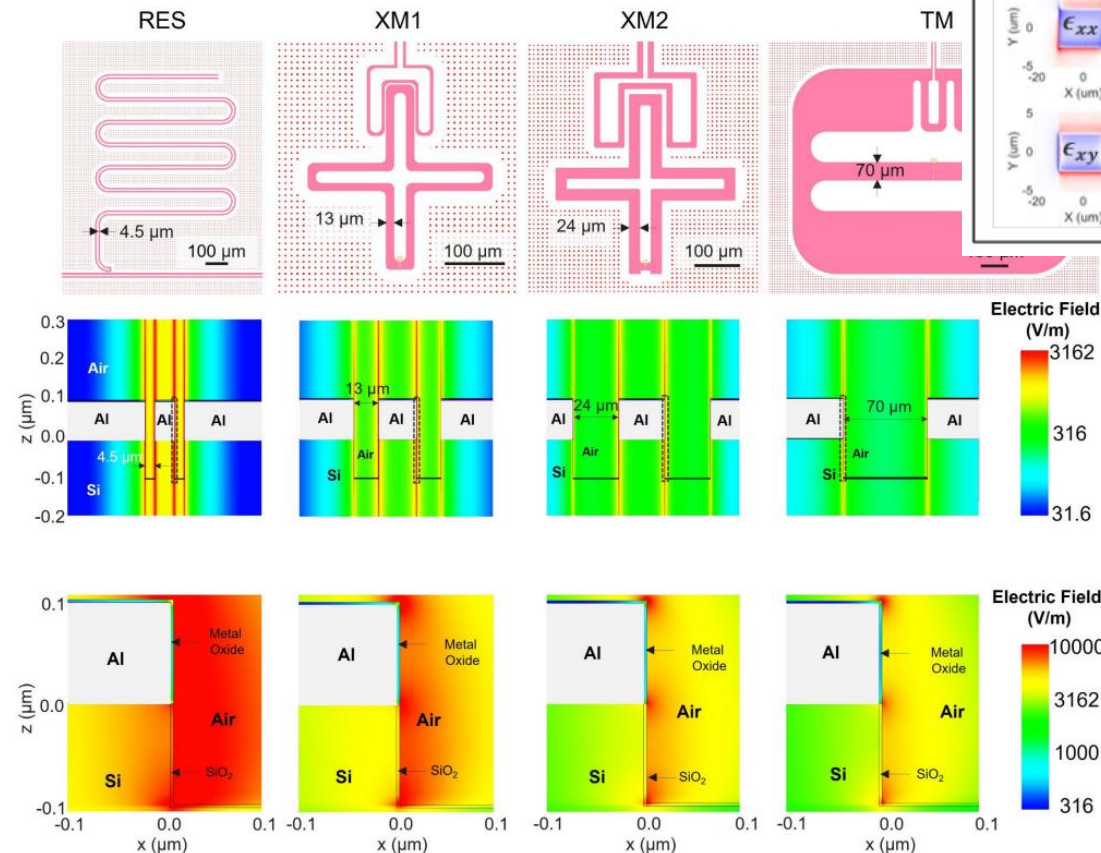
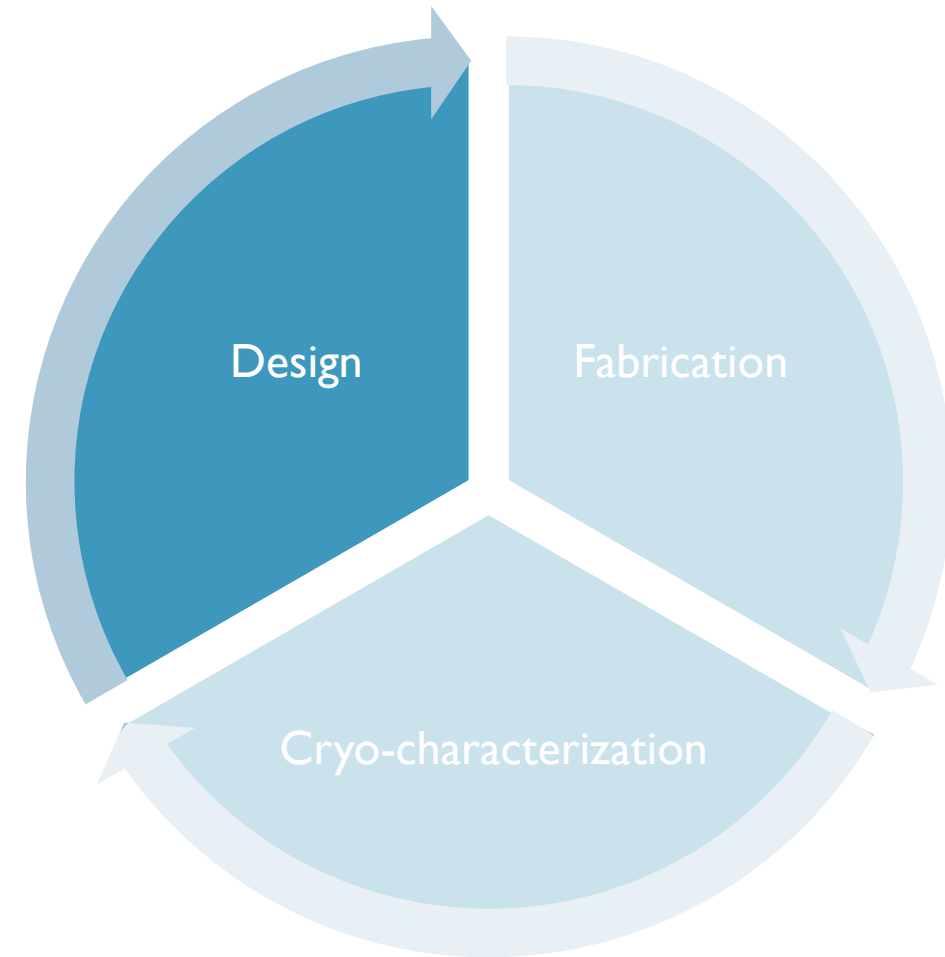


Van Damme, et al. *Nature* 2024

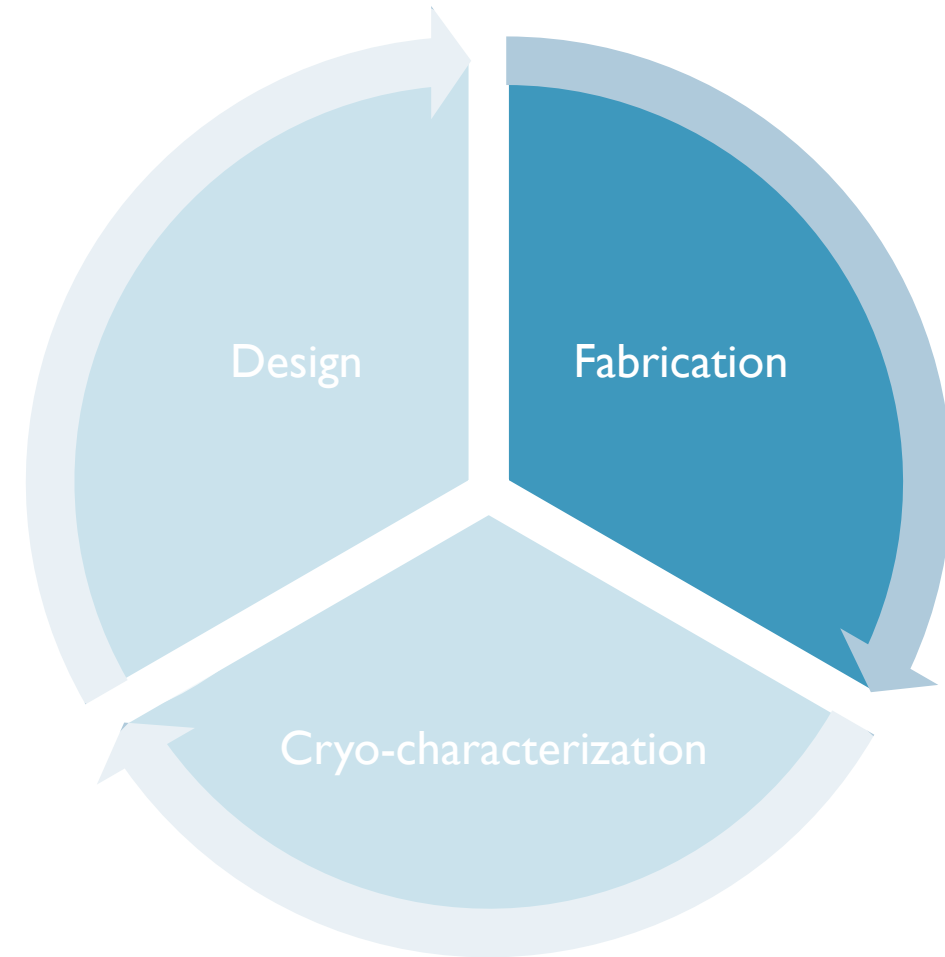
World's 1st high coherence qubits made on 300mm wafers in a CMOS fab

Imec Quantum research ecosystem

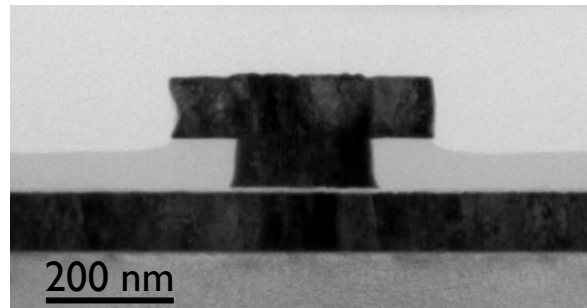
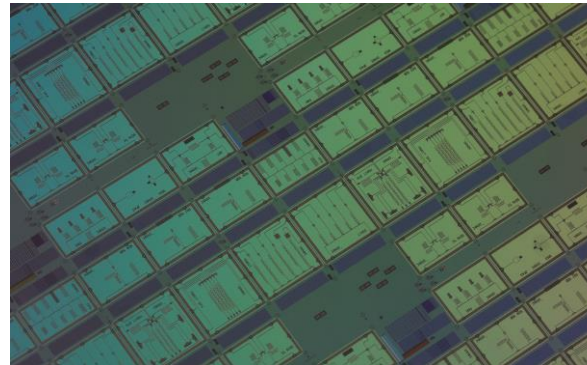
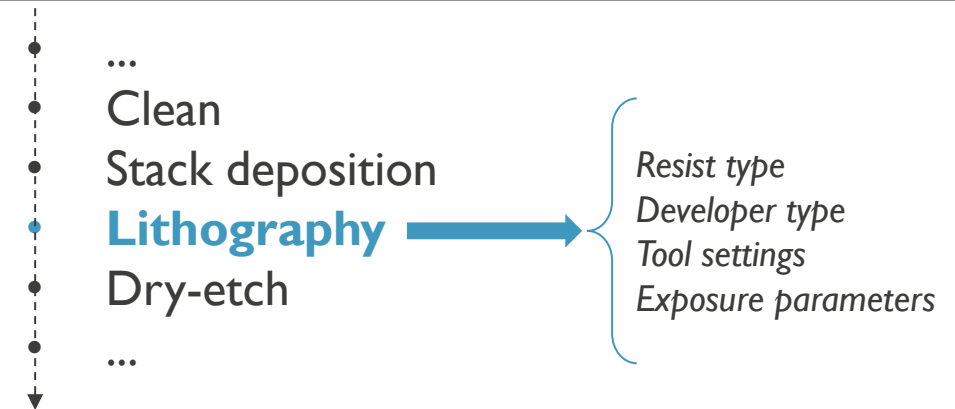
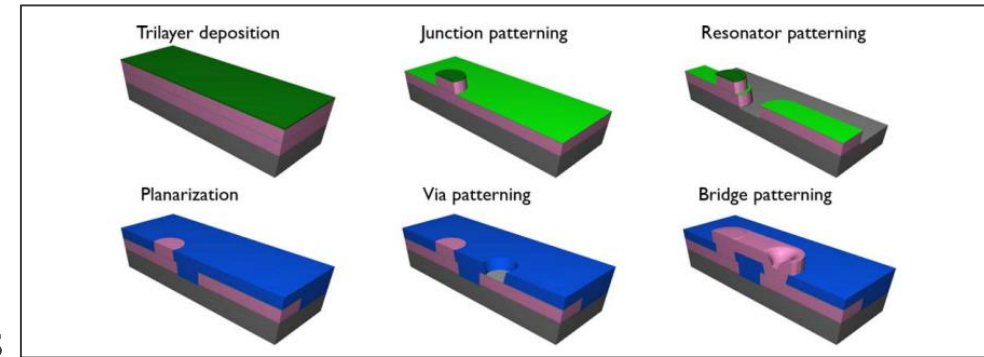
- Simulations
- Design
- Materials/dimensions



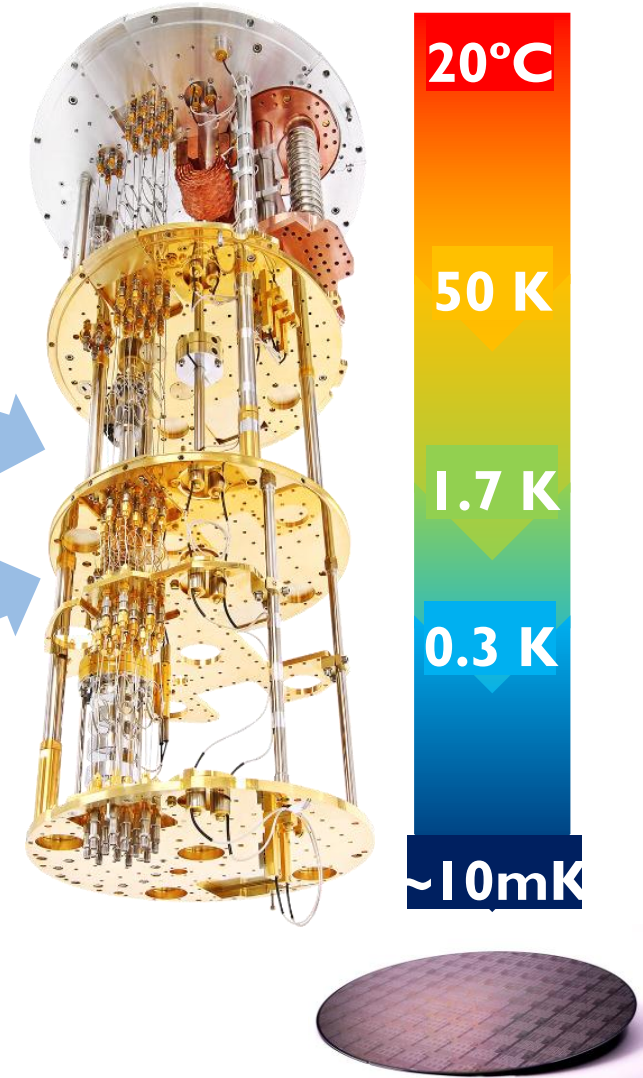
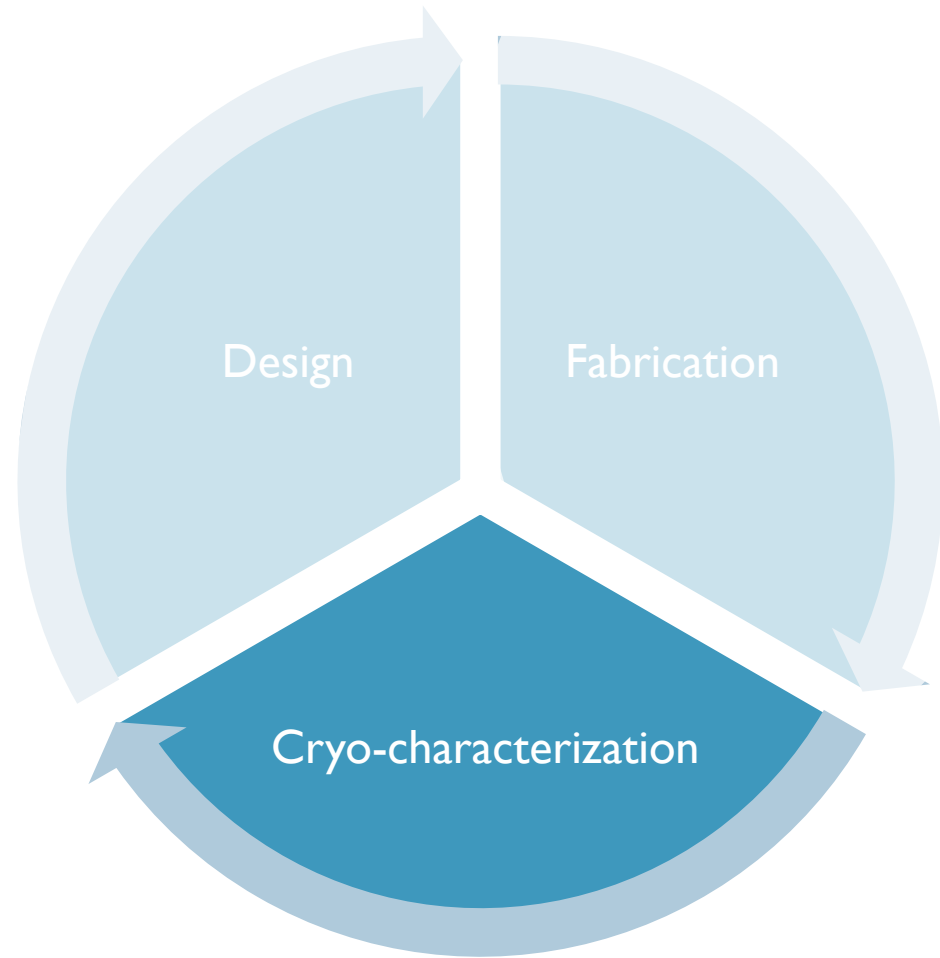
Imec Quantum research ecosystem



- Simulations
- Process flow
- Processing recipes
- Run experimental flows
- Inline characterization



Imec Quantum research ecosystem



My typical workday as integration engineer

Follow-up ongoing experiments

- Review latest data and adapt next steps
- Follow operational execution
- Analyze results

Report and participate in technical meetings

- With device engineers, process engineers, project managers,...
- To analyze and discuss the results and align on the next actions

Prepare next experiments

- Define experiment content, details and documentation
- Create the process flow
- Align on required developments with the involved teams (process, metrology, etc)

Brainstorming sessions for alternative approaches, new ideas



Opportunities come with challenges

- Research on a cutting-edge topic is extremely **dynamic, exciting** and **motivating** but also comes with its share of **pressure**
- What I enjoy the most within this position : the **autonomy, responsibility, ownership** and **diversity** in my work. Alongside the importance of **teamwork**
- From it, I get many opportunities to extend my horizons by **traveling** to meet partners, by presenting our work at international conferences or even receiving the 20 under 30 recognition



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embracing a better life

