Future of Computing

Superconducting Quantum Chips as the Foundation for Quantum Computing

J. Hassel
VP of Quantum Technilogies
IQM Quantum Computers, Espoo, Finland

Abstract
Quantum computing based on superconducting chips is currently one of the most promising approaches for industrially relevant quantum computing. In this presentation, we will review IQM's comprehensive approach to quantum computing, spanning from chip design to full-scale systems, and showcase exemplary computing applications that are enabled by today's quantum computers. We will highlight the key aspects related to superconducting quantum chips, including the specific requirements and solutions for maintaining quantum coherence. Additionally, we will provide an overview of IQM's chip fabrication capabilities and how they align with the company's vision for scaled-up, future systems that will be necessary for fault-tolerant quantum computing. We will also present key performance metrics for our chips, including T1 coherence times of up to nearly one millisecond and 2-qubit gate fidelities of up to 99.93%, which have been achieved using IQM's tunable coupler approach. Furthermore, we will deliver a status update on the development of our full Quantum Processing Units (QPUs), featuring our current-generation chips with up to 54 and 150 qubits. Finally, we will outline IQM's scaling roadmap towards fault-tolerant quantum computing.

Biography
Dr. Juha Hassel received his PhD title in 2004 from Helsinki University of Technology (now Aalto University). As of March 2024, he holds the position of Vice President of Quantum Technologies at IQM Quantum Computers, where he has worked in different leadership positions since 2019. Before joining IQM, he served as Principal Scientist at VTT Technical Research Centre of Finland, where he also led the Applied Quantum Electronics team within the national Centre of Excellence – Quantum Technology Finland.

References

Photonic Integrated Circuits for LiDAR: Enabling 4D Machine Vision with PICs

R. Nicolaescu
Managing Director
Pointcloud, Zurich, Switzerland

Abstract
Detailed and accurate three dimensional (3D) mapping of dynamic environments is essential for machines to interact with their surroundings, and for human machine interaction. While considerable effort has been spent in order to create the equivalent of the CMOS image sensor for the 3D world, scalable, high performance, reliable solutions have proven elusive. Focal plane array (FPA) sensors using frequency modulation (FM) light detection and ranging (LiDAR) have shown potential to meet all the requirements and also provide direct measurement of radial velocity as a fourth dimension (4D). In this talk we present the latest results in the development of large scale, high performance coherent LiDAR FPAs enabled by comprehensive chipscale optoelectronic integration. An overview of performance of a 352x176 pixels two dimensional FM LiDAR FPA comprising over 0.6 million photonic components with all photonics and associated electronics components integrated on chip will be presented, as well as future development directions.

Biography
Remus Nicolaescu is the Co-founder and Managing Director of Pointcloud GmbH/Inc., a Zurich based technology company developing coherent 4D imaging solutions using silicon photonics. Prior to Pointcloud, he held executive roles with technology companies in the US, Europe and Asia. He started his career at Intel, where he performed pioneering work in silicon photonics topics, such as optical Raman amplifiers and lasers in silicon waveguides, and high-speed silicon photonics modulators. He obtained his Masters and Ph.D. in Physics from University of Bucharest and Texas A&M University respectively, and MBA from INSEAD.

References

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

S. Luber
Senior Director Technology & Innovation
Infineon Technologies AG, Neubiberg, Germany

Abstract

Quantum computing holds significant potential to revolutionize the future of technology, and Infineon Technologies is contributing to this evolution through its developments in quantum hardware. This presentation will showcase Infineon's activities in superconducting circuits, semiconducting SiGe-based qubits, and ion trap technologies. Drawing on its expertise in semiconductor manufacturing and design, Infineon is addressing key challenges in scalability, integration, and reliability for quantum computing systems.

The session will explore how Infineon's components and modules contribute to the development of robust quantum computing systems across these three leading technology platforms. Emphasis will be placed on the holistic approach, which combines deep materials science knowledge, advanced process technologies, and collaboration within the quantum ecosystem. Join us to gain insight into how Infineon is shaping the future of computing.

Biography

Sebastian M. Luber holds a PhD in technical physics from the Walter Schottky Institute at the Technical University of Munich and is Senior Director for Technology & Innovation at Infineon Technologies AG. He coordinates Infineon's activities in the field of quantum technologies and acts as an advisor to the Management Board. Luber is involved in a variety of external committees and activities dealing with quantum technologies. Among others, he is member of the Program Committee for Quantum Technologies of the Federal Ministry of Education and Research, and active in QUTAC, the German Quantum Technology & Application Consortium. Previously, he held various positions in the company, including Sensor Technology Line Manager and Automotive Program Manager.

References

From Lab to Leadership - Europe’s bet on Semiconductor Startups

M. Machold
Operational Director - Venture Lab Quantum/Semicon
TUM Venture Labs, Venture Lab Quantum/Semicon, Garching, Germany

Abstract
The semiconductor industry is evolving rapidly. While traditional technologies advance, new computing paradigms are emerging: quantum computing leverages quantum mechanical principles, neuromorphic computing mimics the brain's neural structure, and photonic computing uses light instead of electrons for processing. This session explores these technological trends and examines how European semiconductor startups are positioned to drive innovation. We'll discuss the strategic importance of semiconductor development for Europe's technological sovereignty and economic future. We'll also highlight how collaborative ecosystems are helping startups overcome challenges in this capital-intensive sector by bridging research and commercialization. Join us to discover how industry, investors, policymakers, and entrepreneurs can work together to strengthen Europe's position in the global semiconductor landscape.

Biography
Michael Machold is Operational Director at TUM Venture Labs Quantum/Semicon, where he is building the leading incubation program for founders in semiconductors, photonics, nanotech, and quantum technologies, actively driving Europe's deep-tech startup ecosystem.
With over a decade of experience at Infineon Technologies, including serving as Director – Head of Product Management Automotive Microcontroller, Michael brings deep insights into the semiconductor industry. He holds an M.Sc. in Electrical Engineering from TUM and an Executive MBA from ESADE Business and Law School.

References