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Ca' Foscari  
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# Breaking down the complexity of a superconducting quantum processor.

## An overview on the physics and engineering challenges to build and operate a QPU

**30th June 2025, 10.00 am**  
Orio Zanetto conference room  
Alfa building, Scientific Campus, via Torino 155

### **Dr. Stefano Poletto**

Director of Quantum Engineering at Rigetti Computing (USA)

Superconducting quantum processor units (QPUs) with qubit counting in the 10s to 100 are now commercially available from multiple companies and institutions. However, to build and operate a high performance superconducting QPU several physics and engineering challenges must be addressed. In this talk I will break down the complexity of a superconducting QPU, focusing on the single components and the interplay between them. I will introduce the transmon qubit (the artificial atom), how to read it out, different types of coupling between transmons (fixed and tunable), and the implementation of single- and two-qubit gates. I will conclude with an overview of the Rigetti approach to scalability and the latest results on QPU performances.

Stefano Poletto is Director of Quantum Engineering at Rigetti Computing (Ca, USA), with over 20 years of experience in experimental quantum research and development, including a decade in the industrial sector. He began working on quantum computing with superconducting qubits in 2003 during his master's thesis and continued through his PhD, which he completed in 2007. He has worked as an experimental quantum engineer at IBM (Yorktown Heights), in the group of Leo DiCarlo (Delft, in collaboration with Intel), and in the group of Alexey Ustinov (Karlsruhe). At Rigetti, he has held roles as senior manager and Director of Quantum Engineering, leading the development of the company's fourth-generation QPUs (Ankaa). He has authored 35 peer-reviewed papers and holds 11 patents and patent applications in the field.

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