Contribution ID: **28** Type: **Invited Talk**

Electronic System for the Control and Readout of Superconducting Quantum Bits

Friday, 7 March 2025 08:50 (25 minutes)

Superconducting qubits are among the most promising platforms for quantum computing and quantum sensing, requiring advanced electronic systems for their control and readout. These systems must generate high-fidelity microwave pulses, ensure low-noise amplification, and enable fast, high-precision measurements. The control system relies on arbitrary waveform generators (AWGs) and microwave sources to produce tailored pulse sequences for quantum gate operations. The readout system must efficiently extract quantum state information while minimizing decoherence and measurement-induced backaction. This is typically achieved through dispersive readout schemes, leveraging high-electron-mobility transistor (HEMT) amplifiers at cryogenic temperatures. A key aspect of modern quantum electronics is the integration of control and readout functionalities into programmable hardware. Platforms such as RF system-on-chip (RFSoC) devices offer a powerful solution by combining fast digital-to-analog and analog-to-digital converters (DACs/ADCs) with real-time signal processing capabilities. These allow for low-latency feedback, real-time calibration, and efficient multiplexed readout, essential for scaling up quantum processors.

Beyond computing applications, superconducting qubits are also being explored within INFN projects for fundamental physics, including quantum sensing for light dark matter and radiation detection and quantum simulation of many-body systems. These applications push the limits of current electronic architectures, requiring optimized solutions for scalability and integration. In this talk, I will present an overview of the electronic architecture required to operate superconducting qubits, focusing on both control and readout aspects.

Primary author: GIACHERO, Andrea

Presenter: GIACHERO, Andrea

Session Classification: Future (Electronics for Quantum Technologies (Single Photon Detection), gravitational wave detection (Einstein Telescope), and Real-Time Artificial Intelligence