

**Ph.D. in Information Technology
Thesis Defense**

**April 13th, 2026
At 1:00 p.m.
Room Beta - Building 24**

Arianna Adelaide MAURINA – XXXVIII Cycle

HIGH-SENSITIVITY IMPEDANCE PLATFORM FOR MULTIPLEXING DIAGNOSTICS

Supervisor: Prof. Marco Sampietro

Abstract:

This work focuses on the development of an innovative electronics-based platform for point-of-care viral diagnostics. The ultimate goal is to implement a multiplexing diagnostic platform that is adaptable and reconfigurable for various medical applications, with the potential to significantly improve early disease detection, enhance patient care, and substantially reduce healthcare costs.

The instrument relies on impedance measurements, with the signal enhanced through a polymeric bead-based protocol.

In recent years, there has been increasing interest in the development of multiplex point-of-care devices, in which multiple analytes can be detected from a single biological sample, thereby accelerating the diagnostic process and broadening the clinical picture.

Three fields can be identified and will be deepened: the design and production of the biochip, the improvement of the platform and the microfluidic functioning and, lastly, the proper design of the electronic board for very high-resolution impedance measurements. The electrodes are realized in gold over a borosilicate substrate, and their shape is optimized for multiplexing. The microfluidic chamber is where the reaction with the biological analyte occurs and is designed for a precise liquid control and a real-time supervision of the whole experiment. Finally, the configuration and improvement of the electronic board's software and I firmware is realized, fundamental for high-resolution impedance detection.

The correct functioning and adaptability of the entire project is confirmed by detecting P24-HIV related antigen, COVID-19 and, afterwards, by correctly distinguishing different COVID genes, N1 and N2, validating the multiplexing feature.

The reconfigurability of the system will be further tested with other biological analytes in order to pave the way to the development of a complete and innovative high-resolution medical device for multiplexing diagnostic.

PhD Committee

Prof. Marco Carminati, **Politecnico di Milano**

Prof. Domenico Caputo, **Università degli Studi di Roma “La Sapienza”**

Prof. Andrea De Marcellis, **Università degli Studi dell'Aquila**