

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

April 17th, 2026

At 2:30 p.m.

Room Beta - Building 24

Giulio GUBELLO – XXXVIII Cycle

**LOW-NOISE, MULTICHANNEL, ELECTRONIC INSTRUMENTATION FOR
BROADBAND OPTICAL SPECTROSCOPY APPLICATIONS**

Supervisor: Prof. Giorgio Ferrari

Abstract:

The PhD research focused on developing low-noise, high-speed, multichannel acquisition systems for ultrafast spectroscopy, which uses ultra-short pulsed lasers to achieve high power and precise time resolution for advanced imaging techniques.

The first part of the work led to a 76-channel acquisition system for coherent Raman imaging. This system combined a lock-in based low-noise front-end with parallel data acquisition and real-time processing. An 8-channel ASIC was designed and integrated into a modular architecture controlled by an FPGA, enabling simultaneous acquisition of Raman spectra across multiple wavelengths. The system was developed within the EU-funded CRIMSON project and validated as part of a Raman microscope aimed at real-time, non-invasive imaging for applications such as tumor detection.

The second part focused on designing a faster spectrometer for pump-probe spectroscopy, overcoming the speed limitations of existing CCD-based systems. The developed solution used two ASICs operating in parallel to acquire up to 40 wavelengths simultaneously with high resolution. The system included custom electronics, FPGA-based control, and a C# graphical interface for data acquisition and visualization. It was successfully validated through experimental spectral measurements.

PhD Committee

Prof. Giuseppe Bertuccio, **Politecnico di Milano**

Prof. Giovanni Batignani, **Università degli Studi di Roma “La Sapienza”**

Dr. Sergio Rescia, **Brookhaven National Laboratory**