Ph.D. in Information Technology
Thesis Defenses

March 3, 2023
at 10:00
Room Alpha

Davide DI VITA – XXXV Cycle

SIPM-BASED READOUT OF LABr3 SCINTILLATORS: DEVELOPMENT AND CHARACTERIZATION OF STATE-OF-THE-ART SPECTROSCOPY DETECTORS

Supervisor: Prof. **Carlo Fiorini**

Abstract:

Gamma radiation and its detection play a key role in many fields, from science (nuclear physics, astronomy) to medicine (for both treatment and diagnostics), passing through the food industry (to sterilize food), the oil industry (for well logging), and the nuclear industry (for both safety and security).
This research aims to build and validate a gamma spectroscopy system based on SiPMs for the readout of large lanthanum bromide crystals to replace the PMT-based readout and overcome the limitations associated with it for nuclear physics experiments.
The result also led to the development of various detectors for other areas (mainly medical, but also nuclear safety and environmental) that could be disruptive in these fields.

Edoardo FABBRICA – XXXV Cycle

MIRA: A LOW-NOISE ASIC WITH 35 μm PIXEL PITCH FOR THE READOUT OF MICROCHANNEL PLATES

Supervisor: Prof. **Carlo Fiorini**

Abstract:

Spectroscopic observations in the far and extreme ultraviolet (FUV/EUV) spectral regions are of great interest in various scientific fields, such as Solar Physics, interstellar medium physics, and planetary exospheres studies.
The PLanetary Ultraviolet Spectrometer (PLUS) project aims at developing a novel dual-channel FUV/EUV imaging spectrometer working in the 55 - 200 nm spectral range, characterized by improved detection limit, shorter observations integration time, and unprecedented performance in terms of dynamic range. The detector is the critical component in achieving these goals.
In this framework, the thesis aims to design, develop, and characterize an Application Specific Integrated Circuit (ASIC) readout system with on-chip photon counting capability to be coupled with a microchannel plate (MCP) as the PLUS photon counting detector.
The first prototype of MIRA (MIcrochannel plate Readout ASIC) is able to detect the cloud of electrons generated by each photon interacting with the MCP, sustaining high local and global count rates to fully exploit the MCP intrinsic dynamic range with low dead time. The main rationale that

guided the electronics design is reducing the input Equivalent Noise Charge (ENC) to allow operations with lower MCP gains, thus improving its lifetime, a crucial aspect for long missions in space. MIRA features two selectable analog processing times (130 or 260 ns), granting a count rate per pixel of 100 kcps and an Equivalent Noise Charge ENC = 20 e-rms. A charge sharing correction logic is implemented inside each pixel to achieve high spatial resolution. Thus, a spatial resolution limited to the pixel size (35 µm) is granted, even in the case of charge sharing.

PhD Committee

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

Prof. **Constantin Mihai,** Horia Hulubei National Institute for Physics and Nuclear Engineering (IFINHH), Romania

Prof. **Matteo Porro,** Universita' di Venezia, Ca' Foscari